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FINAL TECHNICAL MEMORANDUM SITE 4 PRE-FEASIBILITY STUDY FISC WILLIAMSBURG VA

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CH2M HILL

Site 4 Pre-Feasibility Study Technical Memorandum, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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Introduction

This Pre-Feasibility Study Technical Memorandum (Pre-FS TM) summarizes the site history and conceptual site model (CSM), provides the results of updated soil human health and ecological risk assessments, defines the soil polycyclic aromatic hydrocarbon (PAH) hotspot area, and presents the rationale for the site media to be evaluated in the FS for Site 4, located at Naval Weapons Station Yorktown Cheatham Annex (CAX). This Pre-FS TM is being developed to detail the steps that need to be completed to move from the Remedial Investigation (RI) to FS stage within the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

The Site 4 Pre-FS TM was prepared for the United States Navy, Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract N62470-11-D-8012, Contract Task Order (CTO) WE63, for submittal to the CAX Tier I Partnering Team, which consists of representatives from NAVFAC Mid-Atlantic, the United States Environmental Protection Agency (USEPA) Region III, and the Virginia Department of Environmental Quality (VDEQ).

Conceptual Site Model

CAX encompasses 2,300 acres east of Williamsburg, between Interstate 64 and the York River on the York-James Peninsula (**Figure 1**). CAX is located on the site of the DuPont Company's former Penniman Shell Loading Plant, and is currently used to supply Atlantic Fleet ships and provide recreational opportunities to military and civilian personnel. The former Penniman facility was used as a powder and shell loading plant during World War I and was closed in 1918.

Site 4, the Outdated Medical Supply Disposal Area, is composed of two burial investigation areas (Burial Investigation Areas 1 and 2), approximately 4 acres in size and located west of D Street, between buildings Cheatham Annex Depot (CAD) 11 and 12 (**Figure 2**). The history of Burial Investigation Area 1 (formerly identified as Area of Concern [AOC] 3 and later incorporated into Site 4) is unknown. It was originally identified as a surface debris pile of metal banding, a few empty drums, and charred wood with approximate dimensions of 20 feet by 20 feet by 10 feet high; the surface debris pile is located in the southwest corner of Burial Investigation Area 1 and adjacent to Upstream Pond (**Figure 2**). However, test pits excavated as part of the Site 4 and AOC 3 Site Inspection (SI) revealed buried debris in this area as well (CH2M HILL, 2011). Burial Investigation Area 2 (formerly known as Site 4 before Site 4 was expanded to include AOC 3) includes out-of-date medical supplies (including intravenous [IV] injection sets with syringes wrapped in aluminum foil or plastic, empty IV bottles, numerous sharps [both] metal and plastic]) and 1- inch metal banding.

Site 4 is heavily vegetated with shrubs and trees. In general, the topography of Site 4 slopes to the northeast towards D Street (**Figure 2**); however, locally the topography slopes towards Upstream Pond. Surface water flows from the areas surrounding CAD 11 and 12 and nearby drainage channels into Upstream Pond. The surface water

in Upstream Pond flows through a culvert under D Street and into Youth Pond. Surface water in Youth Pond then discharges through a culvert into the York River.

In general, soil at Burial Investigation Area 1 is predominately yellowish-brown sandy clay and clay underlain by greenish-grey silty sand. Soil at Burial Investigation Area 2 is predominately brown and gray silty sand. The shallow aquifer underlying Site 4 is the Yorktown-Eastover Aquifer, and during RI field activities, groundwater was encountered between approximately 5.38 and 8.80 feet below ground surface (ft bgs). Groundwater elevations are not expected to be impacted by the tide cycles and groundwater flows generally northeast towards the York River. Based on a calculated average hydraulic conductivity of 2.27 ft/day within the Yorktown-Eastover aquifer, an estimated effective porosity of 0.3, and an average horizontal hydraulic gradient of 0.005 ft/ft, the average lateral groundwater velocity towards the York River is estimated to be 0.038 ft/day.

While Site 4 is located within the restricted CAD area, access is not restricted to authorized CAX visitors (e.g., civilian employees and military personnel) since the gate along D Street near CAD Building 11 is no longer locked on a regular basis. Future land use at Site 4 is not expected to change and will likely continue as a wooded area in the foreseeable future. The CSM for Site 4 is depicted on **Figure 3**.

Previous Investigations

Previous investigations and remedial actions that helped characterize potential contamination at Site 4 are the 1998 Debris Removal (Baker, 2001), the 1999 Field Investigation (FI) (Baker, 2001), the 2001 Test Trench Excavation (Baker, 2002), the Screening-level Ecological Risk Assessment (SERA) (Baker, 2005), the 2009 Sites 4, 9, and AOC 3 Site Investigation (SI) (CH2M HILL, 2011), and the 2012 Site 4 RI (CH2M HILL, 2014). With the exception of a summary of the 2012 RI, detailed below, brief descriptions of the previous investigations are summarized in **Table 1**.

2012 Remedial Investigation

An RI was completed for Site 4 and consisted of buried debris delineation through test pitting, surface and subsurface soil sampling, surface sediment sampling, biota tissue sampling, monitoring well installation, groundwater monitoring and sampling, groundwater hydraulic conductivity “slug” testing, and reference pond surface and subsurface sediment sampling, surface water sampling, and biota tissue sampling. The investigation activities were completed to characterize the nature and extent of buried debris; potential contamination in soil, groundwater, and surface sediment; and to assess the potential risks posed by exposure to contamination by human and ecological receptors via a human health risk assessment (HHRA) and ecological risk assessment (ERA).

The Site 4 RI Report (CH2M HILL, 2014) concluded the following:

- Surface and buried debris within the two burial investigation areas represent the only identified source of CERCLA-regulated contamination at Site 4.
- There is significant potential for contaminants found in soil and sediment within drainages and surface water and sediment in both Upstream and Youth Ponds to have originated from non-CERCLA-regulated sources rather than from sources specific to Site 4.
- Semi-volatile organic compounds (SVOCs), PAHs, polychlorinated biphenyls (PCBs), and metals were detected in soil at concentrations exceeding screening criteria. The highest concentrations of PAHs were found outside of the burial investigation areas, at locations where no historic disposal or operational activities were known to or likely took place that would have resulted in a CERCLA-regulated release, and where the evidence suggests that non-CERCLA-regulated impacts from stormwater runoff in contact with asphalt and other PAH-containing impervious surfaces likely occurred. Since PCBs were only detected within the drainage channels, the evidence suggests that the PCBs may have been transported to and deposited within site drainage channel floodplain areas via stormwater runoff from an unknown source or sources in the upstream developed and industrialized areas to the west and southwest.

- Volatile organic compounds (VOCs), SVOCs, PAHs, metals, and one pesticide (dieldrin) were detected in groundwater at concentrations exceeding screening criteria. The pesticide detection appears to be an isolated occurrence due to the absence of dieldrin in the upgradient and downgradient groundwater samples, only one detection of dieldrin in surface soil, the absence of dieldrin in subsurface soil, and the absence of dieldrin in the Upstream Pond surface water and sediment adjacent to the sample location; therefore, it is likely attributable to normal pesticide use at Department of Defense (DoD) facilities to control pests and weeds and not from pesticide disposal activities.
- The SVOCs and metals detected in surface water within the Site 4 drainage channels and Upstream Pond had concentrations exceeding screening criteria. However, stormwater in contact with PAH-containing impervious surfaces such as asphalt roads, asphalt parking lots, and building rooftops over a developed and industrialized upstream area of substantial acreage discharges to the Site 4 drainage channels and Upstream Pond; therefore, the SVOC concentrations may be the result of impacts from either Site 4 debris, stormwater bringing contaminants from non-CERCLA-regulated sources from upstream paved areas, or a combination of both.
- The SVOCs (primarily PAHs), pesticides, PCBs, and metals detected in sediment samples collected within the drainage channels southwest of Upstream Pond, within Upstream Pond sediment, and within Youth Pond sediment had concentrations exceeding screening criteria. The detected SVOC concentrations in the drainage channel sediment samples could be attributable to non-CERCLA-regulated contaminant sources unrelated to Site 4, to an unknown upstream CERCLA release unrelated to Site 4, or to impacts from buried debris within the Site 4 boundary. There is a strong possibility that the elevated PCB concentrations in Upstream Pond sediment are the result of non-site-related contaminants transported in stormwater from an unknown source or sources in the developed and industrialized areas to the west and south. The detected pesticide concentrations are likely attributable to normal pesticide use at DoD facilities to control pests and weeds rather than pesticide disposal activities.
- In the York River drainage channel, a number of SVOCs were detected at concentrations exceeding screening criteria. Of the SVOCs detected, approximately half were also detected in Youth Pond sediment samples, suggesting that the detected concentrations may be at least partially attributable to offsite contamination transported by the York River.
- There were PCBs and metals detected in Site 4, Upstream Pond, and Youth Pond animal tissue samples.
- The HHRA conducted as part of the Site 4 and Youth Pond RI report identified potential unacceptable risks associated with exposure to soil for exposure groupings that included surface soil within the fenced portion (or within the restricted portion of the CAD area) of Site 4 and combined surface and subsurface soil across the entire site [including areas within the fenced (restricted) portion and outside the fenced portion of the site]. These unacceptable hazards and risks were primarily associated with surface soil within the fenced portion of the site (sample CAA03-SS06-1109) and three samples outside the fenced area, but within the debris area (samples CAS004-4HA06-00-1199, CAS004-4-HA05-01-1199, and CAS004-4HA05-00-1199) (**Figure 4**). Potential unacceptable risks were also identified for exposure to Site 4 groundwater.
- The ERA identified potential unacceptable risks associated with exposure to surface and shallow subsurface soil at Site 4 and sediment within Upstream Pond.

Based on these conclusions and comments from the USEPA on the draft RI Report, the final RI Report recommended an FS be completed to develop and evaluate remedial alternatives to address the following:

- Buried debris and soil at Site 4
- Groundwater at Site 4

- PCBs in Upstream Pond sediment
- PAHs in the drainage channel directing stormwater from the roof of Building CAD 12 and the adjacent paved areas to Site 4

Revised Human Health Risk Assessment – Soil

The HHRA conducted as part of the Site 4 and Youth Pond RI report (CH2M HILL, 2014) identified potential unacceptable non-carcinogenic hazards and carcinogenic risks associated with exposure to soil for exposure groupings that included surface soil within the fenced (restricted) portion of Site 4 and combined surface and subsurface soil across the entire site (including areas within the fenced portion and outside the fenced portion of the site [including the debris areas]). These unacceptable hazards and risks were primarily associated with surface soil within the fenced portion of the site (sample CAA03-SS06-1109) and three samples outside the fenced area, including the disposal areas, but within the debris area (samples CAS004-4HA06-00-1199, CAS004-4-HA05-01-1199, and CAS004-4HA05-00-1199) (**Figure 4**). Therefore, to evaluate if there would be any potential unacceptable hazards or risks associated with future unrestricted use of the area outside the fenced portion of the site only, which includes the debris areas, additional risk calculations were performed for soil. The additional risk calculations were performed for two separate data groupings: all soil (surface and subsurface combined, within and outside of the debris areas) outside the fenced portion of the site (**Attachment 1**) and soil (surface and subsurface) outside the fenced portion of the site that is not within debris areas, since the debris areas will be evaluated for remedial options as part of the FS (**Attachment 2**). The only receptors evaluated in these additional risk calculations were future residents, the most conservative receptors (i.e., would have the highest risks) for evaluating unrestricted future use of the site.

The risk calculations were performed using the same methodology used for the HHRA included in the RI (CH2M HILL, 2014). Additionally, all screening levels to identify the contaminants of potential concern (COPCs), and all toxicity values and exposure factors used to calculate the non-carcinogenic hazards and carcinogenic risks in the RI HHRA, were used in this assessment. The Risk Assessment Guidance for Superfund (RAGS) Part D standard tables (USEPA, 2001) are included as **Attachment 1** and **Attachment 2** and include the Table 2s for identification of COPCs, the Table 3s identifying the exposure point concentrations, the Table 4s that include the exposure factors (the same as those used in the HHRA in the RI), the Table 5s and 6s that identify the toxicity factors (the same as those used in the HHRA in the RI), the Table 7s presenting the risk calculations, and the Table 9s summarizing the risk calculation results. Additionally, the ProUCL output is included in **Attachment 1** and **Attachment 2** for the estimation of the exposure point concentrations for the COPCs.

The COPCs identified for all soil outside the fenced portion of the site and included in the quantification of risk for this soil (**Attachment 1**) are:

- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Bis(2-Ethylhexyl)phthalate
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene
- Aldrin
- Arolcor-1242
- Aroclor-1260
- Aluminum
- Arsenic
- Hexavalent Chromium
- Cobalt
- Iron
- Manganese
- Thallium
- Vanadium

The COPCs identified for soil outside the fenced portion of the site, but not within debris areas, and included in the quantification of risk for this soil (**Attachment 2**) are:

- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene
- Aluminum
- Arsenic
- Hexavalent Chromium
- Cobalt
- Iron
- Thallium
- Vanadium

The results of the additional risk estimates are summarized below by area and receptor. The risk calculations for all soil outside the fenced area are presented in Tables 7.1.RME through 7.3.RME in **Attachment 1**, and summarized in Tables 9.1.RME through 9.3.RME in **Attachment 1**. The risk calculations for soil outside the fenced area not within the debris area are presented in Tables 7.1.RME through 7.3.RME in **Attachment 2**, and summarized in Tables 9.1.RME through 9.3.RME in **Attachment 2**. The constituents of concern (COCs) are identified below for each receptor. The COCs are those COPCs that contribute a hazard index (HI) greater than 0.1 to a cumulative target organ HI that exceeds 1 (USEPA's target HI), or a carcinogenic risk greater than 1×10^{-6} to a cumulative carcinogenic risk that exceeds 1×10^{-4} (upper end of USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$).

All soil outside fenced area and within the boundary of debris

The risk assessment assumed that a future resident could be exposed to combined surface and subsurface soil outside the fenced area through ingestion and dermal contact. Although the soil was not specifically evaluated for emissions from soil to air and inhalation of air as part of the updated risk calculations, this pathway contributed an insignificant hazard and risk to the total hazard and risk associated with all soil (inside and outside the fenced area) in the RI and the concentrations in the soil outside the fenced area are much lower than the concentrations included in the RI HHRA. Non-carcinogenic hazards were calculated for adult and child residents and carcinogenic risks were calculated for a lifetime child/adult resident following USEPA guidance.

Adult Resident

- Total RME HI=0.5 for exposure to soil outside the fenced area are less than the target HI of 1.

Child Resident

- Total RME HI=5 for exposure to soil outside the fenced area exceeds the target HI of 1.
  - COC is arsenic

Lifetime Child/Adult Resident

- Total cancer risk = $3x10^{-4}$, exceeds USEPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.
  - COCs are arsenic, carcinogenic PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, Dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, and bis[2-ethylhexyl]phthalate), PCBs (Aroclor-1242 and Aroclor-1260), and hexavalent chromium

Soil outside fenced area and debris

The risk assessment assumed that a future resident could be exposed to combined surface and subsurface soil outside the fenced area that is not within debris areas through ingestion and dermal contact. Although the soil was not specifically evaluated for emissions from soil to air and inhalation of air as part of the updated risk calculations, this pathway contributed an insignificant hazard and risk to the total hazard and risk associated with all soil (inside and outside the fenced area) in the RI and the concentrations in the soil outside the fenced area are much lower than the concentrations included in the RI HHRA. Non-carcinogenic hazards were calculated for adult and child residents and carcinogenic risks were calculated for a lifetime child/adult resident following USEPA guidance.

Adult Resident

- Total RME HI=0.2 for exposure to soil outside the fenced area, but not within the debris areas, are less than the target HI of 1.

Child Resident

- Total RME HI=2 for exposure to soil outside the fenced area, but not within the debris areas, exceeds the target HI of 1; however, no target organ HIs exceed an HI of 1, therefore, there are no unacceptable non-carcinogenic hazards and no COCs.

Lifetime Child/Adult Resident

- Total cancer risk = $7x10^{-5}$, within USEPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Revised Ecological Risk Assessment – Soil

In order to better support the FS evaluation of remedial alternatives, ecological risks were recalculated for terrestrial habitats using different spatial groupings of the soil data than were used in the RI. All soil samples located in the wooded habitats outside of the CAD building fence were divided into two groups, those within the debris areas and those outside of the debris areas (**Attachment 3 Table E-1**). Because the debris areas will be slated for remediation, this ERA focused on the areas outside of the debris areas to determine if ecological risks in those areas were acceptable or if they also needed to be considered for remediation. For comparison, the risks for the areas within the debris are also provided. The same methodology and parameter values used in the RI ERA were also used for this assessment.

Comparison with Ecological Screening Values

The maximum, arithmetic mean, and 95% upper confidence limit (UCL) of the arithmetic mean soil concentrations were compared with ecological screening values (ESVs). Chemicals were excluded from further consideration in the SERA if the hazard quotient (HQ) based on the maximum concentration was less than 1. Chemicals were generally excluded from further consideration in the Baseline ERA (BERA) if the HQ based on the 95% UCL was less than 1 and/or if the maximum detected concentration was less than the background upper tolerance limit (UTL).

Surface Soil

Maximum surface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-2**. **Attachment 3 Table E-3** identifies the exceedances of ESVs and background UTLs for each surface soil sample. Five metals (aluminum, iron, mercury, selenium, and zinc) and two pesticides (endrin and endrin aldehyde) equaled or exceeded ESVs based on maximum detected concentrations (**Attachment 3 Tables E-2 and E-3**). The ESVs for aluminum and iron were based on soil pH; soil pH data are reported in **Attachment 3 Table E-3**. The VOCs, 2-Butanone and acetone, were detected in at least one surface soil sample, but ESVs were not available. These nine chemicals were identified as Step 2 COPCs. One metal (thallium), one pesticide (endrin ketone), and seven SVOCs were not detected, but maximum detection limits equaled or exceeded ESVs. These nine chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL surface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-2**. Only endrin had an HQ that equaled or exceeded 1, based on detected 95% UCL concentrations, and also equaled or exceeded background UTLs (where available). Aluminum equaled or exceeded both the ESV and background UTL in 3 of 11 samples from this area, and the mean pH was slightly lower than the acceptable range. Thus, aluminum and endrin were identified as COPCs for further risk evaluation.

The VOC 2-Butanone was detected, but a soil ESV was not available. The maximum detected 2-Butanone concentration (24.0 micrograms per kilogram [µg/kg]) was less than soil ESVs for other, similar VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, this chemical was not identified as a COPC for further risk evaluation. Acetone was also detected, but a soil ESV was not available. Acetone was detected at a maximum concentration (640 µg/kg) that exceeded soil ESVs for some other, similar VOCs, which

ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, acetone was identified as a COPC for further risk evaluation.

Atrazine and 4-nitrophenol were not detected, but mean detection limits equaled or exceeded ESVs. These two SVOCs were not identified as COPCs for further risk evaluation, but are discussed in the uncertainty section.

For comparison, the screening of surface soil samples located within the debris areas is contained in **Attachment 3 Tables E-4** and **E-5**.

Shallow Subsurface Soil

Maximum shallow subsurface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-6**. **Attachment 3 Table E-7** identifies the exceedances of ESVs and background UTLs for each shallow subsurface soil sample. Three metals (aluminum, hexavalent chromium [but not total chromium], and iron) and one pesticide (endrin) equaled or exceeded ESVs based on maximum detected concentrations (**Attachment 3 Tables E-6 and E-7**). The ESVs for aluminum and iron were based on soil pH; soil pH data are reported in **Attachment 3 Table E-7**. Acetone was detected in at least one shallow subsurface soil sample, but an ESV was not available. These five chemicals were identified as Step 2 COPCs. Two pesticides (endrin aldehyde and endrin ketone) and six SVOCs were not detected, but maximum detection limits equaled or exceeded ESVs. These eight chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL shallow subsurface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-6**. Only endrin and hexavalent chromium had HQs that equaled or exceeded 1, based on detected 95% UCL concentrations, and also equaled or exceeded background UTLs (where available). Aluminum equaled or exceeded both the ESV and background UTL in 6 of 9 samples from this area, and the mean pH was slightly lower than the acceptable range. Thus, aluminum, hexavalent chromium, and endrin were identified as COPCs for further risk evaluation.

Acetone was detected, but a soil ESV was not available. The maximum acetone concentration (120 µg/kg) was less than soil ESVs for other, similar VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, acetone was not identified as a COPC for further risk evaluation.

Atrazine and 4-nitrophenol were not detected, but mean detection limits equaled or exceeded ESVs. These two SVOCs were not identified as COPCs for further risk evaluation, but are discussed in the uncertainty section.

For comparison, the screening of shallow subsurface soil samples located within the debris areas is contained in **Attachment 3 Tables E-8 and E-9**.

Terrestrial Food Web Exposures

In terrestrial habitats, Step 2 food web COPCs were selected by first comparing maximum surface soil concentrations with the lower of the available bird and mammal Ecological Site Screening Levels (Eco-SSLs) for analytes on the list of bioaccumulative chemicals. Chemicals that equaled or exceeded the Eco-SSLs based on the maximum surface soil concentration were retained for site-specific food web modeling. Those that did not were not evaluated further for terrestrial food web exposures. Chemicals that were on the bioaccumulative chemicals list and did not have Eco-SSLs were automatically included in site-specific food web modeling. The final Step 2 food web COPCs were selected based on a comparison of maximum exposure doses from site-specific food web modeling with the no observed adverse effect level (NOAEL)-based ingestion toxicity reference value (TRV). Those chemicals with an exposure dose equaling or exceeding the NOAEL-based ingestion TRV were identified as Step 2 COPCs. For Step 7, ingestion-based (food web) COPCs were based on a comparison of mean and 95% UCL exposure doses with ingestion TRVs based on the NOAEL, maximum acceptable toxicant concentration (MATC), and lowest observed adverse effect level (LOAEL). An exceedance of the 95% UCL-based MATC was generally considered an unacceptable risk at Step 7, although chemicals that exceeded the MATC, but not the LOAEL, were discussed for possible risk management considerations.

Attachment 3 Table E-10 shows the results of the initial screening against bird and mammal Eco-SSLs for samples outside of the debris areas. Five metals (cadmium, chromium, copper, lead, and zinc) and high molecular weight

(HMW) PAHs equaled or exceeded one or both of the Eco-SSLs based on the maximum detected surface soil concentration and were retained for site-specific food web modeling.

The HQs based on maximum exposure doses for each upper trophic level terrestrial receptor are listed in **Attachment 3 Table E-11**. Based on a comparison to NOAELs, three metals (cadmium, chromium, and mercury) had HQs equaling or exceeding 1 for one or more receptors. Ingestion TRVs were not available for any receptor for 1,2,4,5-tetrachlorobenzene, 4-bromophenyl-phenylether, and 4-chlorophenyl-phenylether, none of which were detected in surface soil samples.

The HQs based on 95% UCL and mean exposure doses for each upper trophic level terrestrial receptor are listed in **Attachment 3 Tables E-12 and E-13**, respectively. Based on a comparison to NOAELs, no chemical had an HQ that equaled or exceeded 1 for any receptor. No chemicals were identified as COPCs for further risk evaluation and risks are acceptable for this exposure pathway.

For comparison, the food web modeling using samples located within the debris areas is contained in **Attachment 3 Tables E-14 through E-17**.

Revised Risk Evaluation – Soil

In surface soil outside of the debris areas, aluminum, endrin, and acetone were identified as COPCs for further risk evaluation (**Attachment 3 Table E-2**), and aluminum, endrin, and hexavalent chromium were identified as COPCs for further risk evaluation in shallow subsurface soil (**Attachment 3 Table E-6**). Aluminum was identified as a COPC in surface soil due largely to the low measured soil pH in the two samples east of Upstream Pond (aluminum was the only COPC identified in this subarea in the RI ERA). The ratios to the background UTL for these two samples were 1.28 and 1.60, so they were not highly elevated relative to background. Thus, potential ecological risks related to aluminum are not expected to be ecologically significant. In shallow subsurface soil, aluminum exceeded both the ESV and background UTL in six samples, and the maximum ratio to the background UTL for these samples (2.45) was higher than in surface soil (1.60). However, there was no discernible pattern to these shallow subsurface exceedances and the range of concentrations for the six samples was fairly uniform (21,000 to 32,000 milligrams per kilogram [mg/kg]), suggesting that they are not site-related and may reflect background conditions.

Endrin exceeded ESVs in three surface soil samples and one shallow subsurface soil sample from the area outside of the debris. The surface soil concentration in two of the samples that exceeded the ESV (3.90 and 3.50 µg/kg) were comparable to the maximum observed concentration (3.50 µg/kg) in surface soil samples collected as part of the background study. The third surface soil exceedance (55.0 µg/kg), and the only shallow subsurface soil exceedance (8.60 µg/kg), occurred at the same sample location [CAA03-SS/SB-09 (**Figure 4**)]. Although the soil concentrations for endrin at this location were well above those observed in background samples, there were no other pesticide ESV exceedances at this location and only one other exceedance of both ESVs and background UTLs (aluminum in the subsurface sample). Thus, this sample location does not appear to be very impacted by potential site activities.

Acetone was identified as a COPC for further risk evaluation in surface soil outside of the debris areas and did not have an available soil ESV or background UTL. Acetone was detected at a maximum concentration (640 µg/kg) that exceeded some soil ESVs for other VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Only 2 of 7 surface soil samples had concentrations that exceeded 173 µg/kg, the lowest ESV for other VOCs. However, the USEPA Region 5 soil ESV for acetone (based on back-calculated food web models) is 2,500 µg/kg, which is greater than the maximum detected concentration in surface soil. Thus, acetone was not identified as a contaminant of concern (COC) in surface soil outside of the debris areas.

Hexavalent chromium exceeded its ESV in the only shallow subsurface soil sample it was analyzed in outside of the debris areas at an HQ of 1.08, but the ESV and background UTL for total chromium were not exceeded in this same sample. Thus, hexavalent chromium was not identified as a COC in surface soil outside of the debris areas.

Uncertainties

The uncertainties related to the BERA were discussed in detail as part of the RI ERA and also generally apply to this assessment except for the reporting limits. Reporting limits for some undetected analytes exceeded applicable ESVs in some media. **Attachment 3 Table E-18** summarizes these chemicals, by medium, and reports both the ratio of the minimum and maximum reporting limits to the ESV as well as the ratio of the mean value (calculated using one-half of the reporting limit for each sample) to the ESV. Because these chemicals were not detected, they are not known to be present on the site, but the potential for unacceptable risks cannot be totally discounted because the reporting limits are higher than the ESVs. The magnitude of the ratios can be used to qualitatively evaluate the magnitude of the associated uncertainty (that is, higher ratios are indicative of a greater likelihood that chemicals are present at concentrations that exceed the ESV relative to lower ratios). In surface soil, two undetected chemicals exceeded reporting limits based on the mean ratio, which exceeded 1.5 for only one of the two. In shallow subsurface soil, two undetected chemicals exceeded reporting limits based on the mean ratio, which exceeded 1.5 for only one of the two.

In summary, there were no chemicals with very high mean ratios, suggesting that the associated uncertainties are relatively low. Because standard analytical methods were used and the sample reporting limits were not elevated relative to the method reporting limits for the vast majority of samples and analytes, these uncertainties are considered acceptable and are unlikely to impact the conclusions of this ERA.

Recommendations

Site 4 Soil Risk Summary

Human Health Risks

Although unacceptable non-carcinogenic hazards and carcinogenic risks were identified for the soil outside the fenced area of Site 4, these risks are associated with the debris areas only, as demonstrated by no unacceptable non-carcinogenic hazards or carcinogenic risks associated with the soil outside the fenced area that does not include the debris areas. Therefore, no additional investigation or evaluation of soil outside the fenced area is necessary, with the exception of the debris area soil that will be evaluated in the FS.

Ecological Risks

The vast majority of the potential ecological risks in terrestrial habitats outside of the CAD area fence are associated with the debris areas. Potential risks in areas outside of the debris were low and considered to be generally acceptable. Therefore, no additional investigation or evaluation of soil outside the fenced area is necessary, with the exception of the debris area soil that will be evaluated in the FS.

Non-CERCLA-Regulated Sources

While a portion of the volume of stormwater runoff discharging to Upstream Pond, and ultimately Youth Pond, is potentially impacted by Site 4, as discussed in the RI Report (CH2M HILL, 2014), a considerable portion of the volume of stormwater runoff draining to these ponds may be impacted by non-CERCLA-regulated contaminant sources unrelated to IR Site 4. For example, the PAHs found in Site 4 samples are ubiquitous in urban environments from sources that include atmospheric emissions from industrial facilities such as power plants, automobile exhaust, tire particles, and asphalt. Stormwater draining from a considerable portion of the developed and industrialized areas north, west, and south of Upstream and Youth Ponds has been in contact with asphalt-paved parking lots and roads, as well as building rooftops, all of which are known to typically contain these PAHs. A component of the stormwater flow that ultimately reaches Youth Pond does not flow through Upstream Pond and is not impacted by Site 4.

In addition, widespread detections of pesticides are likely the result of normal pesticide use at DoD facilities to control pests and weeds. The sample with the highest concentrations of pesticides was located in the immediate vicinity of Building CAD 12, approximately 100 feet upgradient of Burial Investigation Area 1. Pesticides were not known to be disposed at Site 4. The distribution and generally low detected concentrations of pesticides in soil are

likely attributable to normal pesticide use at DoD facilities to control pests and weeds, and not from pesticide disposal activities.

Consequently, there is significant potential for contaminants found in soil and sediment within drainages and surface water and sediment in both Upstream and Youth Ponds to have originated from non-CERCLA-regulated sources rather than from sources specific to Site 4. Therefore, with the exception of the voluntary PAH hotspot removal discussed below, it is recommended no action be taken to address PAHs and pesticides in any site media at Site 4, Upstream Pond, or Youth Pond.

Metals in Upstream Pond Sediment

While there are several possibly site-related metals posing potentially unacceptable ecological risk in sediment within Upstream Pond, given its small size and relative isolation, Upstream Pond contains a fairly abundant and diverse aquatic community. The results of the sediment toxicity testing in the BERA did not indicate any consistent impacts from COCs to organism survival, growth, or reproduction at any of the Upstream Pond locations. There also do not appear to be any widespread impacts from COCs to the benthic invertebrate community in Upstream Pond, based on the semi-quantitative biological survey that was conducted as part of the BERA. Any intrusive remedial actions to address the potential ecological risk would have detrimental physical effects on the habitats and biota that are currently present. These impacts would likely persist for a considerable period of time if natural processes are relied upon for recolonization, since there are no natural sources of colonizing organisms, other than Youth Pond. Further, since urban runoff from the stormwater system is also a possible source for the COCs, there would also be the potential for recontamination following any intrusive remedial action in the pond itself. For these reasons, it is recommended that these COCs in this medium not be carried forward to the FS.

Site 4 Groundwater

A UFP-SAP is currently being prepared for additional investigation of Site 4 groundwater. Therefore, groundwater will not be addressed in the FS unless the results of the forthcoming groundwater investigation indicate that inclusion of Site 4 groundwater in the FS is warranted.

PCBs in Site 4 Soil, Upstream Pond Sediment, and Upstream and Youth Ponds Fish Tissue

The detected PCBs were only found in soil in the immediate vicinity of Drainage Channel #1, near the confluence of Drainage Channels #1 and #2, upgradient of Upstream Pond. The confluence of the two drainage channels is a floodplain area that, while typically dry, is likely to be under water during heavy rain events and a deposition area for sediment transported by stormwater. PCBs were only detected within the drainage channels and debris boundaries, the evidence suggests that the PCBs may have been transported to and deposited within site drainage channel floodplain areas via stormwater runoff.

Two PCBs were detected in sediment samples collected within Upstream Pond sediment at concentrations exceeding both the human health and ecological screening criteria during the RI (CH2M HILL, 2014). The highest PCB concentrations were detected where the site drainage channels direct stormwater into Upstream Pond, northeast of the surface debris pile within Burial Investigation Area 1, and in the northeastern corner of Upstream Pond.

There were PCBs detected in both Upstream and Youth Ponds fish tissue samples. However, the Navy currently has fishing restrictions in place for Youth Pond and will voluntarily keep the fishing restrictions in place to protect against human exposure to PCBs in fish tissue. Since PCBs were detected in the Site 4 soil, Upstream Pond sediment and in Upstream and Youth Ponds fish tissue samples, it is recommended that inclusion of these media in the FS is warranted.

PAH Soil Hotspot

The highest concentrations of PAHs exceeding their respective screening criteria (PAH concentrations one to two orders of magnitude higher than in all other samples) were found in a surface soil sample (CAA03-SS06) collected approximately 100 feet upgradient and entirely outside of Burial Investigation Area 1, in a grassy area

immediately adjacent to the south side of Building CAD 12 (**Figure 4**). The soil sample at this location was collected from a shallow drainage swale that directly receives stormwater runoff from the adjacent road and parking areas, as well as stormwater drainage from the CAD Building 12 rooftop via a downspout directly discharging to this swale, which indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts. Nevertheless, the Navy recommends that a voluntary PAH hotspot removal be completed around surface soil sample location CAA03-SS06 (collected from 0 to 6 inches bgs). The extent of the proposed removal area is approximately 80 square feet (ft^2) (assuming a 5-foot radius around the sample location) to a depth of 2 feet, for a total volume of 6 cubic yards (yd^3). The removal area is based on the nearest surface soil sample (CAA03-SS08) being within 20 feet of CAA03-SS06 and having PAH concentrations two to four orders of magnitude lower than CAA03-SS06 and based on the co-located subsurface soil sample, CAA03-SB06, collected from 6 to 24 inches bgs and having PAH concentrations one to two orders of magnitude lower than CAA03-SS06. Since the evidence indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts, it is recommended no post-excavation confirmation sampling be completed in association with this voluntary hotspot removal action.

Proposed Actions

Based on the conclusions and recommendations presented in the RI Report, as well as the recommendations presented in this pre-FS TM, an FS should be completed to develop and evaluate remedial alternatives to address the following medium and COCs:

- Soil and Buried debris at Site 4 (COCs are arsenic [human health and ecological], hexavalent chromium [human health], mercury [ecological], and zinc [ecological])
- Voluntary removal of the PAH hotspot around surface soil sample CAA03-SS06, near CAD Building 12
- PCBs in Site 4 soil, Upstream Pond sediment, and Upstream and Youth Ponds Fish Tissue

A UFP-SAP is currently being prepared for additional investigation of Site 4 groundwater. Therefore, groundwater will not be addressed in the FS unless the results of the forthcoming groundwater investigation indicate that inclusion of Site 4 groundwater in the FS is warranted.

References

Baker Environmental, Inc. (Baker). 2001. *Site Inspection Report, Site 4 and AOC 1, Naval Weapons Station Yorktown, Yorktown Virginia, Cheatham Annex Site*. May.

Baker. 2002. *Trenching Letter Report Site 1, Site 4, and AOC 2, Naval Weapons Station Yorktown Cheatham Annex Site, Williamsburg, Virginia.* June.

Baker. 2005. *Screening Level Ecological Risk Assessment Report for Sites 4 and 9. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia.* June.

CH2M HILL, Inc. (CH2M HILL). 2011. *Final Site Inspection Report, Site 4, Site 9, and Area of Concern 3. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. December.

CH2M HILL. 2014. *Final Site 4 and Youth Pond Remedial Investigation Report. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. November.

USEPA. 2001. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessment) Final. *Publication 9285.7-47.* Office Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. December.

Table

TABLE 1

Summary of Previous Investigations

Site 4 Pre-Feasibility Study Technical Memorandum

WPNSTA Yorktown Cheatham Annex

Williamsburg, Virginia

Investigations/Action	Year	Investigation/Action Activities
Debris Removal (Baker, 2001)	1998	During a site visit on May 4, 1998, with VDEQ officials, packages of unused needles wrapped in aluminum foil were found at the northeastern end of the site in a small drainage ditch near Upstream Pond. Later in May 1998, approximately 200 pounds of surface debris and 13 pounds of sharps (metal and plastic) were removed from the site. Surface debris removed included IV injection sets, many contained in aluminum or plastic bags, and small quantities (15 containers) of injectable drugs. The injectable drug containers contained either residue or small volumes (a few milliliters of liquid) and had either no labels or labels that were not legible. Additional surface debris, including metal banding, railroad ties, metal, corroded 55-gallon empty drums, and beverage containers, was observed at the site, but not removed.
Field Investigation (Baker, 2001)	1999	Consisted of collecting soil samples from Site 4 and sediment samples from Upstream Pond. These samples were analyzed for Target Compound List (TCL) organic compounds (volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], pesticides, and PCBs), Target Analyte List (TAL) metals, cyanide, and explosives constituents. The results indicated that there was a potential for risk to human health due to the polycyclic aromatic hydrocarbons (PAHs) detected throughout the site.
Test Trench Excavation (Baker, 2002)	2001	14 test trenches (4-TT01 through 4-TT14) and six test holes (4TH01 through 4TH06) were excavated and examined to characterize and delineate the extent and types of buried waste within Burial Investigation Area 1. Based on the results of this investigation, the southern, eastern, and the southwestern subsurface debris boundaries were delineated. Buried material was observed to be thickest in the eastern portion of the site, where waste was encountered up to 5 feet below ground surface (bgs). The volume of buried material and overburden soil cover material was then estimated at 2,100 yd^3. Surface debris, consisting of railroad ties, metal, and various trash items, was also encountered along the northern and western edges of this disposal area.
Screening-Level Ecological Risk Assessment (Baker, 2005)	2005	Completed for soil, sediment, and surface water to determine if potential risk to ecological receptors warranted either additional investigation beyond the conservative screening steps of the Ecological Risk Assessment (ERA) process or the removal of the site from further ecological consideration. In addition, the SERA was completed to identify any data gaps or areas of uncertainty that would require the collection of additional data to support ERA evaluations beyond the screening level. Results of the SERA indicated that there are multiple constituents of potential concern (COPCs) in soil, sediment, and surface water, including VOCs, SVOCs, pesticides, PCBs, and metals. Since multiple COPCs and complete exposure pathways were identified, the SERA recommended proceeding with Step 3A of the ERA process; however, additional data would need to be collected.
Site Inspection (CH2M HILL, 2011)	2009	Consisted of test pitting, surface and subsurface soil sampling, installation of temporary groundwater wells, groundwater well development and sampling, abandonment of temporary groundwater wells, surface water sampling, and sediment (surface and subsurface) sampling. Results from the SI indicated that the extent of buried debris in Burial Investigation Area 2 had been delineated, but additional test pitting would be required to delineate the extent of buried debris in Burial Investigation Area 1. In addition, sampling results indicated potential risks to human health and ecological receptors, and an RI was recommended to further characterize the extent of contamination and to quantify the risks to human health and ecological receptors.

Figures

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\388429_SITE4_YOUTH_POND_RI\FIGURE 1-1 - WPNSTA BASE LOCATION MAP.MXD RLAFLEUR CH2MHILLENV 1/28/2015 8:44:47 AM

Legend

- Youth Pond
- Site 4 Boundary
- Cheatham Annex Boundary

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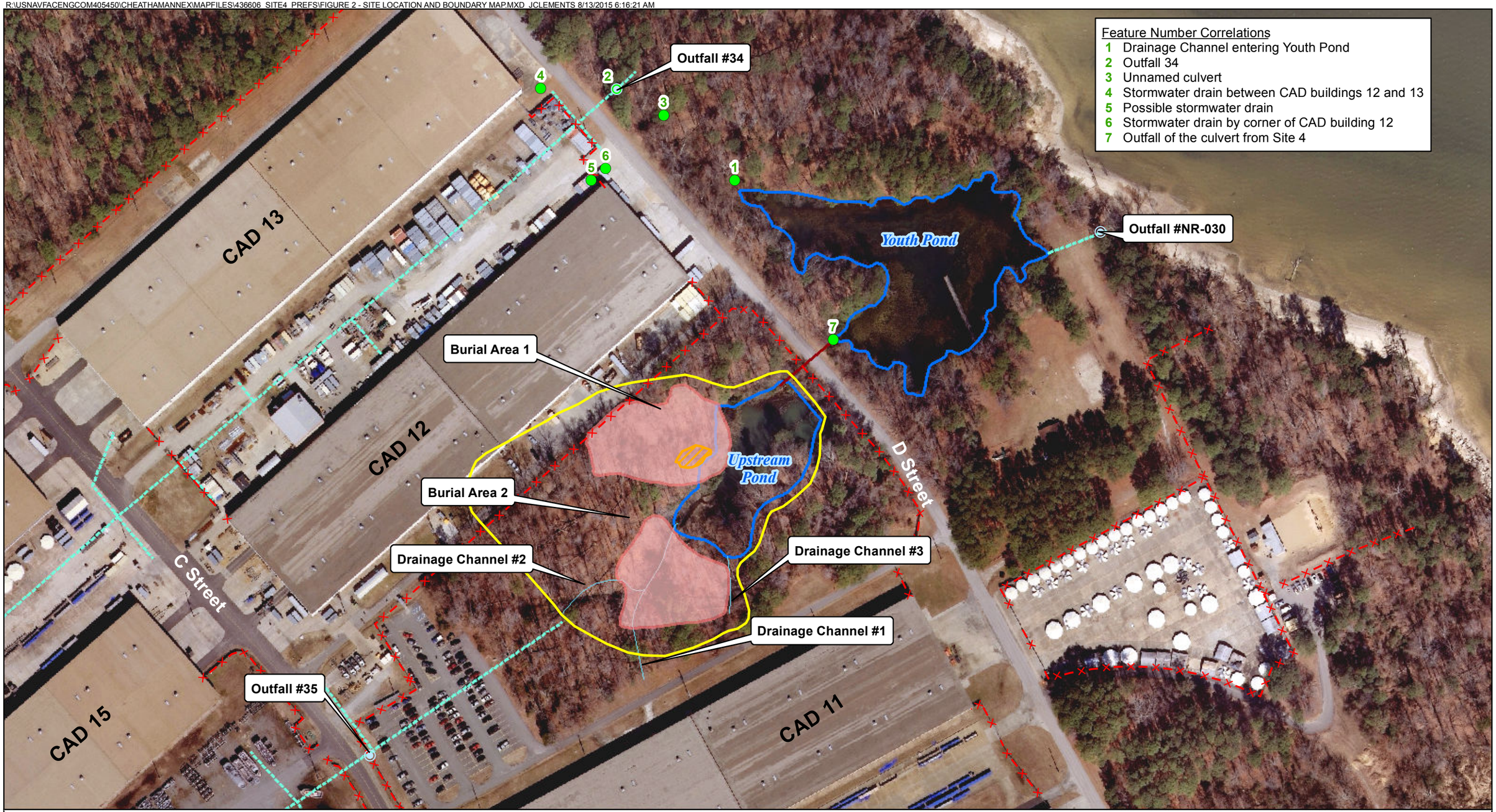
0 1,000 2,000 Feet

Figure 1
Base Location Map
Site 4 Pre-Feasibility Study Technical Memorandum
Cheatham Annex
Williamsburg, Virginia

CH2MHILL

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436606_SITE4_PREFS\FIGURE 2 - SITE LOCATION AND BOUNDARY MAP.MXD JCLEMENTS 8/13/2015 6:16:21 AM



Legend

- Outfall
- Surface Feature Location
- Culvert
- fence_line
- Drainage Channels
- Storm Water Line
- Extent of Buried Debris
- Surface Debris Pile
- Water Body
- Site 4 Boundary

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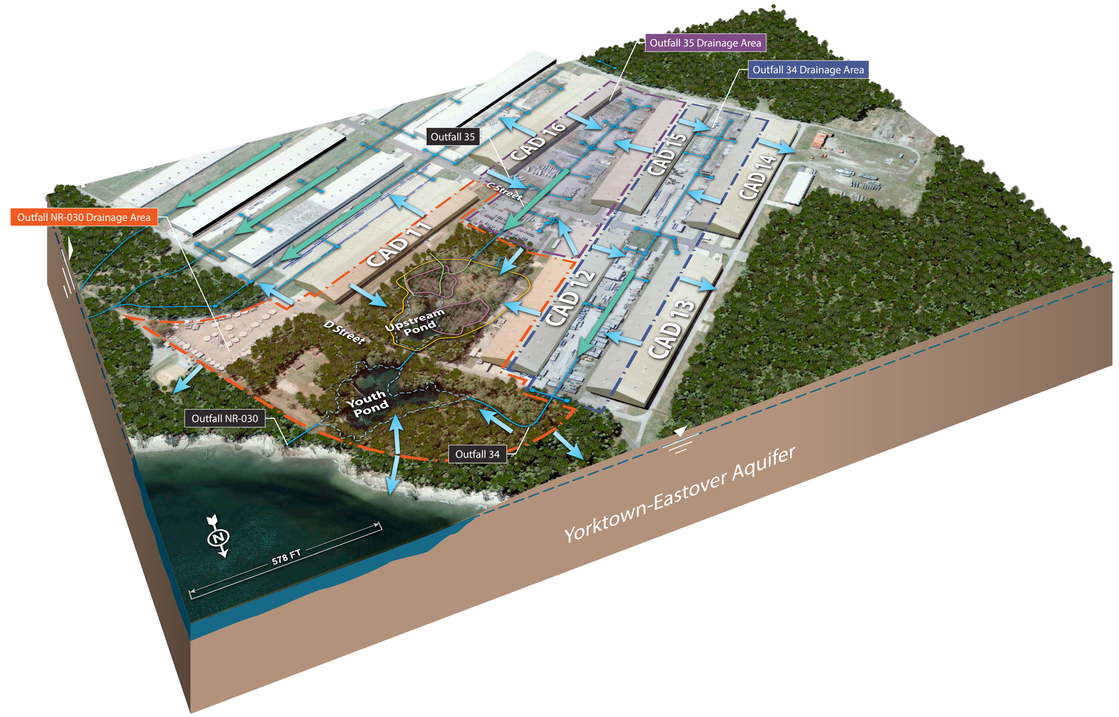
0 75 150 Feet

Figure 2
Site Location and Boundary Map
Site 4 Pre-Feasibility Study Technical Memorandum
Cheatham Annex
Williamsburg, Virginia

CH2MHILL



Surface Feature Number Correlations

1. Drainage Channel entering Youth Pond
2. Culvert
3. Outfall 34
4. Stormwater drain between CAD buildings 12 and 11
5. White PVC pipe exposed at surface
6. Stormwater drain by corner of CAD buildings 12

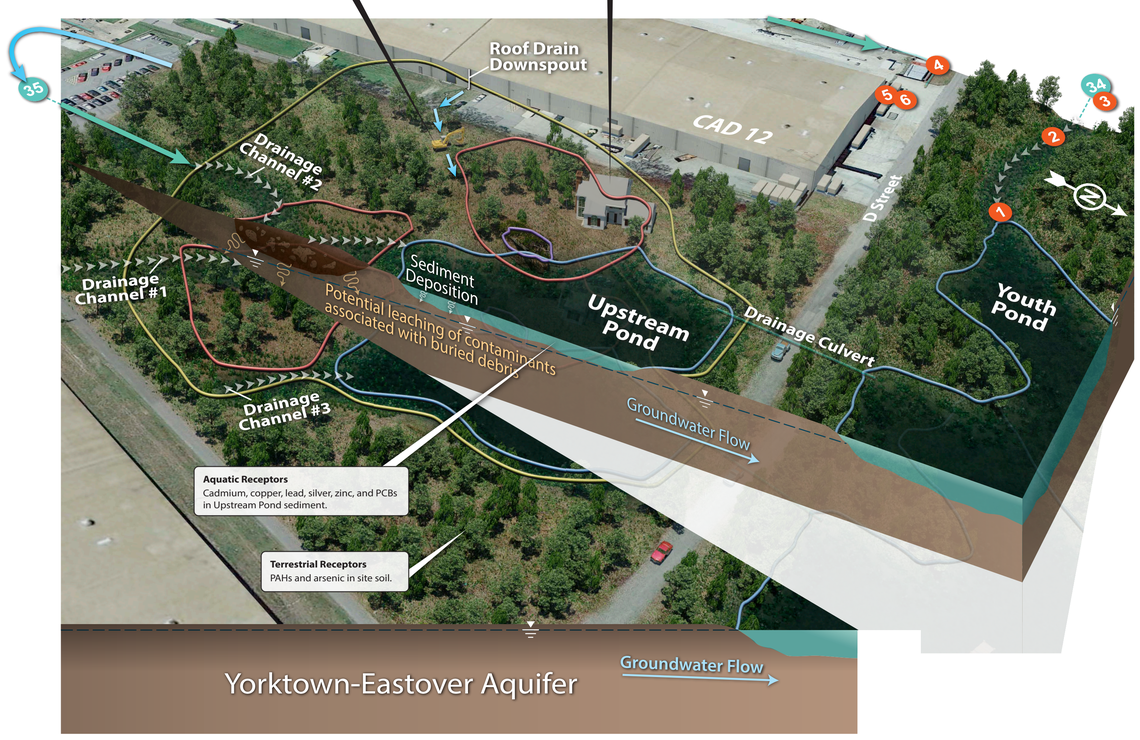
LEGEND

- Drainage Channels
- Drainage Boundaries
- Storm Drains
- Site 4 Boundary
- Burial Areas
- Debris Pile
- Water Body
- Water Table
- Outfall Number
- Surface Water Flow
- Stormwater Flow

Potential Future Adult/Child Resident
PAHs, arsenic, iron, and manganese in groundwater.

Potential Future Lifetime Resident
Buried debris, PAHs, and arsenic in soil. PAHs in the drainage channel directing surface run off from the roof of CAD Building 12 and the adjacent paved areas to Site 4.

Potential Future Construction Worker
1.1-biphenyl and naphthalene vapors in groundwater



Aquatic Receptors
Cadmium, copper, lead, silver, zinc, and PCBs in Upstream Pond sediment.

Terrestrial Receptors
PAHs and arsenic in site soil.

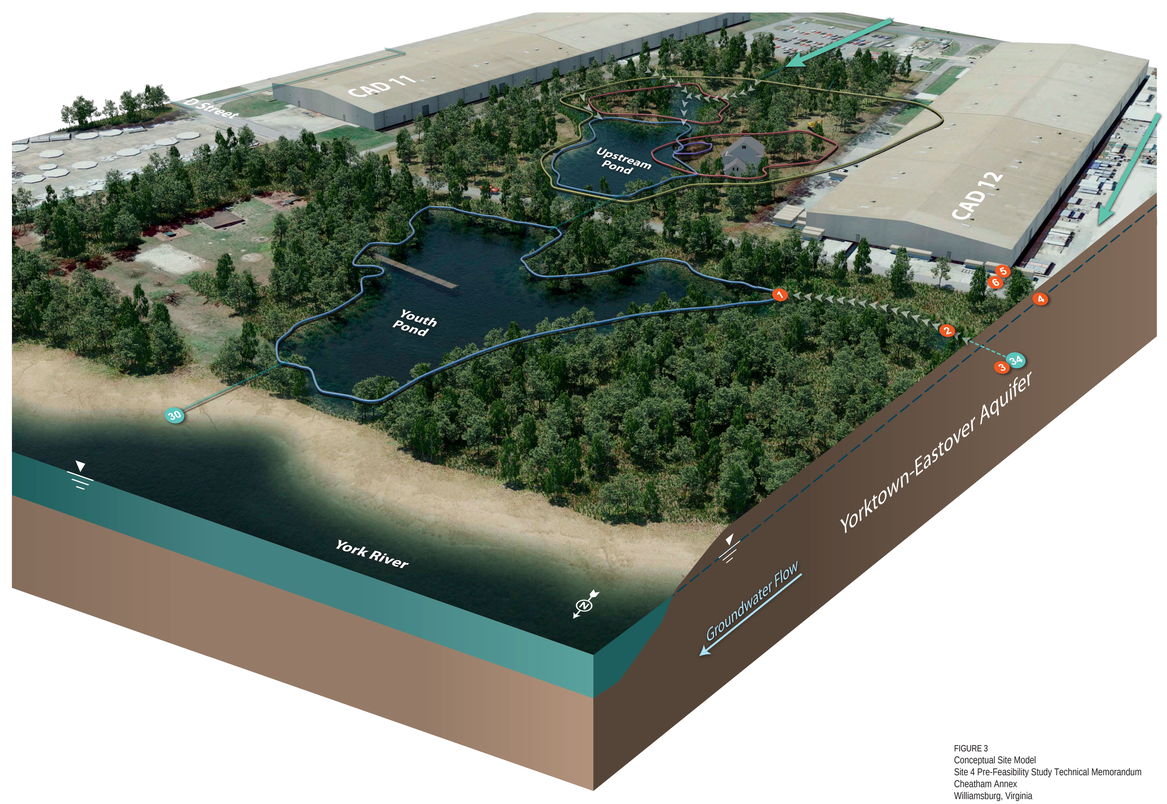
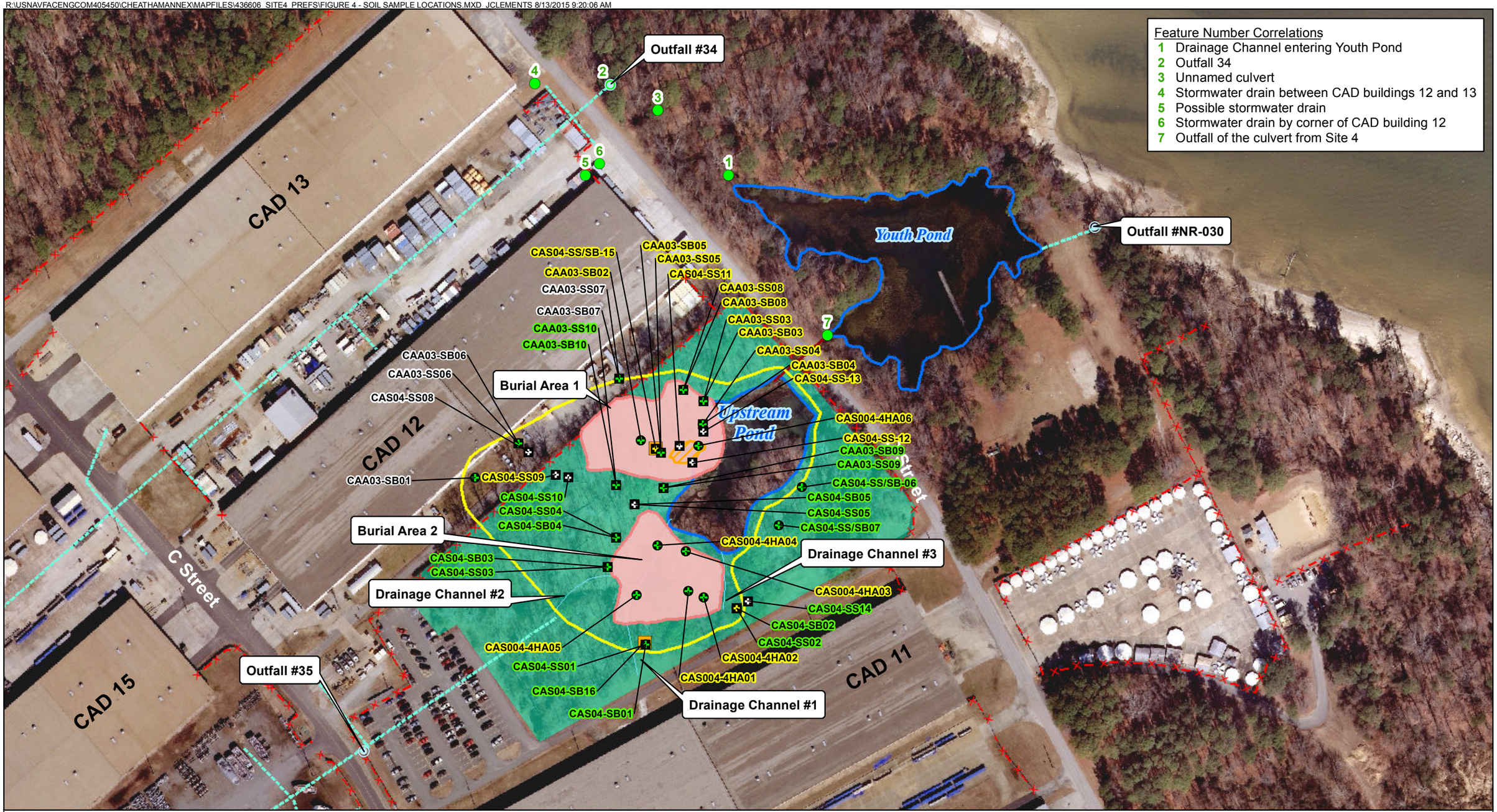


FIGURE 3
Conceptual Site Model
Site 4 Pre-Feasibility Study Technical Memorandum
Cheatham Annex
Williamsburg, Virginia

R:\USNAVFACENGCOM405450\CHEATHAMANNEX\MAPFILES\436606_SITE4_PREFS\FIGURE 4 - SOIL SAMPLE LOCATIONS.MXD JCLEMENTS 8/13/2015 9:20:06 AM



Legend

- Outfall
- Surface Soil Samples
- Surface/Subsurface Soil Samples
- Surface Soil Samples for Hexavalent/Total Chromium
- Subsurface Soil Samples for Total and Hexavalent Chromium Analysis
- Culvert
- Fence Line
- Drainage Channels
- Storm Water Line
- Surface Debris Pile
- Extent of Buried Debris
- Water Body
- Site 4 Boundary
- Soil Outside of Fenced Area

CAS04-SS09 Soil Sample Location Outside Fenced Area
CAS04-SB01 Soil Sample Location Outside Fenced Area and Debris

Note:
Soil sample locations used in the risk assessment for the soil outside of the fenced portion of the site includes all locations both within and outside of the debris.

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Figure 4
Site 4 RI Soil Sample Locations
Site 4 Pre-Feasibility Study Technical Memorandum
Cheatham Annex
Williamsburg, Virginia

CH2MHILL®

Attachment 1
Human Health Risk Assessment Tables – All Soil Outside Fenced Area

TABLE 1.1

Summary of Data Used in Revised Human Health Risk Assessment - Soil

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Medium/SampleID	Date of Sampling	Sample Locations	Parameters
Soil outside Fenced Area of Site 4			
CAA03-SB02-1109A	11/4/2009	CAA03-SB02	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SB03-1109A	11/4/2009	CAA03-SB03	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SB04-1109A	11/4/2009	CAA03-SB04	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SB05-1109A	11/4/2009	CAA03-SB05	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SB08-1109	11/5/2009	CAA03-SB08	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SB08P-11091	11/5/2009	CAA03-SB08	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SB09-1109	11/5/2009	CAA03-SB09	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SB10-1109	11/5/2009	CAA03-SB10	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS02-1109	11/4/2009	CAA03-SS02	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS03-1109	11/4/2009	CAA03-SS03	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS04-1109	11/4/2009	CAA03-SS04	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS05-1109	11/4/2009	CAA03-SS05	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS08-1109	11/5/2009	CAA03-SS08	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS08P-1109[1]	11/5/2009	CAA03-SS08	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS09-1109	11/5/2009	CAA03-SS09	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS10-1109	11/5/2009	CAA03-SS10	VOCs, SVOCs, Pest/PCBs, Metals
CAS004-4HA01-00-1199	11/12/1999	CAS004-4HA01	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4HA02-00-1199	11/12/1999	CAS004-4HA02	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4-HA02-02-1199	11/12/1999	CAS004-4HA02	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4HA02D-00-1199[1]	11/12/1999	CAS004-4HA02	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4HA03-00-1199	11/12/1999	CAS004-4HA03	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4-HA03-02-1199	11/12/1999	CAS004-4HA03	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4HA04-00-1199	11/12/1999	CAS004-4HA04	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4-HA04-01-1199	11/12/1999	CAS004-4HA04	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4HA05-00-1199	11/12/1999	CAS004-4HA05	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4-HA05-01-1199	11/12/1999	CAS004-4HA05	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4HA06-00-1199	11/12/1999	CAS004-4HA06	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS004-4-HA06-02-1199	11/12/1999	CAS004-4HA06	VOCs, SVOCs, Pest/PCBs, Explosives, Metals
CAS04-SB01-1109	11/3/2009	CAS04-SB01	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB02-1109	11/3/2009	CAS04-SB02	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB03-1109	11/3/2009	CAS04-SB03	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB04-1109	11/3/2009	CAS04-SB04	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB05-1109	11/3/2009	CAS04-SB05	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB06-1012	10/23/2012	CAS04-SO06	Select SVOCs, PCBs, Metals
CAS04-SB06P-1012[1]	10/23/2012	CAS04-SO06	Select SVOCs, PCBs, Metals
CAS04-SB07-1012	10/23/2012	CAS04-SO07	Select SVOCs, PCBs, Metals
CAS04-SB15-1012	10/23/2012	CAS04-SO15	Hexavalent Chromium, Total Chromium
CAS04-SB16-1012	10/23/2012	CAS04-SO16	Hexavalent Chromium, Total Chromium
CAS04-SS01-1109	11/3/2009	CAS04-SS01	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS02-1109	11/3/2009	CAS04-SS02	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS03-1109	11/3/2009	CAS04-SS03	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS04-1109	11/3/2009	CAS04-SS04	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS05-1109	11/3/2009	CAS04-SS05	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS06-1012	10/23/2012	CAS04-SO06	Select SVOCs, PCBs, Metals
CAS04-SS07-1012	10/23/2012	CAS04-SO07	Select SVOCs, PCBs, Metals
CAS04-SS09-1012	10/23/2012	CAS04-SO09	Select SVOCs, PCBs, Metals
CAS04-SS10-1012	10/23/2012	CAS04-SO10	Select SVOCs, PCBs, Metals
CAS04-SS11-1012	10/23/2012	CAS04-SO11	Select SVOCs, PCBs, Metals
CAS04-SS12-1012	10/23/2012	CAS04-SO12	Select SVOCs, PCBs, Metals
CAS04-SS12P-1012[1]	10/23/2012	CAS04-SO12	Select SVOCs, PCBs, Metals
CAS04-SS13-1012	10/23/2012	CAS04-SO13	Select SVOCs, PCBs, Metals
CAS04-SS14-1012	10/23/2012	CAS04-SO14	Hexavalent Chromium, Total Chromium
CAS04-SS14P-1012[1]	10/23/2012	CAS04-SO14	Hexavalent Chromium, Total Chromium
CAS04-SS15-1012	10/23/2012	CAS04-SO15	Hexavalent Chromium, Total Chromium

Notes:

[1] Duplicate of previous sample.

SVOCs - Semivolatile Organic Compounds

VOCs - Volatile Organic Compounds

Pest/PCBs - Pesticides/Polychlorinated Biphenyls

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Soil* Outside Fenced Area	78-93-3	2-Butanone	8.0E-03 J	2.4E-02 J	MG/KG	CAA03-SS09-1109	3/34	0.008 - 0.034	2.4E-02	N/A	2.7E+03 N	1.2E-01	SSL	NO	BSL
	67-64-1	Acetone	9.4E-02 J	6.4E-01 J	MG/KG	CAA03-SS09-1109	9/34	0.011 - 0.043	6.4E-01	N/A	6.1E+03 N	2.9E-01	SSL	NO	BSL
	67-66-3	Chloroform	6.0E-04 J	1.0E-03 J	MG/KG	CAA03-SB05-1109A, CAS04-SB04-1109	6/34	0.006 - 0.02	1.0E-03	N/A	3.2E-01 C	6.1E-05	SSL	NO	BSL
	100-41-4	Ethylbenzene	2.0E-03 J	2.0E-03 J	MG/KG	CAS004-4-HA02-02-1199	1/34	0.002 - 0.02	2.0E-03	N/A	5.8E+00 C	1.7E-03	SSL	NO	BSL
	75-09-2	Methylene chloride	9.0E-03 J	1.6E-02 J	MG/KG	CAA03-SB03-1109A	5/35	0.007 - 0.034	1.6E-02	N/A	3.5E+01 N	2.7E-03	SSL	NO	BSL
	100-42-5	Styrene	1.0E-03 J	1.0E-02 J	MG/KG	CAA03-SS10-1109	5/34	0.005 - 0.02	1.0E-02	N/A	6.0E+02 N	1.3E-01	SSL	NO	BSL
	127-18-4	Tetrachloroethene	3.0E-03 J	3.0E-03 J	MG/KG	CAS004-4-HA03-02-1199	1/34	0.003 - 0.024	3.0E-03	N/A	8.1E+00 N	1.8E-03	SSL	NO	BSL
	108-88-3	Toluene	2.0E-03 J	5.0E-03 J	MG/KG	CAA03-SB08P-1109	4/34	0.005 - 0.02	5.0E-03	N/A	4.9E+02 N	7.6E-02	SSL	NO	BSL
	1330-20-7	Xylene, total	2.0E-03 J	2.0E-03 J	MG/KG	CAS004-4HA02-00-1199	1/34	0.011 - 0.02	2.0E-03	N/A	5.8E+01 N	1.9E-02	SSL	NO	BSL
	91-57-6	2-Methylnaphthalene	3.6E-03 J	4.8E-02	MG/KG	CAS04-SS09-1012	6/44	0.018 - 17	4.8E-02	N/A	2.3E+01 N	1.9E-02	SSL	NO	BSL
	83-32-9	Acenaphthene	3.0E-03 J	3.3E-01 J	MG/KG	CAS004-4HA02-00-1199	11/44	0.018 - 17	3.3E-01	N/A	3.5E+02 N	5.5E-01	SSL	NO	BSL
	208-96-8	Acenaphthylene	3.8E-03 J	2.4E-01	MG/KG	CAA03-SS02-1109	10/44	0.018 - 17	2.4E-01	N/A	3.5E+02 N	N/A		NO	BSL
	120-12-7	Anthracene	1.7E-03 J	1.7E+00 J	MG/KG	CAS004-4HA06-00-1199	21/44	0.018 - 17	1.7E+00	N/A	1.7E+03 N	5.8E+00	SSL	NO	BSL
	100-52-7	Benzaldehyde	2.0E-01 J	2.0E-01 J	MG/KG	CAA03-SS08P-1109	1/24	0.032 - 0.046	2.0E-01	N/A	7.8E+02 N	4.3E-02	SSL	NO	BSL
	56-55-3	**Benzo(a)anthracene**	**2.7E-03 J**	**8.8E+00**	**MG/KG**	**CAS004-4HA06-00-1199**	**34/44**	**0.018 - 17**	**8.8E+00**	**N/A**	**1.5E-01 C**	**1.2E-02**	**SSL**	**YES**	**ASL**
	50-32-8	**Benzo(a)pyrene**	**4.4E-03 J**	**7.0E+00**	**MG/KG**	**CAS004-4HA06-00-1199**	**29/44**	**0.018 - 17**	**7.0E+00**	**N/A**	**1.5E-02 C**	**4.0E-03**	**SSL**	**YES**	**ASL**
	205-99-2	**Benzo(b)fluoranthene**	**8.9E-03 J**	**6.8E+00**	**MG/KG**	**CAS004-4HA06-00-1199**	**29/44**	**0.018 - 17**	**6.8E+00**	**N/A**	**1.5E-01 C**	**4.1E-02**	**SSL**	**YES**	**ASL**
	191-24-2	Benzo(g,h,i)perylene	2.4E-03 J	3.4E+00 J	MG/KG	CAS004-4HA06-00-1199	20/41	0.02 - 17	3.4E+00	N/A	1.7E+02 N	N/A		NO	BSL
	207-08-9	**Benzo(k)fluoranthene**	**3.7E-03 J**	**6.8E+00**	**MG/KG**	**CAS004-4HA06-00-1199**	**24/44**	**0.018 - 17**	**6.8E+00**	**N/A**	**1.5E+00 C**	**4.0E-01**	**SSL**	**YES**	**ASL**
	117-81-7	**bis(2-Ethylhexyl)phthalate**	**6.6E-02 J**	**6.3E+01 J**	**MG/KG**	**CAS004-4-HA03-02-1199**	**2/35**	**0.049 - 63**	**6.3E+01**	**N/A**	**3.8E+01 C**	**1.3E+00**	**SSL**	**YES**	**ASL**
	86-74-8	Carbazole	2.1E-03 J	2.5E-01 J	MG/KG	CAS004-4HA02-00-1199	14/35	0.018 - 17	2.5E-01	N/A	**2.4E+01 C**	N/A		NO	BSL
	218-01-9	Chrysene	2.2E-03 J	8.6E+00	MG/KG	CAS004-4HA06-00-1199	28/44	0.018 - 17	8.6E+00	N/A	1.5E+01 C	1.2E+00	SSL	NO	BSL
	53-70-3	**Dibenz(a,h)anthracene**	**3.6E-03 J**	**1.4E+00 J**	**MG/KG**	**CAS004-4HA06-00-1199**	**19/44**	**0.018 - 17**	**1.4E+00**	**N/A**	**1.5E-02 C**	**1.3E-02**	**SSL**	**YES**	**ASL**
	84-74-2	Di-n-butylphthalate	9.0E+01 J	9.0E+01 J	MG/KG	CAS004-4-HA04-01-1199	1/35	0.048 - 90	9.0E+01	N/A	6.2E+02 N	2.3E-01	SSL	NO	BSL
	206-44-0	Fluoranthene	2.7E-03 J	1.4E+01	MG/KG	CAS004-4HA06-00-1199	32/44	0.018 - 17	1.4E+01	N/A	2.3E+02 N	8.9E+00	SSL	NO	BSL
	86-73-7	Fluorene	4.7E-03 J	2.5E-01 J	MG/KG	CAS004-4HA02-00-1199	11/44	0.018 - 17	2.5E-01	N/A	2.3E+02 N	5.4E-01	SSL	NO	BSL
	118-74-1	Hexachlorobenzene	7.2E-03 J	7.2E-03 J	MG/KG	CAA03-SB08P-1109	1/35	0.018 - 17	7.2E-03	N/A	3.3E-01 C	6.1E-04	SSL	NO	BSL
	193-39-5	**Indeno(1,2,3-cd)pyrene**	**3.7E-03 J**	**3.4E+00 J**	**MG/KG**	**CAS004-4HA06-00-1199**	**26/44**	**0.018 - 17**	**3.4E+00**	**N/A**	**1.5E-01 C**	**2.4E-01**	**SSL**	**YES**	**ASL**
	91-20-3	Naphthalene	7.4E-03 J	1.3E-01	MG/KG	CAS04-SS09-1012	6/44	0.018 - 17	1.3E-01	N/A	3.8E+00 C	5.4E-04	SSL	NO	BSL
	85-01-8	Phenanthrene	3.2E-03 J	5.5E+00	MG/KG	CAS004-4HA06-00-1199	27/44	0.018 - 17	5.5E+00	N/A	1.7E+03 N	N/A		NO	BSL
	129-00-0	Pyrene	3.8E-03 J	1.1E+01	MG/KG	CAS004-4HA06-00-1199	32/44	0.018 - 17	1.1E+01	N/A	1.7E+02 N	1.3E+00	SSL	NO	BSL
	72-54-8	4,4'-DDD	1.1E-03 J	2.5E-02 J	MG/KG	CAA03-SS02-1109	11/35	0.0033 - 0.027	2.5E-02	N/A	2.2E+00 C	7.2E-03	SSL	NO	BSL
	72-55-9	4,4'-DDE	8.0E-04 J	8.3E-02	MG/KG	CAA03-SS02-1109	17/35	0.0033 - 0.027	8.3E-02	N/A	1.6E+00 C	5.4E-02	SSL	NO	BSL
	50-29-3	4,4'-DDT	1.6E-03 J	2.2E-01 K	MG/KG	CAS004-4HA05-00-1199	19/35	0.0033 - 0.027	2.2E-01	N/A	1.9E+00 C	7.7E-02	SSL	NO	BSL
	309-00-2	**Aldrin**	**1.1E-03 J**	**3.3E-02 K**	**MG/KG**	**CAS004-4HA05-00-1199**	**3/35**	**0.0017 - 0.027**	**3.3E-02**	**N/A**	**3.1E-02 C**	**7.5E-04**	**SSL**	**YES**	**ASL**

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	5103-71-9	alpha-Chlordane	5.4E-04 J	2.4E-03 J	MG/KG	CAS004-4-HA05-01-1199	3/35	0.0017 - 0.027	2.4E-03	N/A	1.8E+00 C	N/A		NO	BSL
	53469-21-9	**Aroclor-1242**	**1.0E+00 K**	**2.3E+00 L**	**MG/KG**	**CAS004-4-HA05-01-1199**	**2/44**	**0.018 - 2.3**	**2.3E+00**	**N/A**	**2.4E-01 C**	**6.1E-03**	**SSL**	**YES**	**ASL**
	11096-82-5	**Aroclor-1260**	**1.9E-02 J**	**2.7E+00 K**	**MG/KG**	**CAS004-4HA05-00-1199**	**13/44**	**0.018 - 1.6**	**2.7E+00**	**N/A**	**2.4E-01 C**	**2.7E-02**	**SSL**	**YES**	**ASL**
	60-57-1	Dieldrin	6.5E-04 J	3.2E-03 J	MG/KG	CAA03-SB04-1109A	7/35	0.0033 - 0.027	3.2E-03	N/A	3.3E-02 C	6.9E-05	SSL	NO	BSL
	959-98-8	Endosulfan I	9.1E-04 J	9.1E-04 J	MG/KG	CAA03-SS08P-1109	1/35	0.0017 - 0.014	9.1E-04	N/A	3.7E+01 N	1.4E-01	SSL	NO	BSL
	33213-65-9	Endosulfan II	4.4E-03 J	6.5E-03 K	MG/KG	CAS004-4-HA03-02-1199	3/35	0.0033 - 0.027	6.5E-03	N/A	3.7E+01 N	1.4E-01	SSL	NO	BSL
	1031-07-8	Endosulfan sulfate	8.9E-03 J	8.9E-03 J	MG/KG	CAA03-SS02-1109	1/35	0.0033 - 0.027	8.9E-03	N/A	3.7E+01 N	N/A		NO	BSL
	72-20-8	Endrin	3.5E-03 J	9.6E-02 J	MG/KG	CAA03-SB08-1109	11/35	0.0033 - 0.028	9.6E-02	N/A	1.8E+00 N	9.2E-03	SSL	NO	BSL
	7421-93-4	Endrin aldehyde	1.0E-03 J	7.7E-02 K	MG/KG	CAS004-4HA05-00-1199	8/35	0.0033 - 0.028	7.7E-02	N/A	1.8E+00 N	N/A		NO	BSL
	53494-70-5	Endrin ketone	8.8E-04 J	8.7E-02 K	MG/KG	CAS004-4HA05-00-1199	5/35	0.0033 - 0.028	8.7E-02	N/A	1.8E+00 N	N/A		NO	BSL
	58-89-9	gamma-BHC (Lindane)	5.7E-04 J	9.6E-03	MG/KG	CAA03-SS02-1109	4/35	0.0017 - 0.014	9.6E-03	N/A	5.6E-01 C	2.4E-04	SSL	NO	BSL
	5103-74-2	gamma-Chlordane	1.0E-03 J	1.5E-02 K	MG/KG	CAS004-4HA05-00-1199	3/35	0.0017 - 0.014	1.5E-02	N/A	1.8E+00 C	N/A		NO	BSL
	76-44-8	Heptachlor	9.9E-03 J	9.9E-03 J	MG/KG	CAS004-4-HA05-01-1199	1/35	0.0017 - 0.014	9.9E-03	N/A	1.2E-01 C	1.6E-04	SSL	NO	BSL
	72-43-5	Methoxychlor	2.5E-02 J	2.5E-02 J	MG/KG	CAS004-4-HA05-01-1199	1/35	0.017 - 0.14	2.5E-02	N/A	3.1E+01 N	2.0E-01	SSL	NO	BSL
	7429-90-5	**Aluminum**	**3.6E+03 L**	**3.2E+04**	**MG/KG**	**CAS04-SB07-1012**	**44/44**	**19 - 9660**	**3.2E+04**	**1.2E+04**	**7.7E+03 N**	**3.0E+03**	**SSL**	**YES**	**ASL**
	7440-36-0	Antimony	4.0E-02 J	6.7E-01 J	MG/KG	CAS004-4HA04-00-1199	29/44	0.065 - 18	6.7E-01	N/A	3.1E+00 N	3.5E-02	SSL	NO	BSL
	7440-38-2	**Arsenic**	**6.2E-01**	**3.5E+02 J**	**MG/KG**	**CAS04-SS13-1012**	**44/44**	**0.32- 4.2**	**3.5E+02**	**5.5E+00**	**6.7E-01 C**	**1.5E-03**	**SSL**	**YES**	**ASL**
	7440-39-3	Barium	1.1E+01	2.5E+02	MG/KG	CAS004-4-HA04-01-1199	44/44	0.31 - 247	2.5E+02	5.3E+01	1.5E+03 N	1.6E+01	SSL	NO	BSL
	7440-41-7	Beryllium	1.9E-01 J	8.9E-01	MG/KG	CAA03-SB09-1109	33/44	0.31 - 1.5	8.9E-01	5.9E-01	1.6E+01 N	1.9E+00	SSL	NO	BSL
	7440-43-9	Cadmium	3.0E-02 J	3.3E+00	MG/KG	CAS004-4HA05-00-1199	13/44	0.07 - 2.2	3.3E+00	N/A	7.0E+00 N	6.9E-02	SSL	NO	BSL
	7440-70-2	Calcium	1.1E+02	8.4E+03	MG/KG	CAS004-4HA03-00-1199	44/44	4.6 - 5970	8.4E+03	2.3E+03	N/A	N/A		NO	NUT
	18540-29-9	**Chromium (hexavalent)**	**4.3E-01 J**	**4.3E-01 J**	**MG/KG**	**CAS04-SB16-1012**	**1/4**	**0.42 - 0.49**	**4.3E-01**	**N/A**	**3.0E-01 C**	**6.7E-04**	**SSL**	**YES**	**ASL**
	7440-47-3	Chromium	5.8E+00	6.3E+01 J	MG/KG	CAS04-SS13-1012	48/48	0.8 - 29.2	6.3E+01	1.8E+01	1.2E+04 N	4.0E+06	SSL	NO	BSL
	7440-48-4	**Cobalt**	**7.2E-01**	**1.2E+01 J**	**MG/KG**	**CAS04-SS13-1012**	**43/44**	**0.065 - 15**	**1.2E+01**	**5.2E+00**	**2.3E+00 N**	**2.7E-02**	**SSL**	**YES**	**ASL**
	7440-50-8	Copper	1.4E+00 J	1.5E+02	MG/KG	CAS004-4HA05-00-1199	38/44	1.6 - 40.4	1.5E+02	3.2E+00	3.1E+02 N	2.8E+00	SSL	NO	BSL
	57-12-5	Cyanide	7.0E-02 L	4.4E-01 L	MG/KG	CAS004-4-HA04-01-1199	4/35	0.02 - 0.84	4.4E-01	N/A	2.1E+00 N	1.5E-03	SSL	NO	BSL
	7439-89-6	**Iron**	**3.4E+03**	**1.2E+05 J**	**MG/KG**	**CAS04-SS13-1012**	**44/44**	**6.4 - 28000**	**1.2E+05**	**2.0E+04**	**5.5E+03 N**	**3.5E+01**	**SSL**	**YES**	**ASL**
	7439-92-1	Lead	3.8E+00	1.3E+02	MG/KG	CAS004-4HA05-00-1199	41/44	0.32 - 45.3	1.3E+02	8.8E+00	4.0E+02 N	1.4E+01	SSL	NO	BSL
	7439-95-4	Magnesium	3.3E+02 J	2.7E+03	MG/KG	CAA03-SB09-1109	44/44	3.2 - 1730	2.7E+03	1.1E+03	N/A	N/A		NO	NUT
	7439-96-5	**Manganese**	**1.9E+01**	**5.1E+02 J**	**MG/KG**	**CAS04-SS13-1012**	**44/44**	**0.32 - 120**	**5.1E+02**	**1.8E+02**	**1.8E+02 N**	**2.8E+00**	**SSL**	**YES**	**ASL**
	7439-97-6	Mercury	1.0E-02 J	9.1E-01	MG/KG	CAS004-4-HA03-02-1199	43/44	0.027 - 0.91	9.1E-01	1.1E-01	2.3E+00 N	N/A		NO	BSL
	7440-02-0	Nickel	1.8E+00 J	4.7E+01 J	MG/KG	CAS04-SS13-1012	39/44	0.64 - 20.4	4.7E+01	9.5E+00	1.5E+02 N	2.6E+00	SSL	NO	BSL
	7440-09-7	Potassium	2.4E+02	3.7E+03	MG/KG	CAA03-SB09-1109	42/44	62 - 1700	3.7E+03	7.1E+02	N/A	N/A		NO	NUT
	7782-49-2	Selenium	1.8E-01 J	1.0E+00 J	MG/KG	CAS004-4HA04-00-1199	30/44	0.32 - 4	1.0E+00	5.1E-01	3.9E+01 N	5.2E-02	SSL	NO	BSL
	7440-22-4	Silver	9.0E-02 J	2.1E+01 L	MG/KG	CAS004-4HA06-00-1199	12/44	0.64 - 8.5	2.1E+01	N/A	3.9E+01 N	8.0E-02	SSL	NO	BSL
	7440-23-5	Sodium	1.3E+01 J	5.5E+01 K	MG/KG	CAS04-SB01-1109	24/44	11.6 - 1502	5.5E+01	5.2E+02	N/A	N/A		NO	NUT

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-28-0	**Thallium**	**3.3E-01**	**1.1E+00 L**	**MG/KG**	**CAS004-4HA06-00-1199**	**3/44**	**0.13 - 6**	**1.1E+00**	**N/A**	**7.8E-02 N**	**1.4E-03**	**SSL**	**YES**	**ASL**
	7440-62-2	**Vanadium**	**6.5E+00**	**6.4E+01**	**MG/KG**	**CAS04-SB07-1012**	**43/44**	**0.32 - 20.8**	**6.4E+01**	**2.8E+01**	**3.9E+01 N**	**8.6E+00**	**SSL**	**YES**	**ASL**
	7440-66-6	Zinc	7.8E+00 K	3.7E+02	MG/KG	CAS004-4-HA04-01-1199	41/44	12. - 373	3.7E+02	2.7E+01	2.3E+03 N	3.7E+01	SSL	NO	BSL

* Surface soil and subsurface soil combined

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are the lower of surface and subsurface 95% UTL from Cheatham Annex/Yorktown background samples, June 2012.

[4] Oak Ridge National Laboratory (ORNL). January 2015. Regional Screening Levels for Chemical Contaminants at Superfund Sites. [Online]. Residential Soil. Available: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

RSLs based on noncarcinogenic health effects are based on HQ=0.1. RSLs based on carcinogenic effects based on cancer risk of 1x10-6.

Screening value for carbazole calculated using RSL calculator, and oral cancer slope factor of 2.0E-02 (mg/kg-day)-1 from USEPA's Health Affects Assessment Summary Tables, July 1997.

RSL value for acenaphthene used as surrogate for acenaphthylene.

RSL value for pyrene used as surrogate for benzo(g,h,i)perylene.

RSL value for anthracene used as surrogate for phenanthrene.

RSL value for chlordane used as surrogate for alpha- and gamma-chlordane.

RSL value for endosulfan used as surrogate for endosulfan I, endosulfan II, and endosulfan sulfate.

RSL value for endrin used as surrogate for endrin aldehyde and endrin ketone.

RSL value for chromium (III) insoluble salts used for chromium since soil also analyzed for hexavalent chromium.

RSL value for mercuric chloride (and other mercury salts) used as surrogate for mercury.

The soil value of 400 mg/kg for lead is from the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

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

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
K = Biased High
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic
MG/KG = milligrams per kilogram
SSL = Risk Based Soil Screening Levels from RSL table
N/A = not available/not applicable

Table 3.1

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Soil* Outside Fenced Area	Benzo(a)anthracene	MG/KG	4.4E-01	2.6E+00	NP	8.8E+00		2.6E+00	MG/KG	99% KM-c	4
	Benzo(a)pyrene	MG/KG	4.0E-01	2.2E+00	NP	7.0E+00		2.2E+00	MG/KG	99% KM-c	4
	Benzo(b)fluoranthene	MG/KG	4.6E-01	1.5E+00	NP	6.8E+00		1.5E+00	MG/KG	97.5% KM-c	4
	Benzo(k)fluoranthene	MG/KG	3.2E-01	6.9E-01	G	6.8E+00		6.9E-01	MG/KG	95% G-Adj	1, 3
	bis(2-Ethylhexyl)phthalate	MG/KG	3.2E+00	N/A		6.3E+01	J	6.3E+01	MG/KG	Max	5
	Dibenz(a,h)anthracene	MG/KG	7.1E-02	1.4E-01	NP	1.4E+00	J	1.4E-01	MG/KG	95% KM-t	1, 3
	Indeno(1,2,3-cd)pyrene	MG/KG	2.4E-01	8.2E-01	NP	3.4E+00	J	8.2E-01	MG/KG	97.5% KM-c	1
	Aldrin	MG/KG	3.6E-03	N/A		3.3E-02	K	3.3E-02	MG/KG	Max	5
	Aroclor-1242	MG/KG	9.7E+01	N/A		2.3E+00	L	2.3E+00	MG/KG	Max	5
	Aroclor-1260	MG/KG	1.4E-01	4.5E-01	NP	2.7E+00	K	4.5E-01	MG/KG	95% KM-c	4
	Aluminum	MG/KG	1.2E+04	1.7E+04	NP	3.2E+04		1.7E+04	MG/KG	95% Cheb-m	1
	Arsenic	MG/KG	1.2E+01	4.6E+01	NP	3.5E+02	J	4.6E+01	MG/KG	95% Cheb-m	4
	Chromium (hexavalent)	MG/KG	2.8E-01	N/A		4.3E-01	J	4.3E-01	MG/KG	Max	6
	Cobalt	MG/KG	3.1E+00	3.6E+00	NP	1.2E+01	J	3.6E+00	MG/KG	95% G-KM	1, 3
	Iron	MG/KG	1.8E+04	2.2E+04	NP	1.2E+05	J	2.2E+04	MG/KG	95% G-Adj	1, 3
	Manganese	MG/KG	9.2E+01	1.5E+02	NP	5.1E+02	J	1.5E+02	MG/KG	95% Cheb-m	4
	Thallium	MG/KG	3.9E-01	N/A		1.1E+00	L	1.1E+00	MG/KG	Max	5
	Vanadium	MG/KG	2.6E+01	3.7E+01	NP	6.4E+01		3.7E+01	MG/KG	95% KM-c	1

Table 3.1

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale

* Surface soil and subsurface soil combined.

ProUCL, Version 5.0.00 used to determine distribution of data and calculate 95% UCL, following recommendations in user's guide (USEPA. September 2013. Prepared by Lockheed Martin Environmental Services).

Options: 99% Kaplan-Meier (Chebyshev) UCL (99% KM-c); 97.5% Kaplan-Meier (Chebyshev) UCL (97.5% KM-c); 95% Kaplan-Meier (Chebyshev) UCL (95% KM-c); 95% Kaplan-Meier (t) UCL (95% KM-t); 95% Gamma Adjusted UCL (95% G Adj); 95% Chebyshev(Mean, Sd) UCL 95% Cheb-m; 95% Gamma Adjusted Kaplan-Meier UCL (95% G-KM); Maximum detected concentration (Max).

UCL Rationale:

(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
(3) Statistical tests indicate data are gamma distributed.
(4) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(5) Only two or three detected concentrations. ProUCL indicates this is not enough to compute meaningful or reliable statistics and estimates. Therefore, maximum detected concentration used as EPC.
(6) Maximum detected concentration used because less than 8 samples.

Table 3.1

MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale

G - Gamma
J - Estimated Value
K - Biased High
L - Biased Low
MG/KG = milligrams per kilogram
NP - Non-Parametric

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Soil* Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Soil* Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Soil* Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S-A	Ingestion Rate of Soil, Adult	100	mg/day	EPA, 1991	CS x IR-S-Adj x EF x CF1 x 1/AT
				IR-S-C	Ingestion Rate of Soil, Child	200	mg/day	EPA, 1991	
				IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	114.29	mg-year/kg-day	Calculated	IR-S-Adj (mg-year/kg-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Soil* Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Resident	Child	Soil* Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	CDI (mg/kg-day) =
				SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
	Resident	Child/Adult	Soil* Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	CDI (mg/kg-day) =
				SA-A	Skin Surface Area Available for Contact, Adult	5,700	cm^2	EPA, 2004	CS x DA-Adj x DABS x CF1 x EF x 1/AT
				SA-C	Skin Surface Area Available for Contact, Child	2,800	cm^2	EPA, 2004	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.07	mg/cm^2-day	EPA, 2004	DA-Adj (mg-year/kg-day) =
				SSAF-C	Soil to Skin Adherence Factor, Child	0.2	mg/cm^2-day	EPA, 2004	
				DA-Adj	Dermal Absorption, Age-adjusted	361	mg-year/kg-day	Calculated	(ED-C x SA-C x SSAF-C / BW-C) + (ED-A x SA-A x SSAF-A / BW-A)
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

Notes:

* Surface soil and subsurface soil combined

Sources:

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

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

EPA, 2004 . Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July 2004.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (MM/DD/YY)
Benzo(a)anthracene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Benzo(a)pyrene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Benzo(b)fluoranthene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Benzo(k)fluoranthene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Bis(2-Ethylhexyl)phthalate	Chronic	2.0E-02	mg/kg-day	>50%	2.0E-02	mg/kg-day	Liver	1000	IRIS	10/10/2014
	Subchronic	1.0E-01	mg/kg-day	>50%	1.0E-01	mg/kg-day	Reproductive System	100	ATSDR	9/2002
Dibenz(a,h)anthracene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Indeno(1,2,3-cd)pyrene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Aldrin	Chronic	3.0E-05	mg/kg-day	>50%	3.0E-05	mg/kg-day	Liver	1000	IRIS	10/10/2014
	Subchronic	4.0E-05	mg/kg-day	>50%	4.0E-05	mg/kg-day	Kidney	1000	PPRTV	3/14/2005
Aroclor 1242	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Aroclor 1260	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Aluminum	Chronic	1.0E+00	mg/kg-day	N/A	1.0E+00	mg/kg-day	Neurological	100	PPRTV	10/23/2006
	Subchronic	1.0E+00	mg/kg-day	N/A	1.0E+00	mg/kg-day	Neurological	30	ATSDR	9/2008
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3	IRIS	10/10/2014
	Subchronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3	HEAST	7/1997
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	NOE	300/1	IRIS	10/10/2014
	Subchronic	5.0E-03	mg/kg-day	2.5%	1.3E-04	mg/kg-day	Blood	100	ATSDR	9/2012
Cobalt	Chronic	3.0E-04	mg/kg-day	N/A	3.0E-04	mg/kg/day	Thyroid	3000	PPRTV	8/25/2008
	Subchronic	3.0E-03	mg/kg-day	N/A	3.0E-03	mg/kg/day	Thyroid	300	PPRTV	8/25/2008

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (MM/DD/YY)
Iron	Chronic	7.0E-01	mg/kg/day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1.5	PPRTV	9/11/2006
	Subchronic	7.0E-01	mg/kg/day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1.5	PPRTV	9/11/2006
Manganese (non-diet)	Chronic	2.4E-02	mg/kg-day	4%	9.6E-04	mg/kg-day	CNS	1	IRIS	10/10/2014
	Subchronic	N/A			N/A					
Manganese (diet)	Chronic	1.4E-01	mg/kg-day	4%	5.6E-03	mg/kg-day	CNS	1	IRIS	10/10/2014
	Subchronic	1.4E-01	mg/kg-day	4%	5.6E-03	mg/kg-day	CNS	1	HEAST	7/1997
Thallium	Chronic	1.0E-05	mg/kg-day	100%	1.0E-05	mg/kg-day	Hair	3000	PPRTV	10/08/10
	Subchronic	4.0E-05	mg/kg-day	100%	4.0E-05	mg/kg-day	Hair	1000	PPRTV	10/08/10
Vanadium	Chronic	5.0E-03	mg/kg-day	2.6%	1.3E-04	mg/kg-day	Kidney	300	RSL/IRIS	10/10/2014
	Subchronic	7.0E-03	mg/kg-day	2.6%	1.8E-04	mg/kg-day	Whole Body	100	HEAST	7/1997

Notes:

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

(2) Adjusted based on RAGS Part E. (dermal RfD = Oral RfD x oral absorption efficiency)

Definitions:
ATSDR = Agency for Toxic Substances and Disease Registry
CNS = Central Nervous System
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
N/A = Not Available
NOE = No Observed Effects
PPRTV = Provisional Peer-Reviewed Toxicity Value
RSL = USEPA Regional Screening Level Table

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	EPA Carcinogen Group	Source	Date (MM/DD/YY)
Benzo(a)anthracene (3)	7.3E-01	58 - 89%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Benzo(a)pyrene (3)	7.3E+00	58 - 89%	7.3E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	6/19/2013
Benzo(b)fluoranthene (3)	7.3E-01	58 - 89%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Benzo(k)fluoranthene (3)	7.3E-02	58 - 89%	7.3E-02	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Bis(2-Ethylhexyl)phthalate	1.4E-02	Generally > 50%	1.4E-02	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	10/10/2014
Dibenz(a,h)anthracene (3)	7.3E+00	58 - 89%	7.3E+00	$(mg/kg\text{-}day)^{-1}$	2B	NCEA	7/1/1993
Indeno(1,2,3-cd)pyrene (3)	7.3E-01	58 - 89%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Aldrin	1.7E+01	>50%	1.7E+01	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	10/10/2014
Aroclor 1242	2.0E+00	100%	2.0E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	10/10/2014
Aroclor 1260	2.0E+00	100%	2.0E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	10/10/2014
Aluminum	N/A		N/A				
Arsenic	1.5E+00	95%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	10/10/2014
Chromium (hexavalent) (3)	5.0E-01	2.5%	2.0E+01	$(mg/kg\text{-}day)^{-1}$	D	NJ DEP	4/8/2009
Cobalt	N/A		N/A				
Iron	N/A		N/A				
Manganese	N/A		N/A				
Thallium	N/A		N/A				
Vanadium	N/A		N/A				

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	EPA Carcinogen Group	Source	Date (MM/DD/YY)

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

(2) Adjusted based on RAGS Part E. (dermal CSF = Oral CSF / oral absorption efficiency)

(3) This chemical operates with a mutagenic mode of action.

Chemical-specific data are not available; therefore, default age-dependent adjustment factors (ADAF) will be applied to the slope factor as follows:

AGE	AGE ADAF	EXPOSURE DURATION
0-<2	10	2
2-<6	3	4
6-<16	3	10
16-<30	1	14

Definitions:
IRIS = Integrated Risk Information System
N/A = Not Available
NCEA = National Center for Environmental Assessment
NJ DEP = New Jersey Department of Environmental Protection

Weight of Evidence definitions:
Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer.
Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans.
Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans.
Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data.
Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.
Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both.

2B: The agent is possibly carcinogenic to humans

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Soil* Outside Fenced Area	Ingestion	Benzo(a)anthracene	2.6E+00	mg/kg	N/A		N/A		N/A	3.5E-06	mg/kg/day	N/A		N/A
				Benzo(a)pyrene	2.2E+00	mg/kg	N/A		N/A		N/A	3.0E-06	mg/kg/day	N/A		N/A
				Benzo(b)fluoranthene	1.5E+00	mg/kg	N/A		N/A		N/A	2.1E-06	mg/kg/day	N/A		N/A
				Benzo(k)fluoranthene	6.9E-01	mg/kg	N/A		N/A		N/A	9.4E-07	mg/kg/day	N/A		N/A
				bis(2-Ethylhexyl)phthalate	6.3E+01	mg/kg	N/A		N/A		N/A	8.6E-05	mg/kg/day	2.0E-02	mg/kg/day	4.3E-03
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	N/A		N/A		N/A	1.9E-07	mg/kg/day	N/A		N/A
				Indeno(1,2,3-cd)pyrene	8.2E-01	mg/kg	N/A		N/A		N/A	1.1E-06	mg/kg/day	N/A		N/A
				Aldrin	3.3E-02	mg/kg	N/A		N/A		N/A	4.5E-08	mg/kg/day	3.0E-05	mg/kg/day	1.5E-03
				Aroclor-1242	2.3E+00	mg/kg	N/A		N/A		N/A	3.2E-06	mg/kg/day	N/A		N/A
				Aroclor-1260	4.5E-01	mg/kg	N/A		N/A		N/A	6.2E-07	mg/kg/day	N/A		N/A
				Aluminum	1.7E+04	mg/kg	N/A		N/A		N/A	2.3E-02	mg/kg/day	1.0E+00	mg/kg/day	2.3E-02
				Arsenic	4.6E+01	mg/kg	N/A		N/A		N/A	6.2E-05	mg/kg/day	3.0E-04	mg/kg/day	2.1E-01
				Chromium (hexavalent)	4.3E-01	mg/kg	N/A		N/A		N/A	5.9E-07	mg/kg/day	3.0E-03	mg/kg/day	2.0E-04
				Cobalt	3.6E+00	mg/kg	N/A		N/A		N/A	4.9E-06	mg/kg/day	3.0E-04	mg/kg/day	1.6E-02
				Iron	2.2E+04	mg/kg	N/A		N/A		N/A	3.1E-02	mg/kg/day	7.0E-01	mg/kg/day	4.4E-02
				Manganese	1.5E+02	mg/kg	N/A		N/A		N/A	2.1E-04	mg/kg/day	2.4E-02	mg/kg/day	8.7E-03
				Thallium	1.1E+00	mg/kg	N/A		N/A		N/A	1.5E-06	mg/kg/day	1.0E-05	mg/kg/day	1.5E-01
				Vanadium	3.7E+01	mg/kg	N/A		N/A		N/A	5.1E-05	mg/kg/day	5.0E-03	mg/kg/day	1.0E-02
			Exp. Route Total								N/A					4.7E-01

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal Absorption[1]	Benzo(a)anthracene	2.6E+00	mg/kg	N/A		N/A		N/A	1.9E-06	mg/kg/day	N/A		N/A
				Benzo(a)pyrene	2.2E+00	mg/kg	N/A		N/A		N/A	1.6E-06	mg/kg/day	N/A		N/A
				Benzo(b)fluoranthene	1.5E+00	mg/kg	N/A		N/A		N/A	1.1E-06	mg/kg/day	N/A		N/A
				Benzo(k)fluoranthene	6.9E-01	mg/kg	N/A		N/A		N/A	5.1E-07	mg/kg/day	N/A		N/A
				bis(2-Ethylhexyl)phthalate	6.3E+01	mg/kg	N/A		N/A		N/A	3.6E-05	mg/kg/day	2.0E-02	mg/kg/day	1.8E-03
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	N/A		N/A		N/A	1.0E-07	mg/kg/day	N/A		N/A
				Indeno(1,2,3-cd)pyrene	8.2E-01	mg/kg	N/A		N/A		N/A	6.1E-07	mg/kg/day	N/A		N/A
				Aldrin	3.3E-02	mg/kg	N/A		N/A		N/A	1.9E-08	mg/kg/day	3.0E-05	mg/kg/day	6.3E-04
				Aroclor-1242	2.3E+00	mg/kg	N/A		N/A		N/A	1.8E-06	mg/kg/day	N/A		N/A
				Aroclor-1260	4.5E-01	mg/kg	N/A		N/A		N/A	3.6E-07	mg/kg/day	N/A		N/A
				Aluminum	1.7E+04	mg/kg	N/A		N/A		N/A	9.6E-04	mg/kg/day	1.0E+00	mg/kg/day	9.6E-04
				Arsenic	4.6E+01	mg/kg	N/A		N/A		N/A	7.8E-06	mg/kg/day	3.0E-04	mg/kg/day	2.6E-02
				Chromium (hexavalent)	4.3E-01	mg/kg	N/A		N/A		N/A	2.4E-08	mg/kg/day	7.5E-05	mg/kg/day	3.3E-04
				Cobalt	3.6E+00	mg/kg	N/A		N/A		N/A	2.0E-07	mg/kg/day	3.0E-04	mg/kg/day	6.8E-04
				Iron	2.2E+04	mg/kg	N/A		N/A		N/A	1.3E-03	mg/kg/day	7.0E-01	mg/kg/day	1.8E-03
				Manganese	1.5E+02	mg/kg	N/A		N/A		N/A	8.7E-06	mg/kg/day	9.6E-04	mg/kg/day	9.1E-03
				Thallium	1.1E+00	mg/kg	N/A		N/A		N/A	6.3E-08	mg/kg/day	1.0E-05	mg/kg/day	6.3E-03
				Vanadium	3.7E+01	mg/kg	N/A		N/A		N/A	2.1E-06	mg/kg/day	1.3E-04	mg/kg/day	1.6E-02
			Exp. Route Total								N/A					6.4E-02
		Exposure Point Total									N/A					5.3E-01
	Exposure Medium Total										N/A					5.3E-01
Soil* Outside Fenced Area											N/A					5.3E-01
										Total of Receptor Risk	N/A				Total of Receptor Hazard	5.3E-01

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABs of 0.1 used for SVOCs and pesticides, DABS of 0.13 used for PAHs, DABS of 0.14 used for aroclors, DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

* Surface soil and subsurface soil combined.

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Soil* Outside Fenced Area	Ingestion	Benzo(a)anthracene	2.6E+00	mg/kg	N/A		N/A		N/A	3.3E-05	mg/kg/day	N/A		N/A
				Benzo(a)pyrene	2.2E+00	mg/kg	N/A		N/A		N/A	2.8E-05	mg/kg/day	N/A		N/A
				Benzo(b)fluoranthene	1.5E+00	mg/kg	N/A		N/A		N/A	2.0E-05	mg/kg/day	N/A		N/A
				Benzo(k)fluoranthene	6.9E-01	mg/kg	N/A		N/A		N/A	8.8E-06	mg/kg/day	N/A		N/A
				bis(2-Ethylhexyl)phthalate	6.3E+01	mg/kg	N/A		N/A		N/A	8.1E-04	mg/kg/day	2.0E-02	mg/kg/day	4.0E-02
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	N/A		N/A		N/A	1.7E-06	mg/kg/day	N/A		N/A
				Indeno(1,2,3-cd)pyrene	8.2E-01	mg/kg	N/A		N/A		N/A	1.0E-05	mg/kg/day	N/A		N/A
				Aldrin	3.3E-02	mg/kg	N/A		N/A		N/A	4.2E-07	mg/kg/day	3.0E-05	mg/kg/day	1.4E-02
				Aroclor-1242	2.3E+00	mg/kg	N/A		N/A		N/A	2.9E-05	mg/kg/day	N/A		N/A
				Aroclor-1260	4.5E-01	mg/kg	N/A		N/A		N/A	5.8E-06	mg/kg/day	N/A		N/A
				Aluminum	1.7E+04	mg/kg	N/A		N/A		N/A	2.2E-01	mg/kg/day	1.0E+00	mg/kg/day	2.2E-01
				Arsenic	4.6E+01	mg/kg	N/A		N/A		N/A	5.8E-04	mg/kg/day	3.0E-04	mg/kg/day	1.9E+00
				Chromium (hexavalent)	4.3E-01	mg/kg	N/A		N/A		N/A	5.5E-06	mg/kg/day	3.0E-03	mg/kg/day	1.8E-03
				Cobalt	3.6E+00	mg/kg	N/A		N/A		N/A	4.6E-05	mg/kg/day	3.0E-04	mg/kg/day	1.5E-01
				Iron	2.2E+04	mg/kg	N/A		N/A		N/A	2.9E-01	mg/kg/day	7.0E-01	mg/kg/day	4.1E-01
				Manganese	1.5E+02	mg/kg	N/A		N/A		N/A	2.0E-03	mg/kg/day	2.4E-02	mg/kg/day	8.1E-02
				Thallium	1.1E+00	mg/kg	N/A		N/A		N/A	1.4E-05	mg/kg/day	1.0E-05	mg/kg/day	1.4E+00
				Vanadium	3.7E+01	mg/kg	N/A		N/A		N/A	4.8E-04	mg/kg/day	5.0E-03	mg/kg/day	9.5E-02
			Exp. Route Total								N/A					4.4E+00

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal Absorption[1]	Benzo(a)anthracene	2.6E+00	mg/kg	N/A		N/A		N/A	1.2E-05	mg/kg/day	N/A		N/A
				Benzo(a)pyrene	2.2E+00	mg/kg	N/A		N/A		N/A	1.0E-05	mg/kg/day	N/A		N/A
				Benzo(b)fluoranthene	1.5E+00	mg/kg	N/A		N/A		N/A	7.2E-06	mg/kg/day	N/A		N/A
				Benzo(k)fluoranthene	6.9E-01	mg/kg	N/A		N/A		N/A	3.2E-06	mg/kg/day	N/A		N/A
				bis(2-Ethylhexyl)phthalate	6.3E+01	mg/kg	N/A		N/A		N/A	2.3E-04	mg/kg/day	2.0E-02	mg/kg/day	1.1E-02
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	N/A		N/A		N/A	6.3E-07	mg/kg/day	N/A		N/A
				Indeno(1,2,3-cd)pyrene	8.2E-01	mg/kg	N/A		N/A		N/A	3.8E-06	mg/kg/day	N/A		N/A
				Aldrin	3.3E-02	mg/kg	N/A		N/A		N/A	1.2E-07	mg/kg/day	3.0E-05	mg/kg/day	3.9E-03
				Aroclor-1242	2.3E+00	mg/kg	N/A		N/A		N/A	1.2E-05	mg/kg/day	N/A		N/A
				Aroclor-1260	4.5E-01	mg/kg	N/A		N/A		N/A	2.3E-06	mg/kg/day	N/A		N/A
				Aluminum	1.7E+04	mg/kg	N/A		N/A		N/A	6.0E-03	mg/kg/day	1.0E+00	mg/kg/day	6.0E-03
				Arsenic	4.6E+01	mg/kg	N/A		N/A		N/A	4.9E-05	mg/kg/day	3.0E-04	mg/kg/day	1.6E-01
				Chromium (hexavalent)	4.3E-01	mg/kg	N/A		N/A		N/A	1.5E-07	mg/kg/day	7.5E-05	mg/kg/day	2.1E-03
				Cobalt	3.6E+00	mg/kg	N/A		N/A		N/A	1.3E-06	mg/kg/day	3.0E-04	mg/kg/day	4.3E-03
				Iron	2.2E+04	mg/kg	N/A		N/A		N/A	8.0E-03	mg/kg/day	7.0E-01	mg/kg/day	1.1E-02
				Manganese	1.5E+02	mg/kg	N/A		N/A		N/A	5.5E-05	mg/kg/day	9.6E-04	mg/kg/day	5.7E-02
				Thallium	1.1E+00	mg/kg	N/A		N/A		N/A	3.9E-07	mg/kg/day	1.0E-05	mg/kg/day	3.9E-02
				Vanadium	3.7E+01	mg/kg	N/A		N/A		N/A	1.3E-05	mg/kg/day	1.3E-04	mg/kg/day	1.0E-01
			Exp. Route Total								N/A					4.0E-01
		Exposure Point Total									N/A					4.8E+00
	Exposure Medium Total										N/A					4.8E+00
Soil* Outside Fenced Area											N/A					4.8E+00
										Total of Receptor Risk	N/A				Total of Receptor Hazard	4.8E+00

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABs of 0.1 used for SVOCs and pesticides, DABS of 0.13 used for PAHs, DABS of 0.14 used for aroclors, DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

* Surface soil and subsurface soil combined.

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Soil* Outside Fenced Area	Ingestion	Benzo(a)anthracene[2]	2.6E+00	mg/kg			7.3E-01	1/mg/kg-day	1.3E-05	N/A		N/A		N/A
				Benzo(a)pyrene[2]	2.2E+00	mg/kg			7.3E+00	1/mg/kg-day	1.1E-04	N/A		N/A		N/A
				Benzo(b)fluoranthene[2]	1.5E+00	mg/kg			7.3E-01	1/mg/kg-day	7.6E-06	N/A		N/A		N/A
				Benzo(k)fluoranthene[2]	6.9E-01	mg/kg			7.3E-02	1/mg/kg-day	3.4E-07	N/A		N/A		N/A
				bis(2-Ethylhexyl)phthalate	6.3E+01	mg/kg	9.9E-05	mg/kg/day	1.4E-02	1/mg/kg-day	1.4E-06	N/A		N/A		N/A
				Dibenz(a,h)anthracene[2]	1.4E-01	mg/kg			7.3E+00	1/mg/kg-day	6.7E-06	N/A		N/A		N/A
				Indeno(1,2,3-cd)pyrene[2]	8.2E-01	mg/kg			7.3E-01	1/mg/kg-day	4.0E-06	N/A		N/A		N/A
				Aldrin	3.3E-02	mg/kg	5.2E-08	mg/kg/day	1.7E+01	1/mg/kg-day	8.8E-07	N/A		N/A		N/A
				Aroclor-1242	2.3E+00	mg/kg	3.6E-06	mg/kg/day	2.0E+00	1/mg/kg-day	7.2E-06	N/A		N/A		N/A
				Aroclor-1260	4.5E-01	mg/kg	7.1E-07	mg/kg/day	2.0E+00	1/mg/kg-day	1.4E-06	N/A		N/A		N/A
				Aluminum	1.7E+04	mg/kg	2.6E-02	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Arsenic	4.6E+01	mg/kg	7.1E-05	mg/kg/day	1.5E+00	1/mg/kg-day	1.1E-04	N/A		N/A		N/A
				Chromium (hexavalent)[2]	4.3E-01	mg/kg			5.0E-01	1/mg/kg-day	1.4E-06	N/A		N/A		N/A
				Cobalt	3.6E+00	mg/kg	5.6E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Iron	2.2E+04	mg/kg	3.5E-02	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.5E+02	mg/kg	2.4E-04	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Thallium	1.1E+00	mg/kg	1.7E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Vanadium	3.7E+01	mg/kg	5.8E-05	mg/kg/day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								2.6E-04					N/A

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
			Dermal Absorption[1]	Benzo(a)anthracene[2]	2.6E+00	mg/kg			7.3E-01	1/mg/kg-day	4.8E-06	N/A		N/A		N/A
				Benzo(a)pyrene[2]	2.2E+00	mg/kg			7.3E+00	1/mg/kg-day	4.1E-05	N/A		N/A		N/A
				Benzo(b)fluoranthene[2]	1.5E+00	mg/kg			7.3E-01	1/mg/kg-day	2.9E-06	N/A		N/A		N/A
				Benzo(k)fluoranthene[2]	6.9E-01	mg/kg			7.3E-02	1/mg/kg-day	1.3E-07	N/A		N/A		N/A
				bis(2-Ethylhexyl)phthalate	6.3E+01	mg/kg	3.1E-05	mg/kg/day	1.4E-02	1/mg/kg-day	4.4E-07	N/A		N/A		N/A
				Dibenz(a,h)anthracene[2]	1.4E-01	mg/kg			7.3E+00	1/mg/kg-day	2.6E-06	N/A		N/A		N/A
				Indeno(1,2,3-cd)pyrene[2]	8.2E-01	mg/kg			7.3E-01	1/mg/kg-day	1.5E-06	N/A		N/A		N/A
				Aldrin	3.3E-02	mg/kg	1.6E-08	mg/kg/day	1.7E+01	1/mg/kg-day	2.8E-07	N/A		N/A		N/A
				Aroclor-1242	2.3E+00	mg/kg	1.6E-06	mg/kg/day	2.0E+00	1/mg/kg-day	3.2E-06	N/A		N/A		N/A
				Aroclor-1260	4.5E-01	mg/kg	3.1E-07	mg/kg/day	2.0E+00	1/mg/kg-day	6.3E-07	N/A		N/A		N/A
				Aluminum	1.7E+04	mg/kg	8.3E-04	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Arsenic	4.6E+01	mg/kg	6.8E-06	mg/kg/day	1.5E+00	1/mg/kg-day	1.0E-05	N/A		N/A		N/A
				Chromium (hexavalent)[2]	4.3E-01	mg/kg			2.0E+01	1/mg/kg-day	1.7E-06	N/A		N/A		N/A
				Cobalt	3.6E+00	mg/kg	1.8E-07	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Iron	2.2E+04	mg/kg	1.1E-03	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Manganese	1.5E+02	mg/kg	7.6E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Thallium	1.1E+00	mg/kg	5.4E-08	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Vanadium	3.7E+01	mg/kg	1.8E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								6.9E-05					N/A
		Exposure Point Total									3.3E-04					N/A
	Exposure Medium Total										3.3E-04					N/A
Soil* Outside Fenced Area											3.3E-04					N/A
										Total of Receptor Risk	3.3E-04				Total of Receptor Hazard	N/A

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABs of 0.1 used for SVOCs and pesticides, DABS of 0.13 used for PAHs, DABS of 0.14 used for aroclors, DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

[2] See Table 7.3.RME Supplement A for calculation of cancer intake and cancer risk following MMOA method.

* Surface soil and subsurface soil combined.

TABLE 7.3.RME Supplement A

CALCULATION OF CHEMICAL CANCER RISKS FOR COPC WITH MUTAGENIC MODE OF ACTION

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations										
							Intake					CSF/Unit Risk					Cancer Risk
					Value	Units	Value				Units	Value				Units	
							0-2 yrs	2-6 yrs	6-16 years	16-30 yrs		0-2 yrs (ADAF=10)	2-6 yrs (ADAF=3)	6-16 yrs (ADAF=3)	16-30 yrs (ADAF=1)		
Soil*	Soil*	Soil* Outside Fenced Area	Ingestion	Benzo(a)anthracene	2.6E+00	mg/kg	9.4E-07	1.9E-06	5.0E-07	7.1E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	1.3E-05
				Benzo(a)pyrene	2.2E+00	mg/kg	7.9E-07	1.6E-06	4.2E-07	5.9E-07	mg/kg/day	7.3E+01	2.2E+01	2.2E+01	7.3E+00	1/(mg/kg-day)	1.1E-04
				Benzo(b)fluoranthene	1.5E+00	mg/kg	5.7E-07	1.1E-06	3.0E-07	4.2E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	7.6E-06
				Benzo(k)fluoranthene	6.9E-01	mg/kg	2.5E-07	5.0E-07	1.3E-07	1.9E-07	mg/kg/day	7.3E-01	2.2E-01	2.2E-01	7.3E-02	1/(mg/kg-day)	3.4E-07
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	5.0E-08	9.9E-08	2.7E-08	3.7E-08	mg/kg/day	7.3E+01	2.2E+01	2.2E+01	7.3E+00	1/(mg/kg-day)	6.7E-06
				Indeno(1,2,3-cd)pyrene	8.2E-01	mg/kg	3.0E-07	6.0E-07	1.6E-07	2.2E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	4.0E-06
				Chromium (hexavalent)	4.3E-01	mg/kg	1.6E-07	3.1E-07	8.4E-08	1.2E-07	mg/kg/day	5.0E+00	1.5E+00	1.5E+00	5.0E-01	1/(mg/kg-day)	1.4E-06
			Dermal	Benzo(a)anthracene	2.6E+00	mg/kg	3.4E-07	6.8E-07	2.6E-07	3.7E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	4.8E-06
				Benzo(a)pyrene	2.2E+00	mg/kg	2.9E-07	5.8E-07	2.2E-07	3.1E-07	mg/kg/day	7.3E+01	2.2E+01	2.2E+01	7.3E+00	1/(mg/kg-day)	4.1E-05
				Benzo(b)fluoranthene	1.5E+00	mg/kg	2.1E-07	4.1E-07	1.6E-07	2.2E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	2.9E-06
				Benzo(k)fluoranthene	6.9E-01	mg/kg	9.1E-08	1.8E-07	7.0E-08	9.7E-08	mg/kg/day	7.3E-01	2.2E-01	2.2E-01	7.3E-02	1/(mg/kg-day)	1.3E-07
				Dibenz(a,h)anthracene	1.4E-01	mg/kg	1.8E-08	3.6E-08	1.4E-08	1.9E-08	mg/kg/day	7.3E+01	2.2E+01	2.2E+01	7.3E+00	1/(mg/kg-day)	2.6E-06
				Indeno(1,2,3-cd)pyrene	8.2E-01	mg/kg	1.1E-07	2.2E-07	8.3E-08	1.2E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	1.5E-06
				Chromium (hexavalent)	4.3E-01	mg/kg	4.4E-09	8.8E-09	3.4E-09	4.7E-09	mg/kg/day	2.0E+02	6.0E+01	6.0E+01	2.0E+01	1/(mg/kg-day)	1.7E-06

Cancer risk = $(Intake_{0\text{-}2} \times CSF_{0\text{-}2}) + (Intake_{2\text{-}6} \times CSF_{2\text{-}6}) + (Intake_{6\text{-}16} \times CSF_{6\text{-}16}) + (Intake_{16\text{-}30} \times CSF_{16\text{-}30})$

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Soil* Outside Fenced Area	Benzo(a)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(k)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			bis(2-Ethylhexyl)phthalate	N/A	N/A	N/A	N/A	Liver	4E-03	N/A	2E-03	6E-03
			Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Aldrin	N/A	N/A	N/A	N/A	Liver	2E-03	N/A	6E-04	2E-03
			Aroclor-1242	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Aroclor-1260	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Aluminum	N/A	N/A	N/A	N/A	Neurological	2E-02	N/A	1E-03	2E-02
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	2E-01	N/A	3E-02	2E-01
			Chromium (hexavalent)	N/A	N/A	N/A	N/A	NOE	2E-04	N/A	3E-04	5E-04
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-02	N/A	7E-04	2E-02
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	4E-02	N/A	2E-03	5E-02
			Manganese	N/A	N/A	N/A	N/A	CNS	9E-03	N/A	9E-03	2E-02
			Thallium	N/A	N/A	N/A	N/A	Hair	2E-01	N/A	6E-03	2E-01
			Vanadium	N/A	N/A	N/A	N/A	Kidney	1E-02	N/A	2E-02	3E-02
			Chemical Total	N/A	N/A	N/A	N/A		5E-01	N/A	6E-02	5E-01
		Exposure Point Total					N/A					5E-01
	Exposure Medium Total						N/A					5E-01
Soil* Outside Fenced Area							N/A					5E-01
						Receptor Risk Total	N/A				Receptor HI Total	5E-01

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Notes:
N/A = Not applicable
HI = Hazard Index
CNS = Central Nervous System
NOE = No Observed Effects
Soil* = combined surface and subsurface soil.

Target Organ Totals	
Total Skin HI Across All Media =	2E-01
Total Vascular HI Across All Media =	2E-01
Total Hair HI Across All Media =	2E-01
Total Thyroid HI Across All Media =	2E-02
Total Gastrointestinal HI Across All Media =	5E-02
Total Neurological/CNS Across All Media =	4E-02
Total Liver HI Across All Media =	8E-03
Total Kidney HI Across All Media =	3E-02

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Soil* Outside Fenced Area	Benzo(a)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(k)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			bis(2-Ethylhexyl)phthalate	N/A	N/A	N/A	N/A	Liver	4E-02	N/A	1E-02	5E-02
			Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Aldrin	N/A	N/A	N/A	N/A	Liver	1E-02	N/A	4E-03	2E-02
			Aroclor-1242	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Aroclor-1260	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Aluminum	N/A	N/A	N/A	N/A	Neurological	2E-01	N/A	6E-03	2E-01
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	2E+00	N/A	2E-01	2E+00
			Chromium (hexavalent)	N/A	N/A	N/A	N/A	NOE	2E-03	N/A	2E-03	4E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	2E-01	N/A	4E-03	2E-01
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	4E-01	N/A	1E-02	4E-01
			Manganese	N/A	N/A	N/A	N/A	CNS	8E-02	N/A	6E-02	1E-01
			Thallium	N/A	N/A	N/A	N/A	Hair	1E+00	N/A	4E-02	1E+00
			Vanadium	N/A	N/A	N/A	N/A	Kidney	1E-01	N/A	1E-01	2E-01
			Chemical Total	N/A	N/A	N/A	N/A		4E+00	N/A	4E-01	5E+00
		Exposure Point Total					N/A					5E+00
	Exposure Medium Total						N/A					5E+00
Soil* Outside Fenced Area							N/A					5E+00
						Receptor Risk Total	N/A				Receptor HI Total	5E+00

TABLE 9.2.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total

Notes:
N/A = Not applicable
HI = Hazard Index
CNS = Central Nervous System
NOE = No Observed Effects
Soil* = combined surface and subsurface soil.

Target Organ Totals	
Total Skin HI Across All Media =	**2E+00**
Total Vascular HI Across All Media =	**2E+00**
Total Hair HI Across All Media =	1E+00
Total Thyroid HI Across All Media =	2E-01
Total Gastrointestinal HI Across All Media =	4E-01
Total Neurological/CNS Across All Media =	4E-01
Total Liver HI Across All Media =	7E-02
Total Kidney HI Across All Media =	2E-01

TABLE 9.3.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Soil* Outside Fenced Area	Benzo(a)anthracene	1E-05	N/A	5E-06	2E-05	N/A	N/A	N/A	N/A	N/A
			Benzo(a)pyrene	1E-04	N/A	4E-05	1E-04	N/A	N/A	N/A	N/A	N/A
			Benzo(b)fluoranthene	8E-06	N/A	3E-06	1E-05	N/A	N/A	N/A	N/A	N/A
			Benzo(k)fluoranthene	3E-07	N/A	1E-07	5E-07	N/A	N/A	N/A	N/A	N/A
			bis(2-Ethylhexyl)phthalate	1E-06	N/A	4E-07	2E-06	Liver	N/A	N/A	N/A	N/A
			Dibenz(a,h)anthracene	7E-06	N/A	3E-06	9E-06	N/A	N/A	N/A	N/A	N/A
			Indeno(1,2,3-cd)pyrene	4E-06	N/A	2E-06	6E-06	N/A	N/A	N/A	N/A	N/A
			Aldrin	9E-07	N/A	3E-07	1E-06	Liver	N/A	N/A	N/A	N/A
			Aroclor-1242	7E-06	N/A	3E-06	1E-05	N/A	N/A	N/A	N/A	N/A
			Aroclor-1260	1E-06	N/A	6E-07	2E-06	N/A	N/A	N/A	N/A	N/A
			Aluminum	N/A	N/A	N/A	N/A	Neurological	N/A	N/A	N/A	N/A
			Arsenic	1E-04	N/A	1E-05	1E-04	Skin, Vascular	N/A	N/A	N/A	N/A
			Chromium (hexavalent)	1E-06	N/A	2E-06	3E-06	NOE	N/A	N/A	N/A	N/A
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	N/A	N/A	N/A	N/A
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	N/A	N/A	N/A	N/A
			Manganese	N/A	N/A	N/A	N/A	CNS	N/A	N/A	N/A	N/A
			Thallium	N/A	N/A	N/A	N/A	Hair	N/A	N/A	N/A	N/A
			Vanadium	N/A	N/A	N/A	N/A	Kidney	N/A	N/A	N/A	N/A
			Chemical Total	3E-04	N/A	7E-05	3E-04		N/A	N/A	N/A	N/A
		Exposure Point Total					3E-04					N/A
	Exposure Medium Total						3E-04					N/A
Soil* Outside Fenced Area							3E-04					N/A
						Receptor Risk Total	3E-04				Receptor HI Total	N/A

Notes:

N/A = Not applicable

CNS = Central Nervous System

NOE = No Observed Effects

Soil* = combined surface and subsurface soil.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	10/10/2014 9:24:59 AM
From File	ProUCL input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)anthracene

General Statistics

Total Number of Observations	44	Number of Distinct Observations	37
Number of Detects	34	Number of Non-Detects	10
Number of Distinct Detects	29	Number of Distinct Non-Detects	10
Minimum Detect	2.7	Minimum Non-Detect	13
Maximum Detect	8800	Maximum Non-Detect	17000
Variance Detects	2324373	Percent Non-Detects	22.73%
Mean Detects	525.2	SD Detects	1525
Median Detects	23.5	CV Detects	2.903
Skewness Detects	5.14	Kurtosis Detects	28.27
Mean of Logged Detects	4.11	SD of Logged Detects	2.135

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.363	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.366	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	439.8	Standard Error of Mean	214.5
SD	1366	95% KM (BCA) UCL	865.6
95% KM (t) UCL	800.4	95% KM (Percentile Bootstrap) UCL	829.9
95% KM (z) UCL	792.7	95% KM Bootstrap t UCL	1542
90% KM Chebyshev UCL	1083	95% KM Chebyshev UCL	1375
97.5% KM Chebyshev UCL	1780	99% KM Chebyshev UCL	2574

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.627	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.852	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.283	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.163	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.317	k star (bias corrected MLE)	0.309
Theta hat (MLE)	1656	Theta star (bias corrected MLE)	1701
nu hat (MLE)	21.57	nu star (bias corrected)	21
MLE Mean (bias corrected)	525.2	MLE Sd (bias corrected)	945

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.104	nu hat (KM)	9.115
Approximate Chi Square Value (9.12, α)	3.397	Adjusted Chi Square Value (9.12, β)	3.279
95% Gamma Approximate KM-UCL (use when n>=50)	1180	95% Gamma Adjusted KM-UCL (use when n<50)	1223

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	405.8
Maximum	8800	Median	15
SD	1354	CV	3.337
k hat (MLE)	0.191	k star (bias corrected MLE)	0.193
Theta hat (MLE)	2123	Theta star (bias corrected MLE)	2100
nu hat (MLE)	16.82	nu star (bias corrected)	17.01
MLE Mean (bias corrected)	405.8	MLE Sd (bias corrected)	923.1

		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (17.01, α)	8.678	Adjusted Chi Square Value (17.01, β)	8.476
95% Gamma Approximate UCL (use when n>=50)	795.4	95% Gamma Adjusted UCL (use when n<50)	814.4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.889	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.933	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.23	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.152	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	412.1	Mean in Log Scale	3.883
SD in Original Scale	1352	SD in Log Scale	1.945
95% t UCL (assumes normality of ROS data)	754.7	95% Percentile Bootstrap UCL	775.2
95% BCA Bootstrap UCL	992.5	95% Bootstrap t UCL	1508
95% H-UCL (Log ROS)	935.5		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	812.1	Mean in Log Scale	4.354
SD in Original Scale	1965	SD in Log Scale	2.322
95% t UCL (Assumes normality)	1310	95% H-Stat UCL	5007

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL 2574

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Benzo(a)pyrene

General Statistics

Total Number of Observations	44	Number of Distinct Observations	35
Number of Detects	29	Number of Non-Detects	15
Number of Distinct Detects	26	Number of Distinct Non-Detects	12
Minimum Detect	4.4	Minimum Non-Detect	12
Maximum Detect	7000	Maximum Non-Detect	17000
Variance Detects	1790718	Percent Non-Detects	34.09%
Mean Detects	569.3	SD Detects	1338
Median Detects	110	CV Detects	2.35
Skewness Detects	4.304	Kurtosis Detects	20.4
Mean of Logged Detects	4.45	SD of Logged Detects	2.186

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.451	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.336	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.165	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	404.1	Standard Error of Mean	176.8
SD	1123	95% KM (BCA) UCL	739.7
95% KM (t) UCL	701.3	95% KM (Percentile Bootstrap) UCL	717.3
95% KM (z) UCL	694.9	95% KM Bootstrap t UCL	1248
90% KM Chebyshev UCL	934.4	95% KM Chebyshev UCL	1175
97.5% KM Chebyshev UCL	1508	99% KM Chebyshev UCL	2163

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.389	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.844	Detected Data Not Gamma Distributed at 5% Significance Level

K-S Test Statistic	0.238	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.175	Detected Data Not Gamma Distributed at 5% Significance Level	

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.354	k star (bias corrected MLE)	0.341
Theta hat (MLE)	1607	Theta star (bias corrected MLE)	1672
nu hat (MLE)	20.55	nu star (bias corrected)	19.75
MLE Mean (bias corrected)	569.3	MLE Sd (bias corrected)	975.5

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.129	nu hat (KM)	11.39
Approximate Chi Square Value (11.39, α)	4.831	Adjusted Chi Square Value (11.39, β)	4.686
95% Gamma Approximate KM-UCL (use when n>=50)	953.2	95% Gamma Adjusted KM-UCL (use when n<50)	982.7

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	375.2
Maximum	7000	Median	11.5
SD	1114	CV	2.968
k hat (MLE)	0.166	k star (bias corrected MLE)	0.17
Theta hat (MLE)	2262	Theta star (bias corrected MLE)	2211
nu hat (MLE)	14.6	nu star (bias corrected)	14.94
MLE Mean (bias corrected)	375.2	MLE Sd (bias corrected)	910.8
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (14.94, α)	7.218	Adjusted Chi Square Value (14.94, β)	7.035
95% Gamma Approximate UCL (use when n>=50)	776.6	95% Gamma Adjusted UCL (use when n<50)	796.7

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.216	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.165	Detected Data Not Lognormal at 5% Significance Level	

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	382.7	Mean in Log Scale	3.896
SD in Original Scale	1111	SD in Log Scale	1.978
95% t UCL (assumes normality of ROS data)	664.3	95% Percentile Bootstrap UCL	694
95% BCA Bootstrap UCL	903.5	95% Bootstrap t UCL	1268
95% H-UCL (Log ROS)	1044		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	734.1	Mean in Log Scale	4.251
SD in Original Scale	1805	SD in Log Scale	2.301
95% t UCL (Assumes normality)	1192	95% H-Stat UCL	4191

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL 2163

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Benzo(b)fluoranthene

General Statistics

Total Number of Observations	44	Number of Distinct Observations	36
Number of Detects	29	Number of Non-Detects	15

Number of Distinct Detects	28	Number of Distinct Non-Detects	10
Minimum Detect	8.9	Minimum Non-Detect	9.8
Maximum Detect	6800	Maximum Non-Detect	17000
Variance Detects	1724037	Percent Non-Detects	34.09%
Mean Detects	656.8	SD Detects	1313
Median Detects	190	CV Detects	1.999
Skewness Detects	3.956	Kurtosis Detects	17.99
Mean of Logged Detects	5.016	SD of Logged Detects	1.911

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.517	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.311	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.165	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	458.3	Standard Error of Mean	174.7
SD	1112	95% KM (BCA) UCL	777.9
95% KM (t) UCL	752	95% KM (Percentile Bootstrap) UCL	761.4
95% KM (z) UCL	745.6	95% KM Bootstrap t UCL	1107
90% KM Chebyshev UCL	982.4	95% KM Chebyshev UCL	1220
97.5% KM Chebyshev UCL	1549	99% KM Chebyshev UCL	2197

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.02	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.825	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.186	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.173	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.44	k star (bias corrected MLE)	0.418
Theta hat (MLE)	1492	Theta star (bias corrected MLE)	1572
nu hat (MLE)	25.54	nu star (bias corrected)	24.23
MLE Mean (bias corrected)	656.8	MLE Sd (bias corrected)	1016

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.17	nu hat (KM)	14.93
Approximate Chi Square Value (14.93, α)	7.215	Adjusted Chi Square Value (14.93, β)	7.033
95% Gamma Approximate KM-UCL (use when n>=50)	948.5	95% Gamma Adjusted KM-UCL (use when n<50)	973.1

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	432.9
Maximum	6800	Median	23
SD	1105	CV	2.553
k hat (MLE)	0.174	k star (bias corrected MLE)	0.177
Theta hat (MLE)	2495	Theta star (bias corrected MLE)	2448
nu hat (MLE)	15.27	nu star (bias corrected)	15.56
MLE Mean (bias corrected)	432.9	MLE Sd (bias corrected)	1029
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (15.56, α)	7.654	Adjusted Chi Square Value (15.56, β)	7.466
95% Gamma Approximate UCL (use when n>=50)	880.2	95% Gamma Adjusted UCL (use when n<50)	902.4

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.923	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.926	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.17	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.165	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	438.5	Mean in Log Scale	4.081
SD in Original Scale	1103	SD in Log Scale	2.114

95% t UCL (assumes normality of ROS data)	718	95% Percentile Bootstrap UCL	728
95% BCA Bootstrap UCL	895	95% Bootstrap t UCL	1066
95% H-UCL (Log ROS)	1906		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	758.1	Mean in Log Scale	4.439
SD in Original Scale	1792	SD in Log Scale	2.209
95% t UCL (Assumes normality)	1212	95% H-Stat UCL	3710

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 1549

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Benzo(k)fluoranthene

General Statistics

Total Number of Observations	44	Number of Distinct Observations	35
Number of Detects	24	Number of Non-Detects	20
Number of Distinct Detects	24	Number of Distinct Non-Detects	11
Minimum Detect	3.7	Minimum Non-Detect	12
Maximum Detect	6800	Maximum Non-Detect	17000
Variance Detects	1920090	Percent Non-Detects	45.45%
Mean Detects	559.6	SD Detects	1386
Median Detects	145	CV Detects	2.476
Skewness Detects	4.325	Kurtosis Detects	19.83
Mean of Logged Detects	4.614	SD of Logged Detects	2.088

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.411	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.916	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.356	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.181	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	323.6	Standard Error of Mean	167.3
SD	1061	95% KM (BCA) UCL	645.5
95% KM (t) UCL	604.8	95% KM (Percentile Bootstrap) UCL	619.9
95% KM (z) UCL	598.7	95% KM Bootstrap t UCL	1361
90% KM Chebyshev UCL	825.4	95% KM Chebyshev UCL	1053
97.5% KM Chebyshev UCL	1368	99% KM Chebyshev UCL	1988

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.802	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.832	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.147	**Kolmogrov-Smirnoff GOF**	
5% K-S Critical Value	0.191	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.386	k star (bias corrected MLE)	0.366
Theta hat (MLE)	1449	Theta star (bias corrected MLE)	1530
nu hat (MLE)	18.54	nu star (bias corrected)	17.55
MLE Mean (bias corrected)	559.6	MLE Sd (bias corrected)	925.4

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.093	nu hat (KM)	8.186
Approximate Chi Square Value (8.19, α)	2.843	Adjusted Chi Square Value (8.19, β)	2.737
95% Gamma Approximate KM-UCL (use when n>=50)	931.8	95% Gamma Adjusted KM-UCL (use when n<50)	967.9

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	305.3
Maximum	6800	Median	5.7
SD	1052	CV	3.446
k hat (MLE)	0.146	k star (bias corrected MLE)	0.151
Theta hat (MLE)	2095	Theta star (bias corrected MLE)	2023
nu hat (MLE)	12.82	nu star (bias corrected)	13.28
MLE Mean (bias corrected)	305.3	MLE Sd (bias corrected)	785.8
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (13.28, α)	6.081	Adjusted Chi Square Value (13.28, β)	5.916
95% Gamma Approximate UCL (use when n>=50)	666.6	95% Gamma Adjusted UCL (use when n<50)	685.2

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.942	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.916	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.165	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.181	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	311.7	Mean in Log Scale	3.581
SD in Original Scale	1050	SD in Log Scale	1.996
95% t UCL (assumes normality of ROS data)	577.8	95% Percentile Bootstrap UCL	604.6
95% BCA Bootstrap UCL	778.4	95% Bootstrap t UCL	1318
95% H-UCL (Log ROS)	803.9		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.468	95% H-UCL (KM -Log)	866.5
KM SD (logged)	2.058	95% Critical H Value (KM-Log)	3.758
KM Standard Error of Mean (logged)	0.332		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	631.8	Mean in Log Scale	3.937
SD in Original Scale	1783	SD in Log Scale	2.186
95% t UCL (Assumes normality)	1084	95% H-Stat UCL	2085

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	645.5	95% GROS Adjusted Gamma UCL	685.2
95% Adjusted Gamma KM-UCL	967.9		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

bis(2-Ethylhexyl)phthalate

General Statistics

Total Number of Observations	35	Number of Distinct Observations	16
Number of Detects	2	Number of Non-Detects	33
Number of Distinct Detects	2	Number of Distinct Non-Detects	14
Minimum Detect	66	Minimum Non-Detect	49
Maximum Detect	63000	Maximum Non-Detect	16000
Variance Detects	1.980E+9	Percent Non-Detects	94.29%
Mean Detects	31533	SD Detects	44501
Median Detects	31533	CV Detects	1.411
Skewness Detects	N/A	Kurtosis Detects	N/A

Mean of Logged Detects	7.62	SD of Logged Detects	4.852

Warning: Data set has only 2 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	1856	Standard Error of Mean	2507
SD	10486	95% KM (BCA) UCL	N/A
95% KM (t) UCL	6094	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	5979	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	9376	95% KM Chebyshev UCL	12782
97.5% KM Chebyshev UCL	17510	99% KM Chebyshev UCL	26797

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.258	k star (bias corrected MLE)	N/A
Theta hat (MLE)	122199	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	1.032	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0313	nu hat (KM)	2.193
		Adjusted Level of Significance (β)	0.0425
Approximate Chi Square Value (2.19, α)	0.18	Adjusted Chi Square Value (2.19, β)	0.164
95% Gamma Approximate KM-UCL (use when n>=50)	22620	95% Gamma Adjusted KM-UCL (use when n<50)	24820

Gamma (KM) may not be used when k hat (KM) is < 0.1

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1855	Mean in Log Scale	1.634
SD in Original Scale	10641	SD in Log Scale	3.066
95% t UCL (assumes normality of ROS data)	4896	95% Percentile Bootstrap UCL	5441
95% BCA Bootstrap UCL	7284	95% Bootstrap t UCL	271001
95% H-UCL (Log ROS)	10821		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2523	Mean in Log Scale	5.029
SD in Original Scale	10658	SD in Log Scale	1.935
95% t UCL (Assumes normality)	5569	95% H-Stat UCL	3486

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL	26797

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Dibenz(a,h)anthracene

General Statistics

Total Number of Observations	44	Number of Distinct Observations	33
Number of Detects	19	Number of Non-Detects	25
Number of Distinct Detects	18	Number of Distinct Non-Detects	16
Minimum Detect	3.6	Minimum Non-Detect	13

Maximum Detect	1400	Maximum Non-Detect	17000
Variance Detects	99026	Percent Non-Detects	56.82%
Mean Detects	128.3	SD Detects	314.7
Median Detects	37	CV Detects	2.453
Skewness Detects	4.064	Kurtosis Detects	17.15
Mean of Logged Detects	3.346	SD of Logged Detects	1.784

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.406	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.357	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.203	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	71.07	Standard Error of Mean	38.59
SD	227.9	95% KM (BCA) UCL	149.2
95% KM (t) UCL	135.9	95% KM (Percentile Bootstrap) UCL	141.1
95% KM (z) UCL	134.5	95% KM Bootstrap t UCL	328.2
90% KM Chebyshev UCL	186.8	95% KM Chebyshev UCL	239.3
97.5% KM Chebyshev UCL	312.1	99% KM Chebyshev UCL	455

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.158	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.817	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.185	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.212	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.431	k star (bias corrected MLE)	0.398
Theta hat (MLE)	297.6	Theta star (bias corrected MLE)	322.2
nu hat (MLE)	16.38	nu star (bias corrected)	15.13
MLE Mean (bias corrected)	128.3	MLE Sd (bias corrected)	203.3

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0973	nu hat (KM)	8.56
Approximate Chi Square Value (8.56, α)	3.064	Adjusted Chi Square Value (8.56, β)	2.953
95% Gamma Approximate KM-UCL (use when n>=50)	198.6	95% Gamma Adjusted KM-UCL (use when n<50)	206

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	55.4
Maximum	1400	Median	0.01
SD	213.5	CV	3.854
k hat (MLE)	0.148	k star (bias corrected MLE)	0.153
Theta hat (MLE)	373.2	Theta star (bias corrected MLE)	361
nu hat (MLE)	13.06	nu star (bias corrected)	13.5
MLE Mean (bias corrected)	55.4	MLE Sd (bias corrected)	141.4
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (13.50, α)	6.233	Adjusted Chi Square Value (13.50, β)	6.065
95% Gamma Approximate UCL (use when n>=50)	120	95% Gamma Adjusted UCL (use when n<50)	123.3

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.897	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.901	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.203	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	61.43	Mean in Log Scale	2.69
SD in Original Scale	212	SD in Log Scale	1.386
95% t UCL (assumes normality of ROS data)	115.2	95% Percentile Bootstrap UCL	121.6

95% BCA Bootstrap UCL	161.1	95% Bootstrap t UCL	282.1
95% H-UCL (Log ROS)	69.98		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.6	95% H-UCL (KM -Log)	92.43
KM SD (logged)	1.552	95% Critical H Value (KM-Log)	3.05
KM Standard Error of Mean (logged)	0.284		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	599.4	Mean in Log Scale	3.857
SD in Original Scale	1581	SD in Log Scale	2.253
95% t UCL (Assumes normality)	1000	95% H-Stat UCL	2403

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	135.9	95% GROS Adjusted Gamma UCL	123.3
95% Adjusted Gamma KM-UCL	206		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Indeno(1,2,3-cd)pyrene

General Statistics

Total Number of Observations	44	Number of Distinct Observations	34
Number of Detects	26	Number of Non-Detects	18
Number of Distinct Detects	25	Number of Distinct Non-Detects	11
Minimum Detect	3.7	Minimum Non-Detect	18
Maximum Detect	3400	Maximum Non-Detect	17000
Variance Detects	491320	Percent Non-Detects	40.91%
Mean Detects	350.8	SD Detects	700.9
Median Detects	57	CV Detects	1.998
Skewness Detects	3.638	Kurtosis Detects	15.05
Mean of Logged Detects	4.396	SD of Logged Detects	1.852

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.53	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.31	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.174	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	236.9	Standard Error of Mean	93.48
SD	577.8	95% KM (BCA) UCL	420.9
95% KM (t) UCL	394.1	95% KM (Percentile Bootstrap) UCL	400.5
95% KM (z) UCL	390.7	95% KM Bootstrap t UCL	601.9
90% KM Chebyshev UCL	517.4	95% KM Chebyshev UCL	644.4
97.5% KM Chebyshev UCL	820.7	99% KM Chebyshev UCL	1167

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.032	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.821	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.188	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.183	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.442	k star (bias corrected MLE)	0.417
Theta hat (MLE)	793.1	Theta star (bias corrected MLE)	841.4
nu hat (MLE)	23	nu star (bias corrected)	21.68
MLE Mean (bias corrected)	350.8	MLE Sd (bias corrected)	543.3

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.168	nu hat (KM)	14.8
Approximate Chi Square Value (14.80, α)	7.121	Adjusted Chi Square Value (14.80, β)	6.94
95% Gamma Approximate KM-UCL (use when n>=50)	492.4	95% Gamma Adjusted KM-UCL (use when n<50)	505.2

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	207.3
Maximum	3400	Median	12.5
SD	562.2	CV	2.712
k hat (MLE)	0.164	k star (bias corrected MLE)	0.168
Theta hat (MLE)	1263	Theta star (bias corrected MLE)	1233
nu hat (MLE)	14.45	nu star (bias corrected)	14.79
MLE Mean (bias corrected)	207.3	MLE Sd (bias corrected)	505.5
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (14.79, α)	7.118	Adjusted Chi Square Value (14.79, β)	6.937
95% Gamma Approximate UCL (use when n>=50)	430.8	95% Gamma Adjusted UCL (use when n<50)	442

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.948	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.92	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.148	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.174	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	215.8	Mean in Log Scale	3.729
SD in Original Scale	559.2	SD in Log Scale	1.708
95% t UCL (assumes normality of ROS data)	357.5	95% Percentile Bootstrap UCL	376.8
95% BCA Bootstrap UCL	456.2	95% Bootstrap t UCL	549.7
95% H-UCL (Log ROS)	419		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.736	95% H-UCL (KM -Log)	516.8
KM SD (logged)	1.785	95% Critical H Value (KM-Log)	3.372
KM Standard Error of Mean (logged)	0.302		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	654.2	Mean in Log Scale	4.27
SD in Original Scale	1593	SD in Log Scale	2.176
95% t UCL (Assumes normality)	1058	95% H-Stat UCL	2813

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

97.5% KM (Chebyshev) UCL 820.7

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Aldrin

General Statistics

Total Number of Observations	35	Number of Distinct Observations	13
Number of Detects	3	Number of Non-Detects	32
Number of Distinct Detects	3	Number of Distinct Non-Detects	10
Minimum Detect	1.1	Minimum Non-Detect	1.7
Maximum Detect	33	Maximum Non-Detect	3.4
Variance Detects	287.4	Percent Non-Detects	91.43%

Mean Detects	20.37	SD Detects	16.95
Median Detects	27	CV Detects	0.832
Skewness Detects	-1.491	Kurtosis Detects	N/A
Mean of Logged Detects	2.296	SD of Logged Detects	1.908

Warning: Data set has only 3 Detected Values.

This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.885	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.319	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	2.751	Standard Error of Mean	1.397
SD	6.746	95% KM (BCA) UCL	N/A
95% KM (t) UCL	5.113	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	5.049	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	6.941	95% KM Chebyshev UCL	8.839
97.5% KM Chebyshev UCL	11.47	99% KM Chebyshev UCL	16.65

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	0.823	k star (bias corrected MLE)	N/A
Theta hat (MLE)	24.73	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	4.941	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.166	nu hat (KM)	11.64
		Adjusted Level of Significance (β)	0.0425
Approximate Chi Square Value (11.64, α)	4.993	Adjusted Chi Square Value (11.64, β)	4.787
95% Gamma Approximate KM-UCL (use when n>=50)	6.416	95% Gamma Adjusted KM-UCL (use when n<50)	6.692

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.794	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.367	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.311	Mean in Log Scale	0.28
SD in Original Scale	6.901	SD in Log Scale	1.233
95% t UCL (assumes normality of ROS data)	5.284	95% Percentile Bootstrap UCL	5.422
95% BCA Bootstrap UCL	5.86	95% Bootstrap t UCL	10.66
95% H-UCL (Log ROS)	5.066		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.284	95% H-UCL (KM -Log)	2.377
KM SD (logged)	0.767	95% Critical H Value (KM-Log)	2.191
KM Standard Error of Mean (logged)	0.159		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	2.664	Mean in Log Scale	0.191
SD in Original Scale	6.868	SD in Log Scale	0.813
95% t UCL (Assumes normality)	4.627	95% H-Stat UCL	2.302

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	5.113	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Aroclor-1242

General Statistics

Total Number of Observations	44	Number of Distinct Observations	24
Number of Detects	2	Number of Non-Detects	42
Number of Distinct Detects	2	Number of Distinct Non-Detects	22
Minimum Detect	1000	Minimum Non-Detect	8.9
Maximum Detect	2300	Maximum Non-Detect	67
Variance Detects	845000	Percent Non-Detects	95.45%
Mean Detects	1650	SD Detects	919.2
Median Detects	1650	CV Detects	0.557
Skewness Detects	N/A	Kurtosis Detects	N/A
Mean of Logged Detects	7.324	SD of Logged Detects	0.589

Warning: Data set has only 2 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Not Enough Data to Perform GOF Test

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	83.5	Standard Error of Mean	78.64
SD	368.9	95% KM (BCA) UCL	N/A
95% KM (t) UCL	215.7	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	212.8	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	319.4	95% KM Chebyshev UCL	426.3
97.5% KM Chebyshev UCL	574.6	99% KM Chebyshev UCL	866

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	6.092	k star (bias corrected MLE)	N/A
Theta hat (MLE)	270.9	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	24.37	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0512	nu hat (KM)	4.509
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (4.51, α)	0.932	Adjusted Chi Square Value (4.51, β)	0.88
95% Gamma Approximate KM-UCL (use when n>=50)	403.7	95% Gamma Adjusted KM-UCL (use when n<50)	427.7

Gamma (KM) may not be used when k hat (KM) is < 0.1

Lognormal GOF Test on Detected Observations Only

Not Enough Data to Perform GOF Test

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	84.93	Mean in Log Scale	1.597
SD in Original Scale	373.4	SD in Log Scale	1.911
95% t UCL (assumes normality of ROS data)	179.5	95% Percentile Bootstrap UCL	189.2
95% BCA Bootstrap UCL	240.9	95% Bootstrap t UCL	1626
95% H-UCL (Log ROS)	86.28		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	86.21	Mean in Log Scale	2.564
SD in Original Scale	372.6	SD in Log Scale	1.162

95% t UCL (Assumes normality)	180.6	95% H-Stat UCL	40.08

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	215.7	95% KM (% Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Aroclor-1260

General Statistics

Total Number of Observations	44	Number of Distinct Observations	25
Number of Detects	13	Number of Non-Detects	31
Number of Distinct Detects	12	Number of Distinct Non-Detects	14
Minimum Detect	19	Minimum Non-Detect	8.9
Maximum Detect	2700	Maximum Non-Detect	48
Variance Detects	654323	Percent Non-Detects	70.45%
Mean Detects	438.1	SD Detects	808.9
Median Detects	55	CV Detects	1.846
Skewness Detects	2.348	Kurtosis Detects	5.156
Mean of Logged Detects	4.783	SD of Logged Detects	1.57

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.587	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.358	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.246	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	136	Standard Error of Mean	73.05
SD	465.5	95% KM (BCA) UCL	286.2
95% KM (t) UCL	258.8	95% KM (Percentile Bootstrap) UCL	260
95% KM (z) UCL	256.2	95% KM Bootstrap t UCL	679.9
90% KM Chebyshev UCL	355.1	95% KM Chebyshev UCL	454.4
97.5% KM Chebyshev UCL	592.2	99% KM Chebyshev UCL	862.8

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.426	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.792	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.336	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.25	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.49	k star (bias corrected MLE)	0.428
Theta hat (MLE)	893.4	Theta star (bias corrected MLE)	1022
nu hat (MLE)	12.75	nu star (bias corrected)	11.14
MLE Mean (bias corrected)	438.1	MLE Sd (bias corrected)	669.3

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.0853	nu hat (KM)	7.51
Approximate Chi Square Value (7.51, α)	2.455	Adjusted Chi Square Value (7.51, β)	2.358
95% Gamma Approximate KM-UCL (use when n>=50)	416.1	95% Gamma Adjusted KM-UCL (use when n<50)	433.2

Gamma (KM) may not be used when k hat (KM) is < 0.1

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detected data is small such as < 0.1
For such situations, GROS method tends to yield inflated values of UCLs and BTVs
For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	129.4
Maximum	2700	Median	0.01
SD	472.7	CV	3.652
k hat (MLE)	0.119	k star (bias corrected MLE)	0.126
Theta hat (MLE)	1091	Theta star (bias corrected MLE)	1030
nu hat (MLE)	10.44	nu star (bias corrected)	11.06
MLE Mean (bias corrected)	129.4	MLE Sd (bias corrected)	365.1
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (11.06, α)	4.616	Adjusted Chi Square Value (11.06, β)	4.475
95% Gamma Approximate UCL (use when n>=50)	310.2	95% Gamma Adjusted UCL (use when n<50)	320

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.866	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.261	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.246	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	130.5	Mean in Log Scale	1.087
SD in Original Scale	472.5	SD in Log Scale	2.832
95% t UCL (assumes normality of ROS data)	250.2	95% Percentile Bootstrap UCL	252.2
95% BCA Bootstrap UCL	345.7	95% Bootstrap t UCL	661
95% H-UCL (Log ROS)	1366		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	136.1	Mean in Log Scale	2.948
SD in Original Scale	470.9	SD in Log Scale	1.496
95% t UCL (Assumes normality)	255.5	95% H-Stat UCL	115.1

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 454.4

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Aluminum

General Statistics

Total Number of Observations	44	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	3550	Mean	11693
Maximum	31900	Median	9160
SD	7831	Std. Error of Mean	1181
Coefficient of Variation	0.67	Skewness	1.198

Normal GOF Test

Shapiro Wilk Test Statistic	0.833	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.134	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	13678	95% Adjusted-CLT UCL (Chen-1995)	13863
		95% Modified-t UCL (Johnson-1978)	13713

Gamma GOF Test

A-D Test Statistic	1.12	**Anderson-Darling Gamma GOF Test**

5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.152	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.134	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.718	k star (bias corrected MLE)	2.548
Theta hat (MLE)	4302	Theta star (bias corrected MLE)	4589
nu hat (MLE)	239.2	nu star (bias corrected)	224.2
MLE Mean (bias corrected)	11693	MLE Sd (bias corrected)	7325
		Approximate Chi Square Value (0.05)	190.6
Adjusted Level of Significance	0.0445	Adjusted Chi Square Value	189.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	13759	95% Adjusted Gamma UCL (use when n<50)	13835

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.943	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.108	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.134	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.175	Mean of logged Data	9.172
Maximum of Logged Data	10.37	SD of logged Data	0.621

Assuming Lognormal Distribution

95% H-UCL	14091	90% Chebyshev (MVUE) UCL	15101
95% Chebyshev (MVUE) UCL	16685	97.5% Chebyshev (MVUE) UCL	18884
99% Chebyshev (MVUE) UCL	23203		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	13635	95% Jackknife UCL	13678
95% Standard Bootstrap UCL	13558	95% Bootstrap-t UCL	14103
95% Hall's Bootstrap UCL	13843	95% Percentile Bootstrap UCL	13663
95% BCA Bootstrap UCL	13936		
90% Chebyshev(Mean, Sd) UCL	15235	95% Chebyshev(Mean, Sd) UCL	16839
97.5% Chebyshev(Mean, Sd) UCL	19066	99% Chebyshev(Mean, Sd) UCL	23439

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	16839

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	44	Number of Distinct Observations	36
		Number of Missing Observations	0
Minimum	0.62	Mean	11.56
Maximum	346	Median	3.15
SD	51.65	Std. Error of Mean	7.787
Coefficient of Variation	4.47	Skewness	6.609

Normal GOF Test

Shapiro Wilk Test Statistic	0.186	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.475	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.134	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	24.65	95% Adjusted-CLT UCL (Chen-1995)	32.65
		95% Modified-t UCL (Johnson-1978)	25.94

Gamma GOF Test

A-D Test Statistic	7.949	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.812	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.339	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.141	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.516	k star (bias corrected MLE)	0.496
Theta hat (MLE)	22.38	Theta star (bias corrected MLE)	23.28
nu hat (MLE)	45.44	nu star (bias corrected)	43.67
MLE Mean (bias corrected)	11.56	MLE Sd (bias corrected)	16.4
		Approximate Chi Square Value (0.05)	29.52
Adjusted Level of Significance	0.0445	Adjusted Chi Square Value	29.12

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	17.1	95% Adjusted Gamma UCL (use when n<50)	17.33

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.142	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.134	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.478	Mean of logged Data	1.223
Maximum of Logged Data	5.846	SD of logged Data	0.984

Assuming Lognormal Distribution

95% H-UCL	7.847	90% Chebyshev (MVUE) UCL	8.245
95% Chebyshev (MVUE) UCL	9.521	97.5% Chebyshev (MVUE) UCL	11.29
99% Chebyshev (MVUE) UCL	14.77		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	24.36	95% Jackknife UCL	24.65
95% Standard Bootstrap UCL	24.93	95% Bootstrap-t UCL	217.1
95% Hall's Bootstrap UCL	83.66	95% Percentile Bootstrap UCL	27.09
95% BCA Bootstrap UCL	35.48		
90% Chebyshev(Mean, Sd) UCL	34.92	95% Chebyshev(Mean, Sd) UCL	45.5
97.5% Chebyshev(Mean, Sd) UCL	60.18	99% Chebyshev(Mean, Sd) UCL	89.03

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 45.5

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cobalt

General Statistics

Total Number of Observations	44	Number of Distinct Observations	33
Number of Detects	43	Number of Non-Detects	1
Number of Distinct Detects	32	Number of Distinct Non-Detects	1
Minimum Detect	0.72	Minimum Non-Detect	1.4
Maximum Detect	11.5	Maximum Non-Detect	1.4
Variance Detects	3.554	Percent Non-Detects	2.273%

Mean Detects	3.097	SD Detects	1.885
Median Detects	2.8	CV Detects	0.609
Skewness Detects	2.711	Kurtosis Detects	10.22
Mean of Logged Detects	0.991	SD of Logged Detects	0.534

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.752	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.181	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.135	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	3.048	Standard Error of Mean	0.285
SD	1.869	95% KM (BCA) UCL	3.556
95% KM (t) UCL	3.528	95% KM (Percentile Bootstrap) UCL	3.567
95% KM (z) UCL	3.517	95% KM Bootstrap t UCL	3.757
90% KM Chebyshev UCL	3.904	95% KM Chebyshev UCL	4.291
97.5% KM Chebyshev UCL	4.829	99% KM Chebyshev UCL	5.886

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.932	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.753	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.115	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.136	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	3.745	k star (bias corrected MLE)	3.5
Theta hat (MLE)	0.827	Theta star (bias corrected MLE)	0.885
nu hat (MLE)	322.1	nu star (bias corrected)	301
MLE Mean (bias corrected)	3.097	MLE Sd (bias corrected)	1.655

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.66	nu hat (KM)	234.1
Approximate Chi Square Value (234.11, α)	199.7	Adjusted Chi Square Value (234.11, β)	198.6
95% Gamma Approximate KM-UCL (use when n>=50)	3.574	95% Gamma Adjusted KM-UCL (use when n<50)	3.593

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.72	Mean	3.045
Maximum	11.5	Median	2.75
SD	1.894	CV	0.622
k hat (MLE)	3.502	k star (bias corrected MLE)	3.279
Theta hat (MLE)	0.869	Theta star (bias corrected MLE)	0.929
nu hat (MLE)	308.2	nu star (bias corrected)	288.5
MLE Mean (bias corrected)	3.045	MLE Sd (bias corrected)	1.682
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (288.51, α)	250.2	Adjusted Chi Square Value (288.51, β)	249
95% Gamma Approximate UCL (use when n>=50)	3.512	95% Gamma Adjusted UCL (use when n<50)	3.529

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.128	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.135	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	3.053	Mean in Log Scale	0.972
SD in Original Scale	1.886	SD in Log Scale	0.543
95% t UCL (assumes normality of ROS data)	3.531	95% Percentile Bootstrap UCL	3.552
95% BCA Bootstrap UCL	3.657	95% Bootstrap t UCL	3.781
95% H-UCL (Log ROS)	3.593		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	0.967	95% H-UCL (KM -Log)	3.584
KM SD (logged)	0.544	95% Critical H Value (KM-Log)	1.936
KM Standard Error of Mean (logged)	0.0832		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	3.042	Mean in Log Scale	0.96
SD in Original Scale	1.898	SD in Log Scale	0.565
95% t UCL (Assumes normality)	3.523	95% H-Stat UCL	3.627

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Gamma Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL	3.556	95% GROS Adjusted Gamma UCL	3.529
95% Adjusted Gamma KM-UCL	3.593		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Iron

General Statistics

Total Number of Observations	44	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	3390	Mean	17961
Maximum	116000	Median	11600
SD	19486	Std. Error of Mean	2938
Coefficient of Variation	1.085	Skewness	3.454

Normal GOF Test

Shapiro Wilk Test Statistic	0.643	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.227	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.134	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	22900	95% Adjusted-CLT UCL (Chen-1995)	24428
		95% Modified-t UCL (Johnson-1978)	23155

Gamma GOF Test

A-D Test Statistic	1.055	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.766	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.127	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.136	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.631	k star (bias corrected MLE)	1.535
Theta hat (MLE)	11014	Theta star (bias corrected MLE)	11703
nu hat (MLE)	143.5	nu star (bias corrected)	135.1
MLE Mean (bias corrected)	17961	MLE Sd (bias corrected)	14499
		Approximate Chi Square Value (0.05)	109.2
Adjusted Level of Significance	0.0445	Adjusted Chi Square Value	108.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	22213	95% Adjusted Gamma UCL (use when n<50)	22374

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.971	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data appear Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.0794	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.134	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.129	Mean of logged Data	9.459
Maximum of Logged Data	11.66	SD of logged Data	0.782

Assuming Lognormal Distribution

95% H-UCL	22464	90% Chebyshev (MVUE) UCL	24028
95% Chebyshev (MVUE) UCL	27099	97.5% Chebyshev (MVUE) UCL	31360
99% Chebyshev (MVUE) UCL	39731		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	22793	95% Jackknife UCL	22900
95% Standard Bootstrap UCL	22938	95% Bootstrap-t UCL	26115
95% Hall's Bootstrap UCL	42558	95% Percentile Bootstrap UCL	23269
95% BCA Bootstrap UCL	25257		
90% Chebyshev(Mean, Sd) UCL	26774	95% Chebyshev(Mean, Sd) UCL	30766
97.5% Chebyshev(Mean, Sd) UCL	36307	99% Chebyshev(Mean, Sd) UCL	47191

Suggested UCL to Use

95% Adjusted Gamma UCL	22374

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Manganese

General Statistics

Total Number of Observations	44	Number of Distinct Observations	44
		Number of Missing Observations	0
Minimum	19.1	Mean	91.54
Maximum	511	Median	53.85
SD	93.18	Std. Error of Mean	14.05
Coefficient of Variation	1.018	Skewness	2.638

Normal GOF Test

Shapiro Wilk Test Statistic	0.719	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.944	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.218	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.134	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	115.2	95% Adjusted-CLT UCL (Chen-1995)	120.6
		95% Modified-t UCL (Johnson-1978)	116.1

Gamma GOF Test

A-D Test Statistic	1.413	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.767	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.164	**Kolmogrov-Smirnoff Gamma GOF Test**	
5% K-S Critical Value	0.136	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.532	k star (bias corrected MLE)	1.443
Theta hat (MLE)	59.75	Theta star (bias corrected MLE)	63.45
nu hat (MLE)	134.8	nu star (bias corrected)	127
MLE Mean (bias corrected)	91.54	MLE Sd (bias corrected)	76.21
		Approximate Chi Square Value (0.05)	101.9

Adjusted Level of Significance	0.0445	Adjusted Chi Square Value	101.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	114	95% Adjusted Gamma UCL (use when n<50)	114.9

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.932	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.944	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.138	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.134	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.95	Mean of logged Data	4.156
Maximum of Logged Data	6.236	SD of logged Data	0.825

Assuming Lognormal Distribution

95% H-UCL	118	90% Chebyshev (MVUE) UCL	126
95% Chebyshev (MVUE) UCL	142.8	97.5% Chebyshev (MVUE) UCL	166.2
99% Chebyshev (MVUE) UCL	212.1		

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	114.6	95% Jackknife UCL	115.2
95% Standard Bootstrap UCL	114	95% Bootstrap-t UCL	124.4
95% Hall's Bootstrap UCL	129.7	95% Percentile Bootstrap UCL	116
95% BCA Bootstrap UCL	120.8		
90% Chebyshev(Mean, Sd) UCL	133.7	95% Chebyshev(Mean, Sd) UCL	152.8
97.5% Chebyshev(Mean, Sd) UCL	179.3	99% Chebyshev(Mean, Sd) UCL	231.3

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL	152.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Thallium

General Statistics

Total Number of Observations	44	Number of Distinct Observations	33
Number of Detects	3	Number of Non-Detects	41
Number of Distinct Detects	3	Number of Distinct Non-Detects	31
Minimum Detect	0.33	Minimum Non-Detect	0.06
Maximum Detect	1.1	Maximum Non-Detect	2
Variance Detects	0.168	Percent Non-Detects	93.18%
Mean Detects	0.633	SD Detects	0.41
Median Detects	0.47	CV Detects	0.648
Skewness Detects	1.508	Kurtosis Detects	N/A
Mean of Logged Detects	-0.589	SD of Logged Detects	0.619

Warning: Data set has only 3 Detected Values.
This is not enough to compute meaningful or reliable statistics and estimates.

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.881	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.321	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.512	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	0.107	Standard Error of Mean	0.0348
SD	0.176	95% KM (BCA) UCL	N/A

95% KM (t) UCL	0.166	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	0.165	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	0.212	95% KM Chebyshev UCL	0.259
97.5% KM Chebyshev UCL	0.325	99% KM Chebyshev UCL	0.453

Gamma GOF Tests on Detected Observations Only

Not Enough Data to Perform GOF Test

Gamma Statistics on Detected Data Only

k hat (MLE)	3.927	k star (bias corrected MLE)	N/A
Theta hat (MLE)	0.161	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	23.56	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.371	nu hat (KM)	32.64
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (32.64, α)	20.58	Adjusted Chi Square Value (32.64, β)	20.26
95% Gamma Approximate KM-UCL (use when n>=50)	0.17	95% Gamma Adjusted KM-UCL (use when n<50)	0.173

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.946	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.272	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.512	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	0.0768	Mean in Log Scale	-3.219
SD in Original Scale	0.177	SD in Log Scale	0.843
95% t UCL (assumes normality of ROS data)	0.122	95% Percentile Bootstrap UCL	0.124
95% BCA Bootstrap UCL	0.159	95% Bootstrap t UCL	0.212
95% H-UCL (Log ROS)	0.0758		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	-2.617	95% H-UCL (KM -Log)	0.108
KM SD (logged)	0.634	95% Critical H Value (KM-Log)	2.009
KM Standard Error of Mean (logged)	0.133		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	0.215	Mean in Log Scale	-2.012
SD in Original Scale	0.234	SD in Log Scale	0.978
95% t UCL (Assumes normality)	0.274	95% H-Stat UCL	0.306

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	0.166	95% KM (Percentile Bootstrap) UCL	N/A

Warning: One or more Recommended UCL(s) not available!

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Vanadium

General Statistics

Total Number of Observations	44	Number of Distinct Observations	43
Number of Detects	43	Number of Non-Detects	1
Number of Distinct Detects	42	Number of Distinct Non-Detects	1
Minimum Detect	6.5	Minimum Non-Detect	10.1
Maximum Detect	64	Maximum Non-Detect	10.1
Variance Detects	294.7	Percent Non-Detects	2.273%
Mean Detects	26.31	SD Detects	17.17

Median Detects	20.1	CV Detects	0.652
Skewness Detects	1.031	Kurtosis Detects	-0.273
Mean of Logged Detects	3.077	SD of Logged Detects	0.625

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.246	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.135	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	25.9	Standard Error of Mean	2.591
SD	16.99	95% KM (BCA) UCL	30.76
95% KM (t) UCL	30.26	95% KM (Percentile Bootstrap) UCL	30.33
95% KM (z) UCL	30.16	95% KM Bootstrap t UCL	30.82
90% KM Chebyshev UCL	33.67	95% KM Chebyshev UCL	37.2
97.5% KM Chebyshev UCL	42.08	99% KM Chebyshev UCL	51.68

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.277	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.756	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.178	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.136	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	2.742	k star (bias corrected MLE)	2.566
Theta hat (MLE)	9.595	Theta star (bias corrected MLE)	10.25
nu hat (MLE)	235.8	nu star (bias corrected)	220.7
MLE Mean (bias corrected)	26.31	MLE Sd (bias corrected)	16.42

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	2.325	nu hat (KM)	204.6
Approximate Chi Square Value (204.56, α)	172.5	Adjusted Chi Square Value (204.56, β)	171.5
95% Gamma Approximate KM-UCL (use when n>=50)	30.72	95% Gamma Adjusted KM-UCL (use when n<50)	30.9

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	4.914	Mean	25.83
Maximum	64	Median	20.05
SD	17.27	CV	0.669
k hat (MLE)	2.554	k star (bias corrected MLE)	2.395
Theta hat (MLE)	10.11	Theta star (bias corrected MLE)	10.78
nu hat (MLE)	224.7	nu star (bias corrected)	210.8
MLE Mean (bias corrected)	25.83	MLE Sd (bias corrected)	16.69
		Adjusted Level of Significance (β)	0.0445
Approximate Chi Square Value (210.76, α)	178.2	Adjusted Chi Square Value (210.76, β)	177.1
95% Gamma Approximate UCL (use when n>=50)	30.55	95% Gamma Adjusted UCL (use when n<50)	30.72

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.944	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.943	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.136	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.135	Detected Data Not Lognormal at 5% Significance Level

Detected Data appear Approximate Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	25.89	Mean in Log Scale	3.054
SD in Original Scale	17.19	SD in Log Scale	0.636
95% t UCL (assumes normality of ROS data)	30.25	95% Percentile Bootstrap UCL	30.35
95% BCA Bootstrap UCL	30.5	95% Bootstrap t UCL	30.9
95% H-UCL (Log ROS)	31.54		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	3.054	95% H-UCL (KM -Log)	31.3
KM SD (logged)	0.628	95% Critical H Value (KM-Log)	2.003
KM Standard Error of Mean (logged)	0.0959		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	25.83	Mean in Log Scale	3.044
SD in Original Scale	17.27	SD in Log Scale	0.656
95% t UCL (Assumes normality)	30.2	95% H-Stat UCL	31.86

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (Chebyshev) UCL 37.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Attachment 2
Human Health Risk Assessment Tables – Soil Outside Fenced Area and Debris

TABLE 1.1

Summary of Data Used in Revised Human Health Risk Assessment - Soil

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Medium/SampleID	Date of Sampling	Sample Locations	Parameters
Soil outside Fenced Area and Debris of Site 4			
CAA03-SB09-1109	11/5/2009	CAA03-SB09	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SB10-1109	11/5/2009	CAA03-SB10	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS09-1109	11/5/2009	CAA03-SS09	VOCs, SVOCs, Pest/PCBs, Metals
CAA03-SS10-1109	11/5/2009	CAA03-SS10	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB01-1109	11/3/2009	CAS04-SB01	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB02-1109	11/3/2009	CAS04-SB02	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB03-1109	11/3/2009	CAS04-SB03	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB04-1109	11/3/2009	CAS04-SB04	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB05-1109	11/3/2009	CAS04-SB05	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SB06-1012	10/23/2012	CAS04-SO06	Select SVOCs, PCBs, Metals
CAS04-SB06P-1012[1]	10/23/2012	CAS04-SO06	Select SVOCs, PCBs, Metals
CAS04-SB07-1012	10/23/2012	CAS04-SO07	Select SVOCs, PCBs, Metals
CAS04-SB16-1012	10/23/2012	CAS04-SO16	Hexavalent Chromium, Total Chromium
CAS04-SS01-1109	11/3/2009	CAS04-SS01	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS02-1109	11/3/2009	CAS04-SS02	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS03-1109	11/3/2009	CAS04-SS03	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS04-1109	11/3/2009	CAS04-SS04	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS05-1109	11/3/2009	CAS04-SS05	VOCs, SVOCs, Pest/PCBs, Metals
CAS04-SS06-1012	10/23/2012	CAS04-SO06	Select SVOCs, PCBs, Metals
CAS04-SS07-1012	10/23/2012	CAS04-SO07	Select SVOCs, PCBs, Metals
CAS04-SS10-1012	10/23/2012	CAS04-SO10	Select SVOCs, PCBs, Metals
CAS04-SS14-1012	10/23/2012	CAS04-SO14	Hexavalent Chromium, Total Chromium
CAS04-SS14P-1012[1]	10/23/2012	CAS04-SO14	Hexavalent Chromium, Total Chromium

Notes:
[1] Duplicate of previous sample.
SVOCs - Semivolatile Organic Compounds
VOCs - Volatile Organic Compounds
Pest/PCBs - Pesticides/Polychlorinated Biphenyls

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Soil* Outside	78-93-3	2-Butanone	2.2E-02 J	2.4E-02 J	MG/KG	CAA03-SS09-1109	2/14	0.026 - 0.034	2.4E-02	N/A	2.7E+03 N	1.2E-01	SSL	NO	BSL
Debris	67-64-1	Acetone	9.4E-02 J	6.4E-01 J	MG/KG	CAA03-SS09-1109	7/14	0.026 - 0.034	6.4E-01	N/A	6.1E+03 N	2.9E-01	SSL	NO	BSL
Outside	67-66-3	Chloroform	6.0E-04 J	1.0E-03 J	MG/KG	CAS04-SB04-1109	3/14	0.006 - 0.008	1.0E-03	N/A	3.2E-01 C	6.1E-05	SSL	NO	BSL
Fenced Area	75-09-2	Methylene chloride	1.2E-02 J	1.2E-02 J	MG/KG	CAA03-SB10-1109, CAS04-SB04-1109	2/14	0.026 - 0.034	1.2E-02	N/A	3.5E+01 N	2.7E-03	SSL	NO	BSL
	100-42-5	Styrene	2.0E-03 J	1.0E-02 J	MG/KG	CAA03-SS10-1109	3/14	0.005 - 0.007	1.0E-02	N/A	6.0E+02 N	1.3E-01	SSL	NO	BSL
	108-88-3	Toluene	2.0E-03 J	3.0E-03 J	MG/KG	CAA03-SS10-1109	3/14	0.005 - 0.007	3.0E-03	N/A	4.9E+02 N	7.6E-02	SSL	NO	BSL
	91-57-6	2-Methylnaphthalene	7.0E-03 J	4.8E-02	MG/KG	CAS04-SS09-1012	2/20	0.018 - 0.045	4.8E-02	N/A	2.3E+01 N	1.9E-02	SSL	NO	BSL
	83-32-9	Acenaphthene	3.0E-03 J	1.3E-01	MG/KG	CAS04-SS09-1012	3/20	0.018 - 0.045	1.3E-01	N/A	3.5E+02 N	5.5E-01	SSL	NO	BSL
	208-96-8	Acenaphthylene	1.5E-02 J	3.6E-02	MG/KG	CAS04-SS09-1012	2/20	0.018 - 0.045	3.6E-02	N/A	3.5E+02 N	N/A		NO	BSL
	120-12-7	Anthracene	1.7E-03 J	2.6E-01	MG/KG	CAS04-SS09-1012	9/20	0.018 - 0.045	2.6E-01	N/A	1.7E+03 N	5.8E+00	SSL	NO	BSL
	56-55-3	**Benzo(a)anthracene**	**2.7E-03 J**	**1.2E+00**	**MG/KG**	**CAS04-SS09-1012**	**16/20**	**0.018 - 0.280**	**1.2E+00**	**N/A**	**1.5E-01 C**	**1.2E-02**	**SSL**	**YES**	**ASL**
	50-32-8	**Benzo(a)pyrene**	**4.4E-03 J**	**9.7E-01**	**MG/KG**	**CAS04-SS09-1012**	**11/20**	**0.018 - 0.280**	**9.7E-01**	**N/A**	**1.5E-02 C**	**4.0E-03**	**SSL**	**YES**	**ASL**
	205-99-2	**Benzo(b)fluoranthene**	**1.0E-02 J**	**1.6E+00**	**MG/KG**	**CAS04-SS09-1012**	**10/20**	**0.018 - 0.280**	**1.6E+00**	**N/A**	**1.5E-01 C**	**4.1E-02**	**SSL**	**YES**	**ASL**
	191-24-2	Benzo(g,h,i)perylene	2.4E-03 J	5.2E-01	MG/KG	CAS04-SS09-1012	6/17	0.020 - 0.280	5.2E-01	N/A	1.7E+02 N	N/A		NO	BSL
	207-08-9	Benzo(k)fluoranthene	3.7E-03 J	5.6E-01	MG/KG	CAS04-SS09-1012	7/20	0.018 - 0.280	5.6E-01	N/A	1.5E+00 C	4.0E-01	SSL	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	6.6E-02 J	6.6E-02 J	MG/KG	CAS04-SS05-1109	1/14	0.089 - 0.120	6.6E-02	N/A	3.8E+01 C	1.3E+00	SSL	NO	BSL
	86-74-8	Carbazole	2.1E-03 J	4.0E-03 J	MG/KG	CAA03-SS10-1109	6/14	0.018 - 0.025	4.0E-03	N/A	2.4E+01 C	N/A		NO	BSL
	218-01-9	Chrysene	2.2E-03 J	1.5E+00	MG/KG	CAS04-SS09-1012	10/20	0.018 - 0.280	1.5E+00	N/A	1.5E+01 C	1.2E+00	SSL	NO	BSL
	53-70-3	**Dibenz(a,h)anthracene**	**3.6E-03 J**	**1.9E-01**	**MG/KG**	**CAS04-SS09-1012**	**8/20**	**0.018 - 0.045**	**1.9E-01**	**N/A**	**1.5E-02 C**	**1.3E-02**	**SSL**	**YES**	**ASL**
	206-44-0	Fluoranthene	2.7E-03 J	3.0E+00	MG/KG	CAS04-SS09-1012	13/20	0.018 - 0.280	3.0E+00	N/A	2.3E+02 N	8.9E+00	SSL	NO	BSL
	86-73-7	Fluorene	4.7E-03 J	2.0E-01	MG/KG	CAS04-SS09-1012	3/20	0.018 - 0.045	2.0E-01	N/A	2.3E+02 N	5.4E-01	SSL	NO	BSL
	193-39-5	**Indeno(1,2,3-cd)pyrene**	**3.7E-03 J**	**8.5E-01**	**MG/KG**	**CAS04-SS09-1012**	**10/20**	**0.018 - 0.280**	**8.5E-01**	**N/A**	**1.5E-01 C**	**2.4E-01**	**SSL**	**YES**	**ASL**
	91-20-3	Naphthalene	1.1E-02 J	1.3E-01	MG/KG	CAS04-SS09-1012	2/20	0.018 - 0.045	1.3E-01	N/A	3.8E+00 C	5.4E-04	SSL	NO	BSL
	85-01-8	Phenanthrene	3.2E-03 J	2.4E+00	MG/KG	CAS04-SS09-1012	12/20	0.018 - 0.280	2.4E+00	N/A	1.7E+03 N	N/A		NO	BSL
	129-00-0	Pyrene	3.8E-03 J	2.4E+00 J	MG/KG	CAS04-SS09-1012	12/20	0.018 - 0.280	2.4E+00	N/A	1.7E+02 N	1.3E+00	SSL	NO	BSL
	72-55-9	4,4'-DDE	9.0E-04 L	1.7E-03 J	MG/KG	CAA03-SS10-1109	3/14	0.0033 - 0.0041	1.7E-03	N/A	1.6E+00 C	5.4E-02	SSL	NO	BSL
	50-29-3	4,4'-DDT	1.7E-03 J	3.4E-03 J	MG/KG	CAA03-SS10-1109	2/14	0.0033 - 0.0041	3.4E-03	N/A	1.9E+00 C	7.7E-02	SSL	NO	BSL
	5103-71-9	alpha-Chlordane	5.4E-04 J	5.4E-04 J	MG/KG	CAS04-SS04-1109	1/14	0.0017 - 0.0021	5.4E-04	N/A	1.8E+00 C	N/A		NO	BSL
	11096-82-5	Aroclor-1260	1.9E-02 J	5.5E-02	MG/KG	CAS04-SS06-1012	4/20	0.018 - 0.04	5.5E-02	N/A	2.4E-01 C	2.7E-02	SSL	NO	BSL
	60-57-1	Dieldrin	6.5E-04 J	6.5E-04 J	MG/KG	CAA03-SB09-1109	1/14	0.0033 - 0.0041	6.5E-04	N/A	3.3E-02 C	6.9E-05	SSL	NO	BSL
	72-20-8	Endrin	3.5E-03 J	5.5E-02	MG/KG	CAA03-SS09-1109	4/14	0.0033 - 0.0041	5.5E-02	N/A	1.8E+00 N	9.2E-03	SSL	NO	BSL
	7421-93-4	Endrin aldehyde	1.0E-03 J	2.2E-03 J	MG/KG	CAA03-SS10-1109	4/14	0.0033 - 0.0041	2.2E-03	1.2E+04	1.8E+00 N	N/A		NO	BSL
	7429-90-5	**Aluminum**	**4.0E+03**	**3.2E+04**	**MG/KG**	**CAS04-SB07-1012**	**20/20**	**19 - 64**	**3.2E+04**	**N/A**	**7.7E+03 N**	**3.0E+03**	**SSL**	**YES**	**ASL**

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
	7440-36-0	Antimony	4.0E-02 J	2.3E-01 J	MG/KG	CAS04-SS06-1012	16/20	0.065 - 1.7	2.3E-01	5.5E+00	3.1E+00 N	3.5E-02	SSL	NO	BSL
	7440-38-2	**Arsenic**	**6.2E-01**	**1.3E+01**	**MG/KG**	**CAA03-SB09-1109**	**20/20**	**0.32 - 1.7**	**1.3E+01**	**5.3E+01**	**6.7E-01 C**	**1.5E-03**	**SSL**	**YES**	**ASL**
	7440-39-3	Barium	1.1E+01	6.2E+01	MG/KG	CAS04-SS10-1012	20/20	0.31 - 1.1	6.2E+01	5.9E-01	1.5E+03 N	1.6E+01	SSL	NO	BSL
	7440-41-7	Beryllium	1.9E-01 J	8.9E-01	MG/KG	CAA03-SB09-1109	20/20	0.31 - 1.1	8.9E-01	N/A	1.6E+01 N	1.9E+00	SSL	NO	BSL
	7440-43-9	Cadmium	3.0E-02 J	2.7E+00	MG/KG	CAS04-SS10-1012	5/20	0.35 - 2.2	2.7E+00	2.3E+03	7.0E+00 N	6.9E-02	SSL	NO	BSL
	7440-70-2	Calcium	1.1E+02	4.5E+03	MG/KG	CAS04-SS10-1012	20/20	4.6 - 21	4.5E+03	1.8E+01	N/A	N/A		NO	NUT
	18540-29-9	**Chromium (hexavalent)**	**4.3E-01 J**	**4.3E-01 J**	**MG/KG**	**CAS04-SB16-1012**	**1/2**	**0.42 - 0.44**	**4.3E-01**	**N/A**	**3.0E-01 C**	**6.7E-04**	**SSL**	**YES**	**ASL**
	7440-47-3	Chromium	5.8E+00	4.6E+01	MG/KG	CAA03-SB09-1109	22/22	0.5 - 3.3	4.6E+01	5.2E+00	1.2E+04 N	4.0E+06	SSL	NO	BSL
	7440-48-4	**Cobalt**	**7.2E-01**	**4.0E+00**	**MG/KG**	**CAS04-SB07-1012**	**20/20**	**0.065 - 2.1**	**4.0E+00**	**3.2E+00**	**2.3E+00 N**	**2.7E-02**	**SSL**	**YES**	**ASL**
	7440-50-8	Copper	1.4E+00 J	3.2E+01	MG/KG	CAS04-SS10-1012	18/20	1.6 - 5.4	3.2E+01	2.0E+04	3.1E+02 N	2.8E+00	SSL	NO	BSL
	7439-89-6	**Iron**	**3.4E+03**	**3.2E+04**	**MG/KG**	**CAA03-SB09-1109**	**20/20**	**6.5 - 21**	**3.2E+04**	**8.8E+00**	**5.5E+03 N**	**3.5E+01**	**SSL**	**YES**	**ASL**
	7439-92-1	Lead	3.8E+00	5.3E+01	MG/KG	CAS04-SS10-1012	19/20	0.32 - 1.1	5.3E+01	1.1E+03	4.0E+02 N	1.4E+01	SSL	NO	BSL
	7439-95-4	Magnesium	3.4E+02	2.7E+03	MG/KG	CAA03-SB09-1109	20/20	3.2 - 21	2.7E+03	1.8E+02	N/A	N/A		NO	NUT
	7439-96-5	Manganese	1.9E+01	9.2E+01	MG/KG	CAS04-SS09-1012	20/20	0.32 - 1.1	9.2E+01	1.1E-01	1.8E+02 N	2.8E+00	SSL	NO	BSL
	7439-97-6	Mercury	1.0E-02 J	1.0E-01	MG/KG	CAS04-SS10-1012	19/20	0.03 - 0.063	1.0E-01	9.5E+00	2.3E+00 N	N/A		NO	BSL
	7440-02-0	Nickel	1.8E+00 J	8.9E+00	MG/KG	CAA03-SB09-1109	20/20	0.71 - 8.9	8.9E+00	7.1E+02	1.5E+02 N	2.6E+00	SSL	NO	BSL
	7440-09-7	Potassium	2.4E+02	3.7E+03	MG/KG	CAA03-SB09-1109	20/20	62 - 210	3.7E+03	5.1E-01	N/A	N/A		NO	NUT
	7782-49-2	Selenium	1.8E-01 J	5.9E-01 J	MG/KG	CAS04-SS07-1012	16/20	0.32 - 2.1	5.9E-01	N/A	3.9E+01 N	5.2E-02	SSL	NO	BSL
	7440-22-4	Silver	9.0E-02 J	8.2E-01 J	MG/KG	CAA03-SB09-1109	6/20	0.71 - 3.3	8.2E-01	5.2E+02	3.9E+01 N	8.0E-02	SSL	NO	BSL
	7440-23-5	Sodium	1.3E+01 J	5.5E+01 K	MG/KG	CAS04-SB01-1109	14/20	62 - 210	5.5E+01	N/A	N/A	N/A		NO	NUT
	7440-28-0	**Thallium**	**3.3E-01**	**3.3E-01**	**MG/KG**	**CAS04-SB01-1109**	**1/20**	**0.13 - 3.2**	**3.3E-01**	**2.8E+01**	**7.8E-02 N**	**1.4E-03**	**SSL**	**YES**	**ASL**
	7440-62-2	**Vanadium**	**6.5E+00**	**6.4E+01**	**MG/KG**	**CAS04-SB07-1012**	**20/20**	**0.32 - 2.1**	**6.4E+01**	**2.7E+01**	**3.9E+01 N**	**8.6E+00**	**SSL**	**YES**	**ASL**
	7440-66-6	Zinc	7.8E+00 K	2.4E+02	MG/KG	CAS04-SS10-1012	20/20	1.2 - 4.3	2.4E+02		2.3E+03 N	3.7E+01	SSL	NO	BSL

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

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

* Surface soil and subsurface soil combined

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Background values are the lower of surface and subsurface 95% UTL from Cheatham Annex/Yorktown background samples, June 2012.

[4] Oak Ridge National Laboratory (ORNL). January 2015. Regional Screening Levels for Chemical Contaminants at Superfund Sites. [Online]. Residential Soil. Available: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm

RSLs based on noncarcinogenic health effects are based on HQ=0.1. RSLs based on carcinogenic effects based on cancer risk of 1x10-6.

Screening value for carbazole calculated using RSL calculator, and oral cancer slope factor of 2.0E-02 (mg/kg-day)-1 from USEPA's Health Affects Assessment Summary Tables, July 1997.

RSL value for acenaphthene used as surrogate for acenaphthylene.

RSL value for pyrene used as surrogate for benzo(g,h,i)perylene.

RSL value for anthracene used as surrogate for phenanthrene.

RSL value for chlordane used as surrogate for alpha-chlordane.

RSL value for endrin used as surrogate for endrin aldehyde.

RSL value for chromium(III) used for chromium since two samples analyzed for hexavalent.

The soil value of 400 mg/kg for lead is from the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities, USEPA, July 14, 1994.

RSL value for mercuric chloride (and other mercury salts) used as surrogate for mercury.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

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

COPC = Chemical of Potential Concern

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

J = Estimated Value

K = Biased High

L = Biased Low

C = Carcinogenic

N = Noncarcinogenic

MG/KG = milligrams per kilogram

SSL = Risk Based Soil Screening Levels from RSL table

N/A = not available/not applicable

Table 3.1
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Soil* Outside Debris Ouside Fenced Area	Benzo(a)anthracene	MG/KG	9.1E-02	7.1E-01	NP	1.2E+00		7.1E-01	MG/KG	99% KM-c	4
	Benzo(a)pyrene	MG/KG	7.4E-02	5.8E-01	NP	9.7E-01		5.8E-01	MG/KG	99% KM-c	4
	Benzo(b)fluoranthene	MG/KG	1.2E-01	9.7E-01	NP	1.6E+00		9.7E-01	MG/KG	99% KM-c	4
	Dibenz(a,h)anthracene	MG/KG	2.0E-02	3.8E-02	NP	1.9E-01		3.8E-02	MG/KG	95% KM-BCA	1
	Indeno(1,2,3-cd)pyrene	MG/KG	7.5E-02	5.4E-01	NP	8.5E-01		5.4E-01	MG/KG	99% KM-c	4
	Aluminum	MG/KG	1.5E+04	2.0E+04	G	3.2E+04		2.0E+04	MG/KG	95% Adj-G	1, 3
	Arsenic	MG/KG	4.2E+00	5.5E+00	N	1.3E+01		5.5E+00	MG/KG	95% Stud-t	1, 2, 3
	Chromium (hexavalent)	MG/KG	2.7E-01	N/A		4.3E-01	J	4.3E-01	MG/KG	Max	6
	Cobalt	MG/KG	2.4E+00	2.8E+00	N	4.0E+00		2.8E+00	MG/KG	95% Stud-t	1, 2, 3
	Iron	MG/KG	1.5E+04	2.1E+04	G	3.2E+04		2.1E+04	MG/KG	95% Adj-G	1, 3
	Thallium	MG/KG	2.8E-01	N/A		3.3E-01		3.3E-01	MG/KG	Max	5
	Vanadium	MG/KG	3.2E+01	4.5E+01	G	6.4E+01		4.5E+01	MG/KG	95% Adj-G	1, 3

Table 3.1
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale

* Surface soil and subsurface soil combined.
ProUCL, Version 5.0.00 used to determine distribution of data and calculate 95% UCL, following recommendations in user's guide (USEPA. September 2013. Prepared by Lockheed Martin Environmental Services).
Options: 99% Kaplan-Meier (Chebyshev) UCL (99% KM-c); 95% Kaplan-Meier (BCA) UCL (95% KM-BCA); 95% Adjusted Gamma UCL (95% Adj-G); 95% Student's-t UCL (95% Stud-t); Maximum detected concentration (Max).

UCL Rationale:
(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
(3) Statistical tests indicate data are gamma distributed.
(4) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(5) Only one detected concentration. ProUCL indicates ProUCL should not be used on such a data set. Therefore, maximum detected concentration used as EPC.
(6) Maximum detected concentration used because less than 8 samples.

G - Gamma
MG/KG = milligrams per kilogram
N - Normal
NP - Non-Parametric

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Soil* Ouside Debris Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	100	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Soil* Ouside Debris Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S	Ingestion Rate of Soil	200	mg/day	EPA, 1991	CS x IR-S x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Soil* Ouside Debris Outside Fenced Area	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-S-A	Ingestion Rate of Soil, Adult	100	mg/day	EPA, 1991	CS x IR-S-Adj x EF x CF1 x 1/AT
				IR-S-C	Ingestion Rate of Soil, Child	200	mg/day	EPA, 1991	
				IR-S-Adj	Ingestion Rate of Soil, Age-adjusted	114.29	mg-year/kg-day	Calculated	IR-S-Adj (mg-year/kg-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-S-C / BW-C) + (ED-A x IR-S-A / BW-A)
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Medium: Soil*
Exposure Medium: Soil*

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Soil* Ouside Debris	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	CDI (mg/kg-day) =
			Outside Fenced Area	SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
	Resident	Child	Soil* Ouside Debris	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	CDI (mg/kg-day) =
			Outside Fenced Area	SA	Skin Surface Area Available for Contact	2,800	cm^2	EPA, 2004	CS x SA x SSAF x DABS x CF1 x EF x
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm^2-day	EPA, 2004	ED x 1/BW x 1/AT
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
	Resident	Child/Adult	Soil* Ouside Debris	CS	Chemical Concentration in Soil	Table 3.1	mg/kg	Table 3.1	CDI (mg/kg-day) =
			Outside Fenced Area	SA-A	Skin Surface Area Available for Contact, Adult	5,700	cm^2	EPA, 2004	CS x DA-Adj x DABS x CF1 x EF x 1/AT
				SA-C	Skin Surface Area Available for Contact, Child	2,800	cm^2	EPA, 2004	
				SSAF-A	Soil to Skin Adherence Factor, Adult	0.07	mg/cm^2-day	EPA, 2004	DA-Adj (mg-year/kg-day) =
				SSAF-C	Soil to Skin Adherence Factor, Child	0.2	mg/cm^2-day	EPA, 2004	
				DA-Adj	Dermal Absorption, Age-adjusted	361	mg-year/kg-day	Calculated	(ED-C x SA-C x SSAF-C / BW-C) + (ED-A x SA-A x SSAF-A / BW-A)
				DABS	Dermal Absorption Factor Solids	Chemical specific	--	EPA, 2004	
				CF1	Conversion Factor 1	0.000001	kg/mg	- -	
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

Notes:

* Surface soil and subsurface soil combined

Sources:

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

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

EPA, 2004 . Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). EPA/540/R/99/005. July 2004.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (MM/DD/YY)
Benzo(a)anthracene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Benzo(a)pyrene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Benzo(b)fluoranthene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Dibenz(a,h)anthracene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Indeno(1,2,3-cd)pyrene	Chronic	N/A			N/A					
	Subchronic	N/A			N/A					
Aluminum	Chronic	1.0E+00	mg/kg-day	N/A	1.0E+00	mg/kg-day	Neurological	100	PPRTV	10/23/2006
	Subchronic	1.0E+00	mg/kg-day	N/A	1.0E+00	mg/kg-day	Neurological	30	ATSDR	9/2008
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3/1	IRIS	10/10/2014
	Subchronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3	HEAST	7/1997
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	NOE	300/1	IRIS	10/10/2014
	Subchronic	5.0E-03	mg/kg-day	2.5%	1.3E-04	mg/kg-day	Blood	100	ATSDR	9/2012
Cobalt	Chronic	3.0E-04	mg/kg-day	N/A	3.0E-04	mg/kg/day	Thyroid	3000	PPRTV	8/25/2008
	Subchronic	3.0E-03	mg/kg-day	N/A	3.0E-03	mg/kg/day	Thyroid	300	PPRTV	8/25/2008
Iron	Chronic	7.0E-01	mg/kg/day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1.5	PPRTV	9/11/2006
	Subchronic	7.0E-01	mg/kg/day	N/A	7.0E-01	mg/kg/day	Gastrointestinal	1.5	PPRTV	9/11/2006
Thallium	Chronic	1.0E-05	mg/kg-day	100%	1.0E-05	mg/kg-day	Hair	3000	PPRTV	10/08/10
	Subchronic	4.0E-05	mg/kg-day	100%	4.0E-05	mg/kg-day	Hair	1000	PPRTV	10/08/10
Vanadium	Chronic	5.0E-03	mg/kg-day	2.6%	1.3E-04	mg/kg-day	Kidney	300	RSL/IRIS	10/10/2014
	Subchronic	7.0E-03	mg/kg-day	2.6%	1.8E-04	mg/kg-day	Whole Body	100	HEAST	7/1997

Notes:

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

(2) Adjusted based on RAGS Part E. (dermal RfD = Oral RfD x oral absorption efficiency)

Definitions:
ATSDR = Agency for Toxic Substances and Disease Registry
CNS = Central Nervous System
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
N/A = Not Available
NOE = No Observed Effects
PPRTV = Provisional Peer-Reviewed Toxicity Value
RSL = USEPA Regional Screening Level Table

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal Cancer Slope Factor (2)	Units	EPA Carcinogen Group	Source	Date (MM/DD/YY)
Benzo(a)anthracene (3)	7.3E-01	58 - 89%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Benzo(a)pyrene (3)	7.3E+00	58 - 89%	7.3E+00	$(mg/kg\text{-}day)^{-1}$	B2	IRIS	6/19/2013
Benzo(b)fluoranthene (3)	7.3E-01	58 - 89%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Dibenz(a,h)anthracene (3)	7.3E+00	58 - 89%	7.3E+00	$(mg/kg\text{-}day)^{-1}$	2B	NCEA	7/1/1993
Indeno(1,2,3-cd)pyrene (3)	7.3E-01	58 - 89%	7.3E-01	$(mg/kg\text{-}day)^{-1}$	B2	NCEA	7/1/1993
Aluminum	N/A		N/A				
Arsenic	1.5E+00	95%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	10/10/2014
Chromium (hexavalent) (3)	5.0E-01	2.5%	2.0E+01	$(mg/kg\text{-}day)^{-1}$	D	NJ DEP	4/8/2009
Cobalt	N/A		N/A				
Iron	N/A		N/A				
Thallium	N/A		N/A				
Vanadium	N/A		N/A				

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

(2) Adjusted based on RAGS Part E. (dermal CSF = Oral CSF / oral absorption efficiency)

(3) This chemical operates with a mutagenic mode of action.
Chemical-specific data are not available; therefore, default age-dependent adjustment factors (ADAF) will be applied to the slope factor as follows:

AGE	AGE ADAF	EXPOSURE DURATION
0-<2	10	2
2-<6	3	4
6-<16	3	10
16-<30	1	14

Definitions:
IRIS = Integrated Risk Information System
N/A = Not Available
NCEA = National Center for Environmental Assessment
NJ DEP = New Jersey Department of Environmental Protection

Weight of Evidence definitions:
Group A chemicals (known human carcinogens) are agents for which there is sufficient evidence to support the causal association between exposure to the agents in humans and cancer
Group B1 chemicals (probable human carcinogens) are agents for which there is limited evidence of possible carcinogenicity in humans
Group B2 chemicals (probable human carcinogens) are agents for which there is sufficient evidence of carcinogenicity in animals but inadequate or a lack of evidence in humans
Group C chemicals (possible human carcinogens) are agents for which there is limited evidence of carcinogenicity in animals and inadequate or a lack of human data
Group D chemicals (not classifiable as to human carcinogenicity) are agents with inadequate human and animal evidence of carcinogenicity or for which no data are available
Group E chemicals (evidence of noncarcinogenicity in humans) are agents for which there is no evidence of carcinogenicity from human or animal studies, or both

2B: The agent is possibly carcinogenic to humans

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Soil* Outside Debris Outside Fenced Area	Ingestion	Benzo(a)anthracene	7.1E-01	mg/kg	N/A		N/A		N/A	9.7E-07	mg/kg/day	N/A		N/A
				Benzo(a)pyrene	5.8E-01	mg/kg	N/A		N/A		N/A	8.0E-07	mg/kg/day	N/A		N/A
				Benzo(b)fluoranthene	9.7E-01	mg/kg	N/A		N/A		N/A	1.3E-06	mg/kg/day	N/A		N/A
				Dibenz(a,h)anthracene	3.8E-02	mg/kg	N/A		N/A		N/A	5.2E-08	mg/kg/day	N/A		N/A
				Indeno(1,2,3-cd)pyrene	5.4E-01	mg/kg	N/A		N/A		N/A	7.4E-07	mg/kg/day	N/A		N/A
				Aluminum	2.0E+04	mg/kg	N/A		N/A		N/A	2.8E-02	mg/kg/day	1.0E+00	mg/kg/day	2.8E-02
				Arsenic	5.5E+00	mg/kg	N/A		N/A		N/A	7.6E-06	mg/kg/day	3.0E-04	mg/kg/day	2.5E-02
				Chromium (hexavalent)	4.3E-01	mg/kg	N/A		N/A		N/A	5.9E-07	mg/kg/day	3.0E-03	mg/kg/day	2.0E-04
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	3.8E-06	mg/kg/day	3.0E-04	mg/kg/day	1.3E-02
				Iron	2.1E+04	mg/kg	N/A		N/A		N/A	2.9E-02	mg/kg/day	7.0E-01	mg/kg/day	4.1E-02
				Thallium	3.3E-01	mg/kg	N/A		N/A		N/A	4.5E-07	mg/kg/day	1.0E-05	mg/kg/day	4.5E-02
				Vanadium	4.5E+01	mg/kg	N/A		N/A		N/A	6.2E-05	mg/kg/day	5.0E-03	mg/kg/day	1.2E-02
			Exp. Route Total								N/A					1.7E-01
			Dermal Absorption[1]	Benzo(a)anthracene	7.1E-01	mg/kg	N/A		N/A		N/A	5.2E-07	mg/kg/day	N/A		N/A
				Benzo(a)pyrene	5.8E-01	mg/kg	N/A		N/A		N/A	4.3E-07	mg/kg/day	N/A		N/A
				Benzo(b)fluoranthene	9.7E-01	mg/kg	N/A		N/A		N/A	7.2E-07	mg/kg/day	N/A		N/A
				Dibenz(a,h)anthracene	3.8E-02	mg/kg	N/A		N/A		N/A	2.8E-08	mg/kg/day	N/A		N/A
				Indeno(1,2,3-cd)pyrene	5.4E-01	mg/kg	N/A		N/A		N/A	4.0E-07	mg/kg/day	N/A		N/A
				Aluminum	2.0E+04	mg/kg	N/A		N/A		N/A	1.2E-03	mg/kg/day	1.0E+00	mg/kg/day	1.2E-03
				Arsenic	5.5E+00	mg/kg	N/A		N/A		N/A	9.5E-07	mg/kg/day	3.0E-04	mg/kg/day	3.2E-03
				Chromium (hexavalent)	4.3E-01	mg/kg	N/A		N/A		N/A	2.4E-08	mg/kg/day	7.5E-05	mg/kg/day	3.3E-04
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	1.6E-07	mg/kg/day	3.0E-04	mg/kg/day	5.3E-04
				Iron	2.1E+04	mg/kg	N/A		N/A		N/A	1.2E-03	mg/kg/day	7.0E-01	mg/kg/day	1.7E-03
				Thallium	3.3E-01	mg/kg	N/A		N/A		N/A	1.9E-08	mg/kg/day	1.0E-05	mg/kg/day	1.9E-03
				Vanadium	4.5E+01	mg/kg	N/A		N/A		N/A	2.6E-06	mg/kg/day	1.3E-04	mg/kg/day	2.0E-02
			Exp. Route Total								N/A					2.9E-02
		Exposure Point Total									N/A					1.9E-01
	Exposure Medium Total										N/A					1.9E-01
Soil* Outside Fenced Area											N/A					1.9E-01
										Total of Receptor Risk	N/A				Total of Receptor Hazard	1.9E-01

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABs of 0.1 used for SVOCs and pesticides, DABS of 0.13 used for PAHs, DABS of 0.14 used for aroclors, DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

* Surface soil and subsurface soil combined.

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Soil* Outside Debris Outside Fenced Area	Ingestion	Benzo(a)anthracene	7.1E-01	mg/kg	N/A		N/A		N/A	9.0E-06	mg/kg/day	N/A		N/A
				Benzo(a)pyrene	5.8E-01	mg/kg	N/A		N/A		N/A	7.4E-06	mg/kg/day	N/A		N/A
				Benzo(b)fluoranthene	9.7E-01	mg/kg	N/A		N/A		N/A	1.2E-05	mg/kg/day	N/A		N/A
				Dibenz(a,h)anthracene	3.8E-02	mg/kg	N/A		N/A		N/A	4.8E-07	mg/kg/day	N/A		N/A
				Indeno(1,2,3-cd)pyrene	5.4E-01	mg/kg	N/A		N/A		N/A	7.0E-06	mg/kg/day	N/A		N/A
				Aluminum	2.0E+04	mg/kg	N/A		N/A		N/A	2.6E-01	mg/kg/day	1.0E+00	mg/kg/day	2.6E-01
				Arsenic	5.5E+00	mg/kg	N/A		N/A		N/A	7.1E-05	mg/kg/day	3.0E-04	mg/kg/day	2.4E-01
				Chromium (hexavalent)	4.3E-01	mg/kg	N/A		N/A		N/A	5.5E-06	mg/kg/day	3.0E-03	mg/kg/day	1.8E-03
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	3.6E-05	mg/kg/day	3.0E-04	mg/kg/day	1.2E-01
				Iron	2.1E+04	mg/kg	N/A		N/A		N/A	2.7E-01	mg/kg/day	7.0E-01	mg/kg/day	3.9E-01
				Thallium	3.3E-01	mg/kg	N/A		N/A		N/A	4.2E-06	mg/kg/day	1.0E-05	mg/kg/day	4.2E-01
				Vanadium	4.5E+01	mg/kg	N/A		N/A		N/A	5.8E-04	mg/kg/day	5.0E-03	mg/kg/day	1.2E-01
			Exp. Route Total								N/A					1.5E+00
			Dermal Absorption[1]	Benzo(a)anthracene	7.1E-01	mg/kg	N/A		N/A		N/A	3.3E-06	mg/kg/day	N/A		N/A
				Benzo(a)pyrene	5.8E-01	mg/kg	N/A		N/A		N/A	2.7E-06	mg/kg/day	N/A		N/A
				Benzo(b)fluoranthene	9.7E-01	mg/kg	N/A		N/A		N/A	4.5E-06	mg/kg/day	N/A		N/A
				Dibenz(a,h)anthracene	3.8E-02	mg/kg	N/A		N/A		N/A	1.8E-07	mg/kg/day	N/A		N/A
				Indeno(1,2,3-cd)pyrene	5.4E-01	mg/kg	N/A		N/A		N/A	2.5E-06	mg/kg/day	N/A		N/A
				Aluminum	2.0E+04	mg/kg	N/A		N/A		N/A	7.3E-03	mg/kg/day	1.0E+00	mg/kg/day	7.3E-03
				Arsenic	5.5E+00	mg/kg	N/A		N/A		N/A	6.0E-06	mg/kg/day	3.0E-04	mg/kg/day	2.0E-02
				Chromium (hexavalent)	4.3E-01	mg/kg	N/A		N/A		N/A	1.5E-07	mg/kg/day	7.5E-05	mg/kg/day	2.1E-03
				Cobalt	2.8E+00	mg/kg	N/A		N/A		N/A	1.0E-06	mg/kg/day	3.0E-04	mg/kg/day	3.3E-03
				Iron	2.1E+04	mg/kg	N/A		N/A		N/A	7.6E-03	mg/kg/day	7.0E-01	mg/kg/day	1.1E-02
				Thallium	3.3E-01	mg/kg	N/A		N/A		N/A	1.2E-07	mg/kg/day	1.0E-05	mg/kg/day	1.2E-02
				Vanadium	4.5E+01	mg/kg	N/A		N/A		N/A	1.6E-05	mg/kg/day	1.3E-04	mg/kg/day	1.3E-01
			Exp. Route Total								N/A					1.8E-01
		Exposure Point Total									N/A					1.7E+00
	Exposure Medium Total										N/A					1.7E+00
Soil* Outside Fenced Area											N/A					1.7E+00
										Total of Receptor Risk	N/A				Total of Receptor Hazard	1.7E+00

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABs of 0.1 used for SVOCs and pesticides, DABS of 0.13 used for PAHs, DABS of 0.14 used for aroclors, DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

* Surface soil and subsurface soil combined.

TABLE 7.3.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Soil*	Soil*	Soil* Outside Debris Outside Fenced Area	Ingestion	Benzo(a)anthracene[2]	7.1E-01	mg/kg			7.3E-01	1/mg/kg-day	3.5E-06	N/A		N/A		N/A
				Benzo(a)pyrene[2]	5.8E-01	mg/kg			7.3E+00	1/mg/kg-day	2.8E-05	N/A		N/A		N/A
				Benzo(b)fluoranthene[2]	9.7E-01	mg/kg			7.3E-01	1/mg/kg-day	4.8E-06	N/A		N/A		N/A
				Dibenz(a,h)anthracene[2]	3.8E-02	mg/kg			7.3E+00	1/mg/kg-day	1.8E-06	N/A		N/A		N/A
				Indeno(1,2,3-cd)pyrene[2]	5.4E-01	mg/kg			7.3E-01	1/mg/kg-day	2.7E-06	N/A		N/A		N/A
				Aluminum	2.0E+04	mg/kg	3.2E-02	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Arsenic	5.5E+00	mg/kg	8.7E-06	mg/kg/day	1.5E+00	1/mg/kg-day	1.3E-05	N/A		N/A		N/A
				Chromium (hexavalent)[2]	4.3E-01	mg/kg			5.0E-01	1/mg/kg-day	1.4E-06	N/A		N/A		N/A
				Cobalt	2.8E+00	mg/kg	4.4E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Iron	2.1E+04	mg/kg	3.3E-02	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Thallium	3.3E-01	mg/kg	5.2E-07	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Vanadium	4.5E+01	mg/kg	7.1E-05	mg/kg/day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								5.6E-05					N/A
			Dermal Absorption[1]	Benzo(a)anthracene[2]	7.1E-01	mg/kg			7.3E-01	1/mg/kg-day	1.3E-06	N/A		N/A		N/A
				Benzo(a)pyrene[2]	5.8E-01	mg/kg			7.3E+00	1/mg/kg-day	1.1E-05	N/A		N/A		N/A
				Benzo(b)fluoranthene[2]	9.7E-01	mg/kg			7.3E-01	1/mg/kg-day	1.8E-06	N/A		N/A		N/A
				Dibenz(a,h)anthracene[2]	3.8E-02	mg/kg			7.3E+00	1/mg/kg-day	7.1E-07	N/A		N/A		N/A
				Indeno(1,2,3-cd)pyrene[2]	5.4E-01	mg/kg			7.3E-01	1/mg/kg-day	1.0E-06	N/A		N/A		N/A
				Aluminum	2.0E+04	mg/kg	1.0E-03	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Arsenic	5.5E+00	mg/kg	8.2E-07	mg/kg/day	1.5E+00	1/mg/kg-day	1.2E-06	N/A		N/A		N/A
				Chromium (hexavalent)[2]	4.3E-01	mg/kg			2.0E+01	1/mg/kg-day	1.7E-06	N/A		N/A		N/A
				Cobalt	2.8E+00	mg/kg	1.4E-07	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Iron	2.1E+04	mg/kg	1.0E-03	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Thallium	3.3E-01	mg/kg	1.6E-08	mg/kg/day	N/A		N/A	N/A		N/A		N/A
				Vanadium	4.5E+01	mg/kg	2.2E-06	mg/kg/day	N/A		N/A	N/A		N/A		N/A
			Exp. Route Total								1.9E-05					N/A
		Exposure Point Total									7.4E-05					N/A
	Exposure Medium Total										7.4E-05					N/A
Soil* Outside Fenced Area											7.4E-05					N/A
										Total of Receptor Risk	7.4E-05				Total of Receptor Hazard	N/A

N/A = Not applicable.

[1] Dermal absorption factors (DABS) used to calculate dermal absorption intake from soil are chemical specific.

DABs of 0.1 used for SVOCs and pesticides, DABS of 0.13 used for PAHs, DABS of 0.14 used for aroclors, DABS of 0.03 used for arsenic, DABS of 0.01 used for all other inorganics.

[2] See Table 7.3.RME Supplement A for calculation of cancer intake and cancer risk following MMOA method.

* Surface soil and subsurface soil combined.

TABLE 7.3.RME Supplement A

CALCULATION OF CHEMICAL CANCER RISKS FOR COPC WITH MUTAGENIC MODE OF ACTION

REASONABLE MAXIMUM EXPOSURE

Cheatham Annex Site 4/Youth Pond Investigation Report

Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations										
							Intake					CSF/Unit Risk					Cancer Risk
					Value	Units	Value				Units	Value				Units	
							0-2 yrs	2-6 yrs	6-16 years	16-30 yrs		0-2 yrs (ADAF=10)	2-6 yrs (ADAF=3)	6-16 yrs (ADAF=3)	16-30 yrs (ADAF=1)		
Soil*	Soil*	Soil* Outside Debris Outside Fenced Area	Ingestion	Benzo(a)anthracene	7.1E-01	mg/kg	2.6E-07	5.2E-07	1.4E-07	1.9E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	3.5E-06
				Benzo(a)pyrene	5.8E-01	mg/kg	2.1E-07	4.2E-07	1.1E-07	1.6E-07	mg/kg/day	7.3E+01	2.2E+01	2.2E+01	7.3E+00	1/(mg/kg-day)	2.8E-05
				Benzo(b)fluoranthene	9.7E-01	mg/kg	3.5E-07	7.1E-07	1.9E-07	2.7E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	4.8E-06
				Dibenz(a,h)anthracene	3.8E-02	mg/kg	1.4E-08	2.7E-08	7.4E-09	1.0E-08	mg/kg/day	7.3E+01	2.2E+01	2.2E+01	7.3E+00	1/(mg/kg-day)	1.8E-06
				Indeno(1,2,3-cd)pyrene	5.4E-01	mg/kg	2.0E-07	4.0E-07	1.1E-07	1.5E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	2.7E-06
				Chromium (hexavalent)	4.3E-01	mg/kg	1.6E-07	3.1E-07	8.4E-08	1.2E-07	mg/kg/day	5.0E+00	1.5E+00	1.5E+00	5.0E-01	1/(mg/kg-day)	1.4E-06
			Dermal	Benzo(a)anthracene	7.1E-01	mg/kg	9.4E-08	1.9E-07	7.2E-08	1.0E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	1.3E-06
				Benzo(a)pyrene	5.8E-01	mg/kg	7.7E-08	1.5E-07	5.9E-08	8.3E-08	mg/kg/day	7.3E+01	2.2E+01	2.2E+01	7.3E+00	1/(mg/kg-day)	1.1E-05
				Benzo(b)fluoranthene	9.7E-01	mg/kg	1.3E-07	2.6E-07	9.9E-08	1.4E-07	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	1.8E-06
				Dibenz(a,h)anthracene	3.8E-02	mg/kg	5.0E-09	1.0E-08	3.8E-09	5.3E-09	mg/kg/day	7.3E+01	2.2E+01	2.2E+01	7.3E+00	1/(mg/kg-day)	7.1E-07
				Indeno(1,2,3-cd)pyrene	5.4E-01	mg/kg	7.2E-08	1.4E-07	5.5E-08	7.7E-08	mg/kg/day	7.3E+00	2.2E+00	2.2E+00	7.3E-01	1/(mg/kg-day)	1.0E-06
				Chromium (hexavalent)	4.3E-01	mg/kg	4.4E-09	8.8E-09	3.4E-09	4.7E-09	mg/kg/day	2.0E+02	6.0E+01	6.0E+01	2.0E+01	1/(mg/kg-day)	1.7E-06

Cancer risk = $(Intake_{0\text{-}2} \times CSF_{0\text{-}2}) + (Intake_{2\text{-}6} \times CSF_{2\text{-}6}) + (Intake_{6\text{-}16} \times CSF_{6\text{-}16}) + (Intake_{16\text{-}30} \times CSF_{16\text{-}30})$

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Soil* Outside Debris Outside Fenced Area	Benzo(a)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Aluminum	N/A	N/A	N/A	N/A	Neurological	3E-02	N/A	1E-03	3E-02
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	3E-02	N/A	3E-03	3E-02
			Chromium (hexavalent)	N/A	N/A	N/A	N/A	NOE	2E-04	N/A	3E-04	5E-04
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	1E-02	N/A	5E-04	1E-02
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	4E-02	N/A	2E-03	4E-02
			Thallium	N/A	N/A	N/A	N/A	Hair	5E-02	N/A	2E-03	5E-02
			Vanadium	N/A	N/A	N/A	N/A	Kidney	1E-02	N/A	2E-02	3E-02
			Chemical Total	N/A	N/A	N/A	N/A		2E-01	N/A	3E-02	2E-01
		Exposure Point Total					N/A					2E-01
	Exposure Medium Total						N/A					2E-01
Soil* Outside Fenced Area							N/A					2E-01
						Receptor Risk Total	N/A				Receptor HI Total	2E-01

Notes:
N/A = Not applicable
HI = Hazard Index
CNS = Central Nervous System
NOE = No Observed Effects
Soil* = combined surface and subsurface soil.

Target Organ Totals

Total Skin HI Across All Media =	3E-02
Total Vascular HI Across All Media =	3E-02
Total Hair HI Across All Media =	5E-02
Total Thyroid HI Across All Media =	1E-02
Total Gastrointestinal HI Across All Media =	4E-02
Total Neurological/CNS Across All Media =	3E-02
Total Kidney HI Across All Media =	1E-02

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Soil* Outside Debris Outside Fenced Area	Benzo(a)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			Aluminum	N/A	N/A	N/A	N/A	Neurological	3E-01	N/A	7E-03	3E-01
			Arsenic	N/A	N/A	N/A	N/A	Skin, Vascular	2E-01	N/A	2E-02	3E-01
			Chromium (hexavalent)	N/A	N/A	N/A	N/A	NOE	2E-03	N/A	2E-03	4E-03
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	1E-01	N/A	3E-03	1E-01
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	4E-01	N/A	1E-02	4E-01
			Thallium	N/A	N/A	N/A	N/A	Hair	4E-01	N/A	1E-02	4E-01
			Vanadium	N/A	N/A	N/A	N/A	Kidney	1E-01	N/A	1E-01	2E-01
			Chemical Total	N/A	N/A	N/A	N/A		2E+00	N/A	2E-01	2E+00
		Exposure Point Total					N/A					2E+00
	Exposure Medium Total						N/A					2E+00
Soil* Outside Fenced Area							N/A					2E+00
						Receptor Risk Total	N/A				Receptor HI Total	2E+00

Notes:
N/A = Not applicable
HI = Hazard Index
CNS = Central Nervous System
NOE = No Observed Effects
Soil* = combined surface and subsurface soil.

Target Organ Totals

Total Skin HI Across All Media =	3E-01
Total Vascular HI Across All Media =	3E-01
Total Hair HI Across All Media =	4E-01
Total Thyroid HI Across All Media =	1E-01
Total Gastrointestinal HI Across All Media =	4E-01
Total Neurological/CNS Across All Media =	3E-01
Total Kidney HI Across All Media =	1E-01

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
Cheatham Annex Site 4/Youth Pond Investigation Report
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil*	Soil*	Soil* Outside Debris Outside Fenced Area	Benzo(a)anthracene	3E-06	N/A	1E-06	5E-06	N/A	N/A	N/A	N/A	N/A
			Benzo(a)pyrene	3E-05	N/A	1E-05	4E-05	N/A	N/A	N/A	N/A	N/A
			Benzo(b)fluoranthene	5E-06	N/A	2E-06	7E-06	N/A	N/A	N/A	N/A	N/A
			Dibenz(a,h)anthracene	2E-06	N/A	7E-07	3E-06	N/A	N/A	N/A	N/A	N/A
			Indeno(1,2,3-cd)pyrene	3E-06	N/A	1E-06	4E-06	N/A	N/A	N/A	N/A	N/A
			Aluminum	N/A	N/A	N/A	N/A	Neurological	N/A	N/A	N/A	N/A
			Arsenic	1E-05	N/A	1E-06	1E-05	Skin, Vascular	N/A	N/A	N/A	N/A
			Chromium (hexavalent)	1E-06	N/A	2E-06	3E-06	NOE	N/A	N/A	N/A	N/A
			Cobalt	N/A	N/A	N/A	N/A	Thyroid	N/A	N/A	N/A	N/A
			Iron	N/A	N/A	N/A	N/A	Gastrointestinal	N/A	N/A	N/A	N/A
			Thallium	N/A	N/A	N/A	N/A	Hair	N/A	N/A	N/A	N/A
			Vanadium	N/A	N/A	N/A	N/A	Kidney	N/A	N/A	N/A	N/A
			Chemical Total	6E-05	N/A	2E-05	7E-05		N/A	N/A	N/A	N/A
		Exposure Point Total					7E-05					N/A
	Exposure Medium Total						7E-05					N/A
Soil* Outside Fenced Area							7E-05					N/A
						Receptor Risk Total	7E-05				Receptor HI Total	N/A

Notes:
N/A = Not applicable
CNS = Central Nervous System
NOE = No Observed Effects
Soil* = combined surface and subsurface soil.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	10/17/2014 9:36:38 AM
From File	ProUCL input.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)anthracene

General Statistics

Total Number of Observations	20	Number of Distinct Observations	16
Number of Detects	16	Number of Non-Detects	4
Number of Distinct Detects	13	Number of Distinct Non-Detects	4
Minimum Detect	2.7	Minimum Non-Detect	13
Maximum Detect	1200	Maximum Non-Detect	22
Variance Detects	93682	Percent Non-Detects	20%
Mean Detects	111.1	SD Detects	306.1
Median Detects	14	CV Detects	2.754
Skewness Detects	3.459	Kurtosis Detects	12.34
Mean of Logged Detects	2.917	SD of Logged Detects	1.534

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.395	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.487	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.222	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	90.84	Standard Error of Mean	61.93
SD	268.2	95% KM (BCA) UCL	210.1
95% KM (t) UCL	197.9	95% KM (Percentile Bootstrap) UCL	208.9
95% KM (z) UCL	192.7	95% KM Bootstrap t UCL	3731
90% KM Chebyshev UCL	276.6	95% KM Chebyshev UCL	360.8
97.5% KM Chebyshev UCL	477.6	99% KM Chebyshev UCL	707

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	3.107	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.823	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.444	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.231	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.371	k star (bias corrected MLE)	0.343
Theta hat (MLE)	299.3	Theta star (bias corrected MLE)	323.7
nu hat (MLE)	11.88	nu star (bias corrected)	10.99
MLE Mean (bias corrected)	111.1	MLE Sd (bias corrected)	189.6

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.115	nu hat (KM)	4.59
Approximate Chi Square Value (4.59, α)	0.968	Adjusted Chi Square Value (4.59, β)	0.846
95% Gamma Approximate KM-UCL (use when n>=50)	430.9	95% Gamma Adjusted KM-UCL (use when n<50)	492.8

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	88.9
Maximum	1200	Median	11
SD	275.8	CV	3.102
k hat (MLE)	0.234	k star (bias corrected MLE)	0.232
Theta hat (MLE)	380.7	Theta star (bias corrected MLE)	383.5
nu hat (MLE)	9.341	nu star (bias corrected)	9.273
MLE Mean (bias corrected)	88.9	MLE Sd (bias corrected)	184.6
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (9.27, α)	3.493	Adjusted Chi Square Value (9.27, β)	3.217
95% Gamma Approximate UCL (use when n>=50)	236	95% Gamma Adjusted UCL (use when n<50)	256.3

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.763	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.887	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.307	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.222	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	90.8	Mean in Log Scale	2.779
SD in Original Scale	275.1	SD in Log Scale	1.396
95% t UCL (assumes normality of ROS data)	197.2	95% Percentile Bootstrap UCL	209
95% BCA Bootstrap UCL	287.8	95% Bootstrap t UCL	4030
95% H-UCL (Log ROS)	121		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	90.75	Mean in Log Scale	2.774
SD in Original Scale	275.2	SD in Log Scale	1.397
95% t UCL (Assumes normality)	197.1	95% H-Stat UCL	120.7

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL	707

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Benzo(a)pyrene

General Statistics

Total Number of Observations	20	Number of Distinct Observations	16
Number of Detects	11	Number of Non-Detects	9
Number of Distinct Detects	10	Number of Distinct Non-Detects	7
Minimum Detect	4.4	Minimum Non-Detect	12
Maximum Detect	970	Maximum Non-Detect	23
Variance Detects	87377	Percent Non-Detects	45%
Mean Detects	126.9	SD Detects	295.6
Median Detects	11	CV Detects	2.329
Skewness Detects	2.808	Kurtosis Detects	8.045
Mean of Logged Detects	3.016	SD of Logged Detects	1.712

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.487	**Shapiro Wilk GOF Test**

5% Shapiro Wilk Critical Value	0.85	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.459	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.267	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	74.06	Standard Error of Mean	50.91
SD	217.1	95% KM (BCA) UCL	169.7
95% KM (t) UCL	162.1	95% KM (Percentile Bootstrap) UCL	169.5
95% KM (z) UCL	157.8	95% KM Bootstrap t UCL	2871
90% KM Chebyshev UCL	226.8	95% KM Chebyshev UCL	296
97.5% KM Chebyshev UCL	392	99% KM Chebyshev UCL	580.6

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	2.016	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.807	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.428	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.274	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.365	k star (bias corrected MLE)	0.326
Theta hat (MLE)	347.5	Theta star (bias corrected MLE)	389
nu hat (MLE)	8.037	nu star (bias corrected)	7.179
MLE Mean (bias corrected)	126.9	MLE Sd (bias corrected)	222.2

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.116	nu hat (KM)	4.657
Approximate Chi Square Value (4.66, α)	0.997	Adjusted Chi Square Value (4.66, β)	0.873
95% Gamma Approximate KM-UCL (use when n>=50)	345.9	95% Gamma Adjusted KM-UCL (use when n<50)	395

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	72.49
Maximum	970	Median	6.8
SD	223.5	CV	3.083
k hat (MLE)	0.176	k star (bias corrected MLE)	0.183
Theta hat (MLE)	412.2	Theta star (bias corrected MLE)	396.5
nu hat (MLE)	7.035	nu star (bias corrected)	7.313
MLE Mean (bias corrected)	72.49	MLE Sd (bias corrected)	169.5
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (7.31, α)	2.344	Adjusted Chi Square Value (7.31, β)	2.128
95% Gamma Approximate UCL (use when n>=50)	226.2	95% Gamma Adjusted UCL (use when n<50)	249.1

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.74	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.85	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.323	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.267	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	74.92	Mean in Log Scale	2.702
SD in Original Scale	222.5	SD in Log Scale	1.329
95% t UCL (assumes normality of ROS data)	160.9	95% Percentile Bootstrap UCL	168.6
95% BCA Bootstrap UCL	219.2	95% Bootstrap t UCL	2925
95% H-UCL (Log ROS)	93.95		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	74.19	Mean in Log Scale	2.671
SD in Original Scale	222.6	SD in Log Scale	1.312
95% t UCL (Assumes normality)	160.3	95% H-Stat UCL	87.32

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL	580.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Benzo(b)fluoranthene

General Statistics

Total Number of Observations	20	Number of Distinct Observations	14
Number of Detects	10	Number of Non-Detects	10
Number of Distinct Detects	9	Number of Distinct Non-Detects	7
Minimum Detect	10	Minimum Non-Detect	9.8
Maximum Detect	1600	Maximum Non-Detect	23
Variance Detects	261408	Percent Non-Detects	50%
Mean Detects	236.6	SD Detects	511.3
Median Detects	23	CV Detects	2.161
Skewness Detects	2.597	Kurtosis Detects	6.801
Mean of Logged Detects	3.795	SD of Logged Detects	1.68

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.521	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.452	Lilliefors GOF Test
5% Lilliefors Critical Value	0.28	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	124.5	Standard Error of Mean	85.05
SD	360.8	95% KM (BCA) UCL	284.1
95% KM (t) UCL	271.6	95% KM (Percentile Bootstrap) UCL	261.6
95% KM (z) UCL	264.4	95% KM Bootstrap t UCL	5179
90% KM Chebyshev UCL	379.7	95% KM Chebyshev UCL	495.3
97.5% KM Chebyshev UCL	655.7	99% KM Chebyshev UCL	970.8

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.812	Anderson-Darling GOF Test
5% A-D Critical Value	0.796	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.431	Kolmogrov-Smirnoff GOF
5% K-S Critical Value	0.285	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.395	k star (bias corrected MLE)	0.343
Theta hat (MLE)	599.6	Theta star (bias corrected MLE)	690
nu hat (MLE)	7.892	nu star (bias corrected)	6.858
MLE Mean (bias corrected)	236.6	MLE Sd (bias corrected)	404.1

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.119	nu hat (KM)	4.763
Approximate Chi Square Value (4.76, α)	1.044	Adjusted Chi Square Value (4.76, β)	0.916
95% Gamma Approximate KM-UCL (use when n>=50)	567.9	95% Gamma Adjusted KM-UCL (use when n<50)	647.2

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	118.3
Maximum	1600	Median	5.005
SD	372.2	CV	3.146
k hat (MLE)	0.149	k star (bias corrected MLE)	0.16
Theta hat (MLE)	796	Theta star (bias corrected MLE)	741
nu hat (MLE)	5.945	nu star (bias corrected)	6.386
MLE Mean (bias corrected)	118.3	MLE Sd (bias corrected)	296.1
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (6.39, α)	1.84	Adjusted Chi Square Value (6.39, β)	1.655
95% Gamma Approximate UCL (use when n>=50)	410.5	95% Gamma Adjusted UCL (use when n<50)	456.6

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.732	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.344	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.28	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	121	Mean in Log Scale	2.6
SD in Original Scale	371.3	SD in Log Scale	1.78
95% t UCL (assumes normality of ROS data)	264.6	95% Percentile Bootstrap UCL	260.6
95% BCA Bootstrap UCL	360.7	95% Bootstrap t UCL	4266
95% H-UCL (Log ROS)	324.6		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	123	Mean in Log Scale	3.005
SD in Original Scale	370.7	SD in Log Scale	1.426
95% t UCL (Assumes normality)	266.4	95% H-Stat UCL	164.5

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL	970.8

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Dibenz(a,h)anthracene

General Statistics

Total Number of Observations	20	Number of Distinct Observations	13
Number of Detects	8	Number of Non-Detects	12
Number of Distinct Detects	8	Number of Distinct Non-Detects	6

Minimum Detect	3.6	Minimum Non-Detect	13
Maximum Detect	190	Maximum Non-Detect	23
Variance Detects	4508	Percent Non-Detects	60%
Mean Detects	40.35	SD Detects	67.14
Median Detects	9.05	CV Detects	1.664
Skewness Detects	2.043	Kurtosis Detects	3.796
Mean of Logged Detects	2.598	SD of Logged Detects	1.492

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.636	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.408	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.313	Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	20.27	Standard Error of Mean	10.35
SD	43.05	95% KM (BCA) UCL	37.62
95% KM (t) UCL	38.16	95% KM (Percentile Bootstrap) UCL	38.31
95% KM (z) UCL	37.29	95% KM Bootstrap t UCL	134.2
90% KM Chebyshev UCL	51.31	95% KM Chebyshev UCL	65.36
97.5% KM Chebyshev UCL	84.88	99% KM Chebyshev UCL	123.2

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.948	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.758	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.348	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.308	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.567	k star (bias corrected MLE)	0.438
Theta hat (MLE)	71.2	Theta star (bias corrected MLE)	92.22
nu hat (MLE)	9.068	nu star (bias corrected)	7.001
MLE Mean (bias corrected)	40.35	MLE Sd (bias corrected)	61

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.222	nu hat (KM)	8.866
Approximate Chi Square Value (8.87, α)	3.246	Adjusted Chi Square Value (8.87, β)	2.982
95% Gamma Approximate KM-UCL (use when n>=50)	55.36	95% Gamma Adjusted KM-UCL (use when n<50)	60.26

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	20.21
Maximum	190	Median	4.05
SD	44.89	CV	2.221
k hat (MLE)	0.272	k star (bias corrected MLE)	0.265
Theta hat (MLE)	74.3	Theta star (bias corrected MLE)	76.4
nu hat (MLE)	10.88	nu star (bias corrected)	10.58
MLE Mean (bias corrected)	20.21	MLE Sd (bias corrected)	39.29
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (10.58, α)	4.308	Adjusted Chi Square Value (10.58, β)	3.996
95% Gamma Approximate UCL (use when n>=50)	49.63	95% Gamma Adjusted UCL (use when n<50)	53.52

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.818	Detected Data appear Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.259	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.313	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	21.14	Mean in Log Scale	2.212
SD in Original Scale	43.98	SD in Log Scale	1.067
95% t UCL (assumes normality of ROS data)	38.14	95% Percentile Bootstrap UCL	39.48
95% BCA Bootstrap UCL	48.7	95% Bootstrap t UCL	157.8
95% H-UCL (Log ROS)	31.53		

UCLs using Lognormal Distribution and KM Estimates when Detected data are Lognormally Distributed

KM Mean (logged)	2.124	95% H-UCL (KM -Log)	27.07
KM SD (logged)	1.035	95% Critical H Value (KM-Log)	2.686
KM Standard Error of Mean (logged)	0.291		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	22.42	Mean in Log Scale	2.441
SD in Original Scale	43.45	SD in Log Scale	0.924
95% t UCL (Assumes normality)	39.21	95% H-Stat UCL	30.05

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (BCA) UCL 37.62

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Indeno(1,2,3-cd)pyrene

General Statistics

Total Number of Observations	20	Number of Distinct Observations	13
Number of Detects	10	Number of Non-Detects	10
Number of Distinct Detects	10	Number of Distinct Non-Detects	5
Minimum Detect	3.7	Minimum Non-Detect	18
Maximum Detect	850	Maximum Non-Detect	23
Variance Detects	79544	Percent Non-Detects	50%
Mean Detects	139.1	SD Detects	282
Median Detects	15.5	CV Detects	2.028
Skewness Detects	2.279	Kurtosis Detects	4.788
Mean of Logged Detects	3.262	SD of Logged Detects	1.754

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.554	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.454	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.28	Detected Data Not Normal at 5% Significance Level	

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

Mean	74.83	Standard Error of Mean	47.11
SD	199.8	95% KM (BCA) UCL	178.7
95% KM (t) UCL	156.3	95% KM (Percentile Bootstrap) UCL	158.5
95% KM (z) UCL	152.3	95% KM Bootstrap t UCL	1775

90% KM Chebyshev UCL	216.2	95% KM Chebyshev UCL	280.2
97.5% KM Chebyshev UCL	369.1	99% KM Chebyshev UCL	543.6

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.512	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.796	Detected Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.4	**Kolmogrov-Smirnoff GOF**
5% K-S Critical Value	0.285	Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.394	k star (bias corrected MLE)	0.343
Theta hat (MLE)	352.8	Theta star (bias corrected MLE)	405.9
nu hat (MLE)	7.885	nu star (bias corrected)	6.852
MLE Mean (bias corrected)	139.1	MLE Sd (bias corrected)	237.6

Gamma Kaplan-Meier (KM) Statistics

k hat (KM)	0.14	nu hat (KM)	5.608
Approximate Chi Square Value (5.61, α)	1.443	Adjusted Chi Square Value (5.61, β)	1.284
95% Gamma Approximate KM-UCL (use when n>=50)	290.8	95% Gamma Adjusted KM-UCL (use when n<50)	326.8

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detected data is small such as < 0.1

For such situations, GROS method tends to yield inflated values of UCLs and BTVs

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	0.01	Mean	72.37
Maximum	850	Median	5.5
SD	206.2	CV	2.849
k hat (MLE)	0.167	k star (bias corrected MLE)	0.176
Theta hat (MLE)	432.7	Theta star (bias corrected MLE)	412.3
nu hat (MLE)	6.691	nu star (bias corrected)	7.021
MLE Mean (bias corrected)	72.37	MLE Sd (bias corrected)	172.7
		Adjusted Level of Significance (β)	0.038
Approximate Chi Square Value (7.02, α)	2.182	Adjusted Chi Square Value (7.02, β)	1.975
95% Gamma Approximate UCL (use when n>=50)	232.9	95% Gamma Adjusted UCL (use when n<50)	257.3

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.816	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.842	Detected Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.292	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.28	Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	75.52	Mean in Log Scale	2.778
SD in Original Scale	204.8	SD in Log Scale	1.38
95% t UCL (assumes normality of ROS data)	154.7	95% Percentile Bootstrap UCL	159.6
95% BCA Bootstrap UCL	201.8	95% Bootstrap t UCL	1923
95% H-UCL (Log ROS)	115.8		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	74.82	Mean in Log Scale	2.807
SD in Original Scale	205	SD in Log Scale	1.296
95% t UCL (Assumes normality)	154.1	95% H-Stat UCL	96.04

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Data do not follow a Discernible Distribution at 5% Significance Level

Suggested UCL to Use

99% KM (Chebyshev) UCL 543.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Aluminum

General Statistics

Total Number of Observations	20	Number of Distinct Observations	19
		Number of Missing Observations	0
Minimum	3960	Mean	14776
Maximum	31900	Median	13150
SD	9874	Std. Error of Mean	2208
Coefficient of Variation	0.668	Skewness	0.376

Normal GOF Test

Shapiro Wilk Test Statistic	0.875	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.203	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	18594	95% Adjusted-CLT UCL (Chen-1995)	18606
		95% Modified-t UCL (Johnson-1978)	18625

Gamma GOF Test

A-D Test Statistic	0.923	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.752	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.195	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.196	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	2.108	k star (bias corrected MLE)	1.825
Theta hat (MLE)	7011	Theta star (bias corrected MLE)	8097
nu hat (MLE)	84.31	nu star (bias corrected)	72.99
MLE Mean (bias corrected)	14776	MLE Sd (bias corrected)	10938
		Approximate Chi Square Value (0.05)	54.32
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	53.05

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	19856	95% Adjusted Gamma UCL (use when n<50)	20332

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.88	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.176	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.284	Mean of logged Data	9.345
Maximum of Logged Data	10.37	SD of logged Data	0.767

Assuming Lognormal Distribution

95% H-UCL	23085	90% Chebyshev (MVUE) UCL	23440
95% Chebyshev (MVUE) UCL	27228	97.5% Chebyshev (MVUE) UCL	32486
99% Chebyshev (MVUE) UCL	42814		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	18408	95% Jackknife UCL	18594
95% Standard Bootstrap UCL	18235	95% Bootstrap-t UCL	18818
95% Hall's Bootstrap UCL	18360	95% Percentile Bootstrap UCL	18404
95% BCA Bootstrap UCL	18482		
90% Chebyshev(Mean, Sd) UCL	21399	95% Chebyshev(Mean, Sd) UCL	24400
97.5% Chebyshev(Mean, Sd) UCL	28564	99% Chebyshev(Mean, Sd) UCL	36744

Suggested UCL to Use

95% Adjusted Gamma UCL 20332

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Arsenic

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	0.62	Mean	4.241
Maximum	12.7	Median	3.35
SD	3.371	Std. Error of Mean	0.754
Coefficient of Variation	0.795	Skewness	0.894

Normal GOF Test

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.158	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	5.544	95% Adjusted-CLT UCL (Chen-1995)	5.642
		95% Modified-t UCL (Johnson-1978)	5.569

Gamma GOF Test

A-D Test Statistic	0.396	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.758	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.122	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.197	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.519	k star (bias corrected MLE)	1.324
Theta hat (MLE)	2.792	Theta star (bias corrected MLE)	3.202
nu hat (MLE)	60.76	nu star (bias corrected)	52.98
MLE Mean (bias corrected)	4.241	MLE Sd (bias corrected)	3.685

		Approximate Chi Square Value (0.05)	37.26
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	36.21

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	6.031	95% Adjusted Gamma UCL (use when n<50)	6.204

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.94	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.149	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.478	Mean of logged Data	1.081
Maximum of Logged Data	2.542	SD of logged Data	0.937

Assuming Lognormal Distribution

95% H-UCL	7.904	90% Chebyshev (MVUE) UCL	7.531
95% Chebyshev (MVUE) UCL	8.932	97.5% Chebyshev (MVUE) UCL	10.88
99% Chebyshev (MVUE) UCL	14.7		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	5.481	95% Jackknife UCL	5.544
95% Standard Bootstrap UCL	5.46	95% Bootstrap-t UCL	5.705
95% Hall's Bootstrap UCL	5.649	95% Percentile Bootstrap UCL	5.426
95% BCA Bootstrap UCL	5.552		
90% Chebyshev(Mean, Sd) UCL	6.502	95% Chebyshev(Mean, Sd) UCL	7.527
97.5% Chebyshev(Mean, Sd) UCL	8.948	99% Chebyshev(Mean, Sd) UCL	11.74

Suggested UCL to Use

95% Student's-t UCL 5.544

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Cobalt

General Statistics

Total Number of Observations	20	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	0.72	Mean	2.388
Maximum	4	Median	2.35
SD	1.046	Std. Error of Mean	0.234
Coefficient of Variation	0.438	Skewness	-0.0624

Normal GOF Test

Shapiro Wilk Test Statistic	0.945	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.122	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.198	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.792	95% Adjusted-CLT UCL (Chen-1995)	2.769
		95% Modified-t UCL (Johnson-1978)	2.792

Gamma GOF Test

A-D Test Statistic	0.569	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.745	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.158	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.195	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	4.483	k star (bias corrected MLE)	3.844
Theta hat (MLE)	0.533	Theta star (bias corrected MLE)	0.621
nu hat (MLE)	179.3	nu star (bias corrected)	153.8
MLE Mean (bias corrected)	2.388	MLE Sd (bias corrected)	1.218
		Approximate Chi Square Value (0.05)	126.1
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	124.1

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	2.912	95% Adjusted Gamma UCL (use when n<50)	2.958

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.901	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.19	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.329	Mean of logged Data	0.755
Maximum of Logged Data	1.386	SD of logged Data	0.529

Assuming Lognormal Distribution

95% H-UCL	3.137	90% Chebyshev (MVUE) UCL	3.324
95% Chebyshev (MVUE) UCL	3.73	97.5% Chebyshev (MVUE) UCL	4.294
99% Chebyshev (MVUE) UCL	5.401		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	2.773	95% Jackknife UCL	2.792
95% Standard Bootstrap UCL	2.758	95% Bootstrap-t UCL	2.79
95% Hall's Bootstrap UCL	2.756	95% Percentile Bootstrap UCL	2.765
95% BCA Bootstrap UCL	2.76		
90% Chebyshev(Mean, Sd) UCL	3.089	95% Chebyshev(Mean, Sd) UCL	3.407
97.5% Chebyshev(Mean, Sd) UCL	3.848	99% Chebyshev(Mean, Sd) UCL	4.714

Suggested UCL to Use

95% Student's-t UCL	2.792

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Note: For highly negatively-skewed data, confidence limits (e.g., Chen, Johnson, Lognormal, and Gamma) may not be
reliable. Chen's and Johnson's methods provide adjustments for positvely skewed data sets.

Iron

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	3390	Mean	15034
Maximum	31800	Median	12120
SD	10554	Std. Error of Mean	2360
Coefficient of Variation	0.702	Skewness	0.383

Normal GOF Test

Shapiro Wilk Test Statistic	0.867	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.208	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	19115	95% Adjusted-CLT UCL (Chen-1995)	19132
		95% Modified-t UCL (Johnson-1978)	19148

Gamma GOF Test

A-D Test Statistic	0.821	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.149	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.196	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.866	k star (bias corrected MLE)	1.62
Theta hat (MLE)	8056	Theta star (bias corrected MLE)	9283
nu hat (MLE)	74.65	nu star (bias corrected)	64.78
MLE Mean (bias corrected)	15034	MLE Sd (bias corrected)	11813
		Approximate Chi Square Value (0.05)	47.26
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	46.08

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	20607	95% Adjusted Gamma UCL (use when n<50)	21135

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.888	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.163	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.129	Mean of logged Data	9.327
Maximum of Logged Data	10.37	SD of logged Data	0.827

Assuming Lognormal Distribution

95% H-UCL	24909	90% Chebyshev (MVUE) UCL	24816
95% Chebyshev (MVUE) UCL	29049	97.5% Chebyshev (MVUE) UCL	34923
99% Chebyshev (MVUE) UCL	46462		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	18916	95% Jackknife UCL	19115
95% Standard Bootstrap UCL	18854	95% Bootstrap-t UCL	19279
95% Hall's Bootstrap UCL	18847	95% Percentile Bootstrap UCL	18683
95% BCA Bootstrap UCL	19045		
90% Chebyshev(Mean, Sd) UCL	22114	95% Chebyshev(Mean, Sd) UCL	25321
97.5% Chebyshev(Mean, Sd) UCL	29772	99% Chebyshev(Mean, Sd) UCL	38515

Suggested UCL to Use

95% Adjusted Gamma UCL 21135

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Thallium

General Statistics

Total Number of Observations	20	Number of Distinct Observations	15
Number of Detects	1	Number of Non-Detects	19
Number of Distinct Detects	1	Number of Distinct Non-Detects	14

Warning: Only one distinct data value was detected! ProUCL (or any other software) should not be used on such a data set!
It is suggested to use alternative site specific values determined by the Project Team to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Thallium was not processed!

Vanadium

General Statistics

Total Number of Observations	20	Number of Distinct Observations	20
		Number of Missing Observations	0
Minimum	6.5	Mean	32.19
Maximum	64	Median	27.85
SD	22.25	Std. Error of Mean	4.974
Coefficient of Variation	0.691	Skewness	0.194

Normal GOF Test

Shapiro Wilk Test Statistic	0.846	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.202	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.198	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	40.79	95% Adjusted-CLT UCL (Chen-1995)	40.6
		95% Modified-t UCL (Johnson-1978)	40.82

Gamma GOF Test

A-D Test Statistic	1.129	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.754	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.181	**Kolmogrov-Smirnoff Gamma GOF Test**
5% K-S Critical Value	0.197	Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.817	k star (bias corrected MLE)	1.577
Theta hat (MLE)	17.72	Theta star (bias corrected MLE)	20.4
nu hat (MLE)	72.66	nu star (bias corrected)	63.1
MLE Mean (bias corrected)	32.19	MLE Sd (bias corrected)	25.63
		Approximate Chi Square Value (0.05)	45.82
Adjusted Level of Significance	0.038	Adjusted Chi Square Value	44.66

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)	44.32	95% Adjusted Gamma UCL (use when n<50)	45.47

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.862	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.905	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.195	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.198	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.872	Mean of logged Data	3.172
Maximum of Logged Data	4.159	SD of logged Data	0.847

Assuming Lognormal Distribution

95% H-UCL	54.66	90% Chebyshev (MVUE) UCL	54.07
95% Chebyshev (MVUE) UCL	63.44	97.5% Chebyshev (MVUE) UCL	76.46
99% Chebyshev (MVUE) UCL	102		

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL	40.37	95% Jackknife UCL	40.79
95% Standard Bootstrap UCL	40.15	95% Bootstrap-t UCL	40.97
95% Hall's Bootstrap UCL	39.85	95% Percentile Bootstrap UCL	40.23
95% BCA Bootstrap UCL	40.48		
90% Chebyshev(Mean, Sd) UCL	47.11	95% Chebyshev(Mean, Sd) UCL	53.87
97.5% Chebyshev(Mean, Sd) UCL	63.25	99% Chebyshev(Mean, Sd) UCL	81.68

Suggested UCL to Use

95% Adjusted Gamma UCL 45.47

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). However, simulations results will not cover all Real World data sets.
For additional insight the user may want to consult a statistician.

Attachment 3
Ecological Risk Assessment Tables

Table E-1
Samples Used in the Ecological Risk Assessment
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Sample ID	Site	Event	Depth (inches)	Group	Comment
Surface Soil					
CAS004-4HA01-00-1199	Site 4	1999	0-6	In Debris Areas	
CAS004-4HA02-00-1199	Site 4	1999	0-6	In Debris Areas	
CAS004-4HA02D-00-1199	Site 4	1999	0-6	In Debris Areas	
CAS004-4HA03-00-1199	Site 4	1999	0-6	In Debris Areas	
CAS004-4HA04-00-1199	Site 4	1999	0-6	In Debris Areas	
CAS004-4HA05-00-1199	Site 4	1999	0-6	In Debris Areas	
CAS004-4HA06-00-1199	Site 4	1999	0-6	In Debris Areas	
CAS04-SS01-1109	Site 4	2009	0-6	Outside Debris Areas	
CAS04-SS02-1109	Site 4	2009	0-6	Outside Debris Areas	
CAS04-SS03-1109	Site 4	2009	0-6	Outside Debris Areas	
CAS04-SS04-1109	Site 4	2009	0-6	Outside Debris Areas	
CAS04-SS05-1109	Site 4	2009	0-6	Outside Debris Areas	
CAA03-SS02-1109	AOC 3	2009	0-6	In Debris Areas	
CAA03-SS03-1109	AOC 3	2009	0-6	In Debris Areas	
CAA03-SS04-1109	AOC 3	2009	0-6	In Debris Areas	
CAA03-SS05-1109	AOC 3	2009	0-6	In Debris Areas	
CAA03-SS08-1109	AOC 3	2009	0-6	In Debris Areas	
CAA03-SS08P-1109	AOC 3	2009	0-6	In Debris Areas	
CAA03-SS09-1109	AOC 3	2009	0-6	Outside Debris Areas	
CAA03-SS10-1109	AOC 3	2009	0-6	Outside Debris Areas	
CAS04-SS06-1012	Site 4	2012	0-6	Outside Debris Areas	
CAS04-SS07-1012	Site 4	2012	0-6	Outside Debris Areas	
CAS04-SS09-1012	Site 4	2012	0-6	Outside Debris Areas	
CAS04-SS10-1012	Site 4	2012	0-6	Outside Debris Areas	
CAS04-SS11-1012	Site 4	2012	0-6	In Debris Areas	
CAS04-SS12-1012	Site 4	2012	0-6	In Debris Areas	
CAS04-SS12P-1012	Site 4	2012	0-6	In Debris Areas	
CAS04-SS13-1012	Site 4	2012	0-6	In Debris Areas	
CAS04-SS14-1012	Site 4	2012	0-6	Outside Debris Areas	Hexavalent chromium only
CAS04-SS14P-1012	Site 4	2012	0-6	Outside Debris Areas	Hexavalent chromium only
CAS04-SS15-1012	Site 4	2012	0-6	In Debris Areas	Hexavalent chromium only
Shallow Subsurface Soil					
CAS004-4-HA02-02-1199	Site 4	1999	12-24	In Debris Areas	
CAS004-4-HA03-02-1199	Site 4	1999	12-24	In Debris Areas	
CAS004-4-HA04-01-1199	Site 4	1999	6-12	In Debris Areas	
CAS004-4-HA05-01-1199	Site 4	1999	6-12	In Debris Areas	
CAS004-4-HA06-02-1199	Site 4	1999	12-24	In Debris Areas	
CAS04-SB01-1109	Site 4	2009	6-24	Outside Debris Areas	
CAS04-SB02-1109	Site 4	2009	6-24	Outside Debris Areas	
CAS04-SB03-1109	Site 4	2009	6-24	Outside Debris Areas	
CAS04-SB04-1109	Site 4	2009	6-24	Outside Debris Areas	
CAS04-SB05-1109	Site 4	2009	6-24	Outside Debris Areas	
CAA03-SB02-1109A	AOC 3	2009	6-24	In Debris Areas	
CAA03-SB03-1109A	AOC 3	2009	6-24	In Debris Areas	
CAA03-SB04-1109A	AOC 3	2009	6-24	In Debris Areas	
CAA03-SB05-1109A	AOC 3	2009	6-24	In Debris Areas	
CAA03-SB08-1109	AOC 3	2009	6-24	In Debris Areas	
CAA03-SB08P-1109	AOC 3	2009	6-24	In Debris Areas	
CAA03-SB09-1109	AOC 3	2009	6-24	Outside Debris Areas	
CAA03-SB10-1109	AOC 3	2009	6-24	Outside Debris Areas	
CAS04-SB06-1012	Site 4	2012	6-24	Outside Debris Areas	
CAS04-SB06P-1012	Site 4	2012	6-24	Outside Debris Areas	
CAS04-SB07-1012	Site 4	2012	6-24	Outside Debris Areas	
CAS04-SB15-1012	Site 4	2012	6-24	In Debris Areas	Hexavalent chromium only
CAS04-SB16-1012	Site 4	2012	6-24	Outside Debris Areas	Hexavalent chromium only

Shaded cells indicate field duplicates

Table E-2
Ecological Screening Statistics - Site 4 Surface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Volatile Organic Compounds (UG/KG)																		
1,1,1-Trichloroethane	6.00 - 8.00	0 / 7	--	--	--	3.50	0.29	--	1,025	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,1,2,2-Tetrachloroethane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	5,000	-- / --	0.001	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	6.00 - 8.00	0 / 7	--	--	--	3.50	0.29	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloroethane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	2,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethane	6.00 - 8.00	0 / 7	--	--	--	3.50	0.29	--	548	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	173	-- / --	0.04	NO	--	-- / --	--	--	--	NO
1,2,4-Trichlorobenzene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	1,270	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,2-Dibromo-3-chloropropane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,2-Dibromoethane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	300	-- / --	0.02	NO	--	-- / --	--	--	--	NO
1,2-Dichlorobenzene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	1,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,2-Dichloroethane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	2,190	-- / --	0.003	NO	--	-- / --	--	--	--	NO
1,2-Dichloropropane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	38,800	-- / --	0.0002	NO	--	-- / --	--	--	--	NO
1,3-Dichlorobenzene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	1,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,4-Dichlorobenzene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	1,280	-- / --	0.01	NO	--	-- / --	--	--	--	NO
2-Butanone	26.0 - 31.0	2 / 7	22.0	24.0	CAA03-SS09-1109	16.9	4.27	--	NSV	-- / --	NSV	YES	--	-- / --	--	NSV	NSV	NO
2-Hexanone	26.0 - 34.0	0 / 7	--	--	--	15.0	1.26	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Methyl-2-pentanone	26.0 - 34.0	0 / 7	--	--	--	15.0	1.26	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Acetone	70.0 - 78.0	5 / 7	94.0	640	CAA03-SS09-1109	227	258	--	NSV	-- / --	NSV	YES	--	-- / --	--	NSV	NSV	YES
Benzene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	1,140	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Bromodichloromethane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Bromoform	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	300	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Bromomethane	10.0 - 14.0	0 / 7	--	--	--	5.93	0.61	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbon disulfide	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbon tetrachloride	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	3,400	-- / --	0.002	NO	--	-- / --	--	--	--	NO
Chlorobenzene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	2,400	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Chloroethane	10.0 - 14.0	0 / 7	--	--	--	5.93	0.61	--	5,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Chloroform	6.00 - 7.00	2 / 7	0.60	0.90	CAA03-SS09-1109	2.64	1.31	--	1,844	0 / 7	0.0005	NO	--	-- / --	--	--	--	NO
Chloromethane	10.0 - 14.0	0 / 7	--	--	--	5.93	0.61	--	5,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
cis-1,2-Dichloroethene	6.00 - 8.00	0 / 7	--	--	--	3.50	0.29	--	447	-- / --	0.02	NO	--	-- / --	--	--	--	NO
cis-1,3-Dichloropropene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	5,000	-- / --	0.001	NO	--	-- / --	--	--	--	NO
Cyclohexane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	6,000	-- / --	0.001	NO	--	-- / --	--	--	--	NO
Dibromochloromethane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Dichlorodifluoromethane (Freon-12)	10.0 - 14.0	0 / 7	--	--	--	5.93	0.61	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Ethylbenzene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	1,815	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Isopropylbenzene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
m- and p-Xylene	12.0 - 15.0	0 / 7	--	--	--	6.64	0.56	--	1,300	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Methyl acetate	10.0 - 12.0	0 / 7	--	--	--	5.43	0.35	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylcyclohexane	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylene chloride	26.0 - 34.0	0 / 7	--	--	--	15.0	1.26	--	1,250	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Methyl-tert-butyl ether (MTBE)	10.0 - 12.0	0 / 7	--	--	--	5.43	0.35	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
o-Xylene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	1,300	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Styrene	5.00 - 6.00	3 / 7	2.00	10.0	CAA03-SS10-1109	3.64	2.84	--	64,000	0 / 7	0.0002	NO	--	-- / --	--	--	--	NO
Tetrachloroethene	5.00 - 7.00	0 / 7	--	--	--	3.00	0.29	--	179	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Toluene	5.00 - 6.00	2 / 7	2.00	3.00	CAA03-SS10-1109	2.79	0.39	--	40,000	0 / 7	0.0001	NO	--	-- / --	--	--	--	NO
trans-1,2-Dichloroethene	7.00 - 10.0	0 / 7	--	--	--	4.21	0.49	--	447	-- / --	0.02	NO	--	-- / --	--	--	--	NO
trans-1,3-Dichloropropene	7.00 - 10.0	0 / 7	--	--	--	4.21	0.49	--	5,000	-- / --	0.002	NO	--	-- / --	--	--	--	NO
Trichloroethene	6.00 - 8.00	0 / 7	--	--	--	3.50	0.29	--	500	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Trichlorofluoromethane (Freon-11)	10.0 - 14.0	0 / 7	--	--	--	5.93	0.61	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Vinyl chloride	10.0 - 14.0	0 / 7	--	--	--	5.93	0.61	--	412	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Xylene, total	16.0 - 20.0	0 / 7	--	--	--	8.93	0.61	--	1,300	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Semivolatile Organic Compounds (UG/KG)													--	-- / --	--			
1,1-Biphenyl	340 - 410	0 / 7	--	--	--	182	11.9	--	13,600	-- / --	0.03	NO				--	--	NO
1,2,4,5-Tetrachlorobenzene	430 - 520	0 / 7	--	--	--	231	14.9	--	1,000	-- / --	0.52	NO	--	-- / --	--	--	--	NO
2,2'-Oxybis(1-chloropropane)	340 - 410	0 / 7	--	--	--	182	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2,4,5-Trichlorophenol	850 - 1,000	0 / 7	--	--	--	451	26.3	--	1,350	-- / --	0.74	NO	--	-- / --	--	--	--	NO
2,4,6-Trichlorophenol	500 - 590	0 / 7	--	--	--	265	15.5	--	580	-- / --	1.02	YES	--	-- / --	--	--	0.46	NO
2,4-Dichlorophenol	460 - 560	0 / 7	--	--	--	248	16.0	--	500	-- / --	1.12	YES	--	-- / --	--	--	0.50	NO
2,4-Dimethylphenol	520 - 620	0 / 7	--	--	--	276	17.0	--	1,000	-- / --	0.62	NO	--	-- / --	--	--	--	NO
2,4-Dinitrophenol	1,200 - 1,400	0 / 7	--	--	--	621	39.3	--	20,000	-- / --	0.07	NO	--	-- / --	--	--	--	NO
2,4-Dinitrotoluene	340 - 410	0 / 7	--	--	--	182	11.9	--	11,000	-- / --	0.04	NO	--	-- / --	--	--	--	NO
2,6-Dinitrotoluene	340 - 410	0 / 7	--	--	--	182	11.9	--	8,500	-- / --	0.05	NO	--	-- / --	--	--	--	NO
2-Chloronaphthalene	21.0 - 25.0	0 / 7	--	--	--	11.1	0.73	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
2-Chlorophenol	520 - 620	0 / 7	--	--	--	276	17.0	--	500	-- / --	1.24	YES	--	-- / --	--	--	0.55	NO

Table E-2
Ecological Screening Statistics - Site 4 Surface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
2-Methylnaphthalene	10.0 - 25.0	2 / 11	7.00	48.0	CAS04-SS09-1012	13.1	11.8	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
2-Methylphenol	620 - 740	0 / 7	--	--	--	331	20.1	--	1,000	-- / --	0.74	NO	--	-- / --	--	--	--	NO
2-Nitroaniline	850 - 1,000	0 / 7	--	--	--	451	26.3	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2-Nitrophenol	530 - 630	0 / 7	--	--	--	281	17.0	--	1,000	-- / --	0.63	NO	--	-- / --	--	--	--	NO
3- and 4-Methylphenol	590 - 700	0 / 7	--	--	--	314	18.6	--	1,000	-- / --	0.70	NO	--	-- / --	--	--	--	NO
3,3'-Dichlorobenzidine	360 - 430	0 / 7	--	--	--	192	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
3-Nitroaniline	850 - 1,000	0 / 7	--	--	--	451	26.3	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4,6-Dinitro-2-methylphenol	1,100 - 1,400	0 / 7	--	--	--	607	45.0	--	1,000	-- / --	1.40	YES	--	-- / --	--	--	0.61	NO
4-Bromophenyl-phenylether	340 - 410	0 / 7	--	--	--	182	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Chloro-3-methylphenol	520 - 620	0 / 7	--	--	--	276	17.0	--	500	-- / --	1.24	YES	--	-- / --	--	--	0.55	NO
4-Chloroaniline	370 - 440	0 / 7	--	--	--	198	11.9	--	500	-- / --	0.88	NO	--	-- / --	--	--	--	NO
4-Chlorophenyl-phenylether	340 - 410	0 / 7	--	--	--	182	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitroaniline	850 - 1,000	0 / 7	--	--	--	451	26.3	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitrophenol	960 - 1,100	0 / 7	--	--	--	509	28.6	--	380	-- / --	2.89	YES	--	-- / --	--	--	1.34	NO[4]
Acenaphthene	10.0 - 25.0	3 / 11	3.00	130	CAS04-SS09-1012	21.4	36.3	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Acenaphthylene	10.0 - 25.0	2 / 11	15.0	36.0	CAS04-SS09-1012	12.7	8.17	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Acetophenone	560 - 670	0 / 7	--	--	--	299	18.6	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Anthracene	21.0 - 21.0	9 / 11	1.70	260	CAS04-SS09-1012	32.9	77.1	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Atrazine	340 - 410	0 / 7	--	--	--	182	11.9	--	11.9	-- / --	34.5	YES	--	-- / --	--	--	15.3	NO[4]
Benzaldehyde	370 - 440	0 / 7	--	--	--	198	11.9	--	58,400	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Benzo(a)anthracene	-- - --	11 / 11	10.0	1,200	CAS04-SS09-1012	159	364	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(a)pyrene	-- - --	11 / 11	4.40	970	CAS04-SS09-1012	127	296	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(b)fluoranthene	18.0 - 18.0	10 / 11	10.0	1,600	CAS04-SS09-1012	216	490	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(g,h,i)perylene	2.60 - 23.0	5 / 10	2.50	520	CAS04-SS09-1012	76.7	165	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(k)fluoranthene	21.0 - 23.0	7 / 11	3.70	560	CAS04-SS09-1012	73.1	169	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethoxy)methane	340 - 410	0 / 7	--	--	--	182	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethyl)ether	340 - 410	0 / 7	--	--	--	182	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
bis(2-Ethylhexyl)phthalate	100 - 120	1 / 7	66.0	66.0	CAS04-SS05-1109	55.9	5.64	--	30,000	0 / 7	0.002	NO	--	-- / --	--	--	--	NO
Butylbenzylphthalate	340 - 410	0 / 7	--	--	--	182	11.9	--	30,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Caprolactam	450 - 540	0 / 3	--	--	--	245	22.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbazole	22.0 - 22.0	6 / 7	2.10	4.00	CAA03-SS10-1109	4.41	2.99	--	7,000	0 / 7	0.001	NO	--	-- / --	--	--	--	NO
Chrysene	22.0 - 23.0	9 / 11	4.00	1,500	CAS04-SS09-1012	185	453	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Dibenz(a,h)anthracene	21.0 - 23.0	7 / 11	3.60	190	CAS04-SS09-1012	32.6	57.7	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Dibenzofuran	340 - 410	0 / 7	--	--	--	182	11.9	--	4,600	-- / --	0.09	NO	--	-- / --	--	--	--	NO
Diethylphthalate	340 - 410	0 / 7	--	--	--	182	11.9	--	26,800	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Dimethyl phthalate	340 - 410	0 / 7	--	--	--	182	11.9	--	10,640	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Di-n-butylphthalate	100 - 120	0 / 7	--	--	--	54.3	3.45	--	40,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Di-n-octylphthalate	660 - 790	0 / 7	--	--	--	353	21.6	--	30,000	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Fluoranthene	-- - --	11 / 11	14.0	3,000	CAS04-SS09-1012	373	905	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Fluorene	10.0 - 25.0	3 / 11	4.70	200	CAS04-SS09-1012	29.0	57.2	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Hexachlorobenzene	21.0 - 25.0	0 / 7	--	--	--	11.1	0.73	--	1,000	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Hexachlorobutadiene	340 - 410	0 / 7	--	--	--	182	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Hexachlorocyclopentadiene	340 - 410	0 / 7	--	--	--	182	11.9	--	2,000	-- / --	0.21	NO	--	-- / --	--	--	--	NO
Hexachloroethane	21.0 - 25.0	0 / 7	--	--	--	11.1	0.73	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Indeno(1,2,3-cd)pyrene	18.0 - 23.0	8 / 11	9.80	850	CAS04-SS09-1012	128	270	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Isophorone	340 - 410	0 / 7	--	--	--	182	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Naphthalene	10.0 - 25.0	2 / 11	11.0	130	CAS04-SS09-1012	20.9	36.2	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
n-Nitroso-di-n-propylamine	340 - 410	0 / 7	--	--	--	182	11.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
n-Nitrosodiphenylamine	680 - 820	0 / 7	--	--	--	364	23.2	--	1,090	-- / --	0.75	NO	--	-- / --	--	--	--	NO
Nitrobenzene	340 - 410	0 / 7	--	--	--	182	11.9	--	2,260	-- / --	0.18	NO	--	-- / --	--	--	--	NO
PAH (HMW)	-- - --	11 / 11	88.8	9,790	CAS04-SS09-1012	1,291	2,977	--	18,000	0 / 11	0.54	NO	--	-- / --	--	--	--	NO
PAH (LMW)	-- - --	11 / 11	65.1	6,204	CAS04-SS09-1012	783	1,841	--	29,000	0 / 11	0.21	NO	--	-- / --	--	--	--	NO
Pentachlorophenol	100 - 120	0 / 7	--	--	--	54.3	3.45	--	5,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Phenanthrene	-- - --	11 / 11	7.70	2,400	CAS04-SS09-1012	273	717	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Phenol	480 - 580	0 / 7	--	--	--	259	16.4	--	1,880	-- / --	0.31	NO	--	-- / --	--	--	--	NO
Pyrene	-- - --	11 / 11	6.90	2,400	CAS04-SS09-1012	300	725	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO

Table E-2
Ecological Screening Statistics - Site 4 Surface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Pesticides (UG/KG)													--	-- / --	--			
4,4'-DDD	3.50 - 4.10	0 / 7	--	--	--	1.85	0.10	--	583	-- / --	0.01	NO	--	-- / --	--	--	--	NO
4,4'-DDE	0.67 - 4.10	3 / 7	0.90	1.70	CAA03-SS10-1109	1.19	0.69	--	114	0 / 7	0.01	NO				--	--	NO
4,4'-DDT	1.30 - 4.10	2 / 7	1.70	3.40	CAA03-SS10-1109	1.78	0.86	--	100	0 / 7	0.03	NO	--	-- / --	--	--	--	NO
Aldrin	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	3.63	-- / --	0.58	NO	--	-- / --	--	--	--	NO
alpha-BHC	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	226	-- / --	0.01	NO	--	-- / --	--	--	--	NO
alpha-Chlordane	1.80 - 2.10	1 / 7	0.54	0.54	CAS04-SS04-1109	0.89	0.16	--	11.0	0 / 7	0.05	NO	--	-- / --	--	--	--	NO
beta-BHC	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	342	-- / --	0.01	NO	--	-- / --	--	--	--	NO
delta-BHC	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	226	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Dieldrin	3.50 - 4.10	0 / 7	--	--	--	1.85	0.10	--	10.5	-- / --	0.39	NO	--	-- / --	--	--	--	NO
Endosulfan I	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	6.32	-- / --	0.33	NO	--	-- / --	--	--	--	NO
Endosulfan II	3.50 - 4.10	0 / 7	--	--	--	1.85	0.10	--	6.32	-- / --	0.65	NO	--	-- / --	--	--	--	NO
Endosulfan sulfate	3.50 - 4.10	0 / 7	--	--	--	1.85	0.10	--	6.32	-- / --	0.65	NO	--	-- / --	--	--	--	NO
Endrin	3.50 - 4.10	3 / 7	3.50	55.0	CAA03-SS09-1109	9.99	19.9	27.1	1.95	3 / 7	28.2	YES	--	-- / --	--	13.9	5.12	YES
Endrin aldehyde	3.60 - 4.10	4 / 7	1.00	2.20	CAA03-SS10-1109	1.84	0.40	--	1.95	2 / 7	1.13	YES	--	-- / --	--	--	0.95	NO
Endrin ketone	3.50 - 4.10	0 / 7	--	--	--	1.85	0.10	--	1.95	-- / --	2.10	YES	--	-- / --	--	--	0.95	NO
gamma-BHC (Lindane)	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	7.75	-- / --	0.27	NO	--	-- / --	--	--	--	NO
gamma-Chlordane	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	11.0	-- / --	0.19	NO	--	-- / --	--	--	--	NO
Heptachlor	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	52.9	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Heptachlor epoxide	1.80 - 2.10	0 / 7	--	--	--	0.94	0.053	--	52.9	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Methoxychlor	18.0 - 21.0	0 / 7	--	--	--	9.43	0.53	--	500	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Toxaphene	35.0 - 41.0	0 / 7	--	--	--	18.5	1.04	--	500	-- / --	0.08	NO	--	-- / --	--	--	--	NO
Polychlorinated Biphenyls (UG/KG)													--	-- / --	--			
Aroclor-1016	9.30 - 22.0	0 / 11	--	--	--	8.68	2.32	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Aroclor-1221	9.30 - 52.0	0 / 11	--	--	--	17.2	8.78	--	8,000	-- / --	0.01	NO				--	--	NO
Aroclor-1232	11.0 - 34.0	0 / 11	--	--	--	12.6	4.45	--	8,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Aroclor-1242	9.30 - 22.0	0 / 11	--	--	--	8.68	2.32	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Aroclor-1248	9.30 - 23.0	0 / 11	--	--	--	9.04	2.56	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Aroclor-1254	9.30 - 21.0	0 / 11	--	--	--	8.31	2.11	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Aroclor-1260	9.30 - 20.0	4 / 11	19.0	55.0	CAS04-SS06-1012	18.3	16.0	--	8,000	0 / 11	0.01	NO	--	-- / --	--	--	--	NO
Inorganics (MG/KG)																		
Aluminum	-- - --	11 / 11	3,960	29,400	CAS04-SS02-1109	11,482	8,212	--	pH < 5.5	8 / 11	--	YES	12,200	4 / 11	2.41	mean pH < 5.5		YES
Antimony	0.42 - 1.10	9 / 11	0.070	0.23	CAS04-SS06-1012	0.17	0.14	--	78.0	0 / 11	0.003	NO	--	-- / --	--	--	--	NO
Arsenic	-- - --	11 / 11	1.00	7.20	CAS04-SS06-1012	3.20	2.17	--	18.0	0 / 11	0.40	NO	--	-- / --	--	--	--	NO
Barium	-- - --	11 / 11	11.3	61.8	CAS04-SS10-1012	26.5	14.2	--	330	0 / 11	0.19	NO	--	-- / --	--	--	--	NO
Beryllium	-- - --	11 / 11	0.19	0.76	CAS04-SS02-1109	0.41	0.19	--	40.0	0 / 11	0.02	NO	--	-- / --	--	--	--	NO
Cadmium	0.020 - 1.20	3 / 11	0.19	2.70	CAS04-SS10-1012	0.55	0.74	0.85	32.0	0 / 11	0.08	NO	--	-- / --	--	--	--	NO
Calcium [3]	-- - --	11 / 11	137	4,540	CAS04-SS10-1012	1,018	1,374	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chromium (hexavalent)	0.21 - 0.21	0 / 1	--	--	--	0.11	--	--	0.40	-- / --	0.53	NO	--	-- / --	--	--	--	NO
Chromium	-- - --	12 / 12	5.80	45.2	CAS04-SS02-1109	16.3	12.0	22.5	64.0	0 / 12	0.71	NO	--	-- / --	--	--	--	NO
Cobalt	-- - --	11 / 11	0.72	3.50	CAS04-SS02-1109	1.94	0.87	--	13.0	0 / 11	0.27	NO	--	-- / --	--	--	--	NO
Copper	-- - --	11 / 11	1.80	31.5	CAS04-SS10-1012	8.00	11.5	--	70.0	0 / 11	0.45	NO	--	-- / --	--	--	--	NO
Cyanide	0.70 - 0.84	0 / 7	--	--	--	0.38	0.024	--	15.8	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Iron	-- - --	11 / 11	3,450	28,300	CAS04-SS02-1109	11,487	7,814	--	5 < pH > 8	6 / 11	--	YES	19,900	2 / 11	1.42	mean pH in range		NO
Lead	-- - --	11 / 11	7.90	53.3	CAS04-SS10-1012	18.4	13.3	--	120	0 / 11	0.44	NO	--	-- / --	--	--	--	NO
Magnesium [3]	-- - --	11 / 11	340	2,280	CAS04-SS02-1109	912	569	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Manganese	-- - --	11 / 11	19.1	91.8	CAS04-SS09-1012	41.3	22.7	--	220	0 / 11	0.42	NO	--	-- / --	--	--	--	NO
Mercury	-- - --	11 / 11	0.010	0.10	CAS04-SS10-1012	0.039	0.028	0.054	0.10	1 / 11	1.00	YES	0.111	0 / 11	0.90	--	--	NO
Nickel	-- - --	11 / 11	1.80	8.10	CAS04-SS02-1109	4.31	2.16	--	38.0	0 / 11	0.21	NO	--	-- / --	--	--	--	NO
Potassium [3]	-- - --	11 / 11	260	2,580	CAS04-SS02-1109	866	665	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Selenium	0.59 - 1.50	8 / 11	0.18	0.59	CAS04-SS07-1012	0.34	0.18	0.36	0.52	1 / 11	1.13	YES	0.51	1 / 11	1.16	0.69	0.65	NO
Silver	0.28 - 1.80	4 / 11	0.090	0.29	CAA03-SS09-1109	0.42	0.31	--	560	0 / 11	0.001	NO	--	-- / --	--	--	--	NO
Sodium [3]	33.4 - 50.8	7 / 11	14.4	49.6	CAS04-SS02-1109	22.2	11.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Thallium	0.070 - 1.10	0 / 11	--	--	--	0.12	0.15	--	1.00	-- / --	1.10	YES	--	-- / --	--	--	0.12	NO
Vanadium	-- - --	11 / 11	8.60	63.6	CAS04-SS02-1109	25.3	18.0	--	130	0 / 11	0.49	NO	--	-- / --	--	--	--	NO
Zinc	-- - --	11 / 11	9.70	242	CAS04-SS10-1012	43.3	68.6	96.9	120	1 / 11	2.02	YES	26.5	4 / 11	9.13	0.81	0.36	NO
Other Parameters																		
pH	-- - --	11 / 11	3.90	6.50	CAS04-SS09-1012	5.08	0.80	--	--	-- / --	--	--	--	-- / --	--	--	--	--
Total organic carbon (MG/KG)	-- - --	11 / 11	5,600	84,000	CAS04-SS10-1012	29,145	23,131	--	--	-- / --	--	--	--	-- / --	--	--	--	--

NSV - No Screening Value
1 - Count of detected samples exceeding or equaling ESV
2 - Shaded cells indicate hazard quotient based on reporting limits
3 - Macronutrient - Not considered to be a COPC
4 - See uncertainty section

Table E-3
Exceedances - Site 4 Surface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAA03-SS09	CAA03-SS10	CAS04-SS01	CAS04-SS02	CAS04-SS03	CAS04-SS04	CAS04-SS05	CAS04-SO06	CAS04-SO07	CAS04-SO09	CAS04-SO10	CAS04-SO14	
			CAA03-SS09-1109	CAA03-SS10-1109	CAS04-SS01-1109	CAS04-SS02-1109	CAS04-SS03-1109	CAS04-SS04-1109	CAS04-SS05-1109	CAS04-SS06-1012	CAS04-SS07-1012	CAS04-SS09-1012	CAS04-SS10-1012	CAS04-SS14-1012	CAS04-SS14P-1012
			11/05/09	11/05/09	11/03/09	11/03/09	11/03/09	11/03/09	11/03/09	10/23/12	10/23/12	10/23/12	10/23/12	10/23/12	10/23/12
Volatile Organic Compounds (UG/KG)															
2-Butanone	NSV	--	24 J	22 J	26 U	31 U	28 UJ	30 UJ	30 UJ	NA	NA	NA	NA	NA	NA
Acetone	NSV	--	640 J	560 J	70 B	100	78 B	94 J	120 J	NA	NA	NA	NA	NA	NA
Chloroform	1,844	--	0.9 J	0.6 J	6 U	7 U	7 UJ	7 UJ	7 UJ	NA	NA	NA	NA	NA	NA
Styrene	64,000	--	6 UJ	10 J	5 U	2 J	2 J	6 UJ	6 UJ	NA	NA	NA	NA	NA	NA
Toluene	40,000	--	6 UJ	3 J	5 U	6 U	6 UJ	2 J	6 UJ	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/KG)															
2-Methylnaphthalene	LMW PAH	--	21 U	21 U	21 U	25 U	22 U	22 U	23 U	13 U	10 U	48	7 J	NA	NA
Acenaphthene	LMW PAH	--	21 U	21 U	21 U	25 U	22 U	22 U	23 U	3 J	10 U	130	20 J	NA	NA
Acenaphthylene	LMW PAH	--	21 U	21 U	21 U	25 U	22 U	22 U	23 U	13 U	10 U	36	15 J	NA	NA
Anthracene	LMW PAH	--	21 U	21 U	4 J	4.2 J	1.7 J	2.4 J	1.8 J	6 J	2.1 J	260	59	NA	NA
Benzo(a)anthracene	HMW PAH	--	14 J	18 J	16 J	23 J	14 J	16 J	10 J	24 J	12 J	1,200	400	NA	NA
Benzo(a)pyrene	HMW PAH	--	11 J	14 J	7.8 J	14 J	5.8 J	10 J	4.4 J	20 J	9.3 J	970	330	NA	NA
Benzo(b)fluoranthene	HMW PAH	--	20 J	26	18 J	29	16 J	20 J	10 J	37	18 B	1,600	590	NA	NA
Benzo(g,h,i)perylene	HMW PAH	--	21 R	2.6 B	21 UL	2.5 L	22 UL	22 UL	23 UL	12 J	7 J	520	180	NA	NA
Benzo(k)fluoranthene	HMW PAH	--	21 U	21 U	3.7 J	6.3 J	22 U	5.5 J	23 U	9.3 J	5.9 J	560	170	NA	NA
bis(2-Ethylhexyl)phthalate	30,000	--	110 U	100 U	100 U	120 U	110 U	110 U	66 J	NA	NA	NA	NA	NA	NA
Carbazole	7,000	--	3.8 J	4 J	2.6 J	3.8 J	22 U	3.6 J	2.1 J	NA	NA	NA	NA	NA	NA
Chrysene	HMW PAH	--	12 J	16 J	4 J	8.6 J	22 U	7.7 J	23 U	29 J	12 J	1,500	420	NA	NA
Dibenz(a,h)anthracene	HMW PAH	--	21 U	3.6 J	10 J	13 J	22 U	22 U	23 U	4.1 J	4 J	190	90	NA	NA
Fluoranthene	LMW PAH	--	31	40	21	36	17 J	29	14 J	48	22	3,000	840	NA	NA
Fluorene	LMW PAH	--	21 U	21 U	21 U	25 U	22 U	22 U	23 U	4.7 J	10 U	200	32 J	NA	NA
Indeno(1,2,3-cd)pyrene	HMW PAH	--	18 B	20 B	12 K	18 K	9.8 K	20 J	23 U	27 J	13 J	850	430 J	NA	NA
Naphthalene	LMW PAH	--	21 U	21 U	21 U	25 U	22 U	22 U	23 U	13 U	10 U	130	11 J	NA	NA
PAH (HMW)	18,000	--	124	135	96.0	135	96.6	118	88.8	215	96.2	9,790	3,310	NA	NA
PAH (LMW)	29,000	--	124	140	104	136	93.1	112	92.5	119	65.1	6,204	1,424	NA	NA
Phenanthrene	LMW PAH	--	19 J	26	16 J	21 J	8.4 J	15 J	7.7 J	38	16 J	2,400	440	NA	NA
Pyrene	HMW PAH	--	26	36	14 J	21 J	7 J	17 J	6.9 J	53	24	2,400 J	700	NA	NA
Pesticides (UG/KG)															
4,4'-DDE	114	--	3.6 U	1.7 J	0.67 B	4.1 U	0.72 B	1.2 L	0.9 L	NA	NA	NA	NA	NA	NA
4,4'-DDT	100	--	3.6 U	3.4 J	1.3 B	4.1 U	2.2 B	3.5 U	1.7 J	NA	NA	NA	NA	NA	NA
alpha-Chlordane	11.0	--	1.8 U	1.8 U	1.9 UJ	2.1 U	1.9 U	0.54 J	1.9 U	NA	NA	NA	NA	NA	NA
Endrin	1.95	--	55	3.9	3.7 UJ	4.1 U	3.5 J	3.5 U	3.7 U	NA	NA	NA	NA	NA	NA
Endrin aldehyde	1.95	--	3.6 U	2.2 J	3.7 UJ	4.1 U	1.9 J	2.1 J	1 J	NA	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (UG/KG)															
Aroclor-1260	8,000	--	20 U	19 U	20 U	35	20 U	33	19 J	55	9.3 U	9.6 U	20 UL	NA	NA
Inorganics (MG/KG)															
Aluminum	pH < 5.5	12,200	4,100	3,960	6,360	29,400	4,560	5,990	18,000	19,600	15,600	8,030	10,700	NA	NA
Antimony	78.0	11.0	0.08 J	0.07 J	0.08 L	0.2 L	0.09 L	0.08 L	0.14 L	0.23 J	0.12 J	0.42 U	1.1 U	NA	NA
Arsenic	18.0	6.36	2.2	1	1.6	6.4	1.4	1.1	3.6	7.2	5.2	3.1	2.4	NA	NA
Barium	330	52.9	11.3	16.9	17.6	32.1	14.8	24.8 J	22.2 J	32.7	20.6	36.5	61.8	NA	NA
Beryllium	40.0	0.587	0.19 J	0.24 J	0.24 J	0.76	0.22 J	0.46 J	0.42	0.56	0.34 J	0.52	0.6 J	NA	NA
Cadmium	32.0	1.50	0.92 U	0.02 B	0.91 U	1.2 U	0.98 U	0.96 U	0.77 U	0.22 J	0.13 B	0.19 J	2.7	NA	NA
Chromium	64.0	18.2	8.4	5.8	9.2 K	45.2 K	7.3 K	6.9	26.6	27.8	21.8	12.5	16.1	7.4	7.2
Cobalt	13.0	9.93	0.72	0.84	1.2	3.5	1.1	2.1	2.3	2.7	2.4	2.2	2.3	NA	NA
Copper	70.0	4.25	1.9 J	1.9 J	1.8 K	4.4 K	2.4 K	2.5	3.1	4.6	2.9	31	31.5	NA	NA
Iron	5 < pH > 8	19,900	6,140	3,450	7,090	28,300	6,210	4,370 J	15,000 J	20,300	17,400	8,860	9,240	NA	NA
Lead	120	17.4	9.2	10.6	7.9 K	12.6 K	11.7 K	10	23.7	24	13.5	25.9	53.3	NA	NA
Manganese	220	324	19.1	27.9	27.7 K	33.6 K	28.8 K	59 J	24.7 J	40.8	30.2	91.8	70.2	NA	NA
Mercury	0.10	0.111	0.01 J	0.03 J	0.01 J	0.03 J	0.02 J	0.03 J	0.03 J	0.08	0.05	0.04	0.1	NA	NA
Nickel	38.0	9.52	1.8 J	1.9 J	2.3 J	8.1 J	2.2 J	3.1 J	5.6	6	4.8	5.1	6.5	NA	NA
Selenium	0.52	0.51	0.21 J	0.24 J	0.22 J	0.27 J	0.18 J	0.28 J	0.32 J	0.74 B	0.59 J	0.59 U	1.5 U	NA	NA
Silver	560	2.10	0.29 J	0.1 J	1.4 U	1.8 U	1.5 U	1.4 U	1.2 U	0.34 U	0.28 U	0.15 J	0.09 J	NA	NA
Vanadium	130	27.9	11.4	8.6	13.3	63.6	11.9	9.8	41.7	43.3	34.1	18.8	21.6	NA	NA
Zinc	120	26.5	10	9.7	13 K	28.8 K	10.4 K	14.9	20.3	29.5	21.3	76.5	242	NA	NA

Table E-3
Exceedances - Site 4 Surface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAA03-SS09	CAA03-SS10	CAS04-SS01	CAS04-SS02	CAS04-SS03	CAS04-SS04	CAS04-SS05	CAS04-SO06	CAS04-SO07	CAS04-SO09	CAS04-SO10	CAS04-SO14	
			CAA03-SS09-1109	CAA03-SS10-1109	CAS04-SS01-1109	CAS04-SS02-1109	CAS04-SS03-1109	CAS04-SS04-1109	CAS04-SS05-1109	CAS04-SS06-1012	CAS04-SS07-1012	CAS04-SS09-1012	CAS04-SS10-1012	CAS04-SS14-1012	CAS04-SS14P-1012
			11/05/09	11/05/09	11/03/09	11/03/09	11/03/09	11/03/09	11/03/09	10/23/12	10/23/12	10/23/12	10/23/12	10/23/12	10/23/12
Other Parameters															
pH	--	--	**4.60**	**5.00**	**5.00**	**6.00**	**5.20**	**5.50**	**4.60**	**4.00**	**3.90**	**6.50**	**5.60**	NA	NA
Total organic carbon (MG/KG)	--	--	**18,000**	**18,000**	**5,600**	**16,000**	**17,000**	**17,000**	**18,000**	**59,000**	**32,000**	**36,000**	**84,000**	NA	NA

Notes:
Grey highlighting indicates value greater than ESV
Yellow highlighting indicates value equal to ESV
Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL
Bold indicates detections
NA - Not analyzed
NSV - No Screening Value

Table E-4
Ecological Screening Statistics - Site 4 Surface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Volatile Organic Compounds (UG/KG)																		
1,1,1-Trichloroethane	6.00 - 14.8	0 / 10	--	--	--	4.96	1.54	--	1,025	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,1,2,2-Tetrachloroethane	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	5,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	6.00 - 8.00	0 / 5	--	--	--	3.60	0.42	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloroethane	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	2,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethane	6.00 - 14.8	0 / 10	--	--	--	4.96	1.54	--	548	-- / --	0.03	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethene	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	173	-- / --	0.09	NO	--	-- / --	--	--	--	NO
1,2,4-Trichlorobenzene	5.00 - 5,500	0 / 11	--	--	--	678	958	--	1,270	-- / --	4.33	YES	--	-- / --	--	--	0.53	NO
1,2-Dibromo-3-chloropropane	5.00 - 7.00	0 / 5	--	--	--	3.00	0.35	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,2-Dibromoethane	5.00 - 7.00	0 / 5	--	--	--	3.00	0.35	--	300	-- / --	0.02	NO	--	-- / --	--	--	--	NO
1,2-Dichlorobenzene	5.00 - 5,500	0 / 11	--	--	--	678	958	--	1,000	-- / --	5.50	YES	--	-- / --	--	--	0.68	NO
1,2-Dichloroethane	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	2,190	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,2-Dichloroethene (total)	11.2 - 14.8	0 / 5	--	--	--	6.31	0.73	--	447	-- / --	0.03	NO	--	-- / --	--	--	--	NO
1,2-Dichloropropane	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	38,800	-- / --	0.0004	NO	--	-- / --	--	--	--	NO
1,3-Dichlorobenzene	5.00 - 5,500	0 / 11	--	--	--	678	958	--	1,000	-- / --	5.50	YES	--	-- / --	--	--	0.68	NO
1,4-Dichlorobenzene	5.00 - 5,500	0 / 11	--	--	--	678	958	--	1,280	-- / --	4.30	YES	--	-- / --	--	--	0.53	NO
2-Butanone	11.2 - 34.0	0 / 10	--	--	--	10.6	4.65	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2-Hexanone	11.2 - 34.0	0 / 10	--	--	--	10.6	4.65	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Methyl-2-pentanone	11.2 - 34.0	0 / 10	--	--	--	10.6	4.65	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Acetone	5.00 - 110	1 / 10	100	100	CAA03-SS05-1109	29.5	31.0	--	NSV	-- / --	NSV	YES	--	-- / --	--	NSV	NSV	YES
Benzene	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	1,140	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Bromodichloromethane	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Bromoform	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	300	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Bromomethane	10.0 - 14.8	0 / 10	--	--	--	6.16	0.74	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbon disulfide	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbon tetrachloride	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	3,400	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Chlorobenzene	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	2,400	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Chloroethane	10.0 - 14.8	0 / 10	--	--	--	6.16	0.74	--	5,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Chloroform	7.00 - 14.8	1 / 10	0.60	0.60	CAA03-SS05-1109	4.72	1.99	--	1,844	0 / 10	0.0003	NO	--	-- / --	--	--	--	NO
Chloromethane	10.0 - 14.8	0 / 10	--	--	--	6.16	0.74	--	5,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
cis-1,2-Dichloroethene	6.00 - 8.00	0 / 5	--	--	--	3.60	0.42	--	447	-- / --	0.02	NO	--	-- / --	--	--	--	NO
cis-1,3-Dichloropropene	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	5,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Cyclohexane	5.00 - 7.00	0 / 5	--	--	--	3.00	0.35	--	6,000	-- / --	0.001	NO	--	-- / --	--	--	--	NO
Dibromochloromethane	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Dichlorodifluoromethane (Freon-12)	10.0 - 14.0	0 / 5	--	--	--	6.00	0.79	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Ethylbenzene	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	1,815	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Isopropylbenzene	5.00 - 7.00	0 / 5	--	--	--	3.00	0.35	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
m- and p-Xylene	11.0 - 15.0	0 / 5	--	--	--	6.50	0.79	--	1,300	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Methyl acetate	9.00 - 12.0	0 / 5	--	--	--	5.30	0.67	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylcyclohexane	5.00 - 7.00	0 / 5	--	--	--	3.00	0.35	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylene chloride	7.00 - 34.0	2 / 11	9.00	12.0	CAA03-SS04-1109	8.86	4.77	--	1,250	0 / 11	0.01	NO	--	-- / --	--	--	--	NO
Methyl-tert-butyl ether (MTBE)	9.00 - 12.0	0 / 5	--	--	--	5.30	0.67	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
o-Xylene	5.00 - 7.00	0 / 5	--	--	--	3.00	0.35	--	1,300	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Styrene	5.00 - 14.8	1 / 10	1.00	1.00	CAA03-SS08-1109	4.41	2.15	--	64,000	0 / 10	0.00002	NO	--	-- / --	--	--	--	NO
Tetrachloroethene	5.00 - 14.8	0 / 10	--	--	--	4.66	1.83	--	179	-- / --	0.08	NO	--	-- / --	--	--	--	NO
Toluene	4.00 - 14.8	0 / 10	--	--	--	4.56	1.95	--	40,000	-- / --	0.0004	NO	--	-- / --	--	--	--	NO
trans-1,2-Dichloroethene	7.00 - 10.0	0 / 5	--	--	--	4.20	0.57	--	447	-- / --	0.02	NO	--	-- / --	--	--	--	NO
trans-1,3-Dichloropropene	7.00 - 14.8	0 / 10	--	--	--	5.26	1.27	--	5,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Trichloroethene	6.00 - 14.8	0 / 10	--	--	--	4.96	1.54	--	500	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Trichlorofluoromethane (Freon-11)	10.0 - 14.0	0 / 5	--	--	--	6.00	0.79	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Vinyl chloride	10.0 - 14.8	0 / 10	--	--	--	6.16	0.74	--	412	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Xylene, total	11.2 - 20.0	1 / 10	2.00	2.00	CAS004-4HA02-00-1199	7.08	2.34	--	1,300	0 / 10	0.002	NO	--	-- / --	--	--	--	NO
Semivolatile Organic Compounds (UG/KG)																		

Table E-4
Ecological Screening Statistics - Site 4 Surface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
1,1-Biphenyl	340 - 420	0 / 5	--	--	--	192	14.4	--	13,600	-- / --	0.03	NO	--	-- / --	--	--	--	NO
1,2,4,5-Tetrachlorobenzene	440 - 540	0 / 5	--	--	--	245	18.0	--	1,000	-- / --	0.54	NO	--	-- / --	--	--	--	NO
2,2'-Oxybis(1-chloropropane)	340 - 5,500	0 / 11	--	--	--	764	895	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2,4,5-Trichlorophenol	850 - 14,000	0 / 11	--	--	--	1,918	2,265	--	1,350	-- / --	10.4	YES	--	-- / --	--	--	1.42	NO[4]
2,4,6-Trichlorophenol	380 - 5,500	0 / 11	--	--	--	804	867	--	580	-- / --	9.48	YES	--	-- / --	--	--	1.39	NO[4]
2,4-Dichlorophenol	380 - 5,500	0 / 11	--	--	--	796	872	--	500	-- / --	11.0	YES	--	-- / --	--	--	1.59	NO[4]
2,4-Dimethylphenol	380 - 5,500	0 / 11	--	--	--	810	863	--	1,000	-- / --	5.50	YES	--	-- / --	--	--	0.81	NO
2,4-Dinitrophenol	960 - 14,000	0 / 11	--	--	--	2,007	2,204	--	20,000	-- / --	0.70	NO	--	-- / --	--	--	--	NO
2,4-Dinitrotoluene	340 - 500	0 / 11	--	--	--	218	28.0	--	11,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
2,6-Dinitrotoluene	340 - 500	0 / 11	--	--	--	218	28.0	--	8,500	-- / --	0.06	NO	--	-- / --	--	--	--	NO
2-Chloronaphthalene	21.0 - 5,500	0 / 11	--	--	--	682	955	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
2-Chlorophenol	380 - 5,500	0 / 11	--	--	--	810	863	--	500	-- / --	11.0	YES	--	-- / --	--	--	1.62	NO[4]
2-Methylnaphthalene	10.0 - 5,500	3 / 14	6.80	25.0	CAA03-SS02-1109	538	885	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
2-Methylphenol	380 - 5,500	0 / 11	--	--	--	835	847	--	1,000	-- / --	5.50	YES	--	-- / --	--	--	0.84	NO
2-Nitroaniline	850 - 14,000	0 / 11	--	--	--	1,918	2,265	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2-Nitrophenol	380 - 5,500	0 / 11	--	--	--	812	862	--	1,000	-- / --	5.50	YES	--	-- / --	--	--	0.81	NO
3- and 4-Methylphenol	590 - 730	0 / 5	--	--	--	333	25.1	--	1,000	-- / --	0.73	NO	--	-- / --	--	--	--	NO
3,3'-Dichlorobenzidine	360 - 5,500	0 / 11	--	--	--	769	891	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
3-Nitroaniline	850 - 14,000	0 / 11	--	--	--	1,918	2,265	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4,6-Dinitro-2-methylphenol	960 - 14,000	0 / 11	--	--	--	1,994	2,213	--	1,000	-- / --	14.0	YES	--	-- / --	--	--	1.99	NO[4]
4-Bromophenyl-phenylether	340 - 5,500	0 / 11	--	--	--	764	895	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Chloro-3-methylphenol	380 - 5,500	0 / 11	--	--	--	810	863	--	500	-- / --	11.0	YES	--	-- / --	--	--	1.62	NO[4]
4-Chloroaniline	370 - 5,500	0 / 11	--	--	--	772	889	--	500	-- / --	11.0	YES	--	-- / --	--	--	1.54	NO[4]
4-Chlorophenyl-phenylether	340 - 5,500	0 / 11	--	--	--	764	895	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Methylphenol	380 - 5,500	0 / 6	--	--	--	1,240	1,001	--	1,000	-- / --	5.50	YES	--	-- / --	--	--	1.24	NO[4]
4-Nitroaniline	850 - 14,000	0 / 11	--	--	--	1,918	2,265	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitrophenol	960 - 14,000	0 / 11	--	--	--	1,951	2,242	--	380	-- / --	36.8	YES	--	-- / --	--	--	5.14	NO[4]
Acenaphthene	10.0 - 5,500	6 / 14	6.90	330	CAS004-4HA02-00-1199	493	870	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Acenaphthylene	10.0 - 5,500	6 / 14	3.80	240	CAA03-SS02-1109	563	871	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Acetophenone	560 - 690	0 / 5	--	--	--	314	23.3	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Anthracene	380 - 5,500	10 / 14	2.20	1,700	CAS004-4HA06-00-1199	530	819	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Atrazine	340 - 420	0 / 5	--	--	--	192	14.4	--	11.9	-- / --	35.3	YES	--	-- / --	--	--	16.1	NO[4]
Benzaldehyde	370 - 430	1 / 5	200	200	CAA03-SS08-1109	204	11.9	--	58,400	0 / 5	0.003	NO	--	-- / --	--	--	--	NO
Benzo(a)anthracene	380 - 2,600	11 / 14	17.0	8,800	CAS004-4HA06-00-1199	1,188	2,255	--	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Benzo(a)pyrene	380 - 2,600	11 / 14	15.0	7,000	CAS004-4HA06-00-1199	1,067	1,829	--	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Benzo(b)fluoranthene	22.0 - 380	12 / 14	28.0	6,800	CAS004-4HA06-00-1199	1,064	1,780	--	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Benzo(g,h,i)perylene	3.80 - 2,600	10 / 14	8.60	3,400	CAS004-4HA06-00-1199	558	924	--	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Benzo(k)fluoranthene	26.0 - 380	12 / 14	9.00	6,800	CAS004-4HA06-00-1199	809	1,784	--	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
bis(2-Chloroethoxy)methane	340 - 5,500	0 / 11	--	--	--	764	895	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethyl)ether	340 - 5,500	0 / 11	--	--	--	764	895	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
bis(2-Ethylhexyl)phthalate	49.0 - 16,000	0 / 11	--	--	--	1,688	2,726	--	30,000	-- / --	0.53	NO	--	-- / --	--	--	--	NO
Butylbenzylphthalate	340 - 5,500	0 / 11	--	--	--	764	895	--	30,000	-- / --	0.18	NO	--	-- / --	--	--	--	NO
Caprolactam								--	NSV	-- --	NSV	NO	--	-- / --	--	--	--	NO
Carbazole	380 - 5,500	6 / 11	3.20	250	CAS004-4HA02-00-1199	631	941	--	7,000	0 / 11	0.04	NO	--	-- / --	--	--	--	NO
Chrysene	380 - 380	13 / 14	17.0	8,600	CAS004-4HA06-00-1199	1,157	2,237	--	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Dibenz(a,h)anthracene	21.0 - 5,500	8 / 14	3.60	1,400	CAS004-4HA06-00-1199	533	809	--	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Dibenzofuran	340 - 5,500	0 / 11	--	--	--	764	895	--	4,600	-- / --	1.20	YES	--	-- / --	--	--	0.17	NO
Diethylphthalate	340 - 5,500	0 / 11	--	--	--	764	895	--	26,800	-- / --	0.21	NO	--	-- / --	--	--	--	NO
Dimethyl phthalate	340 - 5,500	0 / 11	--	--	--	764	895	--	10,640	-- / --	0.52	NO	--	-- / --	--	--	--	NO
Di-n-butylphthalate	41.0 - 9,900	0 / 11	--	--	--	1,019	1,600	--	40,000	-- / --	0.25	NO	--	-- / --	--	--	--	NO
Di-n-octylphthalate	380 - 5,500	0 / 11	--	--	--	846	840	--	30,000	-- / --	0.18	NO	--	-- / --	--	--	--	NO

Table E-4
Ecological Screening Statistics - Site 4 Surface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Fluoranthene	380 - 380	13 / 14	29.0	14,000	CAS004-4HA06-00-1199	1,914	3,626	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Fluorene	10.0 - 5,500	6 / 14	11.0	250	CAS004-4HA02-00-1199	502	864	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Hexachlorobenzene	21.0 - 5,500	0 / 11	--	--	--	682	955	--	1,000	-- / --	5.50	YES	--	-- / --	--	--	0.68	NO
Hexachlorobutadiene	340 - 5,500	0 / 11	--	--	--	764	895	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Hexachlorocyclopentadiene	340 - 5,500	0 / 11	--	--	--	764	895	--	2,000	-- / --	2.75	YES	--	-- / --	--	--	0.38	NO
Hexachloroethane	21.0 - 5,500	0 / 11	--	--	--	682	955	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Indeno(1,2,3-cd)pyrene	380 - 2,600	12 / 14	19.0	3,400	CAS004-4HA06-00-1199	616	913	--	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Isophorone	340 - 5,500	0 / 11	--	--	--	764	895	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Naphthalene	10.0 - 5,500	3 / 14	7.70	31.0	CAA03-SS02-1109	538	885	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
n-Nitroso-di-n-propylamine	340 - 5,500	0 / 11	--	--	--	764	895	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
n-Nitrosodiphenylamine	380 - 5,500	0 / 11	--	--	--	852	837	--	1,090	-- / --	5.05	YES	--	-- / --	--	--	0.78	NO
Nitrobenzene	340 - 500	0 / 11	--	--	--	218	28.0	--	2,260	-- / --	0.22	NO	--	-- / --	--	--	--	NO
PAH (HMW)	1,710 - 1,710	13 / 14	128	57,200	CAS004-4HA06-00-1199	8,552	14,895	27,333	18,000	1 / 14	3.18	YES	--	-- / --	--	1.52	0.48	YES
PAH (LMW)	1,710 - 1,710	13 / 14	70.2	32,900	CAS004-4HA06-00-1199	6,667	9,802	21,392	29,000	1 / 14	1.13	YES	--	-- / --	--	0.74	0.23	NO
Pentachlorophenol	100 - 14,000	0 / 11	--	--	--	1,730	2,403	--	5,000	-- / --	2.80	YES	--	-- / --	--	--	0.35	NO
Phenanthrene	380 - 2,600	11 / 14	14.0	5,500	CAS004-4HA06-00-1199	1,114	1,478	--	LMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Phenol	380 - 5,500	0 / 11	--	--	--	801	869	--	1,880	-- / --	2.93	YES	--	-- / --	--	--	0.43	NO
Pyrene	380 - 380	13 / 14	26.0	11,000	CAS004-4HA06-00-1199	1,622	2,880	5,170	HMW PAH	-- / --	--	--	--	-- / --	--	--	--	NO
Pesticides (UG/KG)																		
4,4'-DDD	3.80 - 27.0	5 / 11	2.30	25.0	CAA03-SS02-1109	6.59	7.12	--	583	0 / 11	0.04	NO	--	-- / --	--	--	--	NO
4,4'-DDE	3.80 - 27.0	7 / 11	0.80	83.0	CAA03-SS02-1109	15.3	25.6	74.5	114	0 / 11	0.73	NO	--	-- / --	--	--	--	NO
4,4'-DDT	3.80 - 4.00	9 / 11	1.60	220	CAS004-4HA05-00-1199	31.8	66.2	144	100	1 / 11	2.20	YES	--	-- / --	--	1.44	0.32	YES
Aldrin	1.90 - 2.70	1 / 11	33.0	33.0	CAS004-4HA05-00-1199	3.95	9.64	--	3.63	1 / 11	9.09	YES	--	-- / --	--	--	1.09	YES
alpha-BHC	1.90 - 14.0	0 / 11	--	--	--	1.59	1.80	--	226	-- / --	0.06	NO	--	-- / --	--	--	--	NO
alpha-Chlordane	1.90 - 14.0	1 / 11	0.99	0.99	CAA03-SS02-1109	1.59	1.80	--	11.0	0 / 11	0.09	NO	--	-- / --	--	--	--	NO
beta-BHC	1.90 - 14.0	0 / 11	--	--	--	1.59	1.80	--	342	-- / --	0.04	NO	--	-- / --	--	--	--	NO
delta-BHC	1.90 - 14.0	0 / 11	--	--	--	1.59	1.80	--	226	-- / --	0.06	NO	--	-- / --	--	--	--	NO
Dieldrin	3.70 - 27.0	1 / 11	1.40	1.40	CAA03-SS04-1109	3.02	3.49	--	10.5	0 / 11	0.13	NO	--	-- / --	--	--	--	NO
Endosulfan I	1.90 - 14.0	1 / 11	0.91	0.91	CAA03-SS08-1109	1.57	1.80	--	6.32	0 / 11	0.14	NO	--	-- / --	--	--	--	NO
Endosulfan II	3.70 - 27.0	2 / 11	4.40	5.70	CAS004-4HA03-00-1199	3.64	3.50	--	6.32	0 / 11	0.90	NO	--	-- / --	--	--	--	NO
Endosulfan sulfate	3.70 - 27.0	1 / 11	8.90	8.90	CAA03-SS02-1109	3.70	3.85	--	6.32	1 / 11	1.41	YES	--	-- / --	--	--	0.59	NO
Endrin	3.80 - 5.20	5 / 11	6.30	28.0	CAS004-4HA05-00-1199	8.07	8.63	13.6	1.95	5 / 11	14.4	YES	--	-- / --	--	6.99	4.14	YES
Endrin aldehyde	3.80 - 5.20	4 / 11	2.60	77.0	CAS004-4HA05-00-1199	9.38	22.5	23.3	1.95	4 / 11	39.5	YES	--	-- / --	--	11.9	4.81	YES
Endrin ketone	3.70 - 5.20	2 / 11	4.50	87.0	CAS004-4HA05-00-1199	9.97	25.6	--	1.95	2 / 11	44.6	YES	--	-- / --	--	--	5.11	YES
gamma-BHC (Lindane)	1.90 - 14.0	2 / 11	0.82	9.60	CAA03-SS02-1109	2.36	3.00	--	7.75	1 / 11	1.24	YES	--	-- / --	--	--	0.30	NO
gamma-Chlordane	1.90 - 2.70	1 / 11	15.0	15.0	CAS004-4HA05-00-1199	2.31	4.21	--	11.0	1 / 11	1.36	YES	--	-- / --	--	--	0.21	NO
Heptachlor	1.90 - 14.0	0 / 11	--	--	--	1.59	1.80	--	52.9	-- / --	0.26	NO	--	-- / --	--	--	--	NO
Heptachlor epoxide	1.90 - 14.0	0 / 11	--	--	--	1.59	1.80	--	52.9	-- / --	0.26	NO	--	-- / --	--	--	--	NO
Methoxychlor	19.0 - 140	0 / 11	--	--	--	15.9	18.0	--	500	-- / --	0.28	NO	--	-- / --	--	--	--	NO
Toxaphene	37.0 - 1,400	0 / 11	--	--	--	123	197	--	500	-- / --	2.80	YES	--	-- / --	--	--	0.25	NO
Polychlorinated Biphenyls (UG/KG)																		
Aroclor-1016	8.90 - 270	0 / 14	--	--	--	21.9	33.2	--	8,000	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Aroclor-1221	8.90 - 560	0 / 14	--	--	--	45.2	69.3	--	8,000	-- / --	0.07	NO	--	-- / --	--	--	--	NO
Aroclor-1232	10.0 - 270	0 / 14	--	--	--	24.2	32.5	--	8,000	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Aroclor-1242	8.90 - 52.0	1 / 14	1,000	1,000	CAS004-4HA05-00-1199	83.7	264	--	8,000	0 / 14	0.13	NO	--	-- / --	--	--	--	NO
Aroclor-1248	8.90 - 270	0 / 14	--	--	--	22.1	33.2	--	8,000	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Aroclor-1254	8.90 - 270	0 / 14	--	--	--	21.7	33.3	--	8,000	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Aroclor-1260	8.90 - 23.0	6 / 14	53.0	2,700	CAS004-4HA05-00-1199	260	719	640	8,000	0 / 14	0.34	NO	--	-- / --	--	--	--	NO
Explosives (UG/KG)																		
1,3,5-Trinitrobenzene	450 - 500	0 / 6	--	--	--	240	12.2	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,3-Dinitrobenzene	450 - 500	0 / 6	--	--	--	240	12.2	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2,4,6-Trinitrotoluene	450 - 500	0 / 6	--	--	--	240	12.2	--	10,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
2-Amino-4,6-dinitrotoluene	450 - 500	0 / 6	--	--	--	240	12.2	--	80,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO

Table E-4
Ecological Screening Statistics - Site 4 Surface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
2-Nitrotoluene	450 - 500	0 / 6	--	--	--	240	12.2	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
3-Nitrotoluene	450 - 500	0 / 6	--	--	--	240	12.2	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Amino-2,6-dinitrotoluene	450 - 500	0 / 6	--	--	--	240	12.2	--	80,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
4-Nitrotoluene	450 - 500	0 / 6	--	--	--	240	12.2	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
HMX	450 - 500	0 / 6	--	--	--	240	12.2	--	10,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
RDX	450 - 500	0 / 6	--	--	--	240	12.2	--	10,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Tetryl	450 - 500	0 / 6	--	--	--	240	12.2	--	10,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Inorganics (MG/KG)																		
Aluminum	-- - --	14 / 14	4,560	12,600	CAA03-SS08-1109	8,245	2,100	--	pH < 5.5	1 / 14	--	YES	12,200	1 / 14	1.03	mean pH in range		NO
Antimony	0.32 - 12.6	8 / 14	0.070	0.67	CAS004-4HA04-00-1199	0.70	1.62	--	78.0	0 / 14	0.01	NO	--	-- / --	--	--	--	NO
Arsenic	-- - --	14 / 14	1.60	346	CAS04-SS13-1012	27.9	91.6	135	18.0	1 / 14	19.2	YES	6.36	2 / 14	54.4	7.48	1.55	YES
Barium	-- - --	14 / 14	20.3	164	CAS004-4HA04-00-1199	54.1	37.6	--	330	0 / 14	0.50	NO	--	-- / --	--	--	--	NO
Beryllium	0.32 - 0.68	8 / 14	0.34	0.67	CAA03-SS02-1109	0.36	0.14	--	40.0	0 / 14	0.02	NO	--	-- / --	--	--	--	NO
Cadmium	0.020 - 1.20	6 / 14	0.040	3.30	CAS004-4HA05-00-1199	0.46	0.86	0.80	32.0	0 / 14	0.10	NO	--	-- / --	--	--	--	NO
Calcium [3]	-- - --	14 / 14	541	8,420	CAS004-4HA03-00-1199	3,947	2,645	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chromium (hexavalent)	0.24 - 0.24	0 / 1	--	--	--	0.12	--	--	0.40	-- / --	0.60	NO	--	-- / --	--	--	--	NO
Chromium	-- - --	15 / 15	9.00	63.0	CAS04-SS13-1012	21.1	16.9	40.1	64.0	0 / 15	0.98	NO	--	-- / --	--	--	--	NO
Cobalt	1.40 - 1.40	13 / 14	1.70	11.5	CAS04-SS13-1012	3.93	2.90	--	13.0	0 / 14	0.88	NO	--	-- / --	--	--	--	NO
Copper	2.90 - 4.50	11 / 14	3.80	150	CAS004-4HA05-00-1199	30.5	43.6	51.5	70.0	2 / 14	2.14	YES	4.25	10 / 14	35.3	0.74	0.44	NO
Cyanide	0.020 - 0.84	3 / 11	0.070	0.13	CAS004-4HA02-00-1199	0.21	0.18	--	15.8	0 / 11	0.01	NO	--	-- / --	--	--	--	NO
Iron	-- - --	14 / 14	6,720	116,000	CAS04-SS13-1012	24,626	31,431	--	5 < pH > 8	1 / 14	--	YES	19,900	3 / 14	5.83	mean pH in range		NO
Lead	11.6 - 12.9	12 / 14	10.3	129	CAS004-4HA05-00-1199	33.6	37.2	84.5	120	1 / 14	1.08	YES	17.4	8 / 14	7.41	0.70	0.28	NO
Magnesium [3]	-- - --	14 / 14	568	2,140	CAS004-4HA06-00-1199	1,041	527	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Manganese	-- - --	14 / 14	39.9	511	CAS04-SS13-1012	168	127	228	220	4 / 14	2.32	YES	324	1 / 14	1.58	1.04	0.76	YES
Mercury	-- - --	14 / 14	0.020	0.88	CAS004-4HA05-00-1199	0.18	0.28	0.51	0.10	4 / 14	8.80	YES	0.111	4 / 14	7.93	5.14	1.82	YES
Nickel	2.20 - 4.10	11 / 14	3.70	46.7	CAS04-SS13-1012	13.2	15.8	37.3	38.0	3 / 14	1.23	YES	9.52	6 / 14	4.91	0.98	0.35	NO
Potassium [3]	-- - --	14 / 14	366	1,420	CAS004-4HA05-00-1199	755	273	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Selenium	0.60 - 2.80	8 / 14	0.21	1.00	CAS004-4HA04-00-1199	0.53	0.33	0.61	0.52	2 / 14	1.92	YES	0.51	3 / 14	1.96	1.16	1.02	YES
Silver	0.99 - 5.20	4 / 14	0.090	20.6	CAS004-4HA06-00-1199	2.50	5.26	--	560	0 / 14	0.04	NO	--	-- / --	--	--	--	NO
Sodium [3]	23.1 - 73.8	5 / 14	20.1	35.0	CAA03-SS02-1109	27.8	9.50	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Thallium	0.10 - 2.00	2 / 14	0.47	1.10	CAS004-4HA06-00-1199	0.33	0.33	0.43	1.00	1 / 14	1.10	YES	--	-- / --	--	0.43	0.33	NO
Vanadium	-- - --	14 / 14	13.9	35.7	CAS004-4HA06-00-1199	19.9	6.29	--	130	0 / 14	0.27	NO	--	-- / --	--	--	--	NO
Zinc	28.6 - 32.5	12 / 14	16.8	324	CAS004-4HA05-00-1199	83.4	97.8	227	120	3 / 14	2.70	YES	26.5	8 / 14	12.2	1.90	0.70	YES
Other Parameters																		
pH	-- - --	8 / 8	4.90	7.70	CAA03-SS02-1109	6.75	0.88	--	--	-- / --	--	--	--	-- / --	--	--	--	--
Total organic carbon (MG/KG)	-- - --	8 / 8	11,000	55,000	CAS04-SS13-1012	28,625	17,237	--	--	-- / --	--	--	--	-- / --	--	--	--	--

NSV - No Screening Value
1 - Count of detected samples exceeding or equaling ESV
2 - Shaded cells indicate hazard quotient based on reporting limits
3 - Macronutrient - Not considered to be a COPC
4 - See uncertainty section

Table E-5
Exceedances - Site 4 Surface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAA03-SS02	CAA03-SS03	CAA03-SS04	CAA03-SS05	CAA03-SS08		CAS004-4HA01	CAS004-4HA02	
			CAA03-SS02-1109	CAA03-SS03-1109	CAA03-SS04-1109	CAA03-SS05-1109	CAA03-SS08-1109	CAA03-SS08P-1109	CAS004-4HA01-00-1199	CAS004-4HA02-00-1199	CAS004-4HA02D-00-1199
			11/04/09	11/04/09	11/04/09	11/04/09	11/05/09	11/05/09	11/12/99	11/12/99	11/12/99
Volatile Organic Compounds (UG/KG)											
Acetone	NSV	--	74 B	71 B	78 B	**100 J**	110 B	100 B	5 B	13.4 U	11.9 U
Chloroform	1,844	--	7 UJ	8 UJ	7 UJ	**0.6 J**	7 UJ	8 UJ	11.2 U	13.4 U	11.9 U
Methylene chloride	1,250	--	**9 J**	32 UJ	**12 J**	25 UJ	31 UJ	34 UJ	7 B	8 B	11.9 U
Styrene	64,000	--	6 UJ	6 UJ	6 UJ	5 UJ	**1 J**	7 UJ	11.2 U	13.4 U	11.9 U
Xylene, total	1,300	--	17 UJ	19 UJ	17 UJ	15 UJ	19 UJ	20 UJ	11.2 U	**2 J**	11.9 U
Semivolatile Organic Compounds (UG/KG)											
2-Methylnaphthalene	LMW PAH	--	**25**	**6.8 J**	23 U	21 U	26 U	25 U	380 U	2,100 U	2,100 U
Acenaphthene	LMW PAH	--	**65**	**27**	**6.9 J**	21 U	26 U	25 U	380 U	**330 J**	2,100 U
Acenaphthylene	LMW PAH	--	**240**	**72**	**26**	**3.8 J**	26 U	25 U	380 U	2,100 U	2,100 U
Anthracene	LMW PAH	--	**260**	**200**	**37**	**3.8 J**	26 U	**2.7 J**	380 U	**530 J**	2,100 U
Benzaldehyde	58,400	--	430 U	420 U	420 U	370 U	460 U	**200 J**	NA	NA	NA
Benzo(a)anthracene	HMW PAH	--	**1,600**	**740**	**200**	**26**	**20 J**	**28**	380 U	**1,100 J**	**290 J**
Benzo(a)pyrene	HMW PAH	--	**1,200**	**440**	**160**	**20 J**	**16 J**	**22 J**	380 U	**950 J**	**440 J**
Benzo(b)fluoranthene	HMW PAH	--	**2,100**	**670**	**190 J**	**28 J**	**29**	**40**	380 U	**1,100 J**	**320 J**
Benzo(g,h,i)perylene	HMW PAH	--	**440 L**	**70 L**	**23 L**	21 UL	3.8 B	2.6 B	380 U	**650 J**	**340 J**
Benzo(k)fluoranthene	HMW PAH	--	**650**	**140**	**71**	**9.2 J**	26 U	25 U	380 U	**770 J**	**470 J**
Carbazole	7,000	--	**190**	**80**	**18 J**	**3.2 J**	**3 J**	**5.6 J**	380 U	**250 J**	2,100 U
Chrysene	HMW PAH	--	**1,300**	**580**	**170 J**	**17 J**	**18 J**	**26**	380 U	**1,300 J**	**520 J**
Dibenz(a,h)anthracene	HMW PAH	--	**200 K**	**83 K**	**37 K**	21 U	**4.3 J**	**4.6 J**	380 U	2,100 U	2,100 U
Fluoranthene	LMW PAH	--	**3,000**	**1,600**	**350**	**44**	**40**	**57**	380 U	**2,700**	**660 J**
Fluorene	LMW PAH	--	**130**	**110**	**11 J**	21 U	26 U	25 U	380 U	**250 J**	2,100 U
Indeno(1,2,3-cd)pyrene	HMW PAH	--	**240 J**	**280 J**	**160 J**	**33 J**	25 B	**29**	380 U	**600 J**	**250 J**
Naphthalene	LMW PAH	--	**31**	**7.7 J**	23 U	21 U	26 U	25 U	380 U	2,100 U	2,100 U
PAH (HMW)	18,000	--	**10,130**	**4,003**	**1,281**	**180**	**151**	**217**	1,710 U	**9,820**	**4,480**
PAH (LMW)	29,000	--	**5,563**	**3,335**	**595**	**121**	**154**	**176**	1,710 U	**10,410**	**8,570**
Phenanthrene	LMW PAH	--	**1,800**	**1,300**	**130**	**17 J**	**23 J**	**41**	380 U	**2,400**	**560 J**
Pyrene	HMW PAH	--	**2,400**	**1,000**	**270**	**26**	**36**	**54**	380 U	**2,300**	**800 J**
Pesticides (UG/KG)											
4,4'-DDD	583	--	**25 J**	**6 J**	**7.4 J**	**2.3 J**	4 UJ	4.2 UJ	3.8 U	4.2 U	4.2 U
4,4'-DDE	114	--	**83**	**3.5 J**	**7.3**	**1.2 J**	4 UJ	**0.8 J**	3.8 U	**9.6 J**	4.2 U
4,4'-DDT	100	--	**78**	**3.9 J**	**5.4 J**	**1.6 J**	**3.1 J**	4.2 UJ	3.8 U	**7 J**	**4.6 J**
Aldrin	3.63	--	2 U	1.9 U	2 U	1.9 UJ	2.1 UJ	2.1 UJ	2 U	2.1 U	2.2 U
alpha-Chlordane	11.0	--	**0.99 J**	1.9 U	2 U	1.9 UJ	2.1 UJ	2.1 UJ	2 U	2.1 U	2.2 U
Dieldrin	10.5	--	3.9 U	3.7 U	**1.4 J**	3.8 UJ	4 UJ	4.2 UJ	3.8 U	4.2 U	4.2 U
Endosulfan I	6.32	--	2 U	1.9 U	2 U	1.9 UJ	**0.79 J**	**0.91 J**	2 U	2.1 U	2.2 U
Endosulfan II	6.32	--	3.9 U	3.7 U	3.9 U	3.8 UJ	4 UJ	4.2 UJ	**4.4 J**	4.2 U	4.2 U
Endosulfan sulfate	6.32	--	**8.9 J**	3.7 U	3.9 U	3.8 UJ	4 UJ	4.2 UJ	3.8 U	4.2 U	4.2 U
Endrin	1.95	--	3.9 U	**16**	**10**	3.8 UJ	**6.8 J**	**16 J**	**6.3 J**	4.2 U	4.2 U
Endrin aldehyde	1.95	--	3.9 U	**3.8 J**	**2.6 J**	3.8 UJ	**3.5 J**	**5.4 J**	3.8 U	4.2 U	4.2 U
Endrin ketone	1.95	--	3.9 U	3.7 U	3.9 U	3.8 UJ	4 UJ	4.2 UJ	3.8 U	4.2 U	**4.5**
gamma-BHC (Lindane)	7.75	--	**9.6**	**0.82 J**	2 U	1.9 UJ	2.1 UJ	2.1 UJ	2 U	2.1 U	2.2 U
gamma-Chlordane	11.0	--	2 U	1.9 U	2 U	1.9 UJ	2.1 UJ	2.1 UJ	2 U	2.1 U	2.2 U
Polychlorinated Biphenyls (UG/KG)											
Aroclor-1242	8,000	--	21 UL	20 U	21 U	20 UL	22 U	23 U	38 U	42 U	42 U
Aroclor-1260	8,000	--	21 UL	20 U	21 U	20 UL	22 U	23 U	**53**	**64 J**	**75 J**
Explosives (UG/KG)											
No Detections	--	--									

Table E-5
Exceedances - Site 4 Surface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAA03-SS02	CAA03-SS03	CAA03-SS04	CAA03-SS05	CAA03-SS08		CAS004-4HA01	CAS004-4HA02	
			CAA03-SS02-1109	CAA03-SS03-1109	CAA03-SS04-1109	CAA03-SS05-1109	CAA03-SS08-1109	CAA03-SS08P-1109	CAS004-4HA01-00-1199	CAS004-4HA02-00-1199	CAS004-4HA02D-00-1199
			11/04/09	11/04/09	11/04/09	11/04/09	11/05/09	11/05/09	11/12/99	11/12/99	11/12/99
Inorganics (MG/KG)											
Aluminum	pH < 5.5	12,200	**8,930**	**10,800**	**9,870**	**8,080**	**11,800**	**12,600**	**4,560 L**	**5,810 L**	**7,160 L**
Antimony	78.0	11.0	**0.19 L**	**0.25 L**	**0.17 L**	**0.07 L**	**0.15**	**0.15**	0.49 U	0.46 U	0.55 U
Arsenic	18.0	6.36	**3.0**	**3.2**	**3.4**	**1.6**	**3.5**	**3.4**	**2.9 L**	**2.7 L**	**2.6 L**
Barium	330	52.9	**43.6 J**	**47.3 J**	**47.7 J**	**36 J**	**28.7**	**29.1**	**20.3 J**	**36.6 J**	**27.1 J**
Beryllium	40.0	0.587	**0.67**	**0.49**	**0.46 J**	**0.44 J**	**0.34 J**	**0.34 J**	0.33 B	0.64 B	0.36 B
Cadmium	32.0	1.50	**0.12 J**	**0.06 J**	**0.04 J**	**0.04 J**	1.1 U	1.2 U	0.08 U	0.07 U	0.08 U
Chromium	64.0	18.2	**15.2**	**13.1**	**16.7**	**9**	**18.4**	**18.8**	**9.4**	**8.7**	**9.6**
Cobalt	13.0	9.93	**3.4**	**2.7**	**2.5**	**2.5**	**1.8**	**1.9**	1.4 U	**2.8 J**	**3.7 J**
Copper	70.0	4.25	**9.4**	**4.9**	**5**	**3.8**	**4.8**	**4.2**	4.5 B	**10.5**	**12**
Cyanide	15.8	--	0.84 U	0.7 U	0.84 U	0.77 U	0.84 U	0.84 U	0.02 UL	**0.12 L**	**0.13 L**
Iron	5 < pH > 8	19,900	**10,900 J**	**9,710 J**	**9,740 J**	**6,720 J**	**12,100**	**12,200**	**8,900 L**	**9,840 L**	**8,570 L**
Lead	120	17.4	**35.4**	**25.1**	**14.5**	**10.3**	**18.6**	**18.2**	**12.8**	**22.7**	**24**
Manganese	220	324	**155 J**	**121 J**	**106 J**	**98.9 J**	**39.9**	**35.8**	**48.7**	**233**	**127**
Mercury	0.10	0.111	**0.12**	**0.04**	**0.03 J**	**0.02 J**	**0.05**	**0.04**	**0.04 J**	**0.31**	**0.36**
Nickel	38.0	9.52	**9.8**	**5.3**	**5.2**	**3.7 J**	**4.5**	**4.7 J**	2.2 B	3.8 B	4.1 B
Selenium	0.52	0.51	**0.44 J**	**0.45 J**	**0.51**	**0.33 J**	**0.42 J**	**0.47 J**	0.67 U	0.63 U	0.75 U
Silver	560	2.10	1.6 U	1.4 U	1.5 U	1.5 U	**0.25 J**	**0.27 J**	2.8 B	2.6 B	3 B
Thallium	1.00	--	0.17 B	0.12 B	0.13 B	0.1 B	0.14 B	0.13 B	0.54 UL	0.5 UL	0.6 UL
Vanadium	130	27.9	**19.5**	**20**	**17.8**	**14.6**	**29.1**	**29.5**	**13.9**	**13.9**	**15.1**
Zinc	120	26.5	**52.7**	**52.8**	**64.6**	**16.8**	**21.6**	**20.6**	28.6 B	**106**	**102**
Other Parameters											
pH	--	--	**7.70**	**7.60**	**7.00**	**6.40**	**6.50**	**5.90**	NA	NA	NA
Total organic carbon (MG/KG)	--	--	**36,000**	**26,000**	**24,000**	**12,000**	**37,000**	**51,000**	NA	NA	NA

Notes:
Grey highlighting indicates value greater than ESV
Yellow highlighting indicates value equal to ESV
Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL
Bold indicates detections
NA - Not analyzed
NSV - No Screening Value

Table E-5
Exceedances - Site 4 Surface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS004-4HA03	CAS004-4HA04	CAS004-4HA05	CAS004-4HA06	CAS04-SO11	CAS04-SO12		CAS04-SO13	CAS04-SO15
			CAS004-4HA03-00-1199	CAS004-4HA04-00-1199	CAS004-4HA05-00-1199	CAS004-4HA06-00-1199	CAS04-SS11-1012	CAS04-SS12-1012	CAS04-SS12P-1012	CAS04-SS13-1012	CAS04-SS15-1012
			11/12/99	11/12/99	11/12/99	11/12/99	10/23/12	10/23/12	10/23/12	10/23/12	10/23/12
Volatile Organic Compounds (UG/KG)											
Acetone	NSV	--	11.6 U	14.8 U	14.8 R	12.1 UL	NA	NA	NA	NA	NA
Chloroform	1,844	--	11.6 U	14.8 U	14.8 R	12.1 UL	NA	NA	NA	NA	NA
Methylene chloride	1,250	--	9 B	11 B	11 B	12.1 UL	NA	NA	NA	NA	NA
Styrene	64,000	--	11.6 U	14.8 UL	14.8 R	12.1 UL	NA	NA	NA	NA	NA
Xylene, total	1,300	--	11.6 U	14.8 UL	14.8 R	12.1 UL	NA	NA	NA	NA	NA
Semivolatile Organic Compounds (UG/KG)											
2-Methylnaphthalene	LMW PAH	--	400 U	2,600 U	5,500 U	3,900 U	10 U	10 U	10 U	**9.2 J**	NA
Acenaphthene	LMW PAH	--	400 U	2,600 U	5,500 U	3,900 U	**7.5 J**	10 U	10 U	**53 K**	NA
Acenaphthylene	LMW PAH	--	400 U	2,600 U	5,500 U	3,900 U	**18 J**	10 U	10 U	**62**	NA
Anthracene	LMW PAH	--	400 U	2,600 U	5,500 U	**1,700 J**	**48**	**2.2 J**	**1.4 J**	**190 K**	NA
Benzaldehyde	58,400	--	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	HMW PAH	--	400 U	2,600 U	**1,100 J**	**8,800**	**370**	**17 J**	**11 J**	**960**	NA
Benzo(a)pyrene	HMW PAH	--	400 U	2,600 U	**2,300 J**	**7,000**	**310**	**15 J**	**10 J**	**830**	NA
Benzo(b)fluoranthene	HMW PAH	--	**76 J**	**330 J**	**1,700 J**	**6,800**	**460**	22 B	17 B	**1,200**	NA
Benzo(g,h,i)perylene	HMW PAH	--	**61 J**	2,600 U	**1,200 J**	**3,400 J**	**140**	**8.6 J**	**6.6 J**	**320 K**	NA
Benzo(k)fluoranthene	HMW PAH	--	**53 J**	**320 J**	**1,700 J**	**6,800**	**180**	**9 J**	**6 J**	**420**	NA
Carbazole	7,000	--	400 U	2,600 U	5,500 U	3,900 U	NA	NA	NA	NA	NA
Chrysene	HMW PAH	--	**75 J**	**410 J**	**2,200 J**	**8,600**	**380**	**17 J**	**11 J**	**930**	NA
Dibenz(a,h)anthracene	HMW PAH	--	400 U	2,600 U	5,500 U	**1,400 J**	**67**	**3.6 J**	**3.5 J**	**160 K**	NA
Fluoranthene	LMW PAH	--	**49 J**	**510 J**	**1,800 J**	**14,000**	**670**	**29**	**19 J**	**1,800**	NA
Fluorene	LMW PAH	--	400 U	2,600 U	5,500 U	3,900 U	**16 J**	10 U	10 U	**92 K**	NA
Indeno(1,2,3-cd)pyrene	HMW PAH	--	**48 J**	2,600 U	**1,300 J**	**3,400 J**	**260 J**	**19 J**	**11 J**	**770**	NA
Naphthalene	LMW PAH	--	400 U	2,600 U	5,500 U	3,900 U	10 U	10 U	10 U	**13 J**	NA
PAH (HMW)	18,000	--	**959**	**8,000**	**17,250**	**57,200**	**2,717**	**128**	**86.6**	**6,990**	NA
PAH (LMW)	29,000	--	**1,649**	**10,910**	**22,450**	**32,900**	**1,090**	**70.2**	**54.9**	**3,209**	NA
Phenanthrene	LMW PAH	--	400 U	2,600 U	**1,400 J**	**5,500**	**320**	**14 J**	**9.5 J**	**990**	NA
Pyrene	HMW PAH	--	**46 J**	**440 J**	**3,000 J**	**11,000**	**550**	**28**	**19 J**	**1,400**	NA
Pesticides (UG/KG)											
4,4'-DDD	583	--	4 U	5.2 U	27 U	**7.6 K**	NA	NA	NA	NA	NA
4,4'-DDE	114	--	4 U	**43 J**	27 U	3.9 U	NA	NA	NA	NA	NA
4,4'-DDT	100	--	4 U	**9.4**	**220 K**	**18 K**	NA	NA	NA	NA	NA
Aldrin	3.63	--	2.1 U	2.7 U	**33 K**	2 U	NA	NA	NA	NA	NA
alpha-Chlordane	11.0	--	2.1 U	2.7 U	14 U	2 U	NA	NA	NA	NA	NA
Dieldrin	10.5	--	4 U	5.2 U	27 U	3.9 U	NA	NA	NA	NA	NA
Endosulfan I	6.32	--	2.1 U	2.7 U	14 U	2 U	NA	NA	NA	NA	NA
Endosulfan II	6.32	--	**5.7 J**	5.2 U	27 U	3.9 U	NA	NA	NA	NA	NA
Endosulfan sulfate	6.32	--	4 U	5.2 U	27 U	3.9 U	NA	NA	NA	NA	NA
Endrin	1.95	--	4 U	5.2 U	**28 K**	3.9 U	NA	NA	NA	NA	NA
Endrin aldehyde	1.95	--	4 U	5.2 U	**77 K**	3.9 U	NA	NA	NA	NA	NA
Endrin ketone	1.95	--	4 U	5.2 U	**87 K**	3.9 U	NA	NA	NA	NA	NA
gamma-BHC (Lindane)	7.75	--	2.1 U	2.7 U	14 U	2 U	NA	NA	NA	NA	NA
gamma-Chlordane	11.0	--	2.1 U	2.7 U	**15 K**	2 U	NA	NA	NA	NA	NA
Polychlorinated Biphenyls (UG/KG)											
Aroclor-1242	8,000	--	40 U	52 U	**1,000 K**	39 U	9 U	8.9 U	8.9 U	10 U	NA
Aroclor-1260	8,000	--	**53 J**	**600 J**	**2,700 K**	**91 K**	9 U	8.9 U	8.9 U	10 U	NA
Explosives (UG/KG)											
No Detections	--	--									

Table E-5
Exceedances - Site 4 Surface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS004-4HA03	CAS004-4HA04	CAS004-4HA05	CAS004-4HA06	CAS04-SO11	CAS04-SO12		CAS04-SO13	CAS04-SO15
			CAS004-4HA03-00-1199	CAS004-4HA04-00-1199	CAS004-4HA05-00-1199	CAS004-4HA06-00-1199	CAS04-SS11-1012	CAS04-SS12-1012	CAS04-SS12P-1012	CAS04-SS13-1012	CAS04-SS15-1012
			11/12/99	11/12/99	11/12/99	11/12/99	10/23/12	10/23/12	10/23/12	10/23/12	10/23/12
Inorganics (MG/KG)											
Aluminum	pH < 5.5	12,200	**6,760 L**	**9,560 L**	**6,260 L**	**6,320 L**	**7,290**	**9,390**	**9,100**	**7,850**	NA
Antimony	78.0	11.0	0.47 U	**0.67 J**	12.6 B	0.44 UJ	**0.46 J**	0.32 U	0.32 U	**0.47 L**	NA
Arsenic	18.0	6.36	**3 L**	**4.1 L**	**3.5 L**	**2.7 L**	**8.5**	**2.9**	**2.7**	**346 J**	NA
Barium	330	52.9	**25.5 J**	**164**	**68**	**101 J**	**34.9**	**43.4**	**42.1**	**59.3 L**	NA
Beryllium	40.0	0.587	0.35 B	0.68 B	0.65 B	0.32 B	**0.39 J**	**0.48**	**0.46**	**0.34 L**	NA
Cadmium	32.0	1.50	0.07 U	**0.74 J**	**3.3**	0.34 U	1.2 U	0.02 B	0.006 B	1.2 UL	NA
Chromium	64.0	18.2	**11.8**	**16.9**	**19**	**56.6**	**34**	**11.1**	**10.7**	**63 J**	**11.9 K**
Cobalt	13.0	9.93	**1.7 J**	**4.1 J**	**4.6 J**	**8.8 J**	**4.5**	**2.4**	**2.3**	**11.5 J**	NA
Copper	70.0	4.25	3.8 B	**26**	**150**	**77.8 J**	**58.9**	2.9 B	2.7 B	**68.7 K**	NA
Cyanide	15.8	--	0.02 UL	0.03 UL	**0.11 L**	**0.07 L**	NA	NA	NA	NA	NA
Iron	5 < pH > 8	19,900	**8,910 L**	**14,600 L**	**14,300 L**	**61,700 L**	**53,200**	**8,040**	**7,730**	**116,000 J**	NA
Lead	120	17.4	**11.6**	**39.5**	**129**	**105 J**	12.9 B	11.6 B	10 B	**31.7 L**	NA
Manganese	220	324	**43.2**	**151**	**175**	**302 J**	**263**	**103**	**107**	**511 J**	NA
Mercury	0.10	0.111	**0.09 J**	**0.76**	**0.88**	**0.06 J**	**0.02 J**	**0.02 J**	**0.02 J**	**0.06 L**	NA
Nickel	38.0	9.52	4 B	**10.1 J**	**12.1**	**39.6**	**38**	**4**	**3.8**	**46.7 J**	NA
Selenium	0.52	0.51	0.64 U	**1 J**	0.81 U	0.6 U	2.8 U	**0.21 J**	0.45 U	**0.87 L**	NA
Silver	560	2.10	2.4 B	5.2 B	5.2 B	**20.6 L**	0.99 B	**0.05 J**	**0.09 J**	**1.3 L**	NA
Thallium	1.00	--	0.51 UL	0.72 UL	0.65 UL	**1.1 L**	2 U	0.32 U	0.32 U	**0.47 L**	NA
Vanadium	130	27.9	**16.6**	**22.2**	**23.5**	**35.7 J**	**13.9**	**15.9**	**15.6**	**20.4 L**	NA
Zinc	120	26.5	32.5 B	**273**	**324**	**122 J**	**17.5**	**20**	**19**	**66.4 L**	NA
Other Parameters											
pH	--	--	NA	NA	NA	NA	**4.90**	**6.80**	NA	**7.10**	NA
Total organic carbon (MG/KG)	--	--	NA	NA	NA	NA	**11,000**	**14,000**	NA	**55,000**	NA

Notes:
Grey highlighting indicates value greater than ESV
Yellow highlighting indicates value equal to ESV
Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL
Bold indicates detections
NA - Not analyzed
NSV - No Screening Value

Table E-6
Ecological Screening Statistics - Site 4 Shallow Subsurface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Volatile Organic Compounds (UG/KG)																		
1,1,1-Trichloroethane	6.00 - 7.00	0 / 7	--	--	--	3.21	0.27	--	1,025	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,1,2,2-Tetrachloroethane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	5,000	-- / --	0.001	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	6.00 - 7.00	0 / 7	--	--	--	3.21	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloroethane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	2,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethane	6.00 - 7.00	0 / 7	--	--	--	3.21	0.27	--	548	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	173	-- / --	0.03	NO	--	-- / --	--	--	--	NO
1,2,4-Trichlorobenzene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	1,270	-- / --	0.005	NO	--	-- / --	--	--	--	NO
1,2-Dibromo-3-chloropropane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,2-Dibromoethane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	300	-- / --	0.02	NO	--	-- / --	--	--	--	NO
1,2-Dichlorobenzene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	1,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,2-Dichloroethane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	2,190	-- / --	0.003	NO	--	-- / --	--	--	--	NO
1,2-Dichloropropane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	38,800	-- / --	0.0002	NO	--	-- / --	--	--	--	NO
1,3-Dichlorobenzene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	1,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,4-Dichlorobenzene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	1,280	-- / --	0.005	NO	--	-- / --	--	--	--	NO
2-Butanone	27.0 - 29.0	0 / 7	--	--	--	13.8	0.39	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2-Hexanone	27.0 - 29.0	0 / 7	--	--	--	13.8	0.39	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Methyl-2-pentanone	27.0 - 29.0	0 / 7	--	--	--	13.8	0.39	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Acetone	46.0 - 100	2 / 7	98.0	120	CAS04-SB04-1109	57.6	36.5	--	NSV	-- / --	NSV	YES	--	-- / --	--	NSV	NSV	NO
Benzene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	1,140	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Bromodichloromethane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Bromoform	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	300	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Bromomethane	11.0 - 12.0	0 / 7	--	--	--	5.57	0.19	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbon disulfide	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbon tetrachloride	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	3,400	-- / --	0.002	NO	--	-- / --	--	--	--	NO
Chlorobenzene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	2,400	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Chloroethane	11.0 - 12.0	0 / 7	--	--	--	5.57	0.19	--	5,000	-- / --	0.002	NO	--	-- / --	--	--	--	NO
Chloroform	6.00 - 7.00	1 / 7	1.00	1.00	CAS04-SB04-1109	2.93	0.89	--	1,844	0 / 7	0.001	NO	--	-- / --	--	--	--	NO
Chloromethane	11.0 - 12.0	0 / 7	--	--	--	5.57	0.19	--	5,000	-- / --	0.002	NO	--	-- / --	--	--	--	NO
cis-1,2-Dichloroethene	6.00 - 7.00	0 / 7	--	--	--	3.21	0.27	--	447	-- / --	0.02	NO	--	-- / --	--	--	--	NO
cis-1,3-Dichloropropene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	5,000	-- / --	0.001	NO	--	-- / --	--	--	--	NO
Cyclohexane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	6,000	-- / --	0.001	NO	--	-- / --	--	--	--	NO
Dibromochloromethane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Dichlorodifluoromethane (Freon-12)	11.0 - 12.0	0 / 7	--	--	--	5.57	0.19	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Ethylbenzene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	1,815	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Isopropylbenzene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
m- and p-Xylene	12.0 - 13.0	0 / 7	--	--	--	6.07	0.19	--	1,300	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Methyl acetate	10.0 - 10.0	0 / 7	--	--	--	5.00	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylcyclohexane	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylene chloride	27.0 - 29.0	2 / 7	12.0	12.0	CAA03-SB10-1109	13.4	0.99	--	1,250	0 / 7	0.01	NO	--	-- / --	--	--	--	NO
Methyl-tert-butyl ether (MTBE)	10.0 - 10.0	0 / 7	--	--	--	5.00	0.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
o-Xylene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	1,300	-- / --	0.005	NO	--	-- / --	--	--	--	NO
Styrene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	64,000	-- / --	0.0001	NO	--	-- / --	--	--	--	NO
Tetrachloroethene	5.00 - 6.00	0 / 7	--	--	--	2.71	0.27	--	179	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Toluene	5.00 - 6.00	1 / 7	2.00	2.00	CAS04-SB04-1109	2.64	0.38	--	40,000	0 / 7	0.0001	NO	--	-- / --	--	--	--	NO
trans-1,2-Dichloroethene	7.00 - 8.00	0 / 7	--	--	--	3.93	0.19	--	447	-- / --	0.02	NO	--	-- / --	--	--	--	NO
trans-1,3-Dichloropropene	7.00 - 8.00	0 / 7	--	--	--	3.93	0.19	--	5,000	-- / --	0.002	NO	--	-- / --	--	--	--	NO
Trichloroethene	6.00 - 7.00	0 / 7	--	--	--	3.21	0.27	--	500	-- / --	0.01	NO	--	-- / --	--	--	--	NO

Table E-6
Ecological Screening Statistics - Site 4 Shallow Subsurface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Trichlorofluoromethane (Freon-11)	11.0 - 12.0	0 / 7	--	--	--	5.57	0.19	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Vinyl chloride	11.0 - 12.0	0 / 7	--	--	--	5.57	0.19	--	412	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Xylene, total	16.0 - 17.0	0 / 7	--	--	--	8.21	0.27	--	1,300	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Semivolatile Organic Compounds (UG/KG)																		
1,1-Biphenyl	290 - 390	0 / 7	--	--	--	176	17.0	--	13,600	-- / --	0.03	NO	--	-- / --	--	--	--	NO
1,2,4,5-Tetrachlorobenzene	370 - 490	0 / 7	--	--	--	224	21.3	--	1,000	-- / --	0.49	NO	--	-- / --	--	--	--	NO
2,2'-Oxybis(1-chloropropane)	290 - 390	0 / 7	--	--	--	176	17.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2,4,5-Trichlorophenol	730 - 960	0 / 7	--	--	--	440	39.8	--	1,350	-- / --	0.71	NO	--	-- / --	--	--	--	NO
2,4,6-Trichlorophenol	430 - 560	0 / 7	--	--	--	258	22.3	--	580	-- / --	0.97	NO	--	-- / --	--	--	--	NO
2,4-Dichlorophenol	400 - 530	0 / 7	--	--	--	243	22.3	--	500	-- / --	1.06	YES	--	-- / --	--	--	0.49	NO
2,4-Dimethylphenol	440 - 580	0 / 7	--	--	--	268	24.6	--	1,000	-- / --	0.58	NO	--	-- / --	--	--	--	NO
2,4-Dinitrophenol	1,000 - 1,300	0 / 7	--	--	--	607	53.5	--	20,000	-- / --	0.07	NO	--	-- / --	--	--	--	NO
2,4-Dinitrotoluene	290 - 390	0 / 7	--	--	--	176	17.0	--	11,000	-- / --	0.04	NO	--	-- / --	--	--	--	NO
2,6-Dinitrotoluene	290 - 390	0 / 7	--	--	--	176	17.0	--	8,500	-- / --	0.05	NO	--	-- / --	--	--	--	NO
2-Chloronaphthalene	18.0 - 23.0	0 / 7	--	--	--	10.7	0.95	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
2-Chlorophenol	440 - 580	0 / 7	--	--	--	268	24.6	--	500	-- / --	1.16	YES	--	-- / --	--	--	0.54	NO
2-Methylnaphthalene	12.0 - 23.0	0 / 9	--	--	--	9.72	2.14	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
2-Methylphenol	530 - 700	0 / 7	--	--	--	322	29.6	--	1,000	-- / --	0.70	NO	--	-- / --	--	--	--	NO
2-Nitroaniline	730 - 960	0 / 7	--	--	--	440	39.8	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2-Nitrophenol	450 - 600	0 / 7	--	--	--	274	25.9	--	1,000	-- / --	0.60	NO	--	-- / --	--	--	--	NO
3- and 4-Methylphenol	510 - 670	0 / 7	--	--	--	306	27.6	--	1,000	-- / --	0.67	NO	--	-- / --	--	--	--	NO
3,3'-Dichlorobenzidine	310 - 410	0 / 7	--	--	--	187	17.5	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
3-Nitroaniline	730 - 960	0 / 7	--	--	--	440	39.8	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4,6-Dinitro-2-methylphenol	980 - 1,300	0 / 7	--	--	--	591	56.4	--	1,000	-- / --	1.30	YES	--	-- / --	--	--	0.59	NO
4-Bromophenyl-phenylether	290 - 390	0 / 7	--	--	--	176	17.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Chloro-3-methylphenol	440 - 580	0 / 7	--	--	--	268	24.6	--	500	-- / --	1.16	YES	--	-- / --	--	--	0.54	NO
4-Chloroaniline	320 - 420	0 / 7	--	--	--	194	18.4	--	500	-- / --	0.84	NO	--	-- / --	--	--	--	NO
4-Chlorophenyl-phenylether	290 - 390	0 / 7	--	--	--	176	17.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitroaniline	730 - 960	0 / 7	--	--	--	440	39.8	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitrophenol	830 - 1,100	0 / 7	--	--	--	497	46.7	--	380	-- / --	2.89	YES	--	-- / --	--	--	1.31	NO[4]
Acenaphthene	12.0 - 23.0	0 / 9	--	--	--	9.72	2.14	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Acenaphthylene	12.0 - 23.0	0 / 9	--	--	--	9.72	2.14	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Acetophenone	480 - 630	0 / 7	--	--	--	289	25.9	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Anthracene	12.0 - 23.0	0 / 9	--	--	--	9.72	2.14	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Atrazine	290 - 390	0 / 7	--	--	--	176	17.0	--	11.9	-- / --	32.8	YES	--	-- / --	--	--	14.8	NO[4]
Benzaldehyde	320 - 420	0 / 7	--	--	--	194	18.4	--	58,400	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Benzo(a)anthracene	13.0 - 22.0	5 / 9	2.70	8.50	CAS04-SB01-1109	7.54	2.55	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(a)pyrene	12.0 - 23.0	0 / 9	--	--	--	9.72	2.14	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(b)fluoranthene	9.80 - 23.0	0 / 9	--	--	--	9.54	2.48	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(g,h,i)perylene	13.0 - 23.0	1 / 7	2.40	2.40	CAS04-SB06-1012	9.13	3.46	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(k)fluoranthene	12.0 - 23.0	0 / 9	--	--	--	9.72	2.14	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethoxy)methane	290 - 390	0 / 7	--	--	--	176	17.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethyl)ether	290 - 390	0 / 7	--	--	--	176	17.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
bis(2-Ethylhexyl)phthalate	89.0 - 120	0 / 7	--	--	--	54.2	5.49	--	30,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Butylbenzylphthalate	290 - 390	0 / 7	--	--	--	176	17.0	--	30,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Caprolactam	450 - 500	0 / 2	--	--	--	238	17.7	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbazole	18.0 - 23.0	0 / 7	--	--	--	10.7	0.95	--	7,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO

Table E-6
Ecological Screening Statistics - Site 4 Shallow Subsurface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Chrysene	13.0 - 23.0	1 / 9	2.20	2.20	CAS04-SB06-1012	9.30	3.12	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Dibenz(a,h)anthracene	13.0 - 23.0	1 / 9	8.10	8.10	CAS04-SB06-1012	9.96	1.76	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Dibenzofuran	290 - 390	0 / 7	--	--	--	176	17.0	--	4,600	-- / --	0.08	NO	--	-- / --	--	--	--	NO
Diethylphthalate	290 - 390	0 / 7	--	--	--	176	17.0	--	26,800	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Dimethyl phthalate	290 - 390	0 / 7	--	--	--	176	17.0	--	10,640	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Di-n-butylphthalate	89.0 - 120	0 / 7	--	--	--	54.2	5.49	--	40,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Di-n-octylphthalate	570 - 750	0 / 7	--	--	--	344	31.1	--	30,000	-- / --	0.03	NO	--	-- / --	--	--	--	NO
Fluoranthene	18.0 - 23.0	2 / 9	2.70	4.70	CAS04-SB06-1012	9.16	3.24	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Fluorene	12.0 - 23.0	0 / 9	--	--	--	9.72	2.14	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Hexachlorobenzene	18.0 - 23.0	0 / 7	--	--	--	10.7	0.95	--	1,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Hexachlorobutadiene	290 - 390	0 / 7	--	--	--	176	17.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Hexachlorocyclopentadiene	290 - 390	0 / 7	--	--	--	176	17.0	--	2,000	-- / --	0.20	NO	--	-- / --	--	--	--	NO
Hexachloroethane	18.0 - 23.0	0 / 7	--	--	--	10.7	0.95	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Indeno(1,2,3-cd)pyrene	18.0 - 23.0	2 / 9	3.70	7.30	CAS04-SB06-1012	9.56	2.60	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Isophorone	290 - 390	0 / 7	--	--	--	176	17.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Naphthalene	12.0 - 23.0	0 / 9	--	--	--	9.72	2.14	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
n-Nitroso-di-n-propylamine	290 - 390	0 / 7	--	--	--	176	17.0	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
n-Nitrosodiphenylamine	590 - 770	0 / 7	--	--	--	355	31.8	--	1,090	-- / --	0.71	NO	--	-- / --	--	--	--	NO
Nitrobenzene	290 - 390	0 / 7	--	--	--	176	17.0	--	2,260	-- / --	0.17	NO	--	-- / --	--	--	--	NO
PAH (HMW)	81.0 - 99.0	6 / 9	49.8	101	CAS04-SB01-1109	69.5	25.7	--	18,000	0 / 9	0.01	NO	--	-- / --	--	--	--	NO
PAH (LMW)	81.0 - 104	2 / 9	43.9	48.2	CAS04-SB07-1012	47.7	3.98	--	29,000	0 / 9	0.002	NO	--	-- / --	--	--	--	NO
Pentachlorophenol	89.0 - 120	0 / 7	--	--	--	54.2	5.49	--	5,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Phenanthrene	13.0 - 23.0	1 / 9	3.20	3.20	CAS04-SB06-1012	9.41	2.84	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Phenol	420 - 550	0 / 7	--	--	--	253	22.3	--	1,880	-- / --	0.29	NO	--	-- / --	--	--	--	NO
Pyrene	13.0 - 23.0	1 / 9	3.80	3.80	CAS04-SB06-1012	9.48	2.67	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Pesticides (UG/KG)																		
4,4'-DDD	3.30 - 3.80	0 / 7	--	--	--	1.75	0.091	--	583	-- / --	0.01	NO	--	-- / --	--	--	--	NO
4,4'-DDE	3.30 - 3.80	0 / 7	--	--	--	1.75	0.091	--	114	-- / --	0.03	NO	--	-- / --	--	--	--	NO
4,4'-DDT	3.30 - 3.80	0 / 7	--	--	--	1.75	0.091	--	100	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Aldrin	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	3.63	-- / --	0.55	NO	--	-- / --	--	--	--	NO
alpha-BHC	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	226	-- / --	0.01	NO	--	-- / --	--	--	--	NO
alpha-Chlordane	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	11.0	-- / --	0.18	NO	--	-- / --	--	--	--	NO
beta-BHC	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	342	-- / --	0.01	NO	--	-- / --	--	--	--	NO
delta-BHC	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	226	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Dieldrin	3.30 - 3.80	1 / 7	0.65	0.65	CAA03-SB09-1109	1.59	0.42	--	10.5	0 / 7	0.06	NO	--	-- / --	--	--	--	NO
Endosulfan I	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	6.32	-- / --	0.32	NO	--	-- / --	--	--	--	NO
Endosulfan II	3.30 - 3.80	0 / 7	--	--	--	1.75	0.091	--	6.32	-- / --	0.60	NO	--	-- / --	--	--	--	NO
Endosulfan sulfate	3.30 - 3.80	0 / 7	--	--	--	1.75	0.091	--	6.32	-- / --	0.60	NO	--	-- / --	--	--	--	NO
Endrin	3.30 - 3.80	1 / 7	8.60	8.60	CAA03-SB09-1109	2.72	2.59	--	1.95	1 / 7	4.41	YES	--	-- / --	--	--	1.40	YES
Endrin aldehyde	3.30 - 3.80	0 / 7	--	--	--	1.75	0.091	--	1.95	-- / --	1.95	YES	--	-- / --	--	--	0.90	NO
Endrin ketone	3.30 - 3.80	0 / 7	--	--	--	1.75	0.091	--	1.95	-- / --	1.95	YES	--	-- / --	--	--	0.90	NO
gamma-BHC (Lindane)	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	7.75	-- / --	0.26	NO	--	-- / --	--	--	--	NO
gamma-Chlordane	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	11.0	-- / --	0.18	NO	--	-- / --	--	--	--	NO
Heptachlor	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	52.9	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Heptachlor epoxide	1.70 - 2.00	0 / 7	--	--	--	0.91	0.056	--	52.9	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Methoxychlor	17.0 - 20.0	0 / 7	--	--	--	9.14	0.56	--	500	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Toxaphene	33.0 - 38.0	0 / 7	--	--	--	17.5	0.91	--	500	-- / --	0.08	NO	--	-- / --	--	--	--	NO
Polychlorinated Biphenyls (UG/KG)																		

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Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Aroclor-1016	9.80 - 21.0	0 / 9	--	--	--	8.60	2.00	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Aroclor-1221	9.80 - 49.0	0 / 9	--	--	--	18.5	7.62	--	8,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Aroclor-1232	12.0 - 32.0	0 / 9	--	--	--	12.9	3.97	--	8,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Aroclor-1242	9.80 - 21.0	0 / 9	--	--	--	8.60	2.00	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Aroclor-1248	9.80 - 22.0	0 / 9	--	--	--	9.04	2.24	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Aroclor-1254	9.80 - 20.0	0 / 9	--	--	--	8.27	1.81	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Aroclor-1260	9.80 - 21.0	0 / 9	--	--	--	8.60	2.00	--	8,000	-- / --	0.003	NO	--	-- / --	--	--	--	NO
Inorganics (MG/KG)																		
Aluminum	-- - --	9 / 9	4,310	31,900	CAS04-SB07-1012	18,802	10,681	--	pH < 5.5	8 / 9	--	YES	13,000	6 / 9	2.45	mean pH < 5.5		YES
Antimony	0.85 - 0.94	7 / 9	0.040	0.22	CAA03-SB09-1109	0.18	0.16	--	78.0	0 / 9	0.003	NO	--	-- / --	--	--	--	NO
Arsenic	-- - --	9 / 9	0.62	12.7	CAA03-SB09-1109	5.51	4.22	--	18.0	0 / 9	0.71	NO	--	-- / --	--	--	--	NO
Barium	-- - --	9 / 9	17.0	42.8	CAS04-SB01-1109	28.8	7.30	--	330	0 / 9	0.13	NO	--	-- / --	--	--	--	NO
Beryllium	-- - --	9 / 9	0.31	0.89	CAA03-SB09-1109	0.51	0.16	--	40.0	0 / 9	0.02	NO	--	-- / --	--	--	--	NO
Cadmium	0.51 - 2.20	2 / 9	0.030	0.070	CAS04-SB05-1109	0.37	0.31	--	32.0	0 / 9	0.002	NO	--	-- / --	--	--	--	NO
Calcium [3]	-- - --	9 / 9	107	744	CAS04-SB01-1109	284	198	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chromium (hexavalent)	-- - --	1 / 1	0.43	0.43	CAS04-SB16-1012	0.43	--	--	0.40	1 / 1	1.08	YES	--	-- / --	--	--	1.08	YES
Chromium	-- - --	10 / 10	6.00	46.2	CAA03-SB09-1109	27.7	15.6	--	64.0	0 / 10	0.72	NO	--	-- / --	--	--	--	NO
Cobalt	-- - --	9 / 9	1.00	4.00	CAS04-SB07-1012	2.93	1.02	--	13.0	0 / 9	0.31	NO	--	-- / --	--	--	--	NO
Copper	1.90 - 2.00	7 / 9	1.40	4.00	CAA03-SB09-1109	2.53	1.14	--	70.0	0 / 9	0.06	NO	--	-- / --	--	--	--	NO
Cyanide	0.70 - 0.84	0 / 7	--	--	--	0.38	0.024	--	15.8	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Iron	-- - --	9 / 9	3,390	31,800	CAA03-SB09-1109	19,369	12,238	--	5 < pH > 8	8 / 9	--	YES	32,000	0 / 9	0.99	--	--	NO
Lead	11.0 - 11.0	8 / 9	3.80	12.1	CAS04-SB06-1012	8.01	3.25	--	120	0 / 9	0.10	NO	--	-- / --	--	--	--	NO
Magnesium [3]	-- - --	9 / 9	355	2,710	CAA03-SB09-1109	1,297	775	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Manganese	-- - --	9 / 9	20.7	72.8	CAS04-SB02-1109	35.8	15.9	--	220	0 / 9	0.33	NO	--	-- / --	--	--	--	NO
Mercury	0.030 - 0.030	8 / 9	0.010	0.050	CAS04-SB01-1109	0.024	0.016	--	0.10	0 / 9	0.50	NO	--	-- / --	--	--	--	NO
Nickel	-- - --	9 / 9	2.10	8.90	CAA03-SB09-1109	5.94	2.54	--	38.0	0 / 9	0.23	NO	--	-- / --	--	--	--	NO
Potassium [3]	-- - --	9 / 9	235	3,660	CAA03-SB09-1109	1,269	1,078	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Selenium	0.60 - 0.60	8 / 9	0.20	0.51	CAS04-SB01-1109	0.34	0.11	--	0.52	0 / 9	0.98	NO	--	-- / --	--	--	--	NO
Silver	0.50 - 3.20	2 / 9	0.64	0.82	CAA03-SB09-1109	0.71	0.37	--	560	0 / 9	0.001	NO	--	-- / --	--	--	--	NO
Sodium [3]	38.5 - 53.0	7 / 9	12.8	54.8	CAS04-SB01-1109	28.4	13.5	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Thallium	0.060 - 0.94	1 / 9	0.33	0.33	CAS04-SB01-1109	0.18	0.18	--	1.00	0 / 9	0.33	NO	--	-- / --	--	--	--	NO
Vanadium	-- - --	9 / 9	6.50	64.0	CAS04-SB07-1012	40.6	25.0	--	130	0 / 9	0.49	NO	--	-- / --	--	--	--	NO
Zinc	-- - --	9 / 9	7.80	28.2	CAS04-SB01-1109	20.0	8.50	--	120	0 / 9	0.24	NO	--	-- / --	--	--	--	NO
Other Parameters																		
pH	-- - --	9 / 9	3.90	5.80	CAS04-SB02-1109	4.71	0.58	--	--	-- / --	--	--	--	-- / --	--	--	--	--
Total organic carbon (MG/KG)	-- - --	7 / 7	3,400	6,700	CAA03-SB10-1109	5,071	1,283	--	--	-- / --	--	--	--	-- / --	--	--	--	--

NSV - No Screening Value
1 - Count of detected samples exceeding or equaling ESV
2 - Shaded cells indicate hazard quotient based on reporting limits
3 - Macronutrient - Not considered to be a COPC
4 - See uncertainty section

Table E-7
Exceedances - Site 4 Shallow Subsurface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAA03-SB09	CAA03-SB10	CAS04-SB01	CAS04-SB02	CAS04-SB03	CAS04-SB04	CAS04-SB05	CAS04-SO06	
			CAA03-SB09-1109	CAA03-SB10-1109	CAS04-SB01-1109	CAS04-SB02-1109	CAS04-SB03-1109	CAS04-SB04-1109	CAS04-SB05-1109	CAS04-SB06-1012	CAS04-SB06P-1012
			11/05/09	11/05/09	11/03/09	11/03/09	11/03/09	11/03/09	11/03/09	10/23/12	10/23/12
Volatile Organic Compounds (UG/KG)											
Acetone	NSV	--	74 B	100 B	74 B	46 B	76 B	**120 J**	**98**	NA	NA
Chloroform	1,844	--	7 UJ	6 UJ	7 UJ	6 UJ	6 UJ	**1 J**	7 U	NA	NA
Methylene chloride	1,250	--	29 UJ	**12 J**	28 UJ	27 UJ	27 UJ	**12 J**	28 U	NA	NA
Toluene	40,000	--	6 UJ	5 UJ	6 UJ	5 UJ	5 UJ	**2 J**	6 U	NA	NA
Semivolatile Organic Compounds (UG/KG)											
Benzo(a)anthracene	HMW PAH	--	22 U	18 U	**8.5 J**	**7.3 J**	**6.2 J**	21 U	**6.2 J**	**2.7 J**	12 U
Benzo(g,h,i)perylene	HMW PAH	--	22 R	18 R	23 UL	20 UL	23 UL	21 UL	23 UL	12 U	**2.4 J**
Chrysene	HMW PAH	--	22 U	18 U	23 U	20 U	23 U	21 U	23 U	12 U	**2.2 J**
Dibenz(a,h)anthracene	HMW PAH	--	22 U	18 U	23 U	20 U	23 U	21 U	23 U	12 U	**8.1 J**
Fluoranthene	LMW PAH	--	22 U	18 U	23 U	20 U	23 U	21 U	23 U	**4.7 J**	**3.8 J**
Indeno(1,2,3-cd)pyrene	HMW PAH	--	22 U	18 U	23 U	20 U	23 U	21 U	23 U	**7.3 J**	**4.1 J**
PAH (HMW)	18,000	--	99.0 U	81.0 U	**101**	**87.3**	**98.2**	94.5 U	**98.2**	**49.8**	**43.4**
PAH (LMW)	29,000	--	99.0 U	81.0 U	104 U	90.0 U	104 U	94.5 U	104 U	**43.9**	**42.5**
Phenanthrene	LMW PAH	--	22 U	18 U	23 U	20 U	23 U	21 U	23 U	**3.2 J**	**2.7 J**
Pyrene	HMW PAH	--	22 U	18 U	23 U	20 U	23 U	21 U	23 U	**3.8 J**	**3.6 J**
Pesticides (UG/KG)											
Dieldrin	10.5	--	**0.65 J**	3.5 U	3.6 UJ	3.3 U	3.8 U	3.3 UJ	3.4 UJ	NA	NA
Endrin	1.95	--	**8.6 J**	3.5 U	3.6 UJ	3.3 U	3.8 U	3.3 UJ	3.4 UJ	NA	NA
Polychlorinated Biphenyls (UG/KG)											
No Detections	--	--									
Inorganics (MG/KG)											
Aluminum	pH < 5.5	13,000	**22,600**	**4,310**	**29,400**	**5,310**	**22,800**	**6,400**	**20,700**	**25,100**	**25,800**
Antimony	78.0	--	**0.22**	**0.04 J**	**0.15 L**	**0.04 L**	**0.12 L**	**0.05 L**	**0.12 L**	0.85 U	0.62 U
Arsenic	18.0	5.54	**12.7**	**0.71**	**6.9**	**0.62**	**4.8**	**0.89**	**5.7**	**8.8**	**8.9**
Barium	330	84.5	**31.2**	**17**	**42.8**	**28.6**	**32 J**	**25.8 J**	**22 J**	**26.1**	**26.8**
Beryllium	40.0	0.52	**0.89**	**0.31 J**	**0.49 J**	**0.35 J**	**0.48**	**0.53**	**0.57**	**0.47**	**0.48**
Cadmium	32.0	--	**0.03 J**	0.65 U	2.2 U	0.73 U	0.94 U	0.86 U	**0.07 J**	0.51 U	0.37 U
Chromium (hexavalent)	0.40	--	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium	64.0	33.7	**46.2**	**6**	**39.6 K**	**6.1 K**	**32**	**7.3**	**33.4**	**38.8**	**38.7**
Cobalt	13.0	5.18	**3.9**	**1**	**3.9**	**1.8**	**3.4**	**2.6**	**2.8**	**3**	**2.9**
Copper	70.0	3.17	**4**	**1.4 J**	**2.9 K**	**2.8 K**	**2.7**	2 B	**3.4**	**3.6 J**	**3.6**
Iron	5 < pH > 8	32,000	**31,800**	**3,390**	**31,600**	**3,830**	**20,900 J**	**4,300 J**	**21,800 J**	**28,900**	**26,800**
Lead	120	8.79	**9.8**	**3.8**	**11 K**	**4.4 K**	**9.7**	**5.1**	**10.7**	**12**	**12.1**
Manganese	220	176	**30.5**	**20.7**	**32.7 K**	**72.8 K**	**28 J**	**47.2 J**	**22.7 J**	**31.9**	**30.8**
Mercury	0.10	0.14	**0.01 J**	**0.01 J**	**0.05**	0.03 U	**0.04**	**0.01 J**	**0.01 J**	**0.03 J**	**0.03 J**
Nickel	38.0	17.6	**8.9**	**2.1 J**	**8 J**	**2.8 J**	**6.7**	**3.6**	**5.8**	**6.8**	**7.1**
Selenium	0.52	0.64	**0.41 J**	**0.23 J**	**0.51 J**	**0.2 J**	**0.45 J**	**0.3 J**	**0.26 J**	**0.43 J**	**0.42 J**
Silver	560	1.10	**0.82 J**	0.98 U	3.2 U	1.1 U	1.4 U	1.3 U	1.4 U	**0.64 J**	**0.4 J**
Thallium	1.00	--	0.22 B	0.06 B	**0.33**	0.07 B	0.23 B	0.08 B	0.16 B	0.85 U	0.19 B
Vanadium	130	48.3	**57**	**6.5**	**57.7**	**7.8**	**53.7**	**8.4**	**51.8**	**58.7**	**58**
Zinc	120	28.0	**28.1**	**8.1**	**28.2 K**	**7.8 K**	**22.6**	**11.5**	**22.2**	**24.5**	**24.4**
Other Parameters											

Table E-7
Exceedances - Site 4 Shallow Subsurface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAA03-SB09	CAA03-SB10	CAS04-SB01	CAS04-SB02	CAS04-SB03	CAS04-SB04	CAS04-SB05	CAS04-SO06	
			CAA03-SB09-1109	CAA03-SB10-1109	CAS04-SB01-1109	CAS04-SB02-1109	CAS04-SB03-1109	CAS04-SB04-1109	CAS04-SB05-1109	CAS04-SB06-1012	CAS04-SB06P-1012
			11/05/09	11/05/09	11/03/09	11/03/09	11/03/09	11/03/09	11/03/09	10/23/12	10/23/12
pH	--	--	**4.60**	**5.00**	**5.00**	**5.80**	**4.70**	**5.00**	**4.40**	**3.90**	NA
Total organic carbon (MG/KG)	--	--	**5,700**	**6,700**	**4,800**	**3,400**	**6,100**	**5,400**	**3,400**	NA	NA

Notes:
Grey highlighting indicates value greater than ESV
Yellow highlighting indicates value equal to ESV
Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL
Bold indicates detections
NA - Not analyzed
NSV - No Screening Value

Table E-7
Exceedances - Site 4 Shallow Subsurface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS04-SO07 CAS04-SB07-1012 10/23/12	CAS04-SO16 CAS04-SB16-1012 10/23/12
Volatile Organic Compounds (UG/KG)				
Acetone	NSV	--	NA	NA
Chloroform	1,844	--	NA	NA
Methylene chloride	1,250	--	NA	NA
Toluene	40,000	--	NA	NA
Semivolatile Organic Compounds (UG/KG)				
Benzo(a)anthracene	HMW PAH	--	13 U	NA
Benzo(g,h,i)perylene	HMW PAH	--	13 U	NA
Chrysene	HMW PAH	--	13 U	NA
Dibenz(a,h)anthracene	HMW PAH	--	13 U	NA
Fluoranthene	LMW PAH	--	**2.7 J**	NA
Indeno(1,2,3-cd)pyrene	HMW PAH	--	**3.7 J**	NA
PAH (HMW)	18,000	--	**54.1**	NA
PAH (LMW)	29,000	--	**48.2**	NA
Phenanthrene	LMW PAH	--	13 U	NA
Pyrene	HMW PAH	--	13 U	NA
Pesticides (UG/KG)				
Dieldrin	10.5	--	NA	NA
Endrin	1.95	--	NA	NA
Polychlorinated Biphenyls (UG/KG)				
No Detections	--	--		
Inorganics (MG/KG)				
Aluminum	pH < 5.5	13,000	**31,900**	NA
Antimony	78.0	--	0.94 UL	NA
Arsenic	18.0	5.54	**8.4**	NA
Barium	330	84.5	**32.8**	NA
Beryllium	40.0	0.52	**0.5**	NA
Cadmium	32.0	--	0.56 U	NA
Chromium (hexavalent)	0.40	--	NA	**0.43 J**
Chromium	64.0	33.7	**41.3 K**	**25.8**
Cobalt	13.0	5.18	**4**	NA
Copper	70.0	3.17	1.9 B	NA
Iron	5 < pH > 8	32,000	**27,800**	NA
Lead	120	8.79	11 B	NA
Manganese	220	176	**35.6 L**	NA
Mercury	0.10	0.14	**0.04 L**	NA
Nickel	38.0	17.6	**8.5**	NA
Selenium	0.52	0.64	0.6 B	NA
Silver	560	1.10	0.5 B	NA
Thallium	1.00	--	0.94 U	NA
Vanadium	130	48.3	**64**	NA
Zinc	120	28.0	**27.1**	NA
Other Parameters				

Table E-7
Exceedances - Site 4 Shallow Subsurface Soil - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS04-SO07 CAS04-SB07-1012 10/23/12	CAS04-SO16 CAS04-SB16-1012 10/23/12
pH	--	--	**4.00**	NA
Total organic carbon (MG/KG)	--	--	NA	NA

Notes:
Grey highlighting indicates value greater than ESV
Yellow highlighting indicates value equal to ESV
Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL
Bold indicates detections
NA - Not analyzed
NSV - No Screening Value

Table E-8
Ecological Screening Statistics - Site 4 Shallow Subsurface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Volatile Organic Compounds (UG/KG)																		
1,1,1-Trichloroethane	6.00 - 20.4	0 / 10	--	--	--	5.35	2.42	--	1,025	-- / --	0.02	NO	--	-- / --	--	--	--	NO
1,1,2,2-Tetrachloroethane	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	5,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	6.00 - 7.00	0 / 5	--	--	--	3.30	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,1,2-Trichloroethane	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	2,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethane	6.00 - 20.4	0 / 10	--	--	--	5.35	2.42	--	548	-- / --	0.04	NO	--	-- / --	--	--	--	NO
1,1-Dichloroethene	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	173	-- / --	0.12	NO	--	-- / --	--	--	--	NO
1,2,4-Trichlorobenzene	5.00 - 17,000	0 / 10	--	--	--	1,830	2,930	--	1,270	-- / --	13.4	YES	--	-- / --	--	--	1.44	NO[4]
1,2-Dibromo-3-chloropropane	5.00 - 6.00	0 / 5	--	--	--	2.80	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,2-Dibromoethane	5.00 - 6.00	0 / 5	--	--	--	2.80	0.27	--	300	-- / --	0.02	NO	--	-- / --	--	--	--	NO
1,2-Dichlorobenzene	5.00 - 17,000	0 / 10	--	--	--	1,830	2,930	--	1,000	-- / --	17.0	YES	--	-- / --	--	--	1.83	NO[4]
1,2-Dichloroethane	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	2,190	-- / --	0.01	NO	--	-- / --	--	--	--	NO
1,2-Dichloroethene (total)	12.8 - 20.4	0 / 5	--	--	--	7.41	1.59	--	447	-- / --	0.05	NO	--	-- / --	--	--	--	NO
1,2-Dichloropropane	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	38,800	-- / --	0.001	NO	--	-- / --	--	--	--	NO
1,3-Dichlorobenzene	5.00 - 17,000	0 / 10	--	--	--	1,830	2,930	--	1,000	-- / --	17.0	YES	--	-- / --	--	--	1.83	NO[4]
1,4-Dichlorobenzene	5.00 - 17,000	0 / 10	--	--	--	1,830	2,930	--	1,280	-- / --	13.3	YES	--	-- / --	--	--	1.43	NO[4]
2-Butanone	12.8 - 30.0	1 / 10	8.00	8.00	CAS004-4-HA02-02-1199	10.6	3.47	--	NSV	-- / --	NSV	YES	--	-- / --	--	NSV	NSV	YES
2-Hexanone	12.8 - 30.0	0 / 10	--	--	--	10.5	3.58	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Methyl-2-pentanone	12.8 - 30.0	0 / 10	--	--	--	10.5	3.58	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Acetone	12.8 - 68.0	1 / 10	240	240	CAA03-SB08-1109	40.3	71.0	--	NSV	-- / --	NSV	YES	--	-- / --	--	NSV	NSV	YES
Benzene	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	1,140	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Bromodichloromethane	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Bromoform	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	300	-- / --	0.07	NO	--	-- / --	--	--	--	NO
Bromomethane	9.00 - 20.4	0 / 10	--	--	--	6.40	1.56	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbon disulfide	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Carbon tetrachloride	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	3,400	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Chlorobenzene	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	2,400	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Chloroethane	9.00 - 20.4	0 / 10	--	--	--	6.40	1.56	--	5,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Chloroform	6.00 - 20.4	2 / 10	0.80	1.00	CAA03-SB05-1109A	4.88	3.00	--	1,844	0 / 10	0.001	NO	--	-- / --	--	--	--	NO
Chloromethane	9.00 - 20.4	0 / 10	--	--	--	6.40	1.56	--	5,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
cis-1,2-Dichloroethene	6.00 - 7.00	0 / 5	--	--	--	3.30	0.27	--	447	-- / --	0.02	NO	--	-- / --	--	--	--	NO
cis-1,3-Dichloropropene	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	5,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Cyclohexane	5.00 - 6.00	0 / 5	--	--	--	2.80	0.27	--	6,000	-- / --	0.001	NO	--	-- / --	--	--	--	NO
Dibromochloromethane	5.00 - 20.4	0 / 10	--	--	--	5.10	2.66	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Dichlorodifluoromethane (Freon-12)	9.00 - 12.0	0 / 5	--	--	--	5.40	0.65	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Ethylbenzene	5.00 - 20.4	1 / 10	2.00	2.00	CAS004-4-HA02-02-1199	4.62	2.74	--	1,815	0 / 10	0.001	NO	--	-- / --	--	--	--	NO
Isopropylbenzene	5.00 - 6.00	0 / 5	--	--	--	2.80	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
m- and p-Xylene	10.0 - 13.0	0 / 5	--	--	--	5.90	0.65	--	1,300	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Methyl acetate	8.00 - 11.0	0 / 5	--	--	--	4.90	0.65	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylcyclohexane	5.00 - 6.00	0 / 5	--	--	--	2.80	0.27	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Methylene chloride	7.00 - 30.0	1 / 10	16.0	16.0	CAA03-SB03-1109A	10.4	4.18	--	1,250	0 / 10	0.01	NO	--	-- / --	--	--	--	NO
Methyl-tert-butyl ether (MTBE)	8.00 - 11.0	0 / 5	--	--	--	4.90	0.65	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
o-Xylene	5.00 - 6.00	0 / 5	--	--	--	2.80	0.27	--	1,300	-- / --	0.005	NO	--	-- / --	--	--	--	NO
Styrene	5.00 - 20.4	1 / 10	2.00	2.00	CAA03-SB08-1109	5.00	2.76	--	64,000	0 / 10	0.00003	NO	--	-- / --	--	--	--	NO
Tetrachloroethene	5.00 - 20.4	1 / 10	3.00	3.00	CAS004-4-HA03-02-1199	4.70	2.63	--	179	0 / 10	0.02	NO	--	-- / --	--	--	--	NO
Toluene	5.00 - 20.4	1 / 10	5.00	5.00	CAA03-SB08-1109	5.30	2.55	--	40,000	0 / 10	0.0001	NO	--	-- / --	--	--	--	NO
trans-1,2-Dichloroethene	6.00 - 8.00	0 / 5	--	--	--	3.70	0.45	--	447	-- / --	0.02	NO	--	-- / --	--	--	--	NO

Table E-8
Ecological Screening Statistics - Site 4 Shallow Subsurface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
trans-1,3-Dichloropropene	6.00 - 20.4	0 / 10	--	--	--	5.55	2.24	--	5,000	-- / --	0.004	NO	--	-- / --	--	--	--	NO
Trichloroethene	6.00 - 20.4	0 / 10	--	--	--	5.35	2.42	--	500	-- / --	0.04	NO	--	-- / --	--	--	--	NO
Trichlorofluoromethane (Freon-11)	9.00 - 12.0	0 / 5	--	--	--	5.40	0.65	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Vinyl chloride	9.00 - 20.4	0 / 10	--	--	--	6.40	1.56	--	412	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Xylene, total	12.8 - 20.4	0 / 10	--	--	--	7.75	1.27	--	1,300	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Semivolatile Organic Compounds (UG/KG)																		
1,1-Biphenyl	360 - 380	0 / 5	--	--	--	183	4.47	--	13,600	-- / --	0.03	NO	--	-- / --	--	--	--	NO
1,2,4,5-Tetrachlorobenzene	450 - 490	0 / 5	--	--	--	232	8.37	--	1,000	-- / --	0.49	NO	--	-- / --	--	--	--	NO
2,2'-Oxybis(1-chloropropane)	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2,4,5-Trichlorophenol	880 - 42,000	0 / 10	--	--	--	4,862	7,220	--	1,350	-- / --	31.1	YES	--	-- / --	--	--	3.60	NO[4]
2,4,6-Trichlorophenol	480 - 17,000	0 / 10	--	--	--	1,963	2,841	--	580	-- / --	29.3	YES	--	-- / --	--	--	3.38	NO[4]
2,4-Dichlorophenol	480 - 17,000	0 / 10	--	--	--	1,953	2,847	--	500	-- / --	34.0	YES	--	-- / --	--	--	3.91	NO[4]
2,4-Dimethylphenol	480 - 17,000	0 / 10	--	--	--	1,968	2,838	--	1,000	-- / --	17.0	YES	--	-- / --	--	--	1.97	NO[4]
2,4-Dinitrophenol	1,200 - 42,000	0 / 10	--	--	--	4,945	7,163	--	20,000	-- / --	2.10	YES	--	-- / --	--	--	0.25	NO
2,4-Dinitrotoluene	360 - 480	0 / 10	--	--	--	207	26.1	--	11,000	-- / --	0.04	NO	--	-- / --	--	--	--	NO
2,6-Dinitrotoluene	360 - 480	0 / 10	--	--	--	207	26.1	--	8,500	-- / --	0.06	NO	--	-- / --	--	--	--	NO
2-Chloronaphthalene	22.0 - 17,000	0 / 10	--	--	--	1,835	2,928	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
2-Chlorophenol	480 - 17,000	0 / 10	--	--	--	1,968	2,838	--	500	-- / --	34.0	YES	--	-- / --	--	--	3.94	NO[4]
2-Methylnaphthalene	22.0 - 17,000	1 / 10	3.60	3.60	CAA03-SB02-1109A	1,834	2,928	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
2-Methylphenol	480 - 17,000	0 / 10	--	--	--	1,996	2,819	--	1,000	-- / --	17.0	YES	--	-- / --	--	--	2.00	NO[4]
2-Nitroaniline	880 - 42,000	0 / 10	--	--	--	4,862	7,220	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2-Nitrophenol	480 - 17,000	0 / 10	--	--	--	1,970	2,836	--	1,000	-- / --	17.0	YES	--	-- / --	--	--	1.97	NO[4]
3- and 4-Methylphenol	610 - 660	0 / 5	--	--	--	316	9.62	--	1,000	-- / --	0.66	NO	--	-- / --	--	--	--	NO
3,3'-Dichlorobenzidine	380 - 17,000	0 / 10	--	--	--	1,926	2,865	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
3-Nitroaniline	880 - 42,000	0 / 10	--	--	--	4,862	7,220	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4,6-Dinitro-2-methylphenol	1,200 - 42,000	0 / 10	--	--	--	4,940	7,167	--	1,000	-- / --	42.0	YES	--	-- / --	--	--	4.94	NO[4]
4-Bromophenyl-phenylether	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Chloro-3-methylphenol	480 - 17,000	0 / 10	--	--	--	1,968	2,838	--	500	-- / --	34.0	YES	--	-- / --	--	--	3.94	NO[4]
4-Chloroaniline	390 - 17,000	0 / 10	--	--	--	1,929	2,863	--	500	-- / --	34.0	YES	--	-- / --	--	--	3.86	NO[4]
4-Chlorophenyl-phenylether	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Methylphenol	480 - 17,000	0 / 5	--	--	--	3,658	3,312	--	1,000	-- / --	17.0	YES	--	-- / --	--	--	3.66	NO[4]
4-Nitroaniline	880 - 42,000	0 / 10	--	--	--	4,862	7,220	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Nitrophenol	1,000 - 42,000	0 / 10	--	--	--	4,890	7,200	--	380	-- / --	111	YES	--	-- / --	--	--	12.9	NO[4]
Acenaphthene	22.0 - 17,000	2 / 10	5.90	8.50	CAA03-SB02-1109A	1,834	2,928	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Acenaphthylene	22.0 - 17,000	2 / 10	23.0	100	CAA03-SB02-1109A	1,845	2,921	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Acetophenone	580 - 630	0 / 5	--	--	--	298	10.4	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Anthracene	22.0 - 17,000	2 / 10	35.0	66.0	CAA03-SB02-1109A	1,842	2,922	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Atrazine	360 - 380	0 / 5	--	--	--	183	4.47	--	11.9	-- / --	31.9	YES	--	-- / --	--	--	15.4	NO[4]
Benzaldehyde	390 - 420	0 / 5	--	--	--	200	6.12	--	58,400	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Benzo(a)anthracene	4,300 - 17,000	7 / 10	8.00	500	CAS004-4-HA06-02-1199	1,729	2,937	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(a)pyrene	22.0 - 17,000	7 / 10	5.30	600	CAS004-4-HA06-02-1199	1,588	2,947	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(b)fluoranthene	22.0 - 17,000	7 / 10	8.90	510	CAS004-4-HA05-01-1199	1,600	2,940	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(g,h,i)perylene	3.00 - 17,000	4 / 10	66.0	440	CAS004-4-HA06-02-1199	1,689	2,959	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Benzo(k)fluoranthene	22.0 - 17,000	5 / 10	64.0	760	CAS004-4-HA06-02-1199	1,558	2,964	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethoxy)methane	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
bis(2-Chloroethyl)ether	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO

Table E-8
Ecological Screening Statistics - Site 4 Shallow Subsurface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
bis(2-Ethylhexyl)phthalate	110 - 4,300	1 / 10	63,000	63,000	CAS004-4-HA03-02-1199	6,897	19,730	--	30,000	1 / 10	2.10	YES	--	-- / --	--	--	0.23	NO
Butylbenzylphthalate	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	30,000	-- / --	0.57	NO	--	-- / --	--	--	--	NO
Caprolactam								--	NSV	-- --	NSV	NO	--	-- / --	--	--	--	NO
Carbazole	22.0 - 17,000	2 / 10	17.0	39.0	CAA03-SB02-1109A	1,838	2,925	--	7,000	0 / 10	0.01	NO	--	-- / --	--	--	--	NO
Chrysene	22.0 - 17,000	5 / 10	18.0	620	CAS004-4-HA06-02-1199	1,742	2,931	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Dibenz(a,h)anthracene	22.0 - 17,000	3 / 10	4.20	85.0	CAA03-SB02-1109A	1,847	2,919	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Dibenzofuran	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	4,600	-- / --	3.70	YES	--	-- / --	--	--	0.42	NO
Diethylphthalate	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	26,800	-- / --	0.63	NO	--	-- / --	--	--	--	NO
Dimethyl phthalate	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	10,640	-- / --	1.60	YES	--	-- / --	--	--	0.18	NO
Di-n-butylphthalate	66.0 - 5,700	1 / 10	90,000	90,000	CAS004-4-HA04-01-1199	9,721	28,228	--	40,000	1 / 10	2.25	YES	--	-- / --	--	--	0.24	NO
Di-n-octylphthalate	480 - 17,000	0 / 10	--	--	--	2,006	2,813	--	30,000	-- / --	0.57	NO	--	-- / --	--	--	--	NO
Fluoranthene	7.40 - 17,000	6 / 10	4.50	880	CAS004-4-HA05-01-1199	1,687	2,908	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Fluorene	22.0 - 17,000	2 / 10	12.0	33.0	CAA03-SB02-1109A	1,837	2,926	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Hexachlorobenzene	22.0 - 17,000	1 / 10	7.20	7.20	CAA03-SB08-1109	1,834	2,928	--	1,000	0 / 10	0.01	NO	--	-- / --	--	--	--	NO
Hexachlorobutadiene	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Hexachlorocyclopentadiene	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	2,000	-- / --	8.50	YES	--	-- / --	--	--	0.96	NO
Hexachloroethane	22.0 - 17,000	0 / 10	--	--	--	1,835	2,928	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Indeno(1,2,3-cd)pyrene	21.0 - 17,000	4 / 10	14.0	280	CAA03-SB04-1109A	1,866	2,907	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Isophorone	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Naphthalene	22.0 - 17,000	1 / 10	7.40	7.40	CAA03-SB02-1109A	1,834	2,928	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
n-Nitroso-di-n-propylamine	360 - 17,000	0 / 10	--	--	--	1,921	2,869	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
n-Nitrosodiphenylamine	480 - 17,000	0 / 10	--	--	--	2,012	2,809	--	1,090	-- / --	15.6	YES	--	-- / --	--	--	1.85	NO[4]
Nitrobenzene	360 - 480	0 / 10	--	--	--	207	26.1	--	2,260	-- / --	0.21	NO	--	-- / --	--	--	--	NO
PAH (HMW)	49,500 - 76,500	8 / 10	87.0	13,230	CAS004-4-HA05-01-1199	8,976	12,986	--	18,000	0 / 10	0.74	NO	--	-- / --	--	--	--	NO
PAH (LMW)	82.4 - 76,500	6 / 10	96.5	18,080	CAS004-4-HA05-01-1199	9,945	13,464	--	29,000	0 / 10	0.62	NO	--	-- / --	--	--	--	NO
Pentachlorophenol	110 - 42,000	0 / 10	--	--	--	4,663	7,356	--	5,000	-- / --	8.40	YES	--	-- / --	--	--	0.93	NO
Phenanthrene	2.50 - 17,000	4 / 10	100	400	CAS004-4-HA06-02-1199	1,705	2,949	--	LMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Phenol	480 - 17,000	0 / 10	--	--	--	1,960	2,843	--	1,880	-- / --	9.04	YES	--	-- / --	--	--	1.04	NO[4]
Pyrene	23.0 - 17,000	7 / 10	4.10	930	CAS004-4-HA05-01-1199	1,657	2,919	--	HMW PAH	-- / --	--	NO	--	-- / --	--	--	--	NO
Pesticides (UG/KG)																		
4,4'-DDD	3.80 - 6.70	6 / 10	1.10	13.0	CAA03-SB04-1109A	4.52	3.78	--	583	0 / 10	0.02	NO	--	-- / --	--	--	--	NO
4,4'-DDE	3.80 - 4.60	7 / 10	5.30	24.0	CAA03-SB02-1109A	10.3	8.99	--	114	0 / 10	0.21	NO	--	-- / --	--	--	--	NO
4,4'-DDT	3.50 - 4.60	8 / 10	1.80	150	CAS004-4-HA05-01-1199	22.2	45.4	105	100	1 / 10	1.50	YES	--	-- / --	--	1.05	0.22	YES
Aldrin	1.80 - 3.40	2 / 10	1.10	27.0	CAS004-4-HA05-01-1199	3.68	8.20	--	3.63	1 / 10	7.44	YES	--	-- / --	--	--	1.01	YES
alpha-BHC	1.80 - 3.40	0 / 10	--	--	--	1.08	0.25	--	226	-- / --	0.02	NO	--	-- / --	--	--	--	NO
alpha-Chlordane	1.80 - 3.40	1 / 10	2.40	2.40	CAS004-4-HA05-01-1199	1.21	0.49	--	11.0	0 / 10	0.22	NO	--	-- / --	--	--	--	NO
beta-BHC	1.80 - 3.40	0 / 10	--	--	--	1.08	0.25	--	342	-- / --	0.01	NO	--	-- / --	--	--	--	NO
delta-BHC	1.80 - 3.40	0 / 10	--	--	--	1.08	0.25	--	226	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Dieldrin	3.80 - 6.70	5 / 10	1.00	3.20	CAA03-SB04-1109A	2.15	0.73	--	10.5	0 / 10	0.30	NO	--	-- / --	--	--	--	NO
Endosulfan I	1.80 - 3.40	0 / 10	--	--	--	1.08	0.25	--	6.32	-- / --	0.54	NO	--	-- / --	--	--	--	NO
Endosulfan II	3.40 - 6.70	1 / 10	6.50	6.50	CAS004-4-HA03-02-1199	2.53	1.48	--	6.32	1 / 10	1.03	YES	--	-- / --	--	--	0.40	NO
Endosulfan sulfate	3.40 - 6.70	0 / 10	--	--	--	2.11	0.50	--	6.32	-- / --	1.06	YES	--	-- / --	--	--	0.33	NO
Endrin	3.40 - 6.70	2 / 10	13.0	96.0	CAA03-SB08-1109	12.6	29.5	--	1.95	2 / 10	49.2	YES	--	-- / --	--	--	6.48	YES
Endrin aldehyde	3.40 - 6.70	0 / 10	--	--	--	2.11	0.50	--	1.95	-- / --	3.44	YES	--	-- / --	--	--	1.08	NO[4]
Endrin ketone	3.40 - 4.80	3 / 10	0.88	19.0	CAS004-4-HA05-01-1199	4.24	5.66	7.54	1.95	2 / 10	9.74	YES	--	-- / --	--	3.87	2.18	YES
gamma-BHC (Lindane)	1.80 - 3.40	2 / 10	0.57	1.50	CAA03-SB02-1109A	1.11	0.32	--	7.75	0 / 10	0.19	NO	--	-- / --	--	--	--	NO
gamma-Chlordane	1.80 - 3.40	2 / 10	1.00	4.30	CAS004-4-HA05-01-1199	1.41	1.05	--	11.0	0 / 10	0.39	NO	--	-- / --	--	--	--	NO

Table E-8
Ecological Screening Statistics - Site 4 Shallow Subsurface Soil - In Debris Areas
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Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Heptachlor	1.80 - 3.40	1 / 10	9.90	9.90	CAS004-4-HA05-01-1199	1.96	2.80	--	52.9	0 / 10	0.19	NO	--	-- / --	--	--	--	NO
Heptachlor epoxide	1.80 - 3.40	0 / 10	--	--	--	1.08	0.25	--	52.9	-- / --	0.06	NO	--	-- / --	--	--	--	NO
Methoxychlor	18.0 - 34.0	1 / 10	25.0	25.0	CAS004-4-HA05-01-1199	12.2	5.17	--	500	0 / 10	0.05	NO	--	-- / --	--	--	--	NO
Toxaphene	34.0 - 340	0 / 10	--	--	--	71.0	59.0	--	500	-- / --	0.68	NO	--	-- / --	--	--	--	NO
Polychlorinated Biphenyls (UG/KG)																		
Aroclor-1016	19.0 - 67.0	0 / 10	--	--	--	17.0	8.44	--	8,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Aroclor-1221	43.0 - 140	0 / 10	--	--	--	36.0	16.3	--	8,000	-- / --	0.02	NO	--	-- / --	--	--	--	NO
Aroclor-1232	29.0 - 67.0	0 / 10	--	--	--	19.6	6.10	--	8,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Aroclor-1242	19.0 - 67.0	1 / 10	2,300	2,300	CAS004-4-HA05-01-1199	245	722	--	8,000	0 / 10	0.29	NO	--	-- / --	--	--	--	NO
Aroclor-1248	20.0 - 67.0	0 / 10	--	--	--	17.3	8.21	--	8,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Aroclor-1254	18.0 - 67.0	0 / 10	--	--	--	16.7	8.73	--	8,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
Aroclor-1260	19.0 - 48.0	3 / 10	51.0	1,600	CAS004-4-HA05-01-1199	207	499	--	8,000	0 / 10	0.20	NO	--	-- / --	--	--	--	NO
Explosives (UG/KG)																		
1,3,5-Trinitrobenzene	450 - 500	0 / 5	--	--	--	233	11.5	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
1,3-Dinitrobenzene	450 - 500	0 / 5	--	--	--	233	11.5	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
2,4,6-Trinitrotoluene	450 - 500	0 / 5	--	--	--	233	11.5	--	10,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
2-Amino-4,6-dinitrotoluene	450 - 500	0 / 5	--	--	--	233	11.5	--	80,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
2-Nitrotoluene	450 - 500	0 / 5	--	--	--	233	11.5	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
3-Nitrotoluene	450 - 500	0 / 5	--	--	--	233	11.5	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
4-Amino-2,6-dinitrotoluene	450 - 500	0 / 5	--	--	--	233	11.5	--	80,000	-- / --	0.01	NO	--	-- / --	--	--	--	NO
4-Nitrotoluene	450 - 500	0 / 5	--	--	--	233	11.5	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
HMX	450 - 500	0 / 5	--	--	--	233	11.5	--	10,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
RDX	450 - 500	0 / 5	--	--	--	233	11.5	--	10,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Tetryl	450 - 500	0 / 5	--	--	--	233	11.5	--	10,000	-- / --	0.05	NO	--	-- / --	--	--	--	NO
Inorganics (MG/KG)																		
Aluminum	-- - --	10 / 10	3,550	24,500	CAA03-SB08-1109	10,355	6,260	--	pH < 5.5	1 / 10	--	YES	13,000	2 / 10	1.88	mean pH in range		NO
Antimony	0.53 - 1.10	5 / 10	0.050	0.14	CAA03-SB08-1109	0.25	0.18	--	78.0	0 / 10	0.002	NO	--	-- / --	--	--	--	NO
Arsenic	-- - --	10 / 10	1.70	5.70	CAA03-SB08-1109	3.26	1.26	--	18.0	0 / 10	0.32	NO	--	-- / --	--	--	--	NO
Barium	-- - --	10 / 10	20.2	247	CAS004-4-HA04-01-1199	61.0	66.3	--	330	0 / 10	0.75	NO	--	-- / --	--	--	--	NO
Beryllium	0.31 - 0.55	5 / 10	0.53	0.60	CAA03-SB02-1109A	0.38	0.19	--	40.0	0 / 10	0.02	NO	--	-- / --	--	--	--	NO
Cadmium	0.080 - 1.10	2 / 10	0.96	1.20	CAS004-4-HA05-01-1199	0.47	0.38	--	32.0	0 / 10	0.04	NO	--	-- / --	--	--	--	NO
Calcium [3]	-- - --	10 / 10	478	5,970	CAS004-4-HA04-01-1199	2,312	1,693	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Chromium (hexavalent)	0.22 - 0.22	0 / 1	--	--	--	0.11	--	--	0.40	-- / --	0.55	NO	--	-- / --	--	--	--	NO
Chromium	-- - --	11 / 11	6.90	35.6	CAA03-SB08-1109	17.3	8.17	--	64.0	0 / 11	0.56	NO	--	-- / --	--	--	--	NO
Cobalt	-- - --	10 / 10	1.60	4.30	CAS004-4-HA03-02-1199	3.11	0.74	--	13.0	0 / 10	0.33	NO	--	-- / --	--	--	--	NO
Copper	4.40 - 4.40	9 / 10	2.90	40.4	CAS004-4-HA03-02-1199	13.9	14.7	--	70.0	0 / 10	0.58	NO	--	-- / --	--	--	--	NO
Cyanide	0.020 - 0.84	1 / 10	0.44	0.44	CAS004-4-HA04-01-1199	0.25	0.20	--	15.8	0 / 10	0.03	NO	--	-- / --	--	--	--	NO
Iron	-- - --	10 / 10	4,960	28,000	CAS004-4-HA06-02-1199	14,486	7,109	--	5 < pH > 8	2 / 10	--	YES	32,000	0 / 10	0.88	mean pH in range		NO
Lead	-- - --	10 / 10	9.00	45.3	CAS004-4-HA03-02-1199	22.4	14.4	--	120	0 / 10	0.38	NO	--	-- / --	--	--	--	NO
Magnesium [3]	-- - --	10 / 10	327	1,730	CAS004-4-HA06-02-1199	952	452	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Manganese	-- - --	10 / 10	27.3	161	CAA03-SB02-1109A	89.7	44.7	--	220	0 / 10	0.73	NO	--	-- / --	--	--	--	NO
Mercury	-- - --	10 / 10	0.010	0.91	CAS004-4-HA03-02-1199	0.25	0.37	0.83	0.10	4 / 10	9.10	YES	0.14	3 / 10	6.50	8.27	2.54	YES
Nickel	3.50 - 7.70	8 / 10	4.40	20.4	CAS004-4-HA06-02-1199	8.29	6.41	--	38.0	0 / 10	0.54	NO	--	-- / --	--	--	--	NO
Potassium [3]	249 - 920	8 / 10	531	1,740	CAA03-SB08-1109	776	525	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO
Selenium	0.66 - 0.94	6 / 10	0.29	0.78	CAS004-4-HA02-02-1199	0.43	0.14	0.55	0.52	1 / 10	1.50	YES	0.64	1 / 10	1.22	1.06	0.82	YES
Silver	1.30 - 5.80	2 / 10	0.44	8.50	CAS004-4-HA06-02-1199	1.92	2.44	--	560	0 / 10	0.02	NO	--	-- / --	--	--	--	NO
Sodium [3]	11.6 - 57.1	5 / 10	27.9	43.3	CAA03-SB03-1109A	28.1	12.2	--	NSV	-- / --	NSV	NO	--	-- / --	--	--	--	NO

Table E-8
Ecological Screening Statistics - Site 4 Shallow Subsurface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Minimum Concentration Detected	Maximum Concentration Detected	Sample ID of Maximum Detected Concentration	Arithmetic Mean	Standard Deviation of Mean	95% UCL	ESV	Frequency of Exceedance[1]	Maximum Hazard Quotient[2]	Step 2 COPC?	Background UTL	Frequency of UTL Exceedance	Maximum Ratio	95% UCL Hazard Quotient	Mean Hazard Quotient	COPC for Risk Evaluation?
Thallium	0.11 - 0.75	0 / 10	--	--	--	0.19	0.13	--	1.00	-- / --	0.75	NO	--	-- / --	--	--	--	NO
Vanadium	10.1 - 10.1	9 / 10	12.2	52.2	CAA03-SB08-1109	21.4	12.5	--	130	0 / 10	0.40	NO	--	-- / --	--	--	--	NO
Zinc	28.6 - 28.6	9 / 10	15.1	373	CAS004-4-HA04-01-1199	120	144	320	120	4 / 10	3.11	YES	28.0	4 / 10	13.3	2.67	1.00	YES
Other Parameters																		
pH	-- - --	5 / 5	5.20	8.30	CAA03-SB04-1109A	7.32	1.26	--	--	-- / --	--	--	--	-- / --	--	--	--	--
Total organic carbon (MG/KG)	-- - --	5 / 5	5,300	18,000	CAA03-SB04-1109A	9,620	5,246	--	--	-- / --	--	--	--	-- / --	--	--	--	--

NSV - No Screening Value
1 - Count of detected samples exceeding or equaling ESV
2 - Shaded cells indicate hazard quotient based on reporting limits
3 - Macronutrient - Not considered to be a COPC
4 - See uncertainty section

Table E-9
Exceedances - Site 4 Shallow Subsurface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAA03-SB02	CAA03-SB03	CAA03-SB04	CAA03-SB05	CAA03-SB08		CAS004-4HA02	CAS004-4HA03
			CAA03-SB02-1109A	CAA03-SB03-1109A	CAA03-SB04-1109A	CAA03-SB05-1109A	CAA03-SB08-1109	CAA03-SB08P-1109	CAS004-4-HA02-02-1199	CAS004-4-HA03-02-1199
			11/04/09	11/04/09	11/04/09	11/04/09	11/05/09	11/05/09	11/12/99	11/12/99
Volatile Organic Compounds (UG/KG)										
2-Butanone	NSV	--	25 UJ	30 UJ	28 UJ	23 UJ	30 UJ	30 UJ	**8 J**	14.2 U
Acetone	NSV	--	29 B	68 B	60 B	65 B	**220 J**	**240 J**	43 B	14.2 U
Chloroform	1,844	--	6 UJ	7 UJ	7 UJ	**1 J**	**0.8 J**	7 UJ	13.7 U	14.2 U
Ethylbenzene	1,815	--	5 UJ	6 UJ	6 UJ	5 UJ	6 UJ	6 UJ	**2 J**	14.2 U
Methylene chloride	1,250	--	25 UJ	**16 J**	28 UJ	23 UJ	30 UJ	30 UJ	7 B	17 B
Styrene	64,000	--	5 UJ	6 UJ	6 UJ	5 UJ	**2 J**	6 UJ	13.7 U	14.2 U
Tetrachloroethene	179	--	5 UJ	6 UJ	6 UJ	5 UJ	6 UJ	6 UJ	13.7 U	**3 J**
Toluene	40,000	--	5 UJ	6 UJ	6 UJ	5 UJ	6 UJ	**5 J**	13.7 U	14.2 U
Semivolatile Organic Compounds (UG/KG)										
2-Methylnaphthalene	LMW PAH	--	**3.6 J**	22 U	22 U	22 U	23 U	22 U	480 U	11,000 UJ
Acenaphthene	LMW PAH	--	**8.5 J**	22 U	**5.9 J**	22 U	23 U	22 U	480 U	11,000 UJ
Acenaphthylene	LMW PAH	--	**100**	22 U	**23**	22 U	23 U	22 U	480 U	11,000 UJ
Anthracene	LMW PAH	--	**66**	22 U	**35**	22 U	23 U	22 U	480 U	11,000 UJ
Benzo(a)anthracene	HMW PAH	--	**350**	**11 J**	**180**	**8 J**	23 U	**11 J**	**77 J**	11,000 UJ
Benzo(a)pyrene	HMW PAH	--	**330**	**5.3 J**	**260**	22 U	23 U	**12 J**	**110 J**	11,000 UJ
Benzo(b)fluoranthene	HMW PAH	--	**470**	22 U	**360**	**8.9 J**	23 U	**19 J**	**130 J**	11,000 UJ
Benzo(g,h,i)perylene	HMW PAH	--	**130 L**	22 UL	**66 L**	22 UL	23 R	3 B	**79 J**	11,000 UJ
Benzo(k)fluoranthene	HMW PAH	--	**150**	22 U	**84**	22 U	23 U	22 U	**64 J**	11,000 UJ
bis(2-Ethylhexyl)phthalate	30,000	--	110 U	110 U	110 U	110 U	120 U	110 U	670 B	**63,000 J**
Carbazole	7,000	--	**39**	22 U	**17 J**	22 U	23 U	22 U	480 U	11,000 UJ
Chrysene	HMW PAH	--	**320**	22 U	**160 J**	22 U	23 U	**18 J**	**130 J**	11,000 UJ
Dibenz(a,h)anthracene	HMW PAH	--	**85 K**	22 U	**70 K**	22 U	23 U	**4.2 J**	480 U	11,000 UJ
Di-n-butylphthalate	40,000	--	110 U	110 U	110 U	110 U	120 U	110 U	66 B	5,700 B
Fluoranthene	LMW PAH	--	**620**	8.4 B	**320**	7.4 B	**4.5 J**	22 U	**160 J**	11,000 UJ
Fluorene	LMW PAH	--	**33**	22 U	**12 J**	22 U	23 U	22 U	480 U	11,000 UJ
Hexachlorobenzene	1,000	--	22 U	22 U	22 U	22 U	23 U	**7.2 J**	480 U	11,000 UJ
Indeno(1,2,3-cd)pyrene	HMW PAH	--	**230 J**	**14 J**	**280 J**	22 U	5.6 B	21 B	**66 J**	11,000 UJ
Naphthalene	LMW PAH	--	**7.4 J**	22 U	22 U	22 U	23 U	22 U	480 U	11,000 UJ
PAH (HMW)	18,000	--	**2,545**	**89.7**	**1,720**	**87.0**	94.8 U	**98.2**	**1,106**	49,500 U
PAH (LMW)	29,000	--	**1,110**	82.5 U	**559**	82.4 U	**96.5**	99.0 U	**1,940**	49,500 U
Phenanthrene	LMW PAH	--	**260**	2.5 B	**130**	3.4 B	23 U	22 U	**100 J**	11,000 UJ
Pyrene	HMW PAH	--	**480**	**4.4 J**	**260**	**4.1 J**	23 U	22 U	**210 J**	11,000 UJ
Pesticides (UG/KG)										
4,4'-DDD	583	--	**9.2**	**5.1 J**	**13**	**2.6 J**	3.8 UJ	**1.1 J**	**4.5 L**	4.6 U
4,4'-DDE	114	--	**24**	**7.4 J**	**20**	**6**	3.8 UJ	3.8 U	**5.3 P**	4.6 U
4,4'-DDT	100	--	**23**	3.5 UJ	**3.8**	**1.8 J**	**12 J**	3.8 U	**5.8 P**	4.6 U
Aldrin	3.63	--	1.8 U	1.8 UJ	1.8 U	1.8 U	**1.1 J**	2 U	2.5 UL	2.4 U
alpha-Chlordane	11.0	--	1.8 U	1.8 UJ	1.8 U	1.8 U	2 UJ	2 U	2.5 UL	2.4 U
Dieldrin	10.5	--	**1.9 J**	**2 J**	**3.2 J**	**1 J**	**1.3 J**	3.8 U	4.8 UL	4.6 U
Endosulfan II	6.32	--	3.6 U	3.5 UJ	3.6 U	3.4 U	3.8 UJ	3.8 U	4.8 UL	**6.5 K**
Endrin	1.95	--	3.6 U	**13 J**	3.6 U	3.4 U	**96 J**	**5.5 J**	4.8 UL	4.6 U
Endrin ketone	1.95	--	3.6 U	3.5 UJ	3.6 U	3.4 U	**0.88 J**	3.8 U	4.8 UL	4.6 U

Table E-9
Exceedances - Site 4 Shallow Subsurface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAA03-SB02	CAA03-SB03	CAA03-SB04	CAA03-SB05	CAA03-SB08		CAS004-4HA02	CAS004-4HA03
			CAA03-SB02-1109A	CAA03-SB03-1109A	CAA03-SB04-1109A	CAA03-SB05-1109A	CAA03-SB08-1109	CAA03-SB08P-1109	CAS004-4-HA02-02-1199	CAS004-4-HA03-02-1199
			11/04/09	11/04/09	11/04/09	11/04/09	11/05/09	11/05/09	11/12/99	11/12/99
gamma-BHC (Lindane)	7.75	--	**1.5 J**	1.8 UJ	**0.57 J**	1.8 U	2 UJ	2 U	2.5 UL	2.4 U
gamma-Chlordane	11.0	--	1.8 U	1.8 UJ	**1 J**	1.8 U	2 UJ	2 U	2.5 UL	2.4 U
Heptachlor	52.9	--	1.8 U	1.8 UJ	1.8 U	1.8 U	2 UJ	2 U	2.5 UL	2.4 U
Methoxychlor	500	--	18 U	18 UJ	18 U	18 U	20 UJ	20 U	25 UL	24 U
Polychlorinated Biphenyls (UG/KG)										
Aroclor-1242	8,000	--	19 U	19 U	20 U	19 U	21 UJ	21 U	48 UL	46 U
Aroclor-1260	8,000	--	19 U	19 U	20 U	19 U	21 UJ	21 U	48 UL	**51 K**
Explosives (UG/KG)										
No Detections	--	--								
Inorganics (MG/KG)										
Aluminum	pH < 5.5	13,000	**15,800**	**12,100**	**10,600**	**10,300**	**23,100**	**24,500**	**3,670 L**	**9,660 L**
Antimony	78.0	--	**0.11 L**	**0.11 L**	**0.09 L**	**0.05 L**	**0.14**	**0.12**	0.53 U	0.53 U
Arsenic	18.0	5.54	**4**	**2.3**	**2.4**	**1.7**	**5.7**	**5.7**	**1.8 L**	**2.9 L**
Barium	330	84.5	**54.8 J**	**50.4 J**	**45.7 J**	**49.5 J**	**28.1**	**30.8**	**20.2 J**	**48 J**
Beryllium	40.0	0.52	**0.6**	**0.56**	**0.53**	**0.53**	**0.52 J**	**0.55**	0.31 B	0.39 B
Cadmium	32.0	--	0.86 U	1 U	0.85 U	0.89 U	1.1 U	0.98 U	0.08 U	0.08 U
Chromium	64.0	33.7	**18.1**	**14.6**	**13.7**	**11.5**	**33.6**	**35.6**	**6.9**	**15.9**
Cobalt	13.0	5.18	**3.4**	**2.8**	**3**	**2.7**	**3**	**3.1**	**1.6 J**	**4.3 J**
Copper	70.0	3.17	**3.6**	**3.6**	**2.9**	**3**	**3.4**	**3.8**	4.4 B	**40.4**
Cyanide	15.8	2.70	0.77 U	0.84 U	0.7 U	0.77 U	0.84 U	0.77 U	0.03 UL	0.03 UL
Iron	5 < pH > 8	32,000	**16,000 J**	**10,000 J**	**11,100 J**	**7,800 J**	**22,400**	**22,900**	**4,960 L**	**19,300 L**
Lead	120	8.79	**12.9**	**14.9**	**10.8**	**9**	**11.3**	**10.8**	**11.3**	**45.3**
Manganese	220	176	**161 J**	**86.4 J**	**92.8 J**	**122 J**	**27.3**	**26.8**	**28.3**	**120**
Mercury	0.10	0.14	**0.06**	**0.02 J**	**0.03 J**	**0.01 J**	**0.02 J**	**0.02 J**	**0.10 J**	**0.91**
Nickel	38.0	17.6	**5.3**	**5**	**4.5**	**4.4**	**6.5**	**6.8**	3.5 B	**17.3**
Selenium	0.52	0.64	**0.51**	**0.32 J**	**0.34 J**	**0.29 J**	**0.4 J**	**0.47 J**	**0.78 J**	0.72 U
Silver	560	1.10	1.3 U	1.6 U	1.3 U	1.3 U	**0.44 J**	**0.21 J**	1.6 B	5.8 B
Vanadium	130	48.3	**29.2**	**20.2**	**20.1**	**16.8**	**51.1**	**52.2**	10.1 B	**12.2**
Zinc	120	28.0	**20.2**	**21.1**	**18.1**	**15.1**	**20.9**	**21.3**	28.6 B	**334**
Other Parameters										
pH	--	--	**7.60**	**8.20**	**8.30**	**7.30**	**5.20**	**5.20**	NA	NA
Total organic carbon (MG/KG)	--	--	**8,400**	**5,400**	**18,000**	**5,300**	**11,000**	**9,200**	NA	NA

Notes:
Grey highlighting indicates value greater than ESV
Yellow highlighting indicates value equal to ESV
Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL
Bold indicates detections
NA - Not analyzed
NSV - No Screening Value

Table E-9
Exceedances - Site 4 Shallow Subsurface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS004-4HA04 CAS004-4-HA04-01-1199 11/12/99	CAS004-4HA05 CAS004-4-HA05-01-1199 11/12/99	CAS004-4HA06 CAS004-4-HA06-02-1199 11/12/99	CAS04-SO15 CAS04-SB15-1012 10/23/12
Volatile Organic Compounds (UG/KG)						
2-Butanone	NSV	--	20.4 U	13.0 U	12.8 U	NA
Acetone	NSV	--	20.4 U	13.0 U	12.8 U	NA
Chloroform	1,844	--	20.4 U	13.0 U	12.8 U	NA
Ethylbenzene	1,815	--	20.4 U	13.0 U	12.8 UL	NA
Methylene chloride	1,250	--	13 B	12 B	20 B	NA
Styrene	64,000	--	20.4 U	13.0 U	12.8 UL	NA
Tetrachloroethene	179	--	20.4 U	13.0 U	12.8 UL	NA
Toluene	40,000	--	20.4 U	13.0 U	12.8 UL	NA
Semivolatile Organic Compounds (UG/KG)						
2-Methylnaphthalene	LMW PAH	--	17,000 UJ	4,300 U	3,800 U	NA
Acenaphthene	LMW PAH	--	17,000 UJ	4,300 U	3,800 U	NA
Acenaphthylene	LMW PAH	--	17,000 UJ	4,300 U	3,800 U	NA
Anthracene	LMW PAH	--	17,000 UJ	4,300 U	3,800 U	NA
Benzo(a)anthracene	HMW PAH	--	17,000 UJ	4,300 U	**500 J**	NA
Benzo(a)pyrene	HMW PAH	--	17,000 UJ	**550 J**	**600 J**	NA
Benzo(b)fluoranthene	HMW PAH	--	17,000 UJ	**510 J**	**490 J**	NA
Benzo(g,h,i)perylene	HMW PAH	--	17,000 UJ	4,300 U	**440 J**	NA
Benzo(k)fluoranthene	HMW PAH	--	17,000 UJ	**490 J**	**760 J**	NA
bis(2-Ethylhexyl)phthalate	30,000	--	2,600 B	4,300 U	3,800 U	NA
Carbazole	7,000	--	17,000 UJ	4,300 U	3,800 U	NA
Chrysene	HMW PAH	--	17,000 UJ	4,300 U	**620 J**	NA
Dibenz(a,h)anthracene	HMW PAH	--	17,000 UJ	4,300 U	3,800 U	NA
Di-n-butylphthalate	40,000	--	**90,000 J**	4,300 U	3,800 U	NA
Fluoranthene	LMW PAH	--	17,000 UJ	**880 J**	**880 J**	NA
Fluorene	LMW PAH	--	17,000 UJ	4,300 U	3,800 U	NA
Hexachlorobenzene	1,000	--	17,000 UJ	4,300 U	3,800 U	NA
Indeno(1,2,3-cd)pyrene	HMW PAH	--	17,000 UJ	4,300 U	3,800 U	NA
Naphthalene	LMW PAH	--	17,000 UJ	4,300 U	3,800 U	NA
PAH (HMW)	18,000	--	76,500 U	**13,230**	**7,880**	NA
PAH (LMW)	29,000	--	76,500 U	**18,080**	**14,580**	NA
Phenanthrene	LMW PAH	--	17,000 UJ	4,300 U	**400 J**	NA
Pyrene	HMW PAH	--	17,000 UJ	**930 J**	**670 J**	NA
Pesticides (UG/KG)						
4,4'-DDD	583	--	6.7 U	4.3 U	3.8 U	NA
4,4'-DDE	114	--	**24 J**	**10 J**	3.8 U	NA
4,4'-DDT	100	--	**13 J**	**150 L**	**8.4 J**	NA
Aldrin	3.63	--	3.4 U	**27 J**	1.9 U	NA
alpha-Chlordane	11.0	--	3.4 U	**2.4 J**	1.9 U	NA
Dieldrin	10.5	--	6.7 U	4.3 U	3.8 U	NA
Endosulfan II	6.32	--	6.7 U	4.3 U	3.8 U	NA
Endrin	1.95	--	6.7 U	4.3 U	3.8 U	NA
Endrin ketone	1.95	--	**8.9 J**	**19 J**	3.8 U	NA

Table E-9
Exceedances - Site 4 Shallow Subsurface Soil - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Soil ESV	Background UTL	CAS004-4HA04 CAS004-4-HA04-01-1199 11/12/99	CAS004-4HA05 CAS004-4-HA05-01-1199 11/12/99	CAS004-4HA06 CAS004-4-HA06-02-1199 11/12/99	CAS04-SO15 CAS04-SB15-1012 10/23/12
gamma-BHC (Lindane)	7.75	--	3.4 U	2.2 U	1.9 U	NA
gamma-Chlordane	11.0	--	3.4 U	**4.3 J**	1.9 U	NA
Heptachlor	52.9	--	3.4 U	**9.9 J**	1.9 U	NA
Methoxychlor	500	--	34 U	**25 J**	19 U	NA
Polychlorinated Biphenyls (UG/KG)						
Aroclor-1242	8,000	--	67 U	**2,300 L**	38 U	NA
Aroclor-1260	8,000	--	**330 J**	**1,600 L**	38 U	NA
Explosives (UG/KG)						
No Detections	--	--				
Inorganics (MG/KG)						
Aluminum	pH < 5.5	13,000	**7,520 L**	**5,850 L**	**3,550 L**	NA
Antimony	78.0	--	0.69 U	1.1 B	1.1 B	NA
Arsenic	18.0	5.54	**3.9 L**	**3.7 L**	**4.2 L**	NA
Barium	330	84.5	**247**	**30.6 J**	**33.2 J**	NA
Beryllium	40.0	0.52	0.4 B	0.55 B	0.35 B	NA
Cadmium	32.0	--	**0.96 J**	**1.2 J**	0.15 U	NA
Chromium	64.0	33.7	**13.4**	**17.4**	**29.2**	**13.9**
Cobalt	13.0	5.18	**3.8 J**	**2.8 J**	**3.6 J**	NA
Copper	70.0	3.17	**30**	**30.1**	**19.4**	NA
Cyanide	15.8	2.70	**0.44 L**	0.03 UL	0.02 UL	NA
Iron	5 < pH > 8	32,000	**12,100 L**	**12,700 L**	**28,000 L**	NA
Lead	120	8.79	**42.3**	**36.2**	**29.7**	NA
Manganese	220	176	**105**	**40.4**	**114**	NA
Mercury	0.10	0.14	**0.90**	**0.44**	**0.05 J**	NA
Nickel	38.0	17.6	**13.6**	7.7 B	**20.4**	NA
Selenium	0.52	0.64	0.94 U	0.79 U	0.66 U	NA
Silver	560	1.10	3.9 B	3.7 B	**8.5 L**	NA
Vanadium	130	48.3	**17.1**	**20.5**	**20.8**	NA
Zinc	120	28.0	**373**	**150**	**236**	NA
Other Parameters						
pH	--	--	NA	NA	NA	NA
Total organic carbon (MG/KG)	--	--	NA	NA	NA	NA

Notes:
Grey highlighting indicates value greater than ESV
Yellow highlighting indicates value equal to ESV
Red highlighting indicates value ≥ ESV and ≥ background UTL; ≥ ESV and no UTL; ≥ background UTL and no ESV; or detected and no ESV and UTL
Bold indicates detections
NA - Not analyzed
NSV - No Screening Value

Table E-10
Screening Statistics - Site 4 Surface Soil - Outside Debris Areas - Mammal/Bird Eco-SSLs
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Mammal Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient	Bird Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient
Inorganics (MG/KG)									
Arsenic	-- - --	11 / 11	7.20	46.0	0 / 11	0.16	43.0	0 / 11	0.17
Cadmium	0.020 - 1.20	3 / 11	2.70	0.36	1 / 11	7.50	0.77	1 / 11	3.51
Chromium	-- - --	12 / 12	45.2	34.0	1 / 12	1.33	26.0	3 / 12	1.74
Copper	-- - --	11 / 11	31.5	49.0	0 / 11	0.64	28.0	2 / 11	1.13
Lead	-- - --	11 / 11	53.3	56.0	0 / 11	0.95	11.0	7 / 11	4.85
Nickel	-- - --	11 / 11	8.10	130	0 / 11	0.06	210	0 / 11	0.04
Selenium	0.59 - 1.50	8 / 11	0.59	0.63	0 / 11	0.94	1.20	0 / 11	0.49
Silver	0.28 - 1.80	4 / 11	0.29	14.0	0 / 11	0.02	4.20	0 / 11	0.07
Zinc	-- - --	11 / 11	242	79.0	1 / 11	3.06	46.0	2 / 11	5.26
Pesticides (UG/KG)									
4,4'-DDD[1]	3.50 - 4.10	0 / 7	--	21.0	-- / --	0.20	93.0	-- / --	0.04
4,4'-DDE	0.67 - 4.10	3 / 7	1.70	21.0	0 / 7	0.08	93.0	0 / 7	0.02
4,4'-DDT	1.30 - 4.10	2 / 7	3.40	21.0	0 / 7	0.16	93.0	0 / 7	0.04
Dieldrin[1]	3.50 - 4.10	0 / 7	--	4.90	-- / --	0.84	22.0	-- / --	0.19
Semivolatile Organic Compounds (UG/KG)									
PAH (HMW)	-- - --	11 / 11	9,790	1,100	2 / 11	8.90	--	-- - --	--
PAH (LMW)	-- - --	11 / 11	6,204	100,000	0 / 11	0.06	--	-- - --	--
Pentachlorophenol[1]	100 - 120	0 / 7	--	2,800	-- / --	0.04	2,100	-- / --	0.06

Shaded cells indicate HQ ≥ 1
1 - HQs based on reporting limits

Table E-11
Summary of Hazard Quotients for Terrestrial Food Web Exposures - Screening (Step 2) - Maximum - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																								
Cadmium	1.95E-01	6.16E-02	1.95E-02	2.84E+00	8.97E-01	2.84E-01	6.19E-01	1.96E-01	6.19E-02	2.08E-01	6.57E-02	2.08E-02	6.79E-01	3.04E-01	1.36E-01	9.59E-01	4.29E-01	1.92E-01	1.56E-01	6.97E-02	3.12E-02	8.91E-02	3.98E-02	1.78E-02
Chromium	3.27E-01	1.46E-01	6.53E-02	7.30E+00	3.27E+00	1.46E+00	1.52E+00	6.78E-01	3.03E-01	1.72E-01	7.70E-02	3.44E-02	2.89E+00	1.29E+00	5.77E-01	4.19E+00	1.87E+00	8.37E-01	4.39E-01	1.96E-01	8.78E-02	5.93E-02	2.65E-02	1.19E-02
Copper	1.55E-01	1.20E-01	9.28E-02	3.91E-01	3.03E-01	2.34E-01	1.03E-01	7.94E-02	6.15E-02	5.58E-02	4.91E-02	4.33E-02	3.21E-01	1.86E-01	1.07E-01	2.82E-01	1.63E-01	9.43E-02	4.33E-01	2.51E-01	1.45E-01	1.42E-01	8.24E-02	4.77E-02
Lead	8.91E-02	6.48E-02	4.71E-02	7.07E-01	5.14E-01	3.73E-01	1.30E-01	9.43E-02	6.85E-02	8.92E-02	6.48E-02	4.71E-02	3.73E-01	1.67E-01	7.46E-02	4.48E-01	2.00E-01	8.96E-02	6.12E-01	4.33E-01	3.06E-01	8.31E-02	3.72E-02	1.66E-02
Mercury	4.69E-01	2.10E-01	9.38E-02	7.60E+00	3.40E+00	1.52E+00	1.67E+00	7.45E-01	3.33E-01	2.65E-02	2.05E-02	1.59E-02	2.26E-01	1.45E-01	9.24E-02	3.24E-01	2.07E-01	1.32E-01	4.66E-02	3.30E-02	2.33E-02	1.65E-03	1.05E-03	6.73E-04
Zinc	1.55E-01	6.95E-02	3.11E-02	8.69E-01	3.89E-01	1.74E-01	2.07E-01	9.26E-02	4.14E-02	8.79E-02	3.93E-02	1.76E-02	5.07E-01	2.27E-01	1.01E-01	6.15E-01	2.75E-01	1.23E-01	3.27E-01	1.46E-01	6.55E-02	8.14E-02	3.64E-02	1.63E-02
Polychlorinated Biphenyls																								
Aroclor-1016	8.09E-03	3.62E-03	1.62E-03	2.46E-02	1.10E-02	4.91E-03	8.82E-03	3.95E-03	1.76E-03	5.64E-04	3.56E-04	2.25E-04	4.45E-03	1.99E-03	8.91E-04	4.78E-03	2.14E-03	9.57E-04	4.65E-03	2.08E-03	9.30E-04	1.61E-03	7.20E-04	3.22E-04
Aroclor-1221	3.33E-02	1.49E-02	6.67E-03	7.42E-02	3.32E-02	1.48E-02	2.55E-02	1.14E-02	5.11E-03	1.92E-02	8.57E-03	3.83E-03	1.59E-02	7.09E-03	3.17E-03	1.46E-02	6.55E-03	2.93E-03	2.23E-02	9.98E-03	4.46E-03	5.64E-03	2.52E-03	1.13E-03
Aroclor-1232	1.61E-02	7.22E-03	3.23E-03	4.25E-02	1.90E-02	8.49E-03	1.42E-02	6.37E-03	2.85E-03	1.03E-02	4.61E-03	2.06E-03	8.40E-03	3.75E-03	1.68E-03	8.33E-03	3.73E-03	1.67E-03	1.05E-02	4.67E-03	2.09E-03	3.01E-03	1.35E-03	6.02E-04
Aroclor-1242	8.51E-03	3.81E-03	1.70E-03	2.49E-02	1.11E-02	4.98E-03	9.44E-03	4.22E-03	1.89E-03	5.76E-03	2.58E-03	1.15E-03	4.52E-03	2.02E-03	9.04E-04	4.85E-03	2.17E-03	9.69E-04	4.71E-03	2.11E-03	9.42E-04	1.63E-03	7.30E-04	3.27E-04
Aroclor-1248	6.90E-03	3.09E-03	1.38E-03	2.65E-02	1.18E-02	5.29E-03	9.77E-03	4.37E-03	1.95E-03	5.61E-03	2.51E-03	1.12E-03	4.35E-03	1.94E-03	8.70E-04	5.19E-03	2.32E-03	1.04E-03	3.29E-03	1.47E-03	6.59E-04	1.58E-03	7.06E-04	3.16E-04
Aroclor-1254	5.02E-03	2.24E-03	1.00E-03	2.30E-02	1.03E-02	4.61E-03	7.75E-03	3.47E-03	1.55E-03	4.69E-03	2.10E-03	9.39E-04	3.66E-03	1.63E-03	7.31E-04	4.51E-03	2.02E-03	9.03E-04	2.43E-03	1.09E-03	4.85E-04	1.33E-03	5.96E-04	2.66E-04
Aroclor-1260	9.02E-03	4.03E-03	1.80E-03	7.76E-02	3.47E-02	1.55E-02	1.95E-02	8.74E-03	3.91E-03	1.42E-02	6.35E-03	2.84E-03	1.17E-02	5.22E-03	2.34E-03	1.57E-02	7.02E-03	3.14E-03	4.93E-03	2.21E-03	9.86E-04	4.21E-03	1.88E-03	8.43E-04
PCB (total)	7.76E-03	3.47E-03	1.55E-03	7.56E-02	3.38E-02	1.51E-02	1.61E-02	7.20E-03	3.22E-03	1.38E-02	6.15E-03	2.75E-03	1.16E-02	5.17E-03	2.31E-03	1.53E-02	6.84E-03	3.06E-03	5.55E-03	2.48E-03	1.11E-03	4.17E-03	1.86E-03	8.34E-04
Pesticides																								
Aldrin	3.91E-04	1.75E-04	7.81E-05	4.36E-03	1.95E-03	8.73E-04	1.11E-03	4.97E-04	2.22E-04	7.64E-04	3.42E-04	1.53E-04	5.59E-03	2.50E-03	1.12E-03	7.89E-03	3.53E-03	1.58E-03	1.25E-03	5.57E-04	2.49E-04	1.97E-03	8.81E-04	3.94E-04
alpha-BHC	2.49E-04	1.76E-04	1.25E-04	2.07E-04	1.47E-04	1.04E-04	1.21E-04	8.54E-05	6.04E-05	8.94E-05	6.32E-05	4.47E-05	6.25E-04	3.12E-04	1.55E-04	3.26E-04	1.63E-04	8.11E-05	1.29E-03	6.42E-04	3.21E-04	2.20E-04	1.10E-04	5.49E-05
alpha-Chlordane	9.68E-06	6.85E-06	4.84E-06	6.25E-05	4.42E-05	3.13E-05	2.16E-05	1.53E-05	1.08E-05	1.16E-05	8.19E-06	5.79E-06	6.11E-05	2.73E-05	1.22E-05	8.47E-05	3.79E-05	1.69E-05	2.80E-05	1.25E-05	5.61E-06	2.15E-05	9.60E-06	4.29E-06
beta-BHC	2.47E-04	1.75E-04	1.24E-04	2.07E-04	1.47E-04	1.04E-04	1.20E-04	8.50E-05	6.01E-05	8.89E-05	6.29E-05	4.44E-05	6.21E-04	3.10E-04	1.55E-04	3.26E-04	1.63E-04	8.11E-05	1.28E-03	6.37E-04	3.18E-04	2.19E-04	1.09E-04	5.46E-05
delta-BHC	1.94E-04	1.37E-04	9.72E-05	2.04E-04	1.44E-04	1.02E-04	1.06E-04	7.50E-05	5.31E-05	7.62E-05	5.39E-05	3.81E-05	5.29E-04	2.64E-04	1.32E-04	3.26E-04	1.63E-04	8.11E-05	9.87E-04	4.92E-04	2.46E-04	1.88E-04	9.35E-05	4.67E-05
Endosulfan I	2.59E-03	1.16E-03	5.18E-04	2.21E-03	9.87E-04	4.42E-04	1.27E-03	5.68E-04	2.54E-04	9.38E-04	4.19E-04	1.88E-04	3.44E-05	1.54E-05	6.88E-06	1.83E-05	8.16E-06	3.65E-06	7.02E-05	3.14E-05	1.40E-05	1.21E-05	5.43E-06	2.43E-06
Endosulfan II	2.90E-03	1.30E-03	5.79E-04	4.16E-03	1.86E-03	8.33E-04	1.90E-03	8.49E-04	3.80E-04	1.31E-03	5.86E-04	2.62E-04	4.73E-05	2.12E-05	9.47E-06	3.56E-05	1.59E-05	7.12E-06	7.49E-05	3.35E-05	1.50E-05	1.69E-05	7.55E-06	3.38E-06
Endrin	1.90E-02	8.52E-03	3.81E-03	1.32E-01	5.92E-02	2.65E-02	3.12E-02	1.40E-02	6.25E-03	2.51E-02	1.12E-02	5.01E-03	5.80E-01	2.60E-01	1.16E-01	7.42E-01	3.32E-01	1.48E-01	2.04E-02	9.14E-03	4.09E-03	2.04E-01	9.12E-02	4.08E-02
gamma-BHC (Lindane)	6.68E-05	2.99E-05	1.34E-05	8.26E-04	3.69E-04	1.65E-04	1.89E-04	8.45E-05	3.78E-05	1.43E-04	6.38E-05	2.85E-05	7.69E-04	3.44E-04	1.54E-04	1.08E-03	4.82E-04	2.15E-04	1.92E-04	8.58E-05	3.84E-05	2.66E-04	1.19E-04	5.32E-05
gamma-Chlordane	1.89E-05	1.33E-05	9.44E-06	2.28E-04	1.61E-04	1.14E-04	5.67E-05	4.01E-05	2.84E-05	3.96E-05	2.80E-05	1.98E-05	2.19E-04	9.80E-05	4.38E-05	3.11E-04	1.39E-04	6.22E-05	8.19E-05	3.66E-05	1.64E-05	7.70E-05	3.44E-05	1.54E-05
Heptachlor	4.20E-04	1.88E-04	8.41E-05	4.00E-03	1.79E-03	8.00E-04	1.05E-03	4.67E-04	2.09E-04	7.15E-04	3.20E-04	1.43E-04	1.32E-03	5.92E-04	2.65E-04	1.83E-03	8.20E-04	3.67E-04	3.68E-04	1.65E-04	7.36E-05	4.67E-04	2.09E-04	9.35E-05
Heptachlor epoxide	9.77E-04	4.37E-04	1.95E-04	1.26E-02	5.63E-03	2.52E-03	2.95E-03	1.32E-03	5.89E-04	2.17E-03	9.70E-04	4.34E-04	4.20E-03	1.88E-03	8.39E-04	5.93E-03	2.65E-03	1.19E-03	9.32E-04	4.17E-04	1.86E-04	1.46E-03	6.52E-04	2.92E-04
Methoxychlor	3.70E-04	2.62E-04	1.85E-04	7.87E-04	5.57E-04	3.94E-04	3.15E-04	2.23E-04	1.58E-04	2.07E-04	1.46E-04	1.04E-04	5.55E-06	2.48E-06	1.11E-06	5.14E-06	2.30E-06	1.03E-06	6.77E-06	3.03E-06	1.35E-06	1.99E-06	8.92E-07	3.99E-07
Toxaphene	2.75E-04	1.23E-04	5.49E-05	7.62E-04	3.41E-04	1.52E-04	2.84E-04	1.27E-04	5.68E-05	1.81E-04	8.11E-05	3.63E-05	3.42E-03	1.53E-03	6.85E-04	3.56E-03	1.59E-03	7.12E-04	3.37E-03	1.51E-03	6.75E-04	1.24E-03	5.53E-04	2.47E-04
Volatile/Semivolatile Organics																								
1,1,2,2-Tetrachloroethane	2.12E-05	9.48E-06	4.24E-06	2.24E-05	1.00E-05	4.49E-06	2.19E-05	9.78E-06	4.37E-06	7.71E-06	3.45E-06	1.54E-06	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	3.58E-05	2.53E-05	1.79E-05	2.58E-05	1.82E-05	1.29E-05	3.14E-05	2.22E-05	1.57E-05	1.13E-05	8.00E-06	5.65E-06	1.54E-05	6.90E-06	3.09E-06	9.10E-06	4.07E-06	1.82E-06	2.85E-05	1.27E-05	5.70E-06	5.46E-06	2.44E-06	1.09E-06
1,2-Dichlorobenzene	2.53E-05	1.13E-05	5.06E-06	1.65E-05	7.39E-06	3.31E-06	1.49E-05	6.69E-06	2.99E-06	8.12E-06	3.63E-06	1.62E-06	2.02E-05	9.04E-06	4.04E-06	9.52E-06	4.26E-06	1.90E-06	4.33E-05	1.94E-05	8.66E-06	7.10E-06	3.17E-06	1.42E-06
1,3-Dichlorobenzene	2.41E-05	1.08E-05	4.81E-06	1.64E-05	7.36E-06	3.29E-06	1.46E-05	6.54E-06	2.92E-06	7.82E-06	3.50E-06	1.56E-06	1.94E-05	8.68E-06	3.88E-06	9.52E-06	4.26E-06	1.90E-06	4.07E-05	1.82E-05	8.15E-06	6.82E-06	3.05E-06	1.36E-06
1,4-Dichlorobenzene	7.28E-05	4.21E-05	2.43E-05	4.73E-05	2.73E-05	1.58E-05	4.28E-05	2.47E-05	1.43E-05	2.33E-05	1.35E-05	7.78E-06	2.03E-05	9.09E-06	4.07E-06	9.52E-06	4.26E-06	1.90E-06	4.37E-05	1.95E-05	8.74E-06	7.14E-06	3.19E-06	1.43E-06
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	1.81E-02	8.09E-03	3.62E-03	9.84E-02	4.40E-02	1.97E-02	1.84E-02	8.25E-03	3.69E-03	3.70E-03	1.65E-03	7.41E-04	3.84E-03	1.72E-03	7.68E-04	4.14E-03	1.85E-03	8.28E-04	3.67E-03	1.64E-03	7.34E-04	3.40E-06	1.52E-06	6.80E-07
Benzo(a)pyrene	2.50E-02	1.12E-02	5.01E-03	9.31E-02	4.17E-02	1.86E-02	2.03E-02	9.08E-03	4.06E-03	3.46E-03	1.55E-03	6.93E-04	4.12E-03	1.84E-03	8.25E-04	4.08E-03	1.82E-03	8.16E-04	4.66E-03	2.08E-03	9.31E-04	2.40E-06	1.07E-06	4.80E-07
Benzo(b)fluoranthene	1.31E-01	5.87E-02	2.63E-02	1.20E-01	5.39E-02	2.41E-02	4.97E-02	2.22E-02	9.95E-03	8.30E-03	3.71E-03	1.66E-03	1.01E-02	4.52E-03	2.02E-03	4.48E-03	2.00E-03	8.97E-04	2.27E-02	1.02E-02	4.54E-03	5.80E-06	2.59E-06	1.16E-06
Benzo(g,h,i)perylene	3.16E-02	1.42E-02	6.34E-03	3.24E-02	1.45E-02	6.50E-03	1.20E-02	5.36E-03	2.40E-03	2.27E-03	1.01E-03	4.54E-04	2.49E-03	1.11E-03	4.98E-04	1.12E-03	5.00E-04	2.24E-04	5.57E-03	2.49E-03	1.11E-03	1.60E-06	7.16E-07	3.20E-07
Benzo(k)fluoranthene	1.40E-02	6.28E-03	2.81E-03	3.99E-02	1.79E-02	8.00E-03	8.79E-03	3.93E-03	1.76E-03	1.84E-03	8.24E-04	3.69E-04	1.85E-03	8.29E-04	3.71E-04	1.57E-03	7.01E-04	3.13E-04	2.66E-03	1.19E-03	5.32E-04	1.50E-06	6.71E-07	3.00E-07
Chrysene	2.19E-02	9.81E-03	4.39E-03	1.71E-01	7.66E-02	3.43E-02	3.24E-02	1.45E-02	6.50E-03	5.05E-03	2.26E-03	1.01E-03	6.53E-03	2.92E-03	1.31E-03	7.92E-03	3.54E-03	1.58E-03	4.36E-03	1.95E-03	8.73E-04	8.00E-07	3.58E-07	1.60E-07
Dibenz(a,h)anthracene	8.23E-03	3.68E-03	1.65E-03	2.39E-02	1.07E-02	4.80E-03	6.11E-03	2.73E-03	1.22E-03	8.74E-04	3.91E-04	1.75E-04	1.18E-03	5.28E-04	2.36E-04	1.11E-03	4.97E-04	2.22E-04	1.43E-03	6.42E-04	2.87E-04	2.00E-06	8.95E-07	4.00E-07
Hexachlorobenzene	4.23E-04	2.99E-04	2.11E-04	2.75E-03	1.94E-03	1.38E-03	6.75E-04	4.77E-04	3.37E-04	5.31E-04	3.76E-04	2.66E-04	2.37E-02	1.06E-02	4.73E-03	2.99E-02	1.34E-02	5.97E-03	1.28E-02	5.72E-03	2.56E-03	8.47E-03	3.79E-03	1.69E-03
Hexachlorobutadiene	1.68E-02	5.32E-03	1.68E-03	3.04E-02	9.61E-03	3.04E-03	1.21E-02	3.83E-03	1.21E-03	8.62E-03	2.73E-03	8.62E-04	1.23E-02	5.48E-03	2.45E-03	1.03E-02	4.62E-03	2.07E-03	1.71E-02	7.67E-03	3.43E-03	4.39E-03	1.96E-03	8.78E-04

Table E-11
Summary of Hazard Quotients for Terrestrial Food Web Exposures - Screening (Step 2) - Maximum - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Hexachlorocyclopentadiene	2.96E-04	1.32E-04	5.92E-05	8.00E-04	3.58E-04	1.60E-04	2.82E-04	1.26E-04	5.65E-05	1.93E-04	8.65E-05	3.87E-05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	3.75E-05	1.68E-05	7.50E-06	3.69E-05	1.65E-05	7.38E-06	1.72E-05	7.68E-06	3.44E-06	1.45E-05	6.49E-06	2.90E-06	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	2.52E-02	1.13E-02	5.05E-03	9.31E-02	4.17E-02	1.86E-02	2.10E-02	9.40E-03	4.21E-03	3.27E-03	1.46E-03	6.55E-04	4.20E-03	1.88E-03	8.40E-04	4.22E-03	1.89E-03	8.43E-04	4.59E-03	2.05E-03	9.19E-04	2.40E-06	1.07E-06	4.80E-07
Pyrene	9.37E-01	4.19E-01	1.88E-01	3.12E-01	1.40E-01	6.25E-02	2.89E-01	1.30E-01	5.80E-02	3.77E-02	1.69E-02	7.54E-03	5.73E-02	2.56E-02	1.15E-02	1.14E-02	5.09E-03	2.28E-03	1.57E-01	7.01E-02	3.14E-02	2.90E-06	1.30E-06	5.80E-07
Dioxin-Like PCB Congeners																								
2,3,7,8 TCDD (TEQ)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Shaded cells indicate HQ ≥ 1

Table E-12
Summary of Hazard Quotients for Terrestrial Food Web Exposures - Baseline (Step 3A) - 95% UCL - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																								
Cadmium	4.52E-02	1.43E-02	4.52E-03	7.07E-01	2.24E-01	7.07E-02	1.17E-01	3.69E-02	1.17E-02	4.85E-02	1.53E-02	4.85E-03	1.71E-01	7.64E-02	3.42E-02	2.37E-01	1.06E-01	4.73E-02	5.52E-02	2.47E-02	1.10E-02	2.40E-02	1.07E-02	4.80E-03
Chromium	3.20E-02	1.43E-02	6.39E-03	3.28E-01	1.47E-01	6.56E-02	4.32E-02	1.93E-02	8.64E-03	3.65E-02	1.63E-02	7.31E-03	1.25E-01	5.58E-02	2.50E-02	1.47E-01	6.59E-02	2.95E-02	1.04E-01	4.67E-02	2.09E-02	2.75E-02	1.23E-02	5.49E-03
Mercury	1.15E-01	5.15E-02	2.30E-02	1.77E-01	7.92E-02	3.54E-02	5.35E-02	2.39E-02	1.07E-02	2.45E-03	1.90E-03	1.47E-03	1.02E-02	6.53E-03	4.17E-03	6.51E-03	4.16E-03	2.66E-03	2.31E-02	1.63E-02	1.15E-02	2.50E-04	1.60E-04	1.02E-04

Shaded cells indicate HQ ≥ 1

Table E-13
Summary of Hazard Quotients for Terrestrial Food Web Exposures - Baseline (Step 3A) - Mean - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																								
Cadmium	3.46E-02	1.10E-02	3.46E-03	4.98E-01	1.58E-01	4.98E-02	8.30E-02	2.63E-02	8.30E-03	3.31E-02	1.05E-02	3.31E-03	1.22E-01	5.43E-02	2.43E-02	1.67E-01	7.46E-02	3.33E-02	4.29E-02	1.92E-02	8.58E-03	1.62E-02	7.24E-03	3.24E-03
Chromium	2.31E-02	1.03E-02	4.62E-03	2.37E-01	1.06E-01	4.74E-02	3.12E-02	1.40E-02	6.25E-03	2.81E-02	1.25E-02	5.61E-03	9.02E-02	4.03E-02	1.80E-02	1.07E-01	4.76E-02	2.13E-02	7.55E-02	3.38E-02	1.51E-02	2.16E-02	9.68E-03	4.33E-03
Mercury	9.58E-02	4.29E-02	1.92E-02	1.29E-01	5.75E-02	2.57E-02	4.21E-02	1.88E-02	8.42E-03	1.90E-03	1.47E-03	1.14E-03	8.02E-03	5.13E-03	3.28E-03	4.69E-03	3.00E-03	1.91E-03	1.92E-02	1.36E-02	9.60E-03	1.83E-04	1.17E-04	7.47E-05

Shaded cells indicate HQ ≥ 1

Table E-14
Screening Statistics - Site 4 Surface Soil - In Debris Areas - Mammal/Bird Eco-SSLs
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Range of Non-Detect Values	Frequency of Detection	Maximum Concentration Detected	Mammal Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient	Bird Eco-SSL	Frequency of Exceedance	Maximum Hazard Quotient
Inorganics (MG/KG)									
Arsenic	-- - --	14 / 14	346	46.0	1 / 14	7.52	43.0	1 / 14	8.05
Cadmium	0.020 - 1.20	6 / 14	3.30	0.36	2 / 14	9.17	0.77	1 / 14	4.29
Chromium	-- - --	15 / 15	63.0	34.0	3 / 15	1.85	26.0	3 / 15	2.42
Copper	2.90 - 4.50	11 / 14	150	49.0	4 / 14	3.06	28.0	4 / 14	5.36
Lead	11.6 - 12.9	12 / 14	129	56.0	2 / 14	2.30	11.0	11 / 14	11.7
Nickel	2.20 - 4.10	11 / 14	46.7	130	0 / 14	0.36	210	0 / 14	0.22
Selenium	0.60 - 2.80	8 / 14	1.00	0.63	2 / 14	1.59	1.20	0 / 14	0.83
Silver	0.99 - 5.20	4 / 14	20.6	14.0	1 / 14	1.47	4.20	1 / 14	4.90
Zinc	28.6 - 32.5	12 / 14	324	79.0	4 / 14	4.10	46.0	8 / 14	7.04
Pesticides (UG/KG)									
4,4'-DDD	3.80 - 27.0	5 / 11	25.0	21.0	1 / 11	1.19	93.0	0 / 11	0.27
4,4'-DDE	3.80 - 27.0	7 / 11	83.0	21.0	2 / 11	3.95	93.0	0 / 11	0.89
4,4'-DDT	3.80 - 4.00	9 / 11	220	21.0	2 / 11	10.5	93.0	1 / 11	2.37
Dieldrin	3.70 - 27.0	1 / 11	1.40	4.90	0 / 11	0.29	22.0	0 / 11	0.06
Semivolatile Organic Compounds (UG/KG)									
PAH (HMW)	1,710 - 1,710	13 / 14	57,200	1,100	9 / 14	52.0	--	-- - --	--
PAH (LMW)	1,710 - 1,710	13 / 14	32,900	100,000	0 / 14	0.33	--	-- - --	--
Pentachlorophenol[1]	100 - 14,000	0 / 11	--	2,800	-- / --	5.00	2,100	-- / --	6.67

Shaded cells indicate HQ ≥ 1
1 - HQs based on reporting limits

Table E-15
Summary of Hazard Quotients for Terrestrial Food Web Exposures - Screening (Step 2) - Maximum - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																								
Arsenic	5.01E+00	2.24E+00	1.00E+00	2.90E+01	1.30E+01	5.80E+00	2.70E+00	1.21E+00	5.39E-01	5.34E-01	4.22E-01	3.34E-01	1.00E+00	5.78E-01	3.33E-01	7.62E-01	4.40E-01	2.54E-01	1.85E+00	8.29E-01	3.71E-01	3.24E-02	1.87E-02	1.08E-02
Cadmium	2.34E-01	7.40E-02	2.34E-02	4.06E+00	1.28E+00	4.06E-01	8.76E-01	2.77E-01	8.76E-02	2.57E-01	8.13E-02	2.57E-02	9.60E-01	4.29E-01	1.92E-01	1.38E+00	6.16E-01	2.75E-01	1.76E-01	7.86E-02	3.52E-02	1.07E-01	4.80E-02	2.15E-02
Chromium	2.94E-01	1.32E-01	5.89E-02	1.12E+00	5.01E-01	2.24E-01	2.17E-01	9.70E-02	4.34E-02	1.31E-01	5.86E-02	2.62E-02	4.88E-01	2.18E-01	9.76E-02	4.56E-01	2.04E-01	9.13E-02	6.12E-01	2.74E-01	1.22E-01	7.56E-02	3.38E-02	1.51E-02
Copper	3.33E-01	2.58E-01	2.00E-01	1.46E+00	1.13E+00	8.75E-01	2.96E-01	2.29E-01	1.77E-01	8.85E-02	7.79E-02	6.86E-02	9.74E-01	5.64E-01	3.26E-01	1.00E+00	5.79E-01	3.35E-01	1.03E+00	5.94E-01	3.43E-01	1.84E-01	1.06E-01	6.15E-02
Lead	1.59E-01	1.15E-01	8.39E-02	8.11E-01	5.90E-01	4.28E-01	1.15E-01	8.34E-02	6.06E-02	1.46E-01	1.06E-01	7.71E-02	4.00E-01	1.79E-01	8.01E-02	3.65E-01	1.63E-01	7.30E-02	1.26E+00	8.90E-01	6.29E-01	1.29E-01	5.76E-02	2.57E-02
Mercury	1.14E+00	5.11E-01	2.28E-01	1.08E+00	4.85E-01	2.17E-01	4.23E-01	1.89E-01	8.45E-02	6.23E-02	4.83E-02	3.74E-02	6.61E-02	4.23E-02	2.70E-02	2.83E-02	1.81E-02	1.16E-02	1.64E-01	1.16E-01	8.22E-02	1.43E-02	9.12E-03	5.83E-03
Selenium	2.99E-01	2.33E-01	1.81E-01	2.00E+00	1.56E+00	1.21E+00	4.72E-01	3.67E-01	2.86E-01	1.71E-01	1.33E-01	1.04E-01	4.54E-01	2.46E-01	1.33E-01	5.74E-01	3.11E-01	1.68E-01	3.66E-01	2.59E-01	1.83E-01	6.21E-02	3.37E-02	1.82E-02
Silver	1.05E-02	4.69E-03	2.10E-03	3.46E-02	1.55E-02	6.92E-03	4.00E-03	1.79E-03	8.00E-04	2.02E-02	9.02E-03	4.03E-03	4.19E-02	1.87E-02	8.38E-03	2.41E-02	1.08E-02	4.82E-03	8.61E-02	3.85E-02	1.72E-02	5.35E-02	2.39E-02	1.07E-02
Zinc	1.73E-01	7.73E-02	3.46E-02	3.98E-01	1.78E-01	7.97E-02	1.11E-01	4.98E-02	2.23E-02	8.68E-02	3.88E-02	1.74E-02	2.87E-01	1.28E-01	5.74E-02	2.50E-01	1.12E-01	5.00E-02	3.91E-01	1.75E-01	7.82E-02	8.39E-02	3.75E-02	1.68E-02
Polychlorinated Biphenyls																								
Aroclor-1016	8.08E-02	3.61E-02	1.62E-02	6.34E-01	2.83E-01	1.27E-01	1.46E-01	6.52E-02	2.92E-02	1.17E-02	7.41E-03	4.69E-03	1.01E-01	4.54E-02	2.03E-02	1.32E-01	5.89E-02	2.64E-02	5.36E-02	2.40E-02	1.07E-02	3.59E-02	1.60E-02	7.18E-03
Aroclor-1221	3.46E-01	1.55E-01	6.91E-02	1.69E+00	7.58E-01	3.39E-01	4.24E-01	1.90E-01	8.48E-02	3.42E-01	1.53E-01	6.84E-02	2.98E-01	1.33E-01	5.96E-02	3.54E-01	1.58E-01	7.08E-02	2.36E-01	1.06E-01	4.72E-02	1.05E-01	4.68E-02	2.09E-02
Aroclor-1232	1.18E-01	5.30E-02	2.37E-02	6.36E-01	2.85E-01	1.27E-01	1.56E-01	6.98E-02	3.12E-02	1.26E-01	5.65E-02	2.53E-02	1.09E-01	4.88E-02	2.18E-02	1.32E-01	5.89E-02	2.64E-02	8.08E-02	3.62E-02	1.62E-02	3.85E-02	1.72E-02	7.70E-03
Aroclor-1242	3.17E-01	1.42E-01	6.34E-02	3.67E+00	1.64E+00	7.33E-01	8.09E-01	3.62E-01	1.62E-01	6.41E-01	2.87E-01	1.28E-01	5.64E-01	2.52E-01	1.13E-01	7.76E-01	3.47E-01	1.55E-01	1.98E-01	8.84E-02	3.95E-02	1.98E-01	8.86E-02	3.96E-02
Aroclor-1248	5.45E-02	2.44E-02	1.09E-02	6.33E-01	2.83E-01	1.27E-01	1.40E-01	6.25E-02	2.80E-02	1.11E-01	4.97E-02	2.22E-02	9.60E-02	4.30E-02	1.92E-02	1.32E-01	5.90E-02	2.64E-02	3.40E-02	1.52E-02	6.81E-03	3.40E-02	1.52E-02	6.81E-03
Aroclor-1254	4.48E-02	2.01E-02	8.97E-03	6.31E-01	2.82E-01	1.26E-01	1.36E-01	6.09E-02	2.72E-02	1.09E-01	4.86E-02	2.18E-02	9.41E-02	4.21E-02	1.88E-02	1.32E-01	5.89E-02	2.64E-02	2.75E-02	1.23E-02	5.51E-03	3.34E-02	1.49E-02	6.68E-03
Aroclor-1260	4.98E-01	2.23E-01	9.96E-02	1.40E+01	6.24E+00	2.79E+00	2.92E+00	1.31E+00	5.84E-01	2.27E+00	1.02E+00	4.54E-01	2.02E+00	9.05E-01	4.05E-01	2.99E+00	1.34E+00	5.98E-01	2.24E-01	1.00E-01	4.49E-02	7.07E-01	3.16E-01	1.41E-01
PCB (total)	4.62E-01	2.07E-01	9.24E-02	1.69E+00	7.57E-01	3.39E-01	3.72E-01	1.67E-01	7.45E-02	3.92E-01	1.75E-01	7.84E-02	2.91E-01	1.30E-01	5.82E-02	2.88E-01	1.29E-01	5.76E-02	3.73E-01	1.67E-01	7.46E-02	1.12E-01	5.03E-02	2.25E-02
Pesticides																								
4,4'-DDD	7.63E-03	3.41E-03	1.53E-03	1.97E-01	8.81E-02	3.94E-02	4.21E-02	1.88E-02	8.42E-03	3.23E-02	1.44E-02	6.46E-03	2.55E-02	8.07E-03	2.55E-03	3.77E-02	1.19E-02	3.77E-03	2.45E-03	7.76E-04	2.45E-04	5.54E-02	2.48E-02	1.11E-02
4,4'-DDE	2.88E-02	1.29E-02	5.77E-03	1.07E+00	4.77E-01	2.13E-01	2.24E-01	1.00E-01	4.49E-02	1.72E-01	7.68E-02	3.43E-02	1.37E-01	4.32E-02	1.37E-02	2.05E-01	6.48E-02	2.05E-02	6.41E-03	2.03E-03	6.41E-04	2.96E-01	1.32E-01	5.92E-02
4,4'-DDT	5.31E-02	2.37E-02	1.06E-02	1.81E+00	8.10E-01	3.62E-01	3.79E-01	1.70E-01	7.59E-02	2.93E-01	1.31E-01	5.86E-02	2.32E-01	7.34E-02	2.32E-02	3.46E-01	1.10E-01	3.46E-02	1.42E-02	4.50E-03	1.42E-03	5.04E-01	2.25E-01	1.01E-01
Aldrin	3.95E-03	1.77E-03	7.90E-04	6.68E-02	2.99E-02	1.34E-02	1.43E-02	6.39E-03	2.86E-03	1.14E-02	5.08E-03	2.27E-03	8.50E-02	3.80E-02	1.70E-02	1.21E-01	5.42E-02	2.42E-02	1.72E-02	7.71E-03	3.45E-03	3.00E-02	1.34E-02	5.99E-03
alpha-BHC	1.56E-03	1.10E-03	7.78E-04	1.30E-03	9.18E-04	6.49E-04	6.52E-04	4.61E-04	3.26E-04	5.65E-04	4.00E-04	2.83E-04	4.03E-03	2.01E-03	1.00E-03	2.04E-03	1.02E-03	5.07E-04	8.47E-03	4.23E-03	2.11E-03	1.42E-03	7.09E-04	3.54E-04
alpha-Chlordane	1.23E-05	8.72E-06	6.17E-06	1.10E-04	7.80E-05	5.51E-05	3.18E-05	2.25E-05	1.59E-05	1.97E-05	1.39E-05	9.83E-06	1.07E-04	4.77E-05	2.13E-05	1.50E-04	6.71E-05	3.00E-05	4.36E-05	1.95E-05	8.72E-06	3.75E-05	1.68E-05	7.50E-06
beta-BHC	1.54E-03	1.09E-03	7.71E-04	1.30E-03	9.17E-04	6.48E-04	6.48E-04	4.58E-04	3.24E-04	5.62E-04	3.97E-04	2.81E-04	4.00E-03	2.00E-03	9.96E-04	2.04E-03	1.02E-03	5.07E-04	8.40E-03	4.19E-03	2.09E-03	1.41E-03	7.05E-04	3.52E-04
delta-BHC	1.19E-03	8.41E-04	5.95E-04	1.27E-03	9.00E-04	6.37E-04	5.53E-04	3.91E-04	2.77E-04	4.77E-04	3.38E-04	2.39E-04	3.39E-03	1.69E-03	8.44E-04	2.04E-03	1.02E-03	5.07E-04	6.47E-03	3.23E-03	1.61E-03	1.20E-03	6.00E-04	2.99E-04
Endosulfan I	1.24E-03	5.53E-04	2.47E-04	1.05E-03	4.68E-04	2.09E-04	7.15E-04	3.20E-04	1.43E-04	4.39E-04	1.96E-04	8.78E-05	1.57E-05	7.01E-06	3.13E-06	8.68E-06	3.88E-06	1.74E-06	3.11E-05	1.39E-05	6.21E-06	5.53E-06	2.47E-06	1.11E-06
Endosulfan II	3.88E-03	1.73E-03	7.76E-04	5.67E-03	2.53E-03	1.13E-03	2.42E-03	1.08E-03	4.84E-04	1.78E-03	7.96E-04	3.56E-04	6.48E-05	2.90E-05	1.30E-05	4.85E-05	2.17E-05	9.70E-06	1.03E-04	4.62E-05	2.07E-05	2.31E-05	1.03E-05	4.62E-06
Endrin	9.85E-03	4.40E-03	1.97E-03	6.75E-02	3.02E-02	1.35E-02	1.61E-02	7.22E-03	3.23E-03	1.28E-02	5.73E-03	2.56E-03	2.96E-01	1.32E-01	5.92E-02	3.78E-01	1.69E-01	7.56E-02	1.04E-02	4.67E-03	2.09E-03	1.04E-01	4.65E-02	2.08E-02
gamma-BHC (Lindane)	2.92E-04	1.31E-04	5.84E-05	3.76E-03	1.68E-03	7.53E-04	8.44E-04	3.78E-04	1.69E-04	6.48E-04	2.90E-04	1.30E-04	3.50E-03	1.57E-03	7.00E-04	4.91E-03	2.20E-03	9.82E-04	8.67E-04	3.88E-04	1.73E-04	1.21E-03	5.42E-04	2.42E-04
gamma-Chlordane	9.49E-05	6.71E-05	4.74E-05	1.60E-03	1.13E-03	7.99E-04	3.47E-04	2.45E-04	1.73E-04	2.71E-04	1.92E-04	1.36E-04	1.53E-03	6.83E-04	3.05E-04	2.18E-03	9.77E-04	4.37E-04	5.28E-04	2.36E-04	1.06E-04	5.36E-04	2.40E-04	1.07E-04
Heptachlor	1.96E-03	8.76E-04	3.92E-04	2.60E-02	1.16E-02	5.20E-03	5.74E-03	2.57E-03	1.15E-03	4.52E-03	2.02E-03	9.04E-04	8.55E-03	3.82E-03	1.71E-03	1.19E-02	5.34E-03	2.39E-03	2.22E-03	9.94E-04	4.45E-04	3.02E-03	1.35E-03	6.04E-04
Heptachlor epoxide	5.67E-03	2.54E-03	1.13E-03	8.33E-02	3.73E-02	1.67E-02	1.84E-02	8.23E-03	3.68E-03	1.42E-02	6.36E-03	2.84E-03	2.77E-02	1.24E-02	5.54E-03	3.93E-02	1.76E-02	7.85E-03	5.99E-03	2.68E-03	1.20E-03	9.63E-03	4.31E-03	1.93E-03
Methoxychlor	2.05E-03	1.45E-03	1.02E-03	4.91E-03	3.47E-03	2.45E-03	1.49E-03	1.05E-03	7.43E-04	1.26E-03	8.89E-04	6.29E-04	3.48E-05	1.56E-05	6.96E-06	3.21E-05	1.44E-05	6.42E-06	4.34E-05	1.94E-05	8.68E-06	1.25E-05	5.61E-06	2.51E-06
Toxaphene	6.99E-03	3.12E-03	1.40E-03	2.41E-02	1.08E-02	4.82E-03	6.20E-03	2.77E-03	1.24E-03	5.50E-03	2.46E-03	1.10E-03	1.08E-01	4.84E-02	2.16E-02	1.13E-01	5.05E-02	2.26E-02	1.08E-01	4.83E-02	2.16E-02	3.92E-02	1.75E-02	7.84E-03
Volatile/Semivolatile Organics																								
1,1,2,2-Tetrachloroethane	3.18E-05	1.42E-05	6.36E-06	3.70E-05	1.65E-05	7.40E-06	2.72E-05	1.22E-05	5.44E-06	1.25E-05	5.58E-06	2.50E-06	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4,5-Tetrachlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,4-Trichlorobenzene	1.50E-02	1.06E-02	7.50E-03	9.69E-03	6.85E-03	4.84E-03	5.47E-03	3.87E-03	2.73E-03	5.04E-03	3.56E-03	2.52E-03	8.17E-03	3.65E-03	1.63E-03	3.20E-03	1.43E-03	6.40E-04	1.91E-02	8.56E-03	3.83E-03	2.91E-03	1.30E-03	5.81E-04
1,2-Dichlorobenzene	1.58E-02	7.07E-03	3.16E-03	9.72E-03	4.35E-03	1.94E-03	5.80E-03	2.60E-03	1.16E-03	5.19E-03	2.32E-03	1.04E-03	1.39E-02	6.22E-03	2.78E-03	5.51E-03	2.46E-03	1.10E-03	3.24E-02	1.45E-02	6.48E-03	4.88E-03	2.18E-03	9.76E-04
1,3-Dichlorobenzene	1.48E-02	6.63E-03	2.97E-03	9.65E-03	4.32E-03	1.93E-03	5.54E-03	2.48E-03	1.11E-03	4.96E-03	2.22E-03	9.92E-04	1.33E-02	5.93E-03	2.65E-03	5.51E-03	2.46E-03	1.10E-03	3.04E-02	1.36E-02	6.08E-03	4.66E-03	2.09E-03	9.32E-04
1,4-Dichlorobenzene	4.56E-02	2.63E-02	1.52E-02	2.78E-02	1.60E-02	9.27E-03	1.67E-02	9.64E-03	5.56E-03	1.49E-02	8.63E-03	4.98E-03	1.40E-02	6.26E-03	2.80E-03	5.51E-03	2.46E-03	1.10E-03	3.27E-02	1.46E-02	6.54E-03	4.91E-03	2.20E-03	9.83E-04
4-Bromophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4-Chlorophenyl-phenylether	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	8.26E-02	3.70E-02	1.66E-02	7.17E-01	3.21E-01	1.44E-01	1.20E-01	5.37E-02	2.40E-02	2.51E-02	1.12E-02	5.02E-03	2.55E-02	1.14E-02	5.11E-03	3.03E-02	1.35E-02	6.06E-03	1.88E-02	8.41E-03	3.76E-03	3.40E-06	1.52E-06	6.80E-07
Benzo(a)pyrene	1.72E-01	7.72E-02	3.45E-02	6.70E-01	3.00E-01	1.34E-01	1.43E-01	6.40E-02	2.86E-02	2.44E-02	1.09E-02	4.89E-03	2.94E-02	1.31E-02	5.87E-03	2.94E-02	1.31E-02	5.88E-03	3.24E-02	1.45E-02	6.48E-03	2.40E-06	1.07E-06	4.80E-07
Benzo(b)fluoranthene	5.56E-01	2.49E-01	1.11E-01	5.10E-01	2.28E-01	1.02E-01	2.09E-01	9.36E-02	4.19E-02	3.49E-02	1.56E-02	6.98E-03	4.29E-02	1.92E-02	8.58E-03	1.90E-02	8.50E-03	3.80E-03	9.65E-02	4.31E-02	1.93E-02	5.80E-06	2.59E-06	1.16E-06

Table E-15
Summary of Hazard Quotients for Terrestrial Food Web Exposures - Screening (Step 2) - Maximum - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Benzo(g,h,i)perylene	2.84E-01	1.27E-01	5.70E-02	2.17E-01	9.70E-02	4.34E-02	9.83E-02	4.40E-02	1.97E-02	1.72E-02	7.70E-03	3.45E-03	2.04E-02	9.11E-03	4.08E-03	7.29E-03	3.26E-03	1.46E-03	4.94E-02	2.21E-02	9.88E-03	1.60E-06	7.16E-07	3.20E-07
Benzo(k)fluoranthene	1.29E-01	5.75E-02	2.58E-02	4.81E-01	2.15E-01	9.64E-02	9.41E-02	4.21E-02	1.89E-02	2.07E-02	9.25E-03	4.14E-03	2.03E-02	9.10E-03	4.07E-03	1.90E-02	8.49E-03	3.80E-03	2.55E-02	1.14E-02	5.10E-03	1.50E-06	6.71E-07	3.00E-07
Chrysene	8.58E-02	3.84E-02	1.72E-02	9.78E-01	4.38E-01	1.96E-01	1.75E-01	7.83E-02	3.51E-02	2.75E-02	1.23E-02	5.52E-03	3.54E-02	1.58E-02	7.07E-03	4.54E-02	2.03E-02	9.08E-03	1.84E-02	8.25E-03	3.69E-03	8.00E-07	3.58E-07	1.60E-07
Dibenz(a,h)anthracene	5.97E-02	2.67E-02	1.20E-02	1.76E-01	7.86E-02	3.52E-02	4.36E-02	1.95E-02	8.74E-03	6.17E-03	2.76E-03	1.24E-03	8.66E-03	3.87E-03	1.73E-03	8.15E-03	3.65E-03	1.63E-03	1.05E-02	4.72E-03	2.11E-03	2.00E-06	8.95E-07	4.00E-07
Hexachlorobenzene	8.33E-02	5.89E-02	4.16E-02	5.97E-01	4.22E-01	2.99E-01	1.34E-01	9.49E-02	6.71E-02	1.14E-01	8.06E-02	5.70E-02	5.13E+00	2.29E+00	1.03E+00	6.49E+00	2.90E+00	1.30E+00	2.75E+00	1.23E+00	5.50E-01	1.83E+00	8.21E-01	3.67E-01
Hexachlorobutadiene	1.98E-01	6.26E-02	1.98E-02	3.86E-01	1.22E-01	3.86E-02	1.22E-01	3.87E-02	1.22E-02	1.08E-01	3.40E-02	1.08E-02	1.57E-01	7.02E-02	3.14E-02	1.31E-01	5.86E-02	2.62E-02	2.24E-01	1.00E-01	4.48E-02	5.63E-02	2.52E-02	1.13E-02
Hexachlorocyclopentadiene	3.23E-03	1.45E-03	6.47E-04	1.01E-02	4.54E-03	2.03E-03	2.71E-03	1.21E-03	5.43E-04	2.38E-03	1.06E-03	4.76E-04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hexachloroethane	8.06E-03	3.60E-03	1.61E-03	7.96E-03	3.56E-03	1.59E-03	3.50E-03	1.56E-03	6.99E-04	3.13E-03	1.40E-03	6.27E-04	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Indeno(1,2,3-cd)pyrene	1.00E-01	4.49E-02	2.01E-02	3.72E-01	1.66E-01	7.45E-02	8.32E-02	3.73E-02	1.67E-02	1.29E-02	5.78E-03	2.59E-03	1.68E-02	7.50E-03	3.36E-03	1.68E-02	7.53E-03	3.37E-03	1.84E-02	8.21E-03	3.67E-03	2.40E-06	1.07E-06	4.80E-07
Pentachlorophenol	4.99E+00	2.23E+00	9.98E-01	3.20E+00	1.43E+00	6.40E-01	1.92E+00	8.59E-01	3.84E-01	1.64E+00	7.34E-01	3.28E-01	5.31E+00	1.68E+00	5.31E-01	2.34E+00	7.41E-01	2.34E-01	1.19E+01	3.75E+00	1.19E+00	1.83E+00	5.80E-01	1.83E-01
Pyrene	4.29E+00	1.92E+00	8.60E-01	1.43E+00	6.40E-01	2.86E-01	1.33E+00	5.93E-01	2.65E-01	1.72E-01	7.72E-02	3.45E-02	2.62E-01	1.17E-01	5.25E-02	5.21E-02	2.33E-02	1.04E-02	7.19E-01	3.21E-01	1.44E-01	2.90E-06	1.30E-06	5.80E-07
Dioxin-Like PCB Congeners																								
2,3,7,8 TCDD (TEQ)	1.14E-01	3.60E-02	1.14E-02	6.44E+00	2.04E+00	6.44E-01	1.35E+00	4.26E-01	1.35E-01	7.20E-02	2.28E-02	7.20E-03	3.86E-01	1.22E-01	3.86E-02	5.87E-01	1.86E-01	5.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Shaded cells indicate HQ ≥ 1

Table E-16
Summary of Hazard Quotients for Terrestrial Food Web Exposures - Baseline (Step 3A) - 95% UCL - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																								
Arsenic	1.07E+00	4.78E-01	2.14E-01	8.39E+00	3.75E+00	1.68E+00	7.18E-01	3.21E-01	1.44E-01	1.39E-01	1.10E-01	8.71E-02	3.09E-01	1.79E-01	1.03E-01	2.72E-01	1.57E-01	9.05E-02	5.46E-01	2.44E-01	1.09E-01	9.21E-03	5.32E-03	3.07E-03
Cadmium	6.79E-02	2.15E-02	6.79E-03	2.49E+00	7.89E-01	2.49E-01	3.93E-01	1.24E-01	3.93E-02	6.71E-02	2.12E-02	6.71E-03	5.70E-01	2.55E-01	1.14E-01	8.45E-01	3.78E-01	1.69E-01	5.32E-02	2.38E-02	1.06E-02	2.27E-02	1.01E-02	4.53E-03
Chromium	5.69E-02	2.55E-02	1.14E-02	5.83E-01	2.61E-01	1.17E-01	7.66E-02	3.42E-02	1.53E-02	5.87E-02	2.63E-02	1.17E-02	2.22E-01	9.91E-02	4.43E-02	2.61E-01	1.17E-01	5.23E-02	1.86E-01	8.34E-02	3.73E-02	4.20E-02	1.88E-02	8.40E-03
Copper	9.60E-02	7.43E-02	5.75E-02	7.05E-01	5.46E-01	4.23E-01	1.17E-01	9.04E-02	7.00E-02	4.29E-02	3.78E-02	3.33E-02	4.76E-01	2.75E-01	1.59E-01	5.61E-01	3.25E-01	1.88E-01	3.89E-01	2.25E-01	1.30E-01	1.19E-01	6.90E-02	3.99E-02
Lead	5.54E-02	4.02E-02	2.92E-02	3.97E-01	2.88E-01	2.10E-01	4.60E-02	3.35E-02	2.43E-02	7.37E-02	5.36E-02	3.89E-02	2.00E-01	8.96E-02	4.01E-02	1.98E-01	8.88E-02	3.97E-02	6.19E-01	4.37E-01	3.09E-01	8.09E-02	3.62E-02	1.62E-02
Mercury	3.99E-01	1.78E-01	7.97E-02	5.33E-01	2.38E-01	1.07E-01	1.56E-01	6.96E-02	3.11E-02	1.35E-02	1.04E-02	8.09E-03	3.17E-02	2.02E-02	1.29E-02	1.57E-02	1.01E-02	6.43E-03	8.34E-02	5.89E-02	4.17E-02	2.27E-03	1.45E-03	9.25E-04
Selenium	8.87E-02	6.91E-02	5.38E-02	1.22E+00	9.52E-01	7.41E-01	2.04E-01	1.59E-01	1.24E-01	9.23E-02	7.19E-02	5.60E-02	2.58E-01	1.40E-01	7.58E-02	3.52E-01	1.91E-01	1.03E-01	1.48E-01	1.04E-01	7.39E-02	3.99E-02	2.16E-02	1.17E-02
Polychlorinated Biphenyls																								
Aroclor-1221	1.31E-02	5.84E-03	2.61E-03	3.80E-02	1.70E-02	7.60E-03	9.11E-03	4.07E-03	1.82E-03	1.03E-02	4.62E-03	2.07E-03	8.15E-03	3.65E-03	1.63E-03	7.38E-03	3.30E-03	1.48E-03	1.34E-02	6.00E-03	2.68E-03	3.65E-03	1.63E-03	7.29E-04
Aroclor-1242	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Aroclor-1260	4.52E-02	2.02E-02	9.04E-03	1.25E+00	5.60E-01	2.51E-01	1.94E-01	8.69E-02	3.89E-02	2.17E-01	9.71E-02	4.34E-02	1.81E-01	8.08E-02	3.61E-02	2.61E-01	1.17E-01	5.23E-02	3.72E-02	1.66E-02	7.43E-03	8.00E-02	3.58E-02	1.60E-02
PCB (total)	9.66E-02	4.32E-02	1.93E-02	8.65E-01	3.87E-01	1.73E-01	1.37E-01	6.15E-02	2.75E-02	1.76E-01	7.86E-02	3.52E-02	1.35E-01	6.03E-02	2.70E-02	1.65E-01	7.40E-02	3.31E-02	1.08E-01	4.84E-02	2.17E-02	6.24E-02	2.79E-02	1.25E-02
Pesticides																								
4,4'-DDE	1.24E-02	5.53E-03	2.47E-03	6.06E-01	2.71E-01	1.21E-01	9.41E-02	4.21E-02	1.88E-02	1.02E-01	4.54E-02	2.03E-02	7.66E-02	2.42E-02	7.66E-03	1.15E-01	3.63E-02	1.15E-02	4.08E-03	1.29E-03	4.08E-04	2.09E-01	9.33E-02	4.17E-02
4,4'-DDT	1.75E-02	7.84E-03	3.51E-03	7.81E-01	3.49E-01	1.56E-01	1.21E-01	5.42E-02	2.43E-02	1.32E-01	5.89E-02	2.64E-02	9.89E-02	3.13E-02	9.89E-03	1.48E-01	4.67E-02	1.48E-02	6.99E-03	2.21E-03	6.99E-04	2.70E-01	1.21E-01	5.40E-02
Volatile/Semivolatile Organics																								
Hexachlorobenzene	4.89E-03	3.46E-03	2.44E-03	4.62E-02	3.27E-02	2.31E-02	7.70E-03	5.45E-03	3.85E-03	9.20E-03	6.51E-03	4.60E-03	3.92E-01	1.75E-01	7.84E-02	4.96E-01	2.22E-01	9.93E-02	2.38E-01	1.06E-01	4.76E-02	1.76E-01	7.88E-02	3.53E-02
Pentachlorophenol	6.00E-02	2.68E-02	1.20E-02	2.26E-01	1.01E-01	4.53E-02	4.89E-02	2.19E-02	9.78E-03	5.55E-02	2.48E-02	1.11E-02	1.74E-01	5.51E-02	1.74E-02	1.79E-01	5.64E-02	1.79E-02	2.03E-01	6.42E-02	2.03E-02	7.58E-02	2.40E-02	7.58E-03
Pyrene	2.96E-01	1.32E-01	5.92E-02	3.61E-01	1.61E-01	7.23E-02	1.15E-01	5.15E-02	2.31E-02	2.28E-02	1.02E-02	4.56E-03	3.07E-02	1.37E-02	6.13E-03	1.51E-02	6.75E-03	3.02E-03	7.42E-02	3.32E-02	1.48E-02	1.38E-06	6.19E-07	2.77E-07
Dioxin-Like PCB Congeners																								
2,3,7,8 TCDD (TEQ)	5.39E-02	1.70E-02	5.39E-03	4.02E+00	1.27E+00	4.02E-01	6.23E-01	1.97E-01	6.23E-02	4.69E-02	1.48E-02	4.69E-03	2.38E-01	7.52E-02	2.38E-02	3.62E-01	1.14E-01	3.62E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Shaded cells indicate HQ ≥ 1

Table E-17
Summary of Hazard Quotients for Terrestrial Food Web Exposures - Baseline (Step 3A) - Mean - In Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Meadow Vole			Short-tailed Shrew			White-footed Mouse			Red Fox			American Robin (Omnivore)			American Robin (Invertivore)			Mourning Dove			Red-tailed Hawk		
	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL	NOAEL	MATC	LOAEL
Metals																								
Arsenic	3.30E-01	1.48E-01	6.60E-02	3.49E+00	1.56E+00	6.98E-01	4.44E-01	1.99E-01	8.88E-02	3.49E-02	2.76E-02	2.19E-02	1.47E-01	8.49E-02	4.90E-02	1.72E-01	9.94E-02	5.74E-02	1.39E-01	6.24E-02	2.79E-02	1.95E-03	1.12E-03	6.49E-04
Cadmium	5.86E-02	1.85E-02	5.86E-03	2.49E+00	7.87E-01	2.49E-01	3.91E-01	1.24E-01	3.91E-02	5.22E-02	1.65E-02	5.22E-03	5.65E-01	2.53E-01	1.13E-01	8.44E-01	3.78E-01	1.69E-01	3.85E-02	1.72E-02	7.71E-03	1.37E-02	6.13E-03	2.74E-03
Chromium	3.24E-02	1.45E-02	6.48E-03	4.90E-01	2.19E-01	9.80E-02	6.87E-02	3.07E-02	1.37E-02	3.68E-02	1.64E-02	7.36E-03	1.87E-01	8.37E-02	3.74E-02	2.45E-01	1.10E-01	4.90E-02	9.79E-02	4.38E-02	1.96E-02	2.62E-02	1.17E-02	5.24E-03
Copper	7.71E-02	5.97E-02	4.62E-02	6.60E-01	5.11E-01	3.96E-01	1.11E-01	8.59E-02	6.65E-02	3.83E-02	3.37E-02	2.97E-02	4.43E-01	2.56E-01	1.48E-01	5.49E-01	3.18E-01	1.84E-01	2.97E-01	1.72E-01	9.94E-02	1.10E-01	6.34E-02	3.67E-02
Lead	2.98E-02	2.17E-02	1.57E-02	2.71E-01	1.97E-01	1.43E-01	3.74E-02	2.72E-02	1.98E-02	4.38E-02	3.18E-02	2.31E-02	1.44E-01	6.46E-02	2.89E-02	1.68E-01	7.53E-02	3.37E-02	2.97E-01	2.10E-01	1.48E-01	5.12E-02	2.29E-02	1.02E-02
Mercury	2.25E-01	1.01E-01	4.50E-02	3.99E-01	1.79E-01	7.98E-02	1.08E-01	4.84E-02	2.16E-02	6.10E-03	4.72E-03	3.66E-03	2.11E-02	1.35E-02	8.60E-03	1.42E-02	9.07E-03	5.80E-03	4.57E-02	3.23E-02	2.29E-02	8.10E-04	5.18E-04	3.31E-04
Selenium	7.90E-02	6.15E-02	4.79E-02	1.22E+00	9.48E-01	7.38E-01	2.01E-01	1.57E-01	1.22E-01	8.80E-02	6.85E-02	5.34E-02	2.55E-01	1.38E-01	7.47E-02	3.52E-01	1.91E-01	1.03E-01	1.28E-01	9.04E-02	6.40E-02	3.79E-02	2.06E-02	1.11E-02
Polychlorinated Biphenyls																								
Aroclor-1221	1.30E-02	5.82E-03	2.60E-03	3.79E-02	1.70E-02	7.59E-03	9.05E-03	4.05E-03	1.81E-03	1.03E-02	4.61E-03	2.06E-03	8.15E-03	3.64E-03	1.63E-03	7.37E-03	3.30E-03	1.47E-03	1.34E-02	6.00E-03	2.68E-03	3.64E-03	1.63E-03	7.29E-04
Aroclor-1242	1.15E-02	5.14E-03	2.30E-03	8.34E-02	3.73E-02	1.67E-02	1.50E-02	6.73E-03	3.01E-03	1.73E-02	7.73E-03	3.46E-03	1.38E-02	6.19E-03	2.77E-03	1.67E-02	7.48E-03	3.35E-03	1.16E-02	5.20E-03	2.33E-03	6.21E-03	2.78E-03	1.24E-03
Aroclor-1260	1.68E-02	7.52E-03	3.36E-03	3.74E-01	1.67E-01	7.48E-02	5.83E-02	2.61E-02	1.17E-02	6.62E-02	2.96E-02	1.32E-02	5.43E-02	2.43E-02	1.09E-02	7.71E-02	3.45E-02	1.54E-02	1.51E-02	6.77E-03	3.03E-03	2.42E-02	1.08E-02	4.84E-03
PCB (total)	2.85E-02	1.27E-02	5.69E-03	7.58E-01	3.39E-01	1.52E-01	1.18E-01	5.28E-02	2.36E-02	1.31E-01	5.88E-02	2.63E-02	1.10E-01	4.92E-02	2.20E-02	1.59E-01	7.10E-02	3.18E-02	2.33E-02	1.04E-02	4.66E-03	4.85E-02	2.17E-02	9.71E-03
Pesticides																								
4,4'-DDE	3.29E-03	1.47E-03	6.58E-04	1.50E-01	6.70E-02	2.99E-02	2.34E-02	1.05E-02	4.68E-03	2.52E-02	1.13E-02	5.03E-03	1.90E-02	6.01E-03	1.90E-03	2.84E-02	8.99E-03	2.84E-03	1.14E-03	3.62E-04	1.14E-04	5.17E-02	2.31E-02	1.03E-02
4,4'-DDT	5.03E-03	2.25E-03	1.01E-03	2.10E-01	9.40E-02	4.21E-02	3.28E-02	1.47E-02	6.57E-03	3.55E-02	1.59E-02	7.11E-03	2.67E-02	8.45E-03	2.67E-03	3.98E-02	1.26E-02	3.98E-03	2.05E-03	6.50E-04	2.05E-04	7.28E-02	3.26E-02	1.46E-02
Volatile/Semivolatile Organics																								
Hexachlorobenzene	4.89E-03	3.46E-03	2.44E-03	4.62E-02	3.27E-02	2.31E-02	7.70E-03	5.45E-03	3.85E-03	9.20E-03	6.51E-03	4.60E-03	3.92E-01	1.75E-01	7.84E-02	4.96E-01	2.22E-01	9.93E-02	2.38E-01	1.06E-01	4.76E-02	1.76E-01	7.88E-02	3.53E-02
Pentachlorophenol	6.00E-02	2.68E-02	1.20E-02	2.26E-01	1.01E-01	4.53E-02	4.89E-02	2.19E-02	9.78E-03	5.55E-02	2.48E-02	1.11E-02	1.74E-01	5.51E-02	1.74E-02	1.79E-01	5.64E-02	1.79E-02	2.03E-01	6.42E-02	2.03E-02	7.58E-02	2.40E-02	7.58E-03
Pyrene	9.27E-02	4.15E-02	1.86E-02	1.13E-01	5.07E-02	2.27E-02	3.62E-02	1.62E-02	7.24E-03	7.16E-03	3.20E-03	1.43E-03	9.62E-03	4.30E-03	1.92E-03	4.74E-03	2.12E-03	9.48E-04	2.33E-02	1.04E-02	4.66E-03	1.07E-06	4.78E-07	2.14E-07
Dioxin-Like PCB Congeners																								
2,3,7,8 TCDD (TEQ)	5.39E-02	1.70E-02	5.39E-03	4.02E+00	1.27E+00	4.02E-01	6.23E-01	1.97E-01	6.23E-02	4.69E-02	1.48E-02	4.69E-03	2.38E-01	7.52E-02	2.38E-02	3.62E-01	1.14E-01	3.62E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Shaded cells indicate HQ ≥ 1

Table E-18
Reporting Limit to ESV Comparison - Outside Debris Areas
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

Chemical	Units	Frequency of Detection	Minimum Reporting Limit	Maximum Reporting Limit	Mean Concentration	ESV	Minimum Ratio	Maximum Ratio	Mean Ratio
Surface Soil									
2,4,6-Trichlorophenol	UG/KG	0 / 7	500	590	265	580	0.86	1.02	0.46
2,4-Dichlorophenol	UG/KG	0 / 7	460	560	248	500	0.92	1.12	0.50
2-Chlorophenol	UG/KG	0 / 7	520	620	276	500	1.04	1.24	0.55
4,6-Dinitro-2-methylphenol	UG/KG	0 / 7	1,100	1,400	607	1,000	1.10	1.40	0.61
4-Chloro-3-methylphenol	UG/KG	0 / 7	520	620	276	500	1.04	1.24	0.55
4-Nitrophenol	UG/KG	0 / 7	960	1,100	509	380	2.53	2.89	1.34
Atrazine	UG/KG	0 / 7	340	410	182	11.9	28.6	34.5	15.3
Endrin ketone	UG/KG	0 / 7	3.50	4.10	1.85	1.95	1.79	2.10	0.95
Thallium	MG/KG	0 / 11	0.07	1.10	0.12	1.00	0.07	1.10	0.12
Shallow Subsurface Soil									
2,4-Dichlorophenol	UG/KG	0 / 7	400	530	243	500	0.80	1.06	0.49
2-Chlorophenol	UG/KG	0 / 7	440	580	268	500	0.88	1.16	0.54
4,6-Dinitro-2-methylphenol	UG/KG	0 / 7	980	1,300	591	1,000	0.98	1.30	0.59
4-Chloro-3-methylphenol	UG/KG	0 / 7	440	580	268	500	0.88	1.16	0.54
4-Nitrophenol	UG/KG	0 / 7	830	1,100	497	380	2.18	2.89	1.31
Atrazine	UG/KG	0 / 7	290	390	176	11.9	24.4	32.8	14.8
Endrin aldehyde	UG/KG	0 / 7	3.30	3.80	1.75	1.95	1.69	1.95	0.90
Endrin ketone	UG/KG	0 / 7	3.30	3.80	1.75	1.95	1.69	1.95	0.90

Shaded cells indicate ratio > 1

Response to Comments

USEPA Comments

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

July 17, 2015

Mr. Tom Kowalski
NAVFAC MIDLANT, Building N-26
Attention: Code OPHE3
9742 Maryland Avenue
Norfolk, VA 23511-3095

Subject: Site 4 Pre-Feasibility Study Technical Memorandum, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia, March 2015

Mr. Kowalski:

Thank you for the opportunity to review the subject document. Attached are EPA's comments on the document. If you have any questions, please contact me at 215-814-2077.

Sincerely,

Gerald F. Hoover, RPM
NPL/BRAC Federal Facilities Branch

cc: Wade Smith, VDEQ

BTAG Comments:

1. On page 2, the TM states that polychlorinated biphenyls (PCBs) may have been transported to and deposited within the drainage channel from an unknown source. A similar statement is made on page 10. It was BTAG's understanding that runoff from Site 9 (Transformer Storage Area) flowed into Upstream Pond and was the likely source of PCBs found at Site 4. Therefore, there is a potential source within the vicinity that could have impacted the site and this information needs to be added to this section and any other section within the report that states that the source of the PCBs is unknown.

TOX Comments:

Principal Comment:

1. Proposed actions on page 11 appear appropriate and supported by the evidence and analysis in the document.

Additional Comments:

2. Generally helpful if a table of the soil samples incorporated into the analyses of the risk for soils outside the fence (attachment 1) and for soils outside the fence and debris areas (attachment 2). This would improve the transparency of the document. In addition, specify if samples were considered 'inside' or 'outside' the fenced area; this was difficult to follow throughout the pre-FS.

3. Page 2 – The remedial investigation is described as '2012' and referenced as '2014.' Please clarify throughout document.

4. Page 3, Previous Investigations, last 4 bullets – The last 4 bullets in this section highlight the recommendations from the RI and do not include soil at Site 4; however, the RI concluded that the FS should address buried debris and potentially unacceptable risks associated with potentially site-related COCs in soil and groundwater. Please clarify.

5. Page 9 – First paragraph under "Non-CERCLA-Regulated Sources" – Delete 'large' in "A large component of stormwater…" The contribution of the various stormwater routes was not quantified and describing as "large" is a mischaracterization of the evidence.

6. Attachment 1, Table 5.1 – oral-to-dermal adjustment factor for vanadium is 2.6%, not 100%, according to RSL summary table.

Response to Comments
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex
Williamsburg, VA
September 8, 2015

Comments received by email on July 17, 2015 from Gerald Hoover, Environmental Protection Agency, Region 3.

BTAG Comments

EPA Comment #1: On page 2, the TM states that polychlorinated biphenyls (PCBs) may have been transported to and deposited within the drainage channel from an unknown source. A similar statement is made on page 10. It was BTAG's understanding that runoff from Site 9 (Transformer Storage Area) flowed into Upstream Pond and was the likely source of PCBs found at Site 4. Therefore, there is a potential source within the vicinity that could have impacted the site and this information needs to be added to this section and any other section within the report that states that the source of the PCBs is unknown.

Navy Response: Based on more recent information, the Site 9 boundary has been revised. Due to this revision, drainage boundary maps indicate that surface runoff from Site 9 does not discharge at Site 4. However, since PCBs were detected in Site 4 soil, Upstream Pond sediment and Upstream and Youth Ponds fish tissue, the Tech Memo has been revised to state that these media will be evaluated in the upcoming Feasibility Study.

Toxicologist Comments

EPA Comment #2: Proposed actions on page 11 appear appropriate and supported by the evidence and analysis in the document.

Navy Response: Comment noted.

EPA Comment #3: Generally helpful if a table of the soil samples incorporated into the analyses of the risk for soils outside the fence (attachment 1) and for soils outside the fence and debris areas (attachment 2). This would improve the transparency of the document. In addition, specify if samples were considered 'inside' or 'outside' the fenced area; this was difficult to follow throughout the pre-FS.

Navy Response: A table has been added to Attachment 1 and Attachment 2 to identify the soil samples incorporated into the risk analysis. In addition, Figure 4 has been revised to identify soil sample locations as either "inside" or "outside" of the fenced area.

EPA Comment #4: Page 2 – The remedial investigation is described as '2012' and referenced as '2014.' Please clarify throughout document.

Navy Response: The remedial investigation field work was completed in 2012 and the remedial investigation report documenting the field work was finalized in 2014. No changes to the document were made.

EPA Comment #5: Page 3, Previous Investigations, last 4 bullets – The last 4 bullets in this section highlight the recommendations from the RI and do not include soil at Site 4; however, the RI concluded that the FS should address buried debris and potentially unacceptable risks associated with potentially site-related COCs in soil and groundwater. Please clarify.

Navy Response: The first bullet has been revised to include soil at Site 4.

EPA Comment #6: Page 9 – First paragraph under "Non-CERCLA-Regulated Sources" – Delete 'large' in "A large component of stormwater…" The contribution of the various stormwater routes was not quantified and describing as "large" is a mischaracterization of the evidence.

Navy Response: The requested revision has been made.

EPA Comment #7: Attachment 1, Table 5.1 – oral-to-dermal adjustment factor for vanadium is 2.6%, not 100%, according to RSL summary table.

Navy Response: The requested revision has been made.

VDEQ Comments

Sawyer, Stephanie/VBO

From: Smith, Wade (DEQ) <Wade.Smith@deq.virginia.gov>
Sent: Monday, June 29, 2015 3:49 PM
To: tom.kowalski@navy.mil
Cc: Ivester, Marlene/VBO; Sawyer, Stephanie/VBO; Hoover.Gerald@epa.gov
Subject: CAX: Site 4 Pre-FS Tech Memo - DEQ Comments
Attachments: Draft CAX Site 4 Pre-FS TM(DEQ).docx; Draft CAX Site 4 Pre-FS TM(DEQ).pdf

Follow Up Flag: Follow up
Flag Status: Completed

Thank you for giving the DEQ the opportunity to comment on the March 24, 2015 Pre-FS Tech Memo for the Site 4 at CAX.

The Tech Memo was received by the DEQ on March 31, 2015.

The DEQ's comments are attached (track changes via Word).

Please let me know if you have any questions.

Thanks,
wade

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Site 4 Pre-Feasibility Study Technical Memorandum, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia

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DATE: October 19, 2015

Introduction

This Pre-Feasibility Study Technical Memorandum (Pre-FS TM) summarizes the site history and conceptual site model (CSM), provides the results of updated human health and ecological risk assessments, defines the soil polycyclic aromatic hydrocarbon (PAH) hotspot area, and presents the rationale for the site media to be evaluated in the FS for Site 4, located at Naval Weapons Station Yorktown Cheatham Annex (CAX). This Pre-FS TM is being developed to detail the steps ~~which~~ that need to be completed to move from the Remedial Investigation (RI) to FS stage within the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process.

The Site 4 Pre-FS TM was prepared for the United States Navy, Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract N62470-11-D-8012, Contract Task Order (CTO) WE63, for submittal to the CAX Tier I Partnering Team, which consists of representatives from NAVFAC Mid-Atlantic, the United States Environmental Protection Agency (USEPA) Region III, and the Virginia Department of Environmental Quality (VDEQ).

Conceptual Site Model

CAX encompasses 2,300 acres east of Williamsburg, between Interstate 64 and the York River on the York-James Peninsula (**Figure 1**). CAX is located on the site of the DuPont Company's former Penniman Shell Loading Plant, and is currently used to supply Atlantic Fleet ships and provide recreational opportunities to military and civilian personnel. The former Penniman facility was used as a powder and shell loading plant during World War I and was closed in 1918.

Site 4, the Outdated Medical Supply Disposal Area, is composed of two burial investigation areas (Burial Investigation Areas 1 and 2), approximately 4 acres in size and located west of D Street, between Cheatham Annex Depot (CAD) buildings 11 and 12 (**Figure 2**). The history of Burial Investigation Area 1 (formerly identified as Area of Concern [AOC] 3 and later incorporated into Site 4) is unknown. It was originally identified as a surface debris pile of metal banding, a few empty drums, and charred wood with approximate dimensions of 20 feet by 20 feet by 10 feet high; the surface debris pile is located in the southwest corner of Burial Investigation Area 1 and adjacent to Upstream Pond (**Figure 2**). However, test pits excavated as part of the Site 4 and AOC 3 Site Inspection (SI) revealed buried debris in this area as well (CH2M HILL, 2011). Burial Investigation Area 2 (formerly known as Site 4 before Site 4 was expanded to include AOC 3) includes out-of-date medical supplies (including intravenous[IV] injection sets with syringes wrapped in aluminum foil or plastic, empty IV bottles, numerous sharps [both] metal and plastic]), and 1- inch metal banding.

Site 4 is heavily vegetated with shrubs and trees. In general, the topography of Site 4 slopes to the northeast towards D Street (**Figure 2**); however, locally the topography slopes towards Upstream Pond. Surface water flows from the areas surrounding CAD 11 and 12 and nearby drainage channels into Upstream Pond. The surface water

in Upstream Pond flows through a culvert under D Street and into Youth Pond. Surface water in Youth Pond then discharges through a culvert into the York River.

In general, soil at Burial Investigation Area 1 is predominately yellowish-brown sandy clay and clay underlain by greenish-grey silty sand. Soil at Burial Investigation Area 2 is predominately brown and gray silty sand. The shallow aquifer underlying Site 4 is the Yorktown-Eastover Aquifer, and during RI field activities, groundwater was encountered between approximately 5.38 and 8.80 feet below ground surface (ft bgs). Groundwater elevations are not expected to be impacted by the tide cycles and groundwater flows generally northeast towards the York River. Based on a calculated average hydraulic conductivity of 2.27 ft/day within the Yorktown-Eastover aquifer, an estimated effective porosity of 0.3, and an average horizontal hydraulic gradient of 0.005 ft/ft, the average lateral groundwater velocity towards the York River is estimated to be 0.038 ft/day.

While Site 4 is located within the restricted CAD area, access is not restricted to authorized CAX visitors (e.g., civilian employees and military personnel) since the gate along D Street near CAD Building 11 is no longer locked on a regular basis. Future land use at Site 4 is not expected to change and will likely continue as a wooded area in the foreseeable future. The CSM for Site 4 is depicted on **Figure 3**.

Previous Investigations

Previous investigations and remedial actions that helped characterize potential contamination at Site 4 are the 1998 Debris Removal (Baker, 2001), the 1999 Field Investigation (FI) (Baker, 2001), the 2001 Test Trench Excavation (Baker, 2002), the Screening-level Ecological Risk Assessment (SERA) (Baker, 2005), the 2009 Sites 4, 9, and AOC 3 Site Investigation (SI) (CH2M HILL, 2011), and the 2012 Site 4 RI (CH2M HILL, 2014). With the exception of a summary of the 2012 RI, detailed below, brief descriptions of the previous investigations are summarized in **Table 1**.

2012 Remedial Investigation

An RI was completed for Site 4 and consisted of buried debris delineation through test pitting, surface and subsurface soil sampling, surface sediment sampling, biota tissue sampling, monitoring well installation, groundwater monitoring and sampling, groundwater hydraulic conductivity “slug” testing, and reference pond surface and subsurface sediment sampling, surface water sampling, and biota tissue sampling. The investigation activities were completed to characterize the nature and extent of buried debris; potential contamination in soil, groundwater, and surface sediment; and to assess the potential risks posed by exposure to contamination by human and ecological receptors via a human health risk assessment (HHRA) and ecological risk assessment (ERA).

The Site 4 RI Report (CH2M HILL, 2014) concluded the following:

- Surface and buried debris within the two burial investigation areas represent the only identified source of CERCLA-regulated contamination at Site 4.
- There is significant potential for contaminants found in soil and sediment within drainages and surface water and sediment in both Upstream and Youth Ponds to have originated from non-CERCLA-regulated sources rather than from sources specific to Site 4.
- Semi-volatile organic compounds (SVOCs), PAHs, polychlorinated biphenyls (PCBs), and metals were detected in soil at concentrations exceeding screening criteria. The highest concentrations of PAHs were found outside of the burial investigation areas, at locations where no historic disposal or operational activities were known to or likely took place that would have resulted in a CERCLA-regulated release, and where the evidence suggests that non-CERCLA-regulated impacts from stormwater runoff in contact with asphalt and other PAH-containing impervious surfaces likely occurred. Since PCBs were only detected within the drainage channels, the evidence suggests that the PCBs may have been transported to and deposited within site drainage channel floodplain areas via stormwater runoff from an unknown source or sources in the upstream developed and industrialized areas to the west and southwest.
- Volatile organic compounds (VOCs), SVOCs, PAHs, metals, and one pesticide (dieldrin) were detected in groundwater at concentrations exceeding screening criteria. The pesticide detection appears to be an isolated occurrence due to the absence of dieldrin in the upgradient and downgradient groundwater samples, only

one detection of dieldrin in surface soil, the absence of dieldrin in subsurface soil, and the absence of dieldrin in the Upstream Pond surface water and sediment adjacent to the sample location; therefore, it is likely attributable to normal pesticide use at Department of Defense (DoD) facilities to control pests and weeds and not from pesticide disposal activities.

- The SVOCs and metals detected in surface water within the Site 4 drainage channels and Upstream Pond had concentrations exceeding screening criteria. However, stormwater in contact with PAH-containing impervious surfaces such as asphalt roads, asphalt parking lots, and building rooftops over a developed and industrialized upstream area of substantial acreage discharges to the Site 4 drainage channels and Upstream Pond; therefore, the SVOC concentrations may be the result of impacts from either Site 4 debris, stormwater bringing contaminants from non-CERCLA-regulated sources from upstream paved areas, or a combination of both.
- The SVOCs (primarily PAHs), pesticides, PCBs, and metals detected in sediment samples collected within the drainage channels southwest of Upstream Pond, within Upstream Pond sediment, and within Youth Pond sediment had concentrations exceeding screening criteria. The detected SVOC concentrations in the drainage channel sediment samples could be attributable to non-CERCLA-regulated contaminant sources unrelated to Site 4, to an unknown upstream CERCLA release unrelated to Site 4, or to impacts from buried debris within the Site 4 boundary. There is a strong possibility that the elevated PCB concentrations in Upstream Pond sediment are the result of non-site-related contaminants transported in stormwater from an unknown source or sources in the developed and industrialized areas to the west and south. The detected pesticide concentrations are likely attributable to normal pesticide use at DoD facilities to control pests and weeds rather than pesticide disposal activities.
- In the York River drainage channel, a number of SVOCs were detected at concentrations exceeding screening criteria. Of the SVOCs detected, approximately half were also detected in Youth Pond sediment samples, suggesting that the detected concentrations may be at least partially attributable to offsite contamination transported by the York River.
- There were PCBs and metals detected in Site 4, Upstream Pond, and Youth Pond animal tissue samples.
- The HHRA conducted as part of the Site 4 and Youth Pond RI report identified potential unacceptable risks associated with exposure to soil for exposure groupings that included surface soil within the fenced portion (or within the restricted portion of the CAD area) of Site 4 and combined surface and subsurface soil across the entire site [including areas within the fenced (restricted) portion and outside the fenced portion of the site]. These unacceptable hazards and risks were primarily associated with surface soil within the fenced portion of the site (sample CAA03-SS06-1109) and three samples outside the fenced area, but within the debris area (samples CAS004-4HA06-00-1199, CAS004-4-HA05-01-1199, and CAS004-4HA05-00-1199) (**Figure 4**). Potential unacceptable risks were also identified for exposure to Site 4 groundwater.
- The ERA identified potential unacceptable risks associated with exposure to surface and shallow subsurface soil at Site 4 and sediment within Upstream Pond.

Based on these conclusions and comments from the USEPA on the draft RI Report, the final RI Report recommended an FS be completed to develop and evaluate remedial alternatives to address the following:

- Buried debris at Site 4
- Groundwater at Site 4
- PCBs in Upstream Pond sediment
- PAHs in the drainage channel directing surface run off from the roof of CAD Building 12 and the adjacent paved areas to Site 4

Commented [WS1]: The DEQ concurs with the EPA's recommendations to address these items in the FS.

Human Health Risk Assessment

The HHRA conducted as part of the Site 4 and Youth Pond RI report (CH2M HILL, 2014) identified potential unacceptable non-carcinogenic hazards and carcinogenic risks associated with exposure to soil for exposure groupings that included surface soil within the fenced (restricted) portion of Site 4 and combined surface and subsurface soil across the entire site (including areas within the fenced portion and outside the fenced portion of

the site [including the debris areas]). These unacceptable hazards and risks were primarily associated with surface soil within the fenced portion of the site (sample CAA03-SS06-1109) and three samples outside the fenced area, including the disposal areas, but within the debris area (samples CAS004-4HA06-00-1199, CAS004-4-HA05-01-1199, and CAS004-4HA05-00-1199) (**Figure 4**). Therefore, to evaluate if there would be any potential unacceptable hazards or risks associated with future unrestricted use of the area outside the fenced portion of the site only, which includes the debris areas, additional risk calculations were performed for soil.The additional risk calculations were performed for two separate data groupings: all soil (surface and subsurface combined, within and outside of the debris areas) outside the fenced portion of the site (**Attachment 1**) and soil (surface and subsurface) outside the fenced portion of the site that is not within debris areas, since the debris areas will be evaluated for remedial options as part of the FS (**Attachment 2**). The only receptors evaluated in these additional risk calculations were future residents, the most conservative receptors (i.e., would have the highest risks) for evaluating unrestricted future use of the site.

The risk calculations were performed using the same methodology used for the HHRA included in the RI (CH2M HILL, 2014). Additionally, all screening levels to identify the contaminants of potential concern (COPCs), and all toxicity values and exposure factors used to calculate the non-carcinogenic hazards and carcinogenic risks in the RI HHRA, were used in this assessment. The Risk Assessment Guidance for Superfund (RAGS) Part D standard tables (USEPA, 2001) are included as **Attachment 1** and **Attachment 2** and include the Table 2s for identification of COPCs, the Table 3s identifying the exposure point concentrations, the Table 4s that include the exposure factors (the same as those used in the HHRA in the RI), the Table 5s and 6s that identify the toxicity factors (the same as those used in the HHRA in the RI), the Table 7s presenting the risk calculations, and the Table 9s summarizing the risk calculation results. Additionally, the ProUCL output is included in **Attachment 1** and **Attachment 2** for the estimation of the exposure point concentrations for the COPCs.

The COPCs identified for all soil outside the fenced portion of the site and included in the quantification of risk for this soil (**Attachment 1**) are:

- Benz(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Bis(2-Ethylhexyl)phthalate
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene
- Aldrin
- Arolcor-1242
- Aroclor-1260
- Aluminum
- Arsenic
- Hexavalent Chromium
- Cobalt
- Iron
- Manganese
- Thallium
- Vanadium

The COPCs identified for soil outside the fenced portion of the site, but not within debris areas, and included in the quantification of risk for this soil (**Attachment 2**) are:

- Benz(a)anthracene
- Benzo(a)pyrene

- Benzo(b)fluoranthene
- Dibenz(a,h)anthracene
- Indeno(1,2,3-cd)pyrene
- Aluminum
- Arsenic
- Hexavalent Chromium
- Cobalt
- Iron
- Thallium
- Vanadium

The results of the additional risk estimates are summarized below by area and receptor. The risk calculations for all soil outside the fenced area are presented in Tables 7.1.RME through 7.3.RME in **Attachment 1**, and summarized in Tables 9.1.RME through 9.3.RME in **Attachment 1**. The risk calculations for soil outside the fenced area not within the debris area are presented in Tables 7.1.RME through 7.3.RME in **Attachment 2**, and summarized in Tables 9.1.RME through 9.3.RME in **Attachment 2**. The constituents of concern (COCs) are identified below for each receptor. The COCs are those COPCs that contribute a~~n~~ hazard index (HI) greater than 0.1 to a cumulative target organ HI that exceeds 1 (USEPA's target HI), or a carcinogenic risk greater than 1×10^{-6} to a cumulative carcinogenic risk that exceeds 1×10^{-4} (upper end of USEPA's target risk range of $1x10^{-6}$ to $1x10^{-4}$).

All soil outside fenced area

The risk assessment assumed that a future resident could be exposed to combined surface and subsurface soil outside the fenced area through ingestion and dermal contact. Although the soil was not specifically evaluated for emissions from soil to air and inhalation of air as part of the updated risk calculations, this pathway contributed an insignificant hazard and risk to the total hazard and risk associated with all soil (inside and outside the fenced area) in the RI and the concentrations in the soil outside the ~~fence~~fenced area are much lower than the concentrations included in the RI HHRA. Non-carcinogenic hazards were calculated for adult and child residents and carcinogenic risks were calculated for a lifetime child/adult resident following USEPA guidance.

Adult Resident

- Total RME HI=0.5 for exposure to soil outside the fenced area are less than the target HI of 1.

Child Resident

- Total RME HI=5 for exposure to soil outside the fenced area exceeds the target HI of 1.
  - COC is arsenic

Lifetime Child/Adult Resident

- Total cancer risk = $3x10^{-4}$, exceeds USEPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.
  - COCs are arsenic, carcinogenic PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, Dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, and bis[2-ethylhexyl]phthalate), PCBs (Aroclor-1242 and Aroclor-1260), and hexavalent chromium

Soil outside fenced area outside debris

The risk assessment assumed that a future resident could be exposed to combined surface and subsurface soil outside the fenced area that is not within debris areas through ingestion and dermal contact. Although the soil was not specifically evaluated for emissions from soil to air and inhalation of air as part of the updated risk calculations, this pathway contributed an insignificant hazard and risk to the total hazard and risk associated with all soil (inside and outside the fenced area) in the RI and the concentrations in the soil outside the ~~fence~~fenced area are much lower than the concentrations included in the RI HHRA. Non-carcinogenic hazards were calculated

for adult and child residents and carcinogenic risks were calculated for a lifetime child/adult resident following USEPA guidance.

Adult Resident

- Total RME HI=0.2 for exposure to soil outside the fenced area, but not within the debris areas, are less than the target HI of 1.

Child Resident

- Total RME HI=2 for exposure to soil outside the fenced area, but not within the debris areas, exceeds the target HI of 1; however, no target organ HIs exceed an HI of 1, therefore, there are no unacceptable non-carcinogenic hazards and no COCs.

Lifetime Child/Adult Resident

- Total cancer risk = $7x10^{-5}$, within USEPA's target risk range of $1x10^{-4}$ to $1x10^{-6}$.

Ecological Risk Assessment

In order to better support the FS evaluation of remedial alternatives, ecological risks were recalculated for terrestrial habitats using different spatial groupings of the soil data than were used in the RI. All soil samples located in the wooded habitats outside of the CAD building fence were divided into two groups, those within the debris areas and those outside of the debris areas (**Attachment 3 Table E-1**). Because the debris areas will be slated for remediation, this ERA focused on the areas outside of the debris areas to determine if ecological risks in those areas were acceptable or if they also needed to be considered for remediation. For comparison, the risks for the areas within the debris are also provided. The same methodology and parameter values used in the RI ERA were also used for this assessment.

Comparison with Ecological Screening Values

The maximum, arithmetic mean, and 95% upper confidence limit (UCL) of the arithmetic mean soil concentrations were compared with ecological screening values (ESVs). Chemicals were excluded from further consideration in the SERA if the hazard quotient (HQ) based on the maximum concentration was less than 1. Chemicals were generally excluded from further consideration in the Baseline ERA (BERA) if the HQ based on the 95% UCL was less than 1 and/or if the maximum detected concentration was less than the background upper tolerance limit (UTL).

Surface Soil

Maximum surface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-2**. **Attachment 3 Table E-3** identifies the exceedances of ESVs and background UTLs for each surface soil sample. Five metals (aluminum, iron, mercury, selenium, and zinc) and two pesticides (endrin and endrin aldehyde) equaled or exceeded ESVs based on maximum detected concentrations (**Attachment 3 Tables E-2 and E-3**). The ESVs for aluminum and iron were based on soil pH; soil pH data are reported in **Attachment 3 Table E-3**. The VOCs 2-Butanone and acetone were detected in at least one surface soil sample, but ESVs were not available. These nine chemicals were identified as Step 2 COPCs. One metal (thallium), one pesticide (endrin ketone), and seven SVOCs were not detected, but maximum detection limits equaled or exceeded ESVs. These nine chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL surface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-2**. Only endrin had an HQ that equaled or exceeded 1, based on detected 95% UCL concentrations, and also equaled or exceeded background UTLs (where available). Aluminum equaled or exceeded both the ESV and background UTL in 3 of 11 samples from this area, and the mean pH was slightly lower than the acceptable range. Thus, aluminum and endrin were identified as COPCs for further risk evaluation.

The VOC 2-Butanone was detected, but a soil ESV was not available. The maximum detected 2-Butanone concentration (24.0 micrograms per kilogram [µg/kg]) was less than soil ESVs for other, similar VOCs, which

ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, this chemical was not identified as a COPC for further risk evaluation. Acetone was also detected, but a soil ESV was not available. Acetone was detected at a maximum concentration (640 µg/kg) that exceeded soil ESVs for some other, similar VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, acetone was identified as a COPC for further risk evaluation.

Atrazine and 4-nitrophenol were not detected, but mean detection limits equaled or exceeded ESVs. These two SVOCs were not identified as COPCs for further risk evaluation, but are discussed in the uncertainty section.

For comparison, the screening of surface soil samples located within the debris areas is contained in **Attachment 3 Tables E-4** and **E-5**.

Shallow Subsurface Soil

Maximum shallow subsurface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-6**. **Attachment 3 Table E-7** identifies the exceedances of ESVs and background UTLs for each shallow subsurface soil sample. Three metals (aluminum, hexavalent chromium [but not total chromium], and iron) and one pesticide (endrin) equaled or exceeded ESVs based on maximum detected concentrations (**Attachment 3 Tables E-6 and E-7**). The ESVs for aluminum and iron were based on soil pH; soil pH data are reported in **Attachment 3 Table E-7**. Acetone was detected in at least one shallow subsurface soil sample, but an ESV was not available. These five chemicals were identified as Step 2 COPCs. Two pesticides (endrin aldehyde and endrin ketone) and six SVOCs were not detected, but maximum detection limits equaled or exceeded ESVs. These eight chemicals were also identified as Step 2 COPCs.

Mean and 95% UCL shallow subsurface soil concentrations for areas outside of the debris are compared to soil ESVs for plants and soil invertebrates in **Attachment 3 Table E-6**. Only endrin and hexavalent chromium had HQs that equaled or exceeded 1, based on detected 95% UCL concentrations, and also equaled or exceeded background UTLs (where available). Aluminum equaled or exceeded both the ESV and background UTL in 6 of 9 samples from this area, and the mean pH was slightly lower than the acceptable range. Thus, aluminum, hexavalent chromium, and endrin were identified as COPCs for further risk evaluation.

Acetone was detected, but a soil ESV was not available. The maximum acetone concentration (120 µg/kg) was less than soil ESVs for other, similar VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Thus, acetone was not identified as a COPC for further risk evaluation.

Atrazine and 4-nitrophenol were not detected, but mean detection limits equaled or exceeded ESVs. These two SVOCs were not identified as COPCs for further risk evaluation, but are discussed in the uncertainty section.

For comparison, the screening of shallow subsurface soil samples located within the debris areas is contained in **Attachment 3 Tables E-8 and E-9**.

Terrestrial Food Web Exposures

In terrestrial habitats, Step 2 food web COPCs were selected by first comparing maximum surface soil concentrations with the lower of the available bird and mammal Ecological Site Screening Levels (Eco-SSLs) for analytes on the list of bioaccumulative chemicals. Chemicals that equaled or exceeded the Eco-SSLs based on the maximum surface soil concentration were retained for site-specific food web modeling. Those that did not were not evaluated further for terrestrial food web exposures. Chemicals that were on the bioaccumulative chemicals list and did not have Eco-SSLs were automatically included in site-specific food web modeling. The final Step 2 food web COPCs were selected based on a comparison of maximum exposure doses from site-specific food web modeling with the no observed adverse effect level (NOAEL)-based ingestion toxicity reference value (TRV). Those chemicals with an exposure dose equaling or exceeding the NOAEL-based ingestion TRV were identified as Step 2 COPCs. For Step 7, ingestion-based (food web) COPCs were based on a comparison of mean and 95% UCL exposure doses with ingestion TRVs based on the NOAEL, maximum acceptable toxicant concentration (MATC), and lowest observed adverse effect level (LOAEL). An exceedance of the 95% UCL-based MATC was generally considered an unacceptable risk at Step 7, although chemicals that exceeded the MATC, but not the LOAEL, were discussed for possible risk management considerations.

Attachment 3 Table E-10 shows the results of the initial screening against bird and mammal Eco-SSLs for samples outside of the debris areas. Five metals (cadmium, chromium, copper, lead, and zinc) and high molecular weight (HMW) PAHs equaled or exceeded one or both of the Eco-SSLs based on the maximum detected surface soil concentration and were retained for site-specific food web modeling.

The HQs based on maximum exposure doses for each upper trophic level terrestrial receptor are listed in **Attachment 3 Table E-11**. Based on a comparison to NOAELs, three metals (cadmium, chromium, and mercury) had HQs equaling or exceeding 1 for one or more receptors. Ingestion TRVs were not available for any receptor for 1,2,4,5-tetrachlorobenzene, 4-bromophenyl-phenylether, and 4-chlorophenyl-phenylether, none of which were detected in surface soil samples.

The HQs based on 95% UCL and mean exposure doses for each upper trophic level terrestrial receptor are listed in **Attachment 3 Tables E-12 and E-13**, respectively. Based on a comparison to NOAELs, no chemical had an HQ that equaled or exceeded 1 for any receptor. No chemicals were identified as COPCs for further risk evaluation and risks are acceptable for this exposure pathway.

For comparison, the food web modeling using samples located within the debris areas is contained in **Attachment 3 Tables E-14 through E-17**.

Risk Evaluation

In surface soil outside of the debris areas, aluminum, endrin, and acetone were identified as COPCs for further risk evaluation (**Attachment 3 Table E-2**), and aluminum, endrin, and hexavalent chromium were identified as COPCs for further risk evaluation in shallow subsurface soil (**Attachment 3 Table E-6**). Aluminum was identified as a COPC in surface soil due largely to the low measured soil pH in the two samples east of Upstream Pond (aluminum was the only COPC identified in this subarea in the RI ERA). The ratios to the background UTL for these two samples were 1.28 and 1.60, so they were not highly elevated relative to background. Thus, potential ecological risks related to aluminum are not expected to be ecologically significant. In shallow subsurface soil, aluminum exceeded both the ESV and background UTL in six samples, and the maximum ratio to the background UTL for these samples (2.45) was higher than in surface soil (1.60). However, there was no discernible pattern to these shallow subsurface exceedances and the range of concentrations for the six samples was fairly uniform (21,000 to 32,000 milligrams per kilogram [mg/kg]), suggesting that they are not site-related and may reflect background conditions.

Endrin exceeded ESVs in three surface soil samples and one shallow subsurface soil sample from the area outside of the debris. The surface soil concentration in two of the samples that exceeded the ESV (3.90 and 3.50 µg/kg) were comparable to the maximum observed concentration (3.50 µg/kg) in surface soil samples collected as part of the background study. The third surface soil exceedance (55.0 µg/kg), and the only shallow subsurface soil exceedance (8.60 µg/kg), occurred at the same sample location [CAA03-SS/SB-09 (**Figure 4**)]. Although the soil concentrations for endrin at this location were well above those observed in background samples, there were no other pesticide ESV exceedances at this location and only one other exceedance of both ESVs and background UTLs (aluminum in the subsurface sample). Thus, this sample location does not appear to be very impacted by potential site activities.

Acetone was identified as a COPC for further risk evaluation in surface soil outside of the debris areas and did not have an available soil ESV or background UTL. Acetone was detected at a maximum concentration (640 µg/kg) that exceeded some soil ESVs for other VOCs, which ranged from 173 to 64,000 µg/kg, with a median value of 1,290 µg/kg. Only 2 of 7 surface soil samples had concentrations that exceeded 173 µg/kg, the lowest ESV for other VOCs. However, the USEPA Region 5 soil ESV for acetone (based on back-calculated food web models) is 2,500 µg/kg, which is greater than the maximum detected concentration in surface soil. Thus, acetone was not identified as a contaminant of concern (COC) in surface soil outside of the debris areas.

Hexavalent chromium exceeded its ESV in the only shallow subsurface soil sample it was analyzed in outside of the debris areas at an HQ of 1.08, but the ESV and background UTL for total chromium were not exceeded in this same sample. Thus, hexavalent chromium was not identified as a COC in surface soil outside of the debris areas.

Uncertainties

The uncertainties related to the BERA were discussed in detail as part of the RI ERA and also generally apply to this assessment except for the reporting limits. Reporting limits for some undetected analytes exceeded applicable ESVs in some media. **Attachment 3 Table E-18** summarizes these chemicals, by medium, and reports both the ratio of the minimum and maximum reporting limits to the ESV as well as the ratio of the mean value (calculated using one-half of the reporting limit for each sample) to the ESV. Because these chemicals were not detected, they are not known to be present on the site, but the potential for unacceptable risks cannot be totally discounted because the reporting limits are higher than the ESVs. The magnitude of the ratios can be used to qualitatively evaluate the magnitude of the associated uncertainty (that is, higher ratios are indicative of a greater likelihood that chemicals are present at concentrations that exceed the ESV relative to lower ratios). In surface soil, two undetected chemicals exceeded reporting limits based on the mean ratio, which exceeded 1.5 for only one of the two. In shallow subsurface soil, two undetected chemicals exceeded reporting limits based on the mean ratio, which exceeded 1.5 for only one of the two.

In summary, there were no chemicals with very high mean ratios, suggesting that the associated uncertainties are relatively low. Because standard analytical methods were used and the sample reporting limits were not elevated relative to the method reporting limits for the vast majority of samples and analytes, these uncertainties are considered acceptable and are unlikely to impact the conclusions of this ERA.

Recommendations

Site 4 Soil Risk Summary

Human Health Risks

Although unacceptable non-carcinogenic hazards and carcinogenic risks were identified for the soil outside the fenced area of Site 4, these risks are associated with the debris areas only, as demonstrated by no unacceptable non-carcinogenic hazards or carcinogenic risks associated with the soil outside the fenced area that does not include the debris areas. Therefore, no additional investigation or evaluation of soil outside the fenced area is necessary, with the exception of the debris area soil that will be evaluated in the FS.

Ecological Risks

The vast majority of the potential ecological risks in terrestrial habitats outside of the CAD area fence are associated with the debris areas. Potential risks in areas outside of the debris were low and considered to be generally acceptable. Therefore, no additional investigation or evaluation of soil outside the fenced area is necessary, with the exception of the debris area soil that will be evaluated in the FS.

Non-CERCLA-Regulated Sources

While a portion of the volume of stormwater runoff discharging to Upstream Pond, and ultimately Youth Pond, is potentially impacted by Site 4, as discussed in the RI Report (CH2M HILL, 2014), a considerable portion of the volume of stormwater runoff draining to these ponds may be impacted by non-CERCLA-regulated contaminant sources unrelated to Site 4. For example, the PAHs found in Site 4 samples are ubiquitous in urban environments from sources that include atmospheric emissions from industrial facilities such as power plants, automobile exhaust, tire particles, and asphalt. Stormwater draining from a considerable portion of the developed and industrialized areas north, west, and south of Upstream and Youth Ponds has been in contact with asphalt-paved parking lots and roads, as well as building rooftops, all of which are known to typically contain these PAHs. A large component of the stormwater flow that ultimately reaches Youth Pond does not flow through Upstream Pond and is not impacted by Site 4.

In addition, widespread detections of pesticides are likely the result of normal pesticide use at DoD facilities to control pests and weeds. The sample with the highest concentrations of pesticides was located in the immediate vicinity of CAD Building 12, approximately 100 feet upgradient of Burial Investigation Area 1. Pesticides were not known to be disposed at Site 4. The distribution and generally low detected concentrations of pesticides in soil are

likely attributable to normal pesticide use at DoD facilities to control pests and weeds, and not from pesticide disposal activities.

Consequently, there is significant potential for contaminants found in soil and sediment within drainages and surface water and sediment in both Upstream and Youth Ponds to have originated from non-CERCLA-regulated sources rather than from sources specific to Site 4. Therefore, with the exception of the voluntary PAH hotspot removal discussed below, it is recommended no action be taken to address PAHs and pesticides in any site media at Site 4, Upstream Pond, or Youth Pond.

Metals in Upstream Pond Sediment

While there are several possibly site-related metals posing potentially unacceptable ecological risk in sediment within Upstream Pond, given its small size and relative isolation, Upstream Pond contains a fairly abundant and diverse aquatic community. The results of the sediment toxicity testing in the BERA did not indicate any consistent impacts from COCs to organism survival, growth, or reproduction at any of the Upstream Pond locations. There also do not appear to be any widespread impacts from COCs to the benthic invertebrate community in Upstream Pond, based on the semi-quantitative biological survey that was conducted as part of the BERA. Any intrusive remedial actions to address the potential ecological risk would have detrimental physical effects on the habitats and biota that are currently present. These impacts would likely persist for a considerable period of time if natural processes are relied upon for recolonization, since there are no natural sources of colonizing organisms, other than Youth Pond. Further, since urban runoff from the stormwater system is also a possible source for the COCs, there would also be the potential for recontamination following any intrusive remedial action in the pond itself. For these reasons, it is recommended that these COCs in this medium not be carried forward to the FS.

Site 4 Groundwater

A UFP-SAP is currently being prepared for additional investigation of Site 4 groundwater. Therefore, groundwater will not be addressed in the FS unless the results of the forthcoming groundwater investigation indicate that inclusion of Site 4 groundwater in the FS is warranted.

PCBs in Site 4 Soil, Upstream Pond Sediment, and Upstream and Youth Ponds Fish Tissue

The detected PCBs were only found in soil in the immediate vicinity of Drainage Channel #1, near the confluence of Drainage Channels #1 and #2, upgradient of Upstream Pond. The confluence of the two drainage channels is a floodplain area that, while typically dry, is likely to be under water during heavy rain events and a deposition area for sediment transported by stormwater. Since PCBs were only detected within the drainage channels, the evidence suggests that the PCBs may have been transported to and deposited within site drainage channel floodplain areas via stormwater runoff from an unknown source or sources within the upstream developed and industrialized areas to the west and southwest.

Two PCBs were detected in sediment samples collected within Upstream Pond sediment at concentrations exceeding screening criteria during the RI (CH2M HILL, 2014). The highest PCB concentrations were found near where the site drainage channels direct stormwater into Upstream Pond, northeast of the surface debris pile within Burial Investigation Area 1, and in the northeastern corner of Upstream Pond. Since the PCBs detected in Upstream Pond sediment were only otherwise detected in drainage channels upstream of Site 4, there is a strong possibility that the elevated PCB concentrations in Upstream Pond sediment are the result of non-site-related contaminants transported in stormwater from the developed and industrialized areas to the west and south (such as stormwater discharged via Outfalls #35 and #2).

There were PCBs detected in both Upstream and Youth Ponds fish tissue samples. However, the Navy currently has fishing restrictions in place for Youth Pond and will voluntarily keep the fishing restrictions in place to protect against human exposure to PCBs in fish tissue.

As a result of evidence suggesting PCB contamination at Site 4, Upstream Pond, and in fish tissue is the result of non-site-related contaminants, it is recommended to address the PCBs under a separate to-be-determined (TBD)

site and voluntarily keep the Youth Pond fishing restrictions in place until the PCB contamination can be addressed, and any permanent LUCs, if warranted, are recommended under remedial activities associated with the TBD site.

Commented [WS2]: The DEQ concurs with the Navy's recommendation to address the PCBs under a separate TBD site and keep the fishing restrictions in place.

PAH Soil Hotspot

The highest concentrations of PAHs exceeding their respective screening criteria (PAH concentrations one to two orders of magnitude higher than in all other samples) were found in a surface soil sample (CAA03-SS06) collected approximately 100 feet upgradient and entirely outside of Burial Investigation Area 1, in a grassy area immediately adjacent to the south side of CAD Building 12 (**Figure 4**). The soil sample at this location was collected from a shallow drainage swale that directly receives stormwater runoff from the adjacent road and parking areas, as well as stormwater drainage from the CAD Building 12 rooftop via a downspout directly discharging to this swale, which indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts. Nevertheless, the Navy recommends that a voluntary PAH hotspot removal be completed around surface soil sample location CAA03-SS06 (collected from 0 to 6 inches bgs). The extent of the proposed removal area is approximately 80 square feet (ft^2) (assuming a 5-foot radius around the sample location) to a depth of 2 feet, for a total volume of 6 cubic yards (yd^3). The removal area is based on the nearest surface soil sample (CAA03-SS08) being within 20 feet of CAA03-SS06 and having PAH concentrations two to four orders of magnitude lower than CAA03-SS06 and based on the co-located subsurface soil sample, CAA03-SB06, collected from 6 to 24 inches bgs and having PAH concentrations one to two orders of magnitude lower than CAA03-SS06. Since the evidence indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts, it is recommended no post-excavation confirmation sampling be completed in association with this voluntary hotspot removal action.

Commented [WS3]: The DEQ concurs with the Navy's recommendation to complete a voluntary PAH hotspot removal around the referenced surface soil location.

Proposed Actions

Based on the conclusions and recommendations presented in the RI Report, as well as the recommendations presented in this pre-FS TM, an FS should be completed to develop and evaluate remedial alternatives to address the following medium and COCs:

- Soil and Buried debris at Site 4 (COCs are arsenic [human health and ecological], hexavalent chromium [human health], mercury [ecological], and zinc [ecological])
- Voluntary removal of the PAH hotspot around surface soil sample CAA03-SS06, near CAD Building 12

Commented [WS4]: The DEQ concurs with this recommendation for soil and buried debris although we recommend reiterating inclusion of groundwater will not be addressed unless results from the forthcoming groundwater investigation warrant inclusion.

References

Baker Environmental, Inc. (Baker). 2001. *Site Inspection Report, Site 4 and AOC 1, Naval Weapons Station Yorktown, Yorktown Virginia, Cheatham Annex Site*. May.

Baker. 2002. *Trenching Letter Report Site 1, Site 4, and AOC 2, Naval Weapons Station Yorktown Cheatham Annex Site, Williamsburg, Virginia.* June.

Baker. 2005. *Screening Level Ecological Risk Assessment Report for Sites 4 and 9. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia.* June.

CH2M HILL, Inc. (CH2M HILL). 2011. *Final Site Inspection Report, Site 4, Site 9, and Area of Concern 3. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. December.

CH2M HILL. 2014. *Final Site 4 and Youth Pond Remedial Investigation Report. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. November.

USEPA. 2001. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessment) Final. *Publication 9285.7-47.* Office Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. December.

Table

Figures

Attachment 1
Human Health Risk Assessment Tables – All Soil Outside Fenced Area

Attachment 2
Human Health Risk Assessment Tables – Soil Outside Fenced Area and Debris

Attachment 3
Ecological Risk Assessment Tables

Response to Comments

Regulatory Acceptance

site and voluntarily keep the Youth Pond fishing restrictions in place until the PCB contamination can be addressed, and any permanent LUCs, if warranted, are recommended under remedial activities associated with the TBD site.

PAH Soil Hotspot

The highest concentrations of PAHs exceeding their respective screening criteria (PAH concentrations one to two orders of magnitude higher than in all other samples) were found in a surface soil sample (CAA03-SS06) collected approximately 100 feet upgradient and entirely outside of Burial Investigation Area 1, in a grassy area immediately adjacent to the south side of CAD Building 12 (**Figure 4**). The soil sample at this location was collected from a shallow drainage swale that directly receives stormwater runoff from the adjacent road and parking areas, as well as stormwater drainage from the CAD Building 12 rooftop via a downspout directly discharging to this swale, which indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts. Nevertheless, the Navy recommends that a voluntary PAH hotspot removal be completed around surface soil sample location CAA03-SS06 (collected from 0 to 6 inches bgs). The extent of the proposed removal area is approximately 80 square feet (ft^2) (assuming a 5-foot radius around the sample location) to a depth of 2 feet, for a total volume of 6 cubic yards (yd^3). The removal area is based on the nearest surface soil sample (CAA03-SS08) being within 20 feet of CAA03-SS06 and having PAH concentrations two to four orders of magnitude lower than CAA03-SS06 and based on the co-located subsurface soil sample, CAA03-SB06, collected from 6 to 24 inches bgs and having PAH concentrations one to two orders of magnitude lower than CAA03-SS06. Since the evidence indicates that the PAHs detected in this sample are likely the result of non-CERCLA-regulated impacts, it is recommended no post-excavation confirmation sampling be completed in association with this voluntary hotspot removal action.

Proposed Actions

Based on the conclusions and recommendations presented in the RI Report, as well as the recommendations presented in this pre-FS TM, an FS should be completed to develop and evaluate remedial alternatives to address the following medium and COCs:

- Soil and Buried debris at Site 4 (COCs are arsenic [human health and ecological], hexavalent chromium [human health], mercury [ecological], and zinc [ecological])
- Voluntary removal of the PAH hotspot around surface soil sample CAA03-SS06, near CAD Building 12

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Baker Environmental, Inc. (Baker). 2001. *Site Inspection Report, Site 4 and AOC 1, Naval Weapons Station Yorktown, Yorktown Virginia, Cheatham Annex Site*. May.

Baker. 2002. *Trenching Letter Report Site 1, Site 4, and AOC 2, Naval Weapons Station Yorktown Cheatham Annex Site, Williamsburg, Virginia*. June.

Baker. 2005. *Screening Level Ecological Risk Assessment Report for Sites 4 and 9. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. June.

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CH2M HILL. 2014. *Final Site 4 and Youth Pond Remedial Investigation Report. Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia*. November.

USEPA. 2001. Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part D, Standardized Planning, Reporting, and Review of Superfund Risk Assessment) Final. *Publication 9285.7-47*. Office Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. December.

Not included on Table 1

TABLE 1

Summary of Previous Investigations

Site 4 Pre-Feasibility Study Technical Memorandum

WPNSTA Yorktown Cheatham Annex

Williamsburg, Virginia

Investigations/Action	Year	Investigation/Action Activities
Debris Removal (Baker, 2001a)	1998	During a site visit on May 4, 1998, with VDEQ officials, packages of unused needles wrapped in aluminum foil were found at the northeastern end of the site in a small drainage ditch near Upstream Pond. Later in May 1998, approximately 200 pounds of surface debris and 13 pounds of sharps (metal and plastic) were removed from the site. Surface debris removed included IV injection sets, many contained in aluminum or plastic bags, and small quantities (15 containers) of injectable drugs. The injectable drug containers contained either residue or small volumes (a few milliliters of liquid) and had either no labels or labels that were not legible. Additional surface debris, including metal banding, railroad ties, metal, corroded 55-gallon empty drums, and beverage containers, was observed at the site, but not removed.
Field Investigation (Baker, 2001a)	1999	Consisted of collecting soil samples from Site 4 and sediment samples from Upstream Pond. These samples were analyzed for Target Compound List (TCL) organic compounds (volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], pesticides, and PCBs), Target Analyte List (TAL) metals, cyanide, and explosives constituents. The results indicated that there was a potential for risk to human health due to the polycyclic aromatic hydrocarbons (PAHs) detected throughout the site.
Test Trench Excavation (Baker, 2002)	2001	14 test trenches (4-TT01 through 4-TT14) and six test holes (4TH01 through 4TH06) were excavated and examined to characterize and delineate the extent and types of buried waste within Burial Investigation Area 1. Based on the results of this investigation, the southern, eastern, and the southwestern subsurface debris boundaries were delineated. Buried material was observed to be thickest in the eastern portion of the site, where waste was encountered up to 5 feet below ground surface (bgs). The volume of buried material and overburden soil cover material was then estimated at 2,100 yd3. Surface debris, consisting of railroad ties, metal, and various trash items, was also encountered along the northern and western edges of this disposal area.
Screening-level Ecological Risk Assessment (Baker, 2005a)	2005	Completed for soil, sediment, and surface water to determine if potential risk to ecological receptors warranted either additional investigation beyond the conservative screening steps of the Ecological Risk Assessment (ERA) process or the removal of the site from further ecological consideration. In addition, the SERA was completed to identify any data gaps or areas of uncertainty that would require the collection of additional data to support ERA evaluations beyond the screening level. Results of the SERA indicated that there are multiple constituents of potential concern (COPCs) in soil, sediment, and surface water, including VOCs, SVOCs, pesticides, PCBs, and metals. Since multiple COPCs and complete exposure pathways were identified, the SERA recommended proceeding with Step 3A of the ERA process; however, additional data would need to be collected.
Site Inspection (CH2M HILL, 2011a)	2009	Conisted of test pitting, surface and subsurface soil sampling, installation of temporary groundwater wells, groundwater well development and sampling, abandonment of temporary groundwater wells, surface water sampling, and sediment (surface and subsurface) sampling. Results from the SI indicated that the extent of buried debris in Burial Investigation Area 2 had been delineated, but additional test pitting would be required to delineate the extent of buried debris in Burial Investigation Area 1. In addition, sampling results indicated potential risks to human health and ecological receptors, and an RI was recommended to further characterize the extent of contamination and to quantify the risks to human health and ecological receptors.

Consisted

Response to Comments
Site 4 Pre-Feasibility Study Technical Memorandum
Naval Weapons Station Yorktown Cheatham Annex
Williamsburg, VA
September 8, 2015

Comments received by email on June 29, 2015 from Wade Smith, Virginia Department of Environmental Quality.

VDEQ Comment #1: Page 3, bulleted list - VDEQ concurs with the EPA's recommendations to address these items in the FS. All editorial changes were made.

Navy Response: Comment noted.

VDEQ Comment #2: VDEQ concurs with the Navy's recommendation to address the PCBs under a separate TBD site and keep the fishing restrictions in place.

Navy Response: Comment noted. However, the paragraph has been removed based on the Navy decision to address the PCBs detected at Site 4, Upstream Pond (sediment and fish tissue), and Youth Pond (fish tissue) as part of Site 4 FS.

VDEQ Comment #3: VDEQ concurs with the Navy's recommendation to complete a voluntary PAH hotspot removal around the referenced surface soil location.

Navy Response: Comment noted.

VDEQ Comment #4: VDEQ concurs with [the] recommendation for soil and buried debris although we recommend reiterating inclusion of groundwater will not be addressed unless results from the forthcoming groundwater investigation warrant inclusion.

Navy Response: The text has been revised to reiterate groundwater will not be addressed unless results from the forthcoming groundwater investigation warrant inclusion.

VDEQ Comment #5: The 2001 Site Inspection Report and 2014 Remedial Investigation Report are not included in Table 1.

Navy Response: The 2001 Site Inspection Report summarizes the field activities from the 1998 Debris Removal and 1999 Field Investigation. Both investigations are included in Table 1 and the 2001 Site Inspection Report is referenced for both. A summary of the 2012 Remedial Investigation field activities is included in the text rather than in Table 1 and the 2014 Remedial Investigation Report is referenced in the text. No changes to the document were made.

Regulatory Acceptance

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

October 13, 2015

Ms. Angela Jones
Bldg. N-26 Room 3300
NAVFAC MIDLANT
9742 Maryland Ave.
Norfolk, VA 23511

Subject: Response to Comments, Site 4 Pre-Feasibility Study Technical Memorandum, Naval Weapons Station Yorktown Cheatham Annex, Williamsburg, Virginia September 2015

Ms. Jones:

EPA has reviewed the subject response to comments submitted via email from Stephanie Sawyer of CH2M Hill on 9/8/15. EPA finds the responses acceptable and has no additional comments on the subject document. Please provide a final copy for our records. If you have any questions, please contact me at 215-814-2077.

Sincerely,

Gerald F. Hoover

Gerald F. Hoover, RPM
NPL/BRAC Federal Facilities Branch

cc: Wade Smith, VDEQ

COMMONWEALTH of VIRGINIA

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September 29, 2015

Ms. Angela Jones
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Pre-Feasibility Study Technical Memorandum
Site 4 – Outdated Medical Supply Disposal Area
Naval Weapons Station Yorktown
Cheatham Annex
Williamsburg, Virginia

Dear Ms. Jones:

The Virginia Department of Environmental Quality (DEQ) has received the *Response to Comments* (RTCs) associated with the Pre-Feasibility Study Technical Memorandum (Tech Memo) for Site 4 – Outdated Medical Supply Disposal Area at Naval Weapons Station Yorktown, Cheatham Annex (CAX), Williamsburg, Virginia. The RTCs, prepared by CH2M HILL, were received by the DEQ (electronically) on September 8, 2015.

Thank you for providing the DEQ's Office of Remediation Programs the opportunity to review the above-referenced RTCs. Subsequent to DEQ's internal review, this office concurs with the proposed text revisions and recommends submittal of the *Final Tech Memo*.

Please contact me at (804) 698-4125 or wade.smith@deq.virginia.gov with any additional questions.

Sincerely,

Wade M. Smith
Remediation Project Manager
Office of Remediation Programs

cc: Jerry Hoover, EPA