9/29/08 - 02762

1 Declaration

This Record of Decision (ROD) presents the No Action (NA) determination for Area of Concern (AOC) H, Former Naval Ammunition Support Detachment (NASD), Vieques, Puerto Rico. The NA determination has been made in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on information contained in the Administrative Record file for the site. Information not specifically summarized in this ROD or its references but contained in the Administrative Record has been considered and is relevant to the NA determination for AOC H. Thus this ROD is based upon and relies on those portions of the Administrative Record file for the site that pertain to AOC H in making the decision.

The United States (U.S.) Department of the Navy (Navy) is the lead agency and provides funding for environmental restoration activities at the former NASD. The Navy and U.S. Environmental Protection Agency (EPA) Region 2 issue this ROD jointly. The Puerto Rico Environmental Quality Board (PREQB) actively participated throughout the investigation process and, hence, has reviewed this ROD and the materials on which it is based and concurs with this decision. This decision has been made in consultation with the Municipality of Vieques (MOV), the current landowner of the property that includes AOC H.

The former NASD was placed on the National Priorities List (NPL) on February 11, 2005 (EPA ID: PRN000204694). AOC H is one of 17 sites within the Former NASD having been or currently being evaluated in accordance with CERCLA under the Navy's Installation Restoration Program (IRP). The status of IRP sites at the former NASD can be found in the Administrative Record File and Information Repository for Vieques. The NA determination documented in this ROD does not include or affect any other sites at the Former NASD.

1.1 Selected Remedy

As a result of environmental investigations completed under CERCLA at AOC H and risk management decisions made by the Navy, in partnership with EPA, with concurrence by PREQB, and in consultation with the MOV, there is no unacceptable risk over that of background to human health or the environment at AOC H under current or potential future site use. Therefore, no response action is necessary and no restrictions on land use or exposure are necessary. A statutory 5-year review is not required for AOC H under the NA determination.

1.2 Navy Authorizing Signature for the Record of Decision for AOC H, Former Naval Ammunition Support Detachment, Vieques, Puerto Rico

R. David Curfman 9/23/08

R. David Curfman, P.E.
Director, Environmental Programs
Naval Facilities Engineering Command, Atlantic

Date

1.3 EPA Authorizing Signature for the Record of Decision for AOC H, Former Naval Ammunition Support Detachment, Vieques, Puerto Rico

George Pavlou — Date 9/29/08

Acting Director, Emergency and Remedial Response Division
Environmental Protection Agency, Region II

1.4 PREQB Concurrence Signature

16/9/08

Javier J. Rúa, Esq.
Executive Director
Puerto Rico Environmental Quality Board

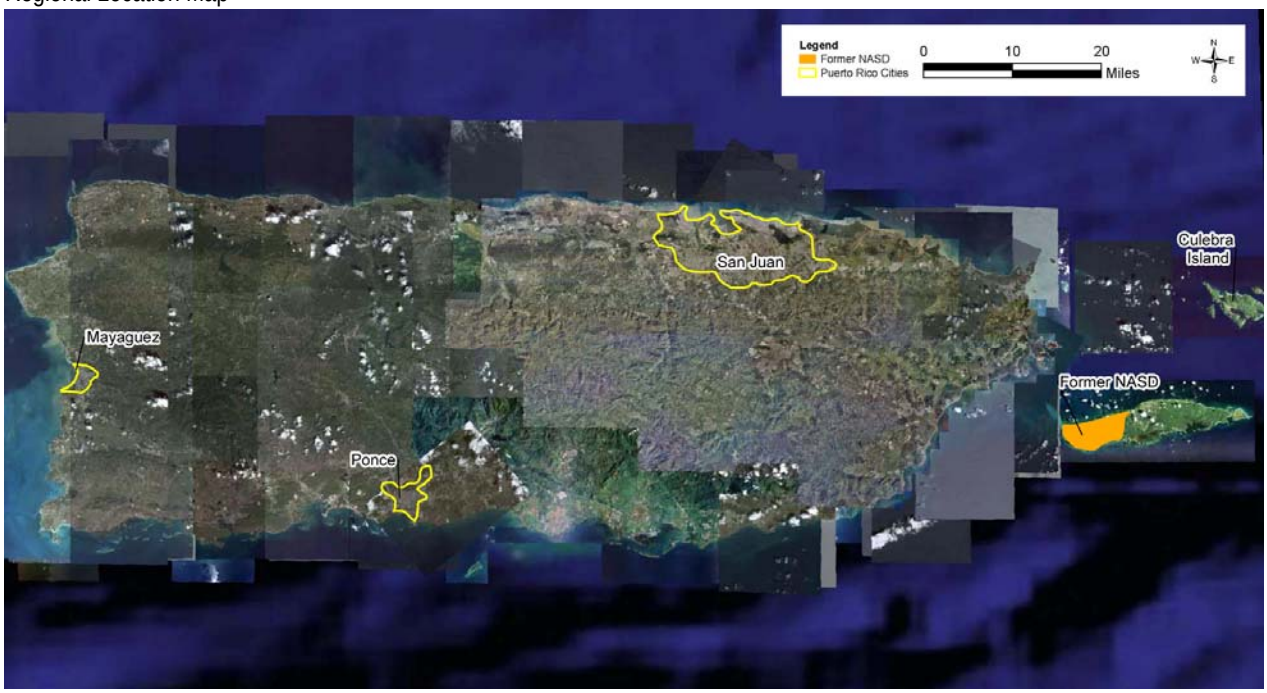
Date

2 Decision Summary

2.1 Site Description and History

Vieques Island is approximately 7 miles southeast of the eastern tip of the main island of Puerto Rico (Figure 1). Vieques is the second-largest island in the Commonwealth of Puerto Rico, encompassing 33,088 acres. The Navy ceased facility wide operations on the former NASD in April 2001, in accordance with the January 30, 2000, Presidential Directive to the Secretary of Defense associated with the transfer of lands of the Navy-owned western portion of Vieques. The land transfer was completed on May 1, 2001, and the Navy has had no military presence at the main operational area since. Currently, the Navy's involvement at the former NASD comprises the environmental restoration program activities.

FIGURE 1
Regional Location Map



AOC H, the Former Power Plant, is located about 200 feet east of the entrance to the MOV public works area just north of Highway 200 and south of Vieques Passage (Figure 2). AOC H is approximately 0.5 acre and consists of an abandoned concrete building (Building 13) approximately 80 feet long and 25 feet wide. An ephemeral stream is located along the western portion of the site. The surrounding area is uninhabited and is heavily vegetated.

From 1941 to 1943 power generation equipment was stored in and around Building 13, including large diesel generators used to provide electricity to a nearby community. Aboveground storage tanks (ASTs) were reportedly located on the west side of the building and held an estimated 2,000 to 3,000 gallons of diesel fuel for operation of the generators. After 1943, the building was vacant until the 1960s when it was used for fire training operations. Fire training operations consisted of the use of diesel fuel, which was poured over rubber tires inside the building and ignited to

simulate structural fires. The fire training activities ceased in the 1980s. The diesel generators, ASTs, and rubber tires are no longer present at the site.

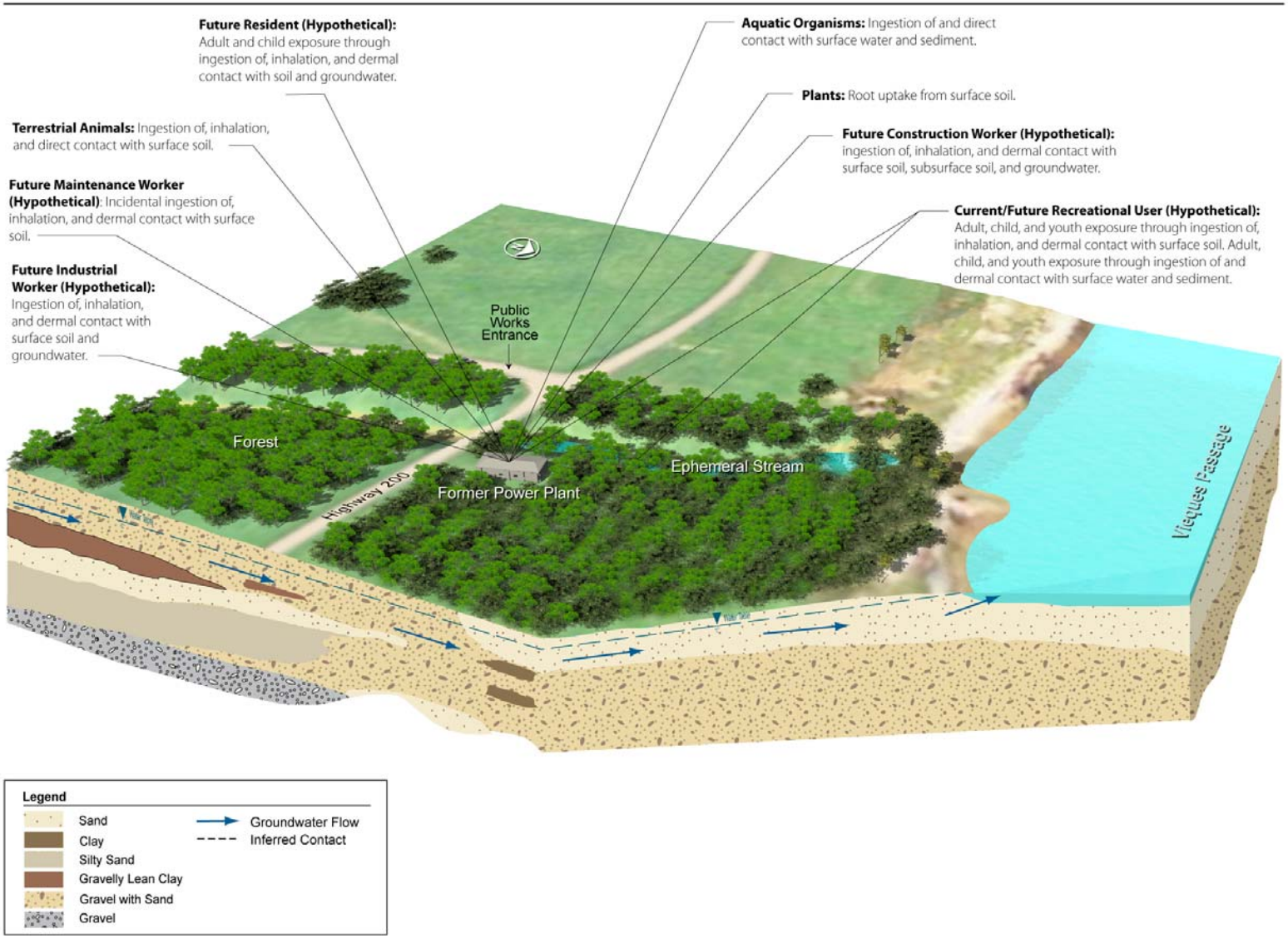
FIGURE 2
AOC H Site Location Map

2.2 Site Characteristics

AOC H and the surrounding area are heavily vegetated with dense thorn shrubs and coastal forest (Figure 3). It serves as a habitat for wildlife such as lizards, birds, and bats. The abandoned power plant building (Building 13) has been noted to be used by fruits bats as a roosting place year-round. A 20- to 40-foot-wide ephemeral stream, averaging 3 to 6 feet deep, exists along the western boundary of the site, and is open to the Vieques Passage during storm events only. The ephemeral stream contains brackish water. Previous investigations indicated water levels in the ephemeral stream were **not tidally influenced**.

The **hydrogeologic setting** beneath AOC H consists of unconfined alluvial deposits of clays, silts, sands, and gravels to a depth of approximately 15 feet below ground surface (bgs). The water table is encountered at approximately 7 feet bgs. The groundwater flow direction at AOC H is predominantly to the north toward the Vieques Passage with a slight influence westward toward the ephemeral stream. However, **groundwater elevation data** do not indicate groundwater is discharging to the stream.

FIGURE 3
Conceptual Site Model



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CH2MHILL

2.3 Investigations

Environmental investigations at AOC H were initiated with an Environmental Baseline Survey (EBS), conducted in 2000 to identify potential contaminants based on historical uses at the former power plant. Subsequent investigations, including a Remedial Investigation (RI), were conducted to further evaluate potential releases associated with historical storage of large diesel generators and ASTs, containing diesel fuel, and potential residual contamination from burning of tires on the ground surface. Table 1 summarizes previous studies and investigations conducted at AOC H.

TABLE 1
Previous Studies and Investigations

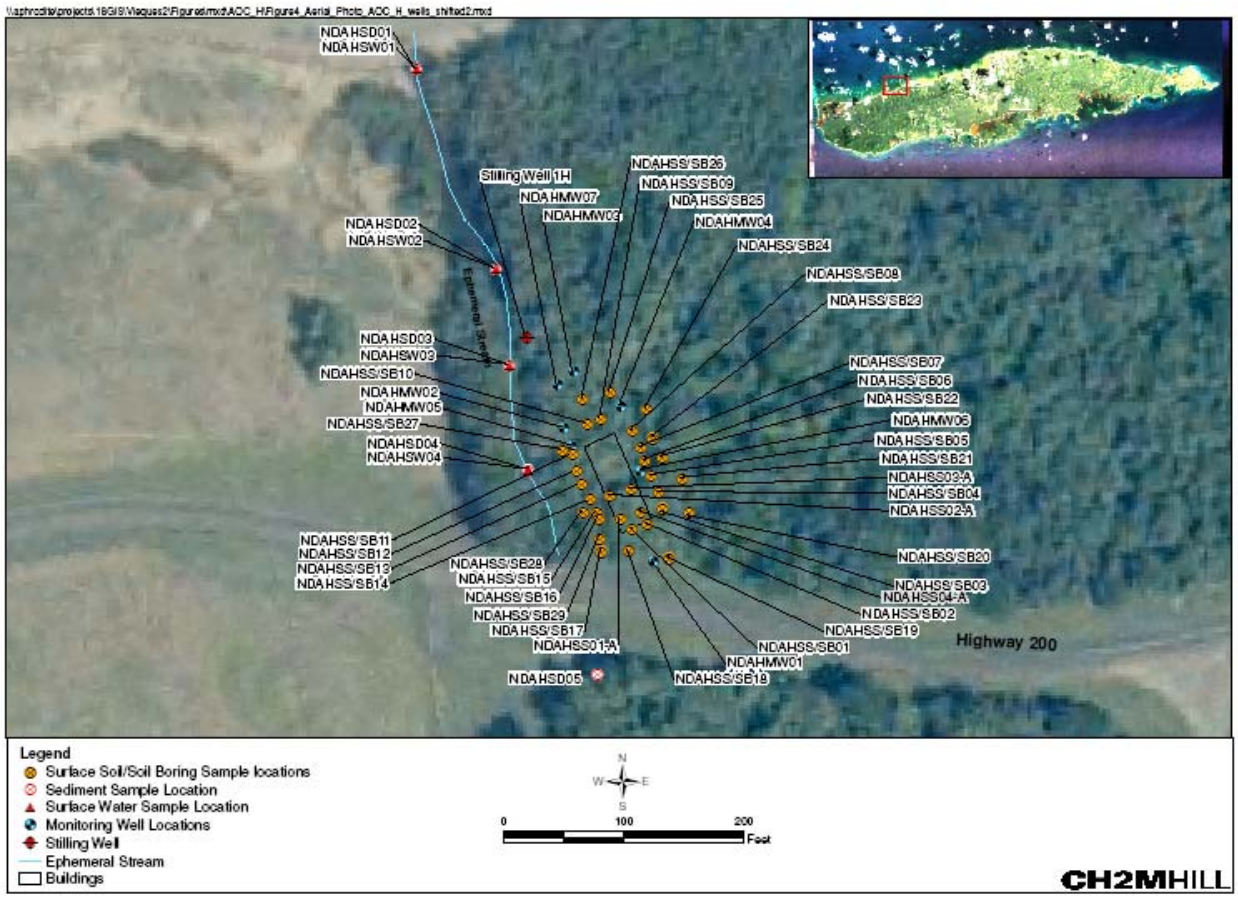
Previous Study/Investigation *	Date	Investigation Activities
Environmental Baseline Survey (EBS)	2000	Records review and personnel interviews were conducted to obtain information on the historical uses of the building. Six building floor **concrete wipe samples** were collected for analysis of polychlorinated biphenyls (PCBs). There were no detections of PCBs. Additional investigations were recommended to assess potential releases as a result of fire training activities.
Ecological Survey	2000	Survey conducted to characterize the site's ecology, identify any protected species, and perform a qualitative impact analysis. The survey found no protected species at AOC H.
Preliminary Assessment/Site Investigation (PA/SI)	2000	PA/SI groundwater and soil (surface and subsurface) samples were collected for analysis of metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, PCBs, explosives, and total petroleum hydrocarbons (TPH). Results identified the presence of metals, SVOCs, and pesticides in surface soil and metals and SVOCs in groundwater at concentrations above EPA screening values. Subsurface soil results were below EPA screening levels. Further investigation was recommended to determine the nature and extent of contamination.
Remedial Investigation (RI)	2003	Soil, groundwater, surface water, and sediment samples were collected for analysis of VOCs, SVOCs, metals, perchlorate, pesticides, PCBs, and explosives. **Data results from the RI and PA/SI** were used to evaluate the nature and extent of contamination and conduct a human health risk assessment (HHRA) and ecological risk assessment (ERA) for AOC H.
Proposed Plan (PP)	2008	Provided the Preferred Alternative for AOC H and invited the public to review and comment prior to making the final decision.

* The documentation listed is available in the Administrative Record and provides detailed information used to support the no action determination for AOC H.

Evaluation of the nature and extent of constituents in site media and the assessment of human health and ecological risks for AOC H were conducted in 2003 as part of the RI. The nature and extent of constituents at AOC H is based on the analysis of soil, groundwater, sediment, and surface water samples (Figure 4) and comparison of site chemical concentrations to risk based screening values for human health (also referred to as EPA Region 2 preliminary remediation goals [PRGs]) and ecological receptors. Metals (inorganics), VOCs, SVOCs, and pesticides were detected in **surface soil** samples above at least one screening criteria and background concentrations. Arsenic was the only metal detected in **subsurface soil** samples above the human health screening

criteria and background. Several metals and one pesticide (DDD) were detected in **groundwater** samples above the PRGs. **Surface water** analytical results indicated the presence of one metal (arsenic) at a concentration above the ecological screening criterion in one unfiltered sample. Caprolactam, a common contaminant introduced in the laboratory during sample preparation, was detected in one surface water sample, but its concentration did not exceed risk screening values. Several metals were present in **sediment**. However, with the exception of barium, all were detected at concentrations below background levels. Barium exceeded background in only one sample; there was no distribution pattern indicative of a barium release at the site; and barium is not identified in any other site media above background.

FIGURE 4
Sample Locations



2.4 Current and Potential Future Land and Resource Uses

The former NASD occupied approximately 8,000 acres, most of which is undeveloped. Military operations ceased on the former NASD in April 2001 and the land containing AOC H was transferred to the MOV.

Currently, the abandoned building is the only historical feature remaining at AOC H (Figure 5). The future land use of the land that includes AOC H, according to the Puerto Rico Planning Board

(PRPB), is as a resource conservation area with no planned development. Although there are a number of conservation zones, prehistoric sites, and historic sites listed on the National Registry of Historic Places (NRHP) on the western end of the island, none of these sites occurs within the AOC H area.

The Navy plugged and abandoned all potable groundwater wells installed on its land in the summer of 2000 as part of the land transfer process. Groundwater is not currently used as a potable water source at or in the vicinity of AOC H because of its brackish quality, influenced by coastal surface waters, making it unsuitable for potable use without treatment.

2.5 Summary of Site Risks

The potential sources of contamination at AOC H were releases from historical diesel generators and ASTs containing diesel fuel, and burning of tires on the ground surface. The primary transport mechanisms of potential contamination as a result of a site release are surface runoff to the ephemeral stream and vertical migration to groundwater. During rain events, constituents may be transported with storm water runoff to surface water and sediment in the adjacent ephemeral stream. Constituents present in soil may also leach through the unsaturated zone and be transported with groundwater flow to discharge into the Vieques Passage. A **conceptual site model** (CSM) is provided as Figure 3. Potential human health and ecological risks were quantitatively evaluated based on the receptor scenarios and potentially impacted media identified in the CSM. The discussion below focuses on those human health and ecological risks calculated to be above regulatory thresholds.

2.5.1 Human Health Risk Assessment

Based on the human health CSM, human health risks were quantitatively evaluated for **potential human receptors** exposed to surface soil, subsurface soil, groundwater, sediment, and surface water using reasonable maximum exposure (RME) concentrations. The RME assumes the highest level of human exposure that could reasonably be expected to occur. The potential non-cancer hazards, expressed as the hazard index (HI), and cancer risk estimates were calculated using RME concentrations. For non-cancer effects, an HI represents the ratio between the reference dose and the RME dose for a person in contact with site constituents of potential concern (COPCs). An HI exceeding 1 indicates that potential health effects are expected to occur. For known or suspected carcinogens, acceptable exposure levels generally are concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} (a 1 in 10,000 chance of developing cancer) and 10^{-6} (a 1 in 1,000,000 chance of developing cancer) using information on the relationship between dose and response.

All pathway, media, and receptor scenarios evaluated in the human health risk assessment (HHRA) lead to the conclusion that there are **no unacceptable human health risks** from historic Navy activities at AOC H. Although the non-cancer HI is greater than 1 for potable use of groundwater by future residents and future industrial workers, and greater than 1 for incidental ingestion by future construction workers due to the presence of arsenic, iron, manganese, thallium, and vanadium, the potential risks/hazards associated with these metals are acceptable and/or not associated with historic Navy activities at AOC H based on the following:

- Total metals used to calculate the risk and hazard estimates are not representative of a potable groundwater scenario as groundwater is brackish and would require filtration prior to potable

use. Dissolved concentrations of these metals in groundwater were significantly lower or were not detected.

- Iron and manganese are naturally occurring and were detected below background concentrations.

Table 2 presents a summary of the receptors with risk and hazard estimates above regulatory levels (although not associated with historic Navy activities).

The HI for future child residents exposed to site soil exceeded 1 due to the presence of vanadium in surface and subsurface soil. However, vanadium concentrations are consistent with background concentrations and are likely part of the background soil mineralogy. Thus, historic Navy activities are not associated with unacceptable health hazards from exposure to site soil. The carcinogenic risks associated with exposure to all receptors and media are below or within EPA's acceptable target risk range.

The RI specifies the **HHRA assumptions and uncertainties** inherent in the risk assessment process due to the number of samples collected or their location, the literature-based values used to calculate risk, and risk characterization across multiple media and exposure pathways.

TABLE 2
Receptors With Risk and Hazard Estimates Above Regulatory Levels

Receptor	Media	Pathway	Chemical of Concern	Exposure Point Concentration	RME Non Cancer Hazard	Non-Cancer Toxicity Factor - Reference Dose (mg/kg-day)
Future Child Resident	Groundwater	Ingestion	Aluminum	9,100 ug/l	0.6	1 *
			Antimony	5.4 ug/l	0.9	0.0004 **
			Arsenic	6.3 ug/l	1	0.0003 **
			Cadmium	2.99 ug/l	0.4	0.0005 **
			Iron	7,030 ug/l	22	0.3 *
			Manganese	14,800 ug/l	7	0.02 **
			Thallium	44.2 ug/l	35	0.00008 **
			Vanadium	70 ug/l	5	0.001 *
	Surface Soil	Ingestion	Aluminum	8,260 mg/kg	0.1	1 *
			Arsenic	19 mg/kg	0.9	0.0003 **
			Iron	21,300 mg/kg	0.9	0.3 *
			Thallium	0.618 mg/kg	0.1	0.00008 **
			Vanadium	47.8 mg/kg	0.6	0.001 *
		Dermal	Vanadium	47.8 mg/kg	0.7	0.000026 *
	Subsurface Soil	Ingestion	Arsenic	6.56 mg/kg	0.3	0.0003 **
Future Industrial Worker	Groundwater	Ingestion	Antimony	5.4 ug/l	0.1	0.0004 **
			Iron	7,030 ug/l	3	0.3 *

TABLE 2
Receptors With Risk and Hazard Estimates Above Regulatory Levels

Receptor	Media	Pathway	Chemical of Concern	Exposure Point Concentration	RME Non Cancer Hazard	Non-Cancer Toxicity Factor - Reference Dose (mg/kg-day)
			Thallium	**44.2 ug/l**	**5**	**0.00008 ****
Future Construction Worker	**Groundwater**	**Dermal (in Excavations)**	**Manganese**	**15,000 ug/l**	**5**	**0.02 ****

* - Source: National Center for Environmental Assessment (NCEA)

** Source: Integrated Risk Information System (IRIS)

2.5.2 Ecological Risk Assessment

An ecological risk assessment (ERA) was conducted for AOC H, consisting of Steps 1 through 3A, in accordance with Navy and EPA policy and guidance. In Step 1 (Problem Formulation), the environmental setting, chemical fate and transport, ecotoxicity and potential receptors and complete exposure pathways were identified. This information was used to develop the CSM and **ecological assessment and measurement endpoints**. Potentially complete pathways were identified for lower trophic level receptors (earthworms), upper-trophic level receptors (mongoose and hawk), and aquatic receptors (fish). These receptor pathways were based on constituents in surface soil, surface water, and sediment.

In Step 2, hazard quotients (HQs) were calculated to characterize the potential for constituents to pose unacceptable ecological risk using conservative exposure assumptions. HQs represent a ratio of the exposure level to an ecological effect level, and are an estimate of potential risk. Maximum sediment, surface water, and surface soil constituent concentrations were used in Step 2 to estimate potential exposures for the ecological receptors selected to represent the assessment endpoints at AOC H. Upper tropic effect levels based on constituents present in surface soil, sediment and surface water were determined by estimating the concentration of each **bioaccumulating chemical** in each relevant dietary component. Only constituents with the potential to bioaccumulate were evaluated for exposures via food web modeling. For lower trophic level receptors, the exposure level for soil were screened against **ecological soil screening levels** (eco-SSLs) developed by EPA or alternate approved screening values if eco-SSLs were not available for specific constituents. Surface water screening values used were the most conservative of the Puerto Rico Water Quality Standards Regulation and the US National Recommended Water Quality Criteria (NRWQC). Sediment screening values were selected from National Oceanic and Atmospheric Administration (NOAA) publications and the State of Florida. Upper tropic level receptor evaluations were based on chronic No Observed Adverse Effect Levels (NOAELs) and chronic Lowest Observed Adverse Effect Levels (LOAELs) for **toxicity values** obtained from scientific literature. Chemicals with HQs greater than 1 were identified as **ecological COPCs** for further evaluation in Step 3 of the ERA.

In Step 3A, the conservative exposure assumptions employed for Step 2 were refined and risk estimates were recalculated using the mean instead of the maximum chemical concentrations of the COPCs as the basis for exposure and estimating upper tropic level doses. Based upon a comparison to LOAELs, no HQ exceeded 1 for any of the terrestrial or aquatic receptors. Only the

HQ for zinc (the pearly-eyed thrasher) exceeded 1 based upon the NOAEL (1.73). Therefore, no COPCs for upper trophic level receptors were retained for further evaluation.

Although some metals, PAHs, pesticides, DDE, and DDT were identified as COPCs in site media, risks to lower trophic level receptors were acceptable based on the following:

- Comparison of inorganic COPC concentrations to background inorganic concentrations
- Comparison of COPC concentrations to other commonly used screening values from scientific literature
- Consideration of the frequency of detection, frequency of screening value exceedances, magnitude of the HQs relative to 1, and limited spatial distribution of the COPCs

The RI specifies the **ERA assumptions and uncertainties** inherent in the risk assessment process due to the number of samples collected or their location, the literature-based values used to calculate risk, and risk characterization across multiple media and exposure pathways.

2.6 No Action Determination

Based on results of RI, HHRA, and ERA there are no unacceptable risks to human health or the environment over that of background from unrestricted exposure to site media at AOC H. The Navy, in partnership with the EPA, with concurrence by PREQB, and in consultation with the MOV, determines no action is warranted. The no action determination meets the statutory requirements of CERCLA and the regulatory requirements of the NCP for protection of human health and the environment. No remedial response action and no restrictions on land use or exposure are necessary at AOC H.

2.7 Community Participation

The Navy, in consultation with the EPA and PREQB, and in partnership with the MOV established a community relations program for the Vieques environmental restoration program in 2001. The program promotes communication regarding site investigations and remediation activities between the stakeholder agencies (Navy, EPA, PREQB, and the MOV) and the public. The community relations program formed a Restoration Advisory Board (RAB) in 2004 to encourage community involvement. RAB meetings are held approximately every 3 months and are open to the public for participation.

In accordance with Section 117(a) of CERCLA, the Navy provided a public comment period between January 28, 2008 and March 12, 2008, for the AOC H Proposed Plan. A public meeting to present the Proposed Plan was held on February 7, 2008 at the Vieques Multiple Use Center. The meeting provided an additional opportunity for the public to submit comments on the Proposed Plan.

The Proposed Plan and previous investigation reports for AOC H were available during the public comment period and are currently available in the NASD Administrative Record. The Administrative Record is accessible to the public via:

Biblioteca Electrónica
Calle Carlos LeBrum #449
Isabel Segunda

Vieques, PR 00765
Phone: (787) 741-2114

Hours of Operation:
Monday – Friday, 8:00 a.m. – 4:00 p.m.

Or online at:
http://public.lantops-ir.org/sites/public/vieques/default.aspx

3 Responsiveness Summary

The participants in the public meeting included RAB members and representatives of the Navy, EPA, and PREQB. Questions and concerns received during the meeting were addressed at the meeting and are documented in the **meeting transcript.** No additional written comments, concerns, or questions were received by the Navy, EPA, PREQB, or the MOV during the public comment period.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
1	**not tidally influenced**	Section 2.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Section 3.2.8, Pages 3-6 through 3-7. July 2007.
2	**hydrogeologic setting**	Section 2.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Sections 2.3.4.2 and 2.3.5, Pages 2-3 through 2-4. July 2007.
3	**groundwater elevation data**	Section 2.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Section 3.2.3, Page 3-4. July 2007
4	**concrete wipe samples**	Table 1	CH2M HILL. Final Expanded Preliminary Assessment/Site Investigation Phase II Seven Sites for Naval Ammunition Storage Detachment Vieques Island, Puerto Rico. November 2002.
5	**Data results from the RI and PA/SI**	Table 1	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Tables 4-A through 4-E. July 2007.
6	**surface soil**	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-9. July 2007b.
7	**subsurface soil**	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-10. July 2007b.
8	**groundwater**	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-11. July 2007b.
9	**surface water**	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-12. July 2007b.
10	**sediment**	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-13. July 2007b.
11	**potential human receptors**	Section 2.5.1	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Section 6.6, Pages 6-7 through 6-10. July 2007.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
12	**no unacceptable human health risks**	Section 2.5.1	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 10.1.RME through 10.5 RME. July 2007.
13	**HHRA assumptions and uncertainties**	Section 2.5.1	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Sections 6.9 through 6.10, Pages 6-15 through 6-19. July 2007.
14	**ecological assessment and measurement endpoints**	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 7-4. July 2007.
15	**bioaccumulating chemical**	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 7-5. July 2007.
16	**ecological soil screening levels**	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Tables 7-6 through 7-13. July 2007.
17	**toxicity values**	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Tables 7-9 through 7-10. July 2007.
18	**Ecological chemicals of potential concern (COPCs)**	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Tables 7-11 through 7-13. July 2007.
19	**ERA assumptions and uncertainties**	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Section 7.4, pages 7-21 through 7-24. July 2007.
20	**meeting transcript**	Section 3	CH2M HILL. Proposed Plan, Area of Concern H, Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. March 2008.

[1] Bold blue text indicates hyperlinks available on the reference CD to detailed site information contained in the publicly available Administrative Record.

For access to information contained in the Administrative Record for AOC H please contact:

Biblioteca Electrónica
Calle Carlos LeBrum #449
Isabel Segunda
Vieques, PR 00765
Phone: (787) 741-2114

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
1	not tidally influenced	Section 2.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Section 3.2.8, Pages 3-6 through 3-7. July 2007.

details regarding sampling, the required containers, preservatives, and holding times for surface water samples. Surface water sample logs are included in Appendix E.

Five sediment samples were collected at the surface water sample locations identified above to assess the horizontal extent of sediment contamination, if present, from the source area. Figure 3-4 illustrates the sediment sampling locations. All samples were collected at a depth of 0 to 6 inches.

The applicable standard operating procedure (SOP) for the collection of sediment samples is presented in the work plan for the former NASD (CH2M HILL, 2001a).

Table 3-12 provides a listing of sediment sample locations and elevations. Sediment samples were analyzed for SVOCs, explosives, perchlorate, total metals, and pesticides. Details regarding the required containers, preservatives, and holding times for groundwater and soil samples are presented in the field sampling plan for the former NASD (CH2M HILL, 2001a).

Table 3-13 provides a listing of sediment sample parameters and methods and also includes the number of sediment samples collected as part of this evaluation, including QA/QC samples. Details regarding the required containers, preservatives, and holding times for groundwater and soil samples are presented in the field sampling plan (CH2M HILL, 2001a). Appendix E includes sediment sampling logs.

Sampling equipment, including hand augers, and bowls, was decontaminated between each sample location using the following procedure:

- Rinse with potable water to remove most of the soil
- Wash with scrub brush using potable water and Alconox (nonphosphate soap)
- Rinse with potable water
- Rinse with laboratory grade deionized water
- Rinse with isopropyl alcohol
- Rinse with laboratory grade deionized water
- Air dry

3.2.7 Background Surface Water and Sediment Sampling

Sample locations NDAHSW05 and NDAHSD05 are south of Highway 200 to provide background surface water and sediment data.

3.2.8 Tidal Fluctuation Study

A hydraulic tidal study was conducted at AOC H from June 9 through June 11, 2003, to determine if there is a tidal influence on groundwater flow at the site. Groundwater level measurements and surface water measurements were recorded from monitoring wells NDAHMW01, NDAHMW02, and NDAHMW04 and the stilling well. Monitoring well NDAHMW01 is the farthest south, just north of Highway 200, and is approximately 80 feet east of the ephemeral stream. Monitoring well NDAHMW02 is located off the northwest corner of the building approximately 30 feet east of the ephemeral stream. Monitoring well NDAHMW04 is located off the northeast corner of the building approximately 70 feet east of the ephemeral stream. The stilling well was placed along the edge of the ephemeral

stream approximately 70 feet north of monitoring well NDAHMW02. Monitoring well and stilling well locations within AOC H are presented in Figure 3-3. The northern border of AOC H is approximately 200 feet south of the Vieques Passage.

Water levels were obtained by measuring the depth to water from a marked location on the TOC, which was surveyed in to the nearest 0.01 foot above msl. Time-series water level data were obtained using an in situ data logger that provided continuous water level recordings in the three monitoring wells and one stilling well. The stilling well was installed by pushing slotted PVC pipe into the ephemeral stream. The data logger transducers were then suspended inside the slotted section and secured. Continuous water levels were captured at approximately 10-minute intervals for a 36-hour period.

Figure 2-6 shows water level data, corrected to elevation above msl, for the monitoring wells NDAHMW01, NDAHMW02, and NDAHMW04. Monitoring well NDAHMW02 shows a gradual rise of approximately 0.2 foot during the tidal study. This may be explained by a rain event that took place on the second day (June 10). The surface water elevation of Stilling Well 1H was most affected by the rain event, showing an increase in surface water elevation of 0.3 foot. Monitoring well NDAHMW02 showed a rise in groundwater elevation after the ephemeral stream surface water elevation rose. Monitoring well NDAHMW02 is close to the ephemeral stream, and its groundwater elevation appears to be affected by changes in the water level in the ephemeral stream. The other two monitoring wells (NDAHMW01 and NDAHMW04) did not appear to be influenced by the rain event. For reference, tidal data compiled by the National Oceanic and Atmospheric Administration (NOAA) were obtained from the nearest tide gauge, which is located at the La Puntilla station at San Juan Bay, Puerto Rico. This location indicated a surface water tidal fluctuation of up to 1.8 feet during the same time period.

A comparison of the surface water tidal fluctuations and the groundwater elevation data shows that there is no significant tidal influence on the groundwater elevations at the AOC H monitoring wells or the ephemeral stream when the mouth of the ephemeral stream is closed off to the Vieques Passage. Thus, the direction of groundwater flow at the site is not influenced by tidal fluctuations.

3.3 Surveying

The monitoring well locations and sampling locations (surface soil, soil borings, and sediment) were surveyed in the field using differential global positioning system (DGPS) techniques by Transystems Inc. The survey established the latitude and longitude coordinates for each of the locations. In addition, the elevation in feet above msl was established to the nearest 0.01 foot for the TOC of the monitoring wells using traditional surveying techniques and DGPS techniques for remote areas. Tables 3-3, 3-7, 3-9, and 3-14 provide the survey data. These survey data are also found in Appendix F.

All sample locations and well elevations were surveyed in accordance with the civil surveying SOP included in the work plan.

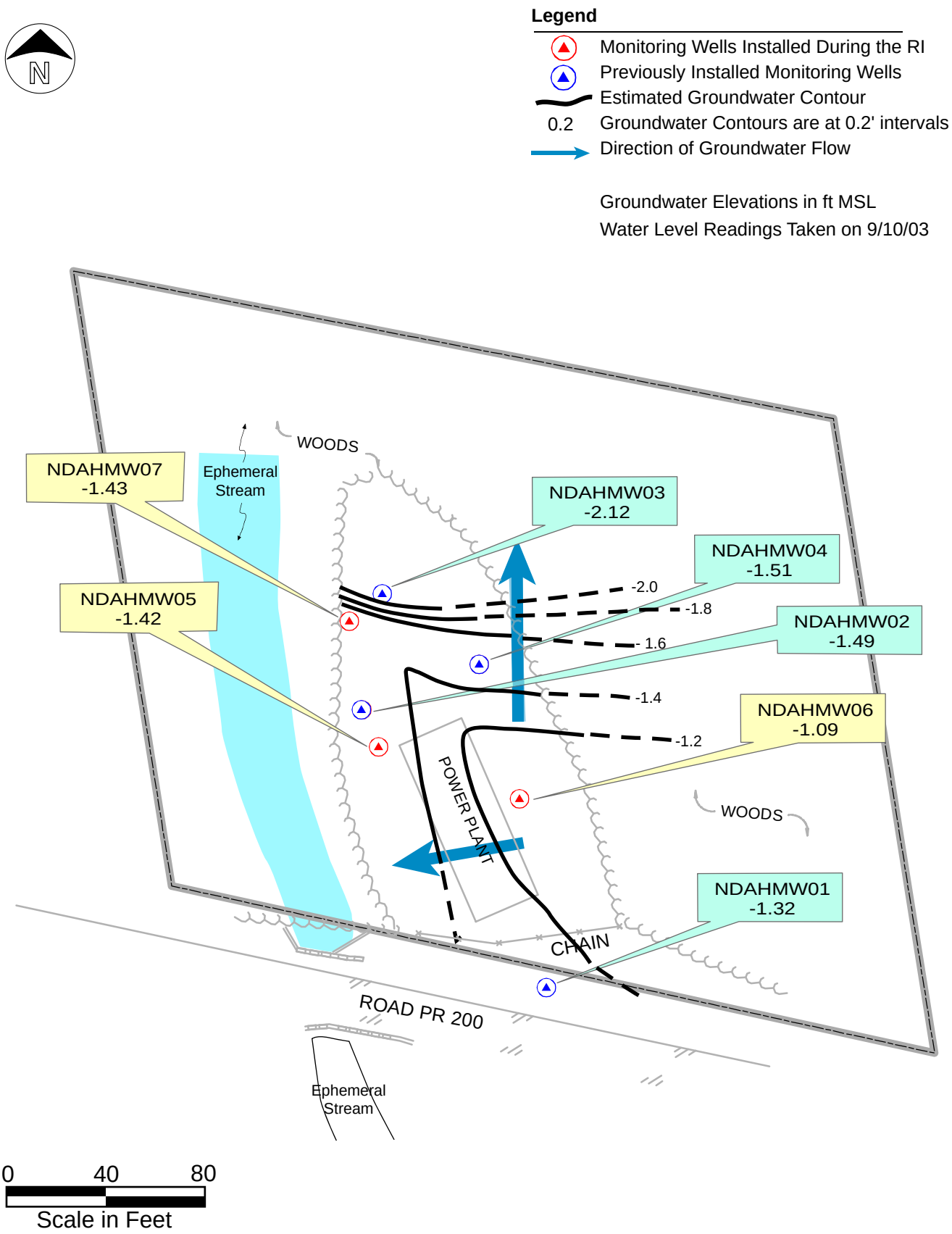


FIGURE 2-6
Groundwater Flow Map
AOC H, Former NASD, Vieques, Puerto Rico

Note: Original Figure Created in Color

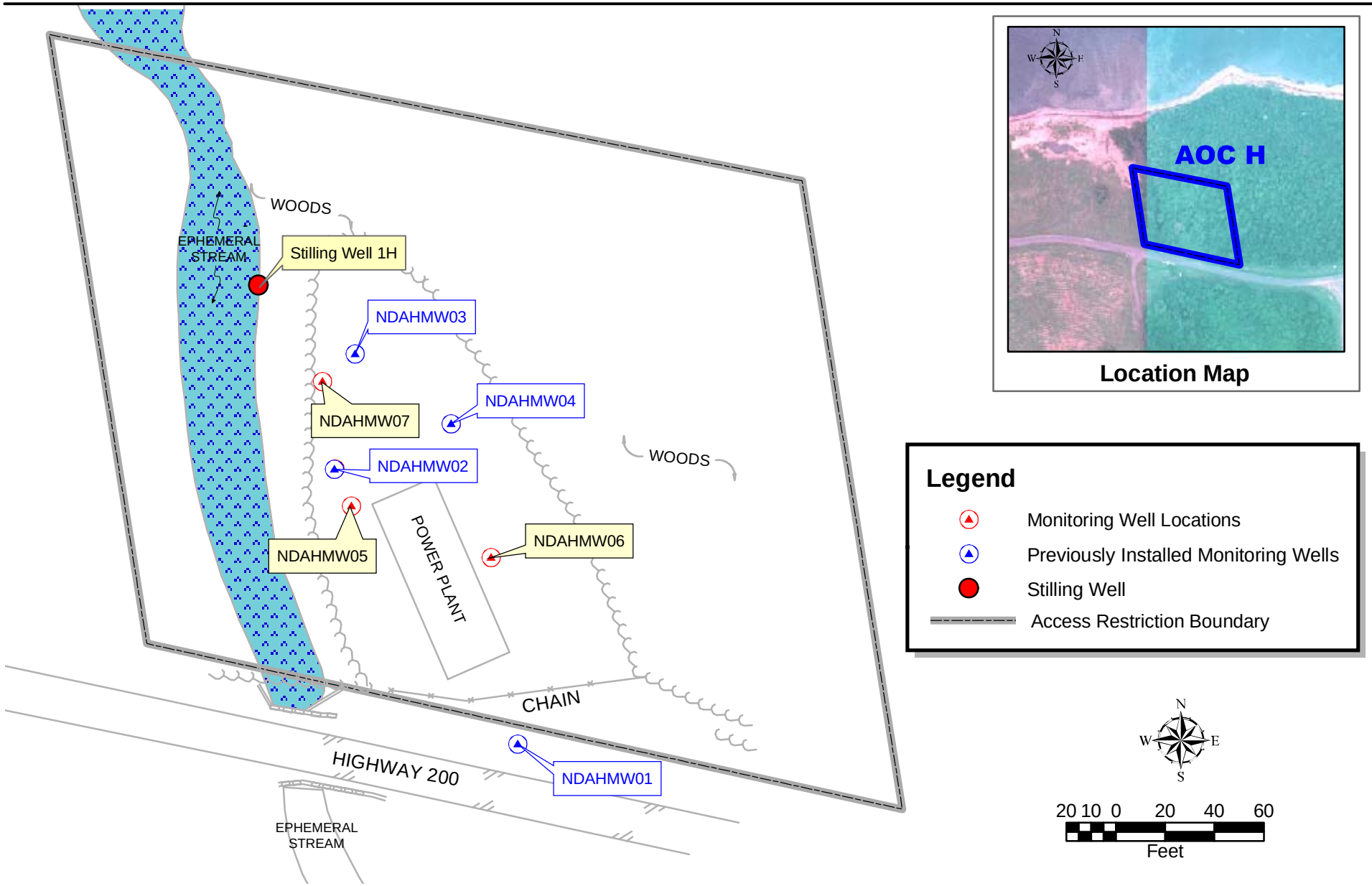


FIGURE 3-3
Remedial Investigation Monitoring Well Location Map
AOC H, Former NASD, Vieques, Puerto Rico

CH2MHILL

ES122005001TPA_180357.RI.DF.AH

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
2	hydrogeologic setting	Section 2.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Sections 2.3.4.2 and 2.3.5, Pages 2-3 through 2-4. July 2007.

2.3.3 Vegetation

Vegetation immediately around the structure was cleared for the installation of monitoring wells prior to the survey. The area to the east consists of dense thorn scrub. West of the building, a mixed thorn scrub and coastal forest transitions to the ephemeral stream that drains to Vieques Passage. Water quality within the ephemeral stream was brackish during the survey. To the north, a densely mixed thorn scrub and coastal forest is present.

Dominant shrubs identified on the site included tantan, Christmas tree, and brisselet. The sandy ground was covered with tantan seedlings. The dominant herbs observed on the site include malva colorada and better man better. Hurricane grass was observed on the southern boundary of the site. AOC H is bordered to the south by the grassy road shoulder, which is maintained frequently.

2.3.4 Geology

2.3.4.1 Regional Geology

The geology of western Vieques is characterized by plutonic rocks generally overlain by alluvial deposits. The plutonic rocks consist of granodiorites that were intruded by a quartz-diorite plutonic complex and are exposed over a large percentage of the island. A gradual change in texture from coarse- to fine-grained quartz-diorite has been observed from the west to the east part of Vieques. A saprolite formation occurs at the surface of the plutonic complex. The alluvial deposits are generally of Quaternary age, consisting of a mixture of sand, silt, and clay that together have an average thickness of 30 feet in western Vieques. The sediments consist of alluvial deposits, beach and dune deposits, and swamp and marsh deposits. The floodplains consist of beach and dune deposits formed by calcite, quartz, plutonic rock fragments, and minor magnetite (USGS, 1989).

2.3.4.2 Local Geology

Geologic profiles for AOC H were developed through the evaluation of soil boring logs and the associated geologic cross-section (Figure 2-5). Soil samples collected during the installation of soil borings and monitoring wells associated with the Expanded PA/SI completed in 2000 and this RI indicate that the soils encountered beneath AOC H consist of a variety of different alluvial deposits such as clay, sand, silty sand, gravel, gravel with sand, and gravelly clay. Soil colors range from a yellowish brown in the clay to a greenish gray sand. The materials in the clay zone generally exhibit low plasticity when moist, are stiff when dry, and are easily crumbled under hand pressure. The materials in the sand and gravel zones also exhibit low plasticity when moist, are generally loose, and can be easily crumbled under hand pressure.

The AOC H area appears to be on the fringes of the Resolución Valley aquifer and contains some of the sands and silty sands described in the USGS 1989 study. The water-bearing sediments (the sands, silty sands, and gravels) are within the upper 30 feet of the alluvium deposits.

2.3.5 Hydrology

2.3.5.1 Surface Water

Surface water on the former NASD consists of several lagoons and intermittent streams. Most of the streams are ephemeral, flowing only for a short period of time after precipitation events. These streams are located throughout the former NASD, generally flowing in a northerly direction.

One surface water body is present at AOC H. An ephemeral stream is located just west of the building and is mostly stagnant. It is possible that during periods of heavy and prolonged rainfall or ocean surge, the mouth of the ephemeral stream opens to the Vieques Passage to the north and at these times the ephemeral stream is subject to tidal influence. However, a tidal study (see Section 3.2) indicated that water levels in the ephemeral stream were not influenced by tides when the mouth of the stream is closed off to the Vieques Passage.

2.3.5.2 Groundwater

The Resolución Valley aquifer, estimated by the USGS to extend across much of the northwest portion of Vieques, is the only known groundwater aquifer on the former NASD property that contains potentially potable water. The Navy installed the only potable wells on the island of Vieques. The Navy plugged and abandoned all potable wells in the summer of 2000 as part of the transfer process. The Resolución Valley slopes from Mount Pirata toward the Vieques Passage and encompasses an area of approximately 8 square miles. Although no perennial streams are present in the valley, this area receives more rainfall than any other part of Vieques. The geology of the Resolución Valley aquifer consists of sedimentary deposits that overlie a saprolite formation derived from plutonic rocks. Geophysical surveys show that the alluvial deposits average approximately 30 feet in thickness (USGS, 1989).

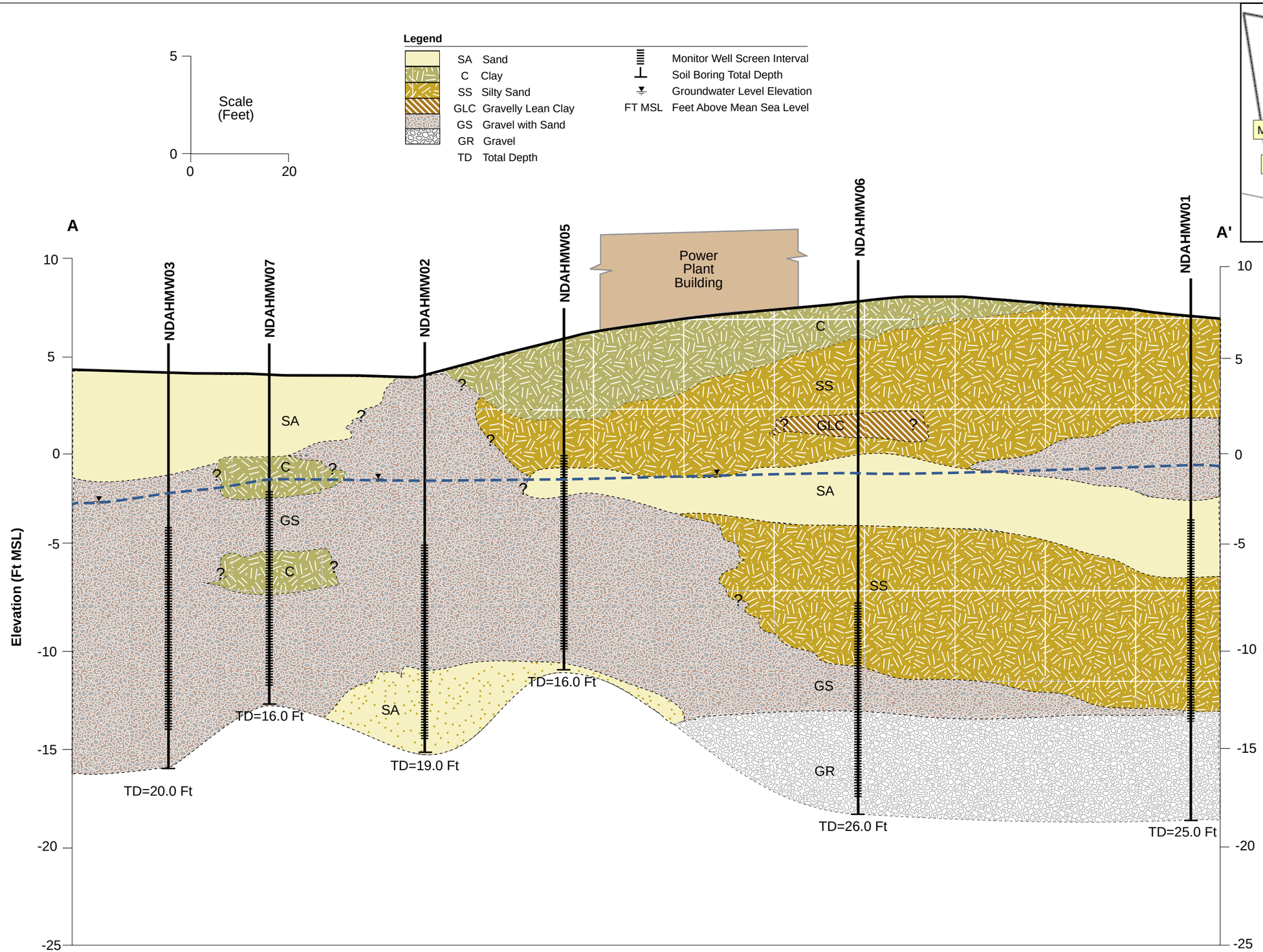
AOC H is underlain by an unconfined groundwater system composed of alluvial deposits made up of sands, silty sands, and gravels. Groundwater was encountered at the site at a depth of approximately 7 feet below land surface (bls). Based on groundwater elevation data collected for this investigation, the groundwater flow direction at AOC H is predominantly to the north toward Vieques Passage. However, at the western part of the site groundwater may flow locally to the west toward the ephemeral stream. (Figure 2-6). The predominant northerly flow is reflected in the steeper gradient to the north of approximately 0.01 ft/ft as compared to the westward gradient of approximately 0.006 ft/ft, as calculated below.

Northern Direction from MW-6 to MW-3

Gradient = (-1.09 ft – (-) 2.12 ft)/100 ft = 1.03 ft/100 ft = 0.01 ft/ft

Western Direction from MW-6 to MW-5

Gradient = (-1.09 ft – (-) 1.42 ft)/60 ft = 0.33 ft/60 ft = 0.006 ft/ft.



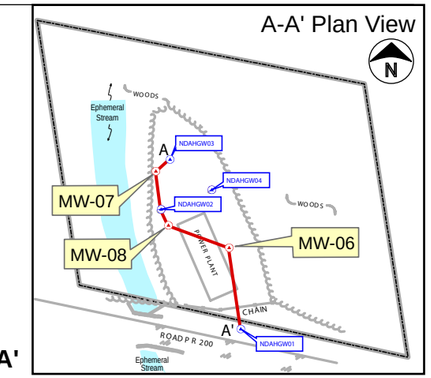


FIGURE 2-5
Geologic Cross-Section A-A'
AOC-H, Former NASD, Vieques, Puerto Rico

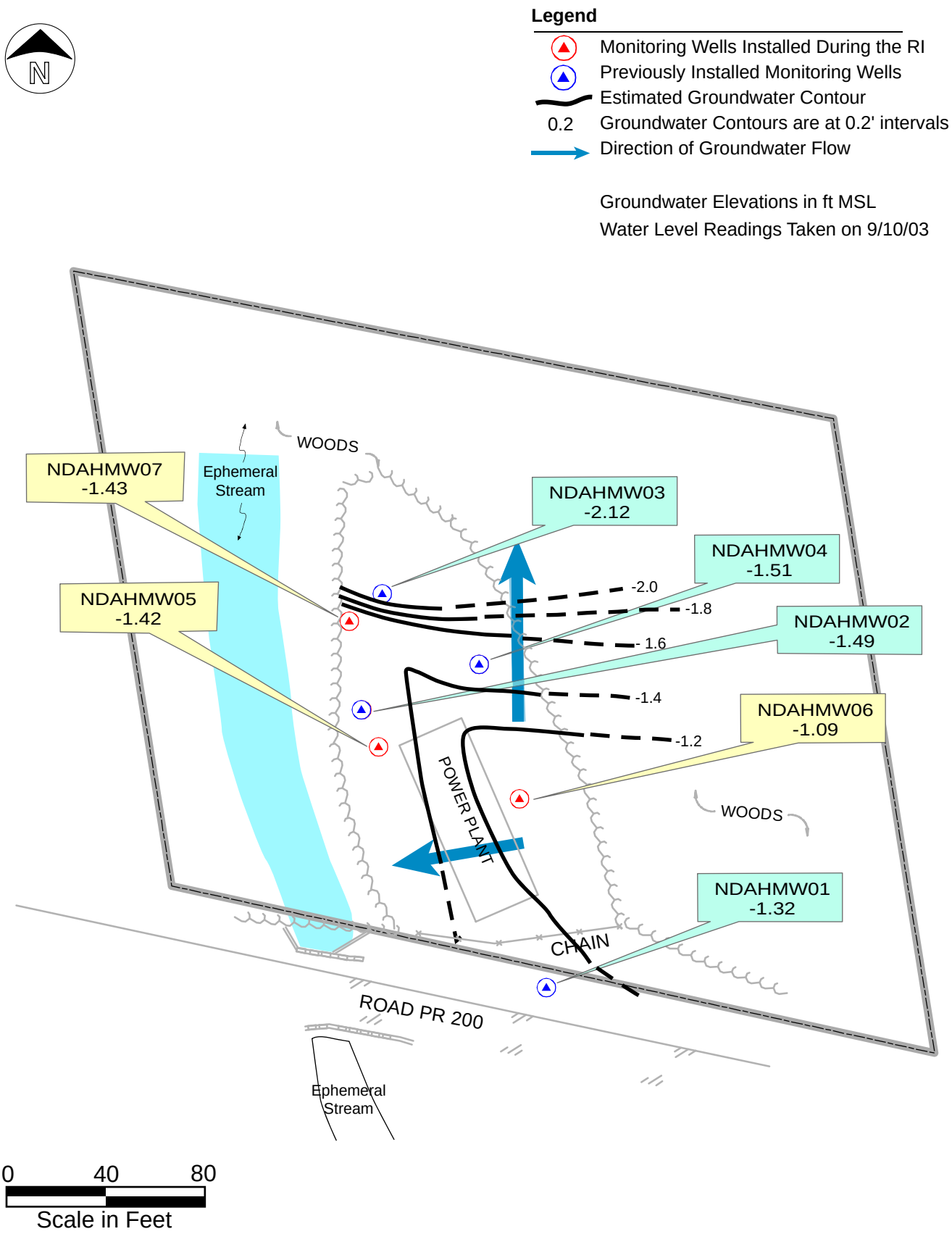


FIGURE 2-6
Groundwater Flow Map
AOC H, Former NASD, Vieques, Puerto Rico

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
3	groundwater elevation data	Section 2.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Section 3.2.3, Page 3-4. July 2007

3.2.2 Monitoring Well Development and Purging

Well development was performed after the grout that was used in well construction had adequately set for at least 24 hours. The groundwater levels were measured to the nearest 0.01 foot from the top of the PVC casing. Development consisted of removing at least three borehole volumes of water. Development continued until groundwater appeared clear. Well development information is included in Appendix C.

Monitoring well development was performed either by using a Whale centrifugal submersible pump with a combination of pumping and swabbing with the pump or by bailing using a Teflon® bailer and surging the well. Development water was discharged into 55-gallon drums. The submersible Whale pump was used on NDAHMW07 and encountered clogging, which made pumping impossible. Bailing was used for the other three wells.

Bailing continued until clear water (of minimal turbidity) was produced. The bailer was moved up and down (swabbed) through the screened interval to force water in and out of the screen. The turbidity increased when the bailer was moved to a new portion of the screen. Bailing and swabbing continued until clear, sediment-free water was generated. This procedure was used for monitoring wells NDAHMW05, NDAHMW06, and NDAHMW07.

During air lifting, air was forced to the bottom of the well, and all water was evacuated. This procedure was continued until the water was clear. This borehole development procedure was used at monitoring wells NDAHMW04, NDAHMW05, and NDAHMW08.

Pumps and bailers were decontaminated between sample locations using the following procedure:

- Rinse with potable water
- Wash with scrub brush using potable water and Alconox (nonphosphate soap) and run pump in large tub
- Rinse and cycle pump with potable water
- Rinse with laboratory grade deionized water
- Air dry

3.2.3 Groundwater Elevation Measurements

Groundwater elevation measurements were obtained from all monitoring wells at AOC H on September 10, 2003. An electronic water level meter was used to measure the depth to water from the TOC of each monitoring well. Table 3-5 summarizes the results of these measurements. Figure 2-6 illustrates the results of the groundwater measurements taken at AOC H. The general groundwater flow direction is northerly toward Vieques Passage; however, in the southern portion of the site, groundwater flows in a more westerly direction toward the ephemeral stream (Figure 2-6).

3.2.4 Monitoring Well Sampling and Analysis

The three newly installed monitoring wells (NDAHMW05, NDAHMW06, and NDAHMW07) and two existing wells (NDAHMW01 and NDAHMW02) were sampled for total and dissolved metals, SVOCs, explosives, pesticides, and perchlorate to evaluate the potential presence of these constituents. Unfiltered metals samples were used for risk

TABLE 3-4
IDW Results for AOC H Soil and Water
AOC H, Former NASD, Vieques, Puerto Rico

Soil Composite Sample			
Parameter	**Method**	**Result**	**Units**
Flash Point	1010	>160	Fahrenheit
Sulfide	376.1	ND	mg/Kg
Metals	6010 TCLP	ND	mg/L
Mercury	7470	ND	mg/L
VOCs	8260 TCLP	ND	µg/L
SVOCs	8270 TCLP	ND	µg/L
Cyanide	9012	ND	mg/Kg
pH	9045	8.35	pH
TPH	FL-PRO	825	mg/Kg
Water Composite Sample			
Parameter	Method	Result	Units
Flash Point	1010	>160	Fahrenheit
Sulfide	376.1	ND	mg/Kg
Metals	6010 TCLP	ND	mg/L
Mercury	7470	ND	mg/L
VOCs	8260 TCLP	ND	µg/L
SVOCs	8270 TCLP	ND	µg/L
Cyanide	9012	ND	mg/Kg
pH	150.1	8.99	pH
TPH	NA	NA	NA

TABLE 3-5
Summary of Monitoring Wells Water Level Measurements
AOC H, Former NASD, Vieques, Puerto Rico

Well ID	Date	Top of PVC Elevation (ft amsl)	Depth to Water (ft)	Groundwater Level (ft amsl)
NDAHMW01	09/10/03	9.08	10.40	-1.32
NDAHMW02	09/10/03	5.81	7.30	-1.49
NDAHMW03	09/10/03	5.75	7.87	-2.12
NDAHMW04	09/10/03	6.41	7.92	-1.51
NDAHMW05	09/10/03	7.53	8.95	-1.42
NDAHMW06	09/10/03	9.96	11.05	-1.09
NDAHMW07	09/10/03	5.76	7.19	-1.43

Notes: amsl = above mean sea level

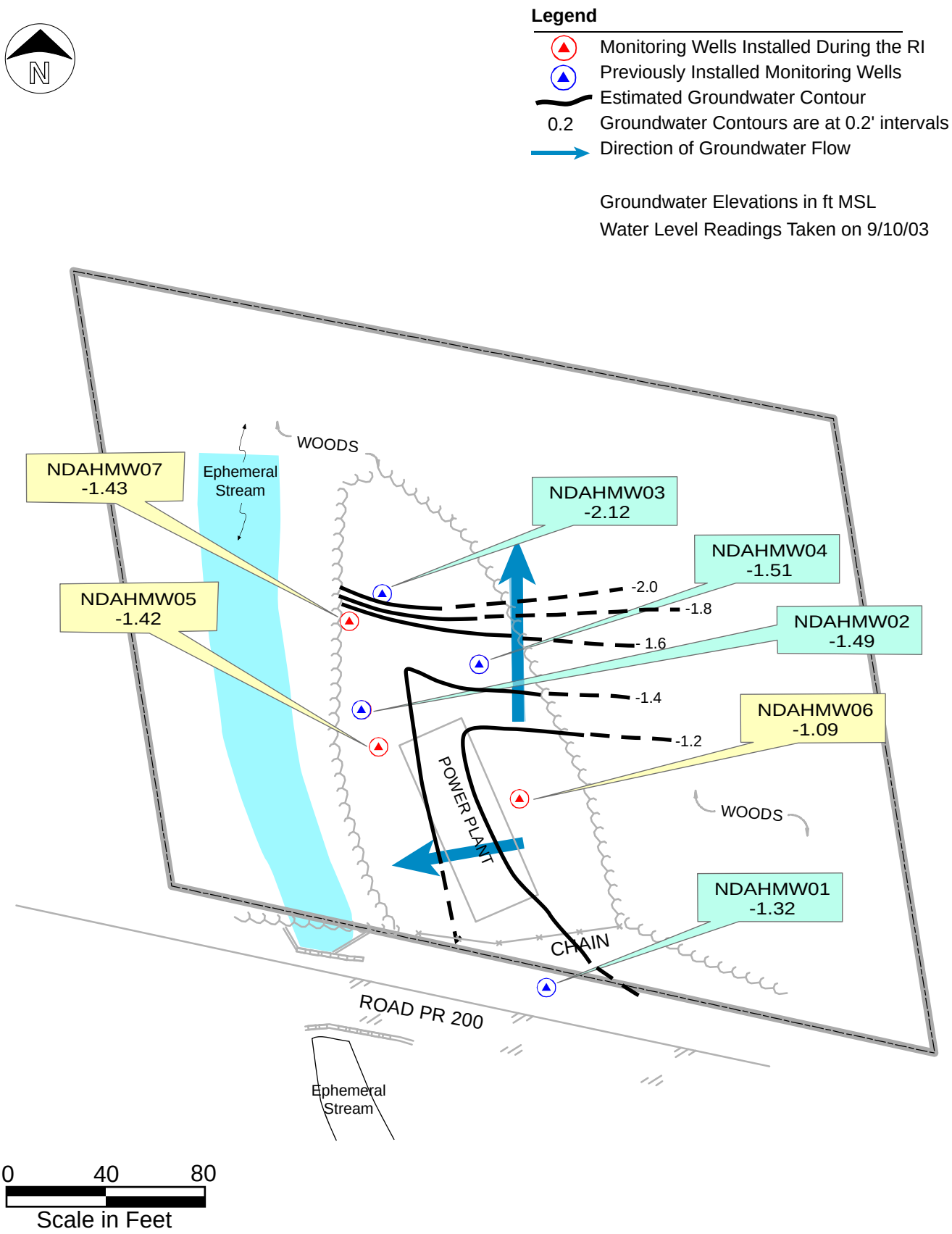


FIGURE 2-6
Groundwater Flow Map
AOC H, Former NASD, Vieques, Puerto Rico

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
4	concrete wipe samples	Table 1	CH2M HILL. Final Expanded Preliminary Assessment/Site Investigation Phase II Seven Sites for Naval Ammunition Storage Detachment Vieques Island, Puerto Rico. November 2002.

Pace Analytical Services, Inc.
9800 Kincey Avenue, Suite 100
Huntersville, NC 28078
Phone: 704.875.9092
Fax: 704.875.9091

Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

Lab Sample No: 922710199 Project Sample Number: 9239710-001 Date Collected: 12/16/02 09:05
Client Sample ID: VNTR-PI6-PCB1 Matrix: Wipe Date Received: 12/19/02 18:00

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
GC Semivolatiles								
Organochlorine PCBs in wipes	Prep/Method: EPA 3550 / EPA 8082							
PCB-1016 (Aroclor 1016)	ND	Total ug	1.0	12/20/02	CBE	12674-11-2		
PCB-1221 (Aroclor 1221)	ND	Total ug	1.0	12/20/02	CBE	11104-28-2		
PCB-1232 (Aroclor 1232)	ND	Total ug	1.0	12/20/02	CBE	11141-16-5		
PCB-1242 (Aroclor 1242)	ND	Total ug	1.0	12/20/02	CBE	53469-21-9		
PCB-1248 (Aroclor 1248)	ND	Total ug	1.0	12/20/02	CBE	12672-29-6		
PCB-1254 (Aroclor 1254)	ND	Total ug	1.0	12/20/02	CBE	11097-69-1		
PCB-1260 (Aroclor 1260)	ND	Total ug	1.0	12/20/02	CBE	11096-82-5		
Decachlorobiphenyl (S)	74	%		12/20/02	CBE	2051-24-3		
Date Extracted	12/19/02			12/19/02				

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NC Wastewater 12
NC Drinking Water 37706
SC 99006

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FL NELAP E87627

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Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

Lab Sample No: 922710207 Project Sample Number: 9239710-002 Date Collected: 12/16/02 09:10
Client Sample ID: VNTR-PI6-PCB2 Matrix: Wipe Date Received: 12/19/02 18:00

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
GC Semivolatiles								
Organochlorine PCBs in wipes	Prep/Method: EPA 3550 / EPA 8082							
PCB-1016 (Aroclor 1016)	ND	Total ug	1.0	12/20/02	CBE	12674-11-2		
PCB-1221 (Aroclor 1221)	ND	Total ug	1.0	12/20/02	CBE	11104-28-2		
PCB-1232 (Aroclor 1232)	ND	Total ug	1.0	12/20/02	CBE	11141-16-5		
PCB-1242 (Aroclor 1242)	ND	Total ug	1.0	12/20/02	CBE	53469-21-9		
PCB-1248 (Aroclor 1248)	ND	Total ug	1.0	12/20/02	CBE	12672-29-6		
PCB-1254 (Aroclor 1254)	ND	Total ug	1.0	12/20/02	CBE	11097-69-1		
PCB-1260 (Aroclor 1260)	ND	Total ug	1.0	12/20/02	CBE	11096-82-5		
Decachlorobiphenyl (S)	52	%		12/20/02	CBE	2051-24-3		
Date Extracted	12/19/02			12/19/02				

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Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

Lab Sample No: 922710215 Project Sample Number: 9239710-003 Date Collected: 12/16/02 09:12
Client Sample ID: VNTR-PI6-PCB3 Matrix: Wipe Date Received: 12/19/02 18:00

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
GC Semivolatiles								
Organochlorine PCBs in wipes	Prep/Method: EPA 3550 / EPA 8082							
PCB-1016 (Aroclor 1016)	ND	Total ug	1.0	12/20/02	CBE	12674-11-2		
PCB-1221 (Aroclor 1221)	ND	Total ug	1.0	12/20/02	CBE	11104-28-2		
PCB-1232 (Aroclor 1232)	ND	Total ug	1.0	12/20/02	CBE	11141-16-5		
PCB-1242 (Aroclor 1242)	ND	Total ug	1.0	12/20/02	CBE	53469-21-9		
PCB-1248 (Aroclor 1248)	ND	Total ug	1.0	12/20/02	CBE	12672-29-6		
PCB-1254 (Aroclor 1254)	ND	Total ug	1.0	12/20/02	CBE	11097-69-1		
PCB-1260 (Aroclor 1260)	ND	Total ug	1.0	12/20/02	CBE	11096-82-5		
Decachlorobiphenyl (S)	49	%		12/20/02	CBE	2051-24-3		
Date Extracted	12/19/02			12/19/02				

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Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

Lab Sample No: 922710223 Project Sample Number: 9239710-004 Date Collected: 12/16/02 09:15
Client Sample ID: VNTR-PI6-PCB4 Matrix: Wipe Date Received: 12/19/02 18:00

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
GC Semivolatiles								
Organochlorine PCBs in wipes	Prep/Method: EPA 3550 / EPA 8082							
PCB-1016 (Aroclor 1016)	ND	Total ug	1.0	12/20/02	CBE	12674-11-2		
PCB-1221 (Aroclor 1221)	ND	Total ug	1.0	12/20/02	CBE	11104-28-2		
PCB-1232 (Aroclor 1232)	ND	Total ug	1.0	12/20/02	CBE	11141-16-5		
PCB-1242 (Aroclor 1242)	ND	Total ug	1.0	12/20/02	CBE	53469-21-9		
PCB-1248 (Aroclor 1248)	ND	Total ug	1.0	12/20/02	CBE	12672-29-6		
PCB-1254 (Aroclor 1254)	ND	Total ug	1.0	12/20/02	CBE	11097-69-1		
PCB-1260 (Aroclor 1260)	ND	Total ug	1.0	12/20/02	CBE	11096-82-5		
Decachlorobiphenyl (S)	64	%		12/20/02	CBE	2051-24-3		
Date Extracted	12/19/02			12/19/02				

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Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

Lab Sample No: 922710231 Project Sample Number: 9239710-005 Date Collected: 12/16/02 09:20
Client Sample ID: VNTR-PI6-PCB5 Matrix: Wipe Date Received: 12/19/02 18:00

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
GC Semivolatiles								
Organochlorine PCBs in wipes	Prep/Method: EPA 3550 / EPA 8082							
PCB-1016 (Aroclor 1016)	ND	Total ug	1.0	12/20/02	CBE	12674-11-2		
PCB-1221 (Aroclor 1221)	ND	Total ug	1.0	12/20/02	CBE	11104-28-2		
PCB-1232 (Aroclor 1232)	ND	Total ug	1.0	12/20/02	CBE	11141-16-5		
PCB-1242 (Aroclor 1242)	ND	Total ug	1.0	12/20/02	CBE	53469-21-9		
PCB-1248 (Aroclor 1248)	ND	Total ug	1.0	12/20/02	CBE	12672-29-6		
PCB-1254 (Aroclor 1254)	ND	Total ug	1.0	12/20/02	CBE	11097-69-1		
PCB-1260 (Aroclor 1260)	ND	Total ug	1.0	12/20/02	CBE	11096-82-5		
Decachlorobiphenyl (S)	54	%		12/20/02	CBE	2051-24-3		
Date Extracted	12/19/02			12/19/02				

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NC Drinking Water 37706
SC 99006

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Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

Lab Sample No: 922710249 Project Sample Number: 9239710-006 Date Collected: 12/16/02 09:25
Client Sample ID: VNTR-PI6-PCB6 Matrix: Wipe Date Received: 12/19/02 18:00

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
GC Semivolatiles								
Organochlorine PCBs in wipes	Prep/Method: EPA 3550 / EPA 8082							
PCB-1016 (Aroclor 1016)	ND	Total ug	1.0	12/20/02	CBE	12674-11-2		
PCB-1221 (Aroclor 1221)	ND	Total ug	1.0	12/20/02	CBE	11104-28-2		
PCB-1232 (Aroclor 1232)	ND	Total ug	1.0	12/20/02	CBE	11141-16-5		
PCB-1242 (Aroclor 1242)	ND	Total ug	1.0	12/20/02	CBE	53469-21-9		
PCB-1248 (Aroclor 1248)	ND	Total ug	1.0	12/20/02	CBE	12672-29-6		
PCB-1254 (Aroclor 1254)	ND	Total ug	1.0	12/20/02	CBE	11097-69-1		
PCB-1260 (Aroclor 1260)	ND	Total ug	1.0	12/20/02	CBE	11096-82-5		
Decachlorobiphenyl (S)	55	%		12/20/02	CBE	2051-24-3		
Date Extracted	12/19/02			12/19/02				

Laboratory Certification IDs
NC Wastewater 12
NC Drinking Water 37706
SC 99006

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Laboratory Certification IDs
KY Drinking Water 90090
VA Drinking Water 213
FL NELAP E87627

Pace Analytical Services, Inc.
9800 Kincey Avenue, Suite 100
Huntersville, NC 28078
Phone: 704.875.9092
Fax: 704.875.9091

Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

PARAMETER FOOTNOTES

ND	Not detected at or above adjusted reporting limit
NC	Not Calculable
J	Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
MDL	Adjusted Method Detection Limit
(S)	Surrogate

Laboratory Certification IDs
NC Wastewater 12
NC Drinking Water 37706
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9800 Kincey Avenue, Suite 100
Huntersville, NC 28078
Phone: 704.875.9092
Fax: 704.875.9091

QUALITY CONTROL DATA

Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

QC Batch: 67854 Analysis Method: EPA 8082
QC Batch Method: EPA 3550 Analysis Description: Organochlorine PCBs in wipes
Associated Lab Samples: 922710199 922710207 922710215 922710223 922710231 922710249

METHOD BLANK: 922710827
Associated Lab Samples: 922710199 922710207 922710215 922710223 922710231 922710249

Parameter	Units	Blank Result	Reporting Limit	Footnotes
PCB-1016 (Aroclor 1016)	Total ug	ND	1.0	
PCB-1221 (Aroclor 1221)	Total ug	ND	1.0	
PCB-1232 (Aroclor 1232)	Total ug	ND	1.0	
PCB-1242 (Aroclor 1242)	Total ug	ND	1.0	
PCB-1248 (Aroclor 1248)	Total ug	ND	1.0	
PCB-1254 (Aroclor 1254)	Total ug	ND	1.0	
PCB-1260 (Aroclor 1260)	Total ug	ND	1.0	
Decachlorobiphenyl (S)	%	78		

LABORATORY CONTROL SAMPLE: 922710835

Parameter	Units	Spike Conc.	LCS Result	LCS % Rec	Footnotes
PCB-1016 (Aroclor 1016)	Total ug	10.00	10.14	101	
PCB-1260 (Aroclor 1260)	Total ug	10.00	10.32	103	
Decachlorobiphenyl (S)				99	

Laboratory Certification IDs
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Fax: 704.875.9091

Lab Project Number: 9239710
Client Project ID: ERM/02I1212ERM Group2

QUALITY CONTROL DATA PARAMETER FOOTNOTES

Consistent with EPA guidelines, unrounded concentrations are displayed and have been used to calculate % Rec and RPD values.

LCS(D)	Laboratory Control Sample (Duplicate)
MS(D)	Matrix Spike (Duplicate)
DUP	Sample Duplicate
ND	Not detected at or above adjusted reporting limit
NC	Not Calculable
J	Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
MDL	Adjusted Method Detection Limit
RPD	Relative Percent Difference
(S)	Surrogate

Laboratory Certification IDs
NC Wastewater 12
NC Drinking Water 37706
SC 99006

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Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
5	Data results from the RI and PA/SI	Table 1	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Tables 4-A through 4-E. July 2007.

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
					Total Metals (mg/kg)			
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Aluminum	9000	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Antimony	1.5	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Arsenic	1.5	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Barium	51	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Calcium	7400	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Chromium, Total	20	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Cobalt	8.1	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Copper	28	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Iron	17000	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Lead	19	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Magnesium	4200	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Manganese	410	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Mercury	0.026	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Nickel	8.1	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Potassium	1300	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Selenium	0.86	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Sodium	180	J	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Vanadium	49	=	mg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Zinc	76	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Aluminum	9700	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Antimony	1.6	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Arsenic	1.4	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Barium	60	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Beryllium	0.11	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Calcium	8800	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Chromium, Total	20	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Cobalt	9	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Copper	31	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Iron	18000	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Lead	20	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Magnesium	4300	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Manganese	490	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Mercury	0.027	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Nickel	8.4	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Potassium	1400	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Selenium	1	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Sodium	230	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Vanadium	52	=	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Zinc	81	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Aluminum	7700	J	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Arsenic	43	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Barium	63	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Beryllium	0.17	J	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Calcium	11000	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Chromium, Total	8.1	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Cobalt	6.9	J	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Copper	110	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Iron	17000	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Lead	24	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Magnesium	2100	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Manganese	360	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Mercury	0.033	J	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Nickel	4.4	J	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Potassium	1500	J	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Sodium	230	J	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Vanadium	46	=	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Zinc	88	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Aluminum	11000	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Antimony	1	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Arsenic	0.86	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Barium	59	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Beryllium	0.15	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Cadmium	0.21	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Calcium	31000	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Chromium, Total	50	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Cobalt	9.1	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Copper	34	=	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS01A	NDE176	12/05/2000	SS	N	Iron	19000	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Lead	27	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Magnesium	5800	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Manganese	350	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Mercury	0.02	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Nickel	15	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Potassium	2000	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Sodium	460	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Vanadium	63	=	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Zinc	170	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Aluminum	9900	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Antimony	0.86	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Arsenic	2.3	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Barium	54	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Calcium	12000	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Chromium, Total	20	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Cobalt	8.3	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Copper	29	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Iron	17000	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Lead	22	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Magnesium	4900	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Manganese	440	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Mercury	0.04	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Nickel	9.7	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Potassium	1400	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Selenium	0.83	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Sodium	210	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Vanadium	45	=	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Zinc	93	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Aluminum	5600	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Arsenic	0.89	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Barium	42	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Beryllium	0.12	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Calcium	30000	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Chromium, Total	18	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Cobalt	5.3	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Copper	21	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Iron	14000	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Lead	13	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Magnesium	2800	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Manganese	290	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Mercury	0.052	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Nickel	5.9	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Potassium	1400	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Sodium	340	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Vanadium	33	=	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Zinc	170	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Aluminum	5600	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Antimony	0.68	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Arsenic	33	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Barium	130	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Calcium	32000	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Chromium, Total	10	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Cobalt	4	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Copper	100	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Iron	12000	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Lead	45	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Magnesium	8400	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Manganese	510	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Mercury	0.024	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Nickel	4.7	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Potassium	3400	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Selenium	0.65	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Sodium	590	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Vanadium	29	=	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	Zinc	110	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Aluminum	4600	J	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Antimony	6.3	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS03A	NDE178	12/05/2000	SS	N	Arsenic	2	J	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Barium	69	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Calcium	30000	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Chromium, Total	46	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Cobalt	6.3	J	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Copper	48	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Iron	39000	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Lead	18	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Magnesium	2600	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Manganese	390	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Mercury	0.014	J	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Nickel	26	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Potassium	1100	J	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Sodium	310	J	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Vanadium	27	=	mg/kg
NDAHSS03A	NDE178	12/05/2000	SS	N	Zinc	260	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Aluminum	8400	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Antimony	0.77	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Arsenic	2.4	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Barium	130	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Calcium	21000	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Chromium, Total	18	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Cobalt	8.2	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Copper	41	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Iron	19000	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Lead	52	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Magnesium	5000	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Manganese	580	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Mercury	0.032	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Nickel	9.3	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Potassium	1900	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Selenium	0.8	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Sodium	460	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Vanadium	45	=	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Zinc	140	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Aluminum	3400	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Antimony	0.61	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Arsenic	0.54	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Barium	23	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Calcium	34000	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Chromium, Total	12	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Cobalt	3.2	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Copper	12	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Iron	7700	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Lead	8.3	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Magnesium	2000	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Manganese	140	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Mercury	0.0049	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Nickel	3.9	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Potassium	860	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Sodium	360	J	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Vanadium	21	=	mg/kg
NDAHSS04A	NDE179	12/05/2000	SS	N	Zinc	100	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Aluminum	9900	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Antimony	1.2	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Arsenic	3.5	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Barium	140	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Beryllium	0.12	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Calcium	16000	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Chromium, Total	14	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Cobalt	8.6	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Copper	28	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Iron	23000	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Lead	21	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Magnesium	5900	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Manganese	560	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Mercury	0.037	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Nickel	7.4	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS05	NDE013	12/05/2000	SS	N	Potassium	1500	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Selenium	1.4	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Sodium	260	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Vanadium	55	=	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	Zinc	97	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Aluminum	11000	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Antimony	2	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Arsenic	2.2	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Barium	50	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Calcium	33000	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Chromium, Total	36	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Cobalt	9.1	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Copper	34	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Iron	19000	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Lead	43	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Magnesium	7700	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Manganese	390	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Mercury	0.021	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Nickel	16	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Potassium	1200	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Selenium	0.98	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Sodium	300	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Vanadium	54	=	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Zinc	130	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Aluminum	9300	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Antimony	1.2	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Arsenic	1.9	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Barium	110	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Calcium	17000	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Chromium, Total	20	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Cobalt	7.2	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Copper	42	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Iron	17000	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Lead	47	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Magnesium	5600	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Manganese	390	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Mercury	0.025	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Nickel	10	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Potassium	1200	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Selenium	1.1	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Silver	0.17	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Sodium	270	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Vanadium	41	=	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Zinc	130	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Aluminum	5300	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Antimony	0.36	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Arsenic	1.4	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Barium	110	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Beryllium	0.15	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Calcium	34000	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Chromium, Total	7.9	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Cobalt	4.2	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Copper	50	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Iron	12000	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Lead	48	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Magnesium	3600	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Manganese	390	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Mercury	0.041	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Nickel	4	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Potassium	2600	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Sodium	420	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Vanadium	29	=	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Zinc	130	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Aluminum	6600	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Antimony	0.77	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Arsenic	6.2	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Barium	76	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Beryllium	0.18	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS09	NDE021	12/05/2000	SS	N	Calcium	15000	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Chromium, Total	17	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Cobalt	6.7	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Copper	36	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Iron	17000	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Lead	63	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Magnesium	2900	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Manganese	370	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Mercury	0.051	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Nickel	8.4	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Potassium	1600	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Selenium	0.62	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Sodium	260	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Vanadium	36	=	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Zinc	140	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Aluminum	7100	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Antimony	0.47	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Arsenic	67	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Barium	290	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Beryllium	0.26	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Calcium	9000	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Chromium, Total	16	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Cobalt	9	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Copper	87	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Iron	21000	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Lead	29	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Magnesium	2800	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Manganese	720	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Mercury	0.035	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Nickel	7.2	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Potassium	1600	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Selenium	0.82	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Sodium	130	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Vanadium	62	=	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Zinc	95	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Aluminum	8100	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Arsenic	1.3	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Barium	57	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Beryllium	0.11	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Calcium	7300	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Chromium, Total	13	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Cobalt	7.6	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Copper	26	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Iron	18000	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Lead	11	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Magnesium	3800	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Manganese	410	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Mercury	0.043	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Nickel	6.2	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Potassium	1500	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Sodium	110	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Vanadium	49	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Zinc	50	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Aluminum	7100	J	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Arsenic	1.7	J	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Barium	52	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Calcium	8100	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Chromium, Total	12	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Cobalt	7.1	J	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Copper	19	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Iron	17000	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Lead	12	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Magnesium	3600	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Manganese	370	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Mercury	0.041	J	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Nickel	6.1	J	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Potassium	1200	J	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Sodium	140	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS12	NDE028	12/05/2000	SS	N	Vanadium	46	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Zinc	51	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Aluminum	6700	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Arsenic	1.5	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Barium	52	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Calcium	8200	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Chromium, Total	11	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Cobalt	6.8	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Copper	19	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Iron	16000	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Lead	11	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Magnesium	3300	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Manganese	360	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Mercury	0.05	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Nickel	5.5	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Potassium	1200	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Sodium	130	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Vanadium	44	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Zinc	49	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Aluminum	5900	J	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Arsenic	1.1	J	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Barium	51	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Calcium	8900	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Chromium, Total	13	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Cobalt	5.9	J	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Copper	20	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Iron	20000	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Lead	15	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Magnesium	2700	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Manganese	340	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Mercury	0.029	J	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Nickel	5.5	J	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Potassium	1200	J	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Sodium	110	J	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Vanadium	48	=	mg/kg
NDAHSS14	NDE032	12/05/2000	SS	N	Zinc	68	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Aluminum	6200	J	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Arsenic	1	J	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Barium	50	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Calcium	20000	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Chromium, Total	13	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Cobalt	6.3	J	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Copper	19	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Iron	17000	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Lead	13	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Magnesium	2900	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Manganese	340	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Mercury	0.019	J	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Nickel	4.8	J	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Potassium	1300	J	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Sodium	220	J	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Vanadium	51	=	mg/kg
NDAHSS15	NDE034	12/05/2000	SS	N	Zinc	88	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Aluminum	7300	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Arsenic	4.7	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Barium	66	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Beryllium	0.11	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Calcium	13000	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Chromium, Total	14	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Cobalt	7.1	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Copper	23	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Iron	15000	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Lead	16	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Magnesium	3800	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Manganese	410	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Mercury	0.04	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Nickel	7	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Potassium	1300	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS16	NDE037	12/05/2000	SS	N	Sodium	200	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Vanadium	43	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Zinc	62	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Aluminum	9300	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Antimony	0.394	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Arsenic	1.18	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Barium	60.4	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Beryllium	0.143	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Cadmium	0.0466	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Calcium	4460	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Chromium, Total	15.4	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Cobalt	7.72	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Copper	25.6	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Iron	18100	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Lead	16.4	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Magnesium	3460	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Manganese	441	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Mercury	0.0308	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Nickel	7.56	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Potassium	1550	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Selenium	0.47	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Silver	0.0709	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Sodium	187	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Thallium	0.944	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Vanadium	51.6	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Zinc	61.8	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Aluminum	10400	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Antimony	0.882	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Arsenic	1.12	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Barium	36.7	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Beryllium	0.101	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Cadmium	0.0742	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Calcium	6830	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Chromium, Total	23.9	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Cobalt	8.42	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Copper	26.4	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Iron	22400	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Lead	16.6	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Magnesium	7220	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Manganese	368	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Mercury	0.00904	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Nickel	13.8	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Potassium	1100	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Selenium	0.382	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Silver	0.0702	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Sodium	252	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Thallium	1.16	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Vanadium	51.3	=	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Zinc	59.1	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Aluminum	9760	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Antimony	1.17	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Arsenic	0.715	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Barium	76.5	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Beryllium	0.133	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Cadmium	0.11	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Calcium	4840	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Chromium, Total	23.7	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Cobalt	10.2	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Copper	30.9	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Iron	20600	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Lead	26.9	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Magnesium	4750	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Manganese	636	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Mercury	0.0227	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Nickel	10.3	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Potassium	1330	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Selenium	0.677	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Silver	0.0346	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Sodium	268	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Thallium	0.867	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Vanadium	61	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Zinc	86.3	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Aluminum	8710	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Aluminum	9140	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Antimony	0.492	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Antimony	0.393	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Arsenic	1.1	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Arsenic	1.58	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Barium	40.7	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Barium	41.5	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Beryllium	0.084	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Beryllium	0.0904	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Cadmium	0.069	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Cadmium	0.0873	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Calcium	11200	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Calcium	13100	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Chromium, Total	22.4	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Chromium, Total	17	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Cobalt	6.42	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Cobalt	7.99	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Copper	19.6	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Copper	22.2	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Iron	14100	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Iron	17100	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Lead	20.8	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Lead	52.4	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Magnesium	4680	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Magnesium	6130	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Manganese	336	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Manganese	369	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Mercury	0.0221	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Mercury	0.0231	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Nickel	9.31	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Nickel	12.3	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Potassium	1230	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Potassium	1310	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Selenium	0.369	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Selenium	0.657	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Silver	0.0491	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Sodium	371	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Sodium	262	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Thallium	0.62	J	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Thallium	0.611	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Vanadium	40.8	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Vanadium	48.9	=	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Zinc	60.3	=	mg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Zinc	65.1	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Aluminum	5720	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Antimony	0.362	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Arsenic	1.92	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Barium	61.7	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Beryllium	0.1	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Cadmium	0.116	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Calcium	20300	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Chromium, Total	7.83	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Cobalt	5.16	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Copper	22.2	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Iron	14600	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Lead	27	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Magnesium	2330	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Manganese	313	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Mercury	0.0367	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Nickel	3.55	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Potassium	1500	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Selenium	0.449	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Sodium	244	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Thallium	0.671	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Vanadium	40.4	=	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Zinc	87.3	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Aluminum	6990	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Antimony	0.585	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Arsenic	1.79	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Barium	56.1	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Beryllium	0.114	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Cadmium	0.135	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Calcium	29600	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Chromium, Total	10.9	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Cobalt	5.58	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Copper	23	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Iron	14400	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Lead	23.7	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Magnesium	3320	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Manganese	325	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Mercury	0.0303	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Nickel	4.81	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Potassium	1950	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Selenium	0.38	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Silver	0.0511	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Sodium	349	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Thallium	0.429	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Vanadium	43.2	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Zinc	71.1	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Aluminum	6850	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Antimony	0.393	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Arsenic	1.13	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Barium	52.1	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Beryllium	0.112	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Cadmium	0.0699	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Calcium	21700	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Chromium, Total	9.51	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Cobalt	5.7	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Copper	20.3	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Iron	13400	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Lead	18.3	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Magnesium	2670	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Manganese	352	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Mercury	0.0383	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Nickel	4.1	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Potassium	1380	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Selenium	0.3	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Silver	0.0579	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Sodium	261	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Thallium	0.488	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Vanadium	40.1	=	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Zinc	56.7	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Aluminum	7030	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Antimony	0.422	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Arsenic	1.49	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Barium	55.5	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Beryllium	0.115	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Cadmium	0.102	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Calcium	14800	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Chromium, Total	10.1	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Cobalt	6.07	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Copper	24.6	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Iron	14800	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Lead	25.4	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Magnesium	2690	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Manganese	375	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Mercury	0.0351	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Nickel	4.92	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Potassium	1360	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Selenium	0.285	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Silver	0.0608	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Sodium	211	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Thallium	0.68	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Vanadium	43.2	=	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Zinc	81.4	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Aluminum	6380	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Antimony	0.381	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Arsenic	2.59	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Barium	85.7	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Beryllium	0.13	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Cadmium	0.152	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Calcium	18600	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Chromium, Total	8.84	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Cobalt	5.11	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Copper	37.4	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Iron	15100	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Lead	58.9	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Magnesium	2330	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Manganese	309	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Mercury	0.0625	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Nickel	4.49	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Potassium	1730	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Selenium	0.234	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Silver	0.0651	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Sodium	282	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Thallium	0.693	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Vanadium	36.1	=	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Zinc	126	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Aluminum	10300	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Antimony	0.661	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Arsenic	6.74	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Barium	77	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Beryllium	0.128	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Cadmium	0.291	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Calcium	22200	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Chromium, Total	17.4	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Cobalt	7.81	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Copper	36.5	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Iron	17200	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Lead	44	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Magnesium	5500	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Manganese	404	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Mercury	0.053	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Nickel	10.4	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Potassium	1810	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Selenium	0.597	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Silver	0.0583	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Sodium	347	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Thallium	0.287	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Vanadium	44.5	=	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Zinc	125	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Aluminum	7530	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Aluminum	7690	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Antimony	0.64	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Antimony	0.457	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Arsenic	2.48	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Arsenic	2.79	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Barium	54.9	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Barium	62.7	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Beryllium	0.118	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Beryllium	0.126	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Cadmium	0.147	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Cadmium	0.159	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Calcium	29700	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Calcium	10900	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Chromium, Total	11.9	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Chromium, Total	10.2	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Cobalt	6	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Cobalt	6.99	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Copper	22	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Copper	24.6	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Iron	15000	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Iron	16800	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Lead	13.5	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Lead	14.6	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Magnesium	2580	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Magnesium	3280	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Manganese	325	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Manganese	359	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Mercury	0.0286	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Mercury	0.0291	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Nickel	4.46	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Nickel	5.87	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Potassium	1560	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Potassium	1420	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Selenium	0.367	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Selenium	0.357	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Silver	0.0332	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Silver	0.0383	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Sodium	328	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Sodium	221	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Thallium	0.45	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Thallium	0.732	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Vanadium	44.3	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Vanadium	48	=	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	Zinc	65.2	=	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	Zinc	72.4	=	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Aluminum	3840	=	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Antimony	0.34	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Arsenic	0.435	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Barium	27.9	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Beryllium	0.0799	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Calcium	5400	=	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Chromium, Total	7.98	=	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Cobalt	3.26	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Copper	11.1	=	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Iron	11200	=	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Lead	4.43	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Magnesium	1630	=	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Manganese	182	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Mercury	0.0168	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Nickel	3.26	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Potassium	721	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Selenium	0.353	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Silver	0.0356	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Sodium	142	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Thallium	0.863	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Vanadium	35.9	=	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	Zinc	31.5	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Aluminum	7920	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Antimony	0.534	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Arsenic	0.701	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Barium	54.4	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Beryllium	0.12	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Cadmium	0.0454	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Calcium	5980	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Chromium, Total	13.8	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Cobalt	8.39	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Copper	24.8	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Iron	16300	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Lead	8.68	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Magnesium	3250	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Manganese	384	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Mercury	0.0194	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Nickel	6.24	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Potassium	1330	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Selenium	0.616	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Silver	0.0611	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Sodium	213	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Thallium	0.613	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Vanadium	48	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Zinc	44.7	=	mg/kg
Volatile Organic Compounds (µg/kg)								
NDAHSS01A	NDE176	12/05/2000	SS	N	m+p Xylene	0.058	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	o-Xylene	0.024	J	mg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Xylenes, Total	0.082	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	1,1-Dichloroethene	0.00078	J	mg/kg
Semivolatile Organic Compounds (µg/kg)								
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Benzo(a)anthracene	30	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Benzo(a)pyrene	41	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Benzo(b)fluoranthene	84	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Benzo(k)fluoranthene	72	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Chrysene	83	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	DI-n-butyl phthalate	49	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Fluoranthene	111	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Phenanthrene	36	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	Pyrene	92	J	µg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Benzo(a)anthracene	0.032	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Benzo(a)pyrene	0.043	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Benzo(b)fluoranthene	0.072	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Benzo(k)fluoranthene	0.054	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Chrysene	0.057	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Fluoranthene	0.056	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Indeno(1,2,3-c,d)pyrene	0.026	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	Pyrene	0.057	J	mg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	2,6-Dinitrotoluene	1220	=	µg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	4-Bromophenyl Phenyl Ether	228	J	µg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	Isophorone	108	J	µg/kg
NDAHSS010	NDE024FD1	12/05/2000	SS	FD	N-Nitrosodi-n-propylamine	595	=	µg/kg
NDAHSS01A	NDE176	12/05/2000	SS	N	Pyrene	1.9	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	Chrysene	0.029	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Benzo(a)pyrene	0.074	J	mg/kg
NDAHSS02A	NDE177	12/05/2000	SS	N	Benzo(g,h,i)perylene	0.06	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	2-Methylnaphthalene	0.055	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Benzo(a)anthracene	0.112	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Benzo(a)pyrene	0.12	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Benzo(b)fluoranthene	0.133	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Benzo(k)fluoranthene	0.124	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Chrysene	0.155	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Fluoranthene	0.187	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Indeno(1,2,3-c,d)pyrene	0.054	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Phenanthrene	0.083	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	Pyrene	0.168	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	2-Methylnaphthalene	0.028	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Benzo(a)anthracene	0.049	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Benzo(a)pyrene	0.053	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Benzo(b)fluoranthene	0.065	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Benzo(k)fluoranthene	0.066	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Chrysene	0.068	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Fluoranthene	0.082	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Phenanthrene	0.032	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	Pyrene	0.076	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Benzo(b)fluoranthene	0.062	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Benzo(k)fluoranthene	0.044	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Chrysene	0.05	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Fluoranthene	0.069	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Phenanthrene	0.034	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	Pyrene	0.066	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	2-Methylnaphthalene	0.176	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Benzo(a)anthracene	0.068	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Benzo(a)pyrene	0.071	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Benzo(b)fluoranthene	0.104	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Benzo(k)fluoranthene	0.088	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Chrysene	0.121	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Dibenzofuran	0.051	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS08	NDE019	12/05/2000	SS	N	Fluoranthene	0.089	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Naphthalene	0.09	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Phenanthrene	0.144	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	Pyrene	0.097	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	2-Methylnaphthalene	0.19	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Benzo(a)pyrene	0.037	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Benzo(b)fluoranthene	0.05	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Benzo(k)fluoranthene	0.044	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Chrysene	0.059	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Dibenzofuran	0.038	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Fluoranthene	0.04	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Naphthalene	0.069	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Phenanthrene	0.092	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	Pyrene	0.049	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	2-Methylnaphthalene	0.036	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Benzo(a)anthracene	0.029	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Fluoranthene	0.033	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Phenanthrene	0.037	J	mg/kg
NDAHSS10	NDE023	12/05/2000	SS	N	Pyrene	0.032	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	2,6-Dinitrotoluene	1.21	=	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	4-Bromophenyl Phenyl Ether	0.238	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	Isophorone	0.106	J	mg/kg
NDAHSS11	NDE026	12/05/2000	SS	N	N-Nitrosodi-n-propylamine	0.658	=	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	4-Bromophenyl Phenyl Ether	0.217	J	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	Isophorone	0.112	J	mg/kg
NDAHSS12	NDE028	12/05/2000	SS	N	N-Nitrosodi-n-propylamine	0.562	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	2,6-Dinitrotoluene	1.23	=	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	3-Nitroaniline	0.048	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	4-Bromophenyl Phenyl Ether	0.267	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Benzo(b)fluoranthene	0.04	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	Indeno(1,2,3-c,d)pyrene	0.037	J	mg/kg
NDAHSS13	NDE030	12/05/2000	SS	N	N-Nitrosodi-n-propylamine	0.717	=	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Benzo(a)anthracene	0.029	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Benzo(a)pyrene	0.05	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Benzo(b)fluoranthene	0.058	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Benzo(k)fluoranthene	0.053	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Chrysene	0.054	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Fluoranthene	0.053	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	Pyrene	0.058	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Benzo(a)anthracene	0.036	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Benzo(a)pyrene	0.042	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0595	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0465	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.0421	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Chrysene	0.044	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Fluoranthene	0.0369	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Indeno(1,2,3-c,d)pyrene	0.0567	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	Pyrene	0.0432	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Benzo(a)anthracene	0.0299	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Benzo(a)pyrene	0.0502	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.092	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0495	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.07	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Chrysene	0.0699	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Fluoranthene	0.0291	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Indeno(1,2,3-c,d)pyrene	0.0636	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	Pyrene	0.045	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Benzo(a)pyrene	0.0323	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0608	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0328	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.0394	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Chrysene	0.0416	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Indeno(1,2,3-c,d)pyrene	0.0442	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Benzo(a)anthracene	32.5	J	µg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Benzo(a)pyrene	0.0283	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Benzo(a)pyrene	31.1	J	µg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0502	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Benzo(b)fluoranthene	52.4	J	µg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0249	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Benzo(g,h,i)perylene	24.5	J	µg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.0359	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Benzo(k)fluoranthene	38.8	J	µg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	bis(2-Ethylhexyl) Phthalate	76.6	J	µg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Chrysene	0.0471	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Chrysene	49.8	J	µg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Fluoranthene	0.0385	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Fluoranthene	42.6	J	µg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Indeno(1,2,3-c,d)pyrene	36.8	J	µg/kg
NDAHSS20	NDAHSS20-R01	08/26/2003	SS	N	Pyrene	0.0435	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	Pyrene	48	J	µg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Benzo(a)pyrene	0.0267	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0279	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0274	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.022	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Chrysene	0.0254	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Fluoranthene	0.0246	J	mg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	Pyrene	0.0296	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0271	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0217	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.0196	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	bis(2-Ethylhexyl) Phthalate	0.08530001	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Chrysene	0.0247	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Fluoranthene	0.0258	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	Pyrene	0.029	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.025	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	bis(2-Ethylhexyl) Phthalate	0.0827	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Chrysene	0.0225	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Fluoranthene	0.0272	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	Pyrene	0.0282	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Benzo(a)anthracene	0.0946	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Benzo(a)pyrene	0.0969	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0935	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0589	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.0763	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	bis(2-Ethylhexyl) Phthalate	0.117	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Chrysene	0.0972	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Fluoranthene	0.112	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Indeno(1,2,3-c,d)pyrene	0.0848	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Phenanthrene	0.0211	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	Pyrene	0.125	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	2-Methylnaphthalene	0.0956	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Benzo(a)anthracene	0.0451	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Benzo(a)pyrene	0.0426	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0544	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0422	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.0339	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	bis(2-Ethylhexyl) Phthalate	0.0831	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Chrysene	0.0671	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Dibenzofuran	0.0294	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Fluoranthene	0.0522	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Indeno(1,2,3-c,d)pyrene	0.0489	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Naphthalene	0.0424	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Phenanthrene	0.0816	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	Pyrene	0.0548	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0187	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	bis(2-Ethylhexyl) Phthalate	0.0729	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	bis(2-Ethylhexyl) Phthalate	0.0766	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	bis(2-Ethylhexyl) Phthalate	81.8	J	ug/Kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	bis(2-Ethylhexyl) Phthalate	0.0905	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Benzo(a)pyrene	0.0257	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Benzo(b)fluoranthene	0.0449	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Benzo(g,h,i)perylene	0.0244	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Benzo(k)fluoranthene	0.0283	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	bis(2-Ethylhexyl) Phthalate	0.0819	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	Chrysene	0.0241	J	mg/kg

TABLE 4-A
Surface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
Pesticides (mg/kg)								
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	p,p'-DDE	3440	J	µg/kg
NDAHSS001	NDE005FD1	12/05/2000	SS	FD	p,p'-DDT	2190	J	µg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	p,p'-DDE	3.99	J	mg/kg
NDAHSS01	NDE004	12/05/2000	SS	N	p,p'-DDT	1.94	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	p,p'-DDE	2.66	J	mg/kg
NDAHSS02	NDE007	12/05/2000	SS	N	p,p'-DDT	1.09	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	p,p'-DDD	0.0024	J	mg/kg
NDAHSS03	NDE009	12/05/2000	SS	N	p,p'-DDE	0.05	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	p,p'-DDD	0.0029	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	p,p'-DDE	0.041	J	mg/kg
NDAHSS04	NDE011	12/05/2000	SS	N	p,p'-DDT	0.017	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	p,p'-DDE	0.014	J	mg/kg
NDAHSS05	NDE013	12/05/2000	SS	N	p,p'-DDT	0.01	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	p,p'-DDE	0.01	J	mg/kg
NDAHSS06	NDE015	12/05/2000	SS	N	p,p'-DDT	0.011	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	p,p'-DDE	0.126	J	mg/kg
NDAHSS07	NDE017	12/05/2000	SS	N	p,p'-DDT	0.075	J	mg/kg
NDAHSS08	NDE019	12/05/2000	SS	N	p,p'-DDE	0.0016	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	p,p'-DDE	0.0078	J	mg/kg
NDAHSS09	NDE021	12/05/2000	SS	N	p,p'-DDT	0.0067	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	p,p'-DDD	0.0048	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	p,p'-DDE	0.041	J	mg/kg
NDAHSS16	NDE037	12/05/2000	SS	N	p,p'-DDT	0.029	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	p,p'-DDD	0.00052	J	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	p,p'-DDE	0.04	=	mg/kg
NDAHSS17	NDAHSS17-R01	08/26/2003	SS	N	p,p'-DDT	0.018	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	p,p'-DDD	0.0021	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	p,p'-DDE	0.095	J	mg/kg
NDAHSS18	NDAHSS18-R01	08/26/2003	SS	N	p,p'-DDT	0.025	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	Methoxychlor	0.00074	J	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	p,p'-DDE	0.023	=	mg/kg
NDAHSS19	NDAHSS19-R01	08/26/2003	SS	N	p,p'-DDT	0.0086	J	mg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	p,p'-DDD	6.6	J	µg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	p,p'-DDE	69	J	µg/kg
NDAHSS20	NDAHFD04P-R01	08/26/2003	SS	FD	p,p'-DDT	4.6	=	µg/kg
NDAHSS21	NDAHSS21-R01	08/26/2003	SS	N	p,p'-DDE	0.0014	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	p,p'-DDD	0.01	J	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	p,p'-DDE	0.19	=	mg/kg
NDAHSS22	NDAHSS22-R01	08/26/2003	SS	N	p,p'-DDT	0.0092	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	p,p'-DDD	0.0036	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	p,p'-DDE	0.016	J	mg/kg
NDAHSS23	NDAHSS23-R01	08/26/2003	SS	N	p,p'-DDT	0.0083	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	p,p'-DDE	0.005	J	mg/kg
NDAHSS24	NDAHSS24-R01	08/26/2003	SS	N	p,p'-DDT	0.0055	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	p,p'-DDD	0.00062	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	p,p'-DDE	0.0025	J	mg/kg
NDAHSS25	NDAHSS25-R01	08/26/2003	SS	N	p,p'-DDT	0.0013	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	p,p'-DDD	0.0023	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	p,p'-DDE	0.016	J	mg/kg
NDAHSS26	NDAHSS26-R01	08/26/2003	SS	N	p,p'-DDT	0.01	J	mg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	p,p'-DDD	0.0019	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	p,p'-DDD	3	J	µg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	p,p'-DDE	0.0088	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	p,p'-DDE	7.5	=	µg/kg
NDAHSS27	NDAHSS27-R01	08/26/2003	SS	N	p,p'-DDT	0.011	J	mg/kg
NDAHSS27	NDAHFD06P-R01	08/26/2003	SS	FD	p,p'-DDT	2.2	J	µg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	p,p'-DDD	0.0011	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	p,p'-DDE	0.092	J	mg/kg
NDAHSS28	NDAHSS28-R01	08/26/2003	SS	N	p,p'-DDT	0.16	J	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	p,p'-DDD	0.0044	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	p,p'-DDE	0.035	=	mg/kg
NDAHSS29	NDAHSS29-R01	08/26/2003	SS	N	p,p'-DDT	0.0077	J	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
Total Metals (mg/kg)								
NDAHSB01	NDE006	12/05/2000	SB	N	Aluminum	5900	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Antimony	0.9	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Arsenic	24	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Barium	44	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Calcium	4800	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Chromium, Total	16	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Cobalt	5.9	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Copper	17	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Iron	16000	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Lead	7.5	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Magnesium	2300	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Manganese	310	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Mercury	0.013	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Nickel	5.5	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Potassium	1100	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Selenium	0.91	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Sodium	140	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Vanadium	44	=	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	Zinc	33	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Aluminum	8500	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Barium	84	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Beryllium	0.23	J	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Calcium	5200	J	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Chromium, Total	9.5	J	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Cobalt	8.5	J	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Copper	24	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Iron	19000	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Lead	2.1	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Magnesium	2700	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Manganese	500	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Mercury	0.011	J	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Nickel	3.9	J	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Potassium	1500	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Selenium	0.9	J	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Sodium	130	J	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Vanadium	54	=	mg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Zinc	27	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Aluminum	8900	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Antimony	0.55	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Arsenic	2.4	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Barium	75	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Beryllium	0.24	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Calcium	2900	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Chromium, Total	10	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Cobalt	9.2	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Copper	25	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Iron	23000	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Lead	1.5	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Magnesium	3100	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Manganese	400	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Mercury	0.0093	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Nickel	4	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Potassium	1800	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Selenium	1	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Sodium	210	J	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Vanadium	68	=	mg/kg
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Zinc	27	=	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Aluminum	2500	=	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Arsenic	0.78	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Barium	26	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Calcium	1400	=	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Chromium, Total	3.6	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Cobalt	2.2	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Copper	7	=	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Iron	6900	=	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Lead	1.8	=	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Magnesium	840	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Manganese	160	=	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Nickel	1.2	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Potassium	440	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Sodium	43	J	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB02	NDE008	12/05/2000	SB	N	Vanadium	20	=	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	Zinc	8.8	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Aluminum	6900	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Antimony	0.59	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Arsenic	10	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Barium	87	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Calcium	5200	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Chromium, Total	10	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Cobalt	6.9	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Copper	31	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Iron	19000	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Lead	8.6	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Magnesium	3600	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Manganese	370	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Mercury	0.011	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Nickel	4.2	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Potassium	2700	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Selenium	1.3	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Sodium	200	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Vanadium	52	=	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Zinc	41	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Aluminum	4200	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Antimony	0.44	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Arsenic	0.69	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Barium	160	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Calcium	2100	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Chromium, Total	5.3	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Cobalt	7.9	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Copper	15	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Iron	12000	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Lead	2.5	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Magnesium	1600	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Manganese	680	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Mercury	0.0038	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Nickel	2.7	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Potassium	980	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Selenium	0.84	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Sodium	48	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Vanadium	36	=	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	Zinc	16	=	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Aluminum	2900	=	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Barium	23	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Calcium	1900	=	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Chromium, Total	3.6	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Cobalt	2.4	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Copper	7.7	=	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Iron	7800	=	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Lead	2	=	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Magnesium	980	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Manganese	110	=	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Mercury	0.0032	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Nickel	1.2	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Potassium	650	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Selenium	0.55	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Sodium	60	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Vanadium	22	=	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Zinc	13	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Aluminum	3100	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Antimony	0.38	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Barium	20	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Calcium	2700	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Chromium, Total	6.4	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Cobalt	3.1	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Copper	10	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Iron	9300	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Lead	5.7	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Magnesium	1400	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Manganese	150	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Nickel	3.1	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Potassium	560	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Selenium	0.79	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Sodium	59	J	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB06	NDE016	12/06/2000	SB	N	Vanadium	27	=	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Zinc	20	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Aluminum	4300	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Antimony	0.44	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Barium	200	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Beryllium	0.15	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Calcium	2700	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Chromium, Total	13	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Cobalt	16	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Copper	16	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Iron	15000	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Lead	4.4	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Magnesium	3100	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Manganese	1000	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Nickel	3.4	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Potassium	970	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Selenium	0.57	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Sodium	46	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Vanadium	40	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	Zinc	26	J	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Aluminum	4200	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Arsenic	0.64	J	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Barium	86	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Beryllium	0.15	J	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Calcium	8400	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Chromium, Total	8.9	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Cobalt	4.2	J	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Copper	16	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Iron	11000	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Lead	5.9	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Magnesium	2500	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Manganese	520	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Nickel	7.5	J	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Potassium	1300	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Sodium	240	J	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Vanadium	31	=	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	Zinc	27	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Aluminum	9700	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Aluminum	11000	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Aluminum	5200	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Antimony	0.49	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Antimony	0.44	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Arsenic	0.76	J	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Barium	63	=	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Barium	69	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Barium	120	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Beryllium	0.22	J	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Beryllium	0.42	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Beryllium	0.48	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Calcium	1800	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Calcium	3000	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Calcium	1800	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Chromium, Total	27	=	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Chromium, Total	23	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Chromium, Total	5.7	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Cobalt	15	=	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Cobalt	8.4	J	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Cobalt	5.1	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Copper	23	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Copper	30	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Copper	14	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Iron	28000	=	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Iron	22000	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Iron	15000	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Lead	1.2	=	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Lead	2.1	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Lead	2.2	=	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Magnesium	3000	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Magnesium	2000	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Magnesium	4200	=	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Manganese	420	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Manganese	600	=	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB09	NDE204	12/06/2000	SB	N	Manganese	850	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Mercury	0.0034	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Nickel	6.9	J	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Nickel	2.9	J	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Nickel	9.2	J	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Potassium	1000	J	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Potassium	840	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Potassium	630	J	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Selenium	0.89	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Selenium	0.9	J	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Selenium	0.76	J	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Sodium	170	J	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Sodium	850	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Sodium	590	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Thallium	0.43	J	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Vanadium	75	=	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Vanadium	79	=	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Vanadium	36	=	mg/kg
NDAHSB09	NDE204	12/06/2000	SB	N	Zinc	28	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	Zinc	20	J	mg/kg
NDAHSB09	NDE022	12/06/2000	SB	N	Zinc	17	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Aluminum	5200	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Arsenic	1.1	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Barium	74	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Beryllium	0.18	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Calcium	2000	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Chromium, Total	6.7	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Cobalt	5.8	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Copper	16	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Iron	18000	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Lead	1.1	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Magnesium	2000	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Manganese	960	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Nickel	2.5	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Potassium	1000	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Selenium	1.2	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Sodium	290	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Vanadium	46	=	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	Zinc	16	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Aluminum	4000	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Barium	60	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Beryllium	0.16	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Calcium	2900	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Chromium, Total	6.4	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Cobalt	5.5	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Copper	10	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Iron	13000	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Lead	1.2	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Magnesium	1600	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Manganese	290	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Mercury	0.0041	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Nickel	2.3	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Potassium	830	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Selenium	0.61	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Sodium	130	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Vanadium	34	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Zinc	15	J	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Aluminum	5000	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Barium	57	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Beryllium	0.19	J	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Calcium	3900	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Chromium, Total	8.1	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Cobalt	6.1	J	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Copper	15	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Iron	17000	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Lead	1.1	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Magnesium	2000	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Manganese	300	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Mercury	0.0094	J	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Nickel	2.7	J	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Potassium	1100	J	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Selenium	0.65	J	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB12	NDE029	12/06/2000	SB	N	Sodium	310	J	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Vanadium	54	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	Zinc	18	J	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Aluminum	3200	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Barium	29	J	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Beryllium	0.17	J	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Calcium	1700	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Chromium, Total	3.3	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Cobalt	4.1	J	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Copper	17	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Iron	11000	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Lead	0.92	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Magnesium	1400	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Manganese	160	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Nickel	1.7	J	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Potassium	700	J	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Sodium	180	J	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Vanadium	37	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	Zinc	15	J	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Aluminum	7000	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Barium	85	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Beryllium	0.21	J	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Calcium	6200	J	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Chromium, Total	8.9	J	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Cobalt	7	J	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Copper	23	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Iron	19000	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Lead	12	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Magnesium	2500	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Manganese	350	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Mercury	0.015	J	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Nickel	3.7	J	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Potassium	1300	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Selenium	1.2	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Sodium	230	J	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Vanadium	51	=	mg/kg
NDAHSB14	NDE033	12/07/2000	SB	N	Zinc	48	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Aluminum	8900	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Barium	98	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Beryllium	0.24	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Calcium	4100	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Chromium, Total	11	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Cobalt	9	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Copper	28	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Iron	20000	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Lead	1.7	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Magnesium	2800	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Manganese	560	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Mercury	0.014	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Nickel	4.3	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Potassium	1600	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Selenium	0.99	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Sodium	110	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Vanadium	61	=	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	Zinc	30	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Aluminum	9400	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Antimony	0.44	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Arsenic	0.88	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Barium	81	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Beryllium	0.26	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Calcium	3300	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Chromium, Total	10	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Cobalt	9	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Copper	25	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Iron	22000	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Lead	1.9	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Magnesium	3000	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Manganese	420	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Mercury	0.0088	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Nickel	4.2	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Potassium	1800	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Selenium	1	J	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB16	NDE038	12/07/2000	SB	N	Sodium	190	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Vanadium	65	=	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	Zinc	28	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Aluminum	6550	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Antimony	0.218	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Arsenic	1.71	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Barium	61.3	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Beryllium	0.112	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Cadmium	0.0442	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Calcium	9420	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Chromium, Total	7.61	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Cobalt	5.79	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Copper	20.6	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Iron	13900	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Lead	18.9	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Magnesium	2130	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Manganese	316	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Mercury	0.0706	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Nickel	3.48	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Potassium	1330	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Selenium	0.383	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Silver	0.0437	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Sodium	190	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Thallium	0.708	J	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Vanadium	38.5	=	mg/kg
NDAHSB17	NDAHSB17-R01	08/26/2003	SB	N	Zinc	59.8	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Aluminum	6880	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Antimony	0.253	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Arsenic	1.29	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Barium	81.4	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Beryllium	0.122	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Cadmium	0.219	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Calcium	15100	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Chromium, Total	9.05	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Cobalt	5.74	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Copper	27.2	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Iron	15400	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Lead	29.1	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Magnesium	2660	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Manganese	345	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Mercury	0.0719	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Nickel	4.17	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Potassium	1820	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Selenium	0.278	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Sodium	297	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Thallium	0.538	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Vanadium	41.8	=	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	Zinc	155	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Aluminum	2930	=	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Antimony	0.14	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Arsenic	0.161	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Barium	25.4	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Beryllium	0.0591	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Calcium	1540	=	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Chromium, Total	3.51	=	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Cobalt	3.24	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Copper	8.56	=	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Iron	9420	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Lead	1.25	=	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Magnesium	1060	=	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Manganese	177	=	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Mercury	0.00506	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Nickel	1.25	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Potassium	709	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Sodium	85.1	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Thallium	0.476	J	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Vanadium	26.5	=	mg/kg
NDAHSB19	NDAHSB19-R01	08/26/2003	SB	N	Zinc	13.3	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Aluminum	5050	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Aluminum	4980	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Antimony	0.199	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Antimony	0.332	J	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Arsenic	0.372	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Arsenic	0.62	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Barium	40.9	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Barium	45.6	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Beryllium	0.0933	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Beryllium	0.0952	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Cadmium	0.0367	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Calcium	6560	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Calcium	9130	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Chromium, Total	6.98	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Chromium, Total	6.04	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Cobalt	4.81	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Cobalt	4.49	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Copper	21.3	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Copper	21.5	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Iron	12100	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Iron	12400	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Lead	5.2	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Lead	6.75	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Magnesium	1680	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Magnesium	1690	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Manganese	286	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Manganese	283	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Mercury	0.0165	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Mercury	0.0146	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Nickel	2.36	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Nickel	2.25	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Potassium	1390	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Potassium	1400	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Selenium	0.351	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Selenium	0.5	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Silver	0.0424	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Sodium	179	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Sodium	196	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Thallium	0.622	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Thallium	0.583	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Vanadium	34.3	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Vanadium	36.2	=	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	Zinc	49.4	=	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	Zinc	54.1	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Aluminum	2620	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Arsenic	0.203	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Barium	32.4	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Beryllium	0.0532	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Calcium	1070	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Chromium, Total	5.15	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Cobalt	2.93	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Copper	7.04	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Iron	7810	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Lead	0.75	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Magnesium	895	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Manganese	161	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Mercury	0.00429	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Nickel	1.26	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Potassium	665	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Selenium	0.268	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Sodium	77.3	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Thallium	0.407	J	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Vanadium	22.8	=	mg/kg
NDAHSB21	NDAHSB21-R01	08/26/2003	SB	N	Zinc	10.2	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Aluminum	3760	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Antimony	0.25	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Arsenic	1.94	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Barium	31	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Beryllium	0.0805	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Calcium	1420	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Chromium, Total	4.32	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Cobalt	2.48	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Copper	46.4	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Iron	8700	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Lead	2.29	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Magnesium	1380	=	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Manganese	80.4	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Mercury	0.009	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Nickel	1.35	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Potassium	1050	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Selenium	0.199	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Sodium	95.9	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Thallium	0.522	J	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Vanadium	25.5	=	mg/kg
NDAHSB22	NDAHSB22-R01	08/26/2003	SB	N	Zinc	17.5	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Aluminum	2630	=	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Arsenic	1.24	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Barium	29.2	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Beryllium	0.0479	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Calcium	1180	=	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Chromium, Total	4.4	=	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Cobalt	2.58	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Copper	8.18	=	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Iron	8360	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Lead	1.11	=	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Magnesium	975	=	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Manganese	117	=	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Mercury	0.00644	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Nickel	1.21	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Potassium	739	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Selenium	0.29	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Sodium	78.8	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Thallium	0.355	J	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Vanadium	25.3	=	mg/kg
NDAHSB23	NDAHSB23-R01	08/26/2003	SB	N	Zinc	12.3	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Aluminum	3020	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Arsenic	1.09	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Barium	37.3	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Beryllium	0.0735	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Calcium	2900	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Chromium, Total	4.54	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Cobalt	3.87	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Copper	9.45	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Iron	9070	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Lead	1.04	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Magnesium	1100	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Manganese	277	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Mercury	0.00318	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Nickel	1.58	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Potassium	809	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Sodium	114	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Thallium	0.553	J	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Vanadium	27.8	=	mg/kg
NDAHSB24	NDAHSB24-R01	08/26/2003	SB	N	Zinc	15	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Aluminum	2110	=	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Arsenic	0.223	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Barium	32.6	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Beryllium	0.0547	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Calcium	1300	=	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Chromium, Total	3.28	=	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Cobalt	3.14	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Copper	7.49	=	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Iron	6660	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Lead	0.91	=	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Magnesium	748	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Manganese	271	=	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Mercury	0.00476	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Nickel	1.13	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Potassium	591	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Sodium	91.6	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Thallium	0.24	J	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Vanadium	19	=	mg/kg
NDAHSB25	NDAHSB25-R01	08/26/2003	SB	N	Zinc	9.07	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Aluminum	4440	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Arsenic	1.18	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Barium	44	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Beryllium	0.103	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Calcium	3220	=	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Chromium, Total	6.75	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Cobalt	5.08	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Copper	14.8	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Iron	14000	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Lead	1.42	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Magnesium	1760	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Manganese	427	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Mercury	0.0061	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Nickel	3.17	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Potassium	1020	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Selenium	0.411	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Silver	0.0405	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Sodium	363	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Thallium	0.661	J	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Vanadium	36.4	=	mg/kg
NDAHSB26	NDAHSB26-R01	08/26/2003	SB	N	Zinc	18.8	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Aluminum	5790	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Antimony	0.168	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Arsenic	0.631	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Barium	43.7	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Beryllium	0.112	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Calcium	4240	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Chromium, Total	7.03	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Cobalt	5.65	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Copper	16.5	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Iron	15400	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Lead	3.23	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Magnesium	2340	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Manganese	199	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Mercury	0.0218	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Nickel	2.71	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Potassium	1240	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Selenium	0.384	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Silver	0.0242	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Sodium	737	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Thallium	0.712	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Vanadium	46.8	=	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	Zinc	31	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Aluminum	5360	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Antimony	0.222	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Arsenic	0.917	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Barium	68.5	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Beryllium	0.134	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Calcium	2780	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Chromium, Total	6.78	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Cobalt	6.25	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Copper	15.4	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Iron	13200	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Lead	1.86	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Magnesium	2030	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Manganese	544	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Mercury	0.0109	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Nickel	2.86	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Potassium	1170	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Selenium	0.572	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Silver	0.0293	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Sodium	205	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Thallium	0.789	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Vanadium	40.3	=	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	Zinc	22.2	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Aluminum	6450	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Antimony	0.412	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Arsenic	0.545	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Barium	69.1	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Beryllium	0.118	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Calcium	6060	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Chromium, Total	8.81	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Cobalt	6.8	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Copper	18.8	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Iron	15800	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Lead	3.02	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Magnesium	2520	=	mg/kg

TABLE 4-B
Subsurface Soil Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Manganese	372	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Mercury	0.0195	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Nickel	3.24	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Potassium	1510	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Selenium	0.362	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Sodium	361	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Thallium	0.954	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Vanadium	48.9	=	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	Zinc	26.8	J	mg/kg
Volatiles (mg/kg)								
NDAHSB016	NDE039FD1	12/07/2000	SB	FD	Carbon disulfide	0.91	J	µg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	Tetrachloroethylene	0.0016	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	Tetrachloroethylene	0.00031	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	1,1-Dichloroethene	0.00045	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	Methylene chloride	0.00058	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	1,1-Dichloroethene	0.00055	J	mg/kg
NDAHSB08	NDE020	12/06/2000	SB	N	1,1-Dichloroethene	0.00052	J	mg/kg
NDAHSB09	NDE203	12/06/2000	SB	N	1,1-Dichloroethene	0.00078	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	1,1-Dichloroethene	0.00059	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Toluene	0.0004	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	Trichloroethylene	0.00034	J	mg/kg
NDAHSB15	NDE035	12/07/2000	SB	N	1,2-Dichloroethane	0.002	J	mg/kg
Semivolatile Organic Compounds (µg/kg)								
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	4-Bromophenyl Phenyl Ether	236	J	µg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Fluorene	76	J	µg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	Isophorone	90	J	µg/kg
NDAHSB015	NDE036FD1	12/07/2000	SB	FD	N-Nitrosodi-n-propylamine	603	=	µg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	bis(2-Ethylhexyl) Phthalate	79.9	J	µg/kg
Pesticides (mg/kg)								
NDAHSB01	NDE006	12/05/2000	SB	N	p,p'-DDE	0.764	J	mg/kg
NDAHSB01	NDE006	12/05/2000	SB	N	p,p'-DDT	0.928	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	p,p'-DDE	0.124	J	mg/kg
NDAHSB02	NDE008	12/05/2000	SB	N	p,p'-DDT	0.022	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	p,p'-DDD	0.0035	J	mg/kg
NDAHSB03	NDE010	12/05/2000	SB	N	p,p'-DDE	0.0039	J	mg/kg
NDAHSB04	NDE012	12/05/2000	SB	N	p,p'-DDE	0.0016	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	p,p'-DDE	0.0087	J	mg/kg
NDAHSB05	NDE014	12/05/2000	SB	N	p,p'-DDT	0.0076	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	p,p'-DDE	0.002	J	mg/kg
NDAHSB06	NDE016	12/06/2000	SB	N	p,p'-DDT	0.0015	J	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	p,p'-DDE	0.0045	=	mg/kg
NDAHSB07	NDE018	12/06/2000	SB	N	p,p'-DDT	0.0025	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	p,p'-DDE	0.0015	J	mg/kg
NDAHSB10	NDE025	12/06/2000	SB	N	p,p'-DDT	0.0009	J	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	p,p'-DDD	0.0049	=	mg/kg
NDAHSB11	NDE027	12/06/2000	SB	N	p,p'-DDE	0.419	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	p,p'-DDD	0.013	=	mg/kg
NDAHSB12	NDE029	12/06/2000	SB	N	p,p'-DDE	0.024	=	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	p,p'-DDD	0.0025	J	mg/kg
NDAHSB13	NDE031	12/06/2000	SB	N	p,p'-DDE	0.0017	J	mg/kg
NDAHSB16	NDE038	12/07/2000	SB	N	p,p'-DDE	0.0038	J	mg/kg
NDAHSB18	NDAHSB18-R01	08/26/2003	SB	N	p,p'-DDE	0.0002	J	mg/kg
NDAHSB20	NDAHSB20-R01	08/26/2003	SB	N	p,p'-DDE	0.00014	J	mg/kg
NDAHSB20	NDAHFD05P-R01	08/26/2003	SB	FD	p,p'-DDE	0.1	J	µg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	p,p'-DDD	0.01	J	mg/kg
NDAHSB27	NDAHSB27-R01	08/26/2003	SB	N	p,p'-DDE	0.0027	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	p,p'-DDD	0.00019	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	p,p'-DDE	0.00061	J	mg/kg
NDAHSB28	NDAHSB28-R01	08/26/2003	SB	N	p,p'-DDT	0.00048	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	p,p'-DDE	0.0032	J	mg/kg
NDAHSB29	NDAHSB29-R01	08/26/2003	SB	N	p,p'-DDT	0.00082	J	mg/kg

TABLE 4-C
Groundwater Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
				Dissolved Metals (µg/L)				
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Aluminum, dissolved	47.7	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Barium, dissolved	62.2	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Barium, dissolved	63	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Barium, dissolved	51	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Calcium, dissolved	15100	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Calcium, dissolved	24000	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Calcium, dissolved	15100	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Chromium, dissolved	0.81	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Copper, dissolved	4.58	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Copper, dissolved	1.21	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Iron, dissolved	16.9	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Iron, dissolved	120	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Lead, dissolved	1.78	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Magnesium, dissolved	10300	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Magnesium, dissolved	13000	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Magnesium, dissolved	10300	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Manganese, dissolved	41.1	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Manganese, dissolved	150	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Manganese, dissolved	39.5	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Nickel, dissolved	7.7	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Potassium, dissolved	4430	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Potassium, dissolved	4100	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Potassium, dissolved	4430	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Selenium, dissolved	3.73	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Selenium, dissolved	2.21	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Sodium, dissolved	272000	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Sodium, dissolved	273000	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Sodium, dissolved	280000	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Thallium, dissolved	9	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Vanadium, dissolved	10.6	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Vanadium, dissolved	10.2	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Vanadium, dissolved	20	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Zinc, dissolved	1.58	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Zinc, dissolved	1.66	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Barium, dissolved	285	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Barium, dissolved	460	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Cadmium, dissolved	4.99	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Calcium, dissolved	554000	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Calcium, dissolved	270000	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Chromium, dissolved	7.91	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Cobalt, dissolved	30.3	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Iron, dissolved	3290	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Magnesium, dissolved	220000	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Magnesium, dissolved	891000	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Manganese, dissolved	14600	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Manganese, dissolved	5800	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Nickel, dissolved	17.6	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Potassium, dissolved	56000	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Potassium, dissolved	203000	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Sodium, dissolved	5870000	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Sodium, dissolved	980000	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Vanadium, dissolved	2.8	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Aluminum, dissolved	100	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Barium, dissolved	210	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Barium, dissolved	190	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Calcium, dissolved	180000	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Calcium, dissolved	180000	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Magnesium, dissolved	100000	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Magnesium, dissolved	97000	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Manganese, dissolved	110	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Manganese, dissolved	92	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Potassium, dissolved	12000	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Potassium, dissolved	12000	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Sodium, dissolved	890000	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Sodium, dissolved	830000	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Vanadium, dissolved	10	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Vanadium, dissolved	9.6	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Aluminum, dissolved	130	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Antimony, dissolved	5.4	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Barium, dissolved	400	=	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Calcium, dissolved	340000	=	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Magnesium, dissolved	280000	=	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Manganese, dissolved	1800	=	µg/L

TABLE 4-C
Groundwater Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHMW04	NDE217	12/19/2000	GW	N	Potassium, dissolved	12000	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Sodium, dissolved	1200000	=	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Vanadium, dissolved	6	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Barium, dissolved	320	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Cadmium, dissolved	6.3	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Calcium, dissolved	712000	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Chromium, dissolved	5.71	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Cobalt, dissolved	24.2	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Iron, dissolved	4180	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Magnesium, dissolved	958000	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Manganese, dissolved	15400	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Potassium, dissolved	183000	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Sodium, dissolved	5950000	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Thallium, dissolved	26.2	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Barium, dissolved	58.1	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Calcium, dissolved	35900	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Cobalt, dissolved	0.626	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Magnesium, dissolved	25100	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Manganese, dissolved	590	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Potassium, dissolved	2170	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Selenium, dissolved	3.56	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Sodium, dissolved	163000	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Vanadium, dissolved	12.7	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Zinc, dissolved	0.489	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Aluminum, dissolved	438	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Barium, dissolved	274	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Cadmium, dissolved	5.78	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Calcium, dissolved	631000	=	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Cobalt, dissolved	40.4	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Magnesium, dissolved	1020000	=	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Manganese, dissolved	13300	=	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Mercury, dissolved	0.0194	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Nickel, dissolved	10.4	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Potassium, dissolved	294000	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Silver, dissolved	7.15	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Sodium, dissolved	7200000	=	µg/L
				Total Metals (µg/L)				
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Aluminum	7050	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Aluminum	6430	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Aluminum	6000	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Barium	127	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Barium	86	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Barium	123	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Cadmium	0.527	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Cadmium	0.435	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Calcium	16800	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Calcium	16500	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Calcium	35000	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Chromium, Total	10.9	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Chromium, Total	11	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Chromium, Total	11.6	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Cobalt	5.1	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Cobalt	4.68	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Cobalt	5.1	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Copper	14.1	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Copper	12.6	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Copper	17	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Iron	8160	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Iron	7560	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Iron	8200	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Magnesium	12900	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Magnesium	19000	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Magnesium	12700	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Manganese	1150	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Manganese	250	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Manganese	1100	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Nickel	6.6	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Nickel	7.55	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Nickel	22	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Potassium	4320	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Potassium	4300	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Potassium	4600	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Silver	0.527	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Sodium	272000	=	µg/L

TABLE 4-C
Groundwater Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Sodium	266000	=	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Sodium	290000	=	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Thallium	3.26	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Thallium	10	=	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Thallium	3.28	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Vanadium	40.5	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Vanadium	43	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Vanadium	38.5	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Zinc	14.2	J	µg/L
NDAHMW01	NDE213	12/19/2000	GW	N	Zinc	19	J	µg/L
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Zinc	12.8	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Aluminum	399	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Aluminum	9100	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Arsenic	6.3	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Barium	490	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Barium	279	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Calcium	320000	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Calcium	556000	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Chromium, Total	9.86	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Chromium, Total	15	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Cobalt	29.9	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Cobalt	22	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Copper	25	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Iron	11000	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Iron	4580	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Magnesium	220000	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Magnesium	860000	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Manganese	8300	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Manganese	14100	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Mercury	0.0165	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Nickel	59	=	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Nickel	10.4	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Potassium	54000	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Potassium	240000	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Sodium	5860000	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Sodium	940000	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Thallium	6.6	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	Thallium	28.7	J	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Vanadium	70	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Zinc	33	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Aluminum	100	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Aluminum	3800	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Barium	210	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Barium	300	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Calcium	170000	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Calcium	200000	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Chromium, Total	5.2	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Chromium, Total	3.2	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Cobalt	9.3	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Cobalt	12	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Copper	10	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Copper	16	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Iron	2900	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Iron	4500	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Magnesium	98000	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Magnesium	110000	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Manganese	1100	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Manganese	1100	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Nickel	7.6	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Nickel	9	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Potassium	12000	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Potassium	13000	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Sodium	850000	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Sodium	890000	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Thallium	8	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Thallium	10	=	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Vanadium	24	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Vanadium	28	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Zinc	11	J	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Zinc	19	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Aluminum	130	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Antimony	5.4	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Barium	400	=	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Calcium	340000	=	µg/L

TABLE 4-C
Groundwater Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHMW04	NDE217	12/19/2000	GW	N	Magnesium	280000	=	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Manganese	1800	=	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Potassium	12000	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Sodium	1200000	=	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Vanadium	6	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Aluminum	481	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Barium	319	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Calcium	719000	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Cobalt	24.5	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Iron	5170	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Magnesium	937000	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Manganese	14800	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Nickel	11.4	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Potassium	221000	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Sodium	6030000	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Aluminum	112	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Antimony	2.62	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Barium	63.1	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Cadmium	0.408	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Calcium	34900	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Iron	83	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Magnesium	24900	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Manganese	620	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Nickel	1.47	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Potassium	1870	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Sodium	163000	=	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Vanadium	13.7	J	µg/L
NDAHMW06	NDAHGW06-R01	09/09/2003	GW	N	Zinc	0.808	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Aluminum	475	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Barium	264	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Cadmium	4.46	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Calcium	606000	=	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Cobalt	33.3	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Magnesium	963000	=	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Manganese	12700	=	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Mercury	0.024	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Nickel	19.4	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Potassium	283000	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Silver	4.9	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Sodium	6950000	=	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Thallium	44.2	J	µg/L
NDAHMW07	NDAHGW07-R01	09/07/2003	GW	N	Vanadium	9.87	J	µg/L
Volatile Organic Compounds (µg/L)								
NDAHMW01	NDE213	12/19/2000	GW	N	Toluene	1.3	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	Toluene	1.3	=	µg/L
NDAHMW03	NDE215	12/19/2000	GW	N	Toluene	0.43	J	µg/L
NDAHMW03	NDE216FD1	12/19/2000	GW	FD	Toluene	1	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	Toluene	1	=	µg/L
Semivolatile Organic Compounds (µg/L)								
NDAHMW01	NDAHGW01-R01	09/08/2003	GW	N	Caprolactam	3	J	µg/L
NDAHMW01	NDAHGWFD01	09/08/2003	GW	FD	Caprolactam	6.2	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	4-Chloroaniline	9.9	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	Caprolactam	6	J	µg/L
Pesticides (µg/L)								
NDAHMW02	NDE214	12/19/2000	GW	N	p,p'-DDD	0.42	J	µg/L
NDAHMW02	NDAHGW02-R01	09/08/2003	GW	N	p,p'-DDD	0.4	=	µg/L
NDAHMW02	NDE214	12/19/2000	GW	N	p,p'-DDE	0.022	J	µg/L
NDAHMW04	NDE217	12/19/2000	GW	N	p,p'-DDT	0.028	J	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	p,p'-DDD	0.39	=	µg/L
NDAHMW05	NDAHGW05-R01	09/08/2003	GW	N	p,p'-DDE	0.018	J	µg/L

TABLE 4-D
Surface Water Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
Dissolved Metals (µg/L)								
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Barium, dissolved	142	J	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Calcium, dissolved	346000	=	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Magnesium, dissolved	939000	=	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Manganese, dissolved	91.7	J	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Potassium, dissolved	486000	=	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Selenium, dissolved	67.9	J	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Sodium, dissolved	7750000	=	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Barium, dissolved	163	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Calcium, dissolved	342000	=	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Magnesium, dissolved	924000	=	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Manganese, dissolved	70	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Potassium, dissolved	479000	=	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Sodium, dissolved	7660000	=	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Barium, dissolved	147	J	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Barium, dissolved	150	J	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Calcium, dissolved	342000	=	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Calcium, dissolved	343000	=	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Magnesium, dissolved	928000	=	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Magnesium, dissolved	925000	=	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Manganese, dissolved	268	J	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Manganese, dissolved	234	J	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Mercury, dissolved	0.0239	J	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Mercury, dissolved	0.0303	J	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Potassium, dissolved	479000	=	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Potassium, dissolved	476000	=	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Sodium, dissolved	7670000	=	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Sodium, dissolved	7630000	=	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Barium, dissolved	149	J	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Calcium, dissolved	335000	=	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Magnesium, dissolved	902000	=	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Manganese, dissolved	419	J	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Mercury, dissolved	0.0224	J	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Potassium, dissolved	460000	=	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Sodium, dissolved	7400000	=	µg/L
Total Metals (µg/L)								
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Barium	146	J	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Calcium	355000	=	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Magnesium	961000	=	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Manganese	450	=	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Mercury	0.0259	J	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Potassium	481000	J	µg/L
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Sodium	7680000	=	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Aluminum	1740	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Arsenic	47.1	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Barium	162	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Cadmium	7.7	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Calcium	371000	=	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Chromium, Total	16.2	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Cobalt	19.6	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Magnesium	1010000	=	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Manganese	385	=	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Mercury	0.0225	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Potassium	473000	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Selenium	63.9	J	µg/L
NDAHSW02	NDAHSW02-R01	09/30/2003	SW	N	Sodium	7480000	=	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Barium	151	J	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Barium	151	J	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Calcium	374000	=	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Calcium	383000	=	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Magnesium	1020000	=	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Magnesium	1050000	=	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Manganese	590	=	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Manganese	654	=	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Mercury	0.043	J	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Mercury	0.0339	J	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Potassium	482000	J	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Potassium	482000	J	µg/L
NDAHSW03	NDAHFD02P-R01	09/30/2003	SW	FD	Sodium	7740000	=	µg/L
NDAHSW03	NDAHSW03-R01	09/30/2003	SW	N	Sodium	7660000	=	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Barium	155	J	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Calcium	371000	=	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Magnesium	1020000	=	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Manganese	633	=	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Mercury	0.0351	J	µg/L
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Potassium	470000	J	µg/L
Semivolatile Organic Compounds (µg/L)								
NDAHSW04	NDAHSW04-R01	09/30/2003	SW	N	Sodium	7510000	=	µg/L
SVOC (µg/L)								
NDAHSW01	NDAHSW01-R01	09/30/2003	SW	N	Caprolactam	0.52	J	µg/L

TABLE 4-E
Sediment Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
				Total Metals (mg/kg)				
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Aluminum	1610	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Aluminum	3320	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Antimony	0.369	J	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Antimony	0.333	J	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Arsenic	0.649	J	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Arsenic	0.882	J	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Barium	6.16	J	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Barium	6	J	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Beryllium	0.0308	J	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Beryllium	0.0486	J	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Calcium	76200	J	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Calcium	2590	J	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Chromium, Total	13.4	J	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Chromium, Total	2.84	J	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Cobalt	1.42	J	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Cobalt	3.56	J	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Copper	3.73	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Copper	7.1	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Iron	2950	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Iron	7990	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Lead	0.446	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Lead	0.853	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Magnesium	1780	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Magnesium	3430	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Manganese	33.6	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Manganese	87.6	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Nickel	1.02	J	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Nickel	4.39	J	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Potassium	774	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Potassium	1040	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Sodium	4000	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Sodium	3290	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Vanadium	9.59	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Vanadium	25.8	=	mg/kg
NDAHSD01	NDAHFD03P-R01	09/29/2003	SD	FD	Zinc	4.58	=	mg/kg
NDAHSD01	NDAHSD01-R01	09/29/2003	SD	N	Zinc	11.3	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Aluminum	3080	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Arsenic	0.249	J	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Barium	57.2	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Beryllium	0.0647	J	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Calcium	2660	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Chromium, Total	4.16	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Cobalt	3.85	J	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Copper	9.76	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Iron	8440	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Lead	1.49	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Magnesium	1530	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Manganese	109	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Mercury	0.0127	J	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Nickel	1.93	J	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Potassium	970	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Sodium	2340	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Thallium	0.494	J	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Vanadium	26.9	=	mg/kg
NDAHSD02	NDAHSD02-R01	09/29/2003	SD	N	Zinc	12.5	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Aluminum	1880	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Antimony	0.107	J	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Barium	13	J	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Beryllium	0.0379	J	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Calcium	890	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Chromium, Total	3.11	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Cobalt	2.31	J	mg/kg

TABLE 4-E
Sediment Analytical Detections
AOC H, Former NASD, Vieques, Puerto Rico

Station	Sample	Collection Date	Matrix	Sample Type	Chemical Name	Result	Qualifier	Unit
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Copper	6.15	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Iron	6040	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Lead	0.964	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Magnesium	1140	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Manganese	62.1	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Mercury	0.00363	J	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Nickel	1.28	J	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Potassium	716	J	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Sodium	2800	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Thallium	0.432	J	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Vanadium	17.3	=	mg/kg
NDAHSD03	NDAHSD03-R01	09/29/2003	SD	N	Zinc	7.31	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Aluminum	3180	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Arsenic	0.202	J	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Barium	13.2	J	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Beryllium	0.0503	J	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Calcium	1130	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Chromium, Total	7.75	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Cobalt	4.27	J	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Copper	9.43	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Iron	8620	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Lead	1.43	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Magnesium	2140	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Manganese	73.6	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Mercury	0.00181	J	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Nickel	4.25	J	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Potassium	1090	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Silver	0.0268	J	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Sodium	2720	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Thallium	0.422	J	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Vanadium	21.9	=	mg/kg
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	Zinc	13.6	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Aluminum	3030	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Antimony	0.183	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Arsenic	0.271	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Barium	22.5	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Beryllium	0.0634	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Calcium	1230	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Chromium, Total	7.36	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Cobalt	4.12	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Copper	10.3	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Iron	15500	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Lead	1.99	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Magnesium	1400	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Manganese	126	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Mercury	0.00181	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Nickel	2.39	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Potassium	673	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Silver	0.0406	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Sodium	90.6	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Thallium	1.12	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Vanadium	50.4	=	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	Zinc	12.1	=	mg/kg
Pesticides (mg/kg)								
NDAHSD04	NDAHSD04-R01	09/29/2003	SD	N	p,p'-DDE	0.00012	J	mg/kg
NDAHSD05	NDAHSD05-R01	09/30/2003	SD	N	p,p'-DDE	0.00007	J	mg/kg

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
6	surface soil	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-9. July 2007b.

TABLE 4-9
Summary of Surface Soil COPCs
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Number Analyzed	Number Detected	Maximum Detect (mg/Kg)	Minimum Detect (mg/Kg)	Mean Concentration [1] (mg/Kg)	Residential PRG [2]	Ecologic Screening Value [3]	Leaching Screening Value [4]	Leaching Screening Value[5]	Background Concentration [5] (mg/Kg)
METALS										
ALUMINUM	33	33	11000	3400	7580	**7610**	**50**	na	na	29000
ARSENIC	33	33	67	0.435	4.88	**0.39**	**18**	**14.5**	**1.45**	**2.2**
CHROMIUM, TOTAL	33	33	50	7.83	17.1	211	**0.4**	**19**	**1.9**	74
COPPER	33	33	100	11.1	31.8	313	**50**	na	na	**68**
IRON	33	33	39000	7700	17300	**2350**	**200**	na	na	**37531**
MANGANESE	33	33	720	140	396	**176**	**100**	na	na	1167
LEAD	33	33	63	4.43	26.4	**40**	**120**	na	na	**6.9**
ANTIMONY	33	26	6.3	0.34	0.78	**3.13**	**78**	**2.5**	**0.25**	**2.3**
SELENIUM	33	22	1.4	0.234	0.507	39.1	**1**	2.5	**0.25**	2
THALLIUM	33	13	1.16	0.287	0.387	**0.516**	**1**	na	na	**0.67**
VANADIUM	33	33	63	21	44.4	**54.7**	**2**	3000	300	130
ZINC	33	33	260	31.5	96.4	2350	**50**	6000	600	**65**
VOCs										
XYLENES, TOTAL	20	1	0.082	0.082	0.0092	27.5	**0.05**	105	10.5	NA
M,P-XYLENE (SUM OF ISOMERS)	20	1	0.058	0.058	0.008	27.5	na	105	10.5	NA
O-XYLENE (1,2-DIMETHYLBENZENE	20	1	0.024	0.024	0.0063	27.5	na	105	10.5	NA
SVOCs										
BENZO(a)PYRENE	33	15	0.12	0.0257	0.747	**0.0621**	**0.1**	4	0.4	NA
2,6-DINITROTOLUENE	33	2	1.23	1.21	0.876	6.11	na	**0.00035**	**0.000035**	NA
FLUORANTHENE	33	16	0.187	0.0246	0.745	229	**0.1**	2150	215	NA
N-NITROSODI-n-PROPYLAMINE	33	3	0.717	0.562	0.852	**0.0695**	na	**0.000025**	**0.0000025**	NA
PHENANTHRENE	33	8	0.144	0.0211	0.78	na	**0.1**	na	na	NA
PYRENE	33	17	1.9	0.0282	0.377	232	**0.1**	2100	210	NA
PESTICIDES										
p,p'-DDD	31	12	0.01	0.00052	0.00228	2.44	**0.0025**	8	0.8	NA
p,p'-DDE	32	22	3.99	0.0014	0.234	**1.72**	**0.0025**	27	**2.7**	NA
p,p'-DDT	32	19	1.94	0.0013	0.109	**1.72**	**0.0025**	16	**1.6**	NA

[1] Mean concentration is based on 1/2 the detection limit for non-detects.

[2] USEPA Region IX PRG (2002) based on a hazard index (HI) of 0.1 for non-carcinogens.

[3] Numerical eco-SSL, if available, then the lower of the toxicological benchmarks for terrestrial plants, (Efroymson, 1997a) or invertebrates and heterotrophs (Efroymson, 1997b), then the lowest value reported in Friday (1998).

[4] USEPA Region IX PRG soil screening level (SSL, 2002) based on a dilution attenuation factor (DAF) of 10.

[5] Final Soil, Groundwater, Surface Water, and Sediment Background Investigation Report (CH2M Hill, 2002).

[6] USEPA Region IX PRG soil screening level (SSL, 2002) based on a dilution attenuation factor (DAF) of 1.

NA indicates that the information is not available or not applicable.

Shading indicates the screening criteria was exceeded by the maximum detected concentration.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
7	**subsurface soil**	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-10. July 2007b.

TABLE 4-10
Summary of Subsurface Soil COPCs
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Number Analyzed	Number Detected	Maximum Detect (mg/Kg)	Minimum Detect (mg/Kg)	Mean Concentration [1] (mg/Kg)	Leaching Screening Value [2]	Leaching Screening Value [4]	Background Concentration [3] (mg/Kg)
METALS								
ARSENIC	31	21	24	0.161	1.68	**14.5**	**1.45**	**2.5**
CHROMIUM, TOTAL	31	31	27	3.28	8.23	**19**	**1.9**	74

[1] Mean concentration is based on 1/2 the detection limit for non-detects.
[2] USEPA Region IX PRG soil screening level (SSL, 2002) based on a dilution attenuation factor (DAF) of 10.
[3] Final Soil, Groundwater, Surface Water, and Sediment Background Investigation Report (CH2M Hill, 2002).
[4] USEPA Region IX PRG soil screening level (SSL, 2002) based on a dilution attenuation factor (DAF) of 1.
NA indicates that the information is not available or not applicable.
Shading indicates the screening criteria was exceeded by the maximum detected concentration.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
8	groundwater	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-11. July 2007b.

TABLE 4-11
Summary of Groundwater COPCs
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Number Analyzed	Number Detected	Maximum Detect (µg/L)	Minimum Detect (µg/L)	Mean Concentration [1] (µg/L)	Tap Water PRG [2]	Background Concentrations Site-Specific [3] (µg/L)	Background Concentrations Base-Wide [4] (µg/L)
METALS								
ALUMINUM	7	7	9100	112	2070	**3650**	**6430**	**3500**
ALUMINUM, DISSOLVED	7	2	438	130	147	3650	**95**	NA
ANTIMONY	7	2	5.4	2.62	6.85	**1.46**	**ND**	**5.2**
ANTIMONY, DISSOLVED	7	1	5.4	5.4	6.65	**1.46**	**ND**	9
ARSENIC	7	1	6.3	6.3	5.83	**0.0448**	**ND**	NA
ARSENIC, DISSOLVED	7	0	0	0	5.14	0.0448	ND	5.5
BARIUM	7	7	490	63.1	302	**255**	**123**	960
BARIUM, DISSOLVED	7	7	460	58.1	284	**255**	**63**	870
CADMIUM	7	2	4.46	0.408	1.26	**1.82**	**0.435**	**1**
CADMIUM, DISSOLVED	7	3	6.3	4.99	2.52	**1.82**	**ND**	**1**
CHROMIUM, TOTAL	7	3	15	5.2	5.21	**11**	**11**	**6.8**
CHROMIUM, DISSOLVED	7	2	7.91	5.71	2.58	11	**0.87**	**5**
IRON	7	5	11000	83	3630	**1090**	**8200**	**4800**
IRON, DISSOLVED	7	2	4180	3290	1090	**1090**	**120**	**490**
MANGANESE	7	7	14800	620	7630	**87.6**	**1100**	17000
MANGANESE, DISSOLVED	7	7	15400	92	7370	**87.6**	**150**	18000
THALLIUM	7	4	44.2	6.6	15	**0.241**	**10**	**18**
THALLIUM, DISSOLVED	7	1	26.2	26.2	8.28	**0.241**	**9**	**16**
VANADIUM	7	5	70	6	18.9	**25.5**	**43**	75
VANADIUM, DISSOLVED	7	4	12.7	2.8	5.4	25.5	20	32
PESTICIDES								
p,p'-DDD	7	3	0.42	0.39	0.179	**0.28**	NA	NA

[1] Mean concentration is based on 1/2 the detection limit for non-detects.
[2] USEPA Region 9 tap-water PRG (2002) based on a hazard index (HI) of 0.1 for noncarcinogens.
[3] Site-specific background sample from well NDAHGW01.
[4] Final Soil, Groundwater, Surface Water, and Sediment Background Investigation Report (CH2M Hill, 2002).
NA indicates that the information is not available or not applicable.
Shading indicates the screening criteria was exceeded by the maximum detected concentration.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
9	surface water	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-12. July 2007b.

TABLE 4-12
Summary of Surface Water COPCs
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Number Analyzed	Number Detected	Maximum Detect (µg/L)	Minimum Detect (µg/L)	Mean Concentration [1] (µg/L)	Ecological Screening Criteria [2]	Background Concentration [3] (µg/L)
METALS							
ARSENIC	4	1	47.1	47.1	27.1	**1.4**	NA
ARSENIC, DISSOLVED	4	0	0	0	20.4	1.4	NA

[1] Mean concentration is based on 1/2 the detection limit for non-detects.
[2] The lower of the USEPA National Recommended Water Quality Criteria (USEPA, 2002) and the Puerto Rico Environmental Quality Board (EQB) Water Quality Standards.
[3] Site-specific background sample from sample location NDAHSW05 was not collected (dry).
ND indicates that the chemical was not detected.
NA indicates that the information is not available or not applicable.
J indicates that the chemical was detected. The reported value is estimated.
= indicates that the chemical was detected. The reported value is the measured concentration.
Shading indicates the screening criteria was exceeded by the maximum detected concentration.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
10	sediment	Section 2.3	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 4-13. July 2007b.

TABLE 4-13
Summary of Sediment COPCs
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Number Analyzed	Number Detected	Maximum Detect (mg/Kg)	Minimum Detect (mg/Kg)	Mean Concentration [1] (mg/Kg)	Ecologic Screening Value [2]	Background Concentrations Site-Specific [3] (mg/Kg)	Background Concentrations Base-Wide [4] (mg/Kg)
METALS								
BARIUM	4	4	57.2	6	22.4	**48**	**22.5**	69

[1] Mean concentration is based on 1/2 the detection limit for non-detects.
[2] NOAA SQUIRT (Buchman 1999).
[3] Site-specific background sample from sediment sample NDAHSD05.
[4] Final Soil, Groundwater, Surface Water, and Sediment Background Investigation Report (CH2M Hill, 2002).
NA indicates that the information is not available or not applicable.
Shading indicates the screening criteria was exceeded by the maximum detected concentration.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
11	potential human receptors	Section 2.5.1	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Section 6.6, Pages 6-7 through 6-10. July 2007.

sediment at AOC H. Collection of a background surface water sample was proposed in the work plan; however, due to the absence of standing water south (upstream) of the site, no such background surface water sample could be collected. The sitewide background surface water data will be used for comparison with AOC H surface water data.

6.6 Exposure Assessment

An exposure assessment was performed to evaluate the potential exposure of the identified human receptors to the site media based on current or anticipated future land use for AOC H. The exposure assessment included potential exposure pathways for human receptors, potential routes of exposure, exposure factors assumed, and exposure concentrations estimated.

6.6.1 Potentially Exposed Populations

The U.S. Navy ceased facility-wide operations on the former NASD on April 30, 2001, in accordance with the January 30, 2000, Presidential Directive to the Secretary of Defense relating to the transfer of lands of the Navy-owned western portion of Vieques. The land transfer was completed on May 1, 2001, and the Navy has had no presence in this portion of the island since that date. The potential future land use plan prepared by the PRPB is presented in Figure 6-1. Additional land transfer details are provided in Section 2.7 regarding the regulatory status of the site.

The former NASD is currently an inactive facility. The area that includes AOC H is part of the property transferred to the MOV, and no specific plans exist for future use of this site and its surrounding area. However, for AOC H, unrestricted land use was assumed; it is the most conservatively protective assumption available for risk assessments. No known human receptors are present, based on the existing land use at AOC H. Because the site is adjacent to Highway 200, it is plausible for visitors to access the site. In accordance with anticipated future land use considerations, the following potentially exposed populations were identified for the risk assessment:

- Maintenance workers
- Construction workers
- Industrial workers
- Recreational receptors (adult, youth, and child)
- Residential receptors (adult and child)

Other potentially exposed populations could exist, though their exposures would likely be lower than exposures to the populations listed above. If the listed receptors are protected, all other potentially exposed populations will also be protected.

Exposure assumptions were selected to be conservatively representative and thus estimate the possible upper-bound exposures by using the reasonable maximum exposure (RME) levels from the EPA guidance. In addition, when multiple exposure factors were available, the most conservative factor was selected to ensure conservatism in the exposure assessment. The exposure factors were selected from various sources such as the following EPA guidance:

- EPA, 1989. *Risk Assessment Guidance for Superfund (RAGS)*, Volume I*: Human Health Evaluation Manual*. Part A, Interim final. December.
- *EPA, 1991a: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final*. OSWER Directive 9285.6-03. March
- EPA, 1997b. Exposure Factors Handbook. EPA/600/P-95/002Fa.
- EPA, 2001b. *Risk Assessment Guidance for Superfund (RAGS)*, Volume I*: Human Health Evaluation Manual*. Part E, *Supplemental Guidance for Dermal Risk Assessment*, Interim draft. September 2001.
- EPA, 2001c. *Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites*, Peer Review Draft. OSWER 9355.4. March.

The following subsections provide descriptions of the individual potentially exposed populations that were evaluated in this risk assessment. Table 6-5 presents the exposure pathways and receptor summaries included in this risk assessment.

6.6.1.1 Maintenance Workers

No maintenance activities are occurring at AOC H at the present time. This exposure pathway under current conditions, therefore, is incomplete. The site is located in a conservation area that is not planned for any future development. However, if in the future the site is developed for an alternative land use, the site activities may include mowing and facilities maintenance. Based on the likely occupational duties, it was assumed that maintenance workers would have the potential for direct or indirect contact with surface soils. A direct exposure to groundwater was not assumed for a maintenance worker. The site groundwater is not currently being used (i.e., pumped), and the activities assumed for a maintenance worker would not result in exposures to site groundwater. Therefore, the groundwater exposure pathway is incomplete for a maintenance worker, and this pathway was not evaluated for the maintenance worker scenario. The exposure assumptions for this scenario include a maintenance activity occurring once a week (52 days/year), with the workers spending the entire workday on the site. The soil ingestion rate (IR) is 100 milligrams per day (mg/day), for an exposure duration (ED) of 25 years. The tables in Appendix J include the relevant details on these exposure assumptions

6.6.1.2 Construction Workers

A future construction worker scenario was evaluated for total soil (0-6 ft) exposure at AOC H. The COPCs were selected by comparing detected concentrations in soil samples from the 0-6 ft interval against industrial PRGs. Typically, construction work is assumed to last for 6 months, resulting in an EF of 250 workdays per year, and an ED of 0.5 year (6 months). The soil IR for a construction worker is 330 mg/day, which is higher than for any other worker scenario. With the exception of the particulate emission factor (PEF), all other exposure factors are similar to those of an industrial worker scenario, as shown in the risk tables in Appendix J. The exposure point concentrations (EPCs) for a construction worker were calculated by using the total soils analytical data.

Dermal contact exposures to site groundwater within 6 ft of land surface were also evaluated. The COPCs were selected by comparing detected concentrations from all groundwater sampling locations except MW-06 (where groundwater exceeds 6 ft bls) to tap water PRGs..

6.6.1.3 Industrial Workers

This scenario was evaluated assuming that the site may be used for a future industrial facility where a worker spends the entire workday at the site in direct contact with soils and using site groundwater while at work. This is a conservative assumption, considering that the site is small in area and the surrounding area is too close to Highway 200 and the ephemeral stream for additional industrial development. For risk management purposes, the site was evaluated for a future industrial land use.

Industrial workers were also assumed to be indoor workers and to have potential exposure to site groundwater as a potable water source. The industrial worker assumptions include a soil IR of 100 mg/day and a groundwater IR of 1 liter (L)/day (EPA, 2001c). The EF is 250 days/year, and the ED is 25 years. The dermal exposure route assumptions were selected for all receptors from the EPA dermal guidance, as cited above.

6.6.1.4 Recreational Receptors

Currently, it is possible that visitors traveling on Highway 200 could casually access the site, although vegetation growth is dense at the present time. Recreational receptors are assumed to have direct contact with site soils, surface water, and sediment. Recreational users are not expected to have exposure to site groundwater, so a groundwater exposure pathway is incomplete. Though the site is too small for recreational activities involving an entire outing time within the site, such a scenario was assumed as a conservatively protective pathway evaluation. Both recreational adult and child receptors were evaluated. Adult and youth receptors were assumed to have an IR of 100 mg/kg, each. A child receptor is assumed to have a soil IR of 200 mg/day. All three recreational receptors are assumed to visit the site both days of the weekend, every weekend of the year. The EF for an adult is 104 days/year with an ED of 24 years. Exposure for youth is assumed to have a EF of 104 days for a duration (ED) of 10 years. A youth is assumed to be 8 to 18 years of age; an exposure duration (ED) of 10 years is assumed. The EF value of 52 days/year assumes one visit per week (i.e., each weekend) throughout the year. The ephemeral stream adjacent to the site is small, relatively narrow, overgrown, and surrounded by steep edges. It is not similar to a pool of water such as rivers, lakes, or oceans. The frequency of exposure is assumed to be half the time a recreational visitor is present at the site.

6.6.1.5 Residential Receptors

To evaluate the most conservative future land use scenario for the site, residential land use was considered to occur where site-specific conditions permit. Future residents were assumed to have direct contact with surface and subsurface soils and to use site groundwater as their potable water source. The site is an abandoned concrete building, has an ephemeral stream adjacent to it, is small in area, and is close to the access road; these elements make it undesirable for residential use. However, this scenario was evaluated to provide the most conservatively protective risk estimation. If the risks for this scenario are within target limits, the site can be used for unrestricted (i.e., residential) land use. The

default exposure assumptions for an adult and child were used, as listed in the above guidance. A child is assumed to have an EF of 350 days/year and an ED of 6 years. For an adult, the EF is 350 days/year, and the ED is 24 years. Thus, the total ED for a residential receptor is 30 years.

6.6.2 Exposure Route Factors

The exposure route factors used for intake and risk estimates at the site, for each receptor identified, are listed in Table 4.1 through 4.9 of the RAGS Part D tables (Appendix J), as well as the site-specific risk estimation tables. All of the risk estimations are presented in RAGS Part D format in this RI report, as the EPA guidance recommends using this format to minimize the narrative text documentation in the report.

6.6.2.1 Surface and Subsurface Soil Ingestion

Table 4s of Appendix J include detailed listing of the exposure factors and equations used for soil intake assessments. Ingestion exposures to surface soil were evaluated for the appropriate receptors and media identified in the site-specific CSM. Subsurface soil (2-6 ft) exposure was also evaluated for a future residential receptor, and total soil (0-6 ft) exposure was evaluated for a future construction worker.

6.6.2.2 Groundwater Ingestion

The shallow water-bearing zone has brackish water that is not suitable for potable use at AOC H. The tidal study indicated a connectivity between the ephemeral stream and the site groundwater, particularly in the water closer to the ephemeral stream; this also suggests that the groundwater in this area is similar to the ephemeral stream water, which has high salinity. However, for conservative risk evaluation purposes, potable use is assumed.

6.6.2.3 Sediment Ingestion

Ingestion exposures to sediments were evaluated for the recreational receptors. The ingestion intake assumptions are based on common use at other federal sites, developed using best professional judgment in consultation with EPA at other federal sites (see Table 4s in Appendix J).

6.6.2.4 Surface Water Ingestion

Ingestion exposures to surface water were evaluated for the recreational receptors. The citation for the selected exposure factors is listed in footnotes to Table 4s in Appendix J, per RAGS Part D guidance.

6.6.2.5 Surface and Subsurface Soil Dermal Contact

The skin surface area available for contact was estimated using best professional judgment and was based on current practices derived from EPA guidance (EPA, 2001b). The surface areas used were selected from the latest dermal guidance (RAGS Part E, EPA, 2001b). The soil adherence factors were estimated using body-part and activity-specific data, also from RAGS Part E. In addition, the dermal exposure estimation was performed according to the equations in RAGS Part E (Table 4s, Appendix J).

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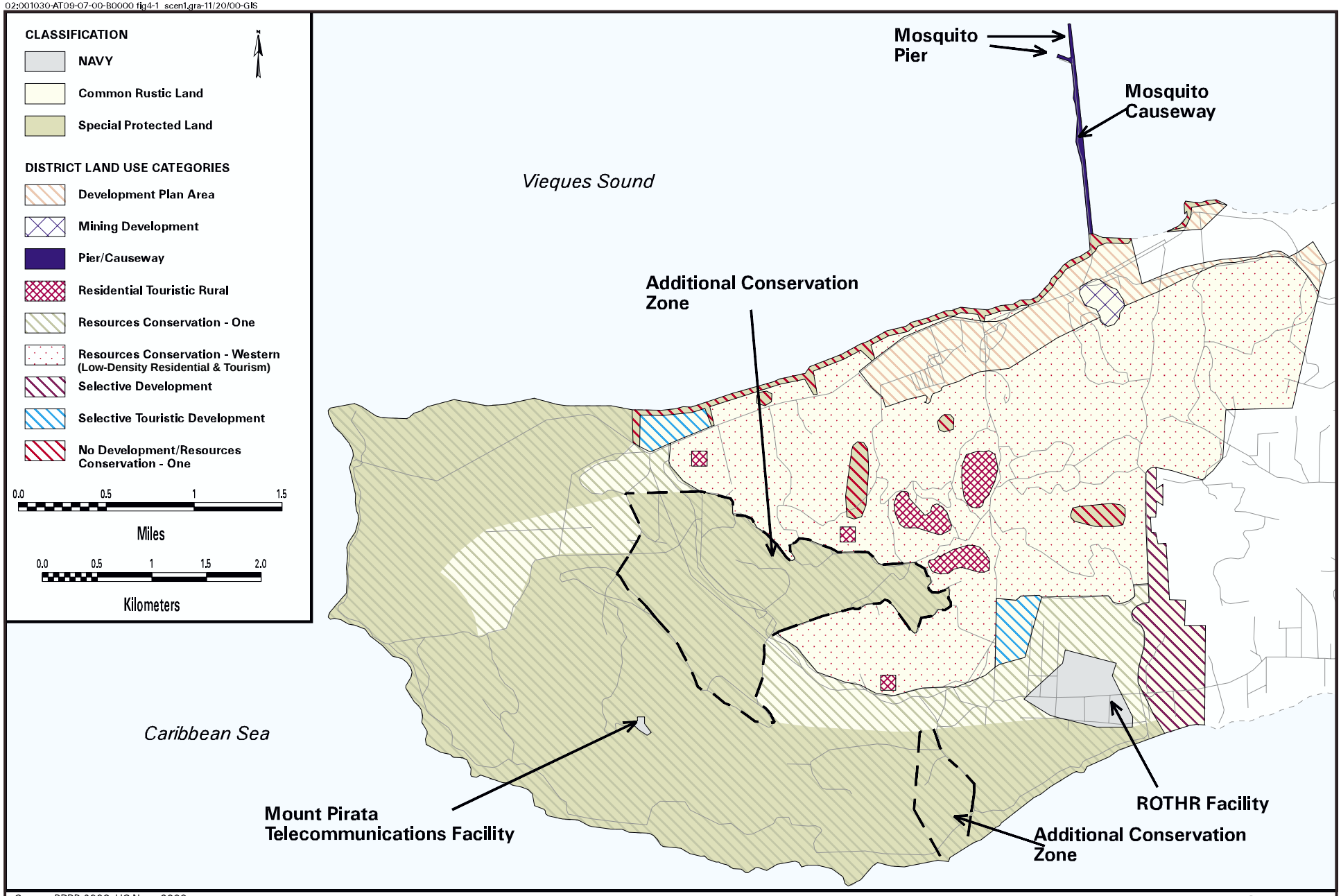

Source: PRPB 2000, US Navy 2000

Figure 6-1
Proposed Land Use and Zoning Classifications by Puerto Rico Planning Board
Former NASD, Vieques Island, Puerto Rico

CH2MHILL

E012004004GNV

TABLE 6-5
Potentially Complete Exposure Pathways and Receptors in Risk Assessment
AOC H, Former NASD, Vieques Island

Future Receptor	Media	Exposure Route and Point of Exposure	Pathway Selected for Evaluation	Reason for Selection or Exclusion
Maintenance Worker	Surface Soil	Ingestion, dermal contact, and inhalation exposure to COPCs in site surface soils	Yes	Scenario is protective of an occasional maintenance work.
Industrial Worker	Surface Soil	Ingestion, dermal contact, and inhalation exposure to COPCs in site surface soils	Yes	Area could be developed in the future for industrial use. Both site soil and groundwater exposure is assumed.
	Groundwater	Ingestion, dermal contact exposure to COPCs in groundwater	Yes	Groundwater is not suiTABLE for poTABLE/industrial use; however, for conservative risk estimation, this medium was included
Construction Worker	Total Soil	Ingestion, dermal contact and inhalation exposure to COPCs in total soils (0-6 ft)	Yes	Scenario is protective of occasional construction activities at the site.
	Groundwater	Dermal contact exposure to COPCs in groundwater	Yes	Shallow groundwater may seep into excavations where groundwater is within 6 ft of land surface
Recreational Users (adult, youth and child)	Surface Soil	Ingestion, dermal contact, and inhalation exposure to COPCs in site surface soils	Yes	Area could be developed in the future for recreational use and would be protective of an occasional trespasser.
	Surface Water	Ingestion, dermal contact, and inhalation exposure to COPCs in site surface water	Yes	Area could be developed in the future for recreational use and would be protective of any occasional trespasser.
	Sediment	Ingestion, and dermal contact, exposure to COPCs in sediments	Yes	Area could be developed in the future for recreational use and would be protective of any occasional trespasser.
Residents (adult and child)	Surface Soil	Ingestion, dermal contact, and inhalation exposure to COPCs in site surface soils	Yes	Although the site is unlikely to be considered for residential development, this is a worst-case scenario for comparison purposes.
	Subsurface Soil	Ingestion, dermal contact and inhalation exposure to COPCs in site subsurface soils	Yes	Scenario is evaluated as a complete exposure pathway, if the site is disturbed for construction at a future time exposing subsurface soil.
	Groundwater	Ingestion and dermal contact exposure to COPCs in site surface soils	Yes	Although the site is unlikely to be considered for residential development, and groundwater is not suiTABLE for poTABLE use, this is a worst-case scenario for comparison purposes.

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Recreational
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			BENZO(a)ANTHRACENE	1.1E-08	NA	1.7E-08	2.8E-08	NA	NA	NA	NA	0.0E+00
			N-NITROSODI-n-PROPYLAMINE	7.0E-07	NA	8.0E-07	1.5E-06	NA	NA	NA	NA	0.0E+00
			p,p'-DDE	8.3E-08	NA	2.8E-08	1.1E-07	NA	NA	NA	NA	0.0E+00
			p,p'-DDT	2.6E-08	3.8E-12	8.9E-09	3.5E-08	Liver	4.5E-04	NA	1.5E-04	6.0E-04
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	3.4E-03	3.5E-04	3.8E-04	4.1E-03
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	1.2E-03	NA	8.8E-04	2.0E-03
			ARSENIC	4.0E-06	5.9E-09	1.4E-06	5.3E-06	Skin, Vascular	2.6E-02	NA	8.8E-03	3.5E-02
			CHROMIUM, TOTAL	NA	1.7E-08	NA	1.7E-08	NOAEL	2.7E-03	4.0E-05	1.2E-02	1.5E-02
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.9E-02	NA	3.3E-03	3.2E-02
			MANGANESE	NA	NA	NA	0.0E+00	CNS	1.4E-03	2.0E-03	4.0E-03	7.4E-03
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	3.1E-03	NA	3.6E-04	3.5E-03
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	1.9E-02	NA	8.5E-02	1.0E-01
Chemical Total				4.8E-06	2.3E-08	2.2E-06	7.0E-06		8.6E-02	2.4E-03	1.2E-01	2.0E-01
Medium Total							7.0E-06					2.0E-01
Sediment	Sediment	Water-filled Ditch										
			ARSENIC	4.6E-08	NA	5.2E-08	9.8E-08	Skin, Vascular	3.0E-04	NA	3.3E-04	6.3E-04
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.9E-03	NA	1.1E-03	4.0E-03
Chemical Total				4.6E-08	0.0E+00	5.2E-08	9.8E-08		3.2E-03	0.0E+00	1.4E-03	4.6E-03
Medium Total							9.8E-08					4.6E-03
Surface Water	Surface Water	Water-filled Ditch										
			ARSENIC	3.2E-06	NA	6.6E-07	3.9E-06	Skin, Vascular	2.1E-02	NA	4.3E-03	2.5E-02
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	1.0E-03	NA	8.4E-03	9.4E-03
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	7.1E-04	NA	1.2E-02	1.3E-02
			MANGANESE	NA	NA	NA	0.0E+00	CNS	6.2E-04	NA	3.2E-03	3.8E-03
			SELENIUM	NA	NA	NA	0.0E+00	Whole Body	1.7E-03	NA	3.5E-04	2.0E-03
Chemical Total				3.2E-06	0.0E+00	6.6E-07	3.9E-06		2.5E-02	NA	2.8E-02	5.3E-02
Medium Total							3.9E-06					5.3E-02
Receptor Total							1.1E-05				Receptor HI Total	2.6E-01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	1.5E-02
Total Skin HI Across All Media =	6.0E-02
Total Vascular HI Across All Media =	6.0E-02
Total Kidney HI Across All Media =	1.1E-01
Total NOAEL HI Across All Media =	2.8E-02
Total Gastrointestinal HI Across All Media =	1.9E-02
Total Blood HI Across All Media =	4.2E-02
Total Liver HI Across All Media =	4.0E-02
Total Hair HI Across All Media =	3.5E-03
Total Whole Body HI Across All Media =	2.0E-03

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Recreational
Receptor Age: Youth

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			BENZO(a)ANTHRACENE	6.5E-09	NA	1.1E-08	1.8E-08	NA	NA	NA	NA	0.0E+00
			N-NITROSODI-n-PROPYLAMINE	4.0E-07	NA	5.3E-07	9.3E-07	NA	NA	NA	NA	0.0E+00
			p,p'-DDE	4.7E-08	NA	1.9E-08	6.6E-08	NA	NA	NA	NA	0.0E+00
			p,p'-DDT	1.5E-08	2.2E-12	5.9E-09	2.1E-08	Liver	6.2E-04	NA	2.4E-04	8.6E-04
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	4.6E-03	4.8E-04	6.1E-04	5.7E-03
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	1.6E-03	NA	1.4E-03	3.0E-03
			ARSENIC	2.3E-06	3.4E-09	9.0E-07	3.2E-06	Skin, Vascular	3.5E-02	NA	1.4E-02	4.9E-02
			CHROMIUM, TOTAL	NA	9.9E-09	NA	9.9E-09	NOAEL	3.7E-03	5.5E-05	2.0E-02	2.4E-02
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	4.0E-02	NA	5.2E-03	4.5E-02
			MANGANESE	NA	NA	NA	0.0E+00	CNS	1.9E-03	2.8E-03	6.4E-03	1.1E-02
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	4.3E-03	NA	5.7E-04	4.9E-03
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	2.7E-02	NA	1.4E-01	1.6E-01
Chemical Total				2.7E-06	1.3E-08	1.5E-06	4.2E-06		1.2E-01	3.3E-03	1.8E-01	3.1E-01
Medium Total							4.2E-06					3.1E-01
Sediment	Sediment	Water-filled Ditch										
			ARSENIC	2.6E-08	NA	2.9E-08	5.6E-08	Skin, Vascular	4.1E-04	NA	4.6E-04	8.7E-04
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	4.0E-03	NA	1.5E-03	5.5E-03
Chemical Total				2.6E-08	0.0E+00	2.9E-08	5.6E-08		4.4E-03	0.0E+00	2.0E-03	6.4E-03
Medium Total							5.6E-08					6.4E-03
Surface Water	Surface Water	Water-filled Ditch										
			ARSENIC	1.8E-06	NA	2.9E-07	2.1E-06	Skin, Vascular	2.9E-02	NA	4.6E-03	3.3E-02
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	1.4E-03	NA	8.9E-03	1.0E-02
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	9.8E-04	NA	1.3E-02	1.4E-02
			MANGANESE	NA	NA	NA	0.0E+00	CNS	8.5E-04	NA	3.4E-03	4.2E-03
			SELENIUM	NA	NA	NA	0.0E+00	Whole Body	7.9E-03	NA	6.3E-04	8.5E-03
Chemical Total				1.8E-06	0.0E+00	2.9E-07	2.1E-06		4.0E-02	NA	3.0E-02	7.0E-02
Medium Total							2.1E-06					7.0E-02
Receptor Total							8.5E-06				Receptor HI Total	3.8E-01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	2.1E-02
Total Skin HI Across All Media =	8.3E-02
Total Vascular HI Across All Media =	8.3E-02
Total Kidney HI Across All Media =	1.7E-01
Total NOAEL HI Across All Media =	3.7E-02
Total Gastrointestinal HI Across All Media =	2.9E-02
Total Blood HI Across All Media =	5.8E-02
Total Liver HI Across All Media =	5.6E-02
Total Hair HI Across All Media =	4.9E-03
Total Whole Body HI Across All Media =	8.5E-03

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Recreational
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			BENZO(a)ANTHRACENE	2.7E-08	NA	9.7E-09	3.6E-08	NA	NA	NA	NA	0.0E+00
			N-NITROSODI-n-PROPYLAMINE	1.6E-06	NA	4.6E-07	2.1E-06	NA	NA	NA	NA	0.0E+00
			p,p'-DDE	1.9E-07	NA	1.6E-08	2.1E-07	NA	NA	NA	NA	0.0E+00
			p,p'-DDT	6.1E-08	3.4E-12	5.1E-09	6.6E-08	Liver	4.2E-03	NA	3.5E-04	4.5E-03
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	3.1E-02	1.2E-03	8.8E-04	3.3E-02
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	1.1E-02	NA	2.0E-03	1.3E-02
			ARSENIC	9.3E-06	5.1E-09	7.8E-07	1.0E-05	Skin, Vascular	2.4E-01	NA	2.0E-02	2.6E-01
			CHROMIUM, TOTAL	NA	1.5E-08	NA	1.5E-08	NOAEL	2.5E-02	1.4E-04	2.9E-02	5.4E-02
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.7E-01	NA	7.6E-03	2.8E-01
			MANGANESE	NA	NA	NA	0.0E+00	CNS	1.3E-02	7.1E-03	9.2E-03	2.9E-02
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	2.9E-02	NA	8.2E-04	3.0E-02
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	1.8E-01	NA	2.0E-01	3.8E-01
Chemical Total				1.1E-05	2.0E-08	1.3E-06	1.2E-05		8.1E-01	8.4E-03	2.6E-01	1.1E+00
Medium Total							1.2E-05					1.1E+00
Sediment	Sediment	Water-filled Ditch										
			ARSENIC	1.1E-07	NA	2.3E-08	1.3E-07	Skin, Vascular	2.8E-03	NA	6.0E-04	3.4E-03
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.7E-02	NA	2.0E-03	2.9E-02
Chemical Total				1.1E-07	0.0E+00	2.3E-08	1.3E-07		3.0E-02	0.0E+00	2.6E-03	3.3E-02
Medium Total							1.3E-07					3.3E-02
Surface Water	Surface Water	Water-filled Ditch										
			ARSENIC	3.7E-06	NA	3.0E-07	4.0E-06	Skin, Vascular	9.7E-02	NA	7.8E-03	1.0E-01
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	4.8E-03	NA	1.5E-02	2.0E-02
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	3.3E-03	NA	2.1E-02	2.5E-02
			MANGANESE	NA	NA	NA	0.0E+00	CNS	2.9E-03	NA	5.8E-03	8.7E-03
			SELENIUM	NA	NA	NA	0.0E+00	Whole Body	7.9E-03	NA	6.3E-04	8.5E-03
Chemical Total				3.7E-06	0.0E+00	3.0E-07	4.0E-06		1.2E-01	NA	5.1E-02	1.7E-01
Medium Total							4.0E-06					1.7E-01
Receptor Total							1.7E-05				Receptor HI Total	1.3E+00

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	7.2E-02
Total Skin HI Across All Media =	3.7E-01
Total Vascular HI Across All Media =	3.7E-01
Total Kidney HI Across All Media =	4.0E-01
Total NOAEL HI Across All Media =	7.9E-02
Total Gastrointestinal HI Across All Media =	8.3E-02
Total Blood HI Across All Media =	3.5E-01
Total Liver HI Across All Media =	3.4E-01
Total Hair HI Across All Media =	3.0E-02
Total Whole Body HI Across All Media =	8.5E-03

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			BENZO(a)ANTHRACENE	3.8E-08	NA	2.0E-08	5.8E-08	NA	NA	NA	NA	0.0E+00
			N-NITROSODI-n-PROPYLAMINE	2.4E-06	NA	9.4E-07	3.3E-06	NA	NA	NA	NA	0.0E+00
			p,p'-DDE	2.8E-07	NA	3.3E-08	3.1E-07	NA	NA	NA	NA	0.0E+00
			p,p'-DDT	8.8E-08	1.3E-11	1.1E-08	9.9E-08	Liver	1.5E-03	NA	1.8E-04	1.7E-03
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	1.1E-02	1.2E-03	4.5E-04	1.3E-02
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	3.9E-03	NA	1.0E-03	4.9E-03
			ARSENIC	1.3E-05	2.0E-08	1.6E-06	1.5E-05	Skin, Vascular	8.7E-02	NA	1.0E-02	9.7E-02
			CHROMIUM, TOTAL	NA	5.8E-08	NA	5.8E-08	NOAEL	9.2E-03	1.3E-04	1.5E-02	2.4E-02
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	9.7E-02	NA	3.9E-03	1.0E-01
			MANGANESE	NA	NA	NA	0.0E+00	CNS	4.7E-03	6.8E-03	4.7E-03	1.6E-02
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	1.1E-02	NA	4.2E-04	1.1E-02
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.5E-02	NA	1.0E-01	1.7E-01
Chemical Total				1.6E-05	7.8E-08	2.6E-06	1.9E-05		2.9E-01	8.1E-03	1.4E-01	4.3E-01
Subsurface Soil	Subsurface Soil	AOC H Subsurface Soil										
			ARSENIC	4.6E-06	NA	5.5E-07	5.2E-06	Skin, Vascular	3.0E-02	NA	3.6E-03	3.4E-02
Chemical Total				4.6E-06	0.0E+00	5.5E-07	5.2E-06		3.0E-02	0.0E+00	3.6E-03	3.4E-02
Medium Total							2.4E-05					4.7E-01
Groundwater	Groundwater	Tap Water										
			p,p'-DDD	9.5E-07	NA	3.9E-12	9.5E-07	NA	NA	NA	NA	0.0E+00
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	2.5E-01	NA	1.3E-09	2.5E-01
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	3.7E-01	NA	1.3E-08	3.7E-01
			ARSENIC	8.9E-05	NA	2.7E-13	8.9E-05	Skin, Vascular	5.8E-01	NA	3.0E-09	5.8E-01
			BARIUM	NA	NA	NA	0.0E+00	NOAEL	1.4E-01	NA	1.0E-08	1.4E-01
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	1.6E-01	NA	3.4E-08	1.6E-01
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	1.4E-01	NA	5.3E-08	1.4E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	9.6E+00	NA	1.3E-06	9.6E+00
			MANGANESE	NA	NA	NA	0.0E+00	CNS	2.9E+00	NA	3.8E-07	2.9E+00
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	1.5E+01	NA	7.9E-08	1.5E+01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	1.9E+00	NA	3.9E-07	1.9E+00
Chemical Total				9.0E-05	0.0E+00	4.1E-12	9.0E-05		3.1E+01	NA	2.2E-06	3.1E+01
Medium Total							9.0E-05					3.1E+01
Receptor Total							1.3E-04				Receptor HI Total	3.2E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	3.2E+00
Total Skin HI Across All Media =	7.1E-01
Total Vascular HI Across All Media =	7.1E-01
Total Kidney HI Across All Media =	2.2E+00
Total NOAEL HI Across All Media =	3.0E-01
Total Gastrointestinal HI Across All Media =	9.7E+00
Total Blood HI Across All Media =	2.5E+01
Total Liver HI Across All Media =	2.5E+01
Total Hair HI Across All Media =	1.5E+01

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			BENZO(a)ANTHRACENE	9.0E-08	NA	3.3E-08	1.2E-07	NA	NA	NA	NA	0.0E+00
			N-NITROSODI-n-PROPYLAMINE	5.5E-06	NA	1.5E-06	7.0E-06	NA	NA	NA	NA	0.0E+00
			p,p'-DDE	6.5E-07	NA	5.5E-08	7.1E-07	NA	NA	NA	NA	0.0E+00
			p,p'-DDT	2.1E-07	1.3E-10	1.7E-08	2.2E-07	Liver	1.4E-02	NA	1.2E-03	1.5E-02
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	1.1E-01	4.1E-03	3.0E-03	1.1E-01
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	3.6E-02	NA	6.8E-03	4.3E-02
			ARSENIC	3.1E-05	2.0E-07	2.6E-06	3.4E-05	Skin, Vascular	8.1E-01	NA	6.8E-02	8.8E-01
			CHROMIUM, TOTAL	NA	6.0E-07	NA	6.0E-07	NOAEL	8.6E-02	4.7E-04	9.6E-02	1.8E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	9.1E-01	NA	2.5E-02	9.3E-01
			MANGANESE	NA	NA	NA	0.0E+00	CNS	4.4E-02	2.4E-02	3.1E-02	9.9E-02
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	9.9E-02	NA	2.8E-03	1.0E-01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.1E-01	NA	6.6E-01	1.3E+00
Chemical Total				3.8E-05	8.0E-07	4.3E-06	4.3E-05		2.7E+00	2.8E-02	8.9E-01	3.6E+00
Subsurface Soil	Subsurface Soil	AOC H Subsurface Soil										
			ARSENIC	1.1E-05	NA	9.1E-07	1.2E-05	Skin, Vascular	2.8E-01	NA	2.3E-02	3.0E-01
Chemical Total				1.1E-05	0.0E+00	9.1E-07	1.2E-05		2.8E-01	0.0E+00	2.3E-02	3.0E-01
Medium Total							5.4E-05					3.9E+00
Groundwater	Groundwater	Tap Water										
			p,p'-DDD	5.5E-07	NA	3.7E-12	5.5E-07	NA	NA	NA	NA	0.0E+00
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	5.8E-01	NA	3.8E-09	5.8E-01
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	8.6E-01	NA	3.8E-08	8.6E-01
			ARSENIC	5.2E-05	NA	3.4E-13	5.2E-05	Skin, Vascular	1.3E+00	NA	8.9E-09	1.3E+00
			BARIUM	NA	NA	NA	0.0E+00	NOAEL	3.2E-01	NA	3.0E-08	3.2E-01
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	3.8E-01	NA	1.0E-07	3.8E-01
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	3.2E-01	NA	1.7E-07	3.2E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.2E+01	NA	3.7E-06	2.2E+01
			MANGANESE	NA	NA	NA	0.0E+00	CNS	6.8E+00	NA	1.1E-06	6.8E+00
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	3.5E+01	NA	2.3E-07	3.5E+01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	4.5E+00	NA	1.1E-06	4.5E+00
Chemical Total				5.2E-05	0.0E+00	4.1E-12	5.2E-05		7.3E+01	NA	6.5E-06	7.3E+01
Medium Total							5.2E-05					7.3E+01
Receptor Total							1.5E-04				Receptor HI Total	8.0E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	7.6E+00
Total Skin HI Across All Media =	2.5E+00
Total Vascular HI Across All Media =	2.5E+00
Total Kidney HI Across All Media =	6.1E+00
Total NOAEL HI Across All Media =	8.2E-01
Total Gastrointestinal HI Across All Media =	2.3E+01
Total Blood HI Across All Media =	6.0E+01
Total Liver HI Across All Media =	5.9E+01
Total Hair HI Across All Media =	3.5E+01

TABLE 9.5.RME SUPPLEMENT
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Child + Adult

Medium	ELCR	Receptor Age	HI
Soil Total	5E-05	Child	4
	2E-05	Adult	0.5
Groundwater Total	5E-05	Child	73
	9E-05	Adult	31
Resident Total	**2E-04**		**108**

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	11
Total Skin HI Across All Media =	3
Total Vascular HI Across All Media =	3
Total Kidney HI Across All Media =	8
Total NOAEL HI Across All Media =	1
Total Gastrointestinal HI Across All Media =	33
Total Blood HI Across All Media =	85
Total Liver HI Across All Media =	84
Total Hair HI Across All Media =	50

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			BENZO(a)ANTHRACENE	2.9E-08	NA	2.5E-08	5.3E-08	NA	NA	NA	NA	0.0E+00
			N-NITROSODI-n-PROPYLAMINE	1.8E-06	NA	1.2E-06	2.9E-06	NA	NA	NA	NA	0.0E+00
			p,p'-DDE	2.1E-07	NA	4.1E-08	2.5E-07	NA	NA	NA	NA	0.0E+00
			p,p'-DDT	6.5E-08	9.6E-12	1.3E-08	7.8E-08	Liver	1.1E-03	NA	2.1E-04	1.3E-03
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	8.1E-03	8.3E-04	5.3E-04	9.4E-03
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	2.8E-03	NA	1.2E-03	4.0E-03
			ARSENIC	9.9E-06	1.5E-08	2.0E-06	1.2E-05	Skin, Vascular	6.2E-02	NA	1.2E-02	7.4E-02
			CHROMIUM, TOTAL	NA	4.3E-08	NA	4.3E-08	NOAEL	6.6E-03	9.6E-05	1.7E-02	2.4E-02
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	7.0E-02	NA	4.6E-03	7.4E-02
			MANGANESE	NA	NA	NA	0.0E+00	CNS	3.4E-03	4.9E-03	5.6E-03	1.4E-02
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	7.6E-03	NA	5.0E-04	8.1E-03
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	4.7E-02	NA	1.2E-01	1.7E-01
Chemical Total				1.2E-05	5.8E-08	3.2E-06	1.5E-05		2.1E-01	5.8E-03	1.6E-01	3.7E-01
Medium Total							1.5E-05					3.7E-01
Groundwater	Groundwater	Tap Water										
			p,p'-DDD	3.5E-07	NA	3.7E-12	3.5E-07	NA	NA	NA	NA	0.0E+00
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	8.9E-02	NA	7.3E-11	8.9E-02
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	1.3E-01	NA	7.3E-10	1.3E-01
			ARSENIC	3.3E-05	NA	3.4E-13	3.3E-05	Skin, Vascular	2.1E-01	NA	1.7E-10	2.1E-01
			BARIUM	NA	NA	NA	0.0E+00	NOAEL	4.9E-02	NA	5.7E-10	4.9E-02
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	5.9E-02	NA	1.9E-09	5.9E-02
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	4.9E-02	NA	3.2E-09	4.9E-02
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	3.4E+00	NA	7.1E-08	3.4E+00
			MANGANESE	NA	NA	NA	0.0E+00	CNS	1.0E+00	NA	2.1E-08	1.0E+00
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	5.4E+00	NA	4.5E-09	5.4E+00
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.8E-01	NA	2.2E-08	6.8E-01
Chemical Total				3.3E-05	0.0E+00	4.1E-12	3.3E-05		1.1E+01	NA	1.3E-07	1.1E+01
Medium Total							3.3E-05					1.1E+01
Receptor Total							4.9E-05				Receptor HI Total	1.2E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	1.1E+00
Total Skin HI Across All Media =	2.8E-01
Total Vascular HI Across All Media =	2.8E-01
Total Kidney HI Across All Media =	9.1E-01
Total NOAEL HI Across All Media =	1.2E-01
Total Gastrointestinal HI Across All Media =	3.5E+00
Total Blood HI Across All Media =	9.1E+00
Total Liver HI Across All Media =	8.9E+00
Total Hair HI Across All Media =	5.4E+00

TABLE 9.7.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Maintenance Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			BENZO(a)ANTHRACENE	5.9E-09	NA	5.1E-09	1.1E-08	NA	NA	NA	NA	0.0E+00
			N-NITROSODI-n-PROPYLAMINE	3.6E-07	NA	2.4E-07	6.1E-07	NA	NA	NA	NA	0.0E+00
			p,p'-DDE	4.3E-08	NA	8.5E-09	5.2E-08	NA	NA	NA	NA	0.0E+00
			p,p'-DDT	1.4E-08	2.0E-12	2.7E-09	1.6E-08	Liver	2.2E-04	NA	4.4E-05	2.7E-04
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	1.7E-03	1.7E-04	1.1E-04	2.0E-03
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	5.8E-04	NA	2.5E-04	8.3E-04
			ARSENIC	2.1E-06	3.1E-09	4.1E-07	2.5E-06	Skin, Vascular	1.3E-02	NA	2.5E-03	1.5E-02
			CHROMIUM, TOTAL	NA	9.0E-09	NA	9.0E-09	NOAEL	1.4E-03	2.0E-05	3.6E-03	5.0E-03
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	1.4E-02	NA	9.5E-04	1.5E-02
			MANGANESE	NA	NA	NA	0.0E+00	CNS	7.0E-04	1.0E-03	1.2E-03	2.9E-03
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	1.6E-03	NA	1.0E-04	1.7E-03
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	9.7E-03	NA	2.5E-02	3.4E-02
Chemical Total				2.5E-06	1.2E-08	6.7E-07	3.2E-06		4.3E-02	1.2E-03	3.3E-02	7.8E-02
Medium Total							3.2E-06					7.8E-02
Receptor Total							3.2E-06				Receptor HI Total	7.8E-02

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	4.8E-03
Total Vascular HI Across All Media =	1.5E-02
Total Kidney HI Across All Media =	3.4E-02
Total NOAEL HI Across All Media =	5.0E-03
Total Gastrointestinal HI Across All Media =	5.0E-03
Total Blood HI Across All Media =	1.8E-02
Total Liver HI Across All Media =	1.7E-02
Total Hair HI Across All Media =	1.7E-03

TABLE 9.8.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Total Soil	Total Soil	AOC H Total Soil	ARSENIC	1E-07	NA	1E-08	1E-07	Skin, Vascular	4E-02	NA	4E-03	5E-02
			N-NITROSODI-n-PROPYLAMINE	1E-07	NA	3E-08	2E-07	NA	NA	NA	NA	NA
		Exposure Point Total		3E-07	NA	5E-08	3E-07		4E-02	NA	4E-03	5E-02
	Exposure Medium Total			3E-07	NA	5E-08	3E-07		4E-02	NA	4E-03	5E-02
	Total Soil	AOC H Total Soil	ARSENIC	NA	6E-09	NA	6E-09	NA	NA	NA	NA	NA
			N-NITROSODI-n-PROPYLAMINE	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Exposure Point Total		NA	6E-09	NA	6E-09		NA	0E+00	NA	0E+00
	Exposure Medium Total			NA	6E-09	NA	6E-09		NA	0E+00	NA	0E+00
Medium Total				3E-07	6E-09	5E-08	3E-07		4E-02	0E+00	4E-03	5E-02
Groundwater	Groundwater	Groundwater (In Excavations)	p,p'-DDD	NA	NA	7E-08	7E-08	NA	NA	NA	NA	NA
			ALUMINUM	NA	NA	NA	NA	CNS	NA	NA	1E-03	1E-03
			ANTIMONY	NA	NA	NA	NA	Blood	NA	NA	2E-02	2E-02
			ARSENIC	NA	NA	2E-08	2E-08	Skin, Vascular	NA	NA	5E-03	5E-03
			BARIUM	NA	NA	NA	NA	NOAEL	NA	NA	2E-02	2E-02
			CADMIUM	NA	NA	NA	NA	Kidney	NA	NA	9E-02	9E-02
			CHROMIUM, TOTAL	NA	NA	NA	NA	NOAEL	NA	NA	7E-02	7E-02
			IRON	NA	NA	NA	NA	Blood, Gastrointestinal, Liver	NA	NA	7E-03	7E-03
			MANGANESE	NA	NA	NA	NA	CNS	NA	NA	5E+00	5E+00
			THALLIUM	NA	NA	NA	NA	Liver, Blood, Hair	NA	NA	8E-02	8E-02
			VANADIUM	NA	NA	NA	NA	Kidney	NA	NA	4E-01	4E-01
		Exposure Point Total		NA	NA	8E-08	8E-08		NA	NA	5E+00	5E+00
	Exposure Medium Total			NA	NA	8E-08	8E-08		NA	NA	5E+00	5E+00
Medium Total				NA	NA	8E-08	8E-08		NA	NA	5E+00	5E+00
Receptor Total				3E-07	6E-09	1E-07	4E-07		4E-02	0E+00	5E+00	6E+00

Toxicity values for aluminum were available at the time the original HHRA was prepared, but have since been withdrawn.

Total Blood HI Across Media =	1E-01
Total CNS HI Across Media =	**5E+00**
Total Gastrointestinal HI Across Media =	7E-03
Total Vascular HI Across Media =	5E-02
Total Kidney HI Across Media =	5E-01
Total Liver HI Across Media =	9E-02
Total Hair HI Across Media =	8E-02
Total Skin HI Across Media =	5E-02

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	AOC H Surface Soil	Ingestion													
				BENZO(a)ANTHRACENE	1.1E-01	MG/KG	1.2E-07	mg/kg/day	7.3E-01	1/(mg/kg-day)	9.0E-08	1.4E-06	mg/kg/day	NA	NA	NA
				N-NITROSODI-n-PROPYLAMINE	7.2E-01	MG/KG	7.9E-07	mg/kg/day	7.0E+00	1/(mg/kg-day)	5.5E-06	9.2E-06	mg/kg/day	NA	NA	NA
				p,p'-DDE	1.7E+00	MG/KG	1.9E-06	mg/kg/day	3.4E-01	1/(mg/kg-day)	6.5E-07	2.2E-05	mg/kg/day	NA	NA	NA
				p,p'-DDT	5.5E-01	MG/KG	6.0E-07	mg/kg/day	3.4E-01	1/(mg/kg-day)	2.1E-07	7.0E-06	mg/kg/day	5.0E-04	mg/kg/day	1.4E-02
				ALUMINUM	8.3E+03	MG/KG	9.1E-03	mg/kg/day	NA	NA	NA	1.1E-01	mg/kg/day	1.0E+00	mg/kg/day	1.1E-01
				ANTIMONY	1.1E+00	MG/KG	1.2E-06	mg/kg/day	NA	NA	NA	1.4E-05	mg/kg/day	4.0E-04	mg/kg/day	3.6E-02
				ARSENIC	1.9E+01	MG/KG	2.1E-05	mg/kg/day	1.5E+00	1/(mg/kg-day)	3.1E-05	2.4E-04	mg/kg/day	3.0E-04	mg/kg/day	8.1E-01
				CHROMIUM, TOTAL	2.0E+01	MG/KG	2.2E-05	mg/kg/day	NA	NA	NA	2.6E-04	mg/kg/day	3.0E-03	mg/kg/day	8.6E-02
				IRON	2.1E+04	MG/KG	2.3E-02	mg/kg/day	NA	NA	NA	2.7E-01	mg/kg/day	3.0E-01	mg/kg/day	9.1E-01
				MANGANESE	4.8E+02	MG/KG	5.3E-04	mg/kg/day	NA	NA	NA	6.2E-03	mg/kg/day	1.4E-01	mg/kg/day	4.4E-02
				THALLIUM	6.2E-01	MG/KG	6.8E-07	mg/kg/day	NA	NA	NA	7.9E-06	mg/kg/day	8.0E-05	mg/kg/day	9.9E-02
				VANADIUM	4.8E+01	MG/KG	5.2E-05	mg/kg/day	NA	NA	NA	6.1E-04	mg/kg/day	1.0E-03	mg/kg/day	6.1E-01
			Exp. Route Total								3.8E-05					2.7E+00
			Dermal													
				BENZO(a)ANTHRACENE	1.1E-01	MG/KG	4.5E-08	mg/kg/day	7.3E-01	1/(mg/kg-day)	3.3E-08	5.2E-07	mg/kg/day	NA	NA	NA
				N-NITROSODI-n-PROPYLAMINE	7.2E-01	MG/KG	2.2E-07	mg/kg/day	7.0E+00	1/(mg/kg-day)	1.5E-06	2.6E-06	mg/kg/day	NA	NA	NA
				p,p'-DDE	1.7E+00	MG/KG	1.6E-07	mg/kg/day	3.4E-01	1/(mg/kg-day)	5.5E-08	1.9E-06	mg/kg/day	NA	NA	NA
				p,p'-DDT	5.5E-01	MG/KG	5.1E-08	mg/kg/day	3.4E-01	1/(mg/kg-day)	1.7E-08	5.9E-07	mg/kg/day	5.0E-04	mg/kg/day	1.2E-03
				ALUMINUM	8.3E+03	MG/KG	2.5E-04	mg/kg/day	NA	NA	NA	3.0E-03	mg/kg/day	1.0E+00	mg/kg/day	3.0E-03
				ANTIMONY	1.1E+00	MG/KG	3.5E-08	mg/kg/day	NA	NA	NA	4.1E-07	mg/kg/day	6.0E-05	mg/kg/day	6.8E-03
				ARSENIC	1.9E+01	MG/KG	1.7E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	2.6E-06	2.0E-05	mg/kg/day	3.0E-04	mg/kg/day	6.8E-02
				CHROMIUM, TOTAL	2.0E+01	MG/KG	6.2E-07	mg/kg/day	NA	NA	NA	7.2E-06	mg/kg/day	7.5E-05	mg/kg/day	9.6E-02
				IRON	2.1E+04	MG/KG	6.5E-04	mg/kg/day	NA	NA	NA	7.6E-03	mg/kg/day	3.0E-01	mg/kg/day	2.5E-02
				MANGANESE	4.8E+02	MG/KG	1.5E-05	mg/kg/day	NA	NA	NA	1.7E-04	mg/kg/day	5.6E-03	mg/kg/day	3.1E-02
				THALLIUM	6.2E-01	MG/KG	1.9E-08	mg/kg/day	NA	NA	NA	2.2E-07	mg/kg/day	8.0E-05	mg/kg/day	2.8E-03
				VANADIUM	4.8E+01	MG/KG	1.5E-06	mg/kg/day	NA	NA	NA	1.7E-05	mg/kg/day	2.6E-05	mg/kg/day	6.6E-01
			Exp. Route Total								4.3E-06					8.9E-01
			Inhalation													
				BENZO(a)ANTHRACENE	1.1E-01	MG/KG	7.9E-11	mg/kg/day	7.3E-01	1/(mg/kg-day)	5.8E-11	7.9E-11	mg/kg/day	NA	NA	NA
				N-NITROSODI-n-PROPYLAMINE	7.2E-01	MG/KG	5.1E-10	mg/kg/day	NA	NA	NA	5.1E-10	mg/kg/day	NA	NA	NA
				p,p'-DDE	1.7E+00	MG/KG	1.2E-09	mg/kg/day	NA	NA	NA	1.2E-09	mg/kg/day	NA	NA	NA
				p,p'-DDT	5.5E-01	MG/KG	3.9E-10	mg/kg/day	3.4E-01	1/(mg/kg-day)	1.3E-10	3.9E-10	mg/kg/day	NA	NA	NA
				ALUMINUM	8.3E+03	MG/KG	5.8E-06	mg/kg/day	NA	NA	NA	5.8E-06	mg/kg/day	1.4E-03	mg/kg/day	4.1E-03
				ANTIMONY	1.1E+00	MG/KG	8.0E-10	mg/kg/day	NA	NA	NA	8.0E-10	mg/kg/day	NA	NA	NA
				ARSENIC	1.9E+01	MG/KG	1.3E-08	mg/kg/day	1.5E+01	1/(mg/kg-day)	2.0E-07	1.3E-08	mg/kg/day	NA	NA	NA
				CHROMIUM, TOTAL	2.0E+01	MG/KG	1.4E-08	mg/kg/day	4.2E+01	1/(mg/kg-day)	6.0E-07	1.4E-08	mg/kg/day	3.0E-05	mg/kg/day	4.7E-04
				IRON	2.1E+04	MG/KG	1.5E-05	mg/kg/day	NA	NA	NA	1.5E-05	mg/kg/day	NA	NA	NA
				MANGANESE	4.8E+02	MG/KG	3.4E-07	mg/kg/day	NA	NA	NA	3.4E-07	mg/kg/day	1.4E-05	mg/kg/day	2.4E-02
				THALLIUM	6.2E-01	MG/KG	4.4E-10	mg/kg/day	NA	NA	NA	4.4E-10	mg/kg/day	NA	NA	NA
				VANADIUM	4.8E+01	MG/KG	3.4E-08	mg/kg/day	NA	NA	NA	3.4E-08	mg/kg/day	NA	NA	NA
			Exp. Route Total								8.0E-07					2.8E-02
		Exposure Point Total									4.3E-05					3.6E+00
	Exposure Medium Total										4.3E-05					3.6E+00

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Subsurface Soil	Subsurface Soil	AOC H Subsurface Soil	Ingestion	ARSENIC	6.6E+00	MG/KG	7.2E-06	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.1E-05	8.4E-05	mg/kg/day	3.0E-04	mg/kg/day	2.8E-01
			Exp. Route Total								1.1E-05					2.8E-01
			Dermal	ARSENIC	6.6E+00	MG/KG	6.0E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	9.1E-07	7.0E-06	mg/kg/day	3.0E-04	mg/kg/day	2.3E-02
			Exp. Route Total								9.1E-07					2.3E-02
			Inhalation	ARSENIC	6.6E+00	MG/KG	4.6E-09	mg/kg/day	0.0E+00	1/(mg/kg-day)	0.0E+00	4.6E-09	mg/kg/day	NA	NA	NA
			Exp. Route Total								0.0E+00					0.0E+00
		Exposure Point Total									1.2E-05					3.0E-01
	Exposure Medium Total										1.2E-05					3.0E-01
Surface Soil Total											5.4E-05					3.9E+00
Groundwater	Groundwater	Tap Water	Ingestion													
				p,p'-DDD	4.2E-01	UG/L	2.3E-06	mg/kg/day	2.4E-01	1/(mg/kg-day)	5.5E-07	2.7E-05	mg/kg/day	NA	NA	NA
				ALUMINUM	9.1E+03	UG/L	5.0E-02	mg/kg/day	NA	NA	NA	5.8E-01	mg/kg/day	1.0E+00	mg/kg/day	5.8E-01
				ANTIMONY	5.4E+00	UG/L	3.0E-05	mg/kg/day	NA	NA	NA	3.5E-04	mg/kg/day	4.0E-04	mg/kg/day	8.6E-01
				ARSENIC	6.3E+00	UG/L	3.5E-05	mg/kg/day	1.5E+00	1/(mg/kg-day)	5.2E-05	4.0E-04	mg/kg/day	3.0E-04	mg/kg/day	1.3E+00
				BARIUM	3.5E+02	UG/L	1.9E-03	mg/kg/day	NA	NA	NA	2.2E-02	mg/kg/day	7.0E-02	mg/kg/day	3.2E-01
				CADMIUM	3.0E+00	UG/L	1.6E-05	mg/kg/day	NA	NA	NA	1.9E-04	mg/kg/day	5.0E-04	mg/kg/day	3.8E-01
				CHROMIUM, TOTAL	1.5E+01	UG/L	8.2E-05	mg/kg/day	NA	NA	NA	9.6E-04	mg/kg/day	3.0E-03	mg/kg/day	3.2E-01
				IRON	7.0E+03	UG/L	3.8E-02	mg/kg/day	NA	NA	NA	4.5E-01	mg/kg/day	2.0E-02	mg/kg/day	2.2E+01
				MANGANESE	1.5E+04	UG/L	8.1E-02	mg/kg/day	NA	NA	NA	9.5E-01	mg/kg/day	1.4E-01	mg/kg/day	6.8E+00
				THALLIUM	4.4E+01	UG/L	2.4E-04	mg/kg/day	NA	NA	NA	2.8E-03	mg/kg/day	8.0E-05	mg/kg/day	3.5E+01
				VANADIUM	7.0E+01	UG/L	3.8E-04	mg/kg/day	NA	NA	NA	4.5E-03	mg/kg/day	1.0E-03	mg/kg/day	4.5E+00
			Exp. Route Total								5.2E-05					7.3E+01
			Dermal													
				p,p'-DDD	4.2E-01	UG/L	1.6E-11	mg/kg/day	2.4E-01	1/(mg/kg-day)	3.7E-12	1.8E-10	mg/kg/day	NA	NA	NA
				ALUMINUM	9.1E+03	UG/L	3.3E-10	mg/kg/day	NA	NA	NA	3.8E-09	mg/kg/day	1.0E+00	mg/kg/day	3.8E-09
				ANTIMONY	5.4E+00	UG/L	2.0E-13	mg/kg/day	NA	NA	NA	2.3E-12	mg/kg/day	6.0E-05	mg/kg/day	3.8E-08
				ARSENIC	6.3E+00	UG/L	2.3E-13	mg/kg/day	1.5E+00	1/(mg/kg-day)	3.4E-13	2.7E-12	mg/kg/day	3.0E-04	mg/kg/day	8.9E-09
				BARIUM	3.5E+02	UG/L	1.3E-11	mg/kg/day	NA	NA	NA	1.5E-10	mg/kg/day	4.9E-03	mg/kg/day	3.0E-08
				CADMIUM	3.0E+00	UG/L	1.1E-13	mg/kg/day	NA	NA	NA	1.3E-12	mg/kg/day	1.3E-05	mg/kg/day	1.0E-07
				CHROMIUM, TOTAL	1.5E+01	UG/L	1.1E-12	mg/kg/day	NA	NA	NA	1.3E-11	mg/kg/day	7.5E-05	mg/kg/day	1.7E-07
				IRON	7.0E+03	UG/L	2.5E-10	mg/kg/day	NA	NA	NA	3.0E-09	mg/kg/day	8.0E-04	mg/kg/day	3.7E-06
				MANGANESE	1.5E+04	UG/L	5.4E-10	mg/kg/day	NA	NA	NA	6.2E-09	mg/kg/day	5.6E-03	mg/kg/day	1.1E-06
				THALLIUM	4.4E+01	UG/L	1.6E-12	mg/kg/day	NA	NA	NA	1.9E-11	mg/kg/day	8.0E-05	mg/kg/day	2.3E-07
				VANADIUM	7.0E+01	UG/L	2.5E-12	mg/kg/day	NA	NA	NA	3.0E-11	mg/kg/day	2.6E-05	mg/kg/day	1.1E-06
			Exp. Route Total								4.1E-12					6.5E-06
		Exposure Point Total									5.2E-05					7.3E+01
Groundwater Total											5.2E-05					7.3E+01
										Total of Receptor Risks Across All Media	1.1E-04			Total of Receptor Hazards Across All Media		7.7E+01

NA = Not applicable.

As of 2007, the toxicity values for aluminum and iron have been withdrawn by NCEA, but were available at the time the original risk assessment was prepared.

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	EPA Carcinogen Group	Source	Date (2) (MM/DD/YY)
Aluminum	NA	NA	NA	NA	D	NCEA	07/26/2001
Antimony	NA	NA	NA	NA	NA	IRIS	11/07/2003
Arsenic	1.5E+00	0.95	1.5E+00	(mg/kg-day) $^{-1}$	A	IRIS	11/07/2003
Barium	NA	NA	NA	NA	NA	IRIS	11/07/2003
Benzo(a)anthracene	7.3E-01	0.58 - 0.89	7.3E-01	(mg/kg-day) $^{-1}$	B2	NCEA	07/01/1993
Cadmium	NA	NA	NA	NA	B1	IRIS	11/07/2003
Chromium (hexavalent)	NA	NA	NA	NA	D	IRIS	11/07/2003
Iron	NA	NA	NA	NA	NA	NCEA	07/23/1996
Manganese (nonfood)	NA	NA	NA	NA	D	IRIS	11/07/2003
N-Nitrosodi-n-propylamine	7.0E+00	1	7.0E+00	(mg/kg-day) $^{-1}$	B2	IRIS	01/05/2004
p,p'-DDD	2.4E-01	0.7 - 0.9	2.4E-01	(mg/kg-day) $^{-1}$	B2	IRIS	01/05/2004
p,p'-DDE	3.4E-01	0.7 - 0.9	3.4E-01	(mg/kg-day) $^{-1}$	B2	IRIS	01/05/2004
p,p'-DDT	3.4E-01	0.7 - 0.9	3.4E-01	(mg/kg-day) $^{-1}$	B2	IRIS	01/05/2004
Selenium	NA	NA	NA	NA	D	IRIS	01/05/2004
Thallium	NA	NA	NA	NA	D	IRIS	01/05/2004
Vanadium	NA	NA	NA	NA	NA	HEAST	07/01/1997

Definitions:

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evalution Manual (Part E, Supplemetnal Guidance for Dermal Risk Assessment (Interim). Section 4.2 and Exhibit 4-1. USEPA recommends that the oral CSF should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

NA = Not Available

IRIS = Integrated Risk Information System

NCEA = National Center for Environmental Assessment

HEAST= Health Effects Assessment Summary Tables

Weight of Evidence definitions:

Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.

Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.

Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.

Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data.

Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both.

TABLE 6.2
CANCER TOXICITY DATA -- INHALATION
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Chemical of Potential Concern	Unit Risk	Units	Adjustment (1)	Inhalation Cancer Slope Factor	Units	Weight of Evidence/ Cancer Guidance Description	Source	Date (2) (MM/DD/YY)
Aluminum	NA	NA	NA	NA	NA	D	NCEA	07/26/2001
Antimony	NA	NA	NA	NA	NA	NA	IRIS	11/07/2003
Arsenic	4.0E-03	$(ug/m^3)^{-1}$	3500	1.5E+01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	11/07/2003
Barium	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	NA	NA	NA	7.3E-01	$(mg/kg\text{-}day)^{-1}$	NA	NCEA - r	07/01/1993
Cadmium	1.8E-03	$(ug/m^3)^{-1}$	3500	6.3E+00	$(mg/kg\text{-}day)^{-1}$	B1	IRIS	11/07/2003
Chromium (hexavalent)	1.2E-02	$(ug/m^3)^{-1}$	3500	4.2E+01	$(mg/kg\text{-}day)^{-1}$	A	IRIS	01/05/2004
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	N/A	NA	NA	NA	NA	B2	IRIS	01/05/2004
p,p'-DDD	NA	NA	NA	NA	NA	B2	IRIS	01/05/2004
p,p'-DDE	NA	NA	NA	NA	NA	B2	IRIS	01/05/2004
p,p'-DDT	9.7E-05	$(ug/m^3)^{-1}$	3500	3.4E-01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	01/05/2004
Selenium	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	N/A	NA	NA	NA	NA	D	IRIS	01/05/2004
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA

Definitions:
NA = Not Available
IRIS = Integrated Risk Information System
NCEA = National Center for Environmental Assessment
r = route-to-route extrapolation

Weight of Evidence definitions:

Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.

Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.

Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.

Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data.

Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units	(1)	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Aluminum	Chronic	1.0E+00	mg/kg-day	NA	1.0E+00	mg/kg-day	CNS	100/3	NCEA (3)	07/26/2001
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	Chronic	4.0E-04	mg/kg-day	0.15	6.0E-05	mg/kg-day	Blood	1000	IRIS	11/07/2003
	Subchronic	4.0E-04	mg/kg-day	0.15	6.0E-05	mg/kg-day	Blood	1000	HEAST	07/01/1997
Arsenic	Chronic	3.0E-04	mg/kg-day	0.95	3.0E-04	mg/kg-day	Skin, Vascular	3/1	IRIS	11/07/2003
	Subchronic	3.0E-04	mg/kg-day	0.95	3.0E-04	mg/kg-day	Skin, Vascular	3	HEAST	07/01/1997
Barium	Chronic	7.0E-02	mg/kg-day	0.07	4.9E-03	mg/kg-day	NOAEL	3	IRIS	11/07/2003
	Subchronic	7.0E-02	mg/kg-day	0.07	4.9E-03	mg/kg-day	Cardiovascular	3	HEAST	07/01/1997
Benzo(a)anthracene	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (Food)	Chronic	1.0E-03	mg/kg-day	0.025	2.5E-05	mg/kg-day	Kidney	10	IRIS	11/07/2003
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium (Water)	Chronic	5.0E-04	mg/kg-day	0.025	1.3E-05	mg/kg-day	Kidney	10	IRIS	11/07/2003
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	0.025	7.5E-05	mg/kg-day	NOAEL	300/3	IRIS	11/07/2003
	Subchronic	2.0E-02	mg/kg-day	0.025	5.0E-04	mg/kg-day	NOAEL	100	HEAST	07/01/1997
Iron	Chronic	3.0E-01	mg/kg-day	1	3.0E-01	mg/kg-day	Blood, Gastrointestinal, Liver	1	NCEA (3)	06/21/2001
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	Chronic	2.0E-02	mg/kg-day	0.04	8.0E-04	mg/kg-day	CNS	1	IRIS	11/07/2003
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (food)	Chronic	1.4E-01	mg/kg-day	0.04	5.6E-03	mg/kg-day	CNS	1/1	IRIS	11/07/2003
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
N-Nitrosodi-n-propylamine	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
p,p'-DDD	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
p,p'-DDE	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
p,p'-DDT	Chronic	5.0E-04	mg/kg-day	0.7 - 0.9	5.0E-04	mg/kg-day	Liver	100/1	IRIS	01/05/2004
	Subchronic	5.0E-04	mg/kg-day	0.7 - 0.9	5.0E-04	mg/kg-day	Liver	100	HEAST	07/01/1997
Selenium	Chronic	5.0E-03	mg/kg-day	30-80%	5.0E-03	mg/kg-day	Whole Body	3/1	IRIS	01/05/2004
	Subchronic	5.0E-03	mg/kg-day	30-80%	5.0E-03	mg/kg-day	Whole Body	3/1	HEAST	07/01/1997
Thallium	Chronic	8.0E-05	mg/kg-day	1	8.0E-05	mg/kg-day	Liver, Blood, Hair	3000/1	IRIS	01/05/2004
	Subchronic	8.0E-04	mg/kg-day	1	8.0E-04	mg/kg-day	Liver, Blood, Hair	300	HEAST	07/01/1997
Vanadium	Chronic	1.0E-03	mg/kg-day	0.026	2.6E-05	mg/kg-day	Kidney	100	NCEA	05/01/2000
	Subchronic	7.0E-03	mg/kg-day	0.026	1.8E-04	mg/kg-day	Lifetime	100	HEAST	07/01/1997

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evalution Manual (Part E, Supplemetnal Guidance for Dermal Risk Assessment (Interim). Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%. Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

(2) See Risk Assessment text for the derivation of the "Absorbed RfD for Dermal"

(3) As of 2007, the toxicity values have been withdrawn by NCEA, but were available at the time the original risk assessment was prepared.

Definitions:

NA = Not Available

IRIS = Integrated Risk Information System

HEAST = Health Effects Assessment Summary Tables

NCEA = National Center for Environmental Assessment

CNS = Central Nervous System

NOAEL = No Observed Adverse Effects Level

TABLE 5-2

NON-CANCER TOXICITY DATA -- INHALATION

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (MM/DD/YY)
Aluminum	Chronic	5.0E-03	mg/m^3	1.4E-03	mg/kg-day	CNS	300	NCEA (2)	07/26/2001
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Antimony	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Barium	Chronic	5.0E-04	mg/m^3	1.4E-04	mg/kg-day	Fetotoxicity	1000	HEAST	07/01/1997
	Subchronic	5.0E-03	mg/m^3	1.4E-03	mg/kg-day	Fetotoxicity	100	HEAST	07/01/1997
Benzo(a)anthracene	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	Chronic	2.0E-04	mg/m^3	5.7E-05	mg/kg-day	Kidney	10	NCEA	06/14/1998
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	Chronic	1.1E-04	mg/m^3	3.0E-05	mg/kg-day	Respiratory System	300/1	IRIS	11/07/2003
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Iron	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.0E-05	mg/m^3	1.4E-05	mg/kg-day	CNS	1000/1	IRIS	11/07/2003
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA
p,p'-DDD	Chronic	N/A	NA	NA	NA	NA	NA	NA	NA
	Subchronic	N/A	NA	NA	NA	NA	NA	NA	NA
p,p'-DDE	Chronic	N/A	NA	NA	NA	NA	NA	NA	NA
	Subchronic	N/A	NA	NA	NA	NA	NA	NA	NA

TABLE 5-2

NON-CANCER TOXICITY DATA -- INHALATION

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Chemical of Potential Concern	Chronic/ Subchronic	Value Inhalation RfC	Units	Adjusted Inhalation RfD (1)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfC:RfD: Target Organ	Dates (MM/DD/YY)
p,p'-DDT	Chronic	N/A	NA	NA	NA	NA	NA	NA	NA
	Subchronic	N/A	NA	NA	NA	NA	NA	NA	NA
Selenium	Chronic	N/A	NA	NA	NA	NA	NA	NA	NA
	Subchronic	N/A	NA	NA	NA	NA	NA	NA	NA
Thallium	Chronic	N/A	NA	NA	NA	NA	NA	NA	NA
	Subchronic	N/A	NA	NA	NA	NA	NA	NA	NA
Vanadium	Chronic	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA

(1) See Risk Assessment text for the derivation of the "Extrapolated RfD".

(2) As of 2007, the toxicity values have been withdrawn by NCEA, but were available at the time the original risk assessment was prepared.

Definitions:

NA = Not Available

IRIS = Integrated Risk Information System

NCEA = National Center for Environmental Assessment

CNS = Central Nervous System

ATSDR = Agency for Toxic Substances and Disease Registry

HEAST = Health Effects Assessment Summary Tables

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational	Adult	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Youth	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997, (3)	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational	Adult	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2001	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Youth	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	4,400	cm^2	EPA, 2001, (4)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm^2-day	EPA, 2001, (5)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	9	years	(2)	
				BW	Body Weight	51	kg	EPA, 1997, (3)	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational	Child	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2001	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

Notes:

(1) Professional judgement assuming 2 days per week for 52 weeks at SWMU 7 for nearby residents trespassing on-site.

(2) Professional judgement assuming adolescents from 9 to 18 years of age.

(3) Body weight is average of the mean values for boys and girls for the ages 9 through 18.

(4) SA is the total of the forearms, hands, lower legs, and feet for the 7 through 18 year old.

(5) SSAF is the 95th percentile for soil adherence for Soccer Players # 1 (teens).

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.2.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational	Adult	Emissions from AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 1991	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Youth	Emissions from AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 1991	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1997, (3)	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Recreational	Child	Emissions from AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	15	m^3/day	EPA, 1997	
				EF	Exposure Frequency	104	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Professional judgement assuming 2 days per week for 52 weeks at SWMU 7 for nearby residents trespassing on-site.

(2) Professional judgement assuming adolescents from 9 to 18 years of age.

(3) Body weight is average of the mean values for boys and girls for the ages 9 through 18; based on Table 7-3 (Body Weights of Children) in the EPA Exposure Factors Handbook (EPA, 1997).

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December, 2002.

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational	Adult	Water-filled Ditch	Csed	Chemical Concentration in Sediment	See Table 3.3.RME	mg/kg	See Table 3.3.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CSed x IR-Sed x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Youth	Water-filled Ditch	Csed	Chemical Concentration in Sediment	See Table 3.3.RME	mg/kg	See Table 3.3.RME	CDI (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	50	mg/day	(1)	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	10	years	(3)	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	51	kg	EPA, 1991, (4)	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	Water-filled Ditch	Csed	Chemical Concentration in Sediment	See Table 3.3.RME	mg/kg	See Table 3.3.RME	CDI (mg/kg-day) =
				IR-Sed	Ingestion Rate of Sediment	100	mg/day	(1)	CS x IR-S x EF x ED x CF x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational	Adult	Water-filled Ditch	Csed	Chemical Concentration in Sediment	See Table 3.3.RME	mg/kg	See Table 3.3.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,170	cm^2	EPA, 1997, (5)	CSed x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.36	mg/cm^2-day	EPA, 1997, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	24	years	(2)	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Youth	Water-filled Ditch	Csed	Chemical Concentration in Sediment	See Table 3.3.RME	mg/kg	See Table 3.3.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	4,000	cm^2	EPA, 1997, (7)	CSed x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.36	mg/cm^2-day	EPA, 1997, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	10	years	(3)	
				BW	Body Weight	51	kg	EPA, 1991, (4)	
				AT-N	Averaging Time (Non-Cancer)	3,650	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational	Child	Water-filled Ditch	Csed	Chemical Concentration in Sediment	See Table 3.3.RME	mg/kg	See Table 3.3.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,000	cm^2	EPA, 1997, (8)	CSed x SA x SSAF x DABS x CF x EF x
				SSAF	Soil to Skin Adherence Factor	0.36	mg/cm^2-day	EPA, 1997, (6)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Professional judgement assuming 1/2 the default value for the residential soil scenario.

(2) Professional judgement assuming 1 day per week for 52 weeks per year.

(3) Professional Judgement assuming adolescents from 6 to 19 years of age.

(4) Body weight is average value for the 6 year old and 18 year old male body weight; based on Table 7-3 (Body Weights of Children) in the EPA Exposure Factors Handbook (EPA, 1997).

(5) SA is the sum of the mean surface areas (for a male) of the hands, forearms, feet, and lower legs.

(6) SSAF is soil adherence to legs for Rugby No. 1 from EPA, 1997, Table 6-12.

(7) Skin surface area (SA) presented for a youth is the surface area for forearms, hands, lower legs, and feet for 7 to 18 year age-group from Exhibit C-1, EPA RAGS Part E guidance.

(8) Skin surface area (SA) presented for a child is the surface area for forearms, hands, lower legs, and feet for 1 to 6 year age-group estimated at 1811 cm^2, rounded to 2000 cm^2 from Exhibit C-1, EPA RAGS Part E guidance.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.4.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational	Adult	Water-filled Ditch	CSW	Chemical Concentration in Surface Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-SW	Ingestion Rate of Surface Water	0.025	l/hour	EPA, 1989, (1)	CSW x IR-SW x ET x EF x ED x CF1 x
				ET	Exposure Time	2.6	hr/day	EPA, 1989	1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Youth	Water-filled Ditch	CSW	Chemical Concentration in Surface Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				IR-SW	Ingestion Rate of Surface Water	0.025	l/hour	EPA, 1989, (1)	CSW x IR-SW x ET x EF x ED x CF1 x
				ET	Exposure Time	2.6	hr/day	EPA, 1989	1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	10	years	(3)	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	51	kg	EPA, 1997, (4)	
				AT-N	Averaging Time (Non-Cancer)	3,650	EPA, 1989	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	EPA, 1989	EPA, 1989	
		Child	Water-filled Ditch	CSW	Chemical Concentration in Surface Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				IR-SW	Ingestion Rate of Surface Water	0.025	l/hour	EPA, 1989, (1)	CSW x IR-SW x ET x EF x ED x CF1 x
				ET	Exposure Time	2.6	hr/day	EPA, 1989	1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	EPA, 1989	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	EPA, 1989	EPA, 1989	

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational	Adult	Water-filled Ditch	CSW	Chemical Concentration in Surface Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical Specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	Chemical Specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical Specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	Chemical Specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical Specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	2.6	hr/event	EPA, 1989	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	5,170	cm^2	EPA, 1997, (5)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	24	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational	Youth	Water-filled Ditch	CSW	Chemical Concentration in Surface Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical Specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	Chemical Specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical Specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	Chemical Specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical Specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	2.6	hr/event	EPA, 1989	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	4,000	cm^2	EPA, 1997, (6)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	10	years	(3)	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	51	kg	EPA, 1997, (4)	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-N	Averaging Time (Non-Cancer)	3,650	EPA, 1989	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-C	Averaging Time (Cancer)	25,550	EPA, 1989	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational	Child	Water-filled Ditch	CSW	Chemical Concentration in Surface Water	See Table 3.4.RME	µg/l	See Table 3.4.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical Specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	Chemical Specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical Specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	Chemical Specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical Specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	2.6	hr/event	EPA, 1989	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	2,000	cm^2	EPA, 1997, (7)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2001	x CF1 x CF2
				EF	Exposure Frequency	52	days/year	(2)	
				ED	Exposure Duration	6	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-N	Averaging Time (Non-Cancer)	2,190	EPA, 1989	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-C	Averaging Time (Cancer)	25,550	EPA, 1989	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

Notes:

(1) Professional Judgment assuming one half of the ingestion rate specified for swimming.

(2) Professional Judgement assuming 1 day per week for 52 weeks per year.

(3) Professional Judgement assuming adolescents from 6 to 19 years of age.

(4) Body weight is average value for the 6 year old and 18 year old male body weight.

(5) SA is the sum of the mean surface areas (for a male) of the hands, forearms, feet, and lower legs.

(6) Surface area is 25% of total surface area (95 percentile) for 6 to 18 year old children.

(7) Surface area is 25% of total surface area (95 percentile) for 0 to 6 year old children.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residential	Adult	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Maintenance Worker	Adult	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Worker	Adult	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
Dermal	Residential	Adult	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2001	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2001	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

TABLE 4.5.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Maintenance Worker	Adult	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2001, (2)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001, (3)	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
	Industrial Worker	Adult	AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2001, (2)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

Notes:

(1) Conservative assumption based on potential maintenance activities (i.e., lawn mowing) at the site, 2 days per week for 26 weeks.

(2) Worker assumed to wear a short-sleeved shirt, long pants, and shoes therefore, the exposed surface area is face, hands and forearms.

(3) SSAF based on maximum adherence factor for utility workers.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.6.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residential	Adult	Emissions from AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	Emissions from AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	15	m^3/day	EPA, 1997	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Maintenance Worker	Adult	Emissions from AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 1991	
				EF	Exposure Frequency	52	days/year	(1)	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Emissions from AOC H Surface Soil	CS	Chemical Concentration in Soil	See Table 3.1.RME	mg/kg	See Table 3.1.RME	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 1991	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Conservative assumption based on potential maintenance activities (i.e., lawn mowing) at the site, once a week throughout the year, for 25 years.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December, 2002.

TABLE 4.7.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residential	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.2.RME	mg/L	See Table 3.2.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1991	CW x IR-W x EF x ED x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.2.RME	mg/L	See Table 3.2.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1991	CW x IR-W x EF x ED x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Industrial Worker	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.2.RME	mg/L	See Table 3.2.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1991	CW x IR-W x EF x ED x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	

TABLE 4.7.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.2.RME	mg/L	See Table 3.2.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical Specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	Chemical Specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical Specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF
				t*	Time to Reach Steady-state	Chemical Specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical Specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	0.58	hr/event	EPA, 2001	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π)) x CF
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	24	years	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	l/cm^3	- -	
				CF2	Conversion Factor 2	0.001	mg/ug	- -	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.2.RME	mg/L	See Table 3.2.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical Specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	Chemical Specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical Specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF
				t*	Time to Reach Steady-state	Chemical Specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical Specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	1	hr/event		t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2001	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π)) x CF
				EV	Event Frequency	1	events/day	EPA, 2001	
				EF	Exposure Frequency	350	days/year	EPA, 2001	
				ED	Exposure Duration	6	years	EPA, 2001	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF
				AT-N	Averaging Time (Non-Cancer)	2190	days	EPA, 1989	

TABLE 4.7.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
				CF1	Conversion Factor 1	0.001	l/cm^3	- -	
				CF2	Conversion Factor 2	0.001	mg/ug	- -	
Dermal	Industrial Worker	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.2.RME	mg/L	See Table 3.2.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical Specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	Chemical Specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical Specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF
				t*	Time to Reach Steady-state	Chemical Specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical Specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	0.05	hr/day	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2001 (2)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π)) x CF
				EV	Event Frequency	5	events/day	(1)	
				EF	Exposure Frequency	250	days/year	EPA, 1991	
				ED	Exposure Duration	25	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF
				AT-N	Averaging Time (Non-Cancer)	9,125	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	l/cm^3	- -	
				CF2	Conversion Factor 2	0.001	mg/ug	- -	
Dermal	Construction Worker	Adult	Groundwater (Excavation)	CW	Chemical Concentration in Water	See Table 3.7.RME	mg/L	See Table 3.7.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	Calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	Chemical Specific	dimensionless	EPA, 2001	
				Kp	Permeability Coefficient	Chemical Specific	cm/hr	EPA, 2001	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	Chemical Specific	hr/event	EPA, 2001	Kp x CW x t_{event} x CF
				t*	Time to Reach Steady-state	Chemical Specific	hours	EPA, 2001	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	Chemical Specific	dimensionless	EPA, 2001	Organics :
				t_{event}	Event Time	8	hr/day	(3)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2001 (2)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π)) x CF
				EV	Event Frequency	1	event/day	(3)	
				EF	Exposure Frequency	250	days/year	EPA, 1989	
				ED	Exposure Duration	0.5	years	(3)	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x

TABLE 4.7.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	$((1 + 3B + 3B^2)/(1+B)^2)) \times CF$
				AT-N	Averaging Time (Non-Cancer)	183	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	l/cm^3	- -	
				CF2	Conversion Factor 2	0.001	mg/ug	- -	

(1) Professional judgement, assumed to be equivalent to dermal event duration for residential adult as recommended by EPA Region II (five 3-minute events).

(2) Worker assumed to wear a short-sleeved shirt, long pants, and shoes therefore, the exposed surface area is face, hands and forearms.

(3) Professional judgement.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

TABLE 4.8.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Subsurface Soil or Total Soil
Exposure Medium: Subsurface Soil or Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residential	Adult	AOC H Subsurface Soil	CS	Chemical Concentration in Soil	See Table 3.2.RME	mg/kg	See Table 3.2.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	AOC H Subsurface Soil	CS	Chemical Concentration in Soil	See Table 3.2.RME	mg/kg	See Table 3.2.RME	CDI (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
	Construction Worker	Adult	AOC H Total Soil	CS	Chemical Concentration in Soil	See Table 3.6.RME	mg/kg	See Table 3.6.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	330	mg/day	EPA, 2002	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	250	days/year	EPA, 1989	
				ED	Exposure Duration	0.5	years	(1)	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	183	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.8.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Subsurface Soil or Total Soil
Exposure Medium: Subsurface Soil or Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Residential	Adult	AOC H Subsurface Soil	CS	Chemical Concentration in Soil	See Table 3.2.RME	mg/kg	See Table 3.2.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2001	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	AOC H Subsurface Soil	CS	Chemical Concentration in Soil	See Table 3.2.RME	mg/kg	See Table 3.2.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2001	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2001	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF	Conversion Factor	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	

TABLE 4.8.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Subsurface Soil or Total Soil
Exposure Medium: Subsurface Soil or Total Soil

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (cont.)	Construction Worker	Adult	AOC H Total Soil	CS	Chemical Concentration in Soil	See Table 3.6.RME	mg/kg	See Table 3.6.RME	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	3,300	cm^2	EPA, 2001 (2)	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm^2-day	EPA, 2002	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical Specific	--	EPA, 2001	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	250	days/year	EPA, 1989	
				ED	Exposure Duration	0.5	years	(1)	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	183	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Recommended by EPA Region II.

(2) Worker assumed to wear a short-sleeved shirt, long pants, and shoes therefore, the exposed surface area is face, hands and forearms.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 2001: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December, 2002.

TABLE 4.9.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Subsurface Soil or Total Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residential	Adult	Emissions from AOC H Subsurface Soil	CS	Chemical Concentration in Soil	See Table 3.2.RME	mg/kg	See Table 3.2.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 1991	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
		Child	Emissions from AOC H Subsurface Soil	CS	Chemical Concentration in Soil	See Table 3.2.RME	mg/kg	See Table 3.2.RME	CDI (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	Calculated	m^3/kg	EPA, 2002	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	15	m^3/day	EPA, 1997	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.9.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Subsurface Soil or Total Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation (cont.)	Construction Worker	Adult	Emissions from AOC H Total Soil	CS	Chemical Concentration in Soil	See Table 3.6.RME	mg/kg	See Table 3.6.RME	Chronic Daily Intake (CDI) (mg/kg-day) =
				CA	Chemical Concentration in Air	Calculated	mg/m^3	EPA, 2002	CA x IN x EF x ED x 1/BW x 1/AT
				PEF	Particulate Emission Factor	1.36E+09	m^3/kg	EPA, 2002	
				VF	Volatilization Factor for volatile constituents	--	--	--	CA (mg/m^3) = CS (1/PEF + 1/VF)
				IN	Inhalation Rate	20	m^3/day	EPA, 1991	
				EF	Exposure Frequency	250	days/year	EPA, 1989	
				ED	Exposure Duration	0.5	years	(1)	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-N	Averaging Time (Non-Cancer)	183	days	EPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

(1) Recommended by EPA Region II.

(2) Worker assumed to wear a short-sleeved shirt, long pants, and shoes therefore, the exposed surface area is face, hands and forearms.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, OSWER 9355.4-24, December, 2002.

Table 4.9 RME Supplement
Particulate Emission Factor - Construction Worker
AOC H
Former NASD, Vieques, Puerto Rico

PEF Equations:

$$Q/C_{Sr} = A \times \exp\left[\frac{(\ln A_{site} - B)^2}{C}\right]$$

Equation 5-6 (EPA, 2002)

$$PEF_{SC} = Q/C_{Sr} \times \frac{1}{F_D} \frac{T \times A_R}{556 \times (W/3)^{0.4} \times \left(\frac{365\ d/yr - p}{365\ d/yr}\right)^3 \times \sum VKT}$$

Equation 5-5 (EPA, 2002)

$$F_D = 0.1852 + \frac{5.3537}{t_c} + \frac{-9.6318}{t_c^{\ 2}}$$

Equation E-16 (EPA, 2002)

PEF and Box Model Input Parameters

Parameter	Definition	Value	Units	Source
Q/C_{Sr}	inverse ratio of the geometric mean air concentration to the emission flux at the center of a square source	**18.4**	m	calculated
A	Constant	12.935	unitless	default (Eqn. 5-6)
B	Constant	5.738	unitless	default (Eqn. 5-6)
C	Constant	71.771	unitless	default (Eqn. 5-6)
A_{site}	Areal extent of site contamination	2	acres	site-specific
PEF_{SC}	subchronic road particulate emission factor	**1.33E+07**	m^3/kg	calculated
F_D	Dispersion correction factor	0.188	unitless	calculated
t_c	duration of construction (250 days for 8 hr/day)	2,000	hr	assumed
T	total time over which construction occurs (t_c x 3600 s/hr)	7,200,000	s	assumed
A_R	surface area of contaminated road segment	274.21	m^2	default (Eqn. 5-5)
W	mean weight of vehicle [(1 car @ 2 tons/car) + (2 trucks @ 20 tons/truck)] / 3 vehicles)	14	tons	assumed
p	number of days with at least 0.01 inches of precipitation (based on measured 2005 data)	92	days/yr	site-specific
VKT	sum of fleet vehicle kilometers traveled during the exposure duration (assumed 3 vehicles x 0.045 km/day x 250 days)	33.8	km	assumed

Source:

EPA, 2002. Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, EPA Office of Solid Waste and Emergency Response. OSWER 9355.4-24. December.

Table 3.1.RME
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
AOC H Surface Soil									
	BENZO(a)PYRENE	MG/KG	7.68E-01	5.39E+00 (NP)	1.12E-01 J	1.12E-01	MG/KG	Max	(5)
	N-NITROSODI-n-PROPYLAMINE	MG/KG	8.71E-01	2.88E+00 (NP)	7.17E-01	7.17E-01	MG/KG	Max	(5)
	p,p'-DDE	MG/KG	2.41E-01	1.75E+00 (NP)	3.99E+00 J	1.75E+00	MG/KG	99% Cheb-m	(3)
	p,p'-DDT	MG/KG	1.12E-01	5.51E-01 (NP)	1.94E+00 J	5.51E-01	MG/KG	97.5% Cheb-m	(3)
	ALUMINUM	MG/KG	7.65E+03	8.26E+03 (N)	1.10E+04 J	8.26E+03	MG/KG	95% UCL-N	(4)
	ANTIMONY	MG/KG	7.93E-01	1.13E+00 (T)	6.30E+00 J	1.13E+00	MG/KG	95% UCL-T	(1)
	ARSENIC	MG/KG	4.99E+00	1.90E+01 (NP)	6.70E+01	1.90E+01	MG/KG	97.5% Cheb-m	(3)
	CHROMIUM, TOTAL	MG/KG	1.74E+01	2.01E+01 (T)	5.00E+01	2.01E+01	MG/KG	95% UCL-T	(1)
	IRON	MG/KG	1.74E+04	2.13E+04 (NP)	3.90E+04	2.13E+04	MG/KG	95% Cheb-m	(3)
	MANGANESE	MG/KG	3.96E+02	4.84E+02 (NP)	7.20E+02	4.84E+02	MG/KG	95% Cheb-m	(3)
	THALLIUM	MG/KG	3.93E-01	6.18E-01 (NP)	1.16E+00 J	6.18E-01	MG/KG	95% Cheb-m	(3)
	VANADIUM	MG/KG	4.49E+01	4.78E+01 (N)	6.30E+01	4.78E+01	MG/KG	95% UCL-N	(2)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. February 2003. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); Mean of Normal Data (Mean-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Select distribution with higher W Test result.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J = Estimated Value

Table 3.2.RME
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
AOC H Subsurface Soil	ARSENIC	MG/KG	1.68E+00	6.56E+00 (NP)	2.40E+01	6.56E+00	MG/KG	97.5% Cheb-m	(3)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. February 2003. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); Mean of Normal Data (Mean-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Select distribution with higher W Test result.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

N = Normal
T = Log-Transformed
NP = Non-Parametric
J = Estimated Value

Table 3.3.RME
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Tap Water									
	p,p'-DDD	UG/L	1.42E-01	5.51E-01 (NP)	4.20E-01 J	4.20E-01	UG/L	Max	(5)
	ALUMINUM	UG/L	2.99E+03	2.44E+04 (T)	9.10E+03	9.10E+03	UG/L	Max	(5)
	ANTIMONY	UG/L	5.60E+00	1.67E+01 (NP)	5.40E+00 J	5.40E+00	UG/L	Max	(5)
	ARSENIC	UG/L	4.81E+00	1.39E+01 (NP)	6.30E+00 J	6.30E+00	UG/L	Max	(5)
	BARIUM	UG/L	2.58E+02	3.47E+02 (N)	4.90E+02	3.47E+02	UG/L	95% UCL-N	(4)
	CADMIUM	UG/L	1.04E+00	2.99E+00 (T)	4.46E+00 J	2.99E+00	UG/L	95% Cheb	(1)
	CHROMIUM, TOTAL	UG/L	6.49E+00	2.66E+01 (T)	1.50E+01	1.50E+01	UG/L	Max	(5)
	IRON	UG/L	4.58E+03	7.03E+03 (N)	1.10E+04	7.03E+03	UG/L	95% UCL-N	(2)
	MANGANESE	UG/L	6.09E+03	4.39E+04 (T)	1.48E+04	1.48E+04	UG/L	Max	(5)
	THALLIUM	UG/L	1.32E+01	7.55E+01 (T)	4.42E+01 J	4.42E+01	UG/L	Max	(5)
	VANADIUM	UG/L	2.37E+01	1.76E+02 (T)	7.00E+01	7.00E+01	UG/L	Max	(5)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. February 2003. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); Mean of Normal Data (Mean-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Select distribution with higher W Test result.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J = Estimated Value

Table 3.4.RME
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	UCL (Distribution) (1)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Water-filled Ditch									
	ARSENIC	MG/KG	3.34E-01	NA	8.82E-01 J	8.82E-01	MG/KG	Max	(1)
	IRON	MG/KG	9.32E+03	NA	8.62E+03	8.62E+03	MG/KG	Max	(1)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. February 2003. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); Mean of Normal Data (Mean-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Less than 5 samples available, therefore, used maximum detected concentration as exposure point concentration.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J = Estimated Value

Table 3.5.RME
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
Water-filled Ditch									
	ARSENIC	UG/L	2.71E+01	5.62E+01 (NP)	4.71E+01 J	4.71E+01	UG/L	Max	(5)
	CADMIUM	UG/L	4.59E+00	9.11E+00 (NP)	7.70E+00 J	7.70E+00	UG/L	Max	(5)
	CHROMIUM, TOTAL	UG/L	8.32E+00	1.98E+01 (NP)	1.62E+01 J	1.62E+01	UG/L	Max	(5)
	MANGANESE	UG/L	5.31E+02	8.43E+02 (T)	6.54E+02	6.54E+02	UG/L	Max	(5)
	SELENIUM	UG/L	3.17E+01	7.85E+01 (NP)	6.39E+01 J	6.39E+01	UG/L	Max	(5)

For non-detects, 1/2 sample quantitation limit was used as a proxy concentration; for duplicate sample results, the maximum value was used in the calculation.
ProUCL, Version 2.1 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. February 2003. ProUCL, Version 2.1. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); Mean of Normal Data (Mean-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Select distribution with higher W Test result.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J = Estimated Value

Table 3.6.RME
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Total Soil (0-6 ft)
Exposure Medium: Total Soil (0-6 ft)

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
AOC H Total Soil									
	ARSENIC	MG/KG	3.42E+00	3.97E+00 (T)	6.70E+01	3.97E+00	MG/KG	95% UCL-T	(1)
	N-NITROSO-DI-N-PROPYLAMINE	MG/KG	3.29E+01	1.44E+02 (NP)	7.17E-01	7.17E-01	MG/KG	Max	(5)

Full statistics for data included in Appendix M.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
Unusually high non-detected values excluded from quantitative risk assessment. Removed non-detects that were one order of magnitude greater than the maximum detected value for each analyte (RAGS Part A, Chapter 5, Dec. 1989).
ProUCL, Version 3.00.02 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% UCL of Normal Data (95% UCL-N); Mean of Normal Data (Mean-N); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); Mean of Log-transformed Data (Mean-T).

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Shapiro-Wilk W Test indicates data neither log-normally or normally distributed. Select distribution with higher W Test result.
(4) Shapiro-Wilk W Test indicates data fit both log-normal and normal distribution. Select distribution with higher W Test result.
(5) 95% UCL exceeds maximum detected concentration. Therefore, maximum concentration used for EPC.

N = Normal
T = Log-Transformed
NP = Non-Parametric

J = Estimated Value

Table 3.7.RME
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T/NP/G)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Groundwater (In Excavations)	4,4-DDD	UG/L	1.6E-01	8.7E-01	NP	4.2E-01	J	4.2E-01	UG/L	Max	(6)
	Aluminum	UG/L	3.4E+03	5.7E+03	N	9.1E+03		5.7E+03	UG/L	95% Stud-t	(2)
	Antimony	UG/L	6.0E+00	2.6E+01	NP	5.4E+00	J	5.4E+00	UG/L	Max	(6)
	Arsenic	UG/L	5.3E+00	2.1E+01	NP	6.3E+00	J	6.3E+00	UG/L	Max	(6)
	Barium	UG/L	2.8E+02	3.7E+02	N	4.9E+02		3.7E+02	UG/L	95% Stud-t	(2)
	Cadmium	UG/L	1.1E+00	6.5E+00	NP	4.5E+00	J	4.5E+00	UG/L	Max	(6)
	Chromium	UG/L	7.3E+00	1.1E+01	N	1.5E+01		1.1E+01	UG/L	95% Stud-t	(2)
	Iron	UG/L	5.1E+03	7.7E+03	N	1.1E+04		7.7E+03	UG/L	95% Stud-t	(2)
	Manganese	UG/L	6.8E+03	1.8E+04	G	1.5E+04		1.5E+04	UG/L	Max	(6)
	Thallium	UG/L	1.5E+01	2.4E+01	N	4.4E+01	J	2.4E+01	UG/L	95% Stud-t	(2)
	Vanadium	UG/L	2.5E+01	4.1E+01	N	7.0E+01		4.1E+01	UG/L	95% Stud-t	(2)

Full statistics for data included in Appendix M.
For non-detects, 1/2 sample quantitation limit was used as a proxy concentration.
Unusually high non-detected values excluded from quantitative risk assessment. Removed non-detects that were one order of magnitude greater than the maximum detected value for each analyte (RAGS Part A, Chapter 5, Dec. 1989).
ProUCL, Version 3.00.02 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).
Statistics: Maximum Detected Value (Max); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); 95% modified-t UCL adjusted for skewness (95% Mod-t); 95% Student's-T test UCL (95% Stud-t); 95% Hall's Bootstrap UCL (95% Hall); 95% Approximate Gamma (App. Gamma); 95% Adjusted Gamma (Adj. Gamma); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T)

Table 3.7.RME
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (N/T/NP/G)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Anderson-Darling Test indicates data are gamma distributed.
(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.
(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(6) The maximum detected concentration was used as the UCL because the value recommended by ProUCL 3.0 was higher than the Max.
(7) The maximum detected concentration was used as the UCL because the sample size was less than 8.
G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J - analyte was detected below the reporting limit in the sample

Table 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
AOC H Surface Soil	75-35-4	1,1-DICHLOROETHENE	7.80E-04 J	7.80E-04 J	MG/KG	AOCHSB009	1/19	0.00032 - 0.036	7.80E-04	NA	1.24E+01 NC	3.00E-02	SSL	NO	BSL
	108-38-3/106-42	M,P-XYLENE (SUM OF ISOMERS)	5.80E-02 J	5.80E-02 J	MG/KG	AOCHSS001	1/19	0.00016 - 0.018	5.80E-02	NA	2.75E+01 NC	1.00E+02	SSL	NO	BSL
	95-47-6	O-XYLENE (1,2-DIMETHYLBENZENE)	2.40E-02 J	2.40E-02 J	MG/KG	AOCHSS001	1/19	0.00015 - 0.017	2.40E-02	NA	2.75E+01 NC	1.00E+02	SSL	NO	BSL
	1330-20-7	XYLENES, TOTAL	8.20E-02 J	8.20E-02 J	MG/KG	AOCHSS001	1/19	0.00016 - 0.018	8.20E-02	NA	2.75E+01 NC	1.00E+02	SSL	NO	BSL
	606-20-2	2,6-DINITROTOLUENE	1.21E+00	1.23E+00	MG/KG	AOCHSB013	2/45	0.023 - 1.53	1.23E+00	NA	6.11E+00 NC	3.00E-04	SSL	NO	BSL
	91-57-6	2-METHYLNAPHTHALENE	2.80E-02 J	1.90E-01 J	MG/KG	AOCHSB009	5/31	0.023 - 1.53	1.90E-01	NA	6.99E+01 NC	NA	NA	NO	BSL
	99-09-2	3-NITROANILINE	4.80E-02 J	4.80E-02 J	MG/KG	AOCHSB013	1/32	0.018 - 1.22	4.80E-02	NA	1.75E-01 NC	NA	NA	NO	BSL
	101-55-3	4-BROMOPHENYL PHENYL ETHER	2.17E-01 J	2.67E-01 J	MG/KG	AOCHSB013	3/32	0.024 - 1.56	2.67E-01	NA	NA	NA	NA	NO	BSL
	56-55-3	BENZO(a)ANTHRACENE	2.90E-02 J	1.12E-01 J	MG/KG	AOCHSB004	9/32	0.02 - 1.35	1.12E-01	NA	6.21E-01 CA	8.00E-01	SSL	NO	BSL
	50-32-8	BENZO(a)PYRENE	2.57E-02 J	1.20E-01 J	MG/KG	AOCHSB004	14/32	0.0222 - 1.74	1.20E-01	NA	6.21E-02 CA	4.00E+00	SSL	YES	ASL
	205-99-2	BENZO(b)FLUORANTHENE	1.87E-02 J	1.33E-01 J	MG/KG	AOCHSB004	18/32	0.0169 - 1.53	1.33E-01	NA	6.21E-01 CA	2.00E+00	SSL	NO	BSL
	191-24-2	BENZO(g,h,i)PERYLENE	2.17E-02 J	6.00E-02 J	MG/KG	AOCHSS002	10/32	0.02 - 1.56	6.00E-02	NA	2.32E+02 NC	2.10E+03	SSL	NO	BSL
	207-08-9	BENZO(k)FLUORANTHENE	1.96E-02 J	1.24E-01 J	MG/KG	AOCHSB004	15/32	0.0179 - 1.84	1.24E-01	NA	6.21E+00 CA	2.00E+01	SSL	NO	BSL
	117-81-7	bis(2-ETHYLHEXYL) PHTHALATE	7.29E-02 J	1.17E-01 J	MG/KG	NDAHSS24	8/32	0.029 - 1.95	1.17E-01	NA	3.47E+01 CA*	0.00E+00	SSL	NO	BSL
	218-01-9	CHRYSENE	2.25E-02 J	1.55E-01 J	MG/KG	AOCHSB004	17/32	0.0211 - 1.48	1.55E-01	NA	6.21E+01 CA	8.00E+01	SSL	NO	BSL
	132-64-9	DIBENZOFURAN	2.94E-02 J	3.80E-02 J	MG/KG	AOCHSB009	2/32	0.02 - 1.35	3.80E-02	NA	2.91E+01 NC	NA	NA	NO	BSL
	206-44-0	FLUORANTHENE	2.46E-02 J	1.87E-01 J	MG/KG	AOCHSB004	15/32	0.019 - 1.61	1.87E-01	NA	2.29E+02 NC	2.10E+03	SSL	NO	BSL
	193-39-5	INDENO(1,2,3-c,d)PYRENE	2.60E-02 J	8.48E-02 J	MG/KG	NDAHSS24	8/32	0.02 - 1.35	8.48E-02	NA	6.21E-01 CA	7.00E+00	SSL	NO	BSL
	78-59-1	ISOPHORONE	1.06E-01 J	1.12E-01 J	MG/KG	AOCHSB012	2/32	0.014 - 0.934	1.12E-01	NA	5.12E+02 CA*	3.00E-01	SSL	NO	BSL
	621-64-7	N-NITROSODI-n-PROPYLAMINE	5.62E-01 J	7.17E-01	MG/KG	AOCHSB013	3/32	0.0232 - 1.84	7.17E-01	NA	6.95E-02 CA	2.00E-05	SSL	YES	ASL
	91-20-3	NAPHTHALENE	4.24E-02 J	6.90E-02 J	MG/KG	AOCHSB009	2/31	0.029 - 1.92	6.90E-02	NA	5.59E+00 NC	4.00E+01	SSL	NO	BSL
	85-01-8	PHENANTHRENE	2.11E-02 J	9.20E-02 J	MG/KG	AOCHSB009	7/32	0.0179 - 1.5	9.20E-02	NA	2.32E+02 NC	2.10E+03	SSL	NO	BSL
	129-00-0	PYRENE	2.82E-02 J	1.90E+00 J	MG/KG	AOCHSS001	16/32	0.022 - 1.45	1.90E+00	NA	2.32E+02 NC	2.10E+03	SSL	NO	BSL
	72-43-5	METHOXYCHLOR	7.40E-04 J	7.40E-04 J	MG/KG	NDAHSS19	1/31	0.00028 - 0.00032	7.40E-04	NA	3.06E+01 NC	8.00E+01	SSL	NO	BSL
	72-54-8	p,p'-DDD	5.20E-04 J	1.00E-02 J	MG/KG	NDAHSS22	12/30	0.00014 - 0.0071	1.00E-02	NA	2.44E+00 CA	8.00E+00	SSL	NO	BSL
	72-55-9	p,p'-DDE	1.40E-03 J	3.99E+00 J	MG/KG	AOCHSB001	21/31	0.000058 - 0.168	3.99E+00	NA	1.72E+00 CA	3.00E+01	SSL	YES	ASL
	50-29-3	p,p'-DDT	1.30E-03 J	1.94E+00 J	MG/KG	AOCHSB001	19/31	0.0002 - 0.039	1.94E+00	NA	1.72E+00 CA*	2.00E+01	SSL	YES	ASL
	7429-90-5	ALUMINUM	3.40E+03 J	1.10E+04 J	MG/KG	AOCHSS001, AOCHSB006	32/32	1.37 - 9.5	1.10E+04	NA	7.61E+03 NC	NA	NA	YES	ASL
	7440-36-0	ANTIMONY	3.40E-01 J	6.30E+00 J	MG/KG	AOCHSS003	25/32	0.0877 - 0.24	6.30E+00	NA	3.13E+00 NC	3.00E+00	SSL	YES	ASL
	7440-38-2	ARSENIC	4.35E-01 J	6.70E+01	MG/KG	AOCHSB010	32/32	0.128 - 0.29	6.70E+01	NA	3.90E-01 CA*	NA	NA	YES	ASL
	7440-39-3	BARIUM	2.30E+01 J	2.90E+02 J	MG/KG	AOCHSB010	32/32	0.00846 - 0.0107	2.90E+02	NA	5.37E+02 NC	8.20E+02	SSL	NO	BSL
	7440-41-7	BERYLLIUM	7.99E-02 J	2.60E-01 J	MG/KG	AOCHSB010	21/32	0.0134 - 0.03	2.60E-01	NA	1.54E+01 NC	3.00E+01	SSL	NO	BSL
	7440-43-9	CADMIUM	4.54E-02 J	2.91E-01 J	MG/KG	NDAHSS26	13/32	0.0117 - 0.02	2.91E-01	NA	3.70E+00 NC	4.00E+00	SSL	NO	BSL
	7440-70-2	CALCIUM	4.46E+03	3.40E+04	MG/KG	AOCHSS004	32/32	2.59 - 3.29	3.40E+04	NA	NA	NA	NA	NO	NUT
	7440-47-3	CHROMIUM, TOTAL	7.83E+00	5.00E+01	MG/KG	AOCHSS001	32/32	0.0375 - 0.08	5.00E+01	NA	3.01E+01 CA**	2.00E+01	SSL	YES	ASL
	7440-48-4	COBALT	3.20E+00 J	1.02E+01 J	MG/KG	NDAHSS19	32/32	0.0303 - 0.04	1.02E+01	NA	9.03E+02 CA**	NA	NA	NO	BSL
	7440-50-8	COPPER	1.11E+01	1.00E+02	MG/KG	AOCHSB003	32/32	0.0595 - 0.08	1.00E+02	NA	3.13E+02 NC	NA	NA	NO	BSL
	7439-89-6	IRON	7.70E+03	3.90E+04	MG/KG	AOCHSS003	32/32	1.06 - 2.5	3.90E+04	NA	2.35E+03 NC	NA	NA	YES	ASL
	7439-92-1	LEAD	4.43E+00 J	6.30E+01	MG/KG	AOCHSB009	32/32	0.16 - 0.221	6.30E+01	NA	4.00E+02 NC	NA	NA	NO	BSL

Table 2.1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Soil
Exposure Medium: Surface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7439-95-4	MAGNESIUM	1.63E+03	8.40E+03	MG/KG	AOCHSB003	32/32	0.13 - 1.32	8.40E+03	NA	NA	NA	NA	NO	NUT
	7439-96-5	MANGANESE	1.40E+02	7.20E+02	MG/KG	AOCHSB010	32/32	0.0189 - 0.0479	7.20E+02	NA	1.76E+02 NC	NA	NA	YES	ASL
	7439-97-6	MERCURY	4.90E-03 J	6.25E-02	MG/KG	NDAHSS25	32/32	0.00135 - 0.0025	6.25E-02	NA	6.11E-01 NC	NA	NA	NO	BSL
	7440-02-0	NICKEL	3.26E+00 J	2.60E+01	MG/KG	AOCHSS003	32/32	0.0516 - 0.09	2.60E+01	NA	1.56E+02 NC	7.00E+01	SSL	NO	BSL
	7440-09-7	POTASSIUM	7.21E+02 J	3.40E+03	MG/KG	AOCHSB003	32/32	2.56 - 3.25	3.40E+03	NA	NA	NA	NA	NO	NUT
	7782-49-2	SELENIUM	2.34E-01 J	1.40E+00	MG/KG	AOCHSB005	22/32	0.183 - 0.46	1.40E+00	NA	3.91E+01 NC	3.00E+00	SSL	NO	BSL
	7440-22-4	SILVER	3.46E-02 J	1.70E-01 J	MG/KG	AOCHSB007	12/32	0.0222 - 0.05	1.70E-01	NA	3.91E+01 NC	2.00E+01	SSL	NO	BSL
	7440-23-5	SODIUM	1.10E+02 J	5.90E+02 J	MG/KG	AOCHSB003	32/32	1.45 - 20	5.90E+02	NA	NA	NA	NA	NO	NUT
	7440-28-0	THALLIUM	2.87E-01 J	1.16E+00 J	MG/KG	NDAHSS18	13/32	0.112 - 0.34	1.16E+00	NA	5.16E-01 NC	NA	NA	YES	ASL
	7440-62-2	VANADIUM	2.10E+01	6.30E+01	MG/KG	AOCHSS001	32/32	0.0335 - 0.07	6.30E+01	NA	5.47E+01 NC	3.00E+03	SSL	YES	ASL
	7440-66-6	ZINC	3.15E+01	2.60E+02	MG/KG	AOCHSS003	32/32	0.0596 - 0.5	2.60E+02	NA	2.35E+03 NC	6.20E+03	SSL	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] EPA Region 9 PRGs Table, October 1, 2002, U.S. EPA Region 9.
PRG value for xylenes used as surrogate for m,p-xylene and o-xylene.
PRG value for 2-methylnaphthalene calculated using provisional reference dose and methods described in Region 9 PRGs Table Users Guide/Technical Background Document, October 1, 2002, U.S. EPA Region 9.
PRG value for 2-nitroaniline used as surrogate for 3-nitroaniline.
PRG value for pyrene used as surrogate for benzo(g,h,i)perylene and phenanthrene.
PRG value for chromium VI used for total chromium.
PRG value for mercury chloride used as surrogate for mercury.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

SSL = Soil Screening Level; Dilution Attenuation Factor = 10 (USEPA, October 2002)
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
CA = Carcinogenic
NC = Noncarcinogenic
CA* (where: NC < 100X CA)
CA**(where: NC < 10X CA)

Table 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
AOC H Subsurface Soil	75-35-4	1,1-DICHLOROETHENE	4.50E-04 J	7.80E-04 J	MG/KG	AOCHSB009	5/19	0.00032 - 0.00045	7.80E-04	NA	4.13E+01 NC	3.00E-02	SSL	NO	BSL
	107-06-2	1,2-DICHLOROETHANE	2.00E-03 J	2.00E-03 J	MG/KG	AOCHSB015	1/19	0.00017 - 0.00024	2.00E-03	NA	6.03E-01 CA*	1.00E-02	SSL	NO	BSL
	75-09-2	METHYLENE CHLORIDE	5.80E-04 J	5.80E-04 J	MG/KG	AOCHSB006	1/19	0.00026 - 0.00036	5.80E-04	NA	2.05E+01 CA	1.00E-02	SSL	NO	BSL
	127-18-4	TETRACHLOROETHYLENE(PCE)	3.10E-04 J	1.60E-03 J	MG/KG	AOCHSB003	2/19	0.00018 - 0.00025	1.60E-03	NA	3.42E+00 CA*	3.00E-02	SSL	NO	BSL
	108-88-3	TOLUENE	4.00E-04 J	4.00E-04 J	MG/KG	AOCHSB011	1/19	0.00016 - 0.00023	4.00E-04	NA	5.20E+02 SAT	6.00E+00	SSL	NO	BSL
	79-01-6	TRICHLOROETHYLENE (TCE)	3.40E-04 J	3.40E-04 J	MG/KG	AOCHSB011	1/19	0.00023 - 0.00032	3.40E-04	NA	1.15E-01 CA	3.00E-02	SSL	NO	BSL
	91-57-6	2-METHYLNAPHTHALENE	1.76E-01 J	1.76E-01 J	MG/KG	AOCHSB008	1/32	0.023 - 0.153	1.76E-01	NA				NO	BSL
	56-55-3	BENZO(a)ANTHRACENE	6.80E-02 J	6.80E-02 J	MG/KG	AOCHSB008	1/32	0.02 - 0.135	6.80E-02	NA	2.11E+00 CA	8.00E-01	SSL	NO	BSL
	50-32-8	BENZO(a)PYRENE	7.10E-02 J	7.10E-02 J	MG/KG	AOCHSB008	1/32	0.0215 - 0.174	7.10E-02	NA	2.11E-01 CA	4.00E+00	SSL	NO	BSL
	205-99-2	BENZO(b)FLUORANTHENE	1.04E-01 J	1.04E-01 J	MG/KG	AOCHSB008	1/32	0.0164 - 0.153	1.04E-01	NA	2.11E+00 CA	2.00E+00	SSL	NO	BSL
	207-08-9	BENZO(k)FLUORANTHENE	8.80E-02 J	8.80E-02 J	MG/KG	AOCHSB008	1/32	0.0174 - 0.185	8.80E-02	NA	2.11E+01 CA	2.00E+01	SSL	NO	BSL
	218-01-9	CHRYSENE	1.21E-01 J	1.21E-01 J	MG/KG	AOCHSB008	1/32	0.0205 - 0.148	1.21E-01	NA	2.11E+02 CA	8.00E+01	SSL	NO	BSL
	132-64-9	DIBENZOFURAN	5.10E-02 J	5.10E-02 J	MG/KG	AOCHSB008	1/32	0.02 - 0.135	5.10E-02	NA	3.13E+02 NC	NA	NA	NO	BSL
	206-44-0	FLUORANTHENE	8.90E-02 J	8.90E-02 J	MG/KG	AOCHSB008	1/32	0.0184 - 0.161	8.90E-02	NA	2.20E+03 NC	2.10E+03	SSL	NO	BSL
	91-20-3	NAPHTHALENE	9.00E-02 J	9.00E-02 J	MG/KG	AOCHSB008	1/32	0.028 - 0.192	9.00E-02	NA	1.88E+01 NC	4.00E+01	SSL	NO	BSL
	85-01-8	PHENANTHRENE	1.44E-01 J	1.44E-01 J	MG/KG	AOCHSB008	1/32	0.0174 - 0.151	1.44E-01	NA	2.91E+03 NC	2.10E+03	SSL	NO	BSL
	129-00-0	PYRENE	9.70E-02 J	9.70E-02 J	MG/KG	AOCHSB008	1/32	0.022 - 0.146	9.70E-02	NA	2.91E+03 NC	2.10E+03	SSL	NO	BSL
	72-54-8	p,p'-DDD	1.90E-04 J	1.30E-02	MG/KG	AOCHSB012	6/31	0.00013 - 0.0015	1.30E-02	NA	9.95E+00 CA	8.00E+00	SSL	NO	BSL
	72-55-9	p,p'-DDE	1.40E-04 J	7.64E-01 J	MG/KG	AOCHSB001	18/32	0.000055 - 0.034	7.64E-01	NA	7.02E+00 CA	3.00E+01	SSL	NO	BSL
	50-29-3	p,p'-DDT	4.80E-04 J	9.28E-01 J	MG/KG	AOCHSB001	8/32	0.0002 - 0.039	9.28E-01	NA	7.02E+00 CA*	2.00E+01	SSL	NO	BSL
	7429-90-5	ALUMINUM	2.11E+03	1.10E+04	MG/KG	AOCHSB009	32/32	1.38 - 9.5	1.10E+04	NA	1.00E+05 MAX	NA	NA	NO	BSL
	7440-36-0	ANTIMONY	1.40E-01 J	9.00E-01 J	MG/KG	AOCHSB001	17/32	0.0889 - 0.24	9.00E-01	NA	4.09E+01 NC	3.00E+00	SSL	NO	BSL
	7440-38-2	ARSENIC	1.61E-01 J	2.40E+01	MG/KG	AOCHSB001	22/32	0.13 - 0.29	2.40E+01	NA	1.59E+00 CA	NA	NA	YES	ASL
	7440-39-3	BARIUM	2.00E+01 J	2.00E+02	MG/KG	AOCHSB007	32/32	0.00857 - 0.0103	2.00E+02	NA	6.66E+03 NC	8.20E+02	SSL	NO	BSL
	7440-41-7	BERYLLIUM	4.79E-02 J	4.80E-01 J	MG/KG	AOCHSB009	26/32	0.0135 - 0.03	4.80E-01	NA	1.94E+03 CA**	3.00E+01	SSL	NO	BSL
	7440-43-9	CADMIUM	3.67E-02 J	2.19E-01 J	MG/KG	NDAHSB18	3/32	0.0118 - 0.02	2.19E-01	NA	4.51E+01 NC	4.00E+00	SSL	NO	BSL
	7440-70-2	CALCIUM	1.07E+03	3.40E+04	MG/KG	AOCHSB008	32/32	2.63 - 3.16	3.40E+04	NA	NA	NA	NA	NO	NUT
	7440-47-3	CHROMIUM, TOTAL	3.28E+00	2.70E+01	MG/KG	AOCHSB009	32/32	0.038 - 0.08	2.70E+01	NA	6.40E+01 CA	2.00E+01	SSL	NO	BSL
	7440-48-4	COBALT	2.20E+00 J	1.60E+01	MG/KG	AOCHSB007	32/32	0.0308 - 0.04	1.60E+01	NA	1.92E+03 CA*	NA	NA	NO	BSL
	7440-50-8	COPPER	7.00E+00	5.00E+01	MG/KG	AOCHSB008	32/32	0.0603 - 0.08	5.00E+01	NA	4.09E+03 NC	NA	NA	NO	BSL
	7439-89-6	IRON	6.66E+03 J	2.80E+04	MG/KG	AOCHSB009	32/32	1.07 - 2.5	2.80E+04	NA	1.00E+05 MAX	NA	NA	NO	BSL
	7439-92-1	LEAD	7.50E-01	4.80E+01	MG/KG	AOCHSB008	32/32	0.16 - 0.213	4.80E+01	NA	7.50E+02 NC	NA	NA	NO	BSL
	7439-95-4	MAGNESIUM	7.48E+02 J	4.20E+03	MG/KG	AOCHSB009	32/32	0.13 - 1.27	4.20E+03	NA	NA	NA	NA	NO	NUT
	7439-96-5	MANGANESE	8.04E+01	1.00E+03	MG/KG	AOCHSB007	32/32	0.0191 - 0.0461	1.00E+03	NA	1.95E+03 NC	NA	NA	NO	BSL
	7439-97-6	MERCURY	3.18E-03 J	7.19E-02 J	MG/KG	NDAHSB18	24/32	0.00124 - 0.0025	7.19E-02	NA	6.16E+00 NC	NA	NA	NO	BSL
	7440-02-0	NICKEL	1.13E+00 J	9.20E+00 J	MG/KG	AOCHSB009	32/32	0.0523 - 0.09	9.20E+00	NA	2.04E+03 NC	7.00E+01	SSL	NO	BSL
	7440-09-7	POTASSIUM	4.40E+02 J	2.70E+03	MG/KG	AOCHSB003	32/32	2.59 - 3.13	2.70E+03	NA	NA	NA	NA	NO	NUT
	7782-49-2	SELENIUM	1.99E-01 J	1.30E+00	MG/KG	AOCHSB003	25/32	0.186 - 0.46	1.30E+00	NA	5.11E+02 NC	3.00E+00	SSL	NO	BSL
	7440-22-4	SILVER	2.42E-02 J	4.37E-02 J	MG/KG	NDAHSB17	4/32	0.0225 - 0.05	4.37E-02	NA	5.11E+02 NC	2.00E+01	SSL	NO	BSL

Table 2.2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Subsurface Soil
Exposure Medium: Subsurface Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-23-5	SODIUM	4.30E+01 J	8.50E+02 J	MG/KG	AOCHSB009	32/32	1.47 - 20	8.50E+02	NA	NA	NA	NA	NO	NUT
	7440-28-0	THALLIUM	2.40E-01 J	9.54E-01 J	MG/KG	NDAHSB29	14/32	0.114 - 0.34	9.54E-01	NA	6.75E+00 NC	NA	NA	NO	BSL
	7440-62-2	VANADIUM	1.90E+01	7.90E+01	MG/KG	AOCHSB009	32/32	0.034 - 0.07	7.90E+01	NA	7.15E+02 NC	3.00E+03	SSL	NO	BSL
	7440-66-6	ZINC	8.80E+00	1.55E+02 J	MG/KG	NDAHSB18	32/32	0.0604 - 0.5	1.55E+02	NA	1.00E+05 MAX	6.20E+03	SSL	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] EPA Region 9 PRGs Table, October 1, 2002, U.S. EPA Region 9.
PRG value for xylenes used as surrogate for m,p-xylene and o-xylene.
PRG value for 2-methylnaphthalene calculated using provisional reference dose and methods described in
Region 9 PRGs Table Users Guide/Technical Background Document, October 1, 2002, U.S. EPA Region 9.
PRG value for 2-nitroaniline used as surrogate for 3-nitroaniline.
PRG value for pyrene used as surrogate for phenanthrene.
PRG value for chromium VI used for total chromium.
PRG value for mercury chloride used as surrogate for mercury.
Lead screening toxicity value is 750 mg/kg, the EPA industrial soil screening level for lead.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

SSL = Soil Screening Level; Dilution Attenuation Factor = 10 (USEPA, October 2002)
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
CA = Carcinogenic
NC = Noncarcinogenic
CA* (where: NC < 100X CA)
CA**(where: NC < 10X CA)
MAX = Ceiling Limit

Table 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
AOC H Groundwater	108-88-3	TOLUENE	1.00E+00	1.30E+00	µg/L	AOC-H-MW01, AOC-H-MW02	4/4	0.28 - 0.28	1.30E+00	NA	7.23E+01 NC	1.00E+03	MCL	NO	BSL
	106-47-8	4-CHLOROANILINE	9.90E+00	9.90E+00	µg/L	NDAHMW05	1/9	0.35 - 0.4	9.90E+00	NA	1.46E+01 NC	NA	NA	NO	BSL
	105-60-2	CAPROLACTAM	6.00E+00 J	6.20E+00 J	µg/L	NDAHMW01	2/2	0.3 - 0.3	6.20E+00	NA	1.82E+03 NC	NA	NA	NO	BSL
	72-54-8	p,p'-DDD	3.90E-01	4.20E-01 J	µg/L	AOC-H-MW02	3/9	0.004 - 0.028	4.20E-01	NA	2.80E-01 CA	NA	NA	YES	ASL
	72-55-9	p,p'-DDE	1.80E-02 J	2.20E-02 J	µg/L	AOC-H-MW02	2/9	0.0056 - 0.014	2.20E-02	NA	1.98E-01 CA	NA	NA	NO	BSL
	50-29-3	p,p'-DDT	2.80E-02 J	2.80E-02 J	µg/L	AOC-H-MW04	1/9	0.0044 - 0.028	2.80E-02	NA	1.98E-01 CA*	NA	NA	NO	BSL
	7429-90-5	ALUMINUM	1.12E+02 J	9.10E+03	µg/L	AOC-H-MW02	9/9	35 - 350	9.10E+03	NA	3.65E+03 NC	5.00E+01	NSDWS	YES	ASL
	7440-36-0	ANTIMONY	2.62E+00 J	5.40E+00 J	µg/L	AOC-H-MW04	2/9	2.4 - 25	5.40E+00	NA	1.46E+00 NC	6.00E+00	MCL	YES	ASL
	7440-38-2	ARSENIC	6.30E+00 J	6.30E+00 J	µg/L	AOC-H-MW02	1/9	2.04 - 20.4	6.30E+00	NA	4.48E-02 CA	1.00E+01	MCL	YES	ASL
	7440-39-3	BARIUM	6.31E+01 J	4.90E+02	µg/L	AOC-H-MW02	9/9	0.13 - 4.91	4.90E+02	NA	2.55E+02 NC	2.00E+03	MCL	YES	ASL
	7440-43-9	CADMIUM	4.08E-01 J	4.46E+00 J	µg/L	NDAHMW07	3/9	0.27 - 3.56	4.46E+00	NA	1.82E+00 NC	5.00E+00	MCL	YES	ASL
	7440-70-2	CALCIUM	1.68E+04	7.19E+05	µg/L	NDAHMW05	9/9	28 - 325	7.19E+05	NA	NA	NA	NA	NO	NUT
	7440-47-3	CHROMIUM, TOTAL	5.20E+00 J	1.50E+01	µg/L	AOC-H-MW02	5/9	0.57 - 5.7	1.50E+01	NA	1.09E+01 NC	1.00E+02	MCL	YES	ASL
	7440-48-4	COBALT	5.10E+00 J	3.33E+01 J	µg/L	NDAHMW07	7/9	0.43 - 5.69	3.33E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7440-50-8	COPPER	1.41E+01 J	2.50E+01	µg/L	AOC-H-MW02	4/9	0.8 - 11.7	2.50E+01	NA	1.46E+02 NC	1.30E+03	AL	NO	BSL
	7439-89-6	IRON	8.30E+01 J	1.10E+04	µg/L	AOC-H-MW02	7/9	16.7 - 167	1.10E+04	NA	1.09E+03 NC	3.00E+02	NSDWS	YES	ASL
	7439-95-4	MAGNESIUM	1.29E+04	9.63E+05	µg/L	NDAHMW07	9/9	5.23 - 52.3	9.63E+05	NA	NA	NA	NA	NO	NUT
	7439-96-5	MANGANESE	2.50E+02	1.48E+04	µg/L	NDAHMW05	9/9	0.167 - 1.67	1.48E+04	NA	8.76E+01 NC	5.00E+01	NSDWS	YES	ASL
	7439-97-6	MERCURY	1.65E-02 J	2.40E-02 J	µg/L	NDAHMW07	2/9	0.0162 - 0.025	2.40E-02	NA	3.65E-01 NC	2.00E+00	MCL	NO	BSL
	7440-02-0	NICKEL	1.47E+00 J	5.90E+01	µg/L	AOC-H-MW02	8/9	0.93 - 9.97	5.90E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7440-09-7	POTASSIUM	1.87E+03 J	2.83E+05 J	µg/L	NDAHMW07	9/9	11.5 - 115	2.83E+05	NA	NA	NA	NA	NO	NUT
	7440-22-4	SILVER	5.27E-01 J	4.90E+00 J	µg/L	NDAHMW07	2/9	0.472 - 4.72	4.90E+00	NA	1.82E+01 NC	1.00E+02	NSDWS	NO	BSL
	7440-23-5	SODIUM	1.63E+05	6.95E+06	µg/L	NDAHMW07	9/9	22.7 - 227	6.95E+06	NA	NA	NA	NA	NO	NUT
	7440-28-0	THALLIUM	3.28E+00 J	4.42E+01 J	µg/L	NDAHMW07	6/9	2.54 - 25.4	4.42E+01	NA	2.41E-01 NC	2.00E+00	MCL	YES	ASL
	7440-62-2	VANADIUM	6.00E+00 J	7.00E+01	µg/L	AOC-H-MW02	7/9	0.447 - 4.47	7.00E+01	NA	2.55E+01 NC	NA	NA	YES	ASL
	7440-66-6	ZINC	8.08E-01 J	3.30E+01	µg/L	AOC-H-MW02	5/9	0.409 - 5	3.30E+01	NA	1.09E+03 NC	5.00E+03	NSDWS	NO	BSL
	7429-90-5	ALUMINUM, DISSOLVED	4.77E+01 J	4.38E+02 J	µg/L	NDAHMW07	4/9	35 - 350	4.38E+02	NA	3.65E+03 NC	2.00E+02	NSDWS	NO	BSL
	7440-36-0	ANTIMONY, DISSOLVED	5.40E+00 J	5.40E+00 J	µg/L	AOC-H-MW04	1/9	2.4 - 25	5.40E+00	NA	1.46E+00 NC	6.00E+00	MCL	YES	ASL
	7440-39-3	BARIUM, DISSOLVED	5.10E+01 J	4.60E+02	µg/L	AOC-H-MW02	9/9	0.13 - 4.91	4.60E+02	NA	2.55E+02 NC	2.00E+03	MCL	YES	ASL
	7440-43-9	CADMIUM, DISSOLVED	4.99E+00 J	6.30E+00 J	µg/L	NDAHMW05	3/9	0.27 - 3.56	6.30E+00	NA	1.82E+00 NC	5.00E+00	MCL	YES	ASL
	7440-70-2	CALCIUM, DISSOLVED	1.51E+04	7.12E+05	µg/L	NDAHMW05	9/9	28 - 325	7.12E+05	NA	NA	NA	NA	NO	NUT
	7440-47-3	CHROMIUM, DISSOLVED	8.10E-01 J	7.91E+00 J	µg/L	NDAHMW02	3/9	0.57 - 5.7	7.91E+00	NA	1.09E+01 NC	1.00E+02	MCL	NO	BSL
	7440-48-4	COBALT, DISSOLVED	6.26E-01 J	4.04E+01 J	µg/L	NDAHMW07	4/9	0.43 - 5.69	4.04E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7440-50-8	COPPER, DISSOLVED	4.58E+00 J	4.58E+00 J	µg/L	NDAHMW01	1/9	0.8 - 11.7	4.58E+00	NA	1.46E+02 NC	1.30E+03	AL	NO	BSL
	7439-89-6	IRON, DISSOLVED	1.69E+01 J	4.18E+03	µg/L	NDAHMW05	4/9	16.7 - 167	4.18E+03	NA	1.09E+03 NC	3.00E+02	NSDWS	YES	ASL
	7439-92-1	LEAD, DISSOLVED	1.78E+00 J	1.78E+00 J	µg/L	NDAHMW01	1/9	1.6 - 17.6	1.78E+00	NA	NA	1.50E+01	AL	NO	BSL
	7439-95-4	MAGNESIUM, DISSOLVED	1.03E+04	1.02E+06	µg/L	NDAHMW07	9/9	5.23 - 52.3	1.02E+06	NA	NA	NA	NA	NO	NUT
	7439-96-5	MANGANESE, DISSOLVED	4.11E+01	1.54E+04	µg/L	NDAHMW05	9/9	0.167 - 1.67	1.54E+04	NA	8.76E+01 NC	5.00E+00	NSDWS	YES	ASL
	7439-97-6	MERCURY, DISSOLVED	1.94E-02 J	1.94E-02 J	µg/L	NDAHMW07	1/9	0.0162 - 0.025	1.94E-02	NA	3.65E-01 NC	2.00E+00	MCL	NO	BSL

Table 2.3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-02-0	NICKEL, DISSOLVED	7.70E+00 J	1.76E+01 J	µg/L	NDAHMW02	3/9	0.93 - 9.97	1.76E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7440-09-7	POTASSIUM, DISSOLVED	2.17E+03 J	2.94E+05 J	µg/L	NDAHMW07	9/9	11.5 - 115	2.94E+05	NA	NA	NA	NA	NO	NUT
	7782-49-2	SELENIUM, DISSOLVED	3.56E+00 J	3.73E+00 J	µg/L	NDAHMW01	2/9	2.1 - 21	3.73E+00	NA	1.82E+01 NC	5.00E+01	MCL	NO	BSL
	7440-22-4	SILVER, DISSOLVED	7.15E+00 J	7.15E+00 J	µg/L	NDAHMW07	1/9	0.472 - 4.72	7.15E+00	NA	1.82E+01 NC	1.00E+02	NSDWS	NO	BSL
	7440-23-5	SODIUM, DISSOLVED	1.63E+05	7.20E+06	µg/L	NDAHMW07	9/9	22.7 - 227	7.20E+06	NA	NA	NA	NA	NO	NUT
	7440-28-0	THALLIUM, DISSOLVED	9.00E+00 J	2.62E+01 J	µg/L	NDAHMW05	2/9	2.54 - 25.4	2.62E+01	NA	2.41E-01 NC	2.00E+00	MCL	YES	ASL
	7440-62-2	VANADIUM, DISSOLVED	2.80E+00 J	2.00E+01 J	µg/L	AOC-H-MW01	6/9	0.447 - 4.47	2.00E+01	NA	2.55E+01 NC	NA	NA	NO	BSL
	7440-66-6	ZINC, DISSOLVED	4.89E-01 J	1.66E+00 J	µg/L	NDAHMW01	2/9	0.409 - 5	1.66E+00	NA	1.09E+03 NC	5.00E+03	NSDWS	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] EPA Region 9 PRGs Table, October 1, 2002, U.S. EPA Region 9.
PRG value for chromium VI used for total chromium.
PRG value for mercury chloride used as surrogate for mercury.
Lead action level is 15 µg/L.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

MCL = Maximum Contaminant Level from EPA's National Primary Drinking Water Standards
The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
NSDWS = National Secondary Drinking Water Standards are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water.
AL = Action Level
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
CA = Carcinogenic
NC = Noncarcinogenic
CA* (where: NC < 100X CA)

Table 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
AOC H Sediment	72-55-9	p,p'-DDE	1.20E-04 J	1.20E-04 J	MG/KG	NDAHSD04	1/4	0.00007 - 0.000073	1.20E-04	NA	1.72E+00 CA	3.00E+01	SSL	NO	BSL
	7429-90-5	ALUMINUM	1.88E+03 =	3.32E+03 =	MG/KG	NDAHSD01	4/4	1.22 - 1.41	3.32E+03	NA	7.61E+03 NC	NA	NA	NO	BSL
	7440-36-0	ANTIMONY	1.07E-01 J	3.33E-01 J	MG/KG	NDAHSD01	2/4	0.078 - 0.0908	3.33E-01	NA	3.13E+00 NC	3.00E+00	SSL	NO	BSL
	7440-38-2	ARSENIC	2.02E-01 J	8.82E-01 J	MG/KG	NDAHSD01	3/4	0.114 - 0.132	8.82E-01	NA	3.90E-01 CA*	1.00E+01	SSL	YES	BSL
	7440-39-3	BARIUM	6.00E+00 J	5.72E+01 =	MG/KG	NDAHSD02	4/4	0.00752 - 0.00875	5.72E+01	NA	5.37E+02 NC	8.20E+02	SSL	NO	BSL
	7440-41-7	BERYLLIUM	3.79E-02 J	6.47E-02 J	MG/KG	NDAHSD02	4/4	0.0119 - 0.0138	6.47E-02	NA	1.54E+01 NC	3.00E+01	SSL	NO	BSL
	7440-70-2	CALCIUM	8.90E+02 =	2.66E+03 =	MG/KG	NDAHSD02	4/4	2.42 - 12.1	2.66E+03	NA	NA	NA	NA	NO	NUT
	7440-47-3	CHROMIUM, TOTAL	3.11E+00 =	1.34E+01 J	MG/KG	NDAHSD01	4/4	0.0334 - 0.0388	1.34E+01	NA	3.01E+01 CA**	2.00E+01	SSL	NO	BSL
	7440-48-4	COBALT	2.31E+00 J	4.27E+00 J	MG/KG	NDAHSD04	4/4	0.027 - 0.0314	4.27E+00	NA	9.03E+02 CA**	NA	NA	NO	BSL
	7440-50-8	COPPER	6.15E+00 =	9.76E+00 =	MG/KG	NDAHSD02	4/4	0.0529 - 0.0616	9.76E+00	NA	3.13E+02 NC	NA	NA	NO	BSL
	7439-89-6	IRON	6.04E+03 =	8.62E+03 =	MG/KG	NDAHSD04	4/4	0.942 - 1.1	8.62E+03	NA	2.35E+03 NC	NA	NA	YES	BSL
	7439-92-1	LEAD	8.53E-01 =	1.49E+00 =	MG/KG	NDAHSD02	4/4	0.155 - 0.181	1.49E+00	NA	4.00E+02 NC	NA	NA	NO	BSL
	7439-95-4	MAGNESIUM	1.14E+03 =	3.43E+03 =	MG/KG	NDAHSD01	4/4	0.928 - 1.08	3.43E+03	NA	NA	NA	NA	NO	NUT
	7439-96-5	MANGANESE	6.21E+01 =	1.09E+02 =	MG/KG	NDAHSD02	4/4	0.0168 - 0.0195	1.09E+02	NA	1.76E+02 NC	NA	NA	NO	BSL
	7439-97-6	MERCURY	1.81E-03 J	1.27E-02 J	MG/KG	NDAHSD02	3/4	0.00108 - 0.00139	1.27E-02	NA	6.11E-01 NC	NA	NA	NO	BSL
	7440-02-0	NICKEL	1.28E+00 J	4.39E+00 J	MG/KG	NDAHSD01	4/4	0.0459 - 0.0534	4.39E+00	NA	1.56E+02 NC	7.00E+01	SSL	NO	BSL
	7440-09-7	POTASSIUM	7.16E+02 J	1.09E+03 =	MG/KG	NDAHSD04	4/4	2.28 - 2.65	1.09E+03	NA	NA	NA	NA	NO	NUT
	7440-22-4	SILVER	2.68E-02 J	2.68E-02 J	MG/KG	NDAHSD04	1/4	0.0197 - 0.023	2.68E-02	NA	3.91E+01 NC	2.00E+01	SSL	NO	BSL
	7440-23-5	SODIUM	2.34E+03 =	3.29E+03 =	MG/KG	NDAHSD01	4/4	1.29 - 1.5	3.29E+03	NA	NA	NA	NA	NO	NUT
	7440-28-0	THALLIUM	4.22E-01 J	4.94E-01 J	MG/KG	NDAHSD02	3/4	0.0998 - 0.116	4.94E-01	NA	5.16E-01 NC	NA	NA	YES	BSL
	7440-62-2	VANADIUM	1.73E+01 =	2.69E+01 =	MG/KG	NDAHSD02	4/4	0.0298 - 0.0347	2.69E+01	NA	5.47E+01 NC	3.00E+03	SSL	NO	BSL
	7440-66-6	ZINC	7.31E+00 =	1.36E+01 =	MG/KG	NDAHSD04	4/4	0.053 - 0.0616	1.36E+01	NA	2.35E+03 NC	6.20E+03	SSL	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] EPA Region 9 PRGs Table, October 1, 2002, U.S. EPA Region 9.
PRG value for chromium VI used for total chromium.
PRG value for mercury chloride used as surrogate for mercury.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

SSL = Soil Screening Level; Dilution Attenuation Factor = 10 (USEPA, October 2002)
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/
To Be Considered
J = Estimated Value
NC = Noncarcinogenic
CA = Carcinogenic
CA**(where: NC < 10X CA)

Table 2.4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Sediment
Exposure Medium: Sediment

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection

Table 2.5

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Surface Water

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
AOC H Surface Water	105-60-2	CAPROLACTAM	5.20E-01 J	5.20E-01 J	µg/L	NDAHSW01	1/1	0.3 - 0.3	5.20E-01	NA	1.82E+03 NC	NA	NA	NO	BSL
	7429-90-5	ALUMINUM	1.74E+03 J	1.74E+03 J	µg/L	NDAHSW02	1/4	700 - 700	1.74E+03	NA	3.65E+03 NC	NA	NA	NO	BSL
	7440-38-2	ARSENIC	4.71E+01 J	4.71E+01 J	µg/L	NDAHSW02	1/4	40.8 - 40.8	4.71E+01	NA	4.48E-02 CA	NA	NA	YES	ASL
	7440-39-3	BARIUM	1.46E+02 J	1.62E+02 J	µg/L	NDAHSW02	4/4	9.82 - 9.82	1.62E+02	NA	2.55E+02 NC	NA	NA	NO	BSL
	7440-43-9	CADMIUM	7.70E+00 J	7.70E+00 J	µg/L	NDAHSW02	1/4	7.12 - 7.12	7.70E+00	NA	1.82E+00 NC	NA	NA	YES	ASL
	7440-70-2	CALCIUM	3.55E+05	3.83E+05	µg/L	NDAHSW03	4/4	650 - 650	3.83E+05	NA	NA	NA	NA	NO	NUT
	7440-47-3	CHROMIUM, TOTAL	1.62E+01 J	1.62E+01 J	µg/L	NDAHSW02	1/4	11.4 - 11.4	1.62E+01	NA	1.09E+01 NC	NA	NA	YES	ASL
	7440-48-4	COBALT	1.96E+01 J	1.96E+01 J	µg/L	NDAHSW02	1/4	11.4 - 11.4	1.96E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7439-95-4	MAGNESIUM	9.61E+05	1.05E+06	µg/L	NDAHSW03	4/4	105 - 105	1.05E+06	NA	NA	NA	NA	NO	NUT
	7439-96-5	MANGANESE	3.85E+02	6.54E+02	µg/L	NDAHSW03	4/4	3.34 - 3.34	6.54E+02	NA	8.76E+01 NC	NA	NA	YES	ASL
	7439-97-6	MERCURY	2.25E-02 J	4.30E-02 J	µg/L	NDAHSW03	4/4	0.0162 - 0.0162	4.30E-02	NA	3.65E-01 NC	NA	NA	NO	BSL
	7440-09-7	POTASSIUM	4.70E+05 J	4.82E+05 J	µg/L	NDAHSW03	4/4	230 - 230	4.82E+05	NA	NA	NA	NA	NO	NUT
	7782-49-2	SELENIUM	6.39E+01 J	6.39E+01 J	µg/L	NDAHSW02	1/4	42 - 42	6.39E+01	NA	1.82E+01 NC	NA	NA	YES	ASL
	7440-23-5	SODIUM	7.48E+06	7.74E+06	µg/L	NDAHSW03	4/4	454 - 454	7.74E+06	NA	NA	NA	NA	NO	NUT
	7440-39-3	BARIUM, DISSOLVED	1.42E+02 J	1.63E+02 J	µg/L	NDAHSW02	4/4	9.82 - 9.82	1.63E+02	NA	2.55E+02 NC	NA	NA	NO	BSL
	7440-70-2	CALCIUM, DISSOLVED	3.35E+05	3.46E+05	µg/L	NDAHSW01	4/4	650 - 650	3.46E+05	NA	NA	NA	NA	NO	NUT
	7439-95-4	MAGNESIUM, DISSOLVED	7.40E+06	7.75E+06	µg/L	NDAHSW01	4/4	454 - 454	7.75E+06	NA	NA	NA	NA	NO	NUT
	7439-96-5	MANGANESE, DISSOLVED	9.02E+05	9.39E+05	µg/L	NDAHSW01	4/4	105 - 105	9.39E+05	NA	8.76E+01 NC	NA	NA	YES	ASL
	7439-97-6	MERCURY, DISSOLVED	7.00E+01 J	4.19E+02 J	µg/L	NDAHSW04	4/4	3.34 - 3.34	4.19E+02	NA	3.65E-01 NC	NA	NA	YES	ASL
	7440-09-7	POTASSIUM, DISSOLVED	2.24E-02 J	3.03E-02 J	µg/L	NDAHSW03	2/4	0.0162 - 0.0162	3.03E-02	NA	NA	NA	NA	NO	NUT
	7782-49-2	SELENIUM, DISSOLVED	4.60E+05	4.86E+05	µg/L	NDAHSW01	4/4	230 - 230	4.86E+05	NA	1.82E+01 NC	NA	NA	YES	ASL
	7440-23-5	SODIUM, DISSOLVED	6.79E+01 J	6.79E+01 J	µg/L	NDAHSW01	1/4	42 - 42	6.79E+01	NA	NA	NA	NA	NO	NUT

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] EPA Region 9 PRGs Table, October 1, 2002, U.S. EPA Region 9.
PRG value for chromium VI used for total chromium.
PRG value for mercuric chloride used as surrogate for mercury.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
CA = Carcinogenic
NC = Noncarcinogenic
CA* (where: NC < 100X CA)
CA**(where: NC < 10X CA)

Table 2.6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Total Soil (0-6 ft)
Exposure Medium: Total Soil (0-6 ft)

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
AOC H Total Soil (0-6 ft)	72-54-8	p,p'-DDD	1.90E-04 J	1.30E-02	MG/KG	AOCHSB012	17 / 59	3.40E-03 - 1.80E-01	1.30E-02	NA	9.95E+00 CA	8.00E+00	SSL	NO	BSL
	72-55-9	p,p'-DDE	1.40E-04 J	3.99E+00 J	MG/KG	AOCHSB001	39 / 61	3.40E-03 - 1.77E+00	3.99E+00	NA	7.02E+00 CA	3.00E+01	SSL	NO	BSL
	50-29-3	p,p'-DDT	4.80E-04 J	1.94E+00 J	MG/KG	AOCHSB001	27 / 61	3.40E-03 - 3.92E-01	1.94E+00	NA	7.02E+00 CA*	2.00E+01	SSL	NO	BSL
	72-43-5	Methoxychlor	7.40E-04 J	7.40E-04 J	MG/KG	NDAHSS19	1 / 60	1.70E-02 - 1.90E-01	7.40E-04	NA	3.08E+02 NC	8.00E+01	SSL	NO	BSL
	606-20-2	2,6-Dinitrotoluene	1.21E+00	1.23E+00	MG/KG	AOCHSB013	2 / 88	1.27E-01 - 2.82E+01	1.23E+00	NA	6.16E+01 NC	3.00E-04	SSL	NO	BSL
	91-57-6	2-Methylnaphthalene	2.80E-02 J	1.90E-01 J	MG/KG	AOCHSB009	6 / 61	3.38E-01 - 2.82E+01	1.90E-01	NA	3.82E+02 CA	NA	NA	NO	BSL
	99-09-2	3-Nitroaniline	4.80E-02 J	4.80E-02 J	MG/KG	AOCHSB013	1 / 62	1.01E+00 - 8.45E+01	4.80E-02	NA	1.76E+00 NC	NA	NA	NO	BSL
	101-55-3	4-Bromophenyl-phenylether	2.17E-01 J	2.67E-01 J	MG/KG	AOCHSB013	3 / 62	3.38E-01 - 2.82E+01	2.67E-01	NA	7.35E+00 CA	NA	NA	NO	BSL
	56-55-3	Benzo(a)anthracene	2.90E-02 J	1.12E-01 J	MG/KG	AOCHSB004	10 / 62	3.38E-01 - 2.82E+01	1.12E-01	NA	2.11E+00 CA	8.00E-01	SSL	NO	BSL
	50-32-8	Benzo(a)pyrene	2.57E-02 J	1.20E-01 J	MG/KG	AOCHSB004	15 / 62	3.38E-01 - 2.82E+01	1.20E-01	NA	2.11E-01 CA	4.00E+00	SSL	NO	BSL
	205-99-2	Benzo(b)fluoranthene	1.87E-02 J	1.33E-01 J	MG/KG	AOCHSB004	19 / 62	3.38E-01 - 2.82E+01	1.33E-01	NA	2.11E+00 CA	2.00E+00	SSL	NO	BSL
	191-24-2	Benzo(g,h,i)perylene	2.17E-02 J	6.00E-02 J	MG/KG	AOCHSS002	10 / 62	3.38E-01 - 2.82E+01	6.00E-02	NA	2.91E+02 NC	2.10E+03	SSL	NO	BSL
	207-08-9	Benzo(k)fluoranthene	1.96E-02 J	1.24E-01 J	MG/KG	AOCHSB004	16 / 62	3.38E-01 - 2.82E+01	1.24E-01	NA	2.11E+01 CA	2.00E+01	SSL	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	7.29E-02 J	1.17E-01 J	MG/KG	NDAHSS24	8 / 62	3.38E-01 - 2.82E+01	1.17E-01	NA	1.23E+02 CA	NA	NA	NO	BSL
	218-01-9	Chrysene	2.25E-02 J	1.55E-01 J	MG/KG	AOCHSB004	18 / 62	3.38E-01 - 2.82E+01	1.55E-01	NA	2.11E+02 CA	8.00E+01	SSL	NO	BSL
	132-64-9	Dibenzofuran	2.94E-02 J	5.10E-02 J	MG/KG	AOCHSB008	3 / 62	3.38E-01 - 2.82E+01	5.10E-02	NA	3.13E+02 NC	NA	NA	NO	BSL
	206-44-0	Fluoranthene	2.46E-02 J	1.87E-01 J	MG/KG	AOCHSB004	16 / 62	3.38E-01 - 2.82E+01	1.87E-01	NA	2.20E+03 NC	2.10E+03	SSL	NO	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	2.60E-02 J	8.48E-02 J	MG/KG	NDAHSS24	8 / 62	3.38E-01 - 2.82E+01	8.48E-02	NA	2.11E+00 CA	7.00E+00	SSL	NO	BSL
	78-59-1	Isophorone	1.06E-01 J	1.12E-01 J	MG/KG	AOCHSB012	2 / 62	3.38E-01 - 2.82E+01	1.12E-01	NA	1.81E+03 CA*	3.00E-01	SSL	NO	BSL
	91-20-3	Naphthalene	4.24E-02 J	9.00E-02 J	MG/KG	AOCHSB008	3 / 61	3.38E-01 - 2.82E+01	9.00E-02	NA	1.88E+01 NC	4.00E+01	SSL	NO	BSL
	621-64-7	N-Nitroso-di-n-propylamine	5.62E-01 J	7.17E-01	MG/KG	AOCHSB013	3 / 62	3.38E-01 - 2.82E+01	7.17E-01	NA	2.46E-01 CA	2.00E-05	SSL	YES	ASL
	85-01-8	Phenanthrene	2.11E-02 J	1.44E-01 J	MG/KG	AOCHSB008	8 / 62	3.38E-01 - 2.82E+01	1.44E-01	NA	2.91E+03 NC	2.10E+03	SSL	NO	BSL
	129-00-0	Pyrene	2.82E-02 J	1.90E+00 J	MG/KG	AOCHSS001	17 / 62	3.38E-01 - 2.82E+01	1.90E+00	NA	2.91E+03 NC	2.10E+03	SSL	NO	BSL
	75-35-4	1,1-Dichloroethene	4.50E-04 J	7.80E-04 J	MG/KG	AOCHSB009	5 / 36	1.00E-02 - 9.48E-01	7.80E-04	NA	4.13E+01 NC	3.00E-02	SSL	NO	BSL
	107-06-2	1,2-Dichloroethane	2.00E-03 J	2.00E-03 J	MG/KG	AOCHSB015	1 / 36	1.00E-02 - 9.48E-01	2.00E-03	NA	6.03E-01 CA*	1.00E-02	SSL	NO	BSL
	m&pXYLENE	m,p-Xylene	5.80E-02 J	5.80E-02 J	MG/KG	AOCHSS001	1 / 36	1.00E-02 - 9.48E-01	5.80E-02	NA	4.20E+02 SAT	1.00E+02	SSL	NO	BSL
	75-09-2	Methylene chloride	5.80E-04 J	5.80E-04 J	MG/KG	AOCHSB006	1 / 36	1.00E-02 - 9.48E-01	5.80E-04	NA	2.05E+01 CA	1.00E-02	SSL	NO	BSL
	95-47-6	o-Xylene	2.40E-02 J	2.40E-02 J	MG/KG	AOCHSS001	1 / 36	1.00E-02 - 9.48E-01	2.40E-02	NA	4.20E+02 SAT	1.00E+02	SSL	NO	BSL
	127-18-4	Tetrachloroethene	3.10E-04 J	1.60E-03 J	MG/KG	AOCHSB003	2 / 36	1.00E-02 - 9.48E-01	1.60E-03	NA	3.42E+00 CA*	3.00E-02	SSL	NO	BSL
	108-88-3	Toluene	4.00E-04 J	4.00E-04 J	MG/KG	AOCHSB011	1 / 36	1.00E-02 - 9.48E-01	4.00E-04	NA	5.20E+02 SAT	6.00E+00	SSL	NO	BSL
	79-01-6	Trichloroethene	3.40E-04 J	3.40E-04 J	MG/KG	AOCHSB011	1 / 36	1.00E-02 - 9.48E-01	3.40E-04	NA	1.15E-01 CA	3.00E-02	SSL	NO	BSL
	1330-20-7	Xylene (total)	8.20E-02 J	8.20E-02 J	MG/KG	AOCHSS001	1 / 36	1.00E-02 - 9.48E-01	8.20E-02	NA	4.20E+02 SAT	1.00E+02	SSL	NO	BSL
	7429-90-5	Aluminum	2.11E+03	1.10E+04 J	MG/KG	AOCHSB006, AOCHSS001	62 / 62	3.19E+01 - 4.80E+01	1.10E+04	NA	1.00E+05 MAX	NA	NA	NO	BSL
	7440-36-0	Antimony	1.40E-01 J	6.30E+00 J	MG/KG	AOCHSS003	40 / 62	9.56E+00 - 1.40E+01	6.30E+00	NA	4.09E+01 NC	3.00E+00	SSL	NO	BSL
	7440-38-2	Arsenic	1.61E-01 J	6.70E+01	MG/KG	AOCHSB010	53 / 62	1.59E+00 - 2.40E+00	6.70E+01	NA	1.59E+00 CA	NA	NA	YES	ASL
	7440-39-3	Barium	2.00E+01 J	2.90E+02 J	MG/KG	AOCHSB010	62 / 62	3.19E+01 - 4.80E+01	2.90E+02	NA	6.66E+03 NC	8.20E+02	SSL	NO	BSL
	7440-41-7	Beryllium	4.79E-02 J	2.60E-01 J	MG/KG	AOCHSB010, AOCHSB016	45 / 62	7.97E-01 - 1.20E+00	2.60E-01	NA	1.94E+03 CA**	3.00E+01	SSL	NO	BSL
	7440-43-9	Cadmium	3.67E-02 J	2.91E-01 J	MG/KG	NDAHSS26	16 / 62	7.97E-01 - 1.20E+00	2.91E-01	NA	4.51E+01 NC	4.00E+00	SSL	NO	BSL
	7440-70-2	Calcium	1.07E+03	3.40E+04	MG/KG	AOCHSB008, AOCHSS004	62 / 62	7.97E+02 - 1.20E+03	3.40E+04	NA	NA	NA	NA	NO	NUT

Table 2.6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Total Soil (0-6 ft)
Exposure Medium: Total Soil (0-6 ft)

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-47-3	Chromium	3.28E+00	5.00E+01	MG/KG	AOCHSS001	62 / 62	1.59E+00 - 2.40E+00	5.00E+01	NA	6.40E+01 CA	2.00E+01	SSL	NO	BSL
	7440-48-4	Cobalt	2.20E+00 J	1.60E+01	MG/KG	AOCHSB007	62 / 62	7.97E+00 - 1.20E+01	1.60E+01	NA	1.92E+03 CA*	NA	NA	NO	BSL
	7440-50-8	Copper	7.00E+00	1.00E+02	MG/KG	AOCHSB003	62 / 62	3.98E+00 - 6.00E+00	1.00E+02	NA	4.09E+03 NC	NA	NA	NO	BSL
	7439-89-6	Iron	6.66E+03 J	3.90E+04	MG/KG	AOCHSS003	62 / 62	1.59E+01 - 2.40E+01	3.90E+04	NA	1.00E+05 MAX	NA	NA	NO	BSL
	7439-92-1	Lead	7.50E-01	6.30E+01	MG/KG	AOCHSB009	62 / 62	4.78E-01 - 7.20E-01	6.30E+01	NA	7.50E+02 NC	NA	NA	NO	BSL
	7439-95-4	Magnesium	7.48E+02 J	8.40E+03	MG/KG	AOCHSB003	62 / 62	7.97E+02 - 1.20E+03	8.40E+03	NA	NA	NA	NA	NO	NUT
	7439-96-5	Manganese	8.04E+01	1.00E+03	MG/KG	AOCHSB007	62 / 62	2.39E+00 - 6.01E+00	1.00E+03	NA	1.95E+03 NC	NA	NA	NO	BSL
	7439-97-6	Mercury	3.18E-03 J	7.19E-02 J	MG/KG	NDAHSB18	56 / 62	2.34E-02 - 4.00E-02	7.19E-02	NA	6.16E+00 NC	NA	NA	NO	BSL
	7440-02-0	Nickel	1.13E+00 J	2.60E+01	MG/KG	AOCHSS003	62 / 62	6.37E+00 - 9.60E+00	2.60E+01	NA	2.04E+03 NC	7.00E+01	SSL	NO	BSL
	7440-09-7	Potassium	4.40E+02 J	3.40E+03	MG/KG	AOCHSB003	62 / 62	7.97E+02 - 1.20E+03	3.40E+03	NA	NA	NA	NA	NO	NUT
	7782-49-2	Selenium	1.99E-01 J	1.40E+00	MG/KG	AOCHSB005	45 / 62	7.97E-01 - 1.20E+00	1.40E+00	NA	5.11E+02 NC	3.00E+00	SSL	NO	BSL
	7440-22-4	Silver	2.42E-02 J	1.70E-01 J	MG/KG	AOCHSB007	16 / 62	1.59E+00 - 2.40E+00	1.70E-01	NA	5.11E+02 NC	2.00E+01	SSL	NO	BSL
	7440-23-5	Sodium	4.30E+01 J	7.37E+02 J	MG/KG	NDAHSB27	62 / 62	7.97E+02 - 1.20E+03	7.37E+02	NA	NA	NA	NA	NO	NUT
	7440-28-0	Thallium	2.40E-01 J	1.16E+00 J	MG/KG	NDAHSS18	26 / 62	1.59E+00 - 2.40E+00	1.16E+00	NA	6.75E+00 NC	NA	NA	NO	BSL
	7440-62-2	Vanadium	1.90E+01	6.50E+01	MG/KG	AOCHSB016	62 / 62	7.97E+00 - 1.20E+01	6.50E+01	NA	7.15E+02 NC	3.00E+03	SSL	NO	BSL
	7440-66-6	Zinc	8.80E+00	2.60E+02	MG/KG	AOCHSS003	62 / 62	3.19E+00 - 4.80E+00	2.60E+02	NA	1.00E+05 MAX	6.20E+03	SSL	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] EPA Region 9 PRGs Table, October 1, 2002, U.S. EPA Region 9.
PRG value for xylenes used as surrogate for m,p-xylene and o-xylene.
PRG value for 2-methylnaphthalene calculated using provisional reference dose and methods described in Region 9 PRGs Table Users Guide/Technical Background Document, October 1, 2002, U.S. EPA Region 9.
PRG value for 2-nitroaniline used as surrogate for 3-nitroaniline.
PRG value for Bis(2-chloroisopropyl) ether used as surrogate for 4-bromophenyl-phenylether.
PRG value for pyrene used as surrogate for benzo(ghi)perylene.
PRG value for pyrene used as surrogate for phenanthrene.
PRG value for chromium VI used for total chromium.
PRG value for mercury chloride used as surrogate for mercury.
[5] Rationale Codes
Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)

SSL = Soil Screening Level; Dilution Attenuation Factor = 10 (USEPA, October 2002)
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
CA = Carcinogenic
NC = Noncarcinogenic
CA* (where: NC < 100X CA)
CA**(where: NC < 10X CA)
MAX = Ceiling Limit

Table 2.7

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
AOC H Groundwater in Excavations	108-88-3	Toluene	4.30E-01 J	1.30E+00	UG/L	AOC-H-MW01, AOC-H-MW02	4 / 4	1.00E+00 - 1.00E+00	1.30E+00	NA	7.23E+01 NC	1.00E+03	MCL	NO	BSL
	106-47-8	4-Chloroaniline	9.90E+00	9.90E+00	UG/L	NDAHMW05	1 / 8	5.00E+00 - 5.40E+00	9.90E+00	NA	1.46E+01 NC	NA	NA	NO	BSL
	105-60-2	Caprolactam	3.00E+00 J	6.00E+00 J	UG/L	NDAHMW05	2 / 2	5.00E+00 - 5.10E+00	6.00E+00	NA	1.82E+03 NC	NA	NA	NO	BSL
	72-54-8	4,4-DDD	3.90E-01	4.20E-01 J	UG/L	AOC-H-MW02	3 / 8	2.00E-02 - 1.00E-01	4.20E-01	NA	2.80E-01 CA	NA	NA	YES	ASL
	72-55-9	4,4-DDE	1.80E-02 J	2.20E-02 J	UG/L	AOC-H-MW02	2 / 8	2.00E-02 - 2.80E-02	2.20E-02	NA	1.98E-01 CA	NA	NA	NO	BSL
	50-29-3	4,4-DDT	2.80E-02 J	2.80E-02 J	UG/L	AOC-H-MW04	1 / 8	2.00E-02 - 2.80E-02	2.80E-02	NA	1.98E-01 CA*	NA	NA	NO	BSL
	7429-90-5	Aluminum	1.30E+02 J	9.10E+03	UG/L	AOC-H-MW02	8 / 8	2.00E+02 - 2.00E+03	9.10E+03	NA	3.65E+03 NC	5.00E+01	NSDWS	YES	ASL
	7440-36-0	Antimony	5.40E+00 J	5.40E+00 J	UG/L	AOC-H-MW04	1 / 8	6.00E+01 - 6.00E+02	5.40E+00	NA	1.46E+00 NC	6.00E+00	MCL	YES	ASL
	7440-38-2	Arsenic	6.30E+00 J	6.30E+00 J	UG/L	AOC-H-MW02	1 / 8	1.00E+01 - 1.00E+02	6.30E+00	NA	4.48E-02 CA	1.00E+01	MCL	YES	ASL
	7440-39-3	Barium	8.60E+01 J	4.90E+02	UG/L	AOC-H-MW02	8 / 8	2.00E+02 - 2.00E+03	4.90E+02	NA	2.55E+02 NC	2.00E+03	MCL	YES	ASL
	7440-43-9	Cadmium	4.35E-01 J	4.46E+00 J	UG/L	NDAHMW07	2 / 8	5.00E+00 - 5.00E+01	4.46E+00	NA	1.82E+00 NC	5.00E+00	MCL	YES	ASL
	7440-70-2	Calcium	1.65E+04	7.19E+05	UG/L	NDAHMW05	8 / 8	5.00E+03 - 5.00E+04	7.19E+05	NA	NA	NA	NA	NO	NUT
	7440-47-3	Chromium	5.20E+00 J	1.50E+01	UG/L	AOC-H-MW02	5 / 8	1.00E+01 - 1.00E+02	1.50E+01	NA	1.09E+01 NC	1.00E+02	MCL	YES	ASL
	7440-48-4	Cobalt	4.68E+00 J	3.33E+01 J	UG/L	NDAHMW07	7 / 8	5.00E+01 - 5.00E+02	3.33E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7440-50-8	Copper	1.26E+01 J	2.50E+01	UG/L	AOC-H-MW02	4 / 8	2.50E+01 - 2.50E+02	2.50E+01	NA	1.46E+02 NC	1.30E+03	AL	NO	BSL
	7439-89-6	Iron	4.50E+03	1.10E+04	UG/L	AOC-H-MW02	6 / 8	1.00E+02 - 1.00E+03	1.10E+04	NA	1.09E+03 NC	3.00E+02	NSDWS	YES	ASL
	7439-95-4	Magnesium	1.27E+04	9.63E+05	UG/L	NDAHMW07	8 / 8	5.00E+03 - 5.00E+04	9.63E+05	NA	NA	NA	NA	NO	NUT
	7439-96-5	Manganese	2.50E+02	1.48E+04	UG/L	NDAHMW05	8 / 8	1.50E+01 - 1.50E+02	1.48E+04	NA	8.76E+01 NC	5.00E+01	NSDWS	YES	ASL
	7439-97-6	Mercury	1.65E-02 J	2.40E-02 J	UG/L	NDAHMW07	2 / 8	2.00E-01 - 2.00E-01	2.40E-02	NA	3.65E-01 NC	2.00E+00	MCL	NO	BSL
	7440-02-0	Nickel	7.55E+00 J	5.90E+01	UG/L	AOC-H-MW02	7 / 8	4.00E+01 - 4.00E+02	5.90E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7440-09-7	Potassium	4.30E+03 J	2.83E+05 J	UG/L	NDAHMW07	8 / 8	5.00E+03 - 5.00E+04	2.83E+05	NA	NA	NA	NA	NO	NUT
	7440-22-4	Silver	4.90E+00 J	4.90E+00 J	UG/L	NDAHMW07	1 / 8	1.00E+01 - 1.00E+02	4.90E+00	NA	1.82E+01 NC	1.00E+02	NSDWS	NO	BSL
	7440-23-5	Sodium	2.66E+05	6.95E+06	UG/L	NDAHMW07	8 / 8	5.00E+03 - 5.00E+04	6.95E+06	NA	NA	NA	NA	NO	NUT
	7440-28-0	Thallium	3.28E+00 J	4.42E+01 J	UG/L	NDAHMW07	6 / 8	1.00E+01 - 1.00E+02	4.42E+01	NA	2.41E-01 NC	2.00E+00	MCL	YES	ASL
	7440-62-2	Vanadium	6.00E+00 J	7.00E+01	UG/L	AOC-H-MW02	6 / 8	5.00E+01 - 5.00E+02	7.00E+01	NA	2.55E+01 NC	NA	NA	YES	ASL
	7440-66-6	Zinc	1.28E+01 J	3.30E+01	UG/L	AOC-H-MW02	4 / 8	2.00E+01 - 2.00E+02	3.30E+01	NA	1.09E+03 NC	5.00E+03	NSDWS	NO	BSL
	7429-90-5_D	Aluminum, Dissolved	1.30E+02 J	4.38E+02 J	UG/L	NDAHMW07	2 / 8	2.00E+02 - 2.00E+03	4.38E+02	NA	3.65E+03 NC	2.00E+02	NSDWS	NO	BSL
	7440-36-0_D	Antimony, Dissolved	5.40E+00 J	5.40E+00 J	UG/L	AOC-H-MW04	1 / 8	6.00E+01 - 6.00E+02	5.40E+00	NA	1.46E+00 NC	6.00E+00	MCL	YES	ASL
	7440-39-3_D	Barium, Dissolved	5.10E+01 J	4.60E+02	UG/L	AOC-H-MW02	8 / 8	2.00E+02 - 2.00E+03	4.60E+02	NA	2.55E+02 NC	2.00E+03	MCL	YES	ASL
	7440-43-9_D	Cadmium, Dissolved	4.99E+00 J	6.30E+00 J	UG/L	NDAHMW05	3 / 8	5.00E+00 - 5.00E+01	6.30E+00	NA	1.82E+00 NC	5.00E+00	MCL	YES	ASL
	7440-70-2_D	Calcium, Dissolved	1.51E+04	7.12E+05	UG/L	NDAHMW05	8 / 8	5.00E+03 - 5.00E+04	7.12E+05	NA	NA	NA	NA	NO	NUT
	7440-47-3_D	Chromium, Dissolved	5.71E+00 J	7.91E+00 J	UG/L	NDAHMW02	2 / 8	1.00E+01 - 1.00E+02	7.91E+00	NA	1.09E+01 NC	1.00E+02	MCL	NO	BSL
	7440-48-4_D	Cobalt, Dissolved	2.42E+01 J	4.04E+01 J	UG/L	NDAHMW07	3 / 8	5.00E+01 - 5.00E+02	4.04E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7440-50-8_D	Copper, Dissolved	1.21E+00 J	1.21E+00 J	UG/L	NDAHMW01	1 / 8	2.50E+01 - 2.50E+02	1.21E+00	NA	1.46E+02 NC	1.30E+03	AL	NO	BSL
	7439-89-6_D	Iron (Dissolved)	1.20E+02	4.18E+03	UG/L	NDAHMW05	3 / 8	1.00E+02 - 1.00E+03	4.18E+03	NA	1.09E+03 NC	3.00E+02	NSDWS	YES	ASL
	7439-95-4_D	Magnesium, Dissolved	1.03E+04	1.02E+06	UG/L	NDAHMW07	8 / 8	5.00E+03 - 5.00E+04	1.02E+06	NA	NA	NA	NA	NO	NUT
	7439-96-5_D	Manganese, Dissolved	3.95E+01	1.54E+04	UG/L	NDAHMW05	8 / 8	1.50E+01 - 1.50E+02	1.54E+04	NA	8.76E+01 NC	5.00E+00	NSDWS	YES	ASL
	7439-97-6_D	Mercury, Dissolved	1.94E-02 J	1.94E-02 J	UG/L	NDAHMW07	1 / 8	2.00E-01 - 2.00E-01	1.94E-02	NA	3.65E-01 NC	2.00E+00	MCL	NO	BSL
	7440-02-0_D	Nickel, Dissolved	7.70E+00 J	1.76E+01 J	UG/L	NDAHMW02	3 / 8	4.00E+01 - 4.00E+02	1.76E+01	NA	7.30E+01 NC	NA	NA	NO	BSL
	7440-09-7_D	Potassium, Dissolved	4.10E+03 J	2.94E+05 J	UG/L	NDAHMW07	8 / 8	5.00E+03 - 5.00E+04	2.94E+05	NA	NA	NA	NA	NO	NUT
	7782-49-2_D	Selenium, Dissolved	2.21E+00 J	2.21E+00 J	UG/L	NDAHMW01	1 / 8	5.00E+00 - 5.00E+01	2.21E+00	NA	1.82E+01 NC	5.00E+01	MCL	NO	BSL

Table 2.7

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-22-4_D	Silver, Dissolved	7.15E+00 J	7.15E+00 J	UG/L	NDAHMW07	1 / 8	1.00E+01 - 1.00E+02	7.15E+00	NA	1.82E+01 NC	1.00E+02	NSDWS	NO	BSL
	7440-23-5_D	Sodium, Dissolved	2.73E+05	7.20E+06	UG/L	NDAHMW07	8 / 8	5.00E+03 - 5.00E+04	7.20E+06	NA	NA	NA	NA	NO	NUT
	7440-28-0_D	Thallium, Dissolved	9.00E+00 J	2.62E+01 J	UG/L	NDAHMW05	2 / 8	1.00E+01 - 1.00E+02	2.62E+01	NA	2.41E-01 NC	2.00E+00	MCL	YES	ASL
	7440-62-2_D	Vanadium, Dissolved	2.80E+00 J	2.00E+01 J	UG/L	AOC-H-MW01	5 / 8	5.00E+01 - 5.00E+02	2.00E+01	NA	2.55E+01 NC	NA	NA	NO	BSL
	7440-66-6_D	Zinc, Dissolved	1.66E+00 J	1.66E+00 J	UG/L	NDAHMW01	1 / 8	2.00E+01 - 2.00E+02	1.66E+00	NA	1.09E+03 NC	5.00E+03	NSDWS	NO	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] EPA Region 9 PRGs Table, October 1, 2002, U.S. EPA Region 9.
PRG value for chromium VI used for total chromium.
PRG value for mercury chloride used as surrogate for mercury.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: Essential Nutrient (NUT)
Below Screening Level (BSL)

MCL = Maximum Contaminant Level from EPA's National Primary Drinking Water Standards
The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.

NSDWS = National Secondary Drinking Water Standards are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water.

COPC = Chemical of Potential Concern

ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered

J = Estimated Value

CA = Carcinogenic

NC = Noncarcinogenic

CA* (where: NC < 100X CA)

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil	Surface Soil	AOC H Surface Soil	Recreational	Adult	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact surface soil.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact surface soil.
					Youth	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact surface soil.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact surface soil.
					Child	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact surface soil.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact surface soil.
		Air	Emissions from AOC H Surface Soil	Recreational	Adult	Inhalation	On-site	Quant	Nearby residents may trespass on site and inhale dust from surface soil.
					Youth	Inhalation	On-site	Quant	Nearby residents may trespass on site and inhale dust from surface soil.
					Child	Inhalation	On-site	Quant	Nearby residents may trespass on site and inhale dust from surface soil.
Current/Future	Sediment	Sediment	Water-filled Ditch	Recreational	Adult	Dermal	On-site	Quant	Nearby residents may trespass on site and contact sediment.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact sediment.
					Youth	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact sediment.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact sediment.
					Child	Dermal	On-site	Quant	Nearby residents may trespass on site and contact sediment.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact sediment.
Current/Future	Surface Water	Surface Water	Water-filled Ditch	Recreational	Adult	Dermal	On-site	Quant	Nearby residents may trespass on site and contact surface water.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact surface water.
					Youth	Dermal Absorption	On-site	Quant	Nearby residents may trespass on site and contact surface water.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact surface water.
					Child	Dermal	On-site	Quant	Nearby residents may trespass on site and contact surface water.
						Ingestion	On-site	Quant	Nearby residents may trespass on site and contact surface water.

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface Soil	Surface Soil	AOC H Surface Soil	Residential	Adult	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
					Child	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
				Maintenance Worker	Adult	Dermal	On-site	Quant	The site is located on steep slope and wooded and is assumed to have some maintenance activity.
						Ingestion	On-site	Quant	The site is located on steep slope and wooded and is assumed to have some maintenance activity.
				Industrial Worker	Adult	Dermal	On-site	Quant	Industrial workers may be present at this site in the future and contact surface soil.
						Ingestion	On-site	Quant	Industrial workers may be present at this site in the future and contact surface soil.
		Air	Emissions from AOC H Surface Soil	Residential	Adult	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
					Child	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
				Maintenance Worker	Adult	Inhalation	On-site	Quant	The site is located on steep slope and wooded and is assumed to have some maintenance activity. Workers may inhale dust from surface soil.
				Industrial Worker	Adult	Inhalation	On-site	Quant	Industrial workers may be present at this site in the future and may inhale vapors or fugitive dust from soil.
Future	Subsurface Soil	Subsurface Soil	AOC H Subsurface Soil	Residential	Adult	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
					Child	Dermal Absorption	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
						Ingestion	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
		Air	Emissions from AOC H Subsurface Soil	Residential	Adult	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
					Child	Inhalation	On-site	Quant	The site is not expected to be developed for residential use; however, the residential scenario is conservatively included in this evaluation.
Future	Total Soil (0-6 ft)	Total Soil (0-6 ft)	AOC H Total Soil (0-6 ft)	Construction Worker	Adult	Dermal	On-site	Quant	Construction workers could contact soil to a depth of 6 ft while performing activities at the site.
						Ingestion	On-site	Quant	Construction workers could contact soil to a depth of 6 ft while performing activities at the site.
			Emissions from AOC H Total Soil (0-6 ft)	Construction Worker	Adult	Inhalation	On-site	Quant	Construction workers could inhale dust from soil to a depth of 6 ft.

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Groundwater	Groundwater	Tap Water	Residential	Adult	Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
						Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply. The adult is assumed to shower, and the child is assumed to bathe.
						Inhalation	On-site	Quant	VOCs were not detected in site groundwater. Therefore inhalation pathway is incomplete.
					Child	Ingestion	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
						Dermal Absorption	On-site	Quant	Although unlikely, groundwater may be used as future potable water supply.
						Inhalation	On-site	Quant	VOCs were not detected in site groundwater. Therefore inhalation pathway is incomplete.
				Industrial Worker	Adult	Dermal	On-site	Quant	Industrial workers may be present at this site in the future and contact groundwater.
						Ingestion	On-site	Quant	Industrial workers may be present at this site in the future and contact groundwater.
						Inhalation	On-site	Quant	VOCs were not detected in site groundwater. Therefore inhalation pathway is incomplete.
			Groundwater (Excavation)	Construction Worker	Adult	Dermal Absorption	On-site	Quant	Construction workers may contact shallow groundwater in excavations.

TABLE 10.1.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Recreational
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			ARSENIC	9.3E-06	5.1E-09	7.8E-07	1.0E-05	Skin, Vascular	2.4E-01	NA	2.0E-02	2.6E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.7E-01	NA	7.6E-03	2.8E-01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	1.8E-01	NA	2.0E-01	3.8E-01
Chemical Total				9.3E-06	5.1E-09	7.8E-07	1.0E-05		6.9E-01	0.0E+00	2.2E-01	9.1E-01
Medium Total							1.0E-05					9.1E-01
Surface Water	Surface Water	Water-filled Ditch										
			ARSENIC	3.7E-06	NA	3.0E-07	4.0E-06	Skin, Vascular	9.7E-02	NA	7.8E-03	1.0E-01
Chemical Total				3.7E-06	0.0E+00	3.0E-07	4.0E-06		9.7E-02	NA	7.8E-03	1.0E-01
Medium Total							4.0E-06					1.0E-01
Receptor Total							2.4E+01				Receptor HI Total	2.5E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total Skin HI Across All Media =	3.7E-01
Total Vascular HI Across All Media =	3.7E-01
Total Kidney HI Across All Media =	3.8E-01
Total Blood HI Across All Media =	2.8E-01
Total Liver HI Across All Media =	2.8E-01

TABLE 10.2.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			ARSENIC	1.3E-05	2.0E-08	1.6E-06	1.5E-05	Skin, Vascular	8.7E-02	NA	1.0E-02	9.7E-02
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.5E-02	NA	1.0E-01	1.7E-01
Chemical Total				1.3E-05	2.0E-08	1.6E-06	1.5E-05		1.5E-01	0.0E+00	1.1E-01	2.6E-01
Groundwater	Groundwater	Tap Water										
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	2.5E-01	NA	1.3E-09	2.5E-01
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	3.7E-01	NA	1.3E-08	3.7E-01
			ARSENIC	8.9E-05	NA	2.7E-13	8.9E-05	Skin, Vascular	5.8E-01	NA	3.0E-09	5.8E-01
			BARIUM	NA	NA	NA	0.0E+00	NOAEL	1.4E-01	NA	1.0E-08	1.4E-01
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	1.6E-01	NA	3.4E-08	1.6E-01
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	1.4E-01	NA	5.3E-08	1.4E-01
Chemical Total				8.9E-05	0.0E+00	2.7E-13	8.9E-05		1.6E+00	NA	1.1E-07	1.6E+00
Medium Total							8.9E-05					1.6E+00
Receptor Total							1.0E-04				Receptor HI Total	1.9E+00

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	2.5E-01
Total Skin HI Across All Media =	6.7E-01
Total Vascular HI Across All Media =	6.7E-01
Total Kidney HI Across All Media =	3.3E-01
Total NOAEL HI Across All Media =	2.7E-01
Total Blood HI Across All Media =	3.7E-01

TABLE 10.3.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	1.1E-01	4.1E-03	3.0E-03	1.1E-01
			ARSENIC	3.1E-05	2.0E-07	2.6E-06	3.4E-05	Skin, Vascular	8.1E-01	NA	6.8E-02	8.8E-01
			CHROMIUM, TOTAL	NA	6.0E-07	NA	6.0E-07	NOAEL	8.6E-02	4.7E-04	9.6E-02	1.8E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	9.1E-01	NA	2.5E-02	9.3E-01
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	9.9E-02	NA	2.8E-03	1.0E-01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.1E-01	NA	6.6E-01	1.3E+00
Chemical Total				3.1E-05	8.0E-07	2.6E-06	3.5E-05		2.6E+00	4.5E-03	8.5E-01	3.5E+00
Subsurface Soil	Subsurface Soil	AOC H Subsurface Soil	ARSENIC	1.1E-05	NA	9.1E-07	1.2E-05	Skin, Vascular	2.8E-01	NA	2.3E-02	3.0E-01
Chemical Total				1.1E-05	0.0E+00	9.1E-07	1.2E-05		2.8E-01	0.0E+00	2.3E-02	3.0E-01
Medium Total							4.6E-05					3.8E+00
Groundwater	Groundwater	Tap Water										
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	5.8E-01	NA	3.8E-09	5.8E-01
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	8.6E-01	NA	3.8E-08	8.6E-01
			ARSENIC	5.2E-05	NA	3.4E-13	5.2E-05	Skin, Vascular	1.3E+00	NA	8.9E-09	1.3E+00
			BARIUM	NA	NA	NA	0.0E+00	NOAEL	3.2E-01	NA	3.0E-08	3.2E-01
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	3.8E-01	NA	1.0E-07	3.8E-01
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	3.2E-01	NA	1.7E-07	3.2E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.2E+01	NA	3.7E-06	2.2E+01
			MANGANESE	NA	NA	NA	0.0E+00	CNS	6.8E+00	NA	1.1E-06	6.8E+00
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	3.5E+01	NA	2.3E-07	3.5E+01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	4.5E+00	NA	1.1E-06	4.5E+00
Chemical Total				5.2E-05	0.0E+00	3.4E-13	5.2E-05		7.3E+01	NA	6.5E-06	7.3E+01
Medium Total							5.2E-05					7.3E+01
Receptor Total							1.3E-04				Receptor HI Total	8.0E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	7.5E+00
Total Skin HI Across All Media =	2.5E+00
Total Vascular HI Across All Media =	2.5E+00
Total Kidney HI Across All Media =	6.1E+00
Total NOAEL HI Across All Media =	8.2E-01
Total Gastrointestinal HI Across All Media =	2.3E+01
Total Blood HI Across All Media =	6.0E+01
Total Liver HI Across All Media =	5.9E+01
Total Hair HI Across All Media =	3.5E+01

TABLE 10.4RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil	VANADIUM	NA	NA	NA	0.0E+00	Kidney	4.7E-02	NA	1.2E-01	1.7E-01
Chemical Total				0.0E+00	0.0E+00	0.0E+00	0.0E+00		4.7E-02	0.0E+00	1.2E-01	1.7E-01
Medium Total							0.0E+00					1.7E-01
Groundwater	Groundwater	Tap Water	ANTIMONY	NA	NA	NA	0.0E+00	Blood	1.3E-01	NA	7.3E-10	1.3E-01
			ARSENIC	3.3E-05	NA	3.4E-13	3.3E-05	Skin, Vascular	2.1E-01	NA	1.7E-10	2.1E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	3.4E+00	NA	7.1E-08	3.4E+00
			MANGANESE	NA	NA	NA	0.0E+00	CNS	1.0E+00	NA	2.1E-08	1.0E+00
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	5.4E+00	NA	4.5E-09	5.4E+00
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.8E-01	NA	2.2E-08	6.8E-01
Chemical Total				3.3E-05	0.0E+00	3.4E-13	3.3E-05		1.1E+01	NA	1.2E-07	1.1E+01
Medium Total							3.3E-05					1.1E+01
Receptor Total							3.3E-05				Receptor HI Total	1.1E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	1.0E+00
Total Skin HI Across All Media =	2.1E-01
Total Vascular HI Across All Media =	2.1E-01
Total Kidney HI Across All Media =	8.5E-01
Total Gastrointestinal HI Across All Media =	3.4E+00
Total Blood HI Across All Media =	9.0E+00
Total Liver HI Across All Media =	8.8E+00
Total Hair HI Across All Media =	5.4E+00

TABLE 10.5.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Groundwater (In Excavations)	MANGANESE					CNS	NA	NA	5E+00	5E+00
		Exposure Point Total		NA	NA	0E+00	0E+00		NA	NA	5E+00	5E+00
	Exposure Medium Total			NA	NA	0E+00	0E+00		NA	NA	5E+00	5E+00
Medium Total				NA	NA	0E+00	0E+00		NA	NA	5E+00	5E+00
Receptor Total				0E+00	0E+00	0E+00	0E+00		0E+00	0E+00	5E+00	5E+00

Total CNS HI Across Media = **5E+00**

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Hotline 513-569-7300, FAX 513-569-7159, E-Mail: STSC.Superfund@epa.gov

April 21, 2003

Michael Sivak
U.S. EPA - Region II

ASSISTANCE REQUESTED: Requested toxicity information on Aluminum and Iron. *(Vieques)*

ENCLOSED INFORMATION:

Attachment 1: **Risk Assessment Issue Paper for: Evaluating the Carcinogenicity of Aluminum (CASRN 7429-90-5)**

Attachment 2: **Risk Assessment Issue Paper for: Derivation of a Provisional Inhalation RfC for Aluminum (CASRN 7429-90-5)**

Attachment 3: **Risk Assessment Issue Paper for: Derivation of a Provisional Oral RfD for Aluminum (CASRN 7429-90-5)**

Attachment 4: **Risk Assessment Issue Paper for: Evaluation of the Carcinogenicity Assessment for Iron (CASRN 7439-89-6) and Compounds**

Attachment 5: **Risk Assessment Issue Paper for: Feasibility of Deriving a Provisional RfC for Iron (CASRN 7439-89-6)and Compounds**

Attachment 6: **Risk Assessment Issue Paper for: Derivation of the Provisional RfD for Iron (CASRN 7439-89-6) and Compounds**

BE ADVISED: Unless specifically indicated to have been peer reviewed, it is to be noted that the attached Risk Assessment Issue Paper(s) have not been through the U.S. EPA's formal review process; therefore, they do not represent a U.S. EPA verified assessment.

If you have any questions regarding this transmission, please contact the STSC at (513) 569-7300.

Attachments (6)

cc: STSC files

Supported by IntelliTech Systems, Incorporated, under
U.S. Environmental Protection Agency Contract No. 68-C-01-147.

Risk Assessment Issue Paper for: Evaluating the Carcinogenicity of Aluminum (CASRN 7429-90-5)

NOTE: This provisional risk assessment paper for the carcinogenicity for Aluminum has received external peer review.

INTRODUCTION

Verified toxicity values for aluminum (Al) and its compounds are unavailable on IRIS or HEAST (U.S. EPA, 1999, 1997), except for a chronic oral RfD of 4E-4 mg/kg-day for aluminum phosphide. However, occupational guidelines and standards have been established for a number of chemical and physical forms of Al, including, from ACGIH, 8-hour TWA-TLVs of 10 mg/m^3 for the compound as a metal dust or oxide, 5 mg/m^3 as "pyro" powders or welding fumes, and 2 mg/m^3 for soluble salts or organic forms of the metal (ACGIH, 1998). From NIOSH, 10-hour TWA-RELs of 10 mg/m^3 are specified for "total" Al dust versus 5 mg/m^3 for the respirable portion (NIOSH, 1994), the institute covers all other forms of the metal by identical values to those specified by ACGIH (ACGIH, 1998). OSHA PELs for Al include an 8-hour TWA value of 15 mg/m^3 for "total" metal dust, versus 5 mg/m^3 for the respirable portion (NIOSH, 1994). The U.S. EPA's CARA list (U.S. EPA, 1994) cites a HEA for Al (U.S. EPA, 1987), and ATSDR has updated its toxicological profile of the element (ATSDR, 1998).

Research papers pertinent to the potential carcinogenic effects of Al were sought through computer searches of the HSDB, RTECS, MEDLINE, and TOXLINE (and its subfiles) databases, covering the time period 1995-1999. The literature searches were conducted in June, 1999.

REVIEW OF THE PERTINENT LITERATURE

The review by Stokinger (1981) gives an account of Al as an all-pervasive component of products that are central to the daily lives of most Americans. For example, the metal is a crucial part of manufactured products for the building, automobile, and container industries, while Al as powder or flake is a component in a number of consumer products, such as paints, fireworks, etc. Al complexes and minerals are used in the brewing and paper industries, and as coagulants for water purification. Al oxide finds application in abrasives, as a catalyst or absorbent, and as a component in fillers. Al chloride is included in cosmetic formulations such as deodorants.

Human exposure to Al arises principally from food, through its widespread use in food additives, packaging and cooking utensils, and in Al-containing medications, particularly antacid, buffered aspirin, anti-ulcer and anti-diarrheal formulations (Marquis, 1989; Lione, 1985). Pennington and Schoen (1995) estimated daily Al intakes of 0.1-0.3 mg/kg-day for infants and children 6 months-6 years of age and 0.1-0.18 mg/kg-day for older children and adults, data are in broad agreement with those of Wilhelm et al. (1995) who reported the dietary intake of Al in German children (living in the Duisberg area) as ranging from 0.008 to 0.11 mg Al/kg-day. These values are consistent with a range of 1-20 mg/day (0.014-0.3 mg/kg-day) for normal oral daily Al intake from food and water reported by other investigators (Ganrot, 1986; Iyengar et al., 1987; Wilhelm et al., 1990). However, users of Al-containing medications can ingest much larger amounts of the element, possibly

as high as 840-5000 mg/day (12-71 mg/kg-day) from antacids, 126-728 mg/day (1.8-10.4 mg/kg-day) from buffered aspirins and 828 mg/day (11.8 mg/kg-day) from anti-ulcer compounds when taken at recommended dosages (Lione, 1985).

There is a large amount of information available on the absorption, transfer from tissue to tissue and elimination of Al from the body, including data that have been amassed from studies on either human volunteers or laboratory animals. In general, the chemical appears to be poorly absorbed from the gastrointestinal tract, though the portion of the load that is retained will vary depending on the concentration, the chemical species administered, the fasting or fed state of the host, gastrointestinal pH, animal model, etc. For example, Yokel and McNamara (1988) administered single oral doses of a number of Al compounds (both water soluble and insoluble) to New Zealand white rabbits and obtained absorbed proportions of the load ranging from 0.27% to 27%. Fractional uptake of Al in humans under normal conditions (i.e., with no intake of large quantities of Al from medicine) was estimated to be 0.1-0.3% assuming an intake of 20 mg Al/day (0.3 mg Al/kg-day) and urinary excretion of 20-50 : g Al/day (0.3-0.7 : g Al/kg-day) (Ganrot, 1986). However, little information is available on the actual mechanism by which the element and its compounds are transported across the brush border. (Wilhelm et al., 1990; Lione et al., 1985).

Aluminum can also be absorbed by inhalation as indicated by age-related deposition in the lungs of the general population and exposure-related increased blood and urine concentrations in workers exposed to aluminum (Bast-Pettersen et al., 1994; Sjogren et al., 1996; Hosovski et al., 1990; Wilhelm et al., 1990; U.S. EPA, 1987). Aluminum occurs primarily in particulate form in the ambient atmosphere and as various dusts and fumes during its production and use. Common forms of inhaled aluminum include aluminum oxide (alumina; Al_2O_3), pyro powders (powder and flake aluminum treated to reduce surface oxidation), aluminum welding fume, and soluble salts (e.g., aluminum chloride and sulfate) (ACGIH, 1991).

There are a number of published reports of studies in which the carcinogenicity of aluminum compounds has been evaluated. These include oral exposure studies in which the compounds were made available to experimental animals in the drinking water or diet (Schroeder and Mitchener, 1975a,b; Oneda et al, 1994), and inhalation epidemiological studies, in which the incidence of tumor formation in persons exposed to aluminum-containing dusts and fumes in an occupational setting was compared to unexposed individuals (Spinelli et al., 1991; Theriault et al., 1984, 1990; Armstrong et al., 1986; Tremblay et al., 1995; Selden et al., 1997; Cullen et al., 1996; Dufresne et al., 1996; Ronneberg and Langmark, 1992). As discussed in the following paragraphs, solid evidence for a positive carcinogenic effect of Al has not emerged from the subject studies, thereby leaving the issue of the potential carcinogenicity of the Al compounds still in doubt.

Oral Exposure

Schroeder and Mitchener (1975a) exposed 52 Long-Evans rats/sex/group to 0 or 5 ppm Al as potassium aluminum sulfate in drinking water for life. Based on default values for drinking water consumption and body weight for this strain of rat in a chronic study (U.S. EPA, 1988), these values are equivalent to Al doses of 0.472 and 0.67 mg/kg-day, for males and females, respectively. Study endpoints included body and heart weight; serum glucose, cholesterol, and uric acid; and urinary protein, glucose, and pH. All animals were necropsied at the time of natural death, and histological examinations were carried out on heart, lung, kidney, liver, spleen and gross tumors, for approximately 50% of the animals in the group. The only remarkable finding was a significant increase ($p<0.005$) in gross tumor incidence in exposed male rats [13/25 (52%) compared to 4/26 (15%) in controls], although the tumor sites were not reported. Six of the tumors in the exposed males (46% of total) were considered malignant compared to two malignant tumors (50% of total) in the male controls. There were no significant differences in tumor incidences between exposed and control females.

In another study by the same investigators, 54 Swiss mice/sex/group were exposed to drinking water containing 0 or 5 ppm Al as aluminum potassium sulfate for life (Schroeder and Mitchener, 1975b). Based on default values for drinking water consumption and body weight for B6C3F1 mice in a chronic study (U.S. EPA, 1988), these values approximate to Al doses of 1.2 mg/kg-day in both males and females. Study endpoints included body weight, gross pathology, and some limited histology of the heart, lung, liver, kidney, and spleen. The incidences of gross tumors were 15/41 (36.6%) and 11/38 (28.9%) in exposed and control males, respectively, and 19/41 (46.3%) and 14/47 (29.8%) in exposed and control females, respectively, differences that did not achieve statistical significance by Fisher's exact test, although incidences of multiple tumors and lymphoma leukemia were considered by the authors to be significantly increased in females ($p<0.025$ and $p<0.05$, respectively). However, a definitive assessment of aluminum carcinogenicity in both this and the rat study (Schroeder and Mitchener, 1975a) is precluded by the limitations of the pathology examinations and reporting.

In a more recent study, the tumorigenic potential of aluminum potassium sulfate was assessed in B6C3F1 mice chronically exposed in the diet (Oneda et al., 1994). Sixty animals/sex/group were fed a diet containing 0, 1.0, 2.5, 5.0, or 10.0% (w/w) for 20 months. These concentrations of aluminum potassium sulfate (as the dodecahydrate) are equivalent to 0, 569, 1422, 2844, and 5687 ppm Al. Using food factors calculated with an algorithm relating food consumption to body weight (U.S. EPA, 1988) and body weight data estimated from growth curves reported by the investigators, the dosages of aluminum are estimated to be 0, 95, 237, 483, or 1024 mg Al/kg-day in males and 0, 97, 242, 512, or 1110 mg Al/kg-day in females. Clinical signs, food consumption, and body weight were evaluated weekly. Hematology, clinical chemistry, or urine endpoints were not assessed. Necropsies that included organ weight measurements and comprehensive histological examinations (including brain) were performed on all animals, including those that died during the course of the study. Survival rates were higher than control values in all treated male and female groups, ranging from 86.7-95.0% compared to 73.3% in males and 86.7-91.7% compared to 78.3% in females. No changes in food consumption were observed, but body weight gain was increased in both sexes at 95-97 and 237-242 mg Al/kg-day (weights were 10-23% higher than controls at end of study), was similar to controls in both sexes at 483-512 mg Al/kg-day, and decreased in both sexes at 1024-1110 mg Al/kg-day (11-16% lower than controls at end of study). There were no exposure-related increased incidences of tumors, other proliferative lesions, or non-neoplastic lesions. In fact, the incidence of spontaneous hepatocellular carcinomas was significantly decreased in males at 1024 mg Al/kg-day (5.5% compared to 20.5% in controls, $p<0.01$).

Inhalation Exposure

A body of epidemiological evidence has pointed to an increased incidence of cancers of various kinds in workers employed in the aluminum production industry. However, as discussed in a review by Ronneberg and Langmark (1992), the concern about potential cancer hazards in the aluminum industry has primarily arisen because of exposures to polycyclic aromatic hydrocarbons (PAHs) and coal tar pitch volatiles (CTPVs) rather than to Al *per se*. Thus, while a number of studies have provided inferential data linking occupationally exposed aluminum workers with an increased risk of developing tumors of the bladder or lung (Gibbs, 1985; Thériault et al., 1984, 1990; Armstrong et al., 1986; Spinelli et al., 1991; Pearson et al., 1993; Tremblay et al., 1995), it would be unwise to ascribe any excess tumor formation to the effects of Al in view of the concurrent exposure to well-documented carcinogenic PAHs such as benzo(a)pyrene. The issue is further complicated by the likely exposure of production workers to other substances such as fluorides, sulfur dioxide, aromatic amines and asbestos (Ronneberg and Langmark, 1992; Tremblay et al., 1995; Dufresne et al., 1996), and to the possible effects of cigarette smoking in affected individuals. Consequently, these studies have failed to provide direct evidence for the carcinogenicity of Al fumes and dusts.

WEIGHT-OF-EVIDENCE CLASSIFICATION

A considerable number of epidemiological studies have examined the incidence of excess tumor formation in persons occupationally exposed to Al in the form of dusts or fumes. In general, a body of inferential evidence exists for an increase in cancer of the bladder and lung through such occupational exposure to Al, although conclusions linking these responses to the effects of Al are confounded by attendant co-exposure to other harmful emissions such as PAHs, CTPVs, and by cigarette smoking. A 20-month exposure of B6C3F1 mice to Al potassium sulfate dodecahydrate in the diet at concentrations up to 10% w/w displayed no indication of compound-related carcinogenicity and, in general, no indication of adverse toxicological effects of any kind (Oneda et al., 1994). Similarly, the life-time exposure of Swiss mice and Long-Evans rats to 5 ppm Al as aluminum potassium sulfate in drinking water provided no convincing evidence for the carcinogenicity of Al compounds (Schroeder and Mitchener 1975a,b). Gene reversion experiments on Al compounds resulted in negative results in *S. typhimurium* (Ahn and Jeffrey, 1994). Taking all of the evidence of Al carcinogenicity together, a qualitative weight-of evidence classification of D, -not classifiable as to human carcinogenicity, is suggested, in line with the agency's guidelines for carcinogenic risk assessment (U.S. EPA, 1986). In accordance with the agency's proposed guidelines for carcinogenic risk assessment (U.S. EPA, 1996), the compound's carcinogenicity *cannot be determined* on the available evidence.

DERIVATION OF AN ORAL SLOPE FACTOR AND INHALATION UNIT RISK

Due to insufficeint data a provisional oral slope factor and inhalation unit risk could not de developed.

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Risk Assessment Issue Paper for:
Derivation of a Provisional Inhalation RfC for Aluminum (CASRN 7429-90-5)

NOTE: This provisional risk assessment paper for the inhalation chronic reference concentration (RfC) for Aluminum has received external peer review.

INTRODUCTION

Verified toxicity values for aluminum (Al) and its compounds are unavailable on IRIS or HEAST (U.S. EPA, 1999, 1997), except for a chronic oral RfD of 4E-4 mg/kg-day for aluminum phosphide. However, occupational guidelines and standards have been established for a number of chemical and physical forms of Al, including, from ACGIH, 8-hour TWA-TLVs of 10 mg/m^3 for the compound as a metal dust or oxide, 5 mg/m^3 as "pyro" powders or welding fumes, and 2 mg/m^3 for soluble salts or organic forms of the metal (ACGIH, 1998). From NIOSH, 10-hour TWA-RELs of 10 mg/m^3 are specified for "total" Al dust versus 5 mg/m^3 for the respirable portion (NIOSH, 1994), NIOSH covers all other forms of the metal by identical values to those specified by ACGIH (ACGIH, 1998). OSHA PELs for Al include an 8-hour TWA value of 15 mg/m^3 for "total" metal dust, versus 5 mg/m^3 for the respirable portion (NIOSH, 1994). The U.S. EPA's CARA list (U.S. EPA, 1994) cites a HEA for Al (U.S. EPA, 1987), and ATSDR has updated its toxicological profile of the element (ATSDR, 1998).

Research papers pertinent to the potential toxicological effects of Al via the inhalation route were sought through computer searches of the HSDB, RTECS, MEDLINE, and TOXLINE (and its subfiles) databases, covering the time period 1995-1999. The literature searches were conducted in June, 1999.

REVIEW OF THE PERTINENT LITERATURE

The review by Stokinger (1981) gives an account of Al as an all-pervasive component of products that are central to the daily lives of most Americans. For example, the metal is a crucial part of manufactured products for the building, automobile, and container industries, while Al as powder or flake is a component in a number of consumer products, such as paints, fireworks, etc. Al complexes and minerals are used in the brewing and paper industries, and as coagulants for water purification. Al oxide finds application in abrasives, as a catalyst or absorbent, and as a component in fillers. Aluminum chloride is included in cosmetic formulations such as deodorants.

Human exposure to Al arises principally from food, through its widespread use in food additives, packaging and cooking utensils, and in Al-containing medications, particularly antacids, buffered aspirin, anti-ulcer and anti-diarrheal formulations (Marquis, 1989; Lione, 1985). Pennington and Schoen (1995) estimated daily Al intakes of 0.1-0.3 mg/kg-day for infants and children 6 months-6 years of age and 0.1-0.18 mg/kg-day for older children and adults, based on the FDA Total Diet Study (1993) and the U.S. Department of Agriculture Nationwide Food Consumption Survey (1987-1988). These data are in broad agreement with those of Wilhelm et al. (1995) who reported the dietary intake of Al in German children (living in the Duisberg area) as ranging from 0.008 to 0.11 mg Al/kg-day. These values are consistent with a range of 1-20 mg/day (0.014-0.3 mg/kg -day) for normal oral daily Al intake from food and water reported by other investigators (Ganrot,

1986; Iyengar et al., 1987; Wilhelm et al., 1990). However, users of Al-containing medications can ingest much larger amounts of the element, possibly as high as 840-5000 mg/day (12-71 mg/kg-day) from antacids, 76-728 mg/day (1.8-10.4 mg/kg-day) from buffered aspirins and 828 mg/day (11.8 mg/kg-day) from anti-ulcer compounds when taken at recommended dosages (Lione, 1985).

There is a large amount of information available on the absorption, transfer from tissue to tissue and elimination of Al from the body, including data that have been amassed from studies on either human volunteers or laboratory animals. In general, the chemical appears to be poorly absorbed from the gastrointestinal tract, though the portion of the load that is retained will vary depending on the concentration, the chemical species administered, the fasting or fed state of the host, gastrointestinal pH, animal model, etc. For example, Yokel and McNamara (1988) administered single oral doses of a number of Al compounds (both water soluble and insoluble) to New Zealand white rabbits and obtained absorbed proportions of the load ranging from 0.27% to 27%. Fractional uptake of Al in humans under normal conditions (i.e., with no intake of large quantities of Al from medicine) was estimated to be 0.1-0.3% assuming an intake of 20 mg Al/day (0.3 mg Al/kg-day) and urinary excretion of 20-50 : g Al/day (0.3-0.7 : g Al/kg-day) (Ganrot, 1986). However, little information is available on the actual mechanism by which the element and its compounds are transported across the brush border. (Wilhelm et al., 1990; Lione, 1985).

Aluminum can also be absorbed by inhalation as indicated by age-related deposition in the lungs of the general population and exposure-related increased blood and urine concentrations in workers exposed to Al (Bast-Pettersen et al., 1994; Sjogren et al., 1996; Hosovski et al., 1990; Wilhelm et al., 1990; U.S. EPA, 1987). Aluminum occurs primarily in particulate form in the ambient atmosphere and as various dusts and fumes during its production and use. Common forms of inhaled Al include aluminum oxide (alumina; Al_2O_3), pyro powders (powder and flake Al-treated to reduce surface oxidation), Al welding fume, and soluble salts (e.g., aluminum chloride and sulfate) (ACGIH, 1998).

Neurotoxicity as a Primary Toxicological Effect of Aluminum

One of the greatest health concerns regarding Al is its neurological effects. The first evidence for Al-induced neurotoxicity in humans was seen in patients who, as a result of receiving long-term hemodialysis for chronic renal failure, developed a degenerative neurological syndrome (dialysis dementia) characterized by the gradual loss of motor, speech, and cognitive functions (Alfrey, 1993). This dementia, attributable to Al in the dialysate, is usually fatal within 6-9 months after the first clinical signs appear. In addition, many patients received high oral doses of Al to act as phosphate binders. Autopsies of these patients revealed increased concentrations of Al in the gray matter and cerebral spinal fluid (CSF) but no evidence of neurofibrillary degeneration (NFD) despite the elevated Al levels. Once the connection between Al and dialysis dementia was established, Al was removed from dialysis fluid and the incidence of dementia rapidly declined, thereby strengthening the argument that Al was a causal agent in dialysis dementia.

Amyotrophic Lateral Sclerosis (ALS) and Parkinson's Disease (PD) are other neurological diseases which have been associated with Al exposure. ALS is a progressive disease of the Central Nervous System (CNS) that is characterized by an accumulation of neurofibrillary tangles. In Guam, southern West New Guinea, and parts of Japan there is an unusually high prevalence of ALS and PD. This may be related to the natural abundance of Al coupled with the virtual lack of magnesium and calcium in the drinking water supplies and soil of these areas. In a study designed to evaluate effects of high Al and low calcium levels in the diet, much like the conditions associated with Guam and other similar areas, cynomolgus monkeys were placed on a low calcium

diet either with or without supplemental Al and manganese (Garruto et al., 1989). Chronic calcium deficiency alone produced neurodegenerative effects, although neurofibrillary changes were most frequently seen in the monkeys on a low calcium diet supplemented with Al and manganese.

Aluminum has also been implicated as having an association with Alzheimer's Disease (AD) (Ganrot, 1986). However, there is no evidence that Al plays a causative role in its development. AD is a chronic progressive disease clinically characterized by a gradual loss of cognitive functions. The pathological diagnosis of AD is based on the presence of large numbers of neuritic plaques and neurons with neurofibrillary changes. The CNS alterations in AD patients differ from those found in sensitive animals given high doses of Al. Even though increased amounts of Al are found in AD patients, there are no neurofibrillary changes like those found in rabbits treated with large amounts of Al.

A large amount of experimental information exists in reports of studies that have explored the possible relationship between occupational exposure to emissions in Al foundries, smelters, etc., with an increased incidence of diseases such as neurological diseases and/or cancer. For example, the etiological link between the increased incidence of tumors at various tissue sites and exposure to Al-based emissions has been thoroughly explored (Gibbs, 1985; Thériault et al., 1984, 1990; Armstrong et al., 1986; Spinelli et al., 1991; Pearson et al., 1993; Tremblay et al., 1995). However, it has been generally concluded that the inferential association between exposure to Al and marginally increased incidences of tumors of the bladder and/or lung are confounded because of the co-exposure of subjects in such settings to other harmful and potentially carcinogenic substances, such as polycyclic aromatic hydrocarbons (PAHs and coal tar pitch volatiles (CTPV) (Ronneberg and Langmark, 1992). However, in contrast to this vitiation of the findings of possible relationships between exposure to Al and tumor formation, any epidemiological links between exposure to Al and neurotoxicological symptoms have generally been accepted, irrespective of the presence of other compounds or harmful substances to which subjects may have been co-exposed. This is rationalized by the recognition of the body of ancillary evidence that exists for the possible neurotoxicological effects of Al (with dialysis dementia as an example), thereby justifying the assumption that, on balance, the neurological symptoms displayed by persons occupationally exposed to Al among other substances are likely to be causally linked to Al rather than to any of the other contaminants. In the paragraphs that follow, reports of studies that have explored that potential neurotoxicological effects of Al borne in dust or fumes is summarized. Where possible, those data that point to a quantitative relationship between exposure and response are emphasized.

INHALATION TOXICITY

uman Toxicity

Principal Study

Neurobehavioral effects were evaluated in a group of 87 Al foundry workers who were occupationally exposed to 4.6-11.5 mg/m^3 Al fumes and dust for a mean of 12.0 years [standard deviation (SD) 4.5 years, shortest exposure 6 years] compared to an unexposed control group (n = 60) who were matched for age, job seniority and social status to exposed subjects (Hosovski et al., 1990). It is reported that environmental Al concentrations were measured for each worker separately during the winter and summer, implying that personal sampling may have been used and that the contributing concentrations are time-weighted averages. In certain places, the number of particles ranged as high as 329-1020/cm^2 air, and dust particle sizes were #1, 1-5 and $5 microns in 65.6, 26.6, and 7.6% of the samples, respectively. Tests of psychomotor ability (simple and complex reaction time, oculomotor coordination), intellectual ability (Wechsler intelligence, performance intelligence and verbal intelligence quotients, and Wechsler subtests on information processing, memory, understanding, calculation, coding, picture completion, picture grouping, object assembling, assembling of cubes and common concepts), and cerebral damage (Bender visual motor test) were conducted. Performance of the exposed workers was found to be significantly ($p<0.02$) impaired on the complex reaction time, oculomotor coordination, memory, coding, picture completion, and object assembling tests. However, the investigators noted that the performance deficits had no clinical manifestations, and that additional studies were probably needed to confirm the possibility of cerebral damage. The study yielded a lowest available non-duration adjusted LOAEL of 4.6 mg Al/m^3 for psychomotor and cognitive impairment during repeated 8-hour occupational exposures (Hosovski et al., 1990), that could be corrected for discontinuous exposure (10 m^3/20 m^3 and 5 days/7 days) to yield a $LOAEL_{HEC}$ of 1.64 mg/m^3 Al.

Supporting Studies

Aluminum oxide powders were administered to Canadian miners (mainly underground gold and uranium miners) in known exposures as a means of prophylaxis against silicosis (Stokinger, 1981; Rifat et al., 1990). Data in which more than 42 million Al treatments (. 150,000 man-years) had been given over a period of 27 years ending in 1971 were reviewed by Stokinger (1981). The effectiveness of this treatment is uncertain but no lung damage or other ill effects (not specified) were observed. The powders (McIntyre powder) were prepared by grinding Al pellets so that 96% of the particles were #1.2 : m in diameter. During this process most of the particles became oxidized to aluminum oxide; the powder contained 85% aluminum oxide and 15% elemental Al. According to Stokinger (1981), recommended exposure concentrations were 30,000 particles of respirable size per cubic centimeter (ppcc) for 10 minutes/day or 10,000-20,000 ppcc for 20 minutes/day (total treatment days not indicated). Rifat et al. (1990) stated that the recommended exposure was to an Al dust concentration of 20,000-34,000 parts per ml air in the miners' changing rooms before each shift for 10 minutes. Stokinger (1981) reported that the 30,000 ppcc concentration corresponds to . 350 mg/m^3, which is equivalent to an 8-hour average concentration of 2 mg/m^3. Based on the Stokinger (1981) data and the fact that one unspecified study used levels 30 times higher than advised, the TLV of 10 mg/m^3 is recommended for Al dust (ACGIH, 1998).

The increasing awareness of the potential neurotoxicity of Al has resulted in a number of investigations of the incidence of neurotoxicological symptoms in Al workers. Although treatment with McIntyre powder had not produced apparent adverse effects, a neurobehavioral evaluation of male miners (261 exposed to McIntyre powder, 346 unexposed) who started working between 1940 and 1979 (additional duration data not reported) was performed in 1988-1989 (Rifat et al., 1990). There were no significant differences between exposed and unexposed miners in reported diagnoses of neurological disorder. Results of cognitive testing (Mini-Mental State Examination for general cognitive function, Ravens colored progressive matrices test for reasoning, and Symbol Digit Modalities Test for spatial perceptual accuracy and information processing), however, showed that the exposed group had significantly (p#0.001) impaired performance on at least one test, and when all test scores were summed. Also, the likelihood of scores in the impaired range increased with duration of exposure.

A neurologic syndrome was described in Al smelting plant potroom workers (White et al., 1992). Twenty-five men were evaluated for suspected work-related neurologic illness based on findings in 3 patients studied previously. The average duration of employment was 18.7 years (SD, 3.6; range, 12-23 years), 15 of the patients were working at the time of evaluation, and 10 had taken early retirement or medical leave due to workplace-related symptoms (mean length of time since exposure was 1.3 years ranging from 0.2-5 years). Quantitative exposure level data were not reported, but 21 of the workers had been employed in the potroom prior to installation of fume hoods for a mean duration of 5.3 years (range 3-7 years). Symptoms most often reported by the patients were frequent loss of balance (88%), memory loss (84%), and joint pain (84%); other symptoms included dizziness (80%), numbness (80%), parasthesias (72%), and tremor (68%). Neurologic examinations showed mild to moderate signs of lack of coordination (tremor, dyssynergy of upper extremity limb movement, or ataxia) in 84% of the patients. Neuropsychologic effects were evaluated in 21 of the patients using the Wechsler Adult Intelligence Scale-Revised (intellectual functioning), Wide Range Achievement Test-Revised (academic functioning), Halstead-Reitan Neuropsychological Test Battery (neuropsychological assessment), and Minnesota Multiphasic Personality Inventory (personality functioning). Memory function was assessed with the Wechsler Memory Scale (14 patients) and Wechsler Memory Scale-Revised (8 patients). The memory function evaluation showed mild to moderate impairment on subtests of immediate recall for verbal or visual information (70-75% of the tested patients) and delayed verbal or visual recall (50-70%). Other effects included mild or moderate impairment on Halstead-Reitan tests of abstract reasoning and flexible thinking (42% of the tested patients), memory for tactile information (53%), and sustained attention and discrimination of tonal and speech patterns (44 and 64%, respectively). On the Wechsler memory and Halstead-Reitan tests, mild and moderate impairment was defined as scores 1.5-2 and $2 standard deviations below the mean of the normal population, respectively. Most (89%) of the patients tested with the Minnesota Multiphasic Personality Inventory had abnormally elevated scores ($2 SDs above the population mean) indicative of clinical depression. Significant positive correlations were found between severity of incoordination (signs and symptoms) and degree of exposure (qualitative) before the introduction of the ventilation hoods.

White et al. (1992) noted two other studies that described neurologic problems among Al smelter workers. Thus, an evaluation of 444 electrolysis workers found neuropsychiatric changes in 123 (28%), "neurotic syndromes" in 89 (20%), and "slight pyramidal and cerebellar changes" in 39 (9%) (Langauer-Lewowicka and Braszczynska, 1983). In the second study, symptoms including mental confusion, concentration, and memory problems were described in 6 potroom workers (Cawthon, 1988).

In another study of Al production workers, neuropsychological effects were assessed in 38 elderly men who had been exposed for at least 10 years exclusively in the potroom (n=14), foundry (n=8), or other manual bor departments of the same plant (n=16, control group) (Bast-Pettersen et al., 1994). The mean ages and hployment durations of the groups were in the ranges 62.5-63.5 years and 19.2-19.6 years, respectively. The men were examined soon after or just before retirement in 1991. Limited environmental monitoring data indicates that the degree of Al exposure varied between the subgroups and over the years. Average annual total dust concentrations in the potroom were reduced significantly from 9.5 mg/m^3 in 1977 to 3.0 mg/m^3 in 1990. Aluminum levels were not specifically reported, but the average Al content in the total potroom dust was approximately 20% by weight; other constituents of the dust included fluoride and coal tar pitch components. Data from an Al uptake/excretion study of workers from the same plant indicated that the level of Al exposure was approximately eight times higher in the potroom than in the foundry (0.48 and 0.06 mg/m^3, respectively) (Drablos et al., 1992). Medical examinations (including lung function, standard laboratory tests, and serum and urine Al concentrations) and a neuropsychological test battery were performed. The battery assessed six mental functions (neuropsychiatric symptoms, motoric/sensoric, reaction time, psychomotor speed/efficiency, memory/learning, and intelligence) using a questionnaire and 15 different objective tests. Some subtle deficits were found in potroom workers that were not considered to be indicative of a significant neurological syndrome. The findings in potroom workers included a subclinical tremor as indicated by results of a static steadiness test [time scores on one of two test indices were significantly worse in comparison with the control group (84% slower, p=0.03)], and possible tendencies (i.e., test results that were about 1 SD below normal mean values but not statistically significant) for increased risk of impaired visuospatial organization (Block Design subtest of the Wechsler Adult Intelligence Scale) and psychomotor tempo (one Halstead ReitanTrail Making test). Although these findings were not considered to be indicative of a neurologic syndrome, it was suggested that they may be early signs of CNS impairment. Additionally, the finding of a subclinical tremor seems to be consistent with the tremor and other signs of incoordination observed in 84% of the patients in the Vhite et al. (1992) study summarized above.

Studies of Al welders are consistent with those of Al smelter workers in indicating that occupational exposure to Al can be neurotoxic. CNS function was evaluated in 17 welders who had an average of 15 years (range 5-27 years) experience, with the last 4 years exclusively with Al (Hanninen et al., 1994). Most of the welders had equipment that ventilated the welding masks but the respiratory protection was not always used. The assessment included measurements of serum and urinary Al, neuropsychological tests (simple reaction time, three tests for psychomotor speed, two tests for visual and spatial ability, four memory tests, and two verbal ability tests), a symptom questionnaire and neurological interview, quantitative electroencephalography (QEEG), and P-300 event-related auditory-evoked responses. Serum and urine Al levels were 3.5 and 8.5 times higher, respectively, than an unexposed reference population. The welders performed normally on the neuropsychological tests, although correlation analysis of test scores and exposure parameters showed weak negative associations between the four memory tests and urinary Al level, and a positive association between the variability (standard deviation) of visual reaction times and serum Al levels. Analysis of the QEEG data showed that serum Al levels were positively correlated with the amount of delta and theta activity in the brain frontal region and negatively correlated with the amount of alpha activity in the frontal region. Results of this study (disturbances of memory and attention, QEEG changes similar to those in patients with Al encephalopathy) were interpreted as consistent with known CNS effects of Al, but insufficient for establishing a definite relationship between Al exposure and effects.

In another study of Al welders, CNS evaluations were performed on 38 men who had at least 5 years exposure (mean 17.1 years), and a control group of 44 railway track welders exposed to metal fumes other than

Al (mean 13.8 years) (Sjogren et al., 1996). Limited monitoring data indicated that the median exposure to welding fumes was 10 mg/m^3 and that the Al content was 40% of the total fumes. Symptom questionnaires, psychological tests (simple reaction time, finger tapping speed and endurance, digit span, vocabulary, tracking, symbol digit coding, cylinders, olfactory threshold, and Luria-Nebraska motor scale), neurophysiological indices [electroencephalography, P-300 auditory-evoked responses, brain-stem auditory evoked responses and diadochokinesis (ability to perform rapidly alternating movements with one limb)], and blood and urine Al levels were assessed. The blood and urine Al concentrations were approximately 3 and 7 times higher in the Al welders than in the controls, but there were no clear correlations between duration of exposure to Al and concentration of Al in blood or urine. The Al welders reported more acute CNS symptoms (e.g., concentration difficulties) and had decreased motor function in five tests (finger tapping in non-dominant hand, two tasks from the Luria-Nebraska motor scale, pegboard peg movement with dominant hand, amplitude of diadochokinesis in dominant hand) when compared to the control group. Urinary Al concentration was significantly correlated with acute CNS symptoms, but not with any of the performance measures. To further study possible dose-effect relationships of Al exposure, the Al welders were combined with the control group and divided into three exposure categories according to urinary Al levels, using the 50th and 75th percentiles as category dividers. The group with the highest mean urinary Al level had significantly more acute CNS symptoms and significantly reduced performance on one of the motor function tests (a Luria-Nebraska motor scale task) when compared to the group with the lowest Al level. In an earlier study of 65 welders with $10 years exposure to Al fumes, the highest exposure category (based on exposure duration) was 2.8 times more likely than unexposed workers to have three or more neuropsychiatric symptoms (Sjogren et al., 1990).

Aluminum Toxicity in Experimental Animals

Groups of 20 weanling Fischer 344 rats/sex and 20 weanling Hartley guinea pigs/sex were exposed to 0, 0.25, 2.5 or 25 mg/m^3 aluminum chlorhydrate [$Al_2(OH)_5Cl@x(H_2O)$] for 6 hours/day, 5 days/week for 6 months (Steinhagen et al., 1978). Analysis of the aluminum chlorhydrate by the investigators showed it to contain 24.5% Al, indicating that the animals were exposed to 0, 0.061, 0.61, and 6.1 mg Al/m^3. Body weights were measured weekly for the first 8 weeks and biweekly thereafter. At the end of the exposure period, 10 animals (5/sex) of each species were sacrificed for organ weight measurements (heart, lung, liver, kidney, spleen, and brain) and histological examination of the lungs, liver, and kidney. In addition, comprehensive histological examinations were performed on animals in the control and 6.1 mg AL/m^3 groups. The remainder of the animals were used for hematology evaluation (RBC, WBC, hematocrit and hemoglobin) and Al measurements in blood and tissues. Apparent effects of Al included multifocal granulomatous pneumonia in both species at $0.61 mg Al/m^3, significantly increased absolute and relative lung weights in both species, and decreased body weight gain in rats and minimal lung edema in guinea pigs at 6.1 mg Al/m^3. The granulomatous reaction was characterized by foci of giant vacuoled particle-containing macrophages in the lungs and macrophages that did not appear to contain vacuoles or other evidence of phagocytized material in the peribronchial lymph nodes. There was a significant dose-related accumulation of Al in the lungs of both species at $0.061 mg Al/m^3. However, a NOAEL of 0.061 mg/m^3 could be identified for the onset of compound-induced histopathological effects.

In other studies, groups of 14-30 guinea pigs, rats, and hamsters were exposed to fine metallic Al powders (pyro, atomized, and flaked) at concentrations of 15, 30, 50, or 100 mg powder/m^3 air for 6 hours/day, 5 days/week for 6 months (Gross et al., 1973). Alveolar proteinosis occurred in exposed animals of all three

species after 2 months of exposure, but fibrosis or other pulmonary changes did not develop. Similarly, groups of 23 or 46 rats and 48 hamsters were exposed to undetermined concentrations of Al fumes or Al powder (20% Al, 80% $Al(OH)_3$) for morning hours only or morning and afternoon for up to 20 months (Christie et al., 1963). Effects were similar for both forms of Al in both species, including initial increased alveolar macrophage proliferation followed by nodular hyalinized areas, with development of pneumonia but no fibrosis.

Exposure to 2.18 mg Al fibers/m^3 for 6 hours/day, 5 days/week for up to 86 weeks produced slightly increased alveolar macrophages and some irritation of the nasal passages in a group of 50 Alderly Park rats (Pigott et al., 1981). Finally, a study by Drew et al. (1974) observed the development of granulomatous nodules also developed in male hamsters that were exposed to 8 mg Al/m^3 of *Alchlor* (a propylene glycol complex of aluminum-chloride-hydroxide) for 6 hours/day, 5 days/week for 20 or 30 exposures. The alterations persisted at the longest post treatment observation (6 weeks) and consistently developed at the bifurcation of the bronchioloalveolar ducts which is a likely site of particulate deposition.

DERIVATION OF A PROVISIONAL CHRONIC INHALATION RfC

As discussed earlier, unlike carcinogenicity or respiratory effects, that cannot be ascribed to Al inhalation due to the presence of other chemicals and confounding factors, Al seems to be the most likely cause for the generally and consistently reported psychomotor and cognitive effects (particularly signs of impaired coordination) in Al production workers and welders (Bast-Pettersen et al., 1994; Rifat et al., 1990; Hosovski et al., 1990; White et al., 1992; Hanninen et al., 1994; Sjogren et al., 1990, 1996). In addition, there is strong evidence that Al is neurotoxic by other routes of exposure. Thus, a degenerative neurological syndrome (dialysis dementia) has been documented in humans with chronic renal failure, apparently due to an increased exposure to Al from dialysis treatment and/or ingestion of phosphate binding agents which contain Al (Alfrey, 1993). This syndrome is characterized by gradual loss of motor, speech, and cognitive functions. Neurotoxicity, particularly neuromuscular effects such as decreased motor activity, startle responsiveness, and grip strength, has also been observed in mice following subchronic oral exposure and in the offspring of mice and rats exposed orally during gestation and/or lactation. Based on this information, as well as evidence that Al is absorbed by Al production workers and welders, the hypothesis that the occupational studies are indicative of a neurotoxic effect of Al appears to be justified. However, the only occupational study that has yielded suitable monitoring data is that of Hosovski et al. (1990), in which workers were exposed to presumed TWA concentrations of 4.6-11.5 mg Al/m^3 magnitude for an average of 12 years. Using 4.6 mg Al/m^3 as the LOAEL for psychomotor and cognitive impairment for an 8-hour occupational exposure (Hosovski et al., 1990) and corrections for discontinuous exposure (10 m^3/20 m^3 and 5 days/7 days), the $LOAEL_{HEC}$ is 1.64 mg/m^3. Applying an uncertainty factor of 300 for intrahuman variability (10), use of a LOAEL (10) and an incomplete database (3) yields a provisional RfC of

$$\mathbf{RfC = 1.64\ mg/m^3/300 = 5E\text{-}3\ mg/m^3.}$$

The lack of inhalation developmental studies may increase uncertainty in the database because oral data in animals indicate that neurotoxic and morphological developmental effects may occur at lower doses than neurotoxicity in adults. Additionally, there is uncertainty related to the lack of corroborating data on air concentrations associated with neurotoxicity. Confidence in the critical study is low to medium because only a LOAEL was identified. Confidence in the database is medium because (1) there are no corroborating data on effect levels (NOAELs and additional LOAELs), (2) no data are available for developmental neurotoxicity by the inhalation route, and (3) a well-designed two-generation reproduction study is lacking. Reflecting the low

to medium confidence in the critical study and database, there is low to medium confidence in the provisional RfC.

RISK CHARACTERIZATION

Cancer Hazard Summary There are no records for Al in the U.S. EPA's IRIS or HEAST databases (U.S. EPA, 1999, 1997), nor has the carcinogenicity of Al compounds been formally evaluated by the agency. However, a number of scientific investigations have addressed the issue of the carcinogenicity of Al, though with inconclusive results. For example, a 20-month exposure of B6C3F1 mice to aluminum potassium sulfate dodecahydrate in the diet at concentrations up to 10% w/w displayed no indication of compound-related carcinogenicity and, in general, no indication of adverse toxicological effects of any kind (Oneda et al., 1994). Similarly, the life-time exposure of Swiss mice and Long-Evans rats to 5 ppm Al as aluminum potassium sulfate in drinking water provided no convincing evidence for the carcinogenicity of Al compounds (Schroeder and Mitchener 1975a,b). A considerable number of epidemiological studies have examined the incidence of excess tumor formation in persons occupationally exposed to Al in the form of dusts or fumes. In general, a body of inferential evidence exists for an increase in cancer of the bladder and lung with occupational exposure to Al, though conclusions linking cause with effect are frequently confounded by co-exposure to other harmful emissions, cigarette smoking, and the absence of adequate reference populations. Taking all of the evidence of Al carcinogenicity together, a qualitative weight-of evidence classification of D, -not classifiable as to human carcinogenicity, is suggested, in line with the agency's guidelines for carcinogenic risk assessment (U.S. EPA, 1986). In accordance with the agency's proposed guidelines for carcinogenic risk assessment (U.S. EPA, 1996), the compound's carcinogenicity *cannot be determined* on the available evidence.

SUPPORTING INFORMATION

Human Data Occupational exposure to fumes and dusts containing Al compounds, for example, in welding shops, has provided insubstantial evidence of links to increased tumor incidence, in some studies. Overall, the links between cause and effect are considered marginal, at best, and are potentially by co-exposure to other carcinogenic substances.

Animal Data Studies of the carcinogenicity of Al compounds in experimental animals have yielded negative results.

Mutagenicity The small amount of evidence that exists on the capacity of the element to induce gene reversion in *S. typhimurium* is negative for Al compounds (Ahn and Jeffrey, 1995).

MODE OF ACTION

No data.

DISCUSSION

Epidemiological studies of metal dusts and fumes in such settings as welding shops, smelters, etc., have provided a body of evidence that suggests but does not prove that emissions containing a number of air-borne Al may be carcinogenic. However, the evidence for such a proposition is weak, yielding data on the borderline of statistical significance, if at all. There is no hard evidence for the carcinogenicity of Al compounds via the oral route.

BRIEFING SUMMARY

Routes	Class	Designation or Rationale	Dose Response
oral/inhalation	cannot be determined	not applicable	no data

Basis for classification/dose response

1. **Human data:** Insufficient evidence in epidemiological/occupational exposure studies.

2. **Animal data:** Existing evidence is largely negative for Al's carcinogenicity.

3. **Structural analogue data:** None.

4. **Other key data:** Available mutagenicity data are negative for Al compounds.

5. **Mode of action:** No data.

6. **Hazard classification/uncertainties:** The chosen weight-of-evidence descriptors are based on a lack of sufficiently hard evidence for the carcinogenicity of Al compounds. Positive evidence of non-carcinogenicity is also lacking.

7. **Dose response:** Not applicable

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Risk Assessment Issue Paper for:
Derivation of a Provisional Oral RfD for Aluminum (CASRN 7429-90-5)

NOTE: This provisional risk assessment paper for the oral chronic reference dose (RfD) for Aluminum has received external peer review.

INTRODUCTION

Verified toxicity values for aluminum (Al) and its compounds are unavailable on IRIS or HEAST (U.S. EPA, 1999, 1997), except for a chronic oral RfD of 4E-4 mg/kg-day for aluminum phosphide. However, occupational guidelines and standards have been established for a number of chemical and physical forms of Al, including, from ACGIH, 8-hour TWA-TLVs of 10 mg/m^3 for the compound as a metal dust or oxide, 5 mg/m^3 as "pyro" powders or welding fumes, and 2 mg/m^3 for soluble salts or organic forms of the metal (ACGIH, 1998). From NIOSH, 10-hour TWA-RELs of 10 mg/m^3 are specified for "total" Al dust versus 5 mg/m^3 for the respirable portion (NIOSH, 1994), NIOSH covers all other forms of the metal by identical values to those specified by ACGIH (ACGIH, 1998). OSHA PELs for Al include an 8-hour TWA value of 15 mg/m^3 for "total" metal dust, versus 5 mg/m^3 for the respirable portion (NIOSH, 1994). The U.S. EPA's CARA list (U.S. EPA, 1994) cites a HEA for Al (U.S. EPA, 1987), and ATSDR has updated its toxicological profile of the element (ATSDR, 1998).

Research papers pertinent to the potential toxicological effects of Al were sought through computer arches of the HSDB, RTECS, MEDLINE, and TOXLINE (and its subfiles) databases, covering the time lod 1995-1999. The literature searches were conducted in June, 1999.

REVIEW OF THE PERTINENT LITERATURE

The review by Stokinger (1981) gives an account of Al as an all-pervasive component of products that are central to the daily lives of most Americans. For example, the metal is a crucial part of manufactured products for the building, automobile, and container industries, while Al as powder or flake is a component in a number of consumer products, such as paints, fireworks, etc. Al complexes and minerals are used in the brewing and paper industries, and as coagulants for water purification. Aluminum oxide finds application in abrasives, as a catalyst or absorbent, and as a component in fillers. Aluminum chloride is included in cosmetic formulations such as deodorants.

Human exposure to Al arises principally from food and water, through its widespread use in food additives, packaging and cooking utensils, and in Al-containing medications, particularly antacid, buffered aspirin, anti-ulcer and anti-diarrheal formulations (Marquis, 1989; Lione, 1985). Pennington and Schoen (1995) estimated daily Al intakes of 0.1-0.3 mg/kg-day for infants and children 6 months-6 years of age and 0.1-0.18 mg/kg-day for older children and adults, based on the FDA Total Diet Study (1993) and the U.S. Department of Agriculture Nationwide Food Consumption Survey (1987-1988). These data are in broad agreement with those of Wilhelm et al. (1995) who reported the dietary intake of Al in German children (living in the Duisberg area) as ranging from 0.008 to 0.11 mg Al/kg-day. In addition, these values are consistent with a range of 1-20 mg/day (0.014-0.3 mg/kg -day) for normal oral daily Al intake from food and water reported by other

investigators (Ganrot, 1986; Iyengar et al., 1987; Wilhelm et al., 1990). However, users of Al-containing medications can ingest much larger amounts of the element, possibly as high as 840-5000 mg/day (12-71 mg/kg-day) from antacids, 126-728 mg/day (1.8-10.4 mg/kg-day) from buffered aspirins and 828 mg/day (11.8 mg/kg-day) from anti-ulcer compounds when taken at recommended dosages (Lione, 1985).

Toxicokinetic of Aluminum

There is a large amount of information available on the absorption, transfer from tissue to tissue and elimination of Al from the body, including data that have been amassed from studies on either human volunteers or laboratory animals. In general, the chemical appears to be poorly absorbed from the gastrointestinal tract, though the portion of the load that is retained will vary depending on the concentration, the chemical species administered, the fasting or fed state of the host, gastrointestinal pH, animal model, etc. For example, Yokel and McNamara (1988) administered single oral doses of a number of Al compounds (both water soluble and insoluble) to New Zealand white rabbits and obtained absorbed proportions of the load ranging from 0.27% to 27%. Fractional uptake of Al in humans under normal conditions (i.e., with no intake of large quantities of Al from medicine) was estimated to be 0.1-0.3% assuming an intake of 20 mg Al/day (0.3 mg Al/kg-day) and urinary excretion of 20-50 : g Al/day (0.3-0.7 : g Al/kg-day) (Ganrot, 1986). However, little information is available on the actual mechanism by which the element and its compounds are transported across the brush border. (Wilhelm et al., 1990; Lione, 1985).

Although the overall extent of Al absorption is poor, there may be significant intake of the compound by those taking large amounts of Al compounds in patented remedies. As stated, absorption of Al is influenced by gastrointestinal conditions and content because Al can form various complexes with different solubilities and oxidation states depending on pH and interactions with dietary constituents. At low pH (3-5) in aqueous solutions, the soluble (ionic) forms of the Al prevail (Al^{3+}); at high pH (>8), Al in the form of soluble aluminum oxide is present; and at pH 5-8, the element is predominantly in the form of aluminum hydroxide, which is insoluble (van der Voet and de Wolff, 1986; Wilhelm et al., 1990). Ingested constituents that can influence absorption by forming complexes with Al include phosphate, fluoride, calcium, citrate and lactate. For example, Al is used to bind dietary phosphorus and decrease its absorption as a control for hyperphosphatemia, and citrate and lactate are complexing agents that can significantly increase Al absorption (Slanina et al., 1984, 1985, 1986; Partridge et al., 1989; Domingo et al. 1991; Ittel et al., 1991; Lione, 1985; Wihelm et al., 1990).

A number of recent reports of studies on the gastrointestinal absorption of Al have examined the influence of organic anions such as citrate. In general, the presence of such components appears to enhance the absorption of Al, within narrow limits. For example, Deng et al. (1998) administered a single oral dose of either distilled water, 2 mmoles/L aluminum chloride or 2 mmoles/L aluminum chloride plus 2 mmoles/L sodium citrate to 6 male Wistar rats/group. Animals were bled at 1, 2 and 4 hours after dosing, then terminated after 6 hours. Inductively coupled plasma (ICP) was used to measure Al concentrations in blood, bone (tibia), kidney, liver and the intestinal wall. Irrespective of treatment, the appearance of Al in the blood of dosed groups peaked after 1 hour, with the concentration of the element at higher levels in those animals receiving citrate in addition to aluminum chloride. In those animals receiving aluminum chloride alone, significant tissue concentrations of the element were restricted to the gastrointestinal wall. Those receiving citrate displayed measurable quantities of the element in several of the other monitored tissues, including bone.

Sutherland and Greger (1998a) used a similar dosing regimen to examine the kinetics of absorption and elimination of Al in male Sprague-Dawley rats that had received a single oral dose of 0, 0.25, 0.5 or 1

mmoles/L/kg body weight aluminum lactate in 1 mL of 16% citrate. Concentrations of Al in serum, liver, kidney or bone (tibia) were measured at various post-dosing time intervals up to 6 hours. Depending on the dose, absorption factors for Al of up to 4.2% of the administered dose were observed, with the greater proportion retained in bone. The authors reported a slower rate of absorption in those animals receiving Al at the higher doses, an observation potentially indicating reduced gut motility and/or saturation of the transcellular absorption processes at the higher concentrations. Aluminum deposited in kidney and bone appeared to turnover at a slower rate than in the liver.

The influence of citrate on the gastrointestinal absorption of Al in man was examined directly by Taylor et al. (1998) who administered a drink containing Al and citrate to three volunteers. Aluminum and citrate concentrations were monitored in serial blood and urine samples for up to 24 hours. The kinetics of citrate and Al differed markedly, the former peaking in plasma after 32 minutes, versus 87 minutes for Al. This suggests that Al probably does not cross the gastrointestinal barrier as the citrate. Furthermore, the authors reported that the overall extent of Al absorption had probably not exceeded 1% in their experiment, a finding that contrasts with the higher values reported by Sutherland and Greger (1998a) in Sprague-Dawley rats and by Deng et al. (1998) in Wistar rats.

As discussed in a report by Glynn et al. (1999), gastrointestinal absorption of Al from aqueous media will be almost impossible to predict, because of the likelihood that the element will become absorbed to food particles in the intestinal lumen. Accordingly, depending on the dose, mode of delivery, and caloric state of the experimental animal (fed/fasted), significant amounts of aqueous forms of Al will be absorbed only when available binding sites on food have become saturated. This presents an inherently complex overall picture of the element's absorption since, additionally, the normal dietary content of Al will be substantial. Thus, it may be assumed that some sequestered Al will be absorbed along with non-sequestered water soluble forms of the element, while the rest will be retained within the gastrointestinal tract.

Sutherland and Greger (1998b) used their aluminum lactate in 16% citrate dosing regimen to examine the comparative importance of biliary versus urinary excretion of Al. Five to seven male Sprague-Dawley rats/group who had previously received an implanted bile cannula were treated by gavage. Another similarly-treated cohort of five animals/group were housed in metabolic cages immediately after dosing to provide 0-3 hour and 3-6 hour urine specimens. At termination, all animals were sacrificed and exsanguinated, and tissue, bile and urine samples were measured by graphite furnace atomic absorption spectroscopy. Among the key findings to emerge from this study was the incremental appearance of Al in bile as early as 15 minutes after dosing. However, overall amounts of Al were greater in the 3-hour urine samples than those that had accumulated in bile samples collected within a similar time frame. The fact that control rats excreted three times more Al in bile than in urine during the first 3 hours after dosing led the authors to conclude that, at low exposure to Al (in controls receiving Al solely from food), the liver is capable of excreting the element to the bile, a mechanism that becomes saturated as the level of Al administration becomes increased. Thereafter, urinary excretion becomes the primary route of elimination in circumstances of Al overload.

Prevailing perceptions of the overall toxicity of Al have changed during recent years. Thus, while the element has not been shown to have a definite biological function and was long regarded as nontoxic largely because gastrointestinal absorption is normally minimal, recent health effects research in humans and animals has shown that elevated levels of Al in the body may be toxic, particularly to the central nervous, skeletal and hematological systems.

Neurotoxicity as a Primary Toxicological Effect of Aluminum

One of the greatest health concerns regarding Al is its neurological effects. The first evidence for Al-induced neurotoxicity in humans was seen in patients who, as a result of receiving long-term hemodialysis for chronic renal failure, developed a degenerative neurological syndrome (dialysis dementia) characterized by the gradual loss of motor, speech, and cognitive functions (Alfrey, 1993). This dementia, attributable to Al in the dialysate, is usually fatal within 6-9 months after the first clinical signs appear. In addition, many patients received high oral doses of Al to act as phosphate binders. Autopsies of these patients revealed increased concentrations of Al in the gray matter and cerebral spinal fluid (CSF) but no evidence of neurofibrillary degeneration (NFD) despite the elevated Al levels. Once the connection between Al and dialysis dementia was established, Al was removed from dialysis fluid and the incidence of dementia rapidly declined, thereby strengthening the argument that Al was a causal agent in dialysis dementia.

Amyotrophic Lateral Sclerosis (ALS) and Parkinson's Disease (PD) are other neurological diseases which have been associated with Al exposure. ALS is a progressive disease of the Central Nervous System (CNS) that is characterized by an accumulation of neurofibrillary tangles. In Guam, southern West New Guinea, and parts of Japan there is an unusually high prevalence of ALS and PD. This may be related to the natural abundance of Al coupled with the virtual lack of magnesium and calcium in the drinking water supplies and soil of these areas. In a study designed to evaluate effects of high Al and low calcium levels in the diet, much like the conditions associated with Guam and other similar areas, cynomolgus monkeys were placed on a low calcium diet either with or without supplemental Al and manganese (Garruto et al., 1989). Chronic calcium deficiency alone produced neurodegenerative effects, although neurofibrillary changes were most frequently seen in the monkeys on a low calcium diet supplemented with Al and manganese.

Perhaps the best evidence for the neurotoxicological effects of Al in human beings comes from studies of patients with reduced renal function who accumulated Al as a result of long-term intravenous hemodialysis therapy with Al-containing dialysis fluid and, in many cases, concurrent administration of high oral doses of aluminum hydroxide or other Al salts to regulate phosphate levels. Inferential evidence that these health effects (dialysis encephalopathy) were associated with exposure to Al is suggested by the fact that such neurological impairments have largely disappeared with improved purification of dialysis water (Ganrot, 1986).

Though a cause and effect relationship between Al and three forms of chronic encephalopathy in humans: senile dementia of the Alzheimer type (SDAT, Alzheimer's Disease), endemic Amyotrophic Lateral Sclerosis (ALS) and endemic Parkinsonism-dementia (PD, a mixture of Parkinsonism and senile dementia) has been suggested, there is no firm evidence that it plays a causal role in the development of these diseases (Ganrot, 1986; Lione, 1985). Thus, in humans, dialysis encephalopathy syndrome is the only neurologic condition commonly accepted as being caused by Al (Ganrot, 1986). The condition is degenerative and characterized by the progressive loss of speech, motor and cognitive functions, with death typically occurring within 1-6 months. Autopsies of patients revealed increased concentrations of Al in the gray matter and cerebral spinal fluid (CSF), though with no conclusive evidence of neurofibrillary degeneration (NFD) or other neuropathological changes despite the elevated Al levels.

The neurotoxicity of Al is well documented in certain animal species. Aluminum induces a spectrum of behavioral abnormalities and brain neurofibrillary degenerative changes in rabbits and cats when injected intracranially or parenterally in high doses, though hamsters and monkeys are less sensitive (Ganrot, 1986; Lione, 1985). Such studies have been designed as models for the possible neurotoxicological effects of Al in humans. However, it should be noted that the neurofibrillary changes in affected animals differ in

morphological detail from those associated with SDAT. As discussed further in the Oral Toxicity section, oral doses of Al can also induce neurobehavioral effects in adult mice and rats and in their developing offspring. In general, such neurotoxic effects of Al appear to be more subtle than those induced through routes of administration that by-pass the gastrointestinal tract, perhaps reflecting the lower doses of Al reaching the brain.

Recent reports of studies on the effects of Al on neurotoxicity in animals have sought to define the biochemical mechanisms that are impaired when Al crosses the blood-brain barrier. However, a unifying concept has yet to emerge, though the passage of the element into various regions of the brain has been clearly demonstrated (Deloncle et al., 1995). Among the many biochemical functions and processes that appear to be perturbed by the presence of Al in the brain are the peroxidation status of biological membranes (Katyal et al., 1997; Deloncle et al., 1999), inhibition of the neuronal glutamate-nitric oxide-cyclic GMP pathway (Cucarella et al., 1998), and the marked reduction of protein- and non-protein-bound thiols and the specific activity of Na^+/K^+ and Mg^{++} ATPases (Katyal et al., 1997). The relative importance of each of these mechanisms and how (or whether) they interact to bring about the observed physiological changes remains unclear.

Osteomalacia was frequently observed among long-term dialysis patients with neurological signs and is commonly attributed to Al overload (Ganrot, 1986; Lione, 1985). This bone condition is characterized by widened osteoid (unmineralized bone matrix) with no fibrosis, reduced mineralization rate, skeletal pain and a strong tendency for fractures, lack of response to vitamin D therapy, and increased Al concentration in bone. Effects on bone histology and elevated bone Al levels have also been observed in patients with normal renal function who received total parenteral nutrition with Al-contaminated casein as a protein source, and in parenteral Al loading induced osteomalacia in rats and dogs (Lione, 1985).

ORAL TOXICITY

In contrast to the well-characterized symptoms associated with dialysis encephalopathy, very few reports have been identified that address the toxicological effects of Al in humans exposed orally. Furthermore, in a review, Reiber et al. (1995) pointed to the conflicting findings that have been reported when the incidence of neurological symptoms has been assessed in relation to Al exposure in either cross-sectional, ecological or case-control epidemiological studies. Among the more recent studies that have used this approach, Martyn et al. (1997) discussed the findings of a case-control study involving 441 men in England and Wales who were afflicted with either Alzheimer's disease, brain cancer, dementia or other neurological conditions. Assessing the historical exposure of these subjects failed to establish a link between Al in drinking water at the prevailing concentrations (below 0.2 mg/L) and the incidence of one or more of the conditions under investigation.

Numerous subchronic animal studies were located in the biomedical/toxicological literature but only those that define the threshold region of the oral dose-response relationship are summarized in this issue paper. A major limitation of many of the studies of Al toxicity is the lack of complete information on total dietary (e.g., food and drinking water) intake of Al and of other elements that are known to effect Al biokinetics and toxicity (e.g., calcium and magnesium). For example, Golub et al. (1992a) reported that commercial grain-based mouse feeds contain high levels of Al (200-1200 ppm), as well as excess and variable amounts of essential and nonessential trace minerals and metal binding ligands. Estimated or reported dosages used in studies in which Al content of the basal diets are not reported must be assumed to underestimate the actual experimental dosages. The magnitude of the underestimate may be considerable. For example, a range of Al contents of 200-1200 mg Al/kg for commercial grain-based diets (Golub, 1992b) would provide 30-200 mg Al/kg bw-day in a subchronic or chronic mouse bioassay [based on U.S. EPA (1988) default values for body weight and food

intake]. On this basis, studies in which complete dietary Al intakes were not reported or could not be estimated may provide some information about the hazards of oral exposure to Al but are inappropriate for establishing NOAELs or LOAELs for the critical effect of Al. NOAELs and LOAELs from studies that provide estimates of total Al dosages, or otherwise provide information relevant to determining the NOAEL/LOAEL boundary for the critical effect of Al are presented in Table 1 and are summarized below.

Systemic Toxicity

Groups of 10 female Sprague-Dawley rats were administered aluminum nitrate nonahydrate in sugar-containing drinking water at doses of 360, 720 and 3600 mg/kg-day (26, 52 and 259 mg Al/kg bw-day, respectively) for 100 days (Domingo et al., 1987). A control group received sugar-containing distilled water only. Sugar had been added to the drinking water of all groups to reduce the taste-aversive effects of Al. The level of Al in the diet was not reported. Animals were housed in metabolic cages to facilitate the collection of fecal and urine samples. Food and water consumption were measured daily, body weights weekly, and blood samples were taken a monthly intervals and at termination to monitor clinical chemistry and hematological parameters. At termination, all animals were necropsied, and the weights of major organs (brain, heart, lungs, kidneys, liver, and spleen) were monitored. Aluminum concentrations were measured in various tissues, pieces of which were processed for histopathological examination. A significant decrease ($p<0.05$) in body weight gain was observed in the 259 mg Al/kg-day group, attributed by the authors to decreased food intake. Overall, no consistent variations in hematological (hemoglobin, hematocrit) or clinical chemistry (SGOT, SGPT, alkaline phosphatase, urea, creatinine, total protein, cholesterol, glucose) parameters were observed. No histopathological alterations in the heart, liver, kidney, spleen, brain and cerebellum were observed. Interpretation of these data was complicated by the concurrent exposure of the rats to high doses of nitrate of up to 475 times the RfD for nitrate (1.6 mg nitrate-nitrogen/kg-day) which is based on methemoglobinemia in humans (U.S. EPA, 1999). Therefore, because of nitrate co-exposure, the absence from the study design of a food-restricted control group and uncertainty surrounding the contribution of Al in food, the apparent effect of Al on body weight gain cannot be conclusively attributed to Al alone.

Some recent studies have identified a number of potential toxicological responses in laboratory animals exposed orally to Al compounds in a subchronic or chronic dosing regimen. In most cases, however, only one dose level was employed in the study compared to controls, and since the amount of Al in the diet was not given, the resulting dose level represents an incremental dose of Al compared to that of controls as baseline. However, while these studies may offer inadequate quantitative dosimetric information for NOAEL/LOAEL identification and consequent RfD development, they provide an qualitative indication of a range of potential toxicological responses that might be induced in humans exposed to the element. For example, Garbossa et al. (1998) studied the potential for water-soluble Al to affect the erythropoietic integrity of late erythroid progenitor cells in the bone marrow. Three groups of five male Wistar rats/group were either (1) gavaged with citrate at a dose of 1.0 : m Al/g-day (27 mg/kg-day), 5 days/week, for 15 weeks, (2) had drinking water containing 100 mmol Al/L made available to them as the citrate for the same length of time, or (3) maintained as controls. As calculated by the authors, the dose associated with the applied concentration of Al in drinking water approximated to 14-17 : mol/g-day (420 mg/kg-day). Rats had access to a standard chow diet, though with no indication of the baseline concentration of Al provided therein. At the end of the in-life phase of the study, all rats were sacrificed, and samples of blood were obtained for hematological investigation. Femoral bone marrow cells were flushed with physiological medium, stimulated with recombinant human erythropoietin, then monitored for the comparative incidence of colony-forming units-erythroid (CFU-E).

Further tests were carried out to monitor the osmotic fragility and average life-span of erythrocytes from each test group. The animals in the group receiving Al at the higher dose showed decreased hematocrit, hemoglobin concentration, median osmotic fragility and erythrocyte life-span values compared to controls. The content of Al increased in the serum and bone of both exposed groups, the distribution of concentrations in bone correlating inversely with the extent of an animal's CFU-E development.

That Al in drinking water may have the ability to cause histopathological changes and altered hepatic enzyme activities was suggested by Basu et al. (1997) who made available aluminum chloride in drinking water to groups of eight male Sprague-Dawley rats at a dose of 50 mg/kg-day (10.1 mg Al/kg-day) for 40 days. Additionally, other groups of similarly-treated rats received drinking water containing either 0, 50, 100, 200 or 400 ppm (mg/L) added calcium (Ca), as the chloride. The authors reported increased specific activities of acid and alkaline phosphatases in liver 10,000 x g supernatants from Al-receiving animals versus controls, and in alkaline phosphatase activity in equivalent kidney preparations. The presence of Ca in the drinking water appeared to reverse these changes, plus the accompanying histopathological features associated with them.

Konishi et al. (1996) examined the ability of Al and Ca to cause opposite and potentially harmful effects in laboratory animals, in relation to the well-documented association between Al and the onset of osteomalacia. Male STD Wistar rats were divided into four groups (n = 4), receiving either (1) a normal diet (Group I), (2) a normal diet supplemented with Al (Group II), (3) a Ca-deficient diet (Group III), or (4) a Ca-deficient diet with supplemental Al (Group IV), for 10 weeks. Blood samples were taken at termination, then animals were perfused with paraformaldehyde/glutaraldehyde fixative. Levels of Ca, iron (Fe) and Al in serum and bone were measured by atomic absorption spectrophotometry, and sections of the resected right tibia were prepared for histopathological examination after decalcification in 5% formic acid in 10% formalin.

There were statistically-significant changes in body weight gain when those of groups 3 and 4 were compared to animals from groups 1 and 2, the values for the latter groups remaining constant from about 4 weeks of dosing. In discussing their histopathological findings, the authors described no decrease in the thickness of cortical bone in Group II compared to control, while bone specimen from Groups III and IV showed "an increase in osteoid as well as osteoblasts and osteoclasts", in addition to other disturbances of ossification. Such effects were considered to suggest bone fragility, with changes being more marked in Group IV compared to III. The amount of Al in the tibia of exposed rats was significantly greater in Group II than in Group I, whereas the average levels in Groups III and IV showed a further increase in Al deposition, most notably in group IV. There were also differences among the groups in the concentration of Fe in bone (tibia), and in the concentrations of Al, Ca, Fe and the levels of parathyroid hormone in blood. The authors concluded that Ca deficiency appeared to potentiate the deposition of orally administered Al in bone, and the attendant inhibition of ossification. Iron deposition was also thought to play a role in the osteogenic disturbance, where Ca is deficient.

A histopathological investigation indicated profound changes in the cerebrovascular and neuronal integrity when male Long-Evans rats (n=9) were exposed for 52 weeks to 0.5 ppm aluminum fluoride in drinking water (Varner et al., 1998). This corresponded to an Al dose of 0.019 mg/kg-day, based on a default drinking water consumption of 0.057 L/day, and a default body weight of 0.472 kg for male Long-Evans rats (U.S. EPA, 1988). Duel control groups received either NaF (fluoride controls) or double distilled deionized water. Tissue levels of Al were measured in brain, liver, and kidney by the use of a direct current plasma technique. Animals receiving aluminum fluoride showed poor survival compared to the other groups, with 6/9 having died by week 48. The tissue concentrations of Al were increased in the brain and kidney compared to

both the control groups, with Al-fluorescence being used to demonstrate that Al deposition was mostly in the vasculature. Morphological and histopathological changes due to treatment were apparent in the liver, kidney and spleen. Some changes in neuronal integrity were also evident in the hippocampus and neocortex. Other cytological changes in the brain were associated with chromatid clumping, pyknosis and vacuolation.

A report by Somova et al. (1997) describes a study in which 10 male Wistar rats/group received either 0, 5 or 20 mg/kg-day aluminum chloride by gavage in water for 6 months. At termination, all animals were exsanguinated, then subjected to a necropsy in which excised pieces of liver, kidney and cardiac and skeletal muscle were taken for histopathological examination. Pieces of brain were examined by electron as well as light microscopy, and all tissues were monitored for Al concentration by atomic absorption spectrophotometry. As tabulated by the authors, Al in plasma and all of the listed tissues was dose-dependently increased to levels that were statistically significantly greater than controls. However, though described in qualitative terms and illustrated photographically, the Al-induced lesions did not receive a quantitative treatment in the report. Thus, while at least some of the low dose rats displayed NFD (neuro fibrillar degeneration) of the hippocampal region of the brain, insufficient data are provided in the report to apply this observation to the identification of a NOAEL or LOAEL.

Dietary Experiments

Six Beagle dogs/sex/group were fed a diet providing either, in males, 0, 118, 317 or 1034 mg/kg-day sodium aluminum phosphate (0, 3.4, 9.0 or 29.4 mg Al/kg-day, respectively) or, in females, 0, 112, 361 or 1087 mg/kg-day sodium aluminum phosphate (0, 3.2, 10.3 or 30.9 mg Al/kg bw-day, respectively), for 6 months (Katz et al., 1984). No information was available on the level of Al in the diet, and no compound-related effects on body weight gain, hematological and clinical chemistry parameters (parameters not specified), or histopathological endpoints (major organs and tissues examined) were observed. A highest NOEL of 30.9 mg Al/kg-day could be tentatively identified in this study, but this would not include the contribution of Al from the basal diet, nor reflect the identification of any toxicological effects, since the NOEL occurred at the upper limit of the dose-response curve.

Neurotoxicity

A number of studies have been reported in which neurotoxicological/neurobehavioral effects have been explicitly evaluated. In others, the effects of Al on neurological developmental have been addressed. For example, Golub et al. (1989) fed diets containing Al as the lactate at 25 (controls), 500 or 1000 mg Al/kg diet (3.3, 65 or 130 mg Al/kg-day) to groups of 15 female Swiss-Webster mice for 6 weeks (Golub et al., 1989). No mice were exposed to lactate alone. While no statistically significant differences in food intake or body weight gain were observed, mice fed the highest Al concentration gained less weight than the controls or low-dose group. As reported by the authors, a significant decrease (20%) in spontaneous motor activity (i.e., total, vertical, and horizontal movement) was observed in the 130 mg Al/kg-day group. Activity in the 65 mg Al/kg-day group was not significantly different than the controls. Thus, the highest NOAEL is 65 mg Al/kg-day and the LOAEL is 130 mg Al/kg-day.

Neurobehavioral effects of aluminum lactate were evaluated in groups of 12 female N:NIH Swiss-Webster mice (4.5-5.5 weeks old) that were fed 25 (controls) or 1000 mg Al/g diet for 90 days (Golub et al., 1992a). Based on a food factor of 0.19 kg diet/kg body weight/day calculated using an algorithm relating food consumption to body weight (U.S. EPA, 1988) and reported body weight data (the time-weighted average weight is 25.4 g), the dosage in the treated mice is estimated to be 190 mg Al/kg bw-day. No mice were

exposed to lactate alone. A neurobehavioral test battery used by Donald et al. (1989) was administered at the beginning of the experiment (day 0) and after 45 and 90 (±3) days, with motor activity evaluated at the latter two time points. Aluminum levels were measured in brain, femur and liver at the end of the exposure period.

Body weight was significantly increased in the treated mice but no exposure-related changes in food intake or overt signs of neurotoxicity were observed. Results of the neurobehavioral tests showed significantly decreased hindlimb grip strength at 90 days, decreased air puff startle response at 90 days and decreased auditory startle response at 45 days in the treated mice. Spontaneous motor activity was reduced at 90 days as indicated by decreased total activity counts, horizontal activity counts and percentage of intervals with high activity counts. Aluminum concentrations in the brain and liver were increased approximately threefold in the treated mice, but brain and liver lipid peroxidation indices were not altered.

Male Wistar rats (6-8 per group) were exposed continuously for 6 months to food containing 1.52 mg Al/kg (normal diet) or 1000 mg Al/kg as aluminum chloride with citrate (Florence et al., 1994). The average daily Al intake was estimated to be 0.13 or 84 mg Al/kg bw-day, assuming a body weight of 0.305 kg (arithmetic mean of default mature weight of male Wistar rats and the starting weight in this study of 0.11 kg) and a food intake of 0.026 kg food/kg bw-day, calculated using an algorithm relating food intake to body weight (U.S. EPA, 1988). The citrate content of the diet was in a 1:1 stoichiometric proportion to Al, therefore, the estimated daily intake was 598 mg/kg-day. Rats exposed to Al developed histopathological abnormalities in brain tissue, not specific to any brain region, characterized by extensive cytoplasmic vacuolization in astrocytes, swelling of astrocytic processes, particularly of astrocyte end-feet abutting blood vessels. Neurons also exhibited vacuolization and nuclear inclusions. Although no specific behavioral assays were reported, the investigators noted that "no significant behavioral changes were observed". Accordingly, the functional significance of the histopathological lesions is uncertain. The lesions appear to differ from the NFD observed with parenteral Al exposures (Kowall et al., 1989; Wakayama et al., 1993); or from exposures to Al in combination with calcium deprivation (Garruto et al., 1989; Kihira et al., 1995; Mitani, 1992). The LOAEL for histopathological changes in the brain was 84 mg Al/kg-day.

Male Sprague-Dawley rats (40 per group) were exposed in drinking water to 0, 50 or 100 mg Al/kg bw-day as aluminum nitrate with citric acid for 6.5 months beginning at 21 days of age, 8 months of age, or 16 months of age (Domingo et al., 1996). The citric acid dosage was 355 or 710 mg/kg-day in the 50 or 100 mg Al/kg bw-day groups, respectively. Controls did not receive citric acid. Dietary Al intake was not reported; the rats were maintained on Panlab rat chow. Animals from control and exposed groups were subjected to a number of neurobehavioral tests, and at termination, Al levels were measured in various excised regions of the brain. The authors observed the highest Al levels in the olfactory bulb and rhachidical bulb, while the cortex and thalamus were the regions showing the lowest Al content. However, compared to controls, there were no significant effects ($p>0.05$) of Al (with citric acid) on spontaneous motor activity (open-field) or passive avoidance operant training or performance (grid floor shock, light/dark shuttle box). Thus, the NOAEL was 100 mg Al/kg-day with citric acid; although this does not include the Al contribution from food. This study is listed on Table 1 because the NOAEL, although probably underestimated because of unreported Al intake from food, is still lower than the LOAELs from other studies.

Groups of 6 male albino rats were administered 0 or 25 mg Al/kg bw-day as aluminum nitrate in normal saline by gavage, 10% ethanol in drinking water, or 25 mg Al/kg bw-day by gavage combined with 10% ethanol in drinking water, 6 days/week for 6 weeks (Flora et al., 1991). The level of Al in the diet was not

reported. Urinary •-aminolevulinic acid (ALA), blood ALA-dehydratase (ALAD), blood zinc protoporphyrin (ZPP), glutamic oxaloacetic transaminase (GOT) and glutamic pyruvic transaminase (GPT) in serum and liver, and brain biogenic amines and their metabolites [dopamine (DA), norepinephrine (NE), 5-hydroxytryptamine (5-HT), homovanillic acid (HVA) and 5-hydroxyindolacetic acid (5-HIAA)] were evaluated at the end of the treatment period. Treatment with Al alone caused significantly increased blood ALAD ($p<0.01$), decreased liver GPT ($p<0.05$), decreased brain DA ($p<0.01$), increased brain NE ($p<0.05$) and decreased brain 5-HT ($p<0.05$). Compared to treatment with Al alone, concurrent exposure to ethanol and Al produced significantly decreased ALAD, increased ALA, increased ZPP, increased liver GPT, increased serum GOT and increased brain HVA. Significant changes found only in the combined Al and ethanol group included increased serum GPT, increased brain NE and decreased brain 5-HT. Treatment with ethanol alone only inhibited blood ALAD. The rats were co-exposed to relatively high levels of nitrate [comparable to those in the Domingo et al. (1987) subchronic study], but it seems likely that some of the changes (i.e., effects on brain chemicals) are related to aluminum which is known to be neurotoxic. Because the toxicological significance of the changes is unclear due to lack of evaluation of neurobehavioral performance and other endpoints, there is uncertainty whether the 25 mg Al/kg-day dose is a NOAEL or a LOAEL, an uncertainty compounded by the absence of information about the level of Al in the basal diet.

Reproductive/Developmental Toxicity

A number of studies have been carried out to examine the effects of Al compounds on developmental toxicity, particularly their effects on postnatal neurobehavioral development. For example, Bernuzzi et al. (1989) exposed groups of 6-12 pregnant Wistar rats to aluminum chloride or aluminum lactate in the diet on gestational days 1 through 21. The rats received nominal daily doses of 0, 100, 300, 400 mg Al/kg as aluminum chloride or 0, 100, 200, or 400 mg Al/kg as aluminum lactate. No rats were exposed to lactate alone, and information regarding level of Al in the basal diet was not reported. On the average, there was a less than 10% decrease in maternal body weight gain and no effect on food or water intake. No significant difference in litter size was observed. However, postnatal mortality increased 55% and 26% in offspring of the rats exposed to 300 or 400 mg Al/kg-day, respectively. The offspring of dams fed $ 300 mg Al/kg-day weighed significantly less than controls on postnatal day 1. Decreased body weight was also observed on postnatal days (PD) 4 and 14 in the offspring of rats fed 400 mg Al/kg-day as aluminum lactate. The following tests were used to assess neuromotor development (maturation): righting reflex, grasping reflex, negative geotaxis, suspension test, and locomotor coordination. The tests were performed on PDs 4, 6, 9, 12 and 20, respectively. Impairment of neuromotor development (righting and grasping reflexes) was observed in the pups exposed to $ 200 mg Al/kg-day. Impaired grasping reflex was also observed in the 100 mg/kg-day aluminum lactate group. Offspring of rats fed 400 mg/kg-day also exhibited altered performance on the locomotor coordination test.

A follow-up study by the same research group found that ingestion of 400 mg Al/kg bw-day as aluminum lactate had no effect on postnatal mortality, body weight and righting and grasping reflex tests (Muller et al., 1990), although significant differences between control and exposure groups were noted in locomotor coordination and operant conditioning tests. Significant differences between controls and exposed groups in the negative geotaxis test were limited to those pups of dams treated during the second and third weeks of gestation, a finding interpreted by the authors to indicate the possibility of long-term effects on the central nervous system of trans-placenta exposure to Al during a later organogenic phase. According to Muller et al. (1990), the contradictions between this and their earlier study (Bernuzzi et al., 1989) could be related to environmental modifications. In particular, the mothers and pups were much more protected in the Muller et al.

(1990) study than in the previous one because they were housed in plastic cages instead of wire mesh cages and received cotton to build nests. Body temperature of the pups, therefore, may have been more adequately maintained in the Muller et al. (1990) study. As discussed in this study, toxicity in pups can be confounded by insufficient body temperature, and delayed pup weight gain could explain the differences in neuromotor performance.

Muller et al. (1990) administered diets supplemented with 0 or 400 mg Al/kg bw-day as aluminum lactate to groups of 6-9 pregnant Wistar rats on days 1-7, 1-14, or 1-21 of gestation. No rats were exposed to lactate alone, and information regarding level of Al in the basal diet was not reported. Neuromotor development was assessed on postnatal days 4, 6, 9, 12 and 20 using tests of righting reflex, grasping reflex, negative geotaxis, suspension and locomotor coordination, respectively. Learning ability was also tested on PD 65 using operant conditioning. No effects on maternal body weight or food intake was observed in dams exposed on gestational days 1-7 or 1-14. In the dams exposed on gestational days (GD) 1-21, a significant decrease in maternal body weight (26 and 35%, respectively) was observed on days 16 and 19 of gestation. Decreased food intake was also observed on day 19 of gestation. No effects on litter size, postnatal mortality, or postnatal body weight were observed. Impairment of neuromotor development ($p<0.05$) was observed in 2 of the 5 tests (negative geotaxis and locomotor coordination); no differences between the three treated groups were observed. For the operant conditioning test, there were significant differences ($p<0.05$) between the treated and control young rats. No differences between the 3 treated groups were observed. The LOAEL for developmental toxicity is 400 mg Al/kg-day, but this does not include the contribution of Al from the basal diet.

Groups of 10 pregnant Sprague Dawley rats were administered 180, 360, or 720 mg/kg-day aluminum nitrate nonahydrate by gavage (13, 26, 52 mg Al/kg bw-day) on GDs 6-14 (Paternain et al., 1988). A vehicle (water) only control group was used. The level of Al in the diet was not reported. Aluminum exposed dams gained significantly less weight than the controls. No significant effect on the numbers of litters, corpora lutea, fetal implants, live fetuses, resorptions, or runt fetuses were observed. Significant decreases in fetal body weight and tail length were observed at all three Al doses; decreased fetal body length was also observed at the 52 mg Al/kg-day dose level. No dose-related external or visceral malformations were observed in the offspring. However, a significant increase in the incidence of skeletal malformations (delayed ossification, hypoplastic deformed ribs) was observed at all three treatment levels. In addition, the incidence of hematomas was significantly increased at the high dose. Because the rats were co-exposed to relatively high levels of nitrate [comparable to those in the Domingo et al. (1987) subchronic study], the effects of treatment cannot be conclusively attributed to Al alone, in the absence of a nitrate-exposed control group.

By contrast to the striking findings of potentially teratogenic effects of aluminum nitrate in Sprague-Dawley rats, as described above (Paternain et al. 1988), equivalent experiments by Domingo et al. (1989) in Swiss mice did not reveal any reproductive, developmental or teratogenic effects of Al, when administered to dams as the hydroxide. Domingo et al. (1989) administered by gavage 0, 66.5, 133, or 266 mg/kg-day aluminum hydroxide (0, 23.9, 47.8, 95.5 mg Al/kg bw-day) to groups of 20 pregnant Swiss mice on GD 6-15. The level of Al in the diet was not reported. The dams were killed on GD 18. No compound-related effects were observed on maternal mortality, clinical signs, body weight, food intake, or absolute or relative heart, lung, spleen, liver, kidney and brain weights. In addition, no compound-related effects were observed on numbers of implantations, resorptions, live and dead fetuses, sex ratio, and the incidences of external malformations, internal soft-tissue defects or skeletal abnormalities. Therefore, this study identifies a NOEL of 95.5 mg Al/kg-day by default for reproductive, developmental and teratogenic toxicity in mice. However, neuromotor development was not assessed and the contribution of Al from the basal diet was not stated in the report.

A number of studies have been designed to evaluate the influence of citrate or lactate on the potential developmental toxicity of Al. For example, Gomez et al. (1991) exposed groups of 15-19 pregnant Sprague-Dawley rats to either distilled water (controls) or 133 mg Al/kg bw-day in the form of either aluminum hydroxide (384 mg/kg-day), aluminum citrate (1064 mg/kg-day) or aluminum hydroxide (384 mg/kg-day) concurrent with citric acid (62 mg/kg-day) by gavage on GD 6-15. The level of Al in the diet was not reported and no rats were exposed to citric acid alone. Terminations were performed on GD 20. Maternal and fetal evaluations showed exposure-related effects only in the group exposed to aluminum hydroxide and citric acid concurrently. Significant changes included reduced maternal body weight gain on GDs 6-20 (but not at sacrifice on day 20), reduced fetal body weight and some skeletal variations (increased delayed occipital and sternebrae ossification and increased absence of xiphoides). No effects were seen on maternal food consumption or clinical signs, maternal absolute or relative liver, kidney or brain weights, gravid uterine weight, corpora lutea/dam, implantations/litter, pre- or postimplantation loss/litter, viable or nonviable implants/litter, fetal sex ratio or fetal malformations (external, visceral or skeletal). This study identified a stand alone minimum LOAEL of 133 mg Al/kg-day for non-neurobehavioral developmental toxicity of aluminum hydroxide and aluminum citrate in rats. Although confidence in this LOAEL is low (because aluminum hydroxide administered concurrently with citric acid induced did developmental effects and because the dose does not include a contribution of Al from the basal diet) the value is consistent with the developmental NOAEL of 95.5 mg Al/kg-day for aluminum hydroxide in mice (Domingo et al., 1989).

In a similar experimental protocol, groups of 11-13 pregnant female Swiss albino (CD-1) mice were administered 57.5 mg Al/kg bw-day as either aluminum hydroxide (166 mg/kg-day), aluminum lactate (627 mg/kg-day) or aluminum hydroxide (166 mg/kg-day) concurrent with lactic acid (570 mg/kg-day) by gavage on gestation days 6-15 (Colomina et al., 1992). Other groups were treated with lactic acid alone (570 mg/kg-day, equivalent to the amount in 627 mg/kg of aluminum lactate) or distilled water (controls). The level of Al in the diet was not reported. Fetal evaluations were performed on GD 18, including examinations for skeletal and visceral abnormalities in approximately two-thirds and one-third of the pups, respectively. The investigators noted that the dose of Al (57.5 mg/kg-day) is equivalent to ingestion of 3.5 g Al/day by a 60 kg person, which is higher than the usual quantities of Al ingested therapeutically for peptic disorders. Maternal body weight gain was significantly lower than control values in the aluminum lactate-treated mice when evaluated over GDs 6-9 (92%), 6-12 (55.6%) and 0-18 (38.5%), and in the mice treated with combined aluminum hydroxide and lactic acid evaluated over GDs 6-12 (37.8%), 6-15 (42.7%) and 0-18 (15.7%). The decreased maternal weight gain in the aluminum lactate group was accompanied by significantly reduced food consumption during gestation days 6-18. Significant developmental and/or teratological effects in the aluminum lactate group included 16% reduced fetal body weight ($p<0.01$) and increased incidences of cleft palate (13.2%, $p<0.05$), dorsal hyperkyphosis (i.e., excessive flexion of spine) (13.5%, $p<0.05$) and delayed parietal ossification (15.4%, $p<0.01$). These developmental effects were not observed in any of the control or aluminum hydroxide exposed pups, and the only other significant changes in the other groups were decreased maternal relative liver weight and delayed fetal parietal ossification in the lactic acid only exposure group. Other types of internal or skeletal malformations or variations were not found in any of the fetuses. Additionally, no effects were seen on maternal absolute or relative kidney weight, gravid uterine weight, numbers of implantation sites/litter, live or dead fetuses, resorptions, postimplantation loss/litter, litters with dead fetuses or fetal sex ratio in any of the groups. By analogy to the findings of the Domingo et al. (1989) and Gomez et al. (1991) studies, the lack of developmental effects of aluminum hydroxide at the tested dose could be related to low solubility and absorption.

In a more recent study, pregnant Swiss mice were administered gavage doses of 0 or 104 mg Al/kg bw-day as aluminum hydroxide on days 6-15 of gestation (Colomina et al., 1994). Dietary Al intake was not reported; e mice were maintained on Panlab rodent chow. Compared to controls, there were no effects ($p>0.05$) of Al l maternal body or organ weight, number of implantations per litter, number of resorptions per litter, number of dead fetuses per litter, percentage of positive post-implantation loss, sex ratio or fetal body weight per litter. Gross external, visceral or skeletal examination of fetuses revealed no abnormalities or developmental variations. Thus, the NOAEL for development effects from this study is 104 mg Al/kg-day, however, this does not include the Al contribution from food. Thus, based on this study and the previous study (Colomina et al., 1992), aluminum lactate appears to be more potent as a developmental toxicant in mice than the less water soluble aluminum hydroxide.

Groups of 16 pregnant Swiss-Webster mice were fed 25 (control group), 500 or 1000 mg Al/kg diet as aluminum lactate throughout gestation and lactation (Donald et al., 1989). The control diet was fed to pups that were selected for post-weaning neurobehavioral assessment. Reported maternal doses were 5, 100 and 200 mg Al/kg bw-day at the beginning of pregnancy and 10.5, 210 and 420 mg Al/kg bw-day near the end of lactation. No mice were exposed to lactate alone. There were no treatment-related changes in maternal survival, body weight (measured on GD 0 and 16 and PDs 0, 5, 10, 15 and 20), food intake, toxic signs or neurobehavior (evaluated after pups were weaned at PD 21 using the same test battery used for the pups and described below), or on litter size or postnatal growth and development in pups as assessed by body weight, toxic signs on PDs 0-55, and by crown-rump length on PDs 0 and 20. Neurobehavioral maturation was tested in 2 pups per litter on PDs 8-18 with a 12 item test battery (fore- and hindlimb grasp, fore- and hindpaw placement on sticks of 2 widths, vibrissa placing, visual placing, auditory and air puff startle, eye opening, and screen grasp, cling and climb). A neurobehavioral test battery was administered to 6 pups per litter at age 25 days (4 days postweaning) or 39 days (fore- and hindlimb grip strengths, temperature sensitivity of tail, negative geotaxis, rtle reflex to air puff and auditory stimuli) or age 21 and 35 days (foot splay). The pre-weaning irobehavioral testing showed that a significant ($p=0.007$) number of pups in the high dose group had impaired vertical screen climb performance. The postweaning neurobehavioral assessment showed significantly ($p<0.05$) altered performance on several tests. These included decreased forelimb grip strength at age 39 days in the low dose group, increased hindlimb grip strength at age 25 days in both low and high dose groups, increased foot splay distance at age 21 days in both low and high dose groups and at age 35 days in the low dose group, and increased forelimb grip strength at age 25 days and decreased thermal sensitivity at age 25 and 39 days in the high dose group. There were no treatment-related changes in concentrations of Al in pup liver or bone (brain tissue was not analyzed).

In a more recent study of similar design by the same group of investigators, groups of 14 and 9 female Swiss Webster mice (6-8 weeks old) were fed 25 (control) or 1000 mg Al/g diet as aluminum lactate, respectively, during gestation and lactation (Golub et al., 1992b). The 1000 mg/g concentration was selected based on the demonstration of neurobehavioral effects in weanlings at this level (Donald et al., 1989). No mice were exposed to lactate alone. Using food intake and body weight values estimated from reported data, maternal doses are estimated to be approximately 4.3 and 174 mg Al/kg bw-day at the beginning of gestation and 4.8 and 607 at the end of the lactation period. At birth, litters were fostered either within or between groups to provide 4 groups of offspring that were exposed to excess Al via maternal diet during gestation, lactation, both or neither (i.e., 25 ppm during gestation and lactation, 1000 ppm during gestation and 25 ppm during lactation, 25 ppm during gestation and 1000 ppm during lactation, and 1000 ppm during gestation and lactation). Maternal effects included significantly (p#0.015) reduced (10-12%) body weight gain and food intake in the treated group during late pregnancy and lactation, and signs of neurotoxicity (hindlimb splaying

and dragging) in one treated dam at postnatal day 21 (weaning); this dam had seizures and died 4 days later. No treatment-related effects on litter size, birth weight, crown-rump length, righting ability at birth, sex ratio or postnatal survival were observed. Both gestation-only and lactation-only exposure caused significantly ($p<0.05$) decreased body weight gain in the treated pups beginning on postnatal day 10; combined gestation and lactation exposure produced the greatest decrease (approximately 24% at weaning). Neurobehavioral testing using the same battery as Donald et al. (1989) was performed at weaning on the dams and on a total of 12, 16, 12 and 6 pups (1 male and 1 female pup per litter) from the control, gestation-only, lactation-only and combined gestation and lactation groups, respectively. Results of this testing showed effects only in pups, including significantly decreased forelimb grip strength after gestation-only exposure, increased hindlimb grip strength after both gestation and lactation exposure, decreased temperature sensitivity after lactation-only exposure, and longer negative geotaxis latency after lactation-only exposure. In general, the findings of this study are consistent with those of Donald et al. (1989) in showing neurodevelopmental effects at the 1000 mg/kg dietary concentration, although intake dosages are dissimilar at the end of lactation. Using the dosage at the beginning of gestation, this study defines a LOAEL of 174 mg/kg-day for developmental effects.

The Donald et al. (1989) study differs from that of Golub et al. (1992b) in that offspring were not fostered, were tested at a later age (25 vs. 21 days), were allowed 4 days of recovery from the treated diet prior to testing, participated in other behavioral tests currently, and experienced no growth retardation. The effects found only in the cross-fostered groups in the Golub et al. (1992b) study (lower forelimb strength after gestation exposure and altered negative geotaxis latencies after lactation only exposure) were not observed by Donald et al. (1989). Increased footsplay was observed by Donald et al. (1989) but not by Golub et al. (1992b), perhaps due to an opposing effect of smaller pup body size in this study. Neither gestation or lactation exposure affected pup brain or liver Al concentrations, but lactation exposure caused significantly lower manganese and iron concentrations in liver and manganese concentrations in brain.

In a further extension of the two previous studies (Donald et al., 1989; Golub et al., 1992b), pregnant female Swiss-Webster mice were exposed continuously to a semi-purified diet containing 7 (control), 500 or 1000 mg Al/kg from the time of conception, through pregnancy and lactation (Golub et al., 1995). At weaning, pups were exposed to the same Al diet as their mothers (500 or 1000 mg Al/kg) until they were 150-170 days of age or were switched to the control diet (7 mg Al/kg) for the same time period. Based on reported dosages in previous studies by the same investigators, estimated daily dosages for mice exposed to 1000 mg Al/kg diet were as follows: 200 mg/kg bw-day in pregnant mice, 420 mg/kg-day in lactating mice and 130 mg/kg-day in offspring (Golub et al., 1994); doses for the mice exposed to 500 mg Al/kg diet were assumed to be approximately half of that of mice fed 1000 mg Al/kg, or 100 mg/kg-day in pregnant mice, 210 mg/kg-day in lactating mice and 65 mg/kg-day in offspring. Compared to the control diet, the Al diet had no effect on dam weight, gestation length, litter size, pup weight, offspring growth or organ weights. Operant conditioning (nose poke) of offspring for delayed spatial alternation or discrimination reversal tasks was initiated at 50 days of age and continued 5 days/wk for a total of 35 sessions. A neurobehavioral test battery was conducted when the offspring were 150-170 days of age (forelimb and hindlimb grip strength, temperature sensitivity, negative geotaxis, air puff and auditory startle response). Maternal and pre-weaning exposure to 500 mg Al/kg significantly affected ($p<0.05$) operant training in the offspring, but not performance after training in delayed spatial alternation or discrimination reversal tasks (i.e., decreased number of training sessions to achieve the training criteria). This exposure also significantly decreased forelimb and hindlimb grip strength and puff startle response ($p<0.05$). Pre-weaning and combined pre- and post-weaning exposure to 1000 mg Al/kg significantly increased ($p<0.05$) incidence of cagemate aggression at the time behavioral testing. No effects were observed on auditory startle response, temperature sensitivity, or negative geotaxis in offspring.

Histopathological examination of the brain and spinal cord revealed no treatment-related changes. Thus, the LOAEL for combined maternal and pre-weaning exposure on neurobehavioral effects in mice would approximate to 100 mg Al/kg-day (estimated daily maternal dosage).

Pregnant Charles River CD rats were administered gavage doses of 0, 250, 500 or 1000 mg Al/kg bw-day ("experiment A") or 0, 5, 25, 50, 250 or 500 mg Al/kg bw-day ("experiment B") as aluminum lactate in distilled water on GDs 5-15 (Agarwal et al., 1996). Dietary Al intake was not reported. Offspring were examined for body weight, anogenital distance, oestrus cycle regularity (after puberty), duration of pseudopregnancy induced by mechanical stimulation of the cervix, oocyte production induced by an injection of human chorionic gonadotropin, and male and female gonad weights. Aluminum had no effect on litter size and no consistent effects on birth weight were observed. For example, birth weights were decreased in male offspring from dams that received 250 mg Al/kg-day, but not at higher dosages, and the effect was observed only in experiment A. Female offspring birth weights decreased at certain dosage levels in experiment A and increased at these same dosage levels in experiment B. Similar inconsistencies between experiment A and B were observed for gonadal weights, anogenital distance, time to puberty (vaginal opening), duration of pseudopregnancy or numbers of superovulated oocytes. A significantly increased ($p<0.05$) number of abnormal oestrus cycle lengths (defined as less than 4 days or greater than 5 days) occurred in offspring from dams that received 250 mg Al/kg-day (in experiment A, the endpoint was not measured in experiment B). However, the effect was most pronounced in the first 3 oestrus cycles (of 5 observed) and not detected by the 5th cycle. Thus, the NOAEL for temporary disturbance of the oestrus cycle in offspring of dams administered Al is 250 mg Al/kg-day. NOAELs for all other reproductive endpoints in this study were 1000 mg Al/kg-day. These NOAELs do not include the contribution of Al in food.

In a three-generation study, Ondreicka et al. (1966) exposed initial groups of 7 female and 3 male Dobra Voda mice to either 0 or 19.3 mg Al/kg bw-day as aluminum chloride in drinking water. The diet also contained 160 to 180 ppm Al, giving an estimated intake of 27-31 mg/kg-day based on default values for food consumption and body weight for chronic exposure of mice (U.S. EPA, 1988). Using this estimate, the total Al intakes (drinking water and food) were 27 mg/kg-day (controls) and 46.3 mg/kg-day (exposed group). The P_0 group produced 3 litters (designated F_{1a}, F_{1b}, and F_{1c}) and the F_{1a} group produced 2 litters (designated F_{2a} and F_{2b}) from which the weanlings were exposed to Al in the drinking water starting at 4 weeks of age. There were no difference in body weight gain among the groups in the P_0 generation, a result that contrasted with the striking decrease in this parameter in the treated F_{1b}, F_{1c}, F_{2a}, and F_{2b} groups. Though no effects on erythrocyte count, hemoglobin levels, or histopathology of the liver, spleen, and kidneys were observed in the P_0, F_1 or F_2 generations at the end of the study and no significant differences were seen in the number of litters or offspring between the exposed and control groups, the study identified a LOAEL of 46.3 mg Al/kg-day, based on the observed changes in body weight gain.

Other Toxicological Effects of Aluminum

In a study designed to determine the effects of oral Al exposure on susceptibility to bacterial infection, female Swiss-Webster mice (13-14 per group) were exposed to a diet containing 25 (control), 500 or 1000 mg Al/kg as aluminum lactate during pregnancy, through lactation and for 10 days following weaning of the pups (Yoshida et al., 1989). Based on reported dosages in previous studies by the same investigators, estimated daily dosages for mice exposed to 1000 mg Al/kg diet are as follows: 200 mg/kg-day during pregnancy and 420 mg/kg-day during lactation; doses for the mice exposed to 500 mg Al/kg diet are assumed to be approximately half of that of mice fed 1000 mg Al/kg, or 100 mg/kg-day in pregnant mice and 210 mg/kg-day in lactating

mice (Golub et al., 1994). At weaning, dams and pups were inoculated with a tail vein injection of *Listeria monocytogenes* and monitored for mortality for 10 days. In a separate experiment, female mice, 6 weeks of age, were exposed to the same dietary Al levels for six weeks and then inoculated with *L. monocytogenes*. Estimated Al dosages were 5, 98 or 195 mg Al/kg bw-day for the 25, 500 or 1000 mg Al/kg dietary levels, respectively, based on a default food factor of 0.195 kg diet/kg bw-day assuming a reference "subchronic" food intake and body weight for female B6C3F1 mice over the period from weaning to 90 days (U.S. EPA, 1988). Inoculation resulted in significantly greater ($p<0.025$) mortality in dams exposed to 500 or 1000 mg Al/kg diet compared to controls. There were no differences in mortality between the groups of inoculated pups or between groups of inoculated adult mice exposed to Al for six weeks. The LOAEL for pregnant mice was 100 mg Al/kg bw-day and the NOAEL for adult, non-pregnant mice was 195 mg Al/kg bw-day. Although the exposure duration in this study was only 7 weeks, it is included in Table 1 because it provides the only dose-response data on the effects of Al on resistance to pathogens.

DERIVATION OF A PROVISIONAL CHRONIC ORAL RFD

This survey of the toxicological effects of Al in rodents suggests that neurotoxicological and developmental (including neurodevelopmental) endpoints are among the most sensitive indicators of Al toxicity. However, as vehicles for the development of toxicity values such as a provisional chronic RfD, the latter group of studies are considered to be more appropriate, since the level of exposure to Al appears to be better characterized. In fact, neurobehavioral deficits have been observed in mice and rats exposed during various stages of development and in subchronic studies (Bernuzzi et al., 1989; Donald et al., 1989; Golub et al., 1989, 1992a, 1992b, 1995; Muller et al., 1990), as described above. These deficits include impaired operant learning, changes in grip strength, altered startle response and impaired motor coordination. In addition, several studies have shown that oral Al can produce histopathological changes in the CNS, although the histopathological lesions have yet to be causally related to the neurobehavioral deficits. Thus, Florence et al. (1994) reported histopathological changes in the brain of rats exposed to dietary Al for 6 months, the changes including the appearance of vacuolation of the cell body and cell processes of astrocytes in the brain and swelling of astrocytic processes. In addition, more localized vacuolization of neurons in the brain also was observed. These changes were observed in rats exposed to elevated Al in the diet and are distinct from the NFD that has been observed in rats, rabbits and monkeys maintained on elevated dietary Al in combination with reduced dietary calcium (Garruto et al., 1989; Kihira et al., 1994; Mitani, 1992; Yano et al., 1989; Yoshida et al., 1990) or in rabbits administered intracisternal or intraventricular injections of Al (Kowall et al., 1989; Wakayama et al., 1993). Interpretation of the low-calcium studies is complicated by the observation that NFD was observed in animals maintained on low-calcium diets without excess Al and was enhanced by the addition of excess Al to these diets (Garruto et al., 1989; Kihira et al., 1994). Furthermore, Al has been shown to inhibit the gastrointestinal absorption of calcium (Orihuela et al., 1996), an effect that may exacerbate the calcium deprivation induced by low calcium diets. Thus, it is not clear whether calcium deprivation enhances the neurotoxicity of Al or Al exacerbates the adverse effects of calcium deprivation.

Donald et al. (1989) and Golub et al. (1995) are co-principal studies that identify a LOAEL of 100 mg Al/kg-day for minimal neurotoxicity in the offspring of mice exposed to dietary aluminum lactate (soluble aluminum) during gestation and lactation. The neurotoxicity associated with this LOAEL is consistent with LOAELs from other developmental and subchronic neurobehavioral studies in mice and rats which used higher dietary dosages of aluminum lactate or aluminum chloride (Golub et al., 1989, 1992a, 1992b; Bernuzzi et al., 1989; Muller et al., 1990). Of the above, Golub et al., (1995) is the only study in which a histopathological examination of the brain and spinal cord was conducted and no abnormalities were reported. The Florence et al.

(1994) study indicates that histopathological abnormalities of the CNS can occur in rats exposed subchronically to 84 mg/kg-day; although this is lower than the LOAEL for neurobehavioral effects, it was not chosen as the principal study because the functional significance of the histopathological lesions are uncertain.

A number of studies were identified that, at face value, appeared to indicate LOAELs at lower doses than the 100 mg Al/kg-day value selected herein, for example, Patermain et al. (1988) and Colomina et al. (1992). However, in these as in many of the studies under consideration, insufficient information on dietary Al (Al content and/or feed type) was reported to permit a reliable estimation of the overall dose level to which the animals were subjected.

Other developmental studies with aluminum hydroxide and/or citrate in mice and rats identified a NOAEL which are equivalent (95.5 mg Al/kg-day) to, or a minimum LOAEL that was greater (133 mg Al/kg-day) than the 100 mg Al/kg-day critical LOAEL (Domingo et al., 1989; Gomez et al., 1991), an overlap potentially related to differences in effective doses due to variations in unreported Al dietary content and factors affecting absorption such as chemical form (e.g., the use of less absorbable aluminum hydroxide). In addition, the LOAEL of 43.3 mg Al/kg-day for decreased body weight gain in mice exposed to aluminum chloride for 180-390 days (Ondreicka et al., 1966) was thought be inappropriate for risk assessment due to the small sample size and to the poor reporting of study details. Aluminum nitrate caused alterations in levels of brain biogenic amines and hepatic and hematological indices in rats exposed to 21.4 mg Al/kg-day for 6 weeks (Flora et al., 1991). This dose is a NOAEL because insufficient information is available to determine if the effects are adverse.

Therefore, the LOAEL of 100 mg Al/kg-day for minimal neurotoxicity in the offspring of mice (Donald et al., 1989, Golub et al., 1995) is selected as the basis for the provisional chronic RfD. The LOAEL is considered minimal because the results of the postweaning neurobehavioral test battery indicate that performance deficits may be marginal. In particular, of the three observed effects (decreased forelimb and increased hindlimb grip strengths, increased hindlimb foot splay distance), one effect (increased grip strength) has unclear toxicological significance and two effects (increased grip strength and foot splay distance) did not persist after two weeks of no further exposure.

Application of an uncertainty factor (UF) of 100 (3 for use of a minimal LOAEL, 10 for interspecies extrapolation, and 3 for intrahuman variability where the critical effects have been observed in a sensitive sub-group) results in a provisional RfD of

RfD = 1E-0 mg Al/kg-day.

The provisional RfD of 1E-0 mg Al/kg-day is approximately 3-fold higher than estimated normal daily Al intake of approximately 0.2-0.3 mg/kg-day (Iyengar et al., 1987; Ganrot, 1986; Wilhelm et al., 1990). Chronic users of medications such as antacids, buffered aspirins and antiulceratives would be expected to ingest much larger amounts of Al, possibly as high as 10-70 mg/kg-day. However, these subjects would not represent the most sensitive population (developing infants), as indicated by the animal data.

Low confidence is placed in the co-critical studies, because they only identify a LOAEL for a sensitive effect and evaluated comparatively small numbers of animals. Confidence in the data base is low because the most reliable supporting data for neurotoxicity of Al in humans are of limited general relevance (e.g., dialysis encephalopathy is manifested in patients with impaired renal function and excessive Al uptake from intravenous

exposure). In fact, neurotoxicity remains to be assessed in animals chronically exposed to Al, and developmental morphology has not been adequately investigated in two animal species. These limitations in the Al data base do not increase uncertainty in the RfD; therefore, a data base uncertainty factor was not used. However, reflecting the low confidence in the co-critical studies, there is low overall confidence in the RfD.

RISK CHARACTERIZATION

Cancer Hazard Summary There are no records for Al in the U.S. EPA's IRIS or HEAST databases (U.S. EPA, 1999, 1997), nor has the carcinogenicity of Al compounds been formally evaluated by the agency. However, a number of scientific investigations have addressed the issue of the carcinogenicity of Al, though with inconclusive results. For example, a 20-month exposure of B6C3F1 mice to aluminum potassium sulfate dodecahydrate in the diet at concentrations up to 10% w/w displayed no indication of compound-related carcinogenicity and, in general, no indication of adverse toxicological effects of any kind (Oneda et al., 1994). Similarly, the life-time exposure of Swiss mice and Long-Evans rats to 5 ppm Al as aluminum potassium sulfate in drinking water provided no convincing evidence for the carcinogenicity of Al compounds (Schroeder and Mitchener 1975a,b). A considerable number of epidemiological studies have examined the incidence of excess tumor formation in persons occupationally exposed to Al in the form of dusts or fumes. In general, a body of inferential evidence exists for an increase in cancer of the bladder and lung with occupational exposure to Al, though conclusions linking cause with effect are frequently confounded by co-exposure to other harmful emissions, cigarette smoking, and the absence of adequate reference populations. Taking all of the evidence of Al carcinogenicity together, a qualitative weight-of evidence classification of D, -not classifiable as to human carcinogenicity, is suggested, in line with the agency's guidelines for carcinogenic risk assessment (U.S. EPA, 1986). In accordance with the agency's proposed guidelines for carcinogenic risk assessment (U.S. EPA, 1996), the compound's carcinogenicity *cannot be determined* on the available evidence.

SUPPORTING INFORMATION

Human Data Occupational exposure to fumes and dusts containing Al compounds, for example, in welding shops, has provided insubstantial evidence of links to increased tumor incidence, in some studies. Overall, the links between cause and effect are considered marginal, at best, and are potentially by co-exposure to other carcinogenic substances.

Animal Data Studies of the carcinogenicity of Al compounds in experimental animals have yielded negative results.

Mutagenicity The small amount of evidence that exists on the capacity of the element to induce gene reversion in *S. typhimurium* is negative for Al compounds (Ahn and Jeffrey, 1995).

MODE OF ACTION

No data.

DISCUSSION

Epidemiological studies of metal dusts and fumes in such settings as welding shops, smelters, etc., have provided a body of evidence that suggests but does not prove that emissions containing a number of air-borne may be carcinogenic. However, the evidence for such a proposition is weak, yielding data on the borderline of statistical significance, if at all. There is no hard evidence for the carcinogenicity of Al compounds via the oral route.

BRIEFING SUMMARY

Routes	Class	Designation or Rationale	Dose Response
oral/inhalation	cannot be determined	not applicable	no data

Basis for classification/dose response

1. **Human data:** Insufficient evidence in epidemiological/occupational exposure studies.

2. **Animal data:** Existing evidence is largely negative for Al's carcinogenicity.

3. **Structural analogue data:** None.

4. **Other key data:** Available mutagenicity data are negative for Al compounds.

5. **Mode of action:** No data.

6. **Hazard classification/uncertainties:** The chosen weight-of-evidence descriptors are based on a lack of sufficiently hard evidence for the carcinogenicity of Al compounds. Positive evidence of non-carcinogenicity is also lacking.

7. **Dose response:** Not applicable

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Table 1. Summary of Oral Toxicity Data for Aluminum[1]

Study	Type	Species	Al	Exposure Concentration (ppm)	Exposure Dosage (mg Al/kg-day)	Exposure Frequency and Duration	Critical Effect	NOAEL (mg Al/kg-day)	LOAEL (mg Al/kg-day)	FEL (mg Al/kg-day)
Ondreicka et al., 1966	Subchronic 3-gen dietary	Dobra Voda mice	chloride	--	27 (control), 46	Continuous, 180-390 day	Decreased body weight gain in F1 and F2.	--	46	--
Golub et al., 1989	Subchronic dietary	S-W mice	lactate	25 (control), 500,1000	3.3 (control), 65,130	Continuous, 6 wk	Decreased spontaneous motor activity; decreased weight gain.	65	130	--
Golub et al., 1992a	Subchronic dietary	S-W mice	lactate	25 (control), 1000	190	Continuous, 90 day	Decreased hindlimb grip, decreased spontaneous motor activity, decreased startle response.	--	190	--
Florence et al., 1994	Subchronic dietary	Wistar rat	chloride (with citric acid)	1.52 (control), 1000	0.13 (control), 84	Continuous, 6 mo.	Histopathological changes in brain astrocytes and neurons.	--	84	--
Domingo et al., 1996	Subchronic drinking water	Sprague Dawley rats	nitrate (with citric acid)	--	0, 50, 100 (plus unreported dietary Al)	Continuous, 6.5 mo.	Operant conditioning and performance	100	--	--
Yoshida et al., 1989	Subchronic dietary	S-W mice	lactate	25 (control), 500, 1000	5 (control), 98, 195	Continuous, 7 wk	Increased mortality from L. monocytogenes inoculation	195	--	--
Donald et al., 1989	Developmental dietary	S-W mice	lactate	25 (control), 500, 1000	5 (control), 100, 200	Continuous, gestation and lactation	Neurobehavioral effects.	--	100	--
Golub et al., 1992b	Developmental dietary	S-W mice	lactate	25 (control), 1000	4 (control), 174	Continuous, gestation and lactation	Neurobehavioral effects.	--	174	--
Golub et al., 1995	Developmental dietary	S-W mice	lactate	7, 500, 1000	1 (control), 100, 200	Continuous, gestation, lactation to maturity	Neurobehavioral effects.	--	100	--
Yoshida et al., 1989	Developmental dietary	S-W mice	lactate	25 (control), 500, 1000	4 (control), 100, 200	Continuous, gestation and lactation	Increased mortality of dams from L. monocytogenes inoculation	--	100	--

[1]Studies for which total dosages were reported or could be estimated (unless otherwise noted).

Attachment 4

SRC SF 01-021c/11-14-01

Risk Assessment Issue Paper for:
Evaluation of the Carcinogenicity Assessment for
Iron (CASRN 7439-89-6) and Compounds

INTRODUCTION

A cancer assessment for iron is not listed on IRIS (U.S. EPA, 2001), the HEAST (U.S. EPA, 1997), or the Drinking Water Standards and Health Advisories list (U.S. EPA, 2000), and was not considered by the CRAVE Work Group (U.S. EPA, 1995). The CARA list (1991, 1994) includes a Health Effects Assessment for Iron and Compounds (U.S. EPA, 1984) that assigned iron and its compounds to weight-of-evidence Group C, possible human carcinogen. This assessment was based on conflicting evidence of lung tumors following occupational inhalation exposure to ferric oxide (mixed exposure), and injection-site tumors in one patient and in mice treated with iron-dextran. IARC (1972, 1987) assigned ferric oxide to Group 3, not classifiable as to its carcinogenicity to humans based on inadequate data in humans (increased incidence of lung cancer following occupational exposure to iron dusts in mixtures) and apparently negative evidence for carcinogenicity in mice, hamsters and guinea pigs exposed by inhalation or intratracheal instillation. For ferric oxide dust and fume, the ACGIH (1991, 2001) lists an A4 notation, not classifiable as a human carcinogen; this is based on mixed exposure studies in humans and primarily negative studies in animals.

Iron has not been the subject of a toxicological review by ATSDR (2001) or the WHO (2001). Monographs by IARC (1972, 1984, 1987), a toxicity review on iron (Grimsley, 2001), and the NTP (2001a, 2001b) management status report and chemical repository summary were consulted for information relevant to the carcinogenicity of iron and inorganic iron compounds. The following computer searches, performed in April, 1993, were screened to identify additional pertinent studies not discussed in review documents: TOXLINE (1983-April, 1993), CANCERLIT (1990 - April, 1993), MEDLINE (1991 - April, 1993), TSCATS, RTECS, and HSDB. Update literature searches were conducted in September, 2001 in TOXLINE (1992-September, 2001), CANCERLIT (1992- September, 2001), MEDLINE (1992-September, 2001), TSCATS, RTECS, DART/ETICBACK, EMIC/EMICBACK, HSDB, GENETOX, and CCRIS.

REVIEW OF PERTINENT LITERATURE

Human Studies

Oral Exposure

Since iron is an essential element, the NAS (2001) has established guidelines for daily dietary intakes, based on gender, age, and physiological status, that are designed to avoid adverse effects of deficiency and excess. Individuals of northern European descent who are affected by hereditary hemochromatosis, an autosomal, recessive disorder, are not protected by these guidelines. These individuals exhibit excessive absorption of dietary iron, which results in abnormally high accumulations of iron in the tissues. When the liver consequently develops cirrhosis, the risk of developing primary hepatocellular carcinoma increases significantly. It is not clear whether these findings are relevant to excess iron intake by the general population.

Bird et al. (1996) investigated the association between plasma ferritin and iron intake and the development of adenomatous polyps, which are intermediate markers for colorectal cancer. The study population consisted of men and women between the ages of 50 and 75 years old who underwent routine screening by flexible sigmoidoscopy at one of two medical centers during 1991-1993. Individuals with cancer, inflammatory bowel disease, or familial polyposis were excluded. Cases (300 men and 167 women) were subjects diagnosed for the first time with one or more histologically confirmed adenomatous polyps. Controls (331 men and 167 women) had no history of polyps and none discovered at sigmoidoscopy. Cases and controls were matched by sex, age (" 5 years), date of sigmoidoscopy (" 3 months), and medical center. Plasma ferritin levels, hematocrit, and certain nutritional indicators (carotenoids, ascobate, folate) were measured in blood samples drawn 6 months after examination. Iron intakes for the year preceding sigmoidoscopy were estimated by means of a semiquantitative food frequency questionnaire. After excluding subjects with possible non-iron-related elevations in ferritin, subjects with high plasma ferritin levels (>289 : g/L) had a multivariate-adjusted odds ratio for colorectal polyps of 1.5 (95% confidence interval (C.I..) 1.0-2.3) compared to subjects with low/normal levels (73-141 : g/L). The pattern for iron intake was U-shaped. Compared with subjects consuming an adequate amount of iron (11.6-13.6 mg/day), multivariate-adjusted odds ratios for colorectal polyps were 1.6 (95% C.I. 1.1-2.4) for intakes below 11.6 mg/day and 1.4 (95% C.I. 0.9-2.0) for intakes above 27.3 mg/day. The authors conclude that there is a weak positive association between iron exposure and colorectal polyps that may increase the risk of colorectal cancer.

Inhalation Exposure

Most studies of cancer incidence following occupational exposure to iron dust are excluded from consideration because of confounding exposures to silica, radon daughters, soot, asbestos, or other types of metals in the study populations (U.S. EPA, 1984; IARC, 1972, 1984, 1987).

A case-control study examined cancer incidence in a Swedish male worker population (1958-1971) with a high exposure to iron oxides from the production of sulfuric acid from pyrite (FeS_2) (Axelson and Sjöberg, 1979). The workers were exposed to iron oxide (Fe_2O_3) along with 1-2% copper, 0.01-0.1% arsenic, nickel and cobalt as impurities. Exposure in the workroom was estimated as approximately 50-100 mg/m^3, and the particle size as 25% below 10 : m and 5-10% below 5 : m. No cases of siderosis were known from the plant. The Swedish National Cancer Register was consulted for locating cases of cancer that could have been caused by environmental exposure; the study examined cancers of the stomach, liver, lung, kidney, and bladder, and hematological malignancies. Each cancer case was matched with two controls from the local population register by matching for sex, age, and residency in the same or adjacent neighborhood block. Company files were searched to determine the length of exposure; those with less than 5 months of exposure were considered to be nonexposed. The study found no association between exposure to iron oxides and any of the selected types of cancer.

Animal Studies

Oral Exposure

Groups of F344 rats (50 per sex per group) were given ferric chloride ($FeCl_3 \cdot 6H_2O$) in drinking water at concentrations of 0, 0.25, or 0.5% (weight/volume) for 104 weeks, and then given distilled water for an 8 week recovery period (Sato et al., 1992). The intake of ferric chloride was reported to be 0, 169.7, or 319.7 mg/kg-day for males and 0, 187.9, or 336.0 mg/kg-day for females. The iron intakes were 0, 58.4, or 110 mg/kg-day in males and 0, 64.6, or 115.6 mg/kg-day in females. Rats were observed daily for clinical signs and mortality. Body weights were measured once a week for 13 weeks and every fourth week thereafter. All rats dying prematurely and survivors at week 112 were examined for gross and microscopic neoplastic and non-neoplastic lesions. There were dose-related decreases in drinking water intake and

terminal body weight in both sexes. These may have been related to reduced palatability. Survival in both sexes was not significantly affected by exposure to ferric chloride. No increases in tumor incidence were observed in rats exposed to ferric chloride for two years.

Inhalation Exposure

Groups of male Syrian hamsters (132 per group) were exposed to filtered air or Fe_2O_3 (analytic grade) dust at a concentration of 40 mg/m^3, 6 hours/day, 5 days/week for life (Nettesheim et al., 1975). The particle size had a geometric mean diameter of 0.11 : m. In addition, two satellite groups (15 hamsters per treatment) were sacrificed, three animals at a time, at 2, 4, 8, 12, and 104 weeks, so that the accumulation of iron in the lung from inhaled Fe_2O_3 could be compared to background iron concentrations in heme. The animals were examined daily, before and after each exposure, for clinical signs; body weights were recorded monthly. All animals except those cannibalized (<2%) were necropsied. Histological analyses were performed for the major organs, including heart, trachea, lungs, and nasal cavities. Examination of the satellite groups demonstrated a gradual increase in iron accumulation in the lung, reaching a total of 10 mg per lung at 104 weeks. Exposure to Fe_2O_3 had no effect on survival or body weight gain and did not increase the incidence of tumors. The authors concluded that inhalation of Fe_2O_3 was not carcinogenic to hamsters.

Groups of Syrian golden hamsters (24 per sex per group) received intratracheal instillations of 0 or 3 mg[1] of Fe_2O_3 dust in 0.2 ml of saline once a week for 15 weeks, and then were observed up to week 120 (Stenbäck et al., 1976). Analysis by the sedimentation method demonstrated that 98% of the particles were less than 10 : m in diameter. Animals were weighed weekly and autopsied. Organs with gross lesions and the larynx, trachea, bronchi, and lungs were examined histologically. Treatment with ferric oxide had no effect on survival and did not affect body weight except during the final weeks of survival (data not shown). Treatment did not induce tumors of the respiratory tract and the incidence of forestomach papillomas in the treatment group was less than in the control group.

Other Studies

Genotoxicity

Genotoxicity assays of inorganic iron salts were primarily negative in bacteria, but were more often positive in mammalian systems. Iron did not induce reverse mutations in *Salmonella typhimurium* strains TA98, TA102, TA1535, or TA1537, with or without activation (Wong, 1988). Ferric chloride and ferrous sulfate tested negative in strains TA98, TA100, TA1535, TA1537, and TA1538 with or without metabolic activation (Shimizu et al., 1985; Dunkel et al., 1999). Ferrous sulfate also tested negative in strains TA97 and TA102, with or without activation (Fujita et al., 1994), but positive in TA1537 and TA1538 (U.S. EPA, 1984). Ferrous and ferric chloride did not induce DNA repair in *Bacillus subtilis* (rec assay) (Leifer et al., 1981). Ferrous sulfate increased the frequency of mutations at the TK locus of mouse L5178Y lymphoma cells, with or without metabolic activation, but only at high concentrations; ferric chloride only increased the frequency of TK mutations when tested with metabolic activation (Dunkel et al., 1999). Ferrous sulfate did not induce sister chromatid exchanges *in vitro* (Ohno et al., 1982). DNA-protein cross-links were generated in mammalian cells cultured in the presence of ferrous iron (Altman et al., 1995). Single- and double-strand DNA breaks were produced in supercoiled plasmid DNA (Toyokuni and Sagripanti, 1992) and in isolated rat liver nuclei (U.S. EPA, 1984) treated with ferrous or ferric chloride. No breakage was detected electrophoretically in Chinese hamster ovary cell DNA treated with ferrous chloride (U.S. EPA, 1984). In a model of oxidative damage within cells, ferrous sulfate, in the presence of hydrogen peroxide, was

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[1]The authors characterized the treatment as a 'maximum dose of 3 mg'. It is not clear whether the hamsters received lower doses on some occasions.

demonstrated to induce double-strand breaks and intra-strand cross-links in DNA *in vitro* (Lloyd and Phillips, 1999).

Cell transformation

Iron compounds have yielded variable results in studies of cell transformation *in vitro*. Particles of magnetite (Fe_3O_4) induced transformation of cultured a Chinese hamster lung cell line (V_{79}), but only at cytotoxic concentrations (Elias et al., 1995). Ferrous chloride and ferrous sulfate induced cell transformation in viral-enhanced Syrian hamster embryo (SA7/SHE) cells (U.S. EPA, 1984).

Mechanistic Studies

Adverse effects of iron are thought to be related to the formation of reactive oxygen species via the Fenton reaction (Henle and Linn, 1997). Hydrogen peroxide can react with ferrous ion, resulting in the conversion to ferric ion and the production of hydroxyl radicals. Ferric ion can also react with hydrogen peroxide, producing superoxide radical. Reactive oxygen species may react with DNA.

PROVISIONAL WEIGHT-OF-EVIDENCE CLASSIFICATION

U.S. EPA (1984) classified iron and its compounds, including ferric dextran, as a possible human carcinogens (Group C). This assessment was based on reports associating an increased incidence of lung cancer with exposure to hematite dust (confounded by coincident exposures to tobacco, alcohol, silica, soot, and fumes of other metals), inconsistent reports of lung tumors in animals exposed by inhalation or tracheal instillation to ferric oxide, and reports of injection site tumors in one patient injected with iron dextran and in mice injected with iron dextran or saccharated iron oxide. The current issue paper excludes organic forms of iron and studies in which the levels of impurities are significant.

Results of the case-control study by Bird et al. (1996) provide evidence of a weak association between elevated iron intake or high plasma ferritin (a measure of body stores) and the prevalence of adenomatous colorectal polyps, a possible precursor to colorectal cancer. Weaknesses of this study include the 6-month period between examination and ferritin measurements, and the possible recall errors affecting the dietary questionnaire for the previous year. Although the association between cirrhotic hereditary hemochromatosis and hepatocellular carcinoma is well established, the evidence for dietary iron intake and hepatic cancer in the general population was characterized by the NAS (2001) as inconclusive. In a chronic rat assay, Sato et al. (1992) found no evidence of carcinogenicity of ferric chloride ingested in drinking water at concentrations up to 0.5%. In summary, the evidence for carcinogenicity of ingested inorganic iron compounds in humans and animals appears to be inadequate.

Evidence from the case-control study of Axelson and Sjöberg (1979) suggests that inhaled iron oxide may not be carcinogenic to humans. However, uncertainty remains because levels of exposure were not measured, the durations of exposure were not reported, and individuals exposed for up to 5 months were categorized as 'nonexposed.' In addition, the lack of reported cases of siderosis in the workplace suggests that the exposure levels may have been lower than estimated. Thus, the evidence for carcinogenicity of inhaled iron oxide in humans is considered inadequate. Results of the study of Nettesheim et al. (1975) indicate that chronic inhalation exposure to iron oxide at a concentration of 40 mg/m^3 is not carcinogenic to hamsters. This finding is supported by the negative results for carcinogenicity of iron oxide administered by intratracheal instillation to hamsters for 15 weeks (Stenbäck et al., 1976). However, as both hamster studies used single exposure concentrations, the possibility of carcinogenicity at higher exposure levels cannot be disregarded.

Based on these data, and genotoxicity results that were primarily negative (albeit positive for DNA strand breaks in mammalian systems), iron and inorganic iron compounds are most appropriately placed in U.S. EPA (1986) Weight-of-Evidence Group D - not classifiable as to human carcinogenicity. Following the U.S. EPA (1996, 1999) proposed guidelines for carcinogen risk assessment, the available data are inadequate for an assessment of the human carcinogenic potential of inhaled iron oxide or ingested iron chloride.

QUANTITATIVE ESTIMATES OF CARCINOGENIC RISK

Derivation of quantitative estimates of cancer risk for ingested or inhaled iron or iron oxide is precluded by the absence of adequate data demonstrating carcinogenicity.

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Attachment 5

SRC SF 01-021b/11-14-01

Risk Assessment Issue Paper for:
Feasibility of Deriving a Provisional RfC for
Iron (CASRN 7439-89-6)and Compounds

INTRODUCTION

An RfC for iron is not listed on IRIS (U.S. EPA, 2001) and was not considered by the RfD/RfC Work Group (U.S. EPA, 1995). The HEAST (U.S. EPA, 1997) reported that data regarding iron were inadequate for quantitative risk assessment. The CARA list (1991, 1994a) includes a Health Effects Assessment for Iron and Compounds (U.S. EPA, 1984) that reported negative epidemiological studies (no association between excess mortality or respiratory diseases and occupational exposure to iron oxide dusts) and no available subchronic or chronic inhalation studies in animals.

Occupational exposure limits have been established for soluble iron salts and iron oxide, as well as for organic iron compounds not covered in this issue paper. The ACGIH (1991a, 2001) has adopted a TLV-TWA, NIOSH (2001a) has established a REL-TWA, and OSHA (2001a, 2001b) has adopted a construction industry PEL-TWA of 1 mg/m^3, as Fe, to reduce the likelihood of irritation to eyes, skin, and respiratory tract from exposure to aerosols or mists of soluble iron salts (ferrous and ferric sulfates and chlorides, and ferric nitrate). The ACGIH (1991b, 2001) has adopted a TLV-TWA and NIOSH (2001b) has established a REL-TWA of 5 mg/m^3, as Fe, for dust and fume of ferric oxide (Fe_2O_3) to protect against siderosis, a benign pneumoconiosis. OSHA (2001c) has adopted a PEL-TWA of 10 mg/m^3 for ferric oxide fume, to protect against accumulation of iron dust in the lungs.

Iron has not been the subject of a toxicological profile by ATSDR (2001) or the WHO (2001). Monographs by IARC (1972, 1984, 1987), a toxicity review on iron (Grimsley, 2001), and the NTP (2001a, 2001b) management status report and chemical repository summary were consulted for information relevant to inhalation toxicity of iron and inorganic iron compounds. The following computer searches, performed in April, 1993, were screened to identify additional pertinent studies not discussed in review documents: TOXLINE (1983-April, 1993), CANCERLIT (1990 - April, 1993), MEDLINE (1991 - April, 1993), TSCATS, RTECS, and HSDB. Update literature searches were conducted in September, 2001 in TOXLINE (1992-September, 2001), CANCERLIT (1992- September, 2001), MEDLINE (1992-September, 2001), TSCATS, RTECS, DART/ETICBACK, EMIC/EMICBACK, HSDB, GENETOX, and CCRIS.

REVIEW OF PERTINENT LITERATURE

Human Studies

A number of studies have examined the relationship between respiratory disease and inhalation exposure to iron compounds for workers employed in hematite mining or other iron-related occupations, such as welding or steel-making (U.S. EPA, 1984; IARC, 1972, 1984; Grimsley, 2001). However, since these studies involved concurrent exposure to silica and other metals, they are not suitable for the health risk assessment of iron or iron compounds. The literature search did not discover any studies that examined subchronic or chronic inhalation exposures of humans to quantified levels of iron or iron compounds alone.

In a case-control study of cancer incidence, a Swedish male worker population (1958-1971) was reported to have had a high exposure to iron oxides from the production of sulfuric acid from pyrite (FeS_2)

(Axelson and Sjöberg, 1979). The workers were exposed to iron oxide (Fe_2O_3) along with 1-2% copper, 0.01-0.1% arsenic, nickel and cobalt as impurities. Exposure in the workroom was estimated as approximately 50-100 mg/m^3, and the particle size as 25% below 10 : m and 5-10% below 5 : m. However, there were no measurements of exposure levels or particle size, and exposure durations were not reported. No cases of siderosis were known from the plant.

Animal Studies

Inhalation studies for iron compounds in animals include a chronic study of hamsters exposed to ferric oxide (Fe_2O_3) dust (Nettesheim et al., 1975) and a 2-month study in rabbits exposed to aerosols of ferric chloride (Johansson et al., 1992).

In a cancer study, groups of male Syrian hamsters (132 per group) were exposed to filtered air or Fe_2O_3 (analytic grade) dust at a concentration of 40 mg/m^3, 6 hours/day, 5 days/week for life (Nettesheim et al., 1975). The particle size had a geometric mean diameter of 0.11 : m. In addition, two satellite groups (15 hamsters per treatment) were sacrificed, three animals at a time, at 2, 4, 8, 12, and 104 weeks, so that the accumulation of iron in the lung from inhaled Fe_2O_3 could be compared to background iron concentrations in heme. The animals were examined daily, before and after each exposure, for clinical signs, and body weights were recorded monthly. All animals except those cannibalized (<2%) were necropsied. Histological analyses were performed on the major organs, including heart, trachea, lungs, and nasal cavities. Examination of the satellite groups demonstrated the gradual increase in iron accumulation in the lung, reaching a total of 10 mg per lung at 104 weeks. Histological examination revealed iron deposits in the lungs and tracheal and bronchial lymph nodes of all exposed animals. Diffuse and focal alveolar fibrosis was also frequently observed in the lungs of treated animals. Results for the histological endpoints were not reported quantitatively. In this study, 40 mg/m^3 is a LOAEL for respiratory effects (alveolar fibrosis) in hamsters exposed to Fe_2O_3 dust.

Groups of 8 male rabbits (strain not reported) were exposed to aerosols of 0, 1.4, or 3.1 mg/m^3 of iron as $FeCl_3$ 6 hours/day, 5 days/week for 2 months (Johansson et al., 1992). At termination, the upper left lung lobe was examined by light microscopy, pieces of the lower left lung were analyzed by electron microscopy or used for phospholipid analysis, and the right lung was lavaged to obtain macrophages for morphological and functional analyses. The mass median aerodynamic diameter of the aerosols was ~1 : m as measured with an impactor. Treatment had no effect on survival. Lungs were spotted with black in 7/8 high-iron rabbits, in 2/8 low-iron rabbits, and in 0/8 controls. The absolute weight of the left lower lobe of the lung was significantly elevated compared to controls in the high-iron group. Exposure-related histopathology was observed in the lungs. In the high-exposure group, the lungs contained naked granulomas [large nodules ($1 mm) of densely packed granular macrophages], accumulations of granular macrophages in terminal bronchioles, and foci of interstitial lymphocytic inflammatory reaction. Small granulomas were observed in one low-iron and one control rabbit. Accumulations of normal and granular macrophages were observed in the alveoli of exposed rabbits. In the control group, normal lung tissue contained some small accumulations of macrophages with occasional small inflammatory reaction. The high exposure group had a significantly higher density of alveolar type II cells than the controls. Ultrastructural analysis of macrophages showed a significantly higher number of abnormal cells, cells with enlarged lysosomes, and black inclusions in cells in both exposed groups; the high-iron group had higher percentages of cells with laminar inclusions or with smooth cell surfaces. In functional tests, macrophages from the high-exposure group showed significantly elevated phagocytic activity, but no significant increase in oxidative metabolic activity (superoxide generation). Total phospholipids were elevated in the high-exposure group, but, as indicated by the lack of increase in phosphatidyl cholines or the percentage of 1,2-dipalmitoylphosphatidylcholine, the amount of surfactant was unchanged. In this study, the low concentration of 1.4 mg/m^3 is a NOAEL and the high concentration of 3.1 mg/m^3 is a LOAEL for adverse lung effects (nodular granulomas $1 mm in diameter, abnormal macrophages) in rabbits exposed to ferric chloride aerosols. Because of its focus on alveolar

macrophage effects, this study provided no information regarding clinical signs of toxicity, body weight changes, clinical biochemistry, nasopharyngeal effects or histology of any other tissue besides the lung.

Other Studies

In a cancer study, groups of Syrian golden hamsters (24 per sex per group) received intratracheal instillations of 0 or "a maximum dose"[2] of 3 mg of Fe_2O_3 dust in 0.2 ml of saline once a week for 15 weeks, and then were observed up to week 120 (Stenbäck et al., 1976). Analysis by the sedimentation method demonstrated that 98% of the particles were less than 10 : m in diameter. Animals were weighed weekly and autopsied. Organs with gross lesions and the larynx, trachea, bronchi, and lungs were examined histologically. Treatment with ferric oxide had no effect on survival and no effect on body weight except during the final weeks of survival (data not shown). Deposited iron oxide was grossly visible as dark patches on the lung surface. Histologically, dust accumulations surrounded by cellular infiltrates were observed in the peribronchial region. Interstitial fibrosis was observed occasionally, but distinct inflammatory changes were rare. Results for the nonneoplastic endpoints were not reported quantitatively.

FEASIBILITY OF DERIVING A PROVISIONAL RfC FOR IRON

No adequate human or animal inhalation data are available for exposure to iron or inorganic iron compounds. The epidemiological study of Axelson and Sjöberg (1979) did not provide quantitative measures of exposure and did not characterize noncancer endpoints. Although Nettesheim et al. (1975) reported diffuse and focal alveolar fibrosis in the lungs of hamsters chronically exposed to iron oxide by inhalation at a concentration of 40 mg/m^3, the lack of incidence data prevents an evaluation of the significance of these findings. The subchronic study of Johansson et al. (1992), in which rabbits were exposed to aerosols of ferric chloride for 2 months, demonstrated a NOAEL of 1.4 mg/m^3 and a LOAEL of 11 mg/m^3 for respiratory effects (granuloma nodules greater than 1 mm diameter in the lungs). However, this study does not meet the minimum standards for an inhalation bioassay as stipulated by the U.S. EPA (1994b) guidelines for derivation of an inhalation reference concentration. Inadequacies of the study include relatively small group sizes, relatively short study duration, and the failure to examine a sufficient array of endpoints. Thus this study is inadequate for the purposes of deriving an RfC for iron.

[2]The authors provided no further information regarding dosage. It is not clear whether animals were given amounts lower than 3 mg on some occasions.

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Risk Assessment Issue Paper for:
Derivation of the Provisional RfD for Iron (CASRN 7439-89-6) and Compounds

INTRODUCTION

An RfD for iron is not available on IRIS (U.S. EPA, 2001) or the Drinking Water Standards and Health Advisories list (U.S. EPA, 2000), and was not discussed by the RfD/RfC Work Group (U.S. EPA, 1995). The HEAST (U.S. EPA, 1997) reported that data regarding iron were inadequate for quantitative risk assessment. The CARA list (1991, 1994) includes a Health Effects Assessment for Iron and Compounds (U.S. EPA, 1984) that found no reliable quantitative oral toxicity data. Iron has not been the subject of a toxicological review by ATSDR (2001) or the WHO (2001). Monographs by IARC (1972, 1987), toxicity reviews by Jacobs (1977), Bothwell et al. (1979), Lauffer (1991), and Grimsley (2001), a review on dietary iron by the NAS (2001), and the NTP (2001a, 2001b) management status report and chemical repository summary were consulted for relevant information. The following computer searches, performed in April, 1993, were screened to identify additional pertinent studies not discussed in review documents: TOXLINE (oral and inhalation toxicity and cancer from 1983-April, 1993), CANCERLIT (1990 - April, 1993), MEDLINE (1991 - April, 1993), TSCATS, RTECS, and HSDB. Update literature searches were conducted in September, 2001 in TOXLINE (1992-September, 2001), CANCERLIT (1992- September, 2001), MEDLINE (1992-September, 2001), TSCATS, RTECS, DART/ETICBACK, EMIC/EMICBACK, HSDB, GENETOX, and CCRIS.

Iron is an essential element, and deriving a risk assessment value for such chemicals poses a special problem in that the dose adversity curve is "U-shaped." Thus, the risk value must be protective against deficiency as well as toxicity. The NAS (2001) has established guidelines for iron intake that take into account physiological differences during different life stages (the following values per kg use the specified reference body weights). For non-breast-fed infants aged 0-6 months, the NAS (2001) established a daily adequate intake (AI) for iron of 0.27 mg/day (0.04 mg/kg-day for infants 2-6 months old) based on the daily amount of iron secreted in human milk; breast-fed infants typically receive only 0.15 to 0.3 mg Fe/day. The NAS (2001) Recommended Dietary Allowances (RDAs) for children are as follows: 11 mg/day (1.2 mg/kg-day) for infants between the ages of 7 and 12 months, 7 mg/day (0.54 mg/kg-day) for children aged 1-3 years, 10 mg/day (0.45 mg/kg-day) for ages 4-8 years, 8 mg/day (0.2 mg/kg-day) for ages 9-13 years, and 11 mg/day (0.17 mg/kg-day) for boys and 15 mg/day (0.26 mg/kg-day) for girls aged 14-18 years. The RDA for men aged 19 years and above is 8 mg/day (0.11 mg/kg-day). The RDA for non-pregnant women is 18 mg/day (0.29 mg/kg-day) for ages between 19 and 50 years and 8 mg/day (0.13 mg/kg-day) for ages 51 years and older. The RDA for pregnant women is 27 mg/day (0.37 mg/kg-day for those aged 14-18 years and 0.35 mg/kg-day for those aged 19-50 years). The RDA during lactation is 10 mg/day (0.18 mg/kg-day) for women aged 14-18 years and 9 mg/day (0.15 mg/kg-day) for women aged 19-50 years.

In humans and other animals, levels in the body are regulated primarily through changes in the amount of iron absorbed by the gastrointestinal mucosa. The absorption of dietary iron is influenced by body stores, by the amount and chemical nature of iron in ingested food, and by a variety of dietary factors that increase or decrease the availability of iron for absorption. However, excessive accumulation of iron in the body resulting from chronic ingestion of high levels of iron cannot be prevented by intestinal regulation of absorption, nor do humans have a mechanism to increase excretion of absorbed iron in response to elevated

body levels (NAS, 1989, 2001). Below are summaries of selected epidemiological and medical studies, and of available toxicity studies in animals exposed to iron and inorganic compounds.

REVIEW OF PERTINENT LITERATURE

Human Studies

While chronic iron toxicity occurs in people with genetic metabolic disorders resulting in excessive iron absorption, with abnormal hemoglobin synthesis, or who receive frequent blood transfusions (Jacobs, 1977; Bothwell et al., 1979), there is a long-standing controversy as to whether a chronic overload due to oral intake is possible in individuals with a normal ability to control iron absorption (Hillman and Finch, 1985). Nevertheless, "the cumulative experience in human subjects suffering from iron overload of various etiologies strongly suggests that iron is noxious to tissues [when]...present in parenchymal cells...for a sufficiently long period of time" (Bothwell et al., 1979).

Looker et al. (1988) made comparisons of dietary iron intake and biochemical indices of iron status based on values taken from the second National Health and Nutrition Examination Survey (NHANES II) data base[3]. NHANES II was a probability sample of the noninstitutionalized U.S. population aged 6 months to 74 years, conducted between 1976 and 1980 by the National Center for Health Statistics. These data suggest that normal intake of iron by men 16-74 years old exceeds the RDAs, and that iron intake is somewhat lower than the RDA for women younger than 51 years. Concomitant with the study of dietary intake, the NHANES II measured the iron status of these populations. The serum ferritin levels, which index total body iron stores, ranged from 23.8 Fg/L, for premenopausal women not using iron supplements, to 105.6 Fg/L for 45- to 64-year-old supplement users. These values are well within the normal range of 12-300 Fg/L (Cook, 1991). (From Taber's Medical Dictionary, ferritin is the form in which iron is stored in the tissues, principally in the reticuloendothelial cells of the liver, spleen, and bone marrow. [It is] an iron-phosphorus-protein complex containing about 23% iron.) The percent serum transferrin saturation, a measure of the residual capacity of the iron transport system to process potential variations in iron from dietary intake or catabolized body stores, ranged from 23.9% saturation for pre- and post-menopausal women not using iron supplements, to 28.9% saturation for male supplement users in the 25- to 44- and 65- to 75-year-old groups. These values are also within the normal range (20-40%), establishing that the intake levels of 0.15-0.27 mg/kg-day consumed by these groups are both sufficient to protect against iron deficiency and insufficient to cause the toxic effects of iron overload (Elinder, 1986; Cook, 1991; Hillman and Finch, 1985). Therefore, 0.15-0.27 mg/kg-day represents a NOEL for chronic dietary iron intake.

Hemosiderosis (or siderosis) and iron overload are increases in tissue iron or a general increase in iron stores without associated tissue damage (Bothwell et al., 1979; Jacobs, 1977). Hemochromatosis describes massive iron overload (15 g of body iron stores or greater) together with cirrhosis and/or other tissue damage attributable to iron. Although focal deposits of iron may occur in any part of the body where red cells are extravasated, the clinical syndrome of hemochromatosis typically involves damage to the

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[3] The latest version of this data base, NHANES III (1984-1988) evaluated 30,000 subjects aged 2 months and above (NAS, 2001). Despite minor differences in the data sets, the conclusions drawn by Looker et al. (1988) based on NHANES II appear to be valid for the NHANES III data.

hepatic parenchyma (particularly fibrosis), heart (cardiac dysfunction including failure) and endocrine glands (particularly hypogonadism). Pancreatic iron deposition is common, and massive deposits may be associated with fibrosis and diabetes. A number of studies involving chronic oral administration of iron to animals have been designed in an attempt to identify an animal model for hemochromatosis. Most of these studies have been negative (Bothwell et al., 1979; NRC, 1979). Animal studies involving parenteral administration of iron have been generally negative as well, even though parenteral routes bypass the mechanisms that regulate absorption of iron from the gastrointestinal tract.

Chronic iron toxicity has been observed in people with idiopathic hemochromatosis (a genetic metabolic disorder resulting in excessive iron absorption), abnormalities of hemoglobin synthesis (e.g., thalassemia) or various anemic states (e.g., sideroblastic anemia), frequent blood transfusions or a combination of these conditions (Jacobs, 1977; Bothwell et al., 1979). Chronic hemochromatosis has also occurred among the South African Bantu population from an excessive intake of absorbable iron in an alcoholic beverage.

Habitual excessive intake of iron by the Bantus is attributed to consumption of home-brewed Kaffir beer, which was contaminated by iron vessels during brewing (Bothwell and Bradlow, 1960; Bothwell et al., 1964). The beer's high acidity (pH 3-3.5) enhanced iron leaching from the vessels. The iron in the beer is readily assimilable (i.e., ionizable) due to the acidity and presence of iron-complexing ligands such as fructose, and is absorbed to approximately the same degree as ferric chloride. The alcohol content of the beer is also believed to contribute to the bioavailability of the iron (Jacobs, 1977; Finch and Monsen, 1972). Based primarily on drinking habits and analyses of beer samples, the estimated average dietary iron intake of the Bantu men ranged from 50-100 mg/day from beer alone (Bothwell et al., 1964). Using a reference body weight of 70 kg (U.S. EPA, 1987), this range corresponds to 0.7-1.4 mg/kg-day. Histological examinations of the liver of 147 Bantus (129 male, 18 female), ranging in age from 11-70 years (most were between 20 and 50 years old) that died from acute traumatic causes, were performed (Bothwell and Bradlow, 1960). Varying degrees of hepatic siderosis were observed in 89% of the cases; the degree tended to increase with age 40-50 years or less. The siderosis was mild in 59%, and severe in 19% of the cases, respectively. There was a close correlation between hepatic iron concentration and portal fibrosis and cirrhosis. Although the overall prevalence was low (15.6% fibrosis and 1.4% cirrhosis), all 11 subjects with the highest iron concentrations (>2.0% dry weight of liver) showed either fibrosis or cirrhosis. Histological examination of the spleen (50 subjects) also showed siderosis and unspecified histological changes. Malnutrition and alcoholism could have played a role in the etiology of the hepatic and splenic siderosis in the Bantus.

Hemosiderosis of the skin and liver with cirrhotic changes, accompanied by a serum iron level of 246 Fg/100 mL and 100% saturation of transferrin, also developed in a 60-year-old female patient who ingested approximately 12,000 g of elemental iron (as 12 g ferrous carbonate/day or 2 g ferrous gluconate/day) for 27 years (Turnberg, 1965). Assuming a mean body weight of 64 kg for a woman 33-60 years old, 12 kg iron 365 days/year for 27 years averages to approximately 19 mg/kg-day. Using an estimated intake of 0.17 mg iron/kg-day for dietary iron, the total intake of iron was approximately 19.2 mg/kg-day. The author noted that the patient was not anemic during the treatment period, was absorbing iron at a normal rate, had no history of hepatitis (a potential complication in people with iron overload following repeated transfusion) and did not consume alcohol. It was concluded that the prolonged high iron intake was the sole origin of the clinical picture of hemochromatosis.

Ethiopia reportedly has the highest per capita iron intake in the world, with an average daily intake of 471 mg iron/day (range 98-1418 mg/day; 1.4-20.3 mg iron/kg-day assuming 70 kg body weight) (Roe, 1966; Hofvander, 1968). Increased stored iron in the liver and adverse health effects have not been observed due to low bioavailability of the iron in Ethiopian food.

A study in Eastern Finnish men suggested that high serum ferritin concentration and high dietary iron intake are risk factors for myocardial infarction (Salonen et al., 1992). Of the 1,931 randomly selected men aged 42-60 years who had no history of coronary heart disease upon entry to the study, 51 experienced an acute myocardial infarction during the average 3-year follow-up. After adjusting via Cox proportional hazards model for age and examination year, cigarette-pack years, ischemic ECG in exercise test, oxygen uptake, systolic blood pressure, blood glucose, serum copper, blood leukocyte count, and concentrations of serum high density lipoprotein cholesterol, apolipoprotein B, and triglyceride, those having serum ferritin at levels $ 200 Fg/L (median value for healthy adult men is 69-140 Fg/L) showed increased risk ($p<0.01$) of myocardial infarction compared to those with lower serum ferritin. Use of the same model and covariates indicated dietary iron intake was also significantly ($p<0.05$) associated with disease risk; consumption of red meat had the strongest correlation of all foods with serum ferritin concentration ($r=0.059$). High serum low density lipoprotein (LDL) cholesterol concentrations (≥ 5.0 mM/L) associated with elevated serum ferritin was also a strong risk factor for acute myocardial infarction; this lent support to the theory that iron overload elevates risk of acute myocardial infarction by promoting oxidation of LDL (Lauffer, 1991; Sullivan, 1992).

Although follow-up studies by the same laboratory and a prospective cohort study by a different investigator reported an association between high serum ferritin concentrations and increased risk of coronary heart disease or carotid vascular disease, respectively, five other large studies found no association between serum ferritin levels and coronary heart disease (NAS, 2001). Various other measures of iron status (serum transferrin saturation, serum iron concentration, and total iron-binding capacity) have been examined for a possible link to cardiovascular disease in prospective cohort studies, but results overall have been characterized as contradictory (Meyers, 1996; NAS, 2001). The NAS (2001) concluded that the available evidence "does not provide convincing support for a causal relationship" between the level of dietary iron intake and the risk for coronary heart disease, although iron cannot be definitively excluded as a risk factor.

The effects of acute oral exposure to iron in humans are well characterized. Acute iron toxicity has most often been observed in small children who accidentally ingested iron supplements, usually in the form of ferrous sulfate, but also as ferrous gluconate, ferrous chloride, ferric chloride or ferric ammonium citrate (Bothwell et al., 1979). The pathogenesis of acute oral iron toxicity consists primarily of gastrointestinal, cardiovascular, metabolic, neurological and hepatic alterations caused by direct corrosive action or the presence of unbound iron in the circulation (Bothwell et al., 1979; Banner and Tong, 1986; Engle et al., 1987; Mann et al., 1989). Gastrointestinal toxicity is due to the direct caustic effect of iron on the mucosa, particularly in the stomach and small intestine, and is characterized initially by vomiting, diarrhea and abdominal pain. These symptoms can progress to gastric and intestinal hemorrhage and/or necrosis and, rarely, 4-6 weeks after ingestion, scarring that may result in stenosis in the stomach outlet and small intestine. Cardiovascular toxicity of iron results from severe hemodynamic alterations characterized by loss of vascular integrity, decreased circulating plasma volume, decreased cardiac output and acidosis, leading to shock and cardiac failure. Neurological effects ranging from lethargy and mild obtundation to coma may occur. Hepatic damage, which can range from cloudy swelling of hepatocytes to necrosis, is a rare complication after ingestion of large quantities of iron in acute overexposure.

Determinations of serum iron concentration and total iron binding capacity (TIBC) in blood 2-4 hours after ingestion may provide reliable laboratory indices of the bioavailability of iron resulting from an acute ingestion (Mann et al., 1989), but are impractical for assessments of environmental exposures because they may be difficult to obtain rapidly. Since iron is rapidly cleared from the plasma and taken up by hepatocytes, samples drawn 4-6 hours after exposure may be low and not indicative of the quantity of iron bioaccumulated following ingestion. Clinically serious acute iron toxicity generally occurs when free unbound iron circulates (i.e., when serum iron exceeds the TIBC of transferrin and the serum transferrin is 100% saturated). Serum levels of iron are normally in the range of 65-165 Fg/100 mL; concentrations of 150-350 Fg/100 mL may be associated with mild symptoms, and concentrations >350 Fg/dL are generally considered toxic if the TIBC or the percent saturation of serum transferrin is not available (Engle et al., 1987; Mann et al., 1989). Except for the case reported by Turnberg (1965), in which a chronically exposed patient suffering iron overload had 246 Fg/100 mL iron in her serum with 100% saturation of her serum transferrin, data on serum levels of iron following repeated exposures were not located.

Information on acute oral toxic doses of iron in humans is available from numerous case reports of ingestions by children, but values vary because it is difficult to obtain accurate estimates of the amount taken in most overdose situations. It may be unclear whether amounts of elemental iron or iron compound are reported, and serum iron levels may peak at different times depending upon the type of product ingested (Engle et al., 1987). Reviews of these case reports indicate that doses in the range of 200-300 mg iron/kg are generally considered lethal (Arena, 1970; Krenzelok and Hoff, 1979; NRC, 1979; Engle et al., 1987; Mann et al., 1989; Klein-Schwartz et al., 1990), although doses as low as 40-60 mg iron/kg have been regarded as potentially fatal (NRC, 1979; Krenzelok and Hoff, 1979).

Minimum acute toxic doses of iron in humans are poorly defined because most of the cases of poisoning were overdose situations that relied on clinical histories (information from the patient or parent) for determination of dose. Additionally, toxicity mitigation procedures may complicate determining actual severity of effects. Management of acute iron poisoning typically includes gastrointestinal decontamination (e.g., emesis with syrup of ipecac, gastric lavage) and/or chelation therapy with deferoxamine performed at varying times after ingestion (Mann et al., 1989). Based on reviews of case reports and consensus opinions, treatment protocols generally consider ingestions of <20 mg iron/kg minimally toxic and ingestions of >40 mg iron/kg potentially serious (Engle et al., 1987; Mann et al., 1989; Elinder, 1986). Klein-Schwartz et al. (1990) analyzed 339 iron ingestion cases to validate the treatment protocol of a regional poison control center. According to the protocol of this center, ingestions of 20-40 mg iron/kg required only home treatment if there were no symptoms other than mild gastrointestinal symptoms, and ingestions 40 mg iron/kg or higher required hospital referral. The median age of the subjects was 3 years (range, 9 months to 33 years). The amount of iron ingestion was known in 199 subjects, ranging from 20-301 mg/kg (mean, 39.5 mg/kg). Of the 199 subjects, 144 ingested 20-40 mg/kg, 31 ingested 40-60 mg/kg, and 24 ingested 60 mg/kg and higher. There was no statistically significant difference in the mean dose ingested by patients with symptoms (abdominal pain, vomiting and/or diarrhea), compared with asymptomatic patients [42.2 mg/kg versus 38.5 mg/kg ($p=0.33$)]. The overall prevalence of the gastrointestinal symptoms was higher in the 40-60 mg/kg and 60 mg/kg or higher groups (41.9 and 33.3%, respectively), than in the 20-40 mg/kg group (22.2%), but the differences among the three groups were not statistically significant ($p=0.058$). Also, there was no statistically significant difference ($p>0.05$) in the development of any of the specific symptoms in any of the groups. The prevalence of symptoms generally increased with increasing serum iron levels, but only 20 of the patients had serum iron levels higher than the concentration of 350 Fg/dL, generally considered toxic. Symptoms more serious than gastrointestinal ones (e.g., metabolic, cardiovascular, central

nervous system or hepatic effects) did not develop in any of the patients. The results of this study suggest that acute iron ingestions in the range of 20-60 mg/kg are unlikely to be serious in children. Based on this study, the poison center protocol was changed to home management (i.e., ipecac syrup), for iron ingestions of 20-60 mg/kg unless significant symptoms developed, and hospital referral for ingestions 60 mg/kg or greater.

Effects of iron therapy on the upper gastrointestinal tract were evaluated in 14 healthy volunteers [13 women, 1 man; mean age 29 years (range, 24-48 years)] who were instructed to ingest 325 mg tablets of ferrous sulfate (65 mg iron) 3 times/day (before meals) for 2 weeks (Laine et al., 1988). This study was performed to ascertain whether there is a basis for implications that iron therapy may cause false-positive fecal occult blood testing. Evaluation consisted of gastrointestinal symptom survey, qualitative (Hemoccult) and quantitative (HemoQuant; mg mercury/g stool) testing for fecal blood loss, endoscopy of the upper gastrointestinal tract and histological examination of pinch biopsies of the gastric body, antrum and duodenum. In a separate portion of the study, Hemoccult testing was performed on 13 other subjects [12 men, 1 woman; mean age 33 years (range 23-50 years)] who were similarly treated with ferrous sulfate for 1 week. All subjects served as their own controls and ingested no other substances that could potentially damage the upper gastrointestinal tract during their participation in the study. Based on actual average ingestion of 2.5 tablets/day (2-week study) and 2.6 tablets/day (1-week study) and a reference human body weight of 70 kg (U.S. EPA, 1987), the estimated doses consumed by the subjects were 2.3 and 2.4 mg iron/kg-day, respectively, in addition to dietary iron. All subjects had significantly increased ($p<0.05$) dark brown-black stools and symptoms of nausea and vomiting during the treatment period, but not abdominal pain, compared to the 2 weeks prior to treatment. The stool samples of all 27 subjects were Hemoccult-negative prior to iron treatment. Only 1 of 27 stool samples was questionably trace positive after treatment. Hemoglobin levels in stool did not change significantly after iron treatment. Endoscopic examination showed a significant ($p=0.003$) increase in abnormalities in the stomach, but not duodenum, after therapy. These changes consisted of erythema, small areas of subepithelial hemorrhage and solitary antral erosions in nine, six and two subjects, respectively, and were considered only minimally abnormal. Linear regression analysis showed that there was a significant correlation between endoscopy scores and abdominal pain scores ($r=0.64$, $p=0.01$), but not with vomiting ($r=0.5$, $p=0.07$), diarrhea ($r=0.46$, $p=0.1$) or nausea ($r=0.4$, $p=0.16$). No treatment-related histological changes were observed and there was no correlation between the endoscopic and histologic findings, although the investigators noted that the correlation between endoscopic findings and histologic changes in small mucosal pinch biopsies is "notoriously" poor. Although it was speculated that the changes in the stomach could represent a mild form of iron poisoning, the investigators concluded that the treatment caused mild endoscopic abnormalities of uncertain clinical significance in the stomach. Evidence for iron overload (tissue biopsies or hematologic iron status indices) was not examined.

Adverse developmental effects in humans have not been associated with the ingestion of supplemental iron during pregnancy. As indicated above, NAS (2001) recommended that pregnant women supplement their diets with 27 mg iron/day (0.37 mg/kg-day). McElhatton et al. (1991) reported on 49 women who took an overdose of a simple iron preparation (53%) or iron with folate preparation (47%). For 48 of the women, the amount of iron ingested was known; 28 took > 1.2 g and the remainder took # 1.2 g. Twenty-five of the women received chelation treatment with desferrioxamine (DFO) and 12 received an emetic. Maternal toxicity, consisting of nausea, vomiting, hematoemesis, abdominal pain and diarrhea, was observed in 35 of the women. Two spontaneous abortions occurred and there were 3 premature deliveries. One of the spontaneous abortions and the premature deliveries were not related to the iron overdose. It is not known if the other spontaneous abortion occurring at 22 weeks (3 weeks after the overdose) was caused by the iron

overdose. A LOAEL for maternal toxicity or NOAEL for developmental toxicity could not be identified due to inexact exposure data, variation in type of mitigation used, and time elapsed prior to its administration.

Animal Studies

Repeated-dose oral studies in experimental animals found no significant effect of treatment with inorganic iron compounds. No treatment-related adverse changes in clinical signs, body or organ weights, food consumption, or histopathology were observed in male Sprague-Dawley rats that had daily dietary intakes of 35, 70, or 140 mg of iron (as $FeSO_4$ or FeEDTA) per kg for up to 61 days (Appel et al., 2001). In male and female F344 rats that were exposed to drinking water containing 0.25 or 0.5% ferric chloride ($FeCl_3 \cdot 6H_2O$) for 104 weeks, there were no dose-related effects other than reduced water intake (possibly affected by palatability) and body weight gain (Sato et al., 1992). In the latter study, the iron intakes were 58 or 110 mg/kg-day in males and 65 or 116 mg/kg-day in females.

No treatment-related teratogenic or embryotoxic effects were observed in rats given 2.7 mg iron/kg-day as ferric chloride on gestational days 6-15 (Nolen et al., 1972), or in rats and mice given 24-76 mg iron/kg-day as ferrous sulfate for 6 days during gestation (days unspecified) (Tadokoro et al., 1979). Some embryonic mortality (numbers and species not reported) occurred in the latter study at 240 mg iron/kg-day.

DERIVATION OF A PROVISIONAL RfD FOR IRON

Most of the quantitative chronic oral toxicity data for iron have been obtained from studies of the Bantu population of South Africa. These data indicate that intakes in the range of 0.7-1.4 mg iron/kg-day in home-brewed beer are associated with hemosiderosis and liver cirrhosis (Bothwell and Bradlow, 1960; Bothwell et al., 1964). However, confounding factors such as malnutrition and unusually high iron bioavailability, due to the high acidity and ethanol in the beer, preclude use of these data for risk assessment. Much higher dietary intakes (average 6.7 mg/kg-day) of less soluble forms of iron are tolerated in nonwestern diets as indicated by studies of populations in Ethiopia. Therapeutic oral doses of 2.3 mg iron/kg-day as ferrous sulfate for 2 weeks were minimally toxic to the gastrointestinal tract, causing nausea, vomiting and endoscopic abnormalities in the stomach (e.g., erythema and small areas of hemorrhage), but no gastric histological changes were found, and evidence for iron overload (tissue biopsies or hematologic iron status indices) was not examined (Laine et al., 1988). One case of hemochromatosis was reported in a woman who ingested 19.2 mg/kg-day of iron for 27 years; treatment was not accompanied by alcohol- or transfusion-induced hepatitis, anemia, malnutrition or abnormal intestinal absorption (Turnberg, 1965). Thus, although toxicity associated with iron overload due to chronic oral intake can be demonstrated qualitatively or even semiquantitatively, assignment of a precise LOAEL for normal individuals consuming western diets is compromised by studies containing confounding factors, inadequate endpoint assessment, too short a duration of exposure or too few subjects.

Nonetheless, it is possible to establish a NOEL for chronic iron overload using the values for dietary intake and iron status indices taken from the second National Health and Nutrition Examination Survey (NHANES II) data base. Looker et al. (1988) made comparisons of dietary iron intake and biochemical indices of iron status using data from NHANES II. The average intakes of iron ranged from 0.15 to 0.27 mg/kg-day. The serum ferritin levels and percent serum transferrin saturation were within the normal range. Thus, intake levels of 0.15-0.27 mg/kg-day are both sufficient to protect against iron deficiency and insufficient to cause the toxic effects of iron overload.

Using the NOAEL of 0.27 (representing the upper bound value in the range of mean dietary iron intakes, dietary plus supplemental, taken from the NHANES II data base) and dividing by an uncertainty factor of 1 yields the provisional chronic oral RfD of 0.3 mg/kg-day. An uncertainty factor of 1 is supported by the fact that iron is an essential element.

The provisional chronic RfD is calculated as follows:

$$RfD = NOAEL_{ADJ} / (UF \times MF)$$

where

NOAEL = 0.27 mg/kg-day (representing the upper bound value in the range of mean dietary iron intakes, dietary plus supplemental, taken from the NHANES II data base)

UF = uncertainty factor = 1 (supported by the fact that iron is an essential element)
MF = modifying factor = 1 (standard default)

thus,

RfD = [0.27 mg/kg-day]/[1] = 0.27 = 0.3 mg/kg-day

In addition, the information used to derive the oral RfD for iron was derived from intake data from over 20,000 individuals aged 6 months to 74 years. Furthermore, humans exert an efficient homeostatic control over iron such that body burdens are kept constant with variations in diet.

NOTE: This RfD supplies adequate levels of iron to meet the nutritional requirements of adults and adolescents over a lifetime. It does not supply the recommended dietary allowance (RDA) to those members of the population that have greater requirements for a short, less-than-lifetime duration such as infants (7-12 months) and pre-adolescent children (1-8 years), and pregnant women. For shorter term requirements for these subpopulations, refer to the RDAs (NAS, 2001). In addition, the RfD exceeds the AI for infants 6 months or younger (NAS, 2001). Furthermore, this RfD may not be protective of people with inherited disorders of iron metabolism and could be conservative if applied to exposure scenarios involving forms of iron with low bioavailability.

STATEMENT OF CONFIDENCE

Confidence in the critical study is high; the NHANES II data were derived from a very large sampling of the U.S. population ranging in age from 6 months to 74 years and are consistent with the findings in the subsequent NHANES III data set (NAS, 2001). Overall confidence in the data base is medium; there are sufficient data to determine what chronic dose level is associated with adverse effects in healthy individuals. While a point estimate has been derived in this risk assessment, individual variations in diet, nutritional status, physiology, etc. suggest that a range of values may be more appropriate. Reflecting the high confidence in the critical study and medium confidence in the data base, confidence in the RfD is medium.

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Michael,

We don't have any toxicity information for Vanadium. However, we do have surrogates for some of the PAHs that you requested. Here are the suggested surrogates:

Chemical	Surrogate
Benzo[a]anthracene	Pyrene (Fluoranthene or Naphthalene)*
Benzo[a]pyrene	None
Benzo[b]fluoranthene	Pyrene (Fluoranthene or Naphthalene)*
Benzo[k]fluoranthene	Pyrene (Fluoranthene or Naphthalene)*
Dibenz[ah]anthracene	Pyrene (Fluoranthene or Naphthalene)*
Indeno[1,2,3-cd]pyrene	Bisphenol A

*Pyrene is the primary suggested surrogate and Fluoranthene or Naphthalene are suggested secondary surrogates.

Please feel free to contact us if you have any other questions.

Thank you,
Ann Parker
STSC

TABLE J-1

Summary of Norway Rat Exposure Doses - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics											
Arsenic	67.00	0.925	61.975	9.074	607.958	0.047	64.462	0.252	1.26	255.8	51.2
Cadmium	0.291	190.000	55.290	22.879	6.658	0.008	0.707	1	10	0.7	0.1
Chromium	50.00	11.416	570.800	0.480	24.000	0.016	2.652	3.28	16.4	0.8	0.2
Copper	100.0	5.492	549.200	7.400	740.000	0.023	78.491	78	104	1.01	0.8
Lead	63.00	228.261	14380.443	10.601	667.863	0.035	70.785	8	80	8.85	0.9
Mercury	0.063	33.000	2.063	12.230	0.764	0.00004	0.081	0.032	0.16	2.53	0.5
Nickel	26.00	7.802	202.852	22.214	577.564	0.020	61.150	40	80	1.53	0.8
Selenium	1.400	13.733	19.226	77.000	107.800	0.064	11.425	0.2	0.33	57.1	34.6
Silver	0.170	19.500	3.315	0.040	0.007	0.009	0.004	9.06	45.3	0.0	0.0
Zinc	260.0	49.510	12872.600	34.286	8914.360	0.008	943.409	160	320	5.90	2.95
Pesticides/PCBs											
4,4'-DDD	0.010	2.000	0.020	0.015	0.0002	0.00002	0.00004	0.8	4	0.0	0.0
4,4'-DDE	3.990	10.60	42.294	0.022	0.0861	0.00002	0.018	0.8	4	0.0	0.0
4,4'-DDT	1.940	0.700	1.358	0.024	0.0459	0.00002	0.009	0.8	4	0.0	0.0
Aldrin	0.002	3.300	0.007	0.043	0.0001	0.00001	0.00002	0.2	1	0.0	0.0
alpha-BHC	0.002	1.000	0.002	0.263	0.0006	0.00001	0.0001	1.6	3.2	0.0	0.0
alpha-Chlordane	0.002	4.000	0.008	0.017	0.0000	0.00001	0.00001	4.58	9.16	0.0	0.0
Aroclor-1016	0.039	65.200	2.543	0.022	0.0009	0.0	0.0002	0.136	0.68	0.0	0.0
Aroclor-1221	0.079	65.200	5.151	0.074	0.0059	0.0	0.001	0.136	0.68	0.0	0.0
Aroclor-1232	0.039	65.200	2.543	0.044	0.0017	0.0	0.0003	0.136	0.68	0.0	0.0
Aroclor-1242	0.039	65.200	2.543	0.022	0.0009	0.0	0.0002	0.136	0.68	0.0	0.0
Aroclor-1248	0.039	65.200	2.543	0.010	0.0004	0.0	0.0001	0.136	0.68	0.0	0.0
Aroclor-1254	0.039	65.200	2.543	0.007	0.0003	0.0	0.0001	0.136	0.68	0.0	0.0
Aroclor-1260	0.039	65.200	2.543	0.005	0.0002	0.00	0.0001	0.14	0.69	0.0	0.0
beta-BHC	0.002	1.000	0.002	0.263	0.0006	0.00001	0.0001	1.6	3.2	0.0	0.0
delta-BHC	0.002	1.000	0.002	0.165	0.0003	0.00001	0.00004	1.6	3.2	0.0	0.0
Dieldrin	0.004	8.000	0.033	0.309	0.0013	0.00002	0.0001	0.04	0.2	0.0	0.0
Endosulfan I	0.002	1.000	0.002	0.344	0.0007	0.00001	0.0001	1.5	7.5	0.0	0.0
Endosulfan II	0.004	1.000	0.004	0.313	0.0013	0.00002	0.0002	1.5	7.5	0.0	0.0
Endrin	0.004	3.600	0.015	0.795	0.0033	0.00002	0.0004	0.184	0.92	0.0	0.0
gamma-BHC (Lindane)	0.002	1.000	0.002	0.317	0.0007	0.00001	0.0001	8	40	0.0	0.0
gamma-Chlordane	0.002	4.000	0.008	0.017	0.0000	0.00001	0.00001	4.58	9.16	0.0	0.0
Heptachlor	0.002	3.000	0.006	0.055	0.0001	0.00001	0.00002	0.325	1.625	0.0	0.0
Heptachlor epoxide	0.002	8.390	0.018	0.367	0.0008	0.00001	0.0001	0.325	1.625	0.0	0.0
Methoxychlor	0.001	1.000	0.001	0.145	0.0001	0.00010	0.00005	4	8	0.0	0.0
Toxaphene	0.210	1.000	0.210	0.122	0.0256	0.00005	0.003	8	40	0.0	0.0
Semivolatile Organics											
1,2,4-Trichlorobenzene	28.200	0.560	15.792	0.219	6.164	0.0	0.713	53	106	0.0	0.0
1,2-Dichlorobenzene	28.200	1.000	28.200	0.548	15.440	0.0	1.694	85.7	428.5	0.0	0.0
1,3-Dichlorobenzene	28.200	1.000	28.200	0.367	10.357	0.0	1.156	85.7	428.5	0.0	0.0

TABLE J-1

Summary of Norway Rat Exposure Doses - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
1,4-Dichlorobenzene	28.200	1.000	28.200	0.505	14.255	0.0	1.569	250	500	0.0	0.0
4-Bromophenyl-phenylether	0.267	1.000	0.267	0.058	0.015	0.0	0.002	NA	NA	--	--
4-Chlorophenyl-phenylether	28.200	1.000	28.200	0.170	4.786	0.0	0.567	NA	NA	--	--
Acenaphthene	28.200	0.300	8.460	0.256	7.231	0.005	0.827	350	700	0.0	0.0
Acenaphthylene	28.200	0.220	6.204	0.165	4.661	0.005	0.555	350	700	0.0	0.0
Anthracene	28.200	0.320	9.024	0.105	2.964	0.005	0.376	1000	5000	0.0	0.0
Benzo(a)anthracene	0.112	0.270	0.030	0.022	0.002	0.005	0.002	2	10	0.0	0.0
Benzo(a)pyrene	0.120	0.340	0.041	0.014	0.002	0.005	0.002	2	10	0.0	0.0
Benzo(b)fluoranthene	0.133	0.210	0.028	0.017	0.002	0.005	0.002	2	10	0.0	0.0
Benzo(g,h,i)perylene	0.060	0.150	0.009	0.006	0.000	0.005	0.002	2	10	0.0	0.0
Benzo(k)fluoranthene	0.124	0.210	0.026	0.011	0.001	0.005	0.002	2	10	0.0	0.0
Chrysene	0.155	0.440	0.068	0.029	0.004	0.005	0.002	2	10	0.0	0.0
Dibenz(a,h)anthracene	28.200	0.490	13.818	0.007	0.191	0.005	0.083	2	10	0.0	0.0
Fluoranthene	0.187	0.370	0.069	0.062	0.012	0.005	0.003	500	2500	0.0	0.0
Fluorene	28.200	0.200	5.640	0.179	5.048	0.005	0.596	500	2500	0.0	0.0
Hexachlorobenzene	28.200	1.690	47.658	0.037	1.036	0.005	0.172	1	2	0.2	0.1
Hexachlorobutadiene	28.200	1.000	28.200	0.071	1.989	0.005	0.273	2	20	0.1	0.0
Hexachlorocyclopentadiene	28.200	1.000	28.200	0.047	1.316	0.005	0.202	75	375	0.0	0.0
Hexachloroethane	28.200	1.000	28.200	0.240	6.765	0.005	0.778	100	500	0.0	0.0
Indeno(1,2,3-cd)pyrene	0.085	0.410	0.035	0.006	0.001	0.005	0.002	2	10	0.0	0.0
Pentachlorophenol	84.500	8.000	676.000	0.049	4.160	0.021	0.629	5	25	0.1	0.0
Phenanthrene	0.144	0.280	0.040	0.115	0.017	0.005	0.004	500	2500	0.0	0.0
Pyrene	1.900	0.390	0.741	0.069	0.130	0.005	0.020	2	10	0.0	0.0
Volatile Organics											
1,1,2,2-Tetrachloroethane	0.948	1.000	0.948	1.790	1.697	0.0	0.182	76	380	0.0	0.0

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.026981381 = Food ingestion rate (kg/day dry weight, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis, from Table 7-8)
PDFi = 0 = Proportion of diet composed of food item (soil invertebrates, dry weight basis, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis, from Table 7-8)
PDFi = 0.98 = Proportion of diet composed of food item (terrestrial plants, dry weight basis, from Table 7-8)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.02 = Proportion of diet composed of soil (dry weight basis, from Table 7-8)
WIR = 0.080987162 = Water ingestion rate (L/day, from Table 7-8)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.25 = Body weight (kg wet weight, from Table 7-8)

TABLE J-1a

Summary of Norway Rat Exposure Doses - Step 3a

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics											
Arsenic	4.880	0.258	1.259	0.037	0.181	0.027	0.038	0.252	1.26	0.15	0.03
Cadmium	0.057	7.660	0.438	0.514	0.029	0.005	0.011	1	10	0.01	0.001
Chromium	17.100	0.320	5.474	0.048	0.813	0.008	0.151	3.28	16.4	0.05	0.01
Copper	31.800	0.468	14.887	0.123	3.914	0.012	0.433	78	104	0.01	0.004
Lead	26.400	0.307	8.104	0.038	0.995	0.018	0.221	8	80	0.03	0.003
Mercury	0.032	1.186	0.038	0.344	0.011	0.00003	0.001	0.032	0.16	0.03	0.01
Nickel	7.960	1.656	13.182	0.034	0.272	0.010	0.297	40	80	0.01	0.004
Selenium	0.507	0.982	0.498	0.567	0.288	0.032	0.021	0.2	0.33	0.10	0.06
Zinc	96.400	2.482	239.249	0.358	34.484	0.004	5.970	160	320	0.04	0.02
Pesticides/PCBs											
4,4'-DDE	0.234	10.60	2.480	0.0048	0.001	0.00001	0.054	0.8	4	0.07	0.01

$$DI = \frac{[AFF[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.019196986 = Food ingestion rate (kg/day dry weight, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis, from Table 7-18)
PDFi = 0.49 = Proportion of diet composed of food item (soil invertebrates, dry weight basis, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis, from Table 7-18)
PDFi = 0.49 = Proportion of diet composed of food item (terrestrial plants, dry weight basis, from Table 7-18)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.02 = Proportion of diet composed of soil (dry weight basis, from Table 7-18)
WIR = 0.047045214 = Water ingestion rate (L/day, from Table 7-18)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.4375 = Body weight (kg wet weight, from Table 7-18)
AFF = 1 = Area foraging factor (Site Size/Home Range; Max. is 1.0; from Table 7-18)

TABLE J-2

Summary of Indian Mongoose Exposure Doses - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics													
Arsenic	67.00	0.925	61.975	9.074	607.958	0.071	4.757	0.047	10.061	1.2	6	8.38	1.68
Cadmium	0.291	190.000	55.290	22.879	6.658	1.705	0.496	0.008	7.727	0.75	3.75	10.3	2.06
Chromium	50.00	11.416	570.800	0.480	24.000	0.800	40.000	0.016	80.737	3.28	16.4	24.6	4.92
Copper	100.0	5.492	549.200	7.400	740.000	0.867	86.700	0.023	78.766	11.7	15.14	6.7	5.20
Lead	63.00	228.261	14380.443	10.601	667.863	0.995	62.685	0.035	2008.998	8	80	251	25.1
Mercury	0.063	33.000	2.063	12.230	0.764	0.192	0.012	0.00004	0.289	0.15	0.25	1.93	1.16
Nickel	26.00	7.802	202.852	22.214	577.564	0.800	20.800	0.020	28.867	25	62.5	1.15	0.46
Selenium	1.400	13.733	19.226	77.000	107.800	1.754	2.456	0.064	2.728	0.2	0.33	13.6	8.27
Silver	0.170	19.500	3.315	0.040	0.007	0.810	0.138	0.009	0.468	9.06	45.3	0.05	0.01
Zinc	260.0	49.510	12872.600	34.286	8914.360	5.850	1521.000	0.008	1802.590	20.8	104	86.7	17.3
Pesticides/PCBs													
4,4'-DDD	0.010	2.000	0.020	0.015	0.0002	see footnote	0.003	0.00002	0.003	1	5	0.00	0.00
4,4'-DDE	3.990	10.60	42.294	0.022	0.0861	see footnote	7.031	0.00002	5.988	1	5	5.99	1.20
4,4'-DDT	1.940	0.700	1.358	0.024	0.0459	see footnote	0.245	0.00002	0.230	1	5	0.23	0.05
Aldrin	0.002	3.300	0.007	0.043	0.0001	see footnote	0.001	0.00001	0.001	0.2	1	0.01	0.00
alpha-BHC	0.002	1.000	0.002	0.263	0.0006	see footnote	0.000	0.00001	0.0003	1.6	3.2	0.00	0.00
alpha-Chlordane	0.002	4.000	0.008	0.017	0.0000	see footnote	0.001	0.00001	0.001	4.58	9.16	0.00	0.00
Aroclor-1016	0.039	65.200	2.543	0.022	0.0009	see footnote	0.103	0.0	0.356	1.37	3.43	0.26	0.10
Aroclor-1221	0.079	65.200	5.151	0.074	0.0059	see footnote	0.209	0.0	0.721	0.138	0.69	5.22	1.04
Aroclor-1232	0.039	65.200	2.543	0.044	0.0017	see footnote	0.103	0.0	0.356	0.138	0.69	2.58	0.52
Aroclor-1242	0.039	65.200	2.543	0.022	0.0009	see footnote	0.103	0.0	0.356	0.138	0.69	2.58	0.52
Aroclor-1248	0.039	65.200	2.543	0.010	0.0004	see footnote	0.103	0.0	0.356	0.14	0.69	2.54	0.52
Aroclor-1254	0.039	65.200	2.543	0.007	0.0003	see footnote	0.103	0.0	0.356	0.14	0.69	2.54	0.52
Aroclor-1260	0.039	65.2	2.543	0.005	0.0002	see footnote	0.103	0.0	0.356	0.14	0.69	2.54	0.52
beta-BHC	0.002	1.000	0.002	0.263	0.0006	see footnote	0.0005	0.00001	0.0003	1.6	3.2	0.0002	0.0001
delta-BHC	0.002	1.000	0.002	0.165	0.0003	see footnote	0.0004	0.00001	0.0003	1.6	3.2	0.0002	0.0001
Dieldrin	0.004	8.000	0.033	0.309	0.0013	see footnote	0.006	0.00002	0.005	0.028	0.14	0.17	0.03
Endosulfan I	0.002	1.000	0.002	0.344	0.0007	see footnote	0.0005	0.00001	0.0003	1	5	0.0003	0.0001
Endosulfan II	0.004	1.000	0.004	0.313	0.0013	see footnote	0.001	0.00002	0.001	1	5	0.001	0.0001
Endrin	0.004	3.600	0.015	0.795	0.0033	see footnote	0.003	0.00002	0.002	0.184	0.92	0.01	0.002
gamma-BHC (Lindane)	0.002	1.000	0.002	0.317	0.0007	see footnote	0.000	0.00001	0.0003	8	40	0.00004	0.00001
gamma-Chlordane	0.002	4.000	0.008	0.017	0.0000	see footnote	0.001	0.00001	0.001	4.58	9.16	0.0003	0.0001
Heptachlor	0.002	3.000	0.006	0.055	0.0001	see footnote	0.001	0.00001	0.001	0.2	1	0.005	0.001
Heptachlor epoxide	0.002	8.390	0.018	0.367	0.0008	see footnote	0.003	0.00001	0.003	0.2	1	0.01	0.003
Methoxychlor	0.001	1.000	0.001	0.145	0.0001	see footnote	0.0002	0.00010	0.0001	4	8	0.00004	0.00002
Toxaphene	0.210	1.000	0.210	0.122	0.0256	see footnote	0.040	0.00005	0.034	8	40	0.004	0.001
Semivolatile Organics													
1,2,4-Trichlorobenzene	28.200	0.560	15.792	0.219	6.164	see footnote	3.819	0.00	2.793	53	106	0.05	0.03
1,2-Dichlorobenzene	28.200	1.000	28.200	0.548	15.440	see footnote	7.402	0.00	4.525	85.7	428.5	0.05	0.01

TABLE J-2

Summary of Indian Mongoose Exposure Doses - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
1,3-Dichlorobenzene	28.200	1.000	28.200	0.367	10.357	see footnote	6.562	0.00	4.525	85.7	428.5	0.05	0.01
1,4-Dichlorobenzene	28.200	1.000	28.200	0.505	14.255	see footnote	7.206	0.00	4.525	250	500	0.02	0.01
4-Bromophenyl-phenylether	0.267	1.000	0.267	0.058	0.015	see footnote	0.012	0.00	0.043	NA	NA	--	--
4-Chlorophenyl-phenylether	28.200	1.000	28.200	0.170	4.786	see footnote	1.777	0.00	4.525	NA	NA	--	--
Acenaphthene	28.200	0.300	8.460	0.256	7.231	see footnote	2.788	0.005	1.771	350	700	0.005	0.003
Acenaphthylene	28.200	0.220	6.204	0.165	4.661	see footnote	1.991	0.005	1.456	350	700	0.004	0.002
Anthracene	28.200	0.320	9.024	0.105	2.964	see footnote	2.177	0.005	1.849	1000	5000	0.002	0.0004
Benzo(a)anthracene	0.112	0.270	0.030	0.022	0.002	see footnote	0.011	0.005	0.008	2	10	0.004	0.001
Benzo(a)pyrene	0.120	0.340	0.041	0.014	0.002	see footnote	0.013	0.005	0.009	2	10	0.005	0.001
Benzo(b)fluoranthene	0.133	0.210	0.028	0.017	0.002	see footnote	0.011	0.005	0.008	2	10	0.004	0.001
Benzo(g,h,i)perylene	0.060	0.150	0.009	0.006	0.000	see footnote	0.007	0.005	0.004	2	10	0.002	0.0004
Benzo(k)fluoranthene	0.124	0.210	0.026	0.011	0.001	see footnote	0.011	0.005	0.007	2	10	0.004	0.001
Chrysene	0.155	0.440	0.068	0.029	0.004	see footnote	0.018	0.005	0.014	2	10	0.01	0.001
Dibenz(a,h)anthracene	28.200	0.490	13.818	0.007	0.191	see footnote	2.511	0.005	2.519	2	10	1.26	0.25
Fluoranthene	0.187	0.370	0.069	0.062	0.012	see footnote	0.020	0.005	0.015	500	2500	0.00003	0.00001
Fluorene	28.200	0.200	5.640	0.179	5.048	see footnote	1.962	0.005	1.377	500	2500	0.003	0.001
Hexachlorobenzene	28.200	1.690	47.658	0.037	1.036	see footnote	8.243	0.005	7.243	1.2	12	6.04	0.60
Hexachlorobutadiene	28.200	1.000	28.200	0.071	1.989	see footnote	5.184	0.005	4.526	2	20	2.26	0.23
Hexachlorocyclopentadiene	28.200	1.000	28.200	0.047	1.316	see footnote	5.073	0.005	4.526	75	375	0.06	0.01
Hexachloroethane	28.200	1.000	28.200	0.240	6.765	see footnote	5.974	0.005	4.526	100	500	0.05	0.01
Indeno(1,2,3-cd)pyrene	0.085	0.410	0.035	0.006	0.001	see footnote	0.012	0.005	0.008	2	10	0.004	0.001
Pentachlorophenol	84.500	8.000	676.000	0.049	4.160	see footnote	112.995	0.021	96.145	5	25	19.2	3.85
Phenanthrene	0.144	0.280	0.040	0.115	0.017	see footnote	0.016	0.005	0.010	500	2500	0.00002	0.000004
Pyrene	1.900	0.390	0.741	0.069	0.130	see footnote	0.162	0.005	0.144	2	10	0.07	0.01
Volatile Organics													
1,1,2,2-Tetrachloroethane	0.948	1.000	0.948	1.790	1.697	see footnote	0.443	0.0	0.152	76	380	0.002	0.0004

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF (wet-weight basis) of 1.0 was assumed.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.048944287 = Food ingestion rate (kg/day dry weight, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis, from Table 7-8)
PDFi = 0.87 = Proportion of diet composed of food item (soil invertebrates, dry weight basis, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis, from Table 7-8)
PDFi = 0.00 = Proportion of diet composed of food item (terrestrial plants, dry weight basis, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (small mammals, dry weight basis, from Table 7-8)
PDFi = 0.000 = Proportion of diet composed of food item (small mammals, dry weight basis, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (benthic invertebrates, dry weight basis, from Table 7-8)
PDFi = 0.000 = Proportion of diet composed of food item (benthic invertebrates, dry weight basis, from Table 7-8)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.13 = Proportion of diet composed of soil (dry weight basis, from Table 7-8)
WIR = 0.068297905 = Water ingestion rate (L/day, from Table 7-8)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.305 = Body weight (kg wet weight, from Table 7-8)

TABLE J-2a

Summary of Indian Mongoose Exposure Doses - Step 3a

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics													
Arsenic	4.880	0.258	1.259	0.037	0.181	0.003	0.016	0.027	0.015	1.2	6	0.01	0.002
Cadmium	0.057	7.660	0.438	0.514	0.029	0.144	0.008	0.005	0.003	0.75	3.75	0.004	0.001
Chromium	17.100	0.320	5.474	0.048	0.813	0.092	1.574	0.008	0.059	3.28	16.4	0.02	0.004
Copper	31.800	0.468	14.887	0.123	3.914	0.111	3.520	0.012	0.141	11.7	15.14	0.01	0.01
Lead	26.400	0.307	8.104	0.038	0.995	0.055	1.448	0.018	0.087	8	80	0.01	0.001
Mercury	0.032	1.186	0.038	0.344	0.011	0.054	0.002	0.00003	0.0003	0.15	0.25	0.002	0.001
Nickel	7.960	1.656	13.182	0.034	0.272	0.168	1.340	0.010	0.093	25	62.5	0.004	0.001
Selenium	0.507	0.982	0.498	0.567	0.288	0.258	0.131	0.032	0.005	0.2	0.33	0.02	0.01
Zinc	96.400	2.482	239.249	0.358	34.484	0.509	49.090	0.004	1.692	20.8	104	0.08	0.02
Pesticides/PCBs													
4,4'-DDE	0.234	10.60	2.480	0.0048	0.001	see footnote	0.171	0.000	0.016	1	5	0.02	0.003

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF (wet-weight basis) of 1.0 was assumed.

$$DI = \frac{[AFF[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.034591811 = Food ingestion rate (kg/day dry weight, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis, from Table 7-18)
PDFi = 0.61 = Proportion of diet composed of food item (soil invertebrates, dry weight basis, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis, from Table 7-18)
PDFi = 0.10 = Proportion of diet composed of food item (terrestrial plants, dry weight basis, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (small mammals, dry weight basis, from Table 7-18)
PDFi = 0.163 = Proportion of diet composed of food item (small mammals, dry weight basis, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (benthic invertebrates, dry weight basis, from Table 7-18)
PDS = 0.13 = Proportion of diet composed of soil (dry weight basis, from Table 7-18)
WIR = 0.046706352 = Water ingestion rate (L/day, from Table 7-18)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.434 = Body weight (kg wet weight, from Table 7-18)
AFF = 0.125 = Area foraging factor (Site Size/Home Range; Max. is 1.0; from Table 7-18)

TABLE J-3

Summary of Pearly-eyed Thrasher Exposure Doses - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics											
Arsenic	67.00	0.925	61.975	9.074	607.958	0.047	8.574	2.46	7.38	3.49	1.16
Cadmium	0.291	190.000	55.290	22.879	6.658	0.008	7.267	1.45	20	5.01	0.36
Chromium	50.00	11.416	570.800	0.480	24.000	0.016	75.316	1	5	75.32	15.06
Copper	100.0	5.492	549.200	7.400	740.000	0.023	72.796	47	61.7	1.55	1.18
Lead	63.00	228.261	14380.443	10.601	667.863	0.035	1889.844	3.85	19.25	490.87	98.17
Mercury	0.063	33.000	2.063	12.230	0.764	0.000	0.271	0.49	1.2	0.55	0.23
Nickel	26.00	7.802	202.852	22.214	577.564	0.020	26.820	77.4	107	0.35	0.25
Selenium	1.400	13.733	19.226	77.000	107.800	0.064	2.544	0.44	1.5	5.78	1.70
Silver	0.170	19.500	3.315	0.040	0.007	0.009	0.438	7	35	0.06	0.01
Zinc	260.0	49.510	12872.600	34.286	8914.360	0.008	1692.974	14.5	131	116.76	12.92
Pesticides/PCBs											
4,4'-DDD	0.010	2.000	0.020	0.015	0.0002	0.00002	0.003	0.5	5	0.01	0.00
4,4'-DDE	3.990	10.60	42.294	0.022	0.0861	0.00002	5.582	0.5	5	11.16	1.12
4,4'-DDT	1.940	0.700	1.358	0.024	0.0459	0.00002	0.191	0.5	5	0.38	0.04
Aldrin	0.002	3.300	0.007	0.043	0.0001	0.00001	0.001	0.0701	0.3505	0.01	0.003
alpha-BHC	0.002	1.000	0.002	0.263	0.0006	0.00001	0.000	0.56	2.25	0.001	0.0001
alpha-Chlordane	0.002	4.000	0.008	0.017	0.0000	0.00001	0.001	2.14	10.7	0.001	0.0001
Aroclor-1016	0.039	65.200	2.543	0.022	0.0009	0.0	0.334	0.41	2.05	0.82	0.16
Aroclor-1221	0.079	65.200	5.151	0.074	0.0059	0.0	0.677	0.41	2.05	1.65	0.33
Aroclor-1232	0.039	65.200	2.543	0.044	0.0017	0.0	0.334	0.41	2.05	0.82	0.16
Aroclor-1242	0.039	65.200	2.543	0.022	0.0009	0.0	0.334	0.41	2.05	0.82	0.16
Aroclor-1248	0.039	65.200	2.543	0.010	0.0004	0.0	0.334	0.41	2.05	0.82	0.16
Aroclor-1254	0.039	65.200	2.543	0.007	0.0003	0.0	0.334	0.41	2.05	0.82	0.16
Aroclor-1260	0.039	65.2	2.543	0.005	0.0002	0.0	0.334	0.41	2.05	0.82	0.16
beta-BHC	0.002	1.000	0.002	0.263	0.0006	0.00001	0.000	0.56	2.25	0.001	0.0001
delta-BHC	0.002	1.000	0.002	0.165	0.0003	0.00001	0.000	0.56	2.25	0.001	0.0001
Dieldrin	0.004	8.000	0.033	0.309	0.0013	0.00002	0.004	0.077	0.385	0.06	0.01
Endosulfan I	0.002	1.000	0.002	0.344	0.0007	0.00001	0.000	10	50	0.00003	0.00001
Endosulfan II	0.004	1.000	0.004	0.313	0.0013	0.00002	0.001	10	50	0.0001	0.00001
Endrin	0.004	3.600	0.015	0.795	0.0033	0.00002	0.002	0.02	0.1	0.10	0.02
gamma-BHC (Lindane)	0.002	1.000	0.002	0.317	0.0007	0.00001	0.000	4	20	0.0001	0.00001
gamma-Chlordane	0.002	4.000	0.008	0.017	0.0000	0.00001	0.001	2.14	10.7	0.001	0.0001
Heptachlor	0.002	3.000	0.006	0.055	0.0001	0.00001	0.001	0.2753	1.3765	0.003	0.001
Heptachlor epoxide	0.002	8.390	0.018	0.367	0.0008	0.00001	0.002	0.2753	1.3765	0.01	0.002
Methoxychlor	0.001	1.000	0.001	0.145	0.0001	0.00010	0.000	355	1775	0.0000003	0.0000001
Toxaphene	0.210	1.000	0.210	0.122	0.0256	0.00005	0.029	1	5	0.03	0.01
Semivolatile Organics											
1,2,4-Trichlorobenzene	28.200	0.560	15.792	0.219	6.164	0.0	2.254	32.16	160.8	0.07	0.01
1,2-Dichlorobenzene	28.200	1.000	28.200	0.548	15.440	0.0	3.884	32.16	160.8	0.12	0.02
1,3-Dichlorobenzene	28.200	1.000	28.200	0.367	10.357	0.0	3.884	32.16	160.8	0.12	0.02

TABLE J-3

Summary of Pearly-eyed Thrasher Exposure Doses - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
1,4-Dichlorobenzene	28.200	1.000	28.200	0.505	14.255	0.0	3.884	32.16	160.8	0.12	0.02
4-Bromophenyl-phenylether	0.267	1.000	0.267	1.505	0.402	1.000	0.170	NA	NA	--	--
4-Chlorophenyl-phenylether	28.200	1.000	28.200	2.505	70.655	2.000	4.151	NA	NA	--	--
Acenaphthene	28.200	0.300	8.460	0.256	7.231	0.005	1.291	7.1	35.5	0.18	0.04
Acenaphthylene	28.200	0.220	6.204	0.165	4.661	0.005	0.994	7.1	35.5	0.14	0.03
Anthracene	28.200	0.320	9.024	0.105	2.964	0.005	1.365	7.1	35.5	0.19	0.04
Benzo(a)anthracene	0.112	0.270	0.030	0.022	0.002	0.005	0.005	7.1	35.5	0.001	0.0002
Benzo(a)pyrene	0.120	0.340	0.041	0.014	0.002	0.005	0.007	7.1	35.5	0.001	0.0002
Benzo(b)fluoranthene	0.133	0.210	0.028	0.017	0.002	0.005	0.005	7.1	35.5	0.001	0.0001
Benzo(g,h,i)perylene	0.060	0.150	0.009	0.006	0.000	0.005	0.002	7.1	35.5	0.0003	0.0001
Benzo(k)fluoranthene	0.124	0.210	0.026	0.011	0.001	0.005	0.005	7.1	35.5	0.001	0.0001
Chrysene	0.155	0.440	0.068	0.029	0.004	0.005	0.011	7.1	35.5	0.001	0.0003
Dibenz(a,h)anthracene	28.200	0.490	13.818	0.007	0.191	0.005	1.995	7.1	35.5	0.28	0.06
Fluoranthene	0.187	0.370	0.069	0.062	0.012	0.005	0.011	7.1	35.5	0.002	0.0003
Fluorene	28.200	0.200	5.640	0.179	5.048	0.005	0.920	7.1	35.5	0.13	0.03
Hexachlorobenzene	28.200	1.690	47.658	0.037	1.036	0.005	6.441	0.113	0.565	57.00	11.40
Hexachlorobutadiene	28.200	1.000	28.200	0.071	1.989	0.005	3.885	3.39	16.95	1.15	0.23
Hexachlorocyclopentadiene	28.200	1.000	28.200	0.047	1.316	0.005	3.885	NA	NA	--	--
Hexachloroethane	28.200	1.000	28.200	0.240	6.765	0.005	3.885	NA	NA	--	--
Indeno(1,2,3-cd)pyrene	0.085	0.410	0.035	0.006	0.001	0.005	0.006	7.1	35.5	0.001	0.0002
Pentachlorophenol	84.500	8.000	676.000	0.049	4.160	0.021	89.357	4.26	8.52	21.0	10.5
Phenanthrene	0.144	0.280	0.040	0.115	0.017	0.005	0.007	7.1	35.5	0.001	0.0002
Pyrene	1.900	0.390	0.741	0.069	0.130	0.005	0.110	7.1	35.5	0.02	0.003
Volatile Organics											
1,1,2,2-Tetrachloroethane	0.948	1.000	0.948	1.790	1.697	0.0	0.131	NA	NA	--	--

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.013083869 = Food ingestion rate (kg/day dry weight, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis, from Table 7-8)
PDFi = 0.954 = Proportion of diet composed of food item (soil invertebrates, dry weight basis, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis, from Table 7-8)
PDFi = 0 = Proportion of diet composed of food item (terrestrial plants, dry weight basis, from Table 7-8)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.046 = Proportion of diet composed of soil (dry weight basis, from Table 7-8)
WIR = 0.012698351 = Water ingestion rate (L/day, from Table 7-8)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.095 = Body weight (kg wet weight, from Table 7-8)

TABLE J-3a
Summary of Pearly-eyed Thrasher Exposure Doses - Step 3a
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Worm BAF	Terrestrial Invertebrate Concentration (mg/kg dw)	Soil-Plant BAF	Terrestrial Plant Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics											
Arsenic	4.880	0.258	1.259	0.037	0.181	0.027	0.163	2.46	7.38	0.07	0.02
Cadmium	0.057	7.660	0.438	0.514	0.029	0.005	0.045	1.45	20	0.03	0.00
Chromium	17.100	0.320	5.474	0.048	0.813	0.008	0.671	1	5	0.67	0.13
Copper	31.800	0.468	14.887	0.123	3.914	0.012	1.778	47	61.7	0.04	0.03
Lead	26.400	0.307	8.104	0.038	0.995	0.018	0.994	3.85	19.25	0.26	0.05
Mercury	0.032	1.186	0.038	0.344	0.011	0.00003	0.004	0.49	1.2	0.01	0.004
Nickel	7.960	1.656	13.182	0.034	0.272	0.010	1.367	77.4	107	0.02	0.01
Selenium	0.507	0.982	0.498	0.567	0.288	0.032	0.064	0.44	1.5	0.15	0.04
Zinc	96.400	2.482	239.249	0.358	34.484	0.004	25.281	14.5	131	1.74	0.19
Pesticides/PCBs											
4,4'-DDE	0.234	10.60	2.480	0.0048	0.001	0.000	0.248	0.5	5	0.50	0.05

$$DI = \frac{[AFF[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.01265848 = Food ingestion rate (kg/day dry weight, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (soil invertebrates, dry weight basis, from Table 7-18)
PDFi = 0.754 = Proportion of diet composed of food item (soil invertebrates, dry weight basis, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (terrestrial plants, dry weight basis, from Table 7-18)
PDFi = 0.2 = Proportion of diet composed of food item (terrestrial plants, dry weight basis, from Table 7-18)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0.046 = Proportion of diet composed of soil (dry weight basis, from Table 7-18)
WIR = 0.01227365 = Water ingestion rate (L/day, from Table 7-18)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.096 = Body weight (kg wet weight, from Table 7-18)
AFF = 1 = Area foraging factor (Site Size/Home Range; Max. is 1.0; from Table 7-18)

TABLE J-4
Summary of Green Heron Exposure Doses - Step 2
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Sediment Concentration (mg/kg)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics									
Arsenic	0.882	0.126	0.111	0.047	0.039	5.14	12.84	0.01	0.003
Cadmium	0.012	0.164	0.002	0.008	0.00168	1.45	20	0.001	0.0001
Chromium	13.400	0.038	0.509	0.016	0.150	1	5	0.15	0.03
Copper	9.760	0.100	0.976	0.023	0.286	47	61.7	0.01	0.005
Lead	1.490	0.070	0.104	0.035	0.035	3.85	19.25	0.01	0.002
Mercury	0.013	4.580	0.058	0.000	0.017	0.026	0.078	0.65	0.22
Nickel	4.390	1.000	4.390	0.020	1.276	77.4	107	0.02	0.01
Selenium	0.190	1.000	0.190	0.064	0.064	1.8	9	0.04	0.01
Silver	0.027	1.000	0.027	0.009	0.009	35.6	178	0.0003	0.0001
Zinc	13.600	0.147	1.999	0.008	0.581	14.5	131	0.04	0.004
Pesticides/PCBs									
4,4'-DDD	0.005	2.250	0.010	0.000020	0.003	0.3	3	0.01	0.001
4,4'-DDE	0.000	26.200	0.003	0.000020	0.001	0.3	3	0.003	0.0003
4,4'-DDT	0.005	8.800	0.040	0.000020	0.011	0.3	3	0.04	0.004
Aldrin	0.002	1.000	0.002	0.000010	0.001	0.155	0.775	0.004	0.001
alpha-BHC	0.002	1.000	0.002	0.000010	0.001	0.56	2.25	0.001	0.0003
alpha-Chlordane	0.002	1.000	0.002	0.000010	0.001	0.8	4	0.001	0.0002
beta-BHC	0.002	1.000	0.002	0.000010	0.001	0.56	2.25	0.001	0.0003
delta-BHC	0.002	1.000	0.002	0.000010	0.001	0.56	2.25	0.001	0.0003
Dieldrin	0.005	1.000	0.005	0.000020	0.001	0.077	0.385	0.02	0.003
Endosulfan I	0.002	1.000	0.002	0.000010	0.001	10	50	0.0001	0.00001
Endosulfan II	0.005	1.000	0.005	0.000020	0.001	10	50	0.0001	0.00003
Endrin	0.005	1.000	0.005	0.000020	0.001	0.3	1.5	0.004	0.001
gamma-BHC (Lindane)	0.002	6.200	0.014	0.000010	0.004	4	20	0.001	0.0002
gamma-Chlordane	0.002	1.000	0.002	0.000010	0.001	0.8	4	0.001	0.0002
Heptachlor	0.002	1.000	0.002	0.000010	0.001	0.48	2.4	0.001	0.0003
Heptachlor epoxide	0.002	1.000	0.002	0.000010	0.001	0.48	2.4	0.001	0.0003
Methoxychlor	0.023	1.000	0.023	0.000100	0.007	355	1775	0.00002	0.0000
Toxaphene	0.230	1.000	0.230	0.000051	0.067	1	5	0.07	0.01
Semivolatile Organics									
4-Bromophenyl-phenylether	0.445	1.000	0.445	0.0001	0.129	NA	NA	--	--
4-Chlorophenyl-phenylether	0.445	1.000	0.445	0.0001	0.129	NA	NA	--	--
Acenaphthene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Acenaphthylene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Anthracene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004

TABLE J-4
Summary of Green Heron Exposure Doses - Step 2
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Sediment Concentration (mg/kg)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Benzo(a)anthracene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Benzo(a)pyrene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Benzo(b)fluoranthene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Benzo(g,h,i)perylene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Benzo(k)fluoranthene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Chrysene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Dibenz(a,h)anthracene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Fluoranthene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Fluorene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Hexachlorobenzene	0.445	0.940	0.418	0.0051	0.122	0.113	0.565	1.08	0.22
Hexachlorobutadiene	0.000	0.384	0.000	0.0051	0.001	3.39	16.95	0.0002	0.00004
Hexachlorocyclopentadiene	0.445	1.000	0.445	0.0051	0.130	NA	NA	--	--
Hexachloroethane	0.000	1.000	0.000	0.0051	0.001	NA	NA	--	--
Indeno(1,2,3-cd)pyrene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Pentachlorophenol	1.330	1.000	1.330	0.0205	0.389	4.26	8.52	0.09	0.05
Phenanthrene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004
Pyrene	0.445	1.000	0.445	0.0051	0.130	7.1	35.5	0.02	0.004

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI =	Chemical-specific	= Dietary intake for chemical (mg chemical/kg body weight/day)
FIR =	0.045817191	= Food ingestion rate (kg/day dry weight, from Table 7-8)
FCxi =	Chemical-specific	= Concentration of chemical in food item (fish, dry weight basis, from Table 7-8)
PDFi =	1.000	= Proportion of diet composed of food item (fish, dry weight basis, from Table 7-8)
SCx =	Chemical-specific	= Concentration of chemical in sediment (mg/kg, dry weight)
PDS =	0	= Proportion of diet composed of sediment (dry weight basis, from Table 7-8)
WIR =	0.022740679	= Water ingestion rate (L/day, from Table 7-8)
WC =	Chemical-specific	= Concentration of chemical in water (mg/L)
BW =	0.158	= Body weight (kg wet weight, from Table 7-8)

TABLE J-4a
Summary of Green Heron Exposure Doses - Step 3a
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Sediment Concentration (mg/kg)	Sediment-Benthic Invertebrate BAF	Benthic Invertebrate Concentration (mg/kg dw)	Sediment-Fish BAF	Fish Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics											
Chromium	7.100	0.083	0.589	0.038	0.270	0.008	0.070	1	5	0.07	0.01
Copper	8.110	0.919	7.457	0.100	0.811	0.012	0.524	47	61.7	0.01	0.01
Zinc	11.200	0.954	10.686	0.147	1.646	0.004	0.815	14.5	131	0.06	0.01

$$DI = \frac{[AFF[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.040479994 = Food ingestion rate (kg/day dry weight, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (fish, dry weight basis, from Table 7-18)
PDFi = 0.710 = Proportion of diet composed of food item (fish, dry weight basis, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (benthic invertebrates, dry weight basis, from Table 7-18)
PDFi = 0.290 = Proportion of diet composed of food item (benthic invertebrates, dry weight basis, from Table 7-18)
SCx = Chemical-specific = Concentration of chemical in sediment (mg/kg, dry weight)
PDS = 0 = Proportion of diet composed of sediment (dry weight basis, from Table 7-18)
WIR = 0.020868779 = Water ingestion rate (L/day, from Table 7-18)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.212 = Body weight (kg wet weight, from Table 7-18)
AFF = 1 = Area foraging factor (Site Size/Home Range; Max. is 1.0; from Table 7-18)

TABLE J-5
Summary of Red-tailed Hawk Doses - Step 2
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics									
Arsenic	67.00	0.071	4.757	0.047	0.200	2.46	7.38	0.08	0.03
Cadmium	0.291	1.705	0.496	0.008	0.021	1.45	20	0.01	0.001
Chromium	50.00	0.800	40.000	0.016	1.653	1	5	1.65	0.33
Copper	100.0	0.867	86.700	0.023	3.582	47	61.7	0.08	0.06
Lead	63.00	0.995	62.685	0.035	2.591	3.85	19.25	0.67	0.13
Mercury	0.063	0.192	0.012	0.000	0.000	0.49	1.2	0.001	0.0004
Nickel	26.00	0.800	20.800	0.020	0.860	77.4	107	0.01	0.01
Selenium	1.400	1.754	2.456	0.064	0.106	0.44	1.5	0.24	0.07
Silver	0.170	0.810	0.138	0.009	0.006	7	35	0.001	0.00
Zinc	260.0	5.850	1521.000	0.008	62.811	14.5	131	4.33	0.48
Pesticides/PCBs									
4,4'-DDD	0.010	see footnote	0.003	0.000020	0.00014	0.08	0.4	0.002	0.0004
4,4'-DDE	3.990	see footnote	7.031	0.000020	0.29034	0.08	0.4	3.63	0.73
4,4'-DDT	1.940	see footnote	0.245	0.000020	0.01012	0.08	0.4	0.13	0.03
Aldrin	0.002	see footnote	0.001	0.000010	0.00005	0.0701	0.3505	0.001	0.0001
alpha-BHC	0.002	see footnote	0.000	0.000010	0.00002	0.56	2.25	0.00004	0.00001
alpha-Chlordane	0.002	see footnote	0.001	0.000010	0.00006	2.14	10.7	0.00003	0.00001
Aroclor-1016	0.039	see footnote	0.103	0.0	0.00425	0.41	2.05	0.01	0.002
Aroclor-1221	0.079	see footnote	0.209	0.0	0.00864	0.41	2.05	0.02	0.004
Aroclor-1232	0.039	see footnote	0.103	0.0	0.00426	0.41	2.05	0.01	0.002
Aroclor-1242	0.039	see footnote	0.103	0.0	0.00425	0.41	2.05	0.01	0.002
Aroclor-1248	0.039	see footnote	0.103	0.0	0.00425	0.41	2.05	0.01	0.002
Aroclor-1254	0.039	see footnote	0.103	0.0	0.00425	0.41	2.05	0.01	0.002
Aroclor-1260	0.039	see footnote	0.103	0.0	0.00425	0.41	2.05	0.01	0.002
beta-BHC	0.002	see footnote	0.000	0.000010	0.00002	0.56	2.25	0.00004	0.00001
delta-BHC	0.002	see footnote	0.000	0.000010	0.00002	0.56	2.25	0.00003	0.00001
Dieldrin	0.004	see footnote	0.006	0.000020	0.00024	0.077	0.385	0.003	0.001
Endosulfan I	0.002	see footnote	0.000	0.000010	0.00002	10	50	0.000002	0.0000004
Endosulfan II	0.004	see footnote	0.001	0.000020	0.00004	10	50	0.000004	0.000001
Endrin	0.004	see footnote	0.003	0.000020	0.00013	0.02	0.1	0.01	0.001
gamma-BHC (Lindane)	0.002	see footnote	0.000	0.000010	0.00002	4	20	0.00001	0.000001
gamma-Chlordane	0.002	see footnote	0.001	0.000010	0.00006	2.14	10.7	0.00003	0.00001
Heptachlor	0.002	see footnote	0.001	0.000010	0.00005	0.2753	1.3765	0.0002	0.00003
Heptachlor epoxide	0.002	see footnote	0.003	0.000010	0.00013	0.2753	1.3765	0.0005	0.0001
Methoxychlor	0.001	see footnote	0.000	0.000100	0.00002	355	1775	0.00000005	0.00000001
Toxaphene	0.210	see footnote	0.040	0.000051	0.00167	1	5	0.002	0.0003
Semivolatile Organics									
1,2,4-Trichlorobenzene	28.200	see footnote	3.819	0.0	0.158	32.16	160.8	0.005	0.001
1,2-Dichlorobenzene	28.200	see footnote	7.402	0.0	0.306	32.16	160.8	0.01	0.002
1,3-Dichlorobenzene	28.200	see footnote	6.562	0.0	0.271	32.16	160.8	0.01	0.002

TABLE J-5
Summary of Red-tailed Hawk Doses - Step 2
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
1,4-Dichlorobenzene	28.200	see footnote	7.206	0.0	0.298	32.16	160.8	0.01	0.002
4-Bromophenyl-phenylether	0.267	see footnote	0.012	0.0	0.000	NA	NA	--	--
4-Chlorophenyl-phenylether	28.200	see footnote	1.777	0.0	0.073	NA	NA	--	--
Acenaphthene	28.200	see footnote	2.788	0.005	0.116	7.1	35.5	0.02	0.003
Acenaphthylene	28.200	see footnote	1.991	0.005	0.083	7.1	35.5	0.01	0.002
Anthracene	28.200	see footnote	2.177	0.005	0.090	7.1	35.5	0.01	0.003
Benzo(a)anthracene	0.112	see footnote	0.011	0.005	0.001	7.1	35.5	0.0001	0.00002
Benzo(a)pyrene	0.120	see footnote	0.013	0.005	0.001	7.1	35.5	0.0001	0.00003
Benzo(b)fluoranthene	0.133	see footnote	0.011	0.005	0.001	7.1	35.5	0.0001	0.00002
Benzo(g,h,i)perylene	0.060	see footnote	0.007	0.005	0.001	7.1	35.5	0.0001	0.00002
Benzo(k)fluoranthene	0.124	see footnote	0.011	0.005	0.001	7.1	35.5	0.0001	0.00002
Chrysene	0.155	see footnote	0.018	0.005	0.001	7.1	35.5	0.0002	0.00003
Dibenz(a,h)anthracene	28.200	see footnote	2.511	0.005	0.104	7.1	35.5	0.01	0.003
Fluoranthene	0.187	see footnote	0.020	0.005	0.001	7.1	35.5	0.0002	0.00003
Fluorene	28.200	see footnote	1.962	0.005	0.081	7.1	35.5	0.01	0.002
Hexachlorobenzene	28.200	see footnote	8.243	0.005	0.341	0.113	0.565	3.02	0.60
Hexachlorobutadiene	28.200	see footnote	5.184	0.005	0.214	3.39	16.95	0.06	0.01
Hexachlorocyclopentadiene	28.200	see footnote	5.073	0.005	0.210	NA	NA	--	--
Hexachloroethane	28.200	see footnote	5.974	0.005	0.247	NA	NA	--	--
Indeno(1,2,3-cd)pyrene	0.085	see footnote	0.012	0.005	0.001	7.1	35.5	0.0001	0.00002
Pentachlorophenol	84.500	see footnote	112.995	0.021	4.668	4.26	8.52	1.10	0.55
Phenanthrene	0.144	see footnote	0.016	0.005	0.001	7.1	35.5	0.0001	0.00003
Pyrene	1.900	see footnote	0.162	0.005	0.007	7.1	35.5	0.001	0.0002
Volatile Organics									
1,1,2,2-Tetrachloroethane	0.948	see footnote	0.443	0.0	0.018	NA	NA	--	--

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF (wet-weight basis) of 1.0 was assumed.

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.03952 = Food ingestion rate (kg/day dry weight, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (small mammals, dry weight basis, from Table 7-8)
PDFi = 1.000 = Proportion of diet composed of food item (small mammals, dry weight basis, from Table 7-8)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0 = Proportion of diet composed of soil (dry weight basis, from Table 7-8)
WIR = 0.067962426 = Water ingestion rate (L/day, from Table 7-8)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.957 = Body weight (kg wet weight, from Table 7-8)

TABLE J-5a

Summary of Red-tailed Hawk Doses - Step 3a

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Surface Soil Concentration (mg/kg)	Soil-Mammal BAF	Small Mammal Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics									
Arsenic	4.880	0.003	0.016	0.027	0.000004	2.46	7.38	0.000001	0.0000005
Cadmium	0.057	0.144	0.008	0.005	0.000001	1.45	20	0.000001	0.00000004
Chromium	17.100	0.092	1.574	0.008	0.000087	1	5	0.00009	0.00002
Copper	31.800	0.111	3.520	0.012	0.000195	47	61.7	0.000004	0.000003
Lead	26.400	0.055	1.448	0.018	0.000081	3.85	19.25	0.00002	0.000004
Mercury	0.032	0.054	0.002	0.00003	0.0000001	0.49	1.2	0.0000002	0.0000001
Nickel	7.960	0.168	1.340	0.010	0.000075	77.4	107	0.000001	0.000001
Selenium	0.507	0.258	0.131	0.032	0.000010	0.44	1.5	0.00002	0.00001
Zinc	96.400	0.509	49.090	0.004	0.002697	14.5	131	0.0002	0.00002
Pesticides/PCBs									
4,4'-DDE	0.234	see footnote	0.171	0.00001	0.000009	0.08	0.4	0.0001	0.00002

It was assumed that the concentration of each chemical in the small mammal's tissues was equal to the chemical concentration in its diet, that is, a diet to whole-body BAF (wet-weight basis) of 1.0 was assumed.

$$DI = \frac{[AFF[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.036032 = Food ingestion rate (kg/day dry weight, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (small mammals, dry weight basis, from Table 7-18)
PDFi = 1.000 = Proportion of diet composed of food item (small mammals, dry weight basis, from Table 7-18)
SCx = Chemical-specific = Concentration of chemical in soil (mg/kg, dry weight)
PDS = 0 = Proportion of diet composed of soil (dry weight basis, from Table 7-18)
WIR = 0.063882622 = Water ingestion rate (L/day, from Table 7-18)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 1.126 = Body weight (kg wet weight, from Table 7-18)
AFF = 0.001716738 = Area foraging factor (Site Size/Home Range; Max. is 1.0; from Table 7-18)

TABLE J-6

Summary of Spotted Sandpiper Doses - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Sediment Concentration (mg/kg)	Sediment-Benthic Invertebrate BAF	Benthic Invertebrate Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics									
Arsenic	0.882	4.330	3.819	0.047	1.055	5.14	12.84	0.21	0.08
Cadmium	0.012	4.878	0.059	0.008	0.018	1.45	20	0.01	0.001
Chromium	13.400	0.190	2.546	0.016	1.429	1	5	1.43	0.29
Copper	9.760	23.870	232.971	0.023	61.003	47	61.7	1.30	0.99
Lead	1.490	0.503	0.749	0.035	0.290	3.85	19.25	0.08	0.02
Mercury	0.013	3.981	0.051	0.000	0.014	0.026	0.078	0.53	0.18
Nickel	4.390	0.237	1.040	0.020	0.526	77.4	107	0.01	0.005
Selenium	0.190	1.000	0.190	0.064	0.080	0.4	0.8	0.20	0.10
Silver	0.027	0.180	0.005	0.009	0.006	35.6	178	0.0002	0.00003
Zinc	13.600	8.479	115.314	0.008	30.693	14.5	131	2.11676697	0.23
Pesticides/PCBs									
4,4'-DDD	0.005	0.350	0.002	0.00002	0.0007	0.12	0.6	0.01	0.001
4,4'-DDE	0.000	3.360	0.000	0.00002	0.0001	0.12	0.6	0.001	0.0002
4,4'-DDT	0.005	2.280	0.010	0.00002	0.0029	0.6	1.5	0.005	0.002
Aldrin	0.002	1.000	0.002	0.00001	0.0007	0.155	0.775	0.005	0.001
alpha-BHC	0.002	1.000	0.002	0.00001	0.0007	0.56	2.25	0.001	0.0003
alpha-Chlordane	0.002	1.000	0.002	0.00001	0.0007	0.8	4	0.001	0.0002
beta-BHC	0.002	1.000	0.002	0.00001	0.0007	0.56	2.25	0.001	0.0003
delta-BHC	0.002	1.000	0.002	0.00001	0.0007	0.56	2.25	0.001	0.0003
Dieldrin	0.005	4.520	0.020	0.00002	0.0055	0.077	0.385	0.07	0.01
Endosulfan I	0.002	1.000	0.002	0.00001	0.0007	10	50	0.0001	0.00001
Endosulfan II	0.005	1.000	0.005	0.00002	0.0014	10	50	0.0001	0.00003
Endrin	0.005	1.000	0.005	0.00002	0.0014	0.3	1.5	0.005	0.001
gamma-BHC (Lindane)	0.002	1.000	0.002	0.00001	0.0007	4	20	0.0002	0.00004
gamma-Chlordane	0.002	1.000	0.002	0.00001	0.0007	0.8	4	0.001	0.0002
Heptachlor	0.002	1.000	0.002	0.00001	0.0007	0.48	2.4	0.002	0.0003
Heptachlor epoxide	0.002	1.000	0.002	0.00001	0.0007	0.48	2.4	0.002	0.0003
Methoxychlor	0.023	1.000	0.023	0.00010	0.0073	355	1775	0.00002	0.000004
Toxaphene	0.230	1.000	0.230	0.00005	0.0728	1	5	0.07	0.01
Semivolatile Organics									
4-Bromophenyl-phenylether	0.445	1.000	0.445	0.0001	0.141	NA	NA	--	--
4-Chlorophenyl-phenylether	0.445	1.000	0.445	0.0001	0.141	NA	NA	--	--
Acenaphthene	0.445	2.040	0.908	0.0051	0.262	7.1	35.5	0.04	0.01

TABLE J-6

Summary of Spotted Sandpiper Doses - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Sediment Concentration (mg/kg)	Sediment-Benthic Invertebrate BAF	Benthic Invertebrate Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Acenaphthylene	0.445	2.040	0.908	0.0051	0.262	7.1	35.5	0.04	0.01
Anthracene	0.445	0.271	0.121	0.0051	0.058	7.1	35.5	0.01	0.002
Benzo(a)anthracene	0.445	1.400	0.623	0.0051	0.189	7.1	35.5	0.03	0.005
Benzo(a)pyrene	0.445	0.191	0.085	0.0051	0.049	7.1	35.5	0.01	0.001
Benzo(b)fluoranthene	0.445	0.160	0.071	0.0051	0.045	7.1	35.5	0.01	0.001
Benzo(g,h,i)perylene	0.445	0.295	0.131	0.0051	0.061	7.1	35.5	0.01	0.002
Benzo(k)fluoranthene	0.445	0.421	0.187	0.0051	0.075	7.1	35.5	0.01	0.002
Chrysene	0.445	0.335	0.149	0.0051	0.066	7.1	35.5	0.01	0.002
Dibenz(a,h)anthracene	0.445	0.271	0.121	0.0051	0.058	7.1	35.5	0.01	0.002
Fluoranthene	0.445	0.312	0.139	0.0051	0.063	7.1	35.5	0.01	0.002
Fluorene	0.445	1.130	0.503	0.0051	0.157	7.1	35.5	0.02	0.004
Hexachlorobenzene	0.445	0.860	0.383	0.0051	0.126	0.113	0.565	1.12	0.22
Hexachlorobutadiene	0.000	0.610	0.000	0.0051	0.002	3.39	16.95	0.0005	0.0001
Hexachlorocyclopentadiene	0.445	1.000	0.445	0.0051	0.142	NA	NA	--	--
Hexachloroethane	0.000	1.000	0.000	0.0051	0.002	NA	NA	--	--
Indeno(1,2,3-cd)pyrene	0.445	0.355	0.158	0.0051	0.068	7.1	35.5	0.01	0.002
Pentachlorophenol	1.330	1.000	1.330	0.0205	0.427	4.26	8.52	0.10	0.05
Phenanthrene	0.445	0.652	0.290	0.0051	0.102	7.1	35.5	0.01	0.003
Pyrene	0.445	0.803	0.357	0.0051	0.120	7.1	35.5	0.02	0.003

$$DI_x = \frac{[[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)] + [(WIR)(WC_x)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.009301553 = Food ingestion rate (kg/day dry weight, from Table 7-8)
FCxi = Chemical-specific = Concentration of chemical in food item (benthic invertebrates, dry weight basis, from
PDFi = 0.820 = Proportion of diet composed of food item (benthic invertebrates, dry weight basis, fro
SCx = Chemical-specific = Concentration of chemical in sediment (mg/kg, dry weight)
PDS = 0.18 = Proportion of diet composed of sediment (dry weight basis, from Table 7-8)
WIR = 0.00893803 = Water ingestion rate (L/day, from Table 7-8)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0294 = Body weight (kg wet weight, from Table 7-8)

TABLE J-6a

Summary of Spotted Sandpiper Doses - Step 3a

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Sediment Concentration (mg/kg)	Sediment-Benthic Invertebrate BAF	Benthic Invertebrate Concentration (mg/kg dw)	Surface Water Concentration (mg/L)	Dietary Intake (mg/kg/day)	NOAEL TRV (mg/kg/d)	LOAEL TRV (mg/kg/d)	NOAEL HQ	LOAEL HQ
Inorganics									
Chromium	7.100	0.083	0.589	0.008	0.316	1	5	0.32	0.06
Copper	8.110	0.919	7.457	0.012	1.353	47	61.7	0.03	0.02
Zinc	11.200	0.954	10.686	0.004	1.923	14.5	131	0.13	0.01

$$DI = \frac{[AFF[\sum_i (FIR)(FC_{xi})(PDF_i)] + [(FIR)(SC_x)(PDS)]]}{BW}$$

DI = Chemical-specific = Dietary intake for chemical (mg chemical/kg body weight/day)
FIR = 0.007205718 = Food ingestion rate (kg/day dry weight, from Table 7-18)
FCxi = Chemical-specific = Concentration of chemical in food item (benthic invertebrates, dry weight basis, from Table 7-18)
PDFi = 0.820 = Proportion of diet composed of food item (benthic invertebrates, dry weight basis, from Table 7-18)
SCx = Chemical-specific = Concentration of chemical in sediment (mg/kg, dry weight)
PDS = 0.18 = Proportion of diet composed of sediment (dry weight basis, from Table 7-18)
WIR = 0.006872702 = Water ingestion rate (L/day, from Table 7-18)
WC = Chemical-specific = Concentration of chemical in water (mg/L)
BW = 0.0404 = Body weight (kg wet weight, from Table 7-18)
AFF = 1 = Area foraging factor (Site Size/Home Range; Max. is 1.0; from Table 7-18)

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
12	no unacceptable human health risks	Section 2.5.1	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 10.1.RME through 10.5 RME. July 2007.

TABLE 10.1.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Current/Future
Receptor Population: Recreational
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			ARSENIC	9.3E-06	5.1E-09	7.8E-07	1.0E-05	Skin, Vascular	2.4E-01	NA	2.0E-02	2.6E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.7E-01	NA	7.6E-03	2.8E-01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	1.8E-01	NA	2.0E-01	3.8E-01
Chemical Total				9.3E-06	5.1E-09	7.8E-07	1.0E-05		6.9E-01	0.0E+00	2.2E-01	9.1E-01
Medium Total							1.0E-05					9.1E-01
Surface Water	Surface Water	Water-filled Ditch										
			ARSENIC	3.7E-06	NA	3.0E-07	4.0E-06	Skin, Vascular	9.7E-02	NA	7.8E-03	1.0E-01
Chemical Total				3.7E-06	0.0E+00	3.0E-07	4.0E-06		9.7E-02	NA	7.8E-03	1.0E-01
Medium Total							4.0E-06					1.0E-01
Receptor Total							2.4E+01				Receptor HI Total	2.5E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total Skin HI Across All Media =	3.7E-01
Total Vascular HI Across All Media =	3.7E-01
Total Kidney HI Across All Media =	3.8E-01
Total Blood HI Across All Media =	2.8E-01
Total Liver HI Across All Media =	2.8E-01

TABLE 10.2.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			ARSENIC	1.3E-05	2.0E-08	1.6E-06	1.5E-05	Skin, Vascular	8.7E-02	NA	1.0E-02	9.7E-02
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.5E-02	NA	1.0E-01	1.7E-01
Chemical Total				1.3E-05	2.0E-08	1.6E-06	1.5E-05		1.5E-01	0.0E+00	1.1E-01	2.6E-01
Groundwater	Groundwater	Tap Water										
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	2.5E-01	NA	1.3E-09	2.5E-01
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	3.7E-01	NA	1.3E-08	3.7E-01
			ARSENIC	8.9E-05	NA	2.7E-13	8.9E-05	Skin, Vascular	5.8E-01	NA	3.0E-09	5.8E-01
			BARIUM	NA	NA	NA	0.0E+00	NOAEL	1.4E-01	NA	1.0E-08	1.4E-01
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	1.6E-01	NA	3.4E-08	1.6E-01
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	1.4E-01	NA	5.3E-08	1.4E-01
Chemical Total				8.9E-05	0.0E+00	2.7E-13	8.9E-05		1.6E+00	NA	1.1E-07	1.6E+00
Medium Total							8.9E-05					1.6E+00
Receptor Total							1.0E-04				Receptor HI Total	1.9E+00

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	2.5E-01
Total Skin HI Across All Media =	6.7E-01
Total Vascular HI Across All Media =	6.7E-01
Total Kidney HI Across All Media =	3.3E-01
Total NOAEL HI Across All Media =	2.7E-01
Total Blood HI Across All Media =	3.7E-01

TABLE 10.3.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Residential
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil										
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	1.1E-01	4.1E-03	3.0E-03	1.1E-01
			ARSENIC	3.1E-05	2.0E-07	2.6E-06	3.4E-05	Skin, Vascular	8.1E-01	NA	6.8E-02	8.8E-01
			CHROMIUM, TOTAL	NA	6.0E-07	NA	6.0E-07	NOAEL	8.6E-02	4.7E-04	9.6E-02	1.8E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	9.1E-01	NA	2.5E-02	9.3E-01
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	9.9E-02	NA	2.8E-03	1.0E-01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.1E-01	NA	6.6E-01	1.3E+00
Chemical Total				3.1E-05	8.0E-07	2.6E-06	3.5E-05		2.6E+00	4.5E-03	8.5E-01	3.5E+00
Subsurface Soil	Subsurface Soil	AOC H Subsurface Soil	ARSENIC	1.1E-05	NA	9.1E-07	1.2E-05	Skin, Vascular	2.8E-01	NA	2.3E-02	3.0E-01
Chemical Total				1.1E-05	0.0E+00	9.1E-07	1.2E-05		2.8E-01	0.0E+00	2.3E-02	3.0E-01
Medium Total							4.6E-05					3.8E+00
Groundwater	Groundwater	Tap Water										
			ALUMINUM	NA	NA	NA	0.0E+00	CNS	5.8E-01	NA	3.8E-09	5.8E-01
			ANTIMONY	NA	NA	NA	0.0E+00	Blood	8.6E-01	NA	3.8E-08	8.6E-01
			ARSENIC	5.2E-05	NA	3.4E-13	5.2E-05	Skin, Vascular	1.3E+00	NA	8.9E-09	1.3E+00
			BARIUM	NA	NA	NA	0.0E+00	NOAEL	3.2E-01	NA	3.0E-08	3.2E-01
			CADMIUM	NA	NA	NA	0.0E+00	Kidney	3.8E-01	NA	1.0E-07	3.8E-01
			CHROMIUM, TOTAL	NA	NA	NA	0.0E+00	NOAEL	3.2E-01	NA	1.7E-07	3.2E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	2.2E+01	NA	3.7E-06	2.2E+01
			MANGANESE	NA	NA	NA	0.0E+00	CNS	6.8E+00	NA	1.1E-06	6.8E+00
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	3.5E+01	NA	2.3E-07	3.5E+01
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	4.5E+00	NA	1.1E-06	4.5E+00
Chemical Total				5.2E-05	0.0E+00	3.4E-13	5.2E-05		7.3E+01	NA	6.5E-06	7.3E+01
Medium Total							5.2E-05					7.3E+01
Receptor Total							1.3E-04				Receptor HI Total	8.0E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	7.5E+00
Total Skin HI Across All Media =	2.5E+00
Total Vascular HI Across All Media =	2.5E+00
Total Kidney HI Across All Media =	6.1E+00
Total NOAEL HI Across All Media =	8.2E-01
Total Gastrointestinal HI Across All Media =	2.3E+01
Total Blood HI Across All Media =	6.0E+01
Total Liver HI Across All Media =	5.9E+01
Total Hair HI Across All Media =	3.5E+01

TABLE 10.4RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Industrial Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	AOC H Surface Soil	VANADIUM	NA	NA	NA	0.0E+00	Kidney	4.7E-02	NA	1.2E-01	1.7E-01
Chemical Total				0.0E+00	0.0E+00	0.0E+00	0.0E+00		4.7E-02	0.0E+00	1.2E-01	1.7E-01
Medium Total							0.0E+00					1.7E-01
Groundwater	Groundwater	Tap Water	ANTIMONY	NA	NA	NA	0.0E+00	Blood	1.3E-01	NA	7.3E-10	1.3E-01
			ARSENIC	3.3E-05	NA	3.4E-13	3.3E-05	Skin, Vascular	2.1E-01	NA	1.7E-10	2.1E-01
			IRON	NA	NA	NA	0.0E+00	Blood, Gastrointestinal, Liver	3.4E+00	NA	7.1E-08	3.4E+00
			MANGANESE	NA	NA	NA	0.0E+00	CNS	1.0E+00	NA	2.1E-08	1.0E+00
			THALLIUM	NA	NA	NA	0.0E+00	Liver, Blood, Hair	5.4E+00	NA	4.5E-09	5.4E+00
			VANADIUM	NA	NA	NA	0.0E+00	Kidney	6.8E-01	NA	2.2E-08	6.8E-01
Chemical Total				3.3E-05	0.0E+00	3.4E-13	3.3E-05		1.1E+01	NA	1.2E-07	1.1E+01
Medium Total							3.3E-05					1.1E+01
Receptor Total							3.3E-05				Receptor HI Total	1.1E+01

HI - Hazard Index
CNS - Central Nervous System
NOAEL = No Observed Adverse Effects Level

Total CNS HI Across All Media =	1.0E+00
Total Skin HI Across All Media =	2.1E-01
Total Vascular HI Across All Media =	2.1E-01
Total Kidney HI Across All Media =	8.5E-01
Total Gastrointestinal HI Across All Media =	3.4E+00
Total Blood HI Across All Media =	9.0E+00
Total Liver HI Across All Media =	8.8E+00
Total Hair HI Across All Media =	5.4E+00

TABLE 10.5.RME
RISK SUMMARY
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Groundwater (In Excavations)	MANGANESE					CNS	NA	NA	5E+00	5E+00
		Exposure Point Total		NA	NA	0E+00	0E+00		NA	NA	5E+00	5E+00
	Exposure Medium Total			NA	NA	0E+00	0E+00		NA	NA	5E+00	5E+00
Medium Total				NA	NA	0E+00	0E+00		NA	NA	5E+00	5E+00
Receptor Total				0E+00	0E+00	0E+00	0E+00		0E+00	0E+00	5E+00	5E+00

Total CNS HI Across Media = **5E+00**

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
13	HHRA assumptions and uncertainties	Section 2.5.1	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Sections 6.9 through 6.10, Pages 6-15 through 6-19. July 2007.

1.0 is further evaluated if any individual target organ HIs exceed a value of 1.0. Unless the cumulative HI to a target organ exceeds 1.0, it is typically not considered an exceedance or unacceptable hazard. The conservative approach used in this analysis and the uncertainty inherent in the risk assessment were considered when interpreting the results. The uncertainty associated with risk assessment is discussed in the uncertainty section below.

For **a current maintenance worker**, the ELCR for exposure to surface soils is 3.2E-6, which is within the target risk range of 1E-4 to 1E-6. The estimated HI for exposure to surface soils is 0.08 and is below the target HI of 1.0 for noncarcinogenic exposure. Thus, maintenance worker exposure to site surface soils is not a carcinogenic or noncarcinogenic health risk.

For **a future industrial worker**, the combined ELCR for exposure to surface soils and groundwater is 4.8E-5, which is within the target risk range of 1E-4 to 1E-6. The estimated HI for exposure to surface soils is 0.37 and is below the target HI of 1.0 for noncarcinogenic exposure. The estimated HI from groundwater is 11, which is above the target value of 1.0, due to the presence of thallium, iron, and manganese. The noncarcinogenic HI is above the target limit, primarily from inorganic chemicals in groundwater.

The ELCR and HI for a **construction worker** exposed to total soils and groundwater were 4E-7 and 5, respectively; the HI is above the target level due to manganese concentrations in groundwater. Thus, construction worker exposure to shallow groundwater in excavations presents a potential HI concern.

The estimated combined ELCRs for a **current/future recreational adult, youth,** and **child** exposed to surface soils, surface water, and sediment are 1.0E-5, 6.4E-6, and 1.7E-5, respectively, and are within the target risk range. HIs for a recreational adult, youth, and child are 0.23, 0.34, and 1.3, respectively. Only the child scenario exceeded a value of 1.0, and the target-organ-specific HI did not exceed 1.0. Thus, the site does not present an exposure concern for site trespassers or visitors.

For a **future residential adult**, the ELCRs are 1.9E-5 from surface soil, 5.2E-6 from subsurface soil and 9.0E-5 from groundwater. The combined ELCR of 1.4 E-4 is slightly higher than the upper-bound target of the cancer risk from arsenic in soil and groundwater. The HIs of 0.43 for surface soil and 0.03 for subsurface soil are both below the target value. The HI of 31 from groundwater is due to thallium, iron, manganese, and vanadium in groundwater.

For a **future residential child**, the ELCRs are 4.2E-5 from surface soil, 1.2E-5 from subsurface soil, and 5.2E-5 from groundwater, primarily from arsenic. These values are all within the target risk range. The combined ELCR of 1.1E-4 is slightly higher than the upper-bound target of the cancer risk from arsenic in soil and groundwater. The HI for exposure to surface soils is 3.6, which exceeds the target HI of 1.0, due to vanadium in soils. The HI for exposure to groundwater is 73 due to thallium, iron, manganese, vanadium, and arsenic in groundwater.

6.9 Uncertainties

This subsection summarizes the general uncertainties associated with various risk assessment steps.

The risk assessment included several assumptions regarding site conditions, EPC estimations, receptor behaviors, and exposure factors. Because these are assumed values, there is an inherent uncertainty associated with these hypothetical scenarios, as well as practical limitations to obtaining an actual value versus an assumed value. Also, the inclusion of chemicals that occur in background conditions attributes risks to a site, even though these chemicals are not likely to be related to the site operations. The toxicity factors supplied by the EPA use several extrapolation methods that contain inherent uncertainty and tend to include conservatively protective assumptions during such extrapolations. Such uncertainty in toxicity factors is not addressed in this assessment, as EPA sources provide adequate documentation of such uncertainty.

6.9.1 COPC Selection

The chemicals detected above the criteria are all inorganic chemicals that occur in soils as part of the natural mineralogy. All the COPCs identified in site soils have also been detected in the background soils. With few exceptions, the detected concentrations (Tables 6-11 and 6-12) are within the range of background samples presented in the draft soil, groundwater, surface water, and sediment background investigation report (CH2M HILL, 2001c) and site-specific background levels for groundwater and sediment. Site shallow groundwater is brackish, hydraulically connected with the surface water in the ephemeral stream, and unsuitable for potable use. Selection of COPCs based on potable water use criteria is part of the conservative approach used for this RA. This adds significant uncertainty to the risk estimations and does not add meaningful value to site management decision making; however, they are included based on existing guidance.

For some of the inorganic chemicals, there are no generic SSLs. However, these chemicals were detected within the range of background concentrations (see Table 6-11) for soils at the former NASD and are not attributable to site activities. Thus, they do not present a site-related specific threat of migration to groundwater. Therefore, despite the lack of a quantitative screening value, these COPCs do not represent site-related contamination but are probably part of the soil mineralogy; thus, there is no significance to the absence of SSL values.

Past operations at AOC H do not indicate the potential for release of thallium. Also, the groundwater analytical results obtained using a method that is capable of detecting thallium below the PRG levels did not identify thallium as a final COC. Thus, its presence is not suspected to be the result of a release, it is not pervasive in site media, and it is within health protective levels. Therefore, the estimated concentrations detected will not alter the risk assessment conclusions.

6.9.2 Exposure Assessment

The site is an abandoned power plant that was also used for firefighter training, but no activities are occurring at the present time. The site is overgrown with native plants. The assumption of future industrial and residential use is overly conservative. Groundwater in this area is brackish, so the potable use assumption is unrealistic and overly conservative. For the foreseeable future, any alteration to land use is unlikely to change the land use for the site itself, so exposure evaluations represent overly conservative assumptions for the risk estimations. Exposure assumptions in the risk assessment for AOC H are overly

conservative, as they assume that each of the receptors spent their time within this small area. The statistical average estimates are based on a relatively large dataset (e.g., 64 soil samples) and thus are associated with relatively high confidence levels.

In the HHRA, it was assumed that hypothetical future residents are exposed to soil in the 0-to-2-ft interval, and the EPCs used in the intake calculations were based on soil concentrations detected in this surface interval. This assumption is expected to represent the most reasonable exposure scenario for a hypothetical future resident. However, the impact of assuming a deeper soil exposure interval (0-to-6 ft) was evaluated to determine if residential exposures to subsurface soil yield higher EPCs and therefore higher risk estimates. Results of this evaluation are provided in Appendix K as Tables K-1, K-2, and K-3. The EPCs for the 0-to-6-ft interval are provided in Attachment A to Appendix K. As shown in Table K-3 of Appendix K, with the exception of benzo(a)pyrene and manganese, the calculated EPCs for the 0-to-6-ft interval are lower than the EPCs for the 0-to-2-ft interval. The EPCs for benzo(a)pyrene and manganese in the 0-to-6-ft interval are only slightly higher than the EPCs in the 0-to-2-ft interval. Therefore, use of an assumed soil exposure depth of 0-to-2 ft versus 0-to-6 ft is not expected to significantly affect the results of the HHRA. However, the impact of the assumed residential exposure interval on the soil risk estimates is discussed quantitatively in Section 6.9.4.

The EPC for manganese in groundwater that was used to evaluate a construction worker exposure was based on the maximum detected concentration. However, a 6-month exposure to the maximum detection concentration (as assumed in the risk assessment) is unrealistic and results in an overestimate of exposure for a construction worker.

6.9.3 Toxicity Assessment

The uncertainty associated with extrapolation of animal toxicity data to humans is described in the EPA databases. Also, most of the inorganic chemicals, particularly iron, are essential nutrients, introducing additional uncertainty to the toxicity assumptions. In addition, all the toxicity studies are based on exposure to the pure form of the inorganic, and bioavailability limitations from exposures to soil minerals are not part of the toxicity assessments; this adds further uncertainty to these toxicity factors. The toxicity assessments conducted by EPA for thallium and vanadium have high uncertainty, as these are interim toxicity values developed in the 1990s due to the absence of adequate scientific studies to establish sufficiently peer-reviewed toxicity factors to be listed on the IRIS substance list. The available toxicity information does not include various mineral forms of these metals and their bioavailability to be applicable to those detected in soil minerals at Vieques.

Additionally, aluminum and iron toxicity reference doses were provisional values from 2001 obtained from NCEA at the draft phase of this risk assessment. These values have been withdrawn since that time. Because future toxicity factors for these constituents, if/when developed, may be different from those used in this risk assessment, the actual hazards/toxicity may be higher or lower than those estimated in this risk assessment. However, the next section in this document compares these naturally occurring inorganic chemicals to their respective background levels. Aluminum concentrations did not exceed its background level, and the concentrations of iron were comparable to its background level, which indicate any toxicity associated with these constituents is likely attributable to background.

Vanadium toxicity criteria have been revised by EPA since the original draft of the risk assessment report. Although the revised toxicity criteria would result in an estimation of a higher HI value for vanadium, the maximum vanadium concentration in site soil of 63 mg/kg is less than the established background concentration of 130 mg/kg. Thus, revision to the risk assessment is not warranted because it will not change the existing findings that vanadium is not from site operations and is consistent with background concentrations.

As noted above, the toxicity reference doses for certain constituents utilized during preparation of the risk assessment were provisional values from 2001 obtained from NCEA. Since that time, the NCEA provisional values for aluminum, iron, and vanadium have been withdrawn. Although it is EPA's policy to utilize the most current toxicity values for published reports, for this site-specific situation, the calculations will not be redone with the most current toxicity values because the ultimate conclusions regarding aluminum, iron, and vanadium would remain the same because their site-specific concentrations are comparable to background levels.

6.9.4 Risk Characterization

The propagation of uncertainty in the other steps such as COPC selection, exposure assessment, and toxicity assessment also introduces uncertainty into the risk estimates.

The HI estimated for a residential scenario was above 1.0 based on potable use of the site groundwater under a future residential land use scenario due to the presence of inorganic chemicals in groundwater. The inorganic chemicals contributing to an HI above 1.0 are thallium (HI=35), iron (HI=22), manganese (HI=7), vanadium (HI=5), and arsenic (HI=1.3). However, these metals were detected in samples analyzed for total metal concentrations, but not detected in the dissolved metals analyses from the same wells (see Table 4-6). These HIs represent the potential hazards associated with the ingestion of unfiltered water as a potable drinking water supply. Based on the quantitative data presented, that demonstrates that groundwater must be filtered prior to use as a potable drinking water supply, the HIs associated with actual exposure are likely to be lower.

The risk estimates for the hypothetical future residents are based on an assumed soil exposure depth of 0-to-2 ft. However, the impact of assuming a deeper soil exposure interval (0-to-6 ft) was evaluated to determine if residential exposures to subsurface soil yield higher risk estimates. Results of this evaluation are provided in Appendix K as Tables K-1, K-2, and K-3. The EPCs for the 0-to-6-ft interval are provided in Attachment A to Appendix K. As shown in Table K-3 of Appendix K and summarized below, the estimated ELCRs and screening HIs (all target organs combined) associated with soil exposures for both child and adult residents ***are lower*** for the 0-to-6-ft interval than for the 0-to-2-ft interval, as summarized below:

- Child Resident – Soil Exposure Scenarios
  - 0-2 ft soil interval – ELCR = $4x10^{-5}$, screening HI = 4
  - 0-6 ft soil interval – ELCR = $2x10^{-5}$, screening HI = 3
- Adult – Soil Exposure Scenarios
  - 0-2 ft soil interval – ELCR = $2x10^{-5}$, screening HI = 0.4
  - 0-6 ft soil interval – ELCR = $7x10^{-6}$, screening HI = 0.3

Therefore, use of a deeper soil exposure interval (0-to-6 ft) in the HHRA would lower the ELCR and HI estimates for future hypothetical child and adult residential receptors.

6.10 Comparison with Background Levels

A background study was conducted to characterize the environmental media for the western portion of Vieques Island (CH2M HILL, 2002b). The primary purpose of the study was to develop a set of background values for inorganic chemicals that occur commonly in environmental media; these values would then be used in comparison with values from sites investigated in the former NASD. Background soil characteristics are discussed in the Final Soil, Groundwater, Surface Water, and Sediment Background Investigation Report (CH2M HILL, October 16, 2002b). The report notes that the soil inorganic concentrations from all soil types were statistically comparable.

Surface soil samples were collected from 0 to 6 inches bls from 26 background locations in the western portion of Vieques Island. Subsurface soil samples were collected from 11 of the surface soil sampling locations at depths ranging from 2 to 6 feet bls, depending on the depth to rock in the sampling area. Five rock samples were also collected from the southwestern end of Vieques. In addition, groundwater was sampled from five newly installed background wells. Also, a site-specific background well (NADHMW01) was installed upgradient of AOC H. One upstream sediment background sample was collected from the adjacent surface water body, and no surface water background samples could be collected as the ephemeral stream is dry in the upstream location.

Tables 6-11 and 6-12 show a comparison of the site soil and groundwater data against background levels. The sediment and surface water inorganic chemicals did not contribute to any cancer risks or HIs above target levels for any of the receptors. Therefore, a background comparison discussion is not included in this section for sediment or surface water.

The cancer risks or noncancer HIs from chemicals occurring in the background are also identified to determine whether estimated cancer risks or HIs are related to the site or are result of background conditions.

When risks and HI are similar to those of background conditions, site risk management actions are not recommended. The possible limitation of comparisons with site-specific background is availability of limited background data, and representativeness of the background hydrogeological conditions compared to site hydrogeological conditions. For example, only one sediment sample from a dry ephemeral stream is selected to represent sediments in the ephemeral stream, and one round of sampling from a single background well were used to compare with the site data. No site-specific surface water background data were collected for AOC H. This adds to uncertainty in a comparison of background data against site data. Table 6-10 includes a summary of the risks and HI estimated for the various receptors from potential exposure to soils, sediments, surface water, and groundwater.

TABLE 4-6
Detected Chemicals Above Criteria and Background in Groundwater
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Station ID	Sample Date	Concentration Total	Qualifer	Concentration Dissolved	Qualifer	Region IX PRG [1]	PRG Exceedances Total	PRG Exceedances Dissolved
Metals (µg/L)									
ANTIMONY	NDAHMW04	12/19/2000	5.4	J	5.4	J	1.46	yes	yes
ARSENIC	NDAHMW02	12/19/2000	6.3	J	ND		0.0448	yes	no
CADMIUM	NDAHMW07	09/07/2003	4.46	J	5.78	J	1.82	yes	yes
	NDAHMW02	09/08/2003	ND		4.99	J		no	yes
	NDAHMW05	09/08/2003	ND		6.3	J		no	yes
CHROMIUM, TOTAL	NDAHMW02	12/19/2000	15	=	ND		11	yes	no
IRON	NDAHMW02	12/19/2000	11000	=	ND		1090	yes	no
	NDAHMW05	09/08/2003	5170	=	4180	=		yes	yes
THALLIUM	NDAHMW07	09/07/2003	44.2	J	ND		0.241	yes	no
	NDAHMW02	09/08/2003	28.7	J	ND			yes	no
Volatile Organic Compounds (µg/L)									
Semivolatile Organic Compounds (µg/L)									
Pesticides (µg/L)									
p,p'-DDD	NDAHMW02	12/19/2000	0.42	J	-		0.28	yes	na
	NDAHMW02	09/08/2003	0.4	=	-			yes	na
	NDAHMW05	09/08/2003	0.39	=	-			yes	na

[1] USEPA Region IX tap water PRG (2002) based on a hazard index (HI) of 0.1 for non-carcinogens.
na - indicates that the information is not available or not applicable.
J indicates that the chemical was detected. The reported value is estimated.
= indicates that the chemical was detected. The reported value is the measured concentration.

TABLE 6-10
Risk Results Summary
AOC H, Former NASD, Vieques, Puerto Rico

Receptor	Exposure Medium	Cancer Risk	Hazard Index	Max HI/target organ	
Maintenance worker	surface soil	3.2E-06	0.08	NA	
Industrial worker	surface soil	1.5E-05	0.37	NA	
	groundwater*	3.3E-05	11.0	5.4	Liver, Blood, Hair
Construction worker	total soil	3E-07	0.05	NA	
	groundwater	8.0E-08	5	5	CNS
Recreational -Adult	surface soil	7.0E-06	0.20	NA	
	sediment	9.8E-08	0.005	NA	
	surface water	3.3E-06	0.02	NA	
Recreational - Youth	surface soil	4.2E-06	0.31	NA	
	sediment	5.6E-08	0.002	NA	
	surface water	2.1E-06	0.03	NA	
Recreational - Child	surface soil	1.2E-05	1.1	NA	
	sediment	1.3E-07	0.04	NA	
	surface water	4.2E-06	0.17	NA	
Residential -Adult	surface soil	1.9E-05	0.43	NA	
	subsurface soil	5.2E-06	0.03	NA	
	groundwater*	9.0E-05	31	15.0	Liver, Blood, Hair
Residential - Child	surface soil	4.2E-05	3.6	1.3	kidney
	subsurface soil	1.2E-05	0.3	NA	
	groundwater*	5.2E-05	73	35	Liver, Blood, Hair
COPCs Contributing to risk >1E-06, or HI>1.0		arsenic in soil (surface and subsurface) and groundwater	vanadium in soil and thallium, iron, manganese, vanadium and arsenic in groundwater.		

Note:

* Groundwater is brackish and not suitable for potable use

TABLE 6-11
Comparison of Surface Soil Inorganic COPCs with Background Levels
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Number Analyzed	Number Detected	Maximum Detect (mg/Kg)	Minimum Detect (mg/Kg)	Mean Concentration [1] (mg/Kg)	Background Concentration[3] UTL95% (mg/Kg)	Minimum (mg/Kg)	Maximum (mg/Kg)
Surface Soil								
ARSENIC	33	33	**67**	0.435	4.88	2.2	0.57	2.5
VANADIUM	33	33	63	21	44.4	130	9	130
Subsurface Soil								
ARSENIC	31	21	**24**	0.161	1.68	2.2	0.57	2.5

[1] Mean concentration is based on 1/2 the detection limit for non-detects.
[2] EPA Region 9 residential PRG for surface soil and industrial PRG for subsurface soil.
[3] for soils -Final Soil, Groundwater, Surface Water, and Sediment Background Investigation Report (CH2M Hill, 2002).

TABLE 6-12
Comparison of Groundwater Inorganic COPCs with Background Levels
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Number Analyzed	Number Detected	Maximum Detect (ug/L)	Minimum Detect (ug/L)	Mean Concentration [1] (ug/L)	Tap Water PRG [2]	Background Concentrations Site-Specific [3] (ug/L)	Background Concentrations Base-Wide [4] (ug/L)
Total Inogranic Chemicals								
ARSENIC	7	1	6.3	6.3	5.83	0.0448	ND	NA
IRON	7	5	11000	83	3630	1090	8200	4800
MANGANESE	7	7	14800	620	7630	87.6	1100	17000
THALLIUM	7	4	44.2	6.6	15	0.241	10	18
VANADIUM	7	5	70	6	18.9	25.5	43	75
Dissolved Inorganic Chemicals								
ARSENIC, DISSOLVED	7	0	0	ND	5.14	0.0448	ND	5.5
IRON, DISSOLVED	7	2	4180	3290	1090	1090	120	490
MANGANESE, DISSOLVED	7	7	15400	92	7370	87.6	150	18000
THALLIUM, DISSOLVED	7	1	26.2	26.2	8.28	0.241	9	16
VANADIUM, DISSOLVED	7	4	12.7	2.8	5.4	25.5	20	32

[1] Mean concentration is based on 1/2 the detection limit for non-detects.
[2] USEPA Region IX tap water PRG (2002) based on a hazard index (HI) of 0.1 for non-carcinogens.
[3] Site-specific background sample from well NDAHMW01.
[4] Final Soil, Groundwater, Surface Water, and Sediment Background Investigation Report (CH2M HILL, 2002).
NA indicates that the information is not available or not applicable.

Table K-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
AOC H Soil (0-6 ft)	75-35-4	1,1-Dichloroethene	0.00045 J	0.00078 J	MG/KG	AOCHSB009	6 / 38	.01 - .948	0.00078	NA	1.24E+01 NC	3.00E-02	SSL	No	BSL
	107-06-2	1,2-Dichloroethane	0.002 J	0.002 J	MG/KG	AOCHSB015	1 / 38	.01 - .948	0.002	NA	6.03E-01 CA*	1.00E-02	SSL	No	BSL
	108-38-3/106-42-3	m- and p-Xylene	0.058 J	0.058 J	MG/KG	AOCHSS001	1 / 38	.01 - .948	0.058	NA	2.75E+01 NC	1.00E+02	SSL	No	BSL
	75-09-2	Methylene chloride	0.00058 J	0.00058 J	MG/KG	AOCHSB006	1 / 38	.01 - .948	0.00058	NA	2.05E+01 CA	1.00E-02	SSL	No	BSL
	95-47-6	o-Xylene	0.024 J	0.024 J	MG/KG	AOCHSS001	1 / 38	.01 - .948	0.024	NA	2.75E+01 NC	1.00E+02	SSL	No	BSL
	127-18-4	Tetrachloroethene	0.00031 J	0.0016 J	MG/KG	AOCHSB003	2 / 38	.01 - .948	0.0016	NA	3.42E+00 CA*	3.00E-02	SSL	No	BSL
	108-88-3	Toluene	0.0004 J	0.0004 J	MG/KG	AOCHSB011	1 / 38	.01 - .948	0.0004	NA	5.20E+02 SAT	6.00E+00	SSL	No	BSL
	79-01-6	Trichloroethene	0.00034 J	0.00034 J	MG/KG	AOCHSB011	1 / 38	.01 - .948	0.00034	NA	1.15E-01 CA	3.00E-02	SSL	No	BSL
	1330-20-7	Xylene, total	0.082 J	0.082 J	MG/KG	AOCHSS001	1 / 38	.01 - .948	0.082	NA	2.75E+01 NC	1.00E+02	SSL	No	BSL
	606-20-2	2,6-Dinitrotoluene	1.21	1.23	MG/KG	AOCHSB013	2 / 64	.127 - 28.2	1.23	NA	6.11E+00 NC	3.00E-04	SSL	No	BSL
	91-57-6	2-Methylnaphthalene	0.028 J	0.19 J	MG/KG	AOCHSB009	6 / 64	.338 - 28.2	0.19	NA	6.99E+01 NC	NA	NA	No	BSL
	99-09-2	3-Nitroaniline	0.048 J	0.048 J	MG/KG	AOCHSB013	1 / 64	1.01 - 84.5	0.048	NA	1.75E-01 NC	NA	NA	No	BSL
	101-55-3	4-Bromophenyl-phenylether	0.217 J	0.267 J	MG/KG	AOCHSB013	3 / 64	.338 - 28.2	0.267	NA	NA	NA	NA	No	NTX
	56-55-3	Benzo(a)anthracene	0.029 J	0.112 J	MG/KG	AOCHSB004	10 / 64	.338 - 28.2	0.112	NA	6.21E-01 CA	8.00E-01	SSL	No	BSL
	50-32-8	Benzo(a)pyrene	0.0257 J	0.12 J	MG/KG	AOCHSB004	15 / 64	.338 - 28.2	0.12	NA	6.21E-02 CA	4.00E+00	SSL	Yes	ASL
	205-99-2	Benzo(b)fluoranthene	0.0187 J	0.133 J	MG/KG	AOCHSB004	19 / 64	.338 - 28.2	0.133	NA	6.21E-01 CA	2.00E+00	SSL	No	BSL
	191-24-2	Benzo(g,h,i)perylene	0.0217 J	0.06 J	MG/KG	AOCHSS002	10 / 64	.338 - 28.2	0.06	NA	2.32E+02 NC	2.10E+03	SSL	No	BSL
	207-08-9	Benzo(k)fluoranthene	0.0196 J	0.124 J	MG/KG	AOCHSB004	16 / 64	.338 - 28.2	0.124	NA	6.21E+00 CA	2.00E+01	SSL	No	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	0.0729 J	0.117 J	MG/KG	NDAHSS24	8 / 64	.338 - 28.2	0.117	NA	3.47E+01 CA*	0.00E+00	SSL	No	BSL
	218-01-9	Chrysene	0.0225 J	0.155 J	MG/KG	AOCHSB004	18 / 64	.338 - 28.2	0.155	NA	6.21E+01 CA	8.00E+01	SSL	No	BSL
	132-64-9	Dibenzofuran	0.0294 J	0.051 J	MG/KG	AOCHSB008	3 / 64	.338 - 28.2	0.051	NA	2.91E+01 NC	NA	NA	No	BSL
	206-44-0	Fluoranthene	0.0246 J	0.187 J	MG/KG	AOCHSB004	16 / 64	.338 - 28.2	0.187	NA	2.29E+02 NC	2.10E+03	SSL	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	0.026 J	0.0848 J	MG/KG	NDAHSS24	8 / 64	.338 - 28.2	0.0848	NA	6.21E-01 CA	7.00E+00	SSL	No	BSL
	78-59-1	Isophorone	0.106 J	0.112 J	MG/KG	AOCHSB012	2 / 64	.338 - 28.2	0.112	NA	5.12E+02 CA*	3.00E-01	SSL	No	BSL
	91-20-3	Naphthalene	0.0424 J	0.09 J	MG/KG	AOCHSB008	3 / 64	.338 - 28.2	0.09	NA	5.59E+00 NC	4.00E+01	SSL	No	BSL
	621-64-7	n-Nitroso-di-n-propylamine	0.562 J	0.717	MG/KG	AOCHSB013	3 / 64	.338 - 28.2	0.717	NA	6.95E-02 CA	2.00E-05	SSL	Yes	ASL
	85-01-8	Phenanthrene	0.0211 J	0.144 J	MG/KG	AOCHSB008	8 / 64	.338 - 28.2	0.144	NA	2.32E+02 NC	2.10E+03	SSL	No	BSL
	129-00-0	Pyrene	0.0282 J	1.9 J	MG/KG	AOCHSS001	17 / 64	.338 - 28.2	1.9	NA	2.32E+02 NC	2.10E+03	SSL	No	BSL
	72-54-8	4,4'-DDD	0.00019 J	0.013	MG/KG	AOCHSB012	17 / 64	.0034 - 1.77	0.013	NA	2.44E+00 CA	8.00E+00	SSL	No	BSL
	72-55-9	4,4'-DDE	0.00014 J	3.99 J	MG/KG	AOCHSB001	39 / 64	.0034 - 1.77	3.99	NA	1.72E+00 CA	3.00E+01	SSL	Yes	ASL
	50-29-3	4,4'-DDT	0.00048 J	1.94 J	MG/KG	AOCHSB001	27 / 64	.0034 - 1.77	1.94	NA	1.72E+00 CA*	2.00E+01	SSL	Yes	ASL
	72-43-5	Methoxychlor	0.00074 J	0.00074 J	MG/KG	NDAHSS19	1 / 64	.017 - 9.12	0.00074	NA	3.06E+01 NC	8.00E+01	SSL	No	BSL
	7429-90-5	Aluminum	2,110	11,000	MG/KG	AOCHSB006, AOCHSS001 AOCHSB009	64 / 64	31.9 - 48	11,000	NA	7.61E+03 NC	NA	NA	Yes	ASL
	7440-36-0	Antimony	0.14 J	6.30 J	MG/KG	AOCHSS003	42 / 64	9.56 - 14	6.30	NA	3.13E+00 NC	3.00E+00	SSL	Yes	ASL
	7440-38-2	Arsenic	0.161 J	67.0	MG/KG	AOCHSB010	54 / 64	1.59 - 2.4	67.0	NA	3.90E-01 CA*	NA	NA	Yes	ASL
	7440-39-3	Barium	20.0 J	290.0 J	MG/KG	AOCHSB010	64 / 64	31.9 - 48	290.0	NA	5.37E+02 NC	8.20E+02	SSL	No	BSL
	7440-41-7	Beryllium	0.0479 J	0.480 J	MG/KG	AOCHSB009	47 / 64	.797 - 1.2	0.480	NA	1.54E+01 NC	3.00E+01	SSL	No	BSL
	7440-43-9	Cadmium	0.0367 J	0.291 J	MG/KG	NDAHSS26	16 / 64	.797 - 1.2	0.291	NA	3.70E+00 NC	4.00E+00	SSL	No	BSL
	7440-70-2	Calcium	1,070	34,000	MG/KG	AOCHSB008, AOCHSS004	64 / 64	797 - 1200	34,000	NA	NA	NA	NA	No	NUT
	7440-47-3	Chromium	3.28	50.0	MG/KG	AOCHSS001	64 / 64	1.59 - 2.4	50.0	NA	3.01E+01 CA**	2.00E+01	SSL	Yes	ASL
	7440-48-4	Cobalt	2.20 J	16.0	MG/KG	AOCHSB007	64 / 64	7.97 - 12	16.0	NA	9.03E+02 CA**	NA	NA	No	BSL
	7440-50-8	Copper	7.0	100.0	MG/KG	AOCHSB003	64 / 64	3.89 - 6	100.0	NA	3.13E+02 NC	NA	NA	No	BSL
	7439-89-6	Iron	6,660 J	39,000	MG/KG	AOCHSS003	64 / 64	15.9 - 24	39,000	NA	2.35E+03 NC	NA	NA	Yes	ASL
	7439-92-1	Lead	0.75	63.0	MG/KG	AOCHSB009	64 / 64	.478 - .72	63.0	NA	4.00E+02 NC	NA	NA	No	BSL
	7439-95-4	Magnesium	748 J	8,400	MG/KG	AOCHSB003	64 / 64	797 - 1200	8,400	NA	NA	NA	NA	No	NUT

Table K-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7439-96-5	Manganese	80.4	1,000	MG/KG	AOCHSB007	64 / 64	2.39 - 6.01	1,000	NA	1.76E+02 NC	NA	NA	Yes	ASL
	7439-97-6	Mercury	0.00260 J	0.0719 J	MG/KG	NDAHSB18	56 / 64	.0234 - .04	0.0719	NA	2.35E+00 NC	NA	NA	No	BSL
	7440-02-0	Nickel	1.13 J	26.0	MG/KG	AOCHSS003	64 / 64	6.37 - 9.6	26.0	NA	1.56E+02 NC	7.00E+01	SSL	No	BSL
	7440-09-7	Potassium	440 J	3,400	MG/KG	AOCHSB003	64 / 64	797 - 1200	3,400	NA	NA	NA	NA	No	NUT
	7782-49-2	Selenium	0.199 J	1.40	MG/KG	AOCHSB005	47 / 64	.797 - 1.2	1.40	NA	3.91E+01 NC	3.00E+00	SSL	No	BSL
	7440-22-4	Silver	0.0242 J	0.170 J	MG/KG	AOCHSB007	16 / 64	1.59 - 2.4	0.170	NA	3.91E+01 NC	2.00E+01	SSL	No	BSL
	7440-23-5	Sodium	46.0 J	850.0 J	MG/KG	AOCHSB009	64 / 64	797 - 1200	850.0	NA	NA	NA	NA	No	NUT
	7440-28-0	Thallium	0.240 J	1.16 J	MG/KG	NDAHSS18	27 / 64	1.59 - 2.4	1.16	NA	5.16E-01 NC	NA	NA	Yes	ASL
	7440-62-2	Vanadium	19.0	79.0	MG/KG	AOCHSB009	64 / 64	7.97 - 12	79.0	NA	5.47E+01 NC	3.00E+03	SSL	Yes	ASL
	7440-66-6	Zinc	9.07 J	260.0	MG/KG	AOCHSS003	64 / 64	3.19 - 4.8	260.0	NA	2.35E+03 NC	6.20E+03	SSL	No	BSL

[1] Minimum/Maximum detected concentrations.
[2] Maximum concentration is used for screening.
[3] Background values not available.
[4] EPA Region 9 PRGs Table, October 1, 2002, U.S. EPA Region 9.
PRG value for xylenes used as surrogate for m,p-xylene and o-xylene.
PRG value for 2-methylnaphthalene calculated using provisional reference dose and methods described in Region 9 PRGs Table Users Guide/Technical Background Document, October 1, 2002, U.S. EPA Region 9.
PRG value for 2-nitroaniline used as surrogate for 3-nitroaniline.
PRG value for pyrene used as surrogate for benzo(g,h,i)perylene and phenanthrene.
PRG value for chromium VI used for total chromium.
PRG value for mercury chloride used as surrogate for mercury.
Lead screening toxicity value is 400 mg/kg, the EPA residential soil screening level for lead.
[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)
Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

SSL = Soil Screening Level; Dilution Attenuation Factor = 10 (USEPA, October 2002)
COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
CA = Carcinogenic
NC = Noncarcinogenic
CA* (where: NC < 100X CA)
CA**(where: NC < 10X CA)

Table K-2
REASONABLE MAXIMUM EXPOSURE
AOC H - Old Power Plant/Fire Training Area Site
NASD, Vieques Island, Puerto Rico

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
AOC H Soil (0-6 ft)											
	Benzo(a)pyrene	MG/KG	5.32E-01	1.99E+00	NP	1.20E-01	J	1.20E-01	MG/KG	Max	(6)
	n-Nitroso-di-n-propylamine	MG/KG	5.86E-01	1.60E+00	NP	7.17E-01	=	7.17E-01	MG/KG	Max	(6)
	4,4'-DDE	MG/KG	1.41E-01	8.98E-01	NP	3.99E+00	J	8.98E-01	MG/KG	99% Cheb-m	(5)
	4,4'-DDT	MG/KG	7.13E-02	3.06E-01	NP	1.94E+00	J	3.06E-01	MG/KG	97.5% Cheb-m	(5)
	Aluminum	MG/KG	6.41E+03	6.93E+03	N	1.10E+04	=	6.93E+03	MG/KG	95% Stud-t	(2)
	Antimony	MG/KG	5.22E-01	9.74E-01	NP	6.30E+00	J	9.74E-01	MG/KG	95% Cheb-m	(5)
	Arsenic	MG/KG	3.33E+00	3.81E+00	T	6.70E+01	=	3.81E+00	MG/KG	95% UCL-t	(1)
	Chromium	MG/KG	1.28E+01	1.46E+01	G	5.00E+01	=	1.46E+01	MG/KG	App. Gamma	(3,4)
	Iron	MG/KG	1.57E+04	1.68E+04	N	3.90E+04	=	1.68E+04	MG/KG	95% Stud-t	(2)
	Manganese	MG/KG	3.88E+02	4.88E+02	NP	1.00E+03	=	4.88E+02	MG/KG	95% Cheb-m	(5)
	Thallium	MG/KG	3.74E-01	5.15E-01	NP	1.16E+00	J	5.15E-01	MG/KG	95% Cheb-m	(5)
	Vanadium	MG/KG	4.24E+01	4.50E+01	N	7.90E+01	=	4.50E+01	MG/KG	95% Stud-t	(2)

For non-detects, 1/2 reporting limit (RL) was used as a proxy concentration.

ProUCL, Version 3.00.02 used to determine distribution of data using the Shapiro-Wilk W Test. ProUCL used to calculate RME EPC, following recommendations based on distribution and standard deviation in users guide (USEPA. April 2004. ProUCL, Version 3.0. Prepared by Lockheed Martin Environmental Services).

Statistics: Maximum Detected Value (Max); 95% UCL of Log-transformed Data, H-Statistic (95% UCL-T); 95% Chebyshev (MVUE) UCL (95% Cheb); 99% Chebyshev (MVUE) UCL (99% Cheb); 95% Chebyshev (mean,std) UCL (95% Cheb-m); 97.5% Chebyshev (mean,std) UCL (97.5% Cheb-m); 99% Chebyshev (mean,std) UCL (99% Cheb-m); 95% modified-t UCL adjusted for skewness (95% Mod-t); 95% Student's-T test UCL (95% Stud-t); 95% Hall's Bootstrap UCL (95% Hall); 95% Approximate Gamma (App. Gamma); 95% Adjusted Gamma (Adj. Gamma); Mean of Log-transformed Data using the Minimum Variance Unbiased Estimate (MVUE) method (Mean-T)

(1) Shapiro-Wilk W Test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test indicates data are normally distributed.
(3) Anderson-Darling Test indicates data are gamma distributed.
(4) Kolmogorov-Smirnov Test indicates data are gamma distributed.
(5) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(6) The maximum detected concentration was used as the UCL because the value recommended by ProUCL 3.0 was higher than the Max.

G = Gamma distribution.
N = Normal distribution.
T = Log-normal distribution.
NP = Non-Parametric distribution.

J = Estimated Value

Table K-3

Comparison of 0-2 Ft Soil Risk Estimates to 0-6 Ft Soil Risk Estimates for Residential Scenario

AOC H - Old Power Plant/Fire Training Area Site

NASD, Vieques Island, Puerto Rico

Child Resident - Soil Exposure Pathways

	Surface Soil - 0-2 Ft			Soil - 0-6 Ft		
COPC	**EPC (mg/kg)**	**ELCR**	**Screening HI**	**EPC (mg/kg)**	**ELCR**	**Screening HI**
Benzo(a)pyrene	1.12E-01	1.2E-07	NA	1.20E-01	1.3E-07	NA
n-Nitroso-di-n-propylamine	7.17E-01	7.0E-06	NA	7.17E-01	7.0E-06	NA
4,4'-DDE	1.75E+00	7.1E-07	NA	8.98E-01	3.6E-07	NA
4,4'-DDT	5.51E-01	2.2E-07	1.5E-02	3.06E-01	1.2E-07	8.5E-03
Aluminum	8.26E+03	NA	1.1E-01	6.93E+03	NA	9.3E-02
Antimony	1.13E+00	NA	4.3E-02	9.74E-01	NA	3.7E-02
Arsenic	1.90E+01	3.4E-05	8.8E-01	3.81E+00	6.8E-06	1.8E-01
Chromium	2.01E+01	4.0E-07	1.8E-01	1.46E+01	2.9E-07	1.3E-01
Iron	2.13E+04	NA	9.3E-01	1.68E+04	NA	7.3E-01
Manganese	4.84E+02	NA	9.1E-02	4.88E+02	NA	9.2E-02
Thallium	6.18E-01	NA	1.0E-01	5.15E-01	NA	8.5E-02
Vanadium	4.78E+01	NA	1.3E+00	4.50E+01	NA	1.2E+00
	Total =	**4E-05**	**4**	**Total =**	**1E-05**	**3**

Adult Resident - Soil Exposure Pathways

	Surface Soil - 0-2 Ft			Soil - 0-6 Ft		
COPC	**EPC (mg/kg)**	**ELCR**	**Screening HI**	**EPC (mg/kg)**	**ELCR**	**Screening HI**
Benzo(a)pyrene	1.12E-01	5.8E-08	NA	1.20E-01	6.2E-08	NA
n-Nitroso-di-n-propylamine	7.17E-01	3.3E-06	NA	7.17E-01	3.3E-06	NA
4,4'-DDE	1.75E+00	3.1E-07	NA	8.98E-01	1.6E-07	NA
4,4'-DDT	5.51E-01	9.9E-08	1.7E-03	3.06E-01	5.5E-08	9.4E-04
Aluminum	8.26E+03	NA	1.3E-02	6.93E+03	NA	1.1E-02
Antimony	1.13E+00	NA	4.9E-03	9.74E-01	NA	4.2E-03
Arsenic	1.90E+01	1.5E-05	9.7E-02	3.81E+00	3.0E-06	1.9E-02
Chromium	2.01E+01	5.8E-08	2.4E-02	1.46E+01	4.2E-08	1.7E-02
Iron	2.13E+04	NA	1.0E-01	1.68E+04	NA	8.0E-02
Manganese	4.84E+02	NA	1.6E-02	4.88E+02	NA	1.6E-02
Thallium	6.18E-01	NA	1.1E-02	5.15E-01	NA	9.2E-03
Vanadium	4.78E+01	NA	1.7E-01	4.50E+01	NA	1.6E-01
	Total =	**2E-05**	**0.4**	**Total =**	**7E-06**	**0.3**

COPC - chemical of potential concern
EPC - exposure point concentration
ELCR - excess lifetime cancer risk
HI - hazard index

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
14	ecological assessment and measurement endpoints	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 7-4. July 2007.

TABLE 7-4

Preliminary Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints

AOC H, Former NASD, Vieques, Puerto Rico

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Terrestrial Habitats			
Survival, growth, and reproduction of terrestrial soil invertebrate communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect soil invertebrate communities?	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Soil invertebrates
Survival, growth, and reproduction of terrestrial plant communities	Are site-related chemical concentrations in surface soil sufficient to adversely effect terrestrial plant communities?	Comparison of maximum chemical concentrations in surface soil with soil screening values.	Terrestrial plants
Survival, growth, and reproduction of terrestrial reptile populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to terrestrial reptile populations?	Evidence of potential risk to other upper trophic level terrestrial receptors evaluated in the ERA.	--
Survival, growth, and reproduction of avian terrestrial omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface soil concentrations.	Pearly-eyed thrasher
Survival, growth, and reproduction of avian terrestrial carnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume small mammals from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface soil concentrations.	Red-tailed hawk
Survival, growth, and reproduction of mammalian terrestrial omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume terrestrial plants and soil invertebrates from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface soil concentrations.	Norway rat
Survival, growth, and reproduction of mammalian terrestrial omnivore populations	Are site-related chemical concentrations in surface soil sufficient to cause adverse effects (on growth, survival, or reproduction) to mammalian receptor populations that may consume small mammals, soil invertebrates, and plants from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum surface soil concentrations.	Indian mongoose
Aquatic Habitats			
Survival, growth, and reproduction of benthic invertebrate communities	Are site-related chemical concentrations in sediment sufficient to adversely affect benthic invertebrate communities?	Comparison of maximum chemical concentrations in sediment with medium-specific screening values.	Benthic invertebrates

TABLE 7-4
Preliminary Assessment Endpoints, Risk Hypotheses, and Measurement Endpoints
AOC H, Former NASD, Vieques, Puerto Rico

Assessment Endpoint	Risk Hypothesis	Measurement Endpoint	Receptor
Survival, growth, and reproduction of water-column invertebrate communities	Are site-related chemical concentrations in surface water sufficient to adversely affect water-column invertebrate communities?	Comparison of maximum chemical concentrations in surface water with medium-specific screening values.	Water-column invertebrates
Survival, growth, and reproduction of aquatic plant communities	Are site-related chemical concentrations in surface water and/or sediment sufficient to adversely affect aquatic plant communities?	Comparison of maximum chemical concentrations in surface water and sediment with medium-specific screening values.	Aquatic plants
Survival, growth, and reproduction of fish communities	Are site-related chemical concentrations in surface water sufficient to adversely effect fish communities?	Comparison of maximum chemical concentrations in surface water with medium-specific screening values.	Fish
Survival, growth, and reproduction of avian aquatic/wetland invertivore populations	Are site-related chemical concentrations in sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume primarily invertebrates from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum sediment concentrations.	Spotted sandpiper
Survival, growth, and reproduction of avian aquatic/wetland piscivore populations	Are site-related chemical concentrations in sediment sufficient to cause adverse effects (on growth, survival, or reproduction) to avian receptor populations that may consume primarily fish from the site?	Comparison of literature-derived chronic No Observed Adverse Effect Level (NOAEL) values for survival, growth, and/or reproductive effects with modeled dietary exposure doses based on maximum sediment concentrations.	Green heron

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
15	bioaccumulating chemical	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Table 7-5. July 2007.

TABLE 7-5
Bioaccumulative Chemicals List and Log K_{ow} Values for Relevant Chemicals
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
Inorganics			
Arsenic	-- - --	--	--
Cadmium	-- - --	--	--
Chromium	-- - --	--	--
Copper	-- - --	--	--
Lead	-- - --	--	--
Mercury	-- - --	--	--
Nickel	-- - --	--	--
Selenium	-- - --	--	--
Silver	-- - --	--	--
Zinc	-- - --	--	--
Pesticides/PCBs			
4,4'-DDD	5.90 - 6.65	6.10	USEPA 1995b
4,4'-DDE	5.63 - 6.96	6.76	USEPA 1995b
4,4'-DDT	5.56 - 7.01	6.53	USEPA 1995b
Aldrin	5.11 - 7.50	6.50	USEPA 1995b
alpha-BHC	3.75 - 3.81	3.80	USEPA 1995b
alpha-Chlordane	5.80 - 6.41	6.32	USEPA 1995b
Aroclor-1016	-- - --	5.60	Sample et al. 1996
Aroclor-1221	-- - --	4.70	Jones et al. 1997
Aroclor-1232	-- - --	5.10	Jones et al. 1997
Aroclor-1242	-- - --	5.60	Jones et al. 1997
Aroclor-1248	-- - --	6.20	Jones et al. 1997
Aroclor-1254	-- - --	6.50	Jones et al. 1997
Aroclor-1260	-- - --	6.80	Jones et al. 1997
beta-BHC	3.75 - 3.84	3.81	USEPA 1995b
delta-BHC	-- - --	4.10	USEPA 1996a
Dieldrin	3.63 - 6.20	5.37	USEPA 1995b
Endosulfan I	3.55 - 3.85	3.83	USEPA 1995b
Endosulfan II	3.62 - 4.52	4.52	USEPA 1995b
Endrin	2.92 - 5.20	5.06	USEPA 1995b
gamma-BHC (Lindane)	3.61 - 3.90	3.73	USEPA 1995b
gamma-Chlordane	5.80 - 6.41	6.32	USEPA 1995b

TABLE 7-5
Bioaccumulative Chemicals List and Log K_{ow} Values for Relevant Chemicals
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Log K_{ow} Range	Selected log K_{ow}	Reference
Heptachlor	4.93 - 6.26	6.26	USEPA 1995b
Heptachlor epoxide	3.50 - 5.40	5.00	USEPA 1995b
Methoxychlor	4.20 - 5.60	5.08	USEPA 1995b
Toxaphene	4.33 - 5.56	5.50	USEPA 1995b
Volatile and Semivolatile Organics			
1,1,2,2-Tetrachloroethane	2.31 - 2.64	2.39	USEPA 1995b
1,2,4-Trichlorobenzene	3.89 - 4.23	4.01	USEPA 1995b
1,2-Dichlorobenzene	3.20 - 3.61	3.43	USEPA 1995b
1,3-Dichlorobenzene	-- - --	3.50	USEPA 1996a
1,4-Dichlorobenzene	3.26 - 3.62	3.42	USEPA 1995b
4-Bromophenyl-phenylether	4.89 - 5.24	5.00	USEPA 1995b
4-Chlorophenyl-phenylether	4.08 - 5.09	4.95	USEPA 1995b
Acenaphthene	3.77 - 4.49	3.92	USEPA 1995b
Acenaphthylene	-- - --	4.10	USEPA 1996a
Anthracene	4.44 - 4.80	4.55	USEPA 1995b
Benzo(a)anthracene	5.61 - 5.79	5.70	USEPA 1995b
Benzo(a)pyrene	5.98 - 6.34	6.11	USEPA 1995b
Benzo(b)fluoranthene	5.79 - 6.40	6.20	USEPA 1995b
Benzo(g,h,i)perylene	6.58 - 7.05	6.70	USEPA 1995b
Benzo(k)fluoranthene	6.12 - 6.27	6.20	USEPA 1995b
Chrysene	5.41 - 5.79	5.70	USEPA 1995b
Dibenz(a,h)anthracene	6.50 - 6.88	6.69	USEPA 1995b
Fluoranthene	4.84 - 5.39	5.12	USEPA 1995b
Fluorene	4.04 - 4.40	4.21	USEPA 1995b
Hexachlorobenzene	5.23 - 6.92	5.89	USEPA 1995b
Hexachlorobutadiene	4.74 - 5.16	4.81	USEPA 1995b
Hexachlorocyclopentadiene	5.05 - 5.51	5.39	USEPA 1995b
Hexachloroethane	3.82 - 4.14	4.00	USEPA 1995b
Indeno(1,2,3-cd)pyrene	6.58 - 6.72	6.65	USEPA 1995b
Pentachlorophenol	5.01 - 5.24	5.09	USEPA 1995b
Phenanthrene	4.37 - 4.57	4.55	USEPA 1995b
Pyrene	4.76 - 5.52	5.11	USEPA 1995b

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
16	ecological soil screening levels	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Tables 7-6 through 7-13. July 2007.

TABLE 7-6

Soil Bioconcentration and Bioaccumulation Factors For Plants, Soil Invertebrates, and Small Mammals - Step 2

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Soil-Plant BCF (dry weight)		Soil-Invertebrate BAF (dry weight)		Soil-Rat BAF (dry weight)[1]	
	Value	Reference	Value	Reference	Value	Reference
Inorganics						
Arsenic	9.074	Bechtel Jacobs 1998a	0.925	Sample et al. 1998a	0.071	Sample et al. 1998b
Cadmium	22.88	Bechtel Jacobs 1998a	190.0	Sample et al. 1998a	1.705	Sample et al. 1998b
Chromium	0.480	Bechtel Jacobs 1998a	11.42	Sample et al. 1998a	0.800	Sample et al. 1998b
Copper	7.400	Bechtel Jacobs 1998a	5.492	Sample et al. 1998a	0.867	Sample et al. 1998b
Lead	10.60	Bechtel Jacobs 1998a	228.3	Sample et al. 1998a	0.995	Sample et al. 1998b
Mercury	12.23	Bechtel Jacobs 1998a	33.00	Sample et al. 1998a	0.192	Sample et al. 1998b
Nickel	22.21	Bechtel Jacobs 1998a	7.802	Sample et al. 1998a	0.800	Sample et al. 1998b
Selenium	77.00	Bechtel Jacobs 1998a	13.73	Sample et al. 1998a	1.754	Sample et al. 1998b
Silver	0.040	Bechtel Jacobs 1998a	19.50	Sample et al. 1998a	0.810	Sample et al. 1998b
Zinc	34.29	Bechtel Jacobs 1998a	49.51	Sample et al. 1998a	5.850	Sample et al. 1998b
Pesticides/PCBs						
4,4'-DDD	0.0151	Travis and Arms 1988	2.00	Menzie et al. 1992	--	see Section 7.2.2.1 (Small Mammals)
4,4'-DDE	0.0216	Travis and Arms 1988	10.6	Menzie et al. 1992	--	see Section 7.2.2.1 (Small Mammals)
4,4'-DDT	0.0237	Travis and Arms 1988	0.70	Menzie et al. 1992	--	see Section 7.2.2.1 (Small Mammals)
Aldrin	0.0431	Travis and Arms 1988	3.30	Edwards and Bohlen 1992	--	see Section 7.2.2.1 (Small Mammals)
alpha-BHC	0.2633	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
alpha-Chlordane	0.0172	Travis and Arms 1988	4.00	Edwards and Bohlen 1992	--	see Section 7.2.2.1 (Small Mammals)
Aroclor-1016	0.0224	Travis and Arms 1988	65.2	Sample et al. 1998a	--	see Section 7.2.2.1 (Small Mammals)
Aroclor-1221	0.0744	Travis and Arms 1988	65.2	Sample et al. 1998a	--	see Section 7.2.2.1 (Small Mammals)
Aroclor-1232	0.0437	Travis and Arms 1988	65.2	Sample et al. 1998a	--	see Section 7.2.2.1 (Small Mammals)
Aroclor-1242	0.0224	Travis and Arms 1988	65.2	Sample et al. 1998a	--	see Section 7.2.2.1 (Small Mammals)
Aroclor-1248	0.0101	Travis and Arms 1988	65.2	Sample et al. 1998a	--	see Section 7.2.2.1 (Small Mammals)
Aroclor-1254	0.0068	Travis and Arms 1988	65.2	Sample et al. 1998a	--	see Section 7.2.2.1 (Small Mammals)
Aroclor-1260	0.0045	Travis and Arms 1988	65.2	Sample et al. 1998a	--	see Section 7.2.2.1 (Small Mammals)
beta-BHC	0.2633	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
delta-BHC	0.1653	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Dieldrin	0.3089	Travis and Arms 1988	8.00	Beyer and Gish 1980	--	see Section 7.2.2.1 (Small Mammals)
Endosulfan I	0.3436	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Endosulfan II	0.3131	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Endrin	0.7948	Travis and Arms 1988	3.60	Edwards and Bohlen 1992	--	see Section 7.2.2.1 (Small Mammals)
gamma-BHC (Lindane)	0.3173	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
gamma-Chlordane	0.0172	Travis and Arms 1988	4.00	Edwards and Bohlen 1992	--	see Section 7.2.2.1 (Small Mammals)
Heptachlor	0.0548	Travis and Arms 1988	3.00	Edwards and Bohlen 1992	--	see Section 7.2.2.1 (Small Mammals)
Heptachlor epoxide	0.3673	Travis and Arms 1988	8.39	USEPA 1999	--	see Section 7.2.2.1 (Small Mammals)
Methoxychlor	0.1447	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Toxaphene	0.1217	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Semivolatile Organics						
1,2,4-Trichlorobenzene	0.2186	Travis and Arms 1988	0.56	Beyer 1996	--	see Section 7.2.2.1 (Small Mammals)
1,2-Dichlorobenzene	0.5475	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
1,3-Dichlorobenzene	0.3673	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
1,4-Dichlorobenzene	0.5055	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
4-Bromophenyl-phenylether	0.0578	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
4-Chlorophenyl-phenylether	0.1697	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Acenaphthene	0.2564	Travis and Arms 1988	0.30	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Acenaphthylene	0.1653	Travis and Arms 1988	0.22	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Anthracene	0.1051	Travis and Arms 1988	0.32	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Benzo(a)anthracene	0.0222	Travis and Arms 1988	0.27	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Benzo(a)pyrene	0.0135	Travis and Arms 1988	0.34	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Benzo(b)fluoranthene	0.0174	Travis and Arms 1988	0.21	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Benzo(g,h,i)perylene	0.0061	Travis and Arms 1988	0.15	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Benzo(k)fluoranthene	0.0112	Travis and Arms 1988	0.21	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Chrysene	0.0289	Travis and Arms 1988	0.44	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Dibenz(a,h)anthracene	0.0068	Travis and Arms 1988	0.49	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Fluoranthene	0.0617	Travis and Arms 1988	0.37	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Fluorene	0.1790	Travis and Arms 1988	0.20	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Hexachlorobenzene	0.0367	Travis and Arms 1988	1.69	Beyer 1996	--	see Section 7.2.2.1 (Small Mammals)
Hexachlorobutadiene	0.0705	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Hexachlorocyclopentadiene	0.0467	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Hexachloroethane	0.2399	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)
Indeno(1,2,3-cd)pyrene	0.0061	Travis and Arms 1988	0.41	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Pentachlorophenol	0.0492	Travis and Arms 1988	8.00	van Gestel and Ma 1988	--	see Section 7.2.2.1 (Small Mammals)
Phenanthrene	0.1154	Travis and Arms 1988	0.28	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Pyrene	0.0687	Travis and Arms 1988	0.39	Beyer and Stafford 1993	--	see Section 7.2.2.1 (Small Mammals)
Volatile Organics						
1,1,2,2-Tetrachloroethane	1.7899	Travis and Arms 1988	1.00	--	--	see Section 7.2.2.1 (Small Mammals)

[1] BAFs developed for omnivorous small mammals.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
17	toxicity values	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Tables 7-9 through 7-10. July 2007.

TABLE 7-9
Ingestion Screening Values for Mammals
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Inorganics								
Arsenic	mouse	0.03	3 generations	oral in water	reproduction	1.26	0.25 a	Sample et al. 1996
Arsenic	dog	10.0	2 years	oral in diet	systemic	6.00 b	1.20	ATSDR 1993a
Cadmium	rat	0.303	6 weeks	oral (gavage)	reproduction	10.0	1.00	Sample et al. 1996
Cadmium	dog	10.0	3 months	oral in diet	reproduction	3.75 b	0.75	ATSDR 1999a
Chromium	rat	0.35	1 year	oral in water	body weight/intake	16.4 b	3.28	Sample et al. 1996
Copper	mouse	0.03	1 month + GD 0-19	oral in diet	developmental	104	78.0	ATSDR 1990a
Copper	mink	1.00	357 days	oral in diet	reproduction	15.1	11.7	Sample et al. 1996
Lead	rat	0.35	3 generations	oral in diet	reproduction	80.0	8.00	Sample et al. 1996
Mercury	rat	0.35	3 generations	oral in diet	reproduction	0.16	0.032	Sample et al. 1996
Mercury	mink	1.00	93 days	oral in diet	survival/weight loss	0.25 c	0.15 c	Sample et al. 1996
Nickel	rat	0.35	3 generations	oral in diet	reproduction	80.0	40.0	Sample et al. 1996
Nickel	dog	10.0	2 years	oral in diet	systemic	62.5	25.0	ATSDR 1997a
Selenium	rat	0.35	1 year	oral in water	reproduction	0.33	0.20	Sample et al. 1996
Silver	rat	0.35	2 weeks	oral in water	survival	45.3 d	9.06 e	ATSDR 1990b
Zinc	rat	0.35	GD 1-16	oral in diet	reproduction	320	160	Sample et al. 1996
Zinc	mink	1.00	25 weeks	oral	reproduction	104 b	20.8	ATSDR 1994a
Pesticides/PCBs								
4,4'-DDD	rat	0.35	2 years	oral in diet	reproduction	4.00	0.80	Sample et al. 1996
4,4'-DDD	dog	10.0	2 generations	oral in diet	reproduction	5.00	1.00	ATSDR 1994b
4,4'-DDE	rat	0.35	2 years	oral in diet	reproduction	4.00	0.80	Sample et al. 1996
4,4'-DDE	dog	10.0	2 generations	oral in diet	reproduction	5.00	1.00	ATSDR 1994b
4,4'-DDT	rat	0.35	2 years	oral in diet	reproduction	4.00	0.80	Sample et al. 1996
4,4'-DDT	dog	10.0	2 generations	oral in diet	reproduction	5.00	1.00	ATSDR 1994b
Aldrin	rat	0.35	3 generations	oral in diet	reproduction	1.00	0.20	Sample et al. 1996
alpha-BHC	rat	0.35	4 generations	oral in diet	reproduction	3.20	1.60	Sample et al. 1996
alpha-Chlordane	mouse	0.03	6 generations	oral in diet	reproduction	9.16	4.58	Sample et al. 1996
Aroclor-1016	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.14 a	Sample et al. 1996
Aroclor-1016	mink	1.00	18 months	oral in diet	reproduction	3.43	1.37	Sample et al. 1996
Aroclor-1221	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.14 a	Sample et al. 1996
Aroclor-1221	mink	1.00	7 months	oral in diet	reproduction	0.69	0.14 a	Sample et al. 1996
Aroclor-1232	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.14 a	Sample et al. 1996
Aroclor-1232	mink	1.00	7 months	oral in diet	reproduction	0.69	0.14 a	Sample et al. 1996
Aroclor-1242	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.14 a	Sample et al. 1996
Aroclor-1242	mink	1.00	7 months	oral in diet	reproduction	0.69	0.14 a	Sample et al. 1996
Aroclor-1248	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.14 a	Sample et al. 1996
Aroclor-1248	mink	1.00	4.5 months	oral in diet	reproduction	0.69	0.14	Sample et al. 1996
Aroclor-1254	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.14 a	Sample et al. 1996
Aroclor-1254	mink	1.00	4.5 months	oral in diet	reproduction	0.69	0.14	Sample et al. 1996
Aroclor-1260	oldfield mouse	0.014	12 months	oral in diet	reproduction	0.68	0.14 a	Sample et al. 1996
Aroclor-1260	mink	1.00	4.5 months	oral in diet	reproduction	0.69	0.14	Sample et al. 1996
beta-BHC	rat	0.35	4 generations	oral in diet	reproduction	3.20	1.60	Sample et al. 1996
delta-BHC	rat	0.35	4 generations	oral in diet	reproduction	3.20	1.60	Sample et al. 1996
Dieldrin	rat	0.35	3 generations	oral in diet	reproduction	0.20	0.04 a	Sample et al. 1996
Dieldrin	dog	10	15.7 months	oral in diet	systemic	0.14	0.03 a	ATSDR 1993b
Endosulfan I	rat	0.35	30 days	oral (gavage)	fertility	7.50 b	1.50	Sample et al. 1996
Endosulfan I	dog	10.0	2 years	oral in diet	systemic	5.00 b	1.00	ATSDR 1993c
Endosulfan II	rat	0.35	30 days	oral (gavage)	fertility	7.50 b	1.50	Sample et al. 1996
Endosulfan II	dog	10.0	2 years	oral in diet	systemic	5.00 b	1.00	ATSDR 1993c
Endrin	mouse	0.03	120 days	oral in diet	reproduction	0.92	0.18 a	Sample et al. 1996
gamma-BHC (Lindane)	rat	0.35	3 generations	oral in diet	reproduction	40.0 b	8.00	Sample et al. 1996
gamma-Chlordane	mouse	0.03	6 generations	oral in diet	reproduction	9.16	4.58	Sample et al. 1996

TABLE 7-9
Ingestion Screening Values for Mammals
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Heptachlor	mouse	0.03	70 days	oral in diet	reproduction	1.63 f	0.33 g	ATSDR 1993d
Heptachlor	mink	1.00	181 days	oral in diet	reproduction	1.00	0.20 a	Sample et al. 1996
Heptachlor epoxide	mouse	0.03	70 days	oral in diet	reproduction	1.63 f	0.33 g	ATSDR 1993d
Heptachlor epoxide	mink	1.00	181 days	oral in diet	reproduction	1.00	0.20 a	Sample et al. 1996
Methoxychlor	rat	0.35	11 months	oral in diet	reproduction	8.00	4.00	Sample et al. 1996
Toxaphene	rat	0.35	3 generations	oral in diet	reproduction	40.0 b	8.00	Sample et al. 1996
Semivolatile Organics								
1,2,4-Trichlorobenzene	rat	0.35	3 generations	oral in water	reproduction	106	53	Coulston and Kolbye 1994
1,2-Dichlorobenzene	rat	0.35	chronic	oral (gavage)	liver/kidney	429 b	85.7	Coulston and Kolbye 1994
1,3-Dichlorobenzene	rat	0.35	chronic	oral (gavage)	liver/kidney	429 b	85.7	Coulston and Kolbye 1994
1,4-Dichlorobenzene	rat	0.35	GD 6-15	oral (gavage)	developmental	500	250	ATSDR 1998a
4-Bromophenyl-phenylether	--	--	--	--	--	NA	NA	--
4-Chlorophenyl-phenylether	--	--	--	--	--	NA	NA	--
Acenaphthene	mouse	0.03	13 weeks	oral (gavage)	reproduction	700	350	ATSDR 1995a
Acenaphthylene	mouse	0.03	13 weeks	oral (gavage)	reproduction	700	350	ATSDR 1995a
Anthracene	mouse	0.03	13 weeks	oral (gavage)	reproduction	5,000 b	1,000	ATSDR 1995a
Benzo(a)anthracene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Benzo(a)pyrene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Benzo(b)fluoranthene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Benzo(g,h,i)perylene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Benzo(k)fluoranthene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Chrysene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Dibenz(a,h)anthracene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Fluoranthene	mouse	0.03	13 weeks	oral (gavage)	reproduction	2,500 b	500	ATSDR 1995a
Fluorene	mouse	0.03	13 weeks	oral (gavage)	reproduction	2,500 b	500	ATSDR 1995a
Hexachlorobenzene	rat	0.35	4 generations	oral in diet	reproduction	2.00	1.00	ATSDR 1996b
Hexachlorobenzene	dog	10.0	1 year	oral	systemic	12.0	1.20	ATSDR 1996b
Hexachlorobutadiene	rat	0.35	GD 1-22; LD 1-21	oral in diet	developmental	20.0	2.00	ATSDR 1994c
Hexachlorocyclopentadiene	mouse	0.03	GD 6-15	oral (gavage)	developmental	375 b	75.0	ATSDR 1999b
Hexachloroethane	rat	0.35	GD 6-16	oral (gavage)	reproduction	500	100	ATSDR 1997b
Indeno(1,2,3-cd)pyrene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Pentachlorophenol	rat	0.35	2 generations	oral in diet	developmental	25.0	5.00 a	ATSDR 1994d
Phenanthrene	mouse	0.03	13 weeks	oral (gavage)	reproduction	2,500 b	500	ATSDR 1995a
Pyrene	mouse	0.03	GD 7-16	oral (gavage)	reproduction	10.0	2.00 a	Sample et al. 1996
Volatile Organics								
1,1,2,2-Tetrachloroethane	rat	0.35	78 weeks	oral (gavage)	reproduction	380 b	76.0	ATSDR 1996a

[a] Uncertainty factor of 5 applied to LOAEL
[b] Uncertainty factor of 5 applied to NOAEL
[c] Does not include subchronic uncertainty factor of 10
[d] Derived from a subchronic NOAEL of 181.2 and an uncertainty factor of 4
[e] Derived from a subchronic NOAEL of 181.2 and an uncertainty factor of 20
[f] Derived from a subchronic NOAEL of 6.50 and an uncertainty factor of 4
[g] Derived from a subchronic NOAEL of 6.50 and an uncertainty factor of 20

TABLE 7-10
Ingestion Screening Values for Birds
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Inorganics								
Arsenic	brown-headed cowbird	0.049	7 months	oral in diet	survival	7.38	2.46	Sample et al. 1996
Arsenic	mallard	1.00	128 days	oral in diet	survival	12.8	5.14	Sample et al. 1996
Cadmium	mallard	1.15	90 days	oral in diet	reproduction	20.0	1.45	Sample et al. 1996
Chromium	American black duck	1.25	10 months	oral in diet	reproduction	5.00	1.00	Sample et al. 1996
Copper	chicken (chicks)	0.534	10 weeks	oral in diet	growth/survival	61.7	47.0	Sample et al. 1996
Lead	Japanese quail	0.15	12 weeks	oral in diet	reproduction	11.3	1.13	Sample et al. 1996
Lead	American kestrel	0.13	7 months	oral in diet	reproduction	19.3 b	3.85	Sample et al. 1996
Mercury	red-tailed hawk	1.10	12 weeks	oral in diet	survival/neurological	1.20	0.49	USEPA 1995b
Mercury	mallard	1.00	3 generations	oral in diet	reproduction	0.078	0.026	USEPA 1997b
Nickel	mallard	0.782	90 days	oral in diet	growth/survival	107	77.4	Sample et al. 1996
Selenium	black-crowned night-heron	0.88	94 days	oral in diet	reproduction	9.00 b	1.80	Sample et al. 1996
Selenium	mallard	1.00	100 days	oral in diet	reproduction	0.80	0.40	Sample et al. 1996
Selenium	screech owl	0.20	13.7 weeks	oral in diet	reproduction	1.50	0.44	Sample et al. 1996
Silver	mallard	1.10	14 days	oral in diet	survival	178 c	35.6 d	USEPA 1999
Silver	chicken (chicks)	0.80	not specified	oral in diet	growth	35.0	7.00 a	Eisler 1996
Zinc	chicken	1.94	44 weeks	oral in diet	reproduction	131	14.5	Sample et al. 1996
Pesticides/PCBs								
4,4'-DDD	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	0.50	USEPA 1995b
4,4'-DDD	barn owl	0.47	2 years	oral in diet	reproduction	0.40 b	0.08	Blus 1996
4,4'-DDD	mallard	1.00	2 years	oral in diet	reproduction	0.60	0.12	USEPA 1995b
4,4'-DDD	bald eagle	4.74	112 days	oral in diet	survival	3.00	0.30	USEPA 1995b
4,4'-DDE	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	0.50	USEPA 1995b
4,4'-DDE	barn owl	0.47	2 years	oral in diet	reproduction	0.40 b	0.08	Blus 1996
4,4'-DDE	mallard	1.00	2 years	oral in diet	reproduction	0.60	0.12	USEPA 1995b
4,4'-DDE	bald eagle	4.74	112 days	oral in diet	survival	3.00	0.30	USEPA 1995b
4,4'-DDT	Japanese quail	0.11	3 generations	oral in diet	reproduction	5.00	0.50	USEPA 1995b
4,4'-DDT	barn owl	0.47	2 years	oral in diet	reproduction	0.40 b	0.08	Blus 1996
4,4'-DDT	mallard	1.00	2 years	oral in diet	reproduction	1.50	0.60	USEPA 1995b
4,4'-DDT	bald eagle	4.74	112 days	oral in diet	survival	3.00	0.30	USEPA 1995b
Aldrin	ring-necked pheasant	1.14	5 days	oral in diet	survival	0.35 b	0.07 e	Hill et al. 1975
Aldrin	mallard	1.00	5 days	oral in diet	survival	0.78 b	0.16 f	Hill et al. 1975
alpha-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
alpha-Chlordane	red-winged blackbird	0.064	84 days	oral in diet	survival	10.7	2.14	Sample et al. 1996
alpha-Chlordane	mallard	1.00	not specified	oral in diet	reproduction	4.00 b	0.80	Wiemeyer 1996
Aroclor-1016	screech owl	0.181	2 generations	oral in diet	reproduction	2.05 b	0.41	Sample et al. 1996
Aroclor-1016	mallard	1.00	1 month	oral in diet	reproduction	7.50 b	1.50	USEPA 1995b
Aroclor-1221	screech owl	0.181	2 generations	oral in diet	reproduction	2.05 b	0.41	Sample et al. 1996
Aroclor-1221	mallard	1.00	1 month	oral in diet	reproduction	7.50 b	1.50	USEPA 1995b
Aroclor-1232	screech owl	0.181	2 generations	oral in diet	reproduction	2.05 b	0.41	Sample et al. 1996
Aroclor-1232	mallard	1.00	1 month	oral in diet	reproduction	7.50 b	1.50	USEPA 1995b
Aroclor-1242	screech owl	0.181	2 generations	oral in diet	reproduction	2.05 b	0.41	Sample et al. 1996
Aroclor-1242	mallard	1.00	1 month	oral in diet	reproduction	7.50 b	1.50	USEPA 1995b
Aroclor-1248	screech owl	0.181	2 generations	oral in diet	reproduction	2.05 b	0.41	Sample et al. 1996
Aroclor-1248	mallard	1.00	1 month	oral in diet	reproduction	7.50 b	1.50	USEPA 1995b
Aroclor-1254	screech owl	0.181	2 generations	oral in diet	reproduction	2.05 b	0.41	Sample et al. 1996
Aroclor-1254	mallard	1.00	1 month	oral in diet	reproduction	7.50 b	1.50	USEPA 1995b
Aroclor-1260	screech owl	0.181	2 generations	oral in diet	reproduction	2.05 b	0.41	Sample et al. 1996
Aroclor-1260	mallard	1.00	1 month	oral in diet	reproduction	7.50 b	1.50	USEPA 1995b
beta-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
delta-BHC	Japanese quail	0.15	90 days	oral in diet	reproduction	2.25	0.56	Sample et al. 1996
Dieldrin	barn owl	0.466	2 years	oral in diet	reproduction	0.39 b	0.08	Sample et al. 1996

TABLE 7-10
Ingestion Screening Values for Birds
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Test Organism	Body Weight (kg)	Duration	Exposure Route	Effect/Endpoint	LOAEL (mg/kg/d)	NOAEL (mg/kg/d)	Reference
Endosulfan I	gray partridge	0.40	4 weeks	oral in diet	reproduction	50.0 b	10.0	Sample et al. 1996
Endosulfan II	gray partridge	0.40	4 weeks	oral in diet	reproduction	50.0 b	10.0	Sample et al. 1996
Endrin	mallard	1.15	>200 days	oral in diet	reproduction	1.50 b	0.30	Sample et al. 1996
Endrin	screech owl	0.181	>83 days	oral in diet	reproduction	0.10	0.02 a	Sample et al. 1996
gamma-BHC (Lindane)	mallard	1.00	8 weeks	oral (gavage)	reproduction	20.0	4.00 a	Sample et al. 1996
gamma-Chlordane	red-winged blackbird	0.064	84 days	oral in diet	survival	10.7	2.14	Sample et al. 1996
gamma-Chlordane	mallard	1.00	not specified	oral in diet	reproduction	4.00 b	0.80	Wiemeyer 1996
Heptachlor	ring-necked pheasant	1.14	5 days	oral in diet	survival	1.38 b	0.28 g	Hill et al. 1975
Heptachlor	mallard	1.00	5 days	oral in diet	survival	2.40 b	0.48 h	Hill et al. 1975
Heptachlor epoxide	ring-necked pheasant	1.14	5 days	oral in diet	survival	1.38 b	0.28 g	Hill et al. 1975
Heptachlor epoxide	mallard	1.00	5 days	oral in diet	survival	2.40 b	0.48 h	Hill et al. 1975
Methoxychlor	chicken	1.50	16 weeks	oral in diet	reproduction	1,775 b	355	Wiemeyer 1996
Toxaphene	American black duck	1.00	2 seasons	oral in diet	reproduction	5.00	1.00	Wiemeyer 1996
Semivolatile Organics								
1,2,4-Trichlorobenzene	northern bobwhite	0.19	14 days	oral	survival	161 i	32.2 j	TERRETOX 2002
1,2-Dichlorobenzene	northern bobwhite	0.19	14 days	oral	survival	161 i	32.2 j	TERRETOX 2002
1,3-Dichlorobenzene	northern bobwhite	0.19	14 days	oral	survival	161 i	32.2 j	TERRETOX 2002
1,4-Dichlorobenzene	northern bobwhite	0.19	14 days	oral	survival	161 i	32.2 j	TERRETOX 2002
4-Bromophenyl-phenylether	--	--	--	--	--	NA	NA	--
4-Chlorophenyl-phenylether	--	--	--	--	--	NA	NA	--
Acenaphthene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Acenaphthylene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Anthracene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Benzo(a)anthracene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Benzo(a)pyrene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Benzo(b)fluoranthene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Benzo(g,h,i)perylene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Benzo(k)fluoranthene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Chrysene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Dibenz(a,h)anthracene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Fluoranthene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Fluorene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Hexachlorobenzene	Japanese quail	0.15	90 days	oral in diet	reproduction	0.565	0.113	Coulston and Kolbye 1994; TERRETOX 2002
Hexachlorobutadiene	Japanese quail	0.15	90 days	oral in diet	reproduction	17.0 b	3.39	Coulston and Kolbye 1994; TERRETOX 2002
Hexachlorocyclopentadiene	--	--	--	--	--	NA	NA	--
Hexachloroethane	--	--	--	--	--	NA	NA	--
Indeno(1,2,3-cd)pyrene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Pentachlorophenol	chicken	1.50	8 weeks	oral in diet	systemic/growth	8.52 l	4.26 m	Eisler 1989
Phenanthrene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Pyrene	chicken	1.50	35 days	oral in diet	reproduction	35.5 b	7.10 k	Rigdon and Neal 1963
Volatile Organics								
1,1,2,2-Tetrachloroethane	--	--	--	--	--	NA	NA	--

[a]Uncertainty factor of 5 applied to LOAEL
[b]Uncertainty factor of 5 applied to NOAEL
[c]Derived from an acute LOAEL of 1,780 and an uncertainty factor of 10
[d]Derived from an acute LOAEL of 1,780 and an uncertainty factor of 50
[e]Derived from a LD50 of 7.01 and an uncertainty factor of 100
[f]Derived from a LD50 of 15.5 and an uncertainty factor of 100
[g]Derived from a LD50 of 27.53 and an uncertainty factor of 100
[h]Derived from a LD50 of 48.0 and an uncertainty factor of 100
[i]Derived from an acute LOAEL of 1,608 and an uncertainty factor of 10
[j]Derived from an acute LOAEL of 1,608 and an uncertainty factor of 50
[k]Uncertainty factor of 10 applied to subchronic NOAEL of 71.0
[l]Uncertainty factor of 10 applied to subchronic LOAEL of 85.2
[m]Uncertainty factor of 10 applied to subchronic NOAEL of 42.6

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
18	Ecological chemicals of potential concern (COPCs)	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Tables 7-11 through 7-13. July 2007.

TABLE 7-11
Step 2 Screening Statistics and COPC Selection - AOC H - Surface Soil
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Reference	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
Inorganics (MG/KG)									
ALUMINUM	-- - --	33 / 33	11000	NDE015, NDE176	50	Efroymson et al. 1997a	33 / 33	220	**YES**
ANTIMONY	0.25 - 0.28	26 / 33	6.3	NDE178	78	USEPA 2005	0 / 33	0.1	NO
ARSENIC	-- - --	33 / 33	67	NDE023	18	USEPA 2005	2 / 33	3.7	**YES**
BARIUM	-- - --	33 / 33	290	NDE023	330	USEPA 2005	0 / 33	0.9	NO
BERYLLIUM	0.035 - 0.039	22 / 33	0.26	NDE023	40	USEPA 2005	0 / 33	0.01	NO
CADMIUM	0.0128 - 0.032	13 / 33	0.291	NDAHSS26-R01	32	USEPA 2005	0 / 33	0.01	NO
CALCIUM [2]	-- - --	33 / 33	34000	NDE019, NDE179	NSV	--	-- / --	NSV	NO
CHROMIUM, TOTAL	-- - --	33 / 33	50	NDE176	0.4	Efroymson et al. 1997b	33 / 33	125	**YES**
COBALT	-- - --	33 / 33	10.2	NDAHSS19-R01	13	USEPA 2005	0 / 33	0.8	NO
COPPER	-- - --	33 / 33	100	NDE009	50	Efroymson et al. 1997b	2 / 33	2.0	**YES**
IRON	-- - --	33 / 33	39000	NDE178	200	Efroymson et al. 1997b	33 / 33	195	**YES**
LEAD	-- - --	33 / 33	63	NDE021	120	USEPA 2005	0 / 33	0.5	NO
MAGNESIUM [2]	-- - --	33 / 33	8400	NDE009	NSV	--	-- / --	NSV	NO
MANGANESE	-- - --	33 / 33	720	NDE023	100	Efroymson et al. 1997b	33 / 33	7.2	**YES**
MERCURY	-- - --	33 / 33	0.0625	NDAHSS25-R01	0.3	Efroymson et al. 1997a	0 / 33	0.2	NO
NICKEL	-- - --	33 / 33	26	NDE178	30	Efroymson et al. 1997a	0 / 33	0.9	NO
POTASSIUM [2]	-- - --	33 / 33	3400	NDE009	NSV	--	-- / --	NSV	NO
SELENIUM	0.48 - 0.54	22 / 33	1.4	NDE013	1	Efroymson et al. 1997a	2 / 33	1.4	**YES**
SILVER	0.024 - 0.067	12 / 33	0.17	NDE017	2	Efroymson et al. 1997a	0 / 33	0.1	NO
SODIUM [2]	-- - --	33 / 33	590	NDE009	NSV	--	-- / --	NSV	NO
THALLIUM	0.36 - 0.4	13 / 33	1.16	NDAHSS18-R01	1	Efroymson et al. 1997a	1 / 33	1.2	**YES**
VANADIUM	-- - --	33 / 33	63	NDE176	2	Efroymson et al. 1997a	33 / 33	32	**YES**
ZINC	-- - --	33 / 33	260	NDE178	50	Efroymson et al. 1997a	29 / 33	5.2	**YES**
Pesticides/Polychlorinated Biphenyls (MG/KG)									
PCB-1016 (AROCHLOR 1016)	0.034 - 0.039	0 / 20	--	--	40	Efroymson et al. 1997a	-- / --	0.001	NO
PCB-1221 (AROCHLOR 1221)	0.07 - 0.079	0 / 20	--	--	40	Efroymson et al. 1997a	-- / --	0.002	NO
PCB-1232 (AROCHLOR 1232)	0.034 - 0.039	0 / 20	--	--	40	Efroymson et al. 1997a	-- / --	0.001	NO
PCB-1242 (AROCHLOR 1242)	0.034 - 0.039	0 / 20	--	--	40	Efroymson et al. 1997a	-- / --	0.001	NO
PCB-1248 (AROCHLOR 1248)	0.034 - 0.039	0 / 20	--	--	40	Efroymson et al. 1997a	-- / --	0.001	NO
PCB-1254 (AROCHLOR 1254)	0.034 - 0.039	0 / 20	--	--	40	Efroymson et al. 1997a	-- / --	0.001	NO
PCB-1260 (AROCHLOR 1260)	0.034 - 0.039	0 / 20	--	--	40	Efroymson et al. 1997a	-- / --	0.001	NO
ALDRIN	0.0018 - 0.0021	0 / 32	--	--	0.0025	Friday 1998	-- / --	0.8	NO
ALPHA BHC (ALPHA HEXACHLOR	0.0018 - 0.0021	0 / 32	--	--	0.0025	Friday 1998	-- / --	0.8	NO
ALPHA ENDOSULFAN	0.0018 - 0.0021	0 / 32	--	--	NSV	--	-- / --	NSV	NO
ALPHA-CHLORDANE	0.0018 - 0.0021	0 / 32	--	--	NSV	--	-- / --	NSV	NO
BETA BHC (BETA HEXACHLORO(	0.0018 - 0.0021	0 / 32	--	--	0.001	Friday 1998	-- / --	2.1	--[3]
BETA ENDOSULFAN	0.0034 - 0.0041	0 / 32	--	--	NSV	--	-- / --	NSV	NO
DELTA BHC (DELTA HEXACHLOR	0.0018 - 0.0021	0 / 32	--	--	NSV	--	-- / --	NSV	NO
DIELDRIN	0.0034 - 0.0041	0 / 32	--	--	0.0005	Friday 1998	-- / --	8.2	--[3]
ENDOSULFAN SULFATE	0.0034 - 0.0041	0 / 32	--	--	NSV	--	-- / --	NSV	NO
ENDRIN	0.0034 - 0.0041	0 / 32	--	--	0.001	Friday 1998	-- / --	4.1	--[3]
ENDRIN ALDEHYDE	0.0034 - 0.0041	0 / 32	--	--	0.1	Friday 1998	-- / --	0.04	NO
ENDRIN KETONE	0.0034 - 0.0041	0 / 32	--	--	0.1	Friday 1998	-- / --	0.04	NO
GAMMA BHC (LINDANE)	0.0018 - 0.0021	0 / 32	--	--	0.00005	Friday 1998	-- / --	42	--[3]
GAMMA-CHLORDANE	0.0018 - 0.0021	0 / 32	--	--	NSV	--	-- / --	NSV	NO
HEPTACHLOR	0.0018 - 0.0021	0 / 32	--	--	NSV	--	-- / --	NSV	NO
HEPTACHLOR EPOXIDE	0.0018 - 0.0021	0 / 32	--	--	NSV	--	-- / --	NSV	NO
METHOXYCHLOR	0.018 - 0.02	1 / 32	0.00074	NDAHSS19-R01	NSV	--	-- / --	NSV	**YES**
p,p'-DDD	0.0034 - 0.0039	12 / 31	0.01	NDAHSS22-R01	0.0025	Friday 1998	5 / 31	4.0	**YES**
p,p'-DDE	0.0035 - 0.0039	22 / 32	3.99	NDE004	0.0025	Friday 1998	19 / 32	1596	**YES**
p,p'-DDT	0.0035 - 0.0039	19 / 32	1.94	NDE004	0.0025	Friday 1998	18 / 32	776	**YES**
TOXAPHENE	0.177 - 0.21	0 / 32	--	--	NSV	--	-- / --	NSV	NO
Semi-volatile Organic Compounds (MG/KG)									
1,2,4-TRICHLOROBENZENE	0.416 - 28.2	0 / 20	--	--	20	Efroymson et al. 1997b	-- / --	1.4	--[3]
1,2-DICHLOROBENZENE	0.416 - 28.2	0 / 20	--	--	NSV	--	-- / --	NSV	NO
1,3-DICHLOROBENZENE	0.416 - 28.2	0 / 20	--	--	NSV	--	-- / --	NSV	NO
1,4-DICHLOROBENZENE	0.416 - 28.2	0 / 20	--	--	20	Efroymson et al. 1997b	-- / --	1.4	--[3]
2,4,5-TRICHLOROPHENOL	1.05 - 84.5	0 / 32	--	--	4	Efroymson et al. 1997a	-- / --	21	--[3]
2,4,6-TRICHLOROPHENOL	0.351 - 28.2	0 / 33	--	--	10	Efroymson et al. 1997b	-- / --	2.8	--[3]
2,4-DICHLOROPHENOL	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
2,4-DIMETHYLPHENOL	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
2,4-DINITROPHENOL	1.05 - 84.5	0 / 33	--	--	20	Efroymson et al. 1997a	-- / --	4.2	--[3]
2,4-DINITROTOLUENE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
2,6-DINITROTOLUENE	0.351 - 28.2	2 / 33	1.23	NDE030	NSV	--	-- / --	NSV	**YES**
2-CHLORONAPHTHALENE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
2-CHLOROPHENOL	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
2-METHYLNAPHTHALENE	0.351 - 28.2	6 / 32	0.19	NDE021	NSV	--	-- / --	NSV	**YES**
2-METHYLPHENOL (o-CRESOL)	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
2-NITROANILINE	1.05 - 84.5	0 / 33	--	--	NSV	--	-- / --	NSV	NO
2-NITROPHENOL	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
3,3'-DICHLOROBENZIDINE	0.712 - 56.3	0 / 33	--	--	NSV	--	-- / --	NSV	NO
3-NITROANILINE	1.05 - 84.5	1 / 33	0.048	NDE030	NSV	--	-- / --	NSV	**YES**
4,6-DINITRO-2-METHYLPHENOL	1.05 - 84.5	0 / 33	--	--	NSV	--	-- / --	NSV	NO
4-BROMOPHENYL PHENYL ETHE	0.351 - 28.2	3 / 33	0.267	NDE030	NSV	--	-- / --	NSV	**YES**
4-CHLORO-3-METHYLPHENOL	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO

TABLE 7-11
Step 2 Screening Statistics and COPC Selection - AOC H - Surface Soil
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Reference	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
4-CHLOROANILINE	0.411 - 28.2	0 / 21	--	--	NSV	--	-- / --	NSV	NO
4-CHLOROPHENYL PHENYL ETH	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
4-METHYLPHENOL (p-CRESOL)	0.351 - 0.411	0 / 13	--	--	NSV	--	-- / --	NSV	NO
4-NITROANILINE	1.05 - 84.5	0 / 33	--	--	NSV	--	-- / --	NSV	NO
4-NITROPHENOL	1.05 - 84.5	0 / 33	--	--	7	Efroymson et al. 1997b	-- / --	12	--[3]
ACENAPHTHENE	0.351 - 28.2	0 / 33	--	--	20	Efroymson et al. 1997a	-- / --	1.4	--[3]
ACENAPHTHYLENE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
ACETOPHENONE	0.351 - 0.379	0 / 12	--	--	NSV	--	-- / --	NSV	NO
ANTHRACENE	0.351 - 28.2	0 / 33	--	--	0.1	Friday 1998	-- / --	282	--[3]
ATRAZINE	0.351 - 0.411	0 / 13	--	--	0.00005	Friday 1998	-- / --	8220	--[3]
Benzaldehyde	0.351 - 0.379	0 / 4	--	--	NSV	--	-- / --	NSV	NO
BENZO(a)ANTHRACENE	0.351 - 28.2	10 / 33	0.112	NDE011	NSV	--	-- / --	NSV	**YES**
BENZO(a)PYRENE	0.356 - 28.2	15 / 33	0.12	NDE011	0.1	Friday 1998	1 / 33	1.2	**YES**
BENZO(b)FLUORANTHENE	0.363 - 28.2	19 / 33	0.133	NDE011	NSV	--	-- / --	NSV	**YES**
BENZO(g,h,i)PERYLENE	0.356 - 28.2	10 / 33	0.06	NDE177	1	Friday 1998	0 / 33	0.06	NO
BENZO(k)FLUORANTHENE	0.356 - 28.2	16 / 33	0.124	NDE011	NSV	--	-- / --	NSV	**YES**
BENZYL BUTYL PHTHALATE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
BIPHENYL (DIPHENYL)	0.351 - 0.411	0 / 13	--	--	NSV	--	-- / --	NSV	NO
bis(2-CHLOROETHOXY) METHAN	0.351 - 28.2	0 / 28	--	--	NSV	--	-- / --	NSV	NO
bis(2-CHLOROETHYL) ETHER (2	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
bis(2-CHLOROISOPROPYL) ETHE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
bis(2-ETHYLHEXYL) PHTHALATE	0.351 - 28.2	8 / 33	0.117	NDAHSS24-R01	NSV	--	-- / --	NSV	**YES**
CAPROLACTAM	0.351 - 0.411	0 / 13	--	--	NSV	--	-- / --	NSV	NO
CARBAZOLE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
CHRYSENE	0.363 - 28.2	18 / 33	0.155	NDE011	NSV	--	-- / --	NSV	**YES**
CRESOLS, m & p	0.416 - 28.2	0 / 20	--	--	NSV	--	-- / --	NSV	NO
DI-n-BUTYL PHTHALATE	0.351 - 28.2	0 / 33	--	--	200	Efroymson et al. 1997a	-- / --	0.1	NO
DI-n-OCTYLPHTHALATE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
DIBENZ(a,h)ANTHRACENE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
DIBENZOFURAN	0.351 - 28.2	3 / 33	0.051	NDE019	NSV	--	-- / --	NSV	**YES**
DIETHYL PHTHALATE	0.351 - 28.2	0 / 33	--	--	100	Efroymson et al. 1997a	-- / --	0.3	NO
DIMETHYL PHTHALATE	0.351 - 28.2	0 / 33	--	--	200	Efroymson et al. 1997b	-- / --	0.1	NO
FLUORANTHENE	0.351 - 28.2	16 / 33	0.187	NDE011	0.1	Friday 1998	2 / 33	1.9	**YES**
FLUORENE	0.351 - 28.2	0 / 32	--	--	30	Efroymson et al. 1997b	-- / --	0.9	NO
HEXACHLOROBENZENE	0.351 - 28.2	0 / 33	--	--	1000	Efroymson et al. 1997b	-- / --	0.03	NO
HEXACHLOROBUTADIENE	0.351 - 28.2	0 / 33	--	--	NSV	--	-- / --	NSV	NO
HEXACHLOROCYCLOPENTADIEN	0.351 - 28.2	0 / 33	--	--	10	Efroymson et al. 1997a	-- / --	2.8	--[3]
HEXACHLOROETHANE	0.416 - 28.2	0 / 20	--	--	NSV	--	-- / --	NSV	NO
INDENO(1,2,3-c,d)PYRENE	0.351 - 28.2	8 / 33	0.0848		NSV	--	-- / --	NSV	**YES**
ISOPHORONE	0.351 - 28.2	2 / 33	0.112	NDE028	NSV	--	-- / --	NSV	**YES**
N-NITROSODI-n-PROPYLAMINE	0.351 - 28.2	3 / 33	0.717	NDE030	NSV	--	-- / --	NSV	**YES**
N-NITROSODIPHENYLAMINE	0.351 - 28.2	0 / 33	--	--	20	Efroymson et al. 1997b	-- / --	1.4	--[3]
NAPHTHALENE	0.351 - 28.2	3 / 32	0.09	NDE019	0.1	Friday 1998	0 / 32	0.9	NO
NITROBENZENE	0.351 - 28.2	0 / 33	--	--	40	Efroymson et al. 1997b	-- / --	0.7	NO
PENTACHLOROPHENOL	1.05 - 84.5	0 / 32	--	--	5	USEPA 2005	-- / --	17	--[3]
PHENANTHRENE	0.351 - 28.2	8 / 33	0.144	NDE019	0.1	Friday 1998	1 / 33	1.4	**YES**
PHENOL	0.351 - 28.2	0 / 33	--	--	30	Efroymson et al. 1997b	-- / --	0.9	NO
PYRENE	0.351 - 11.5	17 / 33	1.9	NDE176	0.1	Friday 1998	3 / 33	19	**YES**
Total PAHs	3.45 - 109.25	23 / 33	255.7	NDE176	1	Friday 1998	23 / 33	256	**YES**
Volatile Organic Compounds (MG/KG)									
1,1,1-TRICHLOROETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
1,1,2,2-TETRACHLOROETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
1,1,2-TRICHLOROETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
1,1-DICHLOROETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
1,1-DICHLOROETHENE	0.01 - 0.948	1 / 20	0.00078	NDE021	NSV	--	-- / --	NSV	**YES**
1,2-DICHLOROETHANE	0.01 - 0.948	0 / 20	--	--	4	Friday 1998	-- / --	0.2	NO
1,2-DICHLOROPROPANE	0.01 - 0.948	0 / 20	--	--	700	Efroymson et al. 1997b	-- / --	0.001	NO
2-HEXANONE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
BENZENE	0.01 - 0.948	0 / 20	--	--	0.05	Friday 1998	-- / --	19	--[3]
BROMODICHLOROMETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
BROMOFORM	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
BROMOMETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
CARBON DISULFIDE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
CARBON TETRACHLORIDE	0.01 - 0.948	0 / 20	--	--	1000	Efroymson et al. 1997b	-- / --	0.001	NO
CHLOROBENZENE	0.01 - 0.948	0 / 20	--	--	40	Efroymson et al. 1997b	-- / --	0.02	NO
CHLOROETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
CHLOROFORM	0.01 - 0.948	0 / 20	--	--	0.001	Friday 1998	-- / --	948	--[3]
CHLOROMETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
cis-1,3-DICHLOROPROPENE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
DIBROMOCHLOROMETHANE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
ETHYLBENZENE	0.01 - 0.948	0 / 20	--	--	0.05	Friday 1998	-- / --	19	--[3]
M,P-XYLENE (SUM OF ISOMERS	0.01 - 0.015	1 / 20	0.058	NDE176	NSV	--	-- / --	NSV	**YES**
METHYL ISOBUTYL KETONE (4-M	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
METHYLENE CHLORIDE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
O-XYLENE (1,2-DIMETHYLBENZE	0.01 - 0.015	1 / 20	0.024	NDE176	NSV	--	-- / --	NSV	**YES**
STYRENE	0.01 - 0.948	0 / 20	--	--	300	Efroymson et al. 1997a	-- / --	0.003	NO
TETRACHLOROETHYLENE(PCE)	0.01 - 0.948	0 / 20	--	--	0.01	Friday 1998	-- / --	95	--[3]

TABLE 7-11
Step 2 Screening Statistics and COPC Selection - AOC H - Surface Soil
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentra-tion Detected	Sample ID of Maximum Concentration	Screening Value	Reference	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
TOLUENE	0.01 - 0.948	0 / 20	--	--	200	Efroymson et al. 1997a	-- / --	0.005	NO
trans-1,3-DICHLOROPROPENE	0.01 - 0.948	0 / 20	--	--	NSV	--	-- / --	NSV	NO
TRICHLOROETHYLENE (TCE)	0.01 - 0.948	0 / 20	--	--	0.001	Friday 1998	-- / --	948	--[3]
VINYL CHLORIDE	0.01 - 0.948	0 / 20	--	--	0.1	Friday 1998	-- / --	9.5	--[3]
XYLENES, TOTAL	0.01 - 0.015	1 / 20	0.082	NDE176	0.05	Friday 1998	1 / 20	1.6	**YES**
Explosives (MG/KG)									
1,3,5-TRINITROBENZENE	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
1,3-DINITROBENZENE	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
2,4,6-TRINITROTOLUENE	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
2,4-DINITROTOLUENE	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
2,6-DINITROTOLUENE	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
2-NITROTOLUENE	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
3-NITROTOLUENE	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
4-NITROTOLUENE	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
HEXAHYDRO-1,3,5-TRINITRO-1,3	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
NITROBENZENE	0.13 - 0.15	0 / 13	--	--	40	Efroymson et al. 1997b	-- / --	0.004	NO
OCTAHYDRO-1,3,5,7-TETRANITR	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO
Perchlorate	0.0946 - 0.129	0 / 13	--	--	NSV	--	-- / --	NSV	NO
TETRYL	0.13 - 0.15	0 / 13	--	--	NSV	--	-- / --	NSV	NO

NSV - No screening value
1 - Maximum HQ based on maximum concentration detected unless frequency of detection is zero, in which case it is based on maximum reporting limit - indicated by shaded cells.
2 - Macronutrient - Not considered to be a COPC.
3 - Chemical not detected, however detection limit exceeded screening value. Chemical not retained as COPC - see Section 7.5 (Uncertainties)

TABLE 7-12

Step 2 Screening Statistics and COPC Selection - AOC H - Surface Water

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
Inorganics (UG/L)								
ALUMINUM	700 - 700	1 / 4	1740	NDAHSW02-R01	NSV	-- / --	NSV	**YES**
ALUMINUM, DISSOLVED	700 - 700	0 / 4	--	--	NSV	-- / --	NSV	NO
ANTIMONY	50 - 50	0 / 4	--	--	4300	-- / --	0.01	NO
ANTIMONY, DISSOLVED	50 - 50	0 / 4	--	--	4300	-- / --	0.01	NO
ARSENIC	40.8 - 40.8	1 / 4	47.1	NDAHSW02-R01	1.4	1 / 4	33.64	**YES**
ARSENIC, DISSOLVED	40.8 - 40.8	0 / 4	--	--	1.4	-- / --	29	--[3]
BARIUM	-- - --	4 / 4	162	NDAHSW02-R01	NSV	-- / --	NSV	**YES**
BARIUM, DISSOLVED	-- - --	4 / 4	163	NDAHSW02-R01	NSV	-- / --	NSV	**YES**
BERYLLIUM	1.89 - 1.89	0 / 4	--	--	NSV	-- / --	NSV	NO
BERYLLIUM, DISSOLVED	1.89 - 1.89	0 / 4	--	--	NSV	-- / --	NSV	NO
CADMIUM	7.12 - 7.12	1 / 4	7.7	NDAHSW02-R01	9.3	0 / 4	0.83	NO
CADMIUM, DISSOLVED	7.12 - 7.12	0 / 4	--	--	9.3	-- / --	0.77	NO
CALCIUM [2]	-- - --	4 / 4	383000	NDAHSW03-R01	NSV	-- / --	NSV	NO
CALCIUM, DISSOLVED [2]	-- - --	4 / 4	346000	NDAHSW01-R01	NSV	-- / --	NSV	NO
CHROMIUM, TOTAL	11.4 - 11.4	1 / 4	16.2	NDAHSW02-R01	50.4	0 / 4	0.32	NO
CHROMIUM, DISSOLVED	11.4 - 11.4	0 / 4	--	--	50	-- / --	0.23	NO
COBALT	11.4 - 11.4	1 / 4	19.6	NDAHSW02-R01	NSV	-- / --	NSV	**YES**
COBALT, DISSOLVED	11.4 - 11.4	0 / 4	--	--	NSV	-- / --	NSV	NO
COPPER	23.4 - 23.4	0 / 4	--	--	3.7	-- / --	6.32	--[3]
COPPER, DISSOLVED	23.4 - 23.4	0 / 4	--	--	3.1	-- / --	7.55	--[3]
IRON	334 - 334	0 / 4	--	--	NSV	-- / --	NSV	NO
IRON, DISSOLVED	334 - 334	0 / 4	--	--	NSV	-- / --	NSV	NO
LEAD	35.2 - 35.2	0 / 4	--	--	8.1	-- / --	4.35	--[3]
LEAD, DISSOLVED	35.2 - 35.2	0 / 4	--	--	8.1	-- / --	4.35	--[3]
MAGNESIUM [2]	-- - --	4 / 4	1050000	NDAHSW03-R01	NSV	-- / --	NSV	NO
MAGNESIUM, DISSOLVED [2]	-- - --	4 / 4	939000	NDAHSW01-R01	NSV	-- / --	NSV	NO
MANGANESE	-- - --	4 / 4	654	NDAHSW03-R01	NSV	-- / --	NSV	**YES**
MANGANESE, DISSOLVED	-- - --	4 / 4	419	NDAHSW04-R01	NSV	-- / --	NSV	**YES**

TABLE 7-12
Step 2 Screening Statistics and COPC Selection - AOC H - Surface Water
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
MERCURY	-- - --	4 / 4	0.0351	NDAHSW04-R01	0.051	0 / 4	0.69	NO
MERCURY, DISSOLVED	0.0162 - 0.016	2 / 4	0.0303	NDAHSW03-R01	0.051	0 / 4	0.59	NO
NICKEL	19.9 - 19.9	0 / 4	--	--	8.2	-- / --	2.43	--[3]
NICKEL, DISSOLVED	19.9 - 19.9	0 / 4	--	--	8.2	-- / --	2.43	--[3]
POTASSIUM [2]	-- - --	4 / 4	482000	NDAHSW03-R01	NSV	-- / --	NSV	NO
POTASSIUM, DISSOLVED [2]	-- - --	4 / 4	486000	NDAHSW01-R01	NSV	-- / --	NSV	NO
SELENIUM	42 - 42	1 / 4	63.9	NDAHSW02-R01	71	0 / 4	0.90	NO
SELENIUM, DISSOLVED	42 - 42	1 / 4	67.9	NDAHSW01-R01	71	0 / 4	0.96	NO
SILVER	9.44 - 9.44	0 / 4	--	--	1.9	-- / --	4.97	--[3]
SILVER, DISSOLVED	9.44 - 9.44	0 / 4	--	--	1.9	-- / --	4.97	--[3]
SODIUM [2]	-- - --	4 / 4	7680000	NDAHSW01-R01	NSV	-- / --	NSV	NO
SODIUM, DISSOLVED [2]	-- - --	4 / 4	7750000	NDAHSW01-R01	NSV	-- / --	NSV	NO
THALLIUM	50.8 - 50.8	0 / 4	--	--	NSV	-- / --	NSV	NO
THALLIUM, DISSOLVED	50.8 - 50.8	0 / 4	--	--	NSV	-- / --	NSV	NO
VANADIUM	8.94 - 8.94	0 / 4	--	--	NSV	-- / --	NSV	NO
VANADIUM, DISSOLVED	8.94 - 8.94	0 / 4	--	--	NSV	-- / --	NSV	NO
ZINC	8.18 - 8.18	0 / 4	--	--	81	-- / --	0.10	NO
ZINC, DISSOLVED	8.18 - 8.18	0 / 4	--	--	81	-- / --	0.10	NO
Pesticides (UG/L)								
ALDRIN	0.0099 - 0.01	0 / 4	--	--	0.0014	-- / --	7.14	--[3]
ALPHA BHC (ALPHA HEXACHLOROCYC	0.0099 - 0.01	0 / 4	--	--	NSV	-- / --	NSV	NO
ALPHA ENDOSULFAN	0.0099 - 0.01	0 / 4	--	--	0.056	-- / --	0.18	NO
ALPHA-CHLORDANE	0.0099 - 0.01	0 / 4	--	--	NSV	-- / --	NSV	NO
BETA BHC (BETA HEXACHLOROCYCLO	0.0099 - 0.01	0 / 4	--	--	NSV	-- / --	NSV	NO
BETA ENDOSULFAN	0.02 - 0.02	0 / 4	--	--	0.056	-- / --	0.36	NO
DELTA BHC (DELTA HEXACHLOROCYCI	0.0099 - 0.01	0 / 4	--	--	NSV	-- / --	NSV	NO
DIELDRIN	0.02 - 0.02	0 / 4	--	--	0.0014	-- / --	14	--[3]
ENDOSULFAN SULFATE	0.02 - 0.02	0 / 4	--	--	NSV	-- / --	NSV	NO
ENDRIN	0.02 - 0.02	0 / 4	--	--	0.0023	-- / --	8.70	--[3]

TABLE 7-12
Step 2 Screening Statistics and COPC Selection - AOC H - Surface Water
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
ENDRIN ALDEHYDE	0.02 - 0.02	0 / 4	--	--	NSV	-- / --	NSV	NO
ENDRIN KETONE	0.02 - 0.02	0 / 4	--	--	NSV	-- / --	NSV	NO
GAMMA BHC (LINDANE)	0.0099 - 0.01	0 / 4	--	--	0.16	-- / --	0.06	NO
GAMMA-CHLORDANE	0.0099 - 0.01	0 / 4	--	--	NSV	-- / --	NSV	NO
HEPTACHLOR	0.0099 - 0.01	0 / 4	--	--	0.0021	-- / --	4.76	--[3]
HEPTACHLOR EPOXIDE	0.0099 - 0.01	0 / 4	--	--	0.0036	-- / --	2.78	--[3]
METHOXYCHLOR	0.099 - 0.1	0 / 4	--	--	0.03	-- / --	3.33	--[3]
p,p'-DDD	0.02 - 0.02	0 / 4	--	--	NSV	-- / --	NSV	NO
p,p'-DDE	0.02 - 0.02	0 / 4	--	--	NSV	-- / --	NSV	NO
p,p'-DDT	0.02 - 0.02	0 / 4	--	--	0.001	-- / --	20	--[3]
TOXAPHENE	0.05 - 0.051	0 / 4	--	--	0.0002	-- / --	255	--[3]
Semi-volatile Organic Compounds (UG/L)								
2,4,5-TRICHLOROPHENOL	20.2 - 20.5	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4,6-TRICHLOROPHENOL	5 - 5.1	0 / 4	--	--	21	-- / --	0.24	NO
2,4-DICHLOROPHENOL	5 - 5.1	0 / 4	--	--	93	-- / --	0.05	NO
2,4-DIMETHYLPHENOL	5 - 5.1	0 / 4	--	--	540	-- / --	0.01	NO
2,4-DINITROPHENOL	20.2 - 20.5	0 / 4	--	--	70	-- / --	0.29	NO
2,4-DINITROTOLUENE	5 - 5.1	0 / 4	--	--	0.11	-- / --	46	--[3]
2,6-DINITROTOLUENE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
2-CHLORONAPHTHALENE	5 - 5.1	0 / 4	--	--	1700	-- / --	0.003	NO
2-CHLOROPHENOL	5 - 5.1	0 / 4	--	--	120	-- / --	0.04	NO
2-METHYLNAPHTHALENE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
2-METHYLPHENOL (o-CRESOL)	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
2-NITROANILINE	20.2 - 20.5	0 / 4	--	--	NSV	-- / --	NSV	NO
2-NITROPHENOL	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
3,3'-DICHLOROBENZIDINE	5 - 5.1	0 / 4	--	--	0.4	-- / --	13	--[3]
3-NITROANILINE	20.2 - 20.5	0 / 4	--	--	NSV	-- / --	NSV	NO
4,6-DINITRO-2-METHYLPHENOL	20.2 - 20.5	0 / 4	--	--	NSV	-- / --	NSV	NO
4-BROMOPHENYL PHENYL ETHER	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
4-CHLORO-3-METHYLPHENOL	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO

TABLE 7-12

Step 2 Screening Statistics and COPC Selection - AOC H - Surface Water

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
4-CHLOROANILINE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
4-CHLOROPHENYL PHENYL ETHER	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
4-METHYLPHENOL (p-CRESOL)	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
4-NITROANILINE	20.2 - 20.5	0 / 4	--	--	NSV	-- / --	NSV	NO
4-NITROPHENOL	20.2 - 20.5	0 / 4	--	--	NSV	-- / --	NSV	NO
ACENAPHTHENE	5 - 5.1	0 / 4	--	--	1200	-- / --	0.004	NO
ACENAPHTHYLENE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
ACETOPHENONE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
ANTHRACENE	5 - 5.1	0 / 4	--	--	9600	-- / --	0.001	NO
ATRAZINE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
Benzaldehyde	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
BENZO(a)ANTHRACENE	5 - 5.1	0 / 4	--	--	0.044	-- / --	116	--[3]
BENZO(a)PYRENE	5 - 5.1	0 / 4	--	--	0.044	-- / --	116	--[3]
BENZO(b)FLUORANTHENE	5 - 5.1	0 / 4	--	--	0.044	-- / --	116	--[3]
BENZO(g,h,i)PERYLENE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
BENZO(k)FLUORANTHENE	5 - 5.1	0 / 4	--	--	0.044	-- / --	116	--[3]
BENZYL BUTYL PHTHALATE	5 - 5.1	0 / 4	--	--	3000	-- / --	0.002	NO
BIPHENYL (DIPHENYL)	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
bis(2-CHLOROETHOXY) METHANE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
bis(2-CHLOROETHYL) ETHER (2-CHLOR	5 - 5.1	0 / 4	--	--	0.31	-- / --	16	--[3]
bis(2-CHLOROISOPROPYL) ETHER	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
bis(2-ETHYLHEXYL) PHTHALATE	10.1 - 10.2	0 / 4	--	--	18	-- / --	0.57	NO
CAPROLACTAM	-- - --	1 / 1	0.52	NDAHSW01-R01	NSV	-- / --	NSV	**YES**
CARBAZOLE	10.1 - 10.2	0 / 4	--	--	NSV	-- / --	NSV	NO
CHRYSENE	5 - 5.1	0 / 4	--	--	0.044	-- / --	116	--[3]
DI-n-BUTYL PHTHALATE	5 - 5.1	0 / 4	--	--	2700	-- / --	0.002	NO
DI-n-OCTYLPHTHALATE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
DIBENZ(a,h)ANTHRACENE	5 - 5.1	0 / 4	--	--	0.044	-- / --	116	--[3]
DIBENZOFURAN	5 - 5.1	0 / 4	--	--	1000	-- / --	0.01	NO
DIETHYL PHTHALATE	5 - 5.1	0 / 4	--	--	23000	-- / --	0.0002	NO

TABLE 7-12

Step 2 Screening Statistics and COPC Selection - AOC H - Surface Water

AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
DIMETHYL PHTHALATE	5 - 5.1	0 / 4	--	--	313000	-- / --	0.00002	NO
FLUORANTHENE	5 - 5.1	0 / 4	--	--	300	-- / --	0.02	NO
FLUORENE	5 - 5.1	0 / 4	--	--	1300	-- / --	0.004	NO
HEXACHLOROBENZENE	5 - 5.1	0 / 4	--	--	0.0075	-- / --	680	--[3]
HEXACHLOROBUTADIENE	5 - 5.1	0 / 4	--	--	4.4	-- / --	1.16	--[3]
HEXACHLOROCYCLOPENTADIENE	5 - 5.1	0 / 4	--	--	240	-- / --	0.02	NO
HEXACHLOROETHANE	5 - 5.1	0 / 4	--	--	19	-- / --	0.27	NO
INDENO(1,2,3-c,d)PYRENE	5 - 5.1	0 / 4	--	--	0.044	-- / --	116	--[3]
ISOPHORONE	5 - 5.1	0 / 4	--	--	360	-- / --	0.01	NO
N-NITROSODI-n-PROPYLAMINE	5 - 5.1	0 / 4	--	--	0.05	-- / --	102	--[3]
N-NITROSODIPHENYLAMINE	5 - 5.1	0 / 4	--	--	50	-- / --	0.10	NO
NAPHTHALENE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
NITROBENZENE	5 - 5.1	0 / 4	--	--	17	-- / --	0.30	NO
PENTACHLOROPHENOL	20.2 - 20.5	0 / 4	--	--	7.9	-- / --	2.59	--[3]
PHENANTHRENE	5 - 5.1	0 / 4	--	--	NSV	-- / --	NSV	NO
PHENOL	5 - 5.1	0 / 4	--	--	21000	-- / --	0.0002	NO
PYRENE	5 - 5.1	0 / 4	--	--	960	-- / --	0.01	NO
Explosives (UG/L)								
1,3,5-TRINITROBENZENE	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
1,3-DINITROBENZENE	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4,6-TRINITROTOLUENE	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4-DINITROTOLUENE	2.5 - 2.5	0 / 4	--	--	0.11	-- / --	23	--[3]
2,6-DINITROTOLUENE	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
2-NITROTOLUENE	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
3-NITROTOLUENE	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
4-NITROTOLUENE	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
HEXAHYDRO-1,3,5-TRINITRO-1,3,5,7-TE	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
NITROBENZENE	2.5 - 2.5	0 / 4	--	--	17	-- / --	0.15	NO
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO
Perchlorate	20 - 20	0 / 4	--	--	NSV	-- / --	NSV	NO

TABLE 7-12
Step 2 Screening Statistics and COPC Selection - AOC H - Surface Water
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
TETRYL	2.5 - 2.5	0 / 4	--	--	NSV	-- / --	NSV	NO

NSV - No screening value
1 - Maximum HQ based on maximum concentration detected unless frequency of detection is zero, in which case it is based on maximum reporting limit - indicated by shaded cells.
2 - Macronutrient - Not considered to be a COPC.
3 - Chemical not detected, however detection limit exceeded screening value. Chemical not retained as COPC - see Section 7.5 (Uncertainties)

TABLE 7-13
Step 2 Screening Statistics and COPC Selection - AOC H - Sediment
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
Inorganics (MG/KG)								
ALUMINUM	-- - --	4 / 4	3320	NDAHSD01-R01	NSV	-- / --	NSV	**YES**
ANTIMONY	0.0817 - 0.0829	2 / 4	0.333	NDAHSD01-R01	12	0 / 4	0.03	NO
ARSENIC	0.132 - 0.132	3 / 4	0.882	NDAHSD01-R01	7.24	0 / 4	0.12	NO
BARIUM	-- - --	4 / 4	57.2	NDAHSD02-R01	NSV	-- / --	NSV	**YES**
BERYLLIUM	-- - --	4 / 4	0.0647	NDAHSD02-R01	NSV	-- / --	NSV	**YES**
CADMIUM	0.0104 - 0.0121	0 / 4	--	--	1.2	-- / --	0.01	NO
CALCIUM [2]	-- - --	4 / 4	2660	NDAHSD02-R01	NSV	-- / --	NSV	NO
CHROMIUM, TOTAL	-- - --	4 / 4	13.4	NDAHSD01-R01	81	0 / 4	0.17	NO
COBALT	-- - --	4 / 4	4.27	NDAHSD04-R01	NSV	-- / --	NSV	**YES**
COPPER	-- - --	4 / 4	9.76	NDAHSD02-R01	18.7	0 / 4	0.52	NO
IRON	-- - --	4 / 4	8620	NDAHSD04-R01	NSV	-- / --	NSV	**YES**
LEAD	-- - --	4 / 4	1.49	NDAHSD02-R01	30.2	0 / 4	0.05	NO
MAGNESIUM [2]	-- - --	4 / 4	3430	NDAHSD01-R01	NSV	-- / --	NSV	NO
MANGANESE	-- - --	4 / 4	109	NDAHSD02-R01	NSV	-- / --	NSV	**YES**
MERCURY	0.00134 - 0.00134	3 / 4	0.0127	NDAHSD02-R01	0.13	0 / 4	0.10	NO
NICKEL	-- - --	4 / 4	4.39	NDAHSD01-R01	15.9	0 / 4	0.28	NO
POTASSIUM [2]	-- - --	4 / 4	1090	NDAHSD04-R01	NSV	-- / --	NSV	NO
SELENIUM	0.163 - 0.19	0 / 4	--	--	NSV	-- / --	NSV	NO
SILVER	0.0197 - 0.023	1 / 4	0.0268	NDAHSD04-R01	2	0 / 4	0.01	NO
SODIUM [2]	-- - --	4 / 4	3290	NDAHSD01-R01	NSV	-- / --	NSV	NO
THALLIUM	0.0998 - 0.0998	3 / 4	0.494	NDAHSD02-R01	NSV	-- / --	NSV	**YES**
VANADIUM	-- - --	4 / 4	26.9	NDAHSD02-R01	NSV	-- / --	NSV	**YES**
ZINC	-- - --	4 / 4	13.6	NDAHSD04-R01	124	0 / 4	0.11	NO
Pesticides (MG/KG)								
ALDRIN	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO
ALPHA BHC (ALPHA HEXACHLOROCYCLO	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO
ALPHA ENDOSULFAN	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO
ALPHA-CHLORDANE	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO
BETA BHC (BETA HEXACHLOROCYCLOHE	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO

TABLE 7-13
Step 2 Screening Statistics and COPC Selection - AOC H - Sediment
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
BETA ENDOSULFAN	0.0043 - 0.0045	0 / 4	--	--	NSV	-- / --	NSV	NO
DELTA BHC (DELTA HEXACHLOROCYCLO	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO
DIELDRIN	0.0043 - 0.0045	0 / 4	--	--	0.0033	-- / --	1.36	--[3]
ENDOSULFAN SULFATE	0.0043 - 0.0045	0 / 4	--	--	NSV	-- / --	NSV	NO
ENDRIN	0.0043 - 0.0045	0 / 4	--	--	0.0033	-- / --	1.36	--[3]
ENDRIN ALDEHYDE	0.0043 - 0.0045	0 / 4	--	--	NSV	-- / --	NSV	NO
ENDRIN KETONE	0.0043 - 0.0045	0 / 4	--	--	NSV	-- / --	NSV	NO
GAMMA BHC (LINDANE)	0.0022 - 0.0023	0 / 4	--	--	0.0033	-- / --	0.70	NO
GAMMA-CHLORDANE	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO
HEPTACHLOR	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO
HEPTACHLOR EPOXIDE	0.0022 - 0.0023	0 / 4	--	--	NSV	-- / --	NSV	NO
METHOXYCHLOR	0.022 - 0.023	0 / 4	--	--	NSV	-- / --	NSV	NO
p,p'-DDD	0.0043 - 0.0045	0 / 4	--	--	0.0033	-- / --	1.36	--[3]
p,p'-DDE	0.0043 - 0.0045	1 / 4	0.00012	NDAHSD04-R01	0.0033	0 / 4	0.04	NO
p,p'-DDT	0.0043 - 0.0045	0 / 4	--	--	0.0033	-- / --	1.36	--[3]
TOXAPHENE	0.22 - 0.23	0 / 4	--	--	NSV	-- / --	NSV	NO
Semi-volatile Organic Compounds (MG/KG)								
2,4,5-TRICHLOROPHENOL	1.26 - 1.33	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4,6-TRICHLOROPHENOL	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4-DICHLOROPHENOL	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4-DIMETHYLPHENOL	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4-DINITROPHENOL	1.26 - 1.33	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4-DINITROTOLUENE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
2,6-DINITROTOLUENE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
2-CHLORONAPHTHALENE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
2-CHLOROPHENOL	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
2-METHYLNAPHTHALENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
2-METHYLPHENOL (o-CRESOL)	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
2-NITROANILINE	1.26 - 1.33	0 / 4	--	--	NSV	-- / --	NSV	NO
2-NITROPHENOL	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO

TABLE 7-13
Step 2 Screening Statistics and COPC Selection - AOC H - Sediment
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
3,3'-DICHLOROBENZIDINE	0.856 - 0.903	0 / 4	--	--	NSV	-- / --	NSV	NO
3-NITROANILINE	1.26 - 1.33	0 / 4	--	--	NSV	-- / --	NSV	NO
4,6-DINITRO-2-METHYLPHENOL	1.26 - 1.33	0 / 4	--	--	NSV	-- / --	NSV	NO
4-BROMOPHENYL PHENYL ETHER	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
4-CHLORO-3-METHYLPHENOL	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
4-CHLOROPHENYL PHENYL ETHER	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
4-METHYLPHENOL (p-CRESOL)	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
4-NITROANILINE	1.26 - 1.33	0 / 4	--	--	NSV	-- / --	NSV	NO
4-NITROPHENOL	1.26 - 1.33	0 / 4	--	--	NSV	-- / --	NSV	NO
ACENAPHTHENE	0.422 - 0.445	0 / 4	--	--	0.016	-- / --	28	--[3]
ACENAPHTHYLENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
ACETOPHENONE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
ANTHRACENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
ATRAZINE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
Benzaldehyde	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
BENZO(a)ANTHRACENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
BENZO(a)PYRENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
BENZO(b)FLUORANTHENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
BENZO(g,h,i)PERYLENE	0.422 - 0.445	0 / 4	--	--	0.655	-- / --	0.68	NO
BENZO(k)FLUORANTHENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
BENZYL BUTYL PHTHALATE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
BIPHENYL (DIPHENYL)	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
bis(2-CHLOROETHYL) ETHER (2-CHLORO	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
bis(2-CHLOROISOPROPYL) ETHER	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
bis(2-ETHYLHEXYL) PHTHALATE	0.422 - 0.445	0 / 4	--	--	0.182	-- / --	2.45	--[3]
CAPROLACTAM	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
CARBAZOLE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
CHRYSENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
DI-n-BUTYL PHTHALATE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO

TABLE 7-13
Step 2 Screening Statistics and COPC Selection - AOC H - Sediment
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
DI-n-OCTYLPHTHALATE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
DIBENZ(a,h)ANTHRACENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
DIBENZOFURAN	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
DIETHYL PHTHALATE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
DIMETHYL PHTHALATE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
FLUORANTHENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
FLUORENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
HEXACHLOROBENZENE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
HEXACHLOROCYCLOPENTADIENE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
INDENO(1,2,3-c,d)PYRENE	0.422 - 0.445	0 / 4	--	--	0.665	-- / --	0.67	NO
ISOPHORONE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
N-NITROSODI-n-PROPYLAMINE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
N-NITROSODIPHENYLAMINE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
NITROBENZENE	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
PENTACHLOROPHENOL	1.26 - 1.33	0 / 4	--	--	0.36	-- / --	3.69	--[3]
PHENANTHRENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
PHENOL	0.422 - 0.445	0 / 4	--	--	NSV	-- / --	NSV	NO
PYRENE	0.422 - 0.445	0 / 4	--	--	0.33	-- / --	1.35	--[3]
Explosives (MG/KG)								
1,3,5-TRINITROBENZENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
1,3-DINITROBENZENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4,6-TRINITROTOLUENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
2,4-DINITROTOLUENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
2,6-DINITROTOLUENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
2-NITROTOLUENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
3-NITROTOLUENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
4-NITROTOLUENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
HEXAHYDRO-1,3,5-TRINITRO-1,3,5,7-TETR	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
NITROBENZENE	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO

TABLE 7-13
Step 2 Screening Statistics and COPC Selection - AOC H - Sediment
AOC H, Former NASD, Vieques, Puerto Rico

Chemical	Detection Limit Range for Non-detects	Frequency of Detection	Maximum Concentration Detected	Sample ID of Maximum Concentration	Screening Value	Frequency of Exceedance	Maximum Hazard Quotient [1]	COPC?
OCTAHYDRO-1,3,5,7-TETRANITRO-1,3,5,7-	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO
Perchlorate	0.105 - 0.115	0 / 4	--	--	NSV	-- / --	NSV	NO
TETRYL	0.158 - 0.166	0 / 4	--	--	NSV	-- / --	NSV	NO

NSV - No screening value
1 - Maximum HQ based on maximum concentration detected unless frequency of detection is zero, in which case it is based on maximum reporting limit - indicated by shaded cells.
2 - Macronutrient - Not considered to be a COPC.
3 - Chemical not detected, however detection limit exceeded screening value. Chemical not retained as COPC - see Section 7.5 (Uncertainties)

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
19	ERA assumptions and uncertainties	Section 2.5.2	CH2M HILL. Final Remedial Investigation Report Area of Concern (AOC) H Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. Section 7.4, pages 7-21 through 7-24. July 2007.

Except for barium, all other inorganics were below background levels. Barium is not widely distributed, exceeded basewide background in only one sample, and does not have a literature screening value available; thus the potential for unacceptable risk is likely to be low, and therefore it was not considered further as a COPC.

Beryllium and thallium were identified as PCOCs in sediment from AOC H. Onsite concentrations of these parameters were compared to concentrations in an upgradient sediment sample in Table 7-25. Ratios were developed for comparing maximum site concentrations with upgradient sediment concentrations. Maximum site concentrations of beryllium slightly exceeded the upgradient concentration (ratio of 1.02), while maximum site concentrations of thallium were below the upgradient concentration (ratio 0.4). Because these inorganics were comparable to or below background conditions, they are not likely to pose unacceptable risk to directly exposed aquatic organisms, and therefore they will not be considered further as PCOCs.

7.3.3.4 Food Web Exposures

The results of the food web exposure modeling identified no COCs. Based upon a comparison to LOAELs, no HQ exceeded one for any of the terrestrial or aquatic receptors. Only the HQ for zinc (pearly-eyed thrasher) exceeded one based upon the NOAEL (HQ of 1.73). The ingestion screening value for zinc used in the HQ calculation was based upon a 44-week chronic study with chickens; endpoints were based upon reproductive effects. The experiment-derived NOAEL (14.5 mg/kg/day) was about a factor of nine lower than the experiment-derived LOAEL (131 mg/kg/day). The actual threshold of an effect is somewhere between the NOAEL and LOAEL. This threshold is often estimated by calculating the geometric mean of the NOAEL and LOAEL. For zinc, this value (43.6 mg/kg/day) would not be exceeded by the calculated dose for the pearly-eyed thrasher, suggesting no unacceptable risk.

7.3.3.5 Summary of COCs

In summary, none of the COPCs carried forward from Step 2 were considered as final COCs following the Step 3A refinement. Although some metals and a few organic chemicals were identified as COPCs, risks to lower trophic level receptors were negligible based on low magnitude of screening value exceedances and comparisons to background/upgradient data. Also, no significant risks were identified for upper trophic level wildlife from potential food web exposures.

7.4 Uncertainties

Uncertainties are present in all risk assessments because of the limitations of the available data and the need to make certain assumptions and extrapolations based upon incomplete information. The uncertainty in this ERA is mainly attributable to the following factors:

- Reporting Limits - Reporting limits for some undetected analytes exceeded applicable screening values in some media. Because these chemicals were not detected, they are not known to be present on the site but the potential for unacceptable risks cannot be totally discounted because the reporting limits are higher than the screening values.

- Selection of COPCs - Chemicals without available screening values for a medium were not retained as COPCs in the SERA portion of the assessment unless they were detected. This could result in an underestimation of risks if these chemicals are actually present on the site at ecologically significant concentrations. For the Step 2 screen: (1) 1 pesticide, 12 SVOCs, and 3 VOCs detected in surface soil lacked screening values; (2) 4 inorganics and 1 SVOC detected in surface water lacked screening values; and (3) 8 inorganics detected in sediment lacked screening values. These chemicals were evaluated in Step 3 through a combination of background/upgradient comparisons and a comparison to toxicological information from the literature. Thus, the uncertainty associated with the lack of screening values for these detected chemicals is low because there were other, relevant data that allowed them to be evaluated.

- Evaluation of Soils - The quantitative evaluation of chemical concentrations in soils was restricted to surface soils from the 0- to 6-inch depth range, where the highest exposures for most ecological receptors would be expected to occur.

- Ingestion Screening Values - Data on the toxicity of many chemicals to the receptor species were sparse or lacking, requiring the extrapolation of data from other wildlife species or from laboratory studies with nonwildlife species. This is a typical limitation and extrapolation for ecological risk assessments because so few wildlife species have been tested directly for most chemicals. The uncertainties associated with toxicity extrapolation were minimized through the selection of the most appropriate test species for which suitable toxicity data were available. The factors considered in selecting a test species to represent a receptor species included taxonomic relatedness, trophic level, foraging method, and similarity of diet.

  A second uncertainty related to the derivation of ingestion screening values applies to metals. Most of the toxicological studies on which the ingestion screening values for metals were based used forms of the metal (such as salts) that have high water solubility and high bioavailability to receptors. Since the analytical samples on which site-specific exposure estimates were based measured total metal, regardless of form, and these highly bioavailable forms are expected to compose only a fraction of the total metal concentration, this is likely to result in an overestimation of potential risks for these chemicals.

  A third source of uncertainty associated with the derivation of ingestion screening values concerns the use of uncertainty factors. For example, NOAELs were extrapolated to LOAELs using an uncertainty factor of ten. This approach is likely to be conservative since Dourson and Stara (1983) determined that 96 percent of the chemicals included in a data review had LOAEL/NOAEL ratios of five or less. The use of an uncertainty factor of 10, although potentially conservative, also serves to counter some of the uncertainty associated with interspecies extrapolations, for which a specific uncertainty factor was not used.

- Chemical Mixtures - Information on the ecotoxicological effects of chemical interactions is generally lacking, which required (as is standard for ecological risk assessments) that the chemicals be evaluated on a compound-by-compound basis during the comparison to screening value. This could result in an underestimation of risk (if there are additive

or synergistic effects among chemicals) or an overestimation of risks (if there are antagonistic effects among chemicals).

- Receptor Species Selection - Reptiles were selected as receptors in the ERA, but were not evaluated quantitatively even when exposure pathways were complete. These taxa were evaluated using other fauna (birds and mammals) as surrogates due to the general lack of taxon-specific toxicological data. This represents an uncertainty in the assessment

  It was also assumed that reptiles were not exposed to significantly higher concentrations of chemicals and were not more sensitive to chemicals than the other receptor species evaluated. This assumption was a source of uncertainty in the ERA. In addition, there is some uncertainty associated with the use of specific receptor species to represent larger groups of organisms (e.g., guilds).

- Food Web Exposure Modeling - Chemical concentrations in terrestrial and aquatic food items (plants, earthworms, small mammals, benthic invertebrates, and fish) were modeled from measured media concentrations and were not directly measured. The use of generic, literature-derived exposure models and bioaccumulation factors introduces some uncertainty into the resulting estimates. The values selected and methodology employed were intended to provide a conservative (SERA) or realistic (Step 3A) estimate of potential food web exposure concentrations.

  Another source of uncertainty is the use of default assumptions for exposure parameters such as BCFs and BAFs. Although BCFs or BAFs for many bioaccumulative chemicals were readily available from the literature and were used in the ERA, the use of a default factor of 1.0 to estimate the concentration of some chemicals in receptor prey items is a source of uncertainty.

  Area use factors were assumed to equal 1.0 in the Screening Exposure Estimation. This is a conservative assumption since a significant percentage of each upper trophic level receptor species time could be spent foraging offsite in unimpacted areas or areas where chemical concentrations are expected to be significantly lower.

- Total Versus Dissolved Metals - EPA guidance (EPA, 1996b) indicates that the dissolved metal fraction should be preferentially used to the total metal fraction in surface water screening. Both total and dissolved concentrations were used in the ERA for the surface water screen. High levels of suspended solids and sediment-adsorbed metals would result in overstating bioavailable water concentrations and thus potential exposures and risks.

- Mean Versus Maximum Media Concentrations - As is typical in an ERA, a finite number of samples of environmental media are used to develop the exposure estimates. The maximum measured concentration provides a conservative estimate for immobile biota or those with a limited home range. The most realistic exposure estimates for mobile species with relatively large home ranges and for species populations (even those that are immobile or have limited home ranges) are those based upon the mean chemical concentrations in each medium to which these receptors are exposed. This is reflected in the wildlife dietary exposure models contained in the Wildlife Exposure Factors Handbook (EPA, 1993), which specify the use of average media concentrations. Given the mobility of the upper trophic level receptor species used in the ERA, the use of

maximum chemical concentrations (rather than mean concentrations) in the SERA to estimate the exposure via food webs is very conservative. This conservatism was reduced to more realistic levels in the values selected for use in the Step 3A evaluation.

- Comparisons to Background/Upgradient Concentrations - Background or upgradient concentrations were used to judge the site-relatedness of individual chemicals in particular media. If site chemical concentrations were consistent with these levels, it was assumed that the concentrations were not site-related. There exists the possibility that concentrations below background or reference were indeed site-related, rendering the assumption false. However the impact of this possibility is minimal since chemicals at concentrations consistent with background or reference conditions should exhibit no different ecological effects than commonly occurring in areas not affected by releases, regardless of their source.

  A single background sediment sample was collected for AOC H. This sample was collected from the stream in an area that was upgradient of potential influences from AOC H. It is appropriate to conclude that there is a range of concentrations attributable to background for any inorganic constituent, and that the datum for a particular constituent from a single background sample represents only one point in that range. Therefore, the single sediment sample collected upstream of AOC H represents a single point in the range of background sediment conditions for the site. The uncertainty associated with use of the single data point as representative of background is relatively low because the upgradient comparison was only used for two inorganics (beryllium and thallium), neither of which is likely site-related.

- Spatial Distribution of Samples - The number and spatial distribution of the analytical samples were sufficient to adequately estimate potential ecological risks. Thirty-three soil samples were collected from AOC H which is approximately 2 acres in size. These samples surrounded and were in close proximity to the former power plant facility. Four surface water and sediment samples were collected from the adjacent ephemeral stream, which was approximately 300 feet long.

Item	Reference Phrase in ROD[1]	Location in ROD	Identification of Referenced Document Available in the Administrative Record[1]
20	meeting transcript	Section 3	CH2M HILL. Proposed Plan, Area of Concern H, Former Naval Ammunition Support Detachment, Vieques Island, Puerto Rico. March 2008.

DEPARTMENT OF THE NAVY
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

PUBLIC MEETING REGARDING
PROPOSED PLAN FOR THE FORMER POWER PLANT
in Western Vieques, Puerto Rico
(Area of Concern AOCH)

(Transcript of English proceedings and simultaneous interpretation of Spanish proceedings)

Date: February 7, 2008, 5:00 p.m.
Place: Centro de Usos M£ltiples
Antonio G. Mellado St.
Vieques, Puerto Rico
Moderator: SUSANA STRUVE

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PROCEEDINGS

MS. STRUVE: (Through the interpreter) Susan Struve, opening--- the west Vieques area of concern H proposed plan.

MR. DOER: Hi, my name is Brett Doer, I'm with CH2M Hill, we're the Navy's environmental restoration program contractor for--- for Vieques.

The purpose of tonight's public meeting is to present the--- what is referred to as a proposed plan for area of concern H. The proposed plan summarizes a history of the site, the work that's been done there, the environmental investigations that have been done, the evaluation of the data that's taken place, the conclusions that were drawn based on those data, and then, the ultimate recommendations. So that's what we're going to cover.

In the back of the room, there is a stack of proposed plans, one stack in English, one stack in Spanish, there's also a few Cds, if folks want to take an electronic copy home with them; so, hopefully, each one of you should be able to pick one of the proposed plan. This goes into much more detail than I go in tonight.

Really, really, this meeting is for the public to--- if you have any particular questions or comments, you want to talk about this, it's--- it's not so much designed for me to stand up here and--- and--- and read this to you, or explain the whole thing to you.

I'm really just going to kind of touch on some of some of the highlights that are contained in the proposed plan. The proposed plan is a summary of what's happened in the past. There's much more detail in the documents that this proposed plan references, and primarily, a remedial investigation report that is available in the public depository.

The--- this public meeting will be recorded, a transcript will be produced from the--- ah--- from the recording, and that transcript will be included as an appendix to the record of decision. That will be the next step from this process. The proposed plan, as the same implies, is what the agencies are proposing to do with this particular site. That is formalized in what is referred to as a record of decision, also known as the ROD. The transcript from this public meeting will be included as appendix to that ROD.

In addition to that, responses to sev--- to comments that are received during--- questions and comments that are received during the forty five day public comment period will also be included as an appendix to the record of decision.

You know, feel free to ask questions as I go through this. You don't need to hold questions or comments till the end, if you--- if you'd like to--- to discuss anything or comment anything as I go through, please, just raise your hand and we'll do it. The only thing I ask you is, because this being recorded, and a transcript is going to be prepared from this, we will need to identify who the speaker is, so each time the microphone changes hands, please, state your name for the record, and then, ask your question. OK.?

OK. The AOC, area of concern, we also refer to as AOC, AOC H was a former power plant. It--- it--- a very--- a sort of very small size power plant, it only occupied an area of about a half an acre, from 1941 to '43, they used it to

house power generation equipment, so the--- you know, they had generators, they had--- ah--- they were diesel generators, so they had the diesel tanks that--- that they used to power the generators. That all ended in 1943. Didn't really last that long. In '43, everything was kind of cleared out of there. They took all the equipment out, and the buildings and the surrounding areas are vacant--you know--for almost twenty years.

In the 1960s--- from the 1960s to part of the 1980s, they used the building as fire training. What they were trying to do is simulate--- ah--- what a structural fire would be like, and so, they put tires inside the building, doused them with a fuel, and set them on fire, and they would put them out.

Next slide.

This is--- this picture on the right is--- This is what the site looks like currently. I think we took this picture--- I don't know, a few weeks ago. The area's been--- been cleared off, and you can see there--- there's the old--- ah--- the old power plant building. It's a very small, concrete building, dirt floor inside.

The site here is shown--- This will show you where the site is relative to west Vieques. Everything over here is the former naval ammunition support detachment, also sometimes referred to as NASD, also sometimes referred to as west Vieques, shows you where all the other environmental sites are out there, shows the various property owners, and here's AOC H, just north of route 200, very close to the--- This whole main operational area, which is now public works area.

One more down on this one, John.

Ah, no, no, go back to the--- Yes.

This is an aerial photograph taken in 1994, just showing the proximate area. Here's the ocean highway 200, and the little cleared area's where you see H is. And this is a little ephemeral stream that runs down. That doesn't connect to the ocean. The beach provides--- basically, it becomes--- a sandbar blocks the entrance of this little ephemeral stream. But usually is water down in that ditch.

OK.

And let's on to the next one. OK.

Number of investigations took place at the site over the years. In 2000, the Navy conducted an environmental baseline survey. The primary purpose of the environmental baseline survey was to evaluate the conditions of all the Navy property, in preparation for the transfer that was going to take place.

At that time, they--- they did take some PCB wipe samples--- ah--- There--- there is really no record of whether there was transformers there, in the building, or not, but in the--- in the chance that there was transformers there, they--- Sometimes, transformers contain PCBs, they wanted to do a PCB sampling, so they took wipe samples inside the building. It's a cloth material you wipe on the--- on the concrete, to see if--- ah--- there's any PCB residue. And they didn't detect any then.

They also began what was referred to as expanded preliminary assessment site investigation. During that investigation, they installed a number of monitoring wells, and

they collected surface and subsurface soil samples, and they collected ground water samples from the monitoring wells. We'll talk about the data in the subsequent slide.

They also conducted an ecological survey. They went out there EE College went out there, looked at the layout of the land, looked to see if there was viable habitat, looked for stressed vegetation, looked for any potential impacts on the ecology, and looked to see if there's any protected or endangered species out there. They didn't identified any--- any--- that there were any ecological impacts at the site.

And to--- But throughout this process, a full remedial investigation was recommended. Primary purpose of the remedial investigation is to further evaluate the nature and extent of contaminants, and then, to perform full quantitative human health and ecological risks assessments.

And so, that work was done in 2003. As part of that, the remedial investigation, they installed two more wells, they took some more soil samples, they took surface water and sediment samples from that ephemeral stream adjacent to the site.

OK.

And this is what they found. In a nutshell, and it's--- Much more detail is provided in the remedial investigation report, if you're interested in looking at the details of every single sample that was collected out there. But in a nutshell, very little levels of constituents were identified, and very few of them were likely contaminants.

We did find a few--- ah--- volatile organic compounds, semi volatile organic compounds, some pesticides, but very few of what was found actually exceeded screening criteria. And when I say screening criteria, the several types of screening criteria that you screen data against; there's ecological values, there's human health values, there's what's called soil screening levels, that's leeching the ground water, screening criteria.

And the reason you compare the screening criteria is to determine whether you should do a further evaluation. Simply exceeding screening criteria doesn't mean that there is a problem. It just means you should do a little bit more quantitative evaluation before you come to your conclusions.

So, there were a few things in the surface soil that exceeded some screening criteria. In ground water, there was a few that exceeded screening criteria as well, and very little, not much, in the surface water sediment.

Nonetheless, the data were then taken and full, quantitative human health and ecological risk assessments were performed.

You want to go on to the next slide, please?

A risk assessment evaluates several what they call scenarios. Those scenarios may never, ever existed at the site, but are done so that you can ensure that any potential use of that site is evaluated. So, for example, you look at recreational use. If the site was going to be used in a--- you know, by recreators; they come out there and go to a pick-nick, or they play in the ephemeral stream, if you were building construction on the site; if you were to have a residence, actually move in and build a house, and live there; if you were

to have--- if it was to, say, stay as a protected area, but you had periodic maintenance work that's done there; or if you were to construct an industrial facility, a strip mall, or some business there, and it was going to be used for industry.

So you look at those kind of exposures, those various scenarios, and the kinds of the media that you'd be exposed to, so if a recreational user was there, that recreational user can come in contact with the soil, when they're picnicking, they could come in contact with the surface water and sediment of the ditch, if you were going to live there, you could come in contact with everything, the soil, the ground water. A resident could also become exposed to the surface water sediment, but the recreational user was--- a recreational user to evaluate that exposure halfway.

So you look at all those different exposure scenarios, you take the chemicals that were detected, the concentrations that were detected, and you perform a human health risk assessment.

When all was done, and the details are in the remedial investigation report, when all that work report was done, what they found was, in the use, they use risk levels that are provided by EPA. These are EPA wide levels of what they call risk levels that you compare that--- the value that you get at your site to determine whether the risks are either acceptable for those various scenarios, or unacceptable.

And based on the risk assessment, that was done to determine that the potential risk of that site, relative to those of the background, were--- they were acceptable for unrestricted use. So is--- The resident exposure is the most--- is--- is the most conservative of all--- of all the risk assessments done. If you pass the residential scenario, the risks for residential scenario are acceptable, and then, your ecological risks are acceptable, the site can then be released for unrestricted use.

From the human health standpoint, the risks of the residential scenario were acceptable.

Next slide.

As I said, a quantitative ecological risk assessment was done as well. Part of that included going to the site, evaluating the site, would--- does the site provide viable habitat, and it certainly does. I think you saw the picture earlier, it's a fairly lush vegetation in that area. It had been cleared, but--- but the jungle was fairly lush in that area, and it provides good habitat for both terrestrial as well as aquatic or semi aquatic animals in that area, plants and animals.

The--- what they did was--- The risk assessment was done, they looked at direct exposure, in other words, if plants and animals were directly exposed to contaminants, whether it's in the soil, or in the surface water sediment. They also looked at food web exposures, in other words, some lower order animal eats contaminated material, and then, something else eats that, and then, something else eats that, and finally--you know--a bird is eating that, so that's called the food web, and they look at those exposures as well.

Under both those scenarios, the risks that they identified were--again--within those acceptable levels.

Next slide, please.

So, after evaluating all that information, after looking at the risk assessments that were done, and in conjunction with the Navy, EPA and EQB worked together on this, and consulted with municipality, it was determined that there were no unacceptable risks relative to the background for unrestricted use at the site, and therefore, based on that, because there were no unacceptable risks, decided and recommended for no action.

I think that may be the last slide. Is it? Yes.

So, I know this is sort of short and sweet, but again, I really wanted to make it--- give folks in the audience the opportunity to provide any comment or ask any questions. Hopefully, we can answer them.

I'm going to give me this, and then, please, state your name.

UNIDENTIFIED VOICE: There isn't any.

MR. DOER: Oh, there's no one? OK.

MR. OJEDA: Jos, Ojeda, for the record. You said that the tests were made on the square area, right here, that shows on the picture, right? How about the area around it?

MR. DOER: Well---

MR. OJEDA: How about outside the square? How about it?

MR. DOER: This is Brett Doer, from CH2M, responding to the question.

The way an investigation works to determining the nature and extent of your contamination is you start where your potential releases took place. You start where the contamination may have started, and you work your way out, to determine how far out contamination goes.

At this particular site, it didn't find the contamination was migrating away from the power plant area. So there--- there--- you know, if--- if there was indication that the contamination was migrating outside that square area, they would have gone outside the square area. But the contamination--- you know, the data did not suggest the contamination was migrating beyond the power plant area.

MR. OJEDA: And how about if it was the other way? If the point of contamination--Jos, Ojeda again, I'm sorry--came from another point, you would have notice, then, inside the AOC that the things happening?

I mean, if it was on the outside, the point of contamination, not in the square area of the AOC, as you name it, would you notice that too?

MR. DOER: This is Brett Doer, from CH2M, again responding.

The sampling proceeds from where the suspected source of contamination is, so you go back and you look at historical records. At this site, there were--- they--- they used--- it was very specific at what the site was used for they had--you know--power generation equipment, they knew what that equipment was, they put tires inside the building and set them on fire, so you know where your source of contamination is, and so, that's where you start.

With respect to if there was something off your site--you know--over here, somehow contaminating, you do

account for things like that, because you take what's called background samples, so you put a well in, upgrading of your site, that's referred to as a background well, so you do compare the data you're taking at your site to what may be upgrading of your site, or--you know--off-site somewhere else, to give you that relative comparison.

MR. OJEDA: And you said that this structure was built to give light--- ah--- electricity to a nearby community, right? On 1943, something like that, right?

MR. DOER: The information--- This is Brett Doer again. The information that I have says that there was power generation equipment stores at this facility. Does anybody know whether this facility's actually been used to generate power? I'm not sure.

MS. CORRADA: I have some historical--- Cristina Corrada. I have some interesting--- (through the interpreter) This was used--- this was used as an electrical generator plant, because there was a huge sugar mill, the Valle Grande sugar mill, of the Ben¡tez family, and they used that to generate electricity for the sugar mill, and so, once the Navy--- the sugar mills were already in financial crisis, and they expropriated people towards Monte Santo and Santa Mar¡a, so it became obsolete, that electrical generator.

MR. OJEDA: OK. And how about this---? Any other structure, besides this one, that was built to give electricity to that area, or just this building that is shown on the picture? Any other structure coming out from it? Any poles? Any---? Something---? Cables? Something? No? Not at all?

(Several people speak away from the microphone; the record is unintelligible.)

MS. CORRADA: (Through the interpreter) The sugar mills had their generators, the only way of generating electricity. I don't know what to answer, because I have no more detail of that.

BRETT DOER: This is Brett Doer again. At this particular site, there's no other structures left, other than the shell of the building.

MR. OJEDA: You said that it was in consult with mayor office here, in Vieques, the comment from them, they're on the--- on the--- "en el informe", they appear? The report?

MR. DOER: This is Brett Doer again. The comment---

MR. OJEDA: Is this from the mayor, or is there any comments at all?

MR. DOER: This proposed plan was provided to the municipality, not--- not mayor. It went to the municipality of Vieques. We have a contact with the municipality, was provided to them, and at the same time, we provided it to the regulators for their consideration. And we set a deadline for the--- any comments to come back, we received comments from EPA and EQB, which ultimately were incorporated into this proposed plan.

We didn't receive any comments from the municipality. We called them back, and asked again if we were going to get any comments back, we didn't get a response from them.

Now, they still have--- This public comment period goes through March 12. If the municipality wants to provide any additional comments, they certainly can through that period. We have not yet rece--- we have not received any comments from the

municipality on this. But they're going to be given an opportunity to comment.

MR. OJEDA: OK., they have time. But how about the--- from outside the municipality of Vieques? Any other public office that you reach out and, even if you have or not, haven't received any answer from them? Any other office?

MR. DOER: Yes, this is Brett Doer again. Let me explain how this was sent out. The--- Once the agencies all agree to what the content of this proposed plan would be, it was put in the administrative record, which is available to the public, and notice was published in the paper, that anybody that would read a paper knows that this is out there and available for review. We contacted RAV members and let them know as well, and I think there may be some other ways that some message got that this was out there now, and ready for review.

I'm unaware of any comments received today. Now, people have, obviously, until March 12, in the postmarked comments by March 12, so there's still plenty of time left. The public comment period just started a week or so ago, not that long ago. Maybe two weeks ago.

I don't--- I haven't heard anything about--- I don't think the Navy received any comments. I don't know if the regulators received comments or not. On here, on the proposed plan, it says who you can send comments to; EQB and EPA and the Navy, and it sounds like nobody has yet received any comments.

MR. OJEDA: No, Natural Resources Department, Departamento de Recursos Naturales, no?

MR. RODRIGUEZ: (Through the interpreter) Good evening, Daniel Rodr¡guez, with the federal Environmental Protection Agency.

(Without the interpreter) The document was only distributed within the agencies. That was EQB, Fish and Wildlife and EPA. We all--- And the municipality of Vieques.

We all provided comments, the municipality of Vieques has not provided comment yet, but they were given an opportunity with the document was at draft stage. At that time, only the involved agencies get to review the document. After that, notice was published--I think it was January 24--and went out for public comment on the 28th.

So the general public, and also include the agencies, if somebody missed something, have an opportunity to provide comments. And that will close on March 12. At that time, we will look at the comments, and EPA will make a decision whether we need to modify the proposed plan, and perhaps change the selected alternative.

If substantial comments are received, or data that indicates that the decision reached was not the most adequate one--- And we will republish that, if it comes to that. If we receive comments, and they're not substantial, we may finalize the document, and note the comment in the administrative record.

MR. OJEDA: And--- Jos, Ojeda again.

And how about any Vieques community organizations? I know that you guys maybe distribute this around Vieques community, but how about reaching them directly, I mean, with them? Any community organization that you would---? I mean,

that it was contact straight, direct to make comments or something?

MR. DOER: This is Brett Doer again.

Not that I'm aware of. The process that was followed is a standard process that's followed on--basically--all superfund sites, where you announce it in the paper, you provide as much public notice as you can tell people where it is, so they can get it, and anybody has access to it.

Go ahead.

MS. RIVERA: Madeline Rivera, from the Navy.

Giovanni, these documents were also mailed to the RAV members this week, so community does have copies. We have been posting them in different offices at Fish and Wildlife, EPA, so they do have some copies. Some groups in the community already have received comments in recommend up the comp--- the proposed plan document directly.

And also, we have published a filer, that is something that goes every month, they have told people where to get the documents, we have posted at the electronic library in Vieques, and there's also a website where they can access that.

MR. DOER: Are there any other questions or comments?

OK., I think we'll officially close the public meeting, then. And I think we'll have just about an hour, and start the RAV meeting at 7:00 p.m.

MS. STRUVE: Everybody's welcome to stay.

(Whereupon the proceedings were concluded.)

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CERTIFICATE OF REPORTER

I, Juan C. Vel zquez, E.R. Reporter, member of FASYO Reporters, do hereby CERTIFY:

That the foregoing is a true and accurate transcript of the recording of proceedings held at the time and place hereinabove set forth; and;

That I am not related by blood or marriage to any of the parties in the above-captioned matter, nor am I in any way interested in the outcome of the same.

In San Juan, Puerto Rico, this 13th day of March 2008.

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JUAN C. VELAZQUEZ
E.R. REPORTER

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