

DRAFT

ADDENDUM

RCRA FACILITY INVESTIGATION REPORT

FOR

**PHASE I INVESTIGATIONS AT
OPERABLE UNITS 1, 6 AND 7**

**NAVAL STATION ROOSEVELT ROADS
CEIBA, PUERTO RICO**

CONTRACT TASK ORDER 0277

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Prepared for:

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**Comprehensive Long-Term Environmental
Action Navy**

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1.0 INTRODUCTION

1.1 Background

In July 1996, the Navy submitted the report entitled “Draft, RCRA Facility Investigation Report for Phase I Investigations at Operable Units 1, 6 and 7, Naval Station Roosevelt Roads, Ceiba, Puerto Rico.” This report was reviewed by the EPA and its contractors and comments were received by the Navy on December 3, 1996. The Navy was given 45 days to provide an amended report.

A conference call, in which Navy, Activity, Baker and EPA personnel participated, was held on December 19, 1996 to discuss the comments and format for response. The Navy indicated the desire to present new information (not available at the time the draft was prepared) and to minimize costs by avoiding the full reproduction of the two volume report most of which was accepted by the EPA. EPA concurred with these points and it was mutually agreed that an addendum to the draft report would best serve the needs of the program.

1.2 Purpose of the Addendum

This addendum to the Draft RFI Report is designed to address EPA comments regarding the findings and conclusions of the report. Comments have been addressed in one of the three manners described below:

- Modification/correction of text and/or tables
- Expansion of discussions, and
- Provision of new information.

1.3 Organization of the Addendum

The addendum is organized into six sections to provide for a logical and coherent discussion of the issues raised in the EPA comments. Section 1 provides a brief introduction to the addendum. Responses to comments are provided in Section 2 (often, comments are responded to by referencing a later section). Section 3 provides a discussion of how the Navy intends to provide for land use restriction on certain portions of the property. A schedule for completing the land use restrictions

is also discussed. Section 4 provides new data, largely related to background concentrations of certain constituents, and compares the new data to data for the individual SWMUs. Risk assessment issues are addressed in Section 5. Section 6 provides a discussion of the investigation work plans which need to be developed for certain SWMUs and provides a schedule for their submission.

2.0 COMMENT RESPONSES

This section contains responses to EPA comments regarding the draft RFI report. The comments have not been repeated but the comment designation system employed in the comment letter has been maintained in the responses. A copy of EPA comments has been included in the Addendum as Appendix A.

Responses to Comments from USEPA Region II

- 1) Paragraph 1: It is the Navy's intent to restrict land use at this site by permanently limiting its use to only industrial use. See Section 3.0 of the Addendum for a description of the land use restriction mechanism.

Paragraph 2: Arsenic and beryllium concentrations found in the soils has been compared to background values obtained as part of OU 2 investigations (performed after the Draft OU 1, 6, and 7 report was prepared). The results of this comparison indicate arsenic and beryllium concentrations at the site are generally within background. See Section 4.0 of the Addendum for a discussion of the comparisons.

The detection of pesticides slightly above industrial soil RBCs in 1 of 12 samples (less than 10%) does not appear highly significant, especially considering that pesticides at low levels are ubiquitous onsite due to former pesticide applications.

Although individual risks are acceptable, when summed, dioxin and benzo(a)pyrene contribute to total site risks that are unacceptable. Benzo(a)pyrene contributed predominately. See Section 5.0 of the Addendum which discusses the likely non-site related source for the benzo(a)pyrene.

Paragraph 3: Based on the foregoing discussion, and in the light of background comparisons and the Navy's intent to permanently restrict property use, the Navy requests that EPA reconsider the need to perform additional investigations at this site.

Paragraph 4: Total hexachlorinated dibenzo-p-dioxins (HxCDD) and total hexachlorinated dibenzofurans (HxCDF) were evaluated for SWMU 6/AOC B surface soils for both on-site workers and future residents. Total HxCDD and total HxCDF were not risk drivers for either receptor from exposure to AOC B/SWMU 6 surface soil. As stated in the Draft RFI Report, the predominant carcinogenic risk drivers were benzo(a)pyrene, beryllium, benzo(b)fluoranthene, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT. The non-carcinogenic risk drivers (future residential children only) were 4,4'-DDT and arsenic. Section 5.2 and Table 5-1 of this Addendum reflect all COPCs evaluated for all SWMUs/AOCs.

Paragraph 5: Refer to Section 5.3, Table 5-2, and Table 5-4 of this Addendum for revised text and tables.

Paragraph 5: Groundwater results have been compared to the recently acquired background data (obtained during the OU 2 investigations). This comparison is discussed in Section 4.0 of the Addendum. Based on the comparison, it appears that all the metals found to exceed criteria are representative of background and therefore do not appear to be site related.

Paragraphs 6 and 7: Based on the findings related to comments in Paragraph 5, the Navy requests that EPA reevaluate the need to further characterize groundwater in the AOC B/SWMU 6 area.

- 2) The upper water bearing unit was penetrated by the Hydropunch® investigations; however, the zone did not produce sufficient water to perform PCB analyses. The zone which contains water is approximately six-inches thick and occurs at the top of the bedrock. Numerous attempts were made (more than double the number proposed in the RFI workplan) to obtain a sample. The foregoing notwithstanding, the Navy will perform additional groundwater investigations at SWMU 10. The workplan discussed in Section 7 of the addendum will address the number, location and types of wells to be employed.
- 3) At the time that the draft report was prepared, the Navy had no inclination to use the property at SWMU 26 for residential purposes. While no residential development is planned at this time, the area is surrounded by residential property and represents a possible

expansion area. Based on this, additional investigations appear warranted. The workplans discussed in Section 7.0 of the addendum will address the scope of those investigations.

- 4) Future residents (adults and young children) were evaluated for surface soil ingestion, dermal contact and inhalation of fugitive dusts at SWMUs 31 and 32. Unacceptable noncarcinogenic surface soil risks were estimated for both the adult and young child at SWMU 32, due predominantly to dermal exposures to Aroclor-1254. Subsurface soil exposure to future residents was screened from evaluation since, in reality, such exposures would occur infrequently and for very short durations, rendering any risks that would be estimated for these exposures as negligible. This is supported by the fact that subsurface soil exposures were evaluated for the more conservative construction worker scenario. Both carcinogenic and noncarcinogenic risks estimated for ingestion, dermal contact and inhalation of fugitive dusts were well below acceptable risk criteria by orders of magnitude. Refer to Section 5.5.1 for further discussion on the non-evaluation of future residents for subsurface soil exposure.

Additional risk assessment using revised dioxin numbers for comparison indicates that there is a slight risk posed to on-site workers by the surface soil. Based on this, the Navy will obtain additional surface soil samples for dioxin. Section 7.0 of the Addendum discusses workplan development for those additional investigations.

There is risk posed under the future resident scenario. Because of the risk to future residents, the Navy will place a permanent land use restriction upon these sites. The mechanism for doing this is discussed in Section 3.0 of the addendum.

- 5) Paragraph 1: The Navy intends to permanently restrict land use to industrial. Section 3.0 of the addendum describes the mechanism to be used to put the restriction in place.

Paragraph 2: Work plans to further investigate this area will be provided as described in Section 7.0 of the addendum.

- 6) A workplan for additional investigations at AOC C will be provided as discussed in Section 7.0 of the addendum.

- 7) Future residents (adults and young children) were conservatively evaluated for surface soil ingestion, dermal contact and inhalation of fugitive dusts at SWMU 25. No unacceptable risks (carcinogenic or noncarcinogenic) were estimated for these receptors. The Navy concurs with USEPA that any future clean-up of SWMU 25 could be tied to closure of the two HWCSAs, and that the land use of the DRMO yard is well-defined and expected to remain the same for the future.
- 8) Addendum Figure 1, showing all the sediment sampling locations is included in this section.
- 9) Workplans for the additional investigations at these sites are discussed in Section 7.0 of the addendum.

Responses to Comments from A.T. Kearney, Inc.

General Comments

SWMU 13: Comment acknowledged.

AOC D (SWMU 2 Portion): The workplan for additional investigation (discussed in Section 7.0) will address the concerns reflected in this comment.

AOC D (SWMU 11/45 Portion): The workplan for additional investigation (discussed in Section 7.0) will address the concerns reflected in this comment.

Page-Specific Comments

Page 4-14 and 4-15, Section 4.8.2.3

Section 4.0 and Figure 4-16 - During the sediment sampling activities at SWMU 3 (AOC D), the area where sediment samples 3SD02 and 3SD03 were proposed was within an active shoreline fill area. This area, located along the northeast corner of the SWMU, is adjacent to the CPO Hut. This area had been receiving fill in order to extend the shoreline out away from the hut and to aid in stopping an erosion problem. Fill material was observed along the shoreline encompassing the two

sediment locations and extending approximately 50 feet or more out into Puerca Bay. A field decision was made to delete these locations since the purpose of the investigation was to collect samples from the interface between the shoreline and the bay. The filling was occurring over the existing sediments and, therefore, the media which could have shown possible impact from landfilling activities was not available for sampling. Thought was given to sampling below the new "made land," however, the new material was thoroughly incorporated into the sediments and all evidence of an interface was obscured. Based on this, it was determined that no equivalent sampling points existed that would provide representative and comparable points of data.

Page 5-13, Paragraph 6, Section 5.2.1.5 - Generally, 2,3,7,8-TCDD toxic equivalence factors (TEFs) are not established for the calculation of toxic equivalent concentrations (TEC) for total PCDDs and PCDFs. Therefore, the most conservative TEFs for the 2,3,7,8-congeners (cited in Section 6.2.3.5 of the Draft RFI Report) corresponding to detected total PCDDs and PCDFs will be applied to the Region III industrial/residential soil RBCs for 2,3,7,8-TCDD to give the following toxic equivalent dioxin/furan RBCs ($\mu\text{g}/\text{kg}$): total PeCDD - 0.08/0.008; total HxCDD - 0.4/0.04; total TCDF - 0.4/0.04; total PeCDF - 0.08/0.008; and total HxCDF - 0.4/0.04. All revised tables from Section 5, i.e., Table 5-1 (AOC B/SWMU 6 Surface Soil), Table 5-9 (SWMU 13 Surface Soil), Table 5-24 (SWMU 31 Surface Soil), Table 5-39 (AOC C Surface Soil), and Table 5-42 (AOC D Sediment) can be found in Appendix A. Dioxins/furans in all of the aforementioned SWMUs/AOCs were retained as COPCs and quantitatively evaluated in this risk assessment addendum. Please refer to Section 5.4 for further discussion of these results.

Page 5-14, Paragraph 2, Section 5.2.1.5 - Please refer to Section 5.2 of the Addendum for revised text and tables.

Page 5-38, Paragraph 1, Section 5.3.6.4 - The referenced samples are both associated with SWMU 2. While the comment is accurate, reanalysis of the sediment sampling results will be made as part of the OU 3/5 investigations when an idea of possible sources for contaminants will be available.

Section 5 Tables - The RBCs for pyrene were used as surrogate values for phenanthrene and benzo(g,h,i)perylene since pyrene has the most conservative toxicity criteria of the noncarcinogenic PAHs. This will be indicated on the applicable tables.

Table 5-2 - The revised table can be found in Appendix A

Table 5-9, Table 5-24, Table 5-39 - Please refer to response to comment regarding Page 5-13, Paragraph 6, Section 5.2.1.5 and Section 5.4 of this Addendum. The revised tables can be found in Appendix B.

Table 5-15 - Pages 3 and 4 are of no relationship with page 1 and 2 and have been deleted. The revised table can be found in Appendix B.

Table 5-18 - The revised table can be found in Appendix B.

Table 5-42, Page 2 - See response to comment regarding Page 5-13, Paragraph 6, Section 5.2.1.5. The revised table can be found in Appendix B.

Page 6-1, Section 6.0 - Please refer to Section 5.1 of this Addendum for revised text and tables.

Page 6-2, Paragraph 5, Section 6.2.1 - Please refer to Section 5.1 of this Addendum for revised text.

Page 6-3, Paragraph 2, Section 6.2.1 - Although it is unlikely that groundwater will ever be used as a potable source due to its poor quality and the fact that the entire base is provided water via aqueduct, tap water RBCs, as well as Federal MCLs, were applied in the selection of groundwater COPCs as a conservative measure. The application of leaching-based soil criteria is not appropriate in this risk assessment since such criteria are based on non-site-specific, default assumptions regarding physical/chemical characteristics of the unsaturated and saturated zones, and are not based on direct contact exposures, which are the basis of the human health risk assessment. Please refer to Section 5.2 of this Addendum for revised text.

Page 6-6, Paragraph 2, Section 6.2.2.1 - Please refer to Sections 5.1 through 5.3 for revised text and tables.

Page 6-7, Paragraph 2, Section 6.2.2.1 - Only subsurface soil data were used to evaluate future construction workers and not surface soil data, since it is assumed that surface soil exposures are

expected to be insignificant relative to subsurface soil exposures. Surface soil data were used to evaluate the much more conservative future residential scenario, as well as the on-site worker scenario. Please refer to Section 5.5.1 for further discussion of uncertainties.

Page 6-9 - The first sentence of the comment is unclear since it seems out of context with the discussion presented on the cited page. In addition, USEPA Risk Assessment Guidance for Superfund (RAGS) recommends the use of both exposure concentrations and inhalation toxicity criteria in evaluating inhalation risks, as was done in this risk assessment. Please refer to Section 5.5.2 for discussion of uncertainty regarding the use of inhalation slope factors and reference doses in evaluating volatile and fugitive dust emissions.

The inhalation RfD provided for beryllium in Appendix N, Table 44 is actually the inhalation cancer slope factor for beryllium. The revised table can be found in Appendix C.

Page 6-15, Paragraph 1, Section 6.2.3.1 - The cited sentence is revised to state: “The RfC is expressed as an air exposure concentration (mass of chemical [mg] per cubic meter of air [m³]) that is continuous for 24 hours per day”.

Page 6-16/Table 6-8 - The sources for the gastrointestinal absorption efficiencies discussed and presented in the cited text and table (as well as other applicable sections of text and tables) include IRIS, NCEA, Ohio EPA, and Region IV (default values). Region IV default values for gastrointestinal absorption efficiencies include the following: VOCs - 0.8, SVOCs/pesticides/PCBs - 0.5, inorganics - 0.2).

Page 6-20, Paragraph 3, Section 6.2.4.3 - The first sentence of the second paragraph under Section 6.2.4.3 of the Draft RFI Report discuss the SWMUs for which no unacceptable risks were estimated. There were no unacceptable risks estimated for SWMU 25. SWMUs 12 and 14 were not evaluated in the HEA since no contaminants were retained as COPCs in any media investigated. Therefore, no risks to human health were associated with SWMUs 12 and 14. SWMU 32 will not be added to the list of SWMUs for which no unacceptable human health risks were estimated since unacceptable risks were estimated for future residents.

Page 6-21, Paragraph 1, Section 6.2.4.3.1 - “AOC D” refers to the collective evaluation of the maximum detected concentrations from among SWMUs 1, 2, 3, 7, and 11, with SWMUs 2 and 11 contributing most of the maximum concentrations. SWMUs 1, 2, 3, 7, and 11 were evaluated individually for workers, recreational users and future residents, and were evaluated collectively for recreational users and future residents.

Table 6-1 - Total HxCDD and total HxCDF were retained and evaluated as AOC B/SWMU 6 surface soil COPCs in the risk assessment, per the exceedences shown in Table 5-1 of the Draft RFI Report. Table 5-1 of this Addendum presents the COPC selection summary for surface soils. Please refer to response to comment regarding page 5-13, Paragraph 6, Section 5.2.1.5 and Section 5.4 of this Addendum for discussion on selection of dioxins/furans as COPCs and risk characterization, respectively.

Page 7-9, Paragraph 2, Section 7.1.9 - The EPA has requested a full RFI for this site (see EPA Comment 1). The Navy has agreed to submit a workplan for additional investigations. Results of the future work will indicate whether a significant release to the environment has occurred.

Page 7-13, Paragraph 5, Section 7.1.13 - There is no potential for future releases from SWMU 37 since it has been replaced by another, similar, facility. The plans for this upgraded facility were provided to the EPA in the “RCRA Quarterly Progress Report for Period November 1, 1995 - January 31, 1996.” The upgraded facilities contain enhanced release control features.

Page 7-20, Paragraph 4, Section 7.3 - The sediment sampling results at SWMU 2 will be reanalyzed during the reporting for OU 3/5 (which includes SWMU 2). At this point, a better understanding of possible sources for the apparent contamination will be available. The points raised in the comment will be taken into account at that time.

Page 7-22, Paragraph 4, Section 7.3 - The need for additional sediment characterization will be assessed following OU 3/5 investigations (which contains SWMU 2). The need for remedial actions related to the sediments will be reviewed as part of SWMU 2.

Page 7-22, Paragraph 5, Section 7.3 - The Navy concurs with this comment.

Appendix C - Slug Test Data - The Navy recognizes the potential limited useability of the slug test data questioned in the comment. The information appears to be non-critical based on related findings at the site.

3.0 LAND USE RESTRICTION

The Navy recognizes the desirability of having land use restrictions placed on sites where there is a potential human health risk posed to future residents but where no residential type use is intended. Presently, this scenario applies to four SWMU areas: SWMU 6/AOC B, SWMUs 31/32, SWMUs 11/45 and SWMU 46. It may well be the case that the need for land use restrictions will become evident for additional sites as the RCRA corrective action program proceeds. Based on these present and potential needs, the Navy is putting into place a system which will prevent residential-type development during Navy occupation of the property and will provide a mechanism for transmitting this information to possible future property owners should the Navy ever decide to vacate the base.

3.1 Land Use Restriction - Navy

There are a number of steps which need to be taken to permanently restrict certain properties within Roosevelt Roads for industrial use only during the period of Navy ownership. These steps are:

- A property survey will be completed that will legally define the boundaries of the affected properties.
- The “Land Use Constraint” and “Planned Land Use” maps of the base master plan will be updated and the affected properties will be labeled “Industrial Use Only - Perpetual EPA Restriction”. These maps will be appended to the current base master plan. [Note: These maps are mandatorily referred to by all planners prior to the inception of any project.]
- A “Base Instruction” will accompany the maps in which the Commanding Officer’s policy that the parcels designated “Industrial Use Only - Perpetual EPA Restriction” will not be used for anything other than industrial use will be stated.
- The base “Real Estate Summary (RES) Map” (which shows all the real estate parcels and associated real estate instruments on the base) will be updated to reflect the new land use restriction.

- The “Naval Facility Assets Database” (NFADB) for Class 1 property (i.e. land) will be edited for the affected properties to show the land use restriction.
- The new restrictions will be added to the real estate files which are maintained for all parcels ever acquired, and
- Installation Restoration Maps will always show these sites as perpetual industrial land use.

A letter signed by a senior officer at Roosevelt Roads will be provided to the EPA within 45 days which will reiterate these steps and provide the assurance that they will be completed.

3.2 Land Use Restriction - Subsequent Property Owner

Property excessed by the Navy typically is conveyed to the GSA which finds either another government use for the site or conveys the property to the public. In either case, the restrictions placed on property use must accompany the property transfer. The Navy will provide the following four items to ensure the restrictions are kept:

- A copy of the updated “Real Estate Summary Map”
- A copy of the edited “Naval Facilities Assets Database”
- The appropriate sections of the real estate files, and
- Installation Restoration maps indicating the sites as perpetual industrial land use.

The final assurance is provided by the need to perform an “Environmental Baseline Survey” prior to excessing any property. Performance of this survey will ensure that all environmental land use restrictions put in place by the Navy will be properly transmitted to all subsequent landowners.

4.0 NEW DATA AND COMPARISON

Section 4.0 presents a comparison of the background surface and subsurface soil and groundwater analytical results to the soil and groundwater results at the following sites: AOC B, SWMU 26, SWMU 31, and SWMU 32. At the time of the Draft RCRA Facility Investigation Report for Phase I Investigations at Operable Units 1, 6, and 7, background information for surface/subsurface soils and groundwater was not available; the site-specific analytical data for these OUs is presented in the referenced RFI Report. During a subsequent investigation conducted at OU 2, surface/subsurface soil and groundwater samples were collected that would serve as representative Station background data for the sites included in OU 1, 6, and 7.

A comparison of the background data to screening criteria is provided below. Sections 4.2.1 through 4.2.4 present a comparison of the background data to the soil and groundwater that was collected at the above referenced sites. In these sections, “background” refers to the value calculated by using the average concentration of the background surface and subsurface soil and groundwater samples, added to two times the normal standard deviation. These calculated values represent a 95 percent confidence interval for the background samples. The addition of two standard deviations to the mean background concentrations compensates for the non-homogeneous distribution of naturally occurring constituents in the earth’s crust and allows a relatively small population of background data points to represent the more probable range of background concentrations.

4.1 Background

The following paragraphs discuss the comparisons of the background data with standards/criteria. As shown on Table 4-1, the soils background comparisons were made with Region III industrial and residential risk-based concentrations (RBCs). For groundwater, background data were compared with Federal maximum contaminant levels (MCLs) and Region III RBCs derived for the use of tap water. The groundwater comparison to criteria is presented in Table 4-2.

Surface Soil

Fluoranthene, butylbenzylphthalate, and bis(2-ethylhexyl)phthalate were the only organic compounds that were detected in the background surface soils. Bis(2-ethylhexyl)phthalate was the only compound that exceeded the residential RBC.

Thirteen inorganics were detected in the background surface soils. However, only arsenic and beryllium exceeded the residential RBC. No inorganic or organic compounds exceeded the industrial RBCs.

Subsurface Soil

Total xylenes was the only VOC and di-n-butylphthalate was the only SVOC detected in the background subsurface soil samples. However, neither of the concentrations for these compounds exceeded the industrial or residential RBCs.

Fourteen inorganics were detected in the background subsurface soils. However, only arsenic and beryllium exceeded the residential RBC. No inorganic or organic compounds exceeded the industrial RBCs.

Groundwater

Total and dissolved inorganics were analyzed for in the background groundwater samples. Ten metals were detected in the total analyses. Arsenic and beryllium concentrations exceeded both the tap water RBC and MCL. Barium, chromium, and nickel exceeded the MCL and copper and lead exceeded the respective MCL/action level. An MCL has not been established for vanadium; however, the concentration of vanadium detected in the background groundwater samples exceeded the tap water RBC.

Barium, copper, vanadium, and zinc were the only metals that were detected in the dissolved fraction of the groundwater. The concentrations associated with barium and copper exceeded the MCL screening criteria.

4.2 Site Specific Data

The following subsections discuss the comparison of SWMU/AOC data with Station background values. SWMUs/AOCs that are addressed in this section include AOC B, SWMU 26, SWMU 31, SWMU 32, SWMU 46, and AOC C. The complete analytical data set is presented in the Phase I RFI Report.

4.2.1 AOC B

Surface and Subsurface Soil

4,4'-DDD, 4,4'-DDE, and 4,4'-DDT were detected at one surface and subsurface soil location of the twelve surface and 14 subsurface soil samples collected at AOC B. The concentration of these pesticides exceeded the RBC screening criteria and the background surface and subsurface soil concentrations. However, detection of pesticides that exceeded screening criteria was limited to one soil location; a less than ten percent frequency of detection. Considering the former frequent applications of pesticides throughout this military installation, it is likely that the detection of the pesticides in the isolated location is the result of concentrated pesticide application and not related to solid waste management activities.

Total HxCDD and HxCDF were detected in two surface soil samples at concentrations exceeding the industrial RBCs, and benzo(a)pyrene was detected in four surface soil samples at concentrations exceeding the residential RBC and in one surface soil sample exceeding the industrial RBC at a AOC B. The frequency of detection of dioxins and benzo(a)pyrene are both relatively low. Additionally, these constituents were not used in site operations at or near this site, nor were they detected in the subsurface soil or groundwater samples collected at the same locations. Therefore, the detection of these constituents should not be a primary concern to the overall investigation.

Several metals were detected in the surface soil samples collected from AOC B. However, arsenic and beryllium were the only metals that exceeded the residential RBCs. The concentrations of arsenic in the surface soil samples at AOC B ranged from 0.6 mg/kg at 6SB02-00 to 10.0 mg/kg at 6SB01-00. Nine of the fourteen soil samples collected at AOC B exceeded the background surface soil concentration of 2.46 mg/kg. Although some of the concentrations of arsenic and beryllium

detected in the surface soil samples exceeded the background concentrations, the margin of exceedance was not significant. Additionally, the use of arsenic and beryllium were not documented at or near this area; therefore, it is not likely that the exceedances of these constituents are site related; they are more likely a result of background conditions.

Groundwater

As shown in Table 4-2, three of the total metals, arsenic, beryllium, and vanadium detected in the background groundwater samples exceeded the tap water RBC, and the majority of the total metals detected in the background groundwater samples exceeded the more stringent MCLs. Table 4-3 presents a comparison of background groundwater data to the groundwater data collected at AOC B. In the dissolved metals background groundwater samples, four metals, barium, copper, vanadium, and zinc were detected. The concentrations of barium and copper exceeded the MCL but not the tap water RBC. Note that there are no MCL criteria for vanadium and zinc. The concentrations of total and dissolved metals detected in the groundwater at AOC B are consistent of the concentrations of metals detected in the background groundwater samples. As shown on Table 4-3, the only metals that were detected in total and dissolved metal analysis at concentrations significantly exceeding the screening criteria were total arsenic and beryllium which also were detected at comparable concentrations in the background samples and dissolved beryllium, which was not detected in the background samples.

4.2.2 SWMU 26

As stated in the EPA comments:

"Of the 5 surface soil samples required at this SWMU, three had arsenic concentrations above the residential risk based concentration(RBC), and a different set of 3 had beryllium above the residential RBC; therefore, in all 5 of the samples collected there was an exceedance of a residential RBC"

As shown on Table 4-1, arsenic and beryllium were the only metals detected in both the surface and subsurface soil samples that exceeded the residential RBC screening criteria. The background surface and subsurface soil concentrations for arsenic were 2.46 mg/kg and 2.57 mg/kg, respectively.

For beryllium, the background surface and subsurface soil concentrations were 0.55 mg/kg and 0.832 mg/kg, respectively.

Six surface soil samples were collected at SWMU 26. Arsenic was detected at concentrations ranging from 0.29J mg/kg at 26SS04 to 1.2J at 26SS02. Beryllium was detected at concentrations ranging from 0.11 mg/kg at 26SS02 to 0.4 mg/kg at 26SS04D. The highest concentrations of both arsenic and beryllium detected in the surface soil samples were well below the concentration of these same metals in the background surface soil samples, indicating that these metals are not indicative of site contamination to SWMU 26.

4.2.3 SWMU 31

As stated in the EPA comments:

"Exceedances of residential RBCs at SWMU #31 include: a) PCBs (1 of 4 samples) and arsenic (2 of 4 samples) in surface soils at building 31; b) beryllium in surface soils (4 of 4 samples) and subsurface soils (4 out of 8 samples) at building 2022"

PCBs were detected in two of the four surface soil samples collected for SWMU 31 at concentrations exceeding residential RBC screening criteria. One of the PCB concentrations also exceeded the industrial RBC. There were no PCBs detected in the background surface soil samples; therefore, in the comparison to background, all samples exceeded background levels. However, the PCB concentrations were low and detections were not widespread.

Arsenic was detected at SWMU 31 at concentrations ranging from 0.52J mg/kg at 31SS02 to 1.3J mg/kg at 31SS04. These concentrations were well below the background concentration of arsenic which was 2.46 mg/kg. As indicated in the EPA comment, beryllium was detected in the surface soil at SWMU 31; however, the data presented in the Draft RFI does not reflect this detection. Beryllium was detected in the subsurface soil at SWMU 31 at concentrations ranging from 0.16 mg/kg at 31SB04-02 to 0.34 mg/kg at 31SB02-03. These concentrations of beryllium did not exceed the background subsurface soil concentration. Therefore, the concentrations of arsenic and beryllium detected in the surface and subsurface soil at SWMU 31 indicate that they are a product of background conditions, and not related to site activities.

4.2.4 SWMU 32

PCBs were detected in one of the four surface soil samples collected for SWMU 32 at concentrations exceeding RBC screening criteria. There were no PCBs detected in the background surface soil samples; therefore, in the comparison to background, all samples exceeded background levels. However, the PCB concentrations were low and detections were not widespread.

Arsenic was detected at SWMU 32 at concentrations ranging from 0.23J mg/kg at 32SS03 to 2.0J mg/kg at 32SS04. These concentrations were all below the background concentration of arsenic which was 2.46 mg/kg. Therefore, the concentrations of arsenic detected in the surface and subsurface soil at SWMU 32 indicate that they are a product of background conditions, and not related to site activities.

5.0 RISK ASSESSMENT ISSUES

Both human health and ecological risk assessments were performed and the results of these were included as part of the Draft RCRA Facility Investigation (RFI) Report submitted July 1996. The Draft RFI Report, including the human health (quantitative) and ecological (qualitative) risk assessments, was subjected to a comprehensive review by USEPA Region II and its technical reviewer, A. T. Kearney, Inc. The Agency review culminated in a set of written comments, dated November 8, 1996. The purpose of Section 5.0 is to provide a complete response to the Agency comments as they pertain to human health risk assessment issues of concern. It should be noted that there were no comments pertaining to the qualitative ecological risk assessment conducted as part of the Draft RFI Report.

Section 5.1 discusses the SWMUs/AOCs that were evaluated in the Health and Environmental Assessment (HEA). Section 5.2 summarizes the chemicals of potential concern (COPCs) selected for each SWMU/AOC evaluated in the HEA. In addition, revised human health risk evaluations associated with groundwater at AOC B and surface soil at SWMU 13, SWMU 31, and AOC C are presented in this addendum and discussed in Sections 5.3 and 5.4. Section 5.5 discusses uncertainty issues raised in the comments. Finally, Section 5.6 provides the results of the revisions brought about by the Agency's comments.

5.1 SWMUs/AOCs Evaluated in the HEA (page 6-1, Section 6.0)

The HEA is prepared as part of the Phase I RFI and was conducted for various media at sixteen SWMUs (Nos. 1, 2, 3, 7, 11, 13, 23, 25, 26, 30, 31, 32, 37, 39, 46, and 51) and three AOCs (AOCs B, C, and D) identified as Operable Units (OUs) 1, 6, and 7 at NSRR, Puerto Rico. It should be noted that SWMU 6 is located within AOC B. Four SWMUs, Nos. 10, 12, 14, and 24 were not evaluated as part of the HEA. Surface soil samples were collected from SWMUs 12 and 14 and analyzed for VOCs, SVOCs, PCBs and TPH. There were no positive detections in the VOC, SVOC, or PCB suites analyzed from soil at either SWMU 12 or 14. For SWMUs 10 and 24, all sample concentrations from media investigated at these sites were within the acceptable limits defined by the comparisons with human health and ecological standards/criteria; therefore, no COPCs were identified for quantitative evaluation.

5.2 Summary of Chemicals of Potential Concern (page 6-2, Paragraph 5, Section 6.2.1; page 6-3, Paragraph 2, Section 6.2.1)

The selection of COPCs was based on information provided in Section 5.0 of the Draft RFI report, which discussed the laboratory analytical results acquired for each SWMU and AOC and compared detected sample concentrations with the appropriate human health and ecological standards/criteria. As stated previously, any exceedence of a standard/criterion by a chemical concentration resulted in the consideration of that chemical as a COPC in the given medium and SWMU/AOC for further evaluation in this HHRA.

The environmental media investigated at each SWMU and AOC includes the following: surface soil in SWMUs 10, 12, 13, 14, 23, 24, 25, 26, 30, 31, 32, 37, 39, 46, and 51 as well as in AOCs B and C; subsurface soil in SWMUs 31, 32 and 46 and AOC B; groundwater in SWMUs 10 and 30 and AOC B; and sediment in SWMUs 1, 2, 3, 7, 11/45, 13, and 25 and AOC D. It should be noted that AOC D is inclusive of SWMUs 1, 2, 3, 7, and 11/45, which are located around the Ensenada Honda, and that SWMU 6 is within AOC B. These SWMUs were evaluated both individually and collectively as AOC D. One surface water sample was collected from the floor of Building 145 in SWMU 6; however, since the quantity of water was very small and was formed by accumulated rain water, the sample was not considered to represent a source of surface water exposure to individuals in the area. Therefore, data acquired for this sample were not used for evaluation in this HHRA.

Human health screening criteria applied to detected soil and groundwater sample data included risk-based concentrations (RBCs), derived by USEPA Region III (USEPA, 1996a). The RBCs were derived by Region III using conservative default exposure pathways and assumptions, and correspond to a target cancer risk level of 1×10^{-6} for carcinogens and a target hazard quotient of 1.0 for noncarcinogens (a more detailed discussion of Region III RBCs is provided in Section 5.0 of the Draft RFI Report). The soil RBCs protective of direct contact exposures were derived under both industrial and residential scenarios and are similar to those derived and presented in USEPA's Soil Screening Guidance (USEPA, 1994a). However, soil RBCs protective of future groundwater use were not compared to soil concentrations measured at the SWMUs/AOCs since it is highly unlikely that groundwater will ever be utilized for potable use. The application of leaching-based soil criteria is not appropriate in this risk assessment since such criteria are based on non-site-specific, default assumptions regarding physical/chemical characteristics of the unsaturated and saturated zones, not

on direct contact exposures, which are the basis of the human health risk assessment. In addition, none of the environmentally immobile organic COPCs that were identified in surface and subsurface soils (which included SVOCs, dioxins/furans, pesticides, and PCBs) were identified as COPCs in the groundwater samples collected from SWMUs 30 and AOC B. The RBCs applied to groundwater concentrations were derived for residential use of tap water.

The evaluation of dioxins and furans as carcinogens is of toxicological significance. In order to develop comparison criteria for those compounds with no CSF, a procedure was developed that incorporates the cancer potencies of these compounds relative to that of 2,3,7,8-TCDD, the most carcinogenically potent of the PCDDs and PCDFs. Generally, 2,3,7,8-TCDD toxic equivalence factors (TEFs) are not established for the calculation of toxic equivalence concentrations (TECs) for total PCDDs and PCDFs. Therefore, the most conservative TEFs for the 2,3,7,8-congeners corresponding to detected total PCDDs and PCDFs will be applied to the Region III industrial/residential soil RBCs for 2,3,7,8-TCDD to give toxic equivalent dioxin/furan RBCs. These RBC values are listed in Section 2.0 of this Addendum, response to A. T. Kearney, Inc. comment *page 5-13, paragraph 6, Section 5.2.1.5.*

Currently, no human health screening criteria have been established for evaluating exposures to sediment; therefore, sediment screening values (SSVs) which include Effects Range - Low (ER-Ls) and Effects Range - Median (ER-Ms) values, as well as Region III residential soil RBCs were applied to detected sediment concentrations. It is important to note that the comparison criteria do not necessarily represent clean-up target levels that must be achieved through the implementation of corrective measures, but rather, they establish presumptive levels that indicate whether or not a closer examination of a particular SWMU or AOC is necessary.

The COPCs identified in Section 5.0 of the Draft RFI Report for surface soil, subsurface soil and groundwater, and sediment are summarized by SWMU and AOC in Addendum Tables 5-1, 5-2 and 5-3, respectively. Although the COPCs were evaluated by SWMU and AOC in this HHRA, the following provides an overall summary of COPCs selected throughout OUs 1, 6 and 7 at NSRR. Surface soil COPCs identified throughout OUs 1, 6 and 7 included SVOCs, specifically, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, bis(2-ethylhexyl)phthalate, and N-nitrosodimethylamine; the pesticides 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, alpha-chlordane, gamma-chlordane, and kepone; the PCBs Aroclor-1254 and Aroclor-1260; the dioxins/furans total

pentachlorinated dibenzo-p-dioxins (PeCDD), total hexachlorinated dibenzo-p-dioxins (HxCDD), total hexachlorinated dibenzofurans (HxCDF), total (TCDF), and total (PeCDF); and the metals arsenic, beryllium, lead, and zinc. OUs 1, 6 and 7 subsurface soil COPCs included 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, antimony, arsenic, and beryllium. OUs 1, 6 and 7 groundwater COPCs (identified for SWMU 30 and AOC B) included total and dissolved antimony, total and dissolved arsenic, total barium, total beryllium, total chromium, total copper, total lead, total nickel, total vanadium, total zinc, dissolved beryllium, and dissolved lead. Sediment COPCs included carcinogenic and noncarcinogenic PAHs, dioxins and furans (total PeCDD, total HxCDD, and total HxCDF), 4,4'-DDE, 4,4'-DDD, 4,4'-DDT, arsenic, beryllium, cadmium, copper, lead, mercury, nickel, and zinc.

As a result of the preliminary comparative screening of SWMUs and AOCs in Section 5.0 of the Draft RFI Report, no exceedences of standards/criteria were noted for detected Hydropunch and surface soil concentrations in SWMU 10 (Substation 2/Building 90), except for acetophenone and chloroform concentrations detected in Hydropunch samples which exceeded tap water RBCs. Acetophenone is not a SWMU-related constituent, since it is most commonly used in the formulation of perfume fragrances. The detection of this compound is unexplainable, unless it may have been the result of field or laboratory personnel wearing heavy perfumes. Chloroform, which was also detected at concentrations in the SWMU 10 Hydropunch samples exceeding the tap water RBC, was detected in a field blank at a concentration of 150 µg/L. The maximum chloroform concentration detected at SWMU 10 was 14 µg/L. Therefore, since acetophenone is not a SWMU-related constituent, and since chloroform was detected in a field blank at a concentration greater than ten times the maximum sample concentration, these compounds were not retained as COPCs for SWMU 10. In addition, no exceedences of standards/criteria were noted for surface soil concentrations detected in SWMU 24 (Oil Spill Oil/Water Separator). Therefore, SWMUs 10 and 24 have not been retained for further quantitative evaluation in this HHRA. Also, SWMUs 12 and 14 were not retained for further evaluation since there were no positive detections in any sample collected from either SWMU. However, all remaining SWMUs/AOCs have been retained for further evaluation in this HHRA due to exceedences of the applied standards/criteria.

5.3 Groundwater Investigation at SWMU 6/AOC B (page 6-6, Paragraph 2, Section 6.2.2.1)

According to information provided in Section 5.0 of the Draft RFI Report, detected concentrations of total arsenic, barium, beryllium, chromium, copper, lead, nickel, and vanadium and dissolved

beryllium and lead exceeded corresponding criteria and are retained as COPCs for AOC B. Currently, since groundwater at NSRR is not being utilized as potable water due to poor quality and low yields, it will be conservatively assumed that child and adult residents will be exposed to dissolved inorganic COPCs identified in the groundwater at AOC B. Total inorganic results were not evaluated since dissolved inorganic results are considered to be more representative of drinking water conditions at the tap. In addition, groundwater concentrations of all organic compounds, including those of 4,4'-DDE were reported to be below the limits of detection.

The maximum detected concentrations of dissolved beryllium and lead were used in calculating the chronic daily intake (CDI) and dermally absorbed dose (DAD). The CDI/DAD for each COPC is calculated by combining the concentration term with assumed or known conservative (RME) exposure factors that describe the rates, frequency and duration of exposure. Since the CDI/DAD is a dose term, body weight of the receptor is also incorporated into the calculation, and the long-term exposure is divided by the total number of days in the averaging period. Thus, the unit obtained for the CDI/DAD resulting from chemical exposure is mg/kg/day. Table 1 and Table 2 in Appendix B contain the specific CDI/DAD calculations for each exposure scenario of interest. These equations were adopted from USEPA's Risk Assessment Guidance for Superfund, Volume I (USEPA, 1989b).

Potential carcinogenic and noncarcinogenic human health risks were estimated for future child and adult residents at AOC B. These risks values are presented in Addendum Table 5-4. This table shows that the ILCR estimated for future residential exposure to groundwater was within USEPA's generally acceptable risk range. The estimated total HI value for groundwater exposure is less than 1.0, indicating that the potential for the occurrence of adverse systemic effects is insignificant. Therefore, the addition of the groundwater ingestion and dermal contact exposure scenarios did not significantly affect the human health risk results estimated in the Draft RFI.

Exposure to surface soil via ingestion, dermal contact, and inhalation of fugitive dusts was also evaluated for future residents at SWMU 6/AOC B in the Draft RFI Report. These results are presented in Addendum Table 5-4. As presented in the Draft RFI, potentially unacceptable carcinogenic risks were estimated for future adult and young child residents that would result predominantly from dermal exposure to benzo(a)pyrene, benzo(b)fluoranthene, 4,4'-DDE, 4,4'-DDT, and beryllium in surface soil.

Individually, these COPCs resulted in risks that are within USEPA's acceptable target risk range. In addition, benzo(a)pyrene and benzo(b)fluoranthene, which were detected infrequently (i.e., less than a 10 percent frequency of detection) in soil samples collected from this area are products of incomplete combustion that may have resulted from trucks and heavy equipment vehicles that have been historically parked in this area. Since it is very common to detect PAHs in such areas, it is highly unlikely that these PAHs are the result of waste management activities. As discussed previously in Section 4.0, the presence of 4,4'-DDE and 4,4'-DDT are likely the result of past applications of pesticides. In addition, the beryllium detections in surface and subsurface soil samples collected from SWMU 6/AOC B are comparable to background (see Section 4.2.1). Therefore, it is unlikely that any unacceptable risks estimated for exposures to SWMU 6/AOC B soils originate from solid waste management activities.

5.4 Revised Risk Characterization for SWMU 13, SWMU 31, and AOC C (page 5-13, Paragraph 6, Section 5.2.1.5)

5.4.1 Current On-Site Workers

The following subsections describe the resultant risk values derived for exposures of current on-site adult workers upon the inclusion of dioxins/furans that exceeded corresponding RBCs as COPCs for surface soil at SWMU 13, SWMU 31, and AOC C. Potentially unacceptable risks were estimated for surface soil at SWMU 13, SWMU 31, and AOC C. Additional carcinogenic risk that was not assessed in the Draft RFI was estimated for on-site workers from exposure to SWMU 13 and SWMU 31 surface soil based on further evaluation conducted after the addition of dioxin/furan COPCs. Potential risks from AOC C surface soil to on-site workers remained as estimated in the Draft RFI Report. Tables 3 through 11 in Appendix B contain the specific CDI/DAD calculations for each exposure pathway. These risks are summarized in Addendum Tables 5-5 through 5-7.

SWMU 13 - Old Pest Control Shop/Building 258

Table 5-5 shows that the total ILCR (6.0×10^{-4}) estimated for the on-site worker exposures to surface soil in SWMU 13 exceeded USEPA's generally acceptable target risk range of 1×10^{-6} to 1×10^{-4} . This exceedence is due to predominantly ingestion and dermal exposures to total PeCDF, which

contributed approximately 93% of the total ILCR. The total HI value estimated for on-site worker exposures to noncarcinogenic COPCs in SWMU 13 was less than 1.0, indicating the potential for the occurrence of adverse systemic effects is insignificant. There were no unacceptable risks estimated for on-site worker exposure to SWMU 13 sediment.

SWMU 31 - Waste Oil Collection Area/Buildings 31 and 2022

Table 5-6 shows that the total ILCR (7.6×10^{-4}) estimated for the on-site worker exposures to surface soil in SWMU 31 exceeded USEPA's generally acceptable target risk range of 1×10^{-6} to 1×10^{-4} . This exceedence is due to predominantly ingestion and dermal exposures to total HxCDF, total PeCDF, and total HxCDD which contributed approximately 55%, 20%, and 15%, respectively, of the total ILCR. The total HI value estimated for on-site worker exposures to noncarcinogenic COPCs in SWMU 31 was less than 1.0, indicating the potential for the occurrence of adverse systemic effects is insignificant.

AOC C - Transformer Storage Pad

Table 5-7 shows that the total ILCR (7.1×10^{-2}) estimated for the on-site worker exposures to surface soil in AOC C exceeded USEPA's generally acceptable target risk range of 1×10^{-6} to 1×10^{-4} . This exceedence is due to predominantly to accidental ingestion and dermal exposures to Aroclor-1260, which contributed greater than 99 percent of the ILCRs estimated for each pathway. The total HI value estimated for on-site worker exposures to noncarcinogenic COPCs in AOC C surface soil is less than 1.0, indicating that the potential for the occurrence of adverse systemic effects is insignificant.

5.4.1 Future Residents

The following subsections describe the resultant risk values derived for exposures of future residents upon the inclusion of dioxins/furans that exceeded corresponding RBCs as COPCs for surface soil at SWMU 13, SWMU 31, and AOC C. Potentially unacceptable risks were estimated for surface soil at SWMU 13, SWMU 31, and AOC C. Based on further evaluation of dioxins/furans, potential carcinogenic risks from surface soil to future residents increased significantly from the Draft RFI estimation for SWMUs 13 and 31. Carcinogenic and noncarcinogenic risk results for future

residents from exposure to AOC C surface soil remained the same as estimated in the Draft RFI Report. Tables 12 through 20 in Appendix B contain the specific DAD/CDI calculations for each exposure pathway. These risks are summarized in Addendum Tables 5-8 through 5-10.

SWMU 13 - Old Pest Control Shop/Building 258

Table 5-8 shows that the total ILCRs (1.2×10^{-3} and 1.3×10^{-3}) estimated for future residential adult and child (respectively) exposures to surface soil exceeded USEPA's generally acceptable target risk range of 1×10^{-6} to 1×10^{-4} . These exceedences are due to predominantly to ingestion and dermal exposures to total PeCDF, which contributed approximately 93 percent of the total ILCR. The total HI value estimated for future residential exposures to noncarcinogenic COPCs in SWMU 13 surface soil is less than 1.0, indicating that the potential for the occurrence of adverse systemic effects is insignificant.

Table 5-8 also shows that the total ILCR (1.3×10^{-4}) estimated for future adult residential exposures to ditch sediment in SWMU 13 exceeded USEPA's generally acceptable target risk range of 1×10^{-6} to 1×10^{-4} . This exceedence is due predominantly to dermal exposures to 4,4'-DDE, 4,4'-DDT and benzo(a)pyrene, which contributed approximately 31 percent, 48 percent and 14 percent, respectively, of the total ILCR. However, it should be noted that ILCRs estimated for each COPC individually were within USEPA's target risk range. The total HI values estimated for both adult and young child residential exposures to noncarcinogenic COPCs in SWMU 13 sediment (1.1 and 2.5, respectively) exceeded USEPA's acceptable target value of 1.0. This exceedence is due predominantly to dermal exposures to 4,4'-DDT in sediment, which contributed approximately 84 percent of the total HI. However, since the individual HQ estimated for this COPC is less than the target value of 1.0, and since the target organs differ from those of the other systemic COPCs evaluated under this scenario (4,4'-DDT - liver; cadmium - renal cortex; copper - gastrointestinal system; mercury - kidney/nervous system; and zinc - blood), it is unlikely that there is any cumulative risk of adverse systemic effects following sediment exposures to the recreational user, as evaluated in this HHRA. In addition, it should be noted that based on the physical features and location of the ditch it is unlikely that whole-body dermal exposures would ever occur to a future resident.

SWMU 31 - Waste Oil Collection Area/Buildings 31 and 2022

Table 5-9 shows that the total ILCRs (1.5×10^{-3} and 1.7×10^{-3}) estimated for future residential adult and child (respectively) exposures to surface soil exceeded USEPA's generally acceptable target risk range of 1×10^{-6} to 1×10^{-4} . These exceedences are due to predominantly to ingestion and dermal exposures to total HxCDF, total PeCDF, and total HxCDD which contributed approximately 55 percent, 20 percent, and 15 percent of the total ILCR. The total HI value estimated for future residential exposures to noncarcinogenic COPCs in SWMU 31 surface soil is less than 1.0, indicating that the potential for the occurrence of adverse systemic effects is insignificant.

AOC C - Transformer Storage Pad

Table 5-10 shows that the total ILCRs estimated for future adult and child residential exposures to surface soil in AOC C (1.2×10^{-1} and 9.4×10^{-2} , respectively) exceeded USEPA's generally acceptable target risk range of 1×10^{-6} to 1×10^{-4} . This exceedence is due to predominantly to ingestion and dermal exposures to 5,200 mg/kg of Aroclor-1260 in the surface soil at location ACSS05, which contributed greater than 99 percent of the total ILCR. The total HI value estimated for young child residential exposures to noncarcinogenic COPCs in AOC C surface soil (2.4) exceeded USEPA's acceptable target value of 1.0. This exceedence is due predominantly to ingestion and dermal exposures to arsenic, 4,4'-DDT, alpha-chlordane, and gamma-chlordane in surface soil. For the ingestion pathway, these COPCs contributed approximately 63 percent, 11 percent, 14 percent, and 12 percent of the total ingestion HI. For the dermal pathway, these COPCs contributed approximately 25 percent, 14 percent, 32 percent, and 29 percent of the total dermal HI. Therefore, there may be a cumulative risk of adverse systemic effects to the residential young child following surface soil exposures, as evaluated in this HHRA.

5.5 Sources of Uncertainties in the HHRA (page 6-7, Paragraph 2, Section 6.2.2.1; page 6-9)

5.5.1 Exposure Assessment

In performing exposure assessments, uncertainties arise from two main sources. First, uncertainties arise in estimating the fate of a compound in the environment, including estimating release and transport in a particular environmental medium. Second, uncertainties arise in the estimation of

chemical intakes resulting from contact by a receptor with a particular medium. An example of uncertainty introduced by the latter source is the estimation of potential intakes to construction workers as a result of direct contact exposures to subsurface soil during excavation/construction activities. Here, the uncertainty lies in the assumption that the only medium of concern for this receptor is subsurface soil. Construction worker exposures to surface soil could also occur; however, it is assumed in this HHRA that at surface soil exposures are insignificant at an excavated construction site relative to subsurface soil exposures. Intakes due to direct contact exposures to surface soil were estimated for the much more conservative residential scenario. The resulting residential risks are expected to be greater than those that would be estimated for the construction worker scenario, and would most likely drive the surface soil remedial efforts.

Similarly, future residents are not evaluated for exposure to subsurface soil. Here, the uncertainty lies in the assumption that the only medium of concern for these receptors is surface soil. Future residential exposures to subsurface soil could also occur; however, it is assumed in this HHRA that subsurface soil exposures are insignificant relative to surface soil exposures when considering a residential scenario. Intakes due to direct contact exposures to subsurface soil were estimated for the much more conservative construction worker scenario. The resulting construction worker risks are expected to be greater than those that would be estimated for the future residential scenario, and would most likely drive the subsurface soil remedial efforts.

5.5.2 Use of Inhalation Slope Factors

Uncertainties associated with risk characterization include USEPA promulgated toxicological indices such as inhalation slope factors and reference doses. Inhalation slope factors and reference doses are derived for the evaluation of volatile contaminants in vapor form. While there were no volatiles retained as COPCs in groundwater for evaluation of inhalation of vapors in this risk assessment, the inhalation of fugitive dusts was evaluated as an exposure pathway for surface soils at SWMUs/AOCs where COPCs were retained in surface soils. There is uncertainty in using the inhalation slope factors and reference doses when evaluating the inhalation of fugitive dusts because these toxicity criteria were developed for inhalation of contaminants in vapor. The method of contaminant intake is different when considering the deposition of a contaminant from a particulate to lung tissue versus the transfer of a contaminant from vapor to lung tissue. However, USEPA

promulgated toxicological indices are calculated to be protective of the human receptor and to err conservatively, so as not to underestimate the potential human health risks.

5.6 Summary of Results of the Additional Evaluation of the HHRA

This section summarizes the results of the additional evaluation of the HHRA based on comments made by USEPA Region II and A. T. Kearney, Inc. This section identifies SWMUs/AOCs that are associated with additional COPCs that were not included in the HHRA of the Draft RFI Report. Receptor groups affected by the further evaluation of the HHRA are current on-site workers and future residents. However, it should be noted that currently, there are no facilities for personnel housing within any of the investigated OUs, nor are any likely to be developed.

SWMU 6/AOC B - Building 145 Storage Area/Building 25

There were no additional risks associated with the evaluation of groundwater as a media of concern for SWMU 6/AOC B. Dissolved beryllium and lead were retained as COPCs, and future residents were evaluated for ingestion and dermal contact exposure to SWMU 6/AOC B groundwater. The ILCR estimated for future residential exposure to groundwater was within USEPA's generally acceptable risk range. The estimated total HI value for groundwater exposure is less than 1.0, indicating that the potential for the occurrence of adverse systemic effects is insignificant. Therefore, the addition of the groundwater ingestion and dermal contact exposure scenarios did not significantly affect the human health risk results estimated in the Draft RFI.

SWMU 13 - Old Pest Control Shop/Building 258

Based on further evaluation conducted after the addition of dioxin/furan COPCs, additional carcinogenic risk that was not assessed in the Draft RFI was estimated for on-site workers and future residential children from exposure to SWMU 13 surface soil. In addition, potential carcinogenic risks from SWMU 13 surface soil to future residential adults increased by an order of magnitude from the ILCR estimated in the Draft RFI. These potentially unacceptable carcinogenic risks would result predominantly from ingestion and dermal exposures to total PeCDF in surface soil.

SWMU 31 - Waste Oil Collection Area/Buildings 31 and 2022

Additional carcinogenic risk that was not assessed in the Draft RFI was estimated for on-site workers and future residential children and adults from exposure to SWMU 31 surface soil based on further evaluation conducted after the addition of dioxin/furan COPCs. These potentially unacceptable carcinogenic risks would result predominantly from ingestion and dermal exposures to total HxCDF, total PeCDF, and total HxCDD in surface soil.

AOC C - Transformer Storage Pad

Potential risks from AOC C surface soil to on-site workers and future residents remained as estimated in the Draft RFI Report. As presented in the Draft RFI, the potentially unacceptable carcinogenic risks estimated for on-site workers and future residents would result from ingestion and dermal exposure to Aroclor-1260 in surface soil. Unacceptable noncarcinogenic risks were also estimated for future adult and child residents that would result predominantly from ingestion and dermal exposures to arsenic, 4,4'-DDT, alpha-chlordane, and gamma-chlordane in the surface soil.

6.0 ADDITIONAL INVESTIGATION WORKPLANS

6.1 Areas Requiring Further Work

The Navy has agreed to perform additional investigations at the following areas:

- SWMU 10 (Substation 90) (groundwater only)
- SWMU 26 (Building 544 area)
- SWMUs 31 and 32 (Public Works Yard)
- SWMU 46 (Pole Storage Yard Covered Pad)
- AOC C (Transformer Storage Pads)
- SWMU 13 (Pesticide Building 258); and
- SWMU 11/45 (Cooling Water Tunnels)

Potential additional investigations at SWMU 6/AOC B pend the results of EPA review of this addendum. Sediment investigations at SWMU 2 will be addressed once the results of the RFI presently in the reporting stage for OU 3/5 are reviewed.

6.2 Scope of Workplans

The workplans prepared will make maximum use the existing, EPA approved, workplans. As such, the additional workplans will be addenda to the existing plan utilizing the Health and Safety Plan, the Quality Assurance Project Plan and Standard Operating Procedures essentially as they are now. The addenda will describe in detail the number and types of environmental data to be gathered and provide a full technical rationale as the basis for investigatory scope development.

6.3 Schedule for Workplan Submission

The complete workplans for the list of sites appearing in Section 7.1 will be submitted to the EPA for their review on February 28, 1997. Included in the workplans will be a schedule for implementation.

TABLES

SECTION 4.0
TABLES

TABLE 4-1

DETECTED CONSTITUENTS IN BACKGROUND SURFACE
AND SUBSURFACE SOIL SAMPLES
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

Constituent	Background Surface Soil ⁽¹⁾	Background Subsurface Soil ⁽¹⁾	Industrial RBC	Residential RBC
Volatiles ($\mu\text{g}/\text{kg}$)				
Xylene (total)	ND	3.79	1E+06	160000
Semivolatiles ($\mu\text{g}/\text{kg}$)				
Bis(2-ethylhexyl)phthalate	193.77	ND	410	46
Butylbenzylphthalate	193.67	ND	410000	16000
Di-n-butylphthalate	ND	391.86	2E+08	7.8E+06
Fluoranthene	193.63	ND	82000	3100
Pesticide/PCBs ($\mu\text{g}/\text{kg}$)				
No detections				
Dioxins ($\mu\text{g}/\text{kg}$)				
No detections				
Total Metals (mg/kg)				
Arsenic	2.46	2.57	3.8	0.43
Barium	205.53	331.23	140000	5500
Beryllium	0.55	0.832	1.3	0.15
Cadmium	ND	0.828	1000	39
Chromium	57.27	172.39	10000	390
Cobalt	40.20	45.57	120000	4700
Copper	298.05	182.99	82000	3100
Lead	15.83	6.86		400 ⁽²⁾
Mercury	0.11	0.270	610	23
Nickel	12.49	45.82	14000	1600
Selenium	2.00	1.36	10000	390
Tin	3.31	4.92	1E+06	47000
Vanadium	263.73	390.81	14000	550
Zinc	126.37	103.22	610000	23000

Notes:

ND = No Detections

⁽¹⁾The background concentration values are representative of the average background detection plus two normal standard deviations.

⁽²⁾USEPA Action Level

Shading indicates background exceedance of residential RBC.

TABLE 4-2

DETECTED CONSTITUENTS IN BACKGROUND GROUNDWATER SAMPLES
 CTO-0277 RFI REPORT OU#1 AND OU#7
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

Compound	Groundwater ⁽¹⁾	Tap Water RBC	MCL
Volatiles (µg/kg)			
No detections			
Semivolatiles (µg/kg)			
Acetophenone	5.19	200000	7800
Total Metals (µg/kg)			
Arsenic	5.20	0.045	0.05
Barium	708.24	2600	2.0
Beryllium	4.01	0.016	0.004
Chromium	121.56	180	0.1
Cobalt	109.67	2200	-
Copper	432.07	1500	1.3
Lead	10.16	-	0.015 ⁽²⁾
Nickel	85.31	730	0.1 ⁽²⁾
Vanadium	674.97	260	-
Zinc	378.46	11000	-
Dissolved Metals (µg/mg)			
Barium	174.18	2600	2.0
Copper	62.9	1500	1.3
Vanadium	14.9	260	-
Zinc	177.84	11000	-

Note:

⁽¹⁾ The background concentrations values are representative of the average background detection plus two normal standard deviations.

⁽²⁾ USEPA Action Level

- Not established

Shading indicates background groundwater exceedance of either the tap water RBC or the MCL.

TABLE 4-3

**BACKGROUND GROUNDWATER COMPARISON FOR AOC B
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO**

Constituent	Background Groundwater ⁽¹⁾	ACBMW01	ACBMW03	Tap Water RBC	MCL
Total Metals ($\mu\text{g}/\text{kg}$)					
Arsenic	5.20	5.6 J	3.6	0.045	0.05
Beryllium	4.01	5.9	1.1 U	0.016	0.004
Dissolved Metals ($\mu\text{g}/\text{kg}$)					
Beryllium	ND	1.9	1.1 U	0.016	0.004

Note:

⁽¹⁾ The background concentrations values are representative of the average background detection plus two normal standard deviations.

SECTION 5.0
TABLES

ADDENDUM TABLE 5-1

**SUMMARY OF SURFACE SOIL COPCs ⁽¹⁾
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

COPCs	SWMU 13	SWMU 23	SWMU 25	SWMU 26	SWMU 30	SWMU 31	SWMU 32	SWMU 37	SWMU 39	SWMU 46	SWMU 51	AOC B	AOC C
Semivolatiles:													
Benzo(a)pyrene	X	X	X					X		X		X	X
Benzo(b)fluoranthene								X		X			
Bis(2-ethylhexyl)phthalate			X										
Dibenzo(a,h)anthracene								X		X			
N-Nitrosodimethylamine											X		
Pesticides:													
4,4'-DDE	X											X	X
4,4'-DDD												X	
4,4'-DDT	X											X	X
alpha-Chlordane													X
gamma-Chlordane													X
Kepone													X
PCBs:													
Aroclor-1254							X						
Aroclor-1260					X	X		X		X			X

ADDENDUM TABLE 5-1 (Continued)

**SUMMARY OF SURFACE SOIL COPCs ⁽¹⁾
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

COPCs	SWMU 13	SWMU 23	SWMU 25	SWMU 26	SWMU 30	SWMU 31	SWMU 32	SWMU 37	SWMU 39	SWMU 46	SWMU 51	AOC B	AOC C
Dioxins:													
Total HxCDD	X					X						X	
Total HxCDF	X					X						X	X
Total PeCDF	X					X							X
Total PeCDD						X							
Total TCDF						X							X
Inorganics:													
Arsenic	X		X	X	X	X	X		X	X		X	X
Beryllium				X						X		X	X
Lead	X												X

Notes:

⁽¹⁾ Only the SWMUs and AOCs for which COPC's were identified are presented in the table.

X Chemical identified as a COPC for SWMU/AOC.

ADDENDUM TABLE 5-2

**SUMMARY OF SUBSURFACE SOIL AND GROUNDWATER COPCs ⁽¹⁾
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

	Subsurface Soil COPCs				Groundwater COPCs	
	SWMU 31	SWMU 32	SWMU 46	AOC B	SWMU 30	AOC B
Pesticides:						
4,4'-DDE				X		
4,4'-DDD				X		
4,4'-DDT				X		
Inorganics:						
Total Antimony					X	
Total Arsenic		X	X	X	X	X
Total Barium						X
Total Beryllium	X			X		X
Total Chromium						X
Total Copper						X
Total Lead						X
Total Nickel						X
Total Vanadium						X
Total Zinc					X	
Dissolved Antimony					X	
Dissolved Arsenic					X	
Dissolved Beryllium						X
Dissolved Lead						X

Notes:

- ⁽¹⁾ Only the SWMUs and AOCs for which COPCs were identified are presented in the table.
X Chemical identified as a COPC for SWMU/AOC.

ADDENDUM TABLE 5-3

**SUMMARY OF SEDIMENT COPCs ⁽¹⁾
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

	SWMU 1	SWMU 2	SWMU 3	SWMU 7	SWMU 11	SWMU 13	SWMU 25	AOC D
Semivolatiles:								
Acenaphthylene					X			X
Anthracene		X			X			X
Benzo(a)anthracene		X			X			X
Benzo(a)pyrene		X		X	X	X		X
Benzo(b)fluoranthene		X			X			X
Benzo(k)fluoranthene					X			X
Chrysene		X		X	X			X
Dibenzo(a,h)anthracene		X			X			X
Fluoranthene		X			X			X
Fluorene		X						
Indeno(1,2,3-cd)pyrene		X			X			X
Phenanthrene		X						X
Pyrene		X			X			X
Dioxins/Furans								
Total PeCDD		X						X
Total HxCDD		X	X					X
Total HxCDF		X						X
Pesticides:								
4,4'-DDE		X				X		X
4,4'-DDD						X		
4,4'-DDT						X		

ADDENDUM TABLE 5-3 (Continued)

**SUMMARY OF SEDIMENT COPCs ⁽¹⁾
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

	SWMU 1	SWMU 2	SWMU 3	SWMU 7	SWMU 11	SWMU 13	SWMU 25	AOC D
Inorganics								
Arsenic				X	X			X
Beryllium			X				X	X
Cadmium		X				X		X
Copper	X	X	X	X		X	X	X
Lead		X	X		X	X		X
Mercury		X				X		X
Nickel							X	
Zinc		X				X		X

Notes:

⁽¹⁾ Only the SWMUs and AOCs for which COPC were identified are presented in the table.

X Chemical identified as a COPC for SWMU/AOC.

ADDENDUM TABLE 5-4*

**INCREMENTAL CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE ADULT AND YOUNG CHILD RESIDENTS**

**AOC B
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

Pathway	Residents			
	Adult		Young Child	
	ICR	HI	ICR	HI
<u>Surface Soil</u>				
Ingestion	3.2 x 10 ⁻⁵	0.08	7.6 x 10 ⁻⁵	0.79
Dermal Contact	2.3 x 10 ⁻⁴	0.32	1.0 x 10 ⁻⁴	0.56
Inhalation ⁽¹⁾	2.5 x 10 ⁻⁸	<0.01	3.0 x 10 ⁻⁸	<0.01
Subtotal	2.6 x 10 ⁻⁴ ⁽²⁾	0.40	1.8 x 10 ⁻⁴ ⁽²⁾	1.4 ⁽³⁾
<u>Groundwater</u>				
Ingestion	7.7 x 10 ⁻⁵	0.01	4.5 x 10 ⁻⁵	0.02
Dermal Contact	1.5 x 10 ⁻⁵	<0.01	7.2 x 10 ⁻⁶	<0.01
Subtotal	9.2 x 10 ⁻⁵	0.01	5.2 x 10 ⁻⁵	0.02
TOTAL	3.5 x 10⁻⁴	0.40	2.3 x 10⁻⁴	1.4

Notes:

* To replace Table 6-21 of the Draft RFI Report.

⁽¹⁾ Inhalation of fugitive dusts.

⁽²⁾ Subtotal surface soil ILCR exceeded USEPA's target risk range due to dermal exposures to benzo(a)pyrene, beryllium, benzo(b)fluoranthene, 4,4'-DDE, 4,4'-DDD, and 4,4'-DDT, (29%, 26%, 7%, 9%, 5%, and 6% risk contributions, respectively) in surface soil. However, the individual ILCRs for these COPCs are within USEPA's acceptable target risk range of 1 x 10⁻⁶ to 1 x 10⁻⁴.

⁽³⁾ Total HI estimated for child exceeded USEPA's acceptable target value of 1.0 due to ingestion exposures to 4,4'-DDT and arsenic (46% and 54% risk contributions, respectively), and also to dermal exposure to 4,4'-DDT and arsenic (72% and 26% risk contributions, respectively) in surface soil. However, the total HIs estimated for the individual exposure pathways are less than 1.0.

Shading indicates exceedence of USEPA acceptable target risk criteria by subtotal and total risk value.

ADDENDUM TABLE 5-5*

**INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR CURRENT ON-SITE WORKERS
SWMU 13
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

Medium/Pathway	Current On-site Worker	
	ILCR	HI
<u>Surface Soil</u>		
Ingestion	1.6 x 10 ⁻⁴	0.01
Dermal Contact	4.4 x 10 ⁻⁴	0.08
Inhalation ⁽¹⁾	3.7 x 10 ⁻⁸	--
Subtotal	6.0 x 10 ⁻⁴	0.09
<u>Sediment</u>		
Ingestion	6.1 x 10 ⁻⁶	0.05
Dermal Contact	6.0 x 10 ⁻⁵	0.55
Subtotal	6.6 x 10 ⁻⁵	0.6
TOTAL	6.7 x 10 ⁻⁴⁽²⁾	0.7

Notes:

* Additional scenario resulting from revisions to Draft RFI Report.

⁽¹⁾ Inhalation of fugitive dusts.

⁽²⁾ Total ILCR exceeded USEPA's target risk range due to ingestion and dermal exposures to total PeCDF (greater than 93% risk contribution for both pathways) in surface soil.

-- Scenario not evaluated due to lack of available toxicity criteria.

Shading indicates exceedence of USEPA acceptable target risk criteria by total risk value.

ADDENDUM TABLE 5-6*

**INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR CURRENT ON-SITE WORKERS
SWMU 31
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

Medium/Pathway	Current On-site Worker	
	ILCR	HI
<u>Surface Soil</u>		
Ingestion	2.0×10^{-4}	<0.01
Dermal Contact	5.6×10^{-4}	0.01
Inhalation ⁽¹⁾	4.5×10^{-8}	--
TOTAL	7.6×10^{-4} ⁽²⁾	0.01

Notes:

* Additional scenario resulting from revisions to Draft RFI Report.

⁽¹⁾ Inhalation of fugitive dusts.

⁽²⁾ Total ILCR exceeded USEPA's target risk range due to ingestion and dermal exposures to total HxCDF, PeCDF, and HxCDD (greater than 55%, 20%, and 15% risk contribution for both pathways) in surface soil.

-- Scenario not evaluated due to lack of available toxicity criteria.

Shading indicates exceedence of USEPA acceptable target risk criteria by total risk value.

ADDENDUM TABLE 5-7*

**INCREMENTAL LIFETIME CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR CURRENT ON-SITE WORKERS
AOC C
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

Medium/Pathway	Current On-site Worker	
	ILCR	HI
<u>Surface Soil</u>		
Ingestion	7.1×10^{-3}	0.05
Dermal Contact	6.3×10^{-2}	0.04
Inhalation ⁽¹⁾	1.5×10^{-8}	<0.01
TOTAL	7.1×10^{-4}⁽²⁾	0.09

Notes:

* To replace Table 6-11 in Draft RFI Report.

⁽¹⁾ Inhalation of fugitive dusts.

⁽²⁾ Total ILCR exceeded USEPA's target risk range due to ingestion and dermal exposures to Aroclor-1260 (greater than 99% risk contribution for both pathways) in surface soil.

Shading indicates exceedence of USEPA acceptable target risk criteria by total risk value.

ADDENDUM TABLE 5-8*

**INCREMENTAL CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE ADULT AND YOUNG CHILD RESIDENTS**

**SWMU 13
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

Pathway	Residents			
	Adult		Young Child	
	ICR	HI	ICR	HI
<u>Surface Soil</u>				
Ingestion	4.2 x 10 ⁻⁴	0.04	9.7 x 10 ⁻⁴	0.36
Dermal Contact	7.6 x 10 ⁻⁴	0.14	3.4 x 10 ⁻⁴	0.24
Inhalation ⁽¹⁾	1.0 x 10 ⁻⁷	--	1.2 x 10 ⁻⁷	--
Subtotal	1.2 x 10 ⁻³⁽²⁾	0.18	1.3 x 10 ⁻³⁽²⁾	0.60
<u>Sediment</u>				
Ingestion	4.9 x 10 ⁻⁶	0.04	1.1 x 10 ⁻⁵	0.42
Dermal Contact	1.2 x 10 ⁻⁴	1.1	5.4 x 10 ⁻⁵	2.1
Subtotal	1.3 x 10 ⁻⁴⁽³⁾	1.1	6.5 x 10 ⁻⁵	2.5
TOTAL	1.4 x 10 ⁻³	1.3 ⁽⁵⁾	1.4 x 10 ⁻³	3.1 ⁽⁵⁾

Notes:

* To replace Table 6-18 in Draft RFI Report.

⁽¹⁾ Inhalation of fugitive dust.

⁽²⁾ Total soil ILCR exceeded USEPA's target risk range due to ingestion and dermal exposures to total PeCDF (greater than 93% contribution).

⁽³⁾ Total sediment ILCR exceeded USEPA's target risk range due to dermal exposures to 4,4'DDE, 4,4'DDT and benzo(a)pyrene (31%, 48% and 14% risk contributions, respectively). However, individual ILCRs are within USEPA's acceptable target risk range of 1 x 10⁻⁶ to 1 x 10⁻⁴.

⁽⁴⁾ Total HI exceeded USEPA's acceptable target value of 1.0 due to dermal exposure to 4,4'DDT (84% risk contribution) in sediment. However, the HQ for this compound is less than 1.0.

⁽⁵⁾ Total HI exceeded USEPA's acceptable target value of 1.0 due to dermal exposure to 4,4'DDT (84% risk contribution) in sediment. The HQ for this compound was also greater than 1.0.

-- Scenario not evaluated due to lack of available toxicity criteria.

Shading indicates exceedence of USEPA acceptable target risk criteria by total risk value.

ADDENDUM TABLE 5-9*

**INCREMENTAL CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE ADULT AND YOUNG CHILD RESIDENTS**

**SWMU 31
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

Pathway	Residents			
	Adult		Young Child	
	ICR	HI	ICR	HI
<u>Surface Soil</u>				
Ingestion	5.5 x 10 ⁻⁴	0.01	1.3 x 10 ⁻³	0.06
Dermal Contact	9.7 x 10 ⁻⁴	0.01	4.3 x 10 ⁻⁴	0.02
Inhalation ⁽¹⁾	1.2 x 10 ⁻⁷	--	1.2 x 10 ⁻⁹	--
TOTAL	1.5 x 10 ^{-3 (2)}	0.02	1.7 x 10 ^{-3 (2)}	0.08

Notes:

* Additional scenario resulting from revisions to Draft RFI Report.

(1) Inhalation of fugitive dusts.

(2) Total ILCR exceeded USEPA's target risk range due to ingestion and dermal exposures to total HxCDF, PeCDF, and HxCDD (greater than 55%, 20%, and 15% risk contributions for both pathways) in surface soil.

-- Scenario not evaluated due to lack of available toxicity criteria.

Shading indicates exceedence of USEPA acceptable target risk criteria by total risk value.

ADDENDUM TABLE 5-10*

**INCREMENTAL CANCER RISKS (ILCRs) AND HAZARD INDICES (HIs)
FOR FUTURE ADULT AND YOUNG CHILD RESIDENTS**

**AOC C
NAVAL STATION ROOSEVELT ROADS
PUERTO RICO**

Pathway	Residents			
	Adult		Young Child	
	ICR	HI	ICR	HI
<u>Surface Soil</u>				
Ingestion	1.9 x 10 ⁻²	0.14	4.4 x 10 ⁻²	1.3
Dermal Contact	1.0 x 10 ⁻¹	0.63	5.0 x 10 ⁻²	1.1
Inhalation ⁽¹⁾	4.1 x 10 ⁻⁸	<0.01	4.7 x 10 ⁻⁸	<0.01
TOTAL	1.2 x 10⁻¹ ⁽²⁾	0.77	9.4 x 10⁻² ⁽²⁾	2.4 ⁽³⁾

Notes:

* To replace Table 6-22 of Draft RFI Report.

⁽¹⁾ Inhalation of fugitive dusts.

⁽²⁾ Total ILCR exceeded USEPA's target risk range due to ingestion and dermal exposures to Aroclor-1260 (greater than 99% risk contribution for both pathways) in surface soil.

⁽³⁾ Total HI exceeded USEPA's acceptable target value of 1.0 due to the ingestion of arsenic, 4,4'-DDT, alpha-chlordane, and gamma-chlordane (63%, 11%, 14%, and 12% risk contribution, respectively) in surface soil. The dermal pathway also contributed to the exceedence of USEPA's acceptable target value due to the presence of arsenic, 4,4'-DDT, alpha-chlordane, and gamma-chlordane (25%, 14%, 32%, and 29% risk contribution, respectively) in surface soil. However, the HQs estimated for the individual COPCs were less than 1.0.

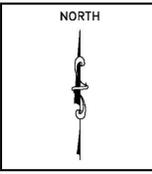
Shading indicates exceedence of USEPA acceptable target risk criteria by total risk value.

FIGURES



REVISIONS	
1	
2	
3	
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DSN/DWN:
 CHK:
 S.O. NO.: 62470-277
 FILE: 277183WP



NAVAL STATION ROOSEVELT ROADS
 Puerto Rico
 Baker Environmental, Inc.
 Coraopolis, Pennsylvania



ADDENDUM 1
 A OCD SEDIMENT SAMPLING LOCATIONS
 SCALE: 1" = 600'
 DATE: JANUARY 15, 1997

SHEET NO.
 OF

SOURCE: LANTDIV, FEB. 1992

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APPENDIX A
EPA COMMENT LETTER



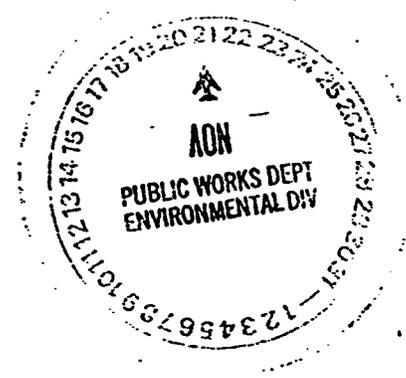
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY - REGION II

290 BROADWAY

NEW YORK, NEW YORK 10007-1866

NOV 08 1996

CERTIFIED MAIL
RETURN RECEIPT REQUESTED



S. J. Pena
Commander, CEC, U.S. Navy
Public Works Officer
U.S. Naval Station Roosevelt Roads
TSC 1008 Box 3001
Code NO
FPO AA 34051-3001

Re: Draft RCRA Facility Investigation (RFI) Report for Operable
Units 1, 6, and 7,
Naval Station Roosevelt Roads
RCRA/HSWA Permit No. PR2170027203

Dear Commander Pena:

The United States Environmental Protection Agency (EPA) Region II has reviewed Volumes I and II of the July 1996 Draft RFI Report for Phase I investigations at Operable Unit 1, 6, and 7 SWMUs/AOCs (transmitted by Baker Environmental, your consultants, on July 30, 1996), and all conclusions and recommendations therein. However, EPA has not completed its review of the data validation reports for the analytical results included with the draft RFI report, but will comment on the usability/acceptability of the analytical results when our data validation review is completed, expected by late November.

Nevertheless, based on our review of Volumes I and II of the July 1996 Draft RFI report, EPA requires that they be revised to address the following, and enclosed, EPA comments. These review comments (and those given in the enclosed Technical Review dated October 16, 1996) are predicated on the assumption that the analytical results submitted for Operable Unit 1, 6, and 7

SWMUs/AOCs will be judged acceptable following EPA's data validation review. Accordingly, EPA reserves its right to revise and/or add to our comments, should EPA not concur with the RFI report's determinations as to the useability of the analytical results submitted.

① 1) The conclusion for the SWMU #6/AOC B area (buildings 145 and former Public Works Department building) given in Section 7.2 (page 7-19) that no unacceptable risk is posed by the site (even though a potential human health risk is calculated for future residents) since "[t]here are no plans to utilize the area for residential development, nor is any scenario for this reasonable, considering its location", is unsubstantiated. The Navy has submitted no documentation (deed restriction, etc.) that, at some point in the future, this site could never be redeveloped for either military or civilian residential usage, or similar usage such as a school or child care center. Accordingly, EPA does not concur with the recommendation given in section 7.2 (page 7-20) that "no further site characterization or corrective measures efforts appear warranted at this site."

Numerous exceedances of EPA Region III residential or industrial risk based concentrations (RBCs) in surface and subsurface soils at the SWMU 6/AOC B area indicate environmental releases have occurred. These exceedances are as follows (the surface soil metals results are from Table 5-2, apparently mislabeled as subsurface):

* Arsenic exceeded the Region III carcinogenic residential RBC in all 12 of the surface soil samples, and the carcinogenic industrial RBC in 5 of the 12. Also, arsenic exceeded the carcinogenic residential RBC in 4 of 14 (at 8 locations) subsurface samples;

* Beryllium exceeded the residential RBC in 9 of the 12 surface soil samples, and in 5 of 14 subsurface samples;

* Pesticides (DDE, DDD, and DDT) were detected above their industrial RBCs in 1 of 12 surface samples, and (at the same location as the surface exceedance) above their residential RBC in 1 of 14 subsurface samples;

* Dioxin congeners were detected above their industrial RBC in 2 surface soil samples;

* Benzo(a)pyrene exceeded its industrial RBC in 1 surface soil sample and the residential RBC in 4 other surface samples.

③ EPA requests additional surface and subsurface soil sampling to complete characterization of the full extent of soil contamination at the SWMU 6/AOC B area. Furthermore, the Human Health Risk Assessment (HHRA) must then be based on results following full characterization of the contamination.

④ Also, the Incremental Lifetime Cancer Risks (ILCRs) and Hazard Indices (HIs) submitted for both current on-site worker exposure and future residential exposure for soils at the SWMU 6/AOC B area did not include dioxin as a chemical of potential concern (COPC), even though 2 dioxin congeners exceeded their industrial RBCs in 2 surface soil samples. Following the additional sampling for full site characterization, the ILCRs and HIs for both current on-site worker exposure and future residential exposure to soils should be recalculated, and include dioxin as a COPC.

⑤ In addition, groundwater at the SWMU 6/AOC B area appears to be impacted by releases. In the two groundwater samples collected (three were required by the September 1995 approved work plan), 7 metal constituents exceeded either their MCL or Tap Water RBC in one sample and 3 in the other groundwater sample. Also, the pesticide DDE exceeded the Ambient Water Quality Standard in one groundwater sample. Yet, there was no assessment of possible environmental impacts for groundwater at the SWMU 6/AOC B area. Even though there may be no groundwater usage in the area, the potential for environmental, or possible human health, impacts from discharges of contaminated groundwater to the surface waters of Ensenada Honda/Puerca Bay must be evaluated, following full characterization.

⑥ As indicated above, the draft RFI report states (section 4.8.1.1) that the third groundwater investigation well required for the SWMU 6/AOC B area by the September 1995 approved RFI work plan "...was eliminated [unilaterally by the Navy] from the scope of work due to the proposed location being adjacent to an existing

6 cont
IR site 10 well, 10GW03". Pursuant to Condition B.8.(d) of Module III of the 1994 RCRA/HSWA Permit, "All plans and schedules required by the conditions of this Permit Module and Appendix C [Compliance Schedule] of this Permit are...incorporated into this Permit by reference and become an enforceable part of this Permit. Any noncompliance with such approved plans and schedules shall be termed non-compliance with this Permit."

7
Nevertheless, EPA will evaluate whether well 10GW03 fulfills the requirements of the approved work plan. However, well 10GW03 must be sampled concurrently with the existing two [RFI] wells for the complete analyte list specified in the September 1995 RFI work plan. In addition, current groundwater elevations (corrected to a standard datum) for all 3 wells, with contours, must be shown on the SWMU 6/AOC B maps (such as Figures 4-1, etc.) to determine flow/gradient direction. Also, the analytical results from this and the existing two RFI wells must then be incorporated into an assessment of environmental, and possible human health, impacts from discharge of contaminated groundwater from the SWMU 6/AOC B area to the surface waters, as discussed above.

2) EPA considers the groundwater investigations at SWMU #10 (Substation 2) inadequate. The September 1995, EPA approved, RFI work plan required 4 groundwater wells to investigate for PCBs, since sampling performed during previous interim corrective measures at this SWMU had established that PCB contaminated soils extended to depths of 4 feet below surface at places within the SWMU. Section 4.8.1.2 of the Draft RFI report indicates that only 3 of the 4 required ["Hydropunch"] wells could be completed, and that groundwater from only 1 (well 10HP02) of the 3 wells was analyzed for PCBs, the primary constituent of concern (based on extensive PCB soil contamination previously remediated at this site). The other 2 sampled wells were analyzed for volatile organic constituents only (instead of the volatiles, semivolatiles, and PCBs as required by the approved work plan), and any detections of these were described as likely laboratory artifacts.

Since PCBs at elevated concentrations were found to be present in soils to depths of 4 feet below ground surface during previous interim corrective measures at this SWMU, one groundwater sample is not sufficient basis for EPA to concur with the no further

action recommendation made in Section 7.1.2 (page 7-2) of the Draft report. In that section, the Navy states that since the depth to bedrock is shallow in the area of the SWMU and there is no groundwater usage between the site and Ensenada Honda, a no further action recommendation is justified based on only 1 sample.

In addition, while the bedrock may be shallow, the investigations have not demonstrated that it lacks sufficient transmissivity to permit groundwater flow. Rather, the Navy was unsuccessful in penetrating sufficient water bearing strata (unconsolidated or bedrock) with the "Hydropunch" to adequately characterize the presence or absence of PCBs in groundwater in the uppermost water bearing strata (unconsolidated/bedrock). Therefore, the potential for environmental, or possible human health, impacts from PCB contaminated groundwater discharges to the surface waters of Ensenada Honda has not been fully evaluated. EPA requests the Navy to submit a program to install 3 bedrock investigation wells at SWMU 10 and sample the groundwater for the analyte list in the September 1995 approved RFI work plan. This work is necessary to complete groundwater characterization, since the previous "Hydropunch" investigations were not adequate.

① 3) The rationale for not performing a Human Health Risk Assessment (HHRA) for residential exposure at SWMU #26 (building 544 area) is unacceptable. The Navy asserts that this site, which is currently an unused area, would never be utilized for residential usage; however, the Navy has submitted no documentation (deed restriction, etc.) that, at some point in the future, this site could never be redeveloped for either military or civilian residential usage, or similar usage such as a school or child care center. Yet, this site would not be subject to any regulatory [environmental] clean-up if its usage changed in the future.

② Also, the recommendation given in section 7.1.9 (page 7-8) that "there is no need for further site characterization or corrective measure evaluation at this SWMU" is unacceptable. Of the 5 surface soil samples required at this SWMU, three had arsenic concentrations above the residential risk based concentration (RBC), and a different set of 3 had beryllium above the residential RBC; therefore, in all 5 of the samples collected there was an exceedance of a residential RBC.

2 cont

Based on the frequency of exceedances of residential RBCs (5 out of 5 samples collected), along with the fact that various semi-volatile hazardous constituents (total of 9 different constituents) were detected in all 5 of the samples, EPA conclude's that a release has been confirmed at SWMU #26. Therefore, pursuant to Section A.4(iii) of Module III of the 1994 RCRA/HSWA Permit, a full RFI is required to fully characterize surface and subsurface soils at this site. Section 7 of the draft RFI report must be revised to reflect that additional site characterization (both surface and subsurface soils) is needed, and a full HHRA (including evaluation of possible future residential exposure) following complete site characterization. EPA requests that work plans to be submitted for SWMU #26 include not only surface soils, but also subsurface soil sampling, to a depth of approximately 3 feet below ground surface. The work plan for the additional surface and subsurface sampling at SWMU #26, including an implementation schedule, must be submitted within 45 days of your receipt of this letter.

4. The Human Health Risk Assessments (HHRAs) for SWMUs #31 (uncontrolled storage at buildings 31/2022 area) and #32 (battery collection area) are not complete. Exceedances of residential RBCs at SWMU #31 include: a) PCBs (1 of 4 samples) and arsenic (2 of 4 samples) in surface soils at building 31; b) beryllium in surface soils (4 of 4 samples) and subsurface soils (4 out of 8 samples) at building 2022, and c) PCBs (1 of 4 samples) and arsenic (3 of 4 samples) in surface soils at SWMU #32. Even though HHRAs were performed for on-site workers (current), the HHRAs did not consider future residential usage. The Navy has submitted no documentation (deed restriction, etc.) that, at some point in the future, these sites could never be redeveloped for either military or civilian residential usage, or similar usage such as a school or child care center. The draft RFI report should be revised to include an HHRA evaluation for possible future residential exposure at SWMUs #31 and #32.

①

5. EPA cannot accept the conclusion for SWMU #46 (Pole Storage Yard) given in Section 7.1.15 (page 7-15) that no unacceptable risk is posed by the site (even though a potential human health risk is calculated for future residents) since "The site is not amenable to development as a residential area." The Navy has submitted no documentation (deed restriction, etc.) that, at some point in the future, this site could never be redeveloped for

1 cont either military or civilian residential usage, or similar usage such as a school or child care center.

Y Nor can EPA accept the recommendation (page 7-16) that "Therefore, there are no further site characterization or corrective measures evaluation efforts required for this SWMU." Surface soils were found to contain PCBs exceeding industrial and/or residential RBCs in 8 of the 9 locations sampled (maximum PCB concentration 3.6 mg/kg) during the Phase RFI investigations. In fact, the draft RFI report states on page 7-15 that "The findings of the Phase 1 RFI indicate that releases from the unit have occurred." EPA concurs. Therefore, pursuant to Section A.4(iii) of Module III of the 1994 RCRA/HSWA Permit, a full RFI is required to fully characterize surface and subsurface soils at this site. Section 7 of the draft RFI report must be revised to reflect that additional site characterization (both surface and subsurface soils) is needed, and a full HHRA (including evaluation of possible future residential exposure) following complete site characterization. EPA requests that work plans to be submitted for SWMU #46 include not only surface soils, but also subsurface soil sampling, to a depth of approximately 3 feet below ground surface. The work plan for the additional surface and subsurface sampling at SWMU #46, including an implementation schedule, must be submitted within 45 days of your receipt of this letter.

① 6. Surface soils at AOC C (transformer storage pads behind building 2042) were found to contain PCBs exceeding industrial and/or residential RBCs in 6 of the 12 surface soil samples collected (maximum PCB concentration 5200 mg/kg) during the Phase 1 RFI investigations. However, the Navy has subsequently (reference the Navy's letter of July 10, 1996) reported that during a maintenance operation at this unit, up to 1 foot of surface soil (i.e., the soil that was sampled during the RFI Phase 1 investigations) was inadvertently excavated, and is now stock-piled at the unit awaiting RCRA/TSCA waste characterization and appropriate disposal. Therefore, the Navy recommends, in section 7.0 of the draft RFI report, that the [present] surface soils at AOC C be re-characterized.

② EPA, however, concludes that a release has in fact been confirmed at AOC C, based on the frequency of PCB exceedances of industrial and/or residential RBCs (6 out of 12 samples collected) in the now removed surface soils, plus the elevated concentrations found in two of the samples (5200 mg/kg in ACSS05D and 140 mg/kg in ACSS02). Therefore, pursuant to Section A.4(iii) of Module III of the 1994 RCRA/HSWA Permit, a full RFI is required to fully characterize surface and subsurface soils this site. EPA requests that work plans to be submitted for AOC C include not only "re-characterization" of the [present] surface soils, but also subsurface soil sampling, to a depth of approximately 3 feet below present ground surface. The work plan for the additional surface and subsurface sampling at AOC C, including an implementation schedule, must be submitted within 45 days of your receipt of this letter.

7. SWMU #25 (the DRMO storage yard) had several exceedances of residential RBCs in surface soils (arsenic in 3 of the 9 samples; and 2 semivolatile constituents in 2 of the 9 samples). HHRA calculations for on-site workers found no excessive risk. No HHRA was performed for possible future residential exposure; however, unlike our above comments for other SWMUs (regarding the lack of HHRAs for possible future residential usage), SWMU #25 is associated with (though not directly part of) the base's two permitted Hazardous Waste Container Storage Areas (HWCSAs). Therefore, if necessary in the future, clean-up of SWMU #25 to residential requirements, could be tied to closure of the 2 HWCSAs (which are located inside the DRMO complex), unlike the other SWMUs discussed above (which are not associated with permitted units). In addition, SWMU #25 (unlike the other above SWMUs/AOCs that lack residential HHRAs), is entirely within a fenced-in area (the DRMO yard), whose current usage is well defined and expected to stay the same for the future.

8. In addition to showing the Ensenada Honda sediment sample locations (AOC D) on individual maps for the SWMUs which they are associated with (reference Figures 4-14, 4-15, 4-16, 4-17, and 4-18), the RFI report should also include a unified AOC D map, similar to Figure 1-1, showing all sediment sample locations that were sampled pursuant to requirements for AOC D (Ensenada Honda marine sediments).

9. Besides the additional work EPA requires at those SWMUs/AOCs discussed previously, the draft RFI report recommends further investigations for the AOC D areas (marine sediments) associated with possible releases from SWMU #2 (Langley Drive Disposal area) and SWMU #11/#45 (the old power plant cooling water tunnels). Also, the draft RFI report recommends additional investigation at SWMU #13 (former pest control building 258). EPA concurs, and requests that complete work plans for these additional investigations, including implementation schedules, be submitted within 45 days of your receipt of this letter.

In addition, please submit, within 45 days of your receipt of this letter, a revised draft RFI report for Phase I investigations at Operable Unit 1, 6, and 7 SWMUs/AOCs to fully address the above comments plus all additional comments given in the enclosed Technical Review dated October 16, 1996.

Please contact Mr. Tim Gordon of my staff, at (212) 637-4167 regarding any questions.

Sincerely yours,



Nicoletta DiForte, Chief
Caribbean Section

Enclosure

cc: Mr. Sindulfo Castillo, NAVSTA Roosevelt Roads
Mr. Israel Torres, EQB
Mr. Christopher T. Penny, LANTDIV Code 1823
Mr. Douglas Sullivan, A.T. Kearney, Inc.

NAVAL STATION ROOSEVELT ROADS
CEIBA, PUERTO RICO

TECHNICAL REVIEW OF
RCRA FACILITY INVESTIGATION REPORT
FOR
PHASE I INVESTIGATIONS AT OPERABLE UNITS 1, 6, AND 7,
DATED JULY 1996

Submitted to:

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October 16, 1996

(revised by EPA October 30, 1996)

NAVAL STATION ROOSEVELT ROADS
CEIBA, PUERTO RICO

TECHNICAL REVIEW OF
RCRA FACILITY INVESTIGATION REPORT

FOR

PHASE I INVESTIGATIONS AT OPERABLE UNITS 1, 6, AND 7,
DATED JULY 1996

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1.0 INTRODUCTION

The U.S. Environmental Protection Agency (EPA) has requested that the A.T. Kearney Team (Kearney Team) provide support to the Agency under Work Assignment No. R02020 for technical review of documents associated with the RCRA Facility Investigation (RFI) of the U.S. Naval Station Roosevelt Roads (NSRR) located in Ceiba, Puerto Rico.

The NSRR is located on the east coast of Puerto Rico in the municipality of Ceiba, approximately 33 miles southeast of San Juan. The primary mission of NSRR is to provide full support for the Atlantic Fleet weapons training and development activities. NSRR is currently operating under a Draft RCRA Corrective Action Permit that includes varying degrees of work at 28 Solid Waste Management Units (SWMUs) and three Areas of Concern (AOCs).

The objective of this Work Assignment is to assist EPA with the evaluation of the *Draft RCRA Facility Investigation (RFI) Report for Phase I Investigations at Operable Units 1, 6, and 7, July 1996*, prepared by Baker Environmental, Inc. The Baxter document is designed to provide a summary of activities and findings completed during the Phase I RFI investigation activities at Operable Units 1, 6, and 7. The report consists of two volumes. Volume I contains eight sections describing the environmental setting, facility background, investigation activities and results, health and environmental risk assessments, and conclusions and recommendations. Volume II consists of appendices which present supporting information including summarized analytical results, slug test data results, toxicological profiles, and human health risk calculations.

This report presents the findings of the Kearney Team's technical evaluation. Section 1.0 of this report discusses the scope of this technical evaluation. Section 2.0 identifies the methods and objectives of this technical evaluation. Section 3.0 presents general comments and Section 4.0 provides page-specific comments.

2.0 METHODOLOGY

Pursuant to the EPA Work Assignment Manager's (WAM's) Technical Directives dated August 1, 1996 and August 12, 1996, the Kearney Team reviewed Sections 5, 6, and 7 of Volume I, and Appendices C, E, and F contained in Volume II to evaluate technical adequacy of the findings, interpretations, and conclusions and recommendations. Section 4 (Volume I) review comments were provided by EPA. As directed by EPA, the Kearney Team's review did not include issues regarding data validation.

As requested by the EPA WAM, the Kearney Team communicated preliminary findings to EPA via teleconference on October 1,

1996. During the teleconference, EPA approved the preliminary findings and requested that the Kearney Team complete the review and finalize findings in this report.

3.0 GENERAL COMMENTS

The Ecological Risk Assessment provided in the report identified three SWMUs which are of particular ecological concern: SWMU 13 (Old Pest Control Shop), AOC D-SWMU 2 (Langley Drive Disposal Area), and AOC D-SWMU 11/45 (Old Power Plant/Building 38). Based on the detected concentrations of sediment contaminants, these three areas present the greatest ecological concern. The remaining SWMUs appear to present a low potential to adversely affect ecological receptors.

SWMU 13: The report recommends additional sampling within the drainage ditch associated with SWMU 13 due to the elevated levels of pesticides (DDT and its derivatives) detected. The additional sampling would identify the extent of contaminant migration from the site. In addition, downgradient monitoring wells are proposed to determine if contamination has migrated to the water table. These recommendations are acceptable and should be implemented.

AOC D (SWMU 2 portion): The recommended additional sediment characterization should be implemented to determine the source of the environmental contamination within the sediments. The additional sediment samples should include the harbor side of the mangroves, as well as additional shoreline areas located south of 2SD03 to determine the extent of contamination. Due to the detection of metals (copper, lead, mercury, and zinc) at concentrations above ER-M guidelines, it is also recommended that sediment characterization include acid volatile sulfide (AVS) and simultaneously extractable metals (SEM) analyses. These results would indicate whether the metals detected within the sediments are bioavailable to ecological receptors.

AOC D (SWMU 11/SWMU 45 portion): Additional sediment samples are proposed to be collected from the vicinity of the intake tunnel from Puerca Bay. The additional sediment sampling should also be analyzed for total organic carbon within the sediments so that sediment effect-levels utilizing the equilibrium partitioning approach can be calculated for the elevated polycyclic aromatic hydrocarbons (PAHs).

4.0 PAGE-SPECIFIC COMMENTS

① Page 4-14 & 4-15, Section 4.8.2.3

A portion of the description of the sampling at SWMU 3, the Base Landfill, is missing. The text at the bottom of page 4-14 refers to SWMU 2, then begins at the top of page 4-15 with "apparently

has been receiving fill to extend the shoreline away from the CPO Hut." Nothing preceds this, including a heading indicating the text is now apparently in Section 4.8.2.3, on SWMU 3.

- ② Figure 4-16
An explanation must be given for deleting the two sediment sampling points on the northeast flank of SWMU 3, between sample location 3SD01 and 3SD04. The text does not elaborate, but this deletion resulted in no sediment data points along the approximately 2800 feet of strand line between the 3SD01 sample point and the 3SD04 sample point.
- ③ Page 5-13, ¶6, Section 5.2.1.5
This section should reference the TEF discussion presented in Section 6.2.3.5. In addition, the Navy needs to explain why toxic equivalent dioxin RBCs were not included in all Section 5 tables. See table-specific comments below.
- ④ Page 5-14, ¶2, Section 5.2.1.5
The text notes that tap water RBCs and MCLs were not exceeded for AOC B/SWMU 6. Table 5-5 indicates several RBC and MCL exceedences. The Navy must provide justification as to why ground water at this AOC/SWMU was not carried through the quantitative risk assessment.
- ⑤ Page 5-38, ¶1, §5.3.6.4
The text should be revised to note that concentrations of copper, lead, mercury, and zinc detected at sample locations 2SD02 and 2SD03 exceeded ER-M values in addition to ER-L sediment guidelines. The text should note that the exceedance of ER-M guidelines indicates that adverse effects to benthic fauna are possible.
- ⑥ Section 5 Tables
The text and tables should be expanded to note the rationale for selecting 61,000,000 ug/kg and 2,300,000 ug/kg as the industrial and residential soil RBCs for phenanthrene and benzo(g,h,i)perylene.
- ⑦ Table 5-2
Should be labeled Surface Soil, not subsurface.
- ⑧ Table 5-9, Table 5-24, Table 5-39
Table 5-9 (SWMU 13 Surface Soil), Table 5-24 (SWMU 31 Surface Soil), and Table 5-39 (AOC C Surface Soil) incorrectly note that Region III industrial or residential soil RBC for dioxins are not available. Table 5-1 correctly lists the dioxin RBC. The appropriate value needs to be included in Table 5-9, Table 5-24, and Table 5-39 and exceedances need to be appropriately highlighted. As a result, dioxins will be selected as contaminants of potential concern (COPCs) at SWMU 13, SWMU 31, and AOC C and will need to be carried through the quantitative

risk assessment.

- ⑨ Table 5-15
The Navy must clarify the relationship of results reported on pages 1 and 2 of Table 5-15 compared with pages 3 and 4 of the same table (where the same constituents, same samples, and same dates are shown as on pages 1 and 2, yet on pages 3 and 4 all constituents are listed as NA, not analyzed).
- ⑩ Table 5-18
The table is incorrectly titled surface soils. It should be sediments.
- ⑪ Table 5-42, Page 2
Provide the source of the industrial and residential RBCs for PECDD, HXCDD, and HXCDF of 0.9 ug/kg and 0.1 ug/kg, respectively. These values are inconsistent with the Region III dioxin RBC and with values presented in Table 5-1.
- ⑫ Page 6-1, Section 6.0
The list of SWMUs/AOCs is not consistent with that presented in Section 1.0 of the Phase I RFI Report. Specifically, SWMU 12 and 14 are not listed. In addition, Section 6.0 must clarify that SWMU 6 is located within AOC B.
- ⑬ Page 6-2, ¶5, Section 6.2.1
The description of environmental media investigated does not include groundwater in SWMU 10. This section should describe the full extent of the RFI regardless of whether certain media are carried through the quantitative risk assessment. Revise the text accordingly.
- ⑭ Page 6-3, ¶2, Section 6.2.1
The rationale for not considering leaching-based soil criteria needs to be clarified. The rationale that it is unlikely that groundwater will ever be utilized for potable use is inconsistent with the use of residential RBCs for the groundwater evaluation.
- ⑮ Page 6-6, ¶2, Section 6.2.2.1
SWMU 30 is identified as the only SWMU investigated for possible groundwater contamination. Groundwater was also investigated at SWMU 6/AOC B and SWMU 10. Additional text needs to be added to explain why ground water at these SWMUs were not carried through the risk assessment.
- ⑯ Page 6-7, ¶2, Section 6.2.2.1
Excavation workers are assumed to be exposed to subsurface soils only. It is more realistic to assume that excavation workers could be exposed to any soils to a depth of 15 feet, including the more shallow surface soils. The surface and subsurface soil data should be combined to evaluate excavation worker exposures/risks and the assessment should be revised accordingly.

17 Page 6-9
The text should be revised to present the rationale for evaluating inhalation risks using inhalation RfDs and inhalation slope factors since current guidance recommends evaluating inhalation risks based on exposure concentration. The text should also discuss uncertainties associated with using inhalation slope factors in evaluating volatile and fugitive dust emissions.

The Navy should provide a reference for the inhalation RfD provided in Appendix N Table 44 for beryllium since there is no RfC/RfD for beryllium in IRIS or HEAST and Table 6-8 of the RFI report does not list an inhalation toxicity value for beryllium.

18 Page 6-15, ¶1, Section 6.2.3.1
The last sentence in this paragraph is confusing in that it implies that the RfC is a dose versus a concentration. Please correct.

19 Page 6-16/Table 6-8
The Region IV default values that are cited should also be referenced. In addition, the source of each of the absorption values presented in Table 6-8 needs to be included.

20 Page 6-20, ¶3, Section 6.2.4.3
Several SWMUs investigated as part of the RFI activities are not discussed in this section -- specifically, SWMUs 12, 14, 25, and 32. Exceedances of residential and/or industrial RBCs were found at SWMUs 25 and 32.

21 Page 6-21 ¶1, Section 6.2.4.3.1
For clarity, the text should be reorganized to clearly state which AOC D SWMUs (i.e., SWMUs 1, 2, 3, 7, and 11) were evaluated and found to drive risk. Individual AOC D SWMUs are discussed at times with no reference to AOC D in some of the text (e.g. pages 6-21 and 6-22) and then discussed collectively in other places (page 6-28). It appears based on the data presented in Table 137 that maximum concentrations detected in any of the AOC D SWMUs were used to evaluate the potential future residential scenario but for all other scenarios AOC D SWMUs were evaluated individually. Please verify and provide rationale.

22 Table 6-1
Justification needs to be provided as to why dioxins were not retained as COPCs for AOC B surface soils. Table 5-1 indicates that detected dioxin concentrations exceeded industrial and residential RBCs.

23 In addition, dioxins should be retained at SWMUs 13 and 31 (see Comments to Tables 5-9 and 5-24). SWMU 31 is designated as requiring no further action; however, dioxin concentrations reported in Table 5-24 range from ND to 43 ug/kg in surface

soils. Detected concentrations of dioxins must be further evaluated and carried through the quantitative risk assessment.

24 Page 7-9, ¶2, §7.1.9

The Conclusion section should be expanded to indicate whether the data suggest a release has occurred.

25 Page 7-13 ¶5, §7.1.13

Given the high potential for continuing or future releases at SWMU 37, the recommendation should be expanded to indicate that alternatives to mitigate future release incidents will be considered.

26 Page 7-20, ¶4, §7.3

The text discussing SWMU 2 must be revised since several metals concentrations exceed NOAA ER-M guidelines and, therefore, are not within a normally expected range.

27 Page 7-22, ¶4, §7.3

The report concludes that any proposed remedial actions within the mangrove areas would result in more damage than leaving the sediments posing low risk in place. Based on the information presented, the majority of the sediments within Ensenada Honda do not appear to pose a significant ecological risk, except as noted at SWMU 11 and particularly at SWMU 2. Sediment concentrations of metals at SWMU 2 are above ER-Ms indicating adverse effects are possible. The conclusions regarding remediation at this SWMU should be deferred until the proposed additional sediment characterization has been conducted.

28 Page 7-22, ¶5, §7.3

The report states that it is unknown if the observed contamination within the sediments adjacent to SWMU 2 are related to the SWMU or past oil spills. It appears that the elevated metals concentrations detected within the SWMU 2 soils indicate that this SWMU is likely to be a source for the elevated metals levels. However, additional investigations within this area should provide additional insight into the source of the metals contamination.

29 Appendix C - Slug Test Data

Based on the information presented in Appendix C, the slug test data from location ACBMW03 may be suspect. The data from ACBMW03 appear to indicate two distinct responses: First, a classic downsloping response, from the 0 to 5 second time period; and a second, stabilized response, from the 5 to 10 second period. It appears that the early part of the data curve may reflect the response of the sand pack around the well and that the latter part of the data curve may reflect a stabilized condition; however, insufficient information is presented to support this interpretation. The suspect nature of the test is also evidenced by the information presented in the test data section of the

figure which indicates that the well had only 1 foot of water at static conditions at the start of the test; however, according to the graph, the withdrawal of the slug resulted in a 2 foot displacement of water. The Navy must provide information demonstrating the validity of slug test results at ACBMW03 or reject the findings.

APPENDIX B
REVISED TABLES

**TABLE 5-1
DETECTED CONCENTRATIONS OF ORGANICS COMPOUNDS
AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO**

SAMPLE ID SAMPLE DATE	Industrial Soils	Residential Soils	ACBSB01-00 03/26/96	ACBSB01-00D 03/26/96	ACBSB02-00 03/26/96	ACBSS01 03/19/96	ACBSS02-00 03/19/96
VOLATILES (ug/kg)							
1,2-DICHLOROETHENE (TOTAL)	18000000	700000	5 U	5 U	5 U	6 U	5 U
XYLENE (TOTAL)	1.00E+09	160000000	5 U	5 U	8	6 U	5 U
SEMIVOLATILES (ug/kg)							
NAPHTHALENE	82000000	3100000	340 U	350 U	1800 U	370 U	340 U
2-METHYLNAPHTHALENE	82000000	3100000	340 U	350 U	1800 U	370 U	340 U
ACENAPHTHYLENE	61000000	2300000	340 U	350 U	1800 U	370 U	340 U
4-CHLOROPHENYL-PHENYLETHER	NA	NA	340 U	350 U	1800 U	370 U	340 U
PHENANTHRENE	61000000	2300000	340 U	350 U	1800 U	370 U	170 J
ANTHRACENE	610000000	230000000	340 U	350 U	1800 U	370 U	340 U
DI-N-BUTYLPHTHALATE	200000000	7800000	77 J	350 U	350 J	370 U	340 U
FLUORANTHENE	82000000	3100000	80 J	100 J	1800 U	86 J	390
PYRENE	61000000	2300000	42 J	62 J	1800 U	76 J	360
BUTYLBENZYLPHTHALATE	410000000	16000000	340 U	350 U	1800 U	370 U	340 U
BENZO(A)ANTHRACENE	7800	880	38 J	47 J	1800 U	370 U	150 J
CHRYSENE	780000	88000	45 J	70 J	1800 U	51 J	250 J
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	340 U	350 U	1800 U	370 U	340 U
BENZO(B)FLUORANTHENE	7800	880	340 U	350 U	1800 U	56 J	200 J
BENZO(K)FLUORANTHENE	78000	8800	340 U	350 U	1800 U	370 U	100 J
BENZO(A)PYRENE	780	88	340 U	350 U	1800 U	39 J	140 J
INDENO(1,2,3-CD)PYRENE	7800	880	340 U	43 J	1800 U	370 U	78 J
DIBENZO(A,H)ANTHRACENE	780	88	340 U	350 U	1800 U	370 U	340 U
BENZO(G,H,I)PERYLENE	61000000	2300000	340 U	350 U	1800 U	370 U	79 J
CARBAZOLE	290000	32000	340 U	350 U	1800 U	370 U	340 U
BENZOIC ACID	1.00E+09	310000000	1700 U	1800 U	8800 U	1900 U	1700 U
ACETOPHENONE	200000000	7800000	340 U	350 U	1800 U	370 U	340 U

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

N = Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

**TABLE 5-1
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AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO**

SAMPLE ID	Industrial Soils	Residential Soils	ACBSB01-00 03/26/96	ACBSB01-00D 03/26/96	ACBSB02-00 03/26/96	ACBSS01 03/19/96	ACBSS02-00 03/19/96
PESTICIDE/PCBS (ug/kg)							
HEPTACHLOR EPOXIDE	630	70	210 U	210 U	42 U	2.6	4 U
4,4'-DDE	17000	1900	19000	22000	15 J	40	8.1 U
4,4'-DDD	24000	2700	17000	18000	40	5.9 NJ	8.1 U
4,4'-DDT	17000	1900	11000	14000	13 J	19 J	8.1 U
DIOXIONS (ug/kg)							
TOTAL HXCDD	0.4	0.04	0.43 U	0.12 U	0.21 U	0.08 U	0.15 U
TOTAL HXCDF	0.4	0.04	0.33 U	0.11 U	0.15 U	0.09 U	0.13 U

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

N = Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-1
DETECTED CONCENTRATIONS OF ORGANICS COMPOUNDS
AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACB-MW01-00 03/19/96	ACBMW02-00 03/19/96	ACBMW03-00 03/19/96	6SB01-00	6SB02-00
	Soils	Soils					
VOLATILES (ug/kg)							
1,2-DICHLOROETHENE (TOTAL)	18000000	700000	5 U	5 U	5 U	2 J	5 U
XYLENE (TOTAL)	1.00E+09	160000000	5 U	5 U	5 U	5 U	5 U
SEMIVOLATILES (ug/kg)							
NAPHTHALENE	82000000	3100000	350 U	340 U	340 U	210 J	340 U
2-METHYLNAPHTHALENE	82000000	3100000	350 U	340 U	340 U	78 J	340 UJ
ACENAPHTHYLENE	61000000	2300000	350 U	340 U	340 U	35 J	340 U
4-CHLOROPHENYL-PHENYLETHER	NA	NA	350 U	340 U			
PHENANTHRENE	61000000	2300000	350 U	340 U	71 J	130 J	340 U
ANTHRACENE	610000000	23000000	350 U	340 U	340 U	61 J	340 U
DI-N-BUTYLPHTHALATE	200000000	7800000	350 U	340 U	340 U	38 J	340 U
FLUORANTHENE	82000000	3100000	350 U	340 U	150 J	500	340 U
PYRENE	61000000	2300000	350 U	340 U	140 J	570	340 U
BUTYLBENZYLPHTHALATE	410000000	16000000	350 U	340 U	340 U	340 U	340 U
BENZO(A)ANTHRACENE	7800	880	350 U	340 U	67 J	150 J	340 U
CHRYSENE	780000	88000	350 U	340 U	95 J	200 J	340 U
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	350 U	340 U	340 U	1000	340 U
BENZO(B)FLUORANTHENE	7800	880	350 U	340 U	91 J	460	340 U
BENZO(K)FLUORANTHENE	78000	8800	350 U	340 U	45 J	190 J	340 U
BENZO(A)PYRENE	780	88	350 U	340 U	69 J	290 J	340 U
INDENO(1,2,3-CD)PYRENE	7800	880	350 U	340 U	46 J	150 J	340 U
DIBENZO(A,H)ANTHRACENE	780	88	350 U	340 U	340 U	340 U	340 U
BENZO(G,H,I)PERYLENE	61000000	2300000	350 U	340 U	46 J	120 J	340 U
CARBAZOLE	290000	32000	350 U	340 U	340 U	74 J	340 U
BENZOIC ACID	1.00E+09	310000000	1700 U	1700 U	1700 U	1700 UJ	1700 UJ
ACETOPHENONE	200000000	7800000	350 U	340 U	340 U	300 J	340 U

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

N = Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

**TABLE 5-1
DETECTED CONCENTRATIONS OF ORGANICS COMPOUNDS
AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO**

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACB-MW01-00 03/19/96	ACBMW02-00 03/19/96	ACBMW03-00 03/19/96	6SB01-00	6SB02-00
	Soils	Soils					
PESTICIDE/PCBS (ug/kg)							
HEPTACHLOR EPOXIDE	630	70	4.1 U	40 U	1.7 NJ	42 U	4.1 U
4,4'-DDE	17000	1900	8.3 U	21 J	8.2 U	11 J	8.2 U
4,4'-DDD	24000	2700	8.3 U	81 U	8.2 U	84 U	8.2 U
4,4'-DDT	17000	1900	8.3 U	81 U	1.7 R	84 U	8.2 U
DIOXIONS (ug/kg)							
TOTAL HXCDD	0.4	0.04	0.11 U	0.1 U	0.23 U	0.25 J	0.3 U
TOTAL HXCDF	0.4	0.04	0.09 U	0.07 U	0.2 U	0.26 J	0.24 U

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

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UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-1
DETECTED CONCENTRATIONS OF ORGANICS COMPOUNDS
AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	6SB03-00	6SS01	6SS01D	6SS02	number exceeding	number exceeding
	Soils	Soils					Industrial	Residential
							Soils	Soils
VOLATILES (ug/kg)								
1,2-DICHLOROETHENE (TOTAL)	18000000	700000	5 U	5 U	5 U	2 J	0/14	0/14
XYLENE (TOTAL)	1.00E+09	160000000	5 U	5 U	5 U	5 U	0/14	0/14
SEMIVOLATILES (ug/kg)								
NAPHTHALENE	82000000	3100000	340 U	340 U	340 U	340 U	0/14	0/14
2-METHYLNAPHTHALENE	82000000	3100000	340 UJ	340 UJ	340 UJ	340 UJ	0/14	0/14
ACENAPHTHYLENE	61000000	2300000	340 U	350	280 J	42 J	0/14	0/14
4-CHLOROPHENYL-PHENYLETHER	NA	NA					NA	NA
PHENANTHRENE	61000000	2300000	60 J	210 J	110 J	240 J	0/14	0/14
ANTHRACENE	610000000	23000000	340 U	370	320 J	77 J	0/14	0/14
DI-N-BUTYLPHTHALATE	200000000	7800000	340 U	340 U	37 J	340 U	0/14	0/14
FLUORANTHENE	82000000	3100000	360	3200	1100	890	0/14	0/14
PYRENE	61000000	2300000	350	4200	1700	840	0/14	0/14
BUTYLBENZYLPHTHALATE	410000000	16000000	340 U	49 J	150 J	100 J	0/14	0/14
BENZO(A)ANTHRACENE	7800	880	170 J	2400	1300	430	0/14	2/14
CHRYSENE	780000	88000	340 J	3300	2300	880	0/14	0/14
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	45 J	170 J	120 J	59 J	0/14	0/14
BENZO(B)FLUORANTHENE	7800	880	310 J	4300	3500	840	0/14	2/14
BENZO(K)FLUORANTHENE	78000	8800	160 J	1300	1000	380	0/14	0/14
BENZO(A)PYRENE	780	88	160 J	1600	1600	380	2/14	6/14
INDENO(1,2,3-CD)PYRENE	7800	880	120 J	790	660	250 J	0/14	0/14
DIBENZO(A,H)ANTHRACENE	780	88	340 U	180 J	140 J	50 J	0/14	2/14
BENZO(G,H,I)PERYLENE	61000000	2300000	100 J	630	540	220 J	0/14	0/14
CARBAZOLE	290000	32000	340 U	330 J	210 J	61 J	0/14	0/14
BENZOIC ACID	1.00E+09	310000000	1700 U	410 J	1700 UJ	1700 UJ	0/14	0/14
ACETOPHENONE	200000000	7800000	340 U	340 U	340 U	340 U	0/14	0/14

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

N = Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-1
DETECTED CONCENTRATIONS OF ORGANICS COMPOUNDS
AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	6SB03-00	6SS01	6SS01D	6SS02	number exceeding	number exceeding
	Soils	Soils					Industrial	Residential
							Soils	Soils
PESTICIDE/PCBS (ug/kg)								
HEPTACHLOR EPOXIDE	630	70	21 U	41 U	41 U	5.6 R	0/13	0/13
4,4'-DDE	17000	1900	42 U	82 U	82 U	42 U	2/14	2/14
4,4'-DDD	24000	2700	42 U	82 U	82 U	42 U	0/14	2/14
4,4'-DDT	17000	1900	42 U	82 U	82 U	42 U	0/13	2/13
DIOXIONS (ug/kg)								
TOTAL HXCDD	0.4	0.04	0.07 U	0.76 J	0.74 J	0.1 U	2/14	3/14
TOTAL HXCDF	0.4	0.04	0.08 U	0.23 J	0.17 J	0.07 U	0/14	3/14

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

N = Tentative identification. Consider present. Special methods may be needed to confirm its presence or absence in future sampling efforts.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

**TABLE 6-2
DETECTED CONCENTRATIONS OF INORGANICS ANALYTES
AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO**

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACBSB01-00 03/26/96	ACBSB01-00D 03/26/96	ACBSB02-00 03/26/96	ACBSS01 03/19/96	ACBSS02-00 03/19/96
	Soils	Soils					
TOTAL METALS (mg/kg)							
ANTIMONY, TOTAL	820	31	1.2 UJ	2 UJ	1.4 UJ	2.2 UJ	1.6 J
ARSENIC, TOTAL	3.8	0.43	4.2 J	4.7 J	1.3 J	1	0.72
BARIUM, TOTAL	140000	5500	76.1	71	49.5	90 J	38.7 J
BERYLLIUM, TOTAL	1.3	0.15	0.05 U	0.08 U	0.05 U	0.44	0.06 U
CADMIUM, TOTAL	1000	39	1.4	1.5	0.85	0.52	0.88
CHROMIUM, TOTAL	10000	390	16	12.9	13.6	23.5 J	31.9 J
COBALT, TOTAL	120000	4700	19.1 J	16.1 J	15.3	30.2 J	14 J
COPPER, TOTAL	82000	3100	123	113	167 J	167	64.6
LEAD, TOTAL	NA	400	34.2	50.1	23.2	16.6	7.9
MERCURY, TOTAL	610	23	0.05 U	0.06	0.05 U	0.04 U	0.09 J
NICKEL, TOTAL	41000	1600	12.1	9.8	14.8	14.6	12.3
SELENIUM, TOTAL	10000	390	0.27 U	0.19 UJ	0.17 UJ	0.5 J	0.14 UJ
TIN, TOTAL	1000000	47000	0.64 U	1.2	1.5	1.2 U	0.83 U
VANADIUM, TOTAL	14000	550	113	98.3	89.5	172	82.2
ZINC, TOTAL	610000	23000	246 J	221 J	291 J	108 J	43.5 J
CYANIDE, TOTAL	41000	1600	0.36 U	0.46 U	0.48 U	1.8	0.44 U

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

mg/kg = milligrams per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

**TABLE 5-2
DETECTED CONCENTRATIONS OF INORGANICS ANALYTES
AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO**

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACBMW01-00 03/19/96	ACBMW02-00 03/19/96	ACBMW03-00 03/19/96	6SB01-00	6SB02-00
	Soils	Soils					
TOTAL METALS (mg/kg)							
ANTIMONY, TOTAL	820	31	1.6 UJ	1.9 UJ	2 UJ	4.1 J	3.6 J
ARSENIC, TOTAL	3.8	0.43	2.9	1.4	2.5	1.0	0.6
BARIIUM, TOTAL	140000	5500	111 J	39.7 J	13 J	98.8	98.5
BERYLLIUM, TOTAL	1.3	0.15	0.55	0.13	0.28	0.27	0.3
CADMIUM, TOTAL	1000	39	0.65	0.38	0.43	0.67	0.19 U
CHROMIUM, TOTAL	10000	390	19.3 J	34.7 J	6.7 J	28.6 J	22.8 J
COBALT, TOTAL	120000	4700	18.4 J	12.3 J	1.8 J	10.2	18
COPPER, TOTAL	82000	3100	137	58.4	11.4	1030	87.3
LEAD, TOTAL	NA	400	4.2	9.7	10.5	225	9.7
MERCURY, TOTAL	610	23	0.05 U	0.04 U	0.07 J	12.6	0.28
NICKEL, TOTAL	41000	1600	12.4	13.2	3.2	9.6	16.5
SELENIUM, TOTAL	10000	390	0.38 J	0.15 UJ	0.68 UJ	0.13 UJ	0.14 UJ
TIN, TOTAL	1000000	47000	1.4	1 U	1.1 U	1.2	0.91 U
VANADIUM, TOTAL	14000	550	87.9	88.5	13.9	71.2	98.5
ZINC, TOTAL	610000	23000	88.2 J	63.3 J	25.1 J	335	67.7
CYANIDE, TOTAL	41000	1600	0.5 U	0.4 U	0.39 U	0.37 U	0.42 U

QUALIFIER DEFINITIONS

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NOTES

mg/kg = milligrams per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-2
DETECTED CONCENTRATIONS OF INORGANICS ANALYTES
AOC B SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	6SB03-00	6SS01	6SS01D	6SS02	number exceeding	number exceeding
	Soils	Soils					Industrial	Residential
							Soils	Soils
TOTAL METALS (mg/kg)								
ANTIMONY, TOTAL	820	31	3.6 J	5.2 J	3.1 J	4.4 J	0/14	0/14
ARSENIC, TOTAL	3.8	0.43	3.4	5.3	3.7	5.7	5/14	14/14
BARIUM, TOTAL	140000	5500	53.9	68.2	69.1	74.8	0/14	0/14
BERYLLIUM, TOTAL	1.3	0.15	0.16	0.25	0.27	0.28	0/14	9/14
CADMIUM, TOTAL	1000	39	1.3	0.51	0.51	0.52	0/14	0/14
CHROMIUM, TOTAL	10000	390	15.7 J	30.8 J	29.7 J	27.7 J	0/14	0/14
COBALT, TOTAL	120000	4700	7.7	11	10.3	17.3	0/14	0/14
COPPER, TOTAL	82000	3100	91.9	203	166	116	0/14	0/14
LEAD, TOTAL	NA	400	50.4	112	131	49.7	NA	0/14
MERCURY, TOTAL	610	23	1.3	4.1	5	0.08	0/14	0/14
NICKEL, TOTAL	41000	1600	5.5	14.5	11.7	11.3	0/14	0/14
SELENIUM, TOTAL	10000	390	0.17 UJ	0.34 UJ	0.75 UJ	0.15 UJ	0/14	0/14
TIN, TOTAL	1000000	47000	1.6	2.7	1.5	1.2	0/14	0/14
VANADIUM, TOTAL	14000	550	49.4	69.1	73.8	101	0/14	0/14
ZINC, TOTAL	610000	23000	105	195	208	125	0/14	0/14
CYANIDE, TOTAL	41000	1600	0.45 U	0.44 U	0.5 U	0.52 U	0/14	0/14

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

mg/kg = milligrams per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-3
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
SWMU 13 SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial Soils	Residential Soils	13SS05 10/24/95	13SS06 10/24/95	13SS07 10/24/95	13SS07D 10/24/95	13SS08 10/24/95
SEMI-VOLATILES (ug/kg)							
BENZOIC ACID	1.00E+09	310000000	650 J	2000 U	1800 U	1800 U	2200 U
PHENANTHRENE	61000000	2300000	370 U	390 U	360 U	360 U	270 J
ANTHRACENE	610000000	23000000	370 U	390 U	360 U	360 U	59 J
FLUORANTHENE	82000000	3100000	370 U	170 J	360 U	360 U	340 J
PYRENE	61000000	2300000	370 U	180 J	360 U	360 U	290 J
BUTYLBENZYLPHTHALATE	410000000	16000000	45 J	390 U	360 U	360 U	450 U
BENZO(A)ANTHRACENE	7800	880	370 U	270 J	360 U	360 U	160 J
CHRYSENE	780000	88000	370 U	370 J	360 U	360 U	150 J
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	94 J	39 J	360 U	360 U	110 J
BENZO(B)FLUORANTHENE	7800	880	370 U	620	360 U	360 U	210 J
BENZO(K)FLUORANTHENE	78000	8800	370 U	290 J	360 U	360 U	96 J
BENZO(A)PYRENE	780	88	370 U	440	360 U	360 U	140 J
INDENO(1,2,3-CD)PYRENE	7800	880	370 U	260 J	360 U	360 U	82 J
DIBENZO(A,H)ANTHRACENE	780	88	370 U	57 J	360 U	360 U	450 U
BENZO(G,H,I)PERYLENE	61000000	2300000	370 U	220 J	360 U	360 U	83 J
PESTICIDE/PCBS (ug/kg)							
4,4'-DDE	17000	1900	2100	97	590	340	7600
4,4'-DDD	24000	2700	4500 U	93 U	88 U	440 U	11000 U
4,4'-DDT	17000	1900	2300	31	46	440 U	6000
DIOXIN (ug/kg)							
TOTAL HXCDD	0.4	0.04	0.18 J	0.15 U	0.13 U	0.16 U	0.17 J
TOTAL PECDF	0.08	0.008	0.16 U	0.22 J	0.1 U	0.09 U	0.13 U
TOTAL HXCDF	0.4	0.04	0.5 J	0.15 J	0.11 U	0.13 U	0.41 J

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

**TABLE 5-9
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
SWMU 13 SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO**

SAMPLE ID SAMPLE DATE	Industrial	Residential	13SS09 10/24/95	number exceeding	number exceeding
	Soils	Soils		Industrial	Residential
				Soils	Soils
SEMIVOLATILES (ug/kg)					
BENZOIC ACID	1.00E+09	310000000	1800 U	0/6	0/6
PHENANTHRENE	61000000	2300000	370 U	0/6	0/6
ANTHRACENE	610000000	23000000	370 U	0/6	0/6
FLUORANTHENE	82000000	3100000	38 J	0/6	0/6
PYRENE	61000000	2300000	370 U	0/6	0/6
BUTYLBENZYLPHTHALATE	410000000	16000000	370 U	0/6	0/6
BENZO(A)ANTHRACENE	7800	880	370 U	0/6	0/6
CHRYSENE	780000	88000	370 U	0/6	0/6
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	370 U	0/6	0/6
BENZO(B)FLUORANTHENE	7800	880	47 J	0/6	0/6
BENZO(K)FLUORANTHENE	78000	8800	370 U	0/6	0/6
BENZO(A)PYRENE	780	88	370 U	0/6	2/6
INDENO(1,2,3-CD)PYRENE	7800	880	370 U	0/6	0/6
DIBENZO(A,H)ANTHRACENE	780	88	370 U	0/6	0/6
BENZO(G,H,I)PERYLENE	61000000	2300000	370 U	0/6	0/6
PESTICIDE/PCBS (ug/kg)					
4,4'-DDE	17000	1900	3100	0/6	3/6
4,4'-DDD	24000	2700	710	0/6	0/6
4,4'-DDT	17000	1900	2500	0/6	3/6
DIOXIN (ug/kg)					
TOTAL HXCDD	0.4	0.04	0.12 U	0/6	2/6
TOTAL PECDF	0.08	0.008	1 J	2/6	2/6
TOTAL HXCDF	0.4	0.04	0.09 J	2/6	4/6

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-15
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
SWMU 25 SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial Soils	Residential Soils	25SS01 10/25/95	25SS02 10/25/95	25SS03 10/25/95	25SS04 10/25/95	25SS04D 10/25/95
SEMIVOLATILES (ug/kg)							
BENZOIC ACID	1000000000	310000000	1800 U	1800 U	1800 U	1800 U	82 J
PHENANTHRENE	61000000	2300000	360 U	360 U	350 U	170 J	130 J
FLUORANTHENE	82000000	3100000	360 U	360 U	350 U	320 J	200 J
PYRENE	61000000	2300000	360 U	360 U	350 U	240 J	200 J
BUTYLBENZYLPHTHALATE	410000000	16000000	360 U	360 U	350 U	350 U	350 U
BENZO(A)ANTHRACENE	7800	880	360 U	360 U	350 U	130 J	81 J
CHRYSENE	780000	88000	360 U	360 U	350 U	140 J	100 J
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	110 J	360 U	140 J	20000	11000
DI-N-OCTYL PHTHALATE	41000000	1600000	360 U	360 U	350 U	350 U	75 J
BENZO(B)FLUORANTHENE	7800	880	360 U	360 U	350 U	230 J	130 J
BENZO(K)FLUORANTHENE	78000	8800	360 U	360 U	350 U	66 J	74 J
BENZO(A)PYRENE	780	88	360 U	360 U	350 U	120 J	93 J
INDENO(1,2,3-CD)PYRENE	7800	880	360 U	360 U	350 U	99 J	60 J
BENZO(G,H,I)PERYLENE	61000000	2300000	360 U	360 U	350 U	94 J	350 U
PESTICIDE/PCBS (ug/kg)							
4,4'-DDE	17000	1900	8.7 U	8.5 U	42 U	83 U	43 U
4,4'-DDT	17000	1900	8.7 U	8.5 U	42 U	83 U	43 U

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-15
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
SWMU 25 SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	25SS05	25SS06	25SS07	25SS08	25SS09
	Soils	Soils	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95
SEMIVOLATILES (ug/kg)							
BENZOIC ACID	100000000	310000000	1800 U	1800 U	1800 U	1800 U	74 J
PHENANTHRENE	61000000	2300000	360 U	360 U	370 U	360 U	370 U
FLUORANTHENE	82000000	3100000	360 U	360 U	370 U	360 U	370 U
PYRENE	61000000	2300000	360 U	360 U	370 U	360 U	370 U
BUTYLBENZYLPHTHALATE	410000000	16000000	360 U	360 U	370 U	100 J	370 U
BENZO(A)ANTHRACENE	7800	880	360 U	360 U	370 U	360 U	370 U
CHRYSENE	780000	88000	360 U	360 U	370 U	360 U	370 U
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	77000	700	170 J	350 J	24000
DI-N-OCTYL PHTHALATE	41000000	1600000	460 J	360 U	370 U	360 U	370 UJ
BENZO(B)FLUORANTHENE	7800	880	360 UJ	360 U	370 U	360 U	370 UJ
BENZO(K)FLUORANTHENE	78000	8800	360 UJ	360 U	370 U	360 U	370 UJ
BENZO(A)PYRENE	780	88	360 UJ	360 U	370 U	360 U	370 UJ
INDENO(1,2,3-CD)PYRENE	7800	880	360 UJ	360 U	370 U	360 U	370 UJ
BENZO(G,H,I)PERYLENE	61000000	2300000	360 UJ	360 U	370 U	360 U	370 UJ
PESTICIDE/PCBS (ug/kg)							
4,4'-DDE	17000	1900	42 U	43 U	8.7 U	5.1 J	44 U
4,4'-DDT	17000	1900	42 U	9.3	6.2	4.7 J	44 U

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 6-15
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
SWMU 25 SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	number exceeding	number exceeding
	Soils	Soils	Industrial Soils	Residential Soils
SEMIVOLATILES (ug/kg)				
BENZOIC ACID	100000000	31000000	0/10	0/10
PHENANTHRENE	61000000	2300000	0/10	0/10
FLUORANTHENE	82000000	3100000	0/10	0/10
PYRENE	61000000	2300000	0/10	0/10
BUTYLBENZYLPHTHALATE	410000000	16000000	0/10	0/10
BENZO(A)ANTHRACENE	7800	880	0/10	0/10
CHRYSENE	780000	88000	0/10	0/10
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	0/10	1/10
DI-N-OCTYL PHTHALATE	41000000	1600000	0/10	0/10
BENZO(B)FLUORANTHENE	7800	880	0/10	0/10
BENZO(K)FLUORANTHENE	78000	8800	0/10	0/10
BENZO(A)PYRENE	780	88	0/10	2/10
INDENO(1,2,3-CD)PYRENE	7800	880	0/10	0/10
BENZO(G,H,I)PERYLENE	61000000	2300000	0/10	0/10
PESTICIDE/PCBS (ug/kg)				
4,4'-DDE	17000	1900	0/10	0/10
4,4'-DDT	17000	1900	0/10	0/10

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-18
DETECTED CONCENTRATIONS OF INORGANIC ANALYTES
SWMU 26 SEDIMENT
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	ERL	ERM	Industrial	Residential	25SD01 10/25/95	number exceeding	number exceeding	number exceeding	number exceeding
	Sediments	Sediments	Soils	Soils		ERL Sediments	ERM Sediments	Industrial Soils	Residential Soils
INORGANICS (mg/kg)									
Silver	1	3.7	10000	390	0.3	0/1	0/1	0/1	0/1
Arsenic	8.2	70	610	23	0.91 J	0/1	0/1	0/1	0/1
Barium	500 (1)	NA	140000	5500	95.1	0/1	NA	0/1	0/1
Beryllium	NA	360 (2)	1.3	0.15	0.19	NA	0/1	0/1	1/1
Cobalt	NA	NA	120000	4700	29.2	NA	NA	0/1	0/1
Chromium	81	370	10000	390	42.7 J	0/1	0/1	0/1	0/1
Copper	34	270	82000	3100	66.6	1/1	0/1	0/1	0/1
Nickel	20.9	51.6	41000	1600	35.2	1/1	0/1	0/1	0/1
Lead	46.7	218	400	400	2.4	0/1	0/1	0/1	0/1
Vanadium	NA	NA	14000	550	137 J	NA	NA	0/1	0/1
Zinc	150	410	610000	23000	95.5 J	0/1	0/1	0/1	0/1

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

NOTES

mg/kg = milligrams per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A

(1) Sullivan et al., 1985

(2) Tetra Tech, Inc., 1986

TABLE 5-24
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
SWMU 31 SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	31SS01 10/31/95	31SS02 10/31/95	31SS03 10/31/95	31SS04 10/31/95	number exceeding	number exceeding
	Soils	Soils					Industrial	Residential
							Soils	Soils
VOLATILES (ug/kg)								
METHYLENE CHLORIDE	760000	85000	6 U	5 U	42	6 U	0/4	0/4
SEMIVOLATILES (ug/kg)								
2-METHYLNAPHTHALENE	82000000	3100000	380 U	120 J	350 U	3600 U	0/4	0/4
PHENANTHRENE	61000000	2300000	380 U	52 J	350 U	3600 U	0/4	0/4
FLUORANTHENE	82000000	3100000	380 U	46 J	350 U	3600 U	0/4	0/4
PYRENE	61000000	2300000	380 U	96 J	350 UJ	3600 U	0/4	0/4
BUTYLBENZYLPHTHALATE	410000000	16000000	380 U	190 J	350 UJ	3600 U	0/4	0/4
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	200 J	700	100 J	610 J	0/4	0/4
PESTICIDE/PCBS (ug/kg)								
4,4'-DDE	17000	1900	9.2 U	46	NA	11 J	0/3	0/3
4,4'-DDD	24000	2700	9.2 U	58	NA	30	0/3	0/3
AROCLOR-1260	740	83	23	230	NA	880 U	0/3	1/3
DIOXIN (ug/kg)								
TOTAL PECDD	0.08	0.008	0.13 U	0.09 U	0.07 U	0.74 J	1/4	1/4
TOTAL HXCDD	0.4	0.04	0.1 U	0.06 U	0.06 U	1.2	1/4	1/4
TOTAL TCDF	0.4	0.04	0.06 U	0.05 U	0.04 U	0.17 J	0/4	1/4
TOTAL PECDF	0.08	0.008	0.07 U	0.06 U	0.06 U	3.1	1/4	1/4
TOTAL HXCDF	0.4	0.04	0.1 U	0.06 J	0.06 U	43	1/4	2/4

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

NOTES

ug/kg = micrograms per kilogram.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-39
DETECTED CONCENTRATIONS OF ORGANIC ANALYTES
AOC C SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial Soils	Residential Soils	ACSS01 10/25/95	ACSS02 10/25/95	ACSS03 10/25/95	ACSS04	ACSS05
VOLATILES (ug/kg)							
METHYLENE CHLORIDE	760000	85000	6 U	7 U	7 U	28	17 U
XYLENE (TOTAL)	1.00E+09	160000000	6 U	7 U	7 UJ	9 U	8 UJ
TRICHLOROFUOROMETHANE	610000000	23000000	12 U	15 U	13 U	4 J	8 UJ
SEMIVOLATILES (ug/kg)							
BENZOIC ACID	1.00E+09	310000000	2000 U	25000 U	710 J	2900 U	140000 U
PHENANTHRENE	61000000	2300000	400 U	5000 U	440 U	63 J	2800 U
DI-N-BUTYLPHTHALATE	200000000	7800000	400 U	5000 U	4800	580 U	2800 U
FLUORANTHENE	82000000	3100000	400 U	5000 U	210 J	150 J	2800 U
PYRENE	61000000	2300000	400 U	5000 U	210 J	120 J	2800 U
BUTYLBENZYLPHTHALATE	410000000	16000000	400 U	5000 U	1100	580 U	2800 U
BENZO(A)ANTHRACENE	7800	880	400 U	5000 U	77 J	54 J	2800 U
CHRYSENE	780000	88000	400 U	5000 U	160 J	97 J	2800 U
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	400 U	5000 U	19000	580 U	2800 U
DI-N-OCTYL PHTHALATE	41000000	1600000	400 U	5000 U	170 J	580 U	2800 U
BENZO(B)FLUORANTHENE	7800	880	400 U	5000 U	480	100 J	2800 U
BENZO(K)FLUORANTHENE	78000	8800	400 U	5000 U	440 U	93 J	2800 U
BENZO(A)PYRENE	780	88	400 U	5000 U	120 J	76 J	2800 U
INDENO(1,2,3-CD)PYRENE	7800	880	400 U	5000 U	74 J	48 J	2800 U
DIBENZO(A,H)ANTHRACENE	780	88	400 U	5000 U	440 U	580 U	2800 U
BENZO(G,H,I)PERYLENE	61000000	2300000	400 U	5000 U	440 U	63 J	2800 U

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

**TABLE 5-39
DETECTED CONCENTRATIONS OF ORGANIC ANALYTES
AOC C SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO**

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACSS01 10/25/95	ACSS02 10/25/95	ACSS03 10/25/95	ACSS04	ACSS05
	Soils	Soils					
PESTICIDE/PCBS (ug/kg)							
4,4'-DDE	17000	1900	49 U	5900 U	2700	NA	NA
4,4'-DDD	24000	2700	49 U	5900 U	240	NA	NA
4,4'-DDT	17000	1900	49 U	5900 U	5400	NA	NA
KEPONE	320	35	49 UJ	5900 UJ	2500	NA	NA
ALPHA-CHLORDANE	4400	490	250 U	29000 U	840 J	NA	NA
GAMMA-CHLORDANE	4400	490	250 U	29000 U	760 J	NA	NA
AROCLOR-1260	740	83	170	140000	10000 U	1100	4900000
DIOXIN (ug/kg)							
TOTAL TCDF	0.4	0.04	0.05 U	1 J	0.07 U	NA	NA
TOTAL PECDF	0.08	0.008	0.06 U	2.4	0.08 U	NA	NA
TOTAL HXCDF	0.4	0.04	0.13 U	2	0.14 J	NA	NA

QUALIFIER DEFINITIONS

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NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-39
DETECTED CONCENTRATIONS OF ORGANIC ANALYTES
AOC C SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACSS05D	ACSS06	ACSS07	ACSS08	ACSS09
	Soils	Soils	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95
VOLATILES (ug/kg)							
METHYLENE CHLORIDE	760000	85000	48 J	14 U	26	24	17 J
XYLENE (TOTAL)	1.00E+09	160000000	10 UJ	3 J	6 U	6 U	6 UJ
TRICHLOROFLUOROMETHANE	610000000	23000000	10 UJ	6 U	6 U	6 U	6 UJ
SEMIVOLATILES (ug/kg)							
BENZOIC ACID	1.00E+09	310000000	15000 U	1900 U	2200 U	2000 U	2200 U
PHENANTHRENE	61000000	2300000	3100 U	380 U	450 U	390 U	440 U
DI-N-BUTYLPHTHALATE	200000000	7800000	3100 U	380 U	450 U	390 U	440 U
FLUORANTHENE	82000000	3100000	410 J	170 J	450 U	390 U	440 U
PYRENE	61000000	2300000	3100 U	200 J	450 U	390 U	440 U
BUTYLBENZYLPHTHALATE	410000000	16000000	3100 U	380 U	450 U	390 U	440 U
BENZO(A)ANTHRACENE	7800	880	3100 U	68 J	450 U	390 U	440 U
CHRYSENE	780000	88000	3100 U	150 J	450 U	390 U	440 U
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	3100 U	380 U	450 U	390 U	160 J
DI-N-OCTYL PHTHALATE	41000000	1600000	3100 U	380 U	450 U	390 U	440 U
BENZO(B)FLUORANTHENE	7800	880	3100 U	130 J	450 U	390 U	440 U
BENZO(K)FLUORANTHENE	78000	8800	3100 U	120 J	450 U	390 U	440 U
BENZO(A)PYRENE	780	88	3100 U	65 J	450 U	390 U	440 U
INDENO(1,2,3-CD)PYRENE	7800	880	3100 U	40 J	450 U	390 U	440 U
DIBENZO(A,H)ANTHRACENE	780	88	3100 U	380 U	450 U	390 U	440 U
BENZO(G,H,I)PERYLENE	61000000	2300000	420 J	43 J	450 U	390 U	440 U

QUALIFIER DEFINITIONS

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UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-39
DETECTED CONCENTRATIONS OF ORGANIC ANALYTES
AOC C SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACSS05D	ACSS06	ACSS07	ACSS08	ACSS09
	Soils	Soils	10/25/95	10/25/95	10/25/95	10/25/95	10/25/95
PESTICIDE/PCBS (ug/kg)							
4,4'-DDE	17000	1900	NA	NA	NA	NA	NA
4,4'-DDD	24000	2700	NA	NA	NA	NA	NA
4,4'-DDT	17000	1900	NA	NA	NA	NA	NA
KEPONE	320	35	NA	NA	NA	NA	NA
ALPHA-CHLORDANE	4400	490	NA	NA	NA	NA	NA
GAMMA-CHLORDANE	4400	490	NA	NA	NA	NA	NA
AROCLOR-1260	740	83	5200000	180	43 U	38 U	79
DIOXIN (ug/kg)							
TOTAL TCDF	0.4	0.04	NA	NA	NA	NA	NA
TOTAL PECDF	0.08	0.008	NA	NA	NA	NA	NA
TOTAL HXCDF	0.4	0.04	NA	NA	NA	NA	NA

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-39
DETECTED CONCENTRATIONS OF ORGANIC ANALYTES
AOC C SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACSS10 10/25/95	ACSS11 10/25/95	ACSS12 10/26/95	number exceeding	number exceeding
	Soils	Soils				Industrial	Residential
VOLATILES (ug/kg)							
METHYLENE CHLORIDE	760000	85000	13 U	17	15 U	0/13	0/13
XYLENE (TOTAL)	1.00E+09	160000000	6 UJ	6 U	6 U	0/13	0/13
TRICHLOROFLUOROMETHANE	610000000	23000000	6 U	6 U	6 U	0/13	0/13
SEMIVOLATILES (ug/kg)							
BENZOIC ACID	1.00E+09	310000000	2100 U	1800 U	2000 U	0/13	0/13
PHENANTHRENE	61000000	2300000	430 U	370 U	400 U	0/13	0/13
DI-N-BUTYLPHTHALATE	200000000	7800000	430 U	370 U	400 U	0/13	0/13
FLUORANTHENE	82000000	3100000	430 U	240 J	400 U	0/13	0/13
PYRENE	61000000	2300000	430 U	430	400 U	0/13	0/13
BUTYLBENZYLPHTHALATE	410000000	16000000	430 U	370 U	400 U	0/13	0/13
BENZO(A)ANTHRACENE	7800	880	430 U	150 J	400 U	0/13	0/13
CHRYSENE	780000	88000	430 U	480	400 U	0/13	0/13
BIS(2-ETHYLHEXYL)PHTHALATE	410000	46000	100 J	370 U	400 U	0/13	0/13
DI-N-OCTYL PHTHALATE	41000000	1600000	430 U	370 U	400 U	0/13	0/13
BENZO(B)FLUORANTHENE	7800	880	430 U	360 J	400 U	0/13	0/13
BENZO(K)FLUORANTHENE	78000	8800	430 U	330 J	400 U	0/13	0/13
BENZO(A)PYRENE	780	88	430 U	220 J	400 U	0/13	2/13
INDENO(1,2,3-CD)PYRENE	7800	880	430 U	120 J	400 U	0/13	0/13
DIBENZO(A,H)ANTHRACENE	780	88	430 U	47 J	400 U	0/13	0/13
BENZO(G,H,I)PERYLENE	61000000	2300000	430 U	140 J	400 U	0/13	0/13

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.
U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.
UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-39
DETECTED CONCENTRATIONS OF ORGANIC ANALYTES
AOC C SURFACE SOIL
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	Industrial	Residential	ACSS10 10/25/95	ACSS11 10/25/95	ACSS12 10/26/95	number exceeding	number exceeding
	Soils	Soils				Industrial	Residential
PESTICIDE/PCBS (ug/kg)						Soils	Soils
4,4'-DDE	17000	1900	NA	NA	NA	0/3	1/3
4,4'-DDD	24000	2700	NA	NA	NA	0/3	0/3
4,4'-DDT	17000	1900	NA	NA	NA	0/3	1/3
KEPONE	320	35	NA	NA	NA	1/3	1/3
ALPHA-CHLORDANE	4400	490	NA	NA	NA	0/3	1/3
GAMMA-CHLORDANE	4400	490	NA	NA	NA	0/3	1/3
AROCLOR-1260	740	83	41 U	74	170	4/13	7/13
DIOXIN (ug/kg)							
TOTAL TCDF	0.4	0.04	NA	NA	NA	1/3	1/3
TOTAL PECDF	0.08	0.008	NA	NA	NA	1/3	1/3
TOTAL HXCDF	0.4	0.04	NA	NA	NA	2/3	2/3

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

UJ = Not detected. Quantitation limit may be inaccurate or imprecise.

NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC Industrial/residential USEPA 1996A.

TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	ERL Sediment	ERM Sediment	Industrial Soils	Residential Soils	7SD01 10/27/95	7SD02 10/27/95	7SD03 10/27/95	7SD04 10/27/95	3SD01 10/29/95	3SD01D 10/29/95
VOLATILES (ug/kg)										
ACETONE	NA	NA	2.00E+08	7800000	120	50	43	15 U	14 U	14 U
CARBON DISULFIDE	NA	NA	200000000	7800000	8 U	8 U	8 U	7 U	7 U	7 U
2-BUTANONE	NA	NA	1000000000	47000000	15 U	16 U	16 U	15 U	14 U	14 U
TETRACHLOROETHENE	NA	140 (1)	110000	12000	8 U	8 U	8 U	7 U	7 U	7 U
SEMIVOLATILES (ug/kg)										
PHENOL	NA	420 (1)	1000000000	47000000	500 U	500 U	520 U	480 U	450 U	450 U
BENZOIC ACID	NA	650 (2)	1000000000	310000000	870 J	680 J	790 J	960 J	2300 U	2200 U
ACENAPHTHYLENE	44	640	120000000	4700000	500 U	500 U	520 U	480 U	450 U	450 U
FLUORENE	19	540	82000000	3100000	500 U	500 U	520 U	480 U	450 U	450 U
PHENANTHRENE	240	1500	61000000	2300000	66 J	86 J	520 U	480 U	450 U	450 U
ANTHRACENE	85.3	1100	610000000	23000000	500 U	500 U	520 U	480 U	450 U	450 U
FLUORANTHENE	600	5100	82000000	3100000	230 J	120 J	520 U	480 U	450 U	450 U
PYRENE	665	2600	610000000	2300000	270 J	150 J	520 U	480 U	450 U	450 U
BENZO(A)ANTHRACENE	261	1600	7800	880	69 J	500 U	520 U	480 U	450 U	450 U
CHRYSENE	384	2800	780000	88000	470 J	140 J	520 U	480 U	450 U	450 U
BIS(2-ETHYLHEXYL)PHTHALATE	NA	1900 (1)	410000	46000	500 U	500 U	520 U	480 U	450 U	450 U
BENZO(B)FLUORANTHENE	NA	3200 (2)	7800	880	390 J	150 J	520 U	480 U	450 U	450 U
BENZO(K)FLUORANTHENE	NA	NA	78000	8800	230 J	72 J	520 U	480 U	450 U	450 U
BENZO(A)PYRENE	430	1600	780	88	150 J	64 J	520 U	480 U	450 U	450 U
INDENO(1,2,3-CD)PYRENE	NA	600 (1)	7800	880	110 J	51 J	55 J	480 U	450 U	450 U
DIBENZO(A,H)ANTHRACENE	63.4	260	780	88	500 U	500 U	520 U	480 U	450 U	450 U
BENZO(G,H,I)PERYLENE	NA	670 (1)	61000000	2300000	86 J	500 U	520 U	480 U	450 U	450 U
P-DIMETHYLAMINOAZOBENZENE	NA	NA	NA	NA	1000 U	1000 U	1000 U	970 U	900 U	900 U
CARBAZOLE	NA	NA	290000	32000	500 U	500 U	520 U	480 U	450 U	450 U

QUALIFIER DEFINITIONS

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NOTES

ug/kg = micrograms per kilogram.

NA = Not analyzed.

Region III RBC industrial/residential USEPA 1996A

(1) Tetra Tech, Inc., 1986

(2) USEPA Region III, 1995

(3) Sullivan et al., 1985

(4) Value for gamma - BHC (lindane)

(5) Value for total TCDD and TCDF dioxin

TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	ERL Sediment	ERM Sediment	Industrial Soils	Residential Soils	7SD01 10/27/95	7SD02 10/27/95	7SD03 10/27/95	7SD04 10/27/95	3SD01 10/29/95	3SD01D 10/29/95
PESTICIDE/PCBS (ug/kg)										
BETA-BHC	50 (3)(4)	NA	NA	NA	60 U	60 U	64 U	58 U	26 U	27 U
4,4'-DDE	2.2	27	17000	1900	120 U	120 U	130 U	120 U	53 U	54 U
HERBICIDES (ug/kg)										
2,4,5-TP (SILVEX)	NA	NA	16000000	630000	100 U	100 U	100 U	40 J	84 U	84 U
DIOXIN (ug/kg)										
TOTAL PECDD	0.001 (3)(5)	NA	0.08	0.008	0.22 U	0.18 U	0.08 U	0.16 U	0.18 U	0.2 U
TOTAL HXCDD	0.001 (3)(5)	NA	0.4	0.04	0.21 U	0.22 U	0.1 U	0.13 U	0.19 U	0.16 U
TOTAL HXCDF	0.001 (3)(5)	NA	0.4	0.04	0.15 U	0.17 U	0.09 U	0.09 U	0.17 U	0.18 U

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(5) Value for total TCDD and TCDF dioxin

TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	3SD02 10/29/95	3SD03 10/29/95	3SD04 10/27/95	3SD05 10/27/95	3SD06 10/27/95	3SD07 10/27/95	3SD08 10/28/95	3SD09 10/28/95
VOLATILES (ug/kg)								
ACETONE	19 U	20 U	17 U	26 U	15 U	18 U	26 U	18 U
CARBON DISULFIDE	8 U	8 U	9 U	8 U	7 U	8 U	10 U	9 U
2-BUTANONE	15 U	16 U	17 U	15 U	15 U	16 U	20 U	18 U
TETRACHLOROETHENE	8 U	8 U	9 U	8 U	7 U	8 U	10 U	9 U
SEMIVOLATILES (ug/kg)								
PHENOL	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
BENZOIC ACID	2500 U	2600 U	3600 U	770 J	770 J	570 J	3300 U	3000 U
ACENAPHTHYLENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
FLUORENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
PHENANTHRENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
ANTHRACENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
FLUORANTHENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
PYRENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
BENZO(A)ANTHRACENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
CHRYSENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
BIS(2-ETHYLHEXYL)PHTHALATE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
BENZO(B)FLUORANTHENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
BENZO(K)FLUORANTHENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
BENZO(A)PYRENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
INDENO(1,2,3-CD)PYRENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
DIBENZO(A,H)ANTHRACENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
BENZO(G,H,I)PERYLENE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U
P-DIMETHYLAMINOAZOBENZENE	1000 U	1000 U	1100 U	1000 U	950 U	1000 U	1300 U	1200 U
CARBAZOLE	500 U	520 U	560 U	510 U	480 U	520 U	660 U	590 U

QUALIFIER DEFINITIONS

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TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID	3SD02	3SD03	3SD04	3SD05	3SD06	3SD07	3SD08	3SD09
SAMPLE DATE	10/29/95	10/29/95	10/27/95	10/27/95	10/27/95	10/27/95	10/28/95	10/28/95
PESTICIDE/PCBS (ug/kg)								
BETA-BHC	30 U	31 U	33 U	31 U	28 U	32 U	39 U	36 U
4,4'-DDE	60 U	63 U	66 U	61 U	57 U	64 U	79 U	71 U
HERBICIDES (ug/kg)								
2,4,5-TP (SILVEX)	99 U	100 U	110 U	100 U	94 U	100 U	130 U	120 U
DIOXIN (ug/kg)								
TOTAL PECDD	0.18 U	0.14 U	0.19 U	0.29 U	0.15 U	0.15 U	0.27 U	0.26 U
TOTAL HXCDD	0.18 U	0.12 U	0.21 U	0.27 U	0.17 U	0.12 U	0.28 U	0.31 U
TOTAL HXCDF	0.18 U	0.11 U	0.18 U	0.27 U	0.14 U	0.14 U	0.25 U	0.26 U

QUALIFIER DEFINITIONS

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NOTES

ug/kg = micrograms per kilogram.

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(5) Value for total TCDD and TCDF dioxin

TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	3SD10 10/27/95	3SD11 10/28/95	3SD12 10/28/95	3SD13 10/28/95	3SD14 10/28/95	3SD15 10/28/95	11SD01 10/28/95	11SD02 10/28/95
VOLATILES (ug/kg)								
ACETONE	22 U	16 U	93	26	18 U	19 U	22 U	37 U
CARBON DISULFIDE	9 U	8 U	10 U	12 U	8 U	8 U	4 J	15
2-BUTANONE	19 U	16 U	19 U	25 U	16 U	16 U	17 U	16 U
TETRACHLOROETHENE	9 U	8 U	10 U	12 U	8 U	8 U	8 U	8 U
SEMIVOLATILES (ug/kg)								
PHENOL	420 J	160 J	800	810 U	100 J	530 U	5500 U	540 U
BENZOIC ACID	2400 J	2600 U	3100 U	4100 U	2600 U	2700 U	2800 U	2700 U
ACENAPHTHYLENE	630 U	520 U	620 U	810 U	520 U	530 U	1800 J	67 J
FLUORENE	630 U	520 U	620 U	810 U	520 U	530 U	5500 U	540 U
PHENANTHRENE	630 U	520 U	620 U	810 U	520 U	530 U	5500 U	540 U
ANTHRACENE	630 U	520 U	620 U	810 U	520 U	530 U	2200 J	82 J
FLUORANTHENE	630 U	520 U	620 U	810 U	520 U	530 U	660 J	85 J
PYRENE	630 U	520 U	620 U	810 U	520 U	530 U	6000	88 J
BENZO(A)ANTHRACENE	630 U	520 U	620 U	810 U	520 U	530 U	3700 J	110 J
CHRYSENE	630 U	520 U	620 U	810 U	520 U	530 U	10000	320 J
BIS(2-ETHYLHEXYL)PHTHALATE	630 U	130 J	64 J	200 J	520 U	59 J	5500 U	97 J
BENZO(B)FLUORANTHENE	630 U	520 U	620 U	810 U	520 U	530 U	24000	850
BENZO(K)FLUORANTHENE	630 U	520 U	620 U	810 U	520 U	530 U	21000	740
BENZO(A)PYRENE	630 U	520 U	620 U	810 U	520 U	530 U	23000	690
INDENO(1,2,3-CD)PYRENE	630 U	520 U	620 U	810 U	520 U	530 U	10000	410 J
DIBENZO(A,H)ANTHRACENE	630 U	520 U	620 U	810 U	520 U	530 U	4000	170 J
BENZO(G,H,I)PERYLENE	630 U	520 U	620 U	810 U	520 U	530 U	11000	450 J
P-DIMETHYLAMINOAZOBENZENE	1300 U	1000 U	1200 U	1600 U	1000 U	1100 U	5500 U	540 J
CARBAZOLE	630 U	520 U	620 U	810 U	520 U	530 U	NA	NA

QUALIFIER DEFINITIONS

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NOTES

ug/kg = micrograms per kilogram.

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TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	3SD10 10/27/95	3SD11 10/28/95	3SD12 10/28/95	3SD13 10/28/95	3SD14 10/28/95	3SD15 10/28/95	11SD01 10/28/95	11SD02 10/28/95
PESTICIDE/PCBS (ug/kg)								
BETA-BHC	38 U	32 U	37 U	49 U	31 U	32 U	NA	NA
4,4'-DDE	75 U	63 U	74 U	97 U	62 U	63 U	NA	NA
HERBICIDES (ug/kg)								
2,4,5-TP (SILVEX)	130 U	100 U	130 U	160 U	100 U	110 U	NA	NA
DIOXIN (ug/kg)								
TOTAL PECDD	0.17 U	0.15 U	0.27 U	0.4 U	0.19 U	0.18 U	NA	NA
TOTAL HXCDD	0.2 U	0.12 U	0.17 U	0.38 U	0.23 U	J	NA	NA
TOTAL HXCDF	0.2 U	0.17 U	0.16 U	0.28 U	0.16 U	0.22 U	NA	NA

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TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	11SD03 10/28/95	1SD01 10/30/95	1SD02 10/30/95	1SD03 10/30/95	2SD01 10/31/95	2SD02 10/31/95	2SD03 10/31/95	2SD03D 10/31/95
VOLATILES (ug/kg)								
ACETONE	17 U	18 U	14 U	22 U	30 U	42 U	33 U	51 U
CARBON DISULFIDE	6 J	6 U	7 U	8 U	9 U	12 U	8 U	7 U
2-BUTANONE	17 U	12 U	14 U	16 U	17 U	24 U	16 U	11 J
TETRACHLOROETHENE	8 U	6 U	2 J	2 J	9 U	12 U	8 U	7 U
SEMIVOLATILES (ug/kg)								
PHENOL	83 J	410 U	470 U	530 U	560 U	780 U	540 U	470 U
BENZOIC ACID	2800 U	2100 U	2300 U	2700 U	2800 U	3900 U	2700 U	2300 U
ACENAPHTHYLENE	120 J	410 U	470 U	530 U	560 U	780 U	540 U	470 U
FLUORENE	560 U	410 U	470 U	530 U	560 U	780 U	540 U	62 J
PHENANTHRENE	70 J	410 U	470 U	530 U	560 U	290 J	630	1900
ANTHRACENE	150 J	410 U	470 U	530 U	560 U	780 U	96 J	300 J
FLUORANTHENE	280 J	410 U	470 U	530 U	560 U	960	1900	3600
PYRENE	530 J	410 U	470 U	530 U	560 U	1200	2200	5500
BENZO(A)ANTHRACENE	300 J	410 U	470 U	530 U	560 U	530 J	970	2200
CHRYSENE	620	410 U	470 U	530 U	560 U	720 J	1200	2600
BIS(2-ETHYLHEXYL)PHTHALATE	140 J	130 J	470 U	110 J	200 J	880	540 U	470 U
BENZO(B)FLUORANTHENE	1600	410 U	470 U	530 U	560 U	780 U	1800	2700
BENZO(K)FLUORANTHENE	1400	410 U	470 U	530 U	560 U	780 U	140 J	1400
BENZO(A)PYRENE	1400	410 U	470 U	530 U	560 U	780 U	920	1900
INDENO(1,2,3-CD)PYRENE	690	410 U	470 U	530 U	560 U	780 U	90 J	1000
DIBENZO(A,H)ANTHRACENE	280 J	410 U	470 U	530 U	560 U	780 U	540 U	260 J
BENZO(G,H,I)PERYLENE	780	410 U	470 U	530 U	560 U	780 U	540 U	870
P-DIMETHYLAMINOAZOBENZENE	560 U	830 U	930 U	1100 U	1100 U	1600 U	1100 U	940 U
CARBAZOLE	NA	410 U	470 U	530 U	560 U	780 U	540 U	65 J

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TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID	11SD03	1SD01	1SD02	1SD03	2SD01	2SD02	2SD03	2SD03D
SAMPLE DATE	10/28/95	10/30/95	10/30/95	10/30/95	10/31/95	10/31/95	10/31/95	10/31/95
PESTICIDE/PCBS (ug/kg)								
BETA-BHC	NA	4.8 U	5.6 U	32 U	34 U	92 U	65 U	22
4,4-DDE	NA	9.7 U	11 U	64 U	68 U	180 U	29	33
HERBICIDES (ug/kg)								
2,4,5-TP (SILVEX)	NA	83 U	93 U	110 U	110 U	150 U	110 U	93 U
DIOXIN (ug/kg)								
TOTAL PECDD	NA	0.14 U	0.15 U	0.21 U	0.19 U	0.2 U	0.24 U	0.26 J
TOTAL HXCDD	NA	0.15 U	0.19 U	0.24 U	0.2 U	0.23 U	2.5	3.3
TOTAL HXCDF	NA	0.13 U	0.13 U	0.22 U	0.19 U	0.2 U	0.31 J	1 J

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(5) Value for total TCDD and TCDF dioxin

TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	number exceeding	number exceeding	number exceeding	number exceeding
	ERL Sediment	ERM Sediment	Industrial Soils	Residential Soils
VOLATILES (ug/kg)				
ACETONE	NA	NA	NA	0/30
CARBON DISULFIDE	NA	NA	NA	0/30
2-BUTANONE	NA	NA	NA	0/30
TETRACHLOROETHENE	NA	0/30	NA	0/30
SEMIVOLATILES (ug/kg)				
PHENOL	NA	1/30	NA	0/30
BENZOIC ACID	NA	8/30	NA	0/30
ACENAPHTHYLENE	3/30	1/30	0/30	0/30
FLUORENE	1-30	0/30	0/30	0/30
PHENANTHRENE	3/30	1/30	0/30	0/30
ANTHRACENE	4/30	0/30	0/30	0/30
FLUORANTHENE	4/30	0/30	0/30	0/30
PYRENE	4/30	2/30	0/30	0/30
BENZO(A)ANTHRACENE	5/30	2/30	0/30	2/30
CHRYSENE	6/30	1/30	0/30	0/30
BIS(2-ETHYLHEXYL)PHTHALATE	NA	0/30	1/30	4/30
BENZO(B)FLUORANTHENE	NA	1/30	1/30	1/30
BENZO(K)FLUORANTHENE	NA	NA	0/30	1/30
BENZO(A)PYRENE	5/30	2/30	4/30	6/30
INDENO(1,2,3-CD)PYRENE	NA	3/30	1/30	2/30
DIBENZO(A,H)ANTHRACENE	4/30	3/30	1/30	4/30
BENZO(G,H,I)PERYLENE	0/30	3/30	0/30	0/30
P-DIMETHYLAMINOAZOBENZENE	NA	NA	NA	NA
CARBAZOLE	0/27	0/27	0/27	0/27

QUALIFIER DEFINITIONS

J = Analyte present. Reported value may not be accurate or precise.

U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

NOTES

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(4) Value for gamma - BHC (lindane)

(5) Value for total TCDD and TCDF dioxin

TABLE 5-42
DETECTED CONCENTRATIONS OF ORGANIC COMPOUNDS
AOC D SEDIMENTS
CTO-0277 RFI REPORT OU#1 AND OU#7
NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

SAMPLE ID SAMPLE DATE	number exceeding	number exceeding	number exceeding	number exceeding
	ERL Sediment	ERM Sediment	Industrial Soils	Residential Soils
PESTICIDE/PCBS (ug/kg)				
BETA-BHC	0/27	NA	NA	NA
4,4'-DDE	2/27	2/27	0/27	0/27
HERBICIDES (ug/kg)				
2,4,5-TP (SILVEX)	NA	NA	0/27	0/27
DIOXIN (ug/kg)				
TOTAL PECDD	1/27	NA	1/27	1/27
TOTAL HXCDD	3/27	NA	3/27	3/27
TOTAL HXCDF	2/27	NA	2/27	2/27

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U = Not detected. The associated number indicates approximate sample concentration necessary to be detected.

NOTES

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(5) Value for total TCDD and TCDF dioxin

APPENDIX C
NEW RISK CALCULATION SPREADSHEETS

TABLE 1
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 INGESTION OF GROUNDWATER AS DRINKING WATER AT AOC B/SWMU 8
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$CDI (mg/kg/d) = (C_w \cdot IR \cdot EF \cdot ED) / (BW \cdot AT)$
 $ILCR = CDI \cdot CSFo$
 $HQ = CDI / RfDo$

Parameter	Description	Young		(Chemical Specific)
		Adult	Child	
CDI	Chronic daily intake (mg/kg/d)	CS	CS	
ILCR	Incremental lifetime cancer risk	CS	CS	
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS	CS	
HQ	Hazard quotient	CS	CS	
RfDo	Oral reference dose (mg/kg/d)	CS	CS	
Cw	Concentration of chemical in water (mg/L)	CS	CS	
IR	Ingestion Rate (L/d)	2	1	
EF	Exposure Frequency (d/yr)	350	350	
ED	Exposure Duration (yrs)	24	6	
BW	Body weight (kg)	70	15	
ATc	Averaging time, carcinogens (d)	25550	25550	
ATn	Averaging time, noncarcinogens (d)	8760	2190	

Parameter	Cw (mg/L)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
				CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Dissolved Beryllium	0.0019	4.30E+00	5.00E-03	1.8E-05	7.7E-05	100.0%	5.2E-05	1.0E-02	100.0%	1.0E-05	4.5E-05	100.0%	1.2E-04	2.4E-02	100.0%
Dissolved Lead	0.0175	NA	NA	1.6E-04	0.0E+00	0.0%	4.8E-04	0.0E+00	0.0%	9.6E-05	0.0E+00	0.0%	1.1E-03	0.0E+00	0.0%
				Total ILCR: 7.7E-05		100.0%	HI: 1.0E-02		100.0%	Total ILCR: 4.5E-05		100.0%	HI: 2.4E-02		100.0%

NOTES:
 NA - Toxicity criterion not available.
 - Not applicable.

TABLE 2
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 DERMAL CONTACT WITH GROUNDWATER AT AOC B/SWMU 6
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$DAD (mg/kg/d) = (Cw \cdot CF \cdot Kp \cdot SA \cdot EF \cdot ED \cdot ET) / (BW \cdot AT)$$

$$ILCR = CDI \cdot CSF_0 \cdot Adj \quad CSF \cdot Adj = CSF/AD$$

$$HQ = CDI/RfD_0 \cdot Adj \quad RfD \cdot Adj = RfD \cdot AD$$

Parameter	Description	Young		(Chemical Specific)
		Adult	Child	
DAD	Dermally absorbed dose (mg/kg/d)	CS	CS	
ILCR	Incremental lifetime cancer risk	CS	CS	
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS	CS	
HQ	Hazard quotient	CS	CS	
RfDo	Oral reference dose (mg/kg/d)	CS	CS	
SA	Skin surface area available for contact (cm ²)	20000	8023	
ET	Exposure frequency (d/yr)	350	350	
ED	Exposure duration (yrs)	24	6	
ET	Exposure time (hrs/day)	0.2	0.2	
BW	Body weight (kg)	70	15	
ATc	Averaging time, carcinogens (d)	25550	25550	
ATn	Averaging time, noncarcinogens (d)	8760	2190	
Cw	Concentration of chemical in water (mg/L)	CS	CS	
CF	Conversion factor (L/cm ³)	0.001	0.001	
Kp	Dermal permeability coefficient (cm/hour)	CS	CS	
AD	Adjustment for Absorbed Dose	CS	CS	

Parameter	Cw (mg/L)	Kp (cm/hour)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	AD (unitless)	Adj CSFo 1/(mg/kg/d)	Adj RfDo (mg/kg/d)	Adult						Young Child					
								Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
								DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Dissolved Beryllium	0.0019	1.00E-03	4.30E+00	5.00E-03	0.01	4.30E+02	5.00E-05	3.6E-08	1.5E-05	100.0%	1.0E-07	2.1E-03	100.0%	1.7E-08	7.2E-06	100.0%	1.9E-07	3.9E-03	100.0%
Dissolved Lead	0.0175	1.00E-03	NA	NA	0.20	NA	NA	3.3E-07	0.0E+00	0.0%	9.6E-07	0.0E+00	0.0%	1.5E-07	0.0E+00	0.0%	1.8E-06	0.0E+00	0.0%
Total ILCR:								1.5E-05	100.0%		HI:	2.1E-03	100.0%	Total ILCR:	7.2E-06	100.0%	HI:	3.9E-03	100.0%

NOTES:
 NA - Toxicity criterion not available.
 - Not applicable.

TABLE 3
 ON-SITE WORKERS - CURRENT SCENARIO
 ACCIDENTAL INGESTION OF SURFACE SOIL IN SWMU 13
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{CDI (mg/kg/d)} = (\text{Cs} \cdot \text{IR} \cdot \text{CF} \cdot \text{FI} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSFo}$$

$$\text{HQ} = \text{CDI} / \text{RfDo}$$

Parameter	Description	On-site Worker
CDI	Chronic daily intake (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDo	Oral reference dose (mg/kg/d)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
IR	Ingestion Rate (mg/d)	100
CF	Conversion factor (kg/mg)	1E-06
FI	Fraction of soil ingested from site	0.5
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
ATc	Averaging time, carcinogens (d)	25550
ATn	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	Carcinogens			Noncarcinogens		
				CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Benzo(a)pyrene	0.44	7.3	NA	7.7E-08	5.6E-07	0.4%	2.2E-07	--	--
4,4'-DDE	7.6	0.34	NA	1.3E-06	4.5E-07	0.3%	3.7E-06	--	--
4,4'-DDT	6	0.34	0.0005	1.0E-06	3.6E-07	0.2%	2.9E-06	5.9E-03	42.9%
Total HxCDD (2378-TCDD TEC)	1.8E-05	156000	NA	3.1E-12	4.9E-07	0.3%	8.8E-12	--	--
Total PeCDF (2378-TCDD TEC)	0.0055	156000	NA	9.6E-10	1.5E-04	96.6%	2.7E-09	--	--
Total HxCDF (2378-TCDD TEC)	8E-05	156000	NA	1.4E-11	2.2E-06	1.4%	3.9E-11	--	--
Arsenic	4.8	1.5	0.0003	8.4E-07	1.3E-06	0.8%	2.3E-06	7.8E-03	57.1%
Lead	413	NA	NA	7.2E-05	--	0.0%	2.0E-04	--	--
				Total ILCR:	1.6E-04	100.0%	Total HI:	1.4E-02	100.0%

NOTES:

NA - Toxicity criterion not available.

-- Not applicable.

TABLE 4
 ON-SITE WORKERS - CURRENT SCENARIO
 DERMAL CONTACT WITH SURFACE SOIL IN SWMU 13
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{DAD (mg/kg/d)} = (\text{Cs} \cdot \text{CF} \cdot \text{AF} \cdot \text{ABS} \cdot \text{A} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSF}_d$$

$$\text{HQ} = \text{CDI} / \text{RfD}_d$$

Parameter	Description	On-site Worker
DAD	Dermally absorbed dose (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSF _o	Oral cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDo	Oral reference dose (mg/kg/d)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
CF	Conversion factor (kg/mg)	1E-06
AF	Soil to skin adherence factor (mg/cm ² -event)	1
ABS	Absorption fraction	CS
A	Skin surface area available for contact (cm ²)	4100
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
AT _c	Averaging time, carcinogens (d)	25550
AT _n	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	ABS	CSF _d 1/(mg/kg/d)	RfD _d (mg/kg/d)	Carcinogens			Noncarcinogens			
					DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	
Benzo(a)pyrene	0.44	0.1	14.6	NA	6.3E-07	9.2E-06	2.1%	1.8E-06	--	--	
4,4'-DDE	7.6	0.1	0.38	NA	1.1E-05	4.1E-06	0.9%	3.0E-05	--	--	
4,4'-DDT	6	0.1	0.38	0.00045	8.6E-06	3.3E-06	0.7%	2.4E-05	5.3E-02	71.2%	
Total HxCDD (2378-TCDD TEC)	1.8E-05	0.03	173333.333	NA	7.7E-12	1.3E-06	0.3%	2.2E-11	--	--	
Total PeCDF (2378-TCDD TEC)	0.0055	0.03	173333.333	NA	2.4E-09	4.1E-04	93.7%	6.6E-09	--	--	
Total HxCDF (2378-TCDD TEC)	8E-05	0.03	173333.333	NA	3.4E-11	6.0E-06	1.4%	9.6E-11	--	--	
Arsenic	4.8	0.032	1.58	0.000285	2.2E-06	3.5E-06	0.8%	6.2E-06	2.2E-02	28.8%	
Lead	413	0.01	NA	NA	5.9E-05	--	--	1.7E-04	--	--	
Total ILCR:					4.4E-04		100.0%	Total HI:		7.5E-02	100.0%

NOTES:

- NA - Toxicity criterion not available.
- Not applicable.

TABLE 5
 ON-SITE WORKERS - CURRENT SCENARIO
 INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL IN SWMU 13
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$CDI \text{ (mg/kg/d)} = (Ca \cdot RR \cdot ET \cdot EF \cdot ED) / (BW \cdot AT)$$

Where: $Ca = Cs \cdot (1/PEF)$

$$ILCR = CDI \cdot CSFI$$

$$HQ = CDI / RfDI$$

Parameter	Description	On-site Worker
CDI	Chronic daily intake (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSFI	Inhalation cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDi	Inhalation reference dose (mg/kg/d)	CS
Ca	Concentration of chemical in air as fugitive dusts (mg/m3)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
PEF	Particulate emission factor (m3/kg)	6.79E+08
RR	Respiration rate (m3/hr)	1.25
ET	Exposure time (hrs/d)	8
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
ATc	Averaging time, carcinogens (d)	25550
ATn	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	Ca (mg/m3)	CSFI 1/(mg/kg/d)	RfDI (mg/kg/d)	Carcinogens			Noncarcinogens		
					CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Benzo(a)pyrene	0.44	6.48E-10	6.1	NA	2.3E-11	1.4E-10	0.4%	6.3E-11	--	--
4,4'-DDE	7.6	1.12E-08	NA	NA	3.9E-10	--	--	1.1E-09	--	--
4,4'-DDT	6	8.84E-09	0.34	NA	3.1E-10	1.0E-10	0.3%	8.6E-10	--	--
Total HxCDD (2378-TCDD TEC)	1.8E-05	2.65E-14	116000	NA	9.3E-16	1.1E-10	0.3%	2.6E-15	--	--
Total PeCDF (2378-TCDD TEC)	0.0055	8.10E-12	116000	NA	2.8E-13	3.3E-08	87.8%	7.9E-13	--	--
Total HxCDF (2378-TCDD TEC)	8E-05	1.18E-13	116000	NA	4.1E-15	4.8E-10	1.3%	1.2E-14	--	--
Arsenic	4.8	7.07E-09	15.1	NA	2.5E-10	3.7E-09	10.0%	6.9E-10	--	--
Lead	413	6.08E-07	NA	NA	2.1E-08	--	--	6.0E-08	--	--
					Total ILCR:	3.7E-08	100.0%	Total HI:	--	--

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 6
 ON-SITE WORKERS - CURRENT SCENARIO
 ACCIDENTAL INGESTION OF SURFACE SOIL IN SWMU 31
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{CDI (mg/kg/d)} = (\text{Cs} \cdot \text{IR} \cdot \text{CF} \cdot \text{FI} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSFo}$$

$$\text{HQ} = \text{CDI} / \text{RfDo}$$

Parameter	Description	On-site Worker
CDI	Chronic daily intake (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDo	Oral reference dose (mg/kg/d)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
IR	Ingestion Rate (mg/d)	100
CF	Conversion factor (kg/mg)	1E-06
FI	Fraction of soil ingested from site	0.5
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
ATc	Averaging time, carcinogens (d)	25550
ATn	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	Carcinogens			Noncarcinogens		
				CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Aroclor-1260	0.23	7.7	NA	4.0E-08	3.1E-07	0.2%	1.1E-07	--	--
Total PeCDD (2378-TCDD TEC)	0.00037	156000	NA	6.5E-11	1.0E-05	5.0%	1.8E-10	--	--
Total HxCDD (2378-TCDD TEC)	0.0012	156000	NA	2.1E-10	3.3E-05	16.1%	5.9E-10	--	--
Total TCDF (2378-TCDD TEC)	1.7E-05	156000	NA	3.0E-12	4.6E-07	0.2%	8.3E-12	--	--
Total PeCDF (2378-TCDD TEC)	0.00155	156000	NA	2.7E-10	4.2E-05	20.8%	7.6E-10	--	--
Total HxCDF (2378-TCDD TEC)	0.0043	156000	NA	7.5E-10	1.2E-04	57.6%	2.1E-09	--	--
Arsenic	1.3	1.5	0.0003	2.3E-07	3.4E-07	0.2%	6.4E-07	2.1E-03	100.0%
Total ILCR:				2.0E-04	100.0%	Total HI:	2.1E-03	100.0%	

NOTES:

NA - Toxicity criterion not available.

-- Not applicable.

TABLE 7
 ON-SITE WORKERS - CURRENT SCENARIO
 DERMAL CONTACT WITH SURFACE SOIL IN SWMU 31
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{DAD (mg/kg/d)} = (\text{Cs} \cdot \text{CF} \cdot \text{AF} \cdot \text{ABS} \cdot \text{A} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSF}_d$$

$$\text{HQ} = \text{CDI} / \text{RfD}_d$$

Parameter	Description	On-site Worker
DAD	Dermally absorbed dose (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSF _o	Oral cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDo	Oral reference dose (mg/kg/d)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
CF	Conversion factor (kg/mg)	1E-06
AF	Soil to skin adherence factor (mg/cm ² -event)	1
ABS	Absorption fraction	CS
A	Skin surface area available for contact (cm ²)	4100
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
AT _c	Averaging time, carcinogens (d)	25550
AT _n	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	ABS	CSF _d 1/(mg/kg/d)	RfD _d (mg/kg/d)	Carcinogens			Noncarcinogens			
					DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	
Aroclor-1260	0.23	0.1	8.7	NA	3.3E-07	2.9E-06	0.5%	9.2E-07	--	--	
Total PeCDD (2378-TCDD TEC)	0.00037	0.03	173333.333	NA	1.6E-10	2.8E-05	4.9%	4.5E-10	--	--	
Total HxCDD (2378-TCDD TEC)	0.0012	0.03	173333.333	NA	5.2E-10	8.9E-05	16.0%	1.4E-09	--	--	
Total TCDF (2378-TCDD TEC)	1.7E-05	0.03	173333.333	NA	7.3E-12	1.3E-06	0.2%	2.0E-11	--	--	
Total PeCDF (2378-TCDD TEC)	0.00155	0.03	173333.333	NA	6.7E-10	1.2E-04	20.7%	1.9E-09	--	--	
Total HxCDF (2378-TCDD TEC)	0.0043	0.03	173333.333	NA	1.8E-09	3.2E-04	57.4%	5.2E-09	--	--	
Arsenic	1.3	0.032	1.58	0.00029	6.0E-07	9.4E-07	0.2%	1.7E-06	5.9E-03	100.0%	
					Total ILCR: 5.6E-04			Total HI: 5.9E-03			100.0%

NOTES:

- NA - Toxicity criterion not available.
- Not applicable.

TABLE 8
 ON-SITE WORKERS - CURRENT SCENARIO
 INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL IN SWMU 31
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$CDI \text{ (mg/kg/d)} = (Ca \cdot RR \cdot ET \cdot EF \cdot ED) / (BW \cdot AT)$$

Where: $Ca = Cs \cdot (1/PEF)$

$$ILCR = CDI \cdot CSFI$$

$$HQ = CDI / RfDi$$

Parameter	Description	On-site Worker
CDI	Chronic daily intake (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSFI	Inhalation cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDi	Inhalation reference dose (mg/kg/d)	CS
Ca	Concentration of chemical in air as fugitive dusts (mg/m ³)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
PEF	Particulate emission factor (m ³ /kg)	6.79E+08
RR	Respiration rate (m ³ /hr)	1.25
ET	Exposure time (hrs/d)	8
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
ATc	Averaging time, carcinogens (d)	25550
ATn	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	Ca (mg/m ³)	CSFI 1/(mg/kg/d)	RfDi (mg/kg/d)	Carcinogens			Noncarcinogens		
					CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Aroclor-1260	0.23	3.39E-10	NA	NA	1.2E-11	--	--	3.3E-11	--	--
Total PeCDD (2378-TCDD TEC)	0.00037	5.45E-13	116000	NA	1.9E-14	2.2E-09	4.9%	5.3E-14	--	--
Total HxCDD (2378-TCDD TEC)	0.0012	1.77E-12	116000	NA	6.2E-14	7.2E-09	15.8%	1.7E-13	--	--
Total TCDF (2378-TCDD TEC)	1.7E-05	2.50E-14	116000	NA	8.7E-16	1.0E-10	0.2%	2.4E-15	--	--
Total PeCDF (2378-TCDD TEC)	0.00155	2.28E-12	116000	NA	8.0E-14	9.3E-09	20.4%	2.2E-13	--	--
Total HxCDF (2378-TCDD TEC)	0.0043	6.33E-12	116000	NA	2.2E-13	2.6E-08	56.5%	6.2E-13	--	--
Arsenic	1.3	1.91E-09	15.1	NA	6.7E-11	1.0E-09	2.2%	1.9E-10	--	--
Total ILCR:					4.5E-08	100.0%	Total HI:	--	--	--

NOTES:

NA - Toxicity criterion not available.

-- Not applicable.

TABLE 8
 ON-SITE WORKERS - CURRENT SCENARIO
 ACCIDENTAL INGESTION OF SURFACE SOIL IN AOC C
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{CDI (mg/kg/d)} = (\text{Cs} \cdot \text{IR} \cdot \text{CF} \cdot \text{FI} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSFo}$$

$$\text{HQ} = \text{CDI} / \text{RfDo}$$

Parameter	Description	On-site Worker
CDI	Chronic daily intake (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDo	Oral reference dose (mg/kg/d)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
IR	Ingestion Rate (mg/d)	100
CF	Conversion factor (kg/mg)	1E-06
FI	Fraction of soil ingested from site	0.5
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
ATc	Averaging time, carcinogens (d)	25550
ATn	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	Carcinogens			Noncarcinogens		
				CDI (mg/kg/d)	ILCR	% Contrib.	CDI (mg/kg/d)	HQ	% Contrib.
Benzo(a)pyrene	0.22	7.3	NA	3.8E-08	2.8E-07	0.0%	1.1E-07	--	--
4,4'-DDE	2.7	0.34	NA	4.7E-07	1.6E-07	0.0%	1.3E-06	--	--
4,4'-DDT	5.4	0.34	0.0005	9.4E-07	3.2E-07	0.0%	2.6E-06	5.3E-03	10.6%
Kepone	2.5	18	NA	4.4E-07	7.8E-06	0.1%	1.2E-06	--	--
alpha-Chlordane	0.84	1.3	0.00006	1.5E-07	1.9E-07	0.0%	4.1E-07	6.8E-03	13.8%
gamma-Chlordane	0.76	1.3	0.00006	1.3E-07	1.7E-07	0.0%	3.7E-07	6.2E-03	12.5%
Aroclor-1260	5,200	7.7	NA	9.1E-04	7.0E-03	99.2%	2.5E-03	--	--
Total TCDF (2378-TCDD TEC)	0.00010	158000	NA	1.7E-11	2.7E-06	0.0%	4.9E-11	--	--
Total PeCDF (2378-TCDD TEC)	0.00120	158000	NA	2.1E-10	3.3E-05	0.5%	5.9E-10	--	--
Total HxCDF (2378-TCDD TEC)	0.00020	158000	NA	3.5E-11	5.5E-06	0.1%	9.8E-11	--	--
Arsenic	19.2	1.5	0.0003	3.4E-06	5.0E-06	0.1%	9.4E-06	3.1E-02	63.0%
Beryllium	0.27	4.3	0.005	4.7E-08	2.0E-07	0.0%	1.3E-07	2.6E-05	0.1%
Lead	7.8	NA	NA	1.4E-06	--	--	3.3E-06	--	--
Total ILCR:				7.1E-03	100.0%		Total HI: 5.0E-02		100.0%

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 10
 ON-SITE WORKERS - CURRENT SCENARIO
 DERMAL CONTACT WITH SURFACE SOIL IN AOC C
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{DAD (mg/kg/d)} = (\text{Cs} \cdot \text{CF} \cdot \text{AF} \cdot \text{ABS} \cdot \text{A} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSF}_d$$

$$\text{HQ} = \text{CDI} / \text{RfD}_d$$

Parameter	Description	On-site Worker
DAD	Dermally absorbed dose (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSF _o	Oral cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfD _o	Oral reference dose (mg/kg/d)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
CF	Conversion factor (kg/mg)	1E-06
AF	Soil to skin adherence factor (mg/cm ² -event)	1
ABS	Absorption fraction	CS
A	Skin surface area available for contact (cm ²)	4100
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
AT _c	Averaging time, carcinogens (d)	25550
AT _n	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	ABS	CSF _d 1/(mg/kg/d)	RfD _d (mg/kg/d)	Carcinogens			Noncarcinogens		
					DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Benzo(a)pyrene	0.22	0.1	14.6	NA	3.2E-07	4.6E-06	0.0%	8.8E-07	--	--
4,4'-DDE	2.7	0.1	0.38	NA	3.9E-06	1.5E-06	0.0%	1.1E-05	--	--
4,4'-DDT	5.4	0.1	0.38	0.00045	7.7E-06	2.9E-06	0.0%	2.2E-05	4.8E-02	13.7%
Kepone	2.5	0.1	36	NA	3.6E-06	1.3E-04	0.2%	1.0E-05	--	--
alpha-Chlordane	0.84	0.1	2.6	0.00003	1.2E-06	3.1E-06	0.0%	3.4E-06	1.1E-01	32.0%
gamma-Chlordane	0.76	0.1	2.6	0.00003	1.1E-06	2.8E-06	0.0%	3.0E-06	1.0E-01	29.0%
Aroclor-1260 (1)	5,200	0.1	8.7	NA	7.5E-03	6.3E-02	99.5%	2.1E-02	--	--
Total TCDF (2378-TCDD TEC)	0.00010	0.03	173333.333	NA	4.3E-11	7.5E-06	0.0%	1.2E-10	--	--
Total PeCDF (2378-TCDD TEC)	0.00120	0.03	173333.333	NA	5.2E-10	8.9E-05	0.1%	1.4E-09	--	--
Total HxCDF (2378-TCDD TEC)	0.00020	0.03	173333.333	NA	8.6E-11	1.5E-05	0.0%	2.4E-10	--	--
Arsenic	19.2	0.032	1.58	0.000285	8.8E-06	1.4E-05	0.0%	2.5E-05	8.6E-02	24.7%
Beryllium	0.27	0.01	430	0.00005	3.9E-08	1.7E-05	0.0%	1.1E-07	2.2E-03	0.6%
Lead	7.8	0.01	NA	NA	1.1E-06	--	--	3.1E-06	--	--
					Total ILCR:	6.3E-02	100.0%	Total HI:	3.5E-01	100.0%

NOTES:

(1) ILCR presented was obtained from USEPA's (1989b) one-hit equation since it exceeds 1.0E-02.

NA - Toxicity criterion not available.

-- Not applicable.

TABLE 11
 ON-SITE WORKERS - CURRENT SCENARIO
 INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL IN AOC C
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$CDI \text{ (mg/kg/d)} = (Ca \cdot RR \cdot ET \cdot EF \cdot ED) / (BW \cdot AT)$$

Where: $Ca = Cs \cdot (1/PEF)$

$$ILCR = CDI \cdot CSFI$$

$$HQ = CDI / RfDI$$

Parameter	Description	On-site Worker
CDI	Chronic daily intake (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSFI	Inhalation cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDI	Inhalation reference dose (mg/kg/d)	CS
Ca	Concentration of chemical in air as fugitive dusts (mg/m3)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
PEF	Particulate emission factor (m3/kg)	6.79E+08
RR	Respiration rate (m3/hr)	1.25
ET	Exposure time (hrs/d)	8
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
ATc	Averaging time, carcinogens (d)	25550
ATn	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	Ca (mg/m3)	CSFI (1/(mg/kg/d))	RfDI (mg/kg/d)	Carcinogens			Noncarcinogens		
					CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Benzo(a)pyrene	0.22	3.24E-10	6.1	NA	1.1E-11	6.9E-11	0.3%	3.2E-11	--	--
4,4'-DDE	2.7	3.98E-09	NA	NA	1.4E-10	--	--	3.9E-10	--	--
4,4'-DDT	5.4	7.95E-09	0.34	NA	2.8E-10	9.4E-11	0.4%	7.8E-10	--	--
Kepona	2.5	3.68E-09	NA	NA	1.3E-10	--	--	3.6E-10	--	--
alpha-Chlordane	0.84	1.24E-09	1.29	NA	4.3E-11	5.6E-11	0.2%	1.2E-10	--	--
gamma-Chlordane	0.76	1.12E-09	1.29	NA	3.9E-11	5.0E-11	0.2%	1.1E-10	--	--
Aroclor-1260	5,200	7.66E-08	NA	NA	2.7E-07	--	--	7.5E-07	--	--
Total TCDF (2378-TCDD TEC)	0.00010	1.47E-13	118000	NA	5.1E-15	6.0E-10	2.5%	1.4E-14	--	--
Total PeCDF (2378-TCDD TEC)	0.00120	1.77E-12	118000	NA	6.2E-14	7.2E-09	29.7%	1.7E-13	--	--
Total HxCDF (2378-TCDD TEC)	0.00020	2.95E-13	118000	NA	1.0E-14	1.2E-09	4.9%	2.9E-14	--	--
Arsenic	19.2	2.83E-08	15.1	NA	9.9E-10	1.5E-08	61.8%	2.8E-09	--	--
Beryllium	0.27	3.98E-10	NA	8.4	1.4E-11	--	--	3.9E-11	4.6E-12	100.0%
Lead	7.8	1.15E-08	NA	NA	4.0E-10	--	--	1.1E-09	--	--
					Total ILCR:	2.4E-08	100.0%	Total HI:	4.6E-12	100.0%

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 12
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 ACCIDENTAL INGESTION OF SURFACE SOIL IN SWMU 13
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$CDI \text{ (mg/kg/d)} = (Cs \cdot IR \cdot CF \cdot FI \cdot EF \cdot ED) / (BW \cdot AT)$$

$$ILCR = CDI \cdot CSF_o$$

$$HQ = CDI / RfDo$$

Parameter	Description	Young	
		Adult	Child
CDI	Chronic daily intake (mg/kg/d)	CS	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS	CS
CSF _o	Oral cancer slope factor (1/(mg/kg/d))	CS	CS
HQ	Hazard quotient	CS	CS
RfDo	Oral reference dose (mg/kg/d)	CS	CS
Cs	Concentration of chemical in soil (mg/kg)	CS	CS
IR	Ingestion Rate (mg/d)	100	200
CF	Conversion factor (kg/mg)	1E-06	1E-06
FI	Fraction of soil ingested from site	1	1
EF	Exposure Frequency (d/yr)	350	350
ED	Exposure Duration (yrs)	24	6
BW	Body weight (kg)	70	15
AT _c	Averaging time, carcinogens (d)	25550	25550
AT _n	Averaging time, noncarcinogens (d)	8760	2190

Parameter	Cs (mg/kg)	CSF _o 1/(mg/kg/d)	RfDo (mg/kg/d)	Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
				CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Benzo(a)pyrene	0.44	7.3	NA	2.1E-07	1.5E-06	0.4%	6.0E-07	--	--	4.8E-07	3.5E-06	0.4%	5.6E-06	--	--
4,4'-DDE	7.8	0.34	NA	3.6E-06	1.2E-06	0.3%	1.0E-05	--	--	8.3E-06	2.8E-06	0.3%	9.7E-05	--	--
4,4'-DDT	6	0.34	0.0005	2.8E-06	9.6E-07	0.2%	8.2E-06	1.6E-02	42.9%	6.6E-06	2.2E-06	0.2%	7.7E-05	1.5E-01	42.9%
Total HxCDD (2378-TCDD TEC)	1.8E-05	158000	NA	8.5E-12	1.3E-06	0.3%	2.5E-11	--	--	2.0E-11	3.1E-06	0.3%	2.3E-10	--	--
Total PeCDF (2378-TCDD TEC)	0.0055	158000	NA	2.6E-09	4.0E-04	96.6%	7.5E-09	--	--	6.0E-09	9.4E-04	96.6%	7.0E-08	--	--
Total HxCDF (2378-TCDD TEC)	8E-05	158000	NA	3.8E-11	5.9E-06	1.4%	1.1E-10	--	--	8.8E-11	1.4E-05	1.4%	1.0E-09	--	--
Arsenic	4.8	1.5	0.0003	2.3E-06	3.4E-06	0.8%	6.6E-06	2.2E-02	57.1%	5.3E-06	7.9E-06	0.8%	6.1E-05	2.0E-01	57.1%
Lead	413	NA	NA	1.9E-04	--	0.0%	5.7E-04	--	--	4.5E-04	--	0.0%	5.3E-03	--	--
				Total ILCR: 4.2E-04 100.0%			Total HI: 3.8E-02 100.0%			Total ILCR: 9.7E-04 100.0%			Total HI: 3.6E-01 100.0%		

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 13
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 DERMAL CONTACT WITH SURFACE SOIL IN SWMU 13
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{DAD (mg/kg/d)} = (\text{Cs} \cdot \text{CF} \cdot \text{AF} \cdot \text{ABS} \cdot \text{A} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSF}_d$$

$$\text{HQ} = \text{CDI} / \text{RfD}_d$$

Parameter	Description	Young	
		Adult	Child
DAD	Dermally absorbed dose (mg/kg/d)	CS	CS
ILCR	Incremental lifetime cancer risk	CS	CS
CSF _o	Oral cancer slope factor (1/(mg/kg/d))	CS	CS
HQ	Hazard quotient	CS	CS
RfD _o	Oral reference dose (mg/kg/d)	CS	CS
Cs	Concentration of chemical in soil (mg/kg)	CS	CS
CF	Conversion factor (kg/mg)	1E-06	1E-06
AF	Soil to skin adherence factor (mg/cm ² -event)	1	1
ABS	Absorption fraction	CS	CS
A	Skin surface area available for contact (cm ²)	5300	2008
EF	Exposure Frequency (d/yr)	350	350
ED	Exposure Duration (yrs)	24	6
BW	Body weight (kg)	70	15
AT _c	Averaging time, carcinogens (d)	25550	25550
AT _n	Averaging time, noncarcinogens (d)	8760	2190

Parameter	Cs (mg/kg)	ABS	CSF _d 1/(mg/kg/d)	RfD _d (mg/kg/d)	Adult						Young Child										
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens							
					DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI					
Benzo(a)pyrene	0.44	0.1	14.6	NA	1.1E-06	1.6E-05	2.1%	3.2E-06	--	--	4.8E-07	7.1E-06	2.1%	5.6E-06	--	--					
4,4'-DDE	7.6	0.1	0.38	NA	1.9E-05	7.2E-06	0.9%	5.5E-05	--	--	8.4E-06	3.2E-06	0.9%	9.7E-05	--	--					
4,4'-DDT	6	0.1	0.38	0.00045	1.5E-05	5.7E-06	0.7%	4.4E-05	9.7E-02	71.2%	6.6E-06	2.5E-06	0.7%	7.7E-05	1.7E-01	71.2%					
Total HxCDD (2378-TCDD TEC)	1.8E-05	0.03	173333.333	NA	1.3E-11	2.3E-06	0.3%	3.9E-11	--	--	5.9E-12	1.0E-06	0.3%	6.9E-11	--	--					
Total PeCDF (2378-TCDD TEC)	0.0055	0.03	173333.333	NA	4.1E-09	7.1E-04	93.7%	1.2E-08	--	--	1.8E-09	3.1E-04	93.7%	2.1E-08	--	--					
Total HxCDF (2378-TCDD TEC)	8E-05	0.03	173333.333	NA	6.0E-11	1.0E-05	1.4%	1.7E-10	--	--	2.6E-11	4.6E-06	1.4%	3.1E-10	--	--					
Arsenic	4.8	0.032	1.58	0.000285	3.8E-06	6.0E-06	0.8%	1.1E-05	3.9E-02	28.8%	1.7E-06	2.7E-06	0.8%	2.0E-05	6.9E-02	28.8%					
Lead	413	0.01	NA	NA	1.0E-04	--	--	3.0E-04	--	--	4.5E-05	--	--	5.3E-04	--	--					
Total ILCR:					7.6E-04	100.0%		Total HI:			1.4E-01	100.0%	Total ILCR:			3.4E-04	100.0%	Total HI:		2.4E-01	100.0%

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 14
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL IN SWMU 13
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$CDI (mg/kg/d) = (Ca \cdot RR \cdot ET \cdot EF \cdot ED) / (BW \cdot AT)$$

Where: $Ca = Cs \cdot (1/PEF)$

$$ILCR = CDI \cdot CSFI$$

$$HQ = CDI / RfDI$$

Parameter	Description	Young	
		Adult	Child
CDI	Chronic daily intake (mg/kg/d)	CS	CS
ILCR	Incremental lifetime cancer risk	CS	CS
CSFI	Inhalation cancer slope factor (1/(mg/kg/d))	CS	CS
HQ	Hazard quotient	CS	CS
RfDI	Inhalation reference dose (mg/kg/d)	CS	CS
Ca	Concentration of chemical in air as fugitive dusts (mg/m ³)	CS	CS
Cs	Concentration of chemical in soil (mg/kg)	CS	CS
PEF	Particulate emission factor (m ³ /kg)	6.79E+08	6.79E+08
RR	Respiration rate (m ³ /hr)	0.83	0.83
ET	Exposure time (hrs/d)	24	24
EF	Exposure Frequency (d/yr)	350	350
ED	Exposure Duration (yrs)	24	6
BW	Body weight (kg)	70	15
ATc	Averaging time, carcinogens (d)	25550	25550
ATn	Averaging time, noncarcinogens (d)	8780	2190

Parameter	Cs (mg/kg)	Ca (mg/m ³)	CSFI (1/(mg/kg/d))	RfDI (mg/kg/d)	Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
					CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Benzo(a)pyrene	0.44	6.48E-10	6.1	NA	6.1E-11	3.7E-10	0.4%	1.8E-10	--	--	7.1E-11	4.3E-10	0.4%	8.3E-10	--	--
4,4'-DDE	7.6	1.12E-08	NA	NA	1.0E-09	--	--	3.1E-09	--	--	1.2E-09	--	--	3.1E-09	--	--
4,4'-DDT	6	8.84E-09	0.34	NA	8.3E-10	2.8E-10	0.3%	2.4E-09	--	--	9.6E-10	3.3E-10	0.3%	2.4E-09	--	--
Total HxCDD (2378-TCDD TEC)	1.8E-05	2.85E-14	116000	NA	2.5E-15	2.9E-10	0.3%	7.2E-15	--	--	2.9E-15	3.4E-10	0.3%	7.2E-15	--	--
Total PeCDF (2378-TCDD TEC)	0.0055	8.10E-12	116000	NA	7.6E-13	8.8E-08	87.8%	2.2E-12	--	--	8.8E-13	1.0E-07	87.8%	2.2E-12	--	--
Total HxCDF (2378-TCDD TEC)	8E-05	1.18E-13	116000	NA	1.1E-14	1.3E-09	1.3%	3.2E-14	--	--	1.3E-14	1.5E-09	1.3%	3.2E-14	--	--
Arsenic	4.8	7.07E-09	15.1	NA	6.6E-10	1.0E-08	10.0%	1.9E-09	--	--	7.7E-10	1.2E-08	10.0%	1.9E-09	--	--
Lead	413	6.08E-07	NA	NA	5.7E-08	--	--	1.7E-07	--	--	6.6E-08	--	--	1.7E-07	--	--
					Total ILCR:	1.0E-07	100.0%	Total HI:	--	--	Total ILCR:	1.2E-07	100.0%	Total HI:	--	--

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 15
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 ACCIDENTAL INGESTION OF SURFACE SOIL IN SWMU 31
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{CDI (mg/kg/d)} = (\text{Cs} \cdot \text{IR} \cdot \text{CF} \cdot \text{FI} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSFo}$$

$$\text{HQ} = \text{CDI} / \text{RfDo}$$

Parameter	Description	Adult	Young Child	
CDI	Chronic daily intake (mg/kg/d)	CS	CS	(Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS	CS	
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS	CS	
HQ	Hazard quotient	CS	CS	
RfDo	Oral reference dose (mg/kg/d)	CS	CS	
Cs	Concentration of chemical in soil (mg/kg)	CS	CS	
IR	Ingestion Rate (mg/d)	100	200	
CF	Conversion factor (kg/mg)	1E-06	1E-06	
FI	Fraction of soil ingested from site	1	1	
EF	Exposure Frequency (d/yr)	350	350	
ED	Exposure Duration (yrs)	24	6	
BW	Body weight (kg)	70	15	
ATc	Averaging time, carcinogens (d)	25550	25550	
ATn	Averaging time, noncarcinogens (d)	8760	2190	

Parameter	Cs (mg/kg)	CSFo 1/(mg/kg/d)	RfDo (mg/kg/d)	Adult						Young Child													
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens										
				CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI								
Aroclor-1260	0.23	7.7	NA	1.1E-07	8.3E-07	0.2%	3.2E-07	--	--	2.5E-07	1.9E-06	0.2%	2.9E-06	--	--								
Total PeCDD (2378-TCDD TEC)	0.00037	156000	NA	1.7E-10	2.7E-05	5.0%	5.1E-10	--	--	4.1E-10	6.3E-05	5.0%	4.7E-09	--	--								
Total HxCDD (2378-TCDD TEC)	0.0012	156000	NA	5.6E-10	8.8E-05	16.1%	1.6E-09	--	--	1.3E-09	2.1E-04	16.1%	1.5E-08	--	--								
Total TCDF (2378-TCDD TEC)	1.7E-05	156000	NA	8.0E-12	1.2E-06	0.2%	2.3E-11	--	--	1.9E-11	2.9E-06	0.2%	2.2E-10	--	--								
Total PeCDF (2378-TCDD TEC)	0.00155	156000	NA	7.3E-10	1.1E-04	20.8%	2.1E-09	--	--	1.7E-09	2.6E-04	20.8%	2.0E-08	--	--								
Total HxCDF (2378-TCDD TEC)	0.0043	156000	NA	2.0E-09	3.2E-04	57.6%	5.9E-09	--	--	4.7E-09	7.4E-04	57.6%	5.5E-08	--	--								
Arsenic	1.3	1.5	0.0003	6.1E-07	9.2E-07	0.2%	1.8E-06	5.9E-03	100.0%	1.4E-06	2.1E-06	0.2%	1.7E-05	5.5E-02	100.0%								
Total ILCR:				5.5E-04	100.0%	Total HI:				5.9E-03	100.0%	Total ILCR:				1.3E-03	100.0%	Total HI:				5.5E-02	100.0%

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 16
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 DERMAL CONTACT WITH SURFACE SOIL IN SWMU 31
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$\text{DAD (mg/kg/d)} = (\text{Cs} \cdot \text{CF} \cdot \text{AF} \cdot \text{ABS} \cdot \text{A} \cdot \text{EF} \cdot \text{ED}) / (\text{BW} \cdot \text{AT})$$

$$\text{ILCR} = \text{CDI} \cdot \text{CSF}_d$$

$$\text{HQ} = \text{CDI} / \text{RfD}_d$$

Parameter	Description	Adult	Young Child	
DAD	Dermally absorbed dose (mg/kg/d)	CS	CS	(Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS	CS	
CSF _o	Oral cancer slope factor (1/(mg/kg/d))	CS	CS	
HQ	Hazard quotient	CS	CS	
RfDo	Oral reference dose (mg/kg/d)	CS	CS	
Cs	Concentration of chemical in soil (mg/kg)	CS	CS	
CF	Conversion factor (kg/mg)	1E-06	1E-06	
AF	Soil to skin adherence factor (mg/cm ² -event)	1	1	
ABS	Absorption fraction	CS	CS	
A	Skin surface area available for contact (cm ²)	5300	2006	
EF	Exposure Frequency (d/yr)	350	350	
ED	Exposure Duration (yrs)	24	6	
BW	Body weight (kg)	70	15	
AT _c	Averaging time, carcinogens (d)	25550	25550	
AT _n	Averaging time, noncarcinogens (d)	8760	2190	

Parameter	Cs (mg/kg)	ABS	CSF _d 1/(mg/kg/d)	RfD _d (mg/kg/d)	Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
					DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Aroclor-1260	0.23	0.1	8.7	NA	5.7E-07	5.0E-06	0.5%	1.7E-06	--	--	2.5E-07	2.2E-06	0.5%	2.9E-06	--	--
Total PeCDD (2378-TCDD TEC)	0.00037	0.03	173333.333	NA	2.8E-10	4.8E-05	4.9%	8.1E-10	--	--	1.2E-10	2.1E-05	4.9%	1.4E-09	--	--
Total HxCDD (2378-TCDD TEC)	0.0012	0.03	173333.333	NA	9.0E-10	1.6E-04	16.0%	2.6E-09	--	--	4.0E-10	6.9E-05	16.0%	4.6E-09	--	--
Total TCDF (2378-TCDD TEC)	1.7E-05	0.03	173333.333	NA	1.3E-11	2.2E-06	0.2%	3.7E-11	--	--	5.6E-12	9.7E-07	0.2%	6.5E-11	--	--
Total PeCDF (2378-TCDD TEC)	0.00155	0.03	173333.333	NA	1.2E-09	2.0E-04	20.7%	3.4E-09	--	--	5.1E-10	8.9E-05	20.7%	6.0E-09	--	--
Total HxCDF (2378-TCDD TEC)	0.0043	0.03	173333.333	NA	3.2E-09	5.6E-04	57.4%	9.4E-09	--	--	1.4E-09	2.5E-04	57.4%	1.7E-08	--	--
Arsenic	1.3	0.032	1.58	0.000285	1.0E-06	1.6E-06	0.2%	3.0E-06	1.1E-02	100.0%	4.6E-07	7.2E-07	0.2%	5.3E-06	1.9E-02	100.0%
					Total ILCR: 9.7E-04 100.0%			Total HI: 1.1E-02 100.0%			Total ILCR: 4.3E-04 100.0%			Total HI: 1.9E-02 100.0%		

NOTES:

NA - Toxicity criterion not available.

-- Not applicable.

TABLE 17
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL IN SWMU 31
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$CDI \text{ (mg/kg/d)} = (Ca \cdot RR \cdot ET \cdot EF \cdot ED) / (BW \cdot AT)$$

Where: $Ca = Cs \cdot (1/PEF)$

$$ILCR = CDI \cdot CSFI$$

$$HQ = CDI / RfDI$$

Parameter	Description	Young	
		Adult	Child
CDI	Chronic daily intake (mg/kg/d)	CS	CS
ILCR	Incremental lifetime cancer risk	CS	CS
CSFI	Inhalation cancer slope factor (1/(mg/kg/d))	CS	CS
HQ	Hazard quotient	CS	CS
RfDI	Inhalation reference dose (mg/kg/d)	CS	CS
Ca	Concentration of chemical in air as fugitive dusts (mg/m ³)	CS	CS
Cs	Concentration of chemical in soil (mg/kg)	CS	CS
PEF	Particulate emission factor (m ³ /kg)	6.79E+08	6.79E+08
RR	Respiration rate (m ³ /hr)	0.83	0.83
ET	Exposure time (hrs/d)	24	24
EF	Exposure Frequency (d/yr)	350	350
ED	Exposure Duration (yrs)	24	6
BW	Body weight (kg)	70	15
ATc	Averaging time, carcinogens (d)	25550	25550
ATn	Averaging time, noncarcinogens (d)	8760	2190

Parameter	Cs (mg/kg)	Ca (mg/m ³)	CSFI 1/(mg/kg/d)	RfDI (mg/kg/d)	Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
					CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI	CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Aroclor-1260	0.23	3.39E-10	NA	NA	3.2E-11	--	--	9.2E-11	--	--	3.7E-11	--	--	4.3E-10	--	--
Total PeCDD (2378-TCDD TEC)	0.00037	5.45E-13	116000	NA	5.1E-14	5.9E-09	4.9%	1.5E-13	--	--	5.9E-14	6.9E-09	4.9%	6.9E-13	--	--
Total HxCDD (2378-TCDD TEC)	0.0012	1.77E-12	116000	NA	1.7E-13	1.9E-08	15.8%	4.8E-13	--	--	1.9E-13	2.2E-08	15.8%	2.3E-12	--	--
Total TCDF (2378-TCDD TEC)	1.7E-05	2.50E-14	116000	NA	2.3E-15	2.7E-10	0.2%	6.8E-15	--	--	2.7E-15	3.2E-10	0.2%	3.2E-14	--	--
Total PeCDF (2378-TCDD TEC)	0.00155	2.28E-12	116000	NA	2.1E-13	2.5E-08	20.4%	6.2E-13	--	--	2.5E-13	2.9E-08	20.4%	2.9E-12	--	--
Total HxCDF (2378-TCDD TEC)	0.0043	6.33E-12	116000	NA	5.9E-13	6.9E-08	56.5%	1.7E-12	--	--	6.9E-13	8.0E-08	56.5%	8.1E-12	--	--
Arsenic	1.3	1.91E-09	15.1	NA	1.8E-10	2.7E-09	2.2%	5.2E-10	--	--	2.1E-10	3.2E-09	2.2%	2.4E-09	--	--
					Total ILCR:	1.2E-07	100.0%	Total HI:	--	--	Total ILCR:	1.4E-07	100.0%	Total HI:	--	--

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 18
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 ACCIDENTAL INGESTION OF SURFACE SOIL IN AOC C
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$CDI \text{ (mg/kg/d)} = (Cs \cdot IR \cdot CF \cdot FI \cdot EF \cdot ED) / (BW \cdot AT)$$

$$ILCR = CDI \cdot CSFo$$

$$HQ = CDI / RfDo$$

Parameter	Description	Adult	Young Child	
CDI	Chronic daily intake (mg/kg/d)	CS	CS	(Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS	CS	
CSFo	Oral cancer slope factor (1/(mg/kg/d))	CS	CS	
HQ	Hazard quotient	CS	CS	
RfDo	Oral reference dose (mg/kg/d)	CS	CS	
Cs	Concentration of chemical in soil (mg/kg)	CS	CS	
IR	Ingestion Rate (mg/d)	100	200	
CF	Conversion factor (kg/mg)	1E-06	1E-06	
FI	Fraction of soil ingested from site	1	1	
EF	Exposure Frequency (d/yr)	350	350	
ED	Exposure Duration (yrs)	24	6	
BW	Body weight (kg)	70	15	
ATc	Averaging time, carcinogens (d)	25550	25550	
ATn	Averaging time, noncarcinogens (d)	8760	2190	

Parameter	Cs (mg/kg)	CSFo (1/(mg/kg/d))	RfDo (mg/kg/d)	Adult						Young Child					
				Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
				CDI (mg/kg/d)	ILCR	% Contrib.	CDI (mg/kg/d)	HQ	% Contrib.	CDI (mg/kg/d)	ILCR	% Contrib.	CDI (mg/kg/d)	HQ	% Contrib.
Benzo(a)pyrene	0.22	7.3	NA	1.0E-07	7.5E-07	0.0%	3.0E-07	--	--	2.4E-07	1.8E-06	0.0%	2.8E-06	--	--
4,4'-DDE	2.7	0.34	NA	1.3E-06	4.3E-07	0.0%	3.7E-06	--	--	3.0E-06	1.0E-06	0.0%	3.5E-05	--	--
4,4'-DDT	5.4	0.34	0.0005	2.5E-06	8.6E-07	0.0%	7.4E-06	1.5E-02	10.6%	5.9E-06	2.0E-06	0.0%	6.9E-05	1.4E-01	10.6%
Kepon	2.5	18	NA	1.2E-06	2.1E-05	0.1%	3.4E-06	--	--	2.7E-06	4.9E-05	0.1%	3.2E-05	--	--
alpha-Chlordane	0.84	1.3	0.00006	3.9E-07	5.1E-07	0.0%	1.2E-06	1.9E-02	13.8%	9.2E-07	1.2E-06	0.0%	1.1E-05	1.8E-01	13.8%
gamma-Chlordane	0.76	1.3	0.00006	3.6E-07	4.6E-07	0.0%	1.0E-06	1.7E-02	12.5%	8.3E-07	1.1E-06	0.0%	9.7E-06	1.6E-01	12.5%
Aroclor-1260 (1)	5,200	7.7	NA	2.4E-03	1.9E-02	99.2%	7.1E-03	--	--	5.7E-03	4.4E-02	99.2%	6.6E-02	--	--
Total TCDF (2378-TCDD TEC)	0.00010	156000	NA	4.7E-11	7.3E-06	0.0%	1.4E-10	--	--	1.1E-10	1.7E-05	0.0%	1.3E-09	--	--
Total PeCDF (2378-TCDD TEC)	0.00120	156000	NA	5.6E-10	8.8E-05	0.5%	1.6E-09	--	--	1.3E-09	2.1E-04	0.5%	1.5E-08	--	--
Total HxCDF (2378-TCDD TEC)	0.00020	156000	NA	9.4E-11	1.5E-05	0.1%	2.7E-10	--	--	2.2E-10	3.4E-05	0.1%	2.6E-09	--	--
Arsenic	19.2	1.5	0.0003	9.0E-06	1.4E-05	0.1%	2.6E-05	8.8E-02	63.0%	2.1E-05	3.2E-05	0.1%	2.5E-04	8.2E-01	63.0%
Beryllium	0.27	4.3	0.005	1.3E-07	5.5E-07	0.0%	3.7E-07	7.4E-05	0.1%	3.0E-07	1.3E-06	0.0%	3.5E-06	6.9E-04	0.1%
Lead	7.8	NA	NA	3.7E-06	--	--	1.1E-05	--	--	8.5E-06	--	--	1.0E-04	--	--
				Total ILCR:	1.9E-02	100.0%	Total HI:	1.4E-01	100.0%	Total ILCR:	4.4E-02	100.0%	Total HI:	1.3E+00	100.0%

NOTES:

(1) ILCR presented was obtained from USEPA's (1989b) one-hit equation since it exceeds 1.0E-02.

NA - Toxicity criterion not available.

-- Not applicable.

TABLE 19
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 DERMAL CONTACT WITH SURFACE SOIL IN AOC C
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

DAD (mg/kg/d) = (Cs*CF*AF*ABS*A*EF*ED)/(BW*AT)
 ILCR = CDI*CSF_d
 HQ = CDI/RfD_d

Parameter	Description	Young	
		Adult	Child
DAD	Dermally absorbed dose (mg/kg/d)	CS	CS
ILCR	Incremental lifetime cancer risk	CS	CS
CSF _d	Oral cancer slope factor (1/(mg/kg/d))	CS	CS
HQ	Hazard quotient	CS	CS
RfD _d	Oral reference dose (mg/kg/d)	CS	CS
Cs	Concentration of chemical in soil (mg/kg)	CS	CS
CF	Conversion factor (kg/mg)	1E-06	1E-06
AF	Soil to skin adherence factor (mg/cm ² -event)	1	1
ABS	Absorption fraction	CS	CS
A	Skin surface area available for contact (cm ²)	5300	2006
EF	Exposure Frequency (d/yr)	350	350
ED	Exposure Duration (yrs)	24	6
BW	Body weight (kg)	70	15
ATc	Averaging time, carcinogens (d)	25550	25550
ATn	Averaging time, noncarcinogens (d)	8760	2190

Parameter	Cs (mg/kg)	ABS	CSF _d 1/(mg/kg/d)	RfD _d (mg/kg/d)	Adult					Young Child						
					Carcinogens			Noncarcinogens		Carcinogens			Noncarcinogens			
					DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI	DAD (mg/kg/d)	ILCR	% Contrib. Total ILCR	DAD (mg/kg/d)	HQ	% Contrib. HI
Benzo(a)pyrene	0.22	0.1	14.6	NA	5.5E-07	8.0E-06	0.0%	1.6E-06	--	--	2.4E-07	3.5E-06	0.0%	2.8E-06	--	--
4,4'-DDE	2.7	0.1	0.38	NA	6.7E-06	2.6E-06	0.0%	2.0E-05	--	--	3.0E-06	1.1E-06	0.0%	3.5E-05	--	--
4,4'-DDT	5.4	0.1	0.38	0.00045	1.3E-05	5.1E-06	0.0%	3.9E-05	8.7E-02	13.7%	5.9E-06	2.3E-06	0.0%	6.9E-05	1.5E-01	13.7%
Kepona	2.5	0.1	36	NA	6.2E-06	2.2E-04	0.2%	1.8E-05	--	--	2.7E-06	9.9E-05	0.2%	3.2E-05	--	--
alpha-Chlordane	0.84	0.1	2.6	0.00003	2.1E-06	5.4E-06	0.0%	6.1E-06	2.0E-01	32.0%	9.2E-07	2.4E-06	0.0%	1.1E-05	3.6E-01	32.0%
gamma-Chlordane	0.76	0.1	2.6	0.00003	1.9E-06	4.9E-06	0.0%	5.5E-06	1.8E-01	29.0%	8.4E-07	2.2E-06	0.0%	9.7E-06	3.2E-01	29.0%
Aroclor-1260 (1)	5,200	0.1	8.7	NA	1.3E-02	1.0E-01	99.5%	3.8E-02	--	--	5.7E-03	5.0E-02	99.6%	6.7E-02	--	--
Total TCDF (2378-TCDD TEC)	0.00010	0.03	173333.333	NA	7.5E-11	1.3E-05	0.0%	2.2E-10	--	--	3.3E-11	5.7E-06	0.0%	3.8E-10	--	--
Total PeCDF (2378-TCDD TEC)	0.00120	0.03	173333.333	NA	9.0E-10	1.6E-04	0.2%	2.6E-09	--	--	4.0E-10	6.9E-05	0.1%	4.6E-09	--	--
Total HxCDF (2378-TCDD TEC)	0.00020	0.03	173333.333	NA	1.5E-10	2.6E-05	0.0%	4.4E-10	--	--	6.6E-11	1.1E-05	0.0%	7.7E-10	--	--
Arsenic	19.2	0.032	1.58	0.00029	1.5E-05	2.4E-05	0.0%	4.5E-05	1.6E-01	24.7%	6.8E-06	1.1E-05	0.0%	7.9E-05	2.8E-01	24.7%
Beryllium	0.27	0.01	430	0.00005	6.7E-08	2.9E-05	0.0%	2.0E-07	3.9E-03	0.6%	3.0E-08	1.3E-05	0.0%	3.5E-07	6.9E-03	0.6%
Lead	7.8	0.01	NA	NA	1.9E-06	--	--	5.7E-06	--	--	8.6E-07	--	--	1.0E-05	--	--
					Total ILCR:	1.0E-01	100.0%	Total HI:	6.3E-01	100.0%	Total ILCR:	5.0E-02	100.0%	Total HI:	1.1E+00	100.0%

NOTES:
 (1) ILCR presented was obtained from USEPA's (1989b) one-hit equation since it exceeds 1.0E-02.
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 20
 ADULT AND YOUNG CHILD RESIDENTS (AGES 1 TO 6 YEARS) - FUTURE SCENARIO
 INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL IN AOC C
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

CDI (mg/kg/d) = (Ca*RR*ET*EF*ED)/(BW*AT)
 Where: Ca = Cs *(1/PEF)

ILCR = CDI*CSF
 HQ = CDI/RfDI

Parameter	Description	Adult	Young Child
CDI	Chronic daily intake (mg/kg/d)	CS	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS	CS
CSF	Inhalation cancer slope factor (1/(mg/kg/d))	CS	CS
HQ	Hazard quotient	CS	CS
RfDI	Inhalation reference dose (mg/kg/d)	CS	CS
Ca	Concentration of chemical in air as fugitive dusts (mg/m3)	CS	CS
Cs	Concentration of chemical in soil (mg/kg)	CS	CS
PEF	Particulate emission factor (m3/kg)	6.79E+08	6.79E+08
RR	Respiration rate (m3/hr)	0.83	0.83
ET	Exposure time (hrs/d)	24	24
EF	Exposure Frequency (d/yr)	350	350
ED	Exposure Duration (yrs)	24	6
BW	Body weight (kg)	70	15
ATc	Averaging time, carcinogens (d)	25550	25550
ATn	Averaging time, noncarcinogens (d)	8760	2190

Parameter	Cs (mg/kg)	Ca (mg/m3)	CSF (1/(mg/kg/d))	RfDI (mg/kg/d)	Adult						Young Child					
					Carcinogens			Noncarcinogens			Carcinogens			Noncarcinogens		
					CDI (mg/kg/d)	ILCR	% Contrib.	CDI (mg/kg/d)	HQ	% Contrib.	CDI (mg/kg/d)	ILCR	% Contrib.	CDI (mg/kg/d)	HQ	% Contrib.
Benzo(a)pyrene	0.22	3.24E-10	6.1	NA	3.0E-11	1.8E-10	0.3%	8.8E-11	--	--	3.5E-11	2.2E-10	0.3%	4.1E-10	--	--
4,4'-DDE	2.7	3.98E-09	NA	NA	3.7E-10	--	--	1.1E-09	--	--	4.3E-10	--	--	5.1E-09	--	--
4,4'-DDT	5.4	7.95E-09	0.34	NA	7.4E-10	2.5E-10	0.4%	2.2E-09	--	--	8.7E-10	3.0E-10	0.4%	1.0E-08	--	--
Kepone	2.5	3.68E-09	NA	NA	3.4E-10	--	--	1.0E-09	--	--	4.0E-10	--	--	4.7E-09	--	--
alpha-Chlordane	0.84	1.24E-09	1.29	NA	1.2E-10	1.5E-10	0.2%	3.4E-10	--	--	1.4E-10	1.7E-10	0.2%	1.6E-09	--	--
gamma-Chlordane	0.76	1.12E-09	1.29	NA	1.0E-10	1.4E-10	0.2%	3.1E-10	--	--	1.2E-10	1.6E-10	0.2%	1.4E-09	--	--
Aroclor-1260	5,200	7.66E-06	NA	NA	7.2E-07	--	--	2.1E-06	--	--	8.4E-07	--	--	9.8E-06	--	--
Total TCDF (2378-TCDD TEC)	0.00010	1.47E-13	116000	NA	1.4E-14	1.6E-09	2.6%	4.0E-14	--	--	1.6E-14	1.9E-09	2.5%	1.9E-13	--	--
Total PeCDF (2378-TCDD TEC)	0.00120	1.77E-12	116000	NA	1.7E-13	1.9E-08	29.7%	4.8E-13	--	--	1.9E-13	2.2E-08	29.7%	2.3E-12	--	--
Total HxCDF (2378-TCDD TEC)	0.00020	2.95E-13	116000	NA	2.8E-14	3.2E-09	4.9%	8.0E-14	--	--	3.2E-14	3.7E-09	4.9%	3.8E-13	--	--
Arsenic	19.2	2.83E-08	15.1	NA	2.6E-09	4.0E-08	61.8%	7.7E-09	--	--	3.1E-09	4.7E-08	61.8%	3.6E-08	--	--
Beryllium	0.27	3.98E-10	NA	8.4	3.7E-11	--	--	1.1E-10	1.3E-11	100.0%	4.3E-11	--	--	5.1E-10	6.0E-11	100.0%
Lead	7.8	1.15E-08	NA	NA	1.1E-09	--	--	3.1E-09	--	--	1.3E-09	--	--	1.5E-08	--	--
					Total ILCR:	6.5E-08	100.0%	Total HI:	1.3E-11	100.0%	Total ILCR:	7.5E-08	100.0%	Total HI:	6.0E-11	100.0%

NOTES:
 NA - Toxicity criterion not available.
 -- Not applicable.

TABLE 44
 ON-SITE WORKERS - CURRENT SCENARIO
 INHALATION OF FUGITIVE DUSTS EMANATING FROM SURFACE SOIL IN SWMU 46
 REASONABLE MAXIMUM EXPOSURE
 POTENTIAL CARCINOGENIC AND NONCARCINOGENIC RISKS
 NAVAL STATION ROOSEVELT ROADS, PUERTO RICO

$$CDI \text{ (mg/kg/d)} = (Ca \cdot RR \cdot ET \cdot EF \cdot ED) / (BW \cdot AT)$$

Where: $Ca = Cs \cdot (1/PEF)$

$$ILCR = CDI \cdot CSFI$$

$$HQ = CDI / RfDi$$

Parameter	Description	On-site Worker
CDI	Chronic daily intake (mg/kg/d)	CS (Chemical Specific)
ILCR	Incremental lifetime cancer risk	CS
CSFI	Inhalation cancer slope factor (1/(mg/kg/d))	CS
HQ	Hazard quotient	CS
RfDi	Inhalation reference dose (mg/kg/d)	CS
Ca	Concentration of chemical in air as fugitive dusts (mg/m ³)	CS
Cs	Concentration of chemical in soil (mg/kg)	CS
PEF	Particulate emission factor (m ³ /kg)	6.79E+08
RR	Respiration rate (m ³ /hr)	1.25
ET	Exposure time (hrs/d)	8
EF	Exposure Frequency (d/yr)	250
ED	Exposure Duration (yrs)	25
BW	Body weight (kg)	70
ATc	Averaging time, carcinogens (d)	25550
ATn	Averaging time, noncarcinogens (d)	9125

Parameter	Cs (mg/kg)	Ca (mg/m ³)	CSFI 1/(mg/kg/d)	RfDi (mg/kg/d)	Carcinogens			Noncarcinogens		
					CDI (mg/kg/d)	ILCR	% Contrib. Total ILCR	CDI (mg/kg/d)	HQ	% Contrib. HI
Benzo(a)pyrene	0.89	1.31E-09	6.1	NA	4.6E-11	2.8E-10	16.7%	1.3E-10	--	--
Benzo(b)fluoranthene	1.2	1.77E-09	0.61	NA	6.2E-11	3.8E-11	2.3%	1.7E-10	--	--
Dibenzo(a,h)anthracene	0.1	1.47E-10	6.1	NA	5.1E-12	3.1E-11	1.9%	1.4E-11	--	--
Aroclor-1260	3.6	5.30E-09	NA	NA	1.9E-10	--	--	5.2E-10	--	--
Arsenic	1.6	2.36E-09	15.1	NA	8.2E-11	1.2E-09	74.5%	2.3E-10	--	--
Beryllium	0.18	2.65E-10	8.4	NA	9.3E-12	7.8E-11	4.7%	2.6E-11	--	--
					Total ILCR:	1.7E-09	100.0%	Total HI:	0.0E+00	0.0%

NOTES:

NA - Toxicity criterion not available.

-- Not applicable.