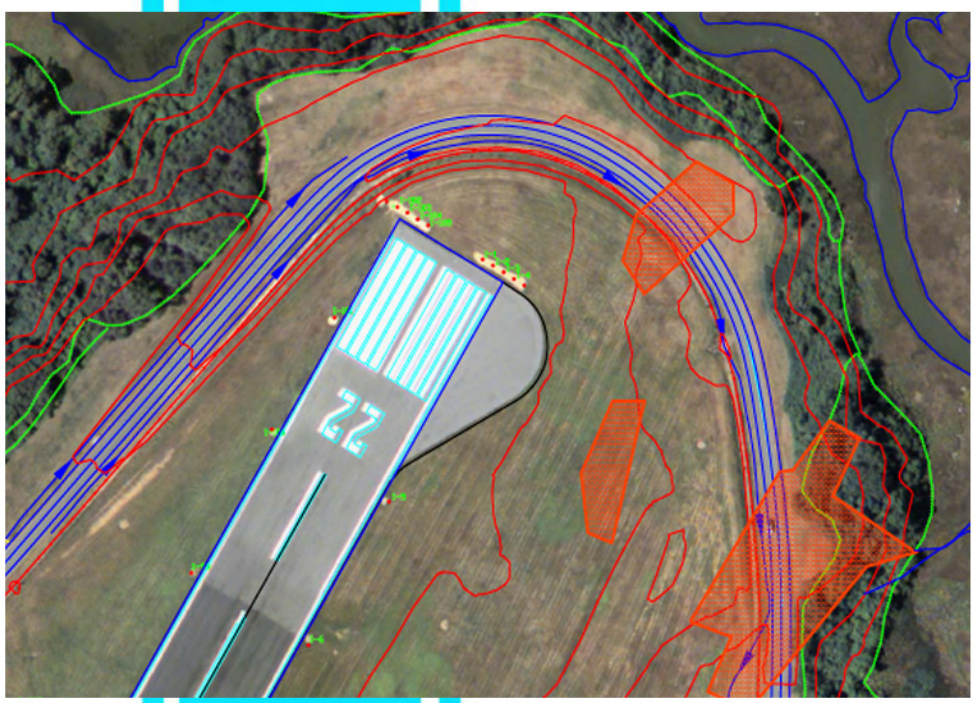
Final Remedial Investigation Report

Remedial Investigation of the Construction Debris Landfill NASA Wallops Flight Facility Accomack County, Virginia

January 14, 2011



VERSAR INC.

FINAL

REMEDIAL INVESTIGATION/RISK ASSESSMENT REPORT FOR THE CONSTRUCTION DEBRIS LANDFILL SITE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION GODDARD SPACE FLIGHT CENTER WALLOPS ISLAND, VIRGINIA

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REMEDIAL INVESTIGATION/RISK ASSESSMENT REPORT
FOR THE
CONSTRUCTION DEBRIS LANDFILL SITE

NASA GODDARD SPACE FLIGHT CENTER
WALLOPS FLIGHT FACILITY
WALLOPS ISLAND, VIRGINIA

SIGNATURE SHEET

This Remedial Investigation/Risk Assessment Report documents the findings of a series of investigations performed during 2007 under Delivery order 0018 of Contract W91236-05-D-0030, and Delivery Order 0006 of Contract W26GLG-5234-4869.

This report was prepared in a joint effort between the United States Army Corps of Engineers (USACE) and Versar, Inc. The USACE accepts no responsibility for either the use or adaptation of this report by others beyond its stated purposes. This report has been prepared in accordance with applicable USACE, United States Environmental Protection Agency (EPA), and Commonwealth of Virginia Department of Environmental Quality (VDEQ) guidance documents. The final report will have been reviewed by USACE, NASA WFF, US EPA, and VDEQ.

This report has been prepared and/or approved by:

1/14/2011

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EXECUTIVE SUMMARY

Versar, Inc., under contract to the US Army Corps of Engineers (USACE), Norfolk and Baltimore Districts, has prepared this Remedial Investigation/Risk Assessment (RI/RA) Report for the Construction Debris Landfill (CDL) Site located in the northern part of the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center's Wallops Flight Facility (WFF) Main Base located near Chincoteague, Virginia. This work was completed under Delivery order 0018 of Contract W91236-05-D-0030, and Delivery Order 0006 of Contract W26GLG-5234-4869.

The CDL Site is comprised of four Areas of Concern (AOCs) visible on USACE aerial photographs as a series of ground disturbances clearly visible in 1949, 1954, 1959, and 1963 aerial photographs. By 1963, some of these features are no longer visible, and by 1974, none of them remained visible (USATEC, 2000). To provide a more geographic frame of reference for discussing the AOCs, they are identified as the Western, Northern, Central, and Southern AOCs, corresponding to the work plan's descriptions as the "shallow excavation", "disturbed ground", "mounds of material", and "burning dump", respectively.

Geophysical Investigation - The investigation consisted of electromagnetic (EM) and limited ground penetrating radar (GPR) surveys to locate suspected metal and non-metal buried debris at the four AOCs. The EM survey exhibited five anomalies across the survey area. Anomalies A through D appear to be from large masses of buried material. Anomaly E corresponds to an area of numerous small buried metal objects where paint was encountered during the Membrane Interface Probe (MIP) Study. With the exception of Anomaly E, all of the anomalies are located along the marsh's shoreline where large metallic objects can also be seen at the surface. A GPR line along the centerline of the road that bisects the CDL Site did not indicate buried debris beneath the road.

MIP Investigation - The MIP survey found only one location with elevated photoionization detector (PID), flame ionization detector (FID), and electron capture detector (ECD) values: MIP-5. All other MIP locations did not indicate volatile organic compounds (VOCs) were present. MIP-5 had significant ECD, PID, and FID readings during the investigation. When the rods were extracted from the boring hole, they were covered in a battleship-gray colored paint.

Test Pit Excavations - Ten test pit (TP) locations were selected for excavation based on the Gore-Sorber passive soil gas investigation (SAIC, 2003), and the EM, GPR, and MIP investigations conducted as part of this RI. TP-1 corresponded with the suspected paint can encountered in MIP-5, and numerous drums were encountered at 11 feet below ground surface (bgs). A petroleum odor was also encountered in the pit at approximated 8.5 feet bgs. TP-3, TP-4, and TP-7, located within the Southern AOC (the burning dump) all showed buried debris: glass bottles and broken glass, various wire, mesh, pipe, and other metal objects, burned material, and a gray ash-like deposit. TP-2 and TP-6 (located within the Central and Southern

AOCs) showed no evidence of debris. TP-5, TP-8, TP-9, and TP-10 (located in the Northern and Western AOCs) showed only undisturbed, native soils.

Soil Sampling Results - Soil concentrations were compared to EPA Regional Screening Levels (RSLs). Results were also compared to a local background sample from boring SB-1, and the mean and maximum background concentrations from the Tetra Tech Background Investigation Report (2004) to highlight elevated contaminant concentrations. Soil samples were generally collected from all sampling locations at two soil horizons: (1) shallow soils (0 to 6 inches, labeled as the A-series), and (2) subsurface (6 to 24 inches, labeled as the B-series). Where additional deeper soil samples were obtained based on visual, olfactory or instrument field screening, these were labeled as "C-series" soil samples. For example, samples collected from test pit number 1 were labeled TP-1A, TP-1B, and TP-1C.

Within the Western AOC's shallow soils, the only organic chemical detected was 4,4-DDE (1.6 micrograms per kilogram [µg/kg]) which is substantially less than the WFF mean background concentration of 539 µg/kg (Tetra Tech, 2004). Widespread application of DDT via diesel fogging at WFF has resulted in prevalent low concentrations of semivolatile organic compounds (SVOCs) and DDT and its degradation products occurring across large areas of the base. In shallow soils, aluminum, arsenic, cadmium, calcium, chromium, iron, mercury, and potassium were detected at concentrations between the mean and maximum background concentrations, but none of the metal detections exceeded the maximum background results (Tetra Tech, 2004), and their concentrations were comparable to or less than the local background sample, SB-1A. The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples, as well as in the local background sample SB-1A. Only arsenic exceeded industrial RSLs, but the arsenic concentration detected in background soils also exceeded industrial RSLs.

Within the subsurface soils of the Western AOC, the only organic compound detected was bis(2-ethylhexyl)phthalate detected at 85 µg/kg detected in SB-2B, and this concentration is well below the WFF mean background value (203 parts per billion [ppb]). Cobalt and manganese were detected at concentrations between the mean and maximum background concentrations, however, cobalt only exceeded its mean background concentration by 0.16 parts per million (ppm). Calcium was the only metal detected at a concentration greater than the maximum background results (Tetra Tech, 2004). However, the highest calcium concentration detected at the Western AOC (TP-8B, 657 ppm) is roughly half the concentration of the local background sample (SB-1B, 1,260 ppm). The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in background. Only arsenic exceeded industrial RSLs, but the arsenic concentrations detected in background soils also exceed industrial RSLs. Overall, no evidence of waste was observed, and no contaminants were detected at concentrations that substantially exceeded background in any of the soil samples from the Western AOC.

In the Northern AOC's shallow soil samples, no organic chemicals were detected. Aluminum, chromium, and iron were detected at concentrations between the mean and

maximum background concentrations, but none of the metal detections exceeded the maximum background results (Tetra Tech, 2004), and their concentrations were comparable to or less than the local background sample, SB-1A. The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in background. Arsenic exceeded industrial RSLs, but arsenic concentrations in background samples also exceed industrial RSLs.

In subsurface soils from the Northern AOC, the only organic compound detected was bis(2-ethylhexyl)phthalate detected at 55.8 µg/kg detected in SB-6B, and this concentration is well below the WFF mean background value (203 ppb). Aluminum, calcium, and nickel were detected at concentrations between the mean and maximum background concentrations, but none of the metal detections exceeded the maximum background results (Tetra Tech, 2004). The maximum detected aluminum concentration (14,300 ppm in SB-6b) was only 200 ppm higher than the WFF mean (14,100 ppm), and the nickel detection (7.2 ppm in SB-6B) exceeded the WFF mean (7.05 ppm) by only 0.15 ppm. Calcium detections (297-350 ppm) in AOC samples are roughly one third the concentration of the local background sample (1,260 ppm in SB-1B). The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in background. Arsenic also exceeded industrial RSLs, but the mean and local background concentrations also exceed industrial RSLs. Overall, no evidence of waste was observed, and no contaminants were detected at concentrations that substantially exceeded background concentrations in any of the soil samples from the Northern AOC.

In contrast to the Northern and Western AOCs, evidence of buried waste is clearly evident in the Central AOC. Sheet metal, broken concrete, cinder block, and other demolition debris are exposed at the surface along the eastern boundary of the Central AOC where it meets the marsh. Shallow soil samples from TP-1A, SB-5A and TP-6A did not detect any VOCs or SVOCs above residential RSLs, however, low concentrations of ethylbenzene, methocyclohexane, toluene, and xylenes were detected in TP-1A. SB-4 (later completed as monitoring well, MW-4) detected petroleum staining near the water table (at 8-10 bgs), and SB-4AD detected methyl acetate at 1190 µg/kg, as well as numerous Polycyclic Aromatic Hydrocarbons (PAHs) detected at concentrations that substantially exceed background: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, phenanthrene, and pyrene. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene all were detected at concentrations exceeding residential RSLs. Of those, benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene also exceeded industrial RSLs. While pesticides were detected in all samples, none were above RSL values.

Among metals detections in shallow soil samples from the Central AOC, arsenic, cadmium, lead, manganese, potassium, and zinc were detected at concentrations between WFF mean and maximum background concentrations (Tetra Tech, 2004), but the concentrations of arsenic detected (2.7 to 4.7 ppm) do not exceed the local background concentration (4.8 ppm in SB-1A). Concentrations of barium, beryllium, calcium, chromium, cobalt, iron, nickel, silver, sodium, and zinc were detected at concentrations higher than the WFF maximum background detections (Tetra Tech, 2004). Metals concentrations in shallow soils for aluminum, arsenic,

iron, lead, manganese, and nickel exceeded residential RSLs. Arsenic also exceeded industrial RSLs, but AOC arsenic concentrations were less than or equal to background concentrations, which also exceeded industrial RSLs.

In subsurface soils collected from 6-24 inches bgs within the Central AOC, no VOCs were detected, and only one SVOC, bis (2-ethylhexyl) phthalate at 51.9 ppb were detected. Aluminum, arsenic, cobalt, copper, lead, magnesium, nickel, potassium, and zinc were detected in the 6-24 inch horizon samples at concentrations between the WFF mean and maximum background concentrations (Tetra Tech, 2004), but the highest arsenic concentration in samples from this AOC (4.8 ppm) was less than the local background concentration (5.5 ppm in SB-1B). Calcium, iron, manganese, mercury, sodium, and vanadium were detected at concentrations that exceeded the WFF maximum background concentrations (Tetra Tech, 2004), but the highest calcium and sodium concentrations detected in AOC samples (1,160 ppm), was less than the local background concentrations (1,260 in SB-1B). As noted in the Northern and Western AOCs, the concentrations of aluminum, arsenic, and iron, exceeded residential RSLs in both the AOC samples and in the site-specific background (SB-1B). Arsenic also exceeded industrial RSLs, but the concentrations in the WFF mean (Tetra Tech, 2004) and in the local background sample, SB-1B, also exceed the Industrial RSL.

Deep subsurface soils were collected from the drum disposal pit and petroleum-stained intervals in TP-1C (8.5-11' bgs) and SB-4C (9-10' bgs), respectively. These deep soil samples detected acetone, benzene, 1,2-dichloroethane, ethylbenzene, isopropylbenzene, methocyclohexane, toluene, m,p-xylene, o-xylene, and total xylenes, however, none of these VOCs exceeded residential RSLs. Only a single pesticide (4,4-DDD at 25.7 ppb) and one SVOC, bis (2-ethylhexyl)phthalate at 102 ppb were detected in the deep samples. Neither of the SVOC or pesticide detections exceeded RSLs. Aluminum and arsenic in the deep samples exceeded residential and industrial RSL, respectively, but both of these metals' concentrations are below WFF mean (Tetra Tech, 2004) concentrations for these metals.

In the Southern AOC, site of the former burning dump, abundant evidence of the former burning dump is present with charred rubbish, cinders, melted glass, and metal readily apparent throughout the AOC. Screening for 2,3,7,8-dioxin in soil samples was negative for all samples. Numerous PAHs were detected in shallow soils, but only benzo(a)pyrene (58.8 µg/kg in TP-3A, 106 µg/kg in TP-7A) and dibenzo(a,h)anthracene (22.6 µg/kg in TP-7A) exceeded residential RSLs. Benzo(a)pyrene detections were less than the WFF mean concentration (206 ppb). Pesticides detected in shallow soils included 4,4-DDD, 4,4-DDE, and 4,4-DDT, however, none of these detections exceeded RSLs. Metals concentrations within the shallow soil samples of the Southern AOC exceeded the WFF maximum background concentrations for all of the metals except antimony, beryllium, and thallium which were detected at concentrations below the WFF mean, and for arsenic which was detected at concentrations between the WFF mean and maximum background concentrations (Tetra Tech, 2004). Among the shallow soils, aluminum, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc exceeded residential RSLs, but the background concentrations for aluminum and iron also exceeded residential RSLs. Only

arsenic and antimony exceeded industrial RSLs, but the background arsenic also exceeds the industrial RSL.

In the Southern AOC subsurface soils, only one VOC, tetrachloroethene, was detected (0.99 to 2.8 ppb). SVOCs detected include the entire PAH suite at fairly low concentrations of 16 to 139 ppb, as well as bis(2-ethylhexyl)phthalate (51 to 199 ppb) and di-n-octylphthalate (25 ppb). Alpha- and gamma-chlordane, 4,4-DDD, 4,4-DDE, 4,4-DDT, and Arochlor-1260 were detected. The concentrations of benzo(a)pyrene (117 ppb) and dibenzo(a, b)anthracene (24 ppb) were the only organic compounds detected that exceeded residential RSLs, and no organic compounds exceeded industrial RSLs. The maximum WFF background concentration (Tetra Tech, 2004) was exceeded for all of the metals except cobalt, thallium, and vanadium whose concentrations were below the WFF mean, and beryllium which was detected at a concentration between the WFF mean and maximum in only one sample (SB-3B at 49 ppb). Concentrations of aluminum, antimony, lead, manganese, silver, and zinc exceeded residential RSLs in the Southern AOC subsurface soil samples. Industrial RSLs were exceeded for arsenic, copper, and iron.

Groundwater Sampling Results - Six groundwater monitoring wells (MW) were installed to monitor the four AOCs. Groundwater is generally shallow and flows to the northeast within the well-sorted quartz sand of the Holocene Columbia Formation. The potentiometric surface mimics topography. Well MW-1 is located upgradient of all of the AOCs and serves as a local background well. Monitoring wells MW-3, MW-4, and MW-5 are downgradient of the Central and Southern AOCs, represent the most contaminated areas of the plume, and data from these wells were used to perform risk/hazard calculations. MW-2 is located downgradient of the Western AOC, and MW-6 is located downgradient of the Northern AOC.

During Round 1 sampling in May 2007, VOCs were detected only in samples from MW-4 and MW-5 located downgradient of the Central AOC and corresponding to the influence of the buried paint drums and oil-stained soils encountered upgradient of these wells. SVOCs were also detected in MW-4. The concentrations of cis-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, trichloroethene, xylenes, 2-methylnaphthalene, and naphthalene in MW-4, and 1,2 dichloroethene in MW-5 exceeded tap water RSLs. The concentrations of 1,2-dichloroethane, tetrachloroethene, and toluene exceed Maximum Contaminant Levels (MCLs). In the May 2007 metals data, arsenic, barium, iron, lead, and manganese concentrations exceeded the WFF mean background concentrations, and calcium, mercury, and sodium exceeded the WFF maximum background concentrations (Tetra Tech, 2004). Arsenic, iron, manganese, and mercury concentrations exceeded RSLs, and mercury exceeded the Virginia Groundwater Quality Standards, but mercury detections were highest in the local background sample from MW-1, and therefore, are not site-related.

As in the first round, VOCs were detected only in samples from MW-4 and MW-5 during Round 2 sampling in December 2007, and SVOCs were only detected in sample from MW-4 (including the duplicate). The concentrations of cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene, tetrachloroethene, toluene, trichloroethene, xylenes, 2-methylnaphthalene, and

naphthalene in MW-4, and 1,2-dichloroethene in MW-5 exceeded tap water RSLs. The concentrations of 1,2-dichloroethane, tetrachloroethene, and toluene exceeded MCLs. In the May 2007 metals data, arsenic, barium, iron, copper, lead, nickel, and potassium exceeded the WFF mean background concentrations, and calcium, magnesium, selenium, sodium, and thallium exceeded the WFF maximum background concentrations (Tetra Tech, 2004). Arsenic, iron, and manganese exceeded RSLs, but no analyte exceeded the Virginia Groundwater Quality Standards during the second round of sampling.

Surface Water Sampling Results – Four surface water (SW) locations were sampled in May 2007 and December, 2007. During May 2007, no organic compounds were detected. The concentrations of aluminum, antimony, arsenic, chromium, manganese, selenium, and sodium exceeded background concentrations. Only mercury concentrations exceeded Biological Technical Assistance Group (BTAG) values, but the highest downstream mercury detection (12 ppb in SW-4) is only 1 ppb greater than the upstream background sample from SW-1 (11 ppb).

During the second round in December 2007, similar metals results were noted, but low concentrations of benzene (0.77 ppb) and carbon disulfide (0.24 ppb) were detected in SW-02, and low concentrations of the SVOCs 2-methylnaphthalene (1.8 ppb) and naphthalene (1.0 ppb) were detected in SW-04. Aluminum, arsenic, calcium, copper, magnesium, manganese, sodium, and vanadium were detected at concentrations which exceeded background concentrations, however, the highest arsenic concentration only exceeded background by 0.4 ppb, the highest copper concentration exceeded background by only 2.7 ppb, the highest manganese detection exceeded background by 2 ppb, and the highest vanadium concentration exceeded background by only 0.7 ppb. Copper was the only metal detected in downstream samples during the second round of sampling that exceeded BTAG criteria.

Sediment Sampling Results - Ten sediment samples (SD) were collected. VOCs were detected in many samples: acetone (SD-5, SD-8, and SD-9), 2-butanone (SD-8 and SD-9), carbon disulfide (SD-2, SD-3, SD-4, SD-6, and SD-9), cyclohexane (SD-4), and methylene chloride (SD-4). Two phthalates, di-n-octylphthalate in SD-5, and bis(2ethylhexyl)phthalate in SD-4, SD-5, and SD-10 were also detected. Aluminum, antimony, arsenic, barium, cadmium, calcium, lead, selenium, silver, sodium, thallium, and zinc were detected at concentrations which exceeded background concentrations. BTAG values were exceeded for bis(2-ethylhexyl) phthalate, 4,4-DDD, 4,4-DDE, arsenic, copper, lead, mercury, nickel, silver, and zinc.

Human Health Risk Assessment (HHRA) – Because site investigations did not indicate the presence of buried waste at the Western and Northern AOCs, these two AOCs were evaluated together, but separately from the other two AOCs. Soil data from the Central and Southern AOCs, where wastes were clearly evident, were also considered together. Exposure point concentrations (EPCs) for soil, sediment, groundwater, and surface water were calculated based on chemical measurements from samples collected at the CDL Site. Because no direct sampling of fish and crabs occurred, EPC levels for these animals were calculated from surface water and sediment data.

A statistical analysis of several commonly occurring chemicals versus background was performed for surface soils (0 to 0.5 feet), and aggregate soils (0 to 10 feet). Of these, arsenic was statistically determined to be equivalent to background concentrations for soils. At the Northern and Western AOCs, all the sample results for arsenic are within the identified range of background concentrations. The highest detected concentration of arsenic in aggregate soil at the Central and Southern AOCs was 8.4 milligrams per kilogram (mg/kg), which is slightly higher than the upper end of the range of background arsenic concentrations (1.1 to 5.3 mg/kg). The EPC for arsenic is within the range of background values for arsenic. The maximum detected concentration of arsenic in groundwater is less than half the mean Tetra Tech (2004) background concentration.

In the HHRA, multiple exposure scenarios were evaluated to calculate carcinogenic risk and hazard indices (non-cancer risks) under baseline and reasonable maximum exposure conditions. These scenarios included current site workers, future commercial workers, current/future recreational fishermen, future construction workers, hypothetical future residents, and trespassers that may come into contact with soil, groundwater, sediment, and surface water.

Central and Southern AOC Risks. Excess carcinogenic risks for the Central and Southern AOCs estimated for current site workers, future commercial workers, and future construction workers are approximately $1.54x10^{-5}$, $4.39x10^{-3}$, and $9.16x10^{-5}$, respectively, and drop slightly to $1.20x10^{-5}$, $4.30x10^{-3}$, and $9.15x10^{-5}$ without arsenic. The risk estimates for site workers and construction workers are within the EPA target risk range of 10^{-6} to 10^{-4}, but exceed the point of departure of $1x10^{-6}$. The risk for future commercial workers from exposure to soil and groundwater exceeds the $1x10^{-4}$ EPA action level.

Lifetime cancer risks were also calculated for hypothetical future residential adults and children, recreational fishermen adults and children, and site trespassers. Potential cancer risks for hypothetical residential adults and children were conservatively estimated at $6.23x10^{-3}$ and $1.23x10^{-2}$, respectively, for the Central and Southern AOCs and were the highest cancer risks calculated from all the receptor groups. Without arsenic, the risks for adult and child residents did not decrease significantly at $6.11x10^{-3}$ and $1.22x10^{-2}$. Residential lifetime cancer risk was estimated to be $1.86x10^{-2}$ for Central and Southern AOCs and $1.84x10^{-2}$ when arsenic is not included.

Adult and children recreational fishermen were estimated to have potential cancer risks of $3.16x10^{-5}$ and $1.38x10^{-5}$, but were $3.00x10^{-7}$ and $2.22x10^{-7}$ without arsenic. In the instance where residents would also be involved in recreational fishing, the estimated cancer risks would be $6.74x10^{-4}$ for adults and $5.82x10^{-3}$ for children or $5.22x10^{-4}$ and $5.72x10^{-3}$ without arsenic. The residential plus recreational fishermen excess cancer risks are higher than $1x10^{-4}$ and are considered to be unacceptable.

In the instance of lifetime residency on the Central and Southern AOCs and recreational exposures, the total cancer risk would be $1.86x10^{-2}$ or $1.84x10^{-2}$ without arsenic. The future

residential scenario was included in this analysis to establish upper bound risk estimates for the CDL Site. However, this future use of the site is not likely.

Cancer risks to site trespassers were calculated to be $7.24x10^{-7}$ (lower at $3.09x10^{-7}$ with arsenic removed), below the $1x10^{-6}$ risk level, indicating that risks are considered to be negligible for this receptor group.

HIs reflecting potential exposures at the Central and Southern AOCs were calculated for all the receptor groups. The target HI of 1.0 was exceeded for all future-use receptor groups. The lifetime residential HI is 17.1, with an HI of 158 when the lifetime resident is assumed to spend a lifetime engaged in recreational activities on the site. HIs for current site workers, trespassers, and fishermen did not exceed 1.0.

Predicted blood-lead concentrations exceed the EPA recommended blood lead goal of no more than 5% of children exceeding 10 µg/dL. Therefore, the hypothetical future child resident is at risk for behavioral neurotoxicity due to the lead concentrations in soil and groundwater. Based on the results of the ALM, lead may potentially be considered to be at levels of concern at the Southern AOC.

Northern and Western AOC Risks. Excess carcinogenic risks for the Northern and Western AOCs estimated for current site workers, future commercial workers, and future construction workers are approximately $2.66x10^{-6}$, $2.82x10^{-4}$, and $9.13x10^{-5}$, respectively (0.00, $1.94x10^{-4}$, and $9.12x10^{-5}$, without arsenic). Some of these risk estimates are within the EPA target risk range of 10^{-6} to 10^{-4}, but exceed the point of departure of $1x10^{-6}$, as a function of using groundwater from impacted sources downgradient of the Central and Southern AOCs. The total cancer risk to the future commercial workers exceeds the $1x10^{-4}$ EPA action level, largely as a function of impacted groundwater use.

Potential cancer risks for residential adults and children were estimated at $6.25x10^{-4}$ and $5.76x10^{-3}$ ($5.06x10^{-4}$ and $5.68x10^{-3}$, without arsenic), respectively, and were the highest cancer risks calculated from all the receptor groups. All the estimated residential cancer risks are higher than the $1x10^{-4}$ EPA action level, as a function of the exposure to groundwater scenario. However, the groundwater data used in this analysis is impacted by the Southern and Central AOCs (data from wells MW-3, MW-4, and MW-5). Also, the combined residential and recreational fishermen lifetime cancer risks are higher than $1x10^{-4}$ and are considered to be unacceptable. Without arsenic, these risks are still unacceptable. The total cancer risk to site trespassers, $4.59x10^{-7}$ ($6.21x10^{-8}$, without arsenic), is below the $1x10^{-6}$ risk level, indicating that risks are considered to be negligible for this receptor group.

HIs reflecting potential exposures at the Northern and Western AOCs were calculated for all the receptor groups. The target HI of 1.0 was exceeded for all receptor groups except the current site workers, trespassers, and fishermen, indicating that only the hypothetical future-use scenario receptor groups are likely to experience adverse health effects from exposures at the

Northern and Western AOCs. Under current conditions, the Northern and Western AOCs do not pose unacceptable risks.

HHRA Risk Summary by Media. Contaminants of concern, those COPCs that contribute cancer risks which exceed $1x10^{-6}$ or HIs that are greater than 1.0 and are not attributable to background conditions include benzo(a)anthracene, benzo(a)pyrene, and dibenz(a,h)anthracene, for surface soils, and benzene, 1,2-dichloroethane, ethylbenzene, tetrachloroethene, naphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, m,p-xylene, Aroclor-1260, chromium, copper, and mercury for aggregate soils in the Central and Southern AOC. However, no contaminants of concern were identified for Northern and Western AOC soils.

Impacted groundwater was identified downgradient of the Central and Southern AOCs where benzene, 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, tetrachloroethene, trichloroethene, toluene, m,p-xylene, o-xylene, xylene (total), 2-methylnaphthalene, naphthalene, arsenic, and iron are contaminants of concern. The only human health contaminants of concern for sediment and surface water was arsenic, but, arsenic detections in soil and groundwater at the CDL Site were all within the range of background concentrations measured for WFF (Tetra Tech, 2004). Statistical analysis indicates that arsenic concentrations in soil at the CDL site are not significantly elevated over background concentrations. Because all of the source media at the CDL Site have been demonstrated to contain arsenic at below background concentrations, it does not follow that the arsenic issues in other media are site-related. The Tetra Tech (2004) maximum background arsenic concentrations in groundwater of 0.018 mg/L is more than twice the highest groundwater concentration of 0.0087 mg/L detected in samples from MW-4D during the May 2007 sampling event.

Carcinogenic risks exceed 10^{-4} and non-cancer risks were higher than 1.0 for the groundwater pathway for future-use scenarios that include: commercial workers, construction workers, and residential adults and children. All groundwater risks result from hypothetical, future-use scenarios that are extremely unlikely to occur.

Groundwater impacted by the CDL Site discharges at the site's eastern border. While groundwater in the area is used for drinking water purposes, the Town of Chincoteague wells are either located in the much deeper Miocene aquifer, or located far enough away (greater than 2,000 feet away), or both. Given the relatively steep hydraulic gradients west of the site and the location of Chincoteague's Columbia Aquifer wells within 500 feet of a virtually infinite recharge area (the marshes of Mosquito Creek and Jenny's Gut), the CDL Site cannot realistically be expected to impact the Town of Chincoteague's well field. Groundwater draws capable of pulling groundwater in the Columbia Aquifer from nearly a half mile away (from below the CDL Site) and overcoming 5-6 feet of hydraulic head, would result in pulling saline waters from the adjacent marsh and the Chincoteague wells would be abandoned as unpotable wells before that would occur. Similarly, no reasonable homeowner, even if the home were located along the NOAA access road, would be expected to install a water-supply well so close

to a salt marsh and draw from the Holocene aquifer, since the probability of salt water encroachment in this setting is very high.

Ecological Risk Assessment (ERA) - Sensitive habitats on and adjacent to the WFF include the Chincoteague National Wildlife Refuge and the Assateague Island National Seashore to the immediate north, and the Wallops Island National Wildlife Refuge which borders the main base to the west. These refuges are federal and state protected areas for both migratory and nonmigratory wildlife. Other sensitive habitats at the WFF include habitat for federally listed threatened and endangered species and wetlands as well as estuarine habitats such as Mosquito Creek, Chincoteague Bay, and Hog Creek.

Because site investigations did not indicate the presence of buried waste, odors, stains, or other obvious evidence of waste disposal at the Western and Northern AOCs, these two AOCs were not evaluated in the Ecological Risk Assessment (ERA). These AOCs were evaluated in the screening level ecological risk assessment (SLERA) and most detected contaminants of potential ecological concern (COPECs) were eliminated. The few detected COPECs from the Northern and Western AOCs which were not eliminated during the SLERA had values similar to background levels and were significantly lower values that those detected in the Central and Southern AOCs. Therefore, the Western and Northern AOCs were not considered to have any potential for ecological risk.

Hazard quotients (HQs) were calculated for terrestrial receptors in the Central and Southern AOCs. The AOCs selection was designed to assess potential risks of high concentrations of COPECs in the localized disturbed areas in the Central and Southern AOCs. These localized areas were less than 1.5 acres in size.

HQs for the several chemicals indicate that there exists a potential for adverse impacts to terrestrial wildlife biota at the Central and Southern AOCs. Calculated HQs for SVOCs indicated a potential for adverse effects on terrestrial plants, however, risks for SVOCs were driven by the conservative use of maximum detected concentrations.

Calculated HQs for DDE/DDT indicated a potential for adverse effects for plants and insectivorous birds. However, DDE and DDT were detected at or below background concentrations. Risks are not considered to warrant remedial action when chemicals are present at concentrations that are within background concentrations.

Calculated HQs for a number of metals indicated a potential for adverse effects to terrestrial plants, soil invertebrates, and insectivorous wildlife. Based on multiple lines of evidence including habitat size and quality, the absence of threatened or endangered species, and a variety of exposure and toxicity-related considerations, some metal HQs greater than one were not considered to have significant potential for terrestrial ecological hazard. Antimony was detected below background concentrations. Chromium HQs were based on the more toxic chromium VI and therefore, were considered to be an overly conservative estimate. Arsenic, barium, cadmium, chromium, lead, selenium, and vanadium HQs exceeded NOEAL TRVs but

did not exceed LOAEL TRVs. Use of NOAEL TRVs are likely to result in conservative assessments of risk.

Calculated HQs for a number of metals and DDD/DDE/DDT indicated a potential for adverse effects on aquatic life and benthic invertebrates. HQs for the majority of chemicals indicate that there exists a negligible potential for adverse impacts to piscivorous birds and mammals. The exception being the potential for adverse impacts to piscivorous wildlife from aluminum.

At present, the terrestrial portion of the site is disturbed and supports minimal forested vegetation mixed with mowed grass and road edges, but it does offer habitat for worms and insects, and does not prohibit use as a forage area for mammals and birds. Ecological risks to many terrestrial species are therefore considered to have marginally significant potential for ecological hazard at the community level. There is potential for adverse effects to plants and soil invertebrates.

Based on the evaluation of the HQs using all available lines of evidence, the following COPECs are expected to result in a significant potential for ecological hazard:

- Plants - barium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, vanadium, and zinc;
- Soil invertebrates - barium, chromium, copper, lead, manganese, nickel, selenium, vanadium, and zinc;
- Aquatic life – aluminum, barium, and selenium;
- Benthic invertebrates – DDD, DDE, DDT, antimony, arsenic, cadmium, iron, lead, mercury, silver, zinc; and
- Piscivorous wildlife – aluminum.

Conclusions. Based on the findings of the RI and risk assessments, no evidence of waste disposal was discovered at the Northern and Western AOCs, and they do not pose unacceptable risks to human health and/or the environment under current use scenarios. Unacceptable risks and hazards generated by future-use scenarios for these two AOCs were the result of the use of groundwater data that is clearly impacted by contamination from the Central and Southern AOCs.

Unacceptable risks associated with the Central and Southern AOCs are present at the site. Solid waste is clearly evident at the surface and persists to a depth of at least 13 feet in some areas. A Feasibility Study will be prepared to evaluate remedial alternatives to address these two sites and downgradient areas. The presence of a mission-critical fiber optics line located on the east side of the NOAA access road must be factored into the remedial design.

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LIST OF ACRONYMS

ABS	dermal absorption factors
ADAF	age-dependent adjustment factors
ADD	average daily dose
AF	adherence factor
ALM	Adult Lead Model
AOC	Area of Concern
ATc	carcinogenic averaging time
atm-m^3/mol	atmospheres per cubic meter per mole
ATnc	non-cancer averaging time
BAF	Bioaccumulation Factor
BCF	Bio-concentration Factor
bgs	below ground surface
BERA	Baseline Ecological Risk Assessment
BTAG	Biological Technical Assistance Group
BTEX	benzene, toluene, ethylbenzene, and xylene
BTV	background threshold value
BW	body weight
C	Celsius
CAG	Carcinogen Assessment Group
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDI	chronic daily intake
CDL	Construction Debris Landfill
cm	centimeters
cm^2	square centimeters
cm/s	centimeters per second
CNAAS	Chincoteague Naval Auxiliary Air Station
COCs	contaminants of concern
COPCs	chemicals of potential concern
COPECs	chemicals of potential ecological concern
DA_{event}	absorbed dose per event
DL	detection limit
DO	Dissolved Oxygen
DOT	U.S. Department of Transportation
EC	Electrical Conductivity
ECD	Electron Capture Detector
ED	exposure duration
EF	exposure frequency
EM	Electromagnetic
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
EPH	Extractable Petroleum Hydrocarbons

LIST OF ACRONYMS (Continued)

ERA	Ecological Risk Assessment
EV	event frequency
ET	exposure time
F	Fahrenheit
FES	Forrest Environmental Services, Inc.
FI	fraction ingested
FID	Flame Ionization Detector
FSAP	Field Sampling and Analysis Plan
ft/yr	feet per year
ft/day	feet per day
FUDS	Formerly Used Defense Site
g/day	grams per day
GC	Gas Chromatograph
gpd/ft	gallons per day per foot
GPR	Ground Penetrating Radar
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
HP	Hydropunch
HQ	hazard quotient
HSA	Hollow-Stem Auger
ID	Inner Diameter
IDW	Investigation-Derived Waste
IEUBK	Integrated Exposure Uptake Biokinetic model
Inh	Inhalation rate
IR-C	crab ingestion
IR-F	fish ingestion
IR-G	groundwater ingestion
IRIS	Integrated Risk Information System
IR-S	ingestion rate of soil
IR-SD	ingestion rate of sediment
IR-SW	surface water ingestion rate
kg	kilogram
L	liters
LADD	lifetime average daily dose
$LD_{50}s$	lethal dose to 50 percent
L/hr	liter per hour
LOAEL	lowest doses at which effects are observed
LSI	Limited Site Investigation
m^3/day	cubic meters per day
m^3/hr	cubic meters per hour
m^3/kg	cubic meter per kilogram

LIST OF ACRONYMS (Continued)

MADEP	Massachusetts Department of Environmental Protection
MCL	maximum contaminant level
MDL	method detection limit
µg/dL	micrograms per deciliter
µg/kg	micrograms per kilogram
µg/L	micrograms per Liter
mg/cm^2	milligrams per square centimeter
mg/day	milligrams per day
mg/kg	milligrams per kilogram
mg/kg/day	milligrams per kilogram per day
mg/kgbody wt/day	milligrams per kilogram of body weight per day
mg/kgsoil	milligrams per kilogram of soil
mg/L	milligrams per liter
mL	milliliter
MHz	megahertz
MIP	Membrane Interface Probe
mmhos/m	millimhols per meter
msl	mean sea level
ms/M	millisiemens per meter
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MTBE	Methyl-tert-butyl-ether
MW	Monitoring Well
NASA	National Aeronautic and Space Administration
NCP	National Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NOAEL	no adverse effect level
NMI	National Wetlands Inventory
ORP	Oxidation Reduction Potential
ORNL	Oak Ridge National Laboratory
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PID	Photoionization Detector
PEF	particulate emission factor
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	part per million
PQLs	practical quantitation limits
PRGs	preliminary remediation goals
PRP	Potential Responsible Party
PVC	Polyvinyl Chloride
QA/QC	Quality Assurance/Quality Control
QSAR	quantitative structure-activity relationships

LIST OF ACRONYMS (Continued)

RA	Risk Assessment
RAGS	Risk Assessment Guidance for Superfund
RBC	risk-based concentration
RfDs	reference doses
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RL	reporting limit
RME	Reasonable Maximum Exposures
RSL	Regional Screening Level
SA	surface area
SB	soil boring
SD	sediment
SF	slope factors
SLERA	Screening Level Ecological Risk Assessment
SPI	site presence index
SSAF	soil-to-skin adherence factor
SSL	soil screening level
SVOC	semi-volatile organic compound
SW	Surface Water
t_{event}	event duration
TAL	target analyte list
TCL	target compound list
TDS	Total Dissolved Solids
THQ	target hazard quotient
TOC	Total Organic Carbon
TP	Test Pit
TRVs	toxicity reference values
UCL	upper confidence limit
U.S.	United States
USACE	U.S. Army Corps of Engineers, Norfolk District
USATEC	U.S. Army Topographic Engineering Center
VDEQ	Virginia Department of Environmental Quality
VOC	Volatile Organic Compound
VPH	Volatile Petroleum Hydrocarbons
VRP	Voluntary Remediation Program
WFF	Wallops Flight Facility
WWII	World War II

1.0 INTRODUCTION

This report presents the results of the Remedial Investigation (RI) for the Construction Debris Landfill (CDL) Site located in the northern part of the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center's Wallops Flight Facility (WFF) Main Base located near Chincoteague, Virginia. The current RI of the CDL Site addresses the United States Environmental Protection Agency (EPA) and Commonwealth of Virginia Department of Environmental Quality's (VDEQ) concerns associated with the presence of elevated concentrations of contaminants detected in initial screening level investigations of the area. The RI also conforms to the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

The overall objective of the RI at Wallops CDL Site was to gather sufficient chemical, hydrogeological, and ecological data to allow a complete assessment of the presence of on-site contamination, potential for offsite migration of contaminants, and impacts on human health and the environment via baseline human health and ecological risk assessments. A further objective was to generate the required data to determine whether further investigations are required, whether remedial action is required, and later, to estimate the scope of any remediation required. To meet these objectives, a multimedia sampling program was designed that included a surface geophysical investigation, test pits and exploratory soil borings, installation of groundwater monitoring wells, and collection of groundwater, surface water, sediment, and soil samples. Following data validation of the analytical results of these samples, data were used to characterize the site, determine the nature and extent of contamination, and perform a human health and ecological risk assessment to evaluate potential threats to human health and the environment according to EPA and VDEQ guidance for performing these studies.

1.1 Background

The WFF is located in Accomack County, Virginia, on the Atlantic Coast of the Delmarva Peninsula (Figure 1-1) approximately 5 miles south of the Maryland/Virginia state boundary, and just to the west of Chincoteague Island. WFF consists of three separate land areas: Wallops Main Base, Wallops Mainland, and Wallops Island (Figure 1-1). The Main Base is approximately 2,230 acres, and is bounded by Little Mosquito Creek to the north, Cedar Creek to the south, Simoneaston Bay to the east, and Wattsville Branch to the west. Wallops Mainland and Wallops Island are located approximately 7.5 miles southeast of the Main Base.

The Department of the Navy acquired the site in 1942 and established the Chincoteague Naval Auxiliary Air Station (CNAAS) as a training facility for World War II (WWII) naval aviators. Prior to development for the CNAAS, this area principally consisted of farmland and marshes. Aerial photographs indicate that by 1943, various buildings and three runways were complete. Over the years the mission of the CNAAS facility changed numerous times; the three runways were modified and extended as needed, resulting in the construction, expansion, and occasional abandonment of numerous associated structures and roadways.

Eventually, the Navy decided to shut down the CNAAS, but it continued to operate until its official closing in 1959. NASA took custody of the Main Base, the northern portion of Wallops Island, and the Mainland area on June 30, 1959; custody was finalized on December 1, 1961. From 1959 to 1974, the area consisting of the Main Base, Wallops Island, and Wallops Mainland was known as Wallops Station and activities were conducted in support of the Civilian Space Program.

In 1975, the facility name was changed to Wallops Flight Center. In July of 1975, NASA excised approximately 397 acres of land along the eastern side of the Main Base to the Fish and Wildlife Service to establish the Wallops Island National Wildlife Refuge. In October 1981, Wallops Flight Center was consolidated with the Goddard Space Flight Center in Maryland and the name was officially changed to the Wallops Flight Facility (WFF). Since then, WFF has become NASA's primary facility for suborbital programs.

WFF is responsible for the planning and launching of scientific satellites, sounding rockets, test vehicles, and other payloads. Wallops Main Base consist of numerous structures used by NASA for various purposes including headquarters, administrative offices, tracking facilities, a range control center, rocket and fuel storage depots, inspection facilities, several support shops, housing units, and an airfield.

The anticipated future use for WFF is the same as the current use, an industrial launch facility/airport. The recent commitment by the State of Virginia to establish WFF as a major spaceport greatly increases the likelihood that the facility's mission will remain largely the same as it is today. Additionally, there are technical reasons related to rocket orbital trajectory and economies that can be achieved from launches at the WFF latitude that cannot be achieved from NASA facilities in Texas and Florida. Therefore, base closure appears unlikely.

The strategy for remediation and closure of the installation is being overseen by the following: EPA Region III, VDEQ, and NASA.

1.2 Site Description and History

The Wallops CDL Site is comprised of four Areas of Concern (AOCs) defined by earlier investigations. Located at the northeast corner of the WFF, the CDL Site (Figure 1-2) was discovered in 2000, when the United States Army Topographic Engineering Center (USATEC) produced a historical analysis report of area ground scars, disturbances, channels, and other activities at WFF dating back to pre-United States (U.S.) involvement in WWII (*Wallops Flight Facility – Main Base – Ground Features; GIS Based Historical Photographic Analysis 1938-1980*, USATEC, November 2000). Specifically, aerial photographs revealed a series of ground disturbances in areas at the northeast corner of WFF that are clearly visible in 1949, 1954, 1959, and 1963 aerial photographs. By 1963, some of these features were no longer visible, and by 1974, none of them remained visible (USATEC, 2000, pages 21-30). To provide a more geographic frame of reference for discussing the AOCs, they will be identified as the Western, Northern, Central, and Southern AOCs (Figure 1-3), corresponding to the work plan's descriptions as the "shallow excavation", "disturbed ground", "mounds of material", and "burning dump", respectively.

One of these features, the Western AOC, was interpreted to be a shallow excavation that would now be located inside the runway area fence. East of this location and the present-day fence were several features that were referred to (listed in order from northeast to east) as Disturbed Ground in 1949, but Excavation in 1954 (Northern AOC); Mounds of Material in 1954, changing to Excavation in 1959 (Central AOC); Disturbed Ground/Probable Burning Dump (the Southern AOC); and two Man-Made Channels. A 1950 Site Map confirms a "Burning Dump" was present at the Southern AOC.

The 2001 Preliminary Potential Responsible Party (PRP) Analysis recommended the Department of Defense and the U.S. Army Corps of Engineers (USACE) assume the responsibility for various sites, under the Formerly Used Defense Sites (FUDS) Program. This included the CDL Site, located at the northeast corner of WFF just east of the approach end of NASA Wallop's Runway 22 and along the access road to the facility. NASA did not use these areas for any known purpose. Figure 1-2 indicates the general location and Figure 1-3 provides a

detailed map of the former CDL Site area, including the four AOCs as identified from USATEC (2000).

The water table aquifer, known as the Pleistocene Columbia Group aquifer (Columbia aquifer), is unconfined and typically overlain by deposited beach sands, silts, and gravel. The aquifer generally occurs between depths of 5 and 60 feet below ground surface (bgs) in upland areas, but is essentially at the surface in marshy areas. Therefore, the water table ranges from depths of 0 to 30 feet bgs in the general vicinity of the CDL Site. Groundwater flow is generally northeastward to east ward towards the marsh area that separates Chincoteague Island from the mainland (NASA, 1994).

The top of the shallowest confined Miocene aquifer of the Yorktown Formation at WFF is found at depths of approximately 100 feet bgs. It is separated from the overlying Columbia aquifer by a 63 foot thick confining layer (aquitard) of clay and silt noted in the geologic log for the Town of Chincoteague Yorktown water supply well located within the CDL Site boundary, TCO6 (Figures 1-2 and 1-3). Additionally, this log indicates a 15-foot thick clay confining layer is found within the Columbia Group at a depth of 27-42 feet bgs. The continuity of this confining layer across the CDL Site was verified by data collected during the MIP investigation conducted as part of the RI.

NASA has five drinking water wells on the Main Base completed in the Yorktown Formation. The town of Chincoteague has seven active drinking water wells along Rt. 175 between the CDL Site and the Visitor Center; three are completed in the Columbia Formation and used seasonally (these wells are just west of Main Base Boat Dock), and four are completed in the Yorktown Formation and used throughout the year.

Sensitive habitats on and adjacent to the WFF include the Chincoteague National Wildlife Refuge and the Assateague Island National Seashore to the immediate north, and the Wallops Island National Wildlife Refuge which borders the main base to the west. These refuges are federal and state protected areas for both migratory and non-migratory wildlife. Other sensitive habitats at the WFF include habitat for federally listed threatened and endangered species and wetlands as well as estuarine habitats such as Mosquito Creek, Chincoteague Bay, and Hog Creek.

The National Wetlands Inventory (NWI) map overlay for Chincoteague and the Accomack County Wetland Maps for the area of the WFF indicate that both tidal and non-tidal wetlands occur at the site. There are three predominant kinds of wetlands at WFF, including marine, estuarine, and palustrine wetlands. The NWI map indicates many large areas of estuarine wetlands adjacent to the main base, with several smaller parcels of palustrine forested wetlands. On Wallops Island, most of the wetlands mapped by NWI are mapped as estuarine.

1.3 Previous Investigations

Two prior investigations have been performed at the site (Figures 1-4 to 1-7). An August 2002 Limited Site Investigation (LSI) by SAIC was dedicated to collecting several soil and groundwater samples around the CDL Site area (SAIC, 2003) from the locations labeled CDL-01, CDL-02, and CDL-03; these sample locations were prefaced with SB (for soil boring) for soils data and HP (for hydropunch) for groundwater data. The 2002 locations were expected to hold some evidence of past activities and suggest if contaminants had been introduced into any of these past areas of disturbance. The investigation indicated elevated organic contamination and elevated arsenic levels above the 2004 Risk Based Concentrations (RBCs) in the subsurface soils as well as organic contamination in the groundwater.

A second field investigation in March/April 2004 used a passive soil gas survey (Gore-Sorber technique) centered around the elevated organic impacted area and indicated the presence of benzene, toluene, ethylbenzene, and xylene (BTEX), as well as chlorinated solvents (Figures 1-4 to 1-7). Soil gas concentrations were highest near the largest of the suspected debris piles at the northern end of the Southern AOC and southeastern end of the Central AOC, but were also elevated to a lesser degree in other areas of the site.

Data used in the RI and risk assessment included samples analyzed for full Target Compound List/Target Analyte List (TCL/TAL) parameters. All TCL/TAL data (100%) was fully validated. The RI also included collection of various other analytical parameters (hardness, alkalinity, Total Dissolved Solids [TDS], Total Organic Carbon [TOC]), and grain size) needed to evaluate the significance of this data to uptake by receptors.

1.3.1 2002 Limited Site Investigation: Soil Sampling

In August 2002, SAIC advanced three GeoProbe borings in the CDL Site (SB-CDL-01, SB-CDL-02, and SB-CDL-03), shown on Figures 1-4 to 1-7. Significant visual and analytical evidence of contamination were found only at the SB-CDL-01 boring location. The locations of the 2002 LSI samples, although faithfully reproduced from the report's map (SAIC, 2003), are likely in error. The plotted location is within the marsh, and a GeoProbe rig could not have operated there. The locations were likely farther west than shown in Figures 1-4 to 1-7.

A prominent layer of contaminated soil was encountered at a depth of 7.5 feet bgs at SB-CDL-01, where a visible jet-black sheen was noted. The sheen persisted to a depth greater than 16 feet (the boring was terminated at 16 feet bgs). Photoionization detector (PID) readings indicated volatile organic compounds (VOCs) at greater than 1,000 parts per million (ppm) when screening soil samples, and registered 62 ppm when held over the open boring hole at the foot of the GeoProbe rig (field logbook entry). Samples were collected from just above and below the water table within the contaminated layer (6.5 and 9 feet bgs, respectively). A GeoProbe Hydropunch groundwater sample was also collected at this location (depth not recorded). All samples were analyzed for mercury and (TAL) metals, semi-volatile organic compounds (SVOCs) and VOCs.

Metals analysis revealed that SB-CDL-02 and SB-CDL-03 had higher metals concentrations than were found at SB-CDL-01. The exceptions were arsenic and barium, which appeared to be roughly equivalent in all three CDL Site boring locations (Tables 1-1 and 1-2). The groundwater sample collected from the SB-CDL-01 location revealed elevated levels of iron and manganese at 28,600 and 791 micrograms per liter (µg/L), respectively, which exceeded the 2004 Region III tap water RBC screening values of 11,000 and 730 µg/L, respectively.

SVOC analytical results for SB-CDL-01 from the 6.50-foot depth sample revealed a variety of SVOCs at estimated concentrations less than the 330 micrograms per kilogram (µg/kg) reporting limit. These included acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, carbazole, chrysene, dibenzofuran, indeno(1,2,3-cd)pyrene, and naphthalene. Additionally, fluoranthene (430 µg/kg), phenanthrene (530 µg/kg), and pyrene (510 µg/mg) were also detected. No VOCs were detected in the 6.5-foot depth (top of interval) soil sample analysis. SVOC analysis of the 9-foot bgs soil sample collected from within the contaminated layer at SB-CDL-01 had concentrations of

fluorene and phenanthrene at estimated values of 95 and 63 µg/kg, and 2-methylnaphthalene and naphthalene above reporting limits at 2,500 and 830 µg/kg, respectively.

VOCs were detected in the 9-foot bgs sample from the SB-CDL-01 boring but not in the 6.5-foot sample. VOC concentrations reported in the 9-foot bgs soil sample from SB-CDL-01 include: 1,2-dichloropropane at 2,000 µg/kg, ethylbenzene at 12,000 µg/kg, m-and/or p-xylene at 9,600 µg/kg, and tetrachloroethene (PCE) at 1,100 µg/kg.

1.3.2 2002 Limited Site Investigation: Groundwater Sampling

At HP-CDL-01, numerous VOCs were detected. At a concentration of 1.1 µg/L, trichloroethene exceeded the 2004 Region III RBC screening value of 0.026 µg/L for tap water. Other VOC constituents detected were: chloromethane at 0.7 µg/L, cis-1,2-dichloroethene (DCE) at 12 µg/L, ethylbenzene at 920 µg/L, m-and/or p-xylene at 3,700 µg/L, o-xylene at 1,700 µg/L, styrene at 22 µg/L, PCE at 12 µg/L, and toluene at 12,000 µg/L (Tables 1-1 and 1-2). PCE and xylenes concentrations were more than an order of magnitude higher than the 2004 RBCs for these compounds.

In the HP-CDL-02 sample, benzene was detected at 0.54 µg/L, which exceeds the Region III RBC tap water screening value for benzene of 0.34 µg/L. Toluene was also detected in the HP-CDL-02 sample at 1.1 µg/L, which is far below the 750 µg/L 2004 Tap Water RBC screening value. Cis-1,2-dichloroethene was detected at 2.3 µg/L in HP-CDL-03, which is below the 2004 RBC.

1.3.3 2004 Forensic Soil Analyses

The 2004 Forensic Soil Investigation was performed by USACE personnel. A single soil sample (04 SGI-CDL-SB01-07) collected from the contaminated layer detected at 7.5 feet in SB-CDL-01 was analyzed for volatile petroleum hydrocarbons (VPH) and extractable petroleum hydrocarbons (EPH) via the Massachusetts Department of Environmental Protection (MADEP) method, and EPA Method 8015 Gas Chromatograph (GC) fingerprinting analysis. The EPA 8015 analyses of the contaminated soil sample material produced a chromatogram that, while clearly in the distillate hydrocarbon range, failed to satisfactorily match the Petroleum Chromatogram Standards, but appeared to be weathered JP-5 aviation fuel with a significant number of the lower boiling point hydrocarbons missing. JP-5 is a high flashpoint (low

volatility) kerosene fuel developed for the Navy in 1952. Due to its combination of high specific performance and exceptional flash resistance, it has been used continuously and heavily since being introduced.

The MADEP VPH method is used to evaluate gasoline, mineral spirits and certain petroleum naphthas. The MADEP EPH method is used to evaluate the sample material for the presence of kerosene, jet fuel, heating oil, lubricating oils and other petroleum products containing a significant percentage of hydrocarbons heavier than C_{12}. The VPH method is also able to measure individual concentrations of the VPH target analytes, including BTEX, naphthalene, and methyl-tert-butyl-ether (MTBE), in water and soil Analytical results are provided in Tables 1-3 to 1-5.

The largest fraction of the material is in the C_{19} to C_{22} hydrocarbon range, noticeably lacking in the lower weight hydrocarbons. Even more distinctive is the complete lack of aliphatic hydrocarbons in the $C_{19} - C_{36}$ weight range. All three analyses, EPA 8015 GC Fingerprinting, as well as MADEP VPH and EPH methods support an interpretation that the unknown contaminant material is a distillate fuel.

1.3.4 2004 Soil Gas Investigation

In 2004, a Gore-Sorber passive soil gas investigation was conducted. Using a modified EPA method 8260/8270, the W.L. Gore Screening Modules Laboratory processed 51 passive soil gas survey modules collected from an array that covered the upland areas of the Wallops CDL Site (Figures 1-4 to 1-7). Four of these survey modules were trip blanks. No target compounds were detected in any of the trip and method blanks. The greatest concentrations were associated with the largest suspect waste disposal area located in the eastern half of the CDL Site.

The passive soil gas survey produced enough data to define several areas of significant contamination, none of which appear to be coming into the area from elsewhere on the WFF. As such, it is very likely that the contaminants discovered and plotted were the result of historic dumping of fuel and solvents related to aircraft operations and maintenance. The most mobile of the contaminants, BTEX, appear to have migrated downgradient and potentially offshore from the probable location of the original burning dump, the Southern AOC, or the former excavation area to the north of it, the Central AOC. Peak areas for chlorinated solvents appear to be more closely associated with the boundary of the Burning Dump, the Southern AOC. Reducing

conditions normally associated with marshlands may be naturally attenuating the chlorinated VOCs in the downgradient areas, whereas BTEX compounds only degrade readily under oxidizing conditions.

The 2004 Gore Sorber passive soil gas anomalies were one of the principal resources used to target sampling activities during this RI. While the high intensity peaks in accessible areas were sampled in most cases, not all of the low intensity anomalies were directly investigated, given the nature of the passive soil gas methods. For instance, the BTEX (and toluene) anomaly near the south end of the Southern AOC is not within the foot print of the former CDL Site burning dump. The single soil gas point responsible for this anomaly is located within a roadside drainage ditch near the confluence of another ditch that drains the area south of the site. The soil gas concentrations detected at this point are extremely low and of the same concentration as a similar anomaly located at the northern end of the Western AOC (SB-2A/2B), at the anomaly at the north end of the Northern AOC (TP-5A/5B), and within the Southern AOC (TP-2A/2B and TP-3A/3B) where analytical samples were collected. None of the soil samples collected from these single point soil gas anomalies detected any BTEX compounds, or any other VOCs, for that matter.

1.4 Report Organization

The format of this report presents data from the RI, Ecological Risk Assessment (ERA), and Human Health Risk Assessment (HHRA). Section 2.0, Site Investigation, addresses a brief discussion of the sampling program, highlighting areas where any modifications to the work plan were encountered or additional procedural information may be helpful; otherwise all field procedures were as documented in the Field Sampling and Analysis Plan (FSAP, Versar, 2007). Section 3.0 discusses the environmental setting.

Section 4.0 provides the results of the RI. Sections 6.0 and 7.0 present the HHRA and ERA, respectively. Throughout the report, extensive use is made of summary data tables, emphasizing the frequency and magnitude of detected contaminants. More expansive data tables are reserved for the Appendices and are provided on a CD-ROM.

2.0 SITE INVESTIGATION

The field activities performed at the CDL Site are described below. At the CDL Site, groundwater transport appears to be the primary contaminant dispersal mechanism. No surface water bodies cross the site, and the site is well vegetated. The purpose of the RI field activities were to fill critical data gaps for groundwater, soils, surface water, and sediments to provide an adequate characterization of the nature and extent of contamination in the immediate vicinity of the CDL Site.

During the RI, Versar performed the following: a geophysical survey, a MIP investigation, test pit and soil boring sampling, well installation, groundwater sampling, aquifer testing, and surface water and sediment sampling. All samples were analyzed for TCL/TAL constituents. The field activities were conducted in a phased approach to better identify potential source areas and/or hot-spots and refine the final placement of groundwater well sites and sampling locations. Sampling locations were finalized based on the results of the screening completed in the phase prior to the activities. All activities were performed as specified in the FSAP (Versar, 2007). The only significant deviation was the addition of several ground penetrating radar (GPR) transects over and above the scope of work provided in the work plan. Please see the Final FSAP for a more detailed discussion of techniques applied during the field activities at the CDL Site.

2.1 Geophysical Survey

Versar retained a specialty subcontractor to delineate the site electromagnetically. Forrest Environmental Services, Inc. (FES) performed a geophysical survey at the CDL Site located east of Runway 22 on Wallops Island, Virginia on March 14 and 15, 2007 (Figure 2-1). The investigation consisted of an electromagnetic (EM) survey across all upland areas of the site and limited GPR surveys at selected target areas to locate suspected metal and non-metal buried debris at the four AOCs. The EM survey was conducted in accordance with Section 5.1 of the FSAP.

The EM survey was located east of the runway. Data was collected along linear 10-foot transverses having stations at 2.5-foot centers that covered approximately 450 by 750 feet. FES placed orange pin flags at 50-foot centers that were labeled with the northing and easting of each station. The GPR was used to confirm the results of the EM survey in a few locations.

2.1.1 Electromagnetic Survey

The EM survey was performed using an EM-31 induction meter to measure the apparent conductivity of the subsurface. The EM-31 consists of two horizontal coplanar loops, one acting as a transmitter and the other as a receiver. The transmitter induces electrical eddy currents in the earth, which in turn produce a secondary magnetic field. The receiver intercepts the secondary field, and the meter measures the terrain conductivity by comparing the strength of the secondary field to that of the primary field.

The depth of investigation by EM is a function of the intercoil spacing and the orientation of the antenna dipoles. The EM-31 has an intercoil spacing of 12 feet, and used in the vertical dipole mode, has an effective penetration depth of approximately 18 feet.

Two readings were obtained from the EM-31 at each measurement station. The EM was connected to a data logger that simultaneously recorded both the quadrature-phase component and the in-phase component. The quadrature-phase component measures the apparent terrain conductivity of the subsurface, and will detect metallic and nonmetallic objects or features with conductivities that deviate from their surroundings. The background apparent terrain conductivity value at the site was approximately 12 millimhols per meter (mmhos/m), as measured in an open area near the NASA Visitors Center off Route 175 (see Appendix A for the location). The EM was calibrated according to the manufacturer's instructions (Appendix A) at the beginning of each day, and periodically throughout the day at the discretion of the geophysicist. The EM was "ground–truthed" based on the experience of the operator during the course of the investigation as the survey covered areas of the site with marked subsurface utilizes, steel reinforced culverts, and other such known sources of cultural interference.

The in-phase component measurements are proportional to an effective, average magnetic susceptibility of the surrounding earth; this mode is sensitive to large metallic objects. The readings do not indicate true magnetic susceptibility because there is an unknown additive constant and multiplying factor that would be required to convert the measured values to magnetic susceptibility.

Generally, negative EM values can indicate the areal extent of large, shallow buried metal objects. The EM displays moderate-sized objects that are buried deep as areas of high conductivity; therefore, both high and negative readings of apparent conductivity can indicate

metal. However, high conductivity materials can also be caused by conductive chemical compounds such as acids, sulfates, fly ash, and salts in the subsurface and by conductive soils such as clay. Low conductivity materials such as wood and oil are generally not detectable by the EM.

The EM survey determined that numerous metallic anomalies were detected across the Central and Southern AOCs, as well as cultural interferences from the fence line, buried underground wiring, and culverts. The EM survey identified five anomalies across the survey area. Each of the five anomalies was not attributed to any anthropogenic interference. Figure 2-1 shows the locations of the suspected EM anomalies. Anomalies A through D appear to be from large masses of buried material. Anomaly E corresponds to an area of numerous small buried metal objects such as 5-gallon pails or paint cans. The entire EM report is found in Appendix A.

2.1.2 Ground Penetrating Radar Survey

The GPR survey was performed using a Noggin Smart Cart with a shielded 250 megahertz (MHz) antenna. GPR is an EM method that detects interfaces between subsurface materials with contrasting dielectric constants. The GPR system consists of an antenna that consists of a transmitter and receiver that were connected to a computer that processes the received signal and located the position of data collection.

The transmitter radiates repetitive short-duration EM waves into the earth from the antenna as it is moved across the ground surface. These radar waves are reflected back to the receiver by interfaces between materials with different dielectric constants. The intensity of the reflected signal is a function of the dielectric constant contrast at the interface, the conductivity of the material the wave is traveling through, and the frequency of the signal. Subsurface features that cause reflections are: (1) natural geologic conditions such as changes in sediment composition, bedding and cementation horizons, voids, and water content, and (2) fill materials or changes in the subsurface such as soil backfill, buried debris, underground storage tanks, pipelines, and utilities. The controlling unit receives the signal from the antenna and produces a continuous cross-section of the subsurface interface reflections.

Depth of GPR signals is highly site-specific and is limited by signal attenuation or absorption of the subsurface. Signal attenuation is dependent on the electrical conductivity of

subsurface materials. Signal attenuation is greatest in materials with high conductivity, such as clays or brackish groundwater, and lowest in low conductivity material, such as unsaturated sand or rock. GPR depth penetration is dependent on antenna frequency. Depth penetration increases with decreasing frequency; however, identification diminishes proportionally with smaller features. The depth penetration of the GPR survey is approximately 8 feet bgs.

The GPR survey used a 250 MHz antenna that was internally shielded from above ground and adjacent anthropogenic sources. The GPR survey was performed by a project geophysicist pulling the antenna adjacent to the proposed column locations. The location of the antenna along the transect lines were marked electronically from a survey wheel. Data were collected at 0.1-foot intervals and stored on the laptop computer.

The GPR data were converted into a GPR depth model using Sensors and Software, Inc. pulse EKKO software. The GPR data was gained and a low frequency response filter was included to the raw data.

The GPR survey was conducted within the four suspected buried areas. Figure 1 of Appendix A shows the four lines which were surveyed to confirm the EM results. GPR lines 1 through 3 support the EM results and also do not indicate buried debris (Figures 4-6 of Appendix A). GPR line 4 (Figure 7 of Appendix A) did not indicate buried debris beneath the road and the four anomalies it did indicate can all be attributed to surface anthropogenic interferences.

2.2 Membrane Interface Probe Investigation

Versar retained a specialty subcontractor to conduct a MIP survey to further investigate the geophysical anomalies and hotspots evident in the Gore-Sorber soil gas data (Section 1.3, Figures 1.4 to 1.7), aerial photography anomalies, and EM/GPR anomalies. Vironex, Inc. performed the MIP investigation at the CDL Site on March 22, 2007. The investigation provided further information to assist in the final placement of test pits, soil borings, and groundwater monitoring wells. The MIP investigation was conducted according to Section 5.2 of the FSAP.

A total of eight locations were selected for MIP investigation (MIP-1 through MIP-8). The MIP was advanced within the four initial test pit areas corresponding to peaks in the Gore-Sorber passive soil gas data. Additionally, four more locations were investigated within the CDL

Site, corresponding to the geophysical EM/GPR anomalies that were identified. MIP investigation locations are shown on Figure 2-1. Data was collected electronically and plotted graphically for analysis. MIP borings were advanced to 26 to 40 feet bgs to ensure the probe penetrated the water table.

The MIP system is an advanced site investigation tool developed for the logging of total VOCs and classifying soil lithology in the subsurface. As the MIP is driven to depth using GeoProbe soil probing equipment, a permeable membrane on the side of the probe is heated at desired intervals to volatilize organic compounds. The VOCs permeate the membrane and are delivered to the surface using an internal carrier gas. The MIP system is equipped with an electrical conductivity (EC) tool, and a lab-grade gas chromatograph equipped with a PID, flame ionization detector (FID), and an electron capture detector (ECD). The order of analysis is ECD, PID, and FID; because FID is a destructive technique it must come last.

The MIP is sensitive to a full range of VOCs, including chlorinated solvents, petroleum hydrocarbons, and methane. Both the FID and PID are sensitive to most common VOCs, while the ECD is used primarily to differentiate chlorinated solvents. An electronic, real-time MIP log produces semi-quantitative information on contaminant levels, a depth/speed graph, an EC log of the formation (lithology), and a temperature log of the heated sensor (used to detect water-bearing zones).

The MIP consisted of a truck-mounted rig (GeoProbe 6600). The rig was equipped with standard rods fitted with the MIP tool and the corresponding carrier gas and conductivity tubing. The MIP was advanced at each location to measure the EC and VOC data. A response check of the MIP and field GC was performed between each location (Appendix B).

As the probe was driven to depth, it was stopped every six inches to gather VOC data. Conductivity data were gathered on a continuous basis. At the desired intervals, the permeable membrane interface on the wall of the probe was heated. Any VOCs that were exposed to the membrane were volatilized and picked up by the carrier gas behind the membrane and delivered to the GC (a Hewlett Packard 5890) and detectors at the surface (PID, FID, and ECD). A stringpot mounted on the probe sensed the movement of the probe and measured the depth and speed. The data was stored in a spreadsheet compatible format for later graphing and analysis.

Results from the MIP survey showed one location where the MIP detected VOCs, MIP-5. All other MIP locations did not indicate any suspect buried debris or contamination. MIP-5 had significant ECD, PID, and FID readings during the investigation. When the rods were extracted from the boring hole, they were covered in a battleship-gray colored paint-like substance. Although the ECD, PID and FID data from MIP-5 indicate peak concentrations at a depth of 16 to 20 feet, the MIP operator indicated that he believed the EC spikes at 9.5 to 10.5 indicated the probe penetrated a paint container and that the data indicates that paint was running down the borehole, rather than indicating new deposits at depth. The substance also had a paint odor. An attempt was later made to locate the paint container that was penetrated by MIP-5, but only empty crushed drums were found. There is ample historical information available on the type of paint used by the Navy at that time of disposal which can be used to make decisions regarding remedial action in the area where the drums were discovered.

The VOC data later collected from co-located test pits confirms the results of the MIP investigation (see Section 4). Of the soil samples collected from locations where the MIP was used, VOCs were detected at substantial concentrations only in the deep sample from the MIP-5 location; in sample TP-1C nine VOCs were detected at concentrations ranging from 179 to 2,830 ppb. While VOCs were also detected in soil samples later collected at the MIP-6 and MIP -8 locations (soil samples TP-3C and TP-4B, respectively), these VOC detections were fairly low (only two VOCs at concentrations ranging from 0.99 to 13.7 ppb).

Notable EC anomalies were noted in the data from MIP-1, MIP-2, MIP-3, and MIP-8 that indicated the presence of the confining layer for the upper Columbia Aquifer (Section 1.2). MIP-4 also had a small EC anomaly that indicated a thin clay layer was present. The entire MIP report is included in Appendix B.

2.3 Test Pit Investigation

Originally, four test pit locations and two soil boring locations were planned for the CDL Site. However, ten test pit locations (TP-1 through TP-10) with eight soil boring locations (TP-1 through TP-8) were selected for excavation based on the Gore-Sorber, EM, GPR, and MIP investigations. Test pits 1 through 8 were chosen primarily to investigate BTEX and chlorinated solvent anomalies in the GoreSorber passive soil gas data (Figures 1-4 to 1-7). The final locations were keyed to EM/GPR anomalies and VOC/EC anomalies noted during the MIP

Investigation. Test pits TP-9 and TP-10 were advanced to ensure that each AOC had at least two test pits.

On April 9 and 10, 2007, each of the test pits was excavated using a backhoe. The backhoe bucket was steam-cleaned between each location to eliminate the potential for cross-contamination. Test pits were generally the width of the bucket and roughly 10 to 15 feet long. Once the entire length of each test pit had been excavated and observations of the top two feet could be made, worst-case soil samples from the 0 to 6 inch and 6 to 24 inch intervals were collected from the sidewall. The first six inches of the open sidewall was discarded, so that the sample collected for analysis were from a fresh cut.

Soil samples were generally collected from at least two horizons (0.0 to 0.5 feet and 0.5 to 2 feet) whether or not waste was present at the surface. These samples were primarily collected for risk assessment purposes. Additional horizons were sampled when buried material was first encountered at deeper intervals. As specified in the FSAP, soil samples were to be collected from "other depths as warranted by the surroundings, [and] samples collected from the test pits may be selected based on any number of criteria including discoloration, unusual odor, or other evidence of disposal." A deeper soil sample was to be collected at the depth of presumed highest concentration based on field observations (odor, appearance, and PID readings) in the locations where deeper waste deposits were observed. Deeper soil samples were collected from the center of the backhoe bucket to minimize any disturbance to the sample caused by excavation.

No visual, olfactory, or PID instrument evidence of waste disposal was noted in the Western and Northern AOCs, so no deeper soil samples were collected there. For the Central AOC, deeper ("C-horizon") soil samples were collected at TP-1. At the other two locations in the Central AOC, waste deposits were not observed.

For the Southern AOC where abundant waste deposits were noted, deeper "C-horizon" soil samples were collected from TP-3. At test pit, TP-2, no waste deposits were apparent based on field observations. At test pit, TP-7, impacted soil was only noted to a depth of about 2 feet bgs and groundwater was noted at 4 feet bgs. TP-4 is the only test pit location where waste deposits were noted at a depth below two feet and a deeper "C-horizon" sample was not collected because the waste deposits were at the surface and both the "A-horizon" and

"B-horizon" soil samples were within the waste materials. Figures 2-2 through 2-7 show representative pictures of the test pits.

Soil samples were collected as grab samples directly from the backhoe bucket; field personnel did not enter any excavations to collect samples. Samples were transferred directly from the backhoe bucket to the appropriate sample containers, labeled, placed immediately into an ice-filled cooler, and shipped to the laboratory for analysis of TCL/TALs parameters. The test pits were dug and sampled according to Section 5.3 of the FSAP.

2.3.1 Test Pits Exhibiting Waste Deposits

Visible waste deposits were noted in test pits TP-1, TP-3, TP-4, and TP-7. In TP-1, no waste materials were noted until a depth of 8.5 feet bgs, where elevated PID readings and an acrid odor was noted. The location of TP-1 corresponded with the suspected paint can encountered in the MIPs investigation (MIP-5). Empty, crushed 55-gallon drums were noted a depth of 11 to 13 feet bgs (Figure 2-2). An additional sample (TP-1C) was taken at 8.5 feet bgs to characterize the strong smelling interval located just above the drum deposit.

In the top 3.5 feet of TP-3, only clean sand was noted; from 3.5 to 5.5 feet a deposit of cinders, burned rubbish (glass, cans, wires, etc.) and ash was encountered, followed by clean sand from 5.5 to 11 feet bgs. An additional sample was taken at TP-3 at four feet bgs to characterize the buried debris.

Cinders and other burned debris (Figure 2-3) were noted at a depth of one foot bgs in TP-4 and these deposits persisted to the maximum depth of the test pit of eight feet bgs where the water table was noted. No additional samples were taken at TP-4 because the first two samples had adequately characterized the waste material. TP-7 was advanced to a depth of four feet bgs where the water table was encountered. Cinders and other burning dump debris was noted at the surface in TP-7, and these materials extended to a depth of two feet bgs. Very little cover material is present in the southeastern part of the Southern AOC; generally waste materials are present at the surface over most of this area. All of the test pits within the Central AOC had sufficient cover material (> 2 feet), or no waste was detected, however, waste materials are present at the surface over the eastern third of the Central AOC.

2.3.2 Test Pits Where Only Native Soils Were Observed

TP-2, TP-5 and TP-6 showed no evidence of debris to their maximum depths of eight feet bgs, but were sampled to evaluate the Gore Sorber soil gas anomalies (See Section 1.3.4, Figures 1-4 to 1-7). TP-8, TP-9, and TP-10 showed only undisturbed, native soils to their maximum depth of 7.5 to 8.0 feet bgs below which the walls began to collapse TP-8 was sampled to evaluate soil gas anomalies for BTEX and toluene (Figures 1-5 and 1-7).

2.4 Soil Boring and Groundwater Monitoring Well Installation

Six locations were selected for groundwater monitoring well installation. These locations were selected to monitor the four AOCs identified at the CDL Site. Groundwater monitoring wells were installed at the CDL Site April 17 and 18, 2007 in accordance with Sections 5.3 through 5.5 of the FSAP. Soil samples at each well location were collected during the well installation process. Soil Boring Logs are provided in Appendix C. Terra-core sampling equipment with field preservation were used to collect VOCs. Sampling depths were chosen at the "A- and B-horizon" depths to support primary risk assessment scenarios (commercial residential, trespasser, and ecological exposures). "C-horizon" samples were collected where deeper waste was noted to support the construction worker scenario.

At each groundwater monitoring well location, soil samples were collected from two horizons (0.0 to 0.5 feet and 0.5 to 2 feet) with additional horizons sampled when suspect material was encountered (e.g. SB-4A, SB-4B, and SB-4C). The soil samples from the well borings (designated SB-series) have the same number as the monitoring wells (e.g. SB-1A and SB-1B are from the boring for MW-1). Soil samples were grab samples collected from properly decontaminated split-spoon samplers advanced during the well drilling process. Samples were transferred directly from the split-spoons to the appropriate sample containers, labeled, placed immediately into an ice-filled cooler, and shipped to the laboratory for analysis of TCL/TAL parameters.

One additional soil sample at MW-4 was taken at 9 to 10 feet bgs (SB-4C) to characterize soil contamination associated with petroleum stains. The split spoon sample showed intense black staining of the soils, petroleum odors, and PID readings above 500 ppm. Starting at approximately 13 to 14 feet bgs, the soils became less stained with depth.

A total of six groundwater monitoring wells were installed at the CDL Site (Figure 1-3). One of the wells (MW-1) was installed near Runway 22 as a background location. The remaining wells were installed downgradient of the four AOCs to intercept groundwater contamination emanating from the site (MW-2 through MW-6). Wells were installed to a depth corresponding to approximately seven feet below the water table and constructed with 10-foot well screens so that the top of the screen is above the water table during all seasonal water table conditions. Monitoring wells were installed to depths ranging from 13 to 33 feet bgs.

Wells were installed by a qualified well driller, using a mobile drill rig fitted with hollow-stem augers (HSA) with an inside diameter (ID) of 4.25 inches. The wells were constructed with new 2-inch ID, Schedule 40 polyvinyl chloride (PVC) well casing with 0.010 slot screens. After the installation of the screen and casing, the boreholes were backfilled with a clean No. 2 sand filter pack to a level corresponding to 2-feet above the top of the screen. A 6-inch thick layer of fine sand (No. 0), followed by a 2-foot thick layer of hydrated bentonite was placed on top of the filter pack to create an impermeable seal. The remaining void was backfilled with a cement-bentonite grout (slurry consisting of 5 to 10 percent bentonite mixed with Portland cement) to grade. Each well was fitted with a locking well cap and protected with either a steel stickup outer casing (measuring at least two feet in height) or flush-mount manhole, set in a three by three foot, 6-inch thick, concrete pad. Lithology was described during drilling operations through the use of samples collected by 2-foot long split-spoons. Well Logs and Well Construction Diagrams are included in Appendix C.

All drilling equipment that came into contact with the samples was constructed of steel and was properly decontaminated between monitoring well locations as described in Section 6.3 of the FSAP. The types of investigation-derived waste (IDW) generated during well installation were soils, development waters, decontamination fluids, and personal protective equipment (PPE). Soils and fluids were contained within 55-gallon DOT-approved drums pending characterization and proper disposal/treatment. The management, handing, and disposal of the wastes complied with applicable federal and Commonwealth of Virginia solid waste and hazardous waste management regulations as described in Section 5.11 of the FSAP.

Following installation, the wells were developed to purge the well of sediments accumulated during drilling activities. The wells were developed by purging a minimum of five well volumes of groundwater from each well. Development was considered complete when the

purge water was clear to the unaided eye and free of suspended solids (based on visual inspection).

Wells MW-1, MW-2, and MW-6 cleaned up quickly during development. However, the wells downgradient of the Central and Southern AOCs (MW-3, MW-4, and MW-5) were excessively cloudy when the crew returned to them for sampling a week or so later. To ensure optimal sampling conditions, these three wells were developed a second time on April 30, 2007, prior to groundwater sampling. The development water in MW-4 began as a dirty gray color with a slightly sweet chemical odor. MW-5 also produced water at a slower rate than the other five wells. Table 2-1 shows a summary of the wells.

2.5 Groundwater Monitoring Well Sampling

On May 1 and 2, 2007, approximately a week and a half after the six groundwater monitoring wells were first installed and developed, the wells were purged and groundwater samples were collected. A second round of groundwater sampling was also conducted December 18 and 19, 2007. Both rounds of sampling were conducted in accordance with Section 5.6 of the FSAP. Before sampling each monitoring well, the wells were checked for the presence of VOCs using a PID. PID readings were recorded from the wellheads, immediately upon opening each well. After checking each monitoring well for the presence of VOCs, the depth to water and total depth of each well was measured to the nearest 0.01 foot using an electronic water level meter (Table 2-1).

Potentiometric contour maps prepared using the May and December 2007 groundwater elevation data indicate similar groundwater flow directions (Figures 2-8 and 2-9). Overall groundwater flows from southwest to northeast across the CDL Site from upland recharge areas along the plateau where the runway is located to discharge to the adjacent marsh areas. As noted in the FSAP, data from the Waste Oil Dump at WFF (Site 16) which is located in a similar geologic setting at the northern end of Runway 17-35, demonstrated that tidal effects are not significant in this setting. The nature of groundwater flow below the site is a simple water table (unconfined) aquifer. The gradient in the center of the CDL Site is approximately 2 feet per 100 feet, or 0.02.

The shape of the potentiometric surface generally mimics the topography, but is influenced locally by the higher permeability of the waste and cinder deposits of the Southern

AOC (Figures 2-8 and 2-9). The relatively high potentiometric surface elevation noted in MW-3 in both sampling rounds appears to be anomalous. MW-3 is the only well whose screened interval is within a thick waste deposit; all of the other wells are set in sand. Approximately 7 feet of debris was noted in the soil boring for MW-3. Also, MW-3 is the only well whose potentiometric surface elevation is higher in the December data than in the May data. Unlike the other downgradient wells (MW-4, MW-5, and MW-6), clay and semi-stiff silty sand were noted near the base of the waste deposit. It seems likely that these fine grained materials may inhibit drainage of the debris deposit (a classic "bathtub effect"), and lead to an anomalously high water level with the debris deposit. The combination of higher permeability aquifer materials in the cinder deposits with discharge inhibited from the Southern AOC by basal clays, leads to localized groundwater mounding within and upgradient of the Southern AOC as shown in Figures 2-8 and 2-9.

Depth to water varies across the CDL Site. The water table is deepest in the interior upland areas and shallowest at locations nearest the marsh. The depth to water in the upgradient well located near the runway varied from 24.76 to 24.65 feet in the May and December 2007 events, respectively. At the well nearest the shoreline, MW-03, the depth to water varied from 7.20 to 5.80 feet for May and December 2007, respectively.

After collecting the well measurements, purging and sampling was conducted in accordance with protocols recommended in EPA Bulletin No. QAD023, entitled *Recommended Procedure for Low-Flow Purging and Sampling of Groundwater Monitoring Wells* (June 16, 1999). After purging was complete, groundwater samples were collected from the monitoring wells for the TCL/TAL analysis. Purging and sampling were conducted using a peristaltic pump or submersible pump capable of obtaining flow rates between 100 and 500 milliliters (mL) per minute. Pumps were fitted with new, dedicated, and disposable Teflon tubing. The tubing inlet was placed at a depth corresponding to the center of each monitoring well's submerged screen interval. The submerged screen intervals of each well were determined through review of the well logs (Appendix C).

The groundwater samples were collected after field parameters stabilized during purging. The following field parameters were monitored during purging: temperature, pH, specific conductivity, dissolved oxygen (DO), oxidation reduction potential (ORP), and turbidity (Appendix C). All of these parameters were measured using a water quality multi-meter and low volume flow cell (Horiba U-22). The low volume flow cell was connected directly to the

discharge tubing with the multi-meter inserted directly into the low volume flow cell. Purging was considered complete when temperature, pH, specific conductivity, DO, and turbidity readings stabilized for a minimum of three consecutive readings. Stabilization for each parameter is defined as ± 0.1 degree Celsius (˚C), ± 0.1 units for pH, ± 3 percent (%) for specific conductivity, and ± 10 % for DO and turbidity. If parameters failed to stabilize, then sampling was conducted after a minimum of three well volumes of water were removed from the well; this only occurred at well MW-3 during the May 2007 event.

The drawdown in each monitoring well was also monitored during purging using electronic water level meters. The flow rate of the pumps were adjusted (where achievable) as to not allow drawdown in each well to exceed 0.3 feet. Field parameters and drawdown were measured every five minutes until the field parameters stabilized. This ensured sampling of formation groundwater as opposed to stagnant groundwater present in the wells; the calculated final purge volume was greater than the stabilized drawdown volume plus the tubing volume.

Samples were transferred to the appropriate sample containers directly from the discharge tubing (once it was removed from the low-flow cell) and were grab samples. Sample containers were labeled, placed immediately into an ice-filled cooler, and shipped to the laboratory for analysis of TCL/TAL parameters.

All of the sampling materials (sample tubing) that were used for sampling each monitoring well were new, dedicated, and disposable, and were replaced between well locations. The water level meters, submersible pumps, flow cells, and multi-meters were properly decontaminated between monitoring well locations as described in Section 6.3 of the FSAP. The types of IDW generated during monitoring well sampling included purge waters, decontamination fluids, and PPE. Purge water and decontamination fluids were contained within 55-gallon DOT-approved drums pending characterization and proper disposal/treatment. The management, handing, and disposal of the wastes complied with applicable federal and Commonwealth of Virginia solid waste and hazardous waste management regulations described in Section 5.11 of the FSAP.

2.6 Surface Water and Sediment Sampling

Four surface water and ten sediment sampling locations were established to characterize any impacts to aquatic receptors. Four of the locations were co-located surface water/sediment

sampling locations along Little Mosquito Creek (SW/SD-1 through SW/SD-4) (Figure 2-10). One of the four co-located locations was an upstream background location (SW/SD-1). Two of the co-locations were designed to intercept the discharge of small man-made drainages from the site in the mixing zone where the drainage meets the tidal channel of Little Mosquito Creek that forms the CDL Site's eastern boundary (SW/SD-2 and SW/SD-3). The most downgradient co-location was intended to assess site impacts beyond the CDL Site boundaries (SW/SD-4). The remaining four sediment only locations (SD-5 through SD-8) were collected in more proximal locations near the headwaters to the man-made ditches where the Gore-Sorber anomalies were noted. Surface water and sediment sampling were conducted according to Section 5.8 of the FSAP.

Surface water samples were collected before the co-located sediment samples and sampling proceeded from downstream to upstream locations. Sediment samples were only collected during the first round of sampling (April 30 to May 2, 2007) while the surface water samples were collected two separate times (May 1-2, and December 19, 2007) to document any seasonal effects that may be present. Surface water samples were collected at the same time as the two groundwater sampling events.

Surface water samples were collected from the mixing zone adjacent to the first few feet of the bank by direct immersion of the sampling containers. Sediment samples were collected using dedicated, pre-cleaned stainless steel scoops. Sample containers were labeled, placed immediately into an ice-filled cooler, and shipped to the laboratory for TCL/TAL analyses. All of the sampling equipment used for the sampling was dedicated with no field decontamination necessary. IDW was limited to PPE and no additional wastes were generated.

2.7 Aquifer Testing

The purpose of aquifer (slug) testing is to assess the hydraulic characteristics (hydraulic conductivity and transmissivity) of the aquifer. To evaluate aquifer hydraulic conductivity, rising head (slug-out) and falling head (slug-in) slug tests are conducted on monitoring wells to provide data to determine the rate of groundwater flow. Data on groundwater flow direction and rate of flow is needed to: (1) identify the most likely contaminant migration pathways; (2) determine potential migration rates and dispersion rates; and (3) provide site-specific data for evaluating treatment options. After data are collected, they are then downloaded, compiled, and analyzed.

Aquifer testing was conducted April 30 and May 1, 2007 on all six groundwater monitoring wells. Both the rising and falling head slug tests were completed at the CDL Site (Appendix C). The slug tests were performed using a closed volume slug, electronic water level indicator, a data logger/pressure transducer, and a laptop computer. The collected data were evaluated using aquifer testing software (AQTESOLV) using the Bouwer and Rice (1976) solution for unconfined aquifers. A modification of the classic method by Bouwer and Rice (1989) was also applied. This modification takes into account that a slug test plot of hydraulic head versus time can sometimes result in two different values for hydraulic conductivity. According to Bouwer and Rice, the first (early time) value represents the hydraulic conductivity of the well's sand pack while the second value is representative of the hydraulic conductivity of the aquifer. In the cases where the CDL Site well data appeared to be impacted by the well's sand pack, the very early data were disregarded.

Prior to starting the aquifer test, the depth to water in the well was measured with a properly decontaminated water level meter. Then the pressure transducer was lowered into the well and suspended approximately 6 inches to one foot off the bottom of the well. This ensured that the transducer would not come into contact with the slug as the slug was dropped into the water column. The well was then allowed to sit for approximately 5 minutes to allow for the conditions inside the well to stabilize from the lowering of the transducer. The slug was then either lowered (falling) or pulled out (rising) of the water column in a manner to create as close to an instantaneous movement of a volume of water inside the well. After a visual check of the monitoring software indicated stabilization was again reached, or after the test was running for 15 minutes, the test was stopped and considered complete.

Results showed that all the wells at the CDL Site had hydraulic conductivities (K) between 3.9×10^{-4} centimeters per second (cm/sec) and 7.9×10^{-2} cm/sec, indicating screened intervals of silty sands to somewhat clean sands. Test results are contained in Appendix C. All of the aquifer testing equipment used for testing each well were properly decontaminated between well locations as described in Section 6.3 of the FSAP. The types of IDW generated during the aquifer testing included decontaminations fluids and PPE. Decontamination fluids were contained were contained within 55-gallon DOT-approved drums pending characterization and proper disposal/treatment. The management, handing, and disposal of the wastes complied with applicable federal and Commonwealth of Virginia solid waste and hazardous waste management regulations as described in Section 5.11 of the FSAP.

2.8 QA/QC Sampling – Data Validation

Surface soil, subsurface soil, ground water, and surface water were collected during the RI and analyzed by Accutest Laboratories of Dayton, Jew Jersey. All data were fully validated by the URS Corporation in Linthicum, Maryland (Appendix D). A summary of the chemicals identified for further evaluation in the HHRA and ERA, the data groupings, and the background sample locations are presented for each medium in Section 4.0. Data tables in Section 4.0 are interpretive, proving the results of screening against relevant environmental criteria for EPA Region III.

Quality control samples (duplicates, trip blanks, and equipment blanks) were collected at a rate of approximately 1:20 (Table 2-2). All duplicates exhibited very good agreement in all media, and trip and equipment blanks were generally very clean with the exception of common laboratory contaminants; no data were rejected during data validation based on the field quality control samples. With the exception of a single chloroform detection in sample FB-1 from the December 2007 groundwater/surface water sampling event, all detections in blank samples were related to method blank issues in the laboratory.

Data validation resulted in the rejection of only one analyte, benzaldehyde, as a result of calibration errors and failure to recover this compound in laboratory control and matrix spikes (Appendix D). Other minor Quality Control (QC) anomalies resulted in "J" flagging of detections and detection limits, but the data were deemed acceptable for all uses.

3.0 GENERAL ENVIRONMENTAL SETTING

3.1 Demography

WFF is located in a rural area where year-round population densities are relatively low for neighboring areas. Chincoteague Island, which lies approximately 5 miles from the Main Base area of the facility, is the largest, most densely populated area near WFF, and has a resident population of approximately 3,600 people. Area populations are seasonal and fluctuate. During the summer months, the population expands due to tourists visiting the nature reserves and beaches of Assateague Island. Daily populations can reach up to 15,000 persons in the summer months. As a result, businesses in the Chincoteague area are generally targeted to the seasonal tourist industry, with the exception of fishing.

3.2 Land Use

Wallops Main Base consists of numerous structures used by NASA for various purposes including headquarters, administrative offices, tracking facilities, a range control center, rocket and fuel storage depots, inspection facilities, several support shops, housing units, and an airfield. WFF is responsible for the planning and launching of scientific satellites, sounding rockets, test vehicles, and other payloads.

The anticipated future use for WFF is the same as the current use, an industrial launch facility/airport. The recent commitment by the State of Virginia to establish WFF as a major spaceport greatly increases the likelihood that the facility's mission will remain largely the same as it is today. Additionally, there are technical reasons related to rocket orbital trajectory and economies that can be achieved from launches at the WFF latitude that cannot be achieved from NASA facilities in Texas and Florida. Therefore, base closure appears unlikely.

3.3 Topography and Drainage

The topography of WFF is typical of the Atlantic Coastal Plain Province and ranges from mean sea level (MSL) to 42 feet above MSL, and is generally flat with slopes of 1 to 2 per cent (NASA, 1999). The topographic slope is abnormally steep locally in some parts of the Wallops CDL Site as a result of the waste deposition. The CDL Site is located on the eastern side of a

peninsular land mass extending northward into a marine estuarine environment, typified by extensive marshes and channels.

A narrow tidal channel that parallels the larger Little Mosquito Creek bounds the CDL Site on the east. Surface water flow on the CDL Site is largely controlled by ditches installed parallel to the access road. Two culverts cross the site: one located north of the Central AOC and another located south of the Southern AOC, and discharge into a man-made (USATEC, 2000) drainage located along the southern boundary of the CDL Site (Figure 1-3). Another smaller man-made drainage receives surface water flow off the largest CDL Site AOC, the Southern AOC, where the burning dump was located (Figure 1-3).

The marsh located east of the CDL Site is the discharge zone for groundwater emanating from the impacted upland areas. Based on observation at other NASA Wallops Main Base sites (Versar, 2001a and 2001b), groundwater flows from upland areas to discharge in the surrounding marshes. Based on topography, groundwater in the shallow aquifer is presumed to flow to the northeast below the CDL Site.

3.4 Climate

The climate at WFF is humid with hot summers, and without a distinct dry season. From October through March, the weather at the facility is dominated by continental air masses with relatively low moisture content. From April through September, the air is more maritime with high moisture content at low levels due to circulation of the Bermuda High cell that reaches it peak during late summer.

The average annual precipitation is 36.8 inches. The average mean temperature is 56 degrees Fahrenheit (˚F), with a mean maximum of 64˚F and a mean minimum of 48˚F. The prevailing wind direction is southerly during the summer and northwesterly during the winter. The average wind speed is 10 knots.

The cloud cover varies from month to month, being at a minimum in August and at a maximum in January. From June through November, the WFF and surrounding areas are subject to severe thunderstorms, high tides, heavy rains, and phenomena generally associated with the hurricane season. From December through March, the area is subject to cold fronts and occasional associated snow storms and sleet.

3.5 Ecological Setting

The NWI map overlay for Chincoteague and the Accomack County Wetland Maps for the area of the WFF indicate that both tidal and nontidal wetlands occur at the site. These marshes are considered sensitive habitat for federally listed and/or endangered species. There are three predominant kinds of wetlands at WFF, including marine, estuarine, and palustrine wetlands. The NWI map indicates that the marsh area east of the CDL Site are estuarine wetlands.

Sensitive habitats on and adjacent to the WFF include the Chincoteague National Wildlife Refuge and the Assateague Island National Seashore to the immediate north, and the Wallops Island National Wildlife Refuge which borders the main base to the west. These refuges are federal and state protected areas for both migratory and non-migratory wildlife. Other sensitive habitats at the WFF include habitat for federally listed threatened and endangered species and wetlands as well as estuarine habitats such as Mosquito Creek, Chincoteague Bay, and Hog Creek. The federally listed threatened and endangered species known to occur at Wallops Island are the piping plover (*Charadrius melodius*), bald eagle (*Haliaeetus leucocephalus*), and peregrine falcon (*Falco peregrinus*).

3.6 Geology and Hydrogeology

WFF is part of the Atlantic Coastal Plain Physiographic Province, a seaward sloping stratified body of sediments bounded on the west by the Fall Line and on the east by the Atlantic Ocean. The facility is underlain by approximately 7,000 feet of unconsolidated sediments dating back to the Cretaceous Period. Below this group of sediments are crystalline basement rocks of igneous and metamorphic origins.

3.6.1 Regional

The water bearing formation within the WFF area consists of sedimentary units, ranging in age from Cretaceous to Quaternary. The two uppermost stratigraphic units, the Miocene Yorktown Formation and the overlying Pleistocene Columbia Group, are the most important water supply formations for agricultural, domestic, public, and industrial uses (NASA, 1994). The upper Columbia Group forms the shallow, unconfined water table aquifer at the site and is roughly 20 to 30 feet thick.

The Yorktown Formation is the uppermost unit in the Chesapeake Group. The upper aquitard is comprised of a thick series of coalescing layers consisting of fine to coarse, greenish gray, glauconitic quartz sand, which is clayey, silty, and in part, contains shell fragments. The formation occurs at depths of 60 to 140 feet in Accomack County (NASA, 1994) and is at least 78 feet thick at WFF and reaches its maximum thickness of 109 feet across the bay in Chincoteague (Meng and Harsh, 1988). The Columbia Group consists of sand, sandy clay, and minor amounts of gravel deposited during sea level fluctuations in the Pleistocene epoch (VSWCB, 1975).

The water table aquifer, known as the Columbia aquifer, is unconfined and typically overlain by deposited beach sands, silts, and gravel. The aquifer occurs between depths of 5 and 60 feet bgs. The water table ranges from depths of 0 to 30 feet bgs. Groundwater flow is generally northeast towards the marsh area that separates Chincoteague Island from the mainland (NASA, 1994). The top of the shallowest confined Miocene aquifer of the Yorktown Formation at WFF is found at depths of approximately 100 feet bgs. It is separated from the overlying Columbia aquifer by a 63 foot thick confining layer (aquitard) of clay and silt noted in the geologic log for the Town of Chincoteague Yorktown water supply well located within the CDL Site boundary, TCO6 (Figures 1-2 and 1-3). Additionally, this log indicates a 15-foot thick clay confining layer is found within the Columbia Group at a depth of 27 to 42 feet bgs. The continuity of this layer across the CDL Site was verified by data collected during the MIP investigation. Generally, potable water supply wells for both the Town of Chincoteague and WFF are screened at the upper portion of the Miocene aquifers, from depths less than 150 feet bgs (NASA, 1994), but Chincoteague also has water supply wells that draw from the Columbia Aquifer that it uses to meet peak demand..

In general, the water table (Columbia) aquifer on the Delmarva Peninsula is recharged by surface waters or by infiltration of precipitation. The Miocene confined aquifers are recharged by the same process, but from more distal areas located beyond the immediate vicinity of the study area. Studies conducted in correlative environmental settings elsewhere on the main base (Versar 2001a and 2001b) indicated that tidal fluctuations occur on onsite monitoring wells, but these fluctuations do not materially affect groundwater flow direction.

Recent aquifer tests estimated hydraulic conductivity values ranging from approximately 80 to 200 feet per day, and specific yield values from 0.01 to 0.13 for the unconfined aquifer. These values are typical of unconfined aquifers with mainly sand units, and demonstrate the ease

of recharge from surface water and/or precipitation. The tests also indicate there is no significant vertical leakage through the aquitard below the unconfined aquifer. The confined aquifers are believed to be recharged laterally from areas with greater vertical leakages. Aquifer tests performed on the upper and middle Miocene aquifers estimated a transmissivity range of 8500 to 14,500 gallons per day per foot (gpd/ft), a storativity of approximately 0.003, and a vertical leakage rate of 0.0352 feet per day for the upper aquifer. The middle Miocene aquifer has an estimated transmissivity of 4000 gpd/ft and a storativity range of 0.002 to 0.0002 (NASA, 1994).

Aquifer tests conducted at NASA WFF demonstrate that there is no significant vertical leakage through the aquitard below the unconfined Columbia aquifer; the top of the shallowest confined Miocene aquifer of the Yorktown Formation at WFF is found at depths of approximately 100 feet bgs (NASA, 1994).

3.6.2 CDL Site Area

Site-specific lithologic borehole logging at the CDL Site during the RI revealed the Columbia aquifer to be fairly uniform across the site (Appendix C). The materials encountered were generally light tan to light gray interbedded silty quartz sands, quartz sands, and minor organic clay layers consistent with the sandy estuarine and beach deposits indicative of Columbia Group deposits. The clay layers found in the bottom of MW-2, MW-3, and MW-5 (Figure 1-3) both appear to be locally limited, as well as the clay in the top of MW-1. The debris associated with the activities at the CDL Site appears to extend to approximately 7.5 feet bgs at MW-3 and MW-5. Groundwater was encountered from between 4 and 26 feet bgs across the site and generally flows to the northeast towards Little Mosquito Creek (Figures 2-8-and 2-9). Groundwater mounding occurs near MW-3 as discussed in Section 2.6. Aquifer testing resulted in hydraulic conductivities typical of silty sands to somewhat clean sands.

3.6.3 Soils

Soils at WFF are Coastal Plain soils that are typically nearly level, very deep and well drained. Soils within the Main Base area are predominately Bojac fine sandy loam. In general, the upland, terrace and level portions of the Main Base are comprised of Bojac fine sandy loam. This soil type is reported to be a low organic content, acidic, well-drained soil with moderately rapid permeability. The more steeply sloped areas found around the perimeter of the Main Base and the slopes leading from the level areas to the marshlands are predominantly classified as

Molena loamy sand. These soils have properties similar to the Bojac series but reportedly have a higher permeability, a higher percentage of coarser sands, and slightly more acidic content. The predominant soil type at the Wallops CDL Site is the Molina loamy sand. Other soil types that appear to be present include silty bands and mucky sandy loam (Chincoteague and Polawana series) which are present within the marshland areas around the extreme perimeter of the Main Base (USDA, 1994).

3.7 Water Supply

WFF is surrounded on three sides by surface water bodies that function as discharge points for groundwater. Based on investigations conducted to date at the Main Base, groundwater within the Columbia aquifer occurs under unconfined conditions between depths of about 5 to 60 feet bgs. Groundwater flow direction within the Columbia aquifer throughout the base is variable, but generally the groundwater flow direction near the CDL Site is northeastward toward nearby creeks and toward the marsh area that separates Chincoteague Island from the mainland (Figures 2-8 and 2-9).

Groundwater is the only source for drinking, agricultural, and process water within the WFF area. This is generally true for a large portion of the Eastern Shore. Because of the reliance on groundwater and the coastal proximity of the area, the Commonwealth of Virginia has declared the Eastern Shore of Virginia a Critical Groundwater Area. The withdrawal of groundwater from the area, including Accomack County, is controlled through the issuance of withdrawal permits under the Virginia Groundwater Management Act. The State Water Control Board, in consultation with local planning commissions and the Department of Health, administers the permitting program and allocates groundwater withdrawal volumes as part of the permitting process.

The town of Chincoteague, Virginia, is located approximately five miles east of NASA WFF, but its wells are located on the WFF property. WFF operates and maintains its own permitted water supply system that includes five wells actively used to withdraw water from the Yorktown Formation (Figure1-2). In addition, the National Oceanic and Atmospheric Administration (NOAA) operates a single well drilled into the Yorktown aquifer; the NOAA facility is located on the other side of a local groundwater divide roughly defined by the trace of Runway 4-22. The Town of Chincoteague has a series of 17 water supply wells located along the northeastern edge of the WFF Main Base. They currently operate only eight of these wells.

All of the inactive wells are screened in the Columbia Aquifer. Of the active wells, four are screened in the Columbia Aquifer and four are screened in the Yorktown Aquifer. Based on the CDL Site potentiometric surface mapping (Figures 2-8 and 2-9), none of these wells are currently impacted by the CDL Site.

VDEQ has expressed concerns that due to the dynamic nature of the potentiometric surface of the Columbia Aquifer, extensive pumping could change the potentiometric surface beneath the CDL Site and possibly funnel site contaminants toward the water supply wells. The nearest Chincoteague supply well within the Columbia Aquifer is located more than 2,000 feet to the south, and their water supply wells are located within 500 feet of an infinite source of recharge (the Little Mosquito Creek Marsh), so USACE feels that this possibility is very remote.

One of the Chincoteague Yorktown Aquifer wells, TOC06, is located within the boundary of the CDL Site in a small brick building located in the open space between the Western and Northern AOCs (Figures 1-2 and 1-3). A review of the geologic log for the TOC06 well (Attachment 1) indicates that there are three separate effective confining layers (15 feet, 63 feet, and 29 feet thick clays) between the shallow Columbia Aquifer and the Yorktown Aquifer.

The Town of Chincoteague wells are sampled and monitored on a regular basis under the drinking water program. In addition, the three Town of Chincoteague Columbia aquifer wells are also periodically sampled as part of a monitoring program associated with an ongoing remedial action at the Old Aviation Fuel Tank Farm Site, a former petroleum tank farm located in the central portion of the WFF Main Base property.

4.0 REMEDIAL INVESTIGATION FINDINGS

During the RI at the CDL Site, Versar completed source area screening investigations, soil and sediment sampling, aquifer testing, and completed two rounds of groundwater and surface water sampling. All field work was conducted in accordance with the Final FSAP dated March 12, 2007, and all analytical data was fully validated according to EPA Region III protocols. This section presents summary figures and screening tables, including results of geophysical investigations (Appendix A), the MIP investigation (Appendix B), and the well logs/aquifer test results (Appendix C). The scope of the geophysical investigation was expanded from the EM survey to also include targeted GPR studies of specific EM anomalies. As proposed in the FSAP, the results of the EM and MIP investigations lead to the establishment of additional test pit locations (Figures 1-3 and 2-1) beyond those originally specified in the work plan that were based on the results of the earlier Gore-Sorber soil gas investigation (see Section 1.3.4).

4.1 Approach

These data comprise all of the media planned for evaluation in the HHRA (Section 6.0) and the Baseline ERA (Section 7.0) Therefore, a qualitative review of these data is appropriate before initiating the risk assessment process. Because the CDL Site is composed of four separate AOCs based on historical photographs and maps, the source characterization treats each of these areas individually. Thereafter, groundwater, surface water and sediment will be discussed in media-specific subsections.

In the summary tables, the data from the CDL Site is highlighted in several ways: (1) with respect to site-specific background samples (e.g., MW-1/SB-1 in Figures 1-3 and 2-1) and base-wide WFF background data (mean and maximum) for soil and groundwater (Tetra Tech, 2004), (2) versus EPA RSLs for Chemical Contaminants for residential and industrial scenarios (May 20, 2008), and (3) for groundwater, compared to Virginia Groundwater Standards and Maximum Contaminant Levels (MCLs). There are no mean and maximum base-wide background data available for surface water and sediment at WFF. A site-specific upstream surface water and sediment location (SW-1/SD-1) at the head of the small tidal channel, and an additional, upgradient surface water/sediment sampling location (1WFF-MB-111-SW/SS) from the Site 14/15 Remedial Investigation/Feasibility Study (RI/FS) (Versar, 2001) were incorporated for use as background (Figure 4).

Statistical methods consistent with the 2002 EPA Background Guidance were performed for select contaminants (Appendix E). Statistical screening of selected pesticides and the metals (Appendix E) revealed that CDL Site arsenic concentrations in soil and groundwater are not significantly greater than background concentrations.

RSL screening levels are the actual RSL concentration for carcinogens and 1/10th the RSL for non-carcinogens to account for cumulative effects. Soil results were screened against both industrial and residential RSLs (Tables 4-1 through 4-8). Any soil results which exceed residential RSLs are color-coded blue and bolded. Overall, only benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, aluminum, antimony, arsenic, cadmium, copper, iron, lead, manganese, nickel, silver, and zinc were detected above residential soil RSLs values. Detected concentrations exceeding industrial RSLs are color-coded red and bolded. In general, very few industrial RSLs were exceeded; these included RSLs for benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, antimony, arsenic, copper, and iron.

Groundwater or surface water results which exceeded tap water screening levels are color coded red and bolded (Tables 4-9 through 4-12). Overall, the concentrations of benzene, 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene, tetrachloroethene, toluene, trichloroethene, m,p-xylene, o-xylene, total xylenes, 2-methylnaphthalene, naphthalene, arsenic, iron, manganese, and mercury exceed the tap water RSLs. Surface water and sediment concentrations that exceeded BTAG values are color-coded red and bolded in the summary tables (Tables 4-11 through 4-13).

4.2 Source Area Characterization

The Wallops CDL Site is comprised of four AOCs defined by aerial photography (see Section 1.0). To provide a more geographic frame of reference for discussing the AOCs (Figure 1-3), they are identified as the Western, Northern, Central, and Southern AOCs, corresponding to the work plan's descriptions as the "shallow excavation", "disturbed ground", "mounds of material", and "burning dump", respectively. As specified in the work plans, soil samples were generally collected at zero to six inches ("A-horizon" shallow samples) and 6 to 24 inches ("B-horizon" subsurface samples) for human health and ecological risk assessment purposes. Where elevated PID readings or visual evidence indicated deeper soil contamination, additional samples were collected in these materials corresponding to "C-horizon" subsurface

soil samples. Test pits were dug to maximum depth of approximately 12 to 13 feet bgs, below which collapse occurred preventing further excavation. Most test pit walls collapsed at about eight feet bgs.

Summary analytical data tables in this section (Tables 4-1 to 4-13) present all detections in a given media (e.g. soil, groundwater, etc.). Where an analyte was not detected in a given sample, the numerical value provided with a "U" qualifier signifies the detection limit. The detection limits provided in these tables are method detection limits (MDLs); reporting limits are always higher than MDLs. MDLs represent the lowest reliable concentration that a particular instrument can detect using the specified method.

4.2.1 Western Area of Concern

The EM survey of the Western AOC (Figure 2-1) did not indicate the presence of buried waste (Appendix A). Two MIP borings (Appendix B), two test pits, and a monitoring well were installed following completion of the EM survey to evaluate this area (Figures 1-3 and 2-1). MIP-1 and Test pit, TP-8, were installed to evaluate the BTEX and toluene detections in the Gore-Sorber data (see Figures 1-4 to 1-7). Data from MIP-1 indicated no strong anomalies, other than a spike in the conductivity meter at 33 feet indicating a clay layer, and a very mild increase in the ECD response (with no corresponding PID or FID response) at 20 to 30 feet (Appendix B). Data from MIP-2 indicated no strong anomalies, other than a spike in the conductivity meter at 30.5 feet, indicating a clay.

The fairly stable EM response noted in the Western AOCs contrasts markedly with the response for the ash and cinder deposits of the Southern AOC and metallic debris of the Central AOC, by virtue of both their differences in porosity and the presence of numerous buried metallic objects as is readily apparent in Figure 2-1. The MIP EC responses behave in a similar fashion: the relatively low (1-3 mill Siemens per meter (mS/M) gentle rising to 3-5 mS/M), stable conductivity responses in the visually un-impacted sand of the Western AOC (MIP-1 and MIP-2) starkly contrasts with the much higher and more erratic response (3-5 and 5-20 mS/M) in MIP-6 and MIP-8 located with the Southern AOC where the burning dump was located.

Substantial ECD responses, in conjunction with elevated PID and FID response, indicates the presence of chlorinated solvents, however, neither the FID or PID were elevated, and no VOCs or SVOCs were detected in either shallow soil (Table 4-1) or subsurface soil (Table 4-2)

from samples from SB-2 and TP-8. Test pits TP-8 and TP-9 were installed in this AOC. Test pits TP-8 and TP-9 were dug to a maximum depth of 7.5 to 8.0 feet, after which the walls of the test pits began to collapse. These test pits only revealed clean, apparently undisturbed sand.

Although the soil in the area in and around the CDL Site has been reworked in some areas, original sedimentary features (beach lags, dewatering structures, cross-bedding, etc.) were noted in the test pit walls in the Northern and Western AOCs. The "clean" nature of the sand deposits from the Northern and Western AOCs stand in stark contrast to the waste deposits noted in the Southern and Central AOCs (Figures 2-2 to 2-7). Based on the lack of EM and MIP response, soil samples were only collected from TP-8 (to evaluate the Gore-Sorber anomaly), and from SB-2, located immediately downgradient of the Western AOC.

Within the Western AOC's shallow soils (Table 4-1), the only organic chemical detected was 4,4-DDE (1.6 µg/kg) which is substantially less than the WFF mean background concentration of 539 µg/kg (Tetra Tech, 2004). Widespread application of DDT via diesel fogging at WFF has resulted in prevalent low concentrations of SVOCs and DDT and its degradation products occurring across large areas of the base. Aluminum, arsenic, cadmium, calcium, chromium, iron, mercury, and potassium were detected at concentrations between the mean and maximum background concentrations, but none of the metal detections exceeded the maximum background results (Tetra Tech, 2004), and their concentrations were comparable to or less than the local background sample, SB-1A. The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples, as well as in the local background sample SB-1A (Figure 4-1). Only arsenic exceeded industrial RSLs, but the arsenic concentrations detected in background soils also exceed industrial RSLs.

Within the subsurface soils of the Western AOC (Table 4-2), the only organic compound detected was bis(2-ethylhexyl)phthalate detected at 85 µg/kg in SB-2B, and this concentration is well below the WFF mean background value (203 ppb). Cobalt and manganese were detected at concentrations between the mean and maximum background concentrations; however, cobalt only exceeded its mean background concentration by 0.16 ppm. Calcium was the only metal detected at a concentration exceeding the maximum WFF background results (Tetra Tech, 2004), but the highest calcium concentration detected at the Western AOC (TP-8B, 657 ppm) is roughly half the concentration of the local background sample (SB-1B, 1,260 ppm). The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in background. Only arsenic exceeded industrial RSLs, but the arsenic concentration detected in

background soils also exceeded industrial RSLs (Figure 4-1). Overall, no evidence of waste was observed, and no contaminants were detected at concentrations that substantially exceeded background in any of the soil samples from the Western AOC.

4.2.2 Northern Area of Concern

The EM survey of the Northern AOC (Figure 2-1) did not indicate the presence of buried waste (Appendix A). The fairly stable EM response noted in the Northern AOC contrasts markedly with the response for the ash and cinder deposits of the Southern AOC and metallic debris of the Central AOC, by virtue of both their differences in porosity and the presence of numerous buried metallic objects as is readily apparent in Figure 2-1. The EM signature that bisects the AOC is the result of surface interference resulting from the presence of the fence that separates the NASA and NOAA facilities and subsurface utilities buried along the shoulder of the NOAA access road.

Two MIP borings (Appendix B), two test pits, and a monitoring well were installed following completion of the EM survey to evaluate this area (Figure 2-1). MIP-4 and test pit TP-5 were installed to evaluate the BTEX detections in the Gore-Sorber data (see Figure 1-5). In MIP-3, a few very minor FID spikes were noted between 25 and 38 feet, however, the lack of a corresponding response from either the ECD or PID suggests that the FID was responding to methane. Generally, a FID response without a corresponding ECD or PID indicates a low molecular weight VOC, which in a marsh setting is likely to be methane. The EC response indicates only clean sands to the maximum depth of penetration. The detection of methane is consistent with the geological history of the site. The Columbia Group was deposited during a transgressive sequence. Organic material may have been locally buried as the sea level and the shoreline moved landward. MIP-4's conductivity probe response indicates the presence of several clay layers, but the ECD, FID, and PID did not indicate the presence of buried waste containing VOCs.

Test Pits TP-5 and TP-10 were installed in the Northern AOC. TP-5 was dug to a maximum depth of 7 feet and TP-10 was dug to a maximum depth of 8 feet. Maximum depth was considered to have been achieved when the walls of the test pit began to collapse. Both test pits revealed only visually clean sand and based on these data, only TP-5 was sampled. TP-5 was a pre-designated sampling point in the FSAP.

In the Northern AOC's shallow soil samples (Table 4-3), no organic chemicals were detected. Aluminum, chromium, and iron were detected at concentrations between the mean and maximum background concentrations, but none of the metal detections exceeded the WFF maximum background concentrations (Tetra Tech, 2004), and their concentrations were comparable to or less than the local background sample, SB-1A. The concentrations of aluminum and iron exceeded residential RSLs in both the AOC samples and background samples (Figure 4-1). Arsenic also exceeded industrial RSLs, but background concentrations for arsenic also exceed RSLs.

In subsurface soils from the Northern AOC (Table 4-4), the only organic compound detected was bis(2-ethylhexyl)phthalate at 55.8 µg/kg detected in SB-6B, and this concentration is well below the WFF mean background value (203 ppb). Aluminum, calcium, and nickel were detected at concentrations between the mean and maximum background concentrations, but none of the metal detections exceeded the maximum background results (Tetra Tech, 2004). The maximum detected aluminum concentration (14,300 ppm in SB-6B) was only 200 ppm higher than the WFF mean (14,100 ppm), and the nickel detection (7.2 ppm in SB-6B) exceeded the WFF mean (7.05 ppm) by only 0.15 ppm. Calcium detections (297-350 ppm) in AOC samples are roughly one third the concentration of the local background sample (1,260 ppm in SB-1B). The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in background. Arsenic also exceeded industrial RSLs, but the mean and local background concentrations also exceed industrial RSLs (Figure 4-1). Overall, no evidence of waste was observed, and no contaminants were detected at concentrations that substantially exceed background concentrations in the soil samples from the Northern AOC.

4.2.3 Central Area of Concern

In contrast to the Northern and Western AOCs, evidence of buried wastes were clearly evident in the Central AOC. Sheet metal, broken concrete, cinder block, bricks, and other demolition debris were exposed at the surface along the eastern boundary of the AOC where it meets the marsh. Three EM anomalies were noted (Figure 2-1): Anomaly C and Anomaly D correspond to the presence of metallic debris at the surface. No visual evidence of surface waste disposal was apparent at Anomaly E (Appendix A). GPR confirmed that Anomaly E resulted from numerous small objects.

Anomaly E (Figure 2-1) corresponds to the location of chlorinated solvent, BTEX, and toluene detections in the Gore-Sorber data (Figures 1-4 to 1-7). MIP-5 was advanced to evaluate Anomaly E. Extremely strong EC spikes occurred at 9.5 to 11.0 feet bgs, followed immediately by strong PID, FID, and ECD responses (Appendix B). When the MIP probe was pulled following completion of the boring, it was covered in battleship gray paint similar to that used on naval aircraft and ships. Later, a good faith effort was made to locate the container where the paint was sourced, but no container that actually contained paint (or paint residues) was found in the test pit (TP-1) that was co-located with MIP-5. Naval historians were able to supply information on the composition of Naval paint of that era to adequately fill this data gap and those historical documents can be found in Attachment 1.

In test pit TP-1, buried drums were found at a depth of approximately 10 to 12 feet (Figure 2-2). When excavated, soil from this depth and immediately above had a strong, sour smell. In addition to the normal soil sample at 0 to 6 inches and 6 to 24 inches (TP-1A and TP-1B), soil sample TP-1C was collected from a depth of 8.5 to 11 feet to characterize the soil adjacent to the buried drums. Another test pit, TP-6 was excavated to evaluate EM Anomaly C (Figure 2-1). TP-6 did not reveal any evidence of waste materials.

Shallow soil samples (Table 4-5) from TP-1A, SB-5A and TP-6A did not detect any VOCs or SVOCs above residential RSLs, however, low concentrations of ethylbenzene, methocyclohexane, toluene, and xylenes were detected in TP-1A. SB-4 (later completed as monitoring well, MW-4) detected petroleum staining near the water table (at 8 to 10 bgs), and SB-4AD detected methyl acetate at 1190 µg/kg, as well as numerous PAHs detected at concentrations that substantially exceed background: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, phenanthrene, and pyrene. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene all were detected at concentrations exceeding residential RSLs. Of those, benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene also exceeded industrial RSLs (Figure 4-1). While pesticides were detected in all samples, none were above RSL values.

Among metals detections in shallow soil samples from the Central AOC, arsenic, cadmium, lead, manganese, potassium, and zinc were detected at concentrations between WFF mean and maximum background concentrations (Tetra Tech, 2004), but the concentrations of arsenic detected (2.7 to 4.7 ppm) do not exceed the local background concentration (4.8 ppm in SB-1A). Concentrations of barium, beryllium, calcium, chromium, cobalt, iron, nickel, silver,

sodium, and zinc were detected at concentrations higher than the WFF maximum background detections (Tetra Tech, 2004). Metals concentrations in shallow soils for aluminum, arsenic, iron, lead, manganese, and nickel exceeded residential RSLs (Figure 4-1). Arsenic also exceeded industrial RSLs, but AOC arsenic concentrations were less than or equal to background concentrations, which also exceeded industrial RSLs.

In subsurface soils (Table 4-6) collected from 6 to 24 inches bgs within the Central AOC, no VOCs were detected, and only one SVOC, bis(2-ethylhexyl)phthalate at 51.9 ppb was detected. Aluminum, arsenic, cobalt, copper, lead, magnesium, nickel, potassium, and zinc were detected in the 6 to 24 inch horizon samples at concentrations between the WFF mean and maximum background concentrations (Tetra Tech, 2004), but the highest arsenic concentration in samples from this AOC (4.8 ppm) were less than the local background concentration (5.5 ppm in SB-1B). Calcium, iron, manganese, mercury, sodium, and vanadium were detected at concentrations that exceeded the WFF maximum background concentrations (Tetra Tech, 2004), but the highest calcium concentration detected in AOC samples (1,160 ppm), was less than the local background concentrations (1,260 in SB-1B). As noted in the Northern and Western AOCs, the concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in the site-specific background (SB-1B). Arsenic also exceeded industrial RSLs (Figure 4-1), but the arsenic concentrations in the WFF mean (Tetra Tech, 2004) and in the local background sample, SB-1B, also exceed the Industrial RSL.

Deep subsurface soils were collected from the drum disposal pit TP-1C (8.5 to 11 feet bgs) and petroleum stained intervals in SB-4C (9 to 10 feet bgs). These deep soil samples (Table 4-6) detected acetone, benzene, 1,2-dichloroethane, ethylbenzene, isopropylbenzene, methocyclohexane, toluene, m,p-xylene, o-xylene, and total xylenes, however, none of these VOCs exceeded residential RSLs. Only a single pesticide (4,4-DDD at 25.7 ppb) and one SVOC, bis(2-ethylhexyl)phthalate at 102 ppb were detected in the deep samples. Neither of the SVOC or pesticide detections exceeded RSLs. Aluminum and arsenic in the deep samples exceeded residential and industrial RSLs (Figure 4-1), respectively, but both of these metals' concentrations are below WFF mean (Tetra Tech, 2004) concentrations.

The VOCs detected in SB-4C are much lower than previously detected by SAIC in the nearby (30 feet away) sample from nine feet bgs at SB-CDL-01 during the 2002 LSI (Table 1-1). In that sample, SAIC detected ethylbenzene at 12,000 µg/kg and total xylenes at 9,600 µg/kg, and these VOCs were detected in SB-4C at 12,420 µg/kg and 207 µg/kg, respectively.

Additionally, PCE was detected at 1,100 µg/kg in SB-CDL-01 from the 2002 LSI (Table 1-1), but was not detected in the similar sample at SB-4C (Table 4-6). This is notable because the groundwater samples from the co-located MW-4 well, had PCE concentrations that exceeded MCLs (Tables 4-9 and 4-10). While the concentration of 1,2-dichloroethane detected in sample SB-4C (8.8 µg/kg) did not exceed RSLs, its detection in this sample, associated with petroleum stains, is notable because 1,2-dichlorethane in groundwater from the co-located MW-4 exceeds MCLs. The close association petroleum stains and the occurrence of BTEX and chlorinated solvents in soil and groundwater data indicates that waste oils found near SB-4 and SB-CDL-01 are the likely source materials impacting groundwater in this area of the site. Waste oils are often impacted by chlorinated solvents as a result of degreasing operations in maintenance facilities.

4.2.4 Southern Area of Concern

In addition to the EM survey, impacts to shallow soil (Table 4-7) and subsurface soil (Table 4-8) within the Southern AOC were investigated through the installation of three MIP borings (MIP-6, -7, and -8), four test pits (TP-2, -3, -4, and -7), and the soil boring (SB-3) for monitoring well, MW-3 (Figures 1-3 and 2-1). Two strong EM anomalies (A and B) were noted; unfortunately they were too far down the slope to reach with the MIP rig. MIP borings (Appendix B) all showed numerous EC spikes indicating buried metal objects, but very little response, with the exception of mildly elevated ECD and PID readings that were later shown to correlate with low concentration benzene and tetrachloroethene detections in subsurface soils (Table 4-8). Test Pits revealed abundant evidence of the former burning dump with charred rubbish, cinders, and melted glass and metal throughout the deposit (Figure 2-3). Screening for 2,3,7,8-dioxin for all soil samples was negative.

No waste materials were noted in test pit TP-2, which was excavated to a depth of 8 feet bgs. In the top 3.5 feet of TP-3, only clean sand was noted; from 3.5 to 5.5 feet a deposit of cinders, burned rubbish (glass, cans, wires, etc.) and ash was encountered, followed by clean sand from 5.5 to 11 feet bgs. An additional sample was taken at TP-3 at four feet bgs to represent the buried debris.

Cinders and other burned debris (Figure 2-3) were noted at a depth of one foot bgs in TP-4 and these deposits persisted to the maximum depth of the test pit (8 feet bgs) where the water table was noted. No deep soil samples were taken at TP-4 because the first two samples were

from waste deposits identical to the deeper horizons. TP-7 was advanced to a depth of four feet bgs where the water table was encountered. Cinders and other burning dump debris were noted at the surface in TP-7, and these materials extended to a depth of two feet bgs. Very little cover material is present in the southeastern part of the Southern AOC; generally waste materials were present at the surface over most of this area. The EM survey indicated that waste materials extended farther east than the original aerial photographic "footprint" and results of the observations at TP-7 confirmed this finding that the Southern AOC extends to the edge of the marsh.

Numerous PAHs were detected in shallow soils (Table 4-7), but only benzo(a)pyrene (58.8 µg/kg in TP-3A, 106 µg/kg in TP-7A) and dibenzo(a,h)anthracene (22.6 µg/kg in TP-7A) exceeded residential RSLs. Benzo(a)pyrene detections were less than the WFF mean concentration (206 ppb). Pesticides detected in shallow soils included 4,4-DDD, 4,4-DDE, and 4,4-DDT, however, none of these detections exceeded RSLs. Metals concentrations within the shallow soil samples of the Southern AOC exceeded the WFF maximum background concentrations for all of the metals except antimony, beryllium, and thallium which were detected at concentrations below the WFF mean, and for arsenic which was detected at concentrations between the WFF mean and maximum background concentrations (Tetra Tech, 2004). Among the shallow soils, aluminum, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc exceeded residential RSLs (Figure 4-1), but the background concentrations for aluminum and iron also exceeded residential RSLs. Only arsenic and antimony exceeded industrial RSLs, but the background arsenic also exceeds the industrial RSL.

In the Southern AOC subsurface soils (Table 4-8), only one VOC, tetrachloroethene, was detected (0.99 to 2.8 ppb). SVOCs detected include the entire PAH suite at fairly low concentrations of 16 to 139 ppb, and bis(2-ethylhexyl)phthalate (51 to 199 ppb) and di-n-octylphthalate (25 ppb). Alpha- and gamma-chlordane, 4,4-DDD, 4,4-DDE, 4,4-DDT, and Arochlor 1260 were detected. The concentrations of benzo(a)pyrene (117 ppb) and dibenzo(a,h)anthracene (24 ppb) were the only organic compounds detected that exceeded residential RSLs, and no organic compounds exceeded industrial RSLs. The maximum WFF background concentration (Tetra Tech, 2004) was exceeded for all of the metals except cobalt, thallium, and vanadium whose concentrations were below the WFF mean, and beryllium which was detected at a concentration between the WFF mean and maximum in only one sample (SB-3B at 49 ppb). Concentrations of aluminum, antimony, lead, manganese, silver, and zinc exceeded residential RSLs (Figure 4-1) in the Southern AOC subsurface soil samples. Industrial

RSLs were exceeded for arsenic, copper, and iron. As noted earlier, background arsenic concentrations also exceed Industrial RSLs.

4.3 Groundwater

Six groundwater monitoring wells were installed to monitor the four AOCs (Figure 1-3 and Tables 4-9 and 4-10). The location of MW-5 was moved approximately 50 feet to the south of the proposed FSAP location to better monitor the buried drums detected in the Central AOC. Groundwater samples were collected in two separate rounds: May 2007 and December 2007. Groundwater is generally shallow and flows east and northeast as indicated by the potentiometric surface shown in Figures 2-8 and 2-9.

The monitoring well network provides representative groundwater data for all four of the AOCs that comprise the CDL Site. Well MW-2 is located downgradient of the Western AOC. Wells MW-3 and MW-4 are downgradient of both the Southern and Western AOCs. The Central AOC is primarily monitored by MW-5, but MW-4 also provides data on the highly impacted southeastern "toe" of the boot-shaped Central AOC. MW-5 is also downgradient of the Western AOC, but the general lack of observed waste deposits in the Western AOC indicates that the primary chemical signature exhibited by wells MW-3, MW-4, and MW-5 belongs to the Southern and Central AOCs. Well MW-6 is downgradient of the Northern AOC.

The shape of the potentiometric surface generally mimics the topography, but is influenced locally by the higher permeability of the waste and cinder deposits of the Southern AOC (Figures 2-8 and 2-9). The relatively high potentiometric surface elevation noted in MW-3 in both rounds of sampling appears to be anomalous. MW-3 is the only well whose screened interval is within a thick waste deposit; all of the other wells are set in sand. Approximately 7 feet of debris was noted in the soil boring for MW-3. Also, MW-3 is the only well whose potentiometric surface elevation is higher in the December data than in the May data. Unlike the other downgradient wells (MW-4, MW-5, and MW-6), clay and semi-stiff silty sand were noted near the base of the waste deposit. It seems likely that these fine grained materials may inhibit drainage of the debris deposit (a classic "bathtub effect"), and lead to an anomalously high water level with the debris deposit. The combination of higher permeability aquifer materials in the cinder deposits with discharge inhibited from the Southern AOC by basal clays, leads to localized groundwater mounding within and upgradient of the Southern AOC as shown in Figures 2-8 and 2-9.

During Round 1 of sampling in May 2007 (Table 4-9), VOCs were detected only in samples from MW-4 and MW-5, located downgradient of the Central AOC corresponding to the influence of the buried paint drums and oil-stained soils encountered therein. SVOCs were also detected in MW-4. The concentrations of cis-1,2-dichloroethene, ethylbenzene, tetrachloroethene, toluene, trichloroethene, xylenes, 2-methylnaphthalene, and naphthalene in MW-4, and 1,2-dichloroethene in MW-5 exceeded tap water RSLs (Figure 4-2). The concentrations of 1,2-dichloroethane, tetrachloroethene, and toluene exceed MCLs. In the May 2007 metals data, arsenic, barium, iron, lead, and manganese concentrations exceeded the WFF mean background concentrations, and calcium, mercury, and sodium exceeded the WFF maximum background concentrations (Tetra Tech, 2004). Arsenic, iron, manganese, and mercury concentrations exceeded RSLs, and mercury exceeded the Virginia Groundwater Quality Standards, but mercury detections are highest in the local background sample from MW-1, and therefore, are not site-related.

As in the first round of sampling, VOCs were detected only in samples from MW-4 and MW-5 during Round 2 of sampling in December 2007 (Table 4-10), and SVOCs were only detected in samples from MW-4 (including the duplicate). The concentrations of cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene, tetrachloroethene, toluene, trichloroethene, xylenes, 2-methylnaphthalene, and naphthalene in MW-4, and 1,2-dichloroethene in MW-5 exceeded tap water RSLs (Figure 4-3). The concentrations of 1,2-dichloroethane , tetrachloroethene, and toluene exceeded MCLs. In the May 2007 metals data, arsenic, barium, iron, copper, lead, nickel, and potassium exceeded the WFF mean background concentrations, and calcium, magnesium, selenium, sodium and thallium exceed the WFF maximum background concentrations (Tetra Tech, 2004). Arsenic, iron, and manganese exceeded RSLs, but no analyte exceeded the Virginia Groundwater Quality Standards during the second round of sampling.

4.4 Surface Water

Four surface water locations were sampled in May and December 2007. During May 2007 sampling (Table 4-11), no organic compounds were detected. The concentrations of aluminum, antimony, arsenic, chromium, manganese, selenium, and sodium exceeded background concentrations. Only mercury concentrations exceeded BTAG values (Figure 4-4).

During the second round of sampling in December 2007 (Table 4-12), similar metals results were noted, but low concentrations of benzene (0.77 ppb) and carbon disulfide (0.24 ppb) were detected in SW-02, and low concentrations of SVOCs 2-methylnaphthalene (1.8 ppb) and naphthalene (1.0 ppb) were detected in SW-04. Aluminum, arsenic, calcium, copper, magnesium, manganese, sodium, and vanadium were detected at concentrations which exceeded background concentrations, however, the highest arsenic concentration only exceeded background by 0.4 ppb, the highest copper concentration exceeded background by only 2.7 ppb, the highest manganese detection exceeded background by 2 ppb, and the highest vanadium concentration exceeded background by only 0.7 ppb. Copper was the only metal detected in downstream samples during the second round that exceeded BTAG criteria (Figure 4-4).

4.5 Sediment

Ten sediment samples were collected. VOCs were detected in many samples (Table 4-13): acetone (SD-5, SD-8, and SD-9), 2-butanone (SD-8 and SD-9), carbon disulfide (SD-2, SD-3, SD-4, SD-6, and SD-9), cyclohexane (SD-4), and methylene chloride (SD-4). Two phthalates, di-n-octylphthalate (SD-5), and bis(2ethylhexyl)phthalate (SD-4, SD-5, and SD-10) were also detected. Aluminum, antimony, arsenic, barium, cadmium, calcium, lead, selenium, silver, sodium, thallium, and zinc were detected at concentrations which exceeded background concentrations. BTAG values were exceeded for bis(2-ethylhexyl)phthalate, 4,4-DDD, 4,4-DDE, arsenic, copper, lead, mercury, nickel, silver, and zinc (Figure 4-5).

5.0 CONTAMINANT FATE AND TRANSPORT

This section discusses the physical and chemical processes that affect contaminant migration in soils/sediment, surface water, and groundwater. There were detections of contaminants in each of these matrices at the CDL Site during investigations.

5.1 Contaminant Presence

Sampling at the CDL Site was designed to evaluate the impact of spilled, buried, and burned waste and debris at the four AOCs identified at the site. Previous studies at the site indicate that the burning and burial of waste resulted in the release of contaminants to soil, sediment, surface water, and groundwater in the area. PAHs may be derived from a number of sources, including stormwater runoff from multiple sources, fuel residue, and the combustion of organic materials. Because PAHs also have a strong tendency to bind to sediment particles rather than dissolve in water, when they enter a body of water, they tend to accumulate in sediments (Lindsey et al, 1998).

5.1.1 Soil

Contamination in surface and subsurface soils were confirmed by this investigation and historical investigations at the CDL Site. The contaminants that are present in the CDL Site soils include alpha- and gamma-chlordane, DDD, DDE, DDT, bis(2-ethylhexyl)phthalate, methyl acetate, PAHs (benzo(a)pyrene, benzo(a)anthracene, dibenzo(a,h)anthracene), metals (aluminum, arsenic, iron, manganese, vanadium, cadmium, chromium, calcium, cobalt, lead, mercury, nickel, selenium, silver, and zinc), and at one location, Arochlor 1260. These contaminants, present in the soil as a result of burial and burning of debris, are subjected to physical, biological, and chemical reactions that directly influence their persistence and potential migration.

Several soil samples were collected from the heavily charred debris, ash, and cinders of the Southern AOC where the burning dump was located (TP-3C, TP-4A, TP-4B, TP-7A, and TP-7B), but the SVOCs within these deposits were generally fairly low in concentration (<200 ppb). The relatively low concentration of SVOCs in deposits such as these, where PAHs would be expected to be abundant as a result of incomplete combustion, suggest that aerobic biodegradation of PAHs over the past 50 years since disposal ended has taken place. This hypothesis is supported by the data from TP-7A and TP-7B, located immediately adjacent to the

marsh, where a full suite of PAHs was detected. In the other locations, only benzo(g,h,i)perylene (TP-3A) and indeno(1,2,3-cd)pyrene (TP-3C and TP-4B) were detected, despite the heavily blackened nature of the soil in these areas (see Figure 2-3). Apparently, TP-7's location near the marsh resulted in less aerobic conditions than what was present in the upland areas of the Southern AOC and that inhibited biodegradation of the SVOCs. The lack of cover material over most of the Southern AOC appears to have facilitated aerobic biodegradation of SVOCs via infiltration of oxygenated rainwater for more than a half century, perhaps aided by microbiological activities associated with plant roots. Biodegradation of PAHs is also favored by the high iron concentrations present in the soils of the Southern AOC. PAHs are notably absent in the groundwater samples from well MW-3 (Tables 4-9 and 4-10), even though the well's screen is set within the waste deposits.

Similarly, detections of isopropylbenzene and methylcyclohexane in groundwater samples from MW-4, and soil samples TP-1C and SB-4C, indicate aerobic biodegradation is occurring; both of these VOCs are typical biodegradation products of gasoline or mineral spirits. In those sampling locations, BTEX compounds were also detected. Biodegradation of chlorinated solvents occurs more readily under anaerobic conditions.

Pesticides are expected to bind tightly to the carbon-rich substrate of the former burning dump (Southern AOC) and with the exception of DDT's transformation to DDD and DDE, most pesticides, including DDT and alpha- and gamma-chlordane are fairly persistent contaminants due to their low chemical reactivity and resistance to oxidation and other degenerative processes.

Metals solubility is assisted by low pH; pH of groundwater tends to be lower than 7.0 and is lowest near the marsh, favoring the dissolution of metals in the Central and Southern AOCs. The area is well vegetated and not prone to erosion or disturbance of the soil by wind, however, large Atlantic storms often impact the area and may cause greater erosion than was noted during the course of the RI.

5.1.2 Groundwater

Waste materials at the CDL Site were buried and burned on the ground at the Central and Southern AOCs. Their impact to groundwater, therefore, is derived by leaching through soil to groundwater. Contamination has been observed in the groundwater at the CDL Site. VOCs and SVOCs were detected only downgradient of the Central AOC corresponding to the influence of

the oil-stained soils encountered therein. Biodegradation of these chlorinated solvents in a marsh environment is possible. However, they would likely remain commingled with the petroleum (waste oils) in the source area. However, chlorinated solvents and other VOCs have different retardation factors and are affected differently by varying geochemical conditions. Such processes may result in discreet plumes of varying composition once the formerly commingled VOCs have entered the groundwater system.

Metals detected in groundwater were associated in the area downgradient of the Central AOC and could be a result of the leaching of metals from material within the debris. Contaminants in groundwater are then subjected to physical, biological, and chemical reactions that directly influence their further persistence and potential migration. Using the average observed hydraulic conductivity as measured during aquifer tests (Appendix C) during the RI (0.011 cm/s), a gradient of 0.02, and assumed of porosity of 30%, Darcy's Law indicates the average groundwater transport velocity across the site is approximately $7.3x10^{-4}$ cm/s (or 759 feet per year [ft/yr], or 2.1 feet per day [ft/day]).

The unconfined groundwater system flowing beneath the CDL Site discharges at the small man-made drainage channels and the tidal channel of Little Mosquito Creek that forms the eastern boundary of the site. Therefore, the maximum extent of groundwater contamination is defined by this surface water feature. It was not possible to place any additional wells further east than the current network because groundwater is essentially at the surface in those locations.

5.1.3 Sediment and Surface Water

Contaminants from soil and groundwater at the CDL Site impact sediment and surface water when stormwater carries soil particles along its path and when groundwater discharges to Little Mosquito Creek. Site-related VOCs detected in groundwater appear to be degraded before reaching the creek, or volatize at the discharge point, or are diluted beyond detection. Sediments and surface water are also impacted by runoff (through erosion and deposition of impacted soils) or releases from other contaminated sites within the same drainage area. The contaminants detected in the sediment and surface water may be attributed to multiple source points. Metals can be attributed to natural transport of surface soils to the marsh area. High concentrations of arsenic as a background condition are reflected in sediment concentrations (of the same order). VOCs detected in the sediments were not detected in soil, groundwater, or surface water samples at the CDL Site, and therefore, may be unrelated to the CDL Site.

Lead, copper, and mercury were elevated in the Southern AOC (only). It is notable that the maximum detected concentration of lead in sediment was less than the background soil concentrations for lead, and that the concentrations of copper and mercury in downgradient sediment samples were similar (although somewhat higher) than the background concentration. Most of the very high metals concentrations in the sediment were found in sample SD-9, located immediately adjacent to the Southern AOC (former burning dump). As noted previously, waste materials were deposited east of the aerial photography foot print of the burning dump as demonstrated by the observations made in TP-7. TP-7 was dug right at the water's edge. SD-9 appears to be strongly influenced by its location within the footprint of the Southern AOC, but the other sediment samples did not appear to be as strongly influenced by the site.

5.2 Overview

Several observations stand out as a result of the RI. The Western and Northern AOCs did not exhibit any strong evidence that these AOCs were waste disposal areas. They may have been borrow pits that supplied fill for site construction activities. The results of the chemical analyses (Figures 4-1), lack of an EM signature (Figure 2-1) and failure of the GPR lines 1, 2, 3, and 4 (Appendix A), and the MIP Investigation (Appendix B) to detect any evidence of waste deposits, as well as direct observation in four targeted test pits, all indicate that no solid wastes were disposed of in these areas. Soil samples from the Western and Northern AOCs detected only metals at concentrations that exceeded RSLs (Figure 4-1), and only arsenic was detected at concentrations which exceeded industrial RSLs. However, the highest arsenic detections were at the local background location, SB-1A and SB-1B, rather than associated with the Northern and Western AOCs.

The Central and Southern AOCs were clearly and unambiguously impacted by waste disposal activities. The Southern AOC is characterized by exposed solid waste across the southeastern half of the AOC leading directly up to and into the adjacent marsh. Four test pits and one soil boring in this area revealed the solid waste in this area to be composed of cinders, ash, and hodgepodge of burned household items, bottles, and laboratory equipment (Figure 2-3) deposited over a large area. The deposits were absent at the north end of the AOC's historical footprint (at TP-2), were partially covered at TP-3, thin to the north and east at TP-3 and TP-7, and were thickest at TP-4 and SB-3/MW-3 where they extended 7 to 8 feet bgs and the waste was in direct contact with groundwater. Data from TP-7 and SD-9 indicated that the wastes were also in direct contact with surface water at the edge of the marsh. The southern and western

extents of the waste deposits (Figure 5-1) were estimated based on direct observation of waste materials at the surface and geophysical data (EM and GPR surveys).

In the Central AOC, evidence of petroleum staining believed to result from the disposal of waste oil contaminated with chlorinated solvents was observed in data from SB-4/MW-4. The presence of exposed scrap metal and other wastes was easily observed along the eastern edge of the Central AOC. The RI findings for the Central AOC were punctuated by the discovery of buried drums in test pit TP-1. During the MIP survey, liquid paint-like substance was detected in location MIP-5 which was drilled in an area identified as an excavation in the 1959 aerial photograph, and which was identified as an anomaly in the BTEX and chlorinated solvent Gore Sorber soil gas investigation. Numerous crushed drums were found in Test Pit TP-1 that was dug in the same location as MIP-5. The EM survey indicated that the drum deposit was located at the eastern edge of the NOAA access road, and was partially below NOAA mission critical utilities (fiber optics) that parallel the eastern shoulder of the road (Figure 2-1).

The drums were encountered at a depth of approximately 8.5 feet bgs. The soil in Test Pit TP-1 had an unusual acrid odor. The soil sample collected from around the drums was collected from the zone of highest PID readings in the test pit from a depth of 8.5 feet bgs and immediately above the drums, which were first noted at 11 to 13 feet. A strong petroleum-like odor was noted at 8.5 feet and the soil sample was collected from the next bucket (at 8.5 to 11 feet), which was accompanied by scraping sounds as the drums were hit. Since the soil was collected from the undisturbed soil in the top of the bucket, its depth was recorded as 8.5 feet.

A good faith effort was made to collect an actual sample of the paint that was encountered in MIP-5. Unfortunately, only empty crushed drums were located when the test pit was dug in this location (TP-1). Naval paint of this era was of an alkyd enamel type; the primary solvent was naphtha (mineral spirits) and made use of linseed oil as a binder (Charles Utz, Naval History Museum, personal communication, May 28, 2009 – see Attachment 1). The historical data suggests that the paint was lead-based enamel containing approximately one-half percent lead by weight. The detections of high concentrations of BTEX and methocyclohexane in the soil sample from this deposit, TP-1C, supports the historical record that the paint was a mineral spirit-based product.

The chlorinated solvents detected in groundwater from downgradient well MW-5 would not have been present in these paints. The chlorinated solvents would be more likely associated

with degreasing operations and/or the waste oil noted nearby in boring SB-4. Although no chlorinated VOCs were detected in the samples from the drum deposits, other sources could be located nearby. Numerous EM anomalies were noted in the area upgradient of MW-5 (Figure 2-1) which indicates other waste deposits are present upgradient of this well.

5.3 Estimated Extent of Waste Disposal Areas

Numerous independent investigatory methods were used to characterize the extent of contamination at the CDL Site. As noted previously, the Northern and Western AOCs showed little or no evidence of waste disposal activities. The evidence collected by the various investigatory methods confirm the Central and Southern AOLs were clearly waste disposal areas, but also indicates that subsequent site activities may have further altered the sites from their original "foot print" as determined by the aerial photography.

Integrating the findings of the 2004 soil gas investigation, the EM survey, MIP study, and test pits/soil borings, it appears that grading construction of the NOAA access road resulted in waste materials being pushed further east than the original "footprints" of these two AOCs. Additionally, the impacted soil and waste materials are confined to an arcuate band on the eastern edge of the hillside, leaving a central core of relatively clean soil that is defined by the observations and sampling data from test pits, TP-2 and TP-6 (Figure 5-1). The boundaries of the waste deposits were estimated from the EM and GPR data, direct observations, and sampling results. The green-shaded area labeled petroleum-impacted soil on Figure 5-1 was estimated by taking half the distance to the nearest adjacent test pit or soil boring (where petroleum stains were not noted). The eastern extent was estimated to be the break in slope of the hillside at the marsh because there is no evidence of burial there, and groundwater is essentially at the surface. The location of the 2002 LSI samples, although faithfully reproduced from the report's (SAIC, 2003) maps, is likely in error. The plotted location is within the marsh, and a GeoProbe could not operate there. The locations were likely farther west than shown in Figures 1-4 to 1-7.

Hydrogeologic cross-sections (Figure 5-2) were developed through the Central AOC (A-A') and Southern (B-B') using the data from the RI to depict the CDL Site geology, water table and, estimated extent of the waste deposits. The locations of these cross-sections were selected to run approximately perpendicular to groundwater flow, and maximize the amount of available information for their construction (test pits, MIP locations, wells, etc.). The water table

shown on Figure 5-2 from the December 2007 potentiometric surface (Figure 2-9) was selected because it more clearly depicts the groundwater mounding associated with the Southern AOC.

Correlating the available information, several differences in the nature of Central and Southern AOCs are apparent. First, soils of the Southern AOC were notably blackened and contained abundant cinders and burned debris as a result of the AOC's history as a burning dump. The other primary difference is that the much of the Central AOC was more deeply buried than the Southern AOC. Solid waste was sporadically exposed along the eastern edge of both AOCs. This finding was consistent with the slightly higher elevation of the Central AOC, which was generally about five to seven feet higher than the Southern AOC, and historical aerial photographs suggested burial was more common at the Central AOC. The Central AOC was originally identified for evaluation based on the presence of "mounds of materials" observed in the 1954 aerial photographs and the presence of an excavation in the 1959 aerial photographs that corresponds to the location of the drum deposit at Test Pit TP-1. The 1949, 1954, and 1959 aerial photographs all suggest that wastes at the Southern AOC were simply burned at the surface.

The historical footprints of the Central and Southern AOCs extend below and a short distance to the west of the NOAA access road. Although there are numerous sources of cultural interferences associated with the fence line (subsurface utilities which parallel the fence and reinforced concrete culverts passing below to the road), the EM survey does not have the characteristically complex pattern contours below and west of the road that typify the eastern areas of the Central and Southern AOCs. Therefore, the waste deposits shown in Figure 5-2 are interpreted to end at the edge of the road. This interpretation is further supported by GPR line 4 which ran parallel to the NOAA access road (Appendix A).

USACE feels that it is likely that waste materials were removed from the road bed to avoid building on an unstable material. This conclusion draws on the lack of an EM signature in the southwestern corner of the Southern AOC (the burning dump), failure of the GPR to detect waste material deposits below the road, and direct observations of waste materials located east of the outline of the Southern and Central AOCs ("the footprints"). The outlines/footprints of the AOCs were taken from the 1954 and 1959 aerial photographs presented in the USATEC (2000) ground features report. The findings of the RI indicate that wastes were clearly located east of these outlines, and that the NOAA access road did not exist in the 1954 and 1959 aerial photographs. Although the GPR survey of the NOAA access road did not indicate buried debris

was present below the road, it is possible that residual contamination may be present below the NOAA access road.

5.4 Contaminant Transport

Arsenic, iron, manganese, and mercury tap water RSLs were exceeded in groundwater samples, but the highest concentration of mercury detected was in MW-1 (0.18 ppb), and so these mercury detections were a background condition for the site (all of the other detections were less than that value). All of the arsenic, iron, and manganese detections in groundwater were less than the Wallops background mean concentrations (Tetra Tech, 2004). In view of these findings, and considering that these metals findings were also true for MW-3, whose screen was placed within the waste material, these data indicated that the metal contaminants within the waste deposits (soil) of the Central and Southern AOC were not strongly impacting groundwater quality. Barium, calcium, copper, lead, magnesium, nickel, potassium, selenium, sodium, and thallium exceeded either mean or maximum background concentrations (Tetra Tech, 2004), but none of these metals were detected at concentrations that exceeded a tapwater RSL or MCL.

All groundwater contamination resulting from organic chemicals that were detected above tap water RSLs occurred in MW-4 and MW-5 (Figure 4-2 and 4-3). VOCs and SVOCs detected within the waste deposits (soils) of the Sothern and Central AOCs clearly impacted groundwater downgradient of the site. SVOCs (2-methylnaphthalene and naphthalene) were detected at concentrations above tapwater RSLs in samples from MW-4 and numerous VOCs were detected at concentrations that exceeded tapwater RSLs in MW-4 and MW-5 including: 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene, tetrachloroethene, trichloroethene, toluene, m,p xylene, o-xylene, and total xylenes. Of these, the concentrations of cis-1,2-dichloroethene, toluene, and tetrachloroethene exceed MCLs,

All of the organic compounds detected in groundwater samples appeared to degrade or be volatilized by the time groundwater discharged to the tidal channel, and surface water quality appeared to be largely unaffected by the CDL Site. Mercury and copper were the only analytes in downstream surface water sampling locations that exceeded BTAG criteria, but all of the downstream mercury detections were lower than the local background location, SW-1 (Figure 4-4), and the downstream copper detections (3.3 to 4.9 ppb) were only very slightly higher than the upgradient background concentrations (2.2 to 3.3 ppb).

Over all, there was no strong correlation between detections of contaminants that exceeded BTAG criteria in the downstream sediment results and data from other environmental media at the CDL Site. Sediment sample SD-9, collected within the footprint of the Southern AOC and in direct contact with the waste materials had the highest number of analytes detected that exceeded BTAG criteria including 4,4-DDE, 4,4-DDD, arsenic, copper, mercury, nickel, silver, and zinc (Figure 4-5). In data from SD-2, located roughly 100 feet downstream of SD-9 on the man-made drainage channel, the only results that exceeded BTAG criteria were for arsenic, copper, lead, and nickel (Figure 4-5). However, the levels of lead and mercury found in surface and subsurface soil at TP-3 may correlate with those found in SD-9.

Arsenic, copper, and nickel were detected in several other sediment sampling locations at concentrations that exceeded BTAG criteria, however, the highest detection of copper (36 ppm) was detected in the upgradient background location, SD-1. The range of arsenic detected in sediment samples (8.5 to 21 ppm) was comparable with the SD-1 background concentration (10 ppm) and the mean and maximum WFF background (Tetra Tech, 2004) values for arsenic in soil of 4.2 and 14.2 ppm, respectively. Similarly, the range of nickel detections in downstream samples (17-22 ppm) was comparable to the 17.1 ppm detection in the upstream background sample, 1WFF-MB-111-SS (Figure 4-5).

The only SVOC detected in sediment at concentrations exceeding BTAG criteria was bis(2-ethylhexyl)phthalate which was detected at concentrations of 4,360 to 162,000 ppb in SD-4 and SD-5, respectively. Because the sediment concentrations are one to three orders of magnitude higher than detected in soil (300 ppb), and a large amount of plastic detritus was observed in the marsh adjacent to the site, these elevated BEHP concentrations could be site-related, but the lack of systematic detections suggest other sources could also be the cause of the high concentrations. The range of 4,4-DDD (26.8 to 149 ppb) and the detection of 4,4-DDE (65 ppb), while significantly higher than the background detections (4.2 to 7.7 ppb), were confined to sampling locations that were within the footprint of the Southern AOC, and sediment locations downstream of the AOCs were not impacted by any pesticides whose concentrations exceeded BTAG criteria.

Overall, only VOCs from the Central and Southern AOCs had a demonstrable impact on groundwater below and immediately adjacent to the AOCs. The impact is severely constrained by the proximity of adjacent discharge areas in the marsh. These VOCs dissipate rapidly and were not observed in surface water or sediment. Contributions of pesticides and metals to

sediment are possible as a result of erosion and deposition of impacted soils. However, beyond the AOCs footprint, only arsenic and nickel were detected at concentrations that exceeded background, and these concentrations were only slightly elevated.

6.0 BASELINE HUMAN HEALTH RISK ASSESSMENT

6.1 Introduction

A baseline HHRA was conducted to determine current and future potential risks to human health as a result of contaminants found in soil and groundwater at the former CDL Site at the WFF in Accomack County, Virginia. Additionally, sediment and surface water samples from the adjacent reaches of Little Mosquito Creek downstream of the CDL Site were assessed. This risk assessment is based on U.S. EPA guidance documents.

This risk assessment will be used to help determine whether remedial action is required for the site by identifying potential hazards and quantifying associated risks from exposures to on-site chemicals of potential concern (COPCs). Site-specific background information for the CDL is provided in the RI portion (Sections 1.0 through 5.0) of this document.

6.2 Scope of Risk Assessment

The EPA provides guidance and specific procedures for conducting baseline risk assessments. This guidance is found in EPA's "Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (RAGS)" (USEPA, 1989a). Supplemental guidance for performing risk assessments is also periodically issued by EPA (e.g., EPA, 2002a, 2004a). These guidelines, as well as the EPA Regional Screening Table (USEPA, 2008a) were the primary sources of guidance used to conduct the human health risk assessment for the CDL Site.

As indicated in RAGS (USEPA, 1989a), there are four major steps involved in conducting a HHRA: (1) data collection and evaluation, (2) exposure assessment, (3) toxicity assessment, and (4) risk characterization. Each step is briefly described below.

Data collection and evaluation involve gathering and evaluating site data relevant to human health and identifying those substances present at the site(s) that should be the focus of the risk assessment process (i.e., COPCs). The RI for CDL Site involved a "hot spot" bias by the use of multiple screening technologies to focus sampling locations on the most impacted areas of the site, wherever possible.

An exposure assessment is conducted to estimate the magnitudes of actual and/or potential human exposures, the frequencies and durations of these exposures, and the pathways by which humans may be exposed. In this exposure assessment, reasonable maximum estimates of exposure have been developed for both current and, if applicable, future land-use assumptions. Current exposure estimates are used to determine potential doses based on existing exposure conditions at the site. Future exposure estimates are used to provide decision-makers with an understanding of potential future exposures and quantitative estimates of the likelihood of such exposures occurring. Conducting an exposure assessment involves analyzing chemical releases; identifying exposed populations; estimating exposure point concentrations for specific pathways, based on both environmental monitoring data and predictive chemical modeling results; and estimating chemical intakes for specific pathways. The results of an exposure assessment are pathway-specific intakes for current and future exposures to individual substances.

A toxicity assessment considers: (1) the types of adverse health effects associated with chemical exposures; (2) the relationships between magnitudes of exposures and potential adverse effects; and (3) related uncertainties such as the weight of evidence of a particular chemical's carcinogenicity in humans. Toxicity assessments are generally accomplished in two steps. The first step, hazard identification, is the process of determining whether exposure to an agent can cause an increase in the incidence of an adverse health effect (e.g., cancer, birth defects). Hazard identification also involves characterizing the nature and strength of the evidence of causation. The second step, dose-response evaluation, is the process of quantitatively evaluating the toxicity information and characterizing the relationships between the doses of the chemicals administered or received and the incidence of adverse health effects in the exposed population. From those quantitative dose-response relationships, toxicity values are derived that can be used to estimate the incidence of adverse effects occurring in humans at different exposure levels. Typically, risk assessments rely heavily on existing toxicity values (e.g., reference doses for chronic exposure [RfDs] and cancer slope factors [SFs]) developed for specific chemicals by EPA.

Risk characterization summarizes and combines outputs of the exposure and toxicity assessments to characterize baseline risks, both in quantitative expressions and qualitative statements. During risk characterization, exposure estimates are combined with chemical-specific toxicity information to determine whether current or future contaminant levels at or near the CDL Site may be of potential concern.

6.3 Media of Potential Concern

Based on available historical aerial photographs of the CDL Site area, four AOCs were recognized and characterized. These AOCs were identified as the Western AOC, Northern AOC, Central AOC, and Southern AOC, corresponding to those areas previously described in the USATEC (2000) historical aerial photo analysis as the "shallow excavation", "disturbed ground", "mounds of material", and "burning dump", respectively. Since site investigations did not indicate the presence of buried waste at the Western and Northern AOCs, soil data from these two AOCs were evaluated together for risk assessment purposes separately from the other two AOCs. Soil sampling data from the Central and Southern AOCs, where wastes were clearly evident, were considered together as one area in the baseline HHRA. However, environmental data from groundwater, surface water and sediment was used that reflects locations that are also impacted by the Central and Southern AOCs. Based on the environmental investigations of the CDL Site, the media of potential concern identified for the CDL Site include:

- Soil (surface and subsurface) from the four designated AOCs;
- Groundwater collected from impacted wells located downgradient of the CDL Site;
- Sediment collected from the adjacent Little Mosquito Creek; and
- Surface water collected from the adjacent Little Mosquito Creek.

In addition to these media, fish and crabs from Little Mosquito Creek were evaluated as media of potential concern. Concentrations of COPCs in fish and crab tissue were modeled from surface water and sediment data since no direct sampling of fish and crabs was performed.

6.4 Data Reduction

Analytical data obtained from multi-media samples collected during the RI field investigation were evaluated to identify COPCs (i.e., TAL and TCL chemicals), in accordance with EPA Quality Assurance Program protocols. The analytical results are presented in Section 4.0 of this document.

The limitations and uncertainties associated with the analytical results were evaluated as part of the data reporting requirements of the analytical laboratories and the data was validated by a third-party validator. Analytical data-related qualifiers identified by the laboratory as well

as information provided for all field and laboratory blank samples were taken into consideration in the evaluation process. Only data validated according to the guidelines established by EPA were used in the risk assessment.

This risk assessment addresses site-related chemicals that were considered to pose significant potential threats to human health. These COPCs for the CDL Site were selected based on a combination of their intrinsic toxicities and their levels of occurrence on site. In general, EPA Headquarters guidance presented in *RAGS* (USEPA, 1989a) were followed to determine the COPCs. This guidance and the data screening process are summarized as follows:

- If a chemical was not detected in any of the samples of a particular medium because it was reported as a non-detect (indicated by a "U" qualifier), that chemical was eliminated from consideration for that medium.

- If a chemical was present in a sample as a result of blank contamination or because it was rejected (indicated by an "R" qualifier), the result was eliminated for that medium.

- Data with "J" qualifiers were assumed to be positive identifications for those media. "J" indicated that the numerical value is an estimated concentration (i.e., it is reported below the minimum confident sample quantitation limit).

- "U" qualified data represent non-detect sample results for the chemicals evaluated. In the past, a value of one-half of the detection limit (DL) was used to represent the concentration of non-detect samples in subsequent calculation (i.e., 95 percent upper-confidence limit of the mean [95% UCL]). According to recent information presented in the *ProUCL Version 4.00.02 User's Guide* describing EPA's statistical program, ProUCL (USEPA, 2007a), the method of assuming one-half the DL is not recommended for small data sets and data sets where more that 10-15% of the samples are NDs. For that reason, for a non-detect sample a value equal to the DL of that sample was assumed.

- For sample duplicates the average of the reported concentrations was used for subsequent calculations. For purposes of screening chemicals to determine COPCs, each concentration was considered individually when determining the

maximum concentration, maximum detection limit, mean, and the detection frequency.

6.5 Data Evaluation

The chemical concentrations found at a site may vary spatially. Furthermore, receptors may move within an area where COPCs have been detected. Therefore, it is important to estimate the concentration of a COPC in a manner consistent with the location and route of potential human exposure. This estimate of a chemical concentration is known as the exposure point concentration (EPC). The objective of the data evaluation is to summarize the sampling data collected by medium and location for use in the risk assessment. Summary tables were prepared using the Standard 2 "Occurrence, Distribution, and Selection of COCs" from EPA RAGS, Part D (USEPA, 2001). The tables contained in this risk assessment present a list of the chemicals detected at the site, the frequency of detection, range of detected concentrations, range of detection limits, as well as the rationale behind the selection or deletion of a chemical as a COPC.

In order to avoid diluting EPCs from impacted areas with data from areas where evidence of waste disposal was not evident, the soil data was segregated into two groups for analysis. These two groupings were: (1) Central and Southern AOCs, and (2) Northern and Western AOCs. Within these two areas, the soil data was further sub-divided based on the soil horizons: one group for surface soil (defined as 0 to 0.5 feet bgs), and another for aggregate soil (0 to 10 feet bgs). One group of data was evaluated for groundwater, in addition to surface water and sediment. Tables 6-1 through 6-7 present this information for soil, groundwater, sediment, and surface water samples collected at the CDL Site.

6.5.1 Screening for Chemicals of Potential Concern

Chemicals that potentially could present a risk to human health were identified as COPCs by utilizing the following criteria:

- If a chemical was not detected in any sample from a specific medium, it was not considered to be a COPC for that medium.
- The maximum concentration for a detected chemical was compared against the corresponding medium-specific screening level in the EPA Regional Screening

Table (USEPA, 2008). Detected chemicals were retained if the screening concentration was found to be above the screening level. Those detected chemicals that were found to be below the screening value were eliminated from further consideration.

- A chemical with no screening limit (i.e., no toxicity data) and no appropriate surrogate toxicity value was not further evaluated if no appropriate surrogate chemical was available.
- Metals considered to be essential nutrients (i.e., calcium, magnesium, potassium, and sodium) were eliminated from further evaluation.
- Although arsenic concentrations were determined to be within a range of background concentrations (Appendix E), they were retained in the analyses of overall risk. An additional, separate risk summary eliminating arsenic was then prepared.

Chemicals were compared to the screening levels presented in the EPA Regional Screening Levels for Chemical Contaminants table (USEPA, 2008) to identify COPCs. For soil and sediment the lowest value between the residential soil RSL value and the protection of groundwater limit was chosen as the RSL limit. Groundwater COPCs were selected by comparing the maximum detected concentration to the tap water RSL. To ensure that chemicals with additive effects were not prematurely eliminated during screening, RSL based on non-cancer toxicity data (denoted with a "nc" in the RSL table) were multiplied by 0.1. In cases where a chemical had both cancer and non-cancer based RSL concentrations, the lower of the two values was used for screening to be more protective of human health.

Lead soil concentrations were compared to the lead remedial goal of 400 mg/kg, the current EPA RSL (USEPA, 2008). Groundwater and surface water concentrations were compared to the lead treatment technique action level of 15 µg/L (USEPA, 2008).

No screening limits for sediment have been developed at this time. Therefore, in order to select COPCs for sediment, the maximum detected concentrations in sediment were compared to adjusted residential soil screening values. Since the expected exposure duration and frequency for a receptor exposed to sediment would be much less than that for a resident to soil, the screening values based on cancer risk were adjusted to correspond to a target cancer risk of $1x10^{5}$ or a target hazard quotient of 1.0. As with sediment, no screening limits have been

developed for surface water, therefore, screening values for groundwater were also adjusted to a target cancer risk of $1x10^{-5}$ and a target hazard quotient of 1.0.

Although the future use of the CDL is expected to remain the same as the current use, theoretical future development, such as residential or commercial use was evaluated. Since the groundwater table is relatively shallow at the CDL Site and VOCs have been detected in both soil and groundwater at the Site, the potential for vapor intrusion into indoor air in future buildings was evaluated. EPA guidance on evaluating vapor intrusion to indoor air pathways (USEPA, 2004b) identifies those chemicals that are sufficiently volatile to present an indoor air concern. A chemical is considered to be sufficiently volatile if its Henry's law constant is $1x10^{-5}$ atmospheres per cubic meter per mole (atm-m^3/mol) or greater (USEPA, 2004b). Detected chemicals in soil and groundwater of sufficient volatility were evaluated for the vapor intrusion pathway.

6.5.2 Identification of Chemicals of Potential Concern

Tables 6-1 and 6-2 present the soil data summaries and the selection process for COPCs in surface soil and aggregate soil for the Central and Southern AOCs, respectively. Tables 6-3 and 6-4 show similar data for surface and aggregate soil sampling results for the Northern and Western AOCs.

VOCs, SVOCs, pesticides, and inorganics were detected in surface soils at the Central and Southern AOCs. VOCs, SVOCs, and pesticides, as well as Aroclor-1260, were also positively detected in the aggregate soil interval (0 to 10 feet bgs). COPCs identified for the Central and Southern AOCs include:

Surface soil: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene, DDD, DDE, DDT, aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, vanadium, and zinc.

Aggregate soil: benzene, 1,2-dichloroethane, ethylbenzene, tetrachloroethene, m,p-xylene, xylene (total), benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-c,d)pyrene,

gamma-chlordane, DDD, DDE, DDT, Aroclor-1260, aluminum, antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, nickel, silver, vanadium, and zinc.

For the surface soil samples from the Northern and Western AOCs, acetone was the only VOC detected, benzaldehyde was the only SVOC detected, and DDE was the only pesticide detected. Most of the inorganics analyzed for were detected in the surface soil. The detected analytes are summarized in Table 6-3. For the aggregate soils from the Northern and Western AOCs, acetone, benzaldehyde, and bis(2-ethylhexyl)phthalate were positively identified, in addition to those chemicals detected in surface soil. Table 6-4 presents the soil data summary and selection rationale for COPCs for the aggregate soils. COPCs identified for the Northern and Western AOCs include:

Surface and aggregate soil: aluminum, arsenic, iron, and mercury.

Similar to the COPC tables for soil and subsurface soil, Table 6-5 contains information on descriptive statistics and the rationale for selecting or deleting a chemical as a COPC for groundwater. Only data from impacted wells were pooled for use in assessing ground water risks/hazards. All of the impacted wells are downgradient of the Western, Central, and Southern AOCs but are dominantly impacted by the waste materials disposed of in the Central and Southern AOCs. COPCs identified for groundwater include VOCs, SVOCs, and metals, although the VOCs and SVOCs did not have high detection frequencies. Arsenic was found to be within background levels in soil (Appendix E) and was not detected at above background concentrations in wells downgradient of the Northern (MW-6) and Western (MW-2) AOCs. Maximum detections for arsenic in groundwater were less than half the Tetra Tech (2004) mean concentration.

Table 6-5 shows the data summary and selection rationale for COPCs identified for groundwater downgradient of the CDL Site, including:

Groundwater: benzene, 1,2-dichloroethane, cis-1,2-dichloroethylene, ethylbenzene, isopropylbenzene, tetrachloroethene, toluene, trichloroethylene, m,p-xylene, xylene (total), 2-methylnapthalene, naphthalene, arsenic, iron, lead, manganese, thallium, and mercury.

Several VOCs and pesticides, in addition to many inorganics, were detected in sediment from Little Mosquito Creek. Of those detected chemicals, only methylene chloride, bis(2-ethylhexyl)phthalate, DDE, arsenic, and mercury were determined to be COPCs. Table 6-6 presents the sediment data summaries and COPC screening. Arsenic has been found to be within the range of background concentrations for CDL Site soil (Appendix E).

Table 6-7 presents the detected analytes, data summaries, and screening process for surface water from Little Mosquito Creek. Only one COPC was identified for surface water, arsenic, but arsenic was determined to be within the range of background concentrations in soil nearby (Appendix E).

Table 6-8 summarizes all the COPCs identified for soil at the Central and Southern AOCs and Northern and Western AOCs. The COPCs for groundwater, sediment, and surface water are shown in Table 6-9. Arsenic was determined to be within the range of background concentrations for soil (Appendix E).

Tables 6-10 and 6-11 present the COPC selection process and results for the vapor intrusion pathway for aggregate soils for the Central and Southern AOCs and Northern and Western AOCs, respectively. Table 6-12 shows the screening performed to identify the volatile COPCs for evaluating vapor intrusion into indoor air from groundwater. The chemicals detected in both soil and groundwater were selected as COPCs based on whether they were identified as being sufficiently volatile as identified in Table 1, "Screening List of Chemicals" found in EPA's *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings* (USEPA, 2004b).

6.6 Exposure Assessment

Exposure bridges the gap between a potential hazard (i.e., presence of a toxic chemical) and a risk. Exposures to chemicals may occur via inhalation, ingestion, or by dermal absorption routes. The objectives of an exposure assessment are to: (1) identify populations that may potentially be exposed to COPCs; (2) identify the pathways by which such exposures may occur; and (3) quantify chemical intakes, or potential dose, based on the magnitudes, frequencies, and durations of these potential exposures. The exposure assessment provides pathway-specific intakes for current and future exposures to site-related COPCs.

An exposure assessment was conducted to estimate the type, timing, and magnitude of exposures that human receptors may experience due to contact with the COPCs remaining in soil at the CDL Site. Exposures were evaluated for both current and potential future site conditions. The following subsections address the identification of potentially exposed populations, the identification of pathways of exposure, and the calculations and assumptions used to quantify potential exposures. Table 6-13 presents the potentially exposed populations and the pathways/routes by which they may be exposed for the exposure scenarios evaluated.

6.6.1 Identification of Potential Exposure Populations

Human receptors potentially at risk from exposure to COPCs were identified based on current and future land uses and potentially exposed population groups that may plausibly be located on or near the CDL Site. It is assumed that the area where the CDL Site is located will remain in its current state, as open space and part of the WFF. However, for purposes of conducting a conservative evaluation of the potential risks from the COPCs at the Site, some receptors that are extremely unlikely to be found at the CDL Site, either currently or in the future (i.e., residents), are evaluated. Although the Western AOC and part of the Northern AOC are behind the WFF fenceline, it is assumed that all the AOCs are equally accessible by all potential human receptor groups being evaluated. Potential current and future receptors and exposure scenarios identified for the CDL Site are described below:

6.6.1.1 Current Scenarios

Based on background information and site visits there does not appear to be any current facility activity at the CDL Site. No residential housing exists on or adjacent to the site; therefore, it is very unlikely that residential exposure to COPCs occurs at the site. However, recreational boaters could be exposed to surface water and sediment along the boundary of the site and may ingest aquatic organisms (i.e., fish and crabs) caught in the surface water or marsh areas.

There are no commercial buildings on the site or nearby; however, maintenance activities, such as mowing, are conducted at the CDL Site. Trespassers could gain access to the Central and Southern AOCs relatively easily; however, the CDL Site covers a small area and is patrolled by security, who would quickly remove any trespassers from the site. Using conservative assumptions, site workers and recreational fishermen (adults and children) were

considered as potential current receptors for the risk assessment (recreational fishermen could also be considered as future receptors). Trespassers were evaluated under a future-use scenario, since there may potentially be more access to the CDL Site if it were redeveloped for another use.

6.6.1.2 Future Scenarios

Future uses of the site are expected to include the current uses described above. In addition, the potential for construction, although unlikely, is assumed to take place on the site. Construction workers would potentially be exposed to soil and groundwater during excavation and construction activities. Also, various utilities run beneath the CDL Site, so some excavation may be necessary for utility repairs/upgrades, particularly if the CDL Site were to be developed.

Although the current use of the CDL Site is not likely to change, residential development of the CDL Site was considered as a potential future scenario for risk assessment purposes. Evaluating residential receptors, which includes adults and children, presents an upper-bound risk for the chemicals found at the CDL Site. As a result, future residents could be exposed to soil and groundwater if the aquifer was developed as a potential drinking water source. High quality municipal supplies are available, and future groundwater use is considered extremely unlikely; nevertheless, groundwater exposure was assessed. In evaluating future-use scenarios that include groundwater, it was assumed that while people may live or work on cleaner areas of the CDL Site, such as the Northern and Western AOCs, their drinking water supplies would be drawn from impacted areas of the site, and they would be exposed to impacted surface water and sediment. This conservative assumption is required to develop the Reasonable Maximum Exposure (RME) for the Site.

Due to the small area that the CDL Site covers, the presence of an access road running through the site, and the proximity to the WFF runway and the creek, no commercial/industrial development is expected on the site, however, this scenario was evaluated as part of this assessment. In addition to soil, commercial/industrial workers could also be exposed to groundwater if the aquifer was developed as a potential drinking water source.

Designation of an exposure pathway as “complete” indicates that human exposure is possible, but does not necessarily mean that exposure will occur, nor that exposure will occur at the levels estimated in this report. Potential sources of COPCs include soil, groundwater,

sediment, surface water, and aquatic organisms. Chemical fate and transport processes were used to define the potential migration pathways at the CDL Site and included: (1) transfer of COPCs between environmental media, such as soil and air; and (2) transport of COPCs through movement of an environmental medium by natural advective and dispersive processes, such as air dispersion.

Based on the above information, the exposure pathways considered for the human health risk assessment of the CDL Site are summarized below:

Soil:

- Current incidental ingestion and dermal absorption of surface soil by site workers;
- Future incidental ingestion and dermal absorption of aggregate soil by construction workers;
- Future incidental ingestion of aggregate soil by commercial workers;
- Future incidental ingestion and dermal absorption of aggregate soil by residents (adult and child);
- Future incidental ingestion and dermal absorption of aggregate soil by trespassers;
- Current inhalation of fugitive dust from surface soil by site workers;
- Future inhalation of fugitive dust from aggregate soil by construction workers during excavation activities;
- Future inhalation of fugitive dust from aggregate soil by residents and trespassers; and
- Future inhalation of COPCs in indoor air that have volatilized from soil by adult and child residents and commercial workers.

Groundwater:

- Future incidental ingestion, inhalation and dermal absorption of water by construction workers during excavation/construction activities;
- Future ingestion of drinking water by commercial/industrial workers;
- Future ingestion of drinking water by adult and child residents;
- Future inhalation and dermal absorption of water by adult residents during showering;
- Future dermal absorption of water by child residents during bathing;

- Future inhalation of COPCs in indoor air that have volatilized from groundwater by adult and child residents and commercial workers;
- Future inhalation of COPCs that have volatilized from groundwater during excavation activities by construction workers.

Sediment:

- Current/future incidental ingestion and dermal absorption of sediment by recreational fishermen; and
- Future incidental ingestion and dermal absorption of sediment by trespassers.

Surface water:

- Current/future incidental ingestion and dermal absorption of surface water by recreational fishermen; and
- Future incidental ingestion and dermal absorption of surface water by trespassers.

Biological tissue (Bluefish and Blue Crabs):

- Current/future ingestion by recreational fishermen.

6.7 Determination of Representative Chemical Concentrations

EPCs for the COPCs were calculated based on chemical measurements from soil, groundwater, sediment, and surface water sampled at the CDL Site. The data distribution was assessed for each COPC in each of the media of interest for the two areas being evaluated.

6.7.1 Soil, Groundwater, Sediment, and Surface Water EPCs

Data for each COPC were assessed utilizing the statistical software package ProUCL (Version 4.00.02), developed for EPA (USEPA, 2007a). ProUCL consists of all parametric and non-parametric upper confidence limit (UCL) computation methods presented in U.S. EPA's revised guidance document *Calculating the Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites* (USEPA, 2002b). The software computes parametric UCLs based upon normal, lognormal, and gamma distributions, as well as using several non-

parametric methods. The recommendations for the most appropriate 95th percentile UCL(s) provided by ProUCL were used to estimate each COPC mean soil concentration. In some instances, when ProUCL determined that there was an insufficient quantity of samples to adequately characterize the COPC concentration, the EPC was then assumed to be the maximum measured concentration. Also, for some COPCs, when the estimated UCL exceeded the maximum concentration for that particular COPC, ProUCL then recommended using the maximum concentration as the EPC or an alternate UCL. ProUCL statistical outputs for all COPCs are provided in Appendix F-1.

The recent guidance in the *ProUCL Version 4.00.02 User Guide* (USEPA, 2007b) provides that "when most (e.g., > 95%) of the observations for a contaminant lie below the detection limit(s) or reporting limits (RLs), the sample median or the sample mode (rather than the sample average which cannot be computed accurately) may be used as an estimate the EPC term." (Note that when the majority of the data are nondetects, the median and the mode will also be a nondetect.) Per EPA (2007b), where the number of available detected samples is small (e.g., < 5), an alternate estimate of the EPC should be developed on site-specific basis. Therefore, in instances when the number of detects were less than or equal to 5, the maximum of the data set was used as an estimate of the EPC.

Tables 6-14 and 6-15 present the EPCs for surface and aggregate soil COPCs for the Central and Southern AOCs, respectively. Tables 6-16 through 6-17 present the EPCs for surface and aggregate soil COPCs for the Northern and Western AOCs, respectively. Table 6-18 presents the EPCs for the COPCs for groundwater at the CDL Site. Tables 6-19 and 6-20 present the EPCs for COPCs identified in Little Mosquito Creek sediment and surface water, respectively.

6.7.2 Indoor Air EPCs

There are no buildings currently on site. Chemicals may volatilize from soil and/or groundwater. Residents and commercial workers could potentially be exposed to concentrations of volatilized chemicals from the surrounding substrate that enter hypothetical future-use buildings. EPCs for COPCs in indoor air were calculated for aggregate soil at the Central and Southern AOCs and Northern and Western AOCs, as well as groundwater at the CDL Site. Contaminant concentrations in indoor air were estimated using Johnson and Ettinger's (1991) analytical solution for convective and diffusive transport of vapor-phase contaminants. The

conceptual model is based on the transport of soil gas into the interior of a hypothetical structure through cracks in the foundation. The driving force is a pressure gradient between the soil and the lower portion of the interior of the structure, which is caused by the rising of warm air inside the structure. The two EPA spreadsheet models used to calculate the EPCs were SL-SCREEN, the screening-level model for contaminated soil, and GW-SCREEN, the screening-level model for contaminated groundwater (USEPA, 2004b).

Because there are no buildings on site, default assumptions for hypothetical building parameters provided in the models were assumed. The contamination layer in soil was assumed to extend from the bottom of the enclosed space floor (15 centimeters [cm]) below the building foundation to the water table. The depth to the water table was assumed to be 7.97 feet (243 cm), the average depth to groundwater at the four AOCs. The assumed input parameters can be seen on the example "DATAENTER" tables in Appendix F-2. The model results for soil at the Central and Southern AOCs are presented in Table 6-21 and for the Northern and Western AOCs in Table 6-22. Model vapor concentration calculations for groundwater intrusion are summarized in Table 6-23. Site-specific soil parameters for the CDL Site were assumed in the model. The indoor air concentration, $C_{building}$, found on the "INTERCALCS" sheet of the models, is based on a unit concentration. Therefore, the calculated result for $C_{building}$ has to be multiplied by the respective COPC concentration in soil or groundwater to obtain the indoor air concentration. The model results shown in the "INTERCALCS" table can be seen for each soil and groundwater COPC in Appendix F-3.

6.7.3 EPCs for Air in a Construction/Utility Trench

In order to estimate the exposure of construction workers to volatiles from groundwater in a construction/utility trench, a combination of a vadose zone model to estimate volatilization of gases from contaminated groundwater into a trench and a box model to estimate dispersion of the contaminants from the air inside the trench into the above-ground atmosphere were used. This approach has been recommended by VDEQ in its Voluntary Remediation Program (VRP) Risk Assessment Guidance (VDEQ, 2008). The detailed elements of the model used to calculate the concentration of volatiles in a construction trench are found in Section 3.2.2, "Exposure of Workers to Volatiles in a Construction/Utility Trench" of the VRP guidance document (VDEQ, 2008).

If the depth to groundwater at a site is less than 15 feet, VDEQ assumes that a construction/utility worker would encounter groundwater when digging an excavation or a trench. The worker would then have direct exposure to the groundwater and would also be exposed to contaminants in the air inside the trench that would result from volatilization from the groundwater pooling at the bottom of the trench.

VRP Table 6.4, "Construction Trench: Contact with Groundwater" (https://www.deq.virginia.gov/vrprisk/tables.html), was used to calculate the trench air concentration. For modeling purposes, VDEQ assumes that the trench is 3 feet wide by 8 feet long. VDEQ also assumes that the trench would only intercept the groundwater for a few inches since a groundwater pool of more than a few inches would likely require dewatering. Therefore, the trench depth was set equal to 8 feet, the average measured depth to groundwater at the CDL Site. The calculated chemical concentrations in trench air are shown in Table 6-24.

6.7.4 Fish and Crab EPCs

Since no direct sampling of fish and crab tissue was performed, estimates of tissue concentrations were based on concentrations of detected chemicals in surface water and sediment from Little Mosquito Creek. The chemical concentrations in bluefish tissue were assumed to be directly equal to the surface water concentration (mg/L). For blue crabs, the chemical concentration in tissue was calculated by assuming that the tissue concentration in benthic invertebrates (i.e., crabs) (mg/kg) is equal to the concentration of a chemical in sediment (µg/kg). Trophic level multipliers were taken from EPA (1999b) which provides the exposure calculations for these pathways. These multipliers are provided in Tables 6-25 and 6-26.

A screening of calculated bluefish and blue crab tissue concentrations was then performed against EPA Region III RSLs for Fish (USEPA, 2009). For screening purposes, a target hazard quotient (THQ) for non-cancer based screening levels of 0.1 was used. Because a THQ of 1.0 was used in the EPA screening values, the screening levels were divided by 10 to achieve the lower THQ. A target cancer risk of $1x10^{-6}$ was used (no adjustments were made for screening levels based on cancer toxicity data).

The fish tissue screening levels were also used for crabs. This is a conservative assumption because the screening level is based on an ingestion rate for fish, which is higher than the crab ingestion rate. Thus, a value that is protective of human health based on fish

consumption will also be protective for consumption of crabs. The tissue concentration calculations and screening results are presented in Tables 6-25 and 6-26 for bluefish and blue crabs, respectively. The COPCs and EPCs for bluefish and blue crabs are summarized in Table 6-27.

6.8 Estimation of Exposure Intake

Chemical exposure is a result of the intake or uptake of a chemical from the environment. This section of the report describes the methods used to quantitatively evaluate potential receptor exposures at the CDL Site. The equations, as well as the parameters, that were used to estimate chronic daily intake (CDI) of the COPCs for each receptor are presented. Each exposure scenario described in this section of the report is based on the premise that the extent of exposure to a chemical in an environmental medium is proportional to the concentration of the chemical in the medium, rate of contact with the medium, and the duration of exposure. RMEs were estimated to ensure that exposures represent the highest level of exposure that may reasonably occur, but are not necessarily the worst level of exposure (USEPA 1989, 1991a, 2002a).

Exposure dose is related to the magnitude, frequency, and duration of exposure. These parameters are calculated by combining the EPC and the various exposure parameters. Two types of doses are calculated representing cancer risk and non-cancer effects. The lifetime average daily dose (LADD) is averaged over a 70-year lifetime and is an estimate of cancer risk. The average daily dose (ADD) is proportional to the actual exposure duration for a receptor and represents non-cancer health effects.

The exposure models and the specific parameter values used to estimate intake for each plausible receptor are summarized in Tables 6-28 to 6-47. Specific values and assumptions used in estimating exposures were selected based on EPA guidance and documents (USEPA 1989a, 1997a, 2002a, 2004a) and professional judgment. The groups of receptors that may be exposed to COPCs at the CDL Site include: (1) current site workers, (2) future commercial workers, (3) current/future recreational fishermen, (4) future construction workers, (5) future residents, and (6) future site trespassers. The exposure scenarios and parameters used in estimating intake of COPCs and risks for each receptor group are described in the following sections.

6.8.1 Current Site Workers

Current site workers could be exposed to COPCs in soil while performing routine activities at the CDL Site, such as periodic maintenance and grounds-keeping. The current site worker was assumed to come into contact with surface soils (0 to 0.5 feet bgs). Soil exposure pathways evaluated include incidental ingestion, dermal contact, and inhalation of atmospherically dispersed particulates. Doses and risks associated with soil exposure were calculated for each of the two identified areas, Southern and Central AOCs and Northern and Western AOCs, separately. Exposure parameters and equations used calculate the daily intakes for the site worker are shown in Table 6-28.

The current site worker was assumed to be an adult with a body weight (BW) of 70 kilograms (kg) who works 8 hours per day (exposure time [ET]), 5 days per week, for a total exposure frequency (EF) of 225 days per year (USEPA, 2002). Exposure duration (ED) was assumed to be 25 years. The carcinogenic averaging time (ATc) was 25,550 days (i.e., 70 years x 365 days/year) (USEPA, 2002a). The non-cancer averaging time (ATnc) was 9,125 days.

Following EPA guidance (USEPA, 2002), the maintenance worker was assumed to ingest surface soil (IR-S) at a rate of 100 milligrams per day (mg/day). This worker was also assumed to have an inhalation rate (Inh) of 20 cubic meters per day (m^3/day) for an 8-hour workday (ET) or 1.75 cubic meters per hour (m^3/hr) (USEPA, 2002) and be exposed to outdoor airborne dusts emitted from soils. The EPA default particulate emission factor (PEF) of 1.36E+09 cubic meters per kilogram (m^3/kg) is assumed (USEPA, 2002a).

Site workers are expected to come into dermal contact with surface soil, however, it was assumed that clothing would provide partial protection. Soil contact was assumed to occur on a skin surface area (SA) of 3,300 square centimeters (cm^2) (USEPA, 2002a). The soil-to-skin adherence factor (SSAF) was conservatively assumed to be 0.2 milligrams per square centimeter (mg/cm^2) (USEPA, 2002a). The dermal absorption factors (ABS) for the COPCs are shown in Table 6-48.

6.8.2 Future Commercial Workers

Although commercial development is not anticipated, hypothetical future commercial workers were evaluated. The commercial workers are not expected to come into direct contact

with soil, as they are assumed to spend the majority of the work day indoors. Soil exposure pathways evaluated for this receptor group include incidental ingestion of soil (Table 6-29) and inhalation of chemicals that may volatilize from soil to indoor air (Table 6-32). The commercial worker was assumed to come into contact with aggregate soil from all depths which is mixed together during construction. The commercial worker was assumed to drink groundwater (Table 6-33) produced from the shallow aquifer at the CDL Site. Additionally, volatiles from groundwater below the hypothetical future building may enter the work environment by vapor intrusion and could subsequently be inhaled by commercial workers (Table 6-39). The worker was assumed to have an inhalation rate (Inh) of 20 m^3/day (USEPA, 2002a).

The commercial worker is exposed for 250 days/year (EF) over a 25-year exposure duration (ED) (USEPA, 2002a). The ATc is 25,550 days (i.e., 70 years x 365 days/year), while the ATnc is 9,125 days. The commercial worker BW is 70 kg (USEPA, 2002a). The soil ingestion rate (IR-S) is assumed to be 50 mg/day (USEPA, 2002a). The receptor is assumed to ingest soil only from the CDL Site, so a value of 1.0 is assumed for the fraction ingested (FI). The worker is assumed to ingest (IR-G) 2 liters (L) of groundwater per day (USEPA, 2002a).

6.8.3 Current/Future Recreational Fishermen

Current and future recreational fishermen fishing and crabbing along and downstream of the CDL Site were evaluated. Bluefish, which are found in Little Mosquito Creek, were chosen to represent all fish. Sampling of bluefish was not performed, so no direct measurements of COPCs in fish tissue were available. The food chain modeling approach from EPA's Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (USEPA, 1999b) was utilized. Section 6.7.4 and Tables 6-25 and 6-26 describe the calculation of EPCs for bluefish and blue crabs with results presented and summarized in Table 6-27.

Recreational fishermen, which include adults and children, are assumed to come into direct contact with sediment and surface water from Little Mosquito Creek. Incidental ingestion of and dermal contact with both sediment (Tables 6-40 and 6-41) and surface water (Tables 6-42 and 6-43) were assumed to occur twice a month during the warmer months of the year, May through September, for an EF of 10 days/year. An ED of 24 years was assumed for adults and 6 years for child recreational fishermen. The ATc is 25,550 days (i.e., 70 years x 365 days/year), while the ATnc is 2,190 days and 8,760 days for a child and adult, respectively (USEPA, 2002a). The child is assumed to have a BW of 15 kg and the adult 70 kg.

Tables 6-46 and 6-47 summarize the exposure parameters and equations used to estimate the daily intakes of fish and crabs for recreational fishermen. An EF of 350 days/year was assumed for fish and crab ingestion. The adult fish ingestion rate (IR-F) was 13.5 grams per day (g/day), representing 75 percent of the 95th percentile total fish and shellfish intake for recreational marine fishermen in the Atlantic region (18 g/day) (USEPA, 1997a). A factor of 0.75 was used to account for the finfish portion of the total intake (USEPA, 1997a). The IR-F for children fishermen was assumed to be 4.5 g/day, calculated by multiplying the total intake (18 g/day) by 0.33 (representing 1/3 of the adult value) and by 0.75.

Crab ingestion (IR-C) by adults was assumed to be 4.5 g/day, representing 25 percent of 18 g/day, the 95th percentile value for total fish and shellfish intake for recreational marine fishermen (USEPA, 1997a). A factor of 0.25 was used to account for the shellfish portion of the total intake (USEPA, 1997a). The child fisherman was assumed to ingest 1.5 g/day. As with fish ingestion, the IR-C was multiplied by 0.33 and 0.25. A value of 0.25 was assumed for FI, the fraction ingested from contaminated media, indicating that 25 percent of all the ingested fish and crabs originate from Little Mosquito Creek.

An incidental surface water ingestion rate (IR-SW) of 0.05 liters per hour (L/hr) (USEPA, 1989a) was assumed with an ET of 2 hours/day. In the absence of recommended sediment ingestion rates (IR-SD), residential soil ingestion rates of 200 mg/day and 100 mg/day for children and adults, respectively, were assumed (USEPA, 2002a).

While fishing and crabbing, recreational fishermen are assumed to come into contact with COPCs in sediment and surface water. Because they are not fully immersed, it was assumed that their feet, lower legs, hands, forearms, and head are exposed. The corresponding SA assumed for adults was 6,900 cubic centimeters per day (cm^2/day) and 2,800 cm^2/day for children (USEPA, 2004a). For sediment contact, an adherence factor (AF) value for reed gatherers of 0.3 mg/cm^2 was assumed for adults (USEPA, 2004a). An AF based on children playing in wet soil, 0.2 mg/cm^2, was used for children (USEPA, 2004a).

For contact with surface water, the absorbed dose per event (DA_{event}) was calculated following the approach in EPA's (2004a) dermal risk assessment guidance. An event duration (t_{event}) of 2 hours/event was used with an event frequency (EV) of 1 event/day. The calculations for DA_{event} are presented in Table 6-51.

6.8.4 Future Construction Workers

Future on-site development could require construction work at the CDL Site. Should construction work occur, it may include excavating, grading, or other soil-moving activities in order to build new structures and add utilities. The construction worker is assumed to be directly exposed to soil from all depths as a result of mixing that would occur during these construction activities. These exposures were evaluated by combining analytical data into one dataset representing COPCs detected in soils sampled to a depth of 10 feet bgs. The potential exposure pathways for the construction worker included incidental soil ingestion (Table 6-29), dermal contact with soil (Table 6-30), and inhalation of dust emissions (Table 6-31). During construction activities the worker could encounter groundwater when digging an excavation or a trench. As a result, the construction worker would have direct exposure to the groundwater and would also be exposed to contaminants in the air inside the trench that would result from volatilization from the groundwater pooling at the bottom of the trench. Potential exposure pathways to COPCs in groundwater include incidental ingestion of groundwater (Table 6-33), dermal absorption of COPCs in groundwater (Table 6-36), and inhalation of volatilized COPCs from the groundwater in the trench (Table 6-38).

A future construction worker was assumed to be a 70-kg adult who works 8 hours per day, 5 days per week. Based on recommended values (USEPA, 2002a), it was assumed that construction work may occur for an entire year and consist of 120 working days (5 days a week for 6 months). The construction worker was assumed to have a soil ingestion rate (IR-S) of 330 mg/day (USEPA, 2002a). The on-site construction worker was assumed to have an inhalation rate (Inh) of 20 m^3/day for an 8-hour day or 2.5 m^3/hr (USEPA, 2002a) and be exposed to outdoor airborne dusts from soils. Clothing was assumed to provide partial protection to construction workers from dermal exposure to soil and groundwater. A skin surface area of 3,300 cm^2 was assumed to contact soil and groundwater, and the recommended soil-to-skin adherence factor of 0.3 mg/cm^2 was used (USEPA, 2002a). The dermal absorption factors (ABS) for the COPCs are shown in Table 6-48. The ATc assumed was 25,550 days (i.e., 70 years x 365 days/year) and the ATnc was 365 days/year (USEPA, 1989a).

For contact with groundwater, the absorbed dose per event (DA_{event}) was calculated following the approach in EPA's (2004a) dermal risk assessment guidance. Table 6-36 shows the equations and parameters associated with the calculations. An event duration (t_{event}) of

2 hours/event with an event frequency (EV) of 1 event/day. The calculations for DA_{event} are presented in Table 6-49.

6.8.5 Hypothetical Future Residents

Residential development of the CDL Site in the future is not considered very likely, however, to obtain an upper-bound estimate of risk, this receptor group was evaluated. Hypothetical residents may contact soil from all depths as a result of the mixing that would be expected to occur during construction. Soil exposure pathways were assumed to include incidental ingestion (Table 6-29), dermal contact (Table 6-30), and inhalation of outdoor dust (Table 6-31). Volatilized COPCs from soil may find their way into the interior of the residence, resulting in an inhalation exposure (Table 6-32). Although not considered likely, this scenario assumes that the groundwater found at the most-impacted parts of the CDL Site is used as a source of drinking water for the household. As a result, hypothetical residents would be expected to ingest groundwater (Table 6-33), inhale VOCs during showering (adult only) (Table 6-37), and have dermal contact while showering (Table 6-34) and bathing (Table 6-35). Vapor intrusion of COPCs from groundwater could also results in inhalation exposure to the adult and child resident (Table 6-39).

The residential receptors were assumed to be exposed for an exposure frequency (EF) of 350 days/year over a 24-year exposure duration (ED) for adults and 6 years for children (USEPA, 2002a). The ATc is 25,550 days (i.e., 70 years x 365 days/year), while the ATnc is 2,190 days and 8,760 days for children and adults, respectively. The child BW is 15 kg and the adult is 70 kg (USEPA, 2002a). The ingestion rate of soil (IR-S) is assumed to be 200 mg/day for children and 100 mg/day for adults (USEPA, 2002a). The residents were assumed to ingest soil only from the CDL Site, so a value of 1.0 was assumed as the fraction ingested from the contaminated source (FI).

The hypothetical residents were assumed to ingest 1 L (child) and 2 L (adult) of water per day (USEPA, 2002a). For dermal contact with soil, SA for a child and adult was assumed to be 2,800 cm^2/day and 5,700 cm^2/day, respectively (USEPA, 2002a). The soil-to-skin AF (SSAF) of 0.2 mg/cm^2 was assumed for children and 0.07 mg/cm^2 for adult residents (USEPA, 2002a). The dermal absorption factors (ABS) for the COPCs are shown in Table 6-48.

For assessing inhalation of outdoor dust and indoor volatiles, the recommended default inhalation rate (Inh) of 20 m^3/day for the child and adult residents was assumed. The EPA default particulate emission factor (PEF) of 1.39E+09 m^3/kg was assumed (USEPA, 2002a). Inhalation of volatiles during showering was assessed for adults based on the Foster-Chrostowski (1987) model. The equations and parameters used in the model are shown in Table 6-37. The exposure time (ET) was assumed to be 1 hr/day (USEPA, 2004a) with an inhalation rate (Inh) of 0.833 m^3/hour (USEPA, 2002a).

For contact with groundwater, the absorbed dose per event (DA_{event}) was calculated following the approach in EPA's (2004a) dermal risk assessment guidance. The SA for adults showering was 18,000 cm^2/day and 6,600 cm^2/day for children bathing. An event duration (t_{event}) of 1 hours/event for children (USEPA, 2004a) and 35 minutes/event or 0.58 hour/event (USEPA, 2004a) for adults with an event frequency (EV) of 1 event/day. The calculations for DA_{event} are presented in Table 6-49.

6.8.6 Trespassers

Although exposures to trespassers may not currently be likely because the Northern and Western AOCs are wholly or partially behind the fenceline, and due to the proximity of the Central and Southern AOCs to the facility boundary fence, such exposures may be present in the future if the site is redeveloped. Site trespassers are assumed to be exposed via soil ingestion (Table 6-29), dermal absorption of soil (Table 6-30), and inhalation of airborne dust (Table 6-31). For this baseline HHRA, a trespasser was conservatively assumed to be a youth between the ages of 12 and 17 years with an average body weight of 60 kg (50^{th} percentile body weight) (USEPA, 1997a). The youth trespassers were assumed to spend 6 days a month for 4 months of the year at the site (VDEQ, 2008) for an ED of 6 years. The ATc is 25,550 days (i.e., 70 years x 365 days/year), while the ATnc is 2,190 days. The ingestion rate of soil (IR-S) was assumed to be 100 mg/day, the same as that for adult resident (USEPA, 2002a). The youths were assumed to ingest soil only from the CDL Site, so a value of 1.0 is assumed as the FI.

Dermal contact with soil was assumed to occur over a SA of 4,300 cm^2/day (representing face, forearms, hands, and lower legs) (USEPA, 2004a). A SSAF of 0.04 mg/cm^2 based on teen exposure to moist soil (USEPA, 2004a), was assumed. The recommended default Inh of 20 m^3/day for an adult was assumed (USEPA, 2002a). The EPA default particulate emission factor (PEF) of 1.39E+09 m^3/kg was assumed (USEPA, 2002a).

Trespassers could be exposed to sediment and surface water at the site. They were assumed to incidentally ingest sediment (Table 6-40), surface water (Table 6-42), and come into dermal contact with sediment (Table 6-41) and surface water (Table 6-43) while wading from the shoreline. The same EF and ED as for soil were assumed for exposure to sediment. Also, the same ingestion rate for sediment (IR-SD) as for soil, 100 mg/day, was assumed (USEPA, 2002a). The skin surface area of 6,300 cm^2/day (representing feet, lower legs, hands, and head) (USEPA, 2004a) was assumed for the youth for contact with sediment and surface water with a SSAF value of 0.04 mg/cm^2 (USEPA, 2004a). An incidental ingestion rate for surface water (IR-SW) of 0.05 L/hr was assumed, with exposures lasting 2 hours per day. The absorbed dose per event (DA_{event}) was calculated following the approach in EPA's (2004a) dermal risk assessment guidance. An event duration (t_{event}) of 2 hours/event with an event frequency (EV) of 1 event/day. The calculations for DA_{event} are presented in Table 6-51.

6.9 Human Toxicity Assessment

The purpose of the toxicity assessment is to evaluate available evidence regarding the potential for site-related chemicals to cause adverse effects in exposed populations and to provide estimates of the relationship between the extent of exposure and the increased likelihood of adverse effects, i.e., dose-response relationships. The results of the toxicity assessment are integrated with the exposure assessment to estimate the cancer risks and noncarcinogenic health impacts in the risk characterization section.

The toxicity assessment for the CDL Site was accomplished in two steps: (1) site data analysis and identification of COPCs (hazard identification) and (2) toxicity evaluation. Toxic responses are generally classified by the EPA as threshold effects and nonthreshold effects. The two principal indices of toxicity are known as slope factors (SFs) and reference doses (RfDs).

For carcinogens, the EPA assumes no threshold or a zero-threshold. This means there is some finite risk no matter how small the dose. The SF for a given chemical carcinogen is a plausible upper-bound estimate of the probability of a response per unit intake of that chemical over a lifetime. The slope factor is used to estimate an upper-bound probability of an individual developing cancer as a result of a lifetime of exposure to a particular level of a potential carcinogen. A second important factor for carcinogens is the EPA weight-of-evidence classification, whereby, carcinogens are grouped according to the quality and quantity of data that indicate that an agent is a human carcinogen.

An RfD for a substance is the daily intake or dose per unit body weight (milligrams per kilogram per day [mg/kg/day]) that is likely to be without appreciable risk to human populations, including sensitive subgroups. The RfD allows for the existence of a threshold dose, that is, a certain minimum intake of substance below which there will be no observable toxic effects based on the metabolic and detoxifying capacities of exposed individuals. EPA considers exposures to most noncarcinogens to have thresholds below which no toxic effects will occur.

Toxicity values were obtained from several primary sources, according to the following order of priority: (1) a listing of carcinogenic SFs and RfDs developed by the EPA found in the Integrated Risk Information System (IRIS) (USEPA, 2008b), (2) toxicity values listed in the EPA's (2008a) Regional Screening Table, and (3) the annual version of the EPA's (1997b) Health Effects Assessment Summary Tables (HEAST). Other sources are noted where appropriate.

6.9.1 Carcinogenic Slope Factors

The EPA's Carcinogen Assessment Group (CAG) have developed SFs (expressed in units of $(mg/kg/day)^{-1}$) for estimating the individual upperbound excess lifetime cancer risks associated with various levels of lifetime exposure to potential human carcinogens. The oral and inhalation SFs used in assessing potential carcinogenic health effects at the CDL Site are shown in Tables 6-52 and 6-53, respectively.

6.9.2 Noncarcinogenic Reference Doses

The chronic oral and inhalation RfDs are shown in Tables 6-54 and 6-55, respectively. These tables also provide information on the health effect of concern or critical effect for each chemical and the uncertainty factor assigned to each RfD (Tables 6-54 and 6-55).

6.9.3 Chemicals for Which EPA Has Not Developed Toxicity Values

Surrogate toxicity values were used to assess dermal exposures and used for chemicals without specific toxicity values. Based on EPA (1992) guidance, oral toxicity values were used to evaluate dermal exposures. This generally is not expected to significantly underestimate the risk or hazard relative to the other routes of exposure. Other toxicity values were determined either by assuming that certain chemical isomers have similar toxic effects or that toxicity values

developed for a specific route of exposure can be extrapolated to other routes (i.e., route-to-route extrapolation). Chemicals evaluated with surrogate toxicity values are noted in Tables 6-52 through 6-55.

The EPA has not developed a RfD for lead, primarily because there is considerable controversy regarding the threshold at which adverse health effects occur. The models used to assess exposures are discussed in Section 6.10.3. The EPA has determined that lead exposure can result in various health effects, depending on the level of exposure. Also, potential health effects differ, depending on whether exposure occurs to an adult or a child. At blood-lead levels of 10 to 15 micrograms per deciliter (μg/dL), or possibly lower, health effects may include inhibited activity of enzymes involved in red blood cell metabolism, interference with heme synthesis, interference with vitamin D hormone synthesis, altered brain wave activity, deficits in intelligence quotient and other mental indices, early childhood growth reductions, and small increases in blood pressure (*Federal Register* [FR] 56[110]:26460-26564). Predicted blood-lead levels were compared to an action level of 10 μg/dL.

6.10 Human Health Risk Characterization

Risk characterization integrates the exposure assessment and chemical toxicity information to quantitatively estimate potential health risks due to COPCs. Risk estimates were determined for individual routes of chemical exposure as well as for additive effects. The results of the risk characterization provide a basis for decisions regarding further action at the CDL Site.

6.10.1 Risk Estimation Procedures

Due to fundamental differences in the calculation of critical toxicity values, the estimates of potential individual excess carcinogenic risks and noncarcinogenic health effects were developed separately.

6.10.1.1 Carcinogenic Risk Probabilities

Risk probabilities determined for each carcinogen were also considered to be additive over all exposure pathways so that an overall risk of cancer was estimated for each group of potentially exposed receptors.

Risk probabilities can be compared to the generally acceptable risk range specified by the EPA. According to the revised National Contingency Plan (NCP) (USEPA, 1990), carcinogenic risks from exposures at Superfund sites are considered to be unacceptable at a level greater than $1x10^{-4}$, whereas risks smaller than $1x10^{-6}$ are considered to be of minimal concern. Action may not be necessary in the risk range of 10^{-6} to 10^{-4}. This is supported in the directive "Role of the Baseline Risk Assessment in Superfund Remedy Selection Decisions" (USEPA, 1991b), which indicates action is generally warranted at a site when the cumulative carcinogenic risk for any medium is greater than 10^{-4} or the cumulative noncarcinogenic hazard index (HI) exceeds 1. In general, a potential excess individual lifetime cancer risk of $1x10^{-4}$ is used by the EPA as a "point of departure" when determining whether chemical exposures represent a potentially unacceptable level of risk to public health. Altogether, this range of potentially acceptable risks helps put the numerical risk estimates into perspective.

6.10.1.2 Noncarcinogenic Hazard Quotients and Hazard Indices

In a manner similar to carcinogens, hazard quotient (HQ) values were summed across exposure pathways and for all chemical exposures to develop HI values. A HQ or HI value greater than 1 indicates that an adverse health effect may occur due to a chemical exposure. HQs and HIs are not risk probabilities, but currently are accepted by the EPA as quantitative levels of risk for noncarcinogens or the noncarcinogenic endpoints of carcinogens.

6.10.2 Risk Estimates

The total carcinogenic risks and overall noncarcinogenic HI values were estimated for each receptor of potential concern at the CDL Site. Risks are provided for each receptor group, each COPC, and each potentially complete exposure pathway. Each set of risk analyses provides a determination of the contribution (noted as percentages) of each compound to the overall risk estimates. The risk analyses therefore provide an indication of the influence of individual organic or inorganic compounds on the overall risk estimates. The risks are presented in Tables 6-56 through 6-72. Detailed calculations are shown in Appendix F-4.

6.10.2.1 Current Site Workers

Carcinogenic risk probabilities were calculated for current site workers potentially exposed to COPCs in soil at the CDL Site. Tables 6-56 and 6-63 show that the overall cancer risk estimate for current site workers exposed to soil is approximately $1.54x10^{-5}$ and $2.66x10^{-6}$ for the Central and Southern AOCs and Northern and Western AOCs, respectively. This risk estimate is within the EPA target risk range of 10^{-6} to 10^{-4}, but exceeds the point of departure of $1x10^{-6}$. The majority of this risk for the Central and Southern AOCs (52.81%) comes from exposure to benzo(a)pyrene and from arsenic (22.08%). All of the risk for the Northern and Western AOCs is due to exposure to arsenic in the soil.

The EPC for arsenic in surface soil at the Central and Southern AOCs is 6.02 mg/kg and 4.70 mg/kg at Northern and Western AOCs. According to background statistics reported in the "Background Soil and Groundwater Investigation Report for Wallops Flight Facility" (Tetra Tech, 2004), the maximum background concentration of arsenic in samples taken in Molena surface soils is 14.2 mg/kg and a mean concentration of 4.2 mg/kg to 3.55 mg/kg surface and subsurface soil, respectively. The maximum detected arsenic concentration at the Central and Southern AOCs was 7.2 mg/kg and 4.8 mg/kg for the Northern and Western AOCs. Thus, it is likely that the arsenic in the surface soil at both AOCs at the CDL Site is due to background conditions and not contamination at the site. Statistical testing (Appendix E) found that there was not a significant difference in arsenic concentrations in soil samples between the AOCs and background.

Non-carcinogenic HIs were also calculated for current site workers potentially exposed to COPCs in surface soil at the CDL Site (Tables 6-56 and 6-62). All of the COPC HIs were determined to be less than 1.0, with the overall HI estimated at approximately 0.32 and 0.034 for the Central and Southern AOC and Northern and Western AOC, respectively. Since the overall HI was estimated to be less than 1.0, the likelihood of a site worker experiencing adverse health effects at the CDL Site is negligible.

6.10.2.2 Future Commercial Workers

Carcinogenic and non-carcinogen information for future commercial workers is summarized in Tables 6-57 and 6-64. Carcinogenic risk probabilities were calculated for future commercial workers potentially exposed to COPCs in soil and groundwater at the CDL Site.

Tables 6-57 and 6-64 show that the overall cancer risk estimates for future commercial workers exposed at the Southern and Central AOCs is approximately $4.39x10^{-3}$ and $2.82x10^{-4}$ for the Northern and Western AOCs. The risks at the Central and Southern AOCs are mainly due to exposure from the soil and groundwater vapor intrusion pathway and groundwater ingestion. For the Central and Southern AOCs the estimated risk from all exposures to soil is $4.16x10^{-3}$, with the risk mainly due to volatilized COPCs. Exposure to groundwater at the Northern and Western AOCs is responsible for the highest risks. Arsenic in soil at the Central and Southern AOCs contributes a risk of $8.78x10^{-5}$. The highest detected concentration of arsenic at the Central and Southern AOCs was 7.6 mg/kg, with an EPC of 4.79 mg/kg. The EPC for arsenic is within the range of background values for arsenic, but the maximum detected concentration is higher than upper value of that range, 5.3 mg/kg. The risk from arsenic at the Northern and Western AOCs is less than $1x10^{-6}$.

The risk associated with exposure to groundwater is the same for both locations, $2.81x10^{-4}$. The cancer risk from groundwater is highest for arsenic ($8.65x10^{-5}$), with several volatile compounds also contributing risks in that range. The mean background concentration for arsenic in groundwater at WFF is 3.93 µg/L (Tetra Tech, 2004), with detected concentrations ranging from 3.6 to 17.7 µg/L. The calculated EPC for arsenic in groundwater at the CDL Site is 8.25 µg/L which does fall within the range of background concentrations; no detected concentration of arsenic in groundwater exceeded the upper range of the background samples for WFF.

Non-carcinogenic HIs were also calculated for future commercial workers potentially exposed to COPCs at the CDL Site (Tables 6-57 and 6-64). The total HIs were estimated at approximately 19.7 and 2.70 for the Central and Southern AOCs and Northern and Western AOCs, respectively. The highest contributing COPC at the Central and Southern AOCs was benzene (HI = 14.3) at 72.43% of the total HI. Although no single COPC had an HI more than 1.0 at the Northern and Western AOCs, the HI for the target organs of the liver and kidneys exceed 1.0.

6.10.2.3 Future Construction Workers

Carcinogenic risk probabilities were calculated for future construction workers potentially exposed to COPCs in soil and groundwater at the CDL Site. Tables 6-58 and 6-65 show that the overall cancer risk estimate for future construction workers is approximately

$9.16x10^{-5}$ for the Central and Southern AOCs and $9.13x10^{-5}$ for the Northern and Western AOCs. The risk estimates for both of the areas assessed are primarily from assumed exposures to groundwater, specifically, from the inhalation of 1,2-dichloroethane, cis-1,2-dichloroethane, ethylbenzene, and tetrachloroethane volatilized from groundwater. 1,2-dichloroethane was only detected in well MW-5 and cis-1,2-dichloroethene and tetrachloroethene were only detected in well MW-4. The risks are within the EPA target risk range of 10^{-6} to 10^{-4}.

The non-carcinogenic risk or HI was also calculated for future construction workers potentially exposed to COPCs in soil and groundwater at the CDL Site (Tables 6-58 and 6-65). For the Central and Southern AOCs the total HI was 146 and, for the Northern and Western AOCs, 145. Both of the estimated HIs are above the target HI of 1.0, with the highest percentage due to exposure to volatiles in groundwater. Five COPCs (ethylbenzene, m,p-xylene, o-xylene, xylenes (total), and naphthalene each exceed the target HI of 1.0 at both AOCs.

6.10.2.4 Future Adult Residents

Carcinogenic risk probabilities were calculated for future adult residents who potentially may be exposed to COPCs in soil and groundwater. Tables 6-59 and 6-66 show that the overall cancer risk estimates for adult residents at Central and Southern AOCs is approximately $6.23x10^{-3}$. At the Northern and Western AOCs, the total cancer risk for adults is $6.25x10^{-4}$. These estimated total cancer risks are above the $1x10^{-4}$ EPA action level. For the Central and Southern AOCs, benzene, 1,2-dichloroethane, ethylbenzene, and tetrachloroethene are the highest contributors to the total cancer risk. Arsenic contributes approximately 1.94% of the total cancer risk. The mean background concentration for arsenic in groundwater at WFF is 3.93 µg/L (Tetra Tech, 2004), with detected concentrations ranging from 3.6 to 17.7 µg/L. The calculated EPC for arsenic in groundwater at the CDL Site is 7.95 µg/L, which falls within the range of background concentrations. As noted in the discussion of cancer risks to the construction workers, detections of these volatiles in groundwater at the CDL is limited in the number of samples and locations. The uncertainties associated with the groundwater results are discussed in the uncertainty section.

Cancer risk estimates for the Northern and Western AOCs are similarly high to those for the Central and Southern AOCs, with a total risk of $6.25x10^{-4}$. Since groundwater is being assessed for the entire CDL Site, the same COPCs, tetrachloroethene, ethylbenzene, cis-1,2-dichloroethene, and arsenic, are also the key contributors to the cancer risk for adult

residents at the Northern and Western AOCs. Carcinogenic risks at levels greater than $1x10^{-4}$ are considered to be unacceptable. Risk associated with ingestion of arsenic in soil is $2.82x10^{-6}$ and ingestion of arsenic in groundwater is $1.17x10^{-4}$, together accounting for 19% of the total risk. However, sampling results for arsenic in groundwater at the CDL Site are within the range of results observed for WFF background samples (Tetra Tech, 2004). Therefore, the risks to adult residents due to exposure to arsenic in groundwater at both sets of AOCs would be undistinguishable from levels of and risks associated with background arsenic. However, even without the risks associated with arsenic, the risk estimate for hypothetical adult residents is above the EPA target risk range of 10^{-6} to 10^{-4} at both Central and Southern AOCs and Northern and Western AOCs, almost entirely as a function of groundwater exposure.

The total HI for future adult residents at the Central and Southern AOCs is estimated to be 29.2. COPCs that each exceed the target risk of 1.0 include benzene, ethylbenzene, and m,p-xylene in soil. The highest contributor to the HI is benzene at 68.69% of the total HI. The total HI for future adult residents at the Northern and Western AOCs is estimated at 2.47, which is above the target HI of 1.0. Arsenic and iron in drinking water are the highest contributors to the HI, although both also present some risk via the soil pathways. No single target organ has an H1 greater than 1.0 for the Northern and Western AOCs.

6.10.2.5 Future Child Residents

Carcinogenic risk probabilities were calculated for future child residents who potentially may be exposed to COPCs in soil and groundwater. Table 6-60 shows that the overall cancer risk estimate for child residents at Central and Southern AOCs is approximately $1.23x10^{-2}$. At the Northern and Western AOCs, the total cancer risk for children is $5.76x10^{-3}$ (Table 6-67). It is important to note that the groundwater scenario uses data from wells downgradient of the Central and Southern AOCs, and therefore, overstates the risk associated with the Northern and Western AOCs. These estimated total cancer risks are above the $1x10^{-4}$ EPA action level. Ethylbenzene, primarily in groundwater, contributes approximately 51% of the total cancer risk at the Central and Southern AOCs and 90% of the total for the Northern and Western AOCs. Both detections of ethylbenzene are limited to well MW-4A. The uncertainties associated with the groundwater results are discussed in the uncertainty section.

The total estimated HI for future child residents at the Central and Southern AOCs is 128 (shown in Table 6-60). This indicates that there may be unacceptable non-cancer risks

associated COPCs found at the Central and Southern AOCs. The top contributor to the total HI is benzene (72.67%), particularly in soil. Since these are multiple COPCs that exceed the target HI of 1.0 it is not necessary to segregate the COPCs into groups by effect and by mechanism of action with separate HIs derived for each group (USEPA, 1989a).

The total HI for the Northern and Western AOCs is 13.5 (Table 6-67), which is above the target HI of 1.0. Approximately 90% of the total HI is from the groundwater pathway, however, the groundwater EPCs are derived solely from data downgradient of the Central and Southern AOCs. The top contributors to the total HI are iron (17.03%), arsenic (14.48%), toluene (12.90%), m,p-xylene (12.11%) and xylene (total) (9.27%). This indicates that there may be unacceptable non-cancer risks associated COPCs found at the Northern and Western AOCs.

The calculated risks for hypothetical future adult and child residents can be added to obtain an estimate of lifetime risk. Lifetime cancer risks are presented in Table 6-61 for Central and Southern AOCs and Table 6-68 for Northern and Western AOCs. The overall cancer risk estimate for lifetime residents at Central and Southern AOCs is approximately 1.86×10^{-2}. At the Northern and Western AOCs, the total cancer risk for lifetime residents is 6.38×10^{-3}. These estimated total cancer risks are both above the 1×10^{-4} EPA action level. Ethylbenzene, primarily in groundwater, contributes approximately 40% and 80% of the total cancer risk at the Central and Southern AOCs and the Northern and Western AOCs, respectively.

The total estimated HI for future lifetime residents at the Central and Southern AOCs is 133, shown in Table 6-61. The top contributors to the total HI are iron, arsenic, toluene, m,p-xylene, xylene (total), 2-methylnaphthalene, and naphthalene with all individually exceeding the target risk of 1.0. For the Northern and Western AOCs (Table 6-68), the total estimated HI is 18.6, namely from toluene, m,p-xylene, xylene (total), 2-methylnaphthalene, and naphthalene, arsenic, and iron. Each of these COPCs exceeds the target risk of 1.0.

6.10.2.6 Future Site Trespassers

Carcinogenic risk probabilities were calculated for site trespassers potentially exposed to COPCs in soil, sediment, and surface water at the CDL. Tables 6-62 and Table 6-69 show that the overall risk estimate for future trespassers from COPCs at Central and Southern AOCs is approximately 7.24×10^{-7} and 4.59×10^{-7} for the Northern and Western AOCs. The risk estimate

lies below the EPA lower target risk, $1x10^{-6}$, indicating that action at these sites may not be necessary based on this receptor group.

Noncarcinogenic HIs were calculated for future visitors potentially exposed to COPCs at the site (Tables 6-62 and 6-69). The HIs were determined to be less than 1.0 for all COPCs identified for all media of concern. The overall HI for the Central and Southern AOCs was estimated to be 0.057 and 0.0163 for the Northern and Western AOCs. Since the overall HIs were estimated to be less than 1.0, the likelihood of a trespasser experiencing adverse health effects at the CDL is negligible.

6.10.2.7 Current/Future Recreational Fishermen

Carcinogenic risk probabilities were calculated for current and future recreational fishermen, assumed to be both adults and children, who potentially may be exposed to COPCs by dermal contact with and ingestion of sediment and surface water, and ingestion of bluefish and blue crabs from Little Mosquito Creek. Tables 6-70 and 6-71 show that the overall cancer risks estimates for adult and children recreational fishermen are approximately $3.17x10^{-5}$ and $1.38x10^{-5}$, respectively. For adults, the risk from ingestion of arsenic in bluefish results in a cancer risk of $3.02x10^{-5}$ and total risk from arsenic in sediment is $1.10x10^{-6}$. For children fishermen, the ingestion of arsenic bluefish and in sediment results in a lifetime cancer risk of $1.18x10^{-5}$ and $1.71x10^{-6}$, respectively. All the risks are less than the upper target risk of $1x10^{-4}$.

Tables 6-70 and 6-71 also show the total HIs for the potentially exposed recreational fishermen. The sum of the HIs for the adult fishermen is 0.250, which is below the target HI of 1.0. The total HI for children fishermen, 0.430, is also below the target HI.

6.10.3 Risks from Lead

Lead was identified as a COPC for surface and aggregate soil for the Southern and Central AOCs because its maximum detected concentration in aggregated soils, $2.12x10^{3}$ mg/kg, was higher than the EPA soil screening level for residential soils, 400 mg/kg (USEPA, 2008a).

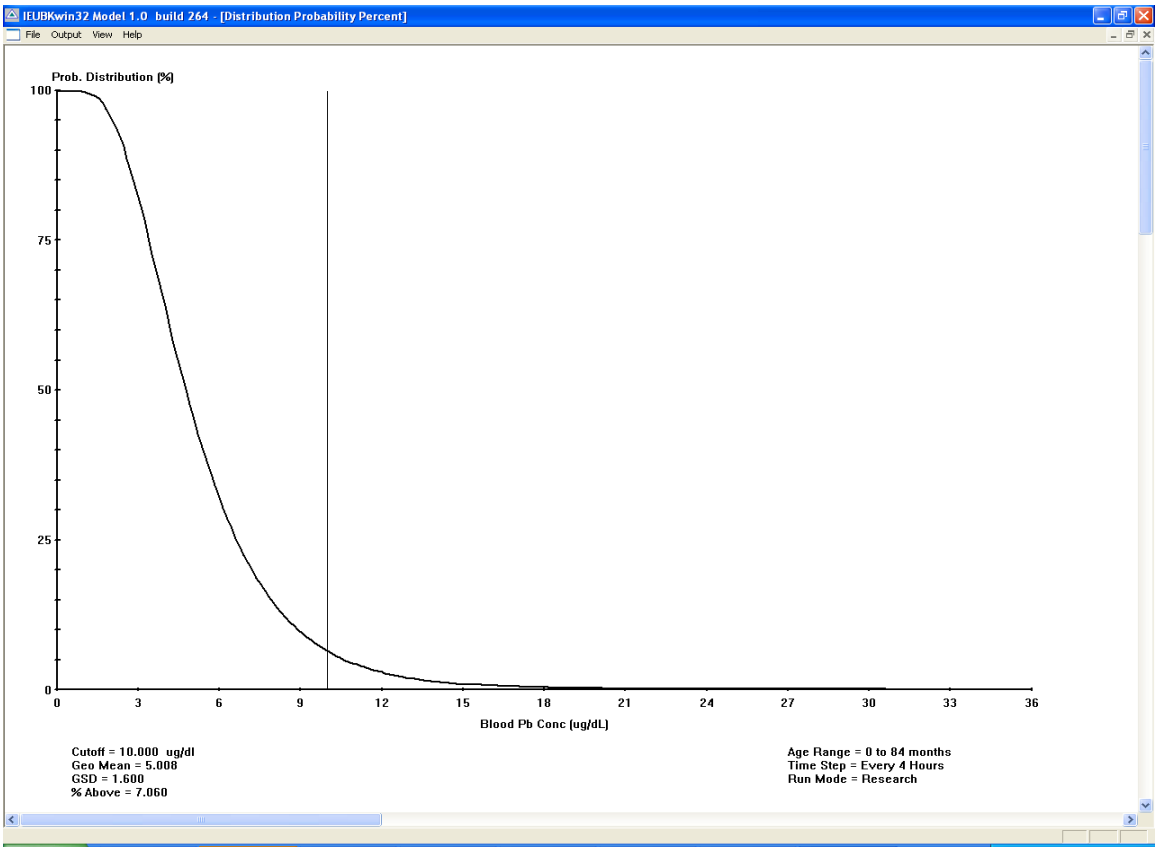
The protocol used to assess potential exposures to lead differs from those used with other pathways. In compliance with EPA guidance, lead exposures were evaluated in terms of potential blood lead concentrations. This was necessary because lead exposure is typically expressed in terms of blood-lead concentrations rather than as intake or absorbed doses (i.e., mg/kg/day).

EPA's Integrated Exposure Uptake Biokinetic model (IEUBK) (USEPA, 2005a) was used to estimate lead risk to children aged 1 to 6 years. The Adult Lead Model (ALM) (USEPA, 2003b) was used to characterize lead risk to unborn infants based on environmental exposure of the mother to lead-contaminated media.

6.10.3.1 IEUBK Model

EPA's IEUBK model integrates exposure from lead in air, water, soil, dust, diet, paint, and other sources with pharmacokinetic modeling to predict blood lead concentrations in children 6 months to 7 years of age. Blood lead levels were estimated for hypothetical future child residents using the IEUBK model (USEPA, 2005a). The average lead concentration in aggregate soil, 388 mg/kg, was used as input into the model. The concentration was used for both the indoor and outdoor dust lead levels. The average lead concentration in groundwater, 4.15 µg/L, was also used in the IEUBK evaluation.

The child's age was assumed to be 1 to 6 years and all other default assumptions from the model were used. Based on the input parameters and assumptions, the geometric mean blood lead level for the hypothetical child resident was 5.0 µg/dL, with 92.94% of the population having blood lead levels less than 10 µg/dL. The result exceeds the EPA recommended blood lead goal of no more than 5% of children exceeding 10 µg/dL. Therefore, the hypothetical future child resident is at risk for behavioral neurotoxicity due to the lead concentrations in soil and groundwater.



Probability Density Plot of 0 Month to 84 Month Old Child

6.10.3.2 ALM

The ALM was run for the commercial worker and the construction worker. The soil lead preliminary remediation goals (PRGs) calculated by the model for the commercial worker and construction worker were 1,979 mg/kg and 625 mg/kg, respectively. The average lead concentration of 388 mg/kg does not exceed either of the PRGs. Only one soil sample, TP-3A (Southern AOC), with a measured lead level of 2,120 mg/kg, exceeds the PRG based on the commercial worker. Three sample locations, TP-3A, TP-3B, and TP-3C (all Southern AOC), exceed the construction worker PRG with lead concentrations of 2,120, 1,070, and 1,070 mg/kg, respectively. Lead may potentially be considered to be at levels of concern at the Southern AOC. ALM model calculations are shown in Appendix F-5.

6.11 Human Health Risk Uncertainty Analysis

Uncertainty can be introduced into a health risk assessment at every step. Despite recent advances in risk assessment methodology, uncertainties are inherent in the risk assessment process. In order to appreciate the limitation and significance of the risk estimates, it is important to have an understanding of the sources and magnitudes of uncertainty. Sources of uncertainty in this risk assessment, as in any risk assessment, may include:

- Sampling and analysis,
- Chemical transport and fate modeling,
- Toxicity data,
- Exposure assessment, and
- Risk estimates.

This section addresses uncertainties associated with: (1) the identification of COPCs, (2) exposure assessment assumptions, and (3) limitations inherent in toxicity assessment. In addition to these sources of uncertainty, additional assumptions that also may contribute to the level of confidence that can be placed on the risk estimates have been introduced into the HHRA.

6.11.1 Uncertainties in Calculating the Concentration Term

Chemicals were selected as COPCs based on their maximum detected concentrations. For some COPCs, however, the frequency of detection may be low, with only one or a few detections in the whole dataset. Although EPA indicates that in some instances infrequently detected data may be screened out of an assessment (USEPA, 1989a), for this HHRA, any detected chemical that was above its screening level was maintained as part of the assessment.

EPA guidance (USEPA, 1989a) indicates that if a chemical is believed to be present at a site, non-detected values should be included when estimating the EPC. Based on EPA guidance (USEPA, 2002c), samples where a chemical was not positively identified are assumed to have concentrations equal to their respective sample-specific DLs. When a result is reported as "not detected", the chemical may actually not be present in that sample, even if the chemical has been detected in other locations at the site, or the concentration is below levels that the laboratory can reliably measure. When calculating concentrations representative of non-detected samples, RLs were conservatively used, since these laboratory limits present a higher degree of confidence

than MDLs. MDLs indicate the lowest concentration that an analyte can be detected by an instrument, while RLs indicate the lowest level at which an analyte may be accurately and reproducibly measured. Assuming that a non-detected analyte is present at the DL introduces uncertainty into the assessment, particularly when based on the RL, which may be a factor of three to five times higher than the MDL. If a RL value is high, the assumed concentration may result in a high value for the EPC and give the appearance that contamination is present at these levels. Uncertainty associated with incorporating non-detected samples should be considered when evaluating the results of the risk analysis.

For the CDL Site risk assessment, these uncertainties are considered to be very low. The sampling program exercised in the RI was extremely focused, employing four independent screening methods (soil gas, geophysics, MIP screening, and aerial photographic analysis) to bias the sample locations towards "hot spots" where maximum contaminant concentrations would be anticipated. If any one of these methods suggested that waste impacts would be found, a sample was collected from (or immediately downgradient of) that area. The suite of contaminants detected as a result of these investigations was entirely consistent with the known and suspected disposal practices for the CDL Site.

6.11.2 Uncertainties in the Exposure Assessment

Exposure assessment is perhaps the most critical step in achieving a reliable estimate of health risks to humans. In this assessment, a number of assumptions were made concerning the human populations that could come into contact with the media at the CDL Site and the frequencies and durations of these contacts. The exposure parameters used in this assessment were largely based on EPA's RAGS, Part A (1989a), EPA's Exposure Factors Handbook (1997a), EPA's RAGS, Part E (2004a), and the EPA's Supplemental Soil Screening Guidance (2002a) and may not be representative of the current and future receptor populations. There is also the presumption that interim and institutional measures at the site would not lead to changes in exposure conditions and receptor behaviors.

Recommended default values were assumed in order to represent the RME scenario for potential receptors. To ensure that risks were not underestimated, many of the assumptions made in the exposure analyses were selected because they were considered to be health protective. Most default exposure inputs in the dose calculations represent an upper bound estimate (i.e., 90^{th} to 95^{th} percentile). The combination of multiple 90^{th} or 95^{th} percentile RME default assumptions, which contribute to overestimation of plausible real-life exposures, combined with

conservative toxicity criteria, can result in upper bound site risk estimates that may be over-protective.

Also, receptor groups that may not likely be found on the site in the future, such as residents, were assessed. Although it is possible that the site could be developed for residential use in the future, it is not very likely. Also, groundwater is not currently used for potable purposes and will likely not be used for that purpose in the future.

Exposure scenarios for the Northern and Western AOCs use groundwater data collected downgradient of the Central and Southern AOCs. None of the carcinogenic VOCs that drive risk for groundwater were detected in wells downgradient of the Northern and Western AOCs. The EPC concentrations of the other carcinogen driving risk, arsenic, at 8.25 mg/L is slightly higher than the mean background arsenic concentration at WFF (3.93 µg/L), but is within the range of background arsenic detection at WFF (3.6 µg/L to 17.7 µg/L).

Additionally, both sites do not cover very large areas, so it would not be likely that receptors, such as a site worker, would manage to spend long continuous periods of time (e.g., 225 days a year for 25 years) working only on one of the assessed areas. Similarly, while Little Mosquito Creek can support recreational fishing, individuals involved in fishing and crabbing, who may frequently contact sediment and surface water, are likely to go fishing and crabbing at other locations given the abundance of more attractive fishing areas in the vicinity of WFF. Such assumptions tend to over estimate the calculated risk.

6.11.3 Environmental Media Sampling and Analysis

Sampling was conducted using accepted procedures in an attempt to collect samples that were representative of environmental media. Analyses were performed in accordance with the EPA QC procedures. Data were subsequently reviewed in a data validation process. However, current analytical procedures may not identify all potentially hazardous contaminants at a site, and analytical errors may have occurred despite stringent Quality Assurance/Quality Control (QA/QC) procedures. In conducting this risk assessment, it was assumed that the reported chemical concentrations were representative of actual site conditions.

6.11.4 Chemical Transport and Fate

The 95th percentile UCL (or maximum) concentrations of COPCs found in soil, surface water, sediment, groundwater, and fish/crab tissue at and around the CDL Site were used as exposure point concentrations. Migration, dispersion, dilution, retardation, degradation, and other attenuation or transformation processes may occur over time that could change the chemical concentrations in various on-site media. It has been conservatively assumed that the concentrations observed at the site will remain relatively unchanged with time because, with the exception of the VOCs and SVOCs, all COPCs are relatively persistent and immobile. PAHs and volatiles were identified as contaminants of concern (COCs) (i.e., chemicals with cancer risks higher than $1x10^{-6}$ or HIs more than 1.0) in soil and groundwater. PAHs can degrade significantly in soils over time and are not environmentally persistent. Therefore, it is expected that the PAHs concentrations will decline in soils over time, although it was assumed that concentrations will stay constant over the assumed assessment period.

6.11.5 Toxicity Data

The available scientific data on toxic effects in humans for chemicals of concern found at the CDL Site are limited. Consequently, varying degrees of uncertainty surround the assessment of adverse health effects in potentially exposed populations. Sources of uncertainty for toxic effects in humans include:

- Use of dose-response data from experiments on homogenous, sensitive animal populations to predict effects in heterogenous human populations with a wide range of sensitivities (interspecies extrapolation);
- Extrapolation of data from high doses in animals to "real-world" low doses, from acute or subchronic to chronic exposure, and from one route to another, e.g., from ingestion to dermal absorption; and
- Use of single chemical data that do not account for possible antagonistic or synergistic responses from multiple chemical exposures.

Toxicity data are largely derived from laboratory animals. Experimental animal data have historically been relied upon by regulatory agencies and other expert groups to assess the hazards of chemicals to humans. Even though this reliance has been supported by empirical observations, there may be slight or marginal interspecies differences in the absorption,

metabolism, excretion, detoxification, and toxic responses to specific chemicals of concern. There may also be uncertainties concerning the relevance of animal studies using exposure routes that differ from human exposure routes. In addition, the frequent necessity to extrapolate results of short-term or chronic animal studies to humans exposed over a lifetime has inherent uncertainty. In order to adjust for many of these uncertainties, EPA often adjusts the RfD for noncarcinogenic effects using uncertainty and modifying factors on the most sensitive animal species.

There is also uncertainty as to whether animal carcinogens are also carcinogenic in humans. While many chemical substances are carcinogenic in one or more animal species, only a small number of chemical substances are known to be human carcinogens. The fact that some chemicals are carcinogenic in some animals, but not in others, raises the possibility that not all animal carcinogens are carcinogenic in humans. EPA assumes that humans are as sensitive to carcinogens as the most sensitive animal species. This policy decision, designed to prevent underestimating risk, may introduce the potential to overestimate carcinogenic risk for some chemicals.

When dealing with exposures to chemical mixtures, EPA assumes dose additivity and does not account for potential synergisms, antagonisms, differences in target organ specificity, or mechanisms of action. Despite these many limitations, animal experiments are widely believed to be a necessary part of toxicity assessment, especially in the absence of human epidemiological data. The safety factors used in RfD derivations for single chemicals may compensate for any unknown effects of synergistic exposures.

6.11.5.1 Background Levels of Chemicals

Appendix E provides a statistical analysis of several chemicals versus background. Of these, arsenic is clearly a background issue. Arsenic in surface soil at both locations is within the background range. At the Northern and Western AOCs, all the sample results for arsenic are within the identified range of background concentrations. The highest detected concentration of arsenic in aggregate soil at the Central and Southern AOCs was 8.4 mg/kg in a deep sample (TP-3C). The EPC for arsenic is within the range of background values for arsenic (1.1 to 5.3 mg/kg) (Tetra Tech, 2004), but the maximum detected concentration, 8.4 mg/kg, is slightly higher than the upper value of that range. The detected concentrations of arsenic in groundwater are also within the range of measured background samples. The risk from arsenic in aggregate

soil and sediment is due to background as demonstrated by the statistical analysis in Appendix E. Background and site concentrations for COCs are compared in Table 6-72.

6.12 Risk Summary

The potential risks to hypothetical receptors at the CDL Site have been estimated for the current site workers, future commercial workers, current/future recreational fishermen, future construction workers, future residents, and future site trespassers that may come into contact with soil, groundwater, sediment, and surface water. Cancer and non-cancer risks were calculated under baseline conditions and used RME exposure assumptions.

Summary risk tables for all contaminants are presented for the Central/Southern and Northern/Western AOCs in Tables 6-73 and 6-74, respectively. Because high arsenic concentrations have been determined to be within the range of background concentrations for impacted soil within the AOCs, summary risk tables which exclude arsenic are provided in Tables 6-75 and 6-76 for the Central and Southern AOCs and Northern and Western AOCs, respectively.

For carcinogens that act via a mutagenic mode of action, special adjustments are made to account for susceptibility during early life. To account for these carcinogens, exposure to these chemicals is evaluated separately for ages 0 to 2, 2 to 6, 6 to 16, and 16 to 30 years, utilizing age-dependent adjustment factors (ADAFs) to give additional weight to early life stages. However, because the calculated risks far exceed the target cancer risk, specific evaluation of mutagens would not change the conclusions of the analysis. Therefore, a mutagenic risk assessment was not performed.

6.12.1 Central and Southern AOCs

The risks for the Central and Southern AOCs are summarized in Tables 6-73 and 6-75. The excess carcinogenic risks estimated for site workers, commercial workers, and construction workers are approximately 1.54×10^{-5}, 4.39×10^{-3}, and 9.16×10^{-5}, respectively, and drop slightly to 1.20×10^{-5}, 4.30×10^{-3}, and 9.15×10^{-5} without arsenic. The risk estimates for site workers and construction workers are within the EPA target risk range of 10^{-6} to 10^{-4}, but exceed the point of departure of 1×10^{-6}. The risk for commercial workers exceeds the 1×10^{-4} EPA action level.

Lifetime cancer risks were also calculated for residential adults and children, recreational fishermen adults and children, and site trespassers. Potential cancer risks for hypothetical residential adults and children were conservatively estimated at $6.23x10^{-3}$ and $1.23x10^{-2}$, respectively, for the Central and Southern AOCs and were the highest cancer risks calculated from all the receptor groups. Without arsenic, the risks for adult and child residents did not decrease significantly at $6.11x10^{-3}$ and $1.22x10^{-2}$. Residential lifetime cancer risk was estimated to be $1.86x10^{-2}$ for Central and Southern AOCs and $1.84x10^{-2}$ when arsenic is not included.

Adult and children recreational fishermen were estimated to have potential cancer risks of $3.16x10^{-5}$ and $1.38x10^{-5}$, but were $3.00x10^{-7}$ and $2.22x10^{-7}$ without arsenic. In the instance where residents would also be involved in recreational fishing, the estimated cancer risks would be $6.74x10^{-4}$ for adults and $5.82x10^{-3}$ for children or $5.22x10^{-4}$ and $5.72x10^{-3}$ without arsenic. The residential plus recreational fishermen excess cancer risks are higher than $1x10^{-4}$ and are considered to be unacceptable.

In the instance of lifetime residency on the Central and Southern AOCs and recreational exposures, the total cancer risk would be $1.86x10^{-2}$ or $1.84x10^{-2}$ without arsenic. The future residential scenario was included in this analysis to establish upper bound risk estimates for the CDL Site. However, this future use of the site is not likely.

Cancer risks to site trespassers were calculated to be $7.24x10^{-7}$ (lower at $3.09x10^{-7}$ with arsenic removed), below the $1x10^{-6}$ risk level, indicating that risks are considered to be negligible for this receptor group.

HIs reflecting potential exposures at the Central and Southern AOCs were calculated for all the receptor groups and are summarized in Table 6-73. The target HI of 1.0 was exceeded for all future-use receptor groups. The lifetime residential HI is 17.1, with an HI of 158 when the lifetime resident is assumed to spend a lifetime engaged in recreational activities on the site. HIs for current site workers, trespassers, and fishermen did not exceed to 1.0.

Predicted blood-lead concentrations exceed the EPA recommended blood lead goal of no more than 5% of children exceeding 10 µg/dL. Therefore, the hypothetical future child resident is at risk for behavioral neurotoxicity due to the lead concentrations in soil and groundwater. Based on the results of the ALM, lead may potentially be considered to be at levels of concern at the Southern AOC.

6.12.2 Northern and Western AOCs

The risks for the Northern and Western AOCs are summarized in Table 6-74. The excess carcinogenic risks estimated for current site workers, future commercial workers, and future construction workers are approximately $2.66x10^{-6}$, $2.82x10^{-4}$, and $9.13x10^{-5}$, respectively (0.00, $1.94x10^{-4}$, and $9.12x10^{-5}$, without arsenic). Some of these risk estimates are within the EPA target risk range of 10^{-6} to 10^{-4}, and exceed the point of departure of $1x10^{-6}$ as a function of using groundwater from impacted sources downgradient of the Central and Southern AOCs. The total cancer risk to the future commercial workers exceeds the $1x10^{-4}$ EPA action level, largely as a function of impacted groundwater use. However, groundwater data used in this analysis is impacted by the Southern and Central AOCs.

Potential cancer risks for residential adults and children were estimated at $6.25x10^{-4}$ and $5.76x10^{-3}$ ($5.06x10^{-4}$ and $5.68x10^{-3}$, without arsenic), respectively, and were the highest cancer risks calculated from all the receptor groups. All the estimated residential cancer risks are higher than the $1x10^{-4}$ EPA action level as a function of the exposure to groundwater scenario. Also, the combined residential and recreational fishermen lifetime cancer risks are higher than $1x10^{-4}$ and are considered to be unacceptable. Without arsenic, these risks are still unacceptable. The total cancer risk to site trespassers, $4.59x10^{-7}$ ($6.21x10^{-8}$, without arsenic), is below the $1x10^{-6}$ risk level, indicating that risks are considered to be negligible for this receptor group.

HIs reflecting potential exposures at the Northern and Western AOCs were calculated for all the receptor groups and are summarized in Table 6-74. The target HI of 1.0 was exceeded for all receptor groups except the current site workers, trespassers, and fishermen, indicating that only the hypothetical future-use scenario receptor groups exposed to groundwater from areas downgradient of the Central and Southern AOCs are likely to experience adverse health effects from exposures at the Northern and Western AOCs. Under current conditions, the Northern and Western AOCs do not pose unacceptable risk.

6.1.2.3 Risk Summary by Media

Contaminants of concern, those COPCs that contribute cancer risks which exceed $1x10^{-6}$ or HIs that are greater than 1.0 and are not attributable to background conditions include:

For Central and Southern AOCs Soils:

- Benzo(a)anthracene, benzo(a)pyrene, and dibenz(a,h)anthracene, for surface soils (arsenic was statistically determined to be equivalent to background concentrations [Appendix E]).

- Benzene, 1,2-dichloroethane, ethylbenzene, tetrachloroethene, naphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, m,p-xylene, Aroclor-1260, chromium, copper, and mercury for aggregate soils (arsenic was statistically determined to be equivalent to background concentrations [Appendix E]).

For Northern and Western AOCs Soils:

- None (i.e., arsenic for surface and aggregate soils was statistically determined to be equivalent to background concentrations [Appendix E]).

For Groundwater:

- Benzene, 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, tetrachloroethene, trichloroethene, toluene, m,p-xylene, o-xylene, xylene (total), 2-methylnaphthalene, naphthalene, arsenic, and iron.

For Sediment:

- Arsenic.

For Surface Water:

- Arsenic.

Arsenic detections in soil and groundwater at the CDL Site were all within the range of background concentrations measured for WFF (Tetra Tech, 2004). Statistical analysis (see Section 6.11.5.1) indicates that arsenic in soil at the CDL Site is a function of natural levels at the site. Because all of the source media at the CDL Site have been demonstrated to contain

arsenic at below background concentrations, it does not follow that the arsenic issues in other media are site-related. The Tetra Tech (2004) maximum background concentrations of 0.018 mg/L is more than twice the highest groundwater concentration of 0.0087 mg/L detected in samples from MW-4D during the May 2007 sampling event.

Carcinogenic risks exceed 10^{-4} and non-cancer risks were higher than 1.0 for the groundwater pathway for future-use scenarios that include: commercial workers, construction workers, and residential adults and children. Arsenic at the site has been demonstrated to be within the range of background concentrations for soils at the CDL Site (see section 6.11.5.1). All groundwater risks result from hypothetical, future-use scenarios that are extremely unlikely to occur.

7.0 ECOLOGICAL RISK ASSESSMENT

7.1 Introduction

Initially, a Screening Level Ecological Risk Assessment (SLERA) was prepared for the CDL Site (see Section 7.2). The SLERA indicated that a further ERA process would be required to systematically evaluate and organize data, information, assumptions, and uncertainties to understand and predict the relationships between chemical stressors and ecological effects in a way that is useful for environmental decision-making (USEPA 1997c, 1998). Potentially complete exposure pathways were identified during screening level risk assessment which suggest that a potential for adverse ecological impacts exists at the CDL Site. Based on the conclusions of this qualitative pathway analysis, a quantitative ERA was recommended. VDEQ and EPA Region III reviewed and commented on a memorandum outlining criteria that was used to select the chemicals of potential ecological concern (COPECs), receptors, exposure parameters, and screening benchmarks that will be used to calculate the risks associated with exposure to the selected COPECs (Versar 2008). In addition, the memorandum proposed the methodology for determining the exposure point concentrations (EPCs).

The purpose of this ERA is to quantitatively evaluate the potential for adverse ecological effects that may occur as a result of past activities at the CDL Site. Information provided by the ERA for the CDL Site will be used to determine the need for and/or to develop, evaluate, and select alternative management options for this site.

7.1.1 Brief Site Description

The CDL Site was discovered during an analysis of historical aerial photographs which showed a series of ground disturbances in areas at the northeast corner of WFF, just east of the approach end of WFFs' Runway 22 and along the access road to the NOAA facility. Four AOCs were noted; two of the AOCs, the Northern and Western AOCs, are simply ground scars. Debris and other waste materials were noted in the Central and Southern AOCs. The CDL Site is a small site with the Central and Southern AOCs of less than 1.5 acres in size. The CDL Site is located on portion of a peninsular land mass extending northward into a marine estuarine environment, typified by extensive marshes and channels. A narrow creek channel that parallels the larger Mosquito Creek bounds the site on the east.

The CDL Site area is relatively flat with a reported highest point of elevation of about 40 feet above mean sea level (msl). The runway complex covers a large portion of the WFF and forms a flat plateau-like feature that covers the majority of the highest elevations at WFF. Drainage from and across the WFF is through natural and man-made drainage structures. Drainage within the industrialized portions of the WFF is controlled and diverted by stormwater collection and conveyance systems. In addition, portions of the base are isolated from surface water drainage areas by the construction of berms and higher elevation structures. The eastern portions of WFF, including the CDL Site, drain towards a series of marshlands, creeks and bays that lead to Chincoteague Bay and the Atlantic Ocean.

7.1.2 Ecological Risk Assessment Approach

The approach for conducting this ERA is consistent with guidance provided by the USEPA (1991c). Results are organized by each element of the ERA and are presented in subsequent sections: Problem Formulation (Section 7.2), Analysis Phase (Section 7.3), and Risk Characterization (Section 7.4).

7.2 Problem Formulation

Problem formulation establishes the scope of the ERA and ensures that plants and wildlife likely to be exposed to COPECs and exposure scenarios most likely to contribute to ecological risk are evaluated. As part of the problem formulation for the CDL Site, the following features were described: potentially affected areas, COPECs, habitats and receptors of concern, potentially complete exposure pathways, and assessment and measurement endpoints

7.2.1 Potentially Affected Areas

An AOC is defined as an area that is potentially affected by chemical releases at a site and consists of relatively similar habitat. Each AOC is distinguished from other AOCs due to differences in the contaminant source(s), fate and transport mechanism(s), and/or types of ecological receptors present. Four AOCs have been recognized and characterized on the CDL Site. These AOCs were identified as the Western AOC, Northern AOC, Central AOC, and Southern AOC, corresponding to those areas previously described as the “shallow excavation”, “disturbed ground”, “mounds of material”, and “burning dump”, respectively (Figure 1-3). The Northern and Western AOCs are considered to be a likely result of runway construction by the Navy. The Southern AOC is documented to be the location of a former landfill where wastes

were buried. Partially-buried wastes are visible along the eastern edge of the Central AOC and empty drums were discovered at depth in the northern part of this AOC.

Because site investigations did not indicate the presence of buried waste, odors, stains, or other obvious evidence of waste disposal at the Western and Northern AOCs, these two AOCs were not evaluated in the ERA. These AOCs were evaluated in the SLERA and most detected COPECs were eliminated. The few detected COPECs which were not eliminated during the SLERA had values similar to background levels and were significantly lower values that those detected in the Central and Southern AOCs (see Appendix G.1 and G.2). Therefore, the Western and Northern AOCs were not considered to have any potential for ecological risk.

Sampling data from the impacted areas (Central and Southern AOCs), where wastes were clearly evident, were considered together as one area in both the HHRA and ERA. The entire marshland and adjacent streams were included in the aquatic portion of the ERA. The areas of these AOCs at the CDL Site are shown below:

Area of Concern	Size (square feet)
Northern AOC	18,912
Western AOC	16,898
Central AOC	25,712
Southern AOC	37,987
Total Site	463,492
Terrestrial Portion of the Site	272,301
Marsh and Water Portion of the Site	191,191

7.2.2 Chemicals of Potential Ecological Concern

Soil and sediment samples collected at the CDL Site were analyzed for metals, VOCs, SVOCs, chlorinated pesticides, PCBs, cyanide, and total organic carbon (Tables 4-1 through 4-8 and 4-13). Surface water and groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, total metals, and cyanide (Tables 4-9 through 4-12). Only detected analytes are shown in Tables 4-1 to 4-12.

COPECs are chemicals detected in potentially affected areas that may adversely impact identified receptors of concern. These COPECs were defined according to the analytical data obtained from the soil, sediment, and surface water samples collected as part of the RI. Groundwater was not considered to be accessible to wildlife and therefore was not evaluated in the ERA. Chemicals detected in soils (less than 5 feet bgs), sediments, and water at results greater than the screening benchmarks were identified as COPECs. Non-detected chemicals were included as COPECs if one half of the detection limit exceeded the screening benchmarks. Furthermore, metals that were considered essential, typically nontoxic nutrients (i.e., iron, calcium, magnesium, potassium, and sodium) were not identified as COPECs in soils and sediments but were included as COPECS for surface water. Surface water at the CDL Site is brackish, therefore the most conservative of the freshwater and marine screening levels for surface water and sediments were utilized.

Consistent with guidance (USEPA, 1989a), four organic compounds in detected soils (acetone, 2-butanone, benzoic acid, and methylene chloride) were not selected as COPECs because they were considered suspected laboratory artifacts based on the weight of the following lines of evidence:

- Detected chemicals are common laboratory reagents;
- Detected chemicals were detected infrequently at concentrations at or less than their practical quantitation limits (PQLs); and
- There is no known source for these compounds at the site.

To ensure protective exposure scenarios, COPECs identified in surface soils were also assigned to deeper soil horizons since burrowing wildlife and plants must pass through these shallower soil horizons. Surface soils (0 to 0.5 feet bgs) typically contain the highest concentrations of the identified COPECs at the site, and thus were often influential in the development of site-specific exposure point concentrations. The initial COPECs for terrestrial and aquatic receptors are summarized in Tables 7-1a and 7-1b. Tables G.1.1 through G.1.6 in Appendix G.1 provide detailed COPEC selection information.

7.2.2.1 SLERA

A SLERA was conducted using the initial COPECs. The maximum detected concentrations were used as the exposure point concentrations for the SLERA. These values can be found in Appendix G.2. For compounds with non-detected concentrations, the median MDL

was utilized (USEPA, 1989a). The full analytical results for each sampling location are provided in Appendix G.3.1 (Analytical Data Summary).

SLERA risks to representative species were evaluated by comparing estimated exposures to screening benchmarks. Listed in the order of importance, the following screening benchmarks were used: Region 3 BTAG (USEPA, 2008c), ECO SSLs (USEPA, 2008d), Oak Ridge National Laboratory Toxicological Benchmarks (ORNL) (Efroymson *et al.,* 1997a and b), and ORNL Toxicological Benchmarks for Wildlife (Sample *et al.,* 1996). Appendix G-2 provides detailed results of the SLERA. Tables G-2.6 through G-2.9 show which COPECs where carried through from the SLERA to the food chain model in the ERA. All detected bioaccumulative COPECs, as listed in Table 4-2 of the *Bioaccumulative Testing and Interpretation for the Purpose of Sediment Quality Assessment, Status and Needs* (USEPA, 2000), were retained as COPECs in the food chain exposure evaluation. Non-detected COPECs that had MDLs exceeding the screening benchmarks were retained in the ERA; however, they were discussed qualitatively in the uncertainty section and not evaluated in the food chain models.

7.2.2.2 Soil

Soils throughout WFF are Coastal Plain soils. In general, the upland, terrace, and level portions of the Main Base and the western portion of the CDL Site are comprised of Bojac fine sandy loam, a low organic content, acidic, well-drained soil with moderately rapid permeability. The more steeply sloped areas of the CDL Site leading from the level areas to the marshlands, are predominantly classified as Molena loamy sand. This soil is similar to the Bojac series but reportedly has a higher permeability, a higher percentage of coarser sands, and a slightly more acidic content. Other soil types that appear to be present include silty bands and mucky sandy loam (Chincoteague and Polawana series), which are present within the marshland areas along the eastern portion of the CDL Site (USDA, 1994). The CDL Site AOCs and soil sample locations largely fall within the Molena loamy sand areas.

COPECs in soils at the CDL Site are listed in Table 7-1. As discussed above, four organic compounds (acetone, 2-butanone, benzoic acid, and methylene chloride) were detected in accessible soils but were not identified as COPECs because they were suspected laboratory artifacts. These chemicals are common laboratory reagents, were detected infrequently at concentrations near their respective PQLs, and exhibited no vertical or horizontal spatial patterns consistent with possible sources of release at the CDL Site.

7.2.2.3 Surface Water and Sediments

Ten sediment samples were collected adjacent to the CDL Site and surface water samples were collected from four co-located sites along the tidal channel of Little Mosquito Creek that forms the eastern boundary of the site. Figure 1-3 presents these sediment and surface water sampling locations.

According to EPA Region III BTAGs, any water body with a salinity of 1.5% or lower should be considered a potential drinking water source. Wildlife tend to utilize water with lower salinity levels (i.e., 0 to 0.5%) with no adverse effect. However, wildlife will tolerate salinity levels of 0.5 to 1.5% if no other sources are available (USEPA 2008e). Based on surface water samples, the sodium content was estimated to range from 1.2 to 1.6% salinity. There are freshwater streams and drainage nearby; therefore it was assumed that terrestrial wildlife would not drink from the higher salinity water at the CDL Site.

7.2.3 Habitats and Receptors of Concern

Ecological receptors include terrestrial plants, soil invertebrates, and wildlife that reside or forage in areas potentially affected by chemicals released from the CDL Site.

7.2.3.1 Habitat

The CDL Site consists of mowed grass along the sand runway access road, bordered by small strips of mixed loblolly pine (*Pinus taeda),* sweetgum (*Liquidambar styraciflua)*, and willow and black oak (*Quercus phellos* and *Qurecus velutina*) forest. The understory contains greenbrier (*Smilax rotundifolia*), blackberries (*Rubus* sp.) and multiflora rose (*Rosa multiflora*). The land drops down into a tidally influenced brackish wetland on the east with the Little Mosquito Creek creating the eastern boundary. This wetland is primarily herbaceous containing Spartina grasses (*Spartina alterniflora*, *S. patens*, and *S. cynosuroides*) and threesquare (*Scirpus pungent*). Receptors of concern were identified for these habitats to focus risk analyses on species of ecological and societal (i.e., regulatory and commercial) concern. More detailed habitat information may be found in Versar (1999).

7.2.3.2 Receptors of Concern at CDL Site

The terrestrial portion of the CDL Site is highly disturbed and provides only marginal habitat. Nonetheless, the CDL Site was considered to provide suitable refuge and foraging habitats for terrestrial wildlife that are characteristic of the habitats at WFF. The CDL Site was also assumed to provide habitats for aquatic life and piscivorous birds and mammals.

Surveys have not been conducted for special-status invertebrates, birds, or mammals at the CDL Site. No federal- or state-listed threatened or endangered species have been observed at the CDL Site; however, their presence cannot be ruled out, nor definitively confirmed given available information. The only special-status avian and mammalian species know to occur on the WFF Main Base is the bald eagle, which is protected under the Bald and Golden Eagle Protection Act.

The CDL Site is located within the Little Mosquito Creek Conservation Site. The Little Mosquito Creek Conservation Site has been assigned a biodiversity significance ranking of B4, which represents a site of general significance (scale = 1 to 5 with 1 being the most significant). Conservation sites represent key areas of the landscape that warrant further review for possible conservation action because of the natural heritage resources and habitats they support. The conservation sites are polygons built around one or more rare plants, animals, or natural communities and are designed to include the element, and where possible, its associated habitat, buffer, or other adjacent land thought necessary for the element's conservation.

The receptors of ecological concern at the site include the following guilds:

- Trees, shrubs, and herbaceous grasses and forbs;
- Soil invertebrates;
- Herbivorous, insectivorous, and carnivorous birds;
- Herbivorous, insectivorous, and carnivorous mammals;
- Aquatic life (including fish);
- Benthic invertebrates; and
- Piscivorous bird and mammals.

Potential risks to reptiles could not be evaluated due to the lack of applicable toxicity data for reptiles. Potential risks to amphibians were not assessed because of the absence of fresh surface water at the site.

7.2.4 Complete Exposure Pathways

Potentially complete exposure pathways consist of a source and mechanism of COPEC release, a transport medium (e.g., soil, water, or tissue), a point or area where receptors of concern may be exposed to COPECs, and an exposure route through which COPEC uptake may occur (e.g., ingestion). A conceptual exposure pathway model that identifies the source, mechanisms of transport, media of concern, exposure routes, and receptors for CDL Site is shown in Figure 7-1. Exposure routes considered in for the CDL Site include:

Surface Soil (≤ 1 foot bgs)

- Uptake of COPECs in surface soil by plants;
- Uptake of COPECs in surface soil by soil invertebrates; and
- Incidental ingestion of COPECs in surface soil by on-site and off-site terrestrial wildlife.

Subsurface Soil (≥ 1 and ≤ 5 feet bgs)

- Uptake of COPECs in subsurface soil by deeper-rooted plants (i.e., trees); and
- Ingestion of COPECs in subsurface soils by on-site burrowing wildlife.

Surface Water and Sediments

- Uptake of COPECs in sediments by benthic invertebrates; and
- Uptake of COPECs in surface water by fish and aquatic life.

Food Items

- Ingestion of COPECs in food items (i.e., plant, invertebrate, or mammal tissues) by terrestrial and aquatic wildlife.

Uptake is defined as the absorption and retention of chemicals by an organism (e.g., plant) from the surrounding medium. Uptake of COPECs by either soil invertebrates, herbs (e.g., shallow-rooted annual grasses and forbs), or shrubs, was assessed for potentially affected soils at the CDL Site. Plants utilize roots to perform uptake of water and nutrients from soils.

Grasses and forbs are low in stature and commonly have shallow roots in soil (≤ 1 foot bgs). The roots of shrubs were assumed to extend down to 2 feet bgs. Even for deeper-rooted plants such as trees, most of the root mass and uptake processes occur in relatively shallow soils (≤ 5 feet bgs) (Jones, 1998; Raven *et al.;* 1986; Schenk and Jackson, 2002). These root zones are consistent with the depths accessed by other plants and animals (Jones, 1998) and were used to illustrate the potential responses of plants across a range of rooting depths. Uptake of COPECs in sediments by benthic invertebrates was assessed at the community level. Uptake in water by fish was assessed using general aquatic life toxicity reference values. A drinking water pathway was not assessed for wildlife potentially exposed to surface water at the CDL Site (as discussed in Section 7.2.2.2).

Exposure Pathways Considered but Dismissed from Further Consideration

Dermal absorption of COPECs was considered to be an insignificant exposure pathway for identified wildlife receptors of concern because:

- Dense undercoats or down effectively prevent COPECs from reaching the skin of wildlife species and significantly reduces the total surface area of exposed skin (Peterle 1991; U.S. Army Corps of Engineers [USACE] 1996); and

- Exposure studies indicate that exposures due to dermal absorption are insignificant compared to ingestion for terrestrial receptors (Peterle, 1991).

Implications of omitting the dermal exposure pathway from the ERA are discussed in Section 7.4.4.1.

7.2.5 Assessment and Measurement Endpoints

Assessment endpoints are environmental values to be protected and, if found to be significantly impacted, would indicate the need for remediation or other management action (USEPA, 1992b). Measurement endpoints are measurable responses to a stress that are related to and are used to evaluate the assessment endpoint (USEPA, 1992b).

7.2.5.1 Assessment Endpoints

Because the future land use includes undisturbed open space, assessment endpoints were established to protect existing plant and wildlife populations. Assessment endpoint statements for receptors of ecological concern for the CDL Site were established to ensure protection at the level of the population (i.e., reproductive success and abundance of the population). Assessment endpoints for plants and soil invertebrates were selected to provide protection at the level of the community. Table 7-2 shows assessment endpoints.

7.2.5.2 Measurement Endpoints

It is not feasible to assess every species individually. Representative species were selected to provide conservative estimates of COPEC exposure for receptors of concern belonging to a common taxonomic and functional group (e.g., herbivorous mammals) (Table 7-2). SLERA risks to representative species were evaluated by comparing estimated exposures to screening benchmarks. For COPECs that were retained for further evaluation (they exceeded the screening benchmarks), no adverse effect level (NOAEL)-equivalent toxicity reference values (TRVs) were derived from toxicity studies examining reproductive and developmental effects. Reproductive and developmental endpoints were considered to be sensitive and ecologically relevant measurement endpoints for evaluating assessment endpoints for the CDL Site.

7.3 Analysis Phase

The analysis phase provides the information necessary to determine or predict ecological responses to COPECs under exposure conditions of interest. This phase consists of two assessments: exposure assessment and effects assessment (USEPA, 1992b). To estimate exposures to representative plants, invertebrates, and wildlife at the CDL Site, wildlife exposure factors, bioaccumulation models, and exposure point concentrations were defined. Chronic NOAEL-equivalent TRVs were established to evaluate the effects of released chemicals on representative plants and wildlife.

7.3.1 Exposure Assessment

To estimate exposures of COPECs to selected plant, invertebrate, and wildlife species, five essential inputs were needed:

- Representative species;
- Exposure point concentrations;
- Exposure equations;
- Wildlife exposure factors; and
- Bioaccumulation models.

To facilitate review, input values used to estimate exposures are provided in Appendix G.4. Additional data utilized for calculations and COPEC concentrations in tissues are also found in Appendix G.5.

7.3.1.1 Representative Species

Because it is impractical to evaluate all receptors of concern at an AOC, the ERA evaluates risks for a set of representative species that are selected for the site based on habitats present. Risks to representative species are subsequently used to infer the potential for adverse impacts to taxonomically and functionally related receptors of concern. Representative species were selected to minimize underestimates of exposure and are listed in Table 7-3.

Terrestrial Plants and Soil Invertebrates

Most of the root mass and uptake processes occur in relatively shallow soils (less than 5 feet bgs), even for deeper-rooted terrestrial plants (Jones, 1998; Raven *et al.;* 1986; Schenk and Jackson, 2002). The root zone of herbaceous grasses and forbs was assumed to be less than 1 foot bgs; and the root zone of shrubs was assumed to be less than 2 feet bgs. Plant rooting depths for the majority of root mass, not necessarily maximum rooting depths, are appropriate for the exposure assessments. Plants are fixed organisms and therefore spend 100 percent of the time at the CDL Site (Table 7-4).

Soil invertebrates were assumed to be exposed to COPECs in soils less than 1 foot bgs and to spend 100 percent of their time at the CDL Site (Table 7-4). Earthworms were assumed to be the dominate soil invertebrate at the CDL Site; however, they are not expected to be found in the marsh portion of the CDL Site, due to the saturated soil conditions found there.

Birds

Representative birds evaluated in this ERA are species that are found in a variety of habitats at WFF, including the CDL Site. The body weight, diet, ingestion, and home range data are shown in Table 7-4.

American Robin: American Robins (*Turdus migratorius*) are insectivorous birds that live in a variety of habitats. This bird is adapted for gleaning from surface soils and consumes predominantly insects and worms (USEPA, 1993). The American Robin was assumed to incidentally ingest surface soils (less than 0.5 foot bgs) at the CDL Site. A percent soil in the diet was obtained from the ECO Soil Screening Level (SSL) (USEPA, 2005b) 90th percentile for the American Robin. The body weight, food ingestion rate, water ingestion rate, and mean home range were obtained from the Wildlife Exposure Factors Handbook (USEPA, 1993).

Red-tailed Hawk: Red-tailed Hawks (*Buteo jamaicensis*) are carnivorous birds that live in a variety of habitats. This bird uses several techniques to capture prey: it sits on open perches to spot and attack ground prey and it soars in the air to spot ground prey (USEPA, 1993). The Red-tailed Hawk preys primarily on small mammals. The exposure scenario for the Red-tailed Hawk assumes that this raptor's diet consists of both of the representative small mammal species (Meadow Vole and Short-tailed Shrew). To ensure a conservative assessment of exposures to CDL Site contaminants, it was assumed that the hawk was exposed via whichever species presented the maximum tissue burden. A percent soil in the diet was obtained from the ECO SSL (USEPA, 2005b) 90th percentile for the Red-tailed Hawk. The body weight, water ingestion rate, and mean home range were obtained from the Wildlife Exposure Factors Handbook (USEPA, 1993). The food ingestion rate was obtained from the ECO SSL (USEPA, 2005b).

Great Blue Heron: The Great Blue Heron (*Ardea herodias*) are large piscivourous birds that live and forage in marshes, streams, rivers, and bays. This bird is adapted for hunting aquatic prey in shallow water (USEPA, 1993). The Great Blue Heron was assumed to incidentally ingest sediments from the CDL Site. The proportion of sediments in the diet was assumed to be <2% obtained from the estimate of soil ingestion by the Blue-winged Teal, another piscivorous species (USEPA, 2005b). The body weight, food ingestion rate, water ingestion rate, and mean home range were obtained from the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

Mammals

Representative mammal species evaluated in this ERA are species that are found in a variety of habitats at WFF, including the CDL Site. The body weight, diet, ingestion, and home range data are shown in Table 7-4.

Meadow Vole: Meadow Voles (*Microtus pennsylvanicus*) are small herbivorous mammals that live in a variety of habitats. This vole feeds on the ground surface and consumes the leafy parts of grasses, sedges, and herbs (USEPA, 1993). The Meadow Vole was assumed to incidentally ingest surface soils (less than 0.5 feet bgs). A percent soil in the diet was obtained from the ECO SSL (USEPA, 2005b). The body weight, water ingestion rate, and mean home ranges were obtained from the *Wildlife Exposure Factors Handbook* (USEPA, 1993). The food ingestion rate was obtained from the ECO SSL (USEPA, 2005b).

Short-tailed Shrew: Short-tailed Shrews (*Blairina brevicauda*) are small insectivorous mammals that live in a variety of habitats. These burrowing small mammals feed on insects and other soil invertebrates found under logs, rocks, and litter (USEPA, 1993). The Short-tailed Shrew was assumed to incidentally ingest deep soils (less than 5 feet bgs). A percent soil in the diet was obtained from the ECO SSL (USEPA, 2005b). The body weight, water ingestion rate, and mean home ranges were obtained from the *Wildlife Exposure Factors Handbook* (USEPA, 1993). The food ingestion rate was obtained from the ECO SSL (USEPA, 2005b).

Red Fox: Red Foxes (*Vulpes vulpes*) are omnivorous mammals that live in a variety of habitats. These opportunistic mammals feed on mice, rats, insects, and carrion. They may also consume berries, seeds, and plants (USEPA, 1993). For the purpose of the SLERA it was assumed the diet was 100% small mammals (the most contaminated prey items). A percent soil in the diet was obtained from Beyer *et al.,* 1994. The body weight, food ingestion rate, water ingestion rate, and mean home ranges were obtained from the *Wildlife Exposure Factors Handbook* (USEPA, 1993).

River Otter: River Otters (*Lutra canadensis*) are large piscivorous mammals that live in a variety of aquatic habitats. These mammals feed primarily on fish (USEPA, 1993). The River Otter was assumed to incidentally ingest sediments from the CDL Site. The proportion of sediments in the diet was not available for any piscivorous mammal species. Therefore, it was assumed to be 2%, which was obtained from the estimate of soil ingestion by the Blue-winged Teal, another piscivorous species (USEPA, 2005b). The body weight, water ingestion rate, and

mean home ranges were obtained from the *Wildlife Exposure Factors Handbook* (USEPA, 1993). Food ingestion rate was obtained from Sample and Suter, 1998.

7.3.1.2 Exposure Equations

COPEC exposures are calculated using pathway-specific exposure equations of the general form:

$$\text{Exposure} = C \times CR \times FC \times AF \times BW^{-1}$$

where:

C = concentration of a COPEC in media that is likely to be contacted by receptors of concern (= exposure point concentration)

CR = contact rates (intake rates), which include wildlife exposure factors, such as ingestion and drinking rates

FC = fraction of media contacted, a measure of the portion of the medium contacted and includes wildlife exposure factors, such as the site presence index and diet portions

AF = assimilation fraction, the amount of the COPEC absorbed through the root, gastrointestinal tract, lungs or skin (100% assimilation is assumed in the baseline ERA)

BW = body weight of the animal

Exposure equations used in this baseline ERA are consistent with federal and state guidance (USEPA, 1993).

7.3.1.3 Wildlife Exposure Factors

Wildlife exposure factors that were used to evaluate exposure equations for identified representative wildlife species are listed in Table 7-4. Body weights were used to estimate intake rates using allometric equations and to metabolically adjust toxicity benchmarks. When available, female weights were utilized due to their often smaller size and to represent the most sensitive population, breeding females. Ingestion rates were used to estimate intake (e.g., the intake of food at the CDL Site). Representative species were assumed to consume 100% of the most contaminated prey item in their diet. Soil depths were used to identify soil horizons to

which representative species were exposed. Use of these values provide for a very conservative assessment.

7.3.1.4 Bioaccumulation Models

Bioaccumulation models were used to estimate COPEC concentrations in food items of representative species. Several means are available to estimate the bioaccumulation of inorganic and organic chemicals in plants, invertebrates, and small mammals. The order of preference of these models or data for bioaccumulation estimates are summarized below:

1. Literature-based bioaccumulation regression models and uptake factors recommended in recent publications (e.g., Bechtel Jacobs Company LLC, 1998, Sample *et al.,* 1998a, 1998b, 1998c).
2. Bioconcentration factors (BCFs) for plants (Baes *et al.,* 1984).
3. If no applicable models were available for a chemical, a default bioaccumulation factor (BAF) of one was assumed (i.e., the tissue concentration equals the soil concentration for a given plant or animal).

The bioaccumulation models used for the exposure calculations for each chemical and receptor are shown in Tables 7-9 through 7-13. Uncertainties associated with the use of bioaccumulation regression models are discussed in Section 7.4.4.1, *Uncertainties in the Exposure Assessment*.

7.3.1.5 Exposure Point Concentrations

ProUCL was utilized to calculate 95% UCL for COPECs. For COPECS with less than 5 detected samples, ProUCL can not reliably calculate the 95% UCL (USEPA, 2007c). For these COPECs the maximum of all the detected values and the practical quantification limit (PQL) was used as the exposure point concentrations (EPC). For non-detected compounds the median PQL was utilized as the EPC (USEPA, 1989a). The full analytical results for each sampling location are provided in Appendix G.2 (Analytical Data Summary). Summary statistics for chemicals detected at the CDL Site, including the EPC concentrations used, are provided in Appendix G.4.

7.3.1.6 Estimates of Wildlife Exposure

Exposure values for plants and invertebrates are simply the soil or sediment concentrations of the COPECs in milligrams per kilogram of soil (mg/kgsoil). COPEC exposures for birds and mammals are expressed as doses in milligrams per kilogram of body weight per day (mg/kgbody wt/day). Estimates of COPEC exposure for representative species are provided in risk tables (see Tables 7-14 to 7-25 and Appendix G.5). All soil concentration measurements and food ingestion values are expressed in terms of dry weight.

7.3.2 Effects Assessment

The effects assessment identifies and quantifies adverse effects elicited by exposure to COPECs and, where possible, evaluates cause-and-effect relationships (USEPA, 1992b). This ERA uses toxicity data obtained from the primary literature, review documents, and available toxicity databases for effects assessment.

7.3.2.1 Toxicity Benchmarks and TRVs

TRVs are concentrations in the medium or doses that are protective of identified representative plant, invertebrate, and wildlife species. Exposures greater than TRVs are considered to pose an unacceptable potential for adverse impacts. Ideally, TRVs are concentrations or doses at which effects begin to occur, and below which no effects are observed. TRVs were obtained from available literature (Tables 7-5 through 7-8 provide TRVs and literature references).

Reproductive impairment and developmental abnormalities can be directly related to reproductive success in wildlife populations and were considered to be sensitive and ecologically relevant endpoints for evaluating ecological risks. Although mortality can be directly related to reproductive success, it is often a less sensitive endpoint compared to reproductive and developmental endpoints. Physiological (e.g., blood chemistry, enzyme activity) and behavioral (e.g., excitability, preening) endpoints are often difficult to relate to quantifiable decreases in reproductive success or adverse effects to wildlife populations. Tumorigenic and carcinogenic toxicity studies were not considered ecologically relevant and were not used to develop toxicity benchmarks because the incidence of debilitating cancers in wildlife are exceedingly rare under field conditions. Mortality typically occurs well before the onset of cancer in the field (Martineau *et al.,* 2002). However, physiological, systemic, behavioral, tumorigenic, and

carcinogenic studies were used to support selection of toxicity benchmarks derived from reproductive and developmental studies (Tables 7-5 through 7-8). Toxicity studies that (1) examined reproductive or developmental effects, (2) administered multiple exposure levels over chronic durations, (3) used large per treatment sample sizes, and (4) reported a NOAEL and a lowest observable adverse effect level (LOAEL) were preferred to develop chronic NOAEL-equivalents TRVs.

The following toxicity assumptions or extrapolations were made for selected COPECs:

- Toxicity data for chromium VI were used to evaluate risks due to exposures to total chromium by mammalian species. Chromium III toxicity data were also available, however chromium VI data were chosen to be most conservative. Chromium III unadjusted NOAEL TRV was reported as 2737 mg/kg/day. In comparison chromium VI unadjusted NOAEL TRV was reported as 3.28 mg/kg/day. Note the chromium VI TRV is three orders of magnitude larger than the chromium III, and likely greatly overestimates the risk from chromium.

- Toxicity benchmarks were not available for many SVOCs (PAHs), and were based on the benchmarks developed for benzo(a)pyrene and naphthalene. These benchmarks were assigned to individual PAHs that are similar in structure, molecular weight, and lipid solubility to benzo(a)pyrene (such as benzo[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene, indeno[1,2,3-cd]pyrene, and pyrene) and naphthalene (acenaphthene, acenaphthylene, anthracene, fluorene, fluoranthene, phenanthrene, and 2-methylnaphthalene).

Use of surrogate chemicals for most PAHs is supported by the abundance of research work on quantitative structure-activity relationships (QSARs), reported in the pharmaceutical and medicinal chemistry literature, which suggests that chemicals with similar molecular or physicochemical properties have similar biological reactivity and toxicity. Use of surrogate chemicals is consistent with guidance for HHRA.

7.4 Risk Characterization

Risk characterization integrates the results of the analysis phase to evaluate the likelihood of adverse ecological impacts associated with exposure to COPECs (USEPA, 1992b). This risk

characterization describes the risk estimates for the CDL Site and the uncertainty associated with the risk estimates.

A key feature of the ERA is the use of multiple lines of evidence to support characterizations of risk. The primary tool of the ERA for the CDL Site was the hazard quotient. However, other lines of evidence that were considered to evaluate the potential for risk include:

- Evaluation of undetected constituents;
- Comparisons to background concentrations;
- Toxicity-related considerations;
- Size and nature of potentially affected habitats; and
- Presence of threatened or endangered species.

The potential for adverse ecological impacts resulting from past activities at the CDL Site was evaluated based on the preponderance of evidence from these factors.

7.4.1 Hazard Quotient

The HQ was used to estimate the potential for adverse ecological impacts when sufficient exposure and toxicity data existed. An HQ is the ratio of the exposure to the toxicity benchmark:

$$HQ = \frac{\text{Estimated Exposure}}{\text{Toxicity Reference Value}}$$

An HQ less than 1 indicates a negligible potential for adverse ecological impacts due to exposure to a particular COPEC, whereas an HQ greater than or equal to 1 indicates a potential for adverse ecological impacts due to exposure to that COPEC.

7.4.2 Significance of Potential Risks

Other lines of evidence were also included to evaluate the significance of risks. Information on the size and nature of potentially affected habitats can support interpretations of the significance of predicted effects. Sites that may affect small areas were considered to pose a less significant potential for ecological hazard compared to sites that may affect large areas. Similarly, sites that would affect disturbed areas were considered to pose a less significant

potential for ecological hazard compared to sites that may affect high quality wildlife habitat. In addition, sites that do not support state or federally threatened or endangered species were considered to pose a less significant potential for ecological hazard compared to sites where state or federally threatened or endangered species have been observed.

7.4.3 Risk Estimates

Risk tables are provided for each representative species at the CDL Site (Tables 7-14 through 7-25). These risk tables present the estimated exposure, TRVs, and HQs for all COPECs and representative species considered at the CDL Site by the AOC in which they occur. Summary tables identifying HQs were prepared to support discussions of risk to biota within the site (Tables 7-26 through 7-29).

In general, some of the HQs suggest that a potential for adverse impacts exists for terrestrial plants, soil invertebrates, benthic invertebrates, and insectivourous birds and mammals due to the uptake or ingestion of COPECs in soils at the CDL Site (Tables 7-14 through 7-25). There was negligible potential for adverse impacts to carnivorous wildlife and minimal potential for adverse impacts to herbivorous and piscivourous wildlife.

Risks within the Central and Southern AOCs were identified for the following detected terrestrial COPECs: SVOCs (anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, fluoranthene, phenanthrene, and pyrene), DDD, DDE, DDT, and metals (antimony, arsenic, barium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, silver, vanadium, and zinc). The risks were predominately to plant and soil invertebrate species. DDD, DDE, and DDT show potential risk to insectivorous and carnivorous bird species. Additionally some metals (antimony, arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, and zinc) may pose a risk to insectivorous species. HQs indicate potential risk to plants from the cumulative effects of total VOCs and to insectivorous and carnivorous wildlife from total pesticides (DDD/DDE/DDT) (Table 7-29).

Risk to aquatic species were identified for the following detected COPECs: carbon disulfide, bis(2-ethylhexyl)phthalate, DDD, DDE, DDT, aluminum, antimony, arsenic, barium, cadmium, copper, iron, lead, mercury, selenium, silver, and zinc. The majority of these risks were identified for benthic invertebrates based on EPA Region III sediment screening levels

(USEPA, 2008c). Risk to general aquatic life, including fish, was identified for several metals (aluminum, barium, iron, and selenium) based on the state of VA water quality standards (VA, 2007). Risk to aquatic wildlife species was identified for only aluminum. Hazard indices indicate potential risk to benthic invertebrates from the cumulative effects of total VOCs and total pesticides (Table 7-29).

Sources of uncertainty in risk estimates that are related to exposure and chemical toxicity are discussed in Section 7.4.4.

7.4.3.1 Potential for Adverse Ecological Impacts at the Entire Site

Mixed loblolly/sweetgum/oak forest and mowed grassland are the dominant terrestrial portions of the CDL Site. This area is highly disturbed habitat with only a small percentage of the area comprised of regenerating forest. The remaining area consists of mowed grass bisected by an active access road and abutts the active Wallops runway to the west. The area is limited in size and therefore is likely to support only a small population of species. Potential adverse impacts due to exposures to COPECs were therefore considered to have minimal potential for ecological hazard to most terrestrial species. Birds and mammals that prefer this type of habitat as well as soil invertebrate populations may have potential for ecological hazard.

The CDL Site drops down into a tidally influenced brackish wetland on the east with a tidal channel of Little Mosquito Creek creating the eastern boundary. Receptors of concern were identified for these habitats to focus risk analyses on species of ecological and societal (i.e., regulatory and commercial) concern.

The CDL Site is located within the Little Mosquito Creek Conservation Site. The Little Mosquito Creek Conservation Site has been assigned a biodiversity significance ranking of B4, which represents a site of general significance. (Scale = 1 to 5 with 1 being the most significant.) Little Mosquito Creek feeds into the extensive marshlands of Chincoteague Bay. Potential adverse impacts due to exposures to COPECs were therefore considered to have potential for ecological hazard to aquatic species.

Summary of Hazard Quotients

The majority of the HQs suggest that a negligible potential exists for adverse impacts herbivorous, carnivorous and piscivorous birds and mammals due to the ingestion of COPECs in soils, sediment, and water at the CDL Site (Tables 7-26 and 7-29). However, HQs for plants,

soil and benthic invertebrates, insectivourous wildlife, and aquatic life indicate potential for adverse impacts from COPECs in the soil, sediment, and surface water at the CDL Site (Tables 7-27 and 7-29).

Exposure-Related Factors

Risks are considered to not warrant remedial action when EPCs for metals are within background concentrations. Tables 4-1 through 4-13 provide comparison of detected COPEC concentrations to background concentration data. The following factors suggest that HQs for some media may not indicate a potential for adverse impacts to biota :

- Central and Southern AOC surface soil concentrations of DDE and DDT are all below background concentrations (Tables 4-5 and 4-7);
- Surface water concentration of bis(2-ethylhexyl)phthalate, DDD, DDE, DDT, barium, cadmium, iron, lead, mercury, silver, and zinc are all below background concentrations (Tables 4-11 and 4-12);
- Sediment concentrations of DDT and copper are all below background concentrations (Table 4-13); and
- Statistical analysis of arsenic in soils (Appendix E) indicates that this metal was not detected at concentrations that are significantly higher than background.

Toxicity-Related Factors

The following factors may affect the interpretation of risks due to assumptions or data gaps in the toxicity assessment.

- Toxicity data for chromium VI were used to evaluate risks due to exposures to total chromium by mammalian species. Chromium III toxicity data were also available, however, chromium VI data were chosen to be most conservative. Chromium III unadjusted NOAEL TRV was reported as 2737 mg/kg/day. In comparison, chromium VI unadjusted NOAEL TRV was reported as 3.28 mg/kg/day. Note the chromium VI TRV is three orders of magnitude larger than the chromium III, and likely greatly overestimates the risk from chromium.

Factors Related to Data Gaps

The HQs could not be calculated for reptiles in this ERA due to the lack of relevant toxicity data. Other data gaps are the absence of TRVs due to either lack of toxicity data or lack of TRV development for receptors for the COPECs as shown in Tables 7-5 through 7-8.

TRVs for wildlife species were unavailable for most VOCs and SVOCs. The majority of these COPECs were not detected in samples and were included only because maximum detection limits exceeded screening benchmarks. Additionally, none of the VOCs or SVOCs with available TRVs indicate potential for risk to wildlife species at the CDL Site from these chemicals.

The absence of TRVs for the following compounds may not be critical data gaps because the compounds were detected in few soil samples at the CDL Site in some applicable soil depths: VOCs (detected in 1/8 surface samples and ≤3/17 subsurface samples), SVOCs (detected in ≤4/8 samples and ≤4/17 subsurface samples), chloradane (detected in 1/17 subsurface samples), Aroclors (detected in 1/17 subsurface samples), antimony (detected in 4/8 surface samples), and selenium (detected in 2/8 surface samples and 4/17 subsurface samples). Additional sample data can be found in Tables 4-5 through 4-8, Appendices G.1 and G.3. Because these chemicals were detected at few locations and maximum detected concentrations were utilized as the EPC, the exposures of plants, invertebrates, birds, or mammals to these chemicals were likely overestimated.

There was a lack of avian data for antimony and benzo(a)pyrene. Ingestion HQs for mammals were approximately 10^{-3} to 10^{+0} for antimony and 10^{-6} to 10^{2} for benzo(a)pyrene. Ingested doses (mg/kg/day) of these chemicals to birds are comparable to ingested doses to mammals. Based on a large database of toxicity data compiled in support of this and other ERAs, ranges in sensitivity to chemicals among different species are typically no greater than ten to one hundred-fold; ranges in metabolically adjusted sensitivities are even less. Based on these numbers, there is little risk to birds from benzo(a)pyrene. There may be some risk to insectivorous birds from antimony based on HQs for insectivorous mammals.

Summary and Significant Potential for Ecological Hazard of Potential Risks

Based on the multiple lines of evidence, a potential exists for adverse impacts to terrestrial plants, invertebrates, and insectivorous wildlife receptors due to exposures to antimony, barium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium,

vanadium, and zinc (plants); barium, chromium, copper, lead, manganese, nickel, selenium, silver, vanadium, and zinc (soil invertebrates); barium, cadmium, chromium, copper, mercury selenium, and zinc (insectivorous birds); antimony and copper (insectivorous mammals); DDD, DDE, DDT, antimony, arsenic, cadmium, iron, lead, mercury, silver, and zinc (benthic invertebrates); aluminum (piscivorous wildlife); and aluminum, barium, and iron (aquatic life) (Table 7-30).

Risk to terrestrial species is likely to have minimal impact for most terrestrial communities due to the small area (63,700 ft^2) and degraded nature of the CDL Site. Additionally risk to terrestrial species in the Central and Southern AOCs will likely be minimal for the entire site as the relatively clean Northern and Western AOCs would dilute the EPCs had they been included in an entire site assessment. Risk to aquatic species may have potential to impact aquatic communities.

7.4.4 Uncertainty Analysis

When it was necessary to fill a data gap, conservative assumptions were used in this ERA to minimize the probability of underestimating ecological risks. However, the use of conservative assumptions also results in an increased probability of overestimating ecological risks. The degree to which estimates of risk may be overestimated cannot be quantified; they can, however, be qualitatively discussed. Key uncertainties identified for the CDL Site are described below.

7.4.4.1 Uncertainties in the Exposure Assessment

Site-specific sources of uncertainties related to COPEC exposure include: (1) nondetected chemicals, (2) exposures comparable to background levels, (3) exposures based on "J"-qualified data, (4) identification of suspected laboratory contaminants and artifacts, (5) use of representative species, (6) exposure parameters, (7) bioaccumulation models, (8) omission of dermal contact and inhalation as significant exposure pathways, (9) uncertainties associated with site characterization, (10) uncertainties associated with soil depth assumptions, and (11) lead bioavailability. The assumptions used to minimize the probability of overestimating ecological risk at the CLD Site are provided in Table 7-30.

Non-detected Chemicals

In accordance with regulatory guidance, reasonable maximum exposure (RME) concentrations were calculated using both detected and non-detected values. Detection limits for chemicals that were not detected were included with detected concentrations in ProUCL calculations. For samples with less than 5 detected values, maximum detected concentrations were utilized. These maximum values for SVOCs, antimony, and selenium were found to generate HQs greater than one for multiple receptors at the CDL Site. These COPECs may not be widely present at the CDL Site and are likely present at levels below the maximum concentrations that were used.

COPECs that did not have any detected concentrations, but which had detection limits above the screening level, were evaluated in the SLERA but were not included in the ERA food chain models (Appendix G.2). These VOCs and SVOCs had several samples with high detection limits from one area. These samples were taken from an area with large amounts of buried debris, including drums with old decaying materials causing matrix interference in the laboratory analyses and resulting in high detection limits. Detection limits from all other areas were low and these compounds were not detected in any sample (Tables 4-1 through 4-8). Therefore, there is minimal potential that exclusion of these samples from the food chain models may have underestimated the potential for adverse ecological effects at the CDL Site.

Exposures Comparable to Background

Risks are not considered to warrant remedial action when metals are present at concentrations that are within background concentrations. The background threshold value (BTV) for soil were based on the ProUCL 95th percentile. Samples were limited for surface water and sediments; therefore, the mean detected concentration or maximum PQL was used to estimate BTVs. Due to the small sample size, these BTVs may be over- or under-estimated.

Exposures Based on "J"-Qualified Data

In accordance with USEPA guidance (1989a), "J"-qualified data were used when the estimated concentrations were between their respective MDLs and the practical quantitation limits (PQLs). Use of "J"-qualified data ensures that the use of available, acceptable data is maximized in the risk assessment.

Identification of Suspected Laboratory Contaminants and Artifacts

Consistent with guidance (USEPA, 1989a), three VOCs (acetone, 2-butanone, and methylene chloride) and one SVOC (benzoic acid) were not selected as COPECs because they were considered suspected laboratory artifacts. Although the omission of these suspected laboratory artifacts resulted in the lack of risk estimates for these chemicals, it is unlikely that the conclusions of the risk assessment would be significantly altered, given the infrequent detections and extremely low concentrations of these common laboratory chemicals.

Use of Representative Species

Representative species are used to conservatively estimate environmental COPEC exposures to receptors of concern. Representative species are species used to represent a functional group of organisms at the site for the evaluation of assessment endpoints. Representative species are chosen based primarily on their function in the ecosystem and secondarily on taxonomic relatedness and known or presumed similarities in physiology and life history. Representative species were selected to maximize the exposure portion of the HQ, thus producing protective estimates of risk to receptors of concern.

Exposure Parameters

Single point estimates of exposure parameters used in this ecological risk assessment do not incorporate variability but are representative of average or typical values. Conservative assumptions were applied in this risk assessment to minimize the probability of underestimating ecological risks due factors including uncertainty and variability in exposure parameters.

Body weights of wildlife receptors were used to calculate food ingestion and drinking rates, ingested doses of chemicals, and adjusted TRVs. Within a given species, body weights can vary with age, sex, nutrition, and geographic range. Average body weights of representative species were selected from the literature.

Wildlife food and water ingestion rates were selected from the literature (USEPA, 1993). The accuracy of estimated food ingestion rates is influenced by assumptions about representative body weights of receptors and variability in feeding and drinking rates among species in a particular functional group. In addition, variability in environmental temperature, territory size, resource availability, and physiology can influence the accuracy of these contact rates for animals.

Diets assumed for receptors determine the soil depth interval, measured dietary concentrations, and predictive bioaccumulation models used in risk calculations. Diets are variable across seasons, habitat types, and geographic ranges of a species. To facilitate identifying ecological hazards by discrete media or trophic transfer pathways, diets were simplified (e.g., herbivorous diets were assumed for species that may consume 90% plant seeds and 10% invertebrates). Limitations in available bioaccumulation models sometimes made it necessary to approximate estimated concentrations in a given dietary item (e.g., mostly vegetative tissues of plants at the CDL Site were analyzed, and the majority of data points in the Bechtel Jacobs Company LLC (1998) plant uptake models were for vegetative tissue, whereas the White-crowned Sparrow has a diet that mainly is comprised of seeds).

Wildlife swallow soil particles during their normal activities such as feeding, preening pelage or feathers, and burrowing. Chemicals attached to soils are therefore available for exposure, and the assumed proportions of ingested soils are expressed as a percentage of the diet. Incidental soil diet proportions can exert an important effect on predicted risks when concentrations in soil differ from those in food, and soil is the main source of exposure to some environmental contaminants. However, data for soil ingestion by wildlife are extremely limited. Estimates of soil diet proportions were obtained by analyzing for acid-insoluble ash content in scat (feces) of wildlife and applying an equation that extrapolates from acid-insoluble ash to dietary soil content (Beyer et al., 1994). It was also necessary to extrapolate soil diet proportion estimates reported for a limited set of species to the representative species at the CDL Site (see Section 7.3.1.1).

The site presence index (SPI) is a proportion of the total time that a receptor is estimated to spend at a given site, which in turn determines the proportion of its total exposures to soils and dietary items that come from that site. This parameter is calculated as the ratio of the site area to a species' home range, which can vary appreciably by age, sex, season, breeding status, resource availability, and climate. An average or typical home range was assumed for each representative species. Uncertainty in the SPI is most important to consider when a value of less than 1 is assumed; that is, when a wide-ranging species is expected to receive only a portion of its total exposures from the site.

Bioaccumulation Models

Bioaccumulation models from the literature based on empirical data were used. The specific model used to calculate tissue concentrations of a given chemical are identified in the risk calculation tables (Tables 7-9 through 7-13). Where literature sources providing specific regressions or uptake factors are limited, and when these means are not available, a default factor of 1 was used. The estimation of bioaccumulation by these means may not accurately represent the actual transfer of toxicants through the food web at a given site.

Bioavailability of chemicals in soils is affected by soil characteristics such as pH, particle size, organic matter content, and total organic carbon. Significant differences in bioavailability between soils at the CDL Site and those in published bioaccumulation models can influence the accuracy of calculated tissue concentrations. Site-specific bioavailability of chlorinated pesticides, PAHs, SVOCs, VOCs, and metals was not accounted for in the use of general literature models at the CDL Site. It was assumed that chemicals are equally available in CDL Site soils and in soils from the other studies. However, uncertainty about site-specific bioavailability is only critical for bioaccumulative chemicals.

Omission of Dermal Contact and Dust Inhalation as Significant Exposure Pathways

Exposure due to dermal contact was considered insignificant and was not assessed in this ERA because:

- Dense undercoats or down effectively prevent COPECs from reaching the skin of wildlife species and significantly reduces the total surface area of exposed skin (Peterle, 1991; USACE, 1996); and

- Exposure studies indicate that exposures due to dermal absorption are insignificant compared to ingestion for terrestrial receptors (Peterle, 1991).

The dermal exposure route is likely minor relative to the ingestion pathway, generally comprising less than 5 percent of the total risks associated with a given chemical. Therefore, the omission of dermal contact is considered to have a negligible effect on conclusions reached in this ERA.

Additionally, uncertainty exists regarding dust inhalation by burrowing mammals. Much of the inhaled dust adheres to mucus in the nasal cavity, mouth, and pharynx. This dust is either discharged through the nose or swallowed, and is implicitly accounted for through the incidental soil ingestion assumption.

Uncertainties Associated with Site Characterization

Some uncertainties in the estimation of risk may have been created when the CDL Site was divided into the AOCs. Risks to species with large foraging areas may potentially be overestimated when the size of the AOC is small relative to the entire site or the species foraging area. However, risks to species with small foraging areas (i.e., less than an AOC) are likely to be more accurately estimated for that AOC because the samples more adequately characterize the AOC.

Uncertainties Associated with Soil Depth Assumptions

Soil depths assigned to exposure pathways for plant roots, soil invertebrates, and wildlife (i.e., birds and mammals) influence the exposure point concentrations (EPCs) of COPECs to which these receptors are potentially exposed. For vegetation at the CDL Site, rooting depths assumed for herbaceous plants and shrubs and trees were 0 to 0.5 feet and 0 to 5 feet bgs, respectively, corresponding to the typical or average rooting depths for the majority of root mass. Even for deeper-rooted plants such as trees, most of the root mass and uptake processes occur in relatively shallow soils (≤ 5 feet bgs) (Jones, 1998; Raven *et al.,* 1986; Schenk and Jackson, 2002). Maximum rooting depths of herbaceous grasses and forbs can extend below 0.5 foot (e.g., soft chess [*Bromus hordeaceus*], whose roots extend down to 1.6 feet in greenhouse conditions; DaSilva and Barolome, 1984).

The soil invertebrate community at the CDL Site is likely to be concentrated in surface soils (i.e., 0 to 0.5 feet). Some members of the soil invertebrate community occur deeper in soils with plant roots (DiCastri and Vitali-DiCastri, 1981; Edwards and Bohlen, 1996; Edwards, 1998). However, the majority of organic material, nutrients, and plant roots are nearer to the surface, and the 0 to 0.5 foot depth interval is representative of the exposures of soil invertebrates, the majority of which occur on the ground surface, beneath leaf litter, and in shallow soils.

Risks to herbivorous and insectivorous wildlife at the CDL Site were not likely to be underestimated despite uncertainty in plant root and soil invertebrate depths that can influence

levels of chemical bioaccumulation in tissues. Exposure of herbivores to COPECs in vegetative tissues of herbaceous plants was calculated based on soil concentrations in the 0 to 0.5 foot soil depth, which for most chemicals are not substantially different from those resulting if grass and forb roots extended down to 2 feet. Insectivorous wildlife are likely to consume mostly surface-dwelling and shallow soil invertebrates in habitat at the CDL Site.

Lead Bioavailability

Bioavailability of ingested COPECs in soils, food, and drinking water was assumed to be 100% in this ERA. This assumption was applied to be protective because site-specific data on COPEC bioavailability in ingested media were not available. However, this may not hold for lead, specifically for that portion of the dose that is obtained from incidental ingestion of soils.

The avian and mammalian TRVs for lead were based on a highly bioavailable form of lead (lead acetate) that was administered in toxicity tests (Edens *et al.,* 1976). However, lead acetate is not likely to occur in site soils, which may be characterized by a less bioavailable form of lead. HQs greater than 1 for lead exposures may represent overestimates of risk, and may not indicate a potential for adverse impacts to these receptors (see Section 7.4.3.1 to 7.3.2.3). Potential overestimation of lead bioavailability in soil could have a significant effect on risks and weighing of further action at the site. To conclude, further action to address lead risks at the CDL Site should consider:

- The assumption of 100% gastrointestinal bioavailability of lead in soil particles may overestimate risks to birds;
- Lead acetate administered in the toxicity tests to Japanese quail chicks is a highly bioavailable form of lead;
- Gastrointestinal bioavailability of lead in soil particles at the CDL Site may be lower than that in the toxicity tests administering lead acetate;
- The form(s) of lead present in soils and the gastrointestinal bioavailability of site-specific lead relative to that in the toxicity tests are unknown; and
- Cleanup levels for lead in soils based on the avian no-effect levels could correspond to soil concentrations less than background. Background exposures to lead should be considered when weighing action levels.

In addition to soil doses, food doses also contribute to the calculated total doses from lead. Bioavailability of biologically incorporated lead (assumed to be 100%) is also a source of

uncertainty in these HQs. It may be assumed that lead in tissues is more available than lead in soil particles, although the extent to which bioavailability in tissues differs from that in soils is unknown. Addressing site-specific bioavailability using a standard *in vitro* bioaccessibility test could help determine whether lead in soils at the CDL Site are readily soluble in the gastrointestinal tract (i.e., similar to lead acetate) or relatively insoluble (i.e., similar to elemental or inorganic lead).

7.4.4.2 Uncertainties in the Effects Assessment

Site-specific sources of uncertainty related to COPEC exposures include: (1) the use of chronic NOAEL-equivalents TRVs, (2) species-to-species toxicity extrapolations, (3) laboratory-to-field toxicity extrapolations, (4) individual-to-population level effect extrapolations, (5) chemical-to-chemical extrapolations, (6) uncertainties related to specific TRVs, and (7) lack of relevant toxicity data for biota.

Use of Chronic NOAEL-Equivalents TRVs

The use of chronic NOAEL-equivalents TRVs is likely to result in conservative assessments of risk because environmental exposures were compared to toxicity levels at which no adverse effects were observed. Studies indicate that the acute lethal dose to 50 percent of the tested population (LD_{50}s) derived from multiple dose toxicity tests show a high positive correlation with observed impacts in the environment (USEPA, 1991c). Thus, use of chronic NOAEL-equivalents TRVs provides a substantially greater level of protection than the use of the lowest doses at which effects are observed (LOAELs) or LD_{50}s.

Species-to-Species Toxicity Extrapolations

A source of uncertainty in the baseline ERA is the lack of applicable wildlife species-specific toxicity data. Because of this common data limitation, TRVs were developed using available toxicity data for laboratory test species. For example, TRVs for the Meadow Vole were developed from toxicity data for mice and rats. This ERA assumes that wildlife species and strains of test species are not significantly different with regard to sensitivities to chemicals. Wildlife populations may be more robust than test species because the wildlife genome is likely to be more heterogeneous compared to inbred laboratory strains.

Uncertainty associated with using allometric extrapolations from toxicity benchmarks to receptor-specific TRVs is discussed in Section 7.3.2.2.

Laboratory-to-Field Toxicity Extrapolations

A number of studies (primarily for aquatic systems) have evaluated the ability of single-chemical laboratory toxicity test results to predict adverse effects of that chemical on organisms under field conditions. Preliminary chemical contaminant studies suggest that laboratory toxicity tests represent more conservative exposure scenarios than those that occur in nature (USEPA, 1991b). Furthermore, concentrations of chemicals causing no effect in laboratory tests also do not appear to affect communities in the field. Thus, the use of chronic NOAEL-equivalent TRVs should provide a conservative level of protection to species living in the field.

Individual-to-Population Level Effect Extrapolations

The individual is the smallest biological "unit" that interacts directly with the environment (Suter, 1993). Most toxicity data selected for the ERA describe reproductive and developmental effects on individuals. Effects on individuals were then used to infer effects at the population level. Chronic reproductive impairment and abnormal development data were selected to facilitate inferences to population-level impacts (e.g., abundance, extinction). Populations are typically more resistant to stress than individuals; the loss of a few sensitive individuals is not likely to significantly affect the population (Ricklefs, 1992). Therefore, inferences from effects on individuals should provide a greater level of protection to populations and communities than inferences from populations (Suter, 1993).

Chemical-to-Chemical Extrapolations

Toxicity extrapolations were performed among methylphenols, chlorinated benzenes, and PAHs due to the limited availability of toxicity data for most PAHs (see Section 7.3.2.1). In all cases, extrapolations were made on the basis of similarity in chemical structure and solubility. TRVs were applied from chemicals with similar or greater toxicity relative to the toxicity of COPECs to ensure that the extrapolations were conservative. The use of surrogate chemicals for PAHs is supported by the abundance of research work, reported in the pharmaceutical and medicinal chemistry literature, which suggests that chemicals with similar molecular or physicochemical properties have similar biological reactivity and toxicity. The use of surrogate chemicals is consistent with guidance for HHRA.

Uncertainties Related to Specific TRVs

Risk estimates for birds and mammals exposed to lead were calculated using toxicity benchmarks based on studies using lead acetate (Edens et al., 1976). Lead acetate is highly soluble and therefore bioavailable (U.S. Air Force, 2000 and U.S. Navy, 1997). Based on available toxicity data, exposures to lead acetate appear to result in greater toxic effects than other inorganic forms of lead (Eisler, 1988). Therefore, risks to birds and mammals are likely to be overestimated. Lead in soils at the CDL Site is likely to be found in an inorganic form that is considerably less available for gastrointestinal absorption in wildlife. Considering the inorganic form of lead most likely to be found in soils at the site, HQs for birds exposed to lead are likely to be less than one and represent negligible ecological risks.

Lack of Relevant Toxicity Data

The potential for adverse impacts to reptiles could not be evaluated due to the lack of relevant toxicity data for all COPECs. Lists of COPECs lacking TRVs at each AOC are provided in Section 7.4.3.1. In general, few metals lack TRVs, though TRVs for a number of VOCs, SVOCs, and PAHs do not have TRVs for plants, soil invertebrates, or birds. The lack of relevant toxicity data (i.e., chronic NOAELs or LOAELs for wildlife reproductive and developmental endpoints) represents a data gap in this baseline ERA.

Although reptiles are likely to be present at the CDL Site, potential risks to reptiles could not be evaluated due to the lack of applicable toxicity data for reptiles. However, toxicity benchmarks for other species present, including birds and mammals, are in most cases expected to be protective of reptiles. Therefore, one can qualitatively understand the risks to reptiles by looking at those for birds and mammals.

The lack of toxicity data for some chemicals may not constitute critical data gaps because (1) the RME soil concentrations for several metals were comparable to background (i.e., less than the 99th percentile BTVs) and (2) several of the chemical qualify as COPECs based only on non-detected PQLs. In addition, several of the organic COPECs lacking TRVs for one or more receptor group were only detected at one or a few locations at the site, likely resulting in an overestimate of the AOC-wide exposures to these chemicals (See Section 7.4.3.1).

7.5 ERA Risk Summary

HQs were calculated for terrestrial receptors in the Central and Southern AOCs. The AOCs selection was designed to assess potential risks of high concentrations of COPECs in the localized disturbed areas in the Central and Southern AOCs. These localized areas were less than 1.5 acres in size.

HQs for the several chemicals indicate that there exists a potential for adverse impacts to terrestrial wildlife biota at the Central and Southern AOCs (Tables 7-28 and 7-29). Calculated HQs for SVOCs indicated a potential for adverse effects on terrestrial plants; however, risk for SVOCs was driven by artificially high maximum non-detect values from a limited sampling area (see Section 7.4.4.1). Therefore, they were not considered to have significant potential for terrestrial ecological hazard.

Calculated HQs for DDE/DDT indicated a potential for adverse effects for plants and insectivorous birds. However, DDE and DDT were detected at or below background concentrations (see Section 7.4.4.1). Risks are not considered to warrant remedial action when chemicals are present at concentrations that are within background concentrations.

Calculated HQs for a number of metals indicated a potential for adverse effects to terrestrial plants, soil invertebrates, and insectivorous wildlife. Based on multiple lines of evidence including habitat size and quality, the absence of threatened or endangered species, and a variety of exposure and toxicity-related considerations, some metal HQs greater than one were not considered to have significant potential for terrestrial ecological hazard (Tables 7-30). Antimony was detected below background concentrations (see Section 7.4.4.1). Chromium HQs were based on the more toxic chromium VI and therefore were considered to be an overly conservative estimate. Arsenic, barium, cadmium, chromium, lead, selenium, and vanadium HQs exceeded NOEAL TRVs, but did not exceed LOAEL TRVs. Use of NOAEL TRVs are likely to result in conservative assessments of risk (see Section 7.4.4.2).

Calculated HQs for a number of metals and DDD/DDE/DDT indicated a potential for adverse effects on aquatic life and benthic invertebrates (Table 7-30). HQs for the majority of chemicals indicate that there exists a negligible potential for adverse impacts to piscivorous birds and mammals. The exception being the potential for adverse impacts to piscivorous wildlife from aluminum (Table 7-28).

At present, the terrestrial portion of the site is disturbed and supports minimal forested vegetation mixed with mowed grass and road edges. Ecological risks to many terrestrial species are therefore considered to have marginally significant potential for ecological hazard at the community level. There is potential for adverse effects to plants and soil invertebrates.

Based on the evaluation of the HQs using all available lines of evidence, the following COPECs are expected to result in a significant potential for ecological hazard (Table 7-30):

- Plants - barium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, vanadium, and zinc;
- Soil invertebrates - barium, chromium, copper, lead, manganese, nickel, selenium, vanadium, and zinc;
- Aquatic life – aluminum, barium, and selenium;
- Benthic invertebrates – DDD, DDE, DDT, antimony, arsenic, cadmium, iron, lead, mercury, silver, zinc; and
- Piscivorous wildlife – aluminum.

8.0 SUMMARY AND CONCLUSIONS

The CDL Site is comprised of four AOCs identified in this RI/RA Report as the Western, Northern, Central, and Southern AOCs, and corresponding to historical aerial photographic analyses as the "shallow excavation", "disturbed ground", "mounds of material", and "burning dump", respectively. These AOCs were evaluated through a focused RI that used existing soil gas data, an EM/GPR survey, a MIP study, and visual observations to target areas suspected of containing the highest concentrations of site contaminants ("hot spots") for further investigation via test pits, surface and subsurface soil, groundwater, surface water , and sediment sampling.

8.1 RI Summary

The Western and Northern AOCs did not exhibit any strong evidence that these AOCs were waste disposal areas. They may have been borrow pits that supplied fill for site construction activities. Soil samples from the Western and Northern AOCs detected only metals at concentrations that exceeded RSLs (Figure 4-1), and only arsenic was detected at concentrations which exceeded industrial RSLs. However, these arsenic concentrations were less than those detected at the local background location, SB-1A and SB-1B.

In contrast, evidence of buried waste is clearly evident in the Central and Southern AOCs. Sheet metal, broken concrete, cinder block, and other demolition debris are exposed at the surface along the eastern boundary of the Central AOC where it meets the marsh. At the Southern AOC, site of the former burning dump, abundant evidence of the former burning dump is present with charred rubbish, cinders, melted glass, and metal readily apparent throughout the AOC. Petroleum staining believed to result from the disposal of waste oil contaminated with chlorinated solvents was observed in data from SB-4/MW-4. A paint-like substance was detected in an area identified as an excavation in the 1959 aerial photograph, and which was identified as an anomaly in the BTEX and chlorinated solvent Gore Sorber soil gas investigation. The EM survey indicated that the drum deposit in this location (TP-1) was located at the eastern edge of the NOAA access road, and was partially below NOAA mission critical utilities (fiber optics) that parallel the eastern shoulder of the road (Figure 2-1).

Integrating the findings of the 2004 soil gas investigation, the EM survey, MIP study, and test pits/soil borings, it appears that grading construction of the NOAA access road resulted in waste materials being pushed further east than the original "footprints" of these two AOCs. The

impacted soil and waste materials are confined to an arcuate band on the eastern edge of the hillside.

Within the Western AOC's shallow soils, the only organic chemical detected was 4,4-DDE (1.6 micrograms per kilogram [µg/kg]) which is substantially less than the WFF mean background concentration of 539 µg/kg (Tetra Tech, 2004). Widespread application of DDT via diesel fogging at WFF has resulted in prevalent low concentrations of semivolatile organic compounds (SVOCs) and DDT and its degradation products occurring across large areas of the base. In shallow soils, aluminum, arsenic, cadmium, calcium, chromium, iron, mercury, and potassium were detected at concentrations between the mean and maximum background concentrations, but none of the metal detections exceeded the maximum background results (Tetra Tech, 2004), and their concentrations were comparable to or less than the local background sample, SB-1A. The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples, as well as in the local background sample SB-1A. Only arsenic exceeded industrial RSLs, but the arsenic concentration detected in background soils also exceeded industrial RSLs.

Within the subsurface soils of the Western AOC, the only organic compound detected was bis(2-ethylhexyl)phthalate detected at 85 µg/kg detected in SB-2B, and this concentration is well below the WFF mean background value (203 parts per billion [ppb]). Cobalt and manganese were detected at concentrations between the mean and maximum background concentrations, however, cobalt only exceeded its mean background concentration by 0.16 parts per million (ppm). Calcium was the only metal detected at a concentration greater than the maximum background results (Tetra Tech, 2004). However, the highest calcium concentration detected at the Western AOC (TP-8B, 657 ppm) is roughly half the concentration of the local background sample (SB-1B, 1,260 ppm). The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in background. Only arsenic exceeded industrial RSLs, but the arsenic concentrations detected in background soils also exceed industrial RSLs. Overall, no evidence of waste was observed, and no contaminants were detected at concentrations that substantially exceeded background in any of the soil samples from the Western AOC.

In the Northern AOC's shallow soil samples, no organic chemicals were detected. Aluminum, chromium, and iron were detected at concentrations between the mean and maximum background concentrations, but none of the metal detections exceeded the maximum background results (Tetra Tech, 2004), and their concentrations were comparable to or less than

the local background sample, SB-1A. The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in background. Arsenic exceeded industrial RSLs, but arsenic concentrations in background samples also exceed industrial RSLs.

In subsurface soils from the Northern AOC, the only organic compound detected was bis(2-ethylhexyl)phthalate detected at 55.8 µg/kg detected in SB-6B, and this concentration is well below the WFF mean background value (203 ppb). Aluminum, calcium, and nickel were detected at concentrations between the mean and maximum background concentrations, but none of the metal detections exceeded the maximum background results (Tetra Tech, 2004). The maximum detected aluminum concentration (14,300 ppm in SB-6b) was only 200 ppm higher than the WFF mean (14,100 ppm), and the nickel detection (7.2 ppm in SB-6B) exceeded the WFF mean (7.05 ppm) by only 0.15 ppm. Calcium detections (297-350 ppm) in AOC samples are roughly one third the concentration of the local background sample (1,260 ppm in SB-1B). The concentrations of aluminum, arsenic, and iron exceeded residential RSLs in both the AOC samples and in background. Arsenic also exceeded industrial RSLs, but the mean and local background concentrations also exceed industrial RSLs. Overall, no evidence of waste was observed, and no contaminants were detected at concentrations that substantially exceeded background concentrations in any of the soil samples from the Northern AOC.

In contrast to the Northern and Western AOCs, evidence of buried waste is clearly evident in the Central AOC. Sheet metal, broken concrete, cinder block, and other demolition debris are exposed at the surface along the eastern boundary of the Central AOC where it meets the marsh. Shallow soil samples from TP-1A, SB-5A and TP-6A did not detect any VOCs or SVOCs above residential RSLs, however, low concentrations of ethylbenzene, methocyclohexane, toluene, and xylenes were detected in TP-1A. SB-4 (later completed as monitoring well, MW-4) detected petroleum staining near the water table (at 8-10 bgs), and SB-4AD detected methyl acetate at 1190 µg/kg, as well as numerous Polycyclic Aromatic Hydrocarbons (PAHs) detected at concentrations that substantially exceed background: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, phenanthrene, and pyrene. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene all were detected at concentrations exceeding residential RSLs. Of those, benzo(a)anthracene, benzo(a)pyrene, and dibenzo(a,h)anthracene also exceeded industrial RSLs. While pesticides were detected in all samples, none were above RSL values.

Among metals detections in shallow soil samples from the Central AOC, arsenic, cadmium, lead, manganese, potassium, and zinc were detected at concentrations between WFF mean and maximum background concentrations (Tetra Tech, 2004), but the concentrations of arsenic detected (2.7 to 4.7 ppm) do not exceed the local background concentration (4.8 ppm in SB-1A). Concentrations of barium, beryllium, calcium, chromium, cobalt, iron, nickel, silver, sodium, and zinc were detected at concentrations higher than the WFF maximum background detections (Tetra Tech, 2004). Metals concentrations in shallow soils for aluminum, arsenic, iron, lead, manganese, and nickel exceeded residential RSLs. Arsenic also exceeded industrial RSLs, but AOC arsenic concentrations were less than or equal to background concentrations, which also exceeded industrial RSLs.

In subsurface soils collected from 6-24 inches bgs within the Central AOC, no VOCs were detected, and only one SVOC, bis (2-ethylhexyl) phthalate at 51.9 ppb were detected. Aluminum, arsenic, cobalt, copper, lead, magnesium, nickel, potassium, and zinc were detected in the 6-24 inch horizon samples at concentrations between the WFF mean and maximum background concentrations (Tetra Tech, 2004), but the highest arsenic concentration in samples from this AOC (4.8 ppm) was less than the local background concentration (5.5 ppm in SB-1B). Calcium, iron, manganese, mercury, sodium, and vanadium were detected at concentrations that exceeded the WFF maximum background concentrations (Tetra Tech, 2004), but the highest calcium and sodium concentrations detected in AOC samples (1,160 ppm), was less than the local background concentrations (1,260 in SB-1B). As noted in the Northern and Western AOCs, the concentrations of aluminum, arsenic, and iron, exceeded residential RSLs in both the AOC samples and in the site-specific background (SB-1B). Arsenic also exceeded industrial RSLs, but the concentrations in the WFF mean (Tetra Tech, 2004) and in the local background sample, SB-1B, also exceed the Industrial RSL.

Deep subsurface soils were collected from the drum disposal pit and petroleum-stained intervals in TP-1C (8.5-11' bgs) and SB-4C (9-10' bgs), respectively. These deep soil samples detected acetone, benzene, 1,2-dichloroethane, ethylbenzene, isopropylbenzene, methocyclohexane, toluene, m,p-xylene, o-xylene, and total xylenes, however, none of these VOCs exceeded residential RSLs. Only a single pesticide (4,4-DDD at 25.7 ppb) and one SVOC, bis (2-ethylhexyl)phthalate at 102 ppb were detected in the deep samples. Neither of the SVOC or pesticide detections exceeded RSLs. Aluminum and arsenic in the deep samples exceeded residential and industrial RSL, respectively, but both of these metals' concentrations are below WFF mean (Tetra Tech, 2004) concentrations for these metals.

In the Southern AOC, site of the former burning dump, abundant evidence of the former burning dump is present with charred rubbish, cinders, melted glass, and metal readily apparent throughout the AOC. Screening for 2,3,7,8-dioxin in soil samples was negative for all samples. Numerous PAHs were detected in shallow soils, but only benzo(a)pyrene (58.8 µg/kg in TP-3A, 106 µg/kg in TP-7A) and dibenzo(a,h)anthracene (22.6 µg/kg in TP-7A) exceeded residential RSLs. Benzo(a)pyrene detections were less than the WFF mean concentration (206 ppb). Pesticides detected in shallow soils included 4,4-DDD, 4,4-DDE, and 4,4-DDT, however, none of these detections exceeded RSLs. Metals concentrations within the shallow soil samples of the Southern AOC exceeded the WFF maximum background concentrations for all of the metals except antimony, beryllium, and thallium which were detected at concentrations below the WFF mean, and for arsenic which was detected at concentrations between the WFF mean and maximum background concentrations (Tetra Tech, 2004). Among the shallow soils, aluminum, cadmium, copper, iron, lead, manganese, mercury, silver, and zinc exceeded residential RSLs, but the background concentrations for aluminum and iron also exceeded residential RSLs. Only arsenic and antimony exceeded industrial RSLs, but the background arsenic also exceeds the industrial RSL.

In the Southern AOC subsurface soils, only one VOC, tetrachloroethene, was detected (0.99 to 2.8 ppb). SVOCs detected include the entire PAH suite at fairly low concentrations of 16 to 139 ppb, as well as bis(2-ethylhexyl)phthalate (51 to 199 ppb) and di-n-octylphthalate (25 ppb). Alpha- and gamma-chlordane, 4,4-DDD, 4,4-DDE, 4,4-DDT, and Arochlor-1260 were detected. The concentrations of benzo(a)pyrene (117 ppb) and dibenzo(a, b)anthracene (24 ppb) were the only organic compounds detected that exceeded residential RSLs, and no organic compounds exceeded industrial RSLs. The maximum WFF background concentration (Tetra Tech, 2004) was exceeded for all of the metals except cobalt, thallium, and vanadium whose concentrations were below the WFF mean, and beryllium which was detected at a concentration between the WFF mean and maximum in only one sample (SB-3B at 49 ppb). Concentrations of aluminum, antimony, lead, manganese, silver, and zinc exceeded residential RSLs in the Southern AOC subsurface soil samples. Industrial RSLs were exceeded for arsenic, copper, and iron.

Groundwater is generally shallow and flows east and northeast as indicated by the potentiometric surface shown in Figures 2-8 and 2-9. The monitoring well network provides representative groundwater data for all four of the AOCs that comprise the CDL Site. The shape of the potentiometric surface generally mimics the topography, but is influenced locally by the higher permeability of the waste and cinder deposits of the Southern AOC (Figures 2-8 and 2-9).

The relatively high potentiometric surface elevation noted in MW-3 in both rounds of sampling appears to be anomalous. The combination of higher permeability aquifer materials in the cinder deposits with discharge inhibited from the Southern AOC by basal clays, leads to localized groundwater mounding within and upgradient of the Southern AOC.

Arsenic, iron, manganese, and mercury tap water RSLs were exceeded in groundwater samples, but the highest concentration of mercury detected was in MW-1 (0.18 ppb), and so these mercury detections were a background condition for the site (all of the other detections were less than that value). All of the arsenic, iron, and manganese detections in groundwater were less than the Wallops background mean concentrations (Tetra Tech, 2004). In view of these findings, and considering that these metals findings were also true for MW-3, whose screen was placed within the waste material, these data indicated that the metal contaminants within the waste deposits (soil) of the Central and Southern AOC were not strongly impacting groundwater quality. Barium, calcium, copper, lead, magnesium, nickel, potassium, selenium, sodium, and thallium exceeded either mean or maximum background concentrations (Tetra Tech, 2004), but of these metals, only thallium was detected at concentrations that exceeded a tapwater RSL or MCL.

All groundwater contamination resulting from organic chemicals that were detected above tap water RSLs occurred in MW-4 and MW-5 (Figure 4-2 and 4-3). VOCs and SVOCs detected within the waste deposits (soils) of the Sothern and Central AOCs clearly impacted groundwater downgradient of the site. SVOCs (2-methylnaphthalene and naphthalene) were detected at concentrations above tapwater RSLs in samples from MW-4 and numerous VOCs were detected at concentrations that exceeded tapwater RSLs in MW-4 and MW-5 including: 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, isopropylbenzene, tetrachloroethene, trichloroethene, toluene, m,p xylene, o-xylene, and total xylenes. Of these, the concentrations of cis-1,2-dichloroethene, toluene, and tetrachloroethene exceed MCLs.

Four surface water and ten sediment sampling locations were evaluated, with surface water sampling occurring twice in December and May 2007. All of the organic compounds detected in groundwater samples appeared to degrade or be volatilized by the time groundwater discharged to the tidal channel, and surface water quality appeared to be largely unaffected by the CDL Site. Mercury and copper were the only analytes in downstream surface water sampling locations that exceeded BTAG criteria, but all of the downstream mercury detections were lower than the local background location, SW-1 (Figure 4-4), and the downstream copper

detections (3.3 to 4.9 ppb) were only very slightly higher than the upgradient background concentrations (2.2 to 3.3 ppb).

Over all, there was no strong correlation between detections of contaminants that exceeded BTAG criteria in the downstream sediment results and data from other environmental media at the CDL Site. Sediment sample SD-9, collected within the footprint of the Southern AOC and in direct contact with the waste materials had the highest number of analytes detected that exceeded BTAG criteria including 4,4-DDE, 4,4-DDD, arsenic, copper, mercury, nickel, silver, and zinc (Figure 4-5). In data from SD-2, located roughly 100 feet downstream of SD-9 on the man-made drainage channel, the only results that exceeded BTAG criteria were for arsenic, copper, lead, and nickel (Figure 4-5). However, the levels of lead and mercury found in surface and subsurface soil at TP-3 may correlate with those found in SD-9.

Arsenic, copper, and nickel were detected in several other sediment sampling locations at concentrations that exceeded BTAG criteria, however, the highest detection of copper (36 ppm) was detected in the upgradient background location, SD-1. The range of arsenic detected in sediment samples (8.5 to 21 ppm) was comparable with the SD-1 background concentration (10 ppm) and the mean and maximum WFF background (Tetra Tech, 2004) values for arsenic in soil of 4.2 and 14.2 ppm, respectively. Similarly, the range of nickel detections in downstream samples (17-22 ppm) was comparable to the 17.1 ppm detection in the upstream background sample, 1WFF-MB-111-SS (Figure 4-5).

The only SVOC detected in sediment at concentrations exceeding BTAG criteria was bis(2-ethylhexyl)phthalate which was detected at concentrations of 4,360 to 162,000 ppb in SD-4 and SD-5, respectively. Because the sediment concentrations are one to three orders of magnitude higher than detected in soil (300 ppb), and a large amount of plastic detritus was observed in the marsh adjacent to the site, these elevated BEHP concentrations could be site-related, but the lack of systematic detections suggests that other sources could also be the cause of the higher concentrations. The range of 4,4-DDD (26.8 to 149 ppb) and the detection of 4,4-DDE (65 ppb), while significantly higher than the background detections (4.2 to 7.7 ppb), were confined to sampling locations that were within the footprint of the Southern AOC, and sediment locations downstream of the AOCs were not impacted by any pesticides whose concentrations exceeded BTAG criteria.

Overall, only VOCs from the Central and Southern AOCs had a demonstrable impact on groundwater below and immediately adjacent to the AOCs. The impact is severely constrained

by the proximity of adjacent discharge areas in the marsh. These VOCs dissipate rapidly and were not observed in surface water or sediment. Contributions of pesticides and metals to sediment are possible as a result of erosion and deposition of impacted soils. However, beyond the AOCs footprint, only arsenic and nickel were detected at concentrations that exceeded background, and these concentrations were only slightly elevated.

8.2 Human Health Risk Assessment Summary

The RI human health risk assessment found unacceptable carcinogenic risks and a target HI exceeding 1.0 for the Northern and Western AOCs only for the hypothetical future-use scenario receptor groups involving use of groundwater tainted by the Central and Southern AOC. Under current conditions, the Northern and Western AOCs do not pose unacceptable risks or hazards to site workers, trespassers, and fishermen.

For the Central and Southern AOCs, carcinogenic risks for current site workers, and future construction workers were calculated to be marginally acceptable at $1.54x10^{-5}$, and $9.16x10^{-5}$, respectively, and drop slightly to $1.20x10^{-5}$, 4 and $9.15x10^{-5}$ without arsenic. Adult and children recreational fishermen were estimated to have potential cancer risks of $3.16x10^{-5}$ and $1.38x10^{-5}$, but were $3.00x10^{-7}$ and $2.22x10^{-7}$ without arsenic. Cancer risks to site trespassers were calculated to be $7.24x10^{-7}$ (lower at $3.09x10^{-7}$ with arsenic removed), below the $1x10^{-6}$ risk level, indicating that risks are considered to be negligible for this receptor group. Similarly, HIs were all less than 1.0 for current site workers, trespassers, and fishermen.

Carcinogenic risks for the Central and Southern AOCs for future commercial workers exposed to soil and groundwater are $4.39x10^{-3}$, and drop slightly to $4.30x10^{-3}$, without arsenic, and are below the EPA threshold for unacceptable risk of 10^{-4}. Potential cancer risks for hypothetical residential adults and children were conservatively estimated at $6.23x10^{-3}$ and $1.23x10^{-2}$, respectively, for the Central and Southern AOCs and were the highest cancer risks calculated from all the receptor groups. Without arsenic, the risks for adult and child residents did not decrease significantly at $6.11x10^{-3}$ and $1.22x10^{-2}$. Residential lifetime cancer risk was estimated to be $1.86x10^{-2}$ for Central and Southern AOCs and $1.84x10^{-2}$ when arsenic is not included. Where residents would also be involved in recreational fishing, the estimated cancer risks would be $6.74x10^{-4}$ for adults and $5.82x10^{-3}$ for children or $5.22x10^{-4}$ and $5.72x10^{-3}$ without arsenic. Future-use residential His all exceeded 1.0 and are considered unacceptable. Also, hypothetical future child residents are at risk for behavioral neurotoxicity due to the lead concentrations in soil and groundwater.

In the instance of lifetime residency on the Central and Southern AOCs and recreational exposures, the total cancer risk would be $1.86x10^{-2}$ or $1.84x10^{-2}$ without arsenic. The lifetime residential HI is $1.71x10^{1}$, with an HI of $1.58x10^{2}$ when the lifetime resident is assumed to spend a lifetime engaged in recreational activities at the site. The future residential scenario was included in this analysis to establish upper bound risk estimates, but this future use of the site is not likely.

Contaminants of concern for the human health (COPCs with cancer risks exceeding $1x10^{-6}$ or HIs > 1.0 that do not result from background conditions) include benzo(a)anthracene, benzo(a)pyrene, and dibenz(a,h)anthracene, for surface soils, and benzene, 1,2-dichloroethane, ethylbenzene, tetrachloroethene, naphthalene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, m,p-xylene, Aroclor-1260, chromium, copper, and mercury for aggregate soils in the Central and Southern AOC.

Impacted groundwater was identified downgradient of the Central and Southern AOCs where benzene, 1,2-dichloroethane, cis-1,2-dichloroethene, ethylbenzene, tetrachloroethene, trichloroethene, toluene, m,p-xylene, o-xylene, xylene (total), 2-methylnaphthalene, naphthalene, arsenic, and iron are contaminants of concern. The only human health contaminants of concern for sediment and surface water was arsenic, but arsenic detections in soil and groundwater were all within the range of background concentrations measured for WFF (Tetra Tech, 2004). Statistical analysis indicates that arsenic in soil at the CDL Site is a function of natural levels at the site. Because all of the source media have been demonstrated to contain arsenic at below background concentrations, it does not follow that the arsenic issues in other media are site-related.

8.3 Ecological Risk Assessment Summary

The ecological risk assessment found that HQs for the several chemicals indicate that there exists a potential for adverse impacts to terrestrial wildlife biota in areas impacted by the Central and Southern AOCs. Calculated HQs for SVOCs indicated a potential for adverse effects on terrestrial plants, however risk for SVOCs was driven by artificially high maximum non-detect values from a limited sampling area and therefore, they were not considered to have significant potential for terrestrial ecological hazard. Calculated HQs for DDE/DDT indicated a potential for adverse effects for plants and insectivorous birds. However, DDE and DDT were detected at or below background concentrations.

Calculated HQs for a number of metals indicated a potential for adverse effects on terrestrial plants, soil invertebrates, and insectivorous wildlife. Based on multiple lines of evidence including habitat size and quality, the absence of threatened or endangered species, and a variety of exposure and toxicity-related considerations, some metal HQs greater than one were not considered to have significant potential for terrestrial ecological hazard. Plants may be impacted by antimony, barium, chromium, cobalt, copper, lead, manganese, mercury, nickel, selenium, vanadium, and zinc, and soil invertebrates by barium, chromium, copper, lead, manganese, nickel, selenium, silver, vanadium, and zinc. However, antimony was detected below background concentrations. Chromium HQs were based on the more toxic chromium VI and therefore, were considered to be an overly conservative estimate. Arsenic, barium, cadmium, chromium, lead, selenium, and vanadium HQs exceeded NOEAL TRVs but did not exceed LOAEL TRVs. Use of NOAEL TRVs are likely to result in conservative assessments of risk.

Calculated HQs for a number of metals and DDD/DDE/DDT indicated a potential for adverse effects on aquatic life and benthic invertebrates including DDD, DDE, DDT, antimony, arsenic, cadmium, iron, lead, mercury, silver, zinc. HQs for the majority of chemicals indicate that there exists a negligible potential for adverse impacts to piscivorous birds and mammals. The exception being the potential for adverse impacts to piscivorous wildlife from aluminum.

At present, the terrestrial portion of the Central and Southern AOCs are disturbed and support minimal forested vegetation mixed with mowed grass and road edges. Ecological risks to many terrestrial species are therefore considered to have marginally significant potential for ecological hazard at the community level. There is potential for adverse effects to plants and soil invertebrates.

8.4 Conclusions

Based on the findings of the RI and risk assessments, no evidence of waste disposal was discovered at the Northern and Western AOCs, and they do not pose unacceptable risks to human health and/or the environment under current use scenarios. Unacceptable risks and hazards generated by future-use scenarios for these two AOCs were the result of the use of groundwater data that is clearly impacted by contamination from the Central and Southern AOCs.

Unacceptable risks associated with the Central and Southern AOCs are present at the site. Solid waste is clearly evident at the surface and persists to a depth of at least 13 feet in some areas. A Feasibility Study will be prepared to evaluate remedial alternatives to address the impacted areas of these two sites and downgradient areas. The presence of a mission-critical fiber optics line located on the east side of the NOAA access road must be factored into the remedial design.

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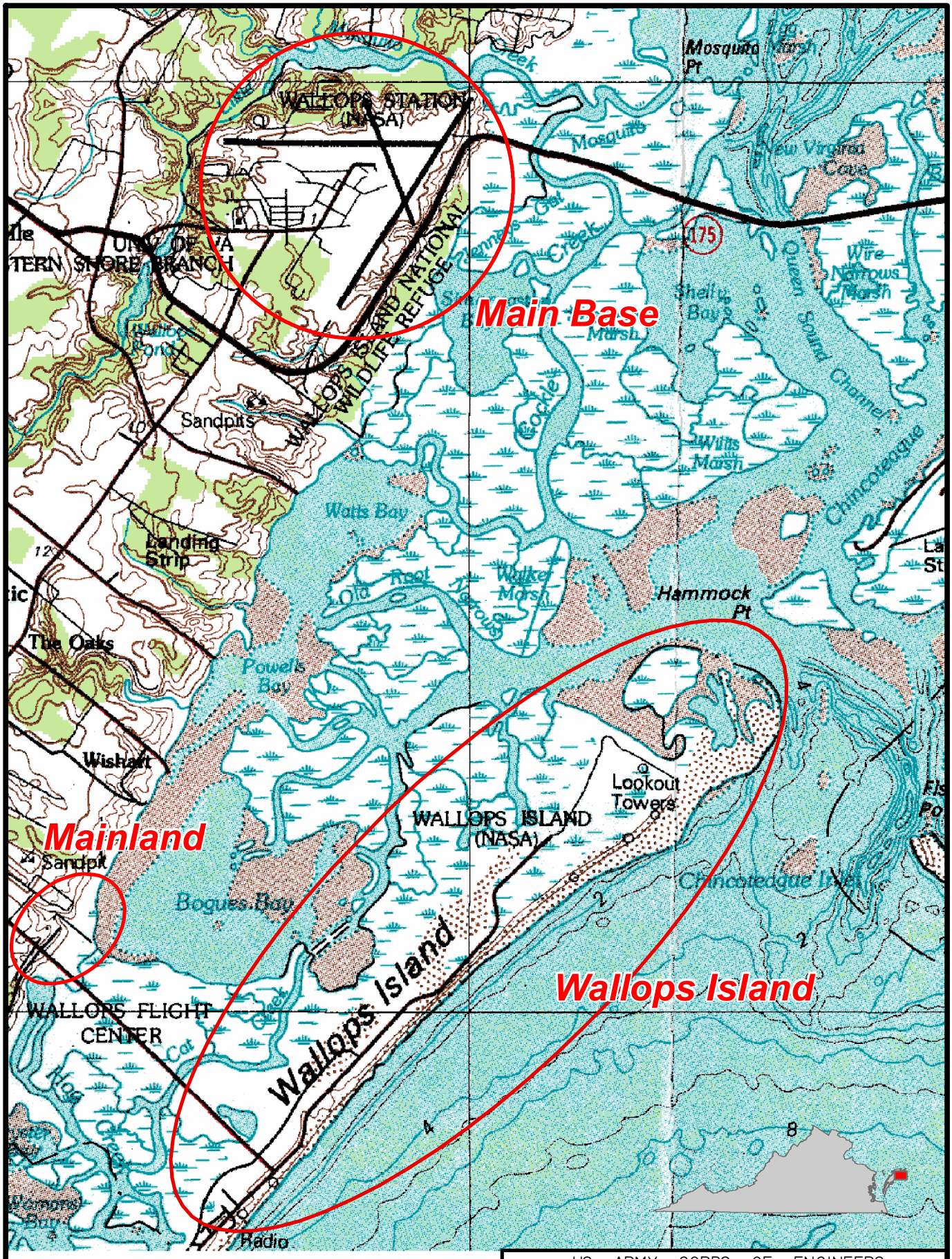
FIGURES



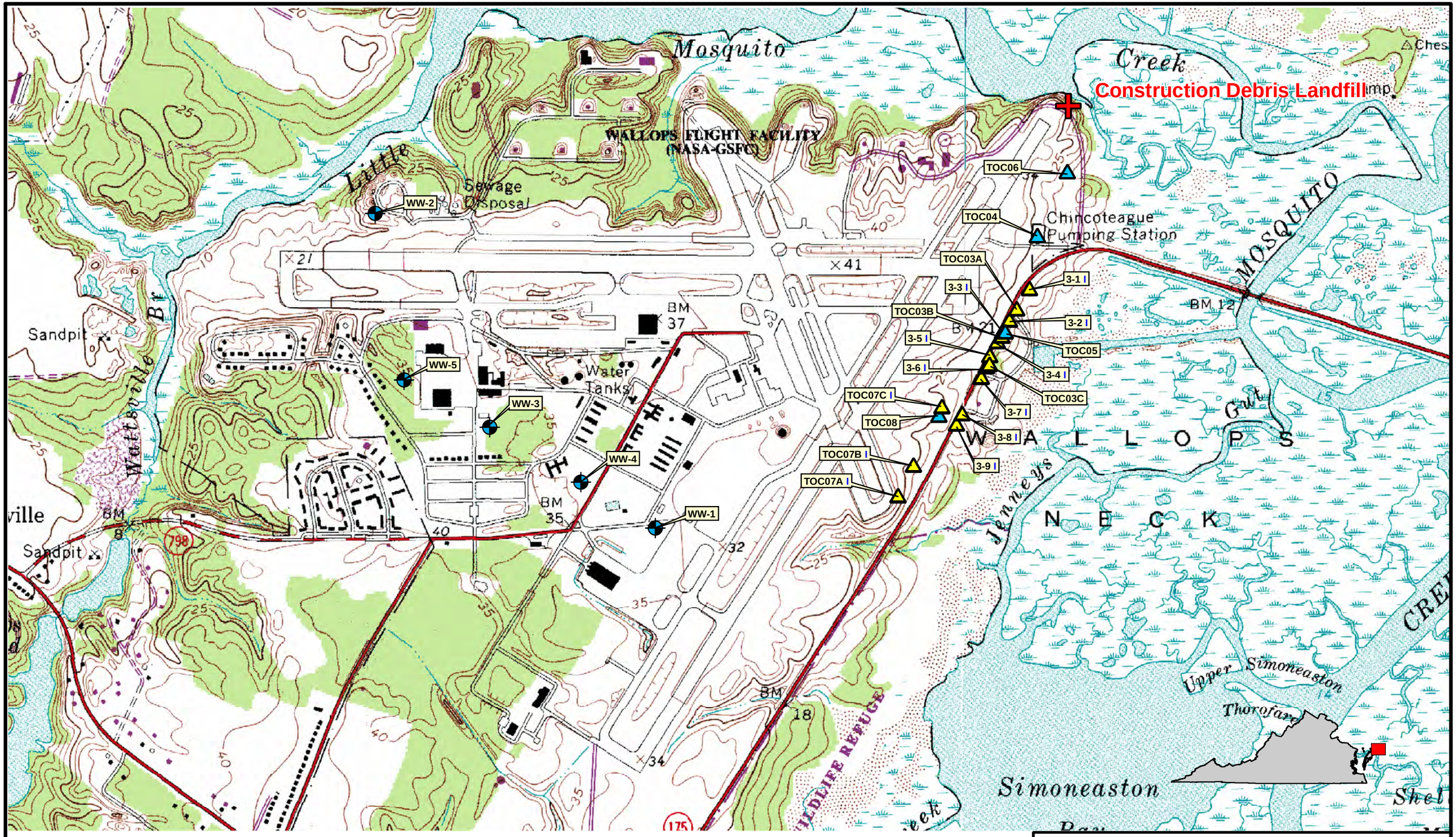
US ARMY CORPS OF ENGINEERS

DESIGNED:	A. Ryder	DATE:	05/27/09
DRAWN:	A. Ryder	DATE:	05/27/09

VICINITY LOCATION MAP
NASA WALLOPS FLIGHT FACILITY

VERSAR
6850 VERSAR CENTER
SPRINGFIELD, VIRGINIA 22151
(703)750-3000

PROJECT NO.	111328.0018	SCALE:	1:100,000
DRAWING NO.		FIGURE:	1-1



Legend

- YORKTOWN-EASTOVER AQUIFER, NASA OWNED
- YORKTOWN-EASTOVER AQUIFER, TOWN OF CHINCOTEAGUE OWNED
- COLUMBIA AQUIFER, TOWN OF CHINCOTEAGUE OWNED

0 440 880 1,760 2,640 3,520 Feet

NOTE: Blue "I" indicates Inactive Well

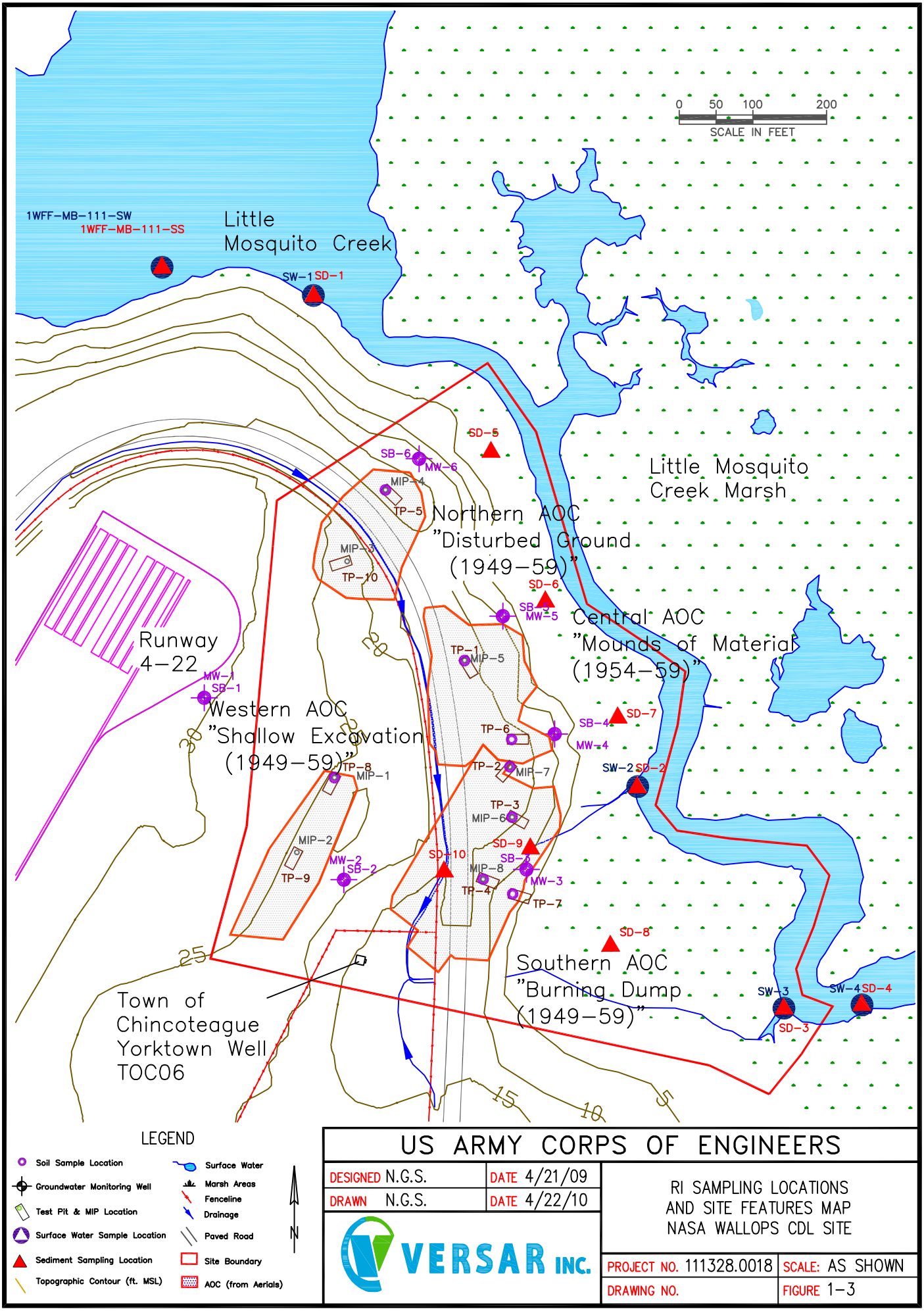
US ARMY CORPS OF ENGINEERS

DESIGNED:	A. Ryder	DATE:	04/28/10
DRAWN:	A. Ryder	DATE:	04/28/10

VERSAR
6850 VERSAR CENTER
SPRINGFIELD, VIRGINIA 22151
(703)750-3000

SITE LOCATION
CONSTRUCTION DEBRIS LANDFILL
NASA WALLOPS FLIGHT FACILITY

PROJECT NO.	SCALE: 1:24,000
DRAWING NO.	FIGURE: 1 - 2



US ARMY CORPS OF ENGINEERS

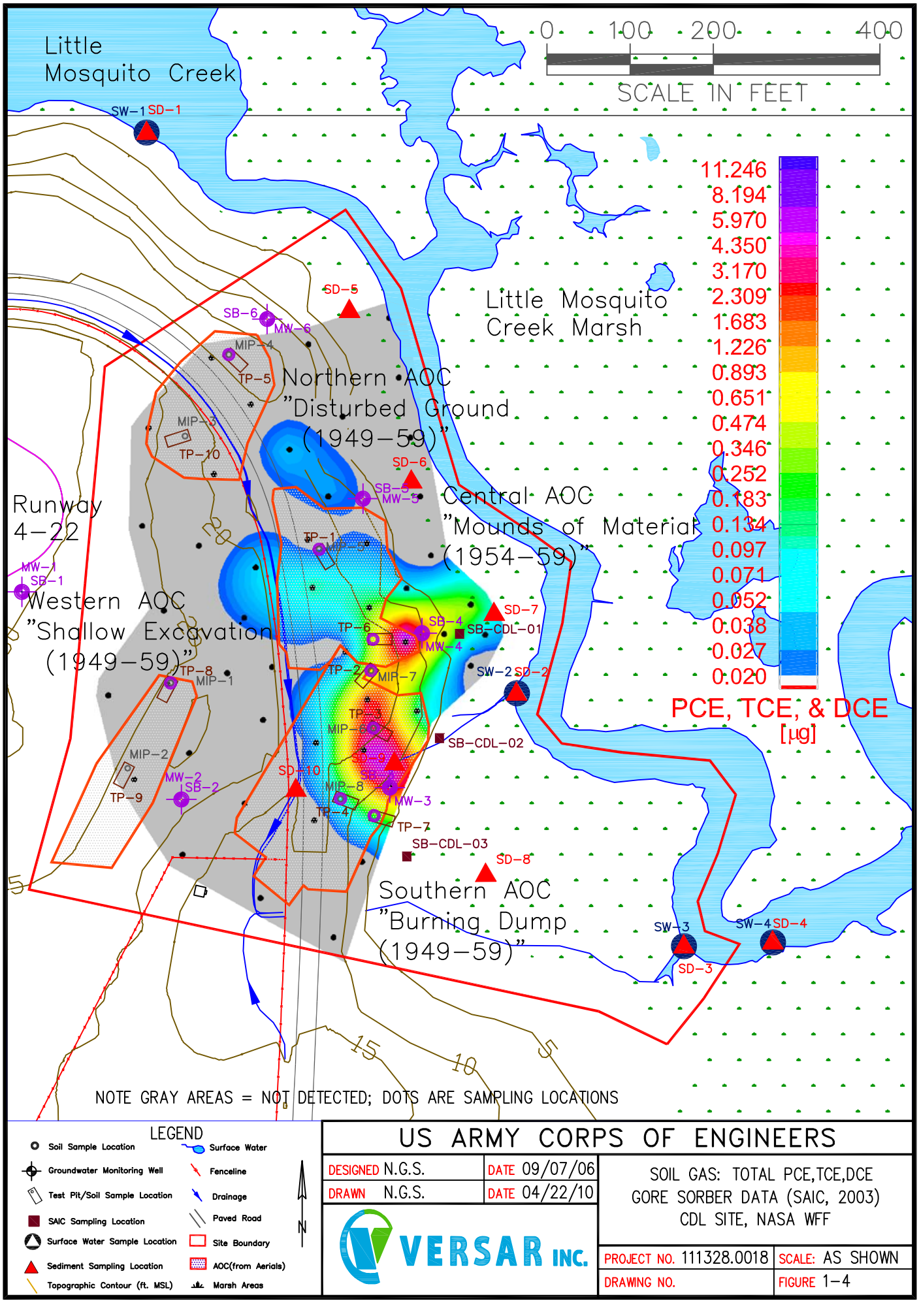
DESIGNED N.G.S.	DATE 4/21/09
DRAWN N.G.S.	DATE 4/22/10

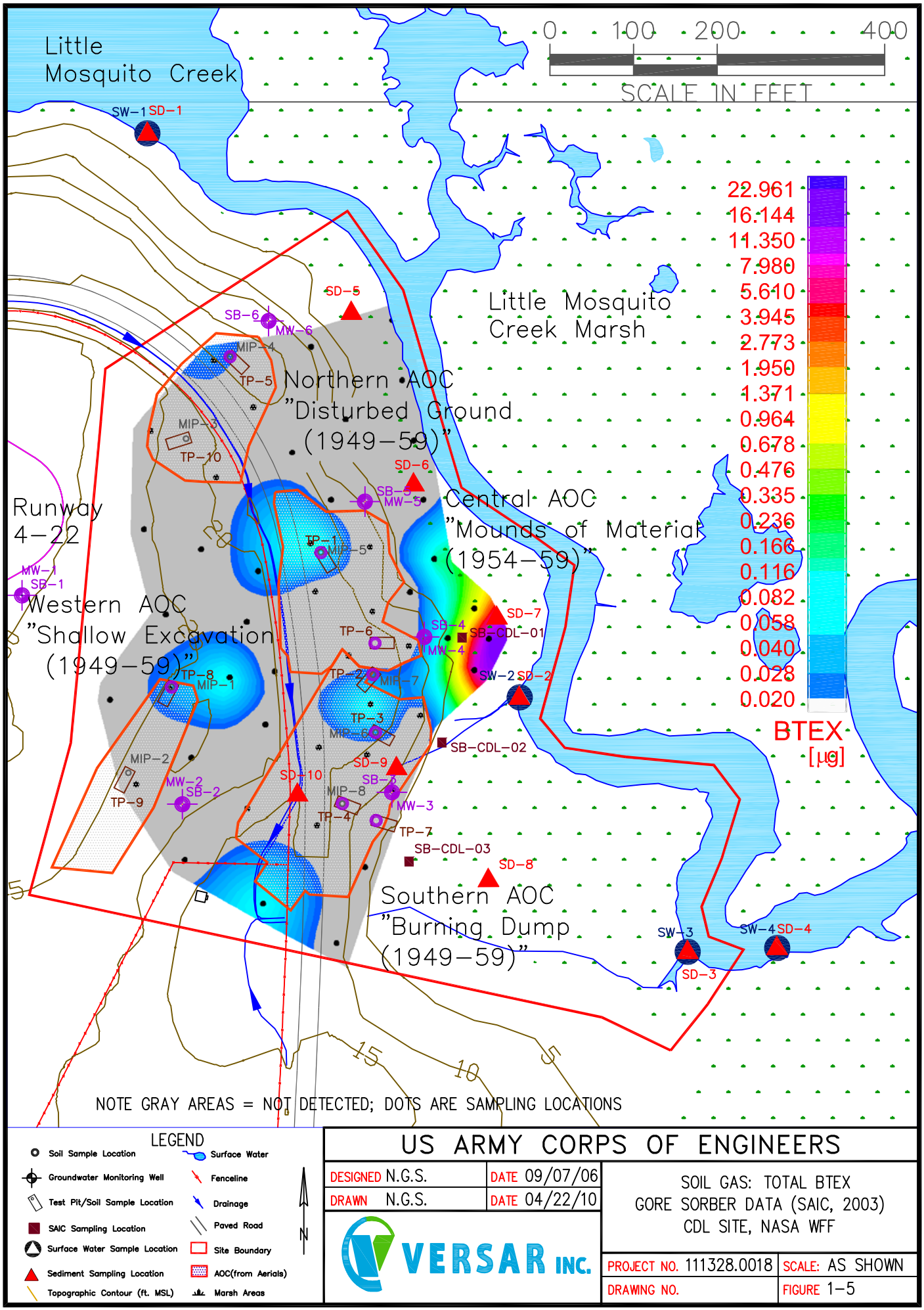
VERSAR INC.

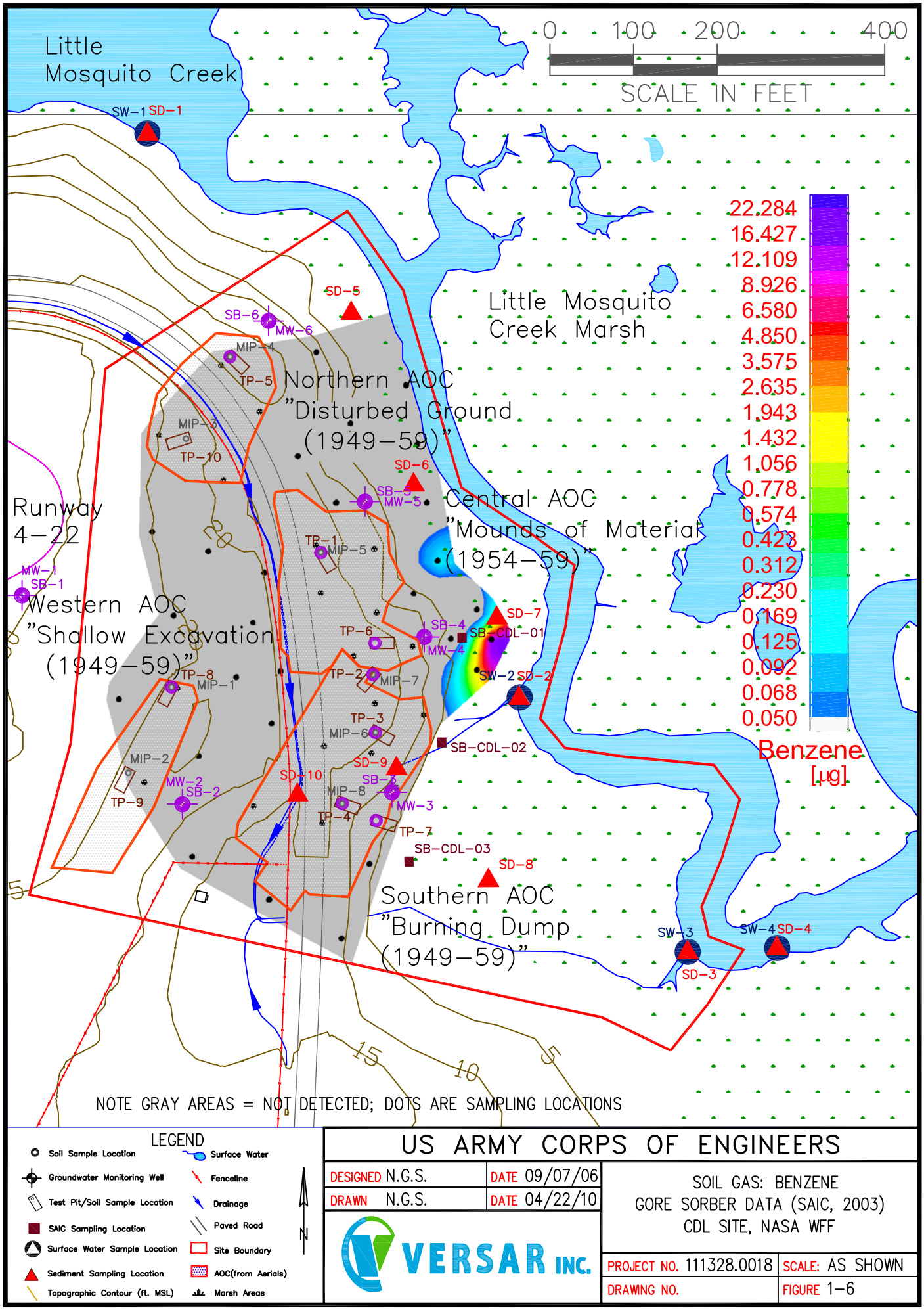
RI SAMPLING LOCATIONS AND SITE FEATURES MAP
NASA WALLOPS CDL SITE

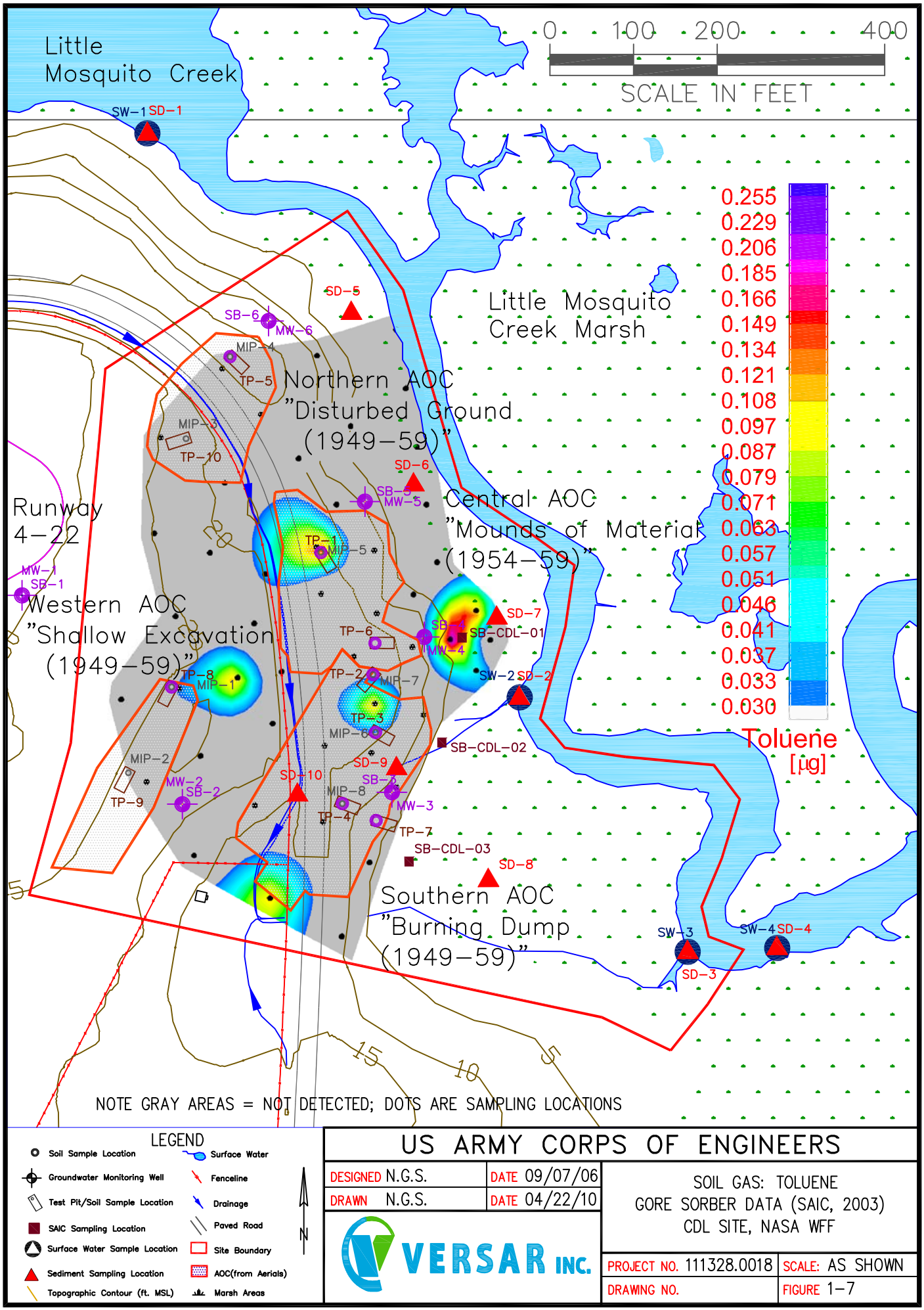
PROJECT NO. 111328.0018	SCALE: AS SHOWN
DRAWING NO.	FIGURE 1-3

\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99


Little Mosquito Creek
0 100 200 400
SCALE IN FEET
SW-1 SD-1
SD-5
SB-6 MW-6
MIP-4
TP-5
Northern AOC "Disturbed Ground (1949-59)"
MIP-3
TP-10
SD-6
SB-5 MW-5
Little Mosquito Creek Marsh
Runway 4-22
Central AOC "Mounds of Material (1954-59)"
MW-1 SB-1
Western AOC "Shallow Excavation (1949-59)"
TP-1 MIP-5
SD-7
SB-4 SB-CDL-01
TP-6
MW-4
TP-8 MIP-1
TP-2 MIP-7
SW-2 SD-2
TP-3
MIP-6
SB-CDL-02
MIP-2
TP-9
MW-2 SB-2
SD-10
MIP-8
TP-4
MW-3
TP-7
SB-CDL-03
SD-8
Southern AOC "Burning Dump (1949-59)"
SW-3
SW-4 SD-4
SD-3
11.246
8.194
5.970
4.350
3.170
2.309
1.683
1.226
0.893
0.651
0.474
0.346
0.252
0.183
0.134
0.097
0.071
0.052
0.038
0.027
0.020
PCE, TCE, & DCE [µg]
NOTE GRAY AREAS = NOT DETECTED; DOTS ARE SAMPLING LOCATIONS
LEGEND
Soil Sample Location
Groundwater Monitoring Well
Test Pit/Soil Sample Location
SAIC Sampling Location
Surface Water Sample Location
Sediment Sampling Location
Topographic Contour (ft. MSL)
Surface Water
Fenceline
Drainage
Paved Road
Site Boundary
AOC(from Aerials)
Marsh Areas
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 09/07/06
DRAWN N.G.S. DATE 04/22/10
VERSAR INC.
SOIL GAS: TOTAL PCE,TCE,DCE
GORE SORBER DATA (SAIC, 2003)
CDL SITE, NASA WFF
PROJECT NO. 111328.0018 SCALE: AS SHOWN
DRAWING NO. FIGURE 1-4


Little Mosquito Creek
0 100 200 400
SCALE IN FEET
SW-1 SD-1
SD-5
SB-6 MW-6
MIP-4
TP-5
Northern AOC "Disturbed Ground (1949-59)"
MIP-3
TP-10
SD-6
SB-5 MW-5
Central AOC "Mounds of Material (1954-59)"
Little Mosquito Creek Marsh
Runway 4-22
MW-1 SB-1
Western AOC "Shallow Excavation (1949-59)"
TP-1 MIP-5
TP-6
SB-4 MW-4
SB-CDL-01
SD-7
SW-2 SD-2
TP-8 MIP-1
TP-2 MIP-7
TP-3
MIP-6
SB-CDL-02
MIP-2
TP-9
MW-2 SB-2
SD-10
SD-9
SB-8
MIP-8
MW-3
TP-4
TP-7
SB-CDL-03
SD-8
Southern AOC "Burning Dump (1949-59)"
SW-3
SW-4 SD-4
SD-3
22.961
16.144
11.350
7.980
5.610
3.945
2.773
1.950
1.371
0.964
0.678
0.476
0.335
0.236
0.166
0.116
0.082
0.058
0.040
0.028
0.020
BTEX [µg]
NOTE GRAY AREAS = NOT DETECTED; DOTS ARE SAMPLING LOCATIONS
LEGEND
Soil Sample Location
Groundwater Monitoring Well
Test Pit/Soil Sample Location
SAIC Sampling Location
Surface Water Sample Location
Sediment Sampling Location
Topographic Contour (ft. MSL)
Surface Water
Fenceline
Drainage
Paved Road
Site Boundary
AOC(from Aerials)
Marsh Areas
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 09/07/06
DRAWN N.G.S. DATE 04/22/10
VERSAR INC.
SOIL GAS: TOTAL BTEX
GORE SORBER DATA (SAIC, 2003)
CDL SITE, NASA WFF
PROJECT NO. 111328.0018 SCALE: AS SHOWN
DRAWING NO. FIGURE 1-5


Little Mosquito Creek
0 100 200 400
SCALE IN FEET
SW-1 SD-1
SD-5
SB-6 MW-6
MIP-4
TP-5
Northern AOC "Disturbed Ground (1949-59)"
MIP-3
TP-10
SD-6
SB-5 MW-5
Central AOC "Mounds of Material (1954-59)"
Little Mosquito Creek Marsh
Runway 4-22
MW-1 SB-1
Western AOC "Shallow Excavation (1949-59)"
TP-1 MIP-5
SD-7
SB-4 SB-CDL-01 MW-4
TP-6
TP-8 MIP-1
TP-2 MIP-7
SW-2 SD-2
TP-3 MIP-6
SB-CDL-02
MIP-2
SD-9
SD-10
SB-8
MW-2 SB-2
TP-9
MIP-8
MW-3
TP-4
TP-7
SB-CDL-03
SD-8
Southern AOC "Burning Dump (1949-59)"
SW-3
SW-4 SD-4
SD-3
22.284
16.427
12.109
8.926
6.580
4.850
3.575
2.635
1.943
1.432
1.056
0.778
0.574
0.423
0.312
0.230
0.169
0.125
0.092
0.068
0.050
Benzene [µg]
NOTE GRAY AREAS = NOT DETECTED; DOTS ARE SAMPLING LOCATIONS
LEGEND
Soil Sample Location
Groundwater Monitoring Well
Test Pit/Soil Sample Location
SAIC Sampling Location
Surface Water Sample Location
Sediment Sampling Location
Topographic Contour (ft. MSL)
Surface Water
Fenceline
Drainage
Paved Road
Site Boundary
AOC(from Aerials)
Marsh Areas
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 09/07/06
DRAWN N.G.S. DATE 04/22/10
VERSAR INC.
SOIL GAS: BENZENE
GORE SORBER DATA (SAIC, 2003)
CDL SITE, NASA WFF
PROJECT NO. 111328.0018 SCALE: AS SHOWN
DRAWING NO. FIGURE 1-6


Little Mosquito Creek
0 100 200 400
SCALE IN FEET
SW-1 SD-1
SD-5
SB-6 MW-6
MIP-4
TP-5
Northern AOC "Disturbed Ground (1949-59)"
MIP-3
TP-10
SD-6
SB-5 MW-5
Central AOC "Mounds of Material (1954-59)"
Little Mosquito Creek Marsh
Runway 4-22
MW-1 SB-1
Western AOC "Shallow Excavation (1949-59)"
TP-1 MIP-5
SD-7
SB-4 SB-CDL-01
MW-4
TP-6
TP-8 MIP-1
TP-2 MIP-7
SW-2 SD-2
TP-3
MIP-6
SB-CDL-02
MIP-2
MW-2 SB-2
TP-9
SD-9
SD-10
SB-3
MIP-8
MW-3
TP-4
TP-7
SB-CDL-03
SD-8
Southern AOC "Burning Dump (1949-59)"
SW-3
SW-4 SD-4
SD-3
0.255
0.229
0.206
0.185
0.166
0.149
0.134
0.121
0.108
0.097
0.087
0.079
0.071
0.063
0.057
0.051
0.046
0.041
0.037
0.033
0.030
Toluene [µg]
NOTE GRAY AREAS = NOT DETECTED; DOTS ARE SAMPLING LOCATIONS
LEGEND
Soil Sample Location
Groundwater Monitoring Well
Test Pit/Soil Sample Location
SAIC Sampling Location
Surface Water Sample Location
Sediment Sampling Location
Topographic Contour (ft. MSL)
Surface Water
Fenceline
Drainage
Paved Road
Site Boundary
AOC(from Aerials)
Marsh Areas
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 09/07/06
DRAWN N.G.S. DATE 04/22/10
VERSAR INC.
SOIL GAS: TOLUENE
GORE SORBER DATA (SAIC, 2003)
CDL SITE, NASA WFF
PROJECT NO. 111328.0018 SCALE: AS SHOWN
DRAWING NO. FIGURE 1-7

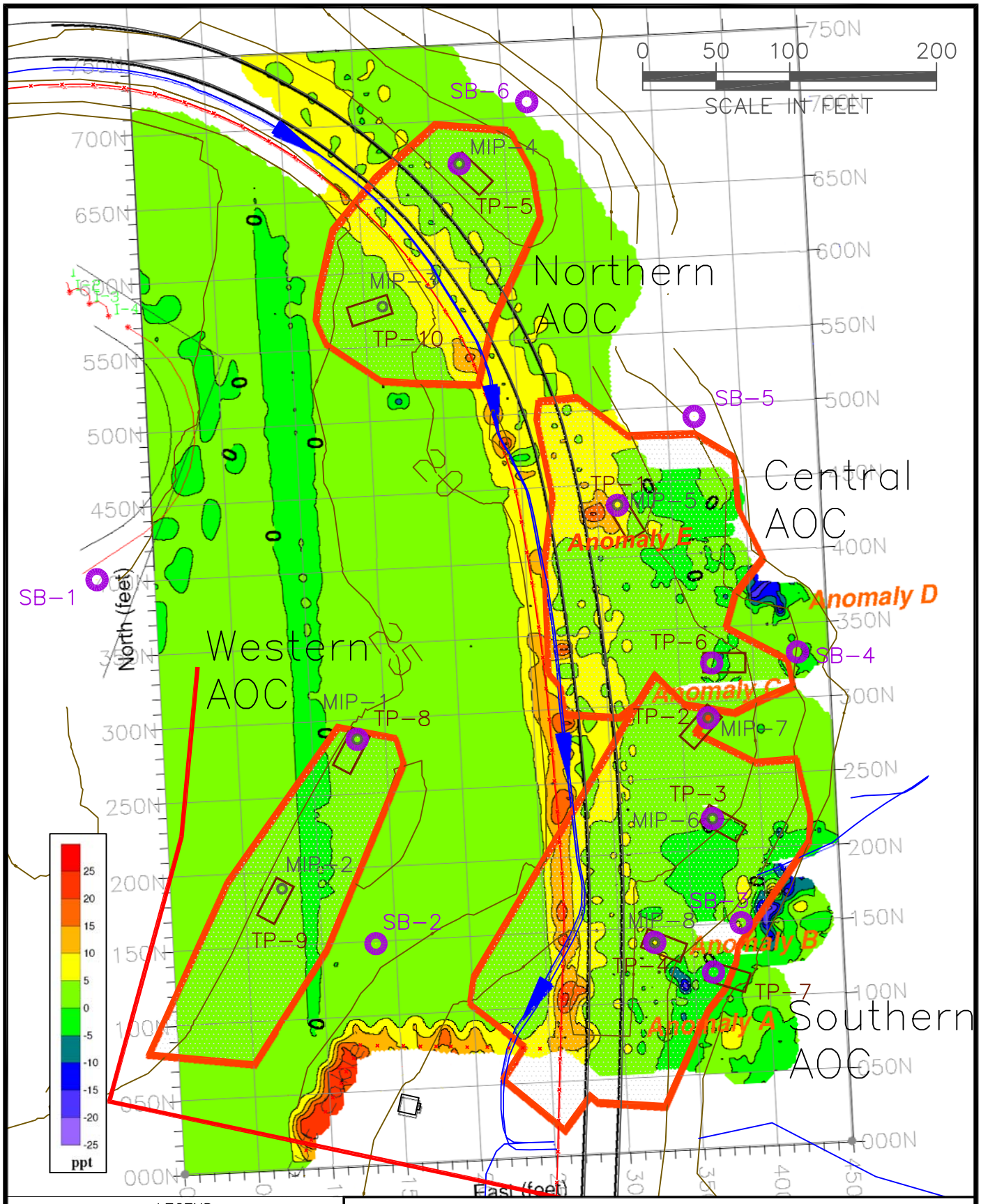

0 50 100 200
SCALE IN FEET
SB-6
MIP-4
TP-5
Northern AOC
MIP-3
TP-10
SB-5
Central AOC
TP-1
MIP-5
Anomaly E
Anomaly D
SB-1
Western AOC
TP-6
SB-4
Anomaly C
MIP-1
TP-8
TP-2
MIP-7
TP-3
MIP-6
MIP-2
TP-9
SB-2
SB-8
MIP-8
Anomaly B
TP-4
TP-7
Anomaly A
Southern AOC
North (feet)
East (feet)
25
20
15
10
5
0
-5
-10
-15
-20
-25
ppt
LEGEND
Soil Sample Location
Test Pit & MIP Location
Site Boundary
Suspect Disposal Area
Topographic Contour (ft. MSL)
Surface Water
Fenceline
Drainage
Paved Road
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 09/07/06
DRAWN N.G.S. DATE 09/07/06
VERSAR INC.
MIP, TEST PIT, AND SOIL SAMPLES OVERLAYED ON EM RESULTS NASA WALLOPS CDL
PROJECT NO. 111328.0018 SCALE: 1:250,000
DRAWING NO. FIGURE 2-1

Figure 2-2. Photographs of Buried Drums in Central AOC, Test Pit TP-1

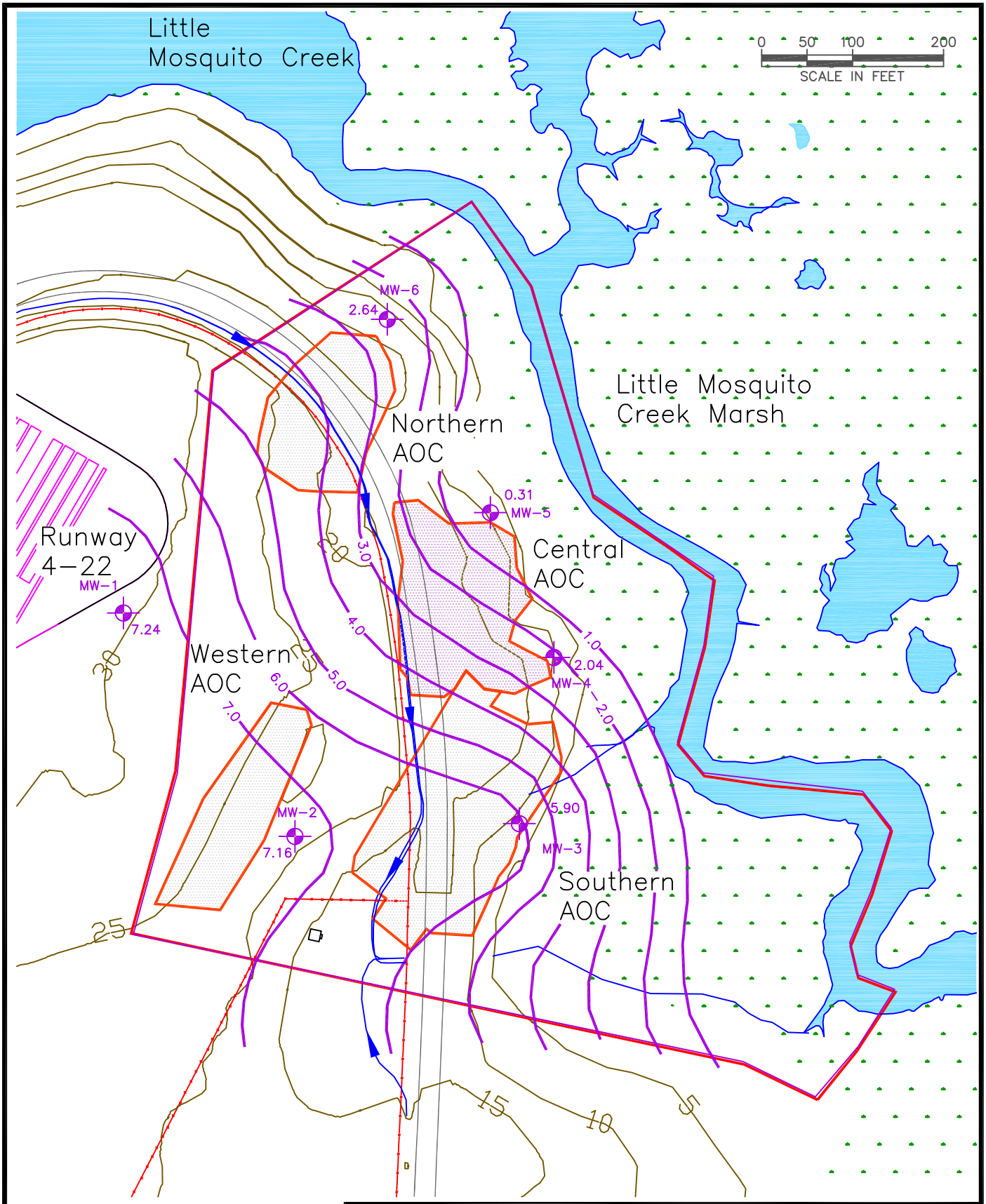
Figure 2-3. Photographs of excavated materials in the Southern AOC.

Figure 2-4. Photograph of excavated materials in the Northern AOC.

Figure 2-5 Photograph of excavated materials in the Northern AOC.

Figure 2-6 Photograph of excavated materials in the Western AOC.

Figure 2-7 Photograph of excavated materials in the Western AOC.



US ARMY CORPS OF ENGINEERS

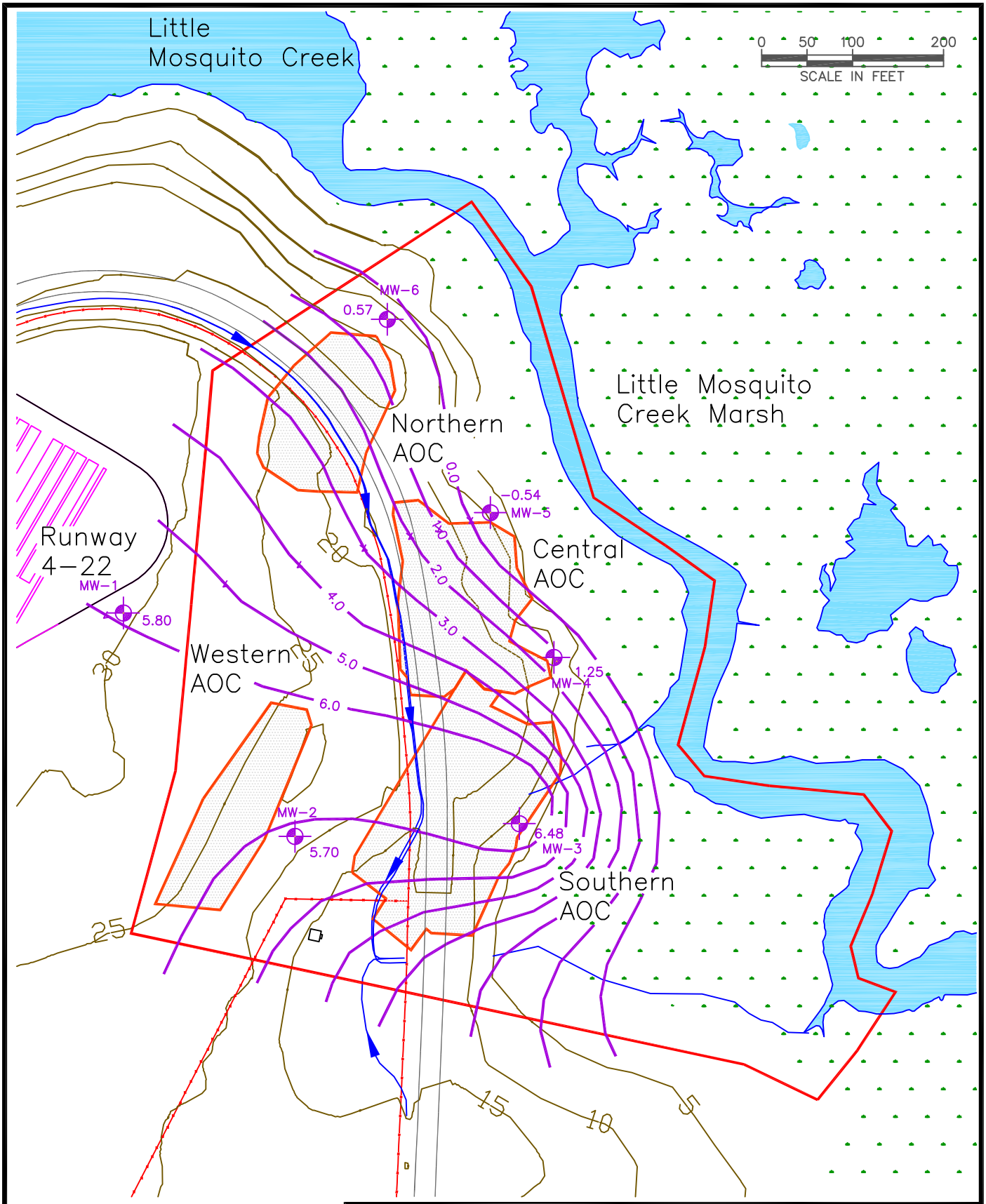
DESIGNED N.G.S.	DATE 4/21/09
DRAWN N.G.S.	DATE 4/22/10

VERSAR INC.

MONITORING WELL LOCATIONS
POTENTIOMETRIC SURFACE MAP
WATER LEVELS – MAY 1, 2007

PROJECT NO. 111328.0018	SCALE: AS SHOWN
DRAWING NO.	FIGURE 2-8

\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99



US ARMY CORPS OF ENGINEERS

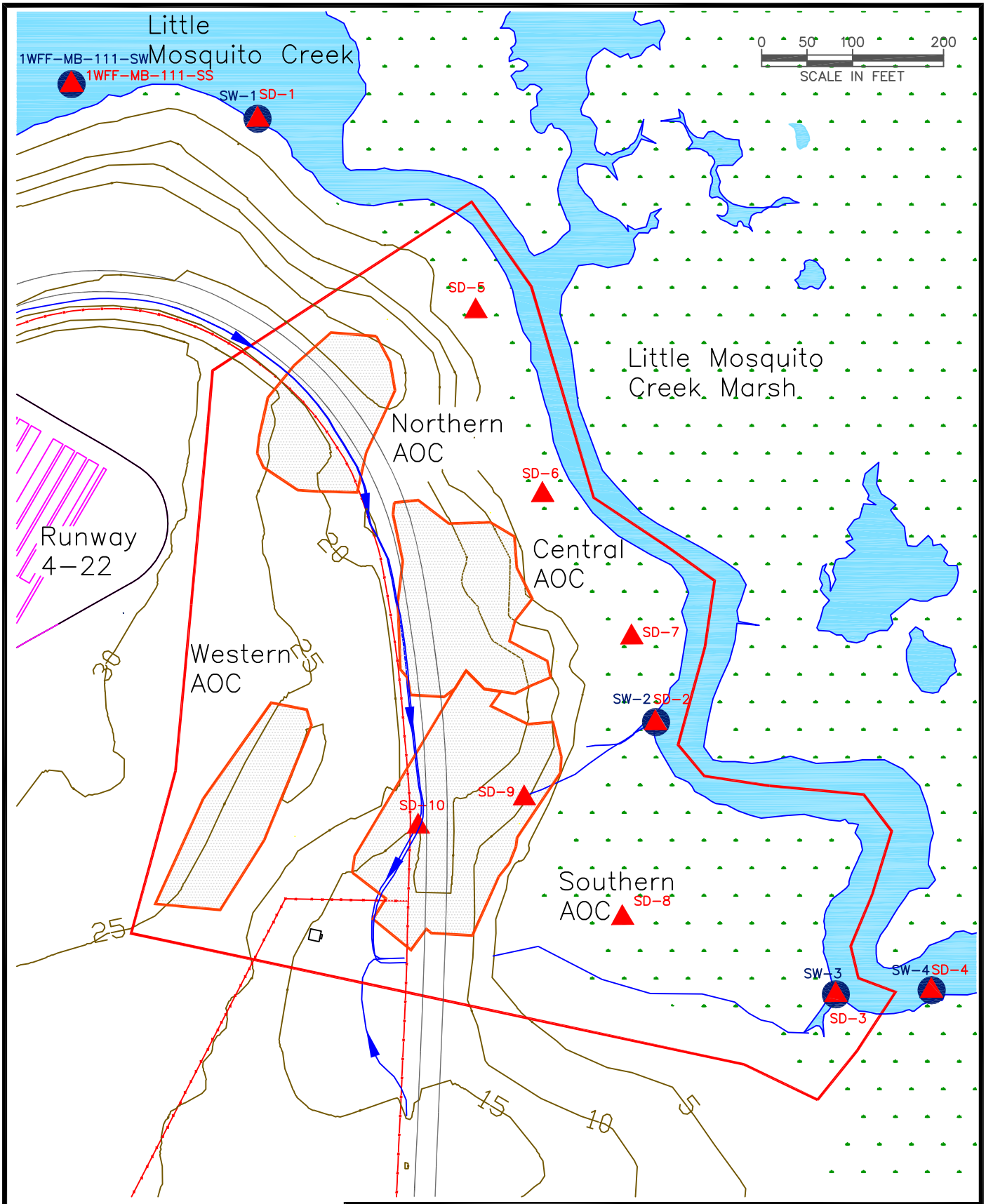
DESIGNED N.G.S.	DATE 4/21/09
DRAWN N.G.S.	DATE 4/22/10

VERSAR INC.

MONITORING WELL LOCATIONS
POTENTIOMETRIC SURFACE MAP
WATER LEVELS – DECEMBER 18, 2007

PROJECT NO. 111328.0018	SCALE: AS SHOWN
DRAWING NO.	FIGURE 2-9

\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99



US ARMY CORPS OF ENGINEERS

DESIGNED N.G.S.	DATE 4/21/09
DRAWN N.G.S.	DATE 4/22/10

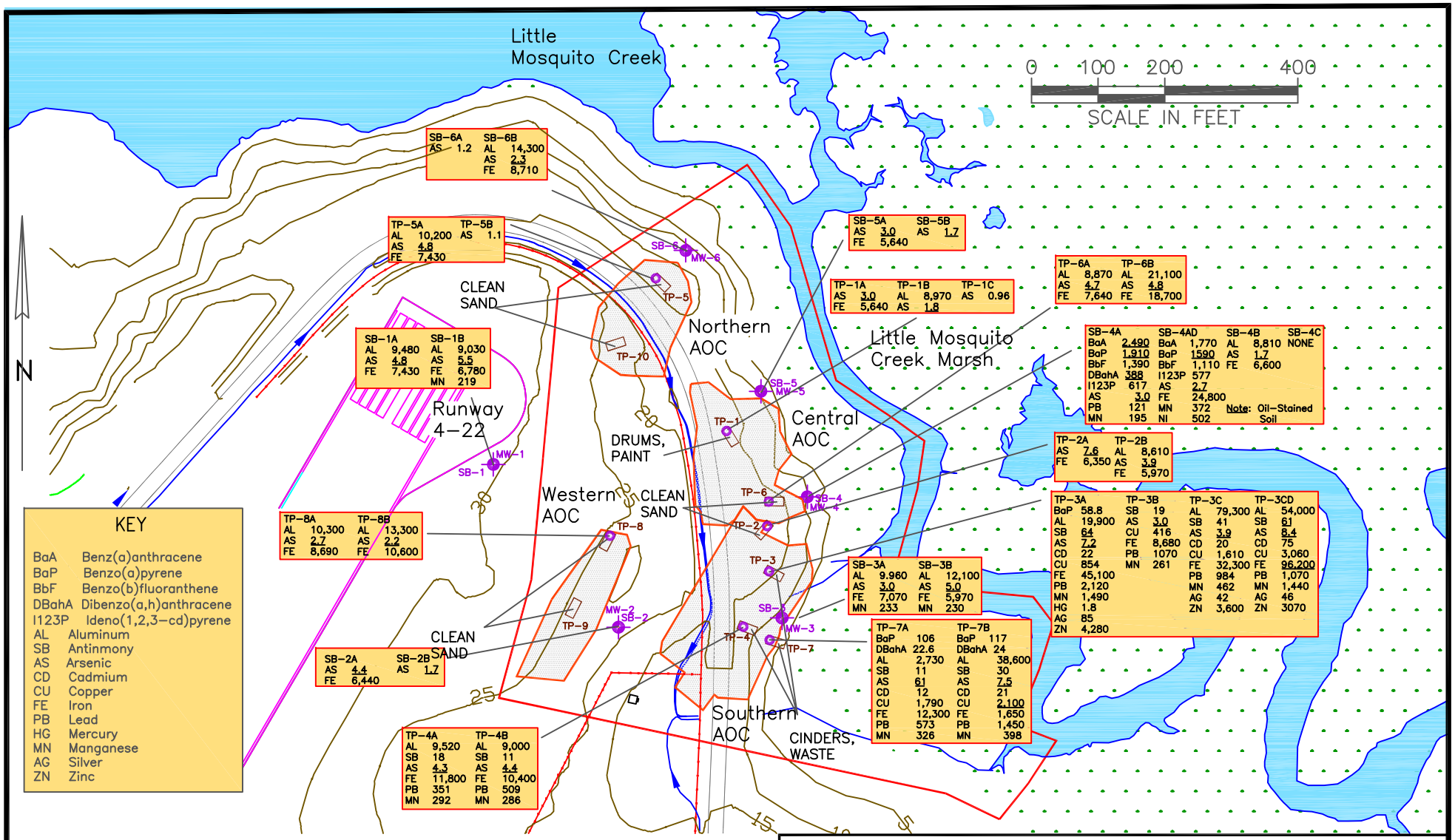
VERSAR INC.

SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS
NASA WALLOPS FLIGHT FACILITY

PROJECT NO. 111328.0018	SCALE: AS SHOWN
DRAWING NO.	FIGURE 2-10

\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99

\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99



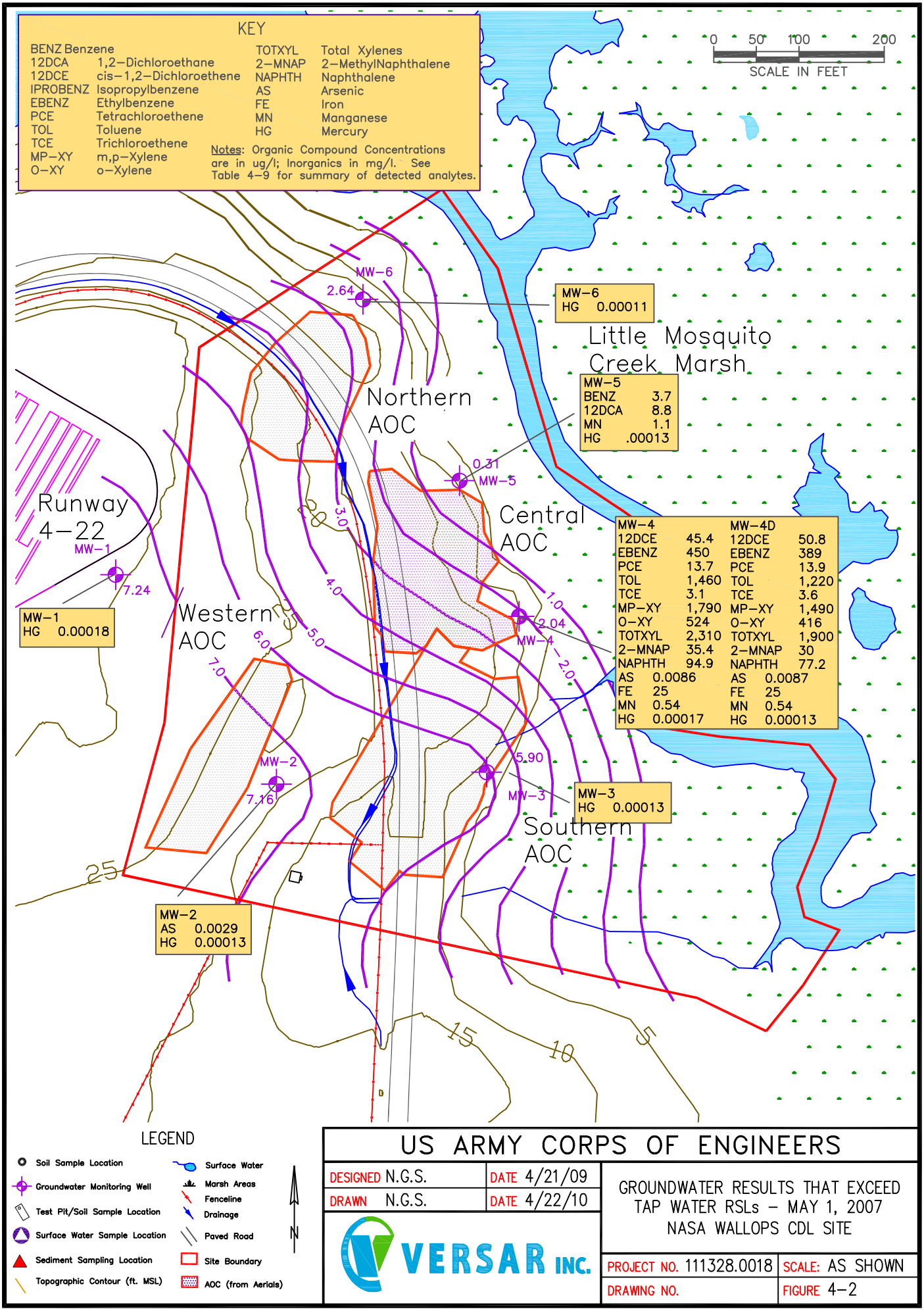
US ARMY CORPS OF ENGINEERS

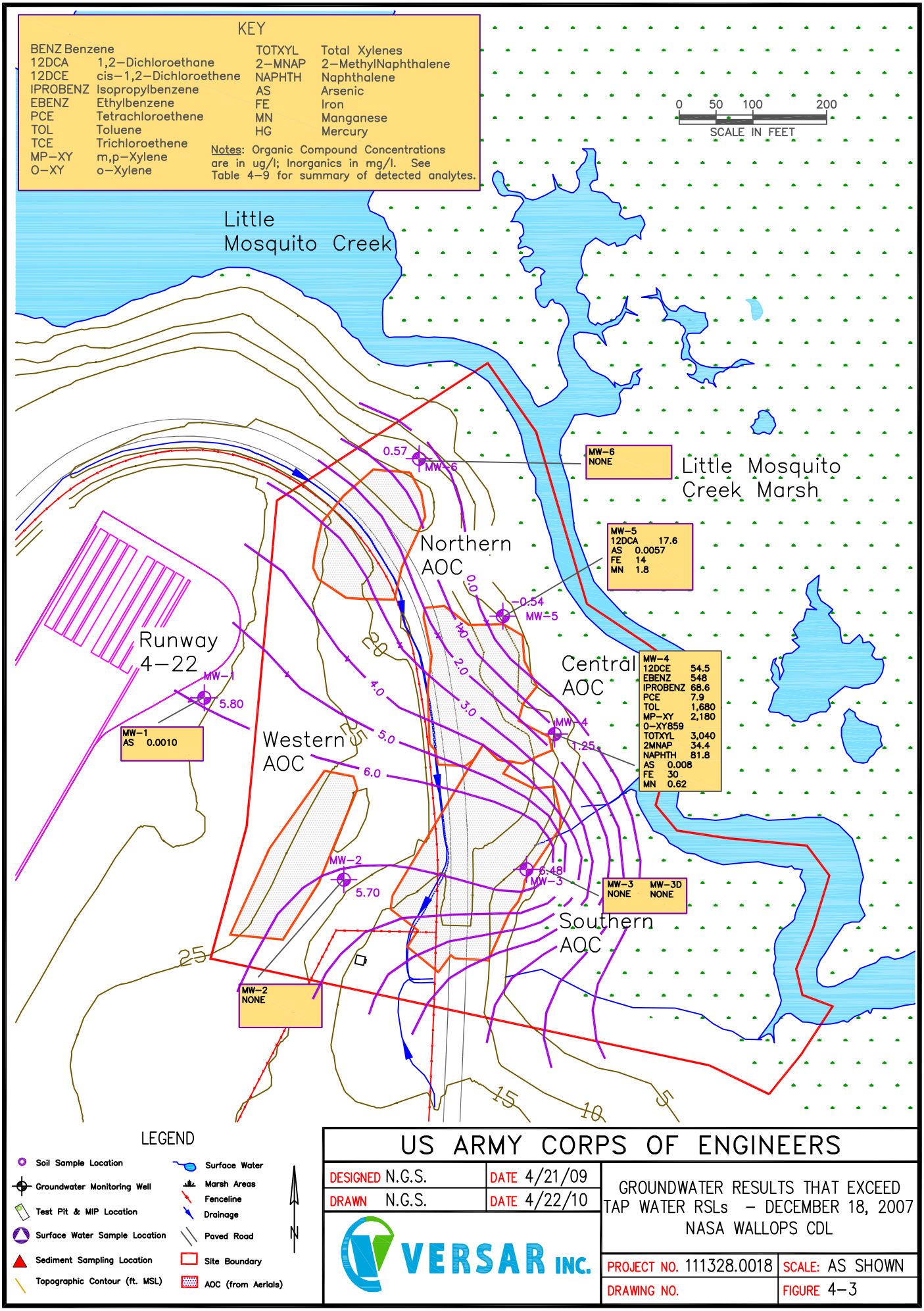
DESIGNED SIMMONS	DATE 04/20/09
DRAWN SIMMONS	DATE 04/20/09

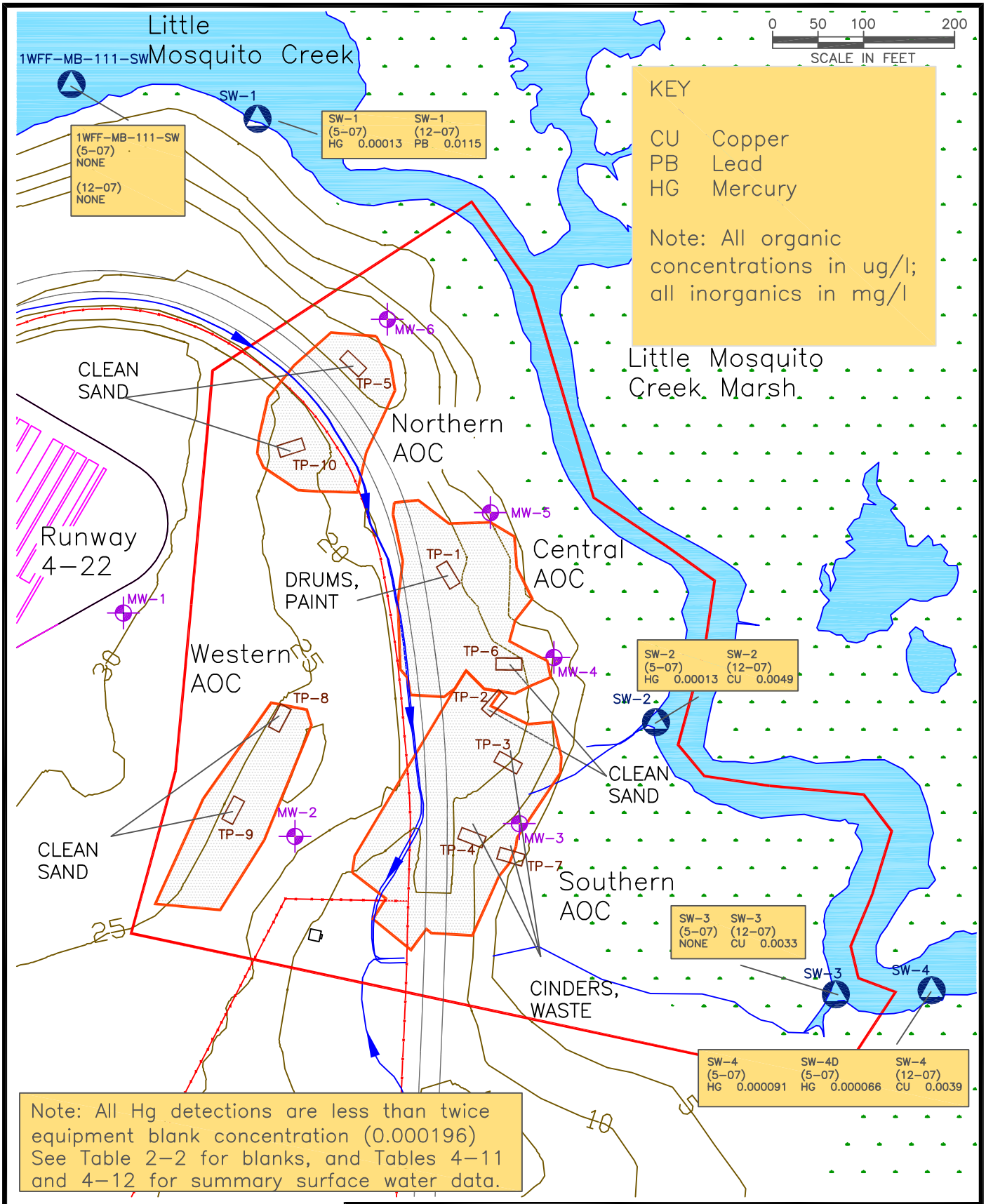
VERSAR INC.

SOIL RESULTS GREATER THAN RISK-SCREENING LEVELS (RSLS)
NASA WALLOPS CDL

PROJECT NO. 11328.0018	SCALE: AS SHOWN
DRAWING NO. 0000-000	FIGURE 4-1


KEY
BENZ Benzene
12DCA 1,2-Dichloroethane
12DCE cis-1,2-Dichloroethene
IPROBENZ Isopropylbenzene
EBENZ Ethylbenzene
PCE Tetrachloroethene
TOL Toluene
TCE Trichloroethene
MP-XY m,p-Xylene
O-XY o-Xylene
TOTXYL Total Xylenes
2-MNAP 2-MethylNaphthalene
NAPTHTH Naphthalene
AS Arsenic
FE Iron
MN Manganese
HG Mercury
Notes: Organic Compound Concentrations are in ug/l; Inorganics in mg/l. See Table 4-9 for summary of detected analytes.
0 50 100 200
SCALE IN FEET
MW-6
2.64
MW-6
HG 0.00011
Little Mosquito Creek Marsh
MW-5
BENZ 3.7
12DCA 8.8
MN 1.1
HG .00013
Northern AOC
0.31
MW-5
Central AOC
MW-4
12DCE 45.4
EBENZ 450
PCE 13.7
TOL 1,460
TCE 3.1
MP-XY 1,790
O-XY 524
TOTXYL 2,310
2-MNAP 35.4
NAPTHTH 94.9
AS 0.0086
FE 25
MN 0.54
HG 0.00017
MW-4D
12DCE 50.8
EBENZ 389
PCE 13.9
TOL 1,220
TCE 3.6
MP-XY 1,490
O-XY 416
TOTXYL 1,900
2-MNAP 30
NAPTHTH 77.2
AS 0.0087
FE 25
MN 0.54
HG 0.00013
2.04
MW-4
Runway 4-22
MW-1
7.24
MW-1
HG 0.00018
Western AOC
MW-2
7.16
MW-2
AS 0.0029
HG 0.00013
5.90
MW-3
MW-3
HG 0.00013
Southern AOC
3.0
4.0
5.0
6.0
7.0
1.0
2.0
25
15
10
5
LEGEND
Soil Sample Location
Groundwater Monitoring Well
Test Pit/Soil Sample Location
Surface Water Sample Location
Sediment Sampling Location
Topographic Contour (ft. MSL)
Surface Water
Marsh Areas
Fenceline
Drainage
Paved Road
Site Boundary
AOC (from Aerials)
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 4/21/09
DRAWN N.G.S. DATE 4/22/10
VERSAR INC.
GROUNDWATER RESULTS THAT EXCEED TAP WATER RSLs - MAY 1, 2007
NASA WALLOPS CDL SITE
PROJECT NO. 111328.0018
SCALE: AS SHOWN
DRAWING NO.
FIGURE 4-2
PLOT DATE: 00-00-99
\DIR\DELTEK-#\0000-000.DWG


KEY
BENZ Benzene
12DCA 1,2-Dichloroethane
12DCE cis-1,2-Dichloroethene
IPROBENZ Isopropylbenzene
EBENZ Ethylbenzene
PCE Tetrachloroethene
TOL Toluene
TCE Trichloroethene
MP-XY m,p-Xylene
O-XY o-Xylene
TOTXYL Total Xylenes
2-MNAP 2-MethylNaphthalene
NAPHTH Naphthalene
AS Arsenic
FE Iron
MN Manganese
HG Mercury
Notes: Organic Compound Concentrations are in ug/l; Inorganics in mg/l. See Table 4-9 for summary of detected analytes.
0 50 100 200
SCALE IN FEET
Little Mosquito Creek
Little Mosquito Creek Marsh
Northern AOC
Central AOC
Western AOC
Southern AOC
Runway 4-22
MW-6 NONE
MW-5 12DCA 17.6 AS 0.0057 FE 14 MN 1.8
MW-4 12DCE 54.5 EBENZ 548 IPROBENZ 68.6 PCE 7.9 TOL 1,680 MP-XY 2,180 O-XY859 TOTXYL 3,040 2MNAP 34.4 NAPHTH 81.8 AS 0.008 FE 30 MN 0.62
MW-1 AS 0.0010
MW-3 NONE MW-3D NONE
MW-2 NONE
0.57 MW-6
0.54 MW-5
5.80 MW-1
1.25 MW-4
5.70 MW-2
6.48 MW-3
0.0
2.0
3.0
4.0
5.0
6.0
10
15
20
25
LEGEND
Soil Sample Location
Groundwater Monitoring Well
Test Pit & MIP Location
Surface Water Sample Location
Sediment Sampling Location
Topographic Contour (ft. MSL)
Surface Water
Marsh Areas
Fenceline
Drainage
Paved Road
Site Boundary
AOC (from Aerials)
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 4/21/09
DRAWN N.G.S. DATE 4/22/10
VERSAR INC.
GROUNDWATER RESULTS THAT EXCEED TAP WATER RSLs - DECEMBER 18, 2007
NASA WALLOPS CDL
PROJECT NO. 111328.0018 SCALE: AS SHOWN
DRAWING NO. FIGURE 4-3
\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99



US ARMY CORPS OF ENGINEERS

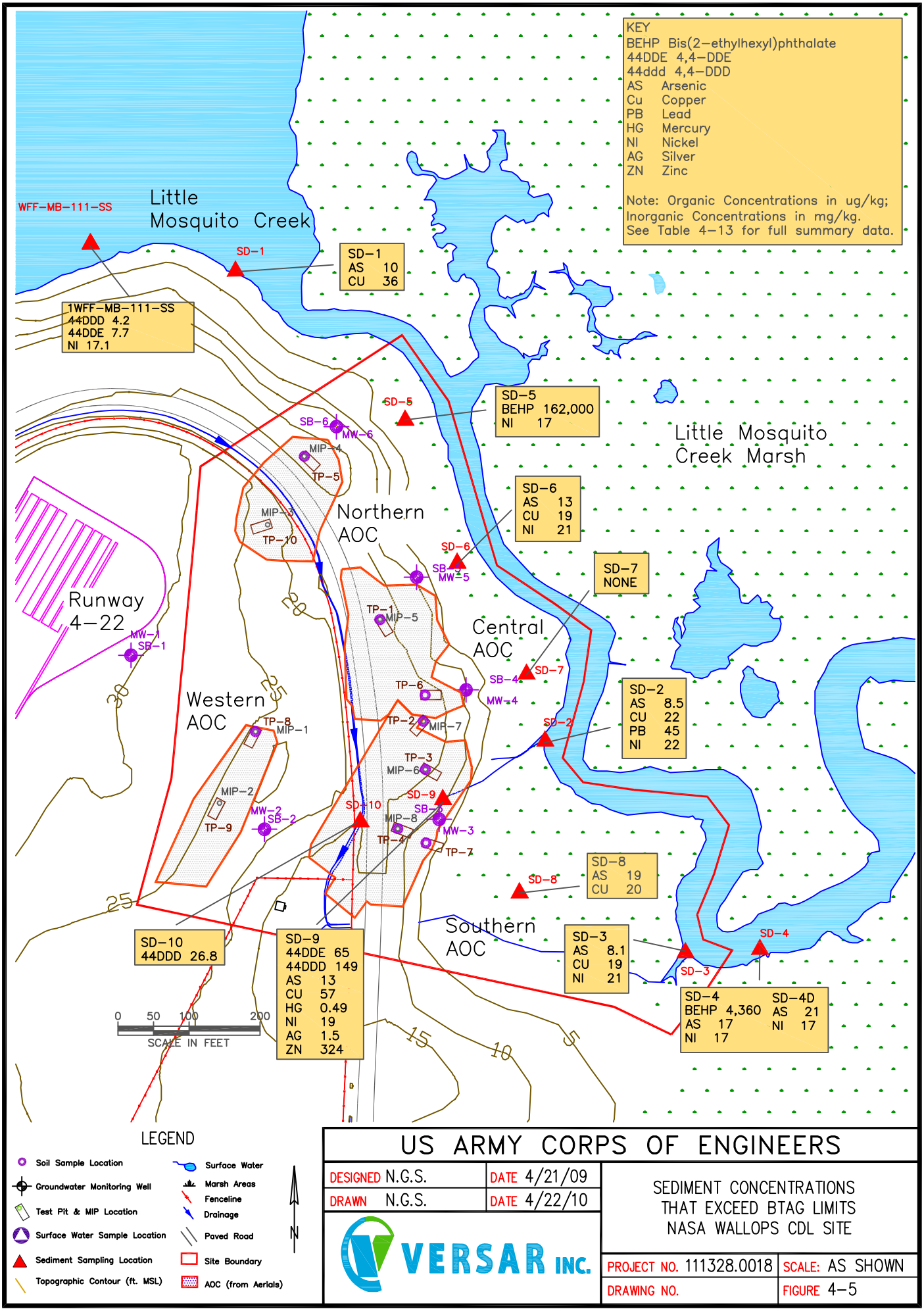
DESIGNED N.G.S.	DATE 4/21/09
DRAWN N.G.S.	DATE 4/22/10

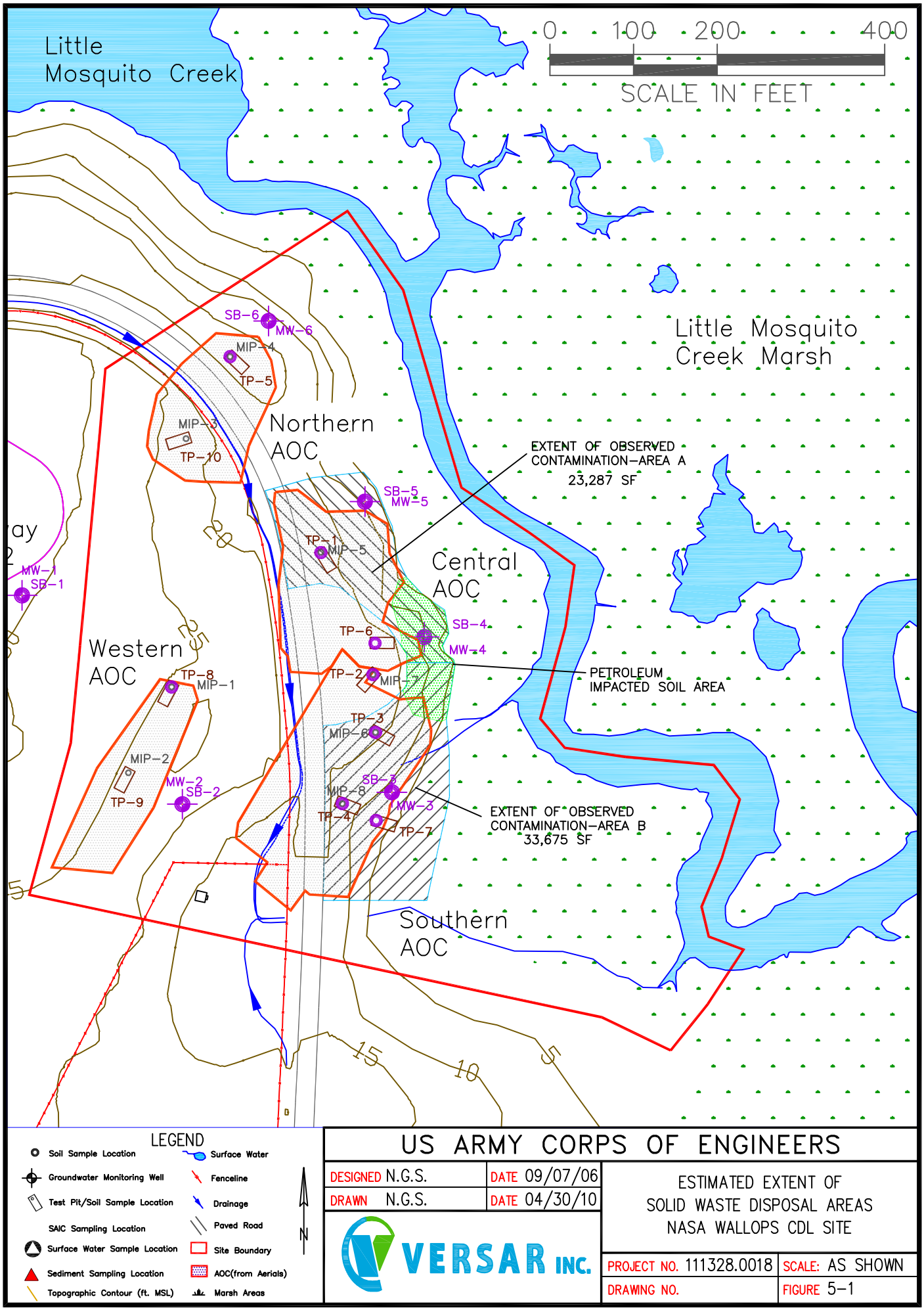
VERSAR INC.

SURFACE WATER CONCENTRATIONS THAT EXCEED BTAG LIMITS
NASA WALLOPS CDL SITE

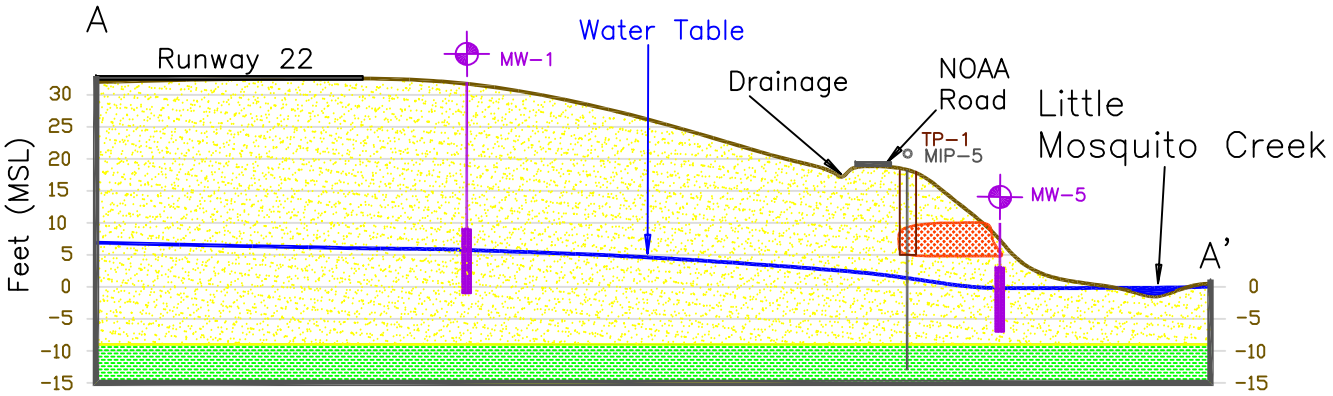
PROJECT NO. 111328.0018	SCALE: AS SHOWN
DRAWING NO.	FIGURE 4-4

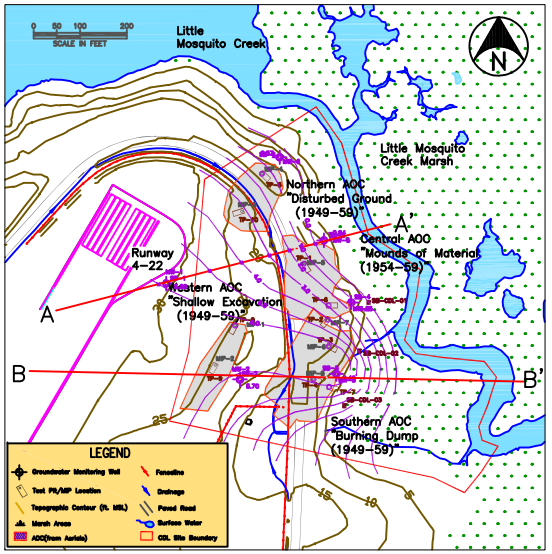
\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99


KEY
BEHP Bis(2-ethylhexyl)phthalate
44DDE 4,4-DDE
44ddd 4,4-DDD
AS Arsenic
Cu Copper
PB Lead
HG Mercury
NI Nickel
AG Silver
ZN Zinc
Note: Organic Concentrations in ug/kg; Inorganic Concentrations in mg/kg. See Table 4-13 for full summary data.
Little Mosquito Creek
WFF-MB-111-SS
SD-1
SD-1 AS 10 CU 36
1WFF-MB-111-SS 44DDD 4.2 44DDE 7.7 NI 17.1
SD-5
SD-5 BEHP 162,000 NI 17
Little Mosquito Creek Marsh
SD-6
SD-6 AS 13 CU 19 NI 21
SD-7 NONE
Northern AOC
Central AOC
Western AOC
Southern AOC
Runway 4-22
SD-2 AS 8.5 CU 22 PB 45 NI 22
SD-8 AS 19 CU 20
SD-3 AS 8.1 CU 19 NI 21
SD-4 BEHP 4,360 AS 17 NI 17
SD-4D AS 21 NI 17
SD-10 44DDD 26.8
SD-9 44DDE 65 44DDD 149 AS 13 CU 57 HG 0.49 NI 19 AG 1.5 ZN 324
SB-1
SB-2
SB-3
SB-4
SB-5
SB-6
MW-1
MW-2
MW-3
MW-4
MW-5
MW-6
MIP-1
MIP-2
MIP-3
MIP-4
MIP-5
MIP-6
MIP-7
MIP-8
TP-1
TP-2
TP-3
TP-4
TP-5
TP-6
TP-7
TP-8
TP-9
TP-10
0 50 100 200
SCALE IN FEET
LEGEND
Soil Sample Location
Groundwater Monitoring Well
Test Pit & MIP Location
Surface Water Sample Location
Sediment Sampling Location
Topographic Contour (ft. MSL)
Surface Water
Marsh Areas
Fenceline
Drainage
Paved Road
Site Boundary
AOC (from Aerials)
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 4/21/09
DRAWN N.G.S. DATE 4/22/10
VERSAR INC.
SEDIMENT CONCENTRATIONS THAT EXCEED BTAG LIMITS
NASA WALLOPS CDL SITE
PROJECT NO. 111328.0018
SCALE: AS SHOWN
DRAWING NO.
FIGURE 4-5
\DIR\DELTEK-#\0000-000.DWG
PLOT DATE: 00-00-99

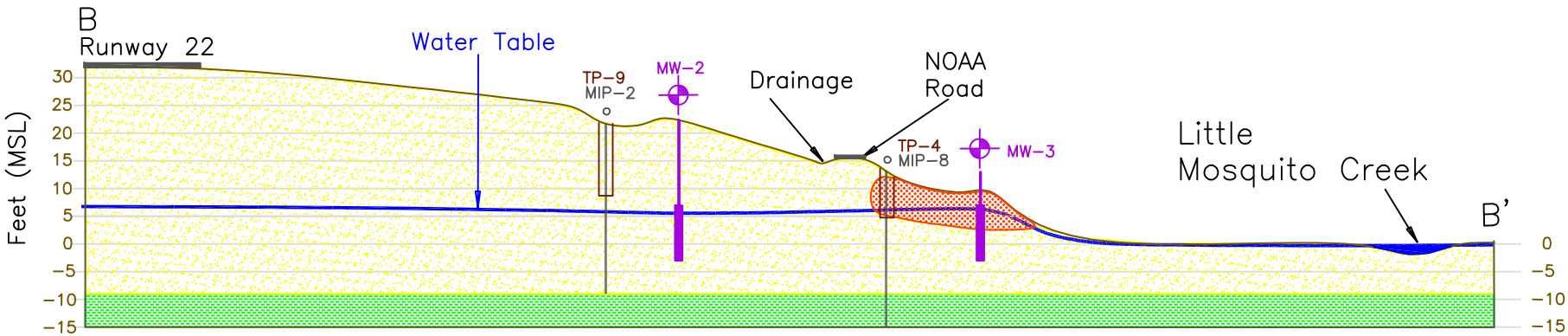

Little Mosquito Creek
0 100 200 400
SCALE IN FEET
Little Mosquito Creek Marsh
Northern AOC
Central AOC
Western AOC
Southern AOC
EXTENT OF OBSERVED CONTAMINATION–AREA A
23,287 SF
PETROLEUM IMPACTED SOIL AREA
EXTENT OF OBSERVED CONTAMINATION–AREA B
33,675 SF
SB-6
MW-6
MIP-4
TP-5
MIP-3
TP-10
SB-5
MW-5
TP-1
MIP-5
MW-1
SB-1
TP-6
SB-4
MW-4
TP-8
MIP-1
TP-2
MIP-7
TP-3
MIP-6
MIP-2
TP-9
MW-2
SB-2
SB-3
MIP-8
MW-3
TP-4
TP-7
LEGEND
Soil Sample Location
Groundwater Monitoring Well
Test Pit/Soil Sample Location
SAIC Sampling Location
Surface Water Sample Location
Sediment Sampling Location
Topographic Contour (ft. MSL)
Surface Water
Fenceline
Drainage
Paved Road
Site Boundary
AOC(from Aerials)
Marsh Areas
N
US ARMY CORPS OF ENGINEERS
DESIGNED N.G.S. DATE 09/07/06
DRAWN N.G.S. DATE 04/30/10
VERSAR INC.
ESTIMATED EXTENT OF SOLID WASTE DISPOSAL AREAS NASA WALLOPS CDL SITE
PROJECT NO. 111328.0018
SCALE: AS SHOWN
DRAWING NO.
FIGURE 5-1

\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99





Cross-Section Location



SCALE

200 Feet

20 Feet

PLEISTOCENE COLUMBIA AQUIFER (SAND)

CLAY CONFINING LAYER (COLUMBIA GROUP)

WASTE DEPOSITS

US ARMY CORPS OF ENGINEERS

DESIGNED N.G.S	DATE 04/30/10
DRAWN N.G.S	DATE 04/30/10

VERSAR INC.

GEOLOGIC CROSS-SECTIONS
CONSTRUCTION DEBRIS LANDFILL SITE
NASA WALLOPS FLIGHT FACILITY

PROJECT NO. 111328.0018	SCALE: 1:24,000
DRAWING NO.	FIGURE 5-2

TABLES

TABLES FOR SECTIONS 1-5

Table 1-1. August 2002 LSI Sampling Results at SB-CDL-01 Screened Against April 2004 EPA Region III RBC Table Criteria

Contaminant	SB-CDL-01	SB-CDL-01	EPA Region III RBC (Apr 2004)	HP-CDL-01	EPA Region III RBC (Apr 2004)
	6.5' bgs soil sample	9.0' bgs soil sample	Residential Soil	groundwater sample	Tapwater
VOCs	**(ug/kg)**	**(ug/kg)**	**(ug/kg)**	**(ug/L)**	**(ug/L)**
Chloromethane	U	U	NA	0.7 J	190
cis-1-2-Dichloroethene (DCE)	U	U	NA	12 J	61
1,2-Dichloropropane(C)	U	2,000 J	9,400	U	NA
Ethylbenzene	U	12,000 J	7,800,000	920 J	1,300
m-and/or p-Xylene	U	9,600 J	16,000,000	**3700 J**	210
o-Xylene	U	U	NA	**1700 J**	210
Styrene	U	U	NA	22 J	1,600
Tetrachloroethene (PCE)	U	1,100 J	1,200	**12 J**	0.10
Toluene	U	U	NA	**12,000**	750
Trichloroethene (TCE) (C)	U	U	NA	**1.1**	0.026
SVOCs					
Acenaphthene	72 J	U	4,700,000	U	NA
Anthracene	150 J	U	23,000,000	U	NA
Benzo(a)anthracene (C)	270 J	U	870	U	NA
Benzo(a)pyrene (C)	**220 J**	U	87	U	NA
Benzo(b)fluoranthene(C)	260 J	U	870	U	NA
Benzo(g,h,i)perylene	150 J	U	no RBC	U	NA
Benzo(k)fluoranthene	94 J	U	8700	U	NA
Carbazole (C)	79 J	U	32000	U	NA
Chrysene (C)	210 J	U	87000	U	NA
Dibenzofuran	44 J	U	160000	U	NA
2,4-Dimethylphenol	U	U	NA	10.4 J	730
Fluoranthene	430	U	3,100,000	U	NA
Fluorene	78 J	95 J	3,100,000	U	NA
Indeno(1,2,3-cd)pyrene (C)	110 J	U	870	U	NA
2-Methylnaphthalene	U	2500 J	310,000	**49**	24
2-Methylphenol	U	U	NA	27	1,800
4-Methylphenol	U	U	NA	46	180
Naphthalene	55 J	830 J	1,600,000	**120**	6.5
Phenanthrene	530	63 J	no RBC	U	U
Pyrene	510	U	2,300,000	U	U

Footnotes:
J – Value is estimated
U – Compound was analyzed for but not detected
NA – Not Applicable

Table 1-2. Construction Debris Landfill
Metal Constituents Detected Above Screening Criteria

Sample Interval (Depth)	Constituent	Sample ID	Field Sample Number	Depth (BLS)	Concentration[a]	Units	Protection of Human Health		Migration to Groundwater
							Concentration Exceeds Region III RBCs Residential Screening Value[b,c]	Concentration Exceeds Region III RBC Industrial Screening Value[b,c]	Concentration Exceeds Region III RBC Screening Value[b,c]
Surface Soil (0 to <0.5 feet BLS)	Antimony	SB-CDL-03	BORE	0	23.5	MG/KG			X
	Arsenic	SB-CDL-02	BORE	0	5	MG/KG	X	X	X
		SB-CDL-03	BORE	0	5.3	MG/KG	X	X	X
		SB-CDL-02	BORE	0	6.9	MG/KG	X	X	X
	Barium	SB-CDL-03	BORE	0	240	MG/KG			
		SB-CDL-02	BORE	0	325	MG/KG			
		SB-CDL-02	BORE	0	371	MG/KG			
	Cadmium	SB-CDL-03	BORE	0	23.9	MG/KG			
		SB-CDL-02	BORE	0	25.9	MG/KG			
		SB-CDL-02	BORE	0	29.7	MG/KG			
	Chromium	SB-CDL-02	BORE	0	26.8	MG/KG			
		SB-CDL-02	BORE	0	29.7	MG/KG			
		SB-CDL-03	BORE	0	53	MG/KG			
	Cobalt	SB-CDL-02	BORE	0	3	MG/KG			
		SB-CDL-03	BORE	0	3.6	MG/KG			
		SB-CDL-02	BORE	0	3.8	MG/KG			
	Copper	SB-CDL-02	BORE	0	1110	MG/KG			
		SB-CDL-02	BORE	0	1240	MG/KG			
		SB-CDL-03	BORE	0	2660	MG/KG			
	Iron	SB-CDL-02	BORE	0	34300	MG/KG	X		
	Lead	SB-CDL-02	BORE	0	253	MG/KG			
		SB-CDL-02	BORE	0	266	MG/KG			
		SB-CDL-03	BORE	0	947	MG/KG			
	Mercury	SB-CDL-03	BORE	0	0.32	MG/KG			
		SB-CDL-02	BORE	0	0.33	MG/KG			
	Selenium	SB-CDL-02	BORE	0	1.3	MG/KG			
		SB-CDL-03	BORE	0	2	MG/KG			
	Silver	SB-CDL-03	BORE	0	16.8	MG/KG			
	Vanadium	SB-CDL-03	BORE	0	13.2	MG/KG			
		SB-CDL-02	BORE	0	14.1	MG/KG			
		SB-CDL-02	BORE	0	14.7	MG/KG			
	Zinc	SB-CDL-03	BORE	0	1030	MG/KG			
		SB-CDL-02	BORE	0	1400	MG/KG			
		SB-CDL-02	BORE	0	1420	MG/KG			

Table 1-2. Construction Debris Landfill
Metal Constituents Detected Above Screening Criteria

Sample Interval (Depth)	Constituent	Sample ID	Field Sample Number	Depth (BLS)	Concentration[a]	Units	Protection of Human Health		Migration to Groundwater
							Concentration Exceeds Region III RBCs Residential Screening Value[b,c]	Concentration Exceeds Region III RBC Industrial Screening Value[b,c]	Concentration Exceeds Region III RBC Screening Value[b,c]
Subsurface Soil (0.5 to 15 feet BLS)	Arsenic	SB-CDL-01	BORE	9	0.54	MG/KG	X		X
		SB-CDL-01	BORE	6.5	1.6	MG/KG	X		X
		SB-CDL-02	BORE	7	1.9	MG/KG	X		X
		SB-CDL-03	BORE	4	6.9	MG/KG	X	X	X
	Barium	SB-CDL-01	BORE	9	5.2	MG/KG			
		SB-CDL-01	BORE	6.5	15.9	MG/KG			
		SB-CDL-02	BORE	7	30.6	MG/KG			
		SB-CDL-03	BORE	4	55.3	MG/KG			
	Cadmium	SB-CDL-01	BORE	6.5	0.03	MG/KG			
		SB-CDL-02	BORE	7	0.04	MG/KG			
		SB-CDL-03	BORE	4	4.9	MG/KG			
	Chromium	SB-CDL-01	BORE	9	3.7	MG/KG			
		SB-CDL-02	BORE	7	6.7	MG/KG			
		SB-CDL-01	BORE	6.5	7.6	MG/KG			
		SB-CDL-03	BORE	4	19.7	MG/KG			
	Cobalt	SB-CDL-01	BORE	9	1.2	MG/KG			
		SB-CDL-01	BORE	6.5	1.3	MG/KG			
		SB-CDL-02	BORE	7	1.6	MG/KG			
		SB-CDL-03	BORE	4	4.3	MG/KG			
	Copper	SB-CDL-02	BORE	7	2.5	MG/KG			
		SB-CDL-01	BORE	6.5	3.5	MG/KG			
		SB-CDL-03	BORE	4	155	MG/KG			
	Iron	SB-CDL-03	BORE	4	39200	MG/KG	X		
	Lead	SB-CDL-02	BORE	7	4	MG/KG			
		SB-CDL-01	BORE	6.5	9.8	MG/KG			
		SB-CDL-01	BORE	9	12.4	MG/KG			
		SB-CDL-03	BORE	4	141	MG/KG			
	Nickel	SB-CDL-03	BORE	4	15.4	MG/KG			
	Selenium	SB-CDL-01	BORE	6.5	0.23	MG/KG			
		SB-CDL-02	BORE	7	0.37	MG/KG			
		SB-CDL-03	BORE	4	1	MG/KG			
	Thallium	SB-CDL-03	BORE	4	1.4	MG/KG			
	Vanadium	SB-CDL-01	BORE	9	3.9	MG/KG			
		SB-CDL-01	BORE	6.5	7.5	MG/KG			
		SB-CDL-02	BORE	7	9.7	MG/KG			
		SB-CDL-03	BORE	4	15.6	MG/KG			

Table 1-2. Construction Debris Landfill
Metal Constituents Detected Above Screening Criteria

Sample Interval (Depth)	Constituent	Sample ID	Field Sample Number	Depth (BLS)	Concentration[a]	Units	Protection of Human Health		Migration to Groundwater
							Concentration Exceeds Region III RBCs Residential Screening Value[b,c]	Concentration Exceeds Region III RBC Industrial Screening Value[b,c]	Concentration Exceeds Region III RBC Screening Value[b,c]
Subsurface Soil (0.5 to 15 feet BLS)	Zinc	SB-CDL-01	BORE	6.5	14.5	MG/KG			
		SB-CDL-02	BORE	7	15.9	MG/KG			
		SB-CDL-03	BORE	4	258	MG/KG			

Sample	Constituent	Sample ID	Field Sample Number	Depth (BLS)	Concentration[a]	Units	Protection of Human Health		Migration to Groundwater
							Concentration Exceeds Region III RBC Screening Value[b,c]	Concentration Exceeds Federal MCL Screening Value[b,d]	
Groundwater	Iron	HP-CDL-01	PNCH	10	28600	µg/L	X		N/A
	Manganese	HP-CDL-01	PNCH	10	791	µg/L	X		N/A

Notes:

[a] Constituent concentrations that exceed screening criteria are listed in ascending order (lowest to highest).
[b] X indicates detected concentration exceeds the screening criteria.
[c] EPA Region III RBCs.
[d] MCL.

Table 1-3. March 2004 (04 SGI-CDL-SB01-07) Soil Sample MADEP VPH and EPH Analytical Results Compared to Aug 2002 LSI Results by Methods 8260 and 8270

Contaminant	04 SGI-CDL-SB01-07	LSI SB-CDL-01	Apr 2004 EPA Region III RBC	Apr 2004 EPA Region III RBC
	7 –7.5' bgs	9' bgs	Residential Soil	Migration to Groundwater (DAF 1)
VOCs	**VPH/EPH (ug/kg)**	**8260/8270 (ug/kg)**	**(ug/kg)**	**(ug/kg)**
cis-1-2-Dichloroethene	NA	U	NA	17
1,2-Dichloropropane(C)	NA	2,000 J	9,400	.1
m-and/or p-Xylene	14,100	9,600 J	16,000,000	**150**
o-Xylene	U	U	NA	150
Ethylbenzene	26,500	12,000 J	7,800,000	**750**
Toluene	5200	U	NA	**440**
Trichloroethene ©	NA	U	NA	.01
SVOCs	**VPH/EPH (ug/kg)**	**8260/8270 (ug/kg)**	**(ug/kg)**	**(ug/kg)**
Acenaphthene	U	U	4,700,000	5,200
Anthracene	U	U	23,000,000	23,000
Benzo(a)anthracene (C)	U	U	870	730
Benzo(a)pyrene (C)	**U**	U	87	190
Benzo(b)fluoranthene(C)	U	U	870	230
Benzo(g,h,i)perylene	U	U	no RBC	no RBC
Contaminant	**04 SGI-CDL-SB01-07**	**LSI SB-CDL-01**	**Apr 2004 EPA Region III RBC**	**Apr 2004 EPA Region III RBC**
	7 –7.5' bgs	9' bgs	Residential Soil	Migration to Groundwater (DAF 1)
SVOCs (continued)	**VPH/EPH (ug/kg)**	**8260/8270 (ug/kg)**	**(ug/kg)**	**(ug/kg)**
Benzo(k)fluoranthene	U	U	8700	2,300
Carbazole (C)	NA	U	32000	230
Chrysene (C)	U	U	87000	7,300
Dibenzofuran	NA	U	160000	190
2,4-Dimethylphenol	NA	U	NA	--
Fluoranthene	U	U	3,100,000	310,000
Fluorene	U	95 J	3,100,000	6,800
Indeno(1,2,3-cd)pyrene (C)	U	U	870	640
2-Methyl-naphthalene	10,600	2500 J	310,000	**220**
2-Methylphenol	NA	U	NA	--
4-Methylphenol	NA	U	NA	--
Naphthalene	3,800/4,800	830 J	1,600,000	**7.7**
Phenanthrene	U	63 J	no RBC	no RBC
Pyrene	U	U	2,300,000	340

Footnotes:
J – Value is estimated
U – Compound was analyzed for but not detected
NA – Not Applicable

Table 1-4. Carbon Polymer Distribution Range by MADEP VPH Analysis

Carbon Range	RL (ug/kg)	Result (ug/kg)
$C_5 – C_8$ Aliphatics (Unadjusted)	3200	1,480,000
$C_9 – C_{12}$ Aliphatics (Unadjusted)	3200	1,440,000
$C_5 – C_8$ Aliphatics	3200	1,470,000
$C_9 – C_{12}$ Aliphatics	3200	1,030,000
$C_9 – C_{10}$ Aromatics	3200	374,000

Table 1-5. Carbon Polymer Distribution Range by MADEP EPH Analysis

Carbon Range	RL (ug/kg)	Result (ug/kg)
C_{11}-C_{22} Aromatics (unadjusted)	57,000	860,000
$C_9 – C_{18}$ Aliphatics	57,000	1,980,000
C_{11}-C_{22} Aromatics	57,000	845,000
$C_{19} – C_{36}$ Aliphatics	57,000	ND

Table 2-1
Well Construction Summary
NASA Wallops CDL

Well Number	MW-01	MW-02	MW-03	MW-04	MW-05	MW-06
Notes				Oil Stains @ W.T.		
TOC Elevation (ft)	32.00	22.55	13.10	11.87	10.06	18.18
Depth to Water - May 2007 (ft)	24.76	15.39	7.2	9.83	9.75	15.54
Groundwater Elevation (May 2007)	7.24	7.16	5.90	2.04	0.31	2.64
Depth to Water December - 2007 (ft)	26.20	16.85	6.62	10.62	10.60	17.61
Groundwater Elevation (December 2007)	5.80	5.70	6.48	1.25	-0.54	0.57
Depth (ft) @ TOC	33	25	16	17	17	24
Depth (ft) @ Surface	33	25	13	14	14	21
Stick Up (ft)	flush mount	flush mount	3	3	3	3
Screened Interval (ft)	23-33	14-24	3-13	4-14	4-14	11-21
Aquifer Material in Screened Interval	sand, f-vcg, poor sorting	sand, vf-vcg, poor sorting	silty sand, little recovery	sand, f-cg, few fines	silty sand to clay	sand, layered, f-mg
PID at Development	0 ppm	0 ppm	0 ppm	peak at 590 ppm	0 ppm	0 ppm
Development Volume	40 gallons	15 gallons	29 gallons	49 gallons	15 gallons	30-35 gallons
Development Time	35 minutes	30 minutes	25 minutes	45 minutes	55 minutes	35 minutes
Approx gallons/minute	1.1 gal/min	0.5 gal/min	1.2 gal/min	1.1 gal/min	0.3 gal/min	0.9-1 gal/min
Development Notes	sandy, orangish brown, cleaned up fast, pump faster than MW-02, clear at end	sandy, light brown gray in color; cleaned up relatively fast, clear at end	med tan color, swamp odor, clear at end	dirty gray in color, clear at end	slow development, well drying up, moderately clear at end	cleaned up quickly, clear at end

Table 2-2. Summary Field/Equipment and Trip Blank Sample Results
NASA Wallops CDL

Sample ID			EQB-1		TB		EQB-2		TB		EQB-3		TB		FB-1		TB	
Sampling Date			4/9/2007		4/10/2007		4/18/2007		4/18/2007		05/02/07		05/02/07		12/19/07		12/19/07	
Parameter		Units	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOC																		
Benzene	ca	ug/l	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.19	U	0.19	U
Carbon disulfide	nc	ug/l	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.21	U	0.14	U	0.14	U
Chloroform	ca	ug/l	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	0.22	U	**10**		0.25	U
Cyclohexane	nc	ug/l	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.50	U	0.85	U	0.85	U
1,2-Dichloroethane	ca	ug/l	0.52	U	0.52	U	0.52	U	0.52	U	0.29	U	0.29	U	0.29	U	0.29	U
cis-1,2-Dichloroethene	nc	ug/l	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.27	U	0.27	U
Ethylbenzene	ca	ug/l	0.20	U	0.20	U	0.20	U	0.20	U	0.2	U	0.2	U	0.21	U	0.21	U
Isopropylbenzene	nc	ug/l	0.20	U	0.20	U	0.20	U	0.20	U	0.2	U	0.2	U	0.54	U	0.54	U
Methylcyclohexane	nc	ug/l	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.18	U	0.50	U	0.5	U
Tetrachloroethene	ca	ug/l	0.28	U	0.28	U	0.28	U	0.28	U	0.28	U	0.28	U	0.28	U	0.28	U
Toluene	nc	ug/l	0.20	U	0.20	U	0.20	U	0.20	U	0.20	U	0.2	U	0.21	U	0.21	U
Trichloroethene	ca	ug/l	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.29	U	0.26	U	0.26	U
m,p-Xylene	nc	ug/l	0.42	U	0.42	U	0.42	U	0.42	U	0.42	U	0.42	U	0.35	U	0.35	U
o-Xylene	nc	ug/l	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.2	U	0.2	U
Xylene (total)	nc	ug/l	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.31	U	0.2	U	0.2	U
SVOC																		
2-Methylphenol	nc	ug/l	1.5	U	NA		1.4	U	NA		1.6	U	NA		1.0	U	NA	
3&4-Methylphenol	nc	ug/l	1.4	U	NA		1.3	U	NA		1.5	U	NA		1.1	U	NA	
1,1'-Biphenyl	nc	ug/l	0.36	U	NA		0.33	U	NA		0.39	U	NA		0.22	U	NA	
Carbazole	ca	ug/l	0.40	U	NA		0.36	U	NA		0.44	U	NA		0.4	U	NA	
Dibenzofuran	nc	ug/l	0.38	U	NA		0.34	U	NA		0.41	U	NA		0.23	U	NA	
bis(2-Ethylhexyl)phthalate	ca	ug/l	0.73	U	NA		0.66	U	NA		0.80	U	NA		0.88	U	NA	
Fluorene	nc	ug/l	0.50	U	NA		0.45	U	NA		0.54	U	NA		0.36	U	NA	
2-Methylnaphthalene	nc	ug/l	0.45	U	NA		0.41	U	NA		0.49	U	NA		0.76	U	NA	
Naphthalene	nc	ug/l	0.36	U	NA		0.32	U	NA		0.39	U	NA		0.18	U	NA	
Phenanthrene	nc	ug/l	0.40	U	NA		0.36	U	NA		0.44	U	NA		0.28	U	NA	
Inorganics																		
Aluminum	nc	mg/l	0.023	U	NA		0.023	U	NA		0.023	U	NA		0.026	U	NA	
Antimony	nc	mg/l	0.0050	U	NA		0.0050	U	NA		0.0050	U	NA		0.00090	U	NA	
Arsenic	ca	mg/l	0.0015	U	NA		0.00094	U	NA		0.00094	U	NA		0.00094	U	NA	
Barium	nc	mg/l	0.0023	U	NA		0.0023	U	NA		0.0023	U	NA		0.0030	U	NA	
Beryllium	nc	mg/l	0.00040	U	NA		0.00040	U	NA		0.00040	U	NA		0.00015	U	NA	
Cadmium	nc	mg/l	0.0013	U	NA		0.0013	U	NA		0.0013	U	NA		0.00024	U	NA	
Calcium	nc	mg/l	0.049	U	NA		0.049	U	NA		**0.18**	B	NA		**0.14**	B	NA	
Chromium	nc	mg/l	**0.00092**	B	NA		0.00080	U	NA		0.00080	U	NA		0.00053	U	NA	
Cobalt	nc	mg/l	0.0018	U	NA		0.0018	U	NA		0.0018	U	NA		0.00015	U	NA	
Copper	nc	mg/l	0.0027	U	NA		0.0027	U	NA		0.0027	U	NA		0.0033	U	NA	
Iron	nc	mg/l	0.025	U	NA		0.025	U	NA		0.025	U	NA		**0.0069**	B	NA	
Lead	nc	mg/l	0.0028	U	NA		0.0028	U	NA		0.0028	U	NA		0.00094	U	NA	
Magnesium	nc	mg/l	0.014	U	NA		0.014	U	NA		**0.084**	B	NA		0.025	U	NA	
Manganese	nc	mg/l	0.00060	U	NA		0.00060	U	NA		0.00060	U	NA		0.0015	U	NA	
Mercury	nc	mg/l	0.000037	U	NA		0.000037	U	NA		**0.000098**	B	NA		0.00015	U	NA	
Nickel	nc	mg/l	0.0028	U	NA		0.0028	U	NA		0.0028	U	NA		0.00073	U	NA	
Potassium	nc	mg/l	0.055	U	NA		0.055	U	NA		**0.095**	B	NA		0.031	U	NA	
Selenium	nc	mg/l	**0.0078**	B	NA		0.0062	U	NA		0.0062	U	NA		0.00073	U	NA	
Silver	nc	mg/l	0.0010	U	NA		**0.0019**	B	NA		0.0010	U	NA		0.0026	U	NA	
Sodium	nc	mg/l	**0.93**	B	NA		0.83	U	NA		**1.6**	B	NA		**0.82**	B	NA	
Thallium	nc	mg/l	0.000090	U	NA		0.00048	U	NA		0.00048	U	NA		0.00048	U	NA	
Vanadium	nc	mg/l	0.0018	U	NA		0.0018	U	NA		0.0018	U	NA		**0.00070**	B	NA	
Zinc	nc	mg/l	**0.0063**	B	NA		**0.016**	B	NA		**0.0039**	B	NA		0.0027	U	NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
bold: detections

Table 4-1. Summary of Surface (0-6") Soil Sample Results
Western AOC - NASA Wallops CDL

Sample ID			EPA Regional Screening Levels, Soil** May 2008		Background Molena Soils, Max Detection TetraTech (2004)	**SB-1A (Local Background)**		**SB-2A**		**TP-8A**	
Sampling Date						4/17/2007		4/17/2007		4/10/2007	
Parameter		Units	Residential	Industrial	Surface	Result	Qual	Result	Qual	Result	Qual
VOCs											
Acetone	nc	ug/kg	6,100,000	61,000,000	-	380	U	300	U	5.5	U
Benzene	c	ug/kg	1,100	5,600	-	64	U	51	U	0.91	U
2-Butanone (MEK)	nc	ug/kg	2,800,000	19,000,000	-	370	U	290	U	5.2	U
Carbon disulfide	nc	ug/kg	67,000	300,000	-	74	U	58	U	1.1	U
Cyclohexane	nc	ug/kg	720,000	3,000,000	-	170	U	140	U	2.4	U
1,2-Dichloroethane	c	ug/kg	450	2,200	-	73	U	57	U	1.0	U
Ethylbenzene	c	ug/kg	5,700	29,000	-	60	U	48	U	0.86	U
Isopropylbenzene	nc	ug/kg	220,000	1,100,000	-	62	U	49	U	0.89	U
Methyl Acetate	nc	ug/kg	7,800,000	100,000,000	-	190	U	150	U	2.7	U
Methylcyclohexane	nc	ug/kg	340,000	1,400,000	-	86	U	68	U	1.2	U
Methylene chloride	c	ug/kg	11,000	54,000	-	92	U	73	U	1.3	U
Tetrachloroethene	c	ug/kg	570	2,700	3	110	U	87	U	1.6	U
Toluene	nc	ug/kg	500,000	4,600,000	-	73	U	57	U	1.0	U
m,p-Xylene	nc	ug/kg	450,000	1,900,000	-	120	U	93	U	1.7	U
o-Xylene	nc	ug/kg	530,000	2,300,000	-	66	U	52	U	0.94	U
Xylene (total)	nc	ug/kg	60,000	260,000	-	66	U	52	U	0.94	U
SVOCs											
Acenaphthylene	nc	ug/kg	NA	NA	-	16	U	16	U	15	U
Anthracene	nc	ug/kg	1,700,000	17,000,000	-	16	U	15	U	33	U
Benzo(a)anthracene	c	ug/kg	150	2,100	550	19	U	19	U	18	U
Benzo(a)pyrene	c	ug/kg	15	210	410	14	U	13	U	13	U
Benzo(b)fluoranthene	c	ug/kg	150	2,100	640	18	U	18	U	17	U
Benzo(g,h,i)perylene	nc	ug/kg	NA	NA	-	22	U	21	U	21	U
Benzo(k)fluoranthene	c	ug/kg	1,500	21,000	290	30	U	29	U	29	U
Benzaldehyde	nc	ug/kg	780,000	10,000,000	-	44	U	42	U	42	U
Chrysene	c	ug/kg	15,000	210,000	630	15	U	14	U	14	U
Dibenzo(a,h)anthracene	c	ug/kg	15	210	-	21	U	20	U	20	U
Di-n-octyl phthalate	nc	ug/kg	NA	NA	-	34	U	33	U	33	U
bis(2-Ethylhexyl)phthalate	c	ug/kg	35,000	120,000	210	51	U	49	U	49	U
Fluoranthene	nc	ug/kg	230,000	2,200,000	1,000	14	U	14	U	13	U
Indeno(1,2,3-cd)pyrene	c	ug/kg	150	2,100	-	25	U	24	U	24	U
Phenanthrene	nc	ug/kg	NA	NA	790	18	U	17	U	17	U
Pyrene	nc	ug/kg	170,000	1,700,000	890	14	U	13	U	13	U
Pesticides / PCBs											
alpha-Chlordane	c	ug/kg	1,600	6,500	-	0.43	U	0.42	U	0.41	U
gamma-Chlordane	c	ug/kg	1,600	6,500	-	0.43	U	0.42	U	0.41	U
4,4'-DDD	c	ug/kg	2,000	7,200	31	0.39	U	0.37	U	0.37	U
4,4'-DDE	c	ug/kg	1,400	5,100	5,000	0.40	U	0.39	U	1.6	
4,4'-DDT	c	ug/kg	1,700	7,000	15,000	0.49		0.47	U	0.46	U
Aroclor 1260	c	ug/kg	220	740	-	8.1	U	7.7	U	7.7	U
Inorganics											
Aluminum	nc	mg/kg	7,700	99,000	13,900	**9,480**		7,760		**10,300**	
Antimony	nc	mg/kg	3.1	41	-	0.83	U	0.85	U	0.82	U
Arsenic	c	mg/kg	0.39	1.6	14	**4.8**		**4.4**		**2.7**	
Barium	nc	mg/kg	1,500	19,000	114	43		31		32	
Beryllium	nc	mg/kg	16	200	1.2	0.23	B	0.17	B	0.23	B
Cadmium	nc	mg/kg	7.0	81	0.84	0.16	U	0.24	B	0.17	B
Calcium	nc	mg/kg	NA	NA	1,390	776		498	B	602	
Chromium	nc	mg/kg	12,000	150,000	18	11		10		11	
Cobalt	nc	mg/kg	NA	NA	7.3	2.8	B	2.5	B	3.1	B
Copper	nc	mg/kg	310	4,100	33	5.3		5.9		7.7	
Iron	nc	mg/kg	5,500	72,000	10,900	**7,430**		**6,440**		**8,690**	
Lead	nc	mg/kg	40	NA	124	9.2		17		11	
Magnesium	nc	mg/kg	NA	NA	1,450	828		673		866	
Manganese	nc	mg/kg	180	2,300	781	158		122		101	
Mercury	nc	mg/kg	0.7	2.8	0.25	0.061		0.077		0.05	
Nickel	nc	mg/kg	160	2,000	11	5.1		4.0	B	5.8	
Potassium	nc	mg/kg	NA	NA	756	438	B	518	B	419	B
Selenium	nc	mg/kg	39	510	1.4	0.86	U	0.89	U	0.85	U
Silver	nc	mg/kg	39	510	0.30	0.17	U	0.18	U	0.17	U
Sodium	nc	mg/kg	NA	NA	31	87	U	89	U	86	U
Thallium	nc	mg/kg	0.51	6.6	1.6	0.093	B	0.079	B	0.049	B
Vanadium	nc	mg/kg	55	720	29	14		12		16	
Zinc	nc	mg/kg	2,300	31,000	104	19		20		19	
Total Organic Carbon	nc	mg/kg	NA	NA	-	NA		NA		NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over Residential values (either full (c) or 1/10th (nc))
highlight blue: over Industrial values (either full (c) or 1/10th (nc))
bold, underline: over double the background Molena max detection level

Table 4-2. Summary of Shallow Subsurface (6"-24") Soil Sample Results
Western AOC - NASA Wallops CDL

Sample ID			EPA Regional Screening Levels, Soil** May 2008		Background Molena Soils, Max Detection TetraTech (2004)	**SB-1B (Local Background)**		**SB-2B**		**TP-8B**	
Sampling Date						4/17/2007		4/17/2007		4/9/2007	
Parameter		Units	Residential	Industrial	Subsurface	Result	Qual	Result	Qual	Result	Qual
VOCs											
Acetone	nc	ug/kg	6,100,000	61,000,000	-	250	U	290	U	2.5	U
Benzene	c	ug/kg	1,100	5,600	-	42	U	48	U	0.42	U
2-Butanone (MEK)	nc	ug/kg	2,800,000	19,000,000	-	240	U	280	U	2.4	U
Carbon disulfide	nc	ug/kg	67,000	300,000	-	48	U	56	U	0.48	U
Cyclohexane	nc	ug/kg	720,000	3,000,000	-	110	U	130	U	1.1	U
1,2-Dichloroethane	c	ug/kg	450	2,200	-	42	U	55	U	0.48	U
Ethylbenzene	c	ug/kg	5,700	29,000	-	39	U	46	U	0.39	U
Isopropylbenzene	nc	ug/kg	220,000	1,100,000	-	41	U	47	U	0.41	U
Methyl Acetate	nc	ug/kg	7,800,000	100,000,000	-	120	U	140	U	1.2	U
Methylcyclohexane	nc	ug/kg	340,000	1,400,000	-	56	U	65	U	0.56	U
Methylene chloride	c	ug/kg	11,000	54,000	-	61	U	70	U	0.61	U
Tetrachloroethene	c	ug/kg	570	2,700	-	72	U	83	U	0.72	U
Toluene	nc	ug/kg	500,000	4,600,000	-	47	U	55	U	0.47	U
m,p-Xylene	nc	ug/kg	450,000	1,900,000	-	77	U	89	U	0.77	U
o-Xylene	nc	ug/kg	530,000	2,300,000	-	43	U	50	U	0.43	U
Xylene (total)	nc	ug/kg	60,000	260,000	-	43	U	50	U	0.43	U
SVOCs											
Acenaphthylene	nc	ug/kg	NA	NA	-	15	U	15	U	15	U
Anthracene	nc	ug/kg	1,700,000	17,000,000	-	14	U	14	U	14	U
Benzo(a)anthracene	c	ug/kg	150	2,100	-	18	U	18	U	18	U
Benzo(a)pyrene	c	ug/kg	15	210	-	13	U	13	U	13	U
Benzo(b)fluoranthene	c	ug/kg	150	2,100	-	17	U	17	U	17	U
Benzo(g,h,i)perylene	nc	ug/kg	NA	NA	-	20	U	20	U	20	U
Benzo(k)fluoranthene	c	ug/kg	1,500	21,000	-	27	U	27	U	28	U
Benzaldehyde	nc	ug/kg	780,000	10,000,000	-	40	U	40	U	40	U
Chrysene	c	ug/kg	15,000	210,000	-	13	U	13	U	14	U
Dibenzo(a,h)anthracene	c	ug/kg	15	210	-	19	U	19	U	19	U
Di-n-octyl phthalate	nc	ug/kg	NA	NA	-	31	U	31	U	31	U
bis(2-Ethylhexyl)phthalate	c	ug/kg	35,000	120,000	-	47	U	**85**		47	U
Fluoranthene	nc	ug/kg	230,000	2,200,000	-	13	U	13	U	13	U
Indeno(1,2,3-cd)pyrene	c	ug/kg	150	2,100	-	23	U	23	U	23	U
Phenanthrene	nc	ug/kg	NA	NA	-	16	U	16	U	16	U
Pyrene	nc	ug/kg	170,000	1,700,000	-	13	U	13	U	13	U
Pesticides / PCBs											
alpha-Chlordane	c	ug/kg	1,600	6,500	-	0.36	U	0.39	U	0.39	U
gamma-Chlordane	c	ug/kg	1,600	6,500	-	0.36	U	0.36	U	0.39	U
4,4'-DDD	c	ug/kg	2,000	7,200	-	0.35	U	0.35	U	0.35	U
4,4'-DDE	c	ug/kg	1,400	5,100	85	0.36	U	0.36	U	0.36	U
4,4'-DDT	c	ug/kg	1,700	7,000	210	0.44	U	0.44	U	0.45	U
Aroclor 1260	c	ug/kg	220	740	-	7.3	U	7.3	U	7.3	U
Inorganics											
Aluminum	nc	mg/kg	7,700	99,000	22,400	**9,030**		7,010		**13,300**	
Antimony	nc	mg/kg	3.1	41	-	0.80	U	0.78	U	0.80	U
Arsenic	c	mg/kg	0.39	1.6	5.3	**5.5**		**1.7**		**2.2**	
Barium	nc	mg/kg	1,500	19,000	89	54		17	B	29	
Beryllium	nc	mg/kg	16	200	0.57	0.33	B	0.17	B	0.25	B
Cadmium	nc	mg/kg	7.0	81	0.36	0.15	U	0.15	U	0.16	U
Calcium	nc	mg/kg	NA	NA	471	**1,260**		285	B	657	
Chromium	nc	mg/kg	12,000	150,000	21	10		6.5		11	
Cobalt	nc	mg/kg	NA	NA	14	3.0	B	1.6	B	4.3	B
Copper	nc	mg/kg	310	4,100	11	4.0		3.5		6.3	
Iron	nc	mg/kg	5,500	72,000	17,900	**6,780**		4,080		**10,600**	
Lead	nc	mg/kg	40	NA	12	6.2		3.2		5.4	
Magnesium	nc	mg/kg	NA	NA	1,780	867		335	B	926	
Manganese	nc	mg/kg	180	2,300	213	**219**		49		105	
Mercury	nc	mg/kg	0.7	2.8	0.048	**0.11**		0.017	B	0.013	B
Nickel	nc	mg/kg	160	2,000	11	4.7		4.5		6.9	
Potassium	nc	mg/kg	NA	NA	853	399	B	254	B	446	B
Selenium	nc	mg/kg	39	510	0.89	0.83	U	0.82	U	0.84	U
Silver	nc	mg/kg	39	510	0.22	0.17	U	0.16	U	0.17	U
Sodium	nc	mg/kg	NA	NA	49	83	U	82	U	84	U
Thallium	nc	mg/kg	0.51	6.6	0.53	0.10	B	0.029	B	0.054	B
Vanadium	nc	mg/kg	55	720	31	13		7.9		18	
Zinc	nc	mg/kg	2,300	31,000	26	17		8.5		16	
Total Organic Carbon	nc	mg/kg	NA	NA	-	NA		NA		NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over Residential values (either full (c) or 1/10th (nc))
highlight blue: over Industrial values (either full (c) or 1/10th (nc))
bold, underline: over double the background Molena max detection level

Table 4-3. Summary of Surface (0-6") Soil Results
Northern AOC - NASA Wallops CDL

Sample ID			EPA Regional Screening Levels, Soil** May 2008		Background Molena Soils, Max Detection TetraTech (2004)	**SB-1A (Local Background)**		**SB-6A**		**TP-5A**	
Sampling Date						4/17/2007		4/18/2007		4/9/2007	
Parameter		Units	Residential	Industrial	Surface	Result	Qual	Result	Qual	Result	Qual
VOCs											
Acetone	nc	ug/kg	6,100,000	61,000,000	-	380	U	320	U	2.5	U
Benzene	c	ug/kg	1,100	5,600	-	64	U	54	U	0.43	U
2-Butanone (MEK)	nc	ug/kg	2,800,000	19,000,000	-	370	U	310	U	2.4	U
Carbon disulfide	nc	ug/kg	67,000	300,000	-	74	U	62	U	0.49	U
Cyclohexane	nc	ug/kg	720,000	3,000,000	-	170	U	140	U	1.1	U
1,2-Dichloroethane	c	ug/kg	450	2,200	-	73	U	61	U	0.48	U
Ethylbenzene	c	ug/kg	5,700	29,000	-	60	U	50	U	0.4	U
Isopropylbenzene	nc	ug/kg	220,000	1,100,000	-	62	U	52	U	0.41	U
Methyl Acetate	nc	ug/kg	7,800,000	100,000,000	-	190	U	160	U	1.3	U
Methylcyclohexane	nc	ug/kg	340,000	1,400,000	-	86	U	72	U	0.57	U
Methylene chloride	c	ug/kg	11,000	54,000	-	92	U	77	U	0.61	U
Tetrachloroethene	c	ug/kg	570	2,700	3	110	U	92	U	0.73	U
Toluene	nc	ug/kg	500,000	4,600,000	-	73	U	61	U	0.48	U
m,p-Xylene	nc	ug/kg	450,000	1,900,000	-	120	U	98	U	0.78	U
o-Xylene	nc	ug/kg	530,000	2,300,000	-	66	U	55	U	0.44	U
Xylene (total)	nc	ug/kg	60,000	260,000	-	66	U	55	U	0.44	U
SVOCs											
Acenaphthylene	nc	ug/kg	NA	NA	-	16	U	15	U	15	U
Anthracene	nc	ug/kg	1,700,000	17,000,000	-	16	U	14	U	14	U
Benzo(a)anthracene	c	ug/kg	150	2,100	550	19	U	18	U	17	U
Benzo(a)pyrene	c	ug/kg	15	210	410	14	U	13	U	12	U
Benzo(b)fluoranthene	c	ug/kg	150	2,100	640	18	U	17	U	16	U
Benzo(g,h,i)perylene	nc	ug/kg	NA	NA	-	22	U	20	U	20	U
Benzo(k)fluoranthene	c	ug/kg	1,500	21,000	290	30	U	28	U	27	U
Benzaldehyde	nc	ug/kg	780,000	10,000,000	-	44	U	41	U	39	U
Chrysene	c	ug/kg	15,000	210,000	630	15	U	14	U	13	U
Dibenzo(a,h)anthracene	c	ug/kg	15	210	-	21	U	19	U	19	U
Di-n-octyl phthalate	nc	ug/kg	NA	NA	-	34	U	32	U	31	U
bis(2-Ethylhexyl)phthalate	c	ug/kg	35,000	120,000	210	51	U	47	U	46	U
Fluoranthene	nc	ug/kg	230,000	2,200,000	1000	14	U	13	U	13	U
Indeno(1,2,3-cd)pyrene	c	ug/kg	150	2,100	-	25	U	23	U	23	U
Phenanthrene	nc	ug/kg	NA	NA	790	18	U	16	U	16	U
Pyrene	nc	ug/kg	170,000	1,700,000	890	14	U	13	U	12	U
Pesticides / PCBs											
alpha-Chlordane	c	ug/kg	1,600	6,500	-	0.43	U	0.40	U	0.38	U
gamma-Chlordane	c	ug/kg	1,600	6,500	-	0.43	U	0.40	U	0.38	U
4,4'-DDD	c	ug/kg	2,000	7,200	31	0.39	U	0.36	U	0.34	U
4,4'-DDE	c	ug/kg	1,400	5,100	5000	0.40	U	0.37	U	0.35	U
4,4'-DDT	c	ug/kg	1,700	7,000	15000	0.49		0.46	U	0.44	U
Aroclor 1260	c	ug/kg	220	740	-	8.1	U	7.5	U	8.2	U
Inorganics											
Aluminum	nc	mg/kg	7,700	99,000	13,900	**9,480**		5,110		**10,200**	
Antimony	nc	mg/kg	3.1	41	-	0.83	U	0.83	U	0.75	U
Arsenic	c	mg/kg	0.39	1.6	14.2	**4.8**		**1.2**		**2.5**	
Barium	nc	mg/kg	1,500	19,000	114	43		12	B	21	B
Beryllium	nc	mg/kg	16	200	1.2	0.23	B	0.10	B	0.17	B
Cadmium	nc	mg/kg	7.0	81	0.84	0.16	U	0.16	U	0.15	U
Calcium	nc	mg/kg	NA	NA	1,390	776		477	B	580	
Chromium	nc	mg/kg	12,000	150,000	18.4	11		4.8		10	
Cobalt	nc	mg/kg	NA	NA	7.3	2.8	B	1.2	B	3.3	B
Copper	nc	mg/kg	310	4,100	33.0	5.3		2.4	B	4.9	
Iron	nc	mg/kg	5,500	72,000	10,900	**7,430**		3,460		**8,880**	
Lead	nc	mg/kg	40	NA	124	9.2		2.6		5.2	
Magnesium	nc	mg/kg	NA	NA	1,450	828		384	B	887	
Manganese	nc	mg/kg	180	2,300	781	158		26		106	
Mercury	nc	mg/kg	0.7	2.8	0.25	0.061		0.014	B	0.019	B
Nickel	nc	mg/kg	160	2,000	10.6	5.1		2.6	B	5.3	
Potassium	nc	mg/kg	NA	NA	756.0	438	B	249	B	392	B
Selenium	nc	mg/kg	39	510	1.4	0.86	U	0.87	U	0.78	U
Silver	nc	mg/kg	39	510	0.3	0.17	U	0.17	U	0.16	U
Sodium	nc	mg/kg	NA	NA	31	87	U	87	U	79	U
Thallium	nc	mg/kg	0.51	6.6	1.6	0.093	B	0.083	B	0.090	B
Vanadium	nc	mg/kg	55	720	29	14		6.8		15	
Zinc	nc	mg/kg	2,300	31,000	104	19		6.8		13	
Total Organic Carbon	nc	mg/kg	NA	NA	-	NA		NA		NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over Residential values (either full (c) or 1/10th (nc))
highlight blue: over Industrial values (either full (c) or 1/10th (nc))
bold, underline: over double the background Molena max detection level

Table 4-4. Summary of Shallow Subsurface (6"-24") Soil Results
Northern AOC - NASA Wallops CDL

Sample ID			EPA Regional Screening Levels, Soil** May 2008		Background Molena Soils, Max Detection TetraTech (2004)	**SB-1B (Local Background)**		**SB-6B**		**TP-5B**	
Sampling Date						4/17/2007		4/18/2007		4/9/2007	
Parameter		Units	Residential	Industrial	Subsurface	Result	Qual	Result	Qual	Result	Qual
VOCs											
Acetone	nc	ug/kg	6,100,000	61,000,000	-	250	U	230	U	3.1	U
Benzene	c	ug/kg	1,100	5,600	-	42	U	39	U	0.53	U
2-Butanone (MEK)	nc	ug/kg	2,800,000	19,000,000	-	240	U	220	U	3	U
Carbon disulfide	nc	ug/kg	67,000	300,000	-	48	U	45	U	0.61	U
Cyclohexane	nc	ug/kg	720,000	3,000,000	-	110	U	100	U	1.4	U
1,2-Dichloroethane	c	ug/kg	450	2,200	-	42	U	44	U	0.6	U
Ethylbenzene	c	ug/kg	5,700	29,000	-	39	U	37	U	0.49	U
Isopropylbenzene	nc	ug/kg	220,000	1,100,000	-	41	U	38	U	0.51	U
Methyl Acetate	nc	ug/kg	7,800,000	100,000,000	-	120	U	110	U	1.6	U
Methylcyclohexane	nc	ug/kg	340,000	1,400,000	-	56	U	52	U	0.71	U
Methylene chloride	c	ug/kg	11,000	54,000	-	61	U	56	U	0.76	U
Tetrachloroethene	c	ug/kg	570	2,700	-	72	U	67	U	0.91	U
Toluene	nc	ug/kg	500,000	4,600,000	-	47	U	44	U	0.6	U
m,p-Xylene	nc	ug/kg	450,000	1,900,000	-	77	U	71	U	0.96	U
o-Xylene	nc	ug/kg	530,000	2,300,000	-	43	U	40	U	0.54	U
Xylene (total)	nc	ug/kg	60,000	260,000	-	43	U	40	U	0.54	U
SVOCs											
Acenaphthylene	nc	ug/kg	NA	NA	-	15	U	15	U	14	U
Anthracene	nc	ug/kg	1,700,000	17,000,000	-	14	U	19	U	14	U
Benzo(a)anthracene	c	ug/kg	150	2,100	-	18	U	18	U	17	U
Benzo(a)pyrene	c	ug/kg	15	210	-	13	U	13	U	12	U
Benzo(b)fluoranthene	c	ug/kg	150	2,100	-	17	U	17	U	16	U
Benzo(g,h,i)perylene	nc	ug/kg	NA	NA	-	20	U	20	U	19	U
Benzo(k)fluoranthene	c	ug/kg	1,500	21,000	-	27	U	27	U	26	U
Benzaldehyde	nc	ug/kg	780,000	10,000,000	-	40	U	40	U	38	U
Chrysene	c	ug/kg	15,000	210,000	-	13	U	13	U	13	U
Dibenzo(a,h)anthracene	c	ug/kg	15	210	-	19	U	19	U	18	U
Di-n-octyl phthalate	nc	ug/kg	NA	NA	-	31	U	31	U	30	U
bis(2-Ethylhexyl)phthalate	c	ug/kg	35,000	120,000	-	47	U	**55.8**	J	45	U
Fluoranthene	nc	ug/kg	230,000	2,200,000	-	13	U	13	U	12	U
Indeno(1,2,3-cd)pyrene	c	ug/kg	150	2,100	-	23	U	23	U	22	U
Phenanthrene	nc	ug/kg	NA	NA	-	16	U	16	U	15	U
Pyrene	nc	ug/kg	170,000	1,700,000	-	13	U	13	U	12	U
Pesticides / PCBs											
alpha-Chlordane	c	ug/kg	1,600	6,500	-	0.36	U	0.40	U	0.38	U
gamma-Chlordane	c	ug/kg	1,600	6,500	-	0.36	U	0.39	U	0.38	U
4,4'-DDD	c	ug/kg	2,000	7,200	-	0.35	U	0.35	U	0.34	U
4,4'-DDE	c	ug/kg	1,400	5,100	85	0.36	U	0.36	U	0.35	U
4,4'-DDT	c	ug/kg	1,700	7,000	210	0.44	U	0.45	U	0.43	U
Aroclor 1260	c	ug/kg	220	740	-	7.3	U	7.4	U	7.1	U
Inorganics											
Aluminum	nc	mg/kg	7,700	99,000	22,400	**9,030**		**14,300**		6,520	
Antimony	nc	mg/kg	3.1	41	-	0.80	U	0.81	U	0.78	U
Arsenic	c	mg/kg	0.39	1.6	5.3	**5.5**		**2.3**		**1.1**	
Barium	nc	mg/kg	1,500	19,000	89	54		26		12	B
Beryllium	nc	mg/kg	16	200	0.57	0.33	B	0.26	B	0.14	B
Cadmium	nc	mg/kg	7.0	81	0.36	0.15	U	0.16	U	0.15	U
Calcium	nc	mg/kg	NA	NA	471	**1,260**		350	B	297	B
Chromium	nc	mg/kg	12,000	150,000	21	10		12		5.7	
Cobalt	nc	mg/kg	NA	NA	14.0	3.0	B	2.8	B	3.2	B
Copper	nc	mg/kg	310	4,100	10.9	4.0		4.6		3.3	
Iron	nc	mg/kg	5,500	72,000	17,900	**6,780**		**8,710**		4,250	
Lead	nc	mg/kg	40	NA	12.2	6.2		4.6		2.6	
Magnesium	nc	mg/kg	NA	NA	1,780	867		683		399	B
Manganese	nc	mg/kg	180	2,300	213	**219**		31		77	
Mercury	nc	mg/kg	0.7	2.8	0.048	**0.11**		0.017	B	0.0089	U
Nickel	nc	mg/kg	160	2,000	11.2	4.7		7.2		3.8	B
Potassium	nc	mg/kg	NA	NA	853	399	B	431	B	247	B
Selenium	nc	mg/kg	39	510	0.89	0.83	U	0.85	U	0.81	U
Silver	nc	mg/kg	39	510	0.22	0.17	U	0.21	B	0.16	U
Sodium	nc	mg/kg	NA	NA	49.3	83	U	85	U	81	U
Thallium	nc	mg/kg	0.51	6.6	0.53	0.10	B	0.18	B	0.059	B
Vanadium	nc	mg/kg	55	720	31	13		17		7.0	
Zinc	nc	mg/kg	2,300	31,000	26	17		11		6.5	
Total Organic Carbon	nc	mg/kg	NA	NA	-	NA		NA		NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over Residential values (either full (c) or 1/10th (nc))
highlight blue: over Industrial values (either full (c) or 1/10th (nc))
bold, underline: over double the background Molena max detection level

Table 4-5. Summary of Surface (0-6") Soil Sample Results
Central AOC - NASA Wallops CDL

Sample ID			EPA Regional Screening Levels, Soil** May 2008		Background Molena Soils, Max Detection TetraTech (2004)	SB-1A (Local Background)		SB-4A		SB-4AD		SB-5A		TP-1A (burn area)		TP-6A	
Sampling Date						4/17/2007		4/18/2007		4/18/2007		4/18/2007		4/9/2007		4/10/2007	
Parameter		Units	Residential	Industrial	Surface	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOCs																	
Acetone	nc	ug/kg	6,100,000	61,000,000	-	380	U	380	U	440	U	320	U	3.3	U	37.8	U
Benzene	c	ug/kg	1,100	5,600	-	64	U	63	U	74	U	53	U	0.55	U	0.48	U
2-Butanone (MEK)	nc	ug/kg	2,800,000	19,000,000	-	370	U	360	U	420	U	300	U	3.2	U	2.8	U
Carbon disulfide	nc	ug/kg	67,000	300,000	-	74	U	73	U	85	U	61	U	0.64	U	0.56	U
Cyclohexane	nc	ug/kg	720,000	3,000,000	-	170	U	170	U	200	U	140	U	1.5	U	1.3	U
1,2-Dichloroethane	c	ug/kg	450	2,200	-	73	U	72	U	83	U	60	U	0.63	U	0.55	U
Ethylbenzene	c	ug/kg	5,700	29,000	-	60	U	60	U	69	U	50	U	**0.63**	J	0.46	U
Isopropylbenzene	nc	ug/kg	220,000	1,100,000	-	62	U	61	U	71	U	51	U	0.54	U	0.47	U
Methyl Acetate	nc	ug/kg	7,800,000	100,000,000	-	190	U	190	U	**1190**		160	U	1.6	U	1.4	U
Methylcyclohexane	nc	ug/kg	340,000	1,400,000	-	86	U	85	U	99	U	71	U	**2.5**	J	0.65	U
Methylene chloride	c	ug/kg	11,000	54,000	-	92	U	91	U	110	U	76	U	0.8	U	0.7	U
Tetrachloroethene	c	ug/kg	570	2,700	3	110	U	110	U	130	U	91	U	0.95	U	0.83	U
Toluene	nc	ug/kg	500,000	4,600,000	-	73	U	72	U	83	U	60	U	**0.96**	J	0.55	U
m,p-Xylene	nc	ug/kg	450,000	1,900,000	-	120	U	120	U	130	U	97	U	**3.5**		0.89	U
o-Xylene	nc	ug/kg	530,000	2,300,000	-	66	U	65	U	76	U	54	U	**1.4**		0.5	U
Xylene (total)	nc	ug/kg	60,000	260,000	-	66	U	65	U	76	U	54	U	**4.9**		0.5	U
SVOCs																	
Acenaphthylene	nc	ug/kg	NA	NA	-	16	U	**158**	J	95	U	17	U	15	U	16	U
Anthracene	nc	ug/kg	1,700,000	17,000,000	-	16	U	**267**	J	**222**	J	16	U	14	U	15	U
Benzo(a)anthracene	c	ug/kg	150	2,100	550	19	U	**2,490**		**1,770**		20	U	18	U	19	U
Benzo(a)pyrene	c	ug/kg	15	210	410	14	U	**1,910**		**1,590**		14	U	13	U	14	U
Benzo(b)fluoranthene	c	ug/kg	150	2,100	640	18	U	**1,390**		**1,110**		19	U	17	U	18	U
Benzo(g,h,i)perylene	nc	ug/kg	NA	NA	-	22	U	**1180**		**1010**		22	U	20	U	21	U
Benzo(k)fluoranthene	c	ug/kg	1,500	21,000	290	30	U	**1030**		**635**		31	U	28	U	29	U
Benzaldehyde	nc	ug/kg	780,000	10,000,000	-	44	U	230	U	260	U	45	U	41	U	**54.2**	J
Chrysene	c	ug/kg	15,000	210,000	630	15	U	**4040**		**2810**		15	U	14	U	14	U
Dibenzo(a,h)anthracene	c	ug/kg	15	210	-	21	U	**388**	J	120	U	22	U	19	U	20	U
Di-n-octyl phthalate	nc	ug/kg	NA	NA	-	34	U	180	U	200	U	35	U	32	U	33	U
bis(2-Ethylhexyl)phthalate	c	ug/kg	35,000	120,000	210	51	U	270	U	300	U	53	U	47	U	50	U
Fluoranthene	nc	ug/kg	230,000	2,200,000	1000	14	U	1790		1500		15	U	13	U	14	U
Indeno(1,2,3-cd)pyrene	c	ug/kg	150	2,100	-	25	U	**617**		**577**		26	U	23	U	25	U
Phenanthrene	nc	ug/kg	NA	NA	790	18	U	**2230**		1470		18	U	16	U	17	U
Pyrene	nc	ug/kg	170,000	1,700,000	890	14	U	**4740**		**3330**		14	U	13	U	13	U
Pesticides / PCBs																	
alpha-Chlordane	c	ug/kg	1,600	6,500	-	0.43	U	0.45	U	0.51	U	0.45	U	0.40	U	0.42	U
gamma-Chlordane	c	ug/kg	1,600	6,500	-	0.43	U	0.45	U	0.51	U	0.45	U	0.40	U	0.42	U
4,4'-DDD	c	ug/kg	2,000	7,200	31	0.39	U	11.3		7.1		1.9		5.6		0.37	U
4,4'-DDE	c	ug/kg	1,400	5,100	5000	0.40	U	137		51.8		15.9		119		2.0	
4,4'-DDT	c	ug/kg	1,700	7,000	15000	0.49		274		199		11.8		58.9		0.48	U
Aroclor 1260	c	ug/kg	220	740	-	8.1	U	8.4	U	9.5	U	8.4	U	7.5	U	7.9	U
Inorganics																	
Aluminum	nc	mg/kg	7,700	99,000	13,900	**9,480**		6,000		4,600		6,870		6,960		**8,870**	
Antimony	nc	mg/kg	3.1	41	-	0.83	U	0.87	U	1.1	U	0.93	U	0.79	U	0.85	U
Arsenic	c	mg/kg	0.39	1.6	14.2	**4.8**		**3.0**		**2.7**		**3.0**		**3.5**		**4.7**	
Barium	nc	mg/kg	1,500	19,000	114	43		195		106		33		44		34	
Beryllium	nc	mg/kg	16	200	1.2	0.23	B	0.18	B	0.15	B	0.18	B	1.3		0.29	B
Cadmium	nc	mg/kg	7.0	81	0.84	0.16	U	0.33	B	0.76		0.23	B	0.15	U	0.17	U
Calcium	nc	mg/kg	NA	NA	1,390	776		**7,750**		**71,900**		1,570		888		809	
Chromium	nc	mg/kg	12,000	150,000	18.4	11		10		**126**		7.6		7.9		10	
Cobalt	nc	mg/kg	NA	NA	7.3	2.8	B	2.1	B	**28**		2.1	B	3.2	B	2.7	B
Copper	nc	mg/kg	310	4,100	33.0	5.3		11		6.8		8.0		7.4		7.2	
Iron	nc	mg/kg	5,500	72,000	10,900	**7,430**		5,050		**24,800**		**5,640**		**6,850**		**7,640**	
Lead	nc	mg/kg	40	NA	124	9.2		**121**		24		13		20		12	
Magnesium	nc	mg/kg	NA	NA	1,450	828		1,650		**76,700**		761		776		974	
Manganese	nc	mg/kg	180	2,300	781	158		**195**		**372**		110		130		137	
Mercury	nc	mg/kg	0.7	2.8	0.25	0.061		0.21		0.23		0.080		0.052		0.051	
Nickel	nc	mg/kg	160	2,000	10.6	5.1		10		**502**		3.9	B	5.3		5.1	
Potassium	nc	mg/kg	NA	NA	756.0	438	B	444	B	531	B	511	B	339	B	423	B
Selenium	nc	mg/kg	39	510	1.4	0.86	U	0.90	U	1.5	B	1.0	U	0.83	U	0.89	U
Silver	nc	mg/kg	39	510	0.3	0.17	U	0.38	B	0.22	U	0.57	B	0.35	B	0.18	U
Sodium	nc	mg/kg	NA	NA	31	**87**	U	**91**	U	**110**	U	**115**	B	**83**	U	**90**	U
Thallium	nc	mg/kg	0.51	6.6	1.6	0.093	B	0.10	B	0.068	B	0.036	B	0.20	B	0.10	B
Vanadium	nc	mg/kg	55	720	29	14		10		10		10		13		14	
Zinc	nc	mg/kg	2,300	31,000	104	19		146		97		22		21		24	
Total Organic Carbon	nc	mg/kg	NA	NA	-	NA		NA		NA		NA		NA		NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over Residential values (either full (c) or 1/10th (nc))
highlight blue: over Industrial values (either full (c) or 1/10th (nc))
bold, underline: over double the background Molena max detection level

Table 4-6. Summary of Subsurface Soil Sample Results
Central AOC - NASA Wallops CDL

Sampling ID			EPA Regional Screening Levels, Soil** May 2008		Background Molena Soils, Max Detection TetraTech (2004)	SB-1B (Local Background)		SB-4B		SB-4C		SB-5B		TP-1B		TP-1C		TP-6B	
Sampling Date						4/17/2007		4/18/2007		4/18/2007		4/18/2000		4/9/2007		4/9/2007		4/10/2007	
Parameter		Units	Residential	Industrial	Subsurface	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOCs																			
Acetone	nc	ug/kg	6,100,000	61,000,000	-	250	U	280	U	300	U	280	U	3.4	U	**2230**		2.7	U
Benzene	c	ug/kg	1,100	5,600	-	42	U	47	U	50	U	46	U	0.58	U	**185**		0.45	U
2-Butanone (MEK)	nc	ug/kg	2,800,000	19,000,000	-	240	U	270	U	290	U	260	U	3.3	U	370	U	2.6	U
Carbon disulfide	nc	ug/kg	67,000	300,000	-	48	U	54	U	58	U	53	U	0.67	U	74	U	0.52	U
Cyclohexane	nc	ug/kg	720,000	3,000,000	-	110	U	130	U	130	U	120	U	1.5	U	170	U	1.2	U
1,2-Dichloroethane	c	ug/kg	450	2,200	-	42	U	53	U	57	U	52	U	0.65	U	**238**		0.51	U
Ethylbenzene	c	ug/kg	5,700	29,000	-	39	U	44	U	**1420**		43	U	0.54	U	**361**		0.42	U
Isopropylbenzene	nc	ug/kg	220,000	1,100,000	-	41	U	46	U	**207**	J	45	U	0.56	U	62	U	0.44	U
Methyl Acetate	nc	ug/kg	7,800,000	100,000,000	-	120	U	140	U	150	U	140	U	1.7	U	190	U	1.3	U
Methylcyclohexane	nc	ug/kg	340,000	1,400,000	-	56	U	63	U	**10700**		62	U	0.78	U	**179**	J	0.6	U
Methylene chloride	c	ug/kg	11,000	54,000	-	61	U	68	U	73	U	67	U	0.83	U	93	U	0.65	U
Tetrachloroethene	c	ug/kg	570	2,700	-	72	U	81	U	86	U	79	U	0.99	U	110	U	0.77	U
Toluene	nc	ug/kg	500,000	4,600,000	-	47	U	53	U	57	U	52	U	0.65	U	**730**		0.51	U
m,p-Xylene	nc	ug/kg	450,000	1,900,000	-	77	U	86	U	**96.8**	J	85	U	1.1	U	**2000**		0.82	U
o-Xylene	nc	ug/kg	530,000	2,300,000	-	43	U	48	U	**132**		48	U	0.59	U	**828**		0.46	U
Xylene (total)	nc	ug/kg	60,000	260,000	-	43	U	48	U	**229**		48	U	0.59	U	**2830**		0.46	U
SVOCs																			
Acenaphthylene	nc	ug/kg	NA	NA	-	15	U	15	U	16	U	15	U	14	U	14	U	15	U
Anthracene	nc	ug/kg	1,700,000	17,000,000	-	14	U	15	U	15	U	14	U	13	U	14	U	15	U
Benzo(a)anthracene	c	ug/kg	150	2,100	-	18	U	18	U	19	U	17	U	17	U	17	U	18	U
Benzo(a)pyrene	c	ug/kg	15	210	-	13	U	13	U	14	U	13	U	12	U	12	U	13	U
Benzo(b)fluoranthene	c	ug/kg	150	2,100	-	17	U	17	U	18	U	16	U	16	U	16	U	17	U
Benzo(g,h,i)perylene	nc	ug/kg	NA	NA	-	20	U	21	U	21	U	20	U	19	U	20	U	21	U
Benzo(k)fluoranthene	c	ug/kg	1,500	21,000	-	27	U	29	U	30	U	27	U	26	U	27	U	28	U
Benzaldehyde	nc	ug/kg	780,000	10,000,000	-	40	U	42	U	43	U	40	U	38	U	39	U	42	U
Chrysene	c	ug/kg	15,000	210,000	-	13	U	14	U	14	U	13	U	13	U	13	U	14	U
Dibenzo(a,h)anthracene	c	ug/kg	15	210	-	19	U	20	U	21	U	19	U	18	U	19	U	20	U
Di-n-octyl phthalate	nc	ug/kg	NA	NA	-	31	U	32	U	34	U	31	U	30	U	31	U	32	U
bis(2-Ethylhexyl)phthalate	c	ug/kg	35,000	120,000	-	47	U	**51.9**	BJ	**102**		46	U	45	U	46	U	48	U
Fluoranthene	nc	ug/kg	230,000	2,200,000	-	13	U	13	U	14	U	13	U	12	U	13	U	13	U
Indeno(1,2,3-cd)pyrene	c	ug/kg	150	2,100	-	23	U	24	U	25	U	23	U	22	U	23	U	24	U
Phenanthrene	nc	ug/kg	NA	NA	-	16	U	17	U	17	U	16	U	15	U	16	U	17	U
Pyrene	nc	ug/kg	170,000	1,700,000	-	13	U	13	U	14	U	12	U	12	U	12	U	13	U
Pesticides / PCBs																			
alpha-Chlordane	c	ug/kg	1,600	6,500	-	0.36	U	0.41	U	0.42	U	0.40	U	0.38	U	0.39	U	0.41	U
gamma-Chlordane	c	ug/kg	1,600	6,500	-	0.36	U	0.41	U	0.42	U	0.39	U	0.38	U	0.39	U	0.41	U
4,4'-DDD	c	ug/kg	2,000	7,200	-	0.35	U	0.36	U	**25.7**		0.35	U	0.34	U	0.34	U	0.36	U
4,4'-DDE	c	ug/kg	1,400	5,100	85	0.36	U	3.1		0.39	U	0.36	U	0.35	U	0.36	U	0.38	U
4,4'-DDT	c	ug/kg	1,700	7,000	210	0.44	U	2.4		0.48	U	0.45	U	0.43	U	0.44	U	0.46	U
Aroclor 1260	c	ug/kg	220	740	-	7.3	U	7.6	U	7.9	U	7.4	U	7.1	U	7.1	U	7.6	U
Inorganics																			
Aluminum	nc	mg/kg	7,700	99,000	22,400	**9,030**		**8,810**		3,380		5,740		**8,970**		6,670		**21,100**	
Antimony	nc	mg/kg	3.1	41	-	0.80	U	0.78	U	0.85	U	0.76	U	0.79	U	0.80	U	0.84	U
Arsenic	c	mg/kg	0.39	1.6	5.3	**5.5**		**1.7**		0.39	U	**1.7**		**1.8**		**0.96**		**4.8**	
Barium	nc	mg/kg	1,500	19,000	89	53.8		29		7.3	B	15.9	B	19.8	B	20.2	B	45.8	
Beryllium	nc	mg/kg	16	200	0.57	0.33	B	0.19	B	0.049	B	0.10	B	0.16	B	0.19	B	0.33	B
Cadmium	nc	mg/kg	7.0	81	0.36	0.15	U	0.15	U	0.16	U	0.15	U	0.15	U	0.15	U	0.16	U
Calcium	nc	mg/kg	NA	NA	471	**1,260**		**1,160**		109	B	282	B	524	B	132	B	827	
Chromium	nc	mg/kg	12,000	150,000	21	9.9		8.4		3.0		5.3		7.0		5.4		20.7	
Cobalt	nc	mg/kg	NA	NA	14.0	3.0	B	2.0	B	0.69	B	1.5	B	2.3	B	1.2	B	4.8	B
Copper	nc	mg/kg	310	4,100	10.9	4.0		4.0		1.2	B	3.0		4.3		3.5		8.6	
Iron	nc	mg/kg	5,500	72,000	17,900	**6,780**		**6,640**		1,390		3,520		5,210		2,330		**18,700**	
Lead	nc	mg/kg	40	NA	12.2	6.2		5.6		7.1		3.6		3.4		3.0		9.6	
Magnesium	nc	mg/kg	NA	NA	1,780	867		913		126	B	346	B	357	B	338	B	1530	
Manganese	nc	mg/kg	180	2,300	213	**219**		65.4		7.1		45.7		40.4		17.1		132	
Mercury	nc	mg/kg	0.7	2.8	0.048	**0.11**		0.022	B	0.0093	U	0.025	B	0.014	B	0.017	B	0.029	B
Nickel	nc	mg/kg	160	2,000	11.2	4.7		4.7		1.0	B	2.9	B	4.9		3.4	B	9.9	
Potassium	nc	mg/kg	NA	NA	853	399	B	355	B	124	B	251	B	256	B	211	B	701	
Selenium	nc	mg/kg	39	510	0.89	0.83	U	0.82	U	0.88	U	0.79	U	0.82	U	0.83	U	0.87	U
Silver	nc	mg/kg	39	510	0.22	0.17	U	0.16	U	0.18	U	0.16	U	0.16	U	0.17	U	0.17	U
Sodium	nc	mg/kg	NA	NA	49.3	83	U	94.2	B	94.9	B	84.3	B	83	U	83	U	88	U
Thallium	nc	mg/kg	0.51	6.6	0.53	0.10	B	0.055	B	0.034	B	0.030	B	0.044	B	0.042	U	0.11	B
Vanadium	nc	mg/kg	55	720	31	12.7		12.7		3.6		7.0		9.9		7.1		32.5	
Zinc	nc	mg/kg	2,300	31,000	26	17		17.7		2.8		7.7		7.4		6.8		23.8	
Total Organic Carbon	nc	mg/kg	NA	NA	-	NA		NA		NA		NA		NA		NA		NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over Residential values (either full (c) or 1/10th (nc))
highlight blue: over Industrial values (either full (c) or 1/10th (nc))
bold, underline: over double the background Molena max detection level

Table 4-7. Summary of Surface (0-6") Soil Results
Southern AOC - NASA Wallops CDL

Sample ID			EPA Regional Screening Levels, Soil** May 2008		Background Molena Soils, Max Detection TetraTech (2004)	**SB-1A (Local Background)**		**SB-3A**		**TP-2A**		**TP-3A (burn area)**		**TP-4A (burn area)**		**TP-7A (burn area)**	
Sampling Date						4/17/2007		4/18/2007		4/9/2007		4/9/2007		4/9/2007		4/10/2007	
Parameter		Units	Residential	Industrial	Surface	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOCs																	
Acetone	nc	ug/kg	6,100,000	61,000,000	-	380	U	400	U	2.9	U	4.8	U	4.0	U	3.5	U
Benzene	c	ug/kg	1,100	5,600	-	64	U	67	U	0.49	U	0.80	U	0.67	U	0.59	U
2-Butanone (MEK)	nc	ug/kg	2,800,000	19,000,000	-	370	U	380	U	2.8	U	4.6	U	3.8	U	3.3	U
Carbon disulfide	nc	ug/kg	67,000	300,000	-	74	U	77	U	0.57	U	0.92	U	0.77	U	0.68	U
Cyclohexane	nc	ug/kg	720,000	3,000,000	-	170	U	180	U	1.3	U	2.1	U	1.8	U	1.6	U
1,2-Dichloroethane	c	ug/kg	450	2,200	-	73	U	75	U	0.56	U	0.91	U	0.76	U	0.67	U
Ethylbenzene	c	ug/kg	5,700	29,000	-	60	U	63	U	0.46	U	0.75	U	0.63	U	0.55	U
Isopropylbenzene	nc	ug/kg	220,000	1,100,000	-	62	U	65	U	0.48	U	0.78	U	0.65	U	0.57	U
Methyl Acetate	nc	ug/kg	7,800,000	100,000,000	-	190	U	200	U	1.4	U	2.4	U	2.0	U	1.7	U
Methylcyclohexane	nc	ug/kg	340,000	1,400,000	-	86	U	90	U	0.66	U	1.1	U	0.9	U	0.79	U
Methylene chloride	c	ug/kg	11,000	54,000	-	92	U	96	U	0.71	U	1.2	U	0.96	U	0.85	U
Tetrachloroethene	c	ug/kg	570	2,700	3	110	U	110	U	0.85	U	1.4	U	1.1	U	1.0	U
Toluene	nc	ug/kg	500,000	4,600,000	-	73	U	75	U	0.56	U	0.91	U	0.75	U	0.66	U
m,p-Xylene	nc	ug/kg	450,000	1,900,000	-	120	U	120	U	0.90	U	1.5	U	1.2	U	1.1	U
o-Xylene	nc	ug/kg	530,000	2,300,000	-	66	U	69	U	0.51	U	0.82	U	0.69	U	0.6	U
Xylene (total)	nc	ug/kg	60,000	260,000	-	66	U	69	U	0.51	U	0.82	U	0.69	U	0.6	U
SVOCs																	
Acenaphthylene	nc	ug/kg	NA	NA	-	16	U	18	U	16	U	18	U	16	U	16	U
Anthracene	nc	ug/kg	1,700,000	17,000,000	-	16	U	17	U	15	U	**22.2**	J	16	U	**16.8**	J
Benzo(a)anthracene	c	ug/kg	150	2,100	550	19	U	22	U	24.3	J	53.4	J	20	U	114	
Benzo(a)pyrene	c	ug/kg	15	210	410	14	U	16	U	14	U	**58.8**	J	14	U	**106**	
Benzo(b)fluoranthene	c	ug/kg	150	2,100	640	18	U	21	U	18	U	98.7		19	U	114	
Benzo(g,h,i)perylene	nc	ug/kg	NA	NA	-	22	U	25	U	22	U	**85**	J	22	U	**66.6**	J
Benzo(k)fluoranthene	c	ug/kg	1,500	21,000	290	30	U	34	U	30	U	95.5		31	U	85.7	
Benzaldehyde	nc	ug/kg	780,000	10,000,000	-	44	U	50	U	44	U	49	U	45	U	45	U
Chrysene	c	ug/kg	15,000	210,000	630	15	U	17	U	19.1	J	111		15	U	117	
Dibenzo(a,h)anthracene	c	ug/kg	15	210	-	21	U	24	U	21	U	23	U	21	U	**22.6**	J
Di-n-octyl phthalate	nc	ug/kg	NA	NA	-	34	U	39	U	34	U	38	U	35	U	35	U
bis(2-Ethylhexyl)phthalate	c	ug/kg	35,000	120,000	210	51	U	58	U	51	U	111		97.4		52.5	J
Fluoranthene	nc	ug/kg	230,000	2,200,000	1,000	14	U	16	U	39.9	J	176		23	J	164	
Indeno(1,2,3-cd)pyrene	c	ug/kg	150	2,100	-	25	U	29	U	25	U	**63.7**	J	26	U	**61.3**	J
Phenanthrene	nc	ug/kg	NA	NA	790	18	U	20	U	26.2	J	25.6	J	18	U	83.1	
Pyrene	nc	ug/kg	170,000	1,700,000	890	14	U	16	U	35.3	J	159		21.3	J	153	
Pesticides / PCBs																	
alpha-Chlordane	c	ug/kg	1,600	6,500	-	0.43	U	0.48	U	0.42	U	0.47	U	0.44	U	4.4	U
gamma-Chlordane	c	ug/kg	1,600	6,500	-	0.43	U	0.48	U	0.42	U	0.47	U	0.44	U	4.4	U
4,4'-DDD	c	ug/kg	2,000	7,200	31	0.39	U	0.43	U	0.38	U	22.7		50.9		**126**	
4,4'-DDE	c	ug/kg	1,400	5,100	5,000	0.40	U	5.3		34.7		204		99.9		1020	
4,4'-DDT	c	ug/kg	1,700	7,000	15,000	0.49		6.3		10.7		90.8		56.4		530	
Aroclor 1260	c	ug/kg	220	740	-	8.1	U	9.0	U	7.9	U	8.9	U	8.2	U	8.2	U
Inorganics																	
Aluminum	nc	mg/kg	7,700	99,000	13,900	**9,480**		**9,960**		7,490		**19,900**		**9,520**		**27,300**	
Antimony	nc	mg/kg	3.1	41	-	0.83	U	0.97	U	0.85	U	**64**		**18**		**11**	
Arsenic	c	mg/kg	0.39	1.6	14.2	**4.8**		**3.0**		**7.6**		**7.2**		**4.3**		**6.1**	
Barium	nc	mg/kg	1,500	19,000	114	43		56		32		**1,160**		117		108	
Beryllium	nc	mg/kg	16	200	1.2	0.23	B	0.32	B	0.28	B	0.051	U	0.29	B	0.086	B
Cadmium	nc	mg/kg	7.0	81	0.84	0.16	U	1.8		0.21	B	**22**		**4.7**		**12**	
Calcium	nc	mg/kg	NA	NA	1,390	776		1,350		634		**12,700**		**3,110**		2,700	
Chromium	nc	mg/kg	12,000	150,000	18.4	11		10		14		**50**		24		**78**	
Cobalt	nc	mg/kg	NA	NA	7.3	2.8	B	2.9	B	2.5	B	10	B	3.8	B	4.4	B
Copper	nc	mg/kg	310	4,100	33.0	5.3		26		8.3		**854**		**193**		**1,790**	
Iron	nc	mg/kg	5,500	72,000	10,900	**7,430**		**7,070**		**6,350**		**45,100**		**11,800**		**12,300**	
Lead	nc	mg/kg	40	NA	124	9.2		17		18		**2,120**		**351**		**573**	
Magnesium	nc	mg/kg	NA	NA	1,450	828		1,090		785		2,360		1,260		1,250	
Manganese	nc	mg/kg	180	2,300	781	158		**233**		148		**1,490**		**292**		**326**	
Mercury	nc	mg/kg	0.7	2.8	0.25	0.061		0.061		0.16		**1.8**		0.18		0.16	
Nickel	nc	mg/kg	160	2,000	10.6	5.1		5.7		4.8		**51**		16		**68**	
Potassium	nc	mg/kg	NA	NA	756.0	438	B	608	B	376	B	1,410		576	B	440	B
Selenium	nc	mg/kg	39	510	1.4	0.86	U	1.0	U	0.89	U	**4.4**		0.90	U	0.88	U
Silver	nc	mg/kg	39	510	0.3	0.17	U	0.20	U	0.18	B	**85**		**4.3**		**25**	
Sodium	nc	mg/kg	NA	NA	31	87	U	**103**	B	89	U	190	U	91	U	88	U
Thallium	nc	mg/kg	0.51	6.6	1.6	0.093	B	0.079	B	0.050	B	0.053	B	0.046	U	0.044	U
Vanadium	nc	mg/kg	55	720	29	14		14		12		51		16		13	
Zinc	nc	mg/kg	2,300	31,000	104	19		65		27		**4,280**		**603**		**708**	
Total Organic Carbon	nc	mg/kg	NA	NA	-	NA		NA		NA		NA		NA		NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over Residential values (either full (c) or 1/10th (nc))
highlight blue: over Industrial values (either full (c) or 1/10th (nc))
bold, underline: over double the background Molena max detection level

Table 4-8. Summary of Subsurface Soil Results
Southern AOC - NASA Wallops CDL

Sample ID			EPA Regional Screening Levels, Soil** May 2008		Background Molena Soils, Max Detection TetraTech (2004)	SB-1B (Local Background) (6-24")		SB-3B (6-24")		TP-2B (6-24")		TP-3B (burn area) (6-24")		TP-3C (burn area) (48-56")		TP-3C-D (burn area) (48-56")		TP-4B (burn area) (6-24")		TP-7B (burn area) (6-24")	
Sampling Date						4/17/2007		4/18/2007		4/9/2007		4/9/2007		4/9/2007		4/9/2007		4/9/2007		4/10/2007	
Parameter		Units	Residential	Industrial	Subsurface	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOCs																					
Acetone	nc	ug/kg	6,100,000	61,000,000	-	250	U	290	U	2.5	U	3.0	U	4.9	U	3.8	U	2.3	U	3.1	U
Benzene	c	ug/kg	1,100	5,600	-	42	U	49	U	0.42	U	0.50	U	**2.4**		**1.1**	J	0.39	U	0.52	U
2-Butanone (MEK)	nc	ug/kg	2,800,000	19,000,000	-	240	U	280	U	2.4	U	2.9	U	4.7	U	3.7	U	2.2	U	2.9	U
Carbon disulfide	nc	ug/kg	67,000	300,000	-	48	U	56	U	0.49	U	0.58	U	0.94	U	0.74	U	0.45	U	0.59	U
Cyclohexane	nc	ug/kg	720,000	3,000,000	-	110	U	130	U	1.1	U	1.3	U	2.2	U	1.7	U	1.0	U	1.4	U
1,2-Dichloroethane	c	ug/kg	450	2,200	-	42	U	55	U	0.48	U	0.57	U	0.93	U	0.73	U	0.44	U	0.58	U
Ethylbenzene	c	ug/kg	5,700	29,000	-	39	U	46	U	0.4	U	0.47	U	0.77	U	0.61	U	0.36	U	0.48	U
Isopropylbenzene	nc	ug/kg	220,000	1,100,000	-	41	U	47	U	0.41	U	0.49	U	0.8	U	0.63	U	0.37	U	0.5	U
Methyl Acetate	nc	ug/kg	7,800,000	100,000,000	-	120	U	140	U	1.2	U	1.5	U	2.4	U	1.9	U	1.1	U	1.5	U
Methylcyclohexane	nc	ug/kg	340,000	1,400,000	-	56	U	65	U	0.57	U	0.68	U	1.1	U	0.87	U	0.52	U	0.69	U
Methylene chloride	c	ug/kg	11,000	54,000	-	61	U	70	U	0.61	U	0.73	U	1.2	U	0.93	U	0.56	U	0.74	U
Tetrachloroethene	c	ug/kg	570	2,700	-	72	U	83	U	0.72	U	**2.8**	J	**9.3**		**13.7**		**0.99**	J	0.89	U
Toluene	nc	ug/kg	500,000	4,600,000	-	47	U	55	U	0.48	U	0.57	U	0.93	U	0.73	U	0.44	U	0.58	U
m,p-Xylene	nc	ug/kg	450,000	1,900,000	-	77	U	89	U	0.77	U	0.92	U	1.5	U	1.2	U	0.71	U	0.94	U
o-Xylene	nc	ug/kg	530,000	2,300,000	-	43	U	50	U	0.43	U	0.52	U	0.84	U	0.66	U	0.40	U	0.53	U
Xylene (total)	nc	ug/kg	60,000	260,000	-	43	U	50	U	0.43	U	0.52	U	0.84	U	0.66	U	0.40	U	0.53	U
SVOCs																					
Acenaphthylene	nc	ug/kg	NA	NA	-	15	U	16	U	15	U	15	U	17	U	17	U	15	U	**16**	
Anthracene	nc	ug/kg	1,700,000	17,000,000	-	14	U	15	U	14	U	14	U	16	U	16	U	14	U	**19.5**	J
Benzo(a)anthracene	c	ug/kg	150	2,100	-	18	U	19	U	18	U	18	U	20	U	20	U	18	U	**114**	
Benzo(a)pyrene	c	ug/kg	15	210	-	13	U	14	U	13	U	13	U	15	U	14	U	13	U	**117**	
Benzo(b)fluoranthene	c	ug/kg	150	2,100	-	17	U	18	U	17	U	17	U	19	U	19	U	17	U	**133**	
Benzo(g,h,i)perylene	nc	ug/kg	NA	NA	-	20	U	21	U	20	U	20	U	23	U	22	U	20	U	**62.3**	J
Benzo(k)fluoranthene	c	ug/kg	1,500	21,000	-	27	U	29	U	28	U	28	U	31	U	31	U	28	U	**107**	
Benzaldehyde	nc	ug/kg	780,000	10,000,000	-	40	U	43	U	40	U	40	U	46	U	45	U	41	U	**44**	
Chrysene	c	ug/kg	15,000	210,000	-	13	U	14	U	14	U	14	U	15	U	15	U	14	U	**117**	
Dibenzo(a,h)anthracene	c	ug/kg	15	210	-	19	U	21	U	19	U	19	U	22	U	21	U	20	U	**24**	J
Di-n-octyl phthalate	nc	ug/kg	NA	NA	-	31	U	33	U	31	U	31	U	36	U	35	U	32	U	**25**	
bis(2-Ethylhexyl)phthalate	c	ug/kg	35,000	120,000	-	47	U	50	U	47	U	47	U	**110**		**79.6**	J	**199**		**51**	
Fluoranthene	nc	ug/kg	230,000	2,200,000	-	13	U	14	U	13	U	13	U	15	U	15	U	13	U	**139**	
Indeno(1,2,3-cd)pyrene	c	ug/kg	150	2,100	-	23	U	25	U	23	U	23	U	26	U	26	U	24	U	**64.3**	J
Phenanthrene	nc	ug/kg	NA	NA	-	16	U	17	U	16	U	16	U	18	U	18	U	16	U	**68.5**	J
Pyrene	nc	ug/kg	170,000	1,700,000	-	13	U	14	U	13	U	13	U	14	U	14	U	13	U	**132**	
Pesticides / PCBs																					
alpha-Chlordane	c	ug/kg	1,600	6,500	-	0.36	U	0.43	U	0.40	U	**26.7**		0.46	U	0.44	U	0.40	U	0.43	U
gamma-Chlordane	c	ug/kg	1,600	6,500	-	0.36	U	0.42	U	0.40	U	**34.6**		0.45	U	0.44	U	0.40	U	0.43	U
4,4'-DDD	c	ug/kg	2,000	7,200	-	0.35	U	1.3	J	0.35	U	**19.2**		**6.2**		**3.3**		**197**		**175**	
4,4'-DDE	c	ug/kg	1,400	5,100	85	0.36	U	26.7		0.37	U	**803**		53.2		21.3		**792**		**1,310**	
4,4'-DDT	c	ug/kg	1,700	7,000	210	0.44	U	19.4		0.45	U	93.4		18.3		7.0		**573**		**577**	
Aroclor 1260	c	ug/kg	220	740	-	7.3	U	7.9	U	7.4	U	**213**		8.5	U	8.2	U	7.5	U	8.0	U
Inorganics																					
Aluminum	nc	mg/kg	7,700	99,000	22,400	**9,030**		**12,100**		**8,610**		7,060		**79,300**		**54,000**		**9,000**		**38,600**	
Antimony	nc	mg/kg	3.1	41	-	0.80	U	0.89	U	0.82	U	**19**		**41**		**61**		**11**		**30**	
Arsenic	c	mg/kg	0.39	1.6	5.3	**5.5**		**5.0**		**3.9**		**3.0**		**3.9**		**8.4**		**4.4**		**7.5**	
Barium	nc	mg/kg	1,500	19,000	89	54		49		40		**213**		**1,110**		**916**		131		135	
Beryllium	nc	mg/kg	16	200	0.57	0.33	B	0.40	B	0.33	B	0.022	U	0.025	U	0.075	U	0.23	B	0.024	U
Cadmium	nc	mg/kg	7.0	81	0.36	0.15	U	0.45	B	0.16	U	**7.0**		**20**		**75**		3.9		**21**	
Calcium	nc	mg/kg	NA	NA	471	**1,260**		234	B	287	B	**4,310**		**9,290**		**7,860**		**1,310**		**2,170**	
Chromium	nc	mg/kg	12,000	150,000	21	10		11		8.0		20		**42**		**56**		19		**616**	
Cobalt	nc	mg/kg	NA	NA	14.0	3.0	B	3.5	B	2.7	B	2.6	B	4.4	B	8.3	B	3.5	B	5.1	B
Copper	nc	mg/kg	310	4,100	10.9	4.0		8.7		5.3		**416**		**1,610**		**3,060**		**119**		**5,100**	
Iron	nc	mg/kg	5,500	72,000	17,900	**6,780**		**8,600**		**5,970**		**8,680**		**32,300**		**96,200**		**10,400**		**16,500**	
Lead	nc	mg/kg	40	NA	12.2	6.2		7.3		5.4		**1,070**		**984**		**1,070**		**509**		**1,450**	
Magnesium	nc	mg/kg	NA	NA	1,780	867		1,040		763		699		1,660		1,810	B	953		2,580	
Manganese	nc	mg/kg	180	2,300	213	**219**		**230**		154		**261**		**462**		**1,440**		**286**		**398**	
Mercury	nc	mg/kg	0.7	2.8	0.048	**0.11**		0.091		0.040		**0.34**		**0.33**		**0.24**		**0.19**		**0.18**	
Nickel	nc	mg/kg	160	2,000	11.2	4.7		6.2		5.1		18		**77**		**72**		10		**132**	
Potassium	nc	mg/kg	NA	NA	853	399	B	527	B	292	B	592		772		935	B	460	B	420	B
Selenium	nc	mg/kg	39	510	0.89	0.83	U	0.92	U	0.86	U	0.84	U	1.5	B	**2.8**	U	0.85	U	0.93	B
Silver	nc	mg/kg	39	510	0.22	0.17	U	0.18	U	0.17	U	**9.0**		**42**		**46**		**2.7**		**32**	
Sodium	nc	mg/kg	NA	NA	49.3	83	U	**100**	B	86	U	**215**	B	96	U	280	U	85	U	91	U
Thallium	nc	mg/kg	0.51	6.6	0.53	0.10	B	0.15	B	0.045	B	0.043	U	0.048	U	0.048	U	0.043	U	0.046	U
Vanadium	nc	mg/kg	55	720	31	13		16		12		12		13		15	B	14		15	
Zinc	nc	mg/kg	2,300	31,000	26	17		22		16		**1,190**		**3,600**		**3,070**		**554**		**1,140**	
Total Organic Carbon	nc	mg/kg	NA	NA	-	NA		NA		NA		NA		NA		NA		NA		NA	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over Residential values (either full (c) or 1/10th (nc))
highlight blue: over Industrial values (either full (c) or 1/10th (nc))
bold, underline: over double the background Molena max detection level

Table 4-9. Summary Groundwater Results, May 2007
NASA Wallops CDL

Sample ID			EPA Regional Tapwater Screening Levels May 2008**	Wallops Groundwater Background Mean TetraTech (2004)	VA Groundwater Quality Standards February 2004	**MW-1 (Local Background)**		**MW-2**		**MW-3**		**MW-4**		**MW-4D**		**MW-5**		**MW-6**	
Sampling Date						05/01/07		05/01/07		05/02/07		05/02/07		05/02/07		05/02/07		05/02/07	
Parameter		Units				Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOC																			
Benzene	ca	ug/l	0.41	-	-	0.21	U	0.21	U	0.21	U	2.1	U	1.1	U	**3.7**		0.21	U
Carbon disulfide	nc	ug/l	100	-	-	0.21	U	0.21	U	0.21	U	2.1	U	1	U	0.21	U	0.21	U
Chloroform	ca	ug/l	0.19	2.0	-	0.22	U	0.22	U	0.22	U	2.2	U	1.1	U	0.22	U	0.22	U
Cyclohexane	nc	ug/l	1,300	-	-	0.50	U	0.50	U	0.50	U	**158**		**128**		0.50	U	0.50	U
1,2-Dichloroethane	ca	ug/l	0.15	-	-	0.29	U	0.29	U	0.29	U	2.9	U	1.5	U	**8.8**		0.29	U
cis-1,2-Dichloroethene	nc	ug/l	37	1.0	-	0.18	U	0.18	U	0.18	U	**45.4**		**50.8**		0.18	U	0.18	U
Ethylbenzene	ca	ug/l	1.5	-	-	0.20	U	0.20	U	0.20	U	**450**		**389**		0.20	U	0.20	U
Isopropylbenzene	nc	ug/l	68	-	-	0.20	U	0.20	U	0.20	U	**48.5**		**49.9**		0.20	U	0.20	U
Methylcyclohexane	nc	ug/l	630	-	-	0.18	U	0.18	U	0.18	U	**110**		**105**		0.18	U	0.18	U
Tetrachloroethene	ca	ug/l	0.11	10	-	0.28	U	0.28	U	0.28	U	**13.7**		**13.9**		0.28	U	0.28	U
Toluene	nc	ug/l	230	-	-	0.20	U	0.20	U	0.20	U	**1,460**		**1,220**		0.20	U	0.20	U
Trichloroethene	ca	ug/l	1.7	-	-	0.29	U	0.29	U	0.29	U	**3.1**	J	**3.6**	J	0.29	U	0.29	U
m,p-Xylene	nc	ug/l	140	-	-	0.42	U	0.42	U	0.42	U	**1,790**		**1,490**		0.42	U	0.42	U
o-Xylene	nc	ug/l	140	-	-	0.31	U	0.31	U	0.31	U	**524**		**416**		0.31	U	0.31	U
Xylene (total)	nc	ug/l	20	-	-	0.31	U	0.31	U	0.31	U	**2,310**		**1,900**		0.31	U	0.31	U
SVOC																			
2-Methylphenol	nc	ug/l	180	-	-	1.4	U	1.4	U	1.4	U	1.4	U	**1.7**	J	1.5	U	1.4	U
3&4-Methylphenol	nc	ug/l	18	-	-	1.4	U	1.3	U	1.3	U	1.3	U	**3.2**	J	1.4	U	1.3	U
1,1'-Biphenyl	nc	ug/l	180	-	-	0.35	U	0.33	U	0.33	U	**2.2**		**1.8**	J	0.36	U	0.33	U
Carbazole	ca	ug/l	3.4	-	-	0.39	U	0.36	U	0.36	U	0.36	U	0.36	U	0.40	U	0.36	U
Dibenzofuran	nc	ug/l	NA	-	-	0.37	U	0.34	U	0.34	U	0.34	U	0.34	U	0.37	U	0.34	U
bis(2-Ethylhexyl)phthalate	ca	ug/l	4.8	-	-	0.70	U	0.66	U	0.66	U	0.66	U	**2.2**	B	0.72	U	**2.5**	B
Fluorene	nc	ug/l	150	-	-	0.48	U	0.45	U	0.45	U	0.45	U	0.45	U	0.49	U	0.45	U
2-Methylnaphthalene	nc	ug/l	15	-	-	0.43	U	0.41	U	0.41	U	**35.4**		**30**		0.44	U	0.41	U
Naphthalene	nc	ug/l	0.62	-	-	0.34	U	0.32	U	0.32	U	**94.9**		**77.2**		0.35	U	0.32	U
Phenanthrene	nc	ug/l	NA	-	-	0.39	U	0.36	U	0.36	U	0.36	U	0.36	U	0.39	U	0.36	U
Inorganics																			
Aluminum	nc	mg/l	3.7	59	-	0.023	U	0.023	U	0.0641	B	0.023	U	0.023	U	0.257		0.0386	B
Antimony	nc	mg/l	0.0015	-	-	0.0050	U	0.0050	U	0.0050	U	0.0050	U	0.0050	U	0.0050	U	0.0050	U
Arsenic	ca	mg/l	0.000045	0.018	0.05	0.00094	U	**0.0029**		**0.0017**	B	**0.0086**	B	**0.0087**	B	0.0047	U	0.0047	U
Barium	nc	mg/l	0.73	0.221	1.0	0.0097	B	0.0073	B	0.0033	B	0.031	B	0.031	B	0.11	B	0.0080	B
Beryllium	nc	mg/l	0.0073	0.0019	-	0.00040	U	0.00040	U	0.00040	U	0.00040	U	0.00040	U	0.00040	U	0.00040	U
Cadmium	nc	mg/l	0.0018	0.00042	0.0004	0.0013	U*	0.0013	U*	0.0013	U*	0.0013	U*	0.0013	U*	0.0013	U*	0.0013	U*
Calcium	nc	mg/l	NA	30	-	29		24		26		25		26		**144**		28	
Chromium	nc	mg/l	5.5	0.046	0.05	0.0020	B	0.00080	U	0.00080	U	0.0014	B	0.00080	B	0.00080	U	0.0011	B
Cobalt	nc	mg/l	NA	0.019	-	0.0018	U	0.0018	U	0.0018	U	0.0018	U	0.0018	U	0.0018	U	0.0018	U
Copper	nc	mg/l	0.15	0.015	1.0	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U
Iron	nc	mg/l	2.6	50	-	0.025	U	0.025	U	0.025	U	**25**		**25**		1.7		0.029	B
Lead	nc	mg/l	NA	0.013	0.05	0.0028	U	0.0028	U	0.0028	U	0.0058		0.0080		0.0028	U	0.0028	U
Magnesium	nc	mg/l	NA	13	-	1.5	B	1.4	B	2.4	B	1.5	B	1.5	B	10		1.6	B
Manganese	nc	mg/l	0.088	3.1	-	0.012	B	0.0047	B	0.0017	B	**0.54**		**0.54**		**1.1**		0.0078	B
Mercury	nc	mg/l	0.000063	-	0.00005	**0.00018**	B	**0.00013**	B	0.000043	B	**0.00017**	B	**0.00013**	B	**0.00013**	B	**0.00011**	B
Nickel	nc	mg/l	0.073	0.015	-	0.0046	B	0.0028	U	0.0028	U	0.0028	U	0.0028	U	0.0028	U	0.0028	U
Potassium	nc	mg/l	NA	8.0	-	1.2	B	1.2	B	1.1	B	1.4	B	1.5	B	1.8	B	1.0	B
Selenium	nc	mg/l	0.018	0.0031	0.01	0.0062	U	0.0062	U	0.0062	U	0.0062	U	0.0062	U	0.0062	U	0.0062	U
Silver	nc	mg/l	0.018	-	-	0.0010	U	0.0010	U	0.0010	U	0.0010	U	0.0010	U	0.0010	U	0.0011	B
Sodium	nc	mg/l	NA	18	270	4.9	B	4.9	B	5.2	B	22		22		25		6.5	B
Thallium	nc	mg/l	0.00024	-	-	0.00048	U	0.00048	U	0.00048	U	0.0024	U	0.0024	U	0.0024	U	0.0024	U
Vanadium	nc	mg/l	0.018	0.070	-	0.0018	U	0.0018	U	0.0018	U	0.0018	U	0.0018	U	0.0024	B	0.0018	U
Zinc	nc	mg/l	1.1	0.085	0.05	0.0038	B	0.0034	U	0.0038	B	0.0039	B	0.0048	B	0.0047	B	0.0040	B

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
U*: MDLs greater than VA GW Quality Standards
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
red, bold: over Tapwater values (either full (c) or 1/10th (nc))
bold, underline: over double the background groundwater max detection level
grey highlighted: over VA GW Quality Standards; mercury detection appears to be related to blank contamination

Table 4-10. Summary Groundwater Results, December 2007
NASA Wallops CDL

Sample ID			EPA Regional Tapwater Screening Levels May 2008**	Wallops Groundwater Background Mean TetraTech (2004)	VA Groundwater Quality Standards February 2004	**MW-01 (Local Background)**		**MW-02**		**MW-03**		**MW-03-D**		**MW-04**		**MW-05**		**MW-06**	
Sampling Date						12/19/07		12/18/07		12/19/07		12/19/07		12/18/07		12/18/07		12/18/07	
Parameter		Units				Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOC																			
Benzene	ca	ug/l	0.41	-	-	0.19	U	0.19	U	0.19	U	0.19	U	1.9	U	0.19	U	0.19	U
Carbon disulfide	nc	ug/l	100	-	-	0.14	U	0.14	U	0.14	U	0.14	U	1.4	U	0.14	U	0.14	U
Chloroform	ca	ug/l	0.19	2.0	-	0.25	U	0.25	U	0.25	U	0.25	U	2.5	U	0.25	U	0.25	U
Cyclohexane	nc	ug/l	1,300	-	-	0.85	U	0.85	U	0.85	U	0.85	U	**216**		0.85	U	0.85	U
1,2-Dichloroethane	ca	ug/l	0.15	-	-	0.29	U	0.29	U	0.29	U	0.29	U	2.9	U	**17.6**		0.29	U
cis-1,2-Dichloroethene	nc	ug/l	37	1.0	-	0.27	U	0.27	U	0.27	U	0.27	U	**54.5**		0.27	U	0.27	U
Ethylbenzene	ca	ug/l	1.5	-	-	0.21	U	0.21	U	0.21	U	0.21	U	**548**		0.21	U	0.21	U
Isopropylbenzene	nc	ug/l	68	-	-	0.54	U	0.54	U	0.54	U	0.54	U	**68.6**		0.54	U	0.54	U
Methylcyclohexane	nc	ug/l	630	-	-	0.50	U	0.50	U	0.50	U	0.50	U	**180**		0.50	U	0.50	U
Tetrachloroethene	ca	ug/l	0.11	10	-	0.28	U	0.28	U	0.28	U	0.28	U	**7.9**	J	0.28	U	0.28	U
Toluene	nc	ug/l	230	-	-	0.21	U	0.21	U	0.21	U	0.21	U	**1680**		0.21	U	0.21	U
Trichloroethene	ca	ug/l	1.7	-	-	0.26	U	0.26	U	0.26	U	0.26	U	2.6	U	0.26	U	0.26	U
m,p-Xylene	nc	ug/l	140	-	-	0.35	U	0.35	U	0.35	U	0.35	U	**2180**		0.35	U	0.35	U
o-Xylene	nc	ug/l	140	-	-	0.20	U	0.20	U	0.20	U	0.20	U	**859**		0.20	U	0.20	U
Xylene (total)	nc	ug/l	20	-	-	0.20	U	0.20	U	0.20	U	0.20	U	**3040**		0.20	U	0.20	U
SVOC																			
2-Methylphenol	nc	ug/l	180	-	-	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U	1.0	U
3&4-Methylphenol	nc	ug/l	18	-	-	1.1	U	1.1	U	1.1	U	1.1	U	1.1	U	1.1	U	1.1	U
1,1'-Biphenyl	nc	ug/l	180	-	-	0.22	U	0.22	U	0.22	U	0.22	U	**2.7**		0.22	U	0.22	U
Carbazole	ca	ug/l	3.4	-	-	0.40	U	0.40	U	0.40	U	0.40	U	0.40	U	**0.60**	J	0.40	U
Dibenzofuran	nc	ug/l	NA	-	-	0.23	U	0.23	U	0.23	U	0.23	U	**0.51**	J	0.23	U	0.23	U
bis(2-Ethylhexyl)phthalate	ca	ug/l	4.8	-	-	0.88	U	0.88	U	0.88	U	0.88	U	0.88	U	0.88	U	0.88	U
Fluorene	nc	ug/l	150	-	-	0.36	U	0.36	U	0.36	U	0.36	U	**0.50**	J	**0.41**	J	0.36	U
2-Methylnaphthalene	nc	ug/l	15	-	-	0.76	U	0.76	U	0.76	U	0.76	U	**34.4**		0.76	U	0.76	U
Naphthalene	nc	ug/l	0.62	-	-	0.18	U	0.18	U	0.18	U	0.18	U	**81.8**		**0.57**	J	0.18	U
Phenanthrene	nc	ug/l	NA	-	-	0.28	U	0.28	U	0.28	U	0.28	U	0.28	U	**0.53**	J	0.28	U
Inorganics																			
Aluminum	nc	mg/l	3.7	59	-	0.91		0.20		0.87		1.4		0.057	B	0.22		0.081	B
Antimony	nc	mg/l	0.0015	-	-	0.00090	U	0.00090	U	0.00090	U	0.00090	U	0.00090	U	0.0010	B	0.00090	U
Arsenic	ca	mg/l	0.000045	0.018	0.05	**0.0010**	B	0.00094	U	0.00094	U	0.00094	U	**0.0080**		**0.0057**		0.00094	U
Barium	nc	mg/l	0.73	0.221	1.0	0.0153	B	0.0076	B	0.0058	B	0.0067	B	0.022	B	0.092	B	0.0095	B
Beryllium	nc	mg/l	0.0073	0.0019	-	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.00015	U
Cadmium	nc	mg/l	0.0018	0.00042	0.0004	0.00024	U	0.00024	U	0.00024	U	0.00024	U	0.00030	B	0.00030	B	0.00024	U
Calcium	nc	mg/l	NA	30	-	48		23		26		27		22		**120**		34	
Chromium	nc	mg/l	5.5	0.046	0.05	0.0057	B	0.00053	U	0.0010	B	0.0015	B	0.00053	U	0.00053	U	0.0020	B
Cobalt	nc	mg/l	NA	0.019	-	0.00020	B	0.00015	U	0.00015	U	0.00015	U	0.00015	U	0.0017	B	0.00015	U
Copper	nc	mg/l	0.15	0.015	1.0	0.0058	B	0.0033	U	0.0033	B	0.0066	B	0.0033	U	0.0033	U	0.0033	U
Iron	nc	mg/l	2.6	50	-	0.44		0.042	B	0.42		0.67		**30**		**14**		0.020	B
Lead	nc	mg/l	NA	0.013	0.05	0.0021	B	0.0017	B	0.0023	B	0.0031		0.0087		0.0020	B	0.0016	B
Magnesium	nc	mg/l	NA	13	-	2.8	B	1.3	B	2.3	B	2.3	B	1.8	B	14		1.7	B
Manganese	nc	mg/l	0.088	3.1	-	0.0069	B	0.0015	U	0.0024	B	0.0029	B	**0.62**		**1.8**		0.0015	U
Mercury	nc	mg/l	0.000063	-	0.00005	0.00015	U*	0.00015	U*	0.00015	U*	0.00015	U*	0.00015	U*	0.00015	U*	0.00015	U*
Nickel	nc	mg/l	0.073	0.015	-	0.0066	B	0.00073	U	0.00080	B	0.0010	B	0.00073	U	0.00080	B	0.0013	B
Potassium	nc	mg/l	NA	8.0	-	1.9	B	1.2	B	1.2	B	1.2	B	1.3	B	3.6	B	1.1	B
Selenium	nc	mg/l	0.018	0.0031	0.01	0.0042	B	0.0030	B	0.0035	B	0.0022	B	0.0020	B	0.0048	B	0.0037	B
Silver	nc	mg/l	0.018	-	-	0.0026	U	0.0026	U	0.0026	U	0.0026	U	0.0026	U	0.0026	U	0.0026	U
Sodium	nc	mg/l	NA	18	270	5.4	B	4.2	B	4.9	B	5.0	B	23		18		6.6	B
Thallium	nc	mg/l	0.00024	-	-	0.00048	U	0.00048	U	0.00048	U	0.00048	U	0.00048	U	0.00048	U	0.0013	
Vanadium	nc	mg/l	0.018	0.070	-	0.0019	B	0.0010	B	0.0017	B	0.0024	B	0.00049	U	0.0035	B	0.00090	B
Zinc	nc	mg/l	1.1	0.085	0.05	0.0237		0.0050	B	0.0042	B	0.0050	B	0.0027	U	0.0027	U	0.0027	U

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
U*: MDLs greater than VA GW Quality Standards
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
red, bold: over Tapwater values (either full (c) or 1/10th (nc))
bold, underline: over double the background groundwater max detection level
grey highlighted: over VA GW Quality Standards

Table 4-11. Summary Surface Water Results, May 2007
NASA Wallops CDL

Sample ID			EPA Region III BTAG Eustarine Surface Water July 2006	Mosquito Creek Background (1WFF-MB-111) Versar (2001)		SW-1 (Local Background)		SW-2		SW-3		SW-4		SW-4D	
Sampling Date						05/01/07		05/01/07		05/01/07		05/01/07		05/01/07	
Parameter		Units		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOC															
Benzene	ca	ug/l	110	-		0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
Carbon disulfide	nc	ug/l	-	-		0.21	U	0.21	U	0.21	U	0.21	U	0.21	U
Chloroform	ca	ug/l	815	-		0.22	U	0.22	U	0.22	U	0.22	U	0.22	U
Cyclohexane	nc	ug/l	-	-		0.5	U	0.5	U	0.5	U	0.5	U	0.5	U
1,2-Dichloroethane	ca	ug/l	1,130	-		0.29	U	0.29	U	0.29	U	0.29	U	0.29	U
cis-1,2-Dichloroethene	nc	ug/l	-	-		0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
Ethylbenzene	ca	ug/l	25	-		0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Isopropylbenzene	nc	ug/l	-	-		0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Methylcyclohexane	nc	ug/l	-	-		0.18	U	0.18	U	0.18	U	0.18	U	0.18	U
Tetrachloroethene	ca	ug/l	45	-		0.28	U	0.28	U	0.28	U	0.28	U	0.28	U
Toluene	nc	ug/l	215	-		0.2	U	0.2	U	0.2	U	0.2	U	0.2	U
Trichloroethene	ca	ug/l	1,940	-		0.29	U	0.29	U	0.29	U	0.29	U	0.29	U
m,p-Xylene	nc	ug/l	-	-		0.42	U	0.42	U	0.42	U	0.42	U	0.42	U
o-Xylene	nc	ug/l	-	-		0.31	U	0.31	U	0.31	U	0.31	U	0.31	U
Xylene (total)	nc	ug/l	19	-		0.31	U	0.31	U	0.31	U	0.31	U	0.31	U
SVOC															
2-Methylphenol	nc	ug/l	1,020	-		1.5	U	1.6	U	1.6	U	1.6	U	1.5	U
3&4-Methylphenol	nc	ug/l	-	-		1.4	U	1.5	U	1.5	U	1.5	U	1.4	U
1,1'-Biphenyl	nc	ug/l	-	-		0.36	U	0.38	U	0.38	U	0.38	U	0.37	U
Carbazole	ca	ug/l	-	-		0.40	U	0.42	U	0.43	U	0.42	U	0.41	U
Dibenzofuran	nc	ug/l	65	-		0.38	U	0.40	U	0.40	U	0.40	U	0.39	U
bis(2-Ethylhexyl)phthalate	ca	ug/l	-	-		0.73	U	0.76	U	0.78	U	0.76	U	0.74	U
Fluorene	nc	ug/l	2.5	-		0.50	U	0.52	U	0.53	U	0.52	U	0.50	U
2-Methylnaphthalene	nc	ug/l	4.2	-		0.45	U	0.47	U	0.48	U	0.47	U	0.46	U
Naphthalene	nc	ug/l	1.4	-		0.36	U	0.37	U	0.38	U	0.37	U	0.36	U
Phenanthrene	nc	ug/l	1.5	-		0.4	U	0.42	U	0.43	U	0.42	U	0.41	U
Inorganics															
Aluminum	nc	mg/l	-	0.057	L	**0.19**	B	**0.21**		**0.17**	B	**0.12**	B	**0.11**	B
Antimony	nc	mg/l	0.50	-		0.0050	U	0.0050	U	0.0062		0.0010	U	0.0050	U
Arsenic	ca	mg/l	0.013	0.0030		**0.011**		**0.011**		**0.0092**	B	**0.012**		**0.011**	
Barium	nc	mg/l	-	0.016		0.012	B	0.028	B	0.015	B	0.015	B	0.014	B
Beryllium	nc	mg/l	-	-		0.00071	B	0.00040	U	0.00052	B	0.00046	B	0.00040	B
Cadmium	nc	mg/l	0.00012	-		0.0013	U	0.0013	U	0.0013	U	0.0013	U	0.0013	U
Calcium	nc	mg/l	-	226		282		230		249		260		259	
Chromium	nc	mg/l	0.056	-		0.00080	U	0.00080	U	0.0020	B	0.0011	B	0.00086	B
Cobalt	nc	mg/l	-	0.00088		0.0018	U	0.0018	U	0.0018	U	0.0018	U	0.0018	U
Copper	nc	mg/l	0.0031	0.0022		0.0027	U	0.0027	U	0.0027	U	0.0027	U	0.0027	U
Iron	nc	mg/l	-	0.58	L	0.34		0.42		0.38		0.31		0.30	
Lead	nc	mg/l	0.0081	0.0013	UL	0.0028	U	0.0028	U	0.0028	U	0.0028	U	0.0028	U
Magnesium	nc	mg/l	-	705		1,100		721		789		823		824	
Manganese	nc	mg/l	-	0.0070		**0.032**		**0.040**		**0.044**		**0.043**		**0.043**	
Mercury	nc	mg/l	0.000016	-		**0.00013**	B	**0.000091**	B	0.000037	U	**0.000091**	B	**0.000066**	B
Nickel	nc	mg/l	0.0082	0.0012		0.0028	U	0.0028	U	0.0029	B	0.0028	U	0.0028	U
Potassium	nc	mg/l	-	392	J	512		387		429		457		451	
Selenium	nc	mg/l	0.071	-		0.0062	U	0.0066	B	0.0088	B	0.0069	B	0.0076	B
Silver	nc	mg/l	0.00023	-		0.0010	U	0.0010	U	0.0010	U	0.0010	U	0.0010	U
Sodium	nc	mg/l	-	5,500		6,680		7,010		7,720		8,150		7,950	
Thallium	nc	mg/l	0.021	-		0.0024	U	0.0024	U	0.0024	U	0.0024	U	0.0024	U
Vanadium	nc	mg/l	-	-		0.0018	U	0.0018	U	0.0018	U	0.0018	U	0.0018	U
Zinc	nc	mg/l	0.081	0.0052		0.0034	U	0.0034	U	0.0034	U	0.0034	U	0.0034	U

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over BTAG values
bold, underline: over twice the background

Table 4-12. Summary Surface Water Results, December 2007
NASA Wallops CDL

Sample ID			EPA Region III BTAG Eustarine Surface Water July 2006	Mosquito Creek Background (1WFF-MB-111) Versar (2001)		SW-01 (Local Background)		SW-02		SW-03		SW-04	
Sampling Date						12/19/07		12/19/07		12/19/07		12/19/07	
Parameter		Units		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOC													
Benzene	ca	ug/l	110	-		0.19	U	0.77	J	0.19	U	0.19	U
Carbon disulfide	nc	ug/l	-	-		0.14	U	0.24	J	0.14	U	0.14	U
Chloroform	ca	ug/l	815	-		0.25	U	0.25	U	0.25	U	0.25	U
Cyclohexane	nc	ug/l	-	-		0.85	U	0.85	U	0.85	U	0.85	U
1,2-Dichloroethane	ca	ug/l	1,130	-		0.29	U	0.29	U	0.29	U	0.29	U
cis-1,2-Dichloroethene	nc	ug/l	-	-		0.27	U	0.27	U	0.27	U	0.27	U
Ethylbenzene	ca	ug/l	25	-		0.21	U	0.21	U	0.21	U	0.21	U
Isopropylbenzene	nc	ug/l	-	-		0.54	U	0.54	U	0.54	U	0.54	U
Methylcyclohexane	nc	ug/l	-	-		0.5	U	0.5	U	0.5	U	0.5	U
Tetrachloroethene	ca	ug/l	45	-		0.28	U	0.28	U	0.28	U	0.28	U
Toluene	nc	ug/l	215	-		0.21	U	0.21	U	0.21	U	0.21	U
Trichloroethene	ca	ug/l	1,940	-		0.26	U	0.26	U	0.26	U	0.26	U
m,p-Xylene	nc	ug/l	-	-		0.35	U	0.35	U	0.35	U	0.35	U
o-Xylene	nc	ug/l	-	-		0.2	U	0.2	U	0.2	U	0.2	U
Xylene (total)	nc	ug/l	19	-		0.2	U	0.2	U	0.2	U	0.2	U
SVOC													
2-Methylphenol	nc	ug/l	1,020	-		1.2	U	1.0	U	1.1	U	1.0	U
3&4-Methylphenol	nc	ug/l	-	-		1.2	U	1.1	U	1.2	U	1.1	U
1,1'-Biphenyl	nc	ug/l	-	-		0.25	U	0.22	U	0.24	U	0.22	U
Carbazole	ca	ug/l	-	-		0.44	U	0.4	U	0.44	U	0.4	U
Dibenzofuran	nc	ug/l	65	-		0.25	U	0.23	U	0.25	U	0.23	U
bis(2-Ethylhexyl)phthalate	ca	ug/l	-	-		0.98	U	0.88	U	0.96	U	0.88	U
Fluorene	nc	ug/l	2.5	-		0.40	U	0.36	U	0.40	U	0.36	U
2-Methylnaphthalene	nc	ug/l	4.2	-		0.85	U	0.76	U	0.84	U	1.8	J
Naphthalene	nc	ug/l	1.4	-		0.2	U	0.18	U	0.2	U	1.0	J
Phenanthrene	nc	ug/l	1.5	-		0.31	U	0.28	U	0.31	U	0.28	U
Inorganics													
Aluminum	nc	mg/l	-	0.057	L	**0.36**		**1.1**		**0.43**		**0.14**	B
Antimony	nc	mg/l	0.50	-		0.011	U	0.0057	U	0.011	U	0.011	U
Arsenic	ca	mg/l	0.013	0.0030		**0.0089**		**0.0093**		**0.0079**		**0.0070**	
Barium	nc	mg/l	-	0.016		0.022	B	0.020	B	0.017	B	0.017	B
Beryllium	nc	mg/l	-	-		0.00015	U	0.00015	U	0.00015	U	0.00015	U
Cadmium	nc	mg/l	0.00012	-		0.00050	U	0.00050	U	0.00050	U	0.00050	U
Calcium	nc	mg/l	-	226		202		240		266		232	
Chromium	nc	mg/l	0.056	-		0.0090	U	0.0090	U	0.0090	U	0.0090	U
Cobalt	nc	mg/l	-	0.00088		0.00087	U	0.00087	U	0.00087	U	0.00087	U
Copper	nc	mg/l	0.0031	0.0022		0.0033	U	**0.0049**	B	**0.0033**	B	**0.0039**	B
Iron	nc	mg/l	-	0.58	L	0.47		1.0		0.53		0.23	
Lead	nc	mg/l	0.0081	0.0013	UL	**0.0115**		**0.0031**		0.0030	U	**0.0040**	
Magnesium	nc	mg/l	-	705		709		837		1,060		867	
Manganese	nc	mg/l	-	0.0070		**0.029**		**0.031**		**0.021**		**0.021**	
Mercury	nc	mg/l	0.000016	-		0.00015	U	0.00015	U	0.00015	U	0.00015	U
Nickel	nc	mg/l	0.0082	0.0012		0.0042	U	0.0042	U	0.0042	U	0.0042	U
Potassium	nc	mg/l	-	392	J	270		330		386		336	
Selenium	nc	mg/l	0.071	-		0.017		0.0097	B	0.011		0.012	
Silver	nc	mg/l	0.00023	-		0.0026	U	0.0026	U	0.0026	U	0.0026	U
Sodium	nc	mg/l	-	5,500		6,350		7,930		9,190		7,920	
Thallium	nc	mg/l	0.021	-		0.00048	U	0.00048	U	0.00048	U	0.00048	U
Vanadium	nc	mg/l	-	-		0.0037	B	0.0044	B	0.0037	B	0.0027	B
Zinc	nc	mg/l	0.081	0.0052		0.0029	U	0.0029	U	0.0029	U	0.0029	U

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over BTAG values
bold, underline: over twice the background

Table 4-13. Summary Sediment Results
NASA Wallops CDL

Sample ID			EPA Region III BTAG Eustarine Sediment July 2006	Mosquito Creek Background (1WFF-MB-111) Versar (2001)		SD-1 (Local Background)		SD-2		SD-3		SD-4		SD-4D		SD-5		SD-6		SD-7		SD-8		SD-9		SD-10	
Sampling Date						5/2/2007		5/2/2007		5/2/2007		5/2/2007		5/2/2007		4/30/2007		4/30/2007		5/2/2007		5/2/2007		5/2/2007		5/2/2007	
Parameter		Units		Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual	Result	Qual
VOCs																											
Acetone	nc	ug/kg	-	57		9.4	U	38.4		32.3	J	18	U	19	U	96.6	J	28	J	23	U	**220**		57.9		3.1	U
Benzene	c	ug/kg	137	-		1.6	U	1.7	U	1.6	U	3.0	U	3.1	U	5.7	U	1.7	U	3.8	U	3.3	U	2.2	U	0.53	U
2-Butanone (MEK)	nc	ug/kg	-	-		9.0	U	9.8	U	9.0	U	17	U	18	U	33	U	9.6	U	22	U	**164**		**38.8**	J	3.0	U
Carbon disulfide	nc	ug/kg	-	-		4.3	J	**9.1**	J	**9.6**	J	**26.8**	J	**20.5**	J	6.6	U	**10.1**	J	4.4	U	**8.4**	J	**9.6**	J	0.61	U
Cyclohexane	nc	ug/kg	-	-		4.2	U	4.6	U	4.2	U	**21.8**	J	**14.5**	J	15	U	4.5	U	10	U	8.9	U	5.9	U	1.4	U
1,2-Dichloroethane	c	ug/kg	-	-		1.8	U	1.9	U	1.8	U	3.4	U	3.5	U	6.5	U	1.9	U	4.3	U	3.8	U	2.5	U	0.6	U
Ethylbenzene	c	ug/kg	305	-		1.5	U	1.6	U	1.5	U	2.8	U	2.9	U	5.4	U	1.6	U	3.6	U	3.1	U	2.1	U	0.49	U
Isopropylbenzene	nc	ug/kg	-	-		1.5	U	1.7	U	1.5	U	2.9	U	3.0	U	5.5	U	1.6	U	3.7	U	3.2	U	2.2	U	0.51	U
Methyl Acetate	nc	ug/kg	-	-		**58.6**		5.0	U	4.6	U	8.7	U	9.2	U	17	U	5.0	U	11	U	9.8	U	6.5	U	1.5	U
Methylcyclohexane	nc	ug/kg	-	-		2.1	U	2.3	U	2.1	U	4.0	U	4.2	U	7.7	U	2.3	U	5.1	U	4.5	U	3.0	U	0.71	U
Methylene chloride	c	ug/kg	-	-		2.3	U	2.5	U	2.3	U	9.2	J	4.5	U	8.2	U	2.4	U	5.5	U	4.8	U	3.2	U	0.76	U
Tetrachloroethene	c	ug/kg	190	-		2.7	U	2.9	U	2.7	U	5.1	U	5.4	U	9.8	U	2.9	U	6.5	U	5.7	U	3.8	U	0.9	U
Toluene	nc	ug/kg	1,090	-		1.8	U	1.9	U	1.8	U	3.4	U	3.5	U	6.5	U	1.9	U	4.3	U	3.8	U	2.5	U	0.59	U
m,p-Xylene	nc	ug/kg	-	-		2.9	U	3.1	U	2.9	U	5.4	U	5.7	U	10	U	3.1	U	7.0	U	6.1	U	4.1	U	0.96	U
o-Xylene	nc	ug/kg	-	-		1.6	U	1.8	U	1.6	U	3.1	U	3.2	U	5.9	U	1.7	U	3.9	U	3.4	U	2.3	U	0.54	U
Xylene (total)	nc	ug/kg	-	-		1.6	U	1.8	U	1.6	U	3.1	U	3.2	U	5.9	U	1.7	U	3.9	U	3.4	U	2.3	U	0.54	U
SVOCs																											
Acenaphthylene	nc	ug/kg	5.9	-		33	U	38	U	37	U	68	U	58	U	1,000	U	37	U	90	U	69	U	44	U	16	U
Anthracene	nc	ug/kg	47	-		32	U	37	U	36	U	65	U	56	U	980	U	35	U	86	U	66	U	42	U	15	U
Benzo(a)anthracene	c	ug/kg	75	-		40	U	46	U	45	U	81	U	69	U	1,200	U	44	U	110	U	82	U	53	U	19	U
Benzo(a)pyrene	c	ug/kg	89	-		29	U	33	U	32	U	58	U	50	U	880	U	32	U	77	U	59	U	38	U	14	U
Benzo(b)fluoranthene	c	ug/kg	-	-		38	U	43	U	42	U	77	U	66	U	1,200	U	42	U	100	U	77	U	50	U	18	U
Benzo(g,h,i)perylene	nc	ug/kg	-	-		45	U	52	U	51	U	92	U	79	U	1,400	U	50	U	120	U	93	U	60	U	22	U
Benzo(k)fluoranthene	c	ug/kg	-	-		62	U	71	U	70	U	130	U	110	U	1,900	U	69	U	170	U	130	U	83	U	30	U
Benzaldehyde	nc	ug/kg	-	-		91	U	100	U	100	U	180	U	160	U	2,800	U	100	U	240	U	190	U	120	U	44	U
Chrysene	c	ug/kg	108	-		30	U	35	U	34	U	62	U	53	U	930	U	34	U	82	U	63	U	40	U	15	U
Dibenzo(a,h)anthracene	c	ug/kg	6.2	-		43	U	50	U	48	U	88	U	75	U	1,300	U	48	U	120	U	89	U	57	U	21	U
Di-n-octyl phthalate	nc	ug/kg	-	-		71	U	81	U	79	U	140	U	120	U	**3,080**		78	U	190	U	140	U	94	U	34	U
bis(2-Ethylhexyl)phthalate	c	ug/kg	182	-		110	U	120	U	120	U	**4,360**		180	U	**162,000**		120	U	280	U	220	U	140	U	**161**	
Fluoranthene	nc	ug/kg	113	-		29	U	33	U	33	U	60	U	51	U	890	U	32	U	78	U	60	U	39	U	14	U
Indeno(1,2,3-cd)pyrene	c	ug/kg	-	-		52	U	60	U	59	U	110	U	91	U	1,600	U	58	U	140	U	110	U	70	U	25	U
Phenanthrene	nc	ug/kg	87	-		36	U	42	U	41	U	74	U	63	U	1,100	U	40	U	97	U	74	U	48	U	17	U
Pyrene	nc	ug/kg	153	-		28	U	33	U	32	U	58	U	50	U	870	U	31	U	76	U	58	U	38	U	14	U
Pesticides / PCBs																											
alpha-Chlordane	c	ug/kg	-	-		9.6	U	11	U	11	U	19	U	16	U	29	U	11	U	25	U	19	U	13	U	1.6	U
gamma-Chlordane	c	ug/kg	-	-		9.6	U	11	U	11	U	19	U	16	U	29	U	11	U	25	U	19	U	13	U	1.6	U
4,4'-DDD	c	ug/kg	1.2	**4.2**	J	9.6	U	11	U	11	U	19	U	16	U	29	U	11	U	25	U	19	U	**65**		1.6	U
4,4'-DDE	c	ug/kg	2.1	**7.7**	J	9.6	U	11	U	11	U	19	U	16	U	29	U	11	U	25	U	19	U	**149**		**26.8**	
4,4'-DDT	c	ug/kg	3.9	-		9.6	U	11	U	11	U	19	U	16	U	29	U	11	U	25	U	19	U	13	U	**10.8**	
Aroclor 1260	c	ug/kg	-			48	U	58	U	55	U	100	U	82	U	150	U	55	U	130	U	98	U	66	U	8.0	U
Inorganics																											
Aluminum	nc	mg/kg	-	15,100		11,000		22,300		21,900		18,500		16,900		16,500		22,100		12,200		12,800		17,600		7,770	
Antimony	nc	mg/kg	-	0.54	L	0.89	U	1.0	U	0.99	U	0.91	U	0.77	U	0.91	U	0.65	U	1.2	U	1.2	U	**2.8**		0.88	U
Arsenic	c	mg/kg	7.2	**9.6**		**10**		**8.5**		**8.1**		**17**		**21**		4.5		**13**		4.0		**19**		**13**		3.0	
Barium	nc	mg/kg	-	**32.6**		22	B	46		44		35		32		30		43		25	B	44		**85**		30	
Beryllium	nc	mg/kg	-	0.61		0.31	B	0.60	B	0.55	B	0.48	B	0.49	B	0.44	B	0.61		0.21	B	0.24	B	0.61		0.20	B
Cadmium	nc	mg/kg	0.68	-		0.17	U	0.37	B	0.21	B	0.18	U	0.15	U	0.27	B	0.13	U	0.23	U	0.24	U	1.5		1.2	
Calcium	nc	mg/kg	-	2,800		1,860		2,920		**8,010**		**30,900**		2,780		**12,500**		2,490		4,570		3,840		3,970		468	B
Chromium	nc	mg/kg	52	34.8		20		50		44		35		33		29		44		23		16		28		8.6	
Cobalt	nc	mg/kg	-	6.5		4.8	B	9.3		9.2		7.1		6.9		6.0	B	9.3		4.5	B	3.0	B	4.2	B	2.0	B
Copper	nc	mg/kg	19	13		**36**		**22**		**19**		12		12		16		**19**		8.8		**20**		**57**		**27**	
Iron	nc	mg/kg	-	24,100		17,600		28,600		27,500		25,000		26,300		14,100		30,800		11,500		12,800		19,400		5,670	
Lead	nc	mg/kg	30	16.6		13		**45**		20		17		16		23		22		8.9		23		**97**		22	
Magnesium	nc	mg/kg	-	6,780		4,040		7,860		7,470		7,520		6,470		7,130		7,410		10,900		3,180		3,720		541	B
Manganese	nc	mg/kg	-	229		75		201		201		134		119		102		243		94		58		111		83	
Mercury	nc	mg/kg	0.13	0.08		0.036	B	0.10		0.070		0.038	B	0.043	B	0.047	B	0.090		0.052	U	0.12	B	**0.49**		0.069	
Nickel	nc	mg/kg	16	**17.1**		10		**22**		**21**		**17**		**17**		**17**		**21**		12		8.3		**19**		5.6	
Potassium	nc	mg/kg	-	3,340		2,280		4,820		4,810		5,160		4,210		3,480		4,720		6,590		1,110		1,300		332	B
Selenium	nc	mg/kg	-	1.4	B	1.6	B	1.8	B	1.8	B	1.4	B	1.8	B	**3.4**		1.6	B	1.3	U	1.4	B	1.7	B	0.91	U
Silver	nc	mg/kg	0.73	0.34		0.19	U	0.24	B	0.21	U	0.19	U	0.16	U	0.20	B	0.41	B	0.25	U	0.26	U	**1.5**		0.65	B
Sodium	nc	mg/kg	-	8,940		11,100		13,500		12,100		**25,900**		**21,300**		14,000		10,600		**53,700**		2,830		2,690		162	B
Thallium	nc	mg/kg	-	-		0.12	B	0.28	B	0.26	B	0.16	B	0.26	B	0.50	B	0.18	B	0.15	B	0.15	B	0.12	B	0.079	B
Vanadium	nc	mg/kg	-	36.7		30		52		51		52		52		43		54		28		24		32		13	
Zinc	nc	mg/kg	124	76		39		113		85		57		55		60		87		44		37		**324**		72	
Total Organic Carbon	nc	mg/kg	-	18,200		**60,900**		**46,900**		**43,900**		**108,000**		**107,000**		**219,000**		**48,500**		**185,000**		**119,000**		**123,000**		21,500	

B: indicates analyte found in associate method blank
c: carcinogenic
J: indicates and estimated value
MDL: method detection limit
NA: not applicable
nc: noncarcinogenic
U: undetected, value recorded is the MDL
**calculated values: all "c" values are full RSL numerical weight; all "nc" values are one tenth (1/10th) of RSL numerical weight
-: not detected
bold, red: over BTAG values
bold, underline: over twice the background

TABLES FOR SECTION 6

Table 6-1
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOILS - CENTRAL AND SOUTHERN AOCs
CDL - Wallops Flight Facility

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soils (0-0.5 ft bgs) Central and Southern AOCs

Exposure Point	Chemical	CAS Number	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Detection Frequency	Minimum Reporting Limit (RL) (mg/kg)	Maximum Reporting Limit (RL) (mg/kg)	Concentration Used for Screening (mg/kg)	Background Value - Mean (mg/kg)	Background Value Maximum (mg/kg)	Residential SSL (mg/kg)	key	0.1*noncancer limit (mg/kg)	Protection of GW Risk-based SSL (mg/kg)	Screening Value (mg/kg)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Surface Soils (Central and Southern AOCs)	**Volatile Organic Compounds**																	
	Ethylbenzene	100-41-4	6.30E-04	6.30E-04	TP-1A (C)	1 / 8	1.00E-03	1.50E-01	6.30E-04	N/A	N/A	5.7E+00	ca	5.70E+00	1.9E-03	1.90E-03	No	BSL
	Methyl acetate	79-20-9	1.19E+00	1.19E+00	SB-4A (C)	1 / 8	5.10E-03	7.70E-01	1.19E+00	N/A	N/A	7.8E+04	sat	7.80E+04	7.6E+00	7.60E+00	No	BSL
	Methylcyclohexane	108-87-2	2.50E-03	2.50E-03	TP-1A (C)	1 / 8	5.10E-03	7.70E-01	2.50E-03	N/A	N/A	3.4E+03	sat	3.40E+03	1.4E+01	1.40E+01	No	BSL
	Toluene	108-88-3	9.60E-04	9.60E-04	TP-1A (C)	1 / 8	1.00E-03	1.50E-01	9.60E-04	N/A	N/A	5.0E+03	sat	5.00E+03	1.7E+00	1.70E+00	No	BSL
	m,p-Xylene	(108-38-3)	3.50E-03	3.50E-03	TP-1A (C)	1 / 8	2.10E-03	3.10E-01	3.50E-03	N/A	N/A	4.5E+03	sat	4.50E+03	1.6E+00	1.60E+00	No	BSL
	o-Xylene	95-47-6	1.40E-03	1.40E-03	TP-1A (C)	1 / 8	1.00E-03	1.50E-01	1.40E-03	N/A	N/A	5.3E+03	sat	5.30E+03	1.6E+00	1.60E+00	No	BSL
	Xylene (total)	1330-20-7	4.90E-03	4.90E-03	TP-1A (C)	1 / 8	2.10E-03	3.10E-01	4.90E-03	N/A	N/A	6.0E+02	sat	6.00E+02	2.3E-01	2.30E-01	No	BSL
	Semi-Volatile Organic Compounds																	
	Acenaphthylene	--	1.58E-01	1.58E-01	SB-4A (C)	1 / 8	7.40E-02	4.70E-01	1.58E-01	N/A	N/A	--		--	--	--	No	BSL
	Anthracene	120-12-7	1.68E-02	2.67E-01	SB-4A (C)	3 / 8	7.40E-02	4.70E-01	2.67E-01	N/A	N/A	1.7E+04	nc	1.70E+03	4.5E+02	4.50E+02	No	BSL
	Benzo[a]anthracene	56-55-3	2.43E-02	2.49E+00	SB-4A (C)	4 / 8	7.40E-02	4.70E-01	2.49E+00	2.37E-01	0.550	1.5E-01	ca	1.50E-01	1.4E-02	1.40E-02	**Yes**	ASL
	Benzo[a]pyrene	50-32-8	5.88E-02	1.91E+00	SB-4A (C)	3 / 8	7.40E-02	4.70E-01	1.91E+00	2.06E-01	0.410	1.5E-02	ca	1.50E-02	4.6E-03	4.60E-03	**Yes**	ASL
	Benzo[b]fluoranthene	205-99-2	9.87E-02	1.39E+00	SB-4A (C)	3 / 8	7.40E-02	4.70E-01	1.39E+00	2.32E-01	0.640	1.5E-01	ca	1.50E-01	4.7E-02	4.70E-02	**Yes**	ASL
	Benzo(g,h,i)perylene	--	6.66E-02	1.18E+00	SB-4A (C)	3 / 8	7.40E-02	4.70E-01	1.18E+00	N/A	N/A	--		--	--	--	No	NBA
	Benzo[k]fluoranthene	207-08-9	8.57E-02	1.03E+00	SB-4A (C)	3 / 8	7.40E-02	4.70E-01	1.03E+00	2.11E-01	0.290	1.5E+00	ca	1.50E+00	4.6E-01	4.60E-01	**Yes**	ASL
	Chrysene	218-01-9	1.91E-02	4.04E+00	SB-4A (C)	4 / 8	7.40E-02	4.70E-01	4.04E+00	2.30E-01	0.630	1.5E+01	ca	1.50E+01	1.4E+00	1.40E+00	**Yes**	ASL
	Dibenz[a,h]anthracene	53-70-3	2.26E-02	3.88E-01	SB-4A (C)	2 / 8	7.40E-02	4.70E-01	3.88E-01	N/A	N/A	1.5E-02	ca	1.50E-02	1.5E-02	1.50E-02	**Yes**	ASL
	bis(2-Ethylhexyl)phthalate	117-81-7	5.25E-02	1.11E-01	TP-3A (S)	3 / 8	7.40E-02	4.70E-01	1.11E-01	2.03E-01	0.210	3.5E+01	ca*	1.20E+01	1.6E+00	1.60E+00	No	BSL
	Fluoranthene	206-44-0	2.30E-02	1.79E+00	SB-4A (C)	5 / 8	7.40E-02	4.70E-01	1.79E+00	2.69E-01	1.00	2.3E+03	nc	2.30E+02	2.1E+02	2.10E+02	No	BSL
	Indeno[1,2,3-c,d]pyrene	193-39-5	6.13E-02	6.17E-01	SB-4A (C)	3 / 8	7.40E-02	4.70E-01	6.17E-01	N/A	N/A	1.5E-01	ca**	1.50E-01	1.6E-01	1.50E-01	**Yes**	ASL
	Phenanthrene	85-01-8	2.56E-02	2.23E+00	SB-4A (C)	4 / 8	7.40E-02	4.70E-01	2.23E+00	2.61E-01	0.790	--		--	--	--	No	NBA
	Pyrene	129-00-0	2.13E-02	4.74E+00	SB-4A (C)	5 / 8	7.40E-02	4.70E-01	4.74E+00	2.61E-01	0.890	1.7E+03	nc	1.70E+02	1.5E+02	1.50E+02	No	BSL
	Pesticides																	
	DDD	72-54-8	1.90E-03	1.26E-01	TP-7A (S)	6 / 8	1.50E-03	1.60E-02	1.26E-01	N/A	N/A	2.0E+00	ca	2.00E+00	8.6E-02	8.60E-02	**Yes**	ASL
	DDE	72-55-9	5.30E-03	1.02E+00	TP-7A (S)	8 / 8	1.60E-03	3.20E-02	1.02E+00	5.39E-01	5	1.4E+00	ca	1.40E+00	6.0E-02	6.00E-02	**Yes**	ASL
	DDT	50-29-3	6.30E-03	5.30E-01	TP-7A (S)	8 / 8	1.50E-03	1.60E-02	5.30E-01	1.56E+00	15	1.7E+00	ca*	3.60E-01	8.7E-02	8.70E-02	**Yes**	ASL
	Inorganics										--							
	Aluminum	7429-90-5	6.00E+03	2.73E+04	TP-7A (S)	8 / 8	2.20E+01	5.10E+01	2.73E+04	9.46E+03	13900	7.7E+04	nc	7.70E+03	--	7.70E+03	**Yes**	ASL
	Antimony	7440-36-0	1.10E+00	6.37E+01	TP-3A (S)	4 / 8	2.20E+00	5.10E+00	6.37E+01	--	--	3.1E+01	nc	3.10E+00	--	3.10E+00	**Yes**	ASL
	Arsenic	7440-38-2	3.00E+00	7.60E+00	TP-2A (S)	8 / 8	4.40E-01	5.90E-01	7.60E+00	4.20E+00	14.2	3.9E-01	ca*	2.20E-01	--	2.20E-01	**Yes**	ASL
	Barium	7440-39-3	3.22E+01	1.16E+03	TP-3A (S)	8 / 8	2.20E+01	5.10E+01	1.16E+03	7.21E+01	114	1.5E+04	nc	1.50E+03	--	1.50E+03	No	BSL
	Beryllium	7440-41-7	8.60E-02	1.30E+00	TP-1A (C)	7 / 8	5.50E-01	1.30E+00	1.30E+00	6.41E-01	1.2	1.6E+02	nc	1.60E+01	--	1.60E+01	No	BSL
	Cadmium	7440-43-9	2.10E-01	2.16E+01	TP-3A (S)	7 / 8	5.50E-01	1.30E+00	2.16E+01	2.09E-01	0.84	7.0E+01	nc	7.00E+00	--	7.00E+00	**Yes**	ASL
	Calcium	7440-70-2	6.34E+02	7.19E+04	SB-4A (C)	8 / 8	5.50E+02	1.30E+03	7.19E+04	5.91E+02	1390	--		--	--	--	No	NUT
	Chromium (assumed VI)	18540-29-9	7.60E+00	1.26E+02	SB-4A (C)	8 / 8	1.10E+00	1.50E+00	1.26E+02	9.57E+00	18.4	2.3E+02	nc	2.30E+01	--	2.30E+01	**Yes**	ASL
	Cobalt	7440-48-4	2.10E+00	2.80E+01	SB-4A (C)	8 / 8	5.50E+00	1.30E+01	2.80E+01	3.60E+00	7.3	--		--	--	--	No	NBA
	Copper	7440-50-8	7.40E+00	1.79E+03	TP-7A (S)	8 / 8	2.80E+00	6.40E+00	1.79E+03	8.91E+00	33	3.1E+03	nc	3.10E+02	--	3.10E+02	**Yes**	ASL
	Iron	7439-89-6	5.64E+03	4.51E+04	TP-3A (S)	8 / 8	1.10E+01	2.60E+01	4.51E+04	7.59E+03	10900	5.5E+04	nc	5.50E+03	--	5.50E+03	**Yes**	ASL
	Lead	7439-92-1	1.29E+01	2.12E+03	TP-3A (S)	8 / 8	2.20E+00	5.10E+00	2.12E+03	3.06E+01	124	4.0E+02	++	4.00E+02	--	4.00E+02	**Yes**	ASL
	Magnesium	--	7.61E+02	7.67E+04	SB-4A (C)	8 / 8	5.50E+02	1.30E+03	7.67E+04	9.68E+02	1450	--		--	--	--	No	NUT
	Manganese	7439-96-5	1.10E+02	1.49E+03	TP-3A (S)	8 / 8	1.70E+00	3.90E+00	1.49E+03	3.68E+02	781	--		--	--	--	No	NBA
	Mercury (inorganic)	--	5.20E-02	1.80E+00	TP-3A (S)	8 / 8	3.30E-02	1.80E-01	1.80E+00	6.88E-02	0.25	6.7E+00	sat	6.70E+00	3.3E-02	3.30E-02	**Yes**	ASL
	Nickel	7440-02-0	3.90E+00	5.02E+02	SB-4A (C)	8 / 8	4.40E+00	1.00E+01	5.02E+02	6.14E+00	10.6	1.6E+03	nc	1.60E+02	--	1.60E+02	**Yes**	ASL
	Potassium	2023695	3.39E+02	1.41E+03	TP-3A (S)	8 / 8	5.50E+02	1.30E+03	1.41E+03	3.94E+02	756	--		--	--	--	No	NUT
	Selenium	7782-49-2	1.40E+00	4.40E+00	TP-3A (S)	2 / 8	2.20E+00	2.90E+00	4.40E+00	6.45E-01	1.4	3.9E+02	nc	3.90E+01	--	3.90E+01	No	BSL
	Silver	7440-22-4	1.80E-01	8.45E+01	TP-3A (S)	7 / 8	1.10E+00	2.60E+00	8.45E+01	1.12E-01	0.3	3.9E+02	nc	3.90E+01	--	3.90E+01	**Yes**	ASL
	Sodium	7440-66-6	1.03E+02	1.15E+02	SB-5A (C)	2 / 8	1.10E+03	2.60E+03	1.15E+02	2.16E+01	31.1	--		--	--	--	No	NUT
	Thallium	7440-28-0	3.60E-02	2.00E-01	TP-1A (C)	6 / 8	1.20E-01	2.20E-01	2.00E-01	5.81E-01	1.6	5.1E+00	nc	5.10E-01	--	5.10E-01	No	BSL
	Vanadium	--	1.03E+01	5.10E+01	TP-3A (S)	8 / 8	5.50E+00	1.30E+01	5.10E+01	1.69E+01	28.5	3.9E+02	nc	3.90E+01	--	3.90E+01	**Yes**	ASL
	Zinc	7440-66-6	2.06E+01	4.28E+03	TP-3A (S)	8 / 8	2.20E+00	2.20E+00	4.28E+03	2.94E+01	104	2.3E+04	nc	2.30E+03	--	2.30E+03	**Yes**	ASL

Rationale Codes:

Selection reason: ASL - Above Screening Level
Deletion reason: BSL - Below Screening Level
NBA - No Benchmark Available
NUT - Essential Nutrient

Note:

The maximum detected concentration is from all samples (i.e., duplicates have not been averaged).
Screening concentrations from EPAs "Regional Screening Table" found at: http://epa-prgs.ornl.gov/chemicals/index.shtml (Accessed August 2008)
Background values from Table 4.24 in "Background Soil and Groundwater Investigation Report for the Main Base NASA Wallops Flight Facility, Wallops, Virginia" (Tetra Tech NUS, 2004).
N/A - Not available.

Table 6-2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN -
AGGREGATE SOILS - CENTRAL AND SOUTHERN AOCs
CDL - Wallops Flight Facility

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Aggregate Soils (0-10 ft bgs) Central and Southern AOCs

Exposure Point	Chemical	CAS Number	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Detection Frequency	Minimum Reporting Limit (RL) (mg/kg)	Maximum Reporting Limit (RL) (mg/kg)	Concentration Used for Screening (mg/kg)	Background Value - Mean (mg/kg)	Background Value Maximum (mg/kg)	Residential SSL (mg/kg)	key	0.1*noncancer limit (mg/kg)	Protection of GW Risk-based SSL (mg/kg)	Screening Value (mg/kg)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Aggregate Soils (Central and Southern AOCs)	**Volatile Organic Compounds**																	
	Acetone	67-64-1	2.23E+00	2.23E+00	TP-1C (C)	1 / 19	8.10E-03	1.50E+00	2.23E+00	N/A	N/A	6.1E+04	nc	6.10E+03	4.4E+00	4.40E+00	No	BSL
	Benzene	71-43-2	2.40E-03	1.85E-01	TP-1C (C)	2 / 19	8.10E-04	1.50E-01	1.85E-01	N/A	N/A	1.1E+00	ca*	1.10E+00	2.3E-04	2.30E-04	**Yes**	ASL
	1,2-Dichloroethane	107-06-2	2.38E-01	2.38E-01	TP-1C (C)	1 / 19	8.10E-04	1.50E-01	2.38E-01	N/A	N/A	4.5E-01	ca	4.50E-01	4.4E-05	4.40E-05	**Yes**	ASL
	Ethylbenzene	100-41-4	6.30E-04	1.42E+00	SB-4C (C)	3 / 19	8.10E-04	1.50E-01	1.42E+00	N/A	N/A	5.7E+00	ca	5.70E+00	1.9E-03	1.90E-03	**Yes**	ASL
	Isopropylbenzene (Cumene)	98-82-8	2.07E-01	2.07E-01	SB-4C (C)	1 / 19	4.00E-03	7.70E-01	2.07E-01	N/A	N/A	2.2E+03	sat	2.20E+03	1.3E+00	1.30E+00	No	BSL
	Methyl acetate	79-20-9	1.19E+00	1.19E+00	SB-4A (C)	1 / 19	4.00E-03	7.70E-01	1.19E+00	N/A	N/A	7.8E+04	sat	7.80E+04	7.6E+00	7.60E+00	No	BSL
	Methylcyclohexane	108-87-2	2.50E-03	1.07E+01	SB-4C (C)	3 / 19	4.00E-03	7.70E-01	1.07E+01	N/A	N/A	3.4E+03	sat	3.40E+03	1.4E+01	1.40E+01	No	BSL
	Tetrachloroethene	127-18-4	9.90E-04	1.37E-02	TP-3C (S)	3 / 19	4.00E-03	7.70E-01	1.37E-02	N/A	N/A	5.7E-01	ca	5.70E-01	5.2E-05	5.20E-05	**Yes**	ASL
	Toluene	108-88-3	9.60E-04	7.30E-01	TP-1C (C)	2 / 19	8.10E-04	1.50E-01	7.30E-01	N/A	N/A	5.0E+03	sat	5.00E+03	1.7E+00	1.70E+00	No	BSL
	m,p-Xylene	(108-38-3)	3.50E-03	2.00E+00	TP-1C (C)	3 / 19	1.60E-03	3.10E-01	2.00E+00	N/A	N/A	4.5E+03	sat	4.50E+03	1.6E+00	1.60E+00	**Yes**	ASL
	o-Xylene	95-47-6	1.40E-03	8.28E-01	TP-1C (C)	3 / 19	8.10E-04	1.50E-01	8.28E-01	N/A	N/A	5.3E+03	sat	5.30E+03	1.6E+00	1.60E+00	No	BSL
	Xylene (total)	1330-20-7	4.90E-03	2.83E+00	TP-1C (C)	3 / 19	1.60E-03	3.10E-01	2.83E+00	N/A	N/A	6.0E+02	sat	6.00E+02	2.3E-01	2.30E-01	**Yes**	ASL
	Semi-Volatile Organic Compounds																	
	Acenaphthylene	--	1.58E-01	1.58E-01	SB-4A (C)	1 / 19	7.00E-02	4.70E-01	1.58E-01	N/A	N/A	--		--	--	--	No	NBA
	Anthracene	120-12-7	1.68E-02	2.67E-01	SB-4A (C)	4 / 19	7.00E-02	4.70E-01	2.67E-01	N/A	N/A	1.7E+04	nc	1.70E+03	4.5E+02	4.50E+02	No	BSL
	Benzo(a)anthracene	56-55-3	2.43E-02	2.49E+00	SB-4A (C)	5 / 19	7.00E-02	4.70E-01	2.49E+00	N/A	N/A	1.5E-01	ca	1.50E-01	1.4E-02	1.40E-02	**Yes**	ASL
	Benzo(a)pyrene	50-32-8	5.88E-02	1.91E+00	SB-4A (C)	4 / 19	7.00E-02	4.70E-01	1.91E+00	N/A	N/A	1.5E-02	ca	1.50E-02	4.6E-03	4.60E-03	**Yes**	ASL
	Benzo(b)fluoranthene	205-99-2	9.87E-02	1.39E+00	SB-4A (C)	4 / 19	7.00E-02	4.70E-01	1.39E+00	N/A	N/A	1.5E-01	ca	1.50E-01	4.7E-02	4.70E-02	**Yes**	ASL
	Benzo(g,h,i)perylene	--	6.23E-02	1.18E+00	SB-4A (C)	4 / 19	7.00E-02	4.70E-01	1.18E+00	N/A	N/A	--		--	--	--	No	NBA
	Benzo(k)fluoranthene	207-08-9	8.57E-02	1.03E+00	SB-4A (C)	4 / 19	7.00E-02	4.70E-01	1.03E+00	N/A	N/A	1.5E+00	ca	1.50E+00	4.6E-01	4.60E-01	**Yes**	ASL
	Chrysene	218-01-9	1.91E-02	4.04E+00	SB-4A (C)	5 / 19	7.00E-02	4.70E-01	4.04E+00	N/A	N/A	1.5E+01	ca	1.50E+01	1.4E+00	1.40E+00	**Yes**	ASL
	Dibenz(a,h)anthracene	53-70-3	2.26E-02	3.88E-01	SB-4A (C)	3 / 19	7.00E-02	4.70E-01	3.88E-01	N/A	N/A	1.5E-02	ca	1.50E-02	1.5E-02	1.50E-02	**Yes**	ASL
	bis(2-Ethylhexyl)phthalate	117-81-7	5.19E-02	1.99E-01	TP-4B (S)	7 / 19	7.00E-02	4.70E-01	1.99E-01	N/A	N/A	3.5E+01	ca*	1.20E+01	1.6E+00	1.60E+00	No	BSL
	Fluoranthene	206-44-0	2.30E-02	1.79E+00	SB-4A (C)	6 / 19	7.00E-02	4.70E-01	1.79E+00	N/A	N/A	2.3E+03	nc	2.30E+02	2.1E+02	2.10E+02	No	BSL
	Indeno(1,2,3-c,d)pyrene	193-39-5	6.13E-02	6.17E-01	SB-4A (C)	4 / 19	7.00E-02	4.70E-01	6.17E-01	N/A	N/A	1.5E-01	ca**	1.50E-01	1.6E-01	1.50E-01	**Yes**	ASL
	Phenanthrene	85-01-8	2.56E-02	2.23E+00	SB-4A (C)	5 / 19	7.00E-02	4.70E-01	2.23E+00	N/A	N/A	--		--	--	--	No	NBA
	Pyrene	129-00-0	2.13E-02	4.74E+00	SB-4A (C)	6 / 19	7.00E-02	4.70E-01	4.74E+00	N/A	N/A	1.7E+03	nc	1.70E+02	1.5E+02	1.50E+02	No	BSL
	Pesticides																	
	alpha-Chlordane	57-74-9	2.67E-02	2.67E-02	TP-3B (S)	1 / 19	1.40E-03	1.60E-02	2.67E-02	N/A	N/A	1.6E+00	ca*	3.50E-01	3.3E-02	3.30E-02	No	BSL
	gamma-Chlordane	5103-74-2	3.46E-02	3.46E-02	TP-3B (S)	1 / 19	1.40E-03	1.60E-02	3.46E-02	N/A	N/A	1.6E+00	ca*	3.50E-01	3.3E-02	3.30E-02	**Yes**	ASL
	DDD	72-54-8	1.30E-03	1.97E-01	TP-4B (S)	12 / 19	1.40E-03	3.70E-02	1.97E-01	N/A	N/A	2.0E+00	ca	2.00E+00	8.6E-02	8.60E-02	**Yes**	ASL
	DDE	72-55-9	3.10E-03	1.31E+00	TP-7B (S)	14 / 19	1.40E-03	3.70E-02	1.31E+00	1.00E-02	8.50E-02	1.4E+00	ca	1.40E+00	6.0E-02	6.00E-02	**Yes**	ASL
	DDT	50-29-3	2.40E-03	5.77E-01	TP-7B (S)	14 / 19	1.40E-03	3.70E-02	5.77E-01	2.23E-02	2.10E-01	1.7E+00	ca*	3.60E-01	8.7E-02	8.70E-02	**Yes**	ASL
	Polychlorinated Biphenyls																	
	Aroclor-1260	11096-82-5	2.13E-01	2.13E-01	TP-3B (S)	1 / 19	3.50E-02	4.70E-02	2.13E-01	N/A	N/A	2.2E-01	ca	2.20E-01	1.4E-02	1.40E-02	**Yes**	ASL

Table 6-2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN -
AGGREGATE SOILS - CENTRAL AND SOUTHERN AOCs
CDL - Wallops Flight Facility

Exposure Point	Chemical	CAS Number	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Detection Frequency	Minimum Reporting Limit (RL) (mg/kg)	Maximum Reporting Limit (RL) (mg/kg)	Concentration Used for Screening (mg/kg)	Background Value - Mean (mg/kg)	Background Value Maximum (mg/kg)	Residential SSL (mg/kg)	key	0.1*noncancer limit (mg/kg)	Protection of GW Risk-based SSL (mg/kg)	Screening Value (mg/kg)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Aggregate Soils (Central and Southern AOCs) (continued)	**Inorganics**																	
	Aluminum	7429-90-5	3.38E+03	7.93E+04	TP-3C (S)	19 / 19	2.10E+01	7.50E+01	7.93E+04	1.41E+04	2.24E+04	7.7E+04	nc	7.70E+03	--	7.70E+03	**Yes**	ASL
	Antimony	7440-36-0	1.10E+00	6.37E+01	TP-3A (S)	8 / 19	2.10E+00	7.50E+00	6.37E+01	N/A	N/A	3.1E+01	nc	3.10E+00	--	3.10E+00	**Yes**	ASL
	Arsenic	7440-38-2	9.60E-01	8.40E+00	TP-3C (S)	18 / 19	4.20E-01	5.90E-01	8.40E+00	3.55E+00	5.30E+00	3.9E-01	ca*	2.20E-01	--	2.20E-01	**Yes**	ASL
	Barium	7440-39-3	7.30E+00	1.16E+03	TP-3A (S)	19 / 19	2.10E+01	7.50E+01	1.16E+03	4.86E+01	8.85E+01	1.5E+04	nc	1.50E+03	--	1.50E+03	No	BSL
	Beryllium	7440-41-7	4.90E-02	1.30E+00	TP-1A (C)	15 / 19	5.30E-01	1.90E+00	1.30E+00	3.45E-01	5.70E-01	1.6E+02	nc	1.60E+01	--	1.60E+01	No	BSL
	Cadmium	7440-43-9	2.10E-01	7.53E+01	TP-3C (S)	12 / 19	5.30E-01	1.90E+00	7.53E+01	1.91E-01	3.60E-01	7.0E+01	nc	7.00E+00	--	7.00E+00	**Yes**	ASL
	Calcium	7440-70-2	1.09E+02	7.19E+04	SB-4A (C)	19 / 19	5.30E+02	1.90E+03	7.19E+04	2.43E+02	4.71E+02	--		--	--	--	No	NUT
	Chromium (assumed VI)	18540-29-9	3.00E+00	6.16E+02	TP-7B (S)	19 / 19	1.10E+00	3.80E+00	6.16E+02	1.26E+01	2.10E+01	2.3E+02	nc	2.30E+01	--	2.30E+01	**Yes**	ASL
	Cobalt	7440-48-4	6.90E-01	2.80E+01	SB-4A (C)	19 / 19	5.30E+00	1.90E+01	2.80E+01	4.14E+00	1.40E+01	--		--	--	--	No	NBA
	Copper	7440-50-8	1.20E+00	5.10E+03	TP-7B (S)	19 / 19	2.60E+00	9.40E+00	5.10E+03	7.04E+00	1.09E+01	3.1E+03	nc	3.10E+02	--	3.10E+02	**Yes**	ASL
	Iron	7439-89-6	1.39E+03	9.62E+04	TP-3C (S)	19 / 19	1.10E+01	3.80E+01	9.62E+04	1.08E+04	1.79E+04	5.5E+04	nc	5.50E+03	--	5.50E+03	**Yes**	ASL
	Lead	7439-92-1	3.00E+00	2.12E+03	TP-3A (S)	19 / 19	2.10E+00	7.50E+00	2.12E+03	7.70E+00	1.22E+01	4.0E+02	++	4.00E+02	--	4.00E+02	**Yes**	ASL
	Magnesium	--	1.26E+02	7.67E+04	SB-4A (C)	19 / 19	5.30E+02	1.90E+03	7.67E+04	9.49E+02	1.78E+03	--		--	--	--	No	NUT
	Manganese	7439-96-5	7.10E+00	1.49E+03	TP-3A (S)	19 / 19	1.60E+00	5.60E+00	1.49E+03	9.77E+01	2.13E+02	--		--	--	--	No	NBA
	Mercury (inorganic)	--	1.40E-02	1.80E+00	TP-3A (S)	18 / 19	3.30E-02	1.80E-01	1.80E+00	2.98E-02	4.80E-02	6.7E+00	sat	6.70E+00	3.3E-02	3.30E-02	**Yes**	ASL
	Nickel	7440-02-0	1.00E+00	5.02E+02	SB-4A (C)	19 / 19	4.20E+00	1.50E+01	5.02E+02	7.05E+00	1.12E+01	1.6E+03	nc	1.60E+02	--	1.60E+02	**Yes**	ASL
	Potassium	2023695	1.24E+02	1.41E+03	TP-3A (S)	19 / 19	5.30E+02	1.90E+03	1.41E+03	4.54E+02	8.53E+02	--		--	--	--	No	NUT
	Selenium	7782-49-2	9.30E-01	4.40E+00	TP-3A (S)	4 / 19	2.10E+00	7.50E+00	4.40E+00	3.98E-01	8.90E-01	3.9E+02	nc	3.90E+01	--	3.90E+01	No	BSL
	Silver	7440-22-4	1.80E-01	8.45E+01	TP-3A (S)	11 / 19	1.10E+00	3.80E+00	8.45E+01	2.29E-01	2.20E-01	3.9E+02	nc	3.90E+01	--	3.90E+01	**Yes**	ASL
	Sodium	7440-66-6	8.43E+01	2.15E+02	TP-3B (S)	7 / 19	1.10E+03	3.80E+03	2.15E+02	3.43E+01	4.93E+01	--		--	--	--	No	NUT
	Thallium	7440-28-0	3.00E-02	2.00E-01	TP-1A (C)	12 / 19	1.10E-01	3.10E-01	2.00E-01	2.16E-01	5.30E-01	5.1E+00	nc	5.10E-01	--	5.10E-01	No	BSL
	Vanadium	--	3.60E+00	5.10E+01	TP-3A (S)	19 / 19	5.30E+00	1.90E+01	5.10E+01	2.00E+01	3.11E+01	3.9E+02	nc	3.90E+01	--	3.90E+01	**Yes**	ASL
	Zinc	7440-66-6	2.80E+00	4.28E+03	TP-3A (S)	19 / 19	2.10E+00	2.10E+00	4.28E+03	1.67E+01	2.63E+01	2.3E+04	nc	2.30E+03	--	2.30E+03	**Yes**	ASL

Rationale Codes:

Selection reason: ASL - Above Screening Level
Deletion reason: BSL - Below Screening Level
NBA - No Benchmark Available
NUT - Essential Nutrient

Note:

The maximum detected concentration is from all samples (i.e., duplicates have not been averaged).
Screening concentrations from EPAs "Regional Screening Table" found at: http://epa-prgs.ornl.gov/chemicals/index.shtml (Accessed August 2008)
Background values from Table 4.25 in "Background Soil and Groundwater Investigation Report for the Main Base NASA Wallops Flight Facility, Wallops, Virginia" (Tetra Tech NUS, 2004).
N/A - Not available.

Table 6-3
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN -
SURFACE SOILS - NORTHERN AND WESTERN AOCs
CDL - Wallops Flight Facility

Scenario Timeframe: Current/Future
Medium: Soil
Exposure Medium: Surface Soils (0-0.5 ft bgs) Northern and Western AOCs

Exposure Point	Chemical	CAS Number	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Detection Frequency	Minimum Reporting Limit (RL) (mg/kg)	Maximum Reporting Limit (RL) (mg/kg)	Concentration Used for Screening (mg/kg)	Background Value - Mean (mg/kg)	Background Value Maximum (mg/kg)	Residential SSL (mg/kg)	key	0.1*noncancer limit (mg/kg)	Protection of GW Risk-based SSL (mg/kg)	Screening Value (mg/kg)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Surface Soils (Northern and Western AOCs)	**Volatile Organic Compounds**																	
	Acetone	67-64-1	3.78E-02	3.78E-02	TP-6A (N)	1 / 5	8.90E-03	1.10E+00	3.78E-02	N/A	N/A	6.1E+04	nc	6.10E+03	4.4E+00	4.40E+00	No	BSL
	Semi-Volatile Organic Compounds																	
	Benzaldehyde	100-52-7	5.42E-02	5.42E-02	TP-6A (N)	1 / 1	1.80E-01	1.90E-01	5.42E-02	N/A	N/A	7.8E+03	sat	7.80E+03	9.7E-01	9.70E-01	No	BSL
	Pesticides																	
	DDE	72-55-9	1.60E-03	2.00E-03	TP-6A (N)	2 / 5	1.40E-03	1.60E-03	2.00E-03	5.39E-01	5	1.4E+00	ca	1.40E+00	6.0E-02	6.00E-02	No	BSL
	Inorganics																	
	Aluminum	7429-90-5	5.11E+03	1.03E+04	TP-8A (W)	5 / 5	2.10E+01	2.40E+01	1.03E+04	9.46E+03	13900	7.7E+04	nc	7.70E+03	--	7.70E+03	**Yes**	ASL
	Arsenic	7440-38-2	1.20E+00	4.70E+00	TP-6A (N)	5 / 5	4.20E-01	4.70E-01	4.70E+00	4.20E+00	14.2	3.9E-01	ca*	2.20E-01	--	2.20E-01	**Yes**	ASL
	Barium	7440-39-3	1.15E+01	3.35E+01	TP-6A (N)	5 / 5	2.10E+01	2.40E+01	3.35E+01	7.21E+01	114	1.5E+04	nc	1.50E+03	--	1.50E+03	No	BSL
	Beryllium	7440-41-7	1.00E-01	2.90E-01	TP-6A (N)	5 / 5	5.20E-01	5.90E-01	2.90E-01	6.41E-01	1.2	1.6E+02	nc	1.60E+01	--	1.60E+01	No	BSL
	Cadmium	7440-43-9	1.70E-01	2.40E-01	SB-2A (W)	2 / 5	5.20E-01	5.90E-01	2.40E-01	2.09E-01	0.84	7.0E+01	nc	7.00E+00	--	7.00E+00	No	BSL
	Calcium	7440-70-2	4.77E+02	8.09E+02	TP-6A (N)	5 / 5	5.20E+02	5.90E+02	8.09E+02	5.91E+02	1390	--		--	--	--	No	NUT
	Chromium (assumed VI)	18540-29-9	4.80E+00	1.10E+01	TP-8A (W)	5 / 5	1.00E+00	1.20E+00	1.10E+01	9.57E+00	18.4	2.3E+02	nc	2.30E+01	--	2.30E+01	No	BSL
	Cobalt	7440-48-4	1.20E+00	3.30E+00	TP-5A (N)	5 / 5	5.20E+00	5.90E+00	3.30E+00	3.60E+00	7.3	--		--	--	--	No	NBA
	Copper	7440-50-8	2.40E+00	7.70E+00	TP-8A (W)	5 / 5	2.60E+00	3.00E+00	7.70E+00	8.91E+00	33	3.1E+03	nc	3.10E+02	--	3.10E+02	No	BSL
	Iron	7439-89-6	3.46E+03	8.88E+03	TP-5A (N)	5 / 5	1.00E+01	1.20E+01	8.88E+03	7.59E+03	10900	5.5E+04	nc	5.50E+03	--	5.50E+03	**Yes**	ASL
	Lead	7439-92-1	2.60E+00	1.73E+01	SB-2A (W)	5 / 5	2.10E+00	2.40E+00	1.73E+01	3.06E+01	124	4.0E+02	++	4.00E+02	--	4.00E+02	No	BSL
	Magnesium	--	3.84E+02	9.74E+02	TP-6A (N)	5 / 5	5.20E+02	5.90E+02	9.74E+02	9.68E+02	1450	--		--	--	--	No	NUT
	Manganese	7439-96-5	2.62E+01	1.37E+02	TP-6A (N)	5 / 5	1.60E+00	1.80E+00	1.37E+02	3.68E+02	781	--		--	--	--	No	NBA
	Mercury (inorganic)	--	1.40E-02	7.70E-02	SB-2A (W)	5 / 5	3.20E-02	3.90E-02	7.70E-02	6.88E-02	0.25	6.7E+00	sat	6.70E+00	3.3E-02	3.30E-02	**Yes**	ASL
	Nickel	7440-02-0	2.60E+00	5.80E+00	TP-8A (W)	5 / 5	4.20E+00	4.70E+00	5.80E+00	6.14E+00	10.6	1.6E+03	nc	1.60E+02	--	1.60E+02	No	BSL
	Potassium	2023695	2.49E+02	5.18E+02	SB-2A (W)	5 / 5	5.20E+02	5.90E+02	5.18E+02	3.94E+02	756	--		--	--	--	No	NUT
	Thallium	7440-28-0	4.90E-02	1.00E-01	TP-6A (N)	5 / 5	1.00E-01	1.20E-01	1.00E-01	5.81E-01	1.6	5.1E+00	nc	5.10E-01	--	5.10E-01	No	BSL
	Vanadium	--	6.80E+00	1.58E+01	TP-8A (W)	5 / 5	5.20E+00	5.90E+00	1.58E+01	1.69E+01	28.5	3.9E+02	nc	3.90E+01	--	3.90E+01	No	BSL
	Zinc	7440-66-6	6.80E+00	2.36E+01	TP-6A (N)	5 / 5	2.10E+00	2.40E+00	2.36E+01	2.94E+01	104	2.3E+04	nc	2.30E+03	--	2.30E+03	No	BSL

Rationale Codes:
Selection reason: ASL - Above Screening Level
Deletion reason: BSL - Below Screening Level
NBA - No Benchmark Available
NUT - Essential Nutrient

Note:
The maximum detected concentration is from all samples (i.e., duplicates have not been averaged).
Screening concentrations from EPAs "Regional Screening Table" found at: http://epa-prgs.ornl.gov/chemicals/index.shtml (Accessed August 2008)
Background values from Table 4.24 in "Background Soil and Groundwater Investigation Report for the Main Base NASA Wallops Flight Facility, Wallops, Virginia" (Tetra Tech NUS, 2004).
N/A - Not available.

Table 6-4
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN -
AGGREGATE SOILS - NORTHERN AND WESTERN AOCs
CDL - Wallops Flight Facility

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Aggregate Soils (0-10 ft bgs) Northern and Western AOCs

Exposure Point	Chemical	CAS Number	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Detection Frequency	Minimum Reporting Limit (RL) (mg/kg)	Maximum Reporting Limit (RL) (mg/kg)	Concentration Used for Screening (mg/kg)	Background Value - Mean (mg/kg)	Background Value Maximum (mg/kg)	Residential SSL (mg/kg)	key	0.1*noncancer limit (mg/kg)	Protection of GW Risk-based SSL (mg/kg)	Screening Value (mg/kg)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Aggregate Soils (Northern and Western AOCs)	**Volatile Organic Compounds**																	
	Acetone	67-64-1	3.78E-02	3.78E-02	TP-6A (N)	1 / 10	8.80E-03	1.10E+00	3.78E-02	N/A	N/A	6.1E+04	nc	6.10E+03	4.4E+00	4.40E+00	No	BSL
	Semi-Volatile Organic Compounds																	
	Benzaldehyde	100-52-7	5.42E-02	5.42E-02	TP-6A (N)	1 / 1	1.70E-01	1.90E-01	5.42E-02	N/A	N/A	7.8E+03	sat	7.80E+03	9.7E-01	9.70E-01	No	BSL
	bis(2-Ethylhexyl)phthalate	117-81-7	5.58E-02	8.50E-02	SB-2B (W)	2 / 10	7.00E-02	7.80E-02	8.50E-02	N/A	N/A	3.5E+01	ca*	1.20E+01	1.6E+00	1.60E+00	No	BSL
	Pesticides																	
	DDE	72-55-9	1.60E-03	2.00E-03	TP-6A (N)	2 / 10	1.40E-03	1.60E-03	2.00E-03	1.00E-02	8.50E-02	1.4E+00	ca	1.40E+00	6.0E-02	6.00E-02	No	BSL
	Inorganics																	
	Aluminum	7429-90-5	5.11E+03	2.11E+04	TP-6B (N)	10 / 10	2.10E+01	2.40E+01	2.11E+04	1.41E+04	2.24E+04	7.7E+04	nc	7.70E+03	--	7.70E+03	**Yes**	ASL
	Arsenic	7440-38-2	1.10E+00	4.80E+00	TP-6B (N)	10 / 10	4.20E-01	4.70E-01	4.80E+00	3.55E+00	5.30E+00	3.9E-01	ca*	2.20E-01	--	2.20E-01	**Yes**	ASL
	Barium	7440-39-3	1.15E+01	4.58E+01	TP-6B (N)	10 / 10	2.10E+01	2.40E+01	4.58E+01	4.86E+01	8.85E+01	1.5E+04	nc	1.50E+03	--	1.50E+03	No	BSL
	Beryllium	7440-41-7	1.00E-01	3.30E-01	TP-6B (N)	10 / 10	5.20E-01	5.90E-01	3.30E-01	3.45E-01	5.70E-01	1.6E+02	nc	1.60E+01	--	1.60E+01	No	BSL
	Cadmium	7440-43-9	1.70E-01	2.40E-01	SB-2A (W)	2 / 10	5.20E-01	5.90E-01	2.40E-01	1.91E-01	3.60E-01	7.0E+01	nc	7.00E+00	--	7.00E+00	No	BSL
	Calcium	7440-70-2	2.85E+02	8.27E+02	TP-6B (N)	10 / 10	5.20E+02	5.90E+02	8.27E+02	2.43E+02	4.71E+02	--		--	--	--	No	NUT
	Chromium (assumed VI)	18540-29-9	4.80E+00	2.07E+01	TP-6B (N)	10 / 10	1.00E+00	1.20E+00	2.07E+01	1.26E+01	2.10E+01	2.3E+02	nc	2.30E+01	--	2.30E+01	No	BSL
	Cobalt	7440-48-4	1.20E+00	4.80E+00	TP-6B (N)	10 / 10	5.20E+00	5.90E+00	4.80E+00	4.14E+00	1.40E+01	--		--	--	--	No	NBA
	Copper	7440-50-8	2.40E+00	8.60E+00	TP-6B (N)	10 / 10	2.60E+00	3.00E+00	8.60E+00	7.04E+00	1.09E+01	3.1E+03	nc	3.10E+02	--	3.10E+02	No	BSL
	Iron	7439-89-6	3.46E+03	1.87E+04	TP-6B (N)	10 / 10	1.00E+01	1.20E+01	1.87E+04	1.08E+04	1.79E+04	5.5E+04	nc	5.50E+03	--	5.50E+03	**Yes**	ASL
	Lead	7439-92-1	2.60E+00	1.73E+01	SB-2A (W)	10 / 10	2.10E+00	2.40E+00	1.73E+01	7.70E+00	1.22E+01	4.0E+02	++	4.00E+02	--	4.00E+02	No	BSL
	Magnesium	--	3.35E+02	1.53E+03	TP-6B (N)	10 / 10	5.20E+02	5.90E+02	1.53E+03	9.49E+02	1.78E+03	--		--	--	--	No	NUT
	Manganese	7439-96-5	2.62E+01	1.37E+02	TP-6A (N)	10 / 10	1.60E+00	1.80E+00	1.37E+02	9.77E+01	2.13E+02	--		--	--	--	No	NBA
	Mercury (inorganic)	--	1.30E-02	7.70E-02	SB-2A (W)	9 / 10	3.20E-02	3.90E-02	7.70E-02	2.98E-02	4.80E-02	6.7E+00	sat	6.70E+00	3.3E-02	3.30E-02	**Yes**	ASL
	Nickel	7440-02-0	2.60E+00	9.90E+00	TP-6B (N)	10 / 10	4.20E+00	4.70E+00	9.90E+00	7.05E+00	1.12E+01	1.6E+03	nc	1.60E+02	--	1.60E+02	No	BSL
	Potassium	2023695	2.47E+02	7.01E+02	TP-6B (N)	10 / 10	5.20E+02	5.90E+02	7.01E+02	4.54E+02	8.53E+02	--		--	--	--	No	NUT
	Silver	7440-22-4	2.10E-01	2.10E-01	SB-6B (N)	1 / 10	1.00E+00	1.20E+00	2.10E-01	3.98E-01	8.90E-01	3.9E+02	nc	3.90E+01	--	3.90E+01	No	BSL
	Thallium	7440-28-0	2.90E-02	1.80E-01	SB-6B (N)	10 / 10	1.00E-01	2.80E-01	1.80E-01	2.16E-01	5.30E-01	5.1E+00	nc	5.10E-01	--	5.10E-01	No	BSL
	Vanadium	--	6.80E+00	3.25E+01	TP-6B (N)	10 / 10	5.20E+00	5.90E+00	3.25E+01	2.00E+01	3.11E+01	3.9E+02	nc	3.90E+01	--	3.90E+01	No	BSL
	Zinc	7440-66-6	6.50E+00	2.38E+01	TP-6B (N)	10 / 10	2.10E+00	2.10E+00	2.38E+01	1.67E+01	2.63E+01	2.3E+04	nc	2.30E+03	--	2.30E+03	No	BSL

Rationale Codes:
Selection reason: ASL - Above Screening Level
Deletion reason: BSL - Below Screening Level
NBA - No Benchmark Available
NUT - Essential Nutrient

Note:
The maximum detected concentration is from all samples (i.e., duplicates have not been averaged).
Screening concentrations from EPAs "Regional Screening Table" found at: http://epa-prgs.ornl.gov/chemicals/index.shtml (Accessed August 2008)
Background values from Table 4.25 in "Background Soil and Groundwater Investigation Report for the Main Base NASA Wallops Flight Facility, Wallops, Virginia" (Tetra Tech NUS, 2004).
N/A - Not available.

Table 6-5
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER (ENTIRE SITE)
CDL - Wallops Flight Facility

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

Exposure Point	Chemical	CAS Number	Minimum Detected Concentration (ug/L)	Maximum Detected Concentration (ug/L)	Location of Maximum Concentration	Detection Frequency	Minimum Reporting Limit (RL) (µg/L)	Maximum Reporting Limit (RL) (µg/L)	Concentration Used for Screening (µg/L)	Background Value - Mean (µg/L)	Background Value Maximum (µg/L)	Tapwater Screening Limit (µg/L)	key	Screening Value (µg/L)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Groundwater (Entire Site)	**Volatile Organic Compounds**															
	Benzene	71-43-2	3.7	3.7	MW-5	1 / 6	1.00E+00	1.00E+01	3.70E+00	N/A	N/A	4.1E-01	ca	4.10E-01	**Yes**	ASL
	Cyclohexane	110-82-7	143	216	MW-4	2 / 6	5.00E+00	5.00E+01	2.16E+02	N/A	N/A	1.3E+04	nc	1.30E+03	No	BSL
	Dichloroethane, 1,2-	107-06-2	8.8	17.6	MW-5	2 / 6	1.00E+00	1.00E+01	1.76E+01	N/A	N/A	1.5E-01	ca	1.50E-01	**Yes**	ASL
	Dichloroethylene, cis-1,2-	156-59-2	48.1	54.5	MW-4	2 / 6	1.00E+00	1.00E+01	5.45E+01	2.48E-02	2.70E-02	3.7E+02	nc	3.70E+01	**Yes**	ASL
	Ethylbenzene	100-41-4	419.5	548	MW-4	2 / 6	1.00E+00	1.00E+01	5.48E+02	N/A	N/A	1.5E+00	ca	1.50E+00	**Yes**	ASL
	Isopropylbenzene (Cumene)	98-82-8	49.2	68.6	MW-4	2 / 6	2.00E+00	2.00E+01	6.86E+01	N/A	N/A	6.8E+02	nc	6.80E+01	**Yes**	ASL
	Methylcyclohexane	108-87-2	180	180	MW-4	1 / 6	5.00E+00	5.00E+01	1.80E+02	N/A	N/A	6.3E+03	nc	6.30E+02	No	BSL
	Tetrachloroethylene	127-18-4	7.9	13.9	MW-4	2 / 6	1.00E+00	1.00E+01	1.39E+01	N/A	N/A	1.1E-01	ca	1.10E-01	**Yes**	ASL
	Toluene	108-88-3	1340	1680	MW-4	2 / 6	1.00E+00	1.00E+01	1.68E+03	N/A	N/A	2.3E+03	nc	2.30E+02	**Yes**	ASL
	Trichloroethylene	79-01-6	3.35	3.6	MW-4	1 / 6	1.00E+00	1.00E+01	3.60E+00	N/A	N/A	1.7E+00	ca	1.70E+00	**Yes**	ASL
	Xylene, m-,p- (assume Xylene, m-)	(108-38-3)	1640	2180	MW-4	2 / 6	1.00E+00	1.00E+01	2.18E+03	N/A	N/A	1.4E+03	nc	1.40E+02	**Yes**	ASL
	Xylene, o-	95-47-6	470	859	MW-4	2 / 6	1.00E+00	1.00E+01	8.59E+02	N/A	N/A	1.4E+03	nc	1.40E+02	**Yes**	ASL
	Xylene, Mixture (Total)	1330-20-7	2105	3040	MW-4	2 / 6	1.00E+00	1.00E+01	3.04E+03	N/A	N/A	2.0E+02	nc	2.00E+01	**Yes**	ASL
	Semivolatile Organic Compounds															
	2-Methylphenol (Cresol, o-)	95-48-7	1.7	1.7	MW-4	1 / 6	5.00E+00	5.40E+00	1.70E+00	N/A	N/A	1.8E+03	nc	1.80E+02	No	BSL
	3&4-Methylphenol	106-44-5	3.2	3.2	MW-4	1 / 6	5.00E+00	5.40E+00	3.20E+00	N/A	N/A	1.8E+02	nc	1.80E+01	No	BSL
	Biphenyl, 1,1'-	92-52-4	2	2.7	MW-4	2 / 6	2.00E+00	2.20E+00	2.70E+00	N/A	N/A	1.8E+03	nc	1.80E+02	No	BSL
	Carbazole	86-74-8	0.6	0.6	MW-5	1 / 6	2.00E+00	2.20E+00	6.00E-01	N/A	N/A	3.4E+00	ca	3.40E+00	No	BSL
	Dibenzofuran	132-64-9	0.51	0.51	MW-4	1 / 6	5.00E+00	5.40E+00	5.10E-01	N/A	N/A	--		--	No	NBA
	Bis(2-ethylhexyl)phthalate	117-81-7	2.2	2.2	MW-4	1 / 6	2.00E+00	2.20E+00	2.20E+00	N/A	N/A	4.8E+00	ca	4.80E+00	No	BSL
	Fluorene	86-73-7	0.41	0.5	MW-4	2 / 6	2.00E+00	2.20E+00	5.00E-01	N/A	N/A	1.5E+03	nc	1.50E+02	No	BSL
	Methylnaphthalene, 2-	91-57-6	32.7	35.4	MW-4	2 / 6	2.00E+00	2.20E+00	3.54E+01	N/A	N/A	1.5E+02	nc	1.50E+01	**Yes**	ASL
	Naphthalene	91-20-3	0.57	94.9	MW-4	3 / 6	2.00E+00	2.20E+00	9.49E+01	N/A	N/A	6.2E+00	nc	6.20E-01	**Yes**	ASL
	Phenanthrene	85-01-8	0.53	0.53	MW-5	1 / 6	2.00E+00	2.20E+00	5.30E-01	N/A	N/A	--		--	No	NBA
	Inorganics															
	Aluminum	7429-90-5	57.1	1380	MW-3	5 / 6	2.00E+02	2.00E+02	1.38E+03	1.00E+04	5.92E+04	3.7E+04	nc	3.70E+03	No	BSL
	Antimony (metallic)	7440-36-0	1	1	MW-5	1 / 6	6.00E+00	6.00E+00	1.00E+00	N/A	N/A	1.5E+01	nc	1.50E+00	No	BSL
	Arsenic, Inorganic	7440-38-2	1.7	8.7	MW-4	4 / 6	2.00E+00	1.00E+01	8.70E+00	3.93E+00	1.77E+01	4.5E-02	ca	4.50E-02	**Yes**	ASL
	Barium	7440-39-3	3.3	107	MW-5	6 / 6	2.00E+02	2.00E+02	1.07E+02	5.27E+01	2.21E+02	7.3E+03	nc	7.30E+02	No	BSL
	Cadmium	7440-43-9	0.3	0.3	MW-4 & -5	2 / 6	4.00E+00	4.00E+00	3.00E-01	6.10E-01	4.20E-01	1.8E+01	nc	1.80E+00	No	BSL
	Calcium	7440-70-2	21600	144000	MW-5	6 / 6	5.00E+03	5.00E+03	1.44E+05	9.70E+03	3.01E+04	--		--	No	NUT
	Chromium (assumed VI)	18540-29-9	1.1	1.5	MW-3	2 / 6	1.00E+01	1.00E+01	1.50E+00	6.52E+00	4.55E+01	--		--	No	NBA
	Cobalt	7440-48-4	1.7	1.7	MW-5	1 / 6	5.00E+01	5.00E+01	1.70E+00	2.77E+00	1.86E+01	--		--	No	NBA
	Copper	7440-50-8	4.95	6.6	MW-3	1 / 6	2.50E+01	2.50E+01	6.60E+00	4.28E+00	1.53E+01	1.5E+03	nc	1.50E+02	No	BSL
	Iron	7439-89-6	543.5	29600	MW-4	5 / 6	1.00E+02	1.00E+02	2.96E+04	1.18E+04	5.00E+04	2.6E+04	nc	2.60E+03	**Yes**	ASL
	Lead and Compounds	7439-92-1	2	8.7	MW-4	4 / 6	3.00E+00	3.00E+00	8.70E+00	3.16E+00	1.27E+01	1.5E+01		1.50E+01	No	BSL
	Magnesium	--	1490	13700	MW-5	6 / 6	5.00E+03	5.00E+03	1.37E+04	4.24E+03	1.27E+04	--		--	No	NUT
	Manganese	7439-96-5	1.7	1810	MW-5	6 / 6	1.50E+01	1.50E+01	1.81E+03	3.03E+02	3.11E+03	8.8E+02	nc	8.80E+01	**Yes**	ASL
	Mercury (inorganic)	--	0.043	0.17	MW-4	3 / 6	2.00E-01	2.00E-01	1.70E-01	N/A	N/A	6.3E-01	nc	6.30E-02	**Yes**	ASL
	Nickel (Soluble Salts)	7440-02-0	0.8	1	MW-3	2 / 6	4.00E+01	4.00E+01	1.00E+00	3.36	1.51E+01	7.3E+02	nc	7.30E+01	No	BSL
	Potassium	2023695	1060	3580	MW-5	6 / 6	5.00E+03	1.00E+04	3.58E+03	2.51E+03	8.46E+03	--		--	No	NUT
	Selenium	7782-49-2	2	4.8	MW-5	3 / 6	1.00E+01	1.00E+01	4.80E+00	2.83E+00	6.96E+01	1.8E+02	nc	1.80E+01	No	BSL
	Sodium	--	4940	24500	MW-5	6 / 6	1.00E+04	1.00E+04	2.45E+04	7.42E+03	1.78E+04	--		--	No	NUT
	Thallium	7440-28-0	1.3	1.3	MW-6	1 / 12	1.00E+11	5.00E+00	1.30E+00	N/A	N/A	2.46+00	nc	2.40E-01	Yes	ASL
	Vanadium and Compounds	--	2.05	3.5	MW-5	3 / 6	5.00E+01	5.00E+01	3.50E+00	8.23E+00	6.96E+01	1.8E+02	nc	1.80E+01	No	BSL
	Zinc (Metallic)	7440-66-6	3.8	4.7	MW-2	4 / 6	2.00E+01	2.00E+01	4.70E+00	2.53E+01	8.45E+01	1.1E+04	nc	1.10E+03	No	BSL

Rationale Codes:
Selection reason: ASL - Above Screening Level
Deletion reason: BSL - Below Screening Level
NBA - No Benchmark Available
NUT - Essential Nutrient

Notes:
The maximum detected concentration is from all samples (i.e., duplicates have not been averaged).
Screening concentrations from EPAs "Regional Screening Table" found at: http://epa-prgs.ornl.gov/chemicals/index.shtml (Accessed August 2008)
For 3&4-Methylphenol assumed 4-Methylphenol (Cresol, p-).
Background values from Table 4.6, "Background Soil and Groundwater Investigation Report for the Main Base NASA Wallops Flight Facility, Wallops, Virginia" (Tetra Tech NUS, 2004).
N/A - Not available.

Table 6-6
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN -
SEDIMENT (MOSQUITO CREEK)
CDL - Wallops Flight Facility

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

Exposure Point	Chemical	CAS Number	Minimum Detected Concentration (mg/kg)	Maximum Detected Concentration (mg/kg)	Location of Maximum Concentration	Detection Frequency	Minimum Reporting Limit (RL) (mg/kg)	Maximum Reporting Limit (RL) (mg/kg)	Concentration Used for Screening (mg/kg)	Residential SSL (mg/kg)	key	10*cancer limit (mg/kg)	Protection of GW Risk-based SSL (mg/kg)	Screening Value (mg/kg)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Sediment (Entire Site)	**Volatile Organic Compounds**															
	Acetone	67-64-1	0.028	0.22	SD-8	6 / 9	0.011	0.12	2.20E-01	6.1E+04	nc	6.10E+04	4.4E+00	4.40E+00	No	BSL
	Methyl ethyl ketone (2-Butanone)	78-93-3	0.0388	0.164	SD-8	2 / 9	0.011	0.12	1.64E-01	2.8E+04	sat	2.80E+04	1.5E+00	1.50E+00	No	BSL
	Carbon disulfide	75-15-0	0.0084	0.02365	SD-4	6 / 9	0.0055	0.06	2.37E-02	6.7E+02	sat	6.70E+02	2.7E-01	2.70E-01	No	BSL
	Cyclohexane	110-82-7	0.01815	0.01815	SD-4	1 / 9	0.0055	0.06	1.82E-02	7.2E+03	sat	7.20E+03	1.3E+01	1.30E+01	No	BSL
	Methylene chloride	75-09-2	0.0092	0.0092	SD-4	1 / 9	0.0055	0.06	9.20E-03	1.1E+01	ca	1.10E+02	1.2E-03	1.20E-03	**Yes**	ASL
	Semivolatile Organic Compounds															
	di-n-Octyl phthalate	117-84-0	3.08	3.08	SD-5	1 / 9	0.08	5.1	3.08E+00	--		--	--	--	No	NBA
	bis(2-Ethylhexyl)phthalate	117-81-7	0.161	162	SD-5	3 / 9	0.08	5.1	1.62E+02	3.5E+01	ca*	3.50E+02	1.6E+00	1.60E+00	**Yes**	ASL
	Pesticides															
	DDD	72-54-8	0.065	0.065	SD-9	1 / 9	1.60E-03	2.90E-02	6.50E-02	2.0E+00	ca	2.00E+01	8.6E-02	8.60E-02	No	BSL
	DDE	72-55-9	0.0268	0.149	SD-9	2 / 9	1.60E-03	2.90E-02	1.49E-01	1.4E+00	ca	1.40E+01	6.0E-02	6.00E-02	**Yes**	ASL
	DDT	50-29-3	0.0108	0.0108	SD-10	1 / 9	1.60E-03	2.90E-02	1.08E-02	1.7E+00	ca*	1.70E+01	8.7E-02	8.70E-02	No	BSL
	Inorganics															
	Aluminum	7429-90-5	7770	22300	SD-2	9 / 9	18	34	2.23E+04	7.7E+04	nc	7.70E+04	--	7.70E+04	No	BSL
	Antimony	7440-36-0	2.8	2.8	SD-9	1 / 9	1.8	3.4	2.80E+00	3.1E+01	nc	3.10E+01	--	3.10E+01	No	BSL
	Arsenic	7440-38-2	3	19.05	SD-4	9 / 9	0.36	0.69	1.91E+01	3.9E-01	ca*	3.90E+00	--	3.90E+00	**Yes**	ASL
	Barium	7440-39-3	24.8	85.2	SD-9	9 / 9	18	34	8.52E+01	1.5E+04	nc	1.50E+04	--	1.50E+04	No	BSL
	Beryllium	7440-41-7	0.2	0.61	SD-6 & -9	9 / 9	0.45	0.86	6.10E-01	1.6E+02	nc	1.60E+02	--	1.60E+02	No	BSL
	Cadmium	7440-43-9	0.21	1.5	SD-9	5 / 9	0.45	0.86	1.50E+00	7.0E+01	nc	7.00E+01	--	7.00E+01	No	BSL
	Calcium	7440-70-2	468	16840	SD-4	9 / 9	450	860	1.68E+04	--		--	--	--	No	NUT
	Chromium (assume VI)	18540-29-9	8.6	49.6	SD-2	9 / 9	0.91	1.7	4.96E+01	2.3E+02	nc	2.30E+02	--	2.30E+02	No	BSL
	Cobalt	7440-48-4	2	9.3	SD-6	9 / 9	4.5	8.6	9.30E+00	--		--	--	--	No	NBA
	Copper	7440-50-8	8.8	56.5	SD-9	8 / 9	2.3	4.3	5.65E+01	3.1E+03	nc	3.10E+03	--	3.10E+03	No	BSL
	Iron	7439-89-6	5670	30800	SD-6	9 / 9	14	26	3.08E+04	5.5E+04	nc	5.50E+04	--	5.50E+04	No	BSL
	Lead	7439-92-1	8.9	96.9	SD-9	9 / 9	1.8	3.4	9.69E+01	4.0E+02	++	4.00E+02	--	4.00E+02	No	BSL
	Magnesium	--	541	10900	SD-7	9 / 9	450	860	1.09E+04	--		--	--	--	No	NUT
	Manganese	7439-96-5	58.3	243	SD-6	9 / 9	1.4	2.6	2.43E+02	--		--	--	--	No	NBA
	Mercury (inorganic)	--	0.0405	0.49	SD-9	8 / 9	0.036	0.21	4.90E-01	6.7E+00	sat	6.70E+00	3.3E-02	3.30E-02	**Yes**	ASL
	Nickel	7440-02-0	5.6	21.8	SD-2	9 / 9	3.6	6.9	2.18E+01	1.6E+03	nc	1.60E+03	--	1.60E+03	No	BSL
	Potassium	2023695	332	6590	SD-7	9 / 9	450	860	6.59E+03	--		--	--	--	No	NUT
	Selenium	7782-49-2	1.4	1.8	SD-2 & -3	7 / 9	1.8	3.4	1.80E+00	3.9E+02	nc	3.90E+02	--	3.90E+02	No	BSL
	Silver	7440-22-4	0.24	1.5	SD-9	5 / 9	0.91	1.7	1.50E+00	3.9E+02	nc	3.90E+02	--	3.90E+02	No	BSL
	Sodium	7440-66-6	162	53700	SD-7	9 / 9	1100	8400	5.37E+04	--		--	--	--	No	NUT
	Thallium	7440-28-0	0.079	0.28	SD-2	9 / 9	0.12	0.63	2.80E-01	5.1E+00	nc	5.10E+00	--	5.10E+00	No	BSL
	Vanadium	--	12.7	53.7	SD-6	9 / 9	4.5	8.6	5.37E+01	3.9E+02	nc	3.90E+02	--	3.90E+02	No	BSL
	Zinc	7440-66-6	36.7	324	SD-9	9 / 9	1.8	3.4	3.24E+02	2.3E+04	nc	2.30E+04	--	2.30E+04	No	BSL

Rationale Codes:
Selection reason: ASL - Above Screening Level
Deletion reason: BSL - Below Screening Level
NBA - No Benchmark Available
NUT - Essential Nutrient

Note:
The maximum detected concentration is from all samples (i.e., duplicates have not been averaged).
Screening concentrations from EPAs "Regional Screening Table" found at: http://epa-prgs.ornl.gov/chemicals/index.shtml (Accessed August 2008)

Table 6-7
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN -
SURFACE WATER (MOSQUITO CREEK)
CDL - Wallops Flight Facility

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

Exposure Point	Chemical	CAS Number	Minimum Detected Concentration (ug/L)	Maximum Detected Concentration (ug/L)	Location of Maximum Concentration	Detection Frequency	Minimum Reporting Limit (RL) (µg/L)	Maximum Reporting Limit (RL) (µg/L)	Concentration Used for Screening (µg/L)	Tapwater (µg/L)	key	Screening Value (µg/L)	COPC Flag (Y/N)	Rationale for Selection or Deletion
Surface Water (Entire Site)	**Volatile Organic Compounds**													
	Benzene	71-43-2	0.77	0.77	SW-2	1 / 6	1.00E+00	1.00E+00	7.70E-01	4.1E-01	ca	4.10E+00	No	BSL
	Carbon Disulfide	75-15-0	0.24	0.24	SW-2	1 / 6	2.00E+00	2.00E+00	2.40E-01	1.0E+03	nc	1.00E+03	No	BSL
	Semivolatile Organic Compounds													
	Methylnaphthalene, 2-	91-57-6	1.8	1.8	SW-4	1 / 6	2.00E+00	2.40E+00	1.80E+00	1.5E+02	nc	1.50E+02	No	BSL
	Naphthalene	91-20-3	1	1	SW-4	1 / 6	2.00E+00	2.40E+00	1.00E+00	6.2E+00	nc	6.20E+00	No	BSL
	Inorganics													
	Aluminum	7429-90-5	112	1060	SW-2	6 / 6	2.00E+02	2.00E+02	1.06E+03	3.7E+04	nc	3.70E+04	No	BSL
	Antimony (metallic)	7440-36-0	6.2	6.2	SW-3	1 / 6	6.00E+00	1.20E+01	6.20E+00	1.5E+01	nc	1.50E+01	No	BSL
	Arsenic, Inorganic	7440-38-2	7	11.1	SW-4	6 / 6	2.00E+00	1.00E+01	1.11E+01	4.5E-02	ca	4.50E-01	**Yes**	ASL
	Barium	7440-39-3	14.55	27.6	SW-2	6 / 6	2.00E+02	2.00E+02	2.76E+01	7.3E+03	nc	7.30E+03	No	BSL
	Beryllium	7440-41-7	0.43	0.52	SW-3	2 / 6	1.00E+00	1.00E+00	5.20E-01	7.3E+01	nc	7.30E+01	No	BSL
	Calcium	7440-70-2	230000	266000	SW-3	6 / 6	5.00E+03	5.00E+03	2.66E+05	--		--	No	NUT
	Chromium (VI)	18540-29-9	0.98	2	SW-3	2 / 6	1.00E+01	1.00E+01	2.00E+00	--		--	No	NBA
	Copper	7440-50-8	3.3	4.9	SW-2	3 / 6	2.50E+01	2.50E+01	4.90E+00	1.5E+03	nc	1.50E+03	No	BSL
	Iron	7439-89-6	228	1030	SW-2	6 / 6	1.00E+02	1.00E+02	1.03E+03	2.6E+04	nc	2.60E+04	No	NBA
	Lead	7439-92-1	3.1	4	SW-4	2 / 6	3.00E+00	3.00E+00	4.00E+00	1.5E+01		1.50E+01	No	BSL
	Magnesium	--	721000	1060000	SW-3	6 / 6	5.00E+03	5.00E+04	1.06E+06	--		--	No	NUT
	Manganese (Water)	7439-96-5	20.9	43.5	SW-3	6 / 6	1.50E+01	1.50E+01	4.35E+01	8.8E+02	nc	8.80E+02	No	BSL
	Mercury (inorganic)	--	0.0785	0.091	SW-2	2 / 6	2.00E-01	2.00E-01	9.10E-02	6.3E-01	nc	6.30E-01	No	BSL
	Nickel Soluble Salts	7440-02-0	2.9	2.9	SW-3	1 / 6	4.00E+01	4.00E+01	2.90E+00	7.3E+02	nc	7.30E+02	No	BSL
	Potassium	2023695	330000	454000	SW-4	6 / 6	5.00E+03	1.00E+04	4.54E+05	--		--	No	NUT
	Selenium	7782-49-2	6.6	11.8	SW-4	6 / 6	1.00E+01	1.00E+01	1.18E+01	1.8E+02	nc	1.80E+02	No	BSL
	Sodium	--	7010000	9190000	SW-3	6 / 6	1.00E+06	1.00E+06	9.19E+06	--		--	No	NUT
	Vanadium	--	2.7	4.4	SW-2	3 / 6	5.00E+01	5.00E+01	4.40E+00	1.8E+02	nc	1.80E+02	No	BSL

Rationale Codes:
Selection reason: ASL - Above Screening Level
Deletion reason: BSL - Below Screening Level
NBA - No Benchmark Available
NUT - Essential Nutrient

Note:
The maximum detected concentration is from all samples (i.e., duplicates have not been averaged).
Screening concentrations from EPAs "Regional Screening Table" found at: http://epa-prgs.ornl.gov/chemicals/index.shtml (Accessed August 2008)

Table 6-8
SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
SOIL
CDL - Wallops Flight Facility

COPC	Central + Southern AOCs		Northern + Western AOCs	
Soil Interval	**Surface Soil**	**Aggregate Soil**	**Surface Soil**	**Aggregate Soil**
Volatile Organic Compounds				
Benzene		X		
1,2-Dichloroethane		X		
Ethylbenzene		X		
Tetrachloroethene		X		
m,p-Xylene		X		
Xylene (total)		X		
Semi-Volatile Organic Compounds				
Benzo[a]anthracene	X	X		
Benzo[a]pyrene	X	X		
Benzo[b]fluoranthene	X	X		
Benzo[k]fluoranthene	X	X		
Crysene	X	X		
Dibenz[a,h]anthracene	X	X		
Indeno[1,2,3-c,d]pyrene	X	X		
Pesticides				
Gamma-Chlordane		X		
DDD	X	X		
DDE	X	X		
DDT	X	X		
Polychlorinated Biphenyls				
Aroclor-1260		X		
Inorganics				
Aluminum	X	X	X	X
Antimony	X	X		
Arsenic	X	X	X	X
Cadmium	X	X		
Chromium, total	X	X		
Copper	X	X		
Iron	X	X	X	X
Lead	X	X		
Mercury	X	X	X	X
Nickel	X	X		
Silver	X	X		
Vanadium	X	X		
Zinc	X	X		

Table 6-9
SUMMARY OF CHEMICALS OF POTENTIAL CONCERN
GROUNDWATER, SEDIMENT, AND SURFACE WATER
CDL - Wallops Flight Facility

COPC	Groundwater	Sediment	Surface Water
Volatile Organic Compounds			
Benzene	X		
Methylene chloride		X	
bis(2-Ethylhexyl)phthalate		X	
Dichloroethane, 1,2-	X		
Dichloroethylene, cis-1,2-	X		
Ethylbenzene	X		
Isopropylbenzene	X		
Tetrachloroethylene	X		
Toluene	X		
Trichloroethylene	X		
Xylene, m-,p-	X		
Xylene, o-	X		
Xylene, Mixture (Total)	X		
Semi-Volatile Organic Compounds			
Methylnaphthalene, 2-	X		
Naphthalene	X		
Pesticides			
DDE		X	
Inorganics			
Arsenic	X	X	X
Iron	X		
Lead			
Manganese	X		
Mercury	X	X	
Thallium	X		

Table 6-10
SELECTION OF COPCs FOR VAPOR INTRUSION ANALYSIS -
AGGREGATE SOIL
CENTRAL AND SOUTHERN AOCs
CDL - Wallops Flight Facility

Soil COPC	CAS No.	Soil Concentration (mg/kg)	Is Chemical Sufficiently Volatile?[1]
Benzene	71432	1.85E-01	**Yes**
1,2-Dichloroethane	107062	2.38E-01	**Yes**
Ethylbenzene	100414	1.42E+00	**Yes**
Tetrachloroethene	127184	1.37E-02	**Yes**
m,p-Xylene	108383	2.00E+00	**Yes**
Xylene (total)	1330207	2.83E+00	NA
Benzo(a)anthracene	56-55-3	9.05E-01	No
Benzo(a)pyrene	50-32-8	1.91E+00	No
Benzo(b)fluoranthene	205992	1.39E+00	**Yes**
Benzo(k)fluoranthene	207-08-9	1.03E+00	No
Chrysene	218019	1.43E+00	**Yes**
Dibenz(a,h)anthracene	53-70-3	3.88E-01	No
Indeno(1,2,3-c,d)pyrene	193-39-5	6.17E-01	No
gamma-Chlordane	5103-74-2	3.46E-02	NA
DDD	72-54-8	6.11E-02	No
DDE	72559	6.54E-01	**Yes**
DDT	50-29-3	3.26E-01	No
Aroclor-1260	11096-82-5	2.13E-01	NA
Aluminum	7429-90-5	2.95E+04	NA
Antimony	7440-36-0	2.58E+01	NA
Arsenic	7440-38-2	4.79E+00	NA
Cadmium	7440-43-9	1.17E+01	NA
Chromium	18540-29-9	3.69E+02	NA
Copper	7440-50-8	3.49E+03	NA
Iron	7439-89-6	1.90E+04	NA
Lead	7439-92-1	3.83E+02	NA
Mercury (inorganic)[2]	--	6.05E-01	NA
Nickel	7440-02-0	8.44E+01	NA
Silver	7440-22-4	2.06E+01	NA
Vanadium	--	2.34E+01	NA
Zinc	7440-66-6	4.28E+03	NA

Notes:
NA = Not Applicable - chemical not included in table/model.
1 - Based on Table 1, "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings" (EPA, 2003).
2 - Mercury found in soil is typically inorganic mercury.

Table 6-11
SELECTION OF COPCs FOR VAPOR INTRUSION ANALYSIS -
AGGREGATE SOIL
NORTHERN AND WESTERN AOCs
CDL - Wallops Flight Facility

Soil COPC	CAS No.	Soil Concentration (mg/kg)	Is Chemical Sufficiently Volatile?[1]
Aluminum	7429-90-5	1.32E+04	NA
Arsenic	7440-38-2	3.57E+00	NA
Iron	7439-89-6	1.07E+04	NA
Mercury (inorganic)[2]	--	6.07E-02	NA

Notes:

NA = Not Applicable - chemical not included in table/model.

1 - Based on Table 1, "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings" (EPA, 2003).

2 - Mercury found in soil is typically inorganic mercury.

TABLE 6-12
SELECTION OF COPCs FOR VAPOR INTRUSION ANALYSIS - GROUNDWATER
CDL - Wallops Flight Facility

Groundwater COPC	CAS No.	Groundwater Concentration (µg/L)	Is Chemical Sufficiently Volatile?[1]
Benzene	71432	1	**Yes**
1,2-Dichloroethane	107062	1	**Yes**
cis-1,2-Dichloroethene	156592	1	**Yes**
Ethylbenzene	100414	1	**Yes**
Isopropylbenzene	98828	1	**Yes**
Tetrachloroethene	127184	1	**Yes**
Toluene	108883	1	**Yes**
Trichloroethene	79016	1	**Yes**
m,p-Xylene	108383	1	**Yes**
o-Xylene	95476	1	**Yes**
Xylene (total)	1330207	1	**Yes**
2-Methylnaphthalene	91576	2	**Yes**
Naphthalene	91203	2	**Yes**
Arsenic	7440382	7.945	NA
Iron	7439896	27300	NA
Manganese	7439965	1430	NA
Mercury (inorganic)[2]	--	0.15	NA

Notes:
Isopropylbenzene = cumene
NA = Not Applicable - chemical not included in table/model.

1 - Based on Table 1, "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings" (EPA, 2003).

2 - Mercury found in soil is typicaly inorganic mercury.

TABLE 6-13
SELECTION OF EXPOSURE PATHWAYS
CDL - Wallops Flight Facility

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current	surface soil	surface soil	surface soil at CDL	Site Worker	adult	ingestion	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
						dermal	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
	surface soil	air	air volatized from surface soil at CDL			inhalation	on-site	none	Based on site information and exposure potential, inhalation is not anticipated to be a significant pathway for this receptor; therefore pathway not selected for evaluation.
			airborne particulate matter at CDL			inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
Current/Future	sediment	sediment	Little Mosquito Creek Sediment	Recreational Fishermen	adult	ingestion	off-site	quantitative	Adult ingests sediment while fishing and crabbing.
						dermal	off-site	quantitative	Adult contacts sediment while fishing and crabbing.
					child	ingestion	off-site	quantitative	Child ingests sediment while fishing and crabbing.
						dermal	off-site	quantitative	Child contacts sediment while fishing and crabbing.
		crab tissue	Blue crab		adult	ingestion	off-site	quantitative	Adult ingests recreationally caught crab
					child	ingestion	off-site	quantitative	Child ingests recreationally caught crab
	surface water	surface water	Little Mosquito Creek Surface Water		adult	ingestion	off-site	quantitative	Adult ingests surface water while fishing and crabbing.
						dermal	off-site	quantitative	Adult contacts surface water while fishing and crabbing.
					child	ingestion	off-site	quantitative	Child ingests surface water while fishing and crabbing.
						dermal	off-site	quantitative	Child contacts surface water while fishing and crabbing.
		fish tissue	Bluefish		adult	ingestion	off-site	quantitative	Adult ingests recreationally caught fish
					child	ingestion	off-site	quantitative	Child ingests recreationally caught fish
Future	aggregate soil	aggregate soil	Aggregate soil at CDL	Commercial Worker	adult	ingestion	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		air	volatilized chemicals enter indoor air through slab			inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
	groundwater	groundwater	water supply well - tap			ingestion	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		air	volatilized chemicals enter indoor air through slab			inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
Future	aggregate soil	aggregate soil	Aggregate soil at CDL	Construction Worker	adult	ingestion	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		aggregate soil	Aggregate soil at CDL			dermal	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		air	air volatized from aggregate soil at CDL			inhalation	on-site	none	Based on site information and exposure potential, inhalation is not anticipated to be a significant pathway for this receptor; therefore pathway not selected for evaluation.
			airborne particulate matter at CDL			inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
	groundwater	groundwater	groundwater at excavation site			ingestion	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
						dermal	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		air	air volatilized from groundwater in trench at excavation site			inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.

TABLE 6-13
SELECTION OF EXPOSURE PATHWAYS
CDL - Wallops Flight Facility

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	aggregate soil	aggregate soil	Aggregate soil at CDL	Resident	adult/child	ingestion	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		aggregate soil	Aggregate soil at CDL		adult/child	dermal	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		air	air volatilized from aggregate soil at CDL		adult/child	inhalation	on-site	none	Based on site information and exposure potential, inhalation is not anticipated to be a significant outdoor pathway for this receptor; therefore pathway not selected for evaluation.
			airborne particulate matter at CDL		adult/child	inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
			volatilized chemicals enter indoor air through slab		adult/child	inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
	groundwater	groundwater	water supply well - tap water		adult/child	ingestion	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
			water supply well - shower/bath scenario		adult/child	dermal	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
			water supply well - vapor from shower head		adult	inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		air	volatilized chemicals enter indoor air through slab		adult/child	inhalation	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
CurrentFuture	aggregate soil	aggregate soil	Aggregate soil at CDL	Trespasser	youth	ingestion	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		aggregate soil	Aggregate soil at CDL			dermal	on-site	quantitative	Pathway potentially complete; selected for quantitative evaluation.
		air	airborne particulate matter at CDL			inhalation	on-site	none	Based on site information and exposure potential, inhalation is not anticipated to be a significant pathway for this receptor; therefore pathway not selected for evaluation.
	sediment	sediment	Little Mosquito Creek Sediment			ingestion dermal	off-site	quantitative	Adult ingests sediment while fishing and crabbing. Adult contacts sediment while fishing and crabbing.
	surface water	surface water	Little Mosquito Creek Surface Water			ingestion dermal	off-site	quantitative	Adult ingests sediment while fishing and crabbing. Adult contacts sediment while fishing and crabbing.

Table 6-14
EXPOSURE POINT CONCENTRATION SUMMARY
SURFACE SOILS - CENTRAL AND SOUTHERN AOCs
CDL - Wallops Flight Facility

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soils (0-0.5 ft bgs) Central and Southern AOCs

Exposure Point	Chemical of Potential Concern	Arithmetic Mean (mg/kg)	UCL (mg/kg)	Distribution	Maximum Concentration (mg/kg)	EPC (mg/kg)	Statistic	Rationale
Surface Soils (Central and Southern AOCs)	**Semi-Volatile Organic Compounds**							
	Benzo(a)anthracene	6.70E-01	N/A	N/A	2.49E+00	8.15E-02	Maximum	≤5 detections
	Benzo(a)pyrene	6.92E-01	N/A	N/A	1.91E+00	8.15E-02	Maximum	≤5 detections
	Benzo(b)fluoranthene	5.34E-01	N/A	N/A	1.39E+00	8.60E-02	Maximum	≤5 detections
	Benzo(k)fluoranthene	4.04E-01	N/A	N/A	1.03E+00	8.39E-02	Maximum	≤5 detections
	Chrysene	1.07E+00	N/A	N/A	4.04E+00	8.60E-02	Maximum	≤5 detections
	Dibenz(a,h)anthracene	2.05E-01	N/A	N/A	3.88E-01	8.15E-02	Maximum	≤5 detections
	Indeno(1,2,3-c,d)pyrene	2.47E-01	N/A	N/A	6.17E-01	8.00E-02	Maximum	≤5 detections
	Pesticides							
	DDD	3.64E-02	0.0957	Nonparametric - 95% KM (Chebyshev) UCL	1.26E-01	9.57E-02	95% KM (Chebyshev) UCL	ProUCL recommendation
	DDE	2.04E-01	0.618	Gamma - 95% Approximate Gamma UCL	1.02E+00	6.18E-01	95% Approximate Gamma UCL	ProUCL recommendation
	DDT	1.30E-01	0.374	Gamma - 95% Approximate Gamma UCL	5.30E-01	3.74E-01	95% Approximate Gamma UCL	ProUCL recommendation
	Inorganics							
	Aluminum	1.18E+04	18191	Gamma - 95% Approximate Gamma UCL	2.73E+04	1.82E+04	95% Approximate Gamma UCL	ProUCL recommendation
	Antimony	2.35E+01	N/A	N/A	6.37E+01	6.37E+01	Maximum	≤5 detections
	Arsenic	4.71E+00	6.02	Normal - 95% Student's-t UCL	7.60E+00	6.02E+00	95% Student's-t UCL	ProUCL recommendation
	Cadmium	5.84E+00	17.14	Nonparametric - 95% KM (Chebyshev) UCL	2.16E+01	1.71E+01	95% KM (Chebyshev) UCL	ProUCL recommendation
	Chromium	3.96E+01	51.72	Normal - 95% Student's-t UCL	1.26E+02	5.17E+01	95% Student's-t UCL	ProUCL recommendation
	Copper	3.62E+02	2592	Gamma - 95% Adjusted Gamma UCL	1.79E+03	1.79E+03	Maximum	Recommended UCL exceeds the maximum observation.
	Iron	1.50E+04	24297	Gamma - 95% Approximate Gamma UCL	4.51E+04	2.43E+04	95% Approximate Gamma UCL	ProUCL recommendation
	Lead	4.04E+02	2329	Gamma - 95% Adjusted Gamma UCL	2.12E+03	4.04E+02	Average	Average value recommended input into Integrated Exposure Uptake Biokinetic (IEUBK) model
	Mercury (elemental)	3.40E-01	0.74	Lognormal - 95% Chebyshev (MVUE) UCL	1.80E+00	7.40E-01	95% Chebyshev (MVUE) UCL	ProUCL recommendation
	Nickel	8.21E+01	164.9	Gamma - 95% Approximate Gamma UCL	2.56E+02	1.65E+02	95% Approximate Gamma UCL	ProUCL recommendation
	Silver	1.64E+01	60.38	Nonparametric - 95% KM (Chebyshev) UCL	8.45E+01	6.04E+01	95% KM (Chebyshev) UCL	ProUCL recommendation
	Vanadium	1.74E+01	38.5	Nonparametric - 95% Chebyshev(Mean, Sd) UCL	5.10E+01	3.85E+01	95% Chebyshev (Mean, Sd) UCL	
	Zinc	7.34E+02	4432	Gamma - 95% Adjusted Gamma UCL	4.28E+03	4.28E+03	Maximum	Recommended UCL exceeds the maximum observation.

Definitions:
AOC Area of Concern
EPC Exposure Point Concentration
mg/kg milligrams per kilogram
N/A Not Applicable - the data set has 5 or less detected concentrations, so it is not recommended to calculate a UCL.
UCL Upper Confidence Limit

Note: UCLs were calculated using the ProUCL statistical program.
Arithmetic mean is of detected concentrations.

Table 6-15
EXPOSURE POINT CONCENTRATION SUMMARY
AGGREGATE SOILS - CENTRAL AND SOUTHERN AOCs
CDL - Wallops Flight Facility

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Aggregate Soils (0-10 ft bgs) Central and Southern AOCs

Exposure Point	Chemical	Arithmetic Mean (mg/kg)	UCL (mg/kg)	Distribution	Maximum Concentration (mg/kg)	EPC (mg/kg)	Statistic	Rationale
Aggregate Soils (Central and Southern AOCs)	**Volatile Organic Compounds**							
	Benzene	9.37E-02	N/A	N/A	1.85E-01	1.85E-01	Maximum	≤5 detected concentrations
	1,2-Dichloroethane	2.38E-01	N/A	N/A	2.38E-01	2.38E-01	Maximum	≤5 detected concentrations
	Ethylbenzene	5.94E-01	N/A	N/A	1.42E+00	1.42E+00	Maximum	≤5 detected concentrations
	Tetrachloroethene	5.83E-03	N/A	N/A	1.37E-02	1.37E-02	Maximum	≤5 detected concentrations
	m,p-Xylene	7.00E-01	N/A	N/A	2.00E+00	2.00E+00	Maximum	≤5 detected concentrations
	Xylene (total)	1.02E+00	N/A	N/A	2.83E+00	2.83E+00	Maximum	≤5 detected concentrations
	Semi-Volatile Organic Compounds							
	Benzo(a)anthracene	5.59E-01	N/A	N/A	2.49E+00	9.05E-01	97.5% KM (Chebyshev) UCL	ProUCL recommendation
	Benzo(a)pyrene	5.48E-01	N/A	N/A	1.91E+00	1.91E+00	Maximum	≤5 detected concentrations
	Benzo(b)fluoranthene	4.34E-01	N/A	N/A	1.39E+00	1.39E+00	Maximum	≤5 detected concentrations
	Benzo(k)fluoranthene	3.30E-01	N/A	N/A	1.03E+00	1.03E+00	Maximum	≤5 detected concentrations
	Chrysene	8.81E-01	N/A	N/A	4.04E+00	1.43E+00	Maximum	ProUCL recommendation
	Dibenz(a,h)anthracene	1.45E-01	N/A	N/A	3.88E-01	3.88E-01	Maximum	≤5 detected concentrations
	Indeno(1,2,3-c,d)pyrene	2.02E-01	N/A	N/A	6.17E-01	6.17E-01	Maximum	≤5 detected concentrations
	Pesticides							
	gamma-Chlordane	3.46E-02	N/A	N/A	3.46E-02	3.46E-02	Maximum	≤5 detected concentrations
	DDD	5.36E-02	0.0579	Nonparametric - 95% KM (BCA) UCL	1.97E-01	6.11E-02	95% KM (BCA) UCL	ProUCL recommendation
	DDE	3.30E-01	0.654	Nonparametric - 95% KM (Chebyshev) UCL	1.31E+00	6.54E-01	95% KM (Chebyshev) UCL	ProUCL recommendation
	DDT	1.66E-01	0.326	Nonparametric - 95% KM (Chebyshev) UCL	5.77E-01	3.26E-01	95% KM (Chebyshev) UCL	ProUCL recommendation
	Polychlorinated Biphenyls							
	Aroclor-1260	2.13E-01	N/A	N/A	2.13E-01	2.13E-01	Maximum	≤5 detected concentrations
	Inorganics							
	Aluminum	1.49E+04	29493	Nonparametric - 95% Chebyshev (Mean, Sd)	6.67E+04	2.95E+04	95% Chebyshev (Mean, Sd) UCL	ProUCL recommendation
	Antimony	2.68E+01	25.98	Nonparametric - 95% KM (Percentile Bootstrap)	6.37E+01	2.58E+01	95% KM (Percentile Bootstrap) UCL	ProUCL recommendation
	Arsenic	4.23E+00	4.789	Nonparametric - 95% KM (t) UCL	7.60E+00	4.79E+00	95% KM (t) UCL	ProUCL recommendation
	Cadmium	1.24E+01	11.48	Nonparametric - 95% KM (BCA)	4.77E+01	1.17E+01	95% KM (BCA) UCL	ProUCL recommendation
	Chromium	5.66E+01	368.5	Nonparametric - 99% Chebyshev (Mean, Sd)	6.16E+02	3.69E+02	99% Chebyshev (Mean, Sd) UCL	ProUCL recommendation
	Copper	6.12E+02	3489	Nonparametric - 99% Chebyshev (Mean, Sd)	5.10E+03	3.49E+03	99% Chebyshev (Mean, Sd) UCL	ProUCL recommendation
	Iron	1.50E+04	19004	Gamma - 95% Approximate Gamma	6.43E+04	1.90E+04	Use 95% Approximate Gamma UCL	ProUCL recommendation
	Lead	3.88E+02	1778	Nonparametric - 99% Chebyshev (Mean, Sd) UCL	2.12E+03	3.83E+02	Average	Average value recommended input into Integrated Exposure Uptake Biokinetic (IEUBK) model
	Mercury (elemental)	2.21E-01	0.605	Nonparametric - 95% KM (Chebyshev)	1.80E+00	6.05E-01	95% KM (Chebyshev) UCL	ProUCL recommendation
	Nickel	4.85E+01	84.44	Lognormal - 95% Chebyshev (MVUE)	2.56E+02	8.44E+01	95% Chebyshev (MVUE) UCL	ProUCL recommendation
	Silver	1.85E+01	19.63	Nonparametric - 95% KM (BCA)	8.45E+01	2.06E+01	95% KM (BCA) UCL	ProUCL recommendation
	Vanadium	1.39E+01	23.36	Nonparametric - 95% Chebyshev (Mean, Sd)	5.10E+01	2.34E+01	95% Chebyshev (Mean, Sd) UCL	ProUCL recommendation
	Zinc	6.55E+02	6093	Lognormal - 99% Chebyshev (MVUE)	4.28E+03	4.28E+03	Maximum	Recommended UCL exceeds the maximum observation.

Definitions:

AOC Area of Concern
EPC Exposure Point Concentration
mg/kg milligrams per kilogram
N/A Not Applicable - the data set has 5 or less detected concentrations, so it is not recommended to calculate a UCL.
UCL Upper Confidence Limit

Note:

UCLs were calculated using the ProUCL statistical program.
Arithmetic mean is calculated for all detected concentrations.
For maximum concentration, results (including non-detects) from each well are averaged
Median includes detected concentrations and detection limits (for non-detects).

Table 6-16
EXPOSURE POINT CONCENTRATION SUMMARY
SURFACE SOILS - NORTHERN AND WESTERN AOCs
CDL - Wallops Flight Facility

Scenario Timeframe: Current
Medium: Soil
Exposure Medium: Surface Soils (0-0.5 ft bgs) Northern and Western AOCs

Exposure Point	Chemical	Arithmetic Mean (mg/kg)	UCL (mg/kg)	Distribution	Maximum Concentration (mg/kg)	EPC (mg/kg)	Statistic	Rationale
Surface Soils (Northern and Western AOCs)	**Inorganics**							
	Aluminum	8.45E+03	N/A	N/A	1.03E+04	1.03E+04	Maximum	too few detections
	Arsenic	3.10E+00	N/A	N/A	4.70E+00	4.70E+00	Maximum	too few detections
	Iron	7.02E+03	N/A	N/A	8.88E+03	8.88E+03	Maximum	too few detections
	Mercury (elemental)	4.22E-02	N/A	N/A	7.70E-02	7.70E-02	Maximum	too few detections

Definitions:

AOC Area of Concern
EPC Exposure Point Concentration
mg/kg milligrams per kilogram
N/A Not Applicable - the data set has 5 or less detected concentrations, so it is not recommended to calculate a UCL.
UCL Upper Confidence Limit

Note: UCLs were calculated using the ProUCL statistical program.
Arithmetic mean is calculated for all detected concentrations.

Table 6-17
EXPOSURE POINT CONCENTRATION SUMMARY
AGGREGATE SOILS - NORTHERN AND WESTERN AOCs
CDL - Wallops Flight Facility

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Aggregate Soils (0-10 ft bgs) Northern and Western AOCs

Exposure Point	Chemical	Arithmetic Mean (mg/kg)	UCL	Distribution	Maximum Concentration (mg/kg)	EPC (mg/kg)	Statistic	Rationale
Aggregate Soils (Northern and Western AOCs)	**Inorganics**							
	Aluminum	1.04E+04	1.32E+04	Normal - 95% Student's-t UCL	2.11E+04	1.32E+04	95% Student's-t UCL	ProUCL recommendation
	Arsenic	2.76E+00	3.57E+00	Normal - 95% Student's-t UCL	4.80E+00	3.57E+00	95% Student's-t UCL	ProUCL recommendation
	Iron	8.15E+03	1.07E+04	Normal - 95% Student's-t UCL	1.87E+04	1.07E+04	95% Student's-t UCL	ProUCL recommendation
	Mercury (elemental)	3.19E-02	6.07E-02	Nonparametric - 95% KM (Chebyshev) UCL	7.70E-02	6.07E-02	95% KM (Chebyshev) UCL	ProUCL recommendation

Definitions:

AOC Area of Concern
EPC Exposure Point Concentration
mg/kg milligrams per kilogram
N/A Not Applicable - the data set has 5 or less detected concentrations, so it is not recommended to calculate a UCL.
UCL Upper Confidence Limit

Note: UCLs were calculated using the ProUCL statistical program.
Arithmetic mean is calculated for all detected concentrations.

Table 6-18
EXPOSURE POINT CONCENTRATION SUMMARY
GROUNDWATER
CDL - Wallops Flight Facility

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

Exposure Point	Chemical	Arithmetic Mean (µg/L)	UCL	Distribution	Maximum Concentration (µg/L)	EPC (µg/L)	Statistic	Rationale
Groundwater (All AOCs)	**Volatile Organic Compounds**							
	Benzene	3.70E+00	N/A	N/A	3.7	3.7	Maximum	No ProUCL recommendation
	Dichloroethane, 1,2-	1.32E+01	14.08	Nonparametric - 95% KM (t) UCL	17.6	14.08	95% KM (t) UCL	ProUCL recommendation
	Dichloroethylene, cis-1,2-	5.13E+01	51.94	Nonparametric - 95% KM (t) UCL	54.5	51.94	95% KM (t) UCL	ProUCL recommendation
	Ethylbenzene	4.84E+02	496.6	Nonparametric - 95% KM (t) UCL	548	496.6	95% KM (t) UCL	ProUCL recommendation
	Isopropylbenzene (Cumene)	5.89E+01	60.84	Nonparametric - 95% KM (t) UCL	68.6	60.84	95% KM (t) UCL	ProUCL recommendation
	Tetrachloroethylene	1.09E+01	11.44	Nonparametric - 95% KM (t) UCL	13.8	11.44	95% KM (t) UCL	ProUCL recommendation
	Toluene	1.51E+03	1544	Nonparametric - 95% KM (t) UCL	1680	1544	95% KM (t) UCL	ProUCL recommendation
	Trichloroethylene	3.35E+00	N/A	N/A	3.35	3.35	Maximum	No ProUCL recommendation
	Xylene, m-,p- (assume Xylene, m-)	1.91E+03	1964	Nonparametric - 95% KM (t) UCL	2180	1964	95% KM (t) UCL	ProUCL recommendation
	Xylene, o-	6.65E+02	703.5	Nonparametric - 95% KM (t) UCL	859	703.5	95% KM (t) UCL	ProUCL recommendation
	Xylene, Mixture (Total)	2.57E+03	2666	Nonparametric - 95% KM (t) UCL	3040	2666	95% KM (t) UCL	ProUCL recommendation
	Semivolatile Organic Compounds							
	Methylnaphthalene, 2-	3.36E+01	33.72	Nonparametric - 95% KM (t) UCL	34.4	33.72	95% KM (t) UCL	ProUCL recommendation
	Naphthalene	5.61E+01	86.05	Nonparametric - 95% KM (Percentile Bootstrap) UCL	86.05	86.05	95% KM (Percentile Bootstrap) UCL and Maximum	ProUCL recommends - 95% KM (Percentile Bootstrap) UCL is same as maximum
	Inorganics							
	Arsenic, Inorganic	6.01E+00	8.254	Nonparametric - 95% KM (t) UCL	8.65	8.254	95% KM (t) UCL	ProUCL recommendation
	Iron	1.42E+04	22872	Nonparametric - 95% KM (t) UCL	29600	22872	95% KM (t) UCL	ProUCL recommendation
	Manganese	6.71E+02	1236	Normal - 95% Student's-t UCL	1810	1236	95% Student's-t UCL	ProUCL recommendation
	Mercury	1.08E-01	0.15	Nonparametric - 95% KM (Percentile Bootstrap) UCL	0.15	0.15	95% KM (Percentile Bootstrap) UCL and Maximum	ProUCL recommendation - KM (t) exceeds maximum and KM (% Bootstrap) UCL is same as max.

Definitions:

AOC Area of Concern
EPC Exposure Point Concentration
ug/L micrograms per liter
N/A Not Applicable - the data set has 5 or less detected concentrations, so it is not recommended to calculate a UCL.
UCL Upper Confidence Limit

Notes: UCLs were calculated using the ProUCL statistical program.
Arithmetic mean is calculated for all detected concentrations.
For maximum concentration, results (including non-detects) from each well are averaged
Median includes detected concentrations and detection limits (for non-detects).

Table 6-19
EXPOSURE POINT CONCENTRATION SUMMARY
SEDIMENT (MOSQUITO CREEK)
CDL - Wallops Flight Facility

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

Exposure Point	Chemical	Arithmetic Mean (mg/kg)	UCL (mg/kg)	Distribution	Maximum Concentration (mg/kg)	EPC (mg/kg)	Statistic	Rationale
Sediment	**Volatile Organic Compounds**							
	Methylene chloride	9.20E-03	N/A	N/A	9.20E-03	9.20E-03	Maximum	Only one detection
	bis(2-Ethylhexyl)phthalate	5.55E+01	N/A	NA	1.62E+02	1.62E+02	Maximum	Recommended UCL exceeds maximum - use maximum
	Pesticides							
	DDE	8.79E-02	N/A	N/A	1.49E-01	1.49E-01	Maximum	No recommended UCL - use maximum
	Inorganics							
	Arsenic	1.02E+01	1.40E+01	Normal - 95% Student's-t UCL	1.91E+01	1.40E+01	95% Student's-t UCL	ProUCL recommendation
	Mercury (inorganic)	1.28E-01	3.29E-01	Nonparametric - 95% KM (Chebyshev) UCL	4.90E-01	3.29E-01	95% KM (Chebyshev) UCL	ProUCL recommendation

Definitions:

AOC Area of Concern
EPC Exposure Point Concentration
mg/kg milligrams per kilogram
N/A Not Applicable - the data set has 5 or less detected concentrations, so it is not recommended to calculate a UCL.
UCL Upper Confidence Limit

Note: UCLs were calculated using the ProUCL statistical program.
Arithmetic mean is calculated for all detected concentrations.

Table 6-20
EXPOSURE POINT CONCENTRATION SUMMARY
SURFACE WATER (MOSQUITO CREEK)
CDL - Wallops Flight Facility

Scenario Timeframe: Current/Future
Medium: Surface Water
Exposure Medium: Little Mosquito Creek

Exposure Point	Chemical	Arithmetic Mean (µg/L)	UCL (µg/L)	Distribution	Maximum Concentration (µg/L)	EPC (µg/L)	Statistic	Rationale
Surface Water	**Inorganics**							
	Arsenic	9.23E+00	N/A	N/A	11.1	1.11E+01	Maximum	Only 3 sample locations - assumed maximum value from data set (the maximum of the two samples collected at SW-4)

Definitions:

EPC Exposure Point Concentration
mg/kg milligrams per kilogram
N/A Not Applicable - the data set has 5 or less detected concentrations, so it is not recommended to calculate a UCL.

Table 6-21
CALCULATION OF INDOOR AIR CONCENTRATIONS FROM VAPOR INTRUSION - AGGREGATE SOIL
CENTRAL AND SOUTHERN AOCs
CDL - Wallops Flight Facility

Soil COPC	CAS No.	Soil Concentration (mg/kg)	Soil Concentration (µg/kg)	Is Chemical Sufficiently Volatile?[1]	Indoor Building Conc., Cbuilding ($\mu g/m^3$)[2]	Indoor Air Conc. (mg/m^3)[3]
Benzene	71432	1.85E-01	1.85E+02	**Yes**	3.38E+00	6.25E-01
1,2-Dichloroethane	107062	2.38E-01	2.38E+02	**Yes**	1.38E+00	3.28E-01
Ethylbenzene	100414	1.42E+00	1.42E+03	**Yes**	8.54E-01	1.21E+00
Tetrachloroethene	127184	1.37E-02	1.37E+01	**Yes**	4.19E+00	5.74E-02
m,p-Xylene[4]	108383	2.00E+00	2.00E+03	**Yes**	7.72E-01	1.54E+00
Xylene (total)	1330207	2.83E+00	2.83E+03	NA[5]	NA	NA
Benzo(a)anthracene	56-55-3	9.05E-01	9.05E+02	No	NC	NC
Benzo(a)pyrene	50-32-8	1.91E+00	1.91E+03	No	NC	NC
Benzo(b)fluoranthene	205992	1.39E+00	1.39E+03	**Yes**	1.38E-03	1.92E-03
Benzo(k)fluoranthene	207-08-9	1.03E+00	1.03E+03	No	NC	NC
Chrysene	218019	1.43E+00	1.43E+03	**Yes**	2.73E-06	3.90E-06
Dibenz(a,h)anthracene	53-70-3	3.88E-01	3.88E+02	No	NC	NC
Indeno(1,2,3-c,d)pyrene	193-39-5	6.17E-01	6.17E+02	No	NC	NC
gamma-Chlordane	5103-74-2	3.46E-02	3.46E+01	NA[5]	NA	NA
DDD	72-54-8	6.11E-02	6.11E+01	No	NC	NC
DDE	72559	6.54E-01	6.54E+02	**Yes**	6.51E-08	4.26E-08
DDT	50-29-3	3.26E-01	3.26E+02	No	NC	NC
Aroclor-1260	11096-82-5	2.13E-01	2.13E+02	NA[5]	NA	NA
Aluminum	7429-90-5	2.95E+04	2.95E+07	NA[5]	NA	NA
Antimony	7440-36-0	2.58E+01	2.58E+04	NA[5]	NA	NA
Arsenic	7440-38-2	4.79E+00	4.79E+03	NA[5]	NA	NA
Cadmium	7440-43-9	1.17E+01	1.17E+04	NA[5]	NA	NA
Chromium	18540-29-9	3.69E+02	3.69E+05	NA[5]	NA	NA
Copper	7440-50-8	3.49E+03	3.49E+06	NA[5]	NA	NA
Iron	7439-89-6	1.90E+04	1.90E+07	NA[5]	NA	NA
Lead	7439-92-1	3.83E+02	3.83E+05	NA[5]	NA	NA
Mercury (inorganic)	--	6.05E-01	6.05E+02	NA[5]	NA	NA
Nickel	7440-02-0	8.44E+01	8.44E+04	NA[5]	NA	NA
Silver	7440-22-4	2.06E+01	2.06E+04	NA[5]	NA	NA
Vanadium	--	2.34E+01	2.34E+04	NA[5]	NA	NA
Zinc	7440-66-6	4.28E+03	4.28E+06	NA[5]	NA	NA

Isopropylbenzene = cumene

NA = Not Applicable - chemical is not sufficiently volatile or not included in the model.

Notes:

1 - Based on Table 1, "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings" (EPA, 2003).

2 - Indoor Building Concentration calculated by model (Infinite Source Bldg. Conc., Cbuilding on "INTERCALCS" page).

3 - Cbuilding is based on unit concentration and must be multiplied by the soil concentration to obtain the indoor air concentration.

4 - Maximum of m-xylene and p-xylene selected.

5 - Vapor intrusion model does not include this chemical.

Table 6-22
CALCULATION OF INDOOR AIR CONCENTRATIONS FROM VAPOR INTRUSION - AGGREGATE SOIL
NORTHERN AND WESTERN AOCs
CDL - Wallops Flight Facility

Soil COPC	CAS No.	Soil Concentration (mg/kg)	Soil Concentration (µg/kg)	Is Chemical Sufficiently Volatile?[1]	Indoor Building Conc., Cbuilding ($\mu g/m^3$)[2]	Indoor Air Conc. (mg/m^3)[3]
Aluminum	7429-90-5	1.32E+04	1.32E+07	NA[4]	NA	NA
Arsenic	7440-38-2	3.57E+00	3.57E+03	NA[4]	NA	NA
Iron	7439-89-6	1.07E+04	1.07E+07	NA[4]	NA	NA
Mercury (inorganic)[5]	--	6.07E-02	6.07E+01	NA[4]	NA	NA

NA = Not Applicable - chemical is not sufficiently volatile or not included in the model.

Notes:

1 Based on Table 1, "User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings" (EPA, 2003).

2 Indoor Building Concentration calculated by model (Infinite Source Bldg. Conc., Cbuilding on "INTERCALCS" page).

3 Cbuilding is based on unit concentration and must be multiplied by the soil concentration to obtain the indoor air concentration.

4 Vapor intrusion model does not include this chemical.

5 Mercury found in soil is typically inorganic mercury.

Table 6-23
CALCULATION OF INDOOR AIR CONCENTRATIONS FROM VAPOR INTRUSION - GROUNDWATER
CDL - Wallops Flight Facility

Groundwater COPC	CAS No.	Groundwater Concentration (µg/L)	Initial groundwater conc., C_W (µg/L)	Infinite source bldg. conc., $C_{building}$ (µg/m^3)	Indoor air conc. (mg/m^3)
Benzene	71432	3.7	1	1.21E-01	4.46E-04
1,2-Dichloroethane	107062	14.08	1	2.39E-02	3.36E-04
cis-1,2-Dichloroethene	156592	51.94	1	8.00E-02	4.15E-03
Ethylbenzene	100414	496.6	1	1.26E-01	6.23E-02
Isopropylbenzene	98828	60.84	1	1.66E-01	1.01E-02
Tetrachloroethene	127184	11.44	1	2.98E-01	3.41E-03
Toluene	108883	1544	1	1.30E-01	2.01E-01
Trichloroethene	79016	3.35	1	1.97E-01	6.60E-04
m,p-Xylene[1]	108383	1964	1	1.24E-01	2.43E-01
o-Xylene	95476	703.5	1	9.14E-02	6.43E-02
Xylene (total)[2]	1330207	2666	1	NA	NA
2-Methylnaphthalene	91576	33.72	1	4.11E-03	1.38E-04
Naphthalene	91203	86.05	1	5.47E-03	4.71E-04
Mercury (inorganic)	--	0.15	1	NA	NA

Notes:

1. Used maximum of m- and p-xylene to represent m,p-xylene

2. Vapor intrusion model does not calculate total xylene.

TABLE 6-24
CALCULATION OF EXPOSURE POINT CONCENTRATIONS -
INHALATION OF CHEMICALS FROM GROUNDWATER IN TRENCH
CDL - Wallops Flight Facility

Kg,H2O	0.833	cm/s	CF1	1.00E-03	L/cm3	Length	8	ft
MWH2O	18		CF2	1.00E+04	cm2/m2		2.44	m
Kg,O2	0.002	cm/s	CF3	3600	s/hr	Width	3	ft
MWO2	32		F	1			0.91	m
T	77	F	ACH	2	hr-1	Depth	8	ft
T	298	K					2.44	m
R	8.20E-05	atm-m3/mol-K				Width/Depth	0.38	

Revised 5/3/07 Groundwater Screening Levels (inhalation) for construction/utility workers in a trench: Groundwater less than 15 feet deep	CAS No.	Molecular Weight MWi g/mol	Henry's Law Constant HLC atm-m3/mol	Gas-Phase Mass Transfer Coefficient Kg cm/s	Liquid-Phase Mass Transfer Coefficient Kl cm/s	Overall Mass Transfer Coefficient Ki cm/s	Volatilization Factor VF L/m3	Concentration of Chemical in Groundwater CGW ug/L	Concentration of Chemical in Trench Ctrench ug/m3
TCL Volatile Organic Compounds (VOCs)									
Benzene	71-43-2	78.11	5.55E-03	5.09E-01	1.28E-03	1.27E-03	9.35E+00	3.7	3.46E+01
1,2-Dichloroethane	107-06-2	98.96	9.79E-04	4.71E-01	1.14E-03	1.07E-03	7.92E+00	14.08	1.11E+02
cis-1,2-Dichloroethene	156-59-2	96.94	4.08E-03	4.74E-01	1.15E-03	1.13E-03	8.36E+00	51.94	4.34E+02
Ethylbenzene	100-41-4	106.17	7.88E-03	4.60E-01	1.10E-03	1.09E-03	8.05E+00	496.6	4.00E+03
Isopropylbenzene	98-82-8	120.19	1.16E+00	4.41E-01	1.03E-03	1.03E-03	7.62E+00	60.84	4.63E+02
Tetrachloroethene	127-18-4	165.83	1.84E-02	3.96E-01	8.79E-04	8.76E-04	6.47E+00	11.44	7.40E+01
Toluene	108-88-3	92.14	6.64E-03	4.82E-01	1.18E-03	1.17E-03	8.62E+00	1544	1.33E+04
Trichloroethene	79-01-6	131.39	1.03E-02	4.28E-01	9.87E-04	9.82E-04	7.25E+00	3.35	2.43E+01
m-xylene	108-38-3	106.17	7.34E-03	4.60E-01	1.10E-03	1.09E-03	8.04E+00	1964	1.58E+04
o-xylene	95-47-6	106.17	5.19E-03	4.60E-01	1.10E-03	1.09E-03	8.02E+00	703.5	5.64E+03
Total Xylenes	1330-20-7	106.16	5.18E-03	4.60E-01	1.10E-03	1.09E-03	8.02E+00	2666	2.14E+04
2-Methylnaphthalene	91-57-6	142.20	5.18E-04	4.17E-01	9.49E-04	8.57E-04	6.32E+00	33.72	2.13E+02
Naphthalene	91-20-3	128.17	4.83E-04	4.32E-01	9.99E-04	8.95E-04	6.60E+00	86.05	5.68E+02
Arsenic	7440-38-2	74.92						8.254	NA
Iron	7439-89-6	55.85						22872	NA
Manganese	7439-96-5	54.94						1236	NA
Mercury	--	200.59						0.15	NA

Note:
Spreadsheet from Virginia Department of Environmental Quality - Table 3.22, Values for Dermal Absorption Models
(http://www.deq.virginia.gov/vrprisk/tables.html).

TABLE 6-25
CALCULATION AND SCREENING OF FISH TISSUE CONCENTRATIONS
CDL - Wallops Flight Facility

Surface Water Detected Chemicals	Surface Water Concentration (mg/L)	BCF (unitless)	Default BCF (unitless)	Bluefish Tissue Concentration (CBF)		Bluefish Tissue Concentration (mg/kg)	Screening Level (mg/kg)	ca or nc?	Adjusted Screening Level (mg/kg)	COPC Flag (Y/N)	Rationale for selection or deletion
				Based on BCF (mg/kg DW)	Based on Default BAF (mg/kg DW)						
Volatile Organic Compounds											
Benzene	7.70E-04	NA	1	--	7.70E-04	7.70E-04	5.74E-02	ca	5.74E-02	No	BSL
Carbon disulfide	2.40E-04	NA	1	--	2.40E-04	2.40E-04	1.35E+02	nc	1.35E+01	No	BSL
Semi-Volatile Organic Compounds											
2-Methylnaphthalene	1.80E-03	NA	1	--	1.80E-03	1.80E-03	5.41E+00	nc	5.41E-01	No	BSL
Naphthalene	1.00E-03	NA	1	--	1.00E-03	1.00E-03	2.70E+01	nc	2.70E+00	No	BSL
Inorganics											
Aluminum	1.06E+00	2.7	1	2.86E+00	1.06E+00	2.86E+00	1.35E+03	nc	1.35E+02	No	BSL
Antimony	6.20E-03	40	1	2.48E-01	6.20E-03	2.48E-01	5.41E-01	nc	5.41E-02	**Yes**	ASL
Arsenic	1.11E-02	114	1	1.27E+00	1.11E-02	1.27E+00	2.10E-03	ca	2.10E-03	**Yes**	ASL
Barium	2.76E-02	633	1	1.75E+01	2.76E-02	1.75E+01	2.70E+02	nc	2.70E+01	No	BSL
Beryllium	5.20E-04	62	1	3.22E-02	5.20E-04	3.22E-02	2.70E+00	nc	2.70E-01	No	BSL
Chromium	2.00E-03	19	1	3.80E-02	2.00E-03	3.80E-02	6.31E-03	nc	6.31E-04	**Yes**	ASL
Copper	4.90E-03	710	1	3.48E+00	4.90E-03	3.48E+00	5.41E+01	nc	5.41E+00	No	BSL
Iron	1.03E+00	NA	1	--	1.03E+00	1.03E+00	9.46E+02	nc	9.46E+01	No	BSL
Lead	4.00E-03	0.09	1	3.60E-04	4.00E-03	4.00E-03	NA	--	NA	No	NBA
Mercury	9.10E-05	11168	1	1.02E+00	9.10E-05	1.02E+00	2.16E-01	nc	2.16E-02	**Yes**	ASL
Nickel	2.90E-03	78	1	2.26E-01	2.90E-03	2.26E-01	2.70E+01	nc	2.70E+00	No	BSL
Selenium	1.18E-02	129	1	1.52E+00	1.18E-02	1.52E+00	6.76E+00	nc	6.76E-01	**Yes**	ASL
Vanadium	4.40E-03	NA	1	--	4.40E-03	4.40E-03	9.46E+00	nc	9.46E-01	No	BSL

Notes:

1 - Maximum detected surface water concentrations evaluated.

2 - Calcium, magnesium, potassium, and sodium were not evaluated since they are essential nutrients and there are not fish tissue screening values for these chemicals.

Selection reason: ASL - Above Screening Level

Deletion reason: BSL - Below Screening Level

NBA - No Benchmark Available

Definitions:

BAF - bioaccumulation factor

BCF - bioconcentration factor

ca - screening level based on cancer

COPC - Chemical of Potential Concern

mg/kg - milligrams per kilogram

mg/L - milligrams per liter

NA - No log Kow values available for inorganics. Bluefish EPC assumed equal to killifish tissue concentration.

nc - noncancer

References:

Screening Levels from EPA Region 3, Fish Tissue Screening Levels: : http://www.epa.gov/reg3hscd/risk/human/pdf/DECEMBER_2009_FISH.pdf

BCFs from EPA (1999) - Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities. Office of Solid Waste and Emergency Response, Washington, D.C.

TABLE 6-26
CALCULATION AND SCREENING OF CRAB TISSUE CONCENTRATIONS
CDL - Wallops Flight Facility

Sediment Detected Chemicals	Sediment Concentration (mg/kg)	Benthic Invertebrates - Blue Crabs (µg/kg)	Benthic Invertebrates - Blue Crabs (mg/kg)	Screening Level (mg/kg)	c or nc?	Adjusted Screening Level (mg/kg)	COPC Flag (Y/N)	Rationale for selection or deletion
Volatile Organic Compounds								
Acetone	2.20E-01	2.20E-01	2.20E-04	1.33E+03	nc	1.33E+02	No	BSL
2-Butanone (MEK)	1.64E-01	1.64E-01	1.64E-04	8.11E+02	nc	8.11E+01	No	BSL
Carbon disulfide	2.37E-02	2.37E-02	2.37E-05	1.35E+02	nc	1.35E+01	No	BSL
Cyclohexane	2.30E-02	2.30E-02	2.30E-05	NA	--	NA	No	NBA
Methylene chloride	9.20E-03	9.20E-03	9.20E-06	4.21E-01	ca	4.21E-01	No	BSL
Semi-Volatile Organic Compounds								
Di-n-octyl phthalate	9.63E+06	9.63E+06	9.63E+03	NA	--	NA	No	NBA
bis(2-Ethylhexyl)phthalate	2.12E+05	2.12E+05	2.12E+02	2.25E-01	ca	2.25E-01	**Yes**	ASL
Pesticides								
4,4'-DDD	6.18E-02	6.18E-02	6.18E-05	1.31E-02	ca	1.31E-02	No	BSL
4,4'-DDE	1.42E-01	1.42E-01	1.42E-04	9.28E-03	ca	9.28E-03	No	BSL
4,4'-DDT	1.03E-02	1.03E-02	1.03E-05	9.28E-03	ca	9.28E-03	No	BSL
Inorganics								
Antimony	2.52E+00	2.52E+00	2.52E-03	5.41E-01	nc	5.41E-02	No	BSL
Arsenic	6.89E+00	6.89E+00	6.89E-03	2.10E-03	ca	2.10E-03	**Yes**	ASL
Barium	7.67E+01	7.67E+01	7.67E-02	2.70E+02	nc	2.70E+01	No	BSL
Beryllium	5.49E-01	5.49E-01	5.49E-04	2.70E+00	nc	2.70E-01	No	BSL
Cadmium	1.38E+00	1.38E+00	1.38E-03	1.35E+00	nc	1.35E-01	No	BSL
Chromium	5.13E+00	5.13E+00	5.13E-03	4.06E+00	nc	4.06E-01	No	BSL
Cobalt	8.37E+00	8.37E+00	8.37E-03	NA	--		No	NBA
Copper	9.12E+00	9.12E+00	9.12E-03	5.41E+01	nc	5.41E+00	No	BSL
Iron	2.77E+04	2.77E+04	2.77E+01	9.46E+02	nc	9.46E+01	No	BSL
Lead	1.79E+01	1.79E+01	1.79E-02	NA	--	NA	No	NBA
Mercury	4.05E-01	4.05E-01	4.05E-04	NA	--	NA	No	NBA
Nickel	1.96E+01	1.96E+01	1.96E-02	2.70E+01	nc	2.70E+00	No	BSL
Selenium	1.62E+00	1.62E+00	1.62E-03	6.76E+00	nc	6.76E-01	No	BSL
Silver	1.35E+00	1.35E+00	1.35E-03	6.76E+00	nc	6.76E-01	No	BSL
Thallium	2.52E-01	2.52E-01	2.52E-04	8.76E-02	nc	8.76E-03	No	BSL
Vanadium	4.83E+01	4.83E+01	4.83E-02	9.46E+00	nc	9.46E-01	No	BSL
Zinc	2.01E+01	2.01E+01	2.01E-02	4.06E+02	nc	4.06E+01	No	BSL

Notes:

1 - Chemical concentration in benthic inertebrates (mg/kg) = 0.001 x sediment concentration (mg/kg)

2 - Sediment concentration is the maximum detected concentration.

3 - Screening level divided by 10 for noncancer based screening concentrations.

4 - Screening Levels from EPA Region 3, Fish Tissue Screening Levels: : www.epa.gov/reg3hscd/risk/human/Region_III_Fish_May_2008.pdf.

Definitions:

COPC - Chemical of Potential Concern

ca - screening level based on cancer

mg/kg - milligrams per kilogram

nc - noncancer

ug/kg - micrograms per kilogram

Rationale Codes:

Selection reason: ASL - Above Screening Level

Deletion reason: BSL - Below Screening Level

NBA - No Benchmark Available

NUT - Essential Nutrient

TABLE 6-27
CHEMICALS OF POTENTIAL CONCERN - FISH AND CRABS
CDL - Wallops Flight Facility

COPC	CAS No.	EPC (mg/kg)
Bluefish		
Antimony	7440360	6.20E-03
Arsenic	7440382	1.11E-02
Chromium	18540299	2.00E-03
Mercury	7439976	9.10E-05
Selenium	7782492	1.18E-02
Crabs		
Arsenic	7440382	1.91E-02
Chromium	18540299	4.96E-02

Note:
EPCs are the maximum detected concentrations.

Definitions:
COPC - Chemical of potential concern
mg/kg - milligrams per kilogram

TABLE 6-28
VALUES USED FOR DAILY INTAKE CALCULATIONS
SITE WORKER
INGESTION, DERMAL, AND INHALATION - SURFACE SOILS
CDL - Wallops Flight Facility

Scenario Timeframe:	Current
Receptor:	Site Worker
Medium:	Soils
Exposure Medium:	Surface Soils

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Site Worker	Adult	Surface Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-14 and -15	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-S x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				IR-S	Ingestion rate of soil	100	mg/day	EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	225	days/year	EPA, 2002	
				ED	Exposure duration	25	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 2002	
Dermal	Site Worker	Adult	Surface Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-14 and -15	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				SA	Skin surface area available for contact	3,300	cm^2/day	EPA, 2002	
				SSAF	Soil to skin adherence factor	0.2	mg/cm^2	EPA, 2002	
				ABS	Dermal absorption factor	Chemical-specific	unitless	See Table 6-42	
				EF	Exposure frequency	225	days/year	EPA, 2002	
				ED	Exposure duration	25	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 2002	
Inhalation	Site Worker	Adult	Surface Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-14 and -15	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x Inh x EF x ED x 1/PEF x1/BW x 1/AT
				Inh	Inhalation rate	2.5	m^3/hr	EPA, 2002	
				ET	Exposure time	8	hr/day	EPA, 2002	
				EF	Exposure frequency	225	days/year	EPA, 2002	
				ED	Exposure duration	25	years	EPA, 2002	
				PEF	Particulate emission factor	1.36E+09	m^3/kg	Default (Eq. 4-5) - EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 2002	

References:

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

TABLE 6-29
VALUES USED FOR DAILY INTAKE CALCULATIONS
COMMERCIAL WORKER, RESIDENT, CONSTRUCTION WORKER, AND TRESPASSER
INGESTION - AGGREGATE SOILS
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Commerial Worker, Adult
	Resident, Adult & Child
	Construction Worker, Adult
	Trespasser, Youth
Medium:	Soils
Exposure Medium:	Aggregate Soils

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Commercial Worker	Adult	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-S x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				IR-S	Ingestion rate of soil	50	mg/day	EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	250	days/year	EPA, 2002	
				ED	Exposure duration	25	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 2002	
	Resident	Adult	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-S x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				IR-S	Ingestion rate of soil	100	mg/day	EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
		Child	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-S x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				IR-S	Ingestion rate of soil	200	mg/day	EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

TABLE 6-29
VALUES USED FOR DAILY INTAKE CALCULATIONS
COMMERCIAL WORKER, RESIDENT, CONSTRUCTION WORKER, AND TRESPASSER
INGESTION - AGGREGATE SOILS
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Commerial Worker, Adult
	Resident, Adult & Child
	Construction Worker, Adult
	Trespasser, Youth
Medium:	Soils
Exposure Medium:	Aggregate Soils

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion (Continued)	Construction Worker	Adult	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-S x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				IR-S	Ingestion rate of soil	330	mg/day	EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	120	days/year	EPA, 2002	
				ED	Exposure duration	0.5	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	183	days	EPA, 2002	
	Trespasser	Youth	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-SD x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-03	mg/µg	--	
				IR-SD	Ingestion rate of sediment	100	mg/day	Assume same as resident adult - EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	24	days/year	6 days per month, 4 months per year - VDEQ (Table 3-20) recommended value for trespasser	
				ED	Exposure duration	6	years	Assume youth, ages 12 to 17	
				BW	Body weight	60	kg	50th percentile body weight for 12-17 year olds (EPA, 1997).	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

References:

EPA, 1997 - Exposure Factors Handbook

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-30
VALUES USED FOR DAILY INTAKE CALCULATIONS
RESIDENT, CONSTRUCTION WORKER, AND TRESPASSER
DERMAL ABSORPTION - AGGREGATE SOILS
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult & Child
	Construction Worker, Adult
	Trespasser, Youth
Medium:	Soils
Exposure Medium:	Aggregate Soils

xposure Rout	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) =
				CF	Conversion factor	1.00E-06	kg/mg	--	EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				SA	Skin surface area available for contact	5,700	cm^2/day	EPA, 2002	
				SSAF	Soil to skin adherence factor	0.07	mg/cm^2	EPA, 2002	
				ABS	Dermal absorption factor	Chemical-specific	unitless	See Table 6-48	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
		Child	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) =
				CF	Conversion factor	1.00E-06	kg/mg	--	EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				SA	Skin surface area available for contact	2,800	cm^2/day	EPA, 2002	
				SSAF	Soil to skin adherence factor	0.2	mg/cm^2	EPA, 2002	
				ABS	Dermal absorption factor	Chemical-specific	unitless	See Table 6-48	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	
	Construction Worker	Adult	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) =
				CF	Conversion factor	1.00E-06	kg/mg	--	EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				SA	Skin surface area available for contact	3,300	cm^2/day	EPA, 2002	
				SSAF	Soil to skin adherence factor	0.3	mg/cm^2	EPA, 2002	
				ABS	Dermal absorption factor	Chemical-specific	unitless	See Table 6-48	
				EF	Exposure frequency	120	days/year	Professional Judgement	
				ED	Exposure duration	1	years	Professional Judgement	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	183	days	EPA, 2002	

TABLE 6-30
VALUES USED FOR DAILY INTAKE CALCULATIONS
RESIDENT, CONSTRUCTION WORKER, AND TRESPASSER
DERMAL ABSORPTION - AGGREGATE SOILS
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult & Child
	Construction Worker, Adult
	Trespasser, Youth
Medium:	Soils
Exposure Medium:	Aggregate Soils

xposure Rout	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (Continued)	Trespasser	Youth	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & - 17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				SA	Skin surface area available for contact	4,300	$cm^{2/}day$	Assume feet, lower legs, hands, and head - EPA, 2004	
				SSAF	Soil to skin adherence factor	0.04	mg/cm^2	Teens (moist conditions) Table C-3, EPA, 2004	
				ABS	Dermal absorption factor	Chemical-specific	unitless	See Table 6-48	
				EF	Exposure frequency	24	days/year	6 days per month, 4 months per year - VDEQ (Table 3-20) recommended value for trespasser	
				ED	Exposure duration	6	years	Assume youth, ages 12 to 17	
				BW	Body weight	60	kg	50th percentile body weight for 12-17 year olds (EPA, 1997).	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

References:

EPA, 1997 - Exposure Factors Handbook

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

EPA, 2004 - Risk Assessment Guidance for Superfund (RAGS). Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).

VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-31
VALUES USED FOR DAILY INTAKE CALCULATIONS
RESIDENT, CONSTRUCTION WORKER, AND TRESPASSER
INHALATION OF DUST - AGGREGATE SOILS
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult & Child
	Construction Worker, Adult
	Trespasser, Youth
Medium:	Soils
Exposure Medium:	Aggregate Soils (Dust in Air)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation - Dust	Resident	Adult	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & -17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x Inh x EF X ED X 1/PEF x 1/BW x 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	24	years	EPA, 2002	
				PEF	Particulate emission factor	1.36E+09	m^3/kg	Default (Eq. 4-5) - EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
		Child	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & -17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x Inh x EF X ED X 1/PEF x 1/BW x 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				PEF	Particulate emission factor	1.36E+09	m^3/kg	Default (Eq. 4-5) - EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	
	Construction Worker	Adult	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & -17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x Inh x EF X ED X 1/PEF x 1/BW x 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	120	days/year	Professional Judgement	
				ED	Exposure duration	0.5	years	Professional Judgement	
				PEF	Particulate emission factor	1.36E+09	m^3/kg	Default (Eq. 4-5) - EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	183	days	EPA, 2002	

TABLE 6-31
VALUES USED FOR DAILY INTAKE CALCULATIONS
RESIDENT, CONSTRUCTION WORKER, AND TRESPASSER
INHALATION OF DUST - AGGREGATE SOILS
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult & Child
	Construction Worker, Adult
	Trespasser, Youth
Medium:	Soils
Exposure Medium:	Aggregate Soils (Dust in Air)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation - Dust (Continued)	Trespasser	Teenager	Aggregate Soils at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Tables 6-15 & -17	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x Inh x EF X ED X 1/PEF x 1/BW x 1/AT
				Inh	Inhalation rate	20	m^3/day	Professional Judgement	
				EF	Exposure frequency	24	days/year	6 days per month, 4 months per year - VDEQ (Table 3-17) recommended value for trespasser	
				ED	Exposure duration	6	years	Assume youth, ages 12 to 17	
				PEF	Particulate emission factor	1.36E+09	m^3/kg	Default (Eq. 4-5) - EPA, 2002	
				BW	Body weight	60	kg	50th percentile body weight for 12-17 year olds (EPA, 1997).	
				AT-C	Averaging time (cancer)	25,550	days	Youth, average age of 12 (EPA, 1997)	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

References:

EPA, 1997 - Exposure Factors Handbook
EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-32

VALUES USED FOR DAILY INTAKE CALCULATIONS

RESIDENT, COMMERCIAL WORKER, AND TRESPASSER

INHALATION OF VOLATILES IN INDOOR AIR FROM VAPOR INTRUSION- AGGREGATE SOILS

CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult & Child
	Commercial Worker, Adult
Medium:	Soils
Exposure Medium:	Air (Indoor)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Indoor Air at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated by model - See Tables 6-21 and 6-22	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
		Child	Indoor Air at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated by model - See Tables 6-21 and 6-22	Chronic Daily Intake (CDI) (mg/kg-day) = 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	
	Commercial Worker	Adult	Indoor Air at CDL	EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated by model - See Tables 6-21 and 6-22	Chronic Daily Intake (CDI) (mg/kg-day) = 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	250	days/yr	EPA, 2002	
				ED	Exposure duration	25	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 2002	

TABLE 6-33
VALUES USED FOR DAILY INTAKE CALCULATIONS
INGESTION OF GROUNDWATER BY RESIDENTS (ADULT AND CHILD) AND COMMERCIAL WORKER
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult and Child
	Construction Worker, Adult
	Commercial Worker, Adult
Medium:	Groundwater
Exposure Medium:	Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Commercial Worker	Adult	Tap Water	EPC	Exposure point concentration	Chemical-specific	µg/L	See Table 6-18	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-G	Ingestion rate of groundwater	2	L/day	EPA, 2002	EPC X IR-G X EF X ED X1/BW x 1/AT
				CF	Conversion factor	1.00E-03	mg/µg	--	
				EF	Exposure frequency	250	days/year	EPA, 2002	
				ED	Exposure duration	25	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 2002	
	Construction Worker	Adult	Trench Water	EPC	Exposure point concentration	Chemical-specific	µg/L	See Table 6-18	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-G	Ingestion rate of groundwater	0.02	L/day	Incidental ingestion - Professional judgement	EPC X IR-G X EF X ED X1/BW x 1/AT
				CF	Conversion factor	1.00E-03	mg/µg	--	
				EF	Exposure frequency	120	days/year	EPA, 2002	
				ED	Exposure duration	0.5	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	183	days	EPA, 2002	
	Resident	Adult	Tap Water	EPC	Exposure point concentration	Chemical-specific	µg/L	See Table 6-18	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-G	Ingestion rate of groundwater	2	L/day	EPA, 2002	EPC X IR-G X EF X ED X1/BW x 1/AT
				CF	Conversion factor	1.00E-03	mg/µg	--	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
		Child	Tap Water	EPC	Exposure point concentration	Chemical-specific	µg/L	See Table 6-18	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-G	Ingestion rate of groundwater	1	L/day	EPA, 2002	EPC X IR-G X EF X ED X1/BW x 1/AT
				CF	Conversion factor	1.00E-03	mg/µg	--	
				EF	Exposure frequency	350	days/year	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

References:

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

TABLE 6-34
VALUES USED FOR DAILY DERMAL INTAKE CALCULATIONS
RESIDENT ADULT EXPOSURE FROM GROUNDWATER WHILE SHOWERING
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult
Medium:	Groundwater
Exposure Medium:	Groundwater (Tap water)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Tap Water While Showering	SA	Skin surface area available for contact	18,000	cm^2	EPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) = DAEVENT x EV X SA X EF X ED X1/BW x 1/AT
				DAEVENT	Absorbed dose per event	Chemical-specific	mg/cm^2-event	See Table 6-49	
				EV	Event frequency	1	event/day	EPA, 2004	
				EF	Exposure frequency	350	days/year	EPA, 2004	
				ED	Exposure duration	24	years	EPA, 2004	
				BW	Body weight	70	kg	EPA, 2004	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2004	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2004	
				FA	Fraction absorbed water	Chemical-specific	unitless	App. B, EPA 2004	
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-18	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	Eq. A.1, EPA 2004	
				t*	Time to reach steady state	Chemical-specific	hour	Eq. A.5 to A.8, EPA 2004	
				τevent	Lag time per event	Chemical-specific	hr/event	App. B, EPA 2004	
				tevent	Event duration	0.58	hr/event	35 min - EPA, 2004	
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	DAEVENT (Inorganic) = Kp x Cw x CF1 x CF2 x tevent
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-18	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				tevent	Event duration	0.58	hr/event	35 min - EPA, 2004	

References:

EPA, 2004 - Risk Assessment Guidance for Superfund (RAGS). Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).

TABLE 6-35
VALUES USED FOR DAILY DERMAL INTAKE CALCULATIONS
RESIDENT CHILD EXPOSURE FROM GROUNDWATER WHILE BATHING
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Child
Medium:	Groundwater
Exposure Medium:	Groundwater (Tap water)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child	Tap Water While Bathing	SA	Skin surface area available for contact	6,600	cm^2	EPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA_{EVENT} x EV X SA X EF X ED X1/BW x 1/AT
				DA_{EVENT}	Absorbed dose per event	Chemical-specific	mg/cm^2-event	See Table 6-49	
				EV	Event frequency	1	event/day	EPA, 2004	
				EF	Exposure frequency	350	days/year	EPA, 2004	
				ED	Exposure duration	6	years	EPA, 2004	
				BW	Body weight	15	kg	EPA, 2004	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2004	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2004	
				FA	Fraction absorbed water	Chemical-specific	unitless	App. B, EPA 2004	If $t_{event} \le t^*$, then : DA_{event} (Organic) = $2\,FA \times K_p \times C_w \sqrt{\frac{6\,\tau_{event} \times t_{event}}{\pi}}$
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-18	
				CF1	Conversion factor	1.00E-03	mg/µg	--	If $t_{event} > t^*$, then : DA_{event} (Organic) = $FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	Eq. A.1, EPA 2004	
				t*	Time to reach steady state	Chemical-specific	hour	Eq. A.5 to A.8, EPA 2004	
				τ_{event}	Lag time per event	Chemical-specific	hr/event	App. B, EPA 2004	
				t_{event}	Event duration	1.00	hr/event	EPA, 2004	
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	DA_{EVENT} (Inorganic) = Kp x Cw x CF1 x CF2 x t_{event}
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-18	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				tevent	Event duration	1.00	hr/event	EPA, 2004	

References:

EPA, 2004 - Risk Assessment Guidance for Superfund (RAGS). Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).

TABLE 6-36
VALUES USED FOR DAILY DERMAL INTAKE CALCULATIONS
CONSTRUCTION WORKER EXPOSURE TO GROUNDWATER IN TRENCH
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Construction Worker, Adult
Medium:	Groundwater
Exposure Medium:	Groundwater (Trench)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Groundwater from Trench	SA	Skin surface area available for contact	3,300	cm^2	EPA, 2002	Dermally Absorbed Dose (DAD) (mg/kg-day) = DA_{EVENT} x EV X SA X EF X ED X1/BW x 1/AT
				DAEVENT	Absorbed dose per event	Chemical-specific	mg/cm^2-event	See Table 6-49	
				EV	Event frequency	1	event/day	EPA, 2002	
				EF	Exposure frequency	120	days/year	Professional Judgement	
				ED	Exposure duration	0.5	years	Professional Judgement	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	183	days	EPA, 2002	
				FA	Fraction absorbed water	Chemical-specific	unitless	App. B, EPA 2004	If $t_{event} \le t^*$, then : DA_{event} (Organic) = $2\,FA \times K_p \times C_w \sqrt{\frac{6\,\tau_{event} \times t_{event}}{\pi}}$ If $t_{event} > t^*$, then : DA_{event} (Organic) = $FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right]$
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-18	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	Eq. A.1, EPA 2004	
				t*	Time to reach steady state	Chemical-specific	hour	Eq. A.5 to A.8, EPA 2004	
				τevent	Lag time per event	Chemical-specific	hr/event	App. B, EPA 2004	
				tevent	Event duration	2.00	hr/event	Professional Judgement	
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	DA_{EVENT} (Inorganic) = Kp x Cw x CF1 x CF2 x tevent
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-18	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				tevent	Event duration	2.00	hr/event	EPA, 2004	

References:

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

EPA, 2004 - Risk Assessment Guidance for Superfund (RAGS). Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).

TABLE 6-37
VALUES USED FOR DAILY INTAKE CALCULATIONS FOR ADULT INHALATION OF VOCs WHILE SHOWERING
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult
Medium:	Groundwater
Exposure Medium:	Air (Shower)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Vapors While Showering	CF	Conversion factor	1.00E-03	mg/µg	--	Inhalation Dose (D) (mg/kg-shower) = (IEC x CF x Inh x ET x EF x ED)/(BW xAT)
				Inh	Inhalation rate	8.33E-01	m^3/hour	Based on 20 m3/day (EPA, 2002)	
				ET	Exposure time	1.00E+00	hour/day	EPA, 2004	
				EF	Exposure frequency	350	days/yr	EPA, 2004	
				ED	Exposure duration	24	years	EPA, 2004	
				BW	Body weight	70	kg	EPA, 2004	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 2004	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2004	
				IEC	Inhalation Exposure Concentration in Shower	Chemical-specific	µg/m^3	See Table 6-50	
				n	Showers per day	1	shower/day	EPA, 2004	
				Ra	Rate of air exchange	0.0083	1/min	0.5/hr - Foster and Chrostowski, 1987	
				Ds	Shower duration	35	min	EPA, 2004	
				Dt	Total time in shower	60	min	EPA, 2004	
				S	Indoor VOC generation rate	Chemical-specific	µg/m^3-min	See Table 6-50	S = Cwd x FR/SV
				FR	Shower flow rate	10	L/min	Foster and Chrostowski, 1987	
				SV	Shower room air volume	6	m^3	Foster and Chrostowski, 1987	
				Cwd	Concentration leaving shower droplet after time	Chemical-specific	µg/L	See Table 6-50	
				Cw0	Shower concentration in water or EPC	Chemical-specific	µg/L	See Table 6-18	
				KaL	Adjusted mass transfer coefficient	Chemical-specific	cm/hr	See Table 6-50	
				ts	Shower droplet time	0.5	seconds	Foster and Chrostowski, 1987	
				d	Droplet diameter	1	mm	Foster and Chrostowski, 1987	

References:

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
EPA, 2004 - Risk Assessment Guidance for Superfund (RAGS). Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment).
Foster and Chrostowski, 1987 - Inhalation Exposures to Volatile Organic Contaminants in the Shower (Presentation).

TABLE 6-38
VALUES USED FOR DAILY INTAKE CALCULATIONS FOR CONSTRUCTION WORKER BY INHALATION OF VOCs FROM GROUNDWATER IN A TRENCH
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Construction Worker, Adult
Medium:	Groundwater
Exposure Medium:	Air (Trench)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Worker	Adult	Vapor from Trench	CF	Conversion factor	1.00E-03	mg/µg	--	Chronic daily intake (CDI) (mg/kg-day) =
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	(Ctrench x CF x Inh x EF x ED)/(BW x AT)
				EF	Exposure frequency	120	days/yr	Professional Judgement	
				ED	Exposure duration	0.5	years	Professional Judgement	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	183	days	EPA, 2002	
				Ctrench	Concentration of contaminant in the trench	Site-specific	µg/m^3	See Table 6-24	Ctrench (ug/m3) = CGW x VF
				CGW	Concentration of contaminant in groundwater	Site-specific	µg/L	See Table 6-18	
				VF	Volatilization factor	Chemical-specific	L/m^3	VDEQ, 2007	
				Ki	Overall mass transfer coefficient of contaminant	Chemical-specific	cm/s	VDEQ, 2007	Volatilization factor (VF) (L/m3) =
				A	Area of the trench	2.44	m^2	VDEQ, 2007	(Ki x A x F x 10-3 x 104 x 3600) / (ACH xV)
				F	Fraction of the floor through which contaminant can enter	1	unitless	VDEQ, 2007	
				ACH	Air changes per hour	2	hr^{-1}	VDEQ, 2007	
				V	Volume of trench	5.42	m^3	VDEQ, 2007	
				10-3	Conversion factor	1.00E-03	L/cm^3	VDEQ, 2007	
				104	Conversion factor	1.00E+04	cm^2/m^2	VDEQ, 2007	
				3600	Conversion factor	3600	s/hr	VDEQ, 2007	
				kiL	Liquid-phase mass transfer coefficient of i	Chemical-specific	cm/s	See Table 6-24	
				R	Ideal gas constant	8.20E-05	atm-m^3/mole-K	VDEQ, 2007	
				T	Average system absolute temperature	298	K	VDEQ, 2007	
				Hi	Henry's Law constant of i	Chemical-specific	atm-m3/mole	VDEQ, 2007	
				KiG	Gas-phase mass transfer coefficient of i	Chemical-specific	cm/s	VDEQ, 2007	
				MWO2	Molecular weight of O2	32	g/mol	VDEQ, 2007	
				MWi	Molecular weight of contaminant i	Chemical-specific	g/mol	VDEQ, 2007	
				kL,O2	Liquid-film mass transfer coefficient, O2	0.002	cm/s	VDEQ, 2007	
				MWH2O	Molecular weight of water	18	g/mol	VDEQ, 2007	
				kg(H2O)	Gas-phase mass transfer coefficient of water	0.833	cm/s	VDEQ, 2007	

References:

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

VDEQ, 2007 - Spreadsheet from Virginia Department of Environmental Quality - Table 3.22, Values for Dermal Absorption Models and Voluntary Remediation Program Risk Assessment Guidance (http://www.deq.virginia.gov/vrprisk/raguide.html).

TABLE 6-39
VALUES USED FOR DAILY INTAKE CALCULATIONS
INHALATION OF VOLATILES IN INDOOR AIR FROM VAPOR INTRUSION FROM GROUNDWATER
ADULT AND CHILD RESIDENT AND COMMERCIAL WORKER
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Child
	Resident, Adult
	Commercial Worker, Adult
Medium:	Groundwater
Exposure Medium:	Air (Indoor)

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	Indoor Air - Vapor Intrusion from Groundwater	EPC	Chemical concentration in air	Chemical-specific	mg/m^3	Modeled concentration - See Table 6-23	Chronic daily intake (CDI) (mg/kg-day) = EPC x Inh x EF X ED X 1/BW x 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	350	days/yr	EPA, 2002	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
		Child	Indoor Air - Vapor Intrusion from Groundwater	EPC	Chemical concentration in air	Chemical-specific	mg/m^3	Modeled concentration - See Table 6-23	Chronic daily intake (CDI) (mg/kg-day) = EPC x Inh x EF X ED X 1/BW x 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	350	days/yr	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	
	Commercial Worker	Adult	Indoor Air - Vapor Intrusion from Groundwater	EPC	Chemical concentration in air	Chemical-specific	mg/m^3	Modeled concentration - See Table 6-23	Chronic daily intake (CDI) (mg/kg-day) = EPC x Inh x EF X ED X 1/BW x 1/AT
				Inh	Inhalation rate	20	m^3/day	EPA, 2002	
				EF	Exposure frequency	250	days/yr	EPA, 2002	
				ED	Exposure duration	25	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	9,125	days	EPA, 2002	

References:

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

TABLE 6-40
VALUES USED FOR DAILY INTAKE CALCULATIONS
INCIDENTAL INGESTION OF SEDIMENT BY RECREATIONAL FISHERMEN AND TRESPASSERS
CDL - Wallops Flight Facility

Scenario Timeframe:	Current/Future
Receptor:	Recreational Fisherman, Adult
	Recreational Fisherman, Child
	Trespasser, Youths
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational Fisherman	Child	Sediment in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Table 6-19	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-SD x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-03	kg/mg	--	
				IR-SD	Ingestion rate of sediment	200	mg/day	Assumed same as soil - EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	10	days/year	Professional Judgement	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	
		Adult	Sediment in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Table 6-19	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-SD x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				IR-SD	Ingestion rate of sediment	100	mg/day	Assumed same as soil - EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	10	days/year	Professional Judgement	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
	Trespasser	Youths	Sediment in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Table 6-19	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x IR-SD x FI x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-03	mg/µg	--	
				IR-SD	Ingestion rate of sediment	100	mg/day	Assumed same as soil - EPA, 2002	
				FI	Fraction ingested	1	unitless	Professional Judgement	
				EF	Exposure frequency	24	days/year	6 days per month, 4 months per year - VDEQ (Table 3-20) recommended value for trespasser	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	60	kg	50th percentile body weight for 12-17 year olds (EPA, 1997).	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

References:
EPA, 1997 - Exposure Factors Handbook
EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
EPA, 2004 - RAGS, Part E - Supplemental Guidance for Dermal Risk Assessment.
VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-41
VALUES USED FOR DAILY INTAKE CALCULATIONS
DERMAL CONTACT WITH SEDIMENT BY RECREATIONAL FISHERMEN AND TRESPASSERS
CDL - Wallops Flight Facility

Scenario Timeframe:	Current/Future
Receptor:	Recreational Fisherman, Adult
	Recreational Fisherman, Child
	Trespasser, Youths
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Recreational Fishermen	Adult	Sediment in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Table 6-19	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				SA	Skin surface area available for contact	6,900	cm^2	Assume feet, lower legs, hands, and head - EPA, 2004	
				SSAF	Sediment to skin adherence factor	0.3	mg/cm^2	Value for Reed gatherers - EPA, 2004	
				ABS	Dermal absorption factor	Chemical-specific	unitless	See Table 6-48	
				EF	Exposure frequency	10	days/year	Professional Judgement	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
		Child	Sediment in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Table 6-19	Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				SA	Skin surface area available for contact	2,800	cm^2/day	Assume feet, lower legs, hands, and head - EPA, 2004	
				SSAF	Sediment to skin adherence factor	0.2	mg/cm^2	Value for children playing in wet soil - EPA, 2004	
				ABS	Dermal absorption factor	Chemical-specific	unitless	See Table 6-48	
				EF	Exposure frequency	10	days/year	Professional Judgement	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

TABLE 6-41
VALUES USED FOR DAILY INTAKE CALCULATIONS
DERMAL CONTACT WITH SEDIMENT BY RECREATIONAL FISHERMEN AND TRESPASSERS
CDL - Wallops Flight Facility

Scenario Timeframe:	Current/Future
Receptor:	Recreational Fisherman, Adult
	Recreational Fisherman, Child
	Trespasser, Youths
Medium:	Sediment
Exposure Medium:	Sediment

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Trespasser	Youths	Sediment in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg		Chronic Daily Intake (CDI) (mg/kg-day) = EPC x CF x SA x SSAF x ABS x EF X ED X 1/BW x 1/AT
				CF	Conversion factor	1.00E-06	kg/mg	--	
				SA	Skin surface area available for contact	6,300	cm^2/day	Assume feet, lower legs, hands, and head - EPA, 2004	
				SSAF	Sediment to skin adherence factor	0.04	mg/cm^2	Teens (moist conditions) Table C-3, EPA, 2004	
				ABS	Dermal absorption factor	Chemical-specific	unitless	See Table 6-48	
				EF	Exposure frequency	24	days/year	6 days per month, 4 months per year - VDEQ (Table 3-20) recommended value for trespasser	
				ED	Exposure duration	6	years	Professional Judgement	
				BW	Body weight	60	kg	50th percentile body weight for 12-17 year olds (EPA, 1997).	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

References:
EPA, 1997 - Exposure Factors Handbook
EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
EPA, 2004 - RAGS, Part E - Supplemental Guidance for Dermal Risk Assessment.
VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-42
VALUES USED FOR DAILY INTAKE CALCULATIONS
INCIDENTAL INGESTION OF SURFACE WATER BY RECREATIONAL FISHERMEN AND TRESPASSERS
CDL - Wallops Flight Facility

Scenario Timeframe:	Current/Future
Receptor:	Recreational Fisherman, Adult
	Recreational Fisherman, Child
	Trespasser, Youth
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational Fisherman	Adult	Surface Water in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/L	See Table 6-20	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-SW	Ingestion rate of surface water	0.05	L/hr	EPA, 1989	EPC x IR-SD x ET x EF X ED X 1/BW x 1/AT
				ET	Exposure time	2	hr/day	Professional Judgement	
				EF	Exposure frequency	10	days/year	Professional Judgement	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
		Child	Surface Water in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg	See Table 6-20	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-SW	Ingestion rate of surface water	0.05	L/hr	EPA, 1989	EPC x IR-SD x ET x EF X ED X 1/BW x 1/AT
				ET	Exposure time	2	hr/day	Professional Judgement	
				EF	Exposure frequency	10	days/year	Professional Judgement	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	
	Trespasser	Youth	Surface Water in Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/L	See Table 6-20	Chronic Daily Intake (CDI) (mg/kg-day) =
				IR-SW	Ingestion rate of surface water	0.05	L/hr	EPA, 1989	EPC x IR-SD x ET x EF X ED X 1/BW x 1/AT
				ET	Exposure time	2	hr/day	VDEQ - Table 3.17	
				EF	Exposure frequency	24	days/year	6 days per month, 4 months per year - VDEQ (Table 3-20) recommended value for trespasser	
				ED	Exposure duration	6	years	Assume youths ages 12 to 17 years	
				BW	Body weight	60	kg	50th percentile body weight for 12-17 year olds (EPA, 1997).	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	

References:

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-43
VALUES USED FOR DAILY INTAKE CALCULATIONS
DERMAL CONTACT WITH SURFACE WATER BY RECREATIONAL ADULT FISHERMEN
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Adult
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Surface Water in Little Mosquito Creek	SA	Skin surface area available for contact	6,900	cm^2	Assume feet, lower legs, hands, and head - EPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				DAEVENT	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated - see Table 6-51	DA_{EVENT} x EV X SA X EF X ED X1/BW x 1/AT
				EV	Event frequency	1	event/day	Professional Judgement	
				EF	Exposure frequency	10	days/year	Professional Judgement	
				ED	Exposure duration	24	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	8,760	days	EPA, 2002	
				FA	Fraction absorbed water	Chemical-specific	unitless	App. B, EPA 2004	If $t_{event} \le t^*$, then : DA_{event} (Organic) = $2\,FA \times K_p \times C_w \sqrt{\frac{6\,\tau_{event} \times t_{event}}{\pi}}$ If $t_{event} > t^*$, then : DA_{event} (Organic) = $FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event} \left(\frac{1+3B+3B^2}{(1+B)^2} \right) \right]$
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-20	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	Eq. A.1, EPA 2004	
				t*	Time to reach steady state	Chemical-specific	hour	Eq. A.5 to A.8, EPA 2004	
				τevent	Lag time per event	Chemical-specific	hr/event	App. B, EPA 2004	
				tevent	Event duration	2.00	hr/event	Professional Judgement	
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	DA_{EVENT} (Inorganic) = Kp x Cw x CF1 x CF2 x tevent
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-20	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				tevent	Event duration	2.00	hr/event	Professional Judgement	

References:
EPA, 1997 - Exposure Factors Handbook
EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
EPA, 2004 - RAGS, Part E - Supplemental Guidance for Dermal Risk Assessment.
VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-44
VALUES USED FOR DAILY INTAKE CALCULATIONS
DERMAL CONTACT WITH SURFACE WATER BY RECREATIONAL CHILD FISHERMEN
CDL - Wallops Flight Facility

Scenario Timeframe:	Future
Receptor:	Resident, Child
Medium:	Surface Water
Exposure Medium:	Surface Water

Receptor Population	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child	Surface Water in Little Mosquito Creek	SA	Skin surface area available for contact	3,000	cm^2	Assume feet, lower legs, hands, and head - EPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				DAEVENT	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated - see Table 6-51	DAEVENT x EV X SA X EF X ED X1/BW x 1/AT
				EV	Event frequency	1	event/day	Professional Judgement	
				EF	Exposure frequency	10	days/year	Professional Judgement	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	70	kg	EPA, 2002	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	
				FA	Fraction absorbed water	Chemical-specific	unitless	App. B, EPA 2004	If $t_{event} \le t^*$, then : DA_{event} (Organic) = $2\,FA \times K_p \times C_w \sqrt{\frac{6\,\tau_{event} \times t_{event}}{\pi}}$
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-20	
				CF1	Conversion factor	1.00E-03	mg/µg	--	If $t_{event} > t^*$, then : DA_{event} (Organic) = $FA \times K_p \times C_w \left[\frac{t_{event}}{1+B} + 2\tau_{event}\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	Eq. A.1, EPA 2004	
				t*	Time to reach steady state	Chemical-specific	hour	Eq. A.5 to A.8, EPA 2004	
				τevent	Lag time per event	Chemical-specific	hr/event	App. B, EPA 2004	
				tevent	Event duration	2.00	hr/event	Professional Judgement	
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	See Table 6-48	DAEVENT (Inorganic) = Kp x Cw x CF1 x CF2 x tevent
				Cw	Chemical concentration in water	Chemical-specific	µg/L	See Table 6-20	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				tevent	Event duration	2.00	hr/event	Professional Judgement	

References: EPA, 1997 - Exposure Factors Handbook
EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
EPA, 2004 - RAGS, Part E - Supplemental Guidance for Dermal Risk Assessment.
VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-45
VALUES USED FOR DAILY INTAKE CALCULATIONS
DERMAL CONTACT WITH SURFACE WATER BY RECREATIONAL YOUTH TRESPASSERS
CDL - Wallops Flight Facility

Scenario Timeframe:	Current/Future
Receptor:	Trespasser, Youth
Medium:	Surface Water
Exposure Medium:	Surface Water

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Trespasser	Youth	Surface Water in Little Mosquito Creek	SA	Skin surface area available for contact	6,300	cm^2	Assume feet, lower legs, hands, and head - EPA, 2004	Dermally Absorbed Dose (DAD) (mg/kg-day) =
				DAEVENT	Absorbed dose per event	Chemical-specific	mg/cm^2-event	Calculated - see Table 6-XX	DAEVENT x EV X SA X EF X ED X1/BW x 1/AT
				EV	Event frequency	1	event/day	Professional Judgement	
				EF	Exposure frequency	24	days/year	6 days per month, 4 months per year - VDEQ (Table 3-17) recommended value for trespasser	
				ED	Exposure duration	6	years	Youths ages 12 to 17 years	
				BW	Body weight	60	kg	50th percentile body weight for 12-17 year olds (EPA, 1997).	
				AT-C	Averaging time (cancer)	25,550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	2,190	days	EPA, 2002	
				FA	Fraction absorbed water	Chemical-specific	unitless	App. B, EPA 2004	
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	App. B, EPA 2004	
				Cw	Chemical concentration in water	Chemical-specific	µg/L	Site-specific	
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm3	--	
				B	Ratio of Permeability Coefficient	Chemical-specific	unitless	Eq. A.1, EPA 2004	
				t*	Time to reach steady state	Chemical-specific	hour	Eq. A.5 to A.8, EPA 2004	
				τevent	Lag time per event	Chemical-specific	hr/event	App. B, EPA 2004	
				tevent	Event duration	2.00	hr/event	Proffesional Judgement	
				Kp	Dermal permeability coefficient	Chemical-specific	cm/hour	App. B, EPA 2004	DAEVENT (Inorganic) =
				Cw	Chemical concentration in water	Chemical-specific	µg/L	Site-specific	Kp x Cw x CF1 x CF2 x tevent
				CF1	Conversion factor	1.00E-03	mg/µg	--	
				CF2	Conversion factor	1.00E-03	L/cm^3	--	
				tevent	Event duration	2.00	hr/event	Proffesional Judgement	

References:
EPA, 1997 - Exposure Factors Handbook
EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.
EPA, 2004 - RAGS, Part E - Supplemental Guidance for Dermal Risk Assessment.
VDEQ, 2008 - Voluntary Remediation Program Risk Assessment Guidance Tables (http://www.deq.virginia.gov/vrprisk/tables.html)

TABLE 6-46
VALUES USED FOR DAILY INTAKE CALCULATIONS
INGESTION OF FISH - ADULT AND CHILD RECREATIONAL FISHERMEN
Wallops CDL - Wallops Flight Facility

Scenario Timeframe:	Current/Future
Receptor:	Recreational Fisherman, Child
	Recreational Fisherman, Adult
Medium:	Fish
Exposure Medium:	Bluefish

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational Fisherman	Child	Bluefish	CBF	Chemical concentration in bluefish	Chemical-specific	mg/kg	Calculated based on maximum detected surface water concentrations - See Table 6-25	Chronic daly intake (CDI) (mg/kg-day) = CBF x IR-F x FI x EF x ED x 1/BW x 1/AT
				IR-F	Ingestion rate of fish	0.0045	kg/day	EPA, 1997	
				FI	Fraction of fish ingested from contaminated source	0.25	unitless	Professional Judgement	
				EF	Exposure frequency	350	days/yr	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	365	days	EPA, 2002	
		Adult	Bluefish	CBF	Chemical concentration in bluefish	Chemical-specific	mg/kg	Calculated based on maximum detected surface water concentrations - See Table 6-25	Chronic daly intake (CDI) (mg/kg-day) = CBF x IR-F x FI x EF x ED x 1/BW x 1/AT
				IR-F	Ingestion rate of fish	0.0135	kg/day	EPA, 1997	
				FI	Fraction of fish ingested from contaminated source	0.25	unitless	EPA, 2002	
				EF	Exposure frequency	350	days/yr	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	365	days	EPA, 2002	

References:

EPA, 1997 - Exposure Factors Handbook.

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

TABLE 6-47
VALUES USED FOR DAILY INTAKE CALCULATIONS
INGESTION OF CRABS - ADULT AND CHILD RECREATIONAL FISHERMEN
Wallops CDL - Wallops Flight Facility

Scenario Timeframe:	Current/Future
Receptor:	Recreational Fisherman, Child
	Recreational Fisherman, Adult
Medium:	Crab
Exposure Medium:	Blue Crabs

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Recreational Fisherman	Child	Blue Crabs from Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated based on maximum detected sediment concentrations - See Table 6-26	Chronic daly intake (CDI) (mg/kg-day) = EPC x IR-F x FI x EF x ED x 1/BW x 1/AT
				IR-C	Ingestion rate of crabs	0.0015	kg/day	EPA, 1997	
				FI	Fraction of crab ingested from contaminated source	0.25	unitless	Professional Judgement	
				EF	Exposure frequency	350	days/yr	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	365	days	EPA, 2002	
		Adult	Blue Crabs from Little Mosquito Creek	EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated based on maximum detected sediment concentrations - See Table 6-26	Chronic daly intake (CDI) (mg/kg-day) = EPC x IR-F x FI x EF x ED x 1/BW x 1/AT
				IR-C	Ingestion rate of crabs	0.0045	kg/day	EPA, 1997	
				FI	Fraction of crab ingested from contaminated source	0.25	unitless	Professional Judgement	
				EF	Exposure frequency	350	days/yr	EPA, 2002	
				ED	Exposure duration	6	years	EPA, 2002	
				BW	Body weight	15	kg	EPA, 2002	
				AT-C	Averaging Time (Cancer)	25550	days	EPA, 2002	
				AT-NC	Averaging Time (Non-Cancer)	365	days	EPA, 2002	

References:

EPA, 1997 - Exposure Factors Handbook.

EPA, 2002 - Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites.

TABLE 6-48
DERMAL EXPOSURE CONSTANTS -
ABSORPTION FRACTION AND PERMEABILITY COEFFICIENT
CDL - Wallops Flight Facility

Chemical	ABSd, Absorption Fraction	Reference[a]	Kp, Permeability Coefficient	Reference[a]
Aluminum	1.00E-03	RAIS	1.00E-03	EPA, 2004
Antimony	1.00E-03	RAIS	1.00E-03	EPA, 2004
Aroclor-1260	1.40E-01	EPA, 2004	5.48	RAIS
Arsenic	3.00E-02	EPA, 2004	1.00E-03	EPA, 2004
Benzene	1.00E-02	RAIS	1.50E-02	EPA, 2004
Benzo(a)anthracene	1.30E-01	EPA, 2004	4.70E-01	EPA, 2004
Benzo(a)pyrene	1.30E-01	EPA, 2004	7.00E-01	EPA, 2004
Benzo(b)fluoranthene	1.30E-01	EPA, 2004	7.00E-01	EPA, 2004
Benzo(k)fluoranthene	1.30E-01	EPA, 2004	7.00E-01	EPA, 2004[b]
bis(2-Ethylhexyl)phthalate	1.00E-01	EPA, 2004	2.50E-02	EPA, 2004
Cadmium	1.00E-03	EPA, 2004	1.00E-03	EPA, 2004
Chromium	1.00E-03	RAIS	2.00E-03	EPA, 2004
cis-1,2-Dichloroethene	1.00E-02	RAIS	1.49E-02	RAIS
Copper	1.00E-03	RAIS	1.00E-03	EPA, 2004
Chrysene	1.30E-01	EPA, 2004	4.70E-01	EPA, 2004
DDD	1.00E-02	RAIS	1.80E-01	EPA, 2004
DDE	1.00E-02	RAIS	1.60E-01	EPA, 2004
DDT	3.00E-02	EPA, 2004	2.70E-01	EPA, 2004
Dibenz(a,h)anthracene	1.30E-01	EPA, 2004	1.5	EPA, 2004
1,2-Dichloroethane	1.00E-02	RAIS	4.20E-03	EPA, 2004
Ethylbenzene	1.00E-02	RAIS	4.90E-02	EPA, 2004
gamma-Chlordane	4.00E-02	EPA, 2004[c]	3.80E-02	EPA, 2004
Indeno(1,2,3-cd)pyrene	1.30E-01	EPA, 2004	1	EPA, 2004
Iron	1.00E-03	RAIS	1.00E-03	EPA, 2004
Isopropylbenzene	1.00E-02	RAIS	1.40E-01	RAIS
Manganese	1.00E-03	RAIS	1.00E-03	EPA, 2004
Mercury	1.00E-03	RAIS	1.00E-03	EPA, 2004
Methylene chloride	1.00E-02	RAIS	3.50E-03	EPA, 2004
2-Methylnaphthalene	1.00E-02	RAIS	1.42E-01	RAIS
Nickel	1.00E-03	RAIS	2.00E-04	EPA, 2004
Silver	1.00E-03	RAIS	6.00E-04	EPA, 2004
Tetrachloroethene	1.00E-02	RAIS	3.30E-02	EPA, 2004
Thallium	1.00E-03	RAIS	1.00E-03	EPA, 2004
Toluene	1.00E-02	RAIS	3.10E-02	EPA, 2004
Trichloroethene	1.00E-02	RAIS	1.20E-02	EPA, 2004
Vanadium	1.00E-03	RAIS	1.00E-03	EPA, 2004
m,p-Xylene	1.00E-02	RAIS	5.30E-02	EPA, 2004
o-Xylene	1.00E-02	RAIS	5.30E-02	EPA, 2004
Xylene (total)	1.00E-02	RAIS	5.30E-02	EPA, 2004
Zinc	1.00E-03	RAIS	6.00E-04	EPA, 2004

Definitions:

DDD - p,p'-Dichlorodiphenyl dichloroethane
DDE - p,p'-Dichlorodiphenyldichloroethylene
DDT - p,p'-Dichlorodiphenyltrichloroethane
EPA - Environmental Protection Agency

Notes:

a RAIS - The Risk Assessment Information System (http://rais.ornl.gov/), accessed July 2008.
EPA (2004) RAGS, Part E - ABSd values from Exhibit 3-4; Kp values from Exhibit B-3 and B-4.
b Assumed same as benzo(a)anthracene and benzo(a) pyrene.
c Assumed same as chlordane

Table 6-49
DERMALLY ABSORBED DOSE PER EVENT (DAevent) CALCULATIONS
EXPOSURE TO GROUNDWATER
CDL - Wallops Flight Facility

Chemical	Note	Chemical Concentration Cw (mg/cm3)	Fraction Absorbed FA (dimensionless)	Permeability Coefficient Kp (cm/hr)	Lag time per event τevent (hr)	Permeability Ratio B (dimensionless)	Time to reach steady-state t* (hr)	Resident, Adult				
								Event time tevent (hr/event)	Is tevent < t*?	Absorb. Dose DAevent (mg/cm2-event)	DADc (mg/kg-day)	DADnc (mg/kg-day)
Benzene	a	3.70E-06	1	1.50E-02	0.29	0.1	0.7	0.58	Yes	5.86E-08	4.95E-06	1.44E-05
1,2-Dichloroethane	a	1.41E-05	1	4.20E-03	0.38	0.0	0.92	0.58	Yes	6.24E-08	5.28E-06	1.54E-05
cis-1,2-Dichloroethene	a,b	5.19E-05	1.0	7.70E-03	0.37	0.0	0.89	0.58	Yes	4.22E-07	3.57E-05	1.04E-04
Ethylbenzene	a	4.97E-04	1.0	4.90E-02	0.42	0.2	1.01	0.58	Yes	2.57E-05	2.17E-03	6.33E-03
Isopropylbenzene	c	6.08E-05	1.0	8.76E-02	0.495	0.369	1.19	0.58	Yes	5.63E-06	4.76E-04	1.39E-03
Tetrachloroethene	a	1.14E-05	1.0	3.30E-02	0.2	2.18	0.91	0.58	Yes	3.98E-07	3.37E-05	9.83E-05
Toluene	a	1.54E-03	1	3.10E-02	0.35	0.1	0.84	0.58	Yes	5.05E-05	4.27E-03	1.25E-02
Trichloroethene	a	3.35E-06	1.0	1.20E-02	0.58	0.10	1.39	0.58	Yes	4.24E-08	3.59E-06	1.05E-05
m,p-Xylene	a	1.96E-03	1.0	5.30E-02	0.2	1.01	0.42	0.58	No	1.03E-04	8.73E-03	2.55E-02
o-Xylene	c,d	7.04E-04	1.0	4.84E-02	0.413	0.192	0.991	0.58	Yes	3.59E-05	3.04E-03	8.86E-03
Xylene (total)	c	2.67E-03	1.0	4.84E-02	0.413	0.192	0.991	0.58	Yes	1.36E-04	1.15E-02	3.36E-02
2-Methylnaphthalene	c	3.37E-05	1.0	8.94E-02	0.657	0.41	1.58	0.58	Yes	3.18E-06	2.69E-04	7.85E-04
Naphthalene	a	8.61E-05	1.0	4.70E-02	0.56	0.2	1.34	0.58	Yes	4.27E-06	3.61E-04	1.05E-03
Arsenic	a	8.25E-06	NA	1.00E-03	NA	NA	NA	0.58	NA	4.81E-09	4.07E-07	1.19E-06
Iron	a	2.29E-02	NA	1.00E-03	NA	NA	NA	0.58	NA	1.33E-05	1.13E-03	3.29E-03
Manganese	a	1.24E-03	NA	1.00E-03	NA	NA	NA	0.58	NA	7.21E-07	6.10E-05	1.78E-04
Mercury	a	1.50E-07	NA	1.00E-03	NA	NA	NA	0.58	NA	8.75E-11	7.40E-09	2.16E-08

Table 6-49
DERMALLY ABSORBED DOSE PER EVENT (DAevent) CALCULATIONS
EXPOSURE TO GROUNDWATER
CDL - Wallops Flight Facility

Chemical	Resident, Child					Construction Worker, Adult				
	Event time tevent (hr/event)	Is tevent < t*?	Absorb. Dose DAevent (mg/cm2-event)	DADc (mg/kg-day)	DADnc (mg/kg-day)	Event time tevent (hr/event)	Is tevent < t*?	Absorb. Dose DAevent (mg/cm2-event)	DADc (mg/kg-day)	DADnc (mg/kg-day)
Benzene	1.00E+00	No	6.48E-08	2.34E-06	2.73E-05	4.00E+00	No	6.48E-08	7.18E-09	1.00E-06
1,2-Dichloroethane	1.00E+00	No	7.94E-08	2.87E-06	3.35E-05	4.00E+00	No	7.94E-08	8.79E-09	1.23E-06
cis-1,2-Dichloroethen	1.00E+00	No	5.29E-07	1.91E-05	2.23E-04	4.00E+00	No	5.29E-07	5.86E-08	8.20E-06
Ethylbenzene	1.00E+00	Yes	2.57E-05	9.29E-04	1.08E-02	4.00E+00	No	3.62E-05	4.01E-06	5.62E-04
Isopropylbenzene	1.00E+00	Yes	5.63E-06	2.03E-04	2.37E-03	4.00E+00	No	9.35E-06	1.04E-06	1.45E-04
Tetrachloroethene	1.00E+00	No	3.95E-07	1.43E-05	1.67E-04	4.00E+00	No	3.95E-07	4.37E-08	6.12E-06
Toluene	1.00E+00	No	6.22E-05	2.25E-03	2.62E-02	4.00E+00	No	6.22E-05	6.89E-06	9.64E-04
Trichloroethene	1.00E+00	Yes	4.24E-08	1.53E-06	1.79E-05	4.00E+00	No	7.26E-08	8.03E-09	1.12E-06
m,p-Xylene	1.00E+00	No	1.03E-04	3.74E-03	4.36E-02	4.00E+00	No	1.03E-04	1.14E-05	1.60E-03
o-Xylene	1.00E+00	No	5.00E-05	1.81E-03	2.11E-02	4.00E+00	No	5.00E-05	5.54E-06	7.76E-04
Xylene (total)	1.00E+00	No	1.90E-04	6.86E-03	8.00E-02	4.00E+00	No	1.90E-04	2.10E-05	2.94E-03
2-Methylnaphthalene	1.00E+00	Yes	3.18E-06	1.15E-04	1.34E-03	4.00E+00	No	6.70E-06	7.41E-07	1.04E-04
Naphthalene	1.00E+00	Yes	4.27E-06	1.54E-04	1.80E-03	4.00E+00	No	7.38E-06	8.17E-07	1.14E-04
Arsenic	1.00E+00	NA	8.25E-09	2.99E-07	3.48E-06	4.00E+00	NA	3.30E-08	3.66E-09	5.12E-07
Iron	1.00E+00	NA	2.29E-05	8.27E-04	9.65E-03	4.00E+00	NA	9.15E-05	1.01E-05	1.42E-03
Manganese	1.00E+00	NA	1.24E-06	4.47E-05	5.21E-04	4.00E+00	NA	4.94E-06	5.47E-07	7.66E-05
Mercury	1.00E+00	NA	3.00E-10	1.08E-08	1.27E-07	5.00E+00	NA	7.50E-10	8.30E-11	1.16E-08

Notes:

a EPA, 2004 (RAGS, Part E) - Values from Exhibit B-3, Calculation of Dermal Absorbed Dose for Organic Chemicals in Water. and Exhibit B-4, Calculation of Dermal Absorbed Dose for Inorganic Chemicals in Water.

b Assumed same as trans-1,2-Dichloroethene.

c Virginia Department of Environmental Quality - Table 3.22, Values for Dermal Absorption Models (http://www.deq.virginia.gov/vrprisk/tables.html).

d Assumed same as total Xylene.

Definitions:

NA - Not applicable - parameter not used for inorganics

TABLE 6-50
CALCULATION OF INHALATION DOSE FOR ADULT WHILE SHOWERING
CDL - Wallops Flight Facility

Parameter	Value	Units	Description
kg (H2O)	3000	cm/hr	gas-film mass transfer coefficient
kl (CO2)	20	cm/hr	liquid-film mass transfer coefficient
Tl	293	°K	calibration temperature of KL
R	8.20E-05	atm-m3/mol-K	gas constant × temperature
Ts	318	°K	shower water temperature
d	1	mm	shower droplet diameter
ts	0.5	sec	shower droplet drop time
FR	10	L/min	shower water flow rate
SV	6	m3	shower room air volume
Ds	35	min	shower duration
Dt	60	min	total time in shower
n	1	unitless	number of showers per day
Ra	0.008333333	min-1	air exchange rate
µl	1.002	cp	viscosity of water at Tl
µs	0.596	cp	viscosity of water at Ts
VR	0.83	m3/hr	ventilation rate (inhalation rate)
ET	1	hr/day	event frequency
EF	350	d/yr	exposure frequency
ED	24	yr	exposure duration
BW	70	kg	body weight
AT-C	25550	days	averaging time (cancer)
AT-NC	8760	days	averaging time (non-cancer)
CF	0.001	mg/ug	conversion factor

Chemical	Henry's Law Constant HLC (atm-m^3/mol)[a]	Molecular Weight MW (g/mole)[a]	Gas-film Mass Transfer Coefficient kg (cm/hr)[a]	Liquid-film Mass Transfer Coefficient kl (cm/hr)[a]	Overall Mass Transfer Coefficient KL (cm/hr)[a]	Adjusted Mass Transfer Coefficient KaL (cm/hr)a	Shower Concentration in Water Cw0 (µg/L)	Concentration Leaving Water Droplet Cwd (µg/L)	Indoor Air Generation Rate S (µg/(m3-min))	Inhalation Exposure Concentration in Shower IEC (µg/m3)	Inhalation Dose (cancer) Dc (mg/kg-d)	Inhalation Dose (noncancer) Dnc (mg/kg-d)
Benzene	5.55E-03	78	1441.15	15.02	14.37	19.41	3.7	0.15	0.25	5.15E+00	2.01E-05	5.86E-05
1,2-Dichloroethane	1.18E-03	99	1279.20	13.33	11.00	14.86	14.08	0.12	0.19	4.02E+00	1.57E-05	4.57E-05
cis-1,2-Dichloroethene	4.08E-03	97	1292.32	13.47	12.69	17.14	51.94	0.13	0.22	4.59E+00	1.79E-05	5.22E-05
Ethylbenzene	7.88E-03	106	1236.25	12.89	12.49	16.87	496.6	0.13	0.22	4.53E+00	1.76E-05	5.15E-05
Isopropylbenzene	1.15E-02	120.2	1160.93	12.10	11.84	16.00	60.84	0.12	0.21	4.31E+00	1.68E-05	4.90E-05
Tetrachloroethene	1.77E-02	166	987.88	10.30	10.15	13.71	11.44	0.11	0.18	3.73E+00	1.45E-05	4.24E-05
Toluene	6.64E-03	92	1326.98	13.83	13.33	18.00	1544	0.14	0.23	4.81E+00	1.87E-05	5.47E-05
Trichloroethene	9.85E-03	131	1112.04	11.59	11.30	15.27	3.35	0.12	0.20	4.12E+00	1.61E-05	4.69E-05
m,p-Xylene	6.63E-03	106	1236.25	12.89	12.42	16.77	1964	0.13	0.22	4.50E+00	1.75E-05	5.12E-05
o-Xylene	6.63E-03	106	1236.25	12.89	12.42	16.77	703.5	0.13	0.22	4.50E+00	1.75E-05	5.12E-05
Xylene (total)	6.63E-03	106	1236.25	12.89	12.42	16.77	2666	0.13	0.22	4.50E+00	1.75E-05	5.12E-05
2-Methylnaphthalene	5.18E-04	142	1068.10	11.13	7.50	10.14	33.72	0.08	0.14	2.80E+00	1.09E-05	3.18E-05
Naphthalene	4.40E-04	128	1125.00	11.73	7.47	10.09	86.05	0.08	0.13	2.78E+00	1.09E-05	3.17E-05
Arsenic	NA	75	1469.69	15.32	NA	NA	8.254	NA	NA	NA	NA	NA
Iron	NA	55.85	1703.12	17.75	NA	NA	22872	NA	NA	NA	NA	NA
Manganese	NA	54.94	1717.17	17.90	NA	NA	1236	NA	NA	NA	NA	NA
Mercury	NA	204.38	890.30	9.28	NA	NA	0.15	NA	NA	NA	NA	NA

Notes:

NA - Not available (not volatile)

a MCP Numerical Standards Spreadsheets - January 2006 (MCP GW.xls)
http://www.mass.gov/dep/service/compliance/riskasmt.htm#site

Table 6-51
Dermally Absorbed Dose per Event (DAevent) Calculations
Exposure to Surface Water
CDL - Wallops Flight Facility

		All Receptors								Recreational, Adult		Recreational, Child		Trespasser	
Chemical	Ref.	Chemical Conc., Cw (mg/cm3)	Permeability Coefficient, Kp (cm/hr)	Lag time per event, τevent (hr)	Time to reach steady-state, t* (hr)	Permeability Ratio, B (dimensionless)	Fraction Absorbed, FA (dimensionless)	Event time, tevent (hr/event)	Absorb. Dose, DAevent (mg/cm2-event)	DADc (mg/kg-day)	DADnc (mg/kg-day)	DADc (mg/kg-day)	DADnc (mg/kg-day)	DADc (mg/kg-day)	DADnc (mg/kg-day)
Arsenic	a	1.11E-05	1.00E-03	NA	NA	NA	NA	2	2.22E-08	4.93E-08	1.44E-07	2.34E-08	2.72E-07	1.31E-08	1.53E-07

Definitions:

NA - Not applicable - parameter not used for inorganics

Notes:

a Exhibit B-4, Calculation of Dermal Absorbed Dose for Inorganic Chemicals in Water.

TABLE 6-52
CANCER TOXICITY DATA - ORAL/DERMAL
CDL -Wallops Flight Facility

Chemical of Potential Concern	Oral Cancer Slope Factor $(mg/kg/day)^{-1}$	Weight of Evidence	Source	Dates
Aluminum	-	-	1	Jun-08
Antimony	-	-	1	Jun-08
Aroclor-1260	2.0E+00	B2	Regional screening table	May-08
Arsenic	1.5E+00	A	Regional screening table	May-08
Benzene	5.5E-02	A	Regional screening table	May-08
Benzo(a)anthracene	7.3E-01	B2	Regional screening table	May-08
Benzo(a)pyrene	7.3E+00	B2	Regional screening table	May-08
Benzo(b)fluoranthene	7.3E-01	B2	Regional screening table	May-08
Benzo(k)fluoranthene	7.3E-02	B2	Regional screening table	May-08
bis(2-Ethylhexyl)phthalate	1.4E-02	B2	Regional screening table	May-08
Cadmium	-	B1	2 - Regional screening table	Jun-08
Chromium	-	D	2 - Regional screening table	Jun-08
cis-1,2-Dichloroethene	9.1E-02	D	Regional screening table	May-08
Copper	-	-	1	-
Chrysene	7.3E-03	B2	Regional screening table	May-08
DDD	2.4E-01	B2	Regional screening table	May-08
DDE	3.4E-01	B2	Regional screening table	May-08
DDT	3.4E-01	B2	Regional screening table	May-08
Dibenz(a,h)anthracene	7.3E+00	B2	Regional screening table	May-08
1,2-Dichloroethane	9.1E-02	B2	Regional screening table	May-08
Ethylbenzene	1.1E-02	D	Regional screening table; Cal/EPA	May-08
gamma-Chlordane	3.5E-01	B2	3 - Regional Screening Table	May-08
Indeno(1,2,3-cd)pyrene	7.3E-01	B2	Regional screening table	May-08
Iron	-	-	1	Jun-08
Isopropylbenzene	-	D	1	Aug-08
Manganese	-	D	1	Aug-08
Mercury	-	D	1	Jun-08
Methylene chloride	7.5E-03	B2	Regional screening table	Aug-08
2-Methylnaphthalene	-	-	1	Aug-08
Naphthalene	-	C	Regional screening table	May-08
Nickel	-	-	1	Jun-08
Silver	-	D	1	Jun-08
Tetrachloroethene	5.4E-01	-	Regional screening table; Cal/EPA	May-08
Thallium	-	-	1	Aug-08
Toluene	-	-	1	Aug-08
Trichloroethene	1.3E-02	-	Regional screening table; Cal/EPA	Aug-08
Vanadium	-	-	1	Jun-08
m,p-Xylene	-	-	1	Jun-08
o-Xylene	-	-	1	Aug-08
Xylene (total)	-	-	1	Jun-08
Zinc	-	D	1	Jun-08

Definitions:

A - Chemical cancer classification (human carcinogen)
B1 - Chemical cancer classification (probable human carcinogen; limited human evidence)
B2 - Chemical cancer classification (probable human carcinogen; sufficiet animal evidence)
C - Chemical cancer classification (possible human carcinogen)
Cal/EPA - California Environmental Protection Agency
D - Chemical cancer classification (not classifiable as to human carcinogenicity)
DDD - p,p'-Dichlorodiphenyl dichloroethane
DDE - p,p'-Dichlorodiphenyldichloroethylene
DDT - p,p'-Dichlorodiphenyltrichloroethane
IRIS - Integrated Risk Information System
$(mg/kg/day)^{-1}$ - Risk per milligram per kilogram per day
EPA - U.S. Environmental Protection Agency

Notes:

All weight of evidence classifications were obtained from U.S.
1 - This chemical has not been demonstrated to be carcinogenic.
2 - This chemical has not been demonstrated to be carcinogenic via this route of exposure.
3 - Chlordane used as surrogate for gamma-Chlordane.

bis(2-Ethylhexyl)phthalate = di-(2-ethylhexyl)phthalate (DEHP)
methylene chloride = dichloromethane

TABLE 6-53
CANCER TOXICITY DATA - INHALATION
CDL -Wallops Flight Facility

Chemical	Inhalation Unit Risk $(ug/m^3)^{-1}$	Inhalation Slope Factor (mg/kg/day)$^{-1}$	Weight of Evidence	Slope Factor Source	Date
Aluminum	-	-	-	1	Jun-08
Antimony	-	-	-	1	Jun-08
Aroclor-1260	5.7E-04	2.0E+00	B2	Regional screening table	May-08
Arsenic	4.3E-03	1.5E+01	A	Regional screening table	May-08
Benzene	7.8E-06	2.7E-02	A	Regional screening table	May-08
Benzo(a)anthracene	1.1E-04	3.9E-01	B2	Regional screening table; Cal/EPA	May-08
Benzo(a)pyrene	1.1E-03	3.9E+00	B2	Regional screening table; Cal/EPA	May-08
Benzo(b)fluoranthene	1.1E-04	3.9E-01	B2	Regional screening table; Cal/EPA	May-08
Benzo(k)fluoranthene	1.1E-04	3.9E-01	B2	Regional screening table; Cal/EPA	May-08
bis(2-Ethylhexyl)phthalate	-	-	-	3 - Regional screening table	May-08
Cadmium	1.80E-03	1.5E+01	B1	Regional screening table	May-08
Chromium	1.20E-02	4.20E+01	A	2 - Regional screening table	May-08
cis-1,2-Dichloroethene	-	-	D	1	Aug-08
Copper	-	-	-	1	Jun-08
Chrysene	1.1E-05	3.9E-02	B2	Regional screening table; Cal/EPA	May-08
DDD	-	-	B2	3 - Regional screening table	May-08
DDE	-	-	B2	3 - Regional screening table	May-08
DDT	9.7E-05	3.40E-01	B2	Regional screening table	May-08
Dibenz(a,h)anthracene	1.2E-03	4.1E+00	B2	Regional screening table; Cal/EPA	May-08
1,2-Dichloroethane	2.6E-05	9.1E-02	B2	Regional screening table	May-08
Ethylbenzene	2.5E-06	8.8E-03	B2	Regional screening table; Cal/EPA	May-08
gamma-Chlordane	1.0E-04	3.5E-01	B2	4 - Regional screening table	May-08
Indeno(1,2,3-cd)pyrene	1.1E-04	3.9E-01	B2	Regional screening table; Cal/EPA	May-08
Iron	-	-	-	1	Jun-08
Isopropylbenzene	-	-	D	1	Aug-08
Manganese	-	-	D	1	Aug-08
Mercury	-	-	D	1	Jun-08
Methylene chloride	4.70E-07	1.7E-03	B2	4 - Regional screening table	May-08
2-Methylnaphthalene	-	-	-	1	Aug-08
Naphthalene	-	-	C	Regional screening table	May-08
Nickel	-	-	-	1	Jun-08
Silver	-	-	D	1	Jun-08
Tetrachloroethene	5.9E-06	2.1E-02	-	Regional screening table; Cal/EPA	May-08
Thallium	-	-	-	1	Aug-08
Toluene	-	-	-	1	Aug-08
Trichloroethene	2.0E-06	7.0E-03	-	Regional screening table; Cal/EPA	Aug-08
Vanadium	-	-	-	1	Jun-08
m,p-Xylene	-	-	-	1	Jun-08
o-Xylene	-	-	-	1	Aug-08
Xylene (total)	-	-	-	1	Jun-08
Zinc	-	-	D	1	Jun-08

Definitions:

A - Chemical cancer classification (human carcinogen)
B1 - Chemical cancer classification (probable human carcinogen; limited human evidence)
B2 - Chemical cancer classification (probable human carcinogen; sufficiet animal evidence)
C - Chemical cancer classification (possible human carcinogen)
Cal/EPA - California Environmental Protection Agency
D - Chemical cancer classification (not classifiable as to human carcinogenicity)
$(mg/kg/day)^{-1}$ - Risk per milligram per kilogram per day
EPA - U.S. Environmental Protection Agency

Notes:

1 - This chemical has not been demonstrated to be carcinogenic.
2 - Assumed Chronium VI
3 - This chemical has not been demonstrated to be carcinogenic via this route of exposure.
4 - Chlordane used as surrogate for gamma-Chlordane.

TABLE 6-54
NON-CANCER TOXICITY DATA - ORAL/DERMAL
CDL -Wallops Flight Facility

Chemical	RfD (mg/kg/day)	Critical Effect	Combined Uncertainty/Modifying Factor	Source	Date
Aluminum	1.0E+00	LOAEL	300	Regional screening table/ provisional value	Aug-08
Antimony	4.0E-04	Longevity, blood glucose, and cholesterol	1,000	Regional screening table	Aug-08
Aroclor-1260	2.0E-05	Ocular/immunological/integument	300	1	Aug-08
Arsenic	3.0E-04	Skin	3	Regional screening table	Aug-08
Benzene	4.0E-03	Blood	300	Regional screening table	Aug-08
Benzo(a)anthracene	-	-	-	Regional screening table	Aug-08
Benzo(a)pyrene	-	-	-	Regional screening table	Aug-08
Benzo(b)fluoranthene	-	-	-	Regional screening table	Aug-08
Benzo(k)fluoranthene	-	-	-	Regional screening table	Aug-08
bis(2-Ethylhexyl)phthalate	2.00E-02	Liver	1,000	Regional screening table	Aug-08
Cadmium	5.0E-04	Proteinuria (kidney)	10	Regional screening table	Aug-08
Chromium	3.0E-03	NOAEL - no critical effect reported	900	2 - Regional screening table	Aug-08
cis-1,2-Dichloroethene	1.00E-02	-	-	Regional screening table/ provisional value	Aug-08
Copper	4.0E-02	Gastrointestinal system	-	Regional screening table	Aug-08
Chrysene	-	-	-	Regional screening table	Aug-08
DDD	-	-	-	Regional screening table	Aug-08
DDE	-	-	-	Regional screening table	Aug-08
DDT	5.0E-04	Liver	100	Regional screening table	Aug-08
Dibenz(a,h)anthracene	-	-	-	Regional screening table	Aug-08
1,2-Dichloroethane	-	-	-	Regional screening table	May-08
Ethylbenzene	1.1E-01	Liver, kidney	1,000	Regional screening table	Aug-08
gamma-Chlordane	5.0E-04	Liver	300	3 - Regional screening table	Aug-08
Indeno(1,2,3-cd)pyrene	-	-	-	Regional screening table	Aug-08
Iron	7.0E-01	Liver, gastrointestinal, body weight, organ weight	-	Regional screening table/ provisional value	May-08
Isopropylbenzene	1.0E-01	Kidney	1,000	Regional screening table	Aug-08
Manganese	1.4E-01	CNS	1	Regional screening table	Aug-08
Mercury	3.00E-04	-	-	Regional screening table	Aug-08
Methylene chloride	6.00E-02	Liver	100	Regional screening table	Aug-08
2-Methylnaphthalene	4.00E-03	Lung	1,000	Regional screening table	Aug-08
Naphthalene	2.00E-02	Body weight	3,000	Regional screening table	Aug-08
Nickel (metallic)	-	-	-	Regional screening table	Aug-08
Silver	5.0E-03	Skin	3	Regional screening table	Aug-08
Tetrachloroethene	1.0E-02	Liver	1,000	Regional screening table	Aug-08
Thallium	6.50E-05	-	-	Regional screening table	Aug-08
Toluene	8.0E-02	Kidney	3,000	Regional screening table	Aug-08
Trichloroethene	-	-	-	Regional screening table	Aug-08
Vanadium	5.0E-03	-	-	Regional screening table	Aug-08
m,p-Xylene	2.0E+00	Decreased body weight & increased mortality	1,000	Regional screening table/HEAST	Aug-08
o-Xylene	2.0E+00	Decreased body weight & increased mortality	1,000	Regional screening table/HEAST	Aug-08
Xylene (total)	2.0E-01	Decreased body weight & increased mortality	1,000	Regional screening table	May-08
Zinc	3.0E-01	Blood	3	Regional screening table	May-08

Definitions:

mg/kg/day - Milligrams per kilogram per day
RfD - Reference dose

Notes:

1 - No toxicity data available for Aroclor-1260; Aroclor-1254 used as a surrogate.
2 Chromium VI ws used as a surrogate fro chromium.
3 - Chlordane used as surrogate for gamma-Chlordane.

TABLE 6-55
NON-CANCER TOXICITY DATA - INHALATION
CDL -Wallops Flight Facility

Chemical	RfD (mg/kg/day)	RfC (mg/m^3)[1]	Critical Effect	UF	Source	Date
Aluminum	1.4E-03	5.0E-03	-	-	Regional screening table/ provisional value	Aug-08
Antimony	-	-	-	-	Regional screening table	Aug-08
Aroclor-1260	-	-	-	-	Regional screening table	Aug-08
Arsenic	8.6E-06	3.0E-05	-	-	Regional screening table; Cal/EPA	Aug-08
Benzene	8.6E-03	3.0E-02	Blood	300	Regional screening table	Aug-08
Benzo(a)anthracene	-	-		-	Regional screening table	Aug-08
Benzo(a)pyrene	-	-	-	-	Regional screening table	Aug-08
Benzo(b)fluoranthene	-	-	-	-	Regional screening table	Aug-08
Benzo(k)fluoranthene	-	-	-	-	Regional screening table	Aug-08
bis(2-Ethylhexyl)phthalate	-	-	-	-		Aug-08
Cadmium	-	-	-	-	Regional screening table	Aug-08
Chromium	3.0E-05	1.0E-04	Lung	300	Regional screening table	Aug-08
cis-1,2-Dichloroethene	-	-	-	-	Regional screening table/ATSDR	Aug-08
Copper	-	-	Gastrointestinal	-	Regional screening table	Aug-08
Chrysene	-	-	-	-	Regional screening table	Aug-08
DDD	-	-	-	-	Regional screening table	Aug-08
DDE	-	-	-	-	Regional screening table	Aug-08
DDT	-	-	-	-	Regional screening table	Aug-08
Dibenz(a,h)anthracene	-	-	-	-	Regional screening table	Aug-08
1,2-Dichloroethane	6.9E-01	2.4E+00	Liver	90	Regional screening table/ ATSDR	Aug-08
Ethylbenzene	2.9E-01	1.0E+00	Developmental	300	Regional screening table	Aug-08
gamma-Chlordane	2.0E-04	7.0E-04	Liver	1000	2 - Regional screening table	Aug-08
Indeno(1,2,3-cd)pyrene	-	-	-	-	Regional screening table	Aug-08
Iron	-	-	-	-	Regional screening table	Aug-08
Isopropylbenzene	-	-	-	-	Regional screening table	Aug-08
Manganese	1.43E-05	5.00E-05	CNS	1000	Regional screening table	Aug-08
Mercury	-	-	-	-	Regional screening table	Aug-08
Methylene chloride	3.14E-01	1.1E+00	Liver	30	Regional screening table/ ATSDR	Aug-08
2-Methylnaphthalene	-	-	-	-	Regional screening table	Aug-08
Naphthalene	8.57E-04	3.0E-03	Nasal	3000	Regional screening table	Aug-08
Nickel (metallic)	-	-	-	-	Regional screening table	Aug-08
Silver	-	-	-	-	Regional screening table	Aug-08
Tetrachloroethene	7.7E-02	2.7E-01	Neurobehavioral	100	Regional screening table/ ATSDR	Aug-08
Thallium	-	-	-	-	Regional screening table	Aug-08
Toluene	1.43E+00	5.0E+00	Neurological	10	Regional screening table	Aug-08
Trichloroethene	-	-	-	-	Regional screening table	Aug-08
Vanadium	-	-	-	-	Regional screening table	Aug-08
m,p-Xylene	2.0E-01	7.0E-01	Nervous system, respiratory system	300	Regional screening table; Cal/EPA	Aug-08
o-Xylene	2.0E-01	7.0E-01	Nervous system, respiratory system	300	Regional screening table; Cal/EPA	Aug-08
Xylene (total)	2.9E-02	1.0E-01	Impaired motor coordination (decreased rotarod performance)	300	Regional screening table; Cal/EPA	Aug-08
Zinc	-	-	-	-	Regional screening table	Aug-08

Definitions:

ATSDR - Agency for Toxic Substances and Disease Registry
Cal/EPA - California Environmental Protection Agency
mg/kg/day - Milligrams per kilogram per day
mg/m3 - Milligrams per cubic meter
RfC - Reference concentration
RfD - Reference dose

Notes:

1 - Inhalation RfCs are converted to RfDs for humans using the equation: $(RfC/1)(20m^3/day)(1/70kg)$.
2 - Chlordane used as surrogate for gamma-Chlordane.

Table 6-56
Summary of Risks to Site Workers
Central and Southern AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Site Workers					
	Soil					
COPC	**Ingestion of Soil**	**Dermal Contact with Soil**	**Inhalation of Dust**	**Subtotal - Soil**	**Total Cancer Risk**	**Percent Contribution to Total**
Benzo(a)anthracene	5.72E-07	4.91E-07	4.49E-11	**1.06E-06**	**1.06E-06**	6.89%
Benzo(a)pyrene	**4.39E-06**	**3.76E-06**	3.45E-10	**8.15E-06**	**8.15E-06**	52.81%
Benzo(b)fluoranthene	3.19E-07	2.74E-07	2.51E-11	5.93E-07	5.93E-07	3.84%
Benzo(k)fluoranthene	2.36E-08	2.03E-08	1.86E-11	4.39E-08	4.40E-08	0.28%
Crysene	9.28E-09	7.96E-09	7.29E-12	1.72E-08	1.72E-08	0.11%
Dibenz(a,h)anthracene	8.91E-07	7.64E-07	7.36E-11	**1.66E-06**	**1.66E-06**	10.73%
Indeno(1,2,3-cd)pyrene	1.42E-07	1.22E-07	1.11E-11	2.63E-07	2.63E-07	1.71%
DDD	7.22E-09	4.77E-10	-	7.70E-09	7.70E-09	0.050%
DDE	6.61E-08	4.36E-09	-	7.04E-08	7.04E-08	0.46%
DDT	4.00E-08	7.92E-09	5.88E-12	4.79E-08	4.79E-08	0.31%
Aluminum	-	-	-	-	0.00E+00	--
Antimony	-	-	-	-	0.00E+00	--
Arsenic	**2.84E-06**	5.62E-07	4.20E-09	**3.40E-06**	**3.41E-06**	22.08%
Cadmium	-	-	1.19E-08	1.43E-12	1.19E-08	0.077%
Chromium	-	-	1.00E-07	2.87E-11	1.00E-07	0.65%
Copper	-	-	-	-	0.00E+00	--
Iron	-	-	-	-	0.00E+00	--
Mercury	-	-	-	-	0.00E+00	--
Nickel	-	-	-	-	0.00E+00	--
Silver	-	-	-	-	0.00E+00	--
Vanadium	-	-	-	-	0.00E+00	--
Zinc	-	-	-	-	0.00E+00	--
Total:	**9.29E-06**	**6.02E-06**	1.17E-07	**1.54E-05**	**1.54E-05**	100.00%

Table 6-56
Summary of Risks to Site Workers
Central and Southern AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Site Workers					
	Soil					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Total HI	Percent Contribution to Total
Benzo(a)anthracene	-	-	-	-	0.00E+00	--
Benzo(a)pyrene	-	-	-	-	0.00E+00	--
Benzo(b)fluoranthene	-	-	-	-	0.00E+00	--
Benzo(k)fluoranthene	-	-	-	-	0.00E+00	--
Crysene	-	-	-	-	0.00E+00	--
Dibenz(a,h)anthracene	-	-	-	-	0.00E+00	--
Indeno(1,2,3-cd)pyrene	-	-	-	-	0.00E+00	--
DDD	-	-	-	-	0.00E+00	--
DDE	-	-	-	-	0.00E+00	--
DDT	6.59E-04	1.30E-04	-	7.89E-04	7.89E-04	0.24%
Aluminum	1.60E-02	1.06E-04	1.65E-03	1.78E-02	1.78E-02	5.43%
Antimony	1.40E-01	9.26E-04	-	1.41E-01	1.41E-01	43.10%
Arsenic	1.77E-02	3.50E-03	9.10E-05	2.13E-02	2.13E-02	6.49%
Cadmium	3.02E-02	1.99E-04	-	3.04E-02	3.04E-02	9.28%
Chromium	1.52E-02	1.00E-04	2.23E-04	1.55E-02	1.55E-02	4.73%
Copper	3.94E-02	2.60E-04	-	3.97E-02	3.97E-02	12.11%
Iron	3.06E-02	2.02E-04	-	3.08E-02	3.08E-02	9.39%
Mercury	-	1.43E-05	1.12E-06	1.55E-05	1.55E-05	0.00%
Nickel	-	-	-	0.00E+00	0.00E+00	0.00%
Silver	1.06E-02	7.02E-05	-	1.07E-02	1.07E-02	3.27%
Vanadium	6.78E-03	4.48E-05	-	6.83E-03	6.83E-03	2.08%
Zinc	1.26E-02	8.29E-05	-	1.26E-02	1.26E-02	3.86%
Total:	3.20E-01	5.63E-03	1.96E-03	3.28E-01	3.28E-01	100.00%

Table 6-57
Summary of Risks to Commercial Workers
Central and Southern AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Commercial Workers							
	Soil			Groundwater				
COPC	Ingestion of Soil	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total Cancer Risk	Percent Contribution to Total
Benzene	1.78E-09	**1.19E-03**	**1.19E-03**	**1.42E-06**	2.84E-07	**1.71E-06**	**1.19E-03**	27.20%
1,2-Dichloroethane	3.78E-09	**2.09E-03**	**2.09E-03**	**8.95E-06**	7.13E-07	**9.67E-06**	**2.10E-03**	47.78%
cis-1,2-Dichloroethene	NA	NA	0.00E+00	**3.30E-05**	-	**3.30E-05**	**3.30E-05**	0.75%
Ethylbenzene	2.73E-09	**7.42E-04**	**7.42E-04**	**3.82E-05**	**1.27E-05**	**5.09E-05**	**7.92E-04**	18.05%
Isopropylbenzene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Tetrachloroethene	1.29E-09	**8.42E-05**	**8.42E-05**	**4.32E-05**	**1.67E-06**	**4.48E-05**	**1.29E-04**	2.94%
Toluene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Trichloroethene	NA	NA	0.00E+00	3.04E-07	1.08E-07	4.12E-07	4.12E-07	0.0094%
m,p-Xylene	-	-	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	-	-	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	1.15E-07	-	1.15E-07	NA	NA	0.00E+00	1.15E-07	0.0026%
Naphthalene	**2.44E-06**	-	**2.44E-06**	NA	NA	0.00E+00	**2.44E-06**	0.055%
Benzo(a)anthracene	1.77E-07	**5.23E-05**	**5.24E-05**	NA	NA	0.00E+00	5.24E-05	1.19%
Benzo(a)pyrene	1.31E-08	-	1.31E-08	NA	NA	0.00E+00	1.31E-08	0.00030%
Benzo(b)fluoranthene	1.82E-09	1.06E-08	1.24E-08	NA	NA	0.00E+00	1.24E-08	0.00028%
Benzo(k)fluoranthene	4.95E-07	-	4.95E-07	NA	NA	0.00E+00	4.95E-07	0.011%
Chrysene	7.87E-08	-	7.87E-08	NA	NA	0.00E+00	7.87E-08	0.0018%
Dibenz(a,h)anthracene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Gamma-Chlordane	2.12E-09	-	2.12E-09	NA	NA	0.00E+00	2.12E-09	0.000048%
DDD	2.56E-09	-	2.56E-09	NA	NA	0.00E+00	2.56E-09	0.000058%
DDE	3.89E-08	-	3.89E-08	NA	NA	0.00E+00	3.89E-08	0.00088%
DDT	1.94E-08	-	1.94E-08	NA	NA	0.00E+00	1.94E-08	0.00044%
Aroclor-1260	7.44E-08	-	7.44E-08	NA	NA	0.00E+00	7.44E-08	0.0017%
Aluminum	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Antimony	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	**1.26E-06**	-	**1.26E-06**	**8.65E-05**	-	**8.65E-05**	**8.78E-05**	2.00%
Cadmium	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Chromium	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Copper	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Iron	-	-	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Nickel	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	-	-	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Vanadium	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Zinc	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Total:	**4.72E-06**	**4.16E-03**	**4.16E-03**	**2.12E-04**	**1.55E-05**	**2.27E-04**	**4.39E-03**	100.00%

Table 6-57
Summary of Risks to Commercial Workers
Central and Southern AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Commercial Workers							
	Soil			Groundwater				
COPC	Ingestion of Soil	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total HI	Percent Contribution to Total
Benzene	2.26E-05	**1.43E+01**	**1.43E+01**	1.81E-02	3.40E-03	2.15E-02	**1.43E+01**	72.43%
1,2-Dichloroethane	-	9.37E-02	9.37E-02	-	3.20E-05	3.20E-05	9.37E-02	0.47%
cis-1,2-Dichloroethene	NA	NA	0.00E+00	1.02E-01	-	1.02E-01	1.02E-01	0.52%
Ethylbenzene	6.32E-06	8.31E-01	8.31E-01	8.83E-02	1.42E-02	1.03E-01	9.33E-01	4.73%
Isopropylbenzene	NA	NA	0.00E+00	1.19E-02	-	1.19E-02	1.19E-02	0.060%
Tetrachloroethene	6.70E-07	1.46E-01	1.46E-01	2.24E-02	2.89E-03	2.53E-02	1.71E-01	0.87%
Toluene	NA	NA	0.00E+00	3.78E-01	9.19E-03	3.87E-01	3.87E-01	1.96%
Trichloroethene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	4.89E-07	**1.51E+00**	**1.51E+00**	1.92E-02	7.91E-02	9.84E-02	**1.61E+00**	8.16%
o-Xylene	NA	NA	0.00E+00	6.88E-03	2.10E-02	2.78E-02	2.78E-02	0.14%
Xylene (total)	6.92E-06	-	6.92E-06	2.61E-01	-	2.61E-01	2.61E-01	1.32%
Benzo(a)anthracene	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(a)pyrene	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(b)fluoranthene	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(k)fluoranthene	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Chrysene	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Dibenz(a,h)anthracene	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	0.00E+00	1.65E-01	-	1.65E-01	1.65E-01	0.84%
Naphthalene	NA	NA	0.00E+00	8.42E-02	3.59E-02	1.20E-01	1.20E-01	0.61%
Gamma-Chlordane	3.39E-05	-	3.39E-05	NA	NA	0.00E+00	3.39E-05	0.00017%
DDD	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
DDE	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
DDT	3.19E-04	-	3.19E-04	NA	NA	0.00E+00	3.19E-04	0.0016%
Aroclor-1260	5.21E-03	-	5.21E-03	NA	NA	0.00E+00	5.21E-03	0.026%
Aluminum	1.44E-02	-	1.44E-02	NA	NA	0.00E+00	1.44E-02	0.073%
Antimony	3.15E-02	-	3.15E-02	NA	NA	0.00E+00	3.15E-02	0.16%
Arsenic	7.81E-03	-	7.81E-03	5.38E-01	-	5.38E-01	5.46E-01	2.77%
Cadmium	1.14E-02	-	1.14E-02	NA	NA	0.00E+00	1.14E-02	0.058%
Chromium	6.01E-02	-	6.01E-02	NA	NA	0.00E+00	6.01E-02	0.30%
Copper	4.27E-02	-	4.27E-02	NA	NA	0.00E+00	4.27E-02	0.22%
Iron	1.33E-02	-	1.33E-02	6.39E-01	-	6.39E-01	6.53E-01	3.31%
Manganese	NA	NA	0.00E+00	1.73E-01	-	1.73E-01	1.73E-01	0.88%
Mercury	9.87E-04	-	9.87E-04	9.78E-03	-	9.78E-03	1.08E-02	0.055%
Nickel	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	2.02E-03	-	2.02E-03	NA	NA	0.00E+00	2.02E-03	0.010%
Vanadium	2.29E-03	-	2.29E-03	NA	NA	0.00E+00	2.29E-03	0.012%
Zinc	6.98E-03	-	6.98E-03	NA	NA	0.00E+00	6.98E-03	0.035%
Total:	1.99E-01	**1.69E+01**	**1.71E+01**	**2.52E+00**	1.66E-01	**2.68E+00**	**1.97E+01**	100.00%

Table 6-58
Summary of Risks to Construction Workers
Central and Southern AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Construction Workers									
	Soil				Groundwater					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Outdoor Vapor in Trench	Subtotal - Groundwater	Total Cancer Risk	Percent Contribution to Total
Benzene	1.13E-10	3.38E-12	2.49E-15	1.16E-10	1.37E-10	3.95E-10	**1.28E-06**	**1.28E-06**	**1.28E-06**	1.39%
1,2-Dichloroethane	2.40E-10	7.19E-12	1.07E-14	2.47E-10	8.60E-10	8.00E-10	**6.81E-06**	**6.81E-06**	**6.81E-06**	7.43%
cis-1,2-Dichloroethene	NA	NA	NA	0.00E+00	3.17E-09	5.33E-09	**2.65E-05**	**2.65E-05**	**2.65E-05**	28.96%
Ethylbenzene	1.73E-10	5.19E-12	6.13E-15	1.78E-10	3.67E-09	4.41E-08	**2.95E-05**	**2.95E-05**	**2.95E-05**	32.25%
Isopropylbenzene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Tetrachloroethene	8.19E-11	2.46E-12	1.42E-16	8.44E-11	4.14E-09	2.36E-08	**2.68E-05**	**2.68E-05**	**2.68E-05**	29.29%
Toluene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Trichloroethene	NA	NA	NA	0.00E+00	2.92E-11	1.04E-10	2.12E-07	2.12E-07	2.12E-07	0.23%
m,p-Xylene	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Benzo(a)anthracene	7.31E-09	2.85E-09	1.74E-13	1.02E-08	NA	NA	NA	0.00E+00	1.02E-08	0.011%
Benzo(a)pyrene	1.54E-07	6.02E-08	3.67E-12	2.15E-07	NA	NA	NA	0.00E+00	2.15E-07	0.23%
Benzo(b)fluoranthene	1.12E-08	4.38E-09	2.67E-13	1.56E-08	NA	NA	NA	0.00E+00	1.56E-08	0.017%
Benzo(k)fluoranthene	8.32E-10	3.25E-10	1.98E-13	1.16E-09	NA	NA	NA	0.00E+00	1.16E-09	0.0013%
Chrysene	1.15E-10	4.50E-11	2.75E-14	1.60E-10	NA	NA	NA	0.00E+00	1.60E-10	0.00018%
Dibenz(a,h)anthracene	3.14E-08	1.22E-08	7.85E-13	4.36E-08	NA	NA	NA	0.00E+00	4.36E-08	0.048%
Indeno(1,2,3-cd)pyrene	4.99E-09	1.94E-09	1.19E-13	6.93E-09	NA	NA	NA	0.00E+00	6.93E-09	0.0076%
2-Methylnaphthalene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Naphthalene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Gamma-Chlordane	1.34E-10	1.61E-11	5.97E-15	1.50E-10	NA	NA	NA	0.00E+00	1.50E-10	0.00016%
DDD	1.62E-10	4.87E-12	-	1.67E-10	NA	NA	NA	0.00E+00	1.67E-10	0.00018%
DDE	2.46E-09	7.39E-11	-	2.54E-09	NA	NA	NA	0.00E+00	2.54E-09	0.0028%
DDT	1.23E-09	1.10E-10	5.47E-14	1.34E-09	NA	NA	NA	0.00E+00	1.34E-09	0.0015%
Aroclor-1260	4.72E-09	1.98E-09	2.10E-13	6.70E-09	NA	NA	NA	0.00E+00	6.70E-09	0.0073%
Aluminum	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Antimony	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	7.95E-08	7.16E-09	3.57E-11	8.67E-08	8.31E-09	5.48E-09	-	1.38E-08	1.01E-07	0.11%
Cadmium	-	-	8.62E-11	8.62E-11	NA	NA	NA	0.00E+00	8.62E-11	0.000094%
Chromium	-	-	7.64E-09	7.64E-09	NA	NA	NA	0.00E+00	7.64E-09	0.0083%
Copper	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Iron	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Nickel	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Vanadium	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Zinc	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Total:	2.99E-07	9.13E-08	7.76E-09	3.98E-07	2.03E-08	7.98E-08	**9.11E-05**	**9.12E-05**	**9.16E-05**	100.00%

Table 6-58
Summary of Risks to Construction Workers
Central and Southern AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Construction Workers									
	Soil				Groundwater					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Ingestion of Groundwater	with Groundwater	Outdoor Vapor in Trench	Subtotal - Groundwater	Total HI	Percent Contribution to Total
Benzene	7.17E-05	2.15E-06	1.49E-09	7.38E-05	8.69E-05	2.51E-04	3.79E-01	3.79E-01	3.79E-01	0.26%
1,2-Dichloroethane	-	-	2.40E-11	2.40E-11	-	-	1.53E-02	1.53E-02	1.53E-02	0.010%
cis-1,2-Dichloroethene	NA	NA	NA	0.00E+00	4.88E-04	8.20E-04	-	1.31E-03	1.31E-03	0.00090%
Ethylbenzene	2.00E-05	6.00E-07	3.43E-10	2.06E-05	4.24E-04	5.11E-03	**1.31E+00**	**1.32E+00**	**1.32E+00**	0.90%
Isopropylbenzene	NA	NA	NA	0.00E+00	5.71E-05	1.45E-03	-	1.51E-03	1.51E-03	0.0010%
Tetrachloroethene	2.12E-06	6.37E-08	1.23E-11	2.19E-06	1.07E-04	6.12E-04	9.01E-02	9.08E-02	9.08E-02	0.062%
Toluene	NA	NA	NA	0.00E+00	1.81E-03	1.21E-02	8.75E-01	8.89E-01	8.89E-01	0.61%
Trichloroethene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	1.55E-06	4.65E-08	6.91E-10	1.60E-06	9.22E-05	8.00E-04	**7.42E+00**	**7.42E+00**	**7.42E+00**	5.08%
o-Xylene	NA	NA	NA	0.00E+00	3.30E-05	3.88E-04	**2.65E+00**	**2.65E+00**	**2.65E+00**	1.81%
Xylene (total)	2.19E-05	6.58E-07	6.84E-09	2.26E-05	1.25E-03	1.47E-02	**7.03E+01**	**7.03E+01**	**7.03E+01**	48.13%
Benzo(a)anthracene	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(a)pyrene	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(b)fluoranthene	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(k)fluoranthene	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Chrysene	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Dibenz(a,h)anthracene	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	NA	0.00E+00	7.92E-04	2.59E-02	-	2.67E-02	2.67E-02	0.018%
Naphthalene	NA	NA	NA	0.00E+00	4.04E-04	5.72E-03	6.23E+01	**6.23E+01**	**6.23E+01**	42.65%
Gamma-Chlordane	1.07E-04	1.29E-05	1.19E-08	1.20E-04	NA	NA	NA	0.00E+00	1.20E-04	0.000082%
DDD	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
DDE	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
DDT	1.01E-03	9.09E-05	-	1.10E-03	NA	NA	NA	0.00E+00	1.10E-03	0.00075%
Aroclor-1260	1.65E-02	6.93E-03	-	2.34E-02	NA	NA	NA	0.00E+00	2.34E-02	0.016%
Aluminum	4.57E-02	1.37E-04	1.43E-03	4.73E-02	NA	NA	NA	0.00E+00	4.73E-02	0.032%
Antimony	9.99E-02	3.00E-04	-	1.00E-01	NA	NA	NA	0.00E+00	1.00E-01	0.069%
Arsenic	2.47E-02	2.23E-03	3.86E-05	2.70E-02	2.58E-03	1.71E-03	-	4.29E-03	3.13E-02	0.021%
Cadmium	3.61E-02	1.08E-04	-	3.62E-02	NA	NA	NA	0.00E+00	3.62E-02	0.025%
Chromium	1.90E-01	5.71E-04	8.48E-04	1.92E-01	NA	NA	NA	0.00E+00	1.92E-01	0.13%
Copper	1.35E-01	4.06E-04	-	1.36E-01	NA	NA	NA	0.00E+00	1.36E-01	0.093%
Iron	4.21E-02	1.26E-04	-	4.22E-02	3.07E-03	2.03E-03	-	5.09E-03	4.73E-02	0.032%
Manganese	NA	NA	NA	0.00E+00	8.29E-04	1.37E-02	-	1.45E-02	1.45E-02	0.0099%
Mercury	3.13E-03	9.38E-06	-	3.14E-03	4.70E-05	3.87E-05	-	8.57E-05	3.22E-03	0.00%
Nickel	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	6.39E-03	1.92E-05	-	6.41E-03	NA	NA	NA	0.00E+00	6.41E-03	0.0044%
Vanadium	7.24E-03	2.17E-05	-	7.26E-03	NA	NA	NA	0.00E+00	7.26E-03	0.0050%
Zinc	2.21E-02	6.63E-05	-	2.22E-02	NA	NA	NA	0.00E+00	2.22E-02	0.015%
Total:	6.31E-01	1.10E-02	2.31E-03	6.44E-01	1.21E-02	8.53E-02	**1.45E+02**	**1.45E+02**	**1.46E+02**	100.0%

Table 6-59
Summary of Risk to Residential Adults
Cental and Southern AOCs
CDL - Wallops Flight Facility

	Cancer Risk - Residential Adults											
	Soil					Groundwater						
COPC	**Ingestion of Soil**	**Dermal Contact with Soil**	**Inhalation of Dust**	**Inhalation of Indoor Vapor**	**Subtotal - Soil**	**Ingestion of Groundwater**	**Dermal Contact with Groundwater**	**Inhalation of Vapors During Showering**	**Inhalation of Indoor Vapors from Groundwater**	**Subtotal - Groundwater**	**Total Cancer Risk**	**Percent Contribution to Total**
Benzene	4.78E-09	1.91E-10	3.49E-13	**1.60E-03**	**1.60E-03**	**1.91E-06**	2.72E-07	**1.11E-06**	**2.31E-06**	**5.60E-06**	**1.61E-03**	25.82%
1,2-Dichloroethane	1.02E-08	4.06E-10	1.50E-12	**2.81E-03**	**2.81E-03**	**1.20E-05**	4.80E-07	**1.43E-06**	**2.87E-06**	**1.68E-05**	**2.82E-03**	45.31%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	**4.44E-05**	**3.25E-06**	**1.63E-06**	**3.55E-05**	**8.48E-05**	**8.48E-05**	1.36%
Ethylbenzene	7.34E-09	2.93E-10	8.58E-13	**9.97E-04**	**9.97E-04**	**5.13E-05**	**2.39E-05**	1.94E-07	**6.44E-05**	**1.40E-04**	**1.14E-03**	18.24%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Tetrachloroethene	3.47E-09	1.39E-10	1.99E-14	**1.13E-04**	**1.13E-04**	**5.80E-05**	**1.82E-05**	**7.84E-06**	**1.73E-04**	**2.57E-04**	**3.70E-04**	5.94%
Toluene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Trichloroethene	NA	NA	NA	NA	0.00E+00	4.09E-07	4.66E-08	2.09E-07	8.07E-07	**1.47E-06**	**1.47E-06**	0.024%
m,p-Xylene	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Benzo(a)anthracene	3.10E-07	1.61E-07	2.44E-11	-	4.71E-07	NA	NA	NA	NA	0.00E+00	4.71E-07	0.0076%
Benzo(a)pyrene	**6.55E-06**	**3.40E-06**	5.14E-10	-	**9.95E-06**	NA	NA	NA	NA	0.00E+00	**9.95E-06**	0.16%
Benzo(b)fluoranthene	4.77E-07	2.47E-07	3.74E-11	**7.02E-05**	**7.10E-05**	NA	NA	NA	NA	0.00E+00	**7.10E-05**	1.14%
Benzo(k)fluoranthene	3.53E-08	1.83E-08	2.77E-11	-	5.37E-08	NA	NA	NA	NA	0.00E+00	5.37E-08	0.00086%
Chrysene	4.89E-09	2.54E-09	3.84E-12	1.43E-08	2.17E-08	NA	NA	NA	NA	0.00E+00	2.17E-08	0.00035%
Dibenz(a,h)anthracene	**1.33E-06**	6.90E-07	1.10E-10	-	**2.02E-06**	NA	NA	NA	NA	0.00E+00	**2.02E-06**	0.032%
Indeno(1,2,3-cd)pyrene	2.12E-07	1.10E-07	1.66E-11	-	3.21E-07	NA	NA	NA	NA	0.00E+00	3.21E-07	0.0052%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Naphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Gamma-Chlordane	5.69E-09	9.08E-10	8.36E-13	-	6.60E-09	NA	NA	NA	NA	0.00E+00	6.60E-09	0.00011%
DDD	6.89E-09	2.75E-10	-	-	7.16E-09	NA	NA	NA	NA	0.00E+00	7.16E-09	0.00011%
DDE	1.04E-07	4.17E-09	-	-	1.09E-07	NA	NA	NA	NA	0.00E+00	1.09E-07	0.0017%
DDT	5.21E-08	6.23E-09	7.66E-12	-	5.83E-08	NA	NA	NA	NA	0.00E+00	5.83E-08	0.00094%
Aroclor-1260	2.00E-07	1.12E-07	2.94E-11	-	3.12E-07	NA	NA	NA	NA	0.00E+00	3.12E-07	0.0050%
Aluminum	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Antimony	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	**3.37E-06**	4.04E-07	4.99E-09	-	**3.78E-06**	**1.16E-04**	6.11E-07	-	-	**1.17E-04**	**1.21E-04**	1.94%
Cadmium	-	-	1.21E-08	-	1.21E-08	NA	NA	NA	NA	0.00E+00	1.21E-08	0.00019%
Chromium	-	-	**1.07E-06**	-	**1.07E-06**	NA	NA	NA	NA	0.00E+00	**1.07E-06**	0.017%
Copper	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Iron	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Nickel	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Vanadium	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Zinc	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Total:	**1.27E-05**	**5.15E-06**	**1.09E-06**	**5.59E-03**	**5.61E-03**	**2.84E-04**	**4.67E-05**	**1.24E-05**	**2.79E-04**	**6.23E-04**	**6.23E-03**	100.00%

Table 6-59
Summary of Risk to Residential Adults
Cental and Southern AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Residential Adults											
	Soil					Groundwater						
COPC	**Ingestion of Soil**	**Dermal Contact with Soil**	**Inhalation of Dust**	**Inhalation of Indoor Vapor**	**Subtotal - Soil**	**Ingestion of Groundwater**	**Dermal Contact with Groundwater**	**Inhalation of Vapors During Showering**	**Inhalation of Indoor Vapors from Groundwater**	**Subtotal - Groundwater**	**Total HI**	**Percent Contribution to Total**
Benzene	6.34E-05	2.53E-06	4.35E-09	**2.00E+01**	**2.00E+01**	2.53E-02	3.61E-03	6.84E-03	1.43E-02	5.01E-02	**2.00E+01**	68.69%
1,2-Dichloroethane	-	-	6.99E-11	1.31E-01	1.31E-01	-	-	6.66E-05	1.34E-04	2.01E-04	1.31E-01	0.45%
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	1.42E-01	1.04E-02	-	-	1.53E-01	1.53E-01	0.52%
Ethylbenzene	1.77E-05	7.06E-07	1.00E-09	**1.16E+00**	**1.16E+00**	1.24E-01	5.76E-02	1.80E-04	5.98E-02	2.41E-01	**1.40E+00**	4.81%
Isopropylbenzene	NA	NA	NA	NA	NA	1.67E-02	1.39E-02	-	-	3.05E-02	3.05E-02	0.10%
Tetrachloroethene	1.88E-06	7.49E-08	3.58E-11	2.04E-01	2.04E-01	3.13E-02	9.83E-03	5.49E-04	1.21E-02	5.38E-02	2.58E-01	0.88%
Toluene	NA	NA	NA	NA	NA	5.29E-01	1.56E-01	3.83E-05	3.86E-02	7.23E-01	7.23E-01	2.48%
Trichloroethene	NA	NA	NA	NA	NA	-	-	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	1.37E-06	5.47E-08	2.01E-09	**2.12E+00**	**2.12E+00**	2.69E-02	1.27E-02	2.56E-04	3.32E-01	3.72E-01	**2.49E+00**	8.53%
o-Xylene	NA	NA	NA	NA	NA	9.64E-03	4.43E-03	2.56E-04	8.80E-02	1.02E-01	1.02E-01	0.35%
Xylene (total)	1.94E-05	7.73E-07	2.00E-08	-	2.02E-05	3.65E-01	1.68E-01	1.79E-03	-	5.35E-01	5.35E-01	1.83%
Benzo(a)anthracene	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(a)pyrene	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(b)fluoranthene	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(k)fluoranthene	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Chrysene	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Dibenz(a,h)anthracene	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	NA	NA	NA	2.31E-01	1.96E-01	-	-	4.27E-01	4.27E-01	1.46%
Naphthalene	NA	NA	NA	NA	NA	1.18E-01	5.26E-02	3.69E-02	1.51E-01	3.58E-01	3.58E-01	1.23%
Gamma-Chlordane	9.48E-05	1.51E-05	3.49E-08	-	1.10E-04	NA	NA	NA	NA	0.00E+00	1.10E-04	0.00038%
DDD	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
DDE	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
DDT	8.93E-04	1.07E-04	-	-	1.00E-03	NA	NA	NA	NA	0.00E+00	1.00E-03	0.0034%
Aroclor-1260	1.46E-02	8.15E-03	-	-	2.27E-02	NA	NA	NA	NA	0.00E+00	2.27E-02	0.078%
Aluminum	4.04E-02	1.61E-04	4.16E-03	-	4.47E-02	NA	NA	NA	NA	0.00E+00	4.47E-02	0.15%
Antimony	8.83E-02	3.52E-04	-	-	8.87E-02	NA	NA	NA	NA	0.00E+00	8.87E-02	0.30%
Arsenic	2.19E-02	2.62E-03	1.13E-04	-	2.46E-02	7.54E-01	3.96E-03	-	-	7.58E-01	7.82E-01	2.68%
Cadmium	3.19E-02	1.27E-04	-	-	3.20E-02	NA	NA	NA	NA	0.00E+00	3.20E-02	0.11%
Chromium	1.68E-01	6.71E-04	2.47E-03	-	1.71E-01	NA	NA	NA	NA	0.00E+00	1.71E-01	0.59%
Copper	1.19E-01	4.77E-04	-	-	1.20E-01	NA	NA	NA	NA	0.00E+00	1.20E-01	0.41%
Iron	3.72E-02	1.48E-04	-	-	3.73E-02	8.95E-01	4.70E-03	-	-	9.00E-01	9.37E-01	3.21%
Manganese	NA	NA	NA	NA	NA	2.42E-01	3.17E-02	-	-	2.74E-01	2.74E-01	0.94%
Mercury	2.76E-03	1.10E-05	-	-	2.77E-03	1.37E-02	7.19E-05	-	-	1.38E-02	1.65E-02	0.057%
Nickel	-	-	-	-	-	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	5.65E-03	2.25E-05	-	-	5.67E-03	NA	NA	NA	NA	0.00E+00	5.67E-03	0.019%
Vanadium	6.40E-03	2.55E-05	-	-	6.43E-03	NA	NA	NA	NA	0.00E+00	6.43E-03	0.022%
Zinc	1.95E-02	7.80E-05	-	-	1.96E-02	NA	NA	NA	NA	0.00E+00	1.96E-02	0.067%
Total:	5.57E-01	1.30E-02	6.75E-03	**2.36E+01**	**2.42E+01**	**3.52E+00**	7.25E-01	4.69E-02	6.96E-01	**4.99E+00**	**2.92E+01**	100.00%

Table 6-60
Summary of Risks to Residential Children
Central and Southern AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Residential Children										
	Soil					Groundwater					
COPC	**Ingestion of Soil**	**Dermal Contact with Soil**	**Inhalation of Dust**	**Inhalation of Indoor Vapor from Soil**	**Subtotal - Soil**	**Ingestion of Groundwater**	**Dermal Contact with Groundwater**	**Inhalation of Indoor Vapors from Groundwater**	**Subtotal - Groundwater**	**Total Cancer Risk**	**Percent Contribution to Total**
Benzene	1.12E-08	7.81E-10	1.16E-16	**1.87E-03**	**1.87E-03**	**1.12E-06**	4.77E-07	**2.69E-06**	**4.28E-06**	**1.87E-03**	15.21%
1,2-Dichloroethane	2.37E-08	1.66E-09	4.99E-16	**3.27E-03**	**3.27E-03**	**7.02E-06**	**3.68E-06**	**3.35E-06**	**1.41E-05**	**3.29E-03**	26.68%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	**2.59E-05**	**9.05E-05**	**4.14E-05**	**1.58E-04**	**1.58E-04**	1.28%
Ethylbenzene	1.71E-08	1.20E-09	2.86E-16	**1.16E-03**	**1.16E-03**	**2.99E-05**	**5.07E-03**	**7.51E-05**	**5.18E-03**	**6.34E-03**	51.46%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Tetrachloroethene	8.11E-09	5.68E-10	6.51E-18	**1.32E-04**	**1.32E-04**	**3.38E-05**	**8.82E-05**	**2.02E-04**	**3.24E-04**	**4.56E-04**	3.70%
Toluene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Trichloroethene	NA	NA	NA	NA	0.00E+00	2.39E-07	6.68E-08	9.41E-07	**1.25E-06**	**1.25E-06**	0.010%
m,p-Xylene	-	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	-	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Benzo(a)anthracene	7.24E-07	6.59E-07	8.02E-15	-	**1.38E-06**	NA	NA	NA	0.00E+00	**1.38E-06**	0.011%
Benzo(a)pyrene	**1.53E-05**	**1.39E-05**	1.69E-13	-	**2.92E-05**	NA	NA	NA	0.00E+00	**2.92E-05**	0.24%
Benzo(b)fluoranthene	**1.11E-06**	**1.01E-06**	1.23E-14	8.19E-05	**8.41E-05**	NA	NA	NA	0.00E+00	**8.41E-05**	0.68%
Benzo(k)fluoranthene	8.24E-08	7.50E-08	9.13E-15	-	1.57E-07	NA	NA	NA	0.00E+00	1.57E-07	0.0013%
Chrysene	1.14E-08	1.04E-08	1.26E-15	1.67E-08	3.85E-08	NA	NA	NA	0.00E+00	3.85E-08	0.00031%
Dibenz(a,h)anthracene	**3.10E-06**	**2.82E-06**	3.75E-14	-	**5.93E-06**	NA	NA	NA	0.00E+00	**5.93E-06**	0.048%
Indeno(1,2,3-cd)pyrene	4.94E-07	4.49E-07	5.47E-15	-	9.43E-07	NA	NA	NA	0.00E+00	9.43E-07	0.0077%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Naphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Gamma-Chlordane	1.33E-08	3.72E-09	2.79E-16	-	1.70E-08	NA	NA	NA	0.00E+00	1.70E-08	0.00014%
DDD	1.61E-08	1.12E-09	-	-	1.72E-08	NA	NA	NA	0.00E+00	1.72E-08	0.00014%
DDE	2.44E-07	1.71E-08	-	-	2.61E-07	NA	NA	NA	0.00E+00	2.61E-07	0.0021%
DDT	1.21E-07	2.55E-08	2.55E-15	-	1.47E-07	NA	NA	NA	0.00E+00	1.47E-07	0.0012%
Aroclor-1260	4.67E-07	4.58E-07	9.78E-15	-	9.24E-07	NA	NA	NA	0.00E+00	9.24E-07	0.0075%
Aluminum	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Antimony	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	**7.87E-06**	**1.65E-06**	1.66E-12	-	**9.53E-06**	**6.78E-05**	**3.70E-06**	-	**7.15E-05**	**8.11E-05**	0.66%
Cadmium	-	-	1.69E-12	-	1.69E-12	NA	NA	NA	0.00E+00	1.69E-12	0.000000014%
Chromium	-	-	3.56E-10	-	3.56E-10	NA	NA	NA	0.00E+00	3.56E-10	0.0000029%
Copper	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Iron	-	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Nickel	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Vanadium	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Zinc	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Total:	**2.96E-05**	**2.11E-05**	3.60E-10	**6.52E-03**	**6.57E-03**	**1.66E-04**	**5.26E-03**	**3.26E-04**	**5.75E-03**	**1.23E-02**	100.00%

Table 6-60
Summary of Risks to Residential Children
Central and Southern AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Residential Children										
	Soil					Groundwater					
COPC	**Ingestion of Soil**	**Dermal Contact with Soil**	**Inhalation of Dust**	**Inhalation of Indoor Vapor**	**Subtotal - Soil**	**Ingestion of Groundwater**	**Dermal Contact with Groundwater**	**Inhalation of Indoor Vapors from Groundwater**	**Subtotal - Groundwater**	**Total HI**	**Percent Contribution to Total**
Benzene	5.91E-04	4.14E-05	2.03E-08	**9.32E+01**	**9.32E+01**	5.91E-02	6.84E-03	6.66E-02	1.33E-01	**9.34E+01**	72.67%
1,2-Dichloroethane	-	-	3.26E-10	6.12E-01	6.12E-01	-	-	6.27E-04	6.27E-04	6.13E-01	0.48%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	3.32E-01	2.23E-02	-	3.54E-01	3.54E-01	0.28%
Ethylbenzene	1.65E-04	1.16E-05	4.67E-09	**5.43E+00**	**5.43E+00**	2.89E-01	9.85E-02	2.79E-01	**6.66E-01**	**6.09E+00**	4.74%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	3.89E-02	2.37E-02	-	6.26E-02	6.26E-02	0.049%
Tetrachloroethene	1.75E-05	1.23E-06	1.67E-10	9.51E-01	9.51E-01	7.31E-02	1.67E-02	5.66E-02	1.46E-01	**1.10E+00**	0.85%
Toluene	NA	NA	NA	NA	0.00E+00	**1.23E+00**	3.28E-01	**1.80E-01**	**1.74E+00**	**1.74E+00**	1.36%
Trichloroethene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	1.28E-05	8.95E-07	9.40E-09	**9.88E+00**	**9.88E+00**	6.28E-02	2.18E-02	**1.55E+00**	**1.64E+00**	**1.15E+01**	8.96%
o-Xylene	NA	NA	NA	NA	0.00E+00	2.25E-02	1.06E-02	4.11E-01	4.44E-01	4.44E-01	0.35%
Xylene (total)	1.81E-04	1.27E-05	9.31E-08	-	1.94E-04	8.52E-01	4.00E-01	-	**1.25E+00**	1.25E+00	0.97%
Benzo(a)anthracene	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(a)pyrene	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(b)fluoranthene	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(k)fluoranthene	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Chrysene	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Dibenz(a,h)anthracene	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	5.39E-01	3.36E-01	-	8.75E-01	8.75E-01	0.68%
Naphthalene	NA	NA	NA	NA	0.00E+00	2.75E-01	9.01E-02	7.03E-01	1.07E+00	1.07E+00	0.83%
Gamma-Chlordane	8.85E-04	2.48E-04	1.63E-07	-	1.13E-03	NA	NA	NA	0.00E+00	1.13E-03	0.00088%
DDD	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
DDE	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
DDT	8.34E-03	1.75E-03	-	-	1.01E-02	NA	NA	NA	0.00E+00	1.01E-02	0.0078%
Aroclor-1260	1.36E-01	1.33E-01	-	-	2.70E-01	NA	NA	NA	0.00E+00	2.70E-01	0.21%
Aluminum	3.77E-01	2.64E-03	1.94E-02	-	3.99E-01	NA	NA	NA	0.00E+00	3.99E-01	0.31%
Antimony	8.24E-01	5.77E-03	-	-	8.30E-01	NA	NA	NA	0.00E+00	8.30E-01	0.65%
Arsenic	2.04E-01	4.29E-02	5.25E-04	-	2.47E-01	**1.76E+00**	1.16E-02	-	**1.77E+00**	**2.02E+00**	1.57%
Cadmium	2.98E-01	2.09E-03	-	-	3.00E-01	NA	NA	NA	0.00E+00	3.00E-01	0.23%
Chromium	**1.57E+00**	1.10E-02	1.15E-02	-	**1.59E+00**	NA	NA	NA	0.00E+00	**1.59E+00**	1.24%
Copper	**1.12E+00**	7.81E-03	-	-	**1.12E+00**	NA	NA	NA	0.00E+00	**1.12E+00**	0.87%
Iron	3.47E-01	2.43E-03	-	-	3.50E-01	**2.09E+00**	1.38E-02	-	**2.10E+00**	**2.45E+00**	1.91%
Manganese	NA	NA	NA	NA	0.00E+00	5.64E-01	9.31E-02	-	6.58E-01	6.58E-01	0.51%
Mercury	2.58E-02	1.80E-04	-	-	**2.60E-02**	3.20E-02	4.22E-04	-	3.24E-02	5.83E-02	0.045%
Nickel	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	5.27E-02	3.69E-04	-	-	5.31E-02	NA	NA	NA	0.00E+00	5.31E-02	0.041%
Vanadium	5.97E-02	4.18E-04	-	-	6.02E-02	NA	NA	NA	0.00E+00	6.02E-02	0.047%
Zinc	1.82E-01	1.28E-03	-	-	1.84E-01	NA	NA	NA	0.00E+00	1.84E-01	0.14%
Total:	**5.20E+00**	2.12E-01	3.15E-02	**1.10E+02**	**1.16E+02**	**8.22E+00**	**1.47E+00**	**3.25E+00**	**1.29E+01**	**1.28E+02**	100.00%

Table 6-61
Summary of Lifetime Risks -
Residential Children and Adults
Central and Southern AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Lifetime Residential											
	Soil					Groundwater						
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Inhalation of Indoor Vapor from Soil	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Vapors During Showering	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total Cancer Risk	Percent Contribution to Total
Benzene	1.59E-08	9.71E-10	3.49E-13	**3.47E-03**	**3.47E-03**	**3.03E-06**	7.49E-07	**1.11E-06**	**5.00E-06**	**9.88E-06**	**3.48E-03**	18.77%
1,2-Dichloroethane	3.39E-08	2.07E-09	1.50E-12	**6.08E-03**	**6.08E-03**	**1.91E-05**	**4.16E-06**	**1.43E-06**	**6.23E-06**	**3.09E-05**	**6.11E-03**	32.94%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	**7.03E-05**	**9.37E-05**	**1.63E-06**	**7.69E-05**	**2.43E-04**	**2.43E-04**	1.31%
Ethylbenzene	2.45E-08	1.49E-09	8.58E-13	**2.16E-03**	**2.16E-03**	**8.12E-05**	**5.10E-03**	1.94E-07	**1.40E-04**	**5.32E-03**	**7.48E-03**	40.30%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Tetrachloroethene	1.16E-08	7.06E-10	1.99E-14	**2.45E-04**	**2.45E-04**	**9.19E-05**	**1.06E-04**	**7.84E-06**	**3.75E-04**	**5.81E-04**	**8.27E-04**	4.45%
Toluene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Trichloroethene	NA	NA	NA	NA	0.00E+00	6.48E-07	1.13E-07	2.09E-07	**1.75E-06**	**2.72E-06**	**2.72E-06**	0.015%
m,p-Xylene	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Benzo(a)anthracene	**1.03E-06**	8.20E-07	2.44E-11	-	**1.85E-06**	NA	NA	NA	NA	0.00E+00	**1.85E-06**	0.010%
Benzo(a)pyrene	**2.18E-05**	**1.73E-05**	5.15E-10	-	**3.91E-05**	NA	NA	NA	NA	0.00E+00	**3.91E-05**	0.21%
Benzo(b)fluoranthene	**1.59E-06**	**1.26E-06**	3.75E-11	1.52E-04	**1.55E-04**	NA	NA	NA	NA	0.00E+00	**1.55E-04**	0.84%
Benzo(k)fluoranthene	1.18E-07	9.33E-08	2.78E-11	-	2.11E-07	NA	NA	NA	NA	0.00E+00	2.11E-07	0.0011%
Chrysene	1.63E-08	1.29E-08	3.85E-12	3.09E-08	6.02E-08	NA	NA	NA	NA	0.00E+00	6.02E-08	0.00032%
Dibenz(a,h)anthracene	**4.43E-06**	**3.51E-06**	1.10E-10	-	**7.95E-06**	NA	NA	NA	NA	0.00E+00	**7.95E-06**	0.043%
Indeno(1,2,3-cd)pyrene	7.05E-07	5.59E-07	1.66E-11	-	**1.26E-06**	NA	NA	NA	NA	0.00E+00	**1.26E-06**	0.0068%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Naphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Gamma-Chlordane	1.90E-08	4.62E-09	8.37E-13	-	2.36E-08	NA	NA	NA	NA	0.00E+00	2.36E-08	0.00013%
DDD	2.30E-08	1.40E-09	-	-	2.44E-08	NA	NA	NA	NA	0.00E+00	2.44E-08	0.00013%
DDE	3.48E-07	2.12E-08	-	-	3.69E-07	NA	NA	NA	NA	0.00E+00	3.69E-07	0.0020%
DDT	1.74E-07	3.17E-08	7.66E-12	-	2.05E-07	NA	NA	NA	NA	0.00E+00	2.05E-07	0.0011%
Aroclor-1260	6.67E-07	5.69E-07	2.94E-11	-	**1.24E-06**	NA	NA	NA	NA	0.00E+00	**1.24E-06**	0.0067%
Aluminum	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Antimony	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	**1.12E-05**	**2.06E-06**	5.00E-09	-	**1.33E-05**	**1.84E-04**	**4.31E-06**	-	-	**1.88E-04**	**2.02E-04**	1.09%
Cadmium	-	-	1.21E-08	-	1.21E-08	NA	NA	NA	NA	0.00E+00	1.21E-08	0.000065%
Chromium	-	-	**1.07E-06**	-	**1.07E-06**	NA	NA	NA	NA	0.00E+00	**1.07E-06**	0.0058%
Copper	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Iron	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Nickel	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Vanadium	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Zinc					0.00E+00					0.00E+00	0.00E+00	0.00%
Total:	**4.23E-05**	**2.63E-05**	**1.09E-06**	**1.21E-02**	**1.22E-02**	**4.50E-04**	**5.31E-03**	**1.24E-05**	**6.05E-04**	**6.37E-03**	**1.86E-02**	100.00%

Table 6-61
Summary of Lifetime Risks -
Residential Children and Adults
Central and Southern AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Lifetime Residential											
	Soil					Groundwater						
COPC	**Ingestion of Soil**	**Dermal Contact with Soil**	**Inhalation of Dust**	**Inhalation of Indoor Vapor**	**Subtotal - Soil**	**Ingestion of Groundwater**	**Dermal Contact with Groundwater**	**Inhalation of Vapors During Showering**	**Inhalation of Indoor Vapors from Groundwater**	**Subtotal - Groundwater**	**Total HI**	**Percent Contribution to Total**
Benzene	5.91E-04	4.14E-05	2.03E-08	**9.32E+01**	**9.32E+01**	8.45E-02	1.04E-02	6.84E-03	8.09E-02	1.83E-01	**9.34E+01**	69.99%
1,2-Dichloroethane	-	-	3.26E-10	6.12E-01	6.12E-01	-	-	6.66E-05	-	6.66E-05	6.12E-01	0.46%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	4.74E-01	3.27E-02	-	-	5.07E-01	5.07E-01	0.38%
Ethylbenzene	1.65E-04	1.16E-05	4.67E-09	**5.43E+00**	**5.43E+00**	4.12E-01	1.56E-01	1.80E-04	3.39E-01	9.07E-01	**6.33E+00**	4.74%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	5.56E-02	3.76E-02	-	-	9.32E-02	9.32E-02	0.070%
Tetrachloroethene	1.75E-05	1.23E-06	1.67E-10	9.51E-01	9.51E-01	1.04E-01	2.65E-02	5.49E-04	6.87E-02	2.00E-01	**1.15E+00**	0.86%
Toluene	NA	NA	NA	NA	0.00E+00	**1.76E+00**	4.84E-01	3.83E-05	2.19E-01	**2.47E+00**	**2.47E+00**	1.85%
Trichloroethene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	1.28E-05	8.95E-07	9.40E-09	**9.88E+00**	**9.88E+00**	8.97E-02	3.45E-02	2.56E-04	1.88E+00	**2.01E+00**	**1.19E+01**	8.90%
o-Xylene	NA	NA	NA	NA	0.00E+00	3.21E-02	1.50E-02	2.56E-04	4.99E-01	5.46E-01	5.46E-01	0.41%
Xylene (total)	1.81E-04	1.27E-05	9.31E-08	-	1.94E-04	1.22E+00	5.68E-01	1.79E-03	-	**1.79E+00**	**1.79E+00**	1.34%
Benzo(a)anthracene	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(a)pyrene	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(b)fluoranthene	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(k)fluoranthene	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Chrysene	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Dibenz(a,h)anthracene	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	7.70E-01	5.32E-01	-	-	**1.30E+00**	**1.30E+00**	0.98%
Naphthalene	NA	NA	NA	NA	0.00E+00	3.93E-01	1.43E-01	3.69E-02	8.53E-01	1.43E+00	1.43E+00	1.07%
Gamma-Chlordane	8.85E-04	2.48E-04	1.63E-07	-	1.13E-03	NA	NA	NA	NA	0.00E+00	1.13E-03	0.00085%
DDD	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
DDE	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
DDT	8.34E-03	1.75E-03	-	-	1.01E-02	NA	NA	NA	NA	0.00E+00	1.01E-02	0.0076%
Aroclor-1260	1.36E-01	1.33E-01	-	-	2.70E-01	NA	NA	NA	NA	0.00E+00	2.70E-01	0.20%
Aluminum	3.77E-01	2.64E-03	1.94E-02	-	3.99E-01	NA	NA	NA	NA	0.00E+00	3.99E-01	0.30%
Antimony	8.24E-01	5.77E-03	-	-	8.30E-01	NA	NA	NA	NA	0.00E+00	8.30E-01	0.62%
Arsenic	2.04E-01	4.29E-02	5.25E-04	-	2.47E-01	**2.51E+00**	1.56E-02	-	-	**2.53E+00**	**2.78E+00**	2.08%
Cadmium	2.98E-01	2.09E-03	-	-	3.00E-01	NA	NA	NA	NA	0.00E+00	3.00E-01	0.22%
Chromium	**1.57E+00**	1.10E-02	1.15E-02	-	**1.59E+00**	NA	NA	NA	NA	0.00E+00	**1.59E+00**	1.19%
Copper	**1.12E+00**	7.81E-03	-	-	**1.12E+00**	NA	NA	NA	NA	0.00E+00	**1.12E+00**	0.84%
Iron	3.47E-01	2.43E-03	-	-	3.50E-01	**2.98E+00**	1.85E-02	-	-	**3.00E+00**	**3.35E+00**	2.51%
Manganese	NA	NA	NA	NA	0.00E+00	8.06E-01	1.25E-01	-	-	9.31E-01	9.31E-01	0.70%
Mercury	2.58E-02	1.80E-04	-	-	2.60E-02	4.57E-02	4.94E-04	-	-	4.62E-02	7.21E-02	0.054%
Nickel	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	5.27E-02	3.69E-04	-	-	5.31E-02	NA	NA	NA	NA	0.00E+00	5.31E-02	0.040%
Vanadium	5.97E-02	4.18E-04	-	-	6.02E-02	NA	NA	NA	NA	0.00E+00	6.02E-02	0.045%
Zinc	1.82E-01	1.28E-03	-	-	1.84E-01	NA	NA	NA	NA	0.00E+00	1.84E-01	0.14%
Total:	**5.20E+00**	2.12E-01	3.15E-02	**1.10E+02**	**1.16E+02**	**1.17E+01**	**2.20E+00**	4.69E-02	**3.94E+00**	**1.79E+01**	**1.33E+02**	100.00%

Table 6-62
Summary of Risks to Site Trespassers (Youths)
Central and Southern ACOs
CDL - Wallops Flight Facility

	Cancer Risk - Site Trespassers											
	Soil				Sediment			Surface Water				
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Ingestion of Sediment	Dermal Contact with Sediment	Subtotal - Sediment	Ingestion of Surface Water	Dermal Contact with Surface Water	Subtotal - Surface Water	Total Cancer Risk	Percent Contribution to Total
Benzene	9.56E-11	1.64E-12	6.28E-15	9.72E-11	NA	NA	0.00E+00	NA	NA	0.00E+00	9.72E-11	0.013%
1,2-Dichloroethane	2.03E-10	3.50E-12	2.69E-14	2.07E-10	NA	NA	0.00E+00	NA	NA	0.00E+00	2.07E-10	0.029%
Ethylbenzene	1.47E-10	2.52E-12	1.54E-14	1.49E-10	NA	NA	0.00E+00	NA	NA	0.00E+00	1.49E-10	0.021%
Methylene chloride	NA	NA	NA	0.00E+00	7.95E-13	1.22E-13	9.18E-13	NA	NA	0.00E+00	9.18E-13	0.00013%
bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.00E+00	2.13E-08	4.03E-08	6.16E-08	NA	NA	0.00E+00	6.16E-08	8.50%
Tetrachloroethene	6.95E-11	1.20E-12	3.58E-16	7.07E-11	NA	NA	0.00E+00	NA	NA	0.00E+00	7.07E-11	0.010%
m,p-Xylene	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Xylene (total)	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(a)anthracene	6.21E-09	1.39E-09	4.39E-13	7.59E-09	NA	NA	0.00E+00	NA	NA	0.00E+00	7.59E-09	1.05%
Benzo(a)pyrene	1.31E-07	2.93E-08	9.26E-12	1.60E-07	NA	NA	0.00E+00	NA	NA	0.00E+00	1.60E-07	22.13%
Benzo(b)fluoranthene	9.53E-09	2.13E-09	6.74E-13	1.17E-08	NA	NA	0.00E+00	NA	NA	0.00E+00	1.17E-08	1.61%
Benzo(k)fluoranthene	7.06E-10	1.58E-10	4.99E-13	8.65E-10	NA	NA	0.00E+00	NA	NA	0.00E+00	8.65E-10	0.12%
Chrysene	9.79E-11	2.19E-11	6.92E-14	1.20E-10	NA	NA	0.00E+00	NA	NA	0.00E+00	1.20E-10	0.017%
Dibenz(a,h)anthracene	2.66E-08	5.95E-09	1.98E-12	3.26E-08	NA	NA	0.00E+00	NA	NA	0.00E+00	3.26E-08	4.50%
Indeno(1,2,3-cd)pyrene	4.23E-09	9.46E-10	2.99E-13	5.18E-09	NA	NA	0.00E+00	NA	NA	0.00E+00	5.18E-09	0.71%
Gamma-Chlordane	1.14E-10	7.83E-12	1.51E-14	1.22E-10	NA	NA	0.00E+00	NA	NA	0.00E+00	1.22E-10	0.017%
DDD	1.38E-10	2.37E-12	-	1.40E-10	NA	NA	0.00E+00	NA	NA	0.00E+00	1.40E-10	0.019%
DDE	2.09E-09	3.59E-11	-	2.12E-09	4.76E-10	8.99E-11	5.66E-10	NA	NA	0.00E+00	2.69E-09	0.37%
DDT	1.04E-09	5.37E-11	1.38E-13	1.10E-09	NA	NA	0.00E+00	NA	NA	0.00E+00	1.10E-09	0.15%
Aroclor-1260	4.00E-09	9.64E-10	5.30E-13	4.97E-09	NA	NA	0.00E+00	NA	NA	0.00E+00	4.97E-09	0.69%
Aluminum	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Antimony	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	6.75E-08	3.48E-09	8.99E-11	7.10E-08	1.97E-07	1.12E-07	3.09E-07	1.56E-08	1.97E-08	3.53E-08	4.15E-07	57.35%
Cadmium	-	-	2.17E-10	2.17E-10	NA	NA	0.00E+00	NA	NA	0.00E+00	2.17E-10	0.030%
Chromium	-	-	1.92E-08	1.92E-08	NA	NA	0.00E+00	NA	NA	0.00E+00	1.92E-08	2.66%
Copper	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Iron	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	0.00E+00	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Nickel	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Vanadium	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Zinc	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Total:	2.54E-07	4.44E-08	1.96E-08	3.18E-07	2.19E-07	1.52E-07	3.71E-07	1.56E-08	1.97E-08	3.53E-08	7.24E-07	100.00%

Table 6-62
Summary of Risks to Site Trespassers (Youths)
Central and Southern ACOs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Site Trespassers											
	Soil				Sediment			Surface Water				
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Ingestion of Sediment	Dermal Contact with Sediment	Subtotal - Sediment	Ingestion of Surface Water	Dermal Contact with Surface Water	Subtotal - Surface Water	Total HI	Percent Contribution to Total
Benzene	5.07E-06	8.72E-08	3.13E-10	5.16E-06	NA	NA	0.00E+00	NA	NA	0.00E+00	5.16E-06	0.0090%
1,2-Dichloroethane	-	-	5.03E-12	5.03E-12	NA	NA	0.00E+00	NA	NA	0.00E+00	5.03E-12	0.0000000088%
Ethylbenzene	1.41E-06	2.43E-08	7.21E-11	1.44E-06	NA	NA	0.00E+00	NA	NA	0.00E+00	1.44E-06	0.0025%
Methylene chloride	NA	NA	NA	0.00E+00	1.68E-08	3.18E-09	2.00E-08	NA	NA	0.00E+00	2.00E-08	0.000035%
bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.00E+00	8.88E-04	1.68E-03	2.57E-03	NA	NA	0.00E+00	2.57E-03	4.50%
Tetrachloroethene	1.50E-07	2.58E-09	2.58E-12	1.53E-07	NA	NA	0.00E+00	NA	NA	0.00E+00	1.53E-07	0.00027%
m,p-Xylene	1.10E-07	1.88E-09	1.45E-10	1.12E-07	NA	NA	0.00E+00	NA	NA	0.00E+00	1.12E-07	0.00020%
Xylene (total)	1.55E-06	2.67E-08	1.44E-09	1.58E-06	NA	NA	0.00E+00	NA	NA	0.00E+00	1.58E-06	0.0028%
Benzo(a)anthracene	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(a)pyrene	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(b)fluoranthene	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Benzo(k)fluoranthene	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Chrysene	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Dibenz(a,h)anthracene	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Indeno(1,2,3-cd)pyrene	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Gamma-Chlordane	7.58E-06	5.22E-07	2.51E-09	8.11E-06	NA	NA	0.00E+00	NA	NA	0.00E+00	8.11E-06	0.014%
DDD	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
DDE	-	-	-	0.00E+00	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
DDT	7.15E-05	3.69E-06	-	7.51E-05	NA	NA	0.00E+00	NA	NA	0.00E+00	7.51E-05	0.13%
Aroclor-1260	1.17E-03	2.81E-04	-	1.45E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	1.45E-03	2.54%
Aluminum	3.23E-03	5.56E-06	2.99E-04	3.54E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	3.54E-03	6.20%
Antimony	7.07E-03	1.22E-05	-	7.08E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	7.08E-03	12.41%
Arsenic	1.75E-03	9.03E-05	8.10E-06	1.85E-03	5.11E-03	2.90E-03	8.01E-03	4.05E-04	5.11E-04	9.16E-04	1.08E-02	18.89%
Cadmium	2.55E-03	4.39E-06	-	2.56E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	2.56E-03	4.49%
Chromium	1.35E-02	2.32E-05	1.78E-04	1.37E-02	NA	NA	0.00E+00	NA	NA	0.00E+00	1.37E-02	23.96%
Copper	9.56E-03	1.64E-05	-	9.58E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	9.58E-03	16.79%
Iron	2.98E-03	5.12E-06	-	2.98E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	2.98E-03	5.23%
Mercury	2.21E-04	3.80E-07	-	2.21E-04	-	-	0.00E+00	-	-	0.00E+00	2.21E-04	0.39%
Nickel	-	-	-	0.00E+00	NA	NA	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Silver	4.52E-04	7.77E-07	-	4.53E-04	NA	NA	0.00E+00	NA	NA	0.00E+00	4.53E-04	0.79%
Vanadium	5.12E-04	8.81E-07	-	5.13E-04	NA	NA	0.00E+00	NA	NA	0.00E+00	5.13E-04	0.90%
Zinc	1.56E-03	2.69E-06	-	1.57E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	1.57E-03	2.75%
Total:	4.46E-02	4.47E-04	4.86E-04	4.55E-02	6.00E-03	4.58E-03	1.06E-02	4.05E-04	5.11E-04	9.16E-04	5.70E-02	100.00%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.

"-" - There is no toxicity data for this COPC, so no risk can be calculated.

Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-63
Summary of Risks to Site Workers
Northern and Western AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Site Workers					
	Soil					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Total Cancer Risk	Percent Contribution to Total
Aluminum	-	-	-	-	0.00E+00	0.00%
Arsenic	**2.22E-06**	**4.39E-07**	3.28E-09	**2.66E-06**	**2.66E-06**	100.00%
Iron	-	-	-	-	0.00E+00	0.00%
Mercury	-	-	-	-	0.00E+00	0.00%
Total:	**2.22E-06**	**4.39E-07**	3.28E-09	**2.66E-06**	**2.66E-06**	100.0%

	Hazard Index (HI) - Site Workers					
	Soil					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Total HI	Percent Contribution to Total
Aluminum	9.07E-03	5.99E-05	9.34E-04	1.01E-02	1.01E-02	26.39%
Arsenic	1.38E-02	2.73E-03	7.10E-05	1.66E-02	1.66E-02	43.53%
Iron	1.12E-02	7.37E-05	-	1.12E-02	1.12E-02	29.49%
Mercury	2.26E-04	1.49E-06	1.16E-07	2.28E-04	2.28E-04	0.60%
Total:	3.43E-02	2.87E-03	1.00E-03	3.81E-02	3.81E-02	100.0%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.
"-" - There is no toxicity data for this COPC, so no risk can be calculated.
Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-64
Summary of Risks to Commerical Workers
Northern and Western AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Commercial Workers							
	Soil			Groundwater				
COPC	Ingestion of Soil	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total Cancer Risk	Percent Contribution to Total
Benzene	NA	NA	0.00E+00	**1.42E-06**	5.72E-07	**1.99E-06**	**1.99E-06**	0.71%
1,2-Dichloroethane	NA	NA	0.00E+00	**8.95E-06**	7.13E-07	**9.67E-06**	**9.67E-06**	3.43%
cis-1,2-Dichloroethene	NA	NA	0.00E+00	**3.30E-05**	**8.80E-06**	**4.18E-05**	**4.18E-05**	14.85%
Ethylbenzene	NA	NA	0.00E+00	**3.82E-05**	**1.60E-05**	**5.42E-05**	**5.42E-05**	19.22%
Isopropylbenzene	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00%
Tetrachloroethene	NA	NA	0.00E+00	**4.32E-05**	**4.29E-05**	**8.61E-05**	**8.61E-05**	30.57%
Toluene	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00%
Trichloroethene	NA	NA	0.00E+00	3.04E-07	2.00E-07	5.04E-07	5.04E-07	0.18%
m,p-Xylene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Naphthalene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Aluminum	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	9.35E-07	-	9.35E-07	**8.65E-05**	-	**8.65E-05**	**8.75E-05**	31.04%
Iron	-	-	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Total:	9.35E-07	0.00E+00	9.35E-07	**2.12E-04**	**6.92E-05**	**2.81E-04**	**2.82E-04**	100.00%

Table 6-64
Summary of Risks to Commerical Workers
Northern and Western AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Commercial Workers							
	Soil			Groundwater				
COPC	Ingestion of Soil	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total HI	Percent Contribution to Total
Benzene	NA	NA	0.00E+00	1.81E-02	3.40E-03	2.15E-02	2.15E-02	0.80%
1,2-Dichloroethane	NA	NA	0.00E+00	-	3.20E-05	3.20E-05	3.20E-05	0.0012%
cis-1,2-Dichloroethene	NA	NA	0.00E+00	1.02E-01	-	1.02E-01	1.02E-01	3.76%
Ethylbenzene	NA	NA	0.00E+00	8.83E-02	1.42E-02	1.03E-01	1.03E-01	3.80%
Isopropylbenzene	NA	NA	0.00E+00	1.19E-02	-	1.19E-02	1.19E-02	0.44%
Tetrachloroethene	NA	NA	0.00E+00	2.24E-02	2.89E-03	2.53E-02	2.53E-02	0.94%
Toluene	NA	NA	0.00E+00	3.78E-01	9.19E-03	3.87E-01	3.87E-01	14.32%
Trichloroethene	NA	NA	0.00E+00	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	NA	NA	0.00E+00	1.92E-02	7.91E-02	9.84E-02	9.84E-02	3.64%
o-Xylene	NA	NA	0.00E+00	6.88E-03	2.10E-02	2.78E-02	2.78E-02	1.03%
Xylene (total)	NA	NA	0.00E+00	2.61E-01	-	2.61E-01	2.61E-01	9.65%
2-Methylnaphthalene	NA	NA	0.00E+00	1.65E-01	-	1.65E-01	1.65E-01	6.11%
Naphthalene	NA	NA	0.00E+00	8.42E-02	3.59E-02	1.20E-01	1.20E-01	4.44%
Aluminum	6.45E-03	-	6.45E-03	NA	NA	0.00E+00	6.45E-03	0.24%
Arsenic	5.82E-03	-	5.82E-03	5.38E-01	-	5.38E-01	5.44E-01	20.14%
Iron	7.48E-03	-	7.48E-03	6.39E-01	-	6.39E-01	6.47E-01	23.94%
Manganese	NA	NA	0.00E+00	1.73E-01	-	1.73E-01	1.73E-01	6.39%
Mercury	9.90E-05	-	9.90E-05	9.78E-03	-	9.78E-03	9.88E-03	0.37%
Total:	1.99E-02	0.00E+00	1.99E-02	**2.52E+00**	1.66E-01	**2.68E+00**	**2.70E+00**	100.00%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.
"-" - There is no toxicity data for this COPC, so no risk can be calculated.
Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-65
Summary of Risks to Construction Workers
Northern and Western AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Construction Workers									
	Soil				Groundwater					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Outdoor Vapor in Trench	Subtotal - Groundwater	Total Cancer Risk	Percent Contribution to Total
Benzene	NA	NA	NA	0.00E+00	1.37E-10	3.95E-10	**1.28E-06**	**1.28E-06**	**1.28E-06**	1.40%
1,2-Dichloroethane	NA	NA	NA	0.00E+00	8.60E-10	8.00E-10	**6.81E-06**	**6.81E-06**	**6.81E-06**	7.46%
cis-1,2-Dichloroethene	NA	NA	NA	0.00E+00	3.17E-09	5.33E-09	**2.65E-05**	**2.65E-05**	**2.65E-05**	29.06%
Ethylbenzene	NA	NA	NA	0.00E+00	3.67E-09	4.41E-08	**2.95E-05**	**2.95E-05**	**2.95E-05**	32.36%
Isopropylbenzene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Tetrachloroethene	NA	NA	NA	0.00E+00	4.14E-09	2.36E-08	**2.68E-05**	**2.68E-05**	**2.68E-05**	29.40%
Toluene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Trichloroethene	NA	NA	NA	0.00E+00	2.92E-11	1.04E-10	2.12E-07	2.12E-07	2.12E-07	0.23%
m,p-Xylene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Naphthalene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Aluminum	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	5.93E-08	5.33E-09	2.66E-11	6.46E-08	8.31E-09	5.48E-09	-	1.38E-08	7.84E-08	0.086%
Iron	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Total:	5.93E-08	5.33E-09	2.66E-11	6.46E-08	2.03E-08	7.98E-08	**9.11E-05**	**9.12E-05**	**9.13E-05**	100.00%

Table 6-65
Summary of Risks to Construction Workers
Northern and Western AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Construction Workers									
	Soil				Groundwater					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Outdoor Vapor in Trench	Subtotal - Groundwater	Total HI	Percent Contribution to Total
Benzene	NA	NA	NA	0.00E+00	8.69E-05	2.51E-04	3.79E-01	3.79E-01	3.79E-01	0.26%
1,2-Dichloroethane	NA	NA	NA	0.00E+00	-	-	1.53E-02	1.53E-02	1.53E-02	0.011%
cis-1,2-Dichloroethene	NA	NA	NA	0.00E+00	4.88E-04	8.20E-04	-	1.31E-03	1.31E-03	0.00090%
Ethylbenzene	NA	NA	NA	0.00E+00	4.24E-04	5.11E-03	**1.31E+00**	**1.32E+00**	**1.32E+00**	0.91%
Isopropylbenzene	NA	NA	NA	0.00E+00	5.71E-05	1.45E-03	-	1.51E-03	1.51E-03	0.0010%
Tetrachloroethene	NA	NA	NA	0.00E+00	1.07E-04	6.12E-04	9.01E-02	9.08E-02	9.08E-02	0.062%
Toluene	NA	NA	NA	0.00E+00	1.81E-03	1.21E-02	8.75E-01	8.89E-01	8.89E-01	0.61%
Trichloroethene	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	NA	NA	NA	0.00E+00	9.22E-05	8.00E-04	7.42E+00	**7.42E+00**	**7.42E+00**	5.10%
o-Xylene	NA	NA	NA	0.00E+00	3.30E-05	3.88E-04	2.65E+00	**2.65E+00**	**2.65E+00**	1.82%
Xylene (total)	NA	NA	NA	0.00E+00	1.25E-03	1.47E-02	**7.03E+01**	**7.03E+01**	**7.03E+01**	48.32%
2-Methylnaphthalene	NA	NA	NA	0.00E+00	7.92E-04	2.59E-02	-	2.67E-02	2.67E-02	0.018%
Naphthalene	NA	NA	NA	0.00E+00	4.04E-04	5.72E-03	**6.23E+01**	**6.23E+01**	**6.23E+01**	42.82%
Aluminum	2.04E-02	6.13E-05	6.38E-04	2.11E-02	NA	NA	NA	0.00E+00	2.11E-02	0.015%
Arsenic	1.84E-02	1.66E-03	2.88E-05	2.01E-02	2.58E-03	1.71E-03	-	4.29E-03	2.44E-02	0.017%
Iron	2.37E-02	7.11E-05	-	2.38E-02	3.07E-03	2.03E-03	-	5.09E-03	2.89E-02	0.020%
Manganese	NA	NA	NA	0.00E+00	8.29E-04	1.37E-02	-	1.45E-02	1.45E-02	0.010%
Mercury	3.14E-04	9.41E-07	-	3.15E-04	4.70E-05	3.87E-05	-	8.57E-05	4.00E-04	0.00%
Total:	6.29E-02	1.79E-03	6.67E-04	6.54E-02	1.21E-02	8.53E-02	**1.45E+02**	**1.45E+02**	**1.45E+02**	100.00%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.

"-" - There is no toxicity data for this COPC, so no risk can be calculated.

Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-66
Summary of Risks to Adult Residents
Northern and Western AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Adult Residents												
	Soil					Groundwater							
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Vapors During Showering	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total Cancer Risk	Percent Contribution to Total
Benzene	NA	NA	NA	NA	0.00E+00	**1.91E-06**	2.72E-07	**1.11E-06**	**2.31E-06**	**5.60E-06**	**5.60E-06**	0.89%
1,2-Dichloroethane	NA	NA	NA	NA	0.00E+00	**1.20E-05**	4.80E-07	**1.43E-06**	**2.87E-06**	**1.68E-05**	**1.68E-05**	2.69%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	**4.44E-05**	**3.25E-06**	**1.63E-06**	**3.55E-05**	**8.48E-05**	**8.48E-05**	13.56%
Ethylbenzene	NA	NA	NA	NA	0.00E+00	**5.13E-05**	**2.39E-05**	1.94E-07	**6.44E-05**	**1.40E-04**	**1.40E-04**	22.35%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
Tetrachloroethene	NA	NA	NA	NA	0.00E+00	**5.80E-05**	**1.82E-05**	**7.84E-06**	**1.73E-04**	**2.57E-04**	**2.57E-04**	41.13%
Toluene	NA	NA	NA	NA	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
Trichloroethene	NA	NA	NA	NA	0.00E+00	4.09E-07	4.66E-08	2.09E-07	8.07E-07	**1.47E-06**	**1.47E-06**	0.24%
m,p-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
o-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
Xylene (total)	NA	NA	NA	NA	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
Naphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
Aluminum	-	-	-	-	0.00E+00	NA	NA	NA	NA	NA	0.00E+00	0.00%
Arsenic	**2.51E-06**	3.01E-07	3.72E-09	0.00E+00	**2.82E-06**	**1.16E-04**	6.11E-07	-	-	**1.17E-04**	**1.20E-04**	19.14%
Iron	-	-	-	-	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
Manganese	NA	NA	NA	NA	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
Mercury	-	-	-	-	0.00E+00	-	-	-	-	-	0.00E+00	0.00%
Total:	**2.51E-06**	3.01E-07	3.72E-09	0.00E+00	**2.82E-06**	**2.84E-04**	**4.67E-05**	**1.24E-05**	**2.79E-04**	**6.23E-04**	**6.25E-04**	100.0%

Table 6-66
Summary of Risks to Adult Residents
Northern and Western AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Adult Residents											
	Soil					Groundwater						
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Vapors During Showering	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total HI	Percent Contribution to Total
Benzene	NA	NA	NA	NA	0.00E+00	2.53E-02	3.61E-03	6.84E-03	1.43E-02	5.01E-02	5.01E-02	2.02%
1,2-Dichloroethane	NA	NA	NA	NA	0.00E+00	-	-	6.66E-05	1.34E-04	2.01E-04	2.01E-04	0.0081%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	1.42E-01	1.04E-02	-	-	2.72E-05	2.72E-05	0.0011%
Ethylbenzene	NA	NA	NA	NA	0.00E+00	1.24E-01	5.76E-02	1.80E-04	5.98E-02	4.08E-03	4.08E-03	0.16%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	1.67E-02	1.39E-02	-	-	5.86E-04	5.86E-04	0.024%
Tetrachloroethene	NA	NA	NA	NA	0.00E+00	3.13E-02	9.83E-03	5.49E-04	1.21E-02	1.39E-05	1.39E-05	0.00056%
Toluene	NA	NA	NA	NA	0.00E+00	5.29E-01	1.56E-01	3.83E-05	3.86E-02	8.79E-03	8.79E-03	0.36%
Trichloroethene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	NA	NA	NA	NA	0.00E+00	2.69E-02	1.27E-02	2.56E-04	3.32E-01	2.92E-01	2.92E-01	11.79%
o-Xylene	NA	NA	NA	NA	0.00E+00	9.64E-03	4.43E-03	2.56E-04	8.80E-02	9.16E-02	9.16E-02	3.70%
Xylene (total)	NA	NA	NA	NA	0.00E+00	3.65E-01	1.68E-01	1.79E-03	-	2.13E-02	2.13E-02	0.86%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	2.31E-01	1.96E-01	-	-	7.11E-06	7.11E-06	0.00029%
Naphthalene	NA	NA	NA	NA	0.00E+00	1.18E-01	5.26E-02	3.69E-02	1.51E-01	7.14E-05	7.14E-05	0.0029%
Aluminum	1.81E-02	7.21E-05	1.86E-03	-	2.00E-02	NA	NA	NA	NA	0.00E+00	2.00E-02	0.81%
Arsenic	1.63E-02	1.95E-03	8.39E-05	-	1.83E-02	7.54E-01	3.96E-03	-	-	7.58E-01	7.76E-01	31.38%
Iron	2.09E-02	8.36E-05	-	-	2.10E-02	8.95E-01	4.70E-03	-	-	9.00E-01	9.21E-01	37.24%
Manganese	NA	NA	NA	NA	0.00E+00	2.42E-01	3.17E-02	-	-	2.74E-01	2.74E-01	11.06%
Mercury	2.77E-04	1.11E-06	-	-	2.78E-04	1.37E-02	7.19E-05	-	-	1.38E-02	1.40E-02	0.57%
Total:	5.56E-02	2.11E-03	1.94E-03	0.00E+00	5.96E-02	**3.52E+00**	7.25E-01	4.69E-02	6.96E-01	**2.41E+00**	**2.47E+00**	100.00%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.

"-" - There is no toxicity data for this COPC, so no risk can be calculated.

Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-67
Summary of Risks to Child Residents
Northern and Western AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Child Residents										
	Soil					Groundwater					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total Cancer Risk	Percent Contribution to Total
Benzene	NA	NA	NA	NA	0.00E+00	**1.12E-06**	4.77E-07	**2.69E-06**	**4.28E-06**	**4.28E-06**	0.074%
1,2-Dichloroethane	NA	NA	NA	NA	0.00E+00	**7.02E-06**	**3.68E-06**	**3.35E-06**	**1.41E-05**	**1.41E-05**	0.24%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	**2.59E-05**	**9.05E-05**	**4.14E-05**	**1.58E-04**	**1.58E-04**	2.74%
Ethylbenzene	NA	NA	NA	NA	0.00E+00	**2.99E-05**	**5.07E-03**	**7.51E-05**	**5.18E-03**	**5.18E-03**	89.93%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Tetrachloroethene	NA	NA	NA	NA	0.00E+00	**3.38E-05**	**8.82E-05**	**2.02E-04**	**3.24E-04**	**3.24E-04**	5.63%
Toluene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Trichloroethene	NA	NA	NA	NA	0.00E+00	2.39E-07	6.68E-08	9.41E-07	**1.25E-06**	**1.25E-06**	0.022%
m,p-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Naphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Aluminum	-	-	-	-	0.00E+00	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	**5.87E-06**	**1.23E-06**	4.34E-09	0.00E+00	**7.10E-06**	**6.78E-05**	**3.70E-06**	-	**7.15E-05**	**7.86E-05**	1.37%
Iron	-	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	-	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
Total:	**5.87E-06**	**1.23E-06**	4.34E-09	0.00E+00	**7.10E-06**	**1.66E-04**	**5.26E-03**	**3.26E-04**	**5.75E-03**	**5.76E-03**	100.00%

Table 6-67
Summary of Risks to Child Residents
Northern and Western AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Child Residents										
	Soil					Groundwater					
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total HI	Percent Contribution to Total
Benzene	NA	NA	NA	NA	0.00E+00	5.91E-02	6.84E-03	6.66E-02	1.33E-01	1.33E-01	0.98%
1,2-Dichloroethane	NA	NA	NA	NA	0.00E+00	-	-	6.27E-04	6.27E-04	6.27E-04	0.0046%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	3.32E-01	2.23E-02	-	3.54E-01	3.54E-01	2.62%
Ethylbenzene	NA	NA	NA	NA	0.00E+00	2.89E-01	9.85E-02	2.79E-01	6.66E-01	6.66E-01	4.93%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	3.89E-02	2.37E-02	-	6.26E-02	6.26E-02	0.46%
Tetrachloroethene	NA	NA	NA	NA	0.00E+00	7.31E-02	1.67E-02	5.66E-02	1.46E-01	1.46E-01	1.08%
Toluene	NA	NA	NA	NA	0.00E+00	**1.23E+00**	3.28E-01	1.80E-01	**1.74E+00**	**1.74E+00**	12.90%
Trichloroethene	NA	NA	NA	NA	0.00E+00	-	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	NA	NA	NA	NA	0.00E+00	6.28E-02	2.18E-02	**1.55E+00**	**1.64E+00**	**1.64E+00**	12.11%
o-Xylene	NA	NA	NA	NA	0.00E+00	2.25E-02	1.06E-02	4.11E-01	4.44E-01	4.44E-01	3.29%
Xylene (total)	NA	NA	NA	NA	0.00E+00	8.52E-01	4.00E-01	-	**1.25E+00**	**1.25E+00**	9.27%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	5.39E-01	3.36E-01	-	8.75E-01	8.75E-01	6.48%
Naphthalene	NA	NA	NA	NA	0.00E+00	2.75E-01	9.01E-02	7.03E-01	**1.07E+00**	**1.07E+00**	7.91%
Aluminum	1.69E-01	1.18E-03	8.68E-03	-	1.79E-01	NA	NA	NA	0.00E+00	1.79E-01	1.32%
Arsenic	1.52E-01	3.19E-02	3.91E-04	-	1.84E-01	**1.76E+00**	1.16E-02	-	**1.77E+00**	**1.95E+00**	14.48%
Iron	1.96E-01	1.37E-03	-	-	1.97E-01	**2.09E+00**	1.38E-02	-	**2.10E+00**	**2.30E+00**	17.03%
Manganese	NA	NA	NA	NA	0.00E+00	5.64E-01	9.31E-02	-	6.58E-01	6.58E-01	4.87%
Mercury	2.59E-03	1.81E-05	-	-	2.61E-03	3.20E-02	4.22E-04	-	3.24E-02	3.50E-02	0.26%
Total:	5.19E-01	3.45E-02	9.07E-03	0.00E+00	5.62E-01	**8.22E+00**	**1.47E+00**	**3.25E+00**	**1.29E+01**	**1.35E+01**	100.00%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.
"-" - There is no toxicity data for this COPC, so no risk can be calculated.
Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-68
Summary of Lifetime Risks -
Residential Children and Adults
Northern and Western AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Residential Lifetime											
	Soil					Groundwater						
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Inhalation of Indoor Vapor from Soil	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Vapors During Showering	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total Cancer Risk	Percent Contribution to Total
Benzene	NA	NA	NA	NA	0.00E+00	**3.03E-06**	7.49E-07	**1.11E-06**	**5.00E-06**	**9.88E-06**	**9.88E-06**	0.15%
1,2-Dichloroethane	NA	NA	NA	NA	0.00E+00	**1.91E-05**	**4.16E-06**	**1.43E-06**	**6.23E-06**	**3.09E-05**	**3.09E-05**	0.48%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	**7.03E-05**	**9.37E-05**	**1.63E-06**	**7.69E-05**	**2.43E-04**	**2.43E-04**	3.80%
Ethylbenzene	NA	NA	NA	NA	0.00E+00	**8.12E-05**	**5.10E-03**	1.94E-07	**1.40E-04**	**5.32E-03**	**5.32E-03**	83.31%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Tetrachloroethene	NA	NA	NA	NA	0.00E+00	**9.19E-05**	**1.06E-04**	**7.84E-06**	**3.75E-04**	**5.81E-04**	**5.81E-04**	9.10%
Toluene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Trichloroethene	NA	NA	NA	NA	0.00E+00	6.48E-07	1.13E-07	2.09E-07	**1.75E-06**	**2.72E-06**	**2.72E-06**	0.043%
m,p-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
o-Xylene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Xylene (total)	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Naphthalene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Aluminum	-	-	-	-	0.00E+00	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	**8.38E-06**	**1.53E-06**	8.06E-09	0.00E+00	**9.92E-06**	**1.84E-04**	**4.31E-06**	-	-	**1.88E-04**	**1.98E-04**	3.11%
Iron	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Manganese	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	-	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
Total:	**8.38E-06**	**1.53E-06**	8.06E-09	0.00E+00	**9.92E-06**	**4.50E-04**	**5.31E-03**	**1.24E-05**	**6.05E-04**	**6.37E-03**	**6.38E-03**	100.00%

Table 6-68
Summary of Lifetime Risks -
Residential Children and Adults
Northern and Western AOCs
CDL - Wallops Flight Facility

	Hazard Index (HI) - Residential Lifetime											
	Soil					Groundwater						
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Inhalation of Indoor Vapor	Subtotal - Soil	Ingestion of Groundwater	Dermal Contact with Groundwater	Inhalation of Vapors During Showering	Inhalation of Indoor Vapors from Groundwater	Subtotal - Groundwater	Total HI	Percent Contribution to Total
Benzene	NA	NA	NA	NA	0.00E+00	8.45E-02	1.04E-02	6.84E-03	8.09E-02	1.83E-01	1.83E-01	0.98%
1,2-Dichloroethane	NA	NA	NA	NA	0.00E+00	-	-	6.66E-05	-	6.66E-05	6.66E-05	0.00036%
cis-1,2-Dichloroethene	NA	NA	NA	NA	0.00E+00	4.74E-01	3.27E-02	-	-	5.07E-01	5.07E-01	2.73%
Ethylbenzene	NA	NA	NA	NA	0.00E+00	4.12E-01	1.56E-01	1.80E-04	3.39E-01	9.07E-01	9.07E-01	4.89%
Isopropylbenzene	NA	NA	NA	NA	0.00E+00	5.56E-02	3.76E-02	-	-	9.32E-02	9.32E-02	0.50%
Tetrachloroethene	NA	NA	NA	NA	0.00E+00	1.04E-01	2.65E-02	5.49E-04	6.87E-02	2.00E-01	2.00E-01	1.08%
Toluene	NA	NA	NA	NA	0.00E+00	**1.76E+00**	4.84E-01	3.83E-05	2.19E-01	**2.47E+00**	**2.47E+00**	13.29%
Trichloroethene	NA	NA	NA	NA	0.00E+00	-	-	-	-	0.00E+00	0.00E+00	0.00%
m,p-Xylene	NA	NA	NA	NA	0.00E+00	8.97E-02	3.45E-02	2.56E-04	**1.88E+00**	**2.01E+00**	**2.01E+00**	10.82%
o-Xylene	NA	NA	NA	NA	0.00E+00	3.21E-02	1.50E-02	2.56E-04	4.99E-01	5.46E-01	5.46E-01	2.94%
Xylene (total)	NA	NA	NA	NA	0.00E+00	**1.22E+00**	5.68E-01	1.79E-03	-	**1.79E+00**	**1.79E+00**	9.63%
2-Methylnaphthalene	NA	NA	NA	NA	0.00E+00	7.70E-01	5.32E-01	-	-	**1.30E+00**	**1.30E+00**	7.02%
Naphthalene	NA	NA	NA	NA	0.00E+00	3.93E-01	1.43E-01	3.69E-02	8.53E-01	**1.43E+00**	**1.43E+00**	7.68%
Aluminum	1.87E-01	1.25E-03	1.05E-02	-	1.99E-01	NA	NA	NA	NA	0.00E+00	1.99E-01	1.07%
Arsenic	1.68E-01	3.39E-02	4.75E-04	-	2.03E-01	**2.51E+00**	1.56E-02	-	-	**2.53E+00**	**2.73E+00**	14.72%
Iron	2.16E-01	1.45E-03	-	-	2.18E-01	**2.98E+00**	1.85E-02	-	-	**3.00E+00**	**3.22E+00**	17.36%
Manganese	NA	NA	NA	NA	0.00E+00	8.06E-01	1.25E-01	-	-	9.31E-01	9.31E-01	5.02%
Mercury	2.86E-03	1.92E-05	-	-	2.88E-03	4.57E-02	4.94E-04	-	-	4.62E-02	4.90E-02	0.26%
Total:	5.74E-01	3.66E-02	1.10E-02	0.00E+00	6.22E-01	**1.17E+01**	**2.20E+00**	4.69E-02	**3.94E+00**	**1.79E+01**	**1.86E+01**	100.00%

Table 6-69
Summary of Risks to Site Trespassers (Youths)
Northern and Western AOCs
CDL - Wallops Flight Facility

	Cancer Risk Probabilities - Site Trespassers											
	Soil				Sediment			Surface Water				
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Ingestion of Sediment	Dermal Contact with Sediment	Subtotal - Sediment	Ingestion of Surface Water	Dermal Contact with Surface Water	Subtotal - Surface Water	Total Cancer Risk	Percent Contribution to Total
Methylene chloride	NA	NA	NA	0.00E+00	7.95E-13	1.22E-13	9.18E-13	NA	NA	0.00E+00	9.18E-13	0.00020%
bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.00E+00	2.13E-08	4.03E-08	6.16E-08	NA	NA	0.00E+00	6.16E-08	13.41%
DDE	NA	NA	NA	0.00E+00	4.76E-10	8.99E-11	5.66E-10	NA	NA	0.00E+00	5.66E-10	0.12%
Aluminum	-	-	-	0.00E+00	NA	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Arsenic	5.03E-08	2.59E-09	1.91E-14	5.29E-08	1.97E-07	1.12E-07	3.09E-07	1.56E-08	1.97E-08	3.53E-08	3.97E-07	86.47%
Iron	-	-	-	0.00E+00	NA	NA	NA	NA	NA	0.00E+00	0.00E+00	0.00%
Mercury	-	-	-	0.00E+00	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Total:	5.03E-08	2.59E-09	1.91E-14	5.29E-08	2.19E-07	1.52E-07	3.71E-07	1.56E-08	1.97E-08	3.53E-08	4.59E-07	100.00%

	Hazard Index (HI) - Site Trespassers											
	Soil				Sediment			Surface Water				
COPC	Ingestion of Soil	Dermal Contact with Soil	Inhalation of Dust	Subtotal - Soil	Ingestion of Sediment	Dermal Contact with Sediment	Subtotal - Sediment	Ingestion of Surface Water	Dermal Contact with Surface Water	Subtotal - Surface Water	Total HI	Percent Contribution to Total
Methylene chloride	NA	NA	NA	0.00E+00	1.68E-08	3.18E-09	2.00E-08	NA	NA	0.00E+00	2.00E-08	0.00012%
bis(2-Ethylhexyl)phthalate	NA	NA	NA	0.00E+00	8.88E-04	1.68E-03	2.57E-03	NA	NA	0.00E+00	2.57E-03	15.77%
DDE	NA	NA	NA	0.00E+00	-	-	0.00E+00	NA	NA	0.00E+00	0.00E+00	0.00%
Aluminum	1.45E-03	2.49E-06	1.34E-04	1.58E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	1.58E-03	9.72%
Arsenic	1.30E-03	6.73E-05	6.04E-06	1.38E-03	5.11E-03	2.90E-03	8.01E-03	4.05E-04	5.11E-04	9.16E-04	1.03E-02	63.31%
Iron	1.68E-03	2.88E-06	-	1.68E-03	NA	NA	0.00E+00	NA	NA	0.00E+00	1.68E-03	10.32%
Mercury	2.22E-05	3.81E-08	-	2.22E-05	0	0	1.22E-04	NA	NA	0.00E+00	1.45E-04	0.89%
Total:	4.45E-03	7.27E-05	1.40E-04	4.66E-03	6.12E-03	4.58E-03	1.07E-02	4.05E-04	5.11E-04	9.16E-04	1.63E-02	100.00%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.

"-" - There is no toxicity data for this COPC, so no risk can be calculated.

Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-70
Summary of Risks to Adult Recreational Fishermen
CDL - Wallops Flight Facility

	Cancer Risk - Recreational Adult Fishermen										
	Fish and Crabs			Sediment			Surface Water				
COPC	Bluefish Ingestion	Blue Crab Ingestion	Subtotal - Fish & Crab Ingestion	Ingestion of Sediment	Dermal Contact with Sediment	Subtotal - Sediment	Ingestion of Surface Water	Dermal Contact with Surface Water	Subtotal -Surface Water	Total Cancer Risk	Percent Contribution to Total
Methylene chloride	NA	NA	-	2.22E-12	5.00E-11	5.22E-11	NA	NA	-	5.22E-11	0.00016%
bis(2-Ethylhexyl)phthalate	NA	NA	-	7.30E-08	1.51E-07	2.24E-07	NA	NA	-	2.24E-07	0.71%
DDE	NA	NA	-	1.63E-09	3.38E-10	1.97E-09	NA	NA	-	1.97E-09	0.0062%
Antimony	-	NA	-	NA	NA	-	NA	NA	-	0.00E+00	0.00%
Arsenic	**3.01E-05**	1.51E-07	**3.02E-05**	6.76E-07	4.20E-07	**1.10E-06**	5.36E-08	7.40E-08	1.28E-07	3.15E-05	99.29%
Chromium	-	-	-	NA	NA	-	NA	NA	-	0.00E+00	0.00%
Mercury	-	NA	-	-	-	-	NA	NA	-	0.00E+00	0.00%
Selenium	-	NA	-	NA	NA	-	NA	NA	-	0.00E+00	0.00%
Total:	**3.01E-05**	1.51E-07	**3.02E-05**	7.51E-07	5.71E-07	**1.32E-06**	5.36E-08	7.40E-08	1.28E-07	**3.17E-05**	100.0%

	Hazard Index (HI) - Recreational Adult Fishermen										
	Fish and Crabs			Sediment			Surface Water				
COPC	Bluefish Ingestion	Blue Crab Ingestion	Subtotal - Fish & Crab Ingestion	Ingestion of Sediment	Dermal Contact with Sediment	Subtotal - Sediment	Ingestion of Surface Water	Dermal Contact with Surface Water	Subtotal -Surface Water	Total HI	Percent Contribution to Total
Methylene chloride	NA	NA	-	1.44E-08	2.98E-09	1.74E-08	NA	NA	-	1.74E-08	0.0000070%
bis(2-Ethylhexyl)phthalate	NA	NA	-	7.61E-04	1.57E-03	2.34E-03	NA	NA	-	2.34E-03	0.93%
DDE	NA	NA	-	-	-	-	NA	NA	-	0.00E+00	0.00%
Antimony	2.87E-02	NA	2.87E-02	NA	NA	-	NA	NA	-	2.87E-02	11.47%
Arsenic	1.95E-01	9.79E-04	1.96E-01	4.38E-03	2.72E-03	7.10E-03	3.48E-04	4.80E-04	8.27E-04	2.04E-01	81.59%
Chromium	5.86E-04	2.55E-04	8.40E-04	NA	NA	-	NA	NA	-	8.40E-04	0.34%
Mercury	-	NA	-	1.03E-04	2.13E-06	1.05E-04	NA	NA	-	1.05E-04	0.04%
Selenium	1.41E-02	NA	1.41E-02	NA	NA	-	NA	NA	-	1.41E-02	5.63%
Total:	2.38E-01	1.23E-03	2.40E-01	5.24E-03	4.30E-03	9.54E-03	3.48E-04	4.80E-04	8.27E-04	2.50E-01	100.0%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.

"-" - There is no toxicity data for this COPC, so no risk can be calculated.

Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-71
Summary of Risks to Child Recreational Fishermen
CDL - Wallops Flight Facility

	Cancer Risk - Recreational Child Fishermen										
	Fish and Crabs			Sediment			Surface Water				
COPC	Bluefish Ingestion	Blue Crab Ingestion	Subtotal - Fish & Crab Ingestion	Ingestion of Sediment	Dermal Contact with Sediment	Subtotal - Sediment	Ingestion of Surface Water	Dermal Contact with Surface Water	Subtotal - Surface Water	Total Cancer Risk	Percent Contribution to Total
Methylene chloride	NA	NA	-	5.19E-12	1.45E-13	5.33E-12	NA	NA	-	5.33E-12	0.000039%
bis(2-Ethylhexyl)phthalate	NA	NA	-	1.70E-07	4.77E-08	2.18E-07	NA	NA	-	2.18E-07	1.58%
DDE	NA	NA	-	3.81E-09	1.07E-10	3.91E-09	NA	NA	-	3.91E-09	0.028%
Antimony	-	NA	-	NA	NA	-	NA	NA	-	0.00E+00	0.00%
Arsenic	**1.17E-05**	5.87E-08	**1.18E-05**	**1.58E-06**	1.32E-07	**1.71E-06**	6.26E-08	3.50E-08	9.76E-08	**1.36E-05**	98.39%
Chromium	-	-	-	NA	NA	-	NA	NA	-	0.00E+00	0.00%
Mercury	-	NA	-	-	-	-	NA	NA	-	0.00E+00	0.00%
Selenium	-	NA	-	NA	NA	-	NA	NA	-	0.00E+00	0.00%
Total:	**1.17E-05**	5.87E-08	**1.18E-05**	**1.75E-06**	1.80E-07	**1.93E-06**	6.26E-08	3.50E-08	9.76E-08	**1.38E-05**	100.0%

	Hazard Index (HI) - Recreational Child Fishermen										
	Fish and Crabs			Sediment			Surface Water				
COPC	Bluefish Ingestion	Blue Crab Ingestion	Subtotal - Fish & Crab Ingestion	Ingestion of Sediment	Dermal Contact with Sediment	Subtotal - Sediment	Ingestion of Surface Water	Dermal Contact with Surface Water	Subtotal - Surface Water	Total HI	Percent Contribution to Total
Methylene chloride	NA	NA	-	1.34E-07	3.76E-09	1.38E-07	NA	NA	-	1.38E-07	0.000032%
bis(2-Ethylhexyl)phthalate	NA	NA	-	7.10E-03	1.99E-03	9.09E-03	NA	NA	-	9.09E-03	2.12%
DDE	NA	NA	-	-	-	-	NA	NA	-	0.00E+00	0.00%
Antimony	4.46E-02	NA	4.46E-02	NA	NA	-	NA	NA	-	4.46E-02	10.38%
Arsenic	3.03E-01	1.52E-03	3.05E-01	4.09E-02	3.43E-03	4.43E-02	1.62E-03	9.08E-04	2.53E-03	3.52E-01	81.88%
Chromium	9.11E-04	3.96E-04	1.31E-03	NA	NA	-	NA	NA	-	1.31E-03	0.30%
Mercury	-	NA	-	9.61E-04	2.69E-06	9.64E-04	NA	NA	-	9.64E-04	0.22%
Selenium	2.19E-02	NA	2.19E-02	NA	NA	-	NA	NA	-	2.19E-02	5.10%
Total:	3.71E-01	1.92E-03	3.73E-01	4.89E-02	5.43E-03	5.44E-02	1.62E-03	9.08E-04	2.53E-03	4.30E-01	100.0%

Notes:

NA - Not applicable. This chemical is not a COPC for this media.

"-" - There is no toxicity data for this COPC, so no risk can be calculated.

Numbers in bold exceed a cancer risk of 1x10-6 or a hazard quotient/index of 1.0.

Table 6-72
Comparison of Site and Reference Chemical Concentrations in Soils
CDL - Wallops Flight Facility

COPC	Site Data		Background Data	
	Range of Detected Concentrations	Arithmetic Mean	Range of Detected Concentrations	Arithmetic Mean
SOIL				
Central and Southern AOCs - Surface Soil				
Arsenic	3.00 - 7.60	6.02	0.78 - 14.2	4.2
Central and Southern AOCs - Aggregate Soil				
Arsenic	0.96 - 8.40	4.79	1.1 - 5.3	3.55
Chromium	3.00 - 616	369	5.7 - 21	12.6
Copper	1.20 - 5,100	3,489	1.6 - 10.9	7.04
Lead	3.00 - 21,200	1,778	1.7 - 12.2	7.7
Northern and Western AOCs - Surface Soil				
Arsenic	1.20 - 4.70	3.1	0.78 - 14.2	4.2
Northern and Western AOCs - Aggregate Soil				
Arsenic	1.10 - 4.80	2.76	1.1 - 5.3	3.55
GROUNDWATER				
Arsenic	1.7 - 8.7	5.93	3.6 - 17.7	3.93
1,2-Dichloroethene (cis)	48.1 - 54.5*	50.2	1 - 1	0.542

Concentrations for soil are in units of mg/kg and for groundwater in ug/L.

* The three detections of cis-1,2-dichloroethene were from the same well (MW-4) with two samples being duplicates.

AOC - area of concern
COC - chemical of concern

Table 6-73
Risk Summary
Central and Southern AOCs
CDL - Wallops Flight Facility

Exposure Route	Cancer Risk	Percent of Total Risk	Hazard Index	Percent of Total Risk
Site Workers				
Soil ingestion	**9.29E-06**	60.25%	3.22E-01	97.70%
Soil dermal contact	**6.02E-06**	38.99%	5.63E-03	1.71%
Dust inhalation	1.17E-07	0.76%	1.96E-03	0.60%
Total	**1.54E-05**		3.30E-01	
Commercial Workers				
Soil ingestion	**4.72E-06**	0.11%	1.99E-01	1.01%
Indoor vapor inhalation	**4.16E-03**	94.72%	**1.69E+01**	85.40%
Soil Subtotal	**4.16E-03**	94.83%	**1.71E+01**	86.41%
Groundwater ingestion	**2.12E-04**	4.82%	**2.52E+00**	12.75%
Indoor vapor inhalation	**1.55E-05**	0.35%	1.66E-01	0.84%
Groundwater Subtotal	**2.27E-04**	5.17%	**2.68E+00**	13.59%
Total	**4.39E-03**		**1.97E+01**	
Construction Workers				
Soil ingestion	2.99E-07	0.33%	6.31E-01	0.43%
Soil dermal contact	9.13E-08	0.10%	1.10E-02	0.0076%
Dust inhalation	7.76E-09	0.0085%	2.31E-03	0.0016%
Soil Subtotal	3.98E-07	0.43%	6.44E-01	0.44%
Groundwater ingestion	2.03E-08	0.022%	1.21E-02	0.0083%
Groundwater dermal contact	7.98E-08	0.087%	8.53E-02	0.058%
Vapor inhalation in trench	**9.11E-05**	99.46%	**1.45E+02**	99.49%
Groundwater Subtotal	**9.12E-05**	99.57%	**1.45E+02**	99.56%
Total	**9.16E-05**		**1.46E+02**	
Residential Adults				
Soil ingestion	**1.27E-05**	0.20%	5.57E-01	1.91%
Soil dermal contact	**5.15E-06**	0.08%	1.30E-02	0.044%
Dust inhalation	**1.09E-06**	0.017%	6.75E-03	0.023%
Indoor vapor inhalation	**5.59E-03**	89.70%	**2.36E+01**	80.91%
Soil Subtotal	**5.61E-03**	90.01%	**2.42E+01**	82.89%
Groundwater ingestion	**2.84E-04**	4.56%	**3.52E+00**	12.08%
Groundwater dermal contact	**4.67E-05**	0.75%	7.25E-01	2.49%
Vapor inhalation during showering	**1.24E-05**	0.20%	4.69E-02	0.16%
Indoor vapor inhalation	**2.79E-04**	4.48%	**6.96E-01**	2.39%
Groundwater Subtotal	**6.23E-04**	9.99%	**4.99E+00**	17.11%
Total	**6.23E-03**		**2.92E+01**	
Residential Children				
Soil ingestion	**2.96E-05**	0.24%	**5.20E+00**	4.05%
Soil dermal contact	**2.11E-05**	0.17%	2.12E-01	0.17%
Dust inhalation	3.60E-10	0.0000029%	3.15E-02	0.024%
Indoor vapor inhalation	**6.52E-03**	52.91%	**1.10E+02**	85.69%
Soil Subtotal	**6.57E-03**	53.33%	**1.16E+02**	89.93%
Groundwater ingestion	**1.66E-04**	1.35%	**8.22E+00**	6.40%
Groundwater dermal contact	**5.26E-03**	42.69%	**1.47E+00**	1.15%
Indoor vapor inhalation	**3.26E-04**	2.64%	**3.25E+00**	2.53%
Groundwater Subtotal	**5.75E-03**	46.67%	**1.29E+01**	10.07%
Total	**1.23E-02**		**1.28E+02**	
Residential Lifetime (Children+Adults)				
Soil ingestion	**4.23E-05**	0.23%	**5.76E+00**	3.65%
Soil dermal contact	**2.63E-05**	0.14%	2.25E-01	0.14%
Dust inhalation	**1.09E-06**	0.0059%	3.82E-02	0.024%
Indoor vapor inhalation	**1.21E-02**	65.27%	**1.34E+02**	84.80%
Soil Subtotal	**1.22E-02**	65.64%	**1.40E+02**	88.63%
Groundwater ingestion	**4.50E-04**	2.43%	**1.17E+01**	7.45%
Groundwater dermal contact	**5.31E-03**	28.60%	**2.20E+00**	1.39%
Indoor vapor inhalation	**6.05E-04**	3.26%	**3.94E+00**	2.50%
Vapor inhalation during showering	**1.24E-05**	0.067%	4.69E-02	0.030%
Groundwater Subtotal	**6.37E-03**	34.36%	**1.79E+01**	11.37%
Total	**1.86E-02**		**1.58E+02**	

Table 6-73
Risk Summary
Central and Southern AOCs
CDL - Wallops Flight Facility

Trespassers				
Soil ingestion	2.54E-07	35.04%	1.31E-07	0.0011%
Soil dermal contact	4.44E-08	6.14%	2.93E-08	0.00025%
Dust inhalation	1.96E-08	2.702%	1.60E-07	0.0014%
Soil Subtotal	3.18E-07	43.88%	3.21E-07	0.0028%
Sediment ingestion	2.19E-07	30.23%	6.00E-03	52.20%
Sediment dermal contact	1.52E-07	21.01%	4.58E-03	39.82%
Sediment Subtotal	3.71E-07	51.24%	1.06E-02	92.02%
Surface water ingestion	1.56E-08	2.16%	4.05E-04	3.53%
Surface water dermal contact	1.97E-08	2.72%	5.11E-04	4.45%
Surface Water Subtotal	3.53E-08	4.88%	9.16E-04	7.98%
Total	7.24E-07		1.15E-02	
Recreational Fishermen - Adults				
Bluefish ingestion	**3.01E-05**	95.11%	2.38E-01	95.36%
Blue crab ingestion	1.51E-07	0.48%	1.23E-03	0.49%
Fish and Crab Ingestion Subtotal	**3.02E-05**	95.59%	2.40E-01	95.85%
Sediment ingestion	7.51E-07	2.37%	5.24E-03	2.10%
Sediment dermal contact	5.71E-07	1.81%	4.30E-03	1.72%
Sediment Subtotal	**1.32E-06**	4.18%	9.54E-03	3.82%
Surface water ingestion	5.36E-11	0.00017%	3.48E-04	0.14%
Surface water dermal contact	7.40E-08	0.23%	4.80E-04	0.19%
Surface Water Subtotal	7.41E-08	0.23%	8.27E-04	0.33%
Total	**3.16E-05**		2.50E-01	
Recreational Fishermen - Children				
Bluefish ingestion	**1.17E-05**	84.86%	3.71E-01	86.50%
Blue crab ingestion	5.87E-08	0.43%	1.92E-03	0.45%
Fish and Crab Ingestion Subtotal	**1.18E-05**	85.28%	3.73E-01	86.95%
Sediment ingestion	**1.75E-06**	12.70%	4.80E-02	11.20%
Sediment dermal contact	1.80E-07	1.31%	5.42E-03	1.27%
Sediment Subtotal	**1.93E-06**	14.01%	5.34E-02	12.46%
Surface water ingestion	6.26E-08	0.45%	1.62E-03	0.38%
Surface water dermal contact	3.50E-08	0.25%	9.08E-04	0.21%
Surface Water Subtotal	9.76E-08	0.71%	2.53E-03	0.59%
Total	**1.38E-05**		4.29E-01	
Residential + Recreational Fishermen - Adults				
Residential Subtotal	**6.23E-03**	99.49%	**2.92E+01**	99.15%
Recreational Subtotal	**3.16E-05**	0.51%	2.50E-01	0.85%
Total	**6.26E-03**		**2.94E+01**	
Residential + Recreational Fishermen - Children				
Residential Subtotal	**1.23E-02**	99.89%	**1.28E+02**	99.67%
Recreational Subtotal	**1.38E-05**	0.11%	4.29E-01	0.33%
Total	**1.23E-02**		**1.29E+02**	
Lifetime Residential + Recreational Fishermen				
Residential Subtotal	**1.86E-02**	99.76%	**1.58E+02**	99.57%
Recreational Subtotal	**4.54E-05**	0.24%	6.79E-01	0.43%
Total	**1.86E-02**		**1.58E+02**	

Values in bold indicate a cancer risk >1x10-6 or a HI >1.0.

Table 6-74
Risk Summary
Northern and Western AOCs
CDL - Wallops Flight Facility

Exposure Route	Cancer Risk	Percent of Total Risk	Hazard Index	Percent of Total Risk
Site Workers				
Soil ingestion	**2.22E-06**	83.37%	3.43E-02	89.85%
Soil dermal contact	4.39E-07	16.51%	2.87E-03	7.52%
Dust inhalation	3.28E-09	0.12%	1.00E-03	2.63%
Total	**2.66E-06**		3.81E-02	
Commercial Workers				
Soil ingestion	9.35E-07	0.33%	1.99E-02	0.73%
Indoor vapor inhalation	0.00E+00	0.00%	0.00E+00	0.00%
Soil Subtotal	9.35E-07	0.33%	1.99E-02	0.73%
Groundwater ingestion	**2.12E-04**	75.10%	**2.52E+00**	93.13%
Indoor vapor inhalation	**6.92E-05**	24.56%	1.66E-01	6.13%
Groundwater Subtotal	**2.81E-04**	99.67%	**2.68E+00**	99.27%
Total	**2.82E-04**		**2.70E+00**	
Construction Workers				
Soil ingestion	5.93E-08	0.065%	6.29E-02	0.043%
Soil dermal contact	5.33E-09	0.0058%	1.79E-03	0.0012%
Dust inhalation	2.66E-11	0.000029%	6.67E-04	0.00046%
Soil Subtotal	6.46E-08	0.071%	6.54E-02	0.045%
Groundwater ingestion	2.03E-08	0.022%	1.21E-02	0.0083%
Groundwater dermal contact	7.98E-08	0.087%	8.53E-02	0.059%
Vapor inhalation in trench	**9.11E-05**	99.82%	**1.45E+02**	99.89%
Groundwater Subtotal	**9.12E-05**	99.93%	**1.45E+02**	99.96%
Total	**9.13E-05**		**1.45E+02**	
Residential Adults				
Soil ingestion	**2.51E-06**	0.40%	5.56E-02	1.10%
Soil dermal contact	3.01E-07	0.048%	2.11E-03	0.042%
Dust inhalation	3.72E-09	0.00060%	1.94E-03	0.038%
Indoor vapor inhalation	0.00E+00	0.00%	0.00E+00	0.00%
Soil Subtotal	**2.82E-06**	0.45%	**5.96E-02**	1.18%
Groundwater ingestion	**2.84E-04**	45.47%	**3.52E+00**	69.75%
Groundwater dermal contact	**4.67E-05**	7.47%	7.25E-01	14.36%
Vapor inhalation during showering	**1.24E-05**	1.98%	4.69E-02	0.93%
Indoor vapor inhalation	**2.79E-04**	44.62%	6.96E-01	13.78%
Groundwater Subtotal	**6.23E-04**	99.55%	**4.99E+00**	98.82%
Total	**6.25E-04**		**5.05E+00**	
Residential Children				
Soil ingestion	**5.87E-06**	0.10%	5.19E-01	3.84%
Soil dermal contact	**1.23E-06**	0.021%	3.45E-02	0.26%
Dust inhalation	4.34E-09	0.000075%	9.07E-03	0.067%
Indoor vapor inhalation	0.00E+00	0.00%	0.00E+00	0.00%
Soil Subtotal	**7.10E-06**	0.12%	5.62E-01	4.17%
Groundwater ingestion	**1.66E-04**	2.88%	**8.22E+00**	60.88%
Groundwater dermal contact	**5.26E-03**	91.34%	**1.47E+00**	10.91%
Indoor vapor inhalation	**3.26E-04**	5.65%	**3.25E+00**	24.05%
Groundwater Subtotal	**5.75E-03**	99.88%	**1.29E+01**	95.83%
Total	**5.76E-03**		**1.35E+01**	
Residential Lifetime (Children+Adults)				
Soil ingestion	**8.38E-06**	0.13%	5.74E-01	3.10%
Soil dermal contact	**1.53E-06**	0.024%	3.66E-02	0.20%
Dust inhalation	8.06E-09	0.00013%	1.10E-02	0.059%
Indoor vapor inhalation	0.00E+00	0.00%	0.00E+00	0.00%
Soil Subtotal	**9.92E-06**	0.16%	6.22E-01	3.35%
Groundwater ingestion	**4.50E-04**	7.05%	**1.17E+01**	63.29%
Groundwater dermal contact	**5.31E-03**	83.13%	**2.20E+00**	11.85%
Indoor vapor inhalation	**6.05E-04**	9.47%	**3.94E+00**	21.25%
Vapor inhalation during showering	**1.24E-05**	0.19%	4.69E-02	0.25%
Groundwater Subtotal	**6.37E-03**	99.84%	**1.79E+01**	96.65%
Total	**6.38E-03**		**1.86E+01**	

Table 6-74
Risk Summary
Northern and Western AOCs
CDL - Wallops Flight Facility

Trespassers				
Soil ingestion	5.03E-08	10.95%	4.45E-03	27.33%
Soil dermal contact	2.59E-09	0.57%	7.27E-05	0.45%
Dust inhalation	1.91E-14	0.0000042%	1.40E-04	0.86%
Soil Subtotal	5.29E-08	11.51%	4.66E-03	28.64%
Sediment ingestion	2.19E-07	47.66%	6.12E-03	37.60%
Sediment dermal contact	1.52E-07	33.12%	4.58E-03	28.13%
Sediment Subtotal	3.71E-07	80.79%	1.07E-02	65.73%
Surface water ingestion	1.56E-08	3.41%	4.05E-04	2.49%
Surface water dermal contact	1.97E-08	4.29%	5.11E-04	3.14%
Surface Water Subtotal	3.53E-08	7.70%	9.16E-04	5.63%
Total	4.59E-07		1.63E-02	
Recreational Fishermen - Adults				
Bluefish ingestion	**3.01E-05**	94.95%	2.38E-01	95.36%
Blue crab ingestion	1.51E-07	0.48%	1.23E-03	0.49%
Fish and Crab Ingestion Subtotal	**3.02E-05**	95.43%	2.40E-01	95.85%
Sediment ingestion	7.51E-07	2.37%	5.24E-03	2.10%
Sediment dermal contact	5.71E-07	1.80%	4.30E-03	1.72%
Sediment Subtotal	**1.32E-06**	4.17%	9.54E-03	3.82%
Surface water ingestion	5.36E-08	0.17%	3.48E-04	0.14%
Surface water dermal contact	7.40E-08	0.23%	4.80E-04	0.19%
Surface Water Subtotal	1.28E-07	0.40%	8.27E-04	0.33%
Total	**3.17E-05**		2.50E-01	
Recreational Fishermen - Children				
Bluefish ingestion	**1.17E-05**	84.86%	3.71E-01	86.31%
Blue crab ingestion	5.87E-08	0.43%	1.92E-03	0.45%
Fish and Crab Ingestion Subtotal	**1.18E-05**	85.28%	3.73E-01	86.75%
Sediment ingestion	**1.75E-06**	12.70%	4.89E-02	11.39%
Sediment dermal contact	1.80E-07	1.31%	5.43E-03	1.26%
Sediment Subtotal	**1.93E-06**	14.01%	5.44E-02	12.66%
Surface water ingestion	6.26E-08	0.45%	1.62E-03	0.38%
Surface water dermal contact	3.50E-08	0.25%	9.08E-04	0.21%
Surface Water Subtotal	9.76E-08	0.71%	2.53E-03	0.59%
Total	**1.38E-05**		4.30E-01	
Residential + Recreational Fishermen - Adults				
Residential Subtotal	**6.25E-04**	95.18%	**5.05E+00**	95.29%
Recreational Subtotal	**3.17E-05**	4.82%	2.50E-01	4.71%
Total	**6.57E-04**		**5.30E+00**	
Residential + Recreational Fishermen - Children				
Residential Subtotal	**5.76E-03**	99.76%	**1.35E+01**	96.92%
Recreational Subtotal	**1.38E-05**	0.24%	4.30E-01	3.08%
Total	**5.77E-03**		**1.39E+01**	
Lifetime Residential + Recreational Fishermen				
Residential Subtotal	**6.38E-03**	99.29%	**1.86E+01**	96.47%
Recreational Subtotal	**4.55E-05**	0.71%	6.80E-01	3.53%
Total	**6.43E-03**		**1.92E+01**	

Values in bold indicate a cancer risk >1x10-6 or a HI >1.0.

Table 6-75
Risk Summary (Adjusted for Arsenic)
Central and Southern AOCs
CDL - Wallops Flight Facility

Exposure Route	Cancer Risk	Percent of Total Risk	Hazard Index	Percent of Total Risk
Site Workers				
Soil ingestion	**6.45E-06**	53.69%	3.04E-01	98.70%
Soil dermal contact	**5.45E-06**	45.37%	2.14E-03	0.69%
Dust inhalation	1.13E-07	0.94%	1.87E-03	0.61%
Total	**1.20E-05**		3.08E-01	
Commercial Workers				
Soil ingestion	**3.46E-06**	0.08%	1.91E-01	1.00%
Indoor vapor inhalation	**4.16E-03**	96.65%	**1.69E+01**	87.83%
Soil Subtotal	**4.16E-03**	96.73%	**1.70E+01**	88.83%
Groundwater ingestion	**1.25E-04**	2.91%	**1.98E+00**	10.31%
Indoor vapor inhalation	**1.55E-05**	0.36%	1.66E-01	0.86%
Groundwater Subtotal	**1.41E-04**	3.27%	**2.14E+00**	11.17%
Total	**4.30E-03**		**1.92E+01**	
Construction Workers				
Soil ingestion	2.20E-07	0.24%	6.06E-01	0.42%
Soil dermal contact	8.42E-08	0.092%	8.80E-03	0.0060%
Dust inhalation	7.73E-09	0.0084%	2.27E-03	0.0016%
Soil Subtotal	3.11E-07	0.34%	6.17E-01	0.42%
Groundwater ingestion	1.20E-08	0.013%	9.50E-03	0.0065%
Groundwater dermal contact	7.44E-08	0.081%	8.36E-02	0.057%
Vapor inhalation in trench	**9.11E-05**	99.57%	**1.45E+02**	99.51%
Groundwater Subtotal	**9.12E-05**	99.66%	**1.45E+02**	99.58%
Total	**9.15E-05**		**1.46E+02**	
Residential Adults				
Soil ingestion	**9.31E-06**	0.15%	5.36E-01	1.89%
Soil dermal contact	**4.75E-06**	0.078%	1.04E-02	0.036%
Dust inhalation	1.08E-06	0.018%	6.63E-03	0.023%
Indoor vapor inhalation	**5.59E-03**	91.48%	**2.36E+01**	83.14%
Soil Subtotal	**5.60E-03**	91.72%	**2.41E+01**	85.08%
Groundwater ingestion	**1.68E-04**	2.75%	**2.77E+00**	9.76%
Groundwater dermal contact	**4.61E-05**	0.75%	7.21E-01	2.54%
Vapor inhalation during showering	**1.24E-05**	0.20%	4.69E-02	0.17%
Indoor vapor inhalation	**2.79E-04**	4.57%	**6.96E-01**	2.45%
Groundwater Subtotal	**5.06E-04**	8.28%	**4.23E+00**	14.92%
Total	**6.11E-03**		**2.84E+01**	
Residential Children				
Soil ingestion	**2.17E-05**	0.18%	**5.00E+00**	3.95%
Soil dermal contact	**1.94E-05**	0.16%	1.69E-01	0.13%
Dust inhalation	3.58E-10	0.0000029%	3.10E-02	0.024%
Indoor vapor inhalation	**6.52E-03**	53.27%	**1.10E+02**	87.06%
Soil Subtotal	**6.56E-03**	53.60%	**1.15E+02**	91.17%
Groundwater ingestion	**9.81E-05**	0.80%	**6.46E+00**	5.11%
Groundwater dermal contact	**5.26E-03**	42.94%	**1.46E+00**	1.16%
Indoor vapor inhalation	**3.26E-04**	2.66%	**3.25E+00**	2.57%
Groundwater Subtotal	**5.68E-03**	46.40%	**1.12E+01**	8.83%
Total	**1.22E-02**		**1.26E+02**	
Residential Lifetime (Children+Adults)				
Soil ingestion	**3.10E-05**	0.17%	**5.53E+00**	3.57%
Soil dermal contact	**2.42E-05**	0.13%	1.80E-01	0.12%
Dust inhalation	**1.08E-06**	0.0059%	3.76E-02	0.024%
Indoor vapor inhalation	**1.21E-02**	65.99%	**1.34E+02**	86.34%
Soil Subtotal	**1.22E-02**	66.29%	**1.39E+02**	90.05%
Groundwater ingestion	**2.66E-04**	1.45%	**9.23E+00**	5.96%
Groundwater dermal contact	**5.30E-03**	28.89%	**2.18E+00**	1.41%
Indoor vapor inhalation	**6.05E-04**	3.29%	**3.94E+00**	2.55%
Vapor inhalation during showering	**1.24E-05**	0.068%	4.69E-02	0.030%
Groundwater Subtotal	**6.19E-03**	33.71%	**1.54E+01**	9.95%
Total	**1.84E-02**		**1.55E+02**	

Table 6-75
Risk Summary (Adjusted for Arsenic)
Central and Southern AOCs
CDL - Wallops Flight Facility

Exposure Route	Cancer Risk	Percent of Total Risk	Hazard Index	Percent of Total Risk
Trespassers				
Soil ingestion	1.86E-07	60.31%	1.31E-07	0.0051%
Soil dermal contact	4.10E-08	13.26%	2.93E-08	0.0011%
Dust inhalation	1.95E-08	6.30581%	1.60E-07	0.0062%
Soil Subtotal	2.47E-07	79.88%	3.21E-07	0.012%
Sediment ingestion	2.18E-08	7.05%	8.88E-04	34.60%
Sediment dermal contact	4.04E-08	13.07%	1.68E-03	65.39%
Sediment Subtotal	6.21E-08	20.12%	2.57E-03	99.99%
Surface water ingestion	0.00E+00	0.00%	0.00E+00	0.00%
Surface water dermal contact	0.00E+00	0.00%	0.00E+00	0.00%
Surface Water Subtotal	0.00E+00	0.00%	0.00E+00	0.00%
Total	3.09E-07		2.57E-03	
Recreational Fishermen - Adults				
Bluefish ingestion	0.00E+00	0.00%	4.33E-02	94.14%
Blue crab ingestion	0.00E+00	0.00%	2.55E-04	0.55%
Fish and Crab Ingestion Subtotal	0.00E+00	0.00%	4.36E-02	94.70%
Sediment ingestion	7.47E-08	24.87%	8.64E-04	1.88%
Sediment dermal contact	1.52E-07	50.48%	1.58E-03	3.43%
Sediment Subtotal	2.26E-07	75.34%	2.44E-03	5.30%
Surface water ingestion	5.36E-11	0.01786%	0.00E+00	0.00%
Surface water dermal contact	7.40E-08	24.64%	0.00E+00	0.00%
Surface Water Subtotal	7.41E-08	24.66%	0.00E+00	0.00%
Total	3.00E-07		4.60E-02	
Recreational Fishermen - Children				
Bluefish ingestion	0.00E+00	0.00%	6.74E-02	87.66%
Blue crab ingestion	0.00E+00	0.00%	3.96E-04	0.52%
Fish and Crab Ingestion Subtotal	0.00E+00	0.00%	6.78E-02	88.18%
Sediment ingestion	1.74E-07	78.46%	7.10E-03	9.24%
Sediment dermal contact	4.78E-08	21.54%	1.99E-03	2.59%
Sediment Subtotal	2.22E-07	100.00%	9.09E-03	11.82%
Surface water ingestion	0.00E+00	0.00%	0.00E+00	0.00%
Surface water dermal contact	0.00E+00	0.00%	0.00E+00	0.00%
Surface Water Subtotal	0.00E+00	0.00%	0.00E+00	0.00%
Total	2.22E-07		7.69E-02	
Residential + Recreational Fishermen - Adults				
Residential Subtotal	**6.11E-03**	100.00%	**2.84E+01**	99.84%
Recreational Subtotal	3.00E-07	0.00%	4.60E-02	0.16%
Total	**6.11E-03**		**2.84E+01**	
Residential + Recreational Fishermen - Children				
Residential Subtotal	**1.22E-02**	100.00%	**1.26E+02**	99.94%
Recreational Subtotal	2.22E-07	0.00%	7.69E-02	0.061%
Total	**1.22E-02**		**1.27E+02**	
Lifetime Residential + Recreational Fishermen				
Residential Subtotal	**1.84E-02**	100.00%	**1.55E+02**	99.92%
Recreational Subtotal	5.22E-07	0.00%	1.23E-01	0.079%
Total	**1.84E-02**		**1.55E+02**	

Values in bold indicate a cancer risk >1x10-6 or a HI >1.0.

Table 6-76
Risk Summary (Adjusted for Arsenic)
Northern and Western AOCs
CDL - Wallops Flight Facility

Exposure Route	Cancer Risk	Percent of Total Risk	Hazard Index	Percent of Total Risk
Site Workers				
Soil ingestion	0.00E+00	0.00%	2.05E-02	95.04%
Soil dermal contact	0.00E+00	0.00%	1.35E-04	0.63%
Dust inhalation	0.00E+00	0.00%	9.34E-04	4.34%
Total	0.00E+00		2.15E-02	
Commercial Workers				
Soil ingestion	0.00E+00	0.00%	1.40E-02	0.65%
Indoor vapor inhalation	0.00E+00	0.00%	0.00E+00	0.00%
Soil Subtotal	0.00E+00	0.00%	1.40E-02	0.65%
Groundwater ingestion	**1.25E-04**	64.38%	**1.98E+00**	91.67%
Indoor vapor inhalation	**6.92E-05**	35.62%	1.66E-01	7.68%
Groundwater Subtotal	**1.94E-04**	100.00%	**2.14E+00**	99.35%
Total	**1.94E-04**		**2.16E+00**	
Construction Workers				
Soil ingestion	0.00E+00	0.00%	4.45E-02	0.031%
Soil dermal contact	0.00E+00	0.00%	1.33E-04	0.000092%
Dust inhalation	0.00E+00	0.00%	6.38E-04	0.00044%
Soil Subtotal	0.00E+00	0.00%	4.52E-02	0.031%
Groundwater ingestion	1.20E-08	0.013%	9.50E-03	0.0065%
Groundwater dermal contact	7.44E-08	0.082%	8.36E-02	0.057%
Vapor inhalation in trench	**9.11E-05**	99.91%	1.45E+02	99.90%
Groundwater Subtotal	**9.12E-05**	100.00%	1.45E+02	99.97%
Total	**9.12E-05**		1.45E+02	
Residential Adults				
Soil ingestion	0.00E+00	0.00%	3.93E-02	0.92%
Soil dermal contact	0.00E+00	0.00%	1.57E-04	0.004%
Dust inhalation	0.00E+00	0.00%	1.86E-03	0.044%
Indoor vapor inhalation	0.00E+00	0.00%	0.00E+00	0.00%
Soil Subtotal	0.00E+00	0.00%	4.13E-02	0.97%
Groundwater ingestion	**1.68E-04**	33.24%	**2.77E+00**	64.78%
Groundwater dermal contact	**4.61E-05**	9.12%	7.21E-01	16.87%
Vapor inhalation during showering	**1.24E-05**	2.45%	4.69E-02	1.10%
Indoor vapor inhalation	**2.79E-04**	55.18%	6.96E-01	16.28%
Groundwater Subtotal	**5.06E-04**	100.00%	**4.23E+00**	99.03%
Total	**5.06E-04**		**4.27E+00**	
Residential Children				
Soil ingestion	0.00E+00	0.00%	3.67E-01	3.18%
Soil dermal contact	0.00E+00	0.00%	2.57E-03	0.02%
Dust inhalation	0.00E+00	0.00%	8.68E-03	0.075%
Indoor vapor inhalation	0.00E+00	0.00%	0.00E+00	0.00%
Soil Subtotal	0.00E+00	0.00%	3.78E-01	3.27%
Groundwater ingestion	**9.81E-05**	1.73%	**6.46E+00**	55.95%
Groundwater dermal contact	**5.26E-03**	92.54%	**1.46E+00**	12.66%
Indoor vapor inhalation	**3.26E-04**	5.73%	**3.25E+00**	28.12%
Groundwater Subtotal	**5.68E-03**	100.00%	**1.12E+01**	96.73%
Total	**5.68E-03**		**1.15E+01**	
Residential Lifetime (Children+Adults)				
Soil ingestion	0.00E+00	0.00%	4.06E-01	2.57%
Soil dermal contact	0.00E+00	0.00%	2.72E-03	0.02%
Dust inhalation	0.00E+00	0.00%	1.05E-02	0.067%
Indoor vapor inhalation	0.00E+00	0.00%	0.00E+00	0.00%
Soil Subtotal	0.00E+00	0.00%	4.19E-01	2.65%
Groundwater ingestion	**2.66E-04**	4.30%	**9.23E+00**	58.34%
Groundwater dermal contact	**5.30E-03**	85.72%	**2.18E+00**	13.80%
Indoor vapor inhalation	**6.05E-04**	9.77%	**3.94E+00**	24.92%
Vapor inhalation during showering	**1.24E-05**	0.20%	4.69E-02	0.30%
Groundwater Subtotal	**6.19E-03**	100.00%	**1.54E+01**	97.35%
Total	**6.19E-03**		**1.58E+01**	

Table 6-76
Risk Summary (Adjusted for Arsenic)
Northern and Western AOCs
CDL - Wallops Flight Facility

Exposure Route	Cancer Risk	Percent of Total Risk	Hazard Index	Percent of Total Risk
Trespassers				
Soil ingestion	0.00E+00	0.00%	3.14E-03	52.65%
Soil dermal contact	0.00E+00	0.00%	5.41E-06	0.09%
Dust inhalation	0.00E+00	0.00%	1.34E-04	2.24%
Soil Subtotal	0.00E+00	0.00%	3.28E-03	54.98%
Sediment ingestion	2.18E-08	35.05%	1.01E-03	16.88%
Sediment dermal contact	4.04E-08	64.95%	1.68E-03	28.14%
Sediment Subtotal	6.21E-08	100.00%	2.69E-03	45.02%
Surface water ingestion	0.00E+00	0.00%	0.00E+00	0.00%
Surface water dermal contact	0.00E+00	0.00%	0.00E+00	0.00%
Surface Water Subtotal	0.00E+00	0.00%	0.00E+00	0.00%
Total	6.21E-08		5.97E-03	
Recreational Fishermen - Adults				
Bluefish ingestion	0.00E+00	0.00%	4.33E-02	94.14%
Blue crab ingestion	0.00E+00	0.00%	2.55E-04	0.55%
Fish and Crab Ingestion Subtotal	0.00E+00	0.00%	4.36E-02	94.70%
Sediment ingestion	7.47E-08	33.00%	8.64E-04	1.88%
Sediment dermal contact	1.52E-07	67.00%	1.58E-03	3.43%
Sediment Subtotal	2.26E-07	100.00%	2.44E-03	5.30%
Surface water ingestion	0.00E+00	0.00%	0.00E+00	0.00%
Surface water dermal contact	0.00E+00	0.00%	0.00E+00	0.00%
Surface Water Subtotal	0.00E+00	0.00%	0.00E+00	0.00%
Total	2.26E-07		4.60E-02	
Recreational Fishermen - Children				
Bluefish ingestion	0.00E+00	0.00%	6.74E-02	86.58%
Blue crab ingestion	0.00E+00	0.00%	3.96E-04	0.51%
Fish and Crab Ingestion Subtotal	0.00E+00	0.00%	6.78E-02	87.08%
Sediment ingestion	1.74E-07	78.46%	8.06E-03	10.36%
Sediment dermal contact	4.78E-08	21.54%	1.99E-03	2.56%
Sediment Subtotal	2.22E-07	100.00%	1.01E-02	12.92%
Surface water ingestion	0.00E+00	0.00%	0.00E+00	0.00%
Surface water dermal contact	0.00E+00	0.00%	0.00E+00	0.00%
Surface Water Subtotal	0.00E+00	0.00%	0.00E+00	0.00%
Total	2.22E-07		7.78E-02	
Residential + Recreational Fishermen - Adults				
Residential Subtotal	**5.06E-04**	99.96%	**4.27E+00**	98.93%
Recreational Subtotal	2.26E-07	0.045%	4.60E-02	1.07%
Total	**5.06E-04**		**4.32E+00**	
Residential + Recreational Fishermen - Children				
Residential Subtotal	**5.68E-03**	99.99%	**1.15E+01**	99.33%
Recreational Subtotal	2.22E-07	0.0039%	7.78E-02	0.67%
Total	**5.68E-03**		**1.16E+01**	
Lifetime Residential + Recreational Fishermen				
Residential Subtotal	**6.19E-03**	99.99%	**1.58E+01**	99.22%
Recreational Subtotal	4.48E-07	0.0072%	1.24E-01	0.78%
Total	**6.19E-03**		**1.59E+01**	

Values in bold indicate a cancer risk >1x10-6 or a HI >1.0.

TABLES FOR SECTION 7

Table 7-1a: Terrestrial Wildlife COPECs for Central and Southern AOCs
Wallops CDL Ecological Risk Assessment

	0-0.5 Soil				0-5 Soil		
	Detected?	COPEC?			Detected?	COPEC?	
		Flora	Invert	Wildlife		Flora	Wildlife
Volatile Organic Compounds							
1,2-Dichlorobenzene	ND	X	X	X	ND	X	X
1,4-Dichlorobenzene	ND	X	X	X	ND	X	X
Methyl Acetate		X	X	X		X	X
Methylcyclohexane		X	X	X		X	X
Tetrachloroethene	ND	X	X	X	ND	X	X
1,2,4-Trichlorobenzene	ND			X	ND		X
Semi-Volatile Organic Compounds							
2-Chlorophenol	ND	X	X	X	ND	X	X
2,4-Dichlorophenol	ND	X	X	X	ND	X	X
2,4-Dimethylphenol	ND	X	X	X	ND	X	X
2,4-Dinitrophenol	ND	X	X	X	ND	X	X
4,6-Dinitro-o-cresol	ND	X	X	X	ND	X	X
2-Methylphenol	ND	X	X	X	ND	X	X
3&4-Methylphenol	ND	X	X	X	ND	X	X
4-Nitrophenol	ND	X		X	ND	X	X
Phenol	ND	X		X	ND	X	X
2,4,5-Trichlorophenol	ND	X		X	ND	X	X
2,4,6-Trichlorophenol	ND	X		X	ND	X	X
Acenaphthene	ND	X	X	X	ND	X	X
Acenaphthylene		X	X	X		X	X
Anthracene		X	X	X		X	X
Benzo(a)anthracene		X	X	X		X	X
Benzo(a)pyrene		X	X	X		X	X
Benzo(b)fluoranthene		X	X	X		X	X
Benzo(g,h,i)perylene		X	X	X		X	X
Benzo(k)fluoranthene		X	X	X		X	X
Chrysene		X	X	X		X	X
Dibenzo(a,h)anthracene		X	X	X		X	X
bis(2-Ethylhexyl)phthalate		X	X	X		X	X
Fluoranthene		X	X	X		X	X
Fluorene	ND	X	X	X	ND	X	X
Indeno(1,2,3-cd)pyrene		X	X	X		X	X
Phenanthrene		X	X	X		X	X
Pyrene		X	X	X		X	X
Pesticides							
alpha-Chlordane	---	---	---	---		X	X
gamma-Chlordane	---	---	---	---		X	X
4,4'-DDD		X	X	X		X	X
4,4'-DDE		X	X	X		X	X
4,4'-DDT		X	X	X		X	X
Polychlorinated Biphenyls							
Aroclor 1260	---	---	---	---		X	X

Table 7-1a: Terrestrial Wildlife COPECs for Central and Southern AOCs
Wallops CDL Ecological Risk Assessment

	0-0.5 Soil				0-5 Soil		
	Detected?	COPEC?			Detected?	COPEC?	
		Flora	Invert	Wildlife		Flora	Wildlife
Dioxins							
2,3,7,8-TCDD	ND	X	X	X	ND	X	X
Inorganics							
Antimony		X		X		X	X
Arsenic		X	X	X		X	X
Barium		X	X			X	
Beryllium		X				X	
Cadmium		X	X	X		X	X
Chromium		X	X	X		X	X
Cobalt		X				X	
Copper		X	X	X		X	X
Lead		X	X	X		X	X
Manganese		X	X			X	
Mercury		X	X	X		X	X
Nickel		X	X	X		X	X
Selenium		X	X	X		X	X
Silver		X	X	X		X	X
Thallium		X	X	X		X	X
Vanadium		X	X	X		X	X
Zinc		X	X	X		X	X
Cyanide	ND	X	X	X	ND	X	X

ND= Not Detected
X indicates chemical was selected as a COPEC for the associated flora or fauna
--- indicates chemical is not a COPEC for the associated media

Table 7-1b: Aquatic Wildlife COPECs
Wallops CDL Ecological Risk Assessment

	Surface water		Sediment	
	Detected?	**COPEC?**	**Detected?**	**COPEC?**
Volatile Organic Compounds				
2-Butanone (MEK)	---	---		X
Carbon disulfide	---	---		X
Cyclohexane	---	---		X
Chlorobenzene	---	---	ND	X
1,2-Dichlorobenzene	---	---	ND	X
cis-1,3-Dichloropropene	ND	X	ND	X
trans-1,3-Dichloropropene	ND	X	ND	X
Methyl Acetate	---	---		X
Semi-Volatile Organic Compounds				
2-Chlorophenol	---	---	ND	X
Pentachlorophenol	ND	X	---	---
Acenaphthene	---	---	ND	X
Acenaphthylene	---	---	ND	X
Anthracene	ND	X	ND	X
Atrazine	ND	X	---	---
Benzo(a)anthracene	ND	X	ND	X
Benzo(a)pyrene	ND	X	ND	X
Benzo(b)fluoranthene	---	---	ND	X
Benzo(g,h,i)perylene	---	---	ND	X
Chrysene	---	---	ND	X
Dibenzo(a,h)anthracene	---	---	ND	X
Di-n-octyl phthalate	---	---		X
bis(2-Ethylhexyl)phthalate	---	---		X
Fluoranthene	ND	X	---	---
Fluorene	---	---	ND	X
Hexachlorobenzene	ND	X	ND	X
Indeno(1,2,3-cd)pyrene	---	---	ND	X
Phenanthrene	ND	X	ND	X
Pyrene	ND	X	ND	X
Pesticides				
Aldrin	---	---	ND	X
alpha-BHC	---	---	ND	X
beta-BHC	---	---	ND	X
Gamma-BCH (Lindane)	---	---	ND	X
alpha-Chlordane	ND	X	ND	X
gamma-Chlordane	ND	X	ND	X
4,4'-DDD	---	---		X
4,4'-DDE	---	---		X
4,4'-DDT	ND	X		X

Table 7-1b: Aquatic Wildlife COPECs
Wallops CDL Ecological Risk Assessment

	Surface water		Sediment	
	Detected?	**COPEC?**	**Detected?**	**COPEC?**
Pesticides (Continued)				
Endrin	---	---	ND	X
Endrin aldehyde	---	---	ND	X
Endrin ketone	---	---	ND	X
Endosulfan sulfate	---	---	ND	X
Endosulfan-I	---	---	ND	X
Heptachlor	ND	X	---	---
Heptachlor epoxide	ND	X	ND	X
Methoxychlor	ND	X	ND	X
Toxaphene	ND	X	---	---
Polychlorinated Biphenyls				
Aroclor 1016	ND	X	ND	X
Aroclor 1221	ND	X	ND	X
Aroclor 1232	ND	X	ND	X
Aroclor 1242	ND	X	ND	X
Aroclor 1248	ND	X	ND	X
Aroclor 1254	ND	X	ND	X
Aroclor 1260	ND	X	ND	X
Inorganics				
Aluminum		X		X
Antimony	---	---		X
Arsenic		X		X
Barium		X		X
Beryllium	---	---		X
Cadmium	ND	X		X
Chromium		X		X
Cobalt	ND	X	---	---
Copper		X		X
Iron		X		X
Lead		X		X
Mercury		X		X
Nickel		X		X
Selenium		X		X
Silver	ND	X		X
Thallium	ND	X		X
Vanadium	---	---		X
Zinc	---	---		X
Cyanide	ND	X	ND	X

ND= Not Detected
X indicates chemical was selected as a COPEC for aquatic wildlife
--- indicates chemical is not a COPEC for the associated media

Table 7-2: Assessment and Measurement Endpoints
Wallops CDL Ecological Risk Assessment

Receptors of Concern[a]	Assessment Endpoint	Measurement Endpoint
Plants		
Grasses Shrubs Trees	• Reduction in plant productivity or development	• Toxicity benchmarks for grasses, shrubs, and trees
Invertebrates		
Soil invertebrates	• Reduction in reproduction or abundance of the soil invertebrate community (plants, soil fauna, and soil microorganisms)	• Toxicity benchmarks for soil invertebrates
Benthic invertebrates	• Reduction in reproduction or abundance of benthic invertebrates	• Toxicity benchmarks for benthic invertebrates
Aquatic Life		
Fish	• Reduction in reproduction or abundance of the aquatic community (including fish)	• Toxicity benchmarks for aquatic life
Birds		
Herbivorous and Insectivorous birds	• Reduction in reproduction or abundance of herbivorous birds	• Toxicity benchmarks for the American Robin
Carnivorous birds	• Reduction in reproduction or abundance of carnivorous birds	• Toxicity benchmarks for the red-tailed hawk
Piscivorous birds	• Reduction in reproduction or abundance of piscivorous birds	• Toxicity benchmarks for the great blue heron
Mammals		
Herbivorous mammals	• Reduction in reproduction or abundance of herbivorous mammals	• Toxicity benchmarks for the meadow vole
Insectivorous mammals	• Reduction in reproduction or abundance of insectivorous mammals	• Toxicity benchmarks for the short-tailed shrew
Carnivorous mammals	• Reduction in reproduction or abundance of carnivorous mammals • Increased mortality, reproductive impairment, or developmental abnormalities to species of regulatory concern	• Toxicity benchmarks for the red fox
Piscivorous mammals	• Reduction in reproduction or abundance of piscivorous mammals	• Toxicity benchmarks for the river otter

Notes:

a - Amphibians were not evaluated due to lack of freshwater aquatic habitat at the CDL. Reptiles were not evaluated due to lack of toxicity data for these species.

Table 7-3: Receptors of Concern and Representative Species
Wallops CDL Ecological Risk Assessment

Receptors of Concern	Status	Terrestrial Habitat	Aquatic Habitat	Concern			Representative Species
				Regulatory	Ecological	Commercial	
Plants							
Herbaceous plants		•			•		Grasses and forbs
Shrubs and Trees		•			•		Shrubs and Trees
Invertebrates							
Soil invertebrates		•			•		Soil invertebrates
Benthic invertebrates			•		•		Benthic invertebrates
Fish							
Fish			•		•		Aquatic Life
Amphibians[a]							
Frogs, salamanders, newts		•			•		
Reptiles[b]							
Lizards, snakes, turtles		•			•		
Herbivorous and Insectivorous Birds							
Passerines, fowl		•			•		Am. Robin
Carnivorous Birds							
Raptors, owls		•			•		Red-tailed Hawk
Herbivorous Mammals							
Rodents, lagomorphs, ruminants		•			•		Meadow vole
Piscivorous Birds							
Herons, bitterns			•				Great blue heron
Insectivorous Mammals							
Shrews, moles, bats		•			•		Short-tailed shrew
Carnivorous Mammals							
Canines, felines, weasels		•			•		Red fox
Piscivorous Mammals							
River Otter, Mink		•	•				River Otter

Notes:

- • - May occur in habitats at the CDL.
- a - Potential risks to amphibians were not assessed because of the absence of fresh surface water at the site.
- b - Potential risks to reptiles could not be assessed due to the lack of applicable toxicity data for reptiles.

Table 7-4: Exposure Factors for Representative Species
Wallops CDL Ecological Risk Assessment

Guild / Common Name	Body Weight (kg)	Food Ingestion Rate [DW] (kg/d)	Soil Ingestion Rate kg/day	Water Ingestion Rate kg/day	Food Item(a)	% Soil	Diet Proportions Plant	Invert	Fish	Mammal	Soil Depth (ft bgs)	Home Range (ha)	AOC (ha)	SPI	Source
Plants															
Grasses and forbs	—	—	—	—	—	—	—	—	—	—	0-0.5	—		1	
Trees and Shrubs	—	—	—	—	—	—	—	—	—	—	0-5	—		1	
Invertebrates															
Soil invertebrates	—	—	—	—	—	—	—	—	—	—	0-0.5	—		1	
Aquatic inverts	—	—	—	—	—	—	—	—	—	—	—	—		1	
Birds															
Insectivorous birds															
American Robin	0.0806	0.0717	0.0118	0.0113	Invertebrates	16.4%	0%	100%	0%	0%	0-0.5	0.15	2.53	1	1, 2
Carnivorous birds															
Red-tailed Hawk	1.204	0.0425	0.0024	0.0662	Sm. mammals	5.7%	0%	0%	0%	100%	0-0.5	60	2.53	0.042	1, 2
Piscivorous bird															
Great blue heron	2.204	0.3967	0.0074	0.0992	Fish	2%	0%	0%	100%	0%	—	0.6	1.78	1	1, 3
Mammals															
Herbivorous mammals															
Meadow vole	0.039	0.0034	0.0001	0.0082	Plant (grasses)	3.2%	100%	0%	0%	0%	0-0.5	0.007	2.53	1	1, 2, 4
Insectivorous mammals															
Short-tailed shrew	0.0174	0.0036	0.0001	0.0039	Invertebrates	3.0%	0%	100%	0%	0%	0-5	0.39	2.53	1	1, 2, 4
Carnivorous mammals															
Red fox	4.13	0.5782	0.0162	0.3552	Sm. mammals	2.8%	0%	0%	0%	100%	0-0.5.	699	2.53	0.004	1, 4, 5
Piscivorous mammals															
River Otter	6.73	0.9	0	0.5519	Fish	2%	2%	0%	100%	0%	0-0.5.	295	4.31	0.015	1, 3, 6

Table 7-4: Exposure Factors for Representative Species
Wallops CDL Ecological Risk Assessment

Definitions:

AOC	-	area of concern
bgs	-	below ground surface
DW	-	dry weight
ft	-	feet
ha	-	hectares
kg	-	kilograms
kg/d	-	kilograms per day
SPI	-	site presence index

Sources:

1	-	Average body weights, diet proportions, food and water ingestion rates, and home ranges were obtained from breeding female or adult values in the Wildlife Exposure Factors Handbook (U.S. EPA 1993).
2	-	Soil % ingestion obtained from Eco SSL Attachment 4-1 (U.S. EPA 2008a) 90th percentile value.
3	-	Soil or sediment % ingestion was not available for this species. Values based on species with similar feeding biology from Eco SSL Attachment 4-1 (USEPA 2008a).
4	-	Soil % ingestion obtained from Beyer *et al*. 1994.
5	-	Food ingestion rate obtained from Sample and Suter 1998.

Table 7-5: Toxicity Reference Values for Plants and Invertebrates
Wallops CDL Ecological Risk Assessment

COPEC	Plants (mg/kg soil)	Plant Reference	Invertebrates (mg/kg soil)	Invertebrate Reference
VOCs				
1,2-Dichlorobenzene	0.1	USEPA 1995	---	
1,4-Dichlorobenzene	0.1	USEPA 1995	20	Efroymson et al. 1997b
Methyl Acetate	---		---	
Methylcyclohexane	---		---	
Tetrachloroethene	0.3	USEPA 1995	---	
SVOCs				
2-Chlorophenol	0.1	USEPA 1995	---	
2,4-Dichlorophenol	20	Efroymson et al. 1997a	---	
2,4-Dimethylphenol	0.1	USEPA 1995	---	
2,4-Dinitrophenol	20	Efroymson et al. 1997a	---	
4,6-Dinitro-o-cresol	0.1	USEPA 1995	---	
2-Methylphenol (o-cresol)	0.1	USEPA 1995	---	
3&4-Methylphenol (m, p-cresol)	0.1	USEPA 1995	---	
4-Nitrophenol	0.1	USEPA 1995	7	Efroymson et al. 1997b
Phenol	0.1	USEPA 1995	100	Efroymson et al. 1997b
2,4,5-Trichlorophenol	4.3	Efroymson et al. 1997a	10	Efroymson et al. 1997b
2,4,6-Trichlorophenol	4.3	Efroymson et al. 1997a	10	Efroymson et al. 1997b
Acenaphthene	0.1	USEPA 1995	18	USEPA 2008a
Acenaphthylene	20	Efroymson et al. 1997a	18	USEPA 2008a
Anthracene	0.1	USEPA 1995	18	USEPA 2008a
Benzo(a)anthracene	0.1	USEPA 1995	29	USEPA 2008a
Benzo(a)pyrene	0.1	USEPA 1995	29	USEPA 2008a
Benzo(b)fluoranthene	0.1	USEPA 1995	29	USEPA 2008a
Benzo(g,h,i)perylene	0.1	USEPA 1995	29	USEPA 2008a
Benzo(k)fluoranthene	0.1	USEPA 1995	29	USEPA 2008a
Chrysene	0.1	USEPA 1995	29	USEPA 2008a
Dibenzo(a,h)anthracene	0.1	USEPA 1995	29	USEPA 2008a
bis(2-Ethylhexyl)phthalate	---		---	
Fluoranthene	0.1	USEPA 1995	29	USEPA 2008a
Fluorene	0.1	USEPA 1995	18	USEPA 2008a
Indeno(1,2,3-cd)pyrene	0.1	USEPA 1995	29	USEPA 2008a
Phenanthrene	0.1	USEPA 1995	29	USEPA 2008a
Pyrene	0.1	USEPA 1995	29	USEPA 2008a

Table 7-5: Toxicity Reference Values for Plants and Invertebrates
Wallops CDL Ecological Risk Assessment

COPEC	Plants (mg/kg soil)	Plant Reference	Invertebrates (mg/kg soil)	Invertebrate Reference
Pesticides				
alpha-Chlordane	---		---	
gamma-Chlordane	---		---	
DDT / DDD / DDE	0.1	USEPA 1995	---	
DDT / DDD / DDE	0.1	USEPA 1995	---	
DDT / DDD / DDE	0.1	USEPA 1995	---	
Polychlorinated Biphenyls				
Aroclor 1260	40*	Efroymson et al. 1997a	---	
Dioxins				
2,3,7,8-TCDD	---		5	Reinecke and Nash 1984
Inorganics				
Antimony	5.0	Efroymson et al. 1997a	78	USEPA 2008a
Arsenic	18	USEPA 2008a	100	Efroymson et al. 1997b
Barium	500	Efroymson et al. 1997a	330	USEPA 2008a
Beryllium	10	Efroymson et al. 1997a	40	USEPA 2008a
Cadmium	32.0	USEPA 2008a	140	USEPA 2008a
Chromium	1.0**	Efroymson et al. 1997a	10	Efroymson et al. 1997b
Cobalt	13	USEPA 2008a	1000	Efroymson et al. 1997b
Copper	70	USEPA 2008a	80	USEPA 2008a
Lead	120	USEPA 2008a	1700	USEPA 2008a
Manganese	220	USEPA 2008a	450	USEPA 2008a
Mercury	0.3	Efroymson et al. 1997a	30	Efroymson et al. 1997b
Nickel	38	USEPA 2008a	280	USEPA 2008a
Selenium	0.52	USEPA 2008a	4.1	USEPA 2008a
Silver	560.0	USEPA 2008a	50	Efroymson et al. 1997b
Thallium	1.0	Efroymson et al. 1997a	---	
Vanadium	2	Efroymson et al. 1997a	20	Efroymson et al. 1997b
Zinc	160	USEPA 2008a	120	USEPA 2008a
Cyanide	---		---	

Notes:

Dash indicates no toxicity benchmark is proposed.

* Value for Total PCBs

** Value for Chrominm VI

Table 7-6: Toxicity Reference Values for Birds
Wallops CDL Ecological Risk Assessment

	Unadjusted Toxicity Benchmark [a]		Reference
	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	
VOCs			
1,2-Dichlorobenzene	---	---	---
1,4-Dichlorobenzene	---	---	---
Methyl Acetate	---	---	---
Methylcyclohexane	---	---	---
Tetrachloroethene	---	---	---
1,2,4-Trichlorobenzene	---	---	---
SVOCs			
2-Chlorophenol	---	---	---
2,4-Dichlorophenol	---	---	---
2,4-Dimethylphenol	---	---	---
2,4-Dinitrophenol	---	---	---
4,6-Dinitro-o-cresol	---	---	---
2-Methylphenol (o-cresol)	---	---	---
3&4-Methylphenol (m, p-cresol)	---	---	---
4-Nitrophenol	---	---	---
Phenol	---	---	---
2,4,5-Trichlorophenol	---	---	---
2,4,6-Trichlorophenol	---	---	---
Acenaphthene	---	---	---
Acenaphthylene	---	---	---
Anthracene	---	---	---
Benzo(a)anthracene	---	---	---
Benzo(a)pyrene	---	---	---
Benzo(b)fluoranthene	---	---	---
Benzo(g,h,i)perylene	---	---	---
Benzo(k)fluoranthene	---	---	---
Chrysene	---	---	---
Dibenzo(a,h)anthracene	---	---	---
bis(2-Ethylhexyl)phthalate	1.10	---	
Fluoranthene	---	---	---
Fluorene	---	---	---
Indeno(1,2,3-cd)pyrene	---	---	---
Phenanthrene	---	---	---
Pyrene	---	---	---
Pesticides			
alpha-Chlordane	2.00E-01	1.10E+00	Stickel et al. 1983
gamma-Chlordane	2.00E-01	1.10E+00	Stickel et al. 1983
DDT / DDD / DDE	0.0028	0.0280	Sample *et al.* 1996
Polychlorinated Biphenyls			
Aroclor 1260	4.17E-01	1.80E+00	McLane & Hughes 1980
Dioxins			
2,3,7,8-TCDD	1.40-05	1.40E-04	Sample *et al.* 1996

Table 7-6: Toxicity Reference Values for Birds
Wallops CDL Ecological Risk Assessment

Inorganics			
Antimony	---	---	---
Arsenic	5.14	12.84	Sample *et al.* 1996
Barium	20.80	41.70	Sample *et al.* 1996
Beryllium	---	---	---
Cadmium	1.45	20.00	Sample *et al.* 1996
Chromium	1.00	5.00	Sample *et al.* 1996
Cobalt	---	---	---
Copper	47.00	61.70	Sample *et al.* 1996
Lead	1.13	11.30	Sample *et al.* 1996
Manganese	977.00	---	Sample *et al.* 1996
Mercury	0.0064	0.06	Sample *et al.* 1996
Nickel	77.40	107.00	Sample *et al.* 1996
Selenium	0.50	1.00	Sample *et al.* 1996
Silver	---	---	---
Thallium	---	---	---
Vanadium	11.40	---	Sample *et al.* 1996
Zinc	14.50	131.00	Sample *et al.* 1996
Cyanide	---	---	---

Notes:

a - Scaling factors were not used as all avian species weights were within two orders of magnitude from test subject weights.

Definitions:

BW - body weight
kg - kilograms
LOAEL - Lowest-observable-adverse-effects limit
NOAEL - No-observable-adverse-effects limit

Table 7-7: Toxicity Reference Values for Mammals
Wallops CDL Ecological Risk Assessment

	Unadjusted Toxicity Benchmark		Meadow Vole		Short-tailed Shrew		Red Fox		Reference
	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	
VOCs									
Dichlorobenzene	50	500	93	930	122	1220	20	200	Giavini et al. 1986
1,4-Dichlorobenzene	50	500	93	930	122	1220	20	200	Dichlorobenzene as surrogate
Methyl Acetate	---	---	---	---	---	---	---	---	
Methylcyclohexane	---	---	---	---	---	---	---	---	
Tetrachloroethene	1.40	7.00	1.27	6.36	1.66	8.32	4.74	2.00	Sample *et al*. 1996
1,2,4-Trichlorobenzene	50	500	93	930	122	1220	20	200	Dichlorobenzene as surrogate
SVOCs									
2-Chlorophenol	---	---	---	---	---	---	---	---	
2,4-Dichlorophenol	---	---	---	---	---	---	---	---	
2,4-Dimethylphenol	---	---	---	---	---	---	---	---	
2,4-Dinitrophenol	---	---	---	---	---	---	---	---	
4,6-Dinitro-o-cresol	---	---	---	---	---	---	---	---	
2-Methylphenol (o-cresol)	219.20	---	478.60	---	626.40	---	150.50	---	Sample *et al*. 1996
3&4-Methylphenol	---	---	---	---	---	---	---	---	
4-Nitrophenol	---	---	---	---	---	---	---	---	
Phenol	---	---	---	---	---	---	---	---	
2,4,5-Trichlorophenol	---	---	---	---	---	---	---	---	
2,4,6-Trichlorophenol	---	---	---	---	---	---	---	---	
Acenaphthene	---	---	---	---	---	---	---	---	
Acenaphthylene	---	---	---	---	---	---	---	---	
Anthracene	---	---	---	---	---	---	---	---	
Benzo(a)anthracene	---	---	---	---	---	---	---	---	
Benzo(a)pyrene	1.00	10.00	0.91	9.09	1.19	11.89	0.29	2.86	Sample *et al*. 1996
Benzo(b)fluoranthene	---	---	---	---	---	---	---	---	
Benzo(g,h,i)perylene	---	---	---	---	---	---	---	---	
Benzo(k)fluoranthene	---	---	---	---	---	---	---	---	
Chrysene	---	---	---	---	---	---	---	---	
Dibenzo(a,h)anthracene	---	---	---	---	---	---	---	---	
bis(2-Ethylhexyl)phthalate	18.30	183.00	16.60	166.00	21.80	218.00	5.20	52.00	Sample *et al*. 1996
Fluoranthene	---	---	---	---	---	---	---	---	
Indeno(1,2,3-cd)pyrene	---	---	---	---	---	---	---	---	
Phenanthrene	---	---	---	---	---	---	---	---	
Pyrene	---	---	---	---	---	---	---	---	
Pesticides									
Chlordane	4.69	9.2	4.20	8.40	5.5	10.9	1.30	2.6	Sample *et al*. 1996
DDT / DDD / DDE	0.80	4.00	1.34	6.72	1.76	8.79	0.42	2.11	Sample *et al*. 1996
Polychlorinated Biphenyls									
Aroclor 1260	0.14	0.70	0.41	2.06	0.54	2.70	0.09	0.04	Aulerich & Ringer 1977 (total PCB as surrogate)
Dioxins									
2,3,7,8-TCDD	1.00E-06	1.00E-05	1.68E-06	1.68E-05	2.20E-06	2.20E-05	5.30E-07	5.30E-06	Sample *et al*. 1996
Inorganics									
Antimony	0.125	1.25	0.114	1.136	0.146	1.487	0.036	0.357	Sample *et al*. 1996
Arsenic	0.126	1.26	0.114	1.145	0.150	1.498	0.036	0.360	Sample *et al*. 1996
Barium	5.10	19.80	9.00	33.30	11.80	43.50	2.80	10.50	Sample *et al*. 1996
Beryllium	0.66	---	1.11	---	1.45	---	0.35	---	Sample *et al*. 1996
Cadmium	1.00	10.00	1.62	16.20	2.12	21.20	0.51	5.09	Sample *et al*. 1996
Chromium III	2737	---	4597	---	6015	---	1445	---	Sample *et al*. 1996
Chromium VI	3.28	13.14	5.51	22.07	7.21	28.88	1.73	6.94	Sample *et al*. 1996
Cobalt	---	---	---	---	---	---	---	---	
Copper	11.70	15.40	25.50	33.60	33.40	44.00	8.00	10.60	Sample *et al*. 1996
Lead	8.00	80.00	13.44	134.35	17.58	175.83	4.22	42.25	Sample *et al*. 1996
Manganese	88.00	284.00	148.00	477.00	193.00	624.00	46.00	150.00	Sample *et al*. 1996
Mercury	1.00	---	2.18	---	2.86	---	0.69	---	Sample *et al*. 1996
Nickel	40.00	80.00	67.18	134.35	87.91	175.83	21.12	42.25	Sample *et al*. 1996
Selenium	0.20	0.33	0.336	0.554	0.440	0.725	0.106	0.174	Sample *et al*. 1996
Silver	---	---	---	---	---	---	---	---	
Thallium	---	---	---	---	---	---	---	---	
Vanadium	0.21	2.10	0.327	3.274	0.428	4.285	0.103	1.030	Sample *et al*. 1996
Zinc	160.00	320.00	268.70	537.40	351.70	703.30	84.50	169.00	Sample *et al*. 1996
Cyanide	68.70	---	108.40	---	141.90	---	34.10	---	Sample *et al*. 1996

Table 7-8: Toxicity Reference Values for Aquatic Species
Wallops CDL Ecological Risk Assessment

COPEC	Aquatic Life (µg/L)	Aquatic Life Reference	Benthic Invert (mg/kg)	Reference	Great Blue Heron			River Otter		
					NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	Reference	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	Reference
VOCs										
2-Butanone (MEK)	NA		---	USEPA 2008c	---	---		810	2091	Sample *et al.* 1996
Carbon disulfide	NA		0.00085	USEPA 2008c	---	---		---	---	
Chlorobenzene	NA		0.00842	USEPA 2008c	---	---		---	---	
Cyclohexane	NA		---	USEPA 2008c	---	---		---	---	
1,2-Dichlorobenzene	NA		0.0165	USEPA 2008c	---	---		17	170	Sample *et al.* 1996
cis-1,2-Dichloroethene	0.055	USEPA 2008c	0.00005	USEPA 2008c	---	---		---	---	
trans-1,2-Dichloroethene	0.055	USEPA 2008c	0.00005	USEPA 2008c	---	---		---	---	
Methyl Acetate	NA		---	USEPA 2008c	---	---		---	---	
SVOCs										
2-Chlorophenol	NA		0.0312	USEPA 2008c	---	---		---	---	
Pentachlorophenol	6.7	VA 2007	NA		---	---		0.110	1.098	Sample *et al.* 1996
Acenaphthene	NA		0.0067	USEPA 2008c	---	---		---	---	
Acenaphthylene	NA		0.0059	USEPA 2008c	---	---		---	---	
Anthracene	0.012	USEPA 2008c	0.0572	USEPA 2008c	---	---		---	---	
Atrazine	1.8	USEPA 2008c	NA		---	---		---	---	
Benzo(a)anthracene	0.018	USEPA 2008c	0.108	USEPA 2008c	---	---		---	---	
Benzo(a)pyrene	0.015	USEPA 2008c	0.15	USEPA 2008c	---	---		0.25	2.47	Sample *et al.* 1996
Benzo(b)fluoranthene	NA		0.0272	USEPA 2008c	---	---		---	---	
Benzo(g,h,i)perylene	NA		0.17	USEPA 2008c	---	---		---	---	
Chrysene	NA		0.166	USEPA 2008c	---	---		---	---	
Dibenzo(a,h)anthracene	NA		0.033	USEPA 2008c	---	---		---	---	
Di-n-octyl phthalate	NA		---	USEPA 2008c	---	---		---	---	
bis(2-Ethylhexyl)phthalate	NA		0.182	USEPA 2008c	1.10	---	Sample *et al.* 1996	4.5	45.0	Sample *et al.* 1996
Fluoranthene	0.04	USEPA 2008c	NA		---	---		---	---	
Fluorene	NA		0.0774	USEPA 2008c	---	---		---	---	
Hexachlorobenzene	0.0003	USEPA 2008c	0.02	USEPA 2008c	---	---		---	---	
Indeno(1,2,3-cd)pyrene	NA		0.017	USEPA 2008c	---	---		---	---	
2-Methylnaphthalene	NA		0.0202	USEPA 2008c	---	---		---	---	
Naphthalene	NA		0.176	USEPA 2008c	---	---		---	---	
Phenanthrene	0.4	USEPA 2008c	0.204	USEPA 2008c	---	---		---	---	
Pyrene	0.025	USEPA 2008c	0.195	USEPA 2008c	---	---		---	---	

Table 7-8: Toxicity Reference Values for Aquatic Species
Wallops CDL Ecological Risk Assessment

COPEC	Aquatic Life (µg/L)	Aquatic Life Reference	Benthic Invert (mg/kg)	Reference	Great Blue Heron			River Otter		
					NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	Reference	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	Reference
Pesticides										
Aldrin	NA		0.002	USEPA 2008c	---	---		0.091	0.457	Sample *et al.* 1996
alpha-BHC	NA		0.006	USEPA 2008c	---	---		---	---	
beta-BHC	NA		0.005	USEPA 2008c	---	---		0.18	0.91	Sample *et al.* 1996
gamma-BHC (Lindane)	NA		0.00237	USEPA 2008c	2.00	20.00	Sample *et al.* 1996	3.66	---	Sample *et al.* 1996
alpha-Chlordane	0.004	VA 2007	0.00324	USEPA 2008c	2.1	10.7	Sample *et al.* 1996	1.1	2.3	Sample *et al.* 1996
gamma-Chlordane	0.004	VA 2007	0.00324	USEPA 2008c	2.1	10.7	Sample *et al.* 1996	1.1	2.3	Sample *et al.* 1996
DDD	NA		0.00488	USEPA 2008c	0.003	0.028	Sample *et al.* 1996	0.37	1.83	Sample *et al.* 1996
DDE	NA		0.00316	USEPA 2008c	0.003	0.028	Sample *et al.* 1996	0.37	1.83	Sample *et al.* 1996
DDT	0.001	VA 2007	0.00416	USEPA 2008c	0.003	0.028	Sample *et al.* 1996	0.37	1.83	Sample *et al.* 1996
Endrin	NA		0.00222	USEPA 2008c	0.010	0.100	Sample *et al.* 1996	0.023	0.228	Sample *et al.* 1996
Endrin aldehyde	NA		0.00222	USEPA 2008c	---	---		---	---	
Endrin ketone	NA		0.00222	USEPA 2008c	---	---		---	---	
Endosulfan sulfate	NA		0.0054	USEPA 2008c	---	---		---	---	
Endosulfan	NA		0.0029	USEPA 2008c	---	---		0.07	---	Sample *et al.* 1996
Heptachlor	0.0036	VA 2007	NA		---	---		0.059	0.595	Sample *et al.* 1996
Heptachlor epoxide	0.0036	VA 2007	0.00247	USEPA 2008c	---	---		---	---	
Methoxychlor	0.03	VA 2007	0.0187	USEPA 2008c	---	---		1.8	3.7	Sample *et al.* 1996
Toxaphene	0.0002	VA 2007	---		---	---		3.7	---	Sample *et al.* 1996
Polychlorinated Biphenyls										
Aroclor 1016	0.014	VA 2007	0.0598	USEPA 2008c	---	---		0.81	2.04	Sample *et al.* 1996
Aroclor 1221	0.014	VA 2007	0.0598	USEPA 2008c	---	---		---	---	
Aroclor 1232	0.014	VA 2007	0.0598	USEPA 2008c	---	---		---	---	
Aroclor 1242	0.014	VA 2007	0.0598	USEPA 2008c	0.410	---	Sample *et al.* 1996	0.041	0.410	Sample *et al.* 1996
Aroclor 1248	0.014	VA 2007	0.0598	USEPA 2008c	---	---		0.009	0.086	Sample *et al.* 1996
Aroclor 1254	0.014	VA 2007	0.0598	USEPA 2008c	0.180	1.800	Sample *et al.* 1996	0.083	0.410	Sample *et al.* 1996
Aroclor 1260	0.014	VA 2007	0.0598	USEPA 2008c	---	---		---	---	
Inorganics										
Aluminum	87	USEPA 2008c	---		44.5	109.7	Sample *et al.* 1996	0.478	4.776	Sample *et al.* 1996
Antimony	NA		2.0	USEPA 2008c	---	---		0.031	0.309	Sample *et al.* 1996
Arsenic	36	VA 2007	9.8	USEPA 2008c	5.1	12.8	Sample *et al.* 1996	0.031	0.312	Sample *et al.* 1996
Barium	4	USEPA 2008c	---		20.8	41.7	Sample *et al.* 1996	2.5	9.1	Sample *et al.* 1996
Beryllium	NA		---		---	---		0.30	---	Sample *et al.* 1996
Cadmium	1.1	VA 2007	0.99	USEPA 2008c	1.45	20.00	Sample *et al.* 1996	0.441	4.412	Sample *et al.* 1996

Table 7-8: Toxicity Reference Values for Aquatic Species
Wallops CDL Ecological Risk Assessment

COPEC	Aquatic Life (µg/L)	Aquatic Life Reference	Benthic Invert (mg/kg)	Reference	Great Blue Heron			River Otter		
					NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	Reference	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	Reference
Inorganics (Continued)										
Chromium	11	USEPA 2008c	43.4	USEPA 2008c	1.00	5.00	Sample *et al.* 1996	1.50	6.01	Sample *et al.* 1996
Cobalt	23	USEPA 2008c	NA		---	---		---	---	
Copper	6	VA 2007	31.6	USEPA 2008c	47.0	61.7	Sample *et al.* 1996	7.0	9.2	Sample *et al.* 1996
Iron	300	USEPA 2008c	20000	USEPA 2008c				---	---	
Lead	9.3	VA 2007	35.8	USEPA 2008c	1.13	11.30	Sample *et al.* 1996	3.66	36.59	Sample *et al.* 1996
Mercury	0.77	VA 2007	0.18	USEPA 2008c	0.45	0.90	Sample *et al.* 1996	0.59	---	Sample *et al.* 1996
Nickel	8.2	VA 2007	22.7	USEPA 2008c	77.40	107.00	Sample *et al.* 1996	18.29	36.59	Sample *et al.* 1996
Selenium	5.0	VA 2007	2.0	USEPA 2008c	0.500	1.000	Sample *et al.* 1996	0.091	0.151	Sample *et al.* 1996
Silver	0.23	USEPA 2008c	1.0	USEPA 2008c	---	---		---	---	
Thallium	0.8	USEPA 2008c	---		---	---		0.003	0.034	Sample *et al.* 1996
Vanadium	NA		---		11.400	---	Sample *et al.* 1996	0.089	0.892	Sample *et al.* 1996
Zinc	NA		121	USEPA 2008c	14.5	131.0	Sample *et al.* 1996	73.2	146.4	Sample *et al.* 1996
Cyanide	1.0	VA 2007	0.1	USEPA 2008c	---	---		29.5	---	Sample *et al.* 1996

NA – Not applicable; not a COPEC for this media.

Table 7-9: Soil to Plant Bioaccumulation Values
Wallops CDL Ecological Risk Assessment

	Slope (m)	Y-Intercept (b)	UF	Source	Default UF	0-0.5 ft Soil EPC (mg/kg)	Plant Tissue Conc. (mg/kg)
Volatile Organic Compounds							
Methyl Acetate	---	---	---	---	1	1.1900	1.1900
Methylcyclohexane	---	---	---	---	1	0.0025	0.0025
Semi-Volatile Organic Compounds							
Acenaphthylene	0.791	-1.144	---	USEPA 2008a	---	0.1580	0.0740
Anthracene	0.7784	-0.9887	---	USEPA 2008a	---	0.2670	0.1331
Benzo(a)anthracene	0.5944	-2.7078	---	USEPA 2008a	---	2.4900	0.1147
Benzo(a)pyrene	0.975	-2.0615	---	USEPA 2008a	---	1.9100	0.2392
Benzo(b)fluoranthene	---	---	0.31	USEPA 2008a	---	1.3900	0.4309
Benzo(g,h,i)perylene	1.1829	-0.9313	---	USEPA 2008a	---	1.1800	0.4793
Benzo(k)fluoranthene	0.8595	-2.1579	---	USEPA 2008a	---	1.0300	0.1185
Chrysene	0.5944	-2.7078	---	USEPA 2008a	---	4.0400	0.1529
Dibenzo(a,h) anthracene	---	---	0.13	USEPA 2008a	---	0.3880	0.0504
bis(2-Ethylhexyl)phthalate	---	---	---	---	1	0.1110	0.1110
Fluoranthene	---	---	0.5	USEPA 2008a	---	0.7272	0.3636
Indeno(1,2,3-cd)pyrene	---	---	0.11	USEPA 2008a	---	0.6170	0.0679
Phenanthrene	0.6203	-0.1665	---	USEPA 2008a	---	2.2300	1.3923
Pyrene	---	---	0.72	USEPA 2008a	---	1.8240	1.3133
Pesticides							
4,4'-DDD	0.7524	-2.5119	---	Bechtel Jacobs 1998a	---	0.09578	0.0139
4,4'-DDE	0.7524	-2.5119	---	Bechtel Jacobs 1998a	---	0.6283	0.0572
4,4'-DDT	0.7524	-2.5119	---	Bechtel Jacobs 1998a	---	0.3916	0.0401
Inorganics							
Antimony	0.938	-3.233	---	USEPA 2008a	---	63.7	1.9418
Arsenic	---	---	0.0375	USEPA 2008a	---	6.025	0.2261
Barium	---	---	0.156	USEPA 2008a	---	603.4	94.1304
Beryllium	0.7345	-0.5361		USEPA 2008a	---	0.607	0.4054
Cadmium	0.546	-0.475	---	USEPA 2008a	---	17.14	2.9341
Chromium	---	---	0.041	USEPA 2008a	---	89.67	3.6765
Cobalt	---	---	0.0075	USEPA 2008a	---	18.62	0.1387
Copper	0.394	0.668	---	USEPA 2008a	---	1790.000	37.3021
Lead	0.561	-1.328	---	USEPA 2008a	---	2120.000	19.4684
Manganese	-	-	0.0792	USEPA 2008a	---	774.4	61.3325
Mercury	0.554	-0.996	---	Bechtel Jacobs 1998a	---	0.746	0.3140
Nickel	0.748	-2.223	---	USEPA 2008a	---	459.5	10.6158
Selenium	1.104	-0.677	---	USEPA 2008a	---	4.4	2.6083
Silver	---	---	0.014	USEPA 2008a	---	60.37	0.8452
Thallium	---	---	0.004	USEPA 2008a	1	0.118	0.0005
Vanadium	---	---	0.0049	USEPA 2008a	---	38.5	0.1867
Zinc	0.554	1.575	---	USEPA 2008a	---	4280	496.4022

$\ln(\text{Plant Tissue}_{DW}) = m * \ln(\text{Soil}_{DW}) + b$
$\text{Plant Tissue}_{DW} = \text{Soil}_{DW} * UF$

Table 7-10: Soil to Invertebrate Bioaccumulation Values
Wallops CDL Ecological Risk Assessment

	Slope (m)	Y-Intercept (b)	UF	Source	Default UF	0-0.5 ft Soil EPC (mg/kg)	Earthworm Tissue Conc. (mg/kg)
Volatile Organic Compounds							
Methyl Acetate	---	---	---	---	1	1.19E+0	1.19E+0
Methylcyclohexane	---	---	---	---	1	2.50E-3	2.50E-3
Semi-Volatile Organic Compounds							
Acenaphthylene	---	---	22.9	USEPA 2008a	---	0.1580	3.62E+0
Anthracene	---	---	2.42	USEPA 2008a	---	0.2670	6.46E-1
Benzo(a)anthracene	---	---	1.59	USEPA 2008a	---	2.4900	3.96E+0
Benzo(a)pyrene	---	---	1.33	USEPA 2008a	---	1.9100	2.54E+0
Benzo(b)fluoranthene	---	---	2.6	USEPA 2008a	---	1.3900	3.61E+0
Benzo(g,h,i)perylene	---	---	2.94	USEPA 2008a	---	1.1800	3.47E+0
Benzo(k)fluoranthene	---	---	2.6	USEPA 2008a	---	1.0300	2.68E+0
Chrysene	---	---	2.29	USEPA 2008a	---	4.0400	9.25E+0
Dibenzo(a,h) anthracene	---	---	2.31	USEPA 2008a	---	0.3880	8.96E-1
bis(2-Ethylhexyl)phthalate	---	---	---	---	1	0.1110	0.1110
Fluoranthene	---	---	3.04	USEPA 2008a	---	0.7272	2.21E+0
Indeno(1,2,3-cd)pyrene	---	---	2.86	USEPA 2008a	---	0.6170	1.76E+0
Phenanthrene	---	---	1.72	USEPA 2008a	---	2.2300	3.84E+0
Pyrene	---	---	1.75	USEPA 2008a	---	1.8240	3.19E+0
Pesticides							
4,4'-DDD	0.6975	1.1613	---	USEPA 2008a	---	0.09578	0.6220
4,4'-DDE	0.8804	2.4771	---	USEPA 2008a	---	0.6283	7.9086
4,4'-DDT	0.8689	2.1247	---	USEPA 2008a	---	0.3916	3.7065
Inorganics							
Antimony	---	---	1.000	Ce=Cs (EPA2008a)	---	63.7	63.7
Arsenic	0.706	-1.421	---	USEPA 2008a	---	6.025	0.8581
Barium	---	---	0.091	USEPA 2008a	---	603.4	54.9094
Beryllium	---	---	0.0450	USEPA 2008a	---	0.607	0.0273
Cadmium	0.795	2.114	---	USEPA 2008a	---	17.14	79.2752
Chromium	---	---	0.306	USEPA 2008a	---	89.67	27.4390
Cobalt	---	---	0.122	USEPA 2008a	---	18.62	2.2716
Copper	---	---	0.515	USEPA 2008a	---	1790.0	921.8500
Lead	0.807	-0.218	---	USEPA 2008a	---	2120.0	388.7558
Manganese	0.682	-0.809	---	USEPA 2008a	---	774.4	41.5844
Mercury	0.118	-0.684	---	Sample et al. 1998a	1	0.746	0.4874
Nickel	-0.260	3.677	---	Sample et al. 1998a	1	459.5	8.0298
Selenium	0.733	-0.075	---	USEPA 2008a	---	4.4	1.7625
Silver	---	---	2.045	USEPA 2008a	---	60.37	123.4567
Thallium	---	---	---	---	1	0.118	0.0260
Vanadium	---	---	0.042	USEPA 2008a	---	38.5	1.6170
Zinc	0.328	4.449	---	USEPA 2008a	---	4280	1328.2802

Cs - Concentration in soil

Ce - Concentration in earthworm

$\ln(\text{Earthworm Tissue}_{DW}) = m * \ln(\text{Soil}_{DW}) + b$

$\text{Earthworm Tissue}_{DW} = \text{Soil}_{DW} * UF$

Table 7-11: Soil to Small Mammal Bioaccumulation Values
Wallops CDL Ecological Risk Assessment

	Slope (m)	Y-Intercept (b)	UF	Other	Source	Default UF	0-0.5 ft Soil EPC (mg/kg)	0-5 ft Soil EPC (mg/kg)	Herbivore Tissue Conc. (mg/kg)	Insectivore Tissue Conc. (mg/kg)
Volatile Organic Compounds										
Methyl Acetate	---	---	---	---	---	1	1.19	1.19	1.19	1.19
Methylcyclohexane	---	---	---	---	---	1	0.0025	0.0025	0.0025	0.0025
Semi-Volatile Organic Compounds										
Acenaphthylene	---	---	---	C_m=0	USEPA 2008a	---	0.1580	0.158	0.00	0.00
Anthracene	---	---	---	C_m=0	USEPA 2008a	---	0.2670	0.267	0.00	0.00
Benzo(a)anthracene	---	---	---	C_m=0	USEPA 2008a	---	2.4900	2.49	0.00	0.00
Benzo(a)pyrene	---	---	---	C_m=0	USEPA 2008a	---	1.9100	1.91	0.00	0.00
Benzo(b)fluoranthene	---	---	---	C_m=0	USEPA 2008a	---	1.3900	1.39	0.00	0.00
Benzo(g,h,i)perylene	---	---	---	C_m=0	USEPA 2008a	---	1.1800	1.18	0.00	0.00
Benzo(k)fluoranthene	---	---	---	C_m=0	USEPA 2008a	---	1.0300	1.03	0.00	0.00
Chrysene	---	---	---	C_m=0	USEPA 2008a	---	4.0400	1.869	0.00	0.00
Dibenzo(a,h) anthracene	---	---	---	C_m=0	USEPA 2008a	---	0.3880	0.388	0.00	0.00
bis(2-Ethylhexyl)phthalate	---	---	---	---	---	1	0.1110	0.090	0.1110	0.090
Fluoranthene	---	---	---	C_m=0	USEPA 2008a	---	0.7272	0.348	0.00	0.00
Indeno(1,2,3-cd)pyrene	---	---	---	C_m=0	USEPA 2008a	---	0.6170	0.617	0.00	0.00
Phenanthrene	---	---	---	C_m=0	USEPA 2008a	---	2.2300	1.046	0.00	0.00
Pyrene	---	---	---	C_m=0	USEPA 2008a	---	1.8240	2.159	0.00	0.00
Pesticides										
alpha-Chlordane	---	---	---	---	---	1	---	2.67E-2	---	2.67E-2
gamma-Chlordane	---	---	---	---	---	1	---	3.46E-2	---	3.46E-2
4,4'-DDD	---	---	4.83	---	USEPA 2008a	---	0.09578	0.06328	0.4626	0.3056
4,4'-DDE	0.641	3.6401	---	---	USEPA 2008a	---	0.6283	0.7222	28.2814	30.9225
4,4'-DDT	0.7524	1.1788	---	---	USEPA 2008a	---	0.3916	0.3632	1.6055	1.5171
Polychlorinated Biphenyls										
Aroclor 1260	---	---	---	---	---	1	---	0.2130	---	0.2130

Table 7-11: Soil to Small Mammal Bioaccumulation Values
Wallops CDL Ecological Risk Assessment

	Slope (m)	Y-Intercept (b)	UF	Other	Source	Default UF	0-0.5 ft Soil EPC (mg/kg)	0-5 ft Soil EPC (mg/kg)	Herbivore Tissue Conc. (mg/kg)	Insectivore Tissue Conc. (mg/kg)
Inorganics										
Antimony	---	---	---	C_m=0.001* 50*C_d	USEPA 2008a	---	63.7	22.11	0.0971	0.1325
Arsenic	0.8188	-4.8471	---		USEPA 2008a	---	6.025	5.348	0.0342	0.0310
Barium	---	---	---	C_m=0.00015 *50*C_d	USEPA 2008a	---	603.4	427.8	0.7060	0.4118
Beryllium	---	---	---	C_m=0.001* 50*C_d	USEPA 2008a	---	0.607	0.442	0.0203	0.0014
Cadmium	0.4723	-1.2571	---	---	USEPA 2008a	---	17.14	28.66	1.0886	1.3878
Chromium	0.7338	-1.4599	---	---	USEPA 2008a	---	89.67	415.7	6.2925	19.3925
Cobalt	1.3070	-4.4669	---	---	USEPA 2008a	---	18.62	11.84	0.5247	0.2903
Copper	0.1444	2.042	---	---	USEPA 2008a	---	1790.0	4074	22.7270	25.5927
Lead	0.4420	0.0761	---	---	USEPA 2008a	---	2120.0	1963	31.8633	30.7979
Manganese	---	---	0.0205	---	USEPA 2008a	---	774.4	558.3	15.8752	11.4452
Mercury	---	---	---	---	USEPA 2008a	1	0.746	0.405	0.7460	0.4050
Nickel	0.4658	-0.2462	---	---	USEPA 2008a	---	459.5	345.8	13.5884	11.9031
Selenium	0.3764	-0.4158	---	---	USEPA 2008a	---	4.4	4.4	1.15	1.15
Silver	---	---	0.0040	---	USEPA 2008a	---	60.370	22.34	0.2415	0.0894
Thallium	---	---	---	---	---	1	0.118	0.0887	0.1180	0.0887
Vanadium	---	---	0.0123	---	USEPA 2008a	---	38.5	19.28	0.4736	0.2371
Zinc	0.0706	4.3632	---	---	USEPA 2008a	---	4280	3814	141.9747	140.5268

$\ln(\text{Mammal Tissue}_{DW}) = m * \ln(\text{Soil}_{DW}) + b$

$\text{MammalTissue}_{DW} = \text{Soil}_{DW} * UF$

C_m= Mammal concentration

C_d = Concentration in diet

Table 7-12: Water to Fish Bioaccumulation Values
Wallops CDL Ecological Risk Assessment

	BSAF	Source	Default UF	Water EPC (µg/L)	Fish Tissue Conc. (µg/kg)
Inorganics					
Aluminum	2.7	USEPA 1999	---	847.20	2287.44
Arsenic	114	USEPA 1999	---	10.79	1230.06
Barium	633	USEPA 1999	---	22.39	14172.87
Chromium	19	USEPA 1999	---	2.00	38.00
Copper	710	USEPA 1999	---	4.9	3479.00
Iron	---	---	1	717.10	717.10
Lead	0.09	USEPA 1999	---	4.0	0.36
Mercury	11168	USEPA 1999	---	0.091	1016.29
Nickel	78	USEPA 1999	---	2.9	226.20
Selenium	129	USEPA 1999	---	10.910	1407.39

Table 7-13: Sediment to Benthic Invertebrate Bioaccumulation Values
Wallops CDL Ecological Risk Assessment

	Slope (m)	Y-Intercept (b)	BSAF	Source	Default UF	Sediment EPC (mg/kg)	Invert Tissue Conc. (mg/kg)
Volatile Organic Compounds							
2-Butanone (MEK)	---	---	---	---	1	0.164	0.037
Carbon disulfide	---	---	---	---	1	0.014	0.014
Chlorobenzene	---	---	---	---	1	0.018	0.018
Methyl Acetate	---	---	---	---	1	0.059	0.059
Semi-Volatile Organic Compounds							
Di-n-octyl phthalate	---	---	---	---	1	3.08	3.08
bis(2-Ethylhexyl)phthalate	---	---	---	---	1	162.000	162.000
Pesticides							
4,4'-DDD	---	---	0.95	DDE as surrogate	---	0.011	0.011
4,4'-DDE	---	---	0.95	USEPA 1999	---	0.011	0.010
4,4'-DDT	---	---	0.95	DDE as surrogate	---	0.015	0.014
Inorganics							
Aluminum	---	---	---	---	1	19900	19900
Antimony	---	---	---	---	1	2.8	2.8
Arsenic	0.7540	-0.2920	---	Bechtel Jacobs Company LLC 1998b	---	13.7	5.374
Barium	---	---	---	---	1	53.2	53.2
Beryllium	---	---	---	---	1	0.581	0.581
Cadmium	0.6920	0.0395	---	Bechtel Jacobs Company LLC 1998b	---	1.50	1.38
Chromium	0.365	0.2092	---	Bechtel Jacobs Company LLC 1998b	---	39.84	4.731
Copper	0.278	1.089	---	Bechtel Jacobs Company LLC 1998b	---	34.59	7.957
Iron	---	---	---	---	1	25771	25771
Lead	0.8010	-0.7760	---	Bechtel Jacobs Company LLC 1998b	---	47.03	10.059
Mercury	0.327	-0.67	---	Bechtel Jacobs Company LLC 1998b	---	0.303	0.346
Nickel	-0.425	1.48	---	Bechtel Jacobs Company LLC 1998b	---	19.26	3.12
Selenium	---	---	---	---	1	1.754	1.754
Silver	---	---	---	---	1	1.5	1.5
Thallium	---	---	---	---	1	0.223	0.223
Vanadium	---	---	---	---	1	47.37	47.37
Zinc	0.2080	1.8000	---	Bechtel Jacobs Company LLC 1998b	---	149.1	17.132

Table 7-14: Exposures and Hazard Quotients for Grasses and Forbes Due to Contact with COPECs in Soil (0-1 ft bgs) Wallops CDL Ecological Risk Assessment

COPEC	0-0.5 ft bgs Soil Interval EPC (mg/kg)	TRV (mg/kg)	HQ
VOCs			
Methyl Acetate	1.19E+00	---	---
Methylcyclohexane	2.50E-03	---	---
SVOCs			
Acenaphthylene	1.58E-01	2.00E+01	7.90E-03
Anthracene	2.67E-01	1.00E-01	2.67E+00
Benzo(a)anthracene	2.49E+00	1.00E-01	2.49E+01
Benzo(a)pyrene	1.91E+00	1.00E-01	1.91E+01
Benzo(b)fluoranthene	1.39E+00	1.00E-01	1.39E+01
Benzo(g,h,i)perylene	1.18E+00	1.00E-01	1.18E+01
Benzo(k)fluoranthene	1.03E+00	1.00E-01	1.03E+01
Chrysene	4.04E+00	1.00E-01	4.04E+01
Dibenzo(a,h)anthracene	3.88E-01	1.00E-01	3.88E+00
bis(2-Ethylhexyl)phthalate	1.11E-01	---	---
Fluoranthene	7.27E-01	1.00E-01	7.27E+00
Indeno(1,2,3-cd)pyrene	6.17E-01	1.00E-01	6.17E+00
Phenanthrene	2.23E+00	1.00E-01	2.23E+01
Pyrene	1.82E+00	1.00E-01	1.82E+01
Pesticides			
DDT / DDD / DDE	9.58E-02	1.00E-01	9.58E-01
DDT / DDD / DDE	6.28E-01	1.00E-01	6.28E+00
DDT / DDD / DDE	3.92E-01	1.00E-01	3.92E+00
Inorganics			
Antimony	6.37E+01	5.00E+00	1.27E+01
Arsenic	6.03E+00	1.80E+01	3.35E-01
Barium	6.03E+02	5.00E+02	1.21E+00
Beryllium	6.07E-01	1.00E+01	6.07E-02
Cadmium	1.71E+01	3.20E+01	5.36E-01
Chromium	8.97E+01	1.00E+00	8.97E+01
Cobalt	1.86E+01	1.30E+01	1.43E+00
Copper	1.79E+03	7.00E+01	2.56E+01
Lead	2.12E+03	1.20E+02	1.77E+01
Manganese	7.74E+02	2.20E+02	3.52E+00
Mercury	7.46E-01	3.00E-01	2.49E+00
Nickel	4.60E+02	3.80E+01	1.21E+01
Selenium	4.40E+00	5.20E-01	8.46E+00
Silver	6.04E+01	5.60E+02	1.08E-01
Thallium	1.18E-01	1.00E+00	1.18E-01
Vanadium	3.85E+01	2.00E+00	1.93E+01
Zinc	4.28E+03	1.60E+02	2.68E+01

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-15: Exposures and Hazard Quotients for Shrubs and Trees Due to Contact with COPECs in Soil (0-5 ft bgs) Wallops CDL Ecological Risk Assessment

COPEC	0-5 ft bgs Soil Interval EPC (mg/kg)	TRV (mg/kg)	HQ
VOCs			
Methyl Acetate	1.19E+00	---	---
Methylcyclohexane	2.50E-03	---	---
SVOCs			
Acenaphthylene	1.58E-01	2.00E+01	7.90E-03
Anthracene	2.67E-01	1.00E-01	2.67E+00
Benzo(a)anthracene	2.49E+00	1.00E-01	2.49E+01
Benzo(a)pyrene	1.91E+00	1.00E-01	1.91E+01
Benzo(b)fluoranthene	1.39E+00	1.00E-01	1.39E+01
Benzo(g,h,i)perylene	1.18E+00	1.00E-01	1.18E+01
Benzo(k)fluoranthene	1.03E+00	1.00E-01	1.03E+01
Chrysene	1.87E+00	1.00E-01	1.87E+01
Dibenzo(a,h)anthracene	3.88E-01	1.00E-01	3.88E+00
bis(2-Ethylhexyl)phthalate	9.02E-02	---	---
Fluoranthene	3.48E-01	1.00E-01	3.48E+00
Indeno(1,2,3-cd)pyrene	6.17E-01	1.00E-01	6.17E+00
Phenanthrene	1.05E+00	1.00E-01	1.05E+01
Pyrene	2.16E+00	1.00E-01	2.16E+01
Pesticides			
alpha-Chlordane	2.67E-02	1.00E-01	2.67E-01
gamma-Chlordane	3.46E-02	1.00E-01	3.46E-01
DDT / DDD / DDE	6.33E-02	1.00E-01	6.33E-01
DDT / DDD / DDE	7.22E-01	1.00E-01	7.22E+00
DDT / DDD / DDE	3.63E-01	1.00E-01	3.63E+00
Polychlorinated Biphenyls			
Aroclor 1260	2.13E-01	4.00E+01	5.33E-03
Inorganics			
Antimony	2.21E+01	5.00E+00	4.42E+00
Arsenic	5.35E+00	1.80E+01	2.97E-01
Barium	4.28E+02	5.00E+02	8.56E-01
Beryllium	4.42E-01	1.00E+01	4.42E-02
Cadmium	2.87E+01	3.20E+01	8.96E-01
Chromium	4.16E+02	1.00E+00	4.16E+02
Cobalt	1.18E+01	1.30E+01	9.11E-01
Copper	4.07E+03	7.00E+01	5.82E+01
Lead	1.96E+03	1.20E+02	1.64E+01
Manganese	5.58E+02	2.20E+02	2.54E+00
Mercury	4.05E-01	3.00E-01	1.35E+00
Nickel	3.46E+02	3.80E+01	9.10E+00
Selenium	4.40E+00	5.20E-01	8.46E+00
Silver	2.23E+01	5.60E+02	3.99E-02
Thallium	8.87E-02	1.00E+00	8.87E-02
Vanadium	1.93E+01	2.00E+00	9.64E+00
Zinc	3.81E+03	1.60E+02	2.38E+01

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-16: Exposures and Hazard Quotients for Soil Invertebrates Due to Contact with COPECs in Soil (0-1 ft bgs) Wallops CDL Ecological Risk Assessment

COPEC	0-5 ft bgs Soil Interval EPC (mg/kg)	TRV (mg/kg)	HQ
VOCs			
Methyl Acetate	1.19E+00	---	---
Methylcyclohexane	2.50E-03	---	---
SVOCs			
Acenaphthylene	1.58E-01	1.80E+01	8.78E-03
Anthracene	2.67E-01	1.80E+01	1.48E-02
Benzo(a)anthracene	2.49E+00	2.90E+01	8.59E-02
Benzo(a)pyrene	1.91E+00	2.90E+01	6.59E-02
Benzo(b)fluoranthene	1.39E+00	2.90E+01	4.79E-02
Benzo(g,h,i)perylene	1.18E+00	2.90E+01	4.07E-02
Benzo(k)fluoranthene	1.03E+00	2.90E+01	3.55E-02
Chrysene	4.04E+00	2.90E+01	1.39E-01
Dibenzo(a,h)anthracene	3.88E-01	2.90E+01	1.34E-02
bis(2-Ethylhexyl)phthalate	1.11E-01	---	---
Fluoranthene	7.27E-01	2.90E+01	2.51E-02
Indeno(1,2,3-cd)pyrene	6.17E-01	2.90E+01	2.13E-02
Phenanthrene	2.23E+00	1.80E+01	1.24E-01
Pyrene	1.82E+00	2.90E+01	6.29E-02
Pesticides			
DDT / DDD / DDE	9.58E-02	---	---
DDT / DDD / DDE	6.28E-01	---	---
DDT / DDD / DDE	3.92E-01	---	---
Inorganics			
Antimony	6.37E+01	7.80E+01	8.17E-01
Arsenic	6.03E+00	1.00E+02	6.03E-02
Barium	6.03E+02	3.30E+02	1.83E+00
Beryllium	6.07E-01	4.00E+01	1.52E-02
Cadmium	1.71E+01	1.40E+02	1.22E-01
Chromium	8.97E+01	1.00E+01	8.97E+00
Cobalt	1.86E+01	1.00E+03	1.86E-02
Copper	1.79E+03	8.00E+01	2.24E+01
Lead	2.12E+03	1.70E+03	1.25E+00
Manganese	7.74E+02	4.50E+02	1.72E+00
Mercury	7.46E-01	3.00E+01	2.49E-02
Nickel	4.60E+02	2.80E+02	1.64E+00
Selenium	4.40E+00	4.10E+00	1.07E+00
Silver	6.04E+01	5.00E+01	1.21E+00
Thallium	1.18E-01	---	---
Vanadium	3.85E+01	2.00E+01	1.93E+00
Zinc	4.28E+03	1.20E+02	3.57E+01

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-17: Exposures and Hazard Quotients for American Robin Due to Contact with COPECs in Soil (0-0.5 ft bgs) Wallops CDL Ecological Risk Assessment

COPEC	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Dose (mg/kg-day)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs							
Methyl Acetate	1.74E-1	1.06E+0	1.23E+0	---	---	---	---
Methylcyclohexane	3.65E-4	2.23E-3	2.59E-3	---	---	---	---
SVOCs							
Acenaphthylene	2.31E-2	3.22E+0	3.24E+0	---	---	---	---
Anthracene	3.90E-2	5.75E-1	6.14E-1	---	---	---	---
Benzo(a)anthracene	3.63E-1	3.52E+0	3.89E+0	---	---	---	---
Benzo(a)pyrene	2.79E-1	2.26E+0	2.54E+0	---	---	---	---
Benzo(b)fluoranthene	2.03E-1	3.22E+0	3.42E+0	---	---	---	---
Benzo(g,h,i)perylene	1.72E-1	3.09E+0	3.26E+0	---	---	---	---
Benzo(k)fluoranthene	1.50E-1	2.38E+0	2.53E+0	---	---	---	---
Chrysene	5.90E-1	8.23E+0	8.82E+0	---	---	---	---
Dibenzo(a,h)anthracene	5.66E-2	7.98E-1	8.54E-1	---	---	---	---
bis(2 Ethylhexyl)phthalate	1.62E-2	9.88E-2	1.15E-1	1.10	11.00	1.05E-01	1.05E-02
Fluoranthene	1.06E-1	1.97E+0	2.07E+0	---	---	---	---
Indeno(1,2,3-cd)pyrene	9.01E-2	1.57E+0	1.66E+0	---	---	---	---
Phenanthrene	3.25E-1	3.41E+0	3.74E+0	---	---	---	---
Pyrene	2.66E-1	2.84E+0	3.11E+0	---	---	---	---
Pesticides							
DDT / DDD / DDE	1.40E-2	5.54E-1	5.68E-1	0.0028	0.0280	2.03E+02	2.03E+01
DDT / DDD / DDE	9.17E-2	7.04E+0	7.13E+0	0.0028	0.0280	2.55E+03	2.55E+02
DDT / DDD / DDE	5.72E-2	3.30E+0	3.36E+0	0.0028	0.0280	1.20E+03	1.20E+02
Inorganics							
Antimony	9.30E+0	5.67E+1	6.60E+1	---	---	---	---
Arsenic	8.79E-1	7.64E-1	1.64E+0	5.14	12.84	3.20E-01	1.28E-01
Barium	8.81E+1	4.89E+1	1.37E+2	20.80	41.70	6.58E+00	3.28E+00
Beryllium	8.86E-2	2.43E-2	1.13E-1	---	---	---	---
Cadmium	2.50E+0	7.06E+1	7.31E+1	1.45	20.00	5.04E+01	3.65E+00
Chromium	1.31E+1	2.44E+1	3.75E+1	1.00	5.00	3.75E+01	7.50E+00
Cobalt	2.72E+0	2.02E+0	4.74E+0	---	---	---	---
Copper	2.61E+2	8.20E+2	1.08E+3	47.00	61.70	2.30E+01	1.75E+01
Lead	3.09E+2	3.46E+2	6.55E+2	1.13	11.30	5.80E+02	5.80E+01
Manganese	1.13E+2	3.70E+1	1.50E+2	977.00	9770	1.54E-01	1.54E-02
Mercury	1.09E-1	4.34E-1	5.43E-1	0.0064	0.06	8.48E+01	8.48E+00
Nickel	6.71E+1	7.15E+0	7.42E+1	77.40	107.00	9.59E-01	6.94E-01
Selenium	6.42E-1	2.45E+0	3.09E+0	0.50	1.00	6.18E+00	3.09E+00
Silver	8.81E+0	1.10E+2	1.19E+2	---	---	---	---
Thallium	1.72E-2	2.31E-2	4.03E-2	---	---	---	---
Vanadium	5.62E+0	1.44E+0	7.06E+0	11.40	114.00	6.19E-01	6.19E-02
Zinc	6.25E+2	1.18E+3	1.81E+3	14.50	131.00	1.25E+02	1.38E+01

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-18: Exposures and Hazard Quotients for Meadow Vole Due to Contact with COPECs in Soil (0-0.5 ft bgs) Wallops CDL Ecological Risk Assessment

COPEC	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Dose (mg/kg-day)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs							
Methyl Acetate	3.33E-03	1.04E-01	1.07E-01	---	---	---	---
Methylcyclohexane	7.00E-06	2.19E-04	2.26E-04	---	---	---	---
SVOCs							
Acenaphthylene	4.42E-04	6.48E-03	6.92E-03	---	---	---	---
Anthracene	7.48E-04	1.16E-02	1.24E-02	---	---	---	---
Benzo(a)anthracene	6.97E-03	1.00E-02	1.70E-02	---	---	---	---
Benzo(a)pyrene	5.35E-03	2.09E-02	2.63E-02	0.91	9.09	2.89E-02	2.89E-03
Benzo(b)fluoranthene	3.89E-03	3.77E-02	4.16E-02	---	---	---	---
Benzo(g,h,i)perylene	3.30E-03	4.19E-02	4.52E-02	---	---	---	---
Benzo(k)fluoranthene	2.88E-03	1.04E-02	1.33E-02	---	---	---	---
Chrysene	1.13E-02	1.34E-02	2.47E-02	---	---	---	---
Dibenzo(a,h)anthracene	1.09E-03	4.41E-03	5.50E-03	---	---	---	---
bis(2 Ethylhexyl)phthalate	3.11E-04	9.71E-03	1.00E-02	16.60	166.00	6.04E-04	6.04E-05
Fluoranthene	2.04E-03	3.18E-02	3.39E-02	---	---	---	---
Indeno(1,2,3-cd)pyrene	1.73E-03	5.94E-03	7.67E-03	---	---	---	---
Phenanthrene	6.24E-03	1.22E-01	1.28E-01	---	---	---	---
Pyrene	5.11E-03	1.15E-01	1.20E-01	---	---	---	---
Pesticides							
DDT / DDD / DDE	2.68E-04	1.22E-03	1.48E-03	1.34	6.72	1.11E-03	2.21E-04
DDT / DDD / DDE	1.76E-03	5.00E-03	6.76E-03	1.34	6.72	5.05E-03	1.01E-03
DDT / DDD / DDE	1.10E-03	3.51E-03	4.60E-03	1.34	6.72	3.43E-03	6.85E-04
Polychlorinated Biphenyls							
Aroclor 1260	1.15E-04	3.59E-03	3.70E-03	0.41	2.06	9.03E-03	1.80E-03
Dioxins							
2,3,7,8-TCDD	5.60E-04	2.49E-03	3.05E-03	1.68E-06	1.68E-05	1.82E+03	1.82E+02
Inorganics							
Antimony	1.78E-01	1.70E-01	3.48E-01	0.11	1.14	3.05E+00	3.07E-01
Arsenic	1.69E-02	1.98E-02	3.67E-02	0.11	1.15	3.22E-01	3.20E-02
Barium	1.69E+00	8.24E+00	9.93E+00	9.00	33.30	1.10E+00	2.98E-01
Beryllium	1.70E-03	3.55E-02	3.72E-02	1.11	11.10	3.35E-02	3.35E-03
Cadmium	4.80E-02	2.56E-01	3.04E-01	1.62	16.20	1.88E-01	1.88E-02
Chromium	2.51E-01	3.22E-01	5.73E-01	5.51	22.07	1.04E-01	2.60E-02
Cobalt	5.21E-02	1.21E-02	6.43E-02	---	---	---	---
Copper	5.01E+00	3.26E+00	8.28E+00	25.50	33.60	3.25E-01	2.46E-01
Lead	5.94E+00	1.70E+00	7.64E+00	13.44	134.35	5.68E-01	5.69E-02
Manganese	2.17E+00	5.37E+00	7.53E+00	148.00	477.00	5.09E-02	1.58E-02
Mercury	2.09E-03	2.75E-02	2.96E-02	2.18	21.80	1.36E-02	1.36E-03
Nickel	1.29E+00	9.29E-01	2.22E+00	67.18	134.35	3.30E-02	1.65E-02
Selenium	1.23E-02	2.28E-01	2.41E-01	0.34	0.55	7.16E-01	4.34E-01
Silver	1.69E-01	7.40E-02	2.43E-01	---	---	---	---
Thallium	3.30E-04	4.13E-05	3.72E-04	---	---	---	---
Vanadium	1.08E-01	1.63E-02	1.24E-01	0.33	3.27	3.80E-01	3.79E-02
Zinc	1.20E+01	4.34E+01	5.54E+01	268.70	537.40	2.06E-01	1.03E-01

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-19: Exposures and Hazard Quotients for Short-tailed Shrew Due to Contact with COPECs in Soil (0-5 ft bgs) Wallops CDL Ecological Risk Assessment

COPEC	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Dose (mg/kg-day)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs							
Methyl Acetate	7.46E-03	2.49E-01	2.56E-01	---	---	---	---
Methylcyclohexane	1.57E-05	5.23E-04	5.38E-04	---	---	---	---
SVOCs							
Acenaphthylene	9.91E-04	7.56E-01	7.57E-01	---	---	---	---
Anthracene	1.67E-03	1.35E-01	1.37E-01	---	---	---	---
Benzo(a)anthracene	1.56E-02	8.27E-01	8.43E-01	---	---	---	---
Benzo(a)pyrene	1.20E-02	5.31E-01	5.43E-01	1.190	11.890	4.56E-01	4.57E-02
Benzo(b)fluoranthene	8.72E-03	7.55E-01	7.64E-01	---	---	---	---
Benzo(g,h,i)perylene	7.40E-03	7.25E-01	7.32E-01	---	---	---	---
Benzo(k)fluoranthene	6.46E-03	5.60E-01	5.66E-01	---	---	---	---
Chrysene	1.17E-02	1.93E+00	1.95E+00	---	---	---	---
Dibenzo(a,h)anthracene	2.43E-03	1.87E-01	1.90E-01	---	---	---	---
bis(2 Ethylhexyl)phthalate	5.65E-04	2.32E-02	2.38E-02	21.800	218.000	1.09E-03	1.09E-04
Fluoranthene	2.18E-03	4.62E-01	4.64E-01	---	---	---	---
Indeno(1,2,3-cd)pyrene	3.87E-03	3.69E-01	3.73E-01	---	---	---	---
Phenanthrene	6.56E-03	8.02E-01	8.08E-01	---	---	---	---
Pyrene	1.35E-02	6.67E-01	6.81E-01	---	---	---	---
Pesticides							
alpha-Chlordane	1.67E-04	0.00E+00	1.67E-04	5.500	10.900	3.04E-05	1.54E-05
gamma-Chlordane	2.17E-04	0.00E+00	2.17E-04	5.500	10.900	3.94E-05	1.99E-05
DDT / DDD / DDE	3.97E-04	1.30E-01	1.30E-01	1.760	8.790	7.41E-02	1.48E-02
DDT / DDD / DDE	4.53E-03	1.65E+00	1.66E+00	1.760	8.790	9.42E-01	1.89E-01
DDT / DDD / DDE	2.28E-03	7.75E-01	7.77E-01	1.760	8.790	4.41E-01	8.84E-02
Polychlorinated Biphenyls							
Aroclor 1260	1.34E-03	0.00E+00	1.34E-03	0.540	2.700	2.47E-03	4.95E-04
Inorganics							
Antimony	1.39E-01	1.33E+01	1.35E+01	0.146	1.487	9.21E+01	9.05E+00
Arsenic	3.35E-02	1.79E-01	2.13E-01	0.150	1.498	1.42E+00	1.42E-01
Barium	2.68E+00	1.15E+01	1.42E+01	11.800	43.500	1.20E+00	3.25E-01
Beryllium	2.77E-03	5.71E-03	8.48E-03	1.450	14.500	5.85E-03	5.85E-04
Cadmium	1.80E-01	1.66E+01	1.67E+01	2.120	21.200	7.90E+00	7.90E-01
Chromium	2.61E+00	5.73E+00	8.34E+00	7.210	28.880	1.16E+00	2.89E-01
Cobalt	7.42E-02	4.75E-01	5.49E-01	---	---	---	---
Copper	2.55E+01	1.93E+02	2.18E+02	33.400	44.000	6.53E+00	4.96E+00
Lead	1.23E+01	8.12E+01	9.36E+01	17.580	175.830	5.32E+00	5.32E-01
Manganese	3.50E+00	8.69E+00	1.22E+01	193.000	624.000	6.32E-02	1.95E-02
Mercury	2.54E-03	1.02E-01	1.04E-01	2.860	28.600	3.65E-02	3.65E-03
Nickel	2.17E+00	1.68E+00	3.85E+00	87.910	175.830	4.38E-02	2.19E-02
Selenium	2.76E-02	5.74E-01	6.02E-01	0.440	0.725	1.37E+00	8.30E-01
Silver	1.40E-01	2.58E+01	2.59E+01	---	---	---	---
Thallium	5.56E-04	5.43E-03	5.98E-03	---	---	---	---
Vanadium	1.21E-01	3.38E-01	4.59E-01	0.428	4.285	1.07E+00	1.07E-01
Zinc	2.39E+01	2.78E+02	3.02E+02	351.700	703.300	8.57E-01	4.29E-01

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-20: Exposures and Hazard Quotients for Red-tailed Hawk Due to Contact with COPECs in Soil (0-0.5 ft bgs) Wallops CDL Ecological Risk Assessment

COPEC	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Dose (mg/kg-day)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs							
Methyl Acetate	2.39E-03	4.20E-02	1.87E-03	---	---	---	---
Methylcyclohexane	5.03E-06	8.83E-05	3.93E-06	---	---	---	---
SVOCs							
Acenaphthylene	3.18E-04	0.00E+00	1.34E-05	---	---	---	---
Anthracene	5.37E-04	0.00E+00	2.27E-05	---	---	---	---
Benzo(a)anthracene	5.01E-03	0.00E+00	2.11E-04	---	---	---	---
Benzo(a)pyrene	3.84E-03	0.00E+00	1.62E-04	---	---	---	---
Benzo(b)fluoranthene	2.80E-03	0.00E+00	1.18E-04	---	---	---	---
Benzo(g,h,i)perylene	2.37E-03	0.00E+00	1.00E-04	---	---	---	---
Benzo(k)fluoranthene	2.07E-03	0.00E+00	8.74E-05	---	---	---	---
Chrysene	8.13E-03	0.00E+00	3.43E-04	---	---	---	---
Dibenzo(a,h)anthracene	7.81E-04	0.00E+00	3.29E-05	---	---	---	---
bis(2 Ethylhexyl)phthalate	2.23E-04	3.92E-03	1.75E-04	1.10	11.00	1.59E-04	1.59E-05
Fluoranthene	1.46E-03	0.00E+00	6.17E-05	---	---	---	---
Indeno(1,2,3-cd)pyrene	1.24E-03	0.00E+00	5.23E-05	---	---	---	---
Phenanthrene	4.49E-03	0.00E+00	1.89E-04	---	---	---	---
Pyrene	3.67E-03	0.00E+00	1.55E-04	---	---	---	---
Pesticides							
alpha-Chlordane	0.00E+00	9.43E-04	3.97E-05	0.20	1.10	1.99E-04	3.61E-05
gamma-Chlordane	0.00E+00	1.22E-03	5.15E-05	0.20	1.10	2.58E-04	4.68E-05
DDT / DDD / DDE	1.93E-04	1.63E-02	6.97E-04	0.0028	0.0280	2.49E-01	2.49E-02
DDT / DDD / DDE	1.26E-03	1.09E+00	4.61E-02	0.0028	0.0280	1.65E+01	1.65E+00
DDT / DDD / DDE	7.88E-04	5.67E-02	2.42E-03	0.0028	0.0280	8.65E-01	8.65E-02
Polychlorinated Biphenyls							
Aroclor 1260	0.00E+00	7.52E-03	3.17E-04	0.42	1.8000	7.60E-04	1.76E-04
Inorganics							
Antimony	1.28E-01	4.68E-03	5.60E-03	---	---	---	---
Arsenic	1.21E-02	1.21E-03	5.62E-04	5.14	12.84	1.09E-04	4.38E-05
Barium	1.21E+00	2.49E-02	5.22E-02	20.80	41.70	2.51E-03	1.25E-03
Beryllium	1.22E-03	7.16E-04	8.17E-05	---	---	---	---
Cadmium	3.45E-02	4.90E-02	3.52E-03	1.45	20.00	2.43E-03	1.76E-04
Chromium	1.80E-01	6.85E-01	3.65E-02	1.00	5.00	3.65E-02	7.29E-03
Cobalt	3.75E-02	1.85E-02	2.36E-03	---	---	---	---
Copper	3.60E+00	9.03E-01	1.90E-01	47.00	61.70	4.04E-03	3.08E-03
Lead	4.27E+00	1.12E+00	2.27E-01	1.13	11.30	2.01E-01	2.01E-02
Manganese	1.56E+00	5.60E-01	8.93E-02	977.00	9770	9.14E-05	9.14E-06
Mercury	1.50E-03	2.63E-02	1.17E-03	0.0064	0.06	1.83E-01	1.83E-02
Nickel	9.25E-01	4.80E-01	5.92E-02	77.40	107.00	7.65E-04	5.53E-04
Selenium	8.85E-03	4.06E-02	2.09E-03	0.50	1.00	4.17E-03	2.09E-03
Silver	1.21E-01	8.52E-03	5.48E-03	---	---	---	---
Thallium	2.37E-04	4.17E-03	1.86E-04	---	---	---	---
Vanadium	7.75E-02	1.67E-02	3.97E-03	11.40	114.00	3.48E-04	3.48E-05
Zinc	8.61E+00	5.00E+00	5.74E-01	14.50	131.00	3.96E-02	4.38E-03

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-21: Exposures and Hazard Quotients for Red Fox Due to Contact with COPECs in Soil (0-0.5 ft bgs) Wallops CDL Ecological Risk Assessment

COPEC	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Dose (mg/kg-day)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs							
Methyl Acetate	4.66E-03	1.67E-01	6.20E-04	---	---	---	---
Methylcyclohexane	9.80E-06	3.50E-04	1.30E-06	---	---	---	---
SVOCs							
Acenaphthylene	6.19E-04	0.00E+00	2.24E-06	---	---	---	---
Anthracene	1.05E-03	0.00E+00	3.79E-06	---	---	---	---
Benzo(a)anthracene	9.76E-03	0.00E+00	3.53E-05	---	---	---	---
Benzo(a)pyrene	7.49E-03	0.00E+00	2.71E-05	0.290	2.86	9.34E-05	9.48E-06
Benzo(b)fluoranthene	5.45E-03	0.00E+00	1.97E-05	---	---	---	---
Benzo(g,h,i)perylene	4.63E-03	0.00E+00	1.67E-05	---	---	---	---
Benzo(k)fluoranthene	4.04E-03	0.00E+00	1.46E-05	---	---	---	---
Chrysene	1.58E-02	0.00E+00	5.73E-05	---	---	---	---
Dibenzo(a,h)anthracene	1.52E-03	0.00E+00	5.51E-06	---	---	---	---
bis(2 Ethylhexyl)phthalate	4.35E-04	1.55E-02	5.78E-05	5.20	52.0	1.11E-05	1.11E-06
Fluoranthene	2.85E-03	0.00E+00	1.03E-05	---	---	---	---
Indeno(1,2,3-cd)pyrene	2.42E-03	0.00E+00	8.75E-06	---	---	---	---
Phenanthrene	8.74E-03	0.00E+00	3.16E-05	---	---	---	---
Pyrene	7.15E-03	0.00E+00	2.59E-05	---	---	---	---
Pesticides							
alpha-Chlordane	0.00E+00	3.74E-03	1.35E-05	1.30	2.60	1.04E-05	5.20E-06
gamma-Chlordane	0.00E+00	4.84E-03	1.75E-05	1.30	2.60	1.35E-05	6.74E-06
DDT / DDD / DDE	3.75E-04	6.48E-02	2.36E-04	0.42	2.11	5.61E-04	1.12E-04
DDT / DDD / DDE	2.46E-03	4.33E+00	1.57E-02	0.42	2.11	3.73E-02	7.43E-03
DDT / DDD / DDE	1.54E-03	2.25E-01	8.19E-04	0.42	2.11	1.95E-03	3.88E-04
Polychlorinated Biphenyls							
Aroclor 1260	0.00E+00	2.98E-02	1.08E-04	0.09	0.04	1.20E-03	2.70E-03
Inorganics							
Antimony	2.50E-01	1.86E-02	9.71E-04	0.04	0.36	2.70E-02	2.72E-03
Arsenic	2.36E-02	4.78E-03	1.03E-04	0.04	0.36	2.86E-03	2.86E-04
Barium	2.37E+00	9.88E-02	8.92E-03	2.80	10.50	3.19E-03	8.49E-04
Beryllium	2.38E-03	2.84E-03	1.89E-05	0.35	3.50	5.40E-05	5.40E-06
Cadmium	6.72E-02	1.94E-01	9.46E-04	0.51	5.09	1.86E-03	1.86E-04
Chromium	3.52E-01	2.71E+00	1.11E-02	1.73	6.94	6.42E-03	1.60E-03
Cobalt	7.30E-02	7.35E-02	5.30E-04	---	---	---	---
Copper	7.02E+00	3.58E+00	3.84E-02	8.00	10.60	4.80E-03	3.62E-03
Lead	8.31E+00	4.46E+00	4.62E-02	4.22	42.25	1.10E-02	1.09E-03
Manganese	3.04E+00	2.22E+00	1.90E-02	46.00	150.00	4.14E-04	1.27E-04
Mercury	2.92E-03	1.04E-01	3.89E-04	0.69	6.90	5.63E-04	5.63E-05
Nickel	1.80E+00	1.90E+00	1.34E-02	21.12	42.25	6.35E-04	3.17E-04
Selenium	1.72E-02	1.61E-01	6.45E-04	0.11	0.17	6.09E-03	3.71E-03
Silver	2.37E-01	3.38E-02	9.79E-04	---	---	---	---
Thallium	4.63E-04	1.65E-02	6.15E-05	---	---	---	---
Vanadium	1.51E-01	6.63E-02	7.86E-04	0.10	1.03	7.63E-03	7.63E-04
Zinc	1.68E+01	1.98E+01	1.33E-01	84.50	169.00	1.57E-03	7.84E-04

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-22: Exposures and Hazard Quotients for Aquatic Life Due to Contact with COPECs in Surface Water Wallops CDL Ecological Risk Assessment

COPEC	Surface Water EPC (mg/kg)	TRV (mg/kg)	HQ
Inorganics			
Aluminum	8.47E+02	8.70E+01	9.74E+00
Arsenic	1.08E+01	3.60E+01	3.00E-01
Barium	2.24E+01	4.00E+00	5.60E+00
Chromium	2.00E+00	1.10E+01	1.82E-01
Copper	4.90E+00	6.00E+00	8.17E-01
Iron	7.17E+02	3.00E+02	2.39E+00
Lead	4.00E+00	9.30E+00	4.30E-01
Mercury	9.10E-02	7.70E-01	1.18E-01
Nickel	2.90E+00	8.20E+00	3.54E-01
Selenium	1.09E+01	5.00E+00	2.18E+00

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-23: Exposures and Hazard Quotients for Benthic Invertebrates Due to Contact with COPECs in Sediments Wallops CDL Ecological Risk Assessment

COPEC	Sediment EPC (ug/L)	TRV (ug/L)	HQ
VOCs			
2-Butanone (MEK)	1.64E-01	---	---
Carbon disulfide	1.43E-02	8.50E-04	1.68E+01
Cyclohexane	1.82E-02	---	---
Methyl Acetate	5.86E-02	---	---
SVOCs			
Di-n-octyl phthalate	3.08E+00	---	---
bis(2-Ethylhexyl)phthalate	1.62E+02	1.82E-01	8.90E+02
Pesticides			
4,4'-DDD	6.50E-02	4.88E-03	1.33E+01
4,4'-DDE	1.49E-01	3.16E-03	4.72E+01
4,4'-DDT	1.08E-02	4.16E-03	2.60E+00
Inorganics			
Aluminum	1.99E+04	---	---
Antimony	2.80E+00	2.00E+00	1.40E+00
Arsenic	1.37E+01	9.80E+00	1.40E+00
Barium	5.32E+01	---	---
Beryllium	5.81E-01	---	---
Cadmium	1.50E+00	9.90E-01	1.52E+00
Chromium	3.98E+01	4.34E+01	9.18E-01
Copper	3.46E+01	3.16E+01	1.09E+00
Iron	2.58E+04	2.00E+04	1.29E+00
Lead	4.70E+01	3.58E+01	1.31E+00
Mercury	3.03E-01	1.80E-01	1.68E+00
Nickel	1.93E+01	2.27E+01	8.48E-01
Selenium	1.75E+00	2.00E+00	8.77E-01
Silver	1.50E+00	1.00E+00	1.50E+00
Thallium	2.23E-01	---	---
Vanadium	4.74E+01	---	---
Zinc	1.49E+02	1.21E+02	1.23E+00

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-24: Exposures and Hazard Quotients for Great Blue Heron Due to Ingestion of COPECs in Sediments and Fish Wallops CDL Ecological Risk Assessment

COPEC	Sediment Ingestion Dose (mg/kg-day)	Food Ingestion Dose (mg/kg-day)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs							
2-Butanone (MEK)	5.90E-4	0.00E+00	5.90E-4	---	---	---	---
Carbon disulfide	5.14E-5	0.00E+00	5.14E-5	---	---	---	---
Cyclohexane	6.53E-5	0.00E+00	6.53E-5	---	---	---	---
Methyl Acetate	2.11E-4	0.00E+00	2.11E-4	---	---	---	---
SVOCs							
Di-n-octyl phthalate	1.11E-2	0.00E+00	1.11E-2	---	---	---	---
bis(2-Ethylhexyl)phthalate	5.83E-1	0.00E+00	5.83E-1	1.10E+0	1.10E+1	1.30E-1	1.30E-2
Pesticides							
4,4'-DDD	2.34E-4	0.00E+00	2.34E-4	3.00E-3	2.80E-2	6.32E-4	1.28E-4
4,4'-DDE	5.36E-4	0.00E+00	5.36E-4	3.00E-3	2.80E-2	1.45E-3	2.93E-4
4,4'-DDT	3.89E-5	0.00E+00	3.89E-5	3.00E-3	2.80E-2	1.05E-4	2.12E-5
Inorganics							
Aluminum	7.16E+1	4.12E-01	7.21E+1	4.45E+1	1.10E+2	1.62E+0	6.57E-1
Antimony	1.01E-2	0.00E+00	1.01E-2	---	---	---	---
Arsenic	4.93E-2	2.21E-01	2.71E-1	5.10E+0	1.28E+1	5.31E-2	2.12E-2
Barium	1.92E-1	2.55E+00	2.74E+0	2.08E+1	4.17E+1	1.32E-1	6.58E-2
Beryllium	2.09E-3	0.00E+00	2.09E-3	---	---	---	---
Cadmium	5.40E-3	0.00E+00	5.40E-3	1.45E+0	2.00E+1	3.72E-3	2.70E-4
Chromium	1.43E-1	6.84E-03	1.50E-1	1.00E+0	5.00E+0	1.50E-1	3.01E-2
Copper	1.25E-1	6.26E-01	7.51E-1	4.70E+1	6.17E+1	1.60E-2	1.22E-2
Iron	9.28E+1	1.29E-01	9.29E+1	---	---	---	---
Lead	1.69E-1	6.48E-05	1.69E-1	1.13E+0	1.13E+1	1.50E-1	1.50E-2
Mercury	1.09E-3	1.83E-01	1.84E-1	4.50E-1	9.00E-1	4.09E-1	2.04E-1
Nickel	6.93E-2	4.07E-02	1.10E-1	7.74E+1	1.07E+2	1.42E-3	1.03E-3
Selenium	6.31E-3	2.53E-01	2.60E-1	5.00E-1	1.00E+0	5.19E-1	2.60E-1
Silver	5.40E-3	0.00E+00	5.40E-3	---	---	---	---
Thallium	8.03E-4	0.00E+00	8.03E-4	---	---	---	---
Vanadium	1.71E-1	0.00E+00	1.71E-1	1.14E+1	1.14E+2	1.50E-2	1.50E-3
Zinc	5.37E-1	0.00E+00	5.37E-1	1.45E+1	1.31E+2	3.70E-2	4.10E-3

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-25: Exposures and Hazard Quotients for River Otter Due to Ingestion of COPECs in Sediments and Fish Wallops CDL Ecological Risk Assessment

COPEC	Sediment Ingestion Dose (mg/kg-day)	Food Ingestion Dose (mg/kg-day)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs							
2-Butanone (MEK)	4.39E-4	0.00E+00	6.41E-6	8.10E+2	2.09E+3	7.91E-9	3.06E-9
Carbon disulfide	3.82E-5	0.00E+00	5.58E-7	---	---	---	---
Cyclohexane	4.85E-5	0.00E+00	7.09E-7	---	---	---	---
Methyl Acetate	1.57E-4	0.00E+00	2.29E-6	---	---	---	---
SVOCs							
Di-n-octyl phthalate	8.24E-3	0.00E+00	1.20E-4	---	---	---	---
bis(2-Ethylhexyl)phthalate	4.33E-1	0.00E+00	6.33E-3	4.50E+0	4.50E+1	1.41E-3	1.41E-4
Pesticides							
4,4'-DDD	1.74E-4	0.00E+00	2.54E-6	3.70E-1	1.83E+0	6.86E-6	1.39E-6
4,4'-DDE	3.99E-4	0.00E+00	5.82E-6	3.70E-1	1.83E+0	1.57E-5	3.18E-6
4,4'-DDT	2.89E-5	0.00E+00	4.22E-7	3.70E-1	1.83E+0	1.14E-6	2.31E-7
Inorganics							
Aluminum	5.32E+1	3.06E-1	7.82E-1	4.78E-1	4.78E+0	1.64E+0	1.64E-1
Antimony	7.49E-3	0.00E+00	1.09E-4	3.10E-2	3.09E-1	3.53E-3	3.54E-4
Arsenic	3.66E-2	1.64E-1	2.94E-3	3.10E-2	3.12E-1	9.48E-2	9.42E-3
Barium	1.42E-1	1.90E+0	2.98E-2	2.50E+0	9.10E+0	1.19E-2	3.27E-3
Beryllium	1.55E-3	0.00E+00	2.27E-5	3.00E-1	3.00E+0	7.57E-5	7.57E-6
Cadmium	4.01E-3	0.00E+00	5.86E-5	4.41E-1	4.41E+0	1.33E-4	1.33E-5
Chromium	1.07E-1	5.08E-3	1.63E-3	1.50E+0	6.01E+0	1.09E-3	2.71E-4
Copper	9.25E-2	4.65E-1	8.15E-3	7.00E+0	9.20E+0	1.16E-3	8.86E-4
Iron	6.89E+1	9.59E-2	1.01E+0	---	---	---	---
Lead	1.26E-1	4.81E-5	1.84E-3	3.66E+0	3.66E+1	5.02E-4	5.02E-5
Mercury	8.10E-4	1.36E-1	2.00E-3	5.90E-1	5.90E+0	3.39E-3	3.39E-4
Nickel	5.15E-2	3.02E-2	1.19E-3	1.83E+1	3.66E+1	6.53E-5	3.26E-5
Selenium	4.69E-3	1.88E-1	2.82E-3	9.10E-2	1.51E-1	3.10E-2	1.87E-2
Silver	4.01E-3	0.00E+00	5.86E-5	---	---	---	---
Thallium	5.96E-4	0.00E+00	8.71E-6	3.00E-3	3.40E-2	2.90E-3	2.56E-4
Vanadium	1.27E-1	0.00E+00	1.85E-3	8.90E-2	8.92E-1	2.08E-2	2.08E-3
Zinc	3.99E-1	0.00E+00	5.83E-3	7.32E+1	1.46E+2	7.96E-5	3.98E-5

Notes:

A dash indicates the absence of an applicable TRV and corresponding calculated HQ.
Shaded cells indicate HQs greater than 1.

Definitions:

COPEC - Chemical of potential ecological concern
EPC - Exposure point concentration.
HQ - Hazard quotient
mg/kg - Milligrams per kilogram
TRV - Toxicity reference value

Table 7-26: Summary of Hazard Quotients for Plants and Inverts
Wallops CDL Ecological Risk Assessment

	Grasses and Forbs HQ	Trees HQ	Invertebrates HQ
Detected COPECS			
VOCs			
Methyl Acetate	---	---	---
Methylcyclohexane	---	---	---
SVOCs			
Acenaphthylene	7.90E-03	7.90E-03	8.78E-03
Anthracene	2.67E+00	2.67E+00	1.48E-02
Benzo(a)anthracene	2.49E+01	2.49E+01	8.59E-02
Benzo(a)pyrene	1.91E+01	1.91E+01	6.59E-02
Benzo(b)fluoranthene	1.39E+01	1.39E+01	4.79E-02
Benzo(g,h,i)perylene	1.18E+01	1.18E+01	4.07E-02
Benzo(k)fluoranthene	1.03E+01	1.03E+01	3.55E-02
Chrysene	4.04E+01	1.87E+01	1.39E-01
Dibenzo(a,h)anthracene	3.88E+00	3.88E+00	1.34E-02
bis(2-Ethylhexyl)phthalate	---	---	---
Fluoranthene	7.27E+00	3.48E+00	2.51E-02
Indeno(1,2,3-cd)pyrene	6.17E+00	6.17E+00	2.13E-02
Phenanthrene	2.23E+01	1.05E+01	1.24E-01
Pyrene	1.82E+01	2.16E+01	6.29E-02
Pesticides			
alpha-Chlordane	NA	2.67E-01	NA
gamma-Chlordane	NA	3.46E-01	NA
4,4'-DDD	9.58E-01	6.33E-01	---
4,4'-DDE	6.28E+00	7.22E+00	---
4,4'-DDT	3.92E+00	3.63E+00	---
Polychlorinated Biphenyls			
Aroclor 1260	NA	5.33E-03	NA
Metals			
Antimony	1.27E+01	4.42E+00	8.17E-01
Arsenic	3.35E-01	2.97E-01	6.03E-02
Barium	1.21E+00	8.56E-01	1.83E+00
Beryllium	6.07E-02	4.42E-02	1.52E-02
Cadmium	5.36E-01	8.96E-01	1.22E-01
Chromium	8.97E+01	4.16E+02	8.97E+00
Cobalt	1.43E+00	9.11E-01	1.86E-02
Copper	2.56E+01	5.82E+01	2.24E+01
Lead	1.77E+01	1.64E+01	1.25E+00
Manganese	3.52E+00	2.54E+00	1.72E+00
Mercury	2.49E+00	1.35E+00	2.49E-02
Nickel	1.21E+01	9.10E+00	1.64E+00
Selenium	8.46E+00	8.46E+00	1.07E+00
Silver	1.08E-01	3.99E-02	1.21E+00
Thallium	1.18E-01	8.87E-02	---
Vanadium	1.93E+01	9.64E+00	1.93E+00
Zinc	2.68E+01	2.38E+01	3.57E+01

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-27: Summary of Hazard Quotients for Terrestrial Wildlife
Wallops CDL Ecological Risk Assessment

COPEC	American Robin		Meadow Vole		Short-tailed Shrew		Red-tailed Hawk		Red Fox	
	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Detected COPECs										
VOCs										
Methyl Acetate	---	---	---	---	---	---	---	---	---	---
Methylcyclohexane	---	---	---	---	---	---	---	---	---	---
SVOCs										
Acenaphthylene	---	---	---	---	---	---	---	---	---	---
Anthracene	---	---	---	---	---	---	---	---	---	---
Benzo(a)anthracene	---	---	---	---	---	---	---	---	---	---
Benzo(a)pyrene	---	---	2.89E-02	2.89E-03	4.56E-01	4.57E-02	---	---	9.34E-05	9.48E-06
Benzo(b)fluoranthene	---	---	---	---	---	---	---	---	---	---
Benzo(g,h,i)perylene	---	---	---	---	---	---	---	---	---	---
Benzo(k)fluoranthene	---	---	---	---	---	---	---	---	---	---
Chrysene	---	---	---	---	---	---	---	---	---	---
Dibenzo(a,h) anthracene	---	---	---	---	---	---	---	---	---	---
bis(2-Ethylhexyl)phthalate	1.05E-01	1.05E-02	6.04E-04	6.04E-05	1.09E-03	1.09E-04	1.59E-04	1.59E-05	1.11E-05	1.11E-06
Fluoranthene	---	---	---	---	---	---	---	---	---	---
Indeno(1,2,3-cd) pyrene	---	---	---	---	---	---	---	---	---	---
Phenanthrene	---	---	---	---	---	---	---	---	---	---
Pyrene	---	---	---	---	---	---	---	---	---	---
Pesticides										
alpha-Chlordane	NA	NA	NA	NA	3.04E-05	1.54E-05	1.99E-04	3.61E-05	1.04E-05	5.20E-06
gamma-Chlordane	NA	NA	NA	NA	3.94E-05	1.99E-05	2.58E-04	4.68E-05	1.35E-05	6.74E-06
4,4'-DDD	2.03E+02	2.03E+01	1.11E-03	2.21E-04	7.41E-02	1.48E-02	2.49E-01	2.49E-02	5.61E-04	1.12E-04
4,4'-DDE	2.55E+03	2.55E+02	5.05E-03	1.01E-03	9.42E-01	1.89E-01	1.65E+01	1.65E+00	3.73E-02	7.43E-03
4,4'-DDT	1.20E+03	1.20E+02	3.43E-03	6.85E-04	4.41E-01	8.84E-02	8.65E-01	8.65E-02	1.95E-03	3.88E-04
Polychlorinated Biphenyls										
Aroclor 1260	NA	NA	NA	NA	2.47E-03	4.95E-04	7.60E-04	1.76E-04	1.20E-03	2.70E-03
Metals										
Antimony	---	---	3.05E+00	3.07E-01	9.21E+01	9.05E+00	---	---	2.70E-02	2.72E-03
Arsenic	3.20E-01	1.28E-01	3.22E-01	3.20E-02	1.42E+00	1.42E-01	1.09E-04	4.38E-05	2.86E-03	2.86E-04
Barium	6.58E+00	3.28E+00	1.10E+00	2.98E-01	1.20E+00	3.25E-01	2.51E-03	1.25E-03	3.19E-03	8.49E-04
Beryllium	---	---	3.35E-02	3.35E-03	5.85E-03	5.85E-04	---	---	5.40E-05	5.40E-06
Cadmium	5.04E+01	3.65E+00	1.88E-01	1.88E-02	7.90E+00	7.90E-01	2.43E-03	1.76E-04	1.86E-03	1.86E-04
Chromium	3.75E+01	7.50E+00	1.04E-01	2.60E-02	1.16E+00	2.89E-01	3.65E-02	7.29E-03	6.42E-03	1.60E-03
Copper	2.30E+01	1.75E+01	3.25E-01	2.46E-01	6.53E+00	4.96E+00	4.04E-03	3.08E-03	4.80E-03	3.62E-03
Lead	5.80E+02	5.80E+01	5.68E-01	5.69E-02	5.32E+00	5.32E-01	2.01E-01	2.01E-02	1.10E-02	1.09E-03
Manganese	1.54E-01	1.54E-02	5.09E-02	1.58E-02	6.32E-02	1.95E-02	9.14E-05	9.14E-06	4.14E-04	1.27E-04
Mercury	8.48E+01	8.48E+00	1.36E-02	1.36E-03	3.65E-02	3.65E-03	1.83E-01	1.83E-02	5.63E-04	5.63E-05
Nickel	9.59E-01	6.94E-01	3.30E-02	1.65E-02	4.38E-02	2.19E-02	7.65E-04	5.53E-04	6.35E-04	3.17E-04
Selenium	6.18E+00	3.09E+00	7.16E-01	4.34E-01	1.37E+00	8.30E-01	4.17E-03	2.09E-03	6.09E-03	3.71E-03
Silver	---	---	---	---	---	---	---	---	---	---
Thallium	---	---	---	---	---	---	---	---	---	---
Vanadium	6.19E-01	6.19E-02	3.80E-01	3.79E-02	1.07E+00	1.07E-01	3.48E-04	3.48E-05	7.63E-03	7.63E-04
Zinc	1.25E+02	1.38E+01	2.06E-01	1.03E-01	8.57E-01	4.29E-01	3.96E-02	4.38E-03	1.57E-03	7.84E-04

Notes: A dash indicates the absence of an applicable TRV and corresponding calculated HQ
Shaded cells indicate HQs greater than 1.
NA indicates the chemical was not a COPEC for the receptor

Definitions:

COPEC - Chemical of Potential Ecological Concern
HQ - Hazard quotient.
LOAEL - Lowest Observable Adverse Effect Limit
NOAEL - No Observable Adverse Effect Limit

Table 7-28: Summary of Hazard Quotients for Aquatic Wildlife
Wallops CDL Ecological Risk Assessment

	Aquatic Life	Benthic Inverts	Great Blue Heron		River Otter	
COPEC	HQ	HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Detected COPECs						
VOCs						
2-Butanone (MEK)	NA	---	---	---	7.91E-09	3.06E-09
Carbon disulfide	NA	1.68E+01	---	---	---	---
Cyclohexane	NA	---	---	---	---	---
Methyl Acetate	NA	---	---	---	---	---
SVOCs						
Di-n-octyl phthalate	NA	---	---	---	---	---
bis(2-Ethylhexyl)phthalate	NA	8.90E+02	1.30E-01	1.30E-02	1.41E-03	1.41E-04
Pesticides						
4,4'-DDD	NA	1.33E+01	6.32E-04	1.28E-04	6.86E-06	1.39E-06
4,4'-DDE	NA	4.72E+01	1.45E-03	2.93E-04	1.57E-05	3.18E-06
4,4'-DDT	NA	2.60E+00	1.05E-04	2.12E-05	1.14E-06	2.31E-07
Metals						
Aluminum	9.74E+00	---	1.62E+00	6.57E-01	1.64E+00	1.64E-01
Antimony	NA	1.40E+00	---	---	3.53E-03	3.54E-04
Arsenic	3.00E-01	1.40E+00	5.31E-02	2.12E-02	9.48E-02	9.42E-03
Barium	5.60E+00	---	1.32E-01	6.58E-02	1.19E-02	3.27E-03
Beryllium	NA	---	---	---	7.57E-05	7.57E-06
Cadmium	NA	1.52E+00	3.72E-03	2.70E-04	1.33E-04	1.33E-05
Chromium	1.82E-01	9.18E-01	1.50E-01	3.01E-02	1.09E-03	2.71E-04
Copper	8.17E-01	1.09E+00	1.60E-02	1.22E-02	1.16E-03	8.86E-04
Iron	2.39E+00	1.29E+00	---	---	---	---
Lead	4.30E-01	1.31E+00	1.50E-01	1.50E-02	5.02E-04	5.02E-05
Mercury	1.18E-01	1.68E+00	4.09E-01	2.04E-01	3.39E-03	3.39E-04
Nickel	3.54E-01	8.48E-01	1.42E-03	1.03E-03	6.53E-05	3.26E-05
Selenium	2.18E+00	8.77E-01	5.19E-01	2.60E-01	3.10E-02	1.87E-02
Silver	NA	1.50E+00	---	---	---	---
Thallium	NA	---	---	---	2.90E-03	2.56E-04
Vanadium	NA	---	1.50E-02	1.50E-03	2.08E-02	2.08E-03
Zinc	NA	1.23E+00	3.70E-02	4.10E-03	7.96E-05	3.98E-05

Table 7-29: Summary of Hazard Indicies
Wallops CDL Ecological Risk Assessment

COPEC	Grasses	Trees	Invertebrate	American Robin	Meadow Vole	Short-tailed Shrew	Red-tailed Hawk	Red Fox
NOAEL-based TRVs								
Total VOCs	1.81E+02	1.47E+02	6.85E-01	1.05E-01	2.95E-02	4.57E-01	1.59E-04	1.05E-04
Total Pesticides	1.12E+01	1.21E+01	-	3.95E+03	9.59E-03	1.46E+00	1.76E+01	3.99E-02
PCBs as Aroclors	NA	5.33E-03	-	NA	NA	2.47E-03	7.60E-04	1.20E-03
LOAEL-based TRVs								
Total VOCs	NA	NA	NA	1.05E-02	2.95E-03	4.58E-02	1.59E-05	1.06E-05
Total Pesticides	NA	NA	NA	3.95E+02	1.91E-03	2.92E-01	1.76E+00	7.94E-03
PCBs as Aroclors	NA	NA	NA	NA	NA	4.95E-04	1.76E-04	2.70E-03

COPEC	Aquatic Life	Benthic Inverts	Great Blue Heron	River Otter
NOAEL-based TRVs				
Total VOCs	NA	9.07E+02	1.30E-01	1.41E-03
Total Pesticides	NA	6.31E+01	2.19E-03	2.37E-05
LOAEL-based TRVs				
Total VOCs	NA	NA	1.30E-02	1.41E-04
Total Pesticides	NA	NA	4.42E-04	4.80E-06

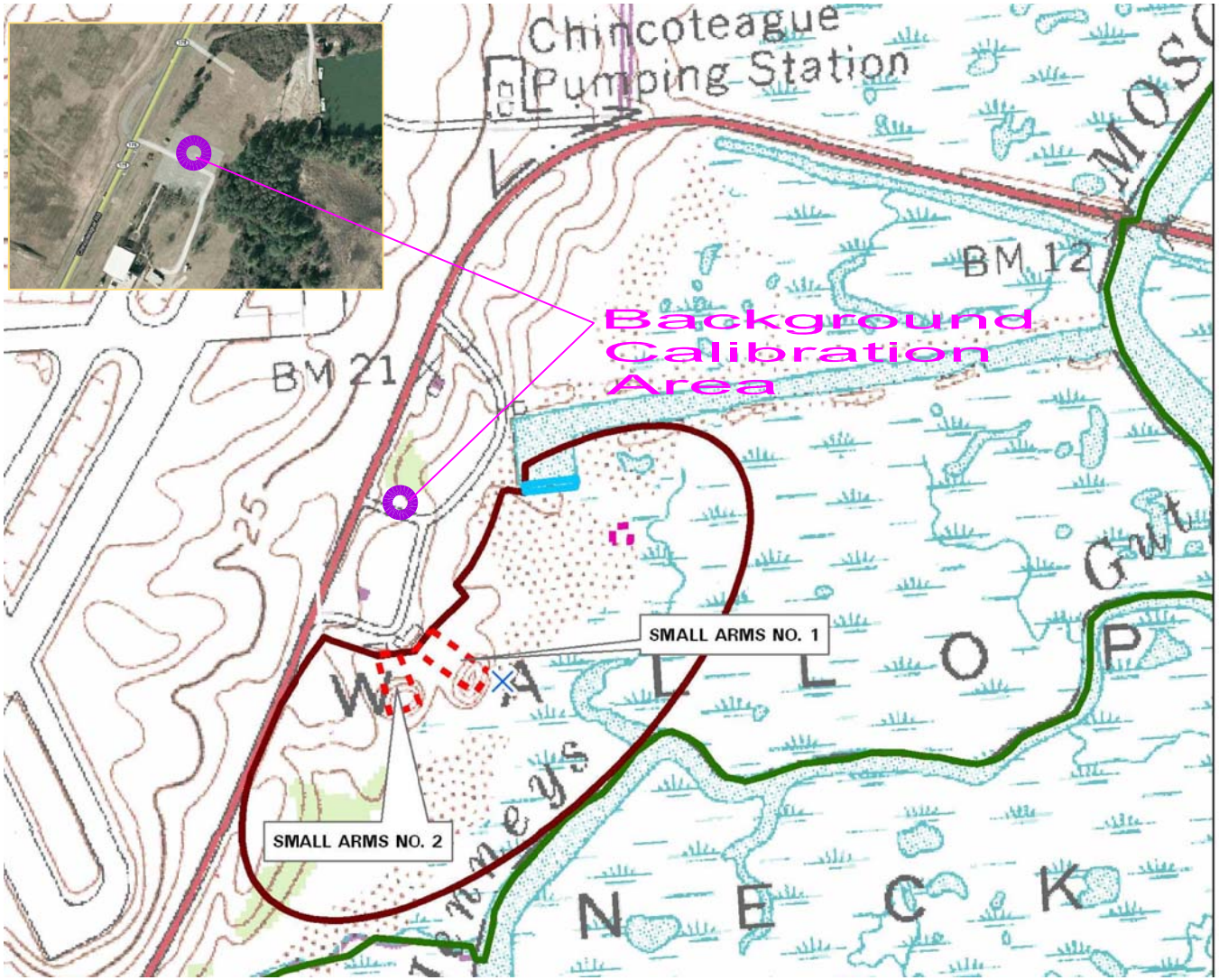
Table 7-30:
Evaluation of Potential Hazard
Wallops CDL Ecological Risk Assessment

	Surface Soil (0-0.5 ft bgs)	Subsurface Soil (0-5 ft bgs)	Water	Sediment
COPECs with HQ > 1	SVOCs, DDD, DDE, DDT, Sb, Ba, Cd, Cr, Co, Cu, Pb, Mn, Hg, Ni, Se, Ag, V, Zn	SVOCs, DDE, DDT, Sb, As, Ba, Cd, Cr, Cu, Pb, Mn, Hg, Ni, Se, V, Zn	Al, Ba, Fe, Se	Carbon Disulfide, DDD, DDE, DDT, Sb, As, Cd, Cu, Fe, Pb, Hg, Ag, Zn
Habitat-Related Considerations				
Habitat quality	|<—— Disturbed ——>|			
Habitat size	|<—— Small ——>|			
Presence of threatened or endangered species	|<—— None observed ——>|			
Exposure-Related Considerations				
Less than or comparable to background	DDE, DDT, Sb		Fe	Carbon Disulfide, Cu
Non-detect driven risk	SVOCs	SVOCs		
Toxicity-Related Considerations				
Exceeds NOAEL HQ but not exceed LOEAL HQ	Sb	As, Ba, Cd, Cr, Pb, Se,V		
TRVs based on most toxic form of chemical and not on form most likely to be present at site	Cr	Cr		
HQs Ecologically Significant Potential for Hazard	To Plants and Invertebrates: Ba, Cr, Co, Cu, Pb, Mn, Hg, Ni, Se, V, Zn To Insectivorous birds: Ba, Cd, Cu, Co, Hg, Se, Zn	To Plants: Sb, Cu, Mn, Hg, Ni, Zn To Insectivorous mammals: Sb, Cu	To Aquatic Life: Al, Ba, Se	To Benthic Inverts: DDD, DDE, DDT Sb, As, Cd, Fe, Pb, Hg, Ag, Zn

APPENDIX A

RESULTS OF THE GEOPHYSICAL SURVEY OF THE WALLOPS CDL SITE

\DIR\DELTEK-#\0000-000.DWG PLOT DATE: 00-00-99



Legend

CENTROID
UTM ZONE 17 (NAD 83)
987385.5 m E
4213401.5 m N
37° 56' 15" N
75° 27' 201" W

APPROXIMATE MRA BOUNDARY
TOTAL ACREAGE = 49 Ac
LAND ACREAGE = 48 Ac
WATER ACREAGE = 1

PYROTECHNICS AREA
987526.7 m E
4213580.0 m N
37° 56' 20" N
75° 27' 14" W
ACREAGE = 0.1 Ac

BOAT BASIN AREA
987443.0 m E
4213637.5 m N
37° 56' 22" N
75° 27' 17" W
ACREAGE = 0.2 Ac

SMALL ARMS NO. 1
987259.3 m E
4213402.1 m N
37° 56' 15" N
75° 27' 17" W
ACREAGE = 0.5 Ac

SMALL ARMS NO. 2
987325.8 m E
4213428.6 m N
37° 56' 16" N
75° 27' 22" W
ACREAGE = 0.7 Ac

APPROXIMATE PROPERTY BOUNDARY

0 250 500 1000
SCALE IN FEET

N

US ARMY CORPS OF ENGINEERS

DESIGNED N.G.S	DATE 05/17/10
DRAWN N.G.S	DATE 05/17/10

VERSAR INC.

LOCATION OF BACKGROUND
TERRAIN CONDUCTIVITY MEASUREMENT
FOR ELECTROMAGNETIC SURVEY

PROJECT NO. 111328.0018	SCALE: 1:24,000
DRAWING NO.	FIGURE

Geophysical Survey
CDL Site
Wallops Island, Virginia

Prepared For:

Versar, Inc.

6850 Versar Center
Springfield, Virginia 22151

Prepared By:

Forrest Environmental Services, Inc.
3057 Crosen Court
Oak Hill, Virginia 20171
(703) 648-9090

March 2007

FES Project No. 07130

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1.0 Introduction

Forrest Environmental Services, Inc. (FES) performed a geophysical survey located at the CDL Site located east of Runway 22 in Walllops Island, Virginia on the 14th and 15th March 2007. The investigation consisted of electromagnetic (EM) and a ground penetrating radar (GPR) surveys to locate suspected metal and non-metal buried debris at 4our suspected waste-disposal areas.

The EM survey was located east of the runway. Data was collected along linear 10-foot traverses having stations at 2.5-foot centers that covered approximately 450 by 750 feet. FES placed labeled orange pin flags at 50-foot centers with the northing and easting of each station. The GPR was used to confirm the results of the EM survey. The survey boundary was selected by a Versar Inc. representative.

Topographically, the site slopes gently to the east. The site consists mostly of grassed areas and cleared wooded areas at the eastern section of the survey. Survey locations and physical features are shown in Figure 1.

Details of the geophysical survey are described in the following sections.

2.0 Equipment and Procedures

EM Survey

The EM survey was performed using an EM-31 induction meter to measure the apparent conductivity of the subsurface. The EM-31 consists of two horizontal coplanar loops, one acting as a transmitter and the other as a receiver. The transmitter induces electrical eddy currents in the earth, which in turn produce a secondary magnetic field. The receiver intercepts the secondary field, and the meter measures the terrain conductivity by comparing the strength of the secondary field to that of the primary field.

The depth of investigation by EM is a function of the intercoil spacing and the orientation of the antenna dipoles. The EM-31 has an intercoil spacing of 12 feet, and used in the vertical dipole mode, has an effective penetration depth of approximately 18 feet.

Two readings were obtained from the EM-31 at each measurement station. The EM was connected to a data logger that simultaneously recorded both the quadrature-phase component and the in-phase component. The quadrature-phase component measures the apparent terrain conductivity of the subsurface, and will detect metallic and nonmetallic objects or features with conductivities that deviate from their surroundings. The background apparent terrain conductivity value at the site was approximately 12 millimhos per meter (mmhos/m).

The in-phase component measurements are proportional to an effective, average magnetic susceptibility of the surrounding earth; this mode is sensitive to large metallic objects. The readings do not indicate true magnetic susceptibility because there is an unknown additive constant and multiplying factor that would be required to convert the measured values to magnetic susceptibility.

Generally, negative EM values can indicate the areal extent of large, shallow buried metal objects. The EM displays moderate-sized metal objects that are buried deep as areas of high conductivity; therefore, both high and negative readings of apparent conductivity can indicate

metal. However, high conductivity materials can also be caused by conductive chemical compounds such as acids, sulfates, fly ash, and salts in the subsurface and by conductive soils such as clay. Low conductivity materials such as wood and oil are generally not detectable by the EM.

Ground Penetrating Radar Survey

The GPR survey was performed using a Noggin Smart Cart with a shielded 250 megahertz (MHz) antenna. GPR is an EM method that detects interfaces between subsurface materials with contrasting dielectric constants. The GPR system consists of an antenna that consists of a transmitter and receiver that were connected to a computer that processes the received signal and locates the position of data collection.

The transmitter radiates repetitive short-duration EM waves into the earth from the antenna as it is moved across the ground surface. These radar waves are reflected back to the receiver by interfaces between materials with different dielectric constants. The intensity of the reflected signal is a function of the dielectric constant contrast at the interface, the conductivity of the material the wave is traveling through, and the frequency of the signal. Subsurface features that cause reflections are: 1) natural geologic conditions such as changes in sediment composition, bedding and cementation horizons, voids, and water content and 2) fill materials or changes in the subsurface such as soil backfill, buried debris, USTs, pipelines, and utilities. The controlling unit receives the signal from the antenna and produces a continuous cross-section of the subsurface interface reflections.

Depth of GPR signals is highly site-specific and is limited by signal attenuation or absorption of the subsurface. Signal attenuation is dependent on the electrical conductivity of subsurface materials. Signal attenuation is greatest in materials with high conductivity, such as clays or brackish groundwater, and lowest in low conductivity material, such as unsaturated sands or rock. GPR depth penetration is dependent on antenna frequency. Depth penetration increases with decreasing frequency; however, identification diminishes proportionally with smaller features. The depth penetration of the GPR survey is approximately 2.5 meters (8 feet) below surface.

The GPR survey used a 250 MHz antenna that was internally shielded from above ground and adjacent anthropogenic sources. The GPR survey was performed by a project geophysicist pulling the antenna adjacent to the proposed column locations. The location of the antenna along the transects lines were marked electronically from a survey wheel. Data were collected at 0.1-foot intervals and stored on the laptop computer.

The GPR data were converted into a GPR depth model using Sensor's and Software pulse EKKO software. The GPR data was gained and a low frequency response filter was included to the raw data.

3.0 Survey Results and Conclusions

The objective of the geophysical survey was to locate the presence of suspected buried metal and non-metal debris. The EM apparent terrain conductivity contour map (Figure 2) exhibited five anomalies that are not of anthropogenic interferences within the survey area. The anthropogenic anomalies include the metal fence and underground utilities adjacent to Runway 22 and east and west of the service road. The EM average magnetic susceptibility contour map (Figure 3) confirms the presence of anomalies of Figure 2.

One negative anomaly is centered at 110 East 340 North. Anomaly A appears to be from a large mass of buried metal.

One negative anomaly is centered at 150 East 400 North. Anomaly B appears to be from a large mass of buried metal.

One negative anomaly is centered at 375 East 325 North. Anomaly C appears to be from a large mass of buried metal.

One negative anomaly is centered at 350 East 420 North. Anomaly D appears to be from a large mass of buried metal.

One high anomaly is centered at 300 East 430 North. Anomaly E appears to be from numerous small material of buried metal such as numerous 5-gallon pails or paint cans.

The GPR survey was conducted within the four suspected buried areas and was selected by a Versar Inc. representative. GPR Line 1 (Figure 4) and GPR Line 2 (Figure 5) confirm the results of the EM survey and does not indicate buried debris. GPR Line 2 anomaly at 110 feet East appears to be from the steep slope.

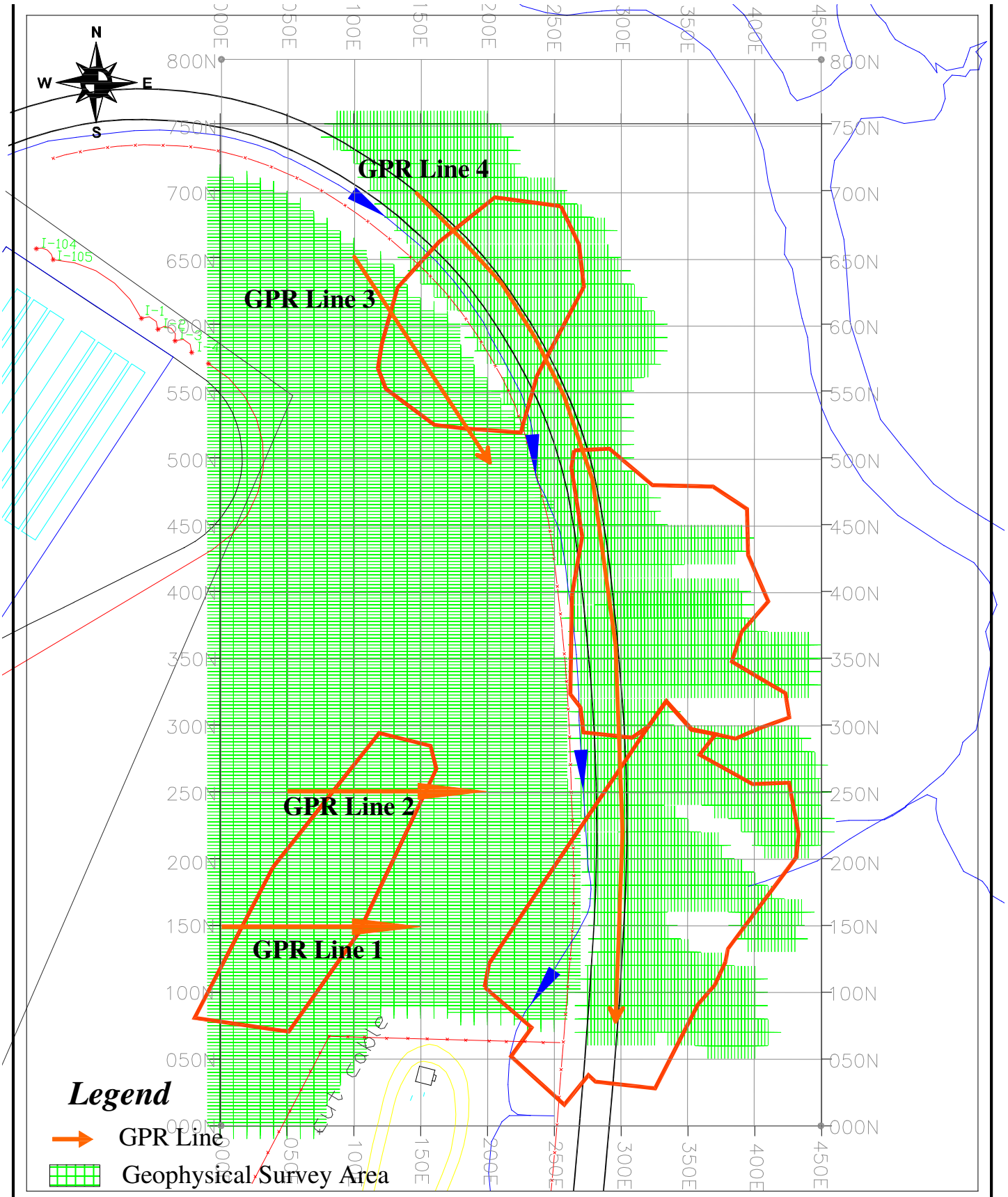
GPR Line 3 was conducted at the northern suspected buried area (Figure 6). GPR Line 3 confirm the results of the EM and does not indicate buried debris. The anomaly at 10 feet Southeast appears to be gopher holes.

GPR Line 4 was conducted at the three eastern suspected buried areas (Figure 7) and on the service road. GPR Line 4 confirm the results of the EM and does not indicate buried debris beneath of the service road. The anomalies at 275 feet South and 780 feet South appear to be culverts.

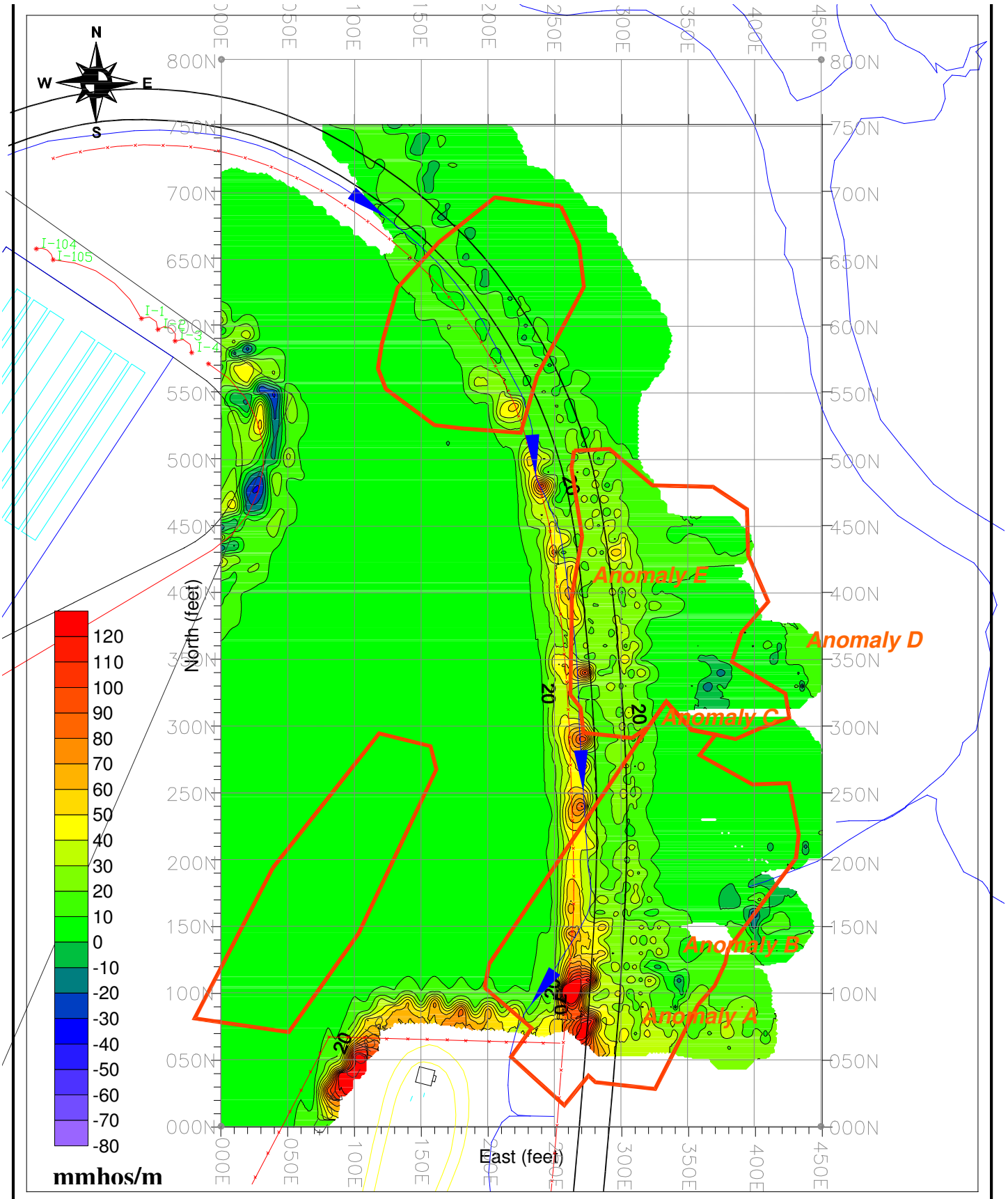
The geophysical survey indicates four anomalies that appear to be from surface anthropogenic interferences. The anomaly located at the southern boundary of the site and west of the service road appears to be from the fence. The linear anomaly east of Runway 22 appears to be underground utilities. The two linear anomalies located west and east of the service road appears to be underground utilities.

The EM and GPR survey indicated four anomalies from that appears to be large masses of buried metal (Figure 8). The four anomalies that indicate large mass of buried metal are located between the service road and mosquito creek.

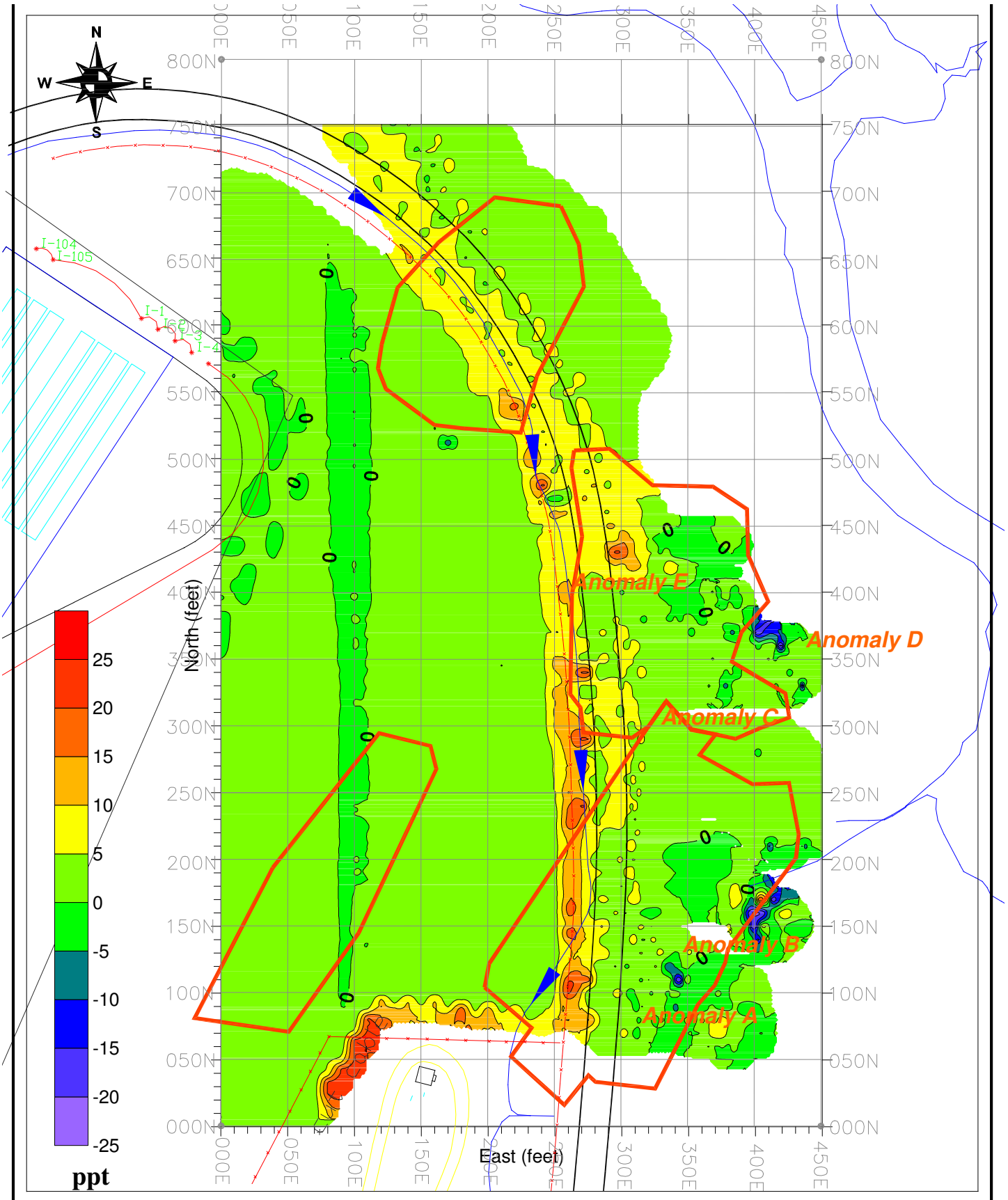
The EM and GPR survey indicated a high anomaly that appears to be numerous small metal and non-metal debris such as 5-gallon pails and paint cans. The high anomaly appears to be east of the service road. Buried material appears to be confined between the service road and Mosquito Creek.



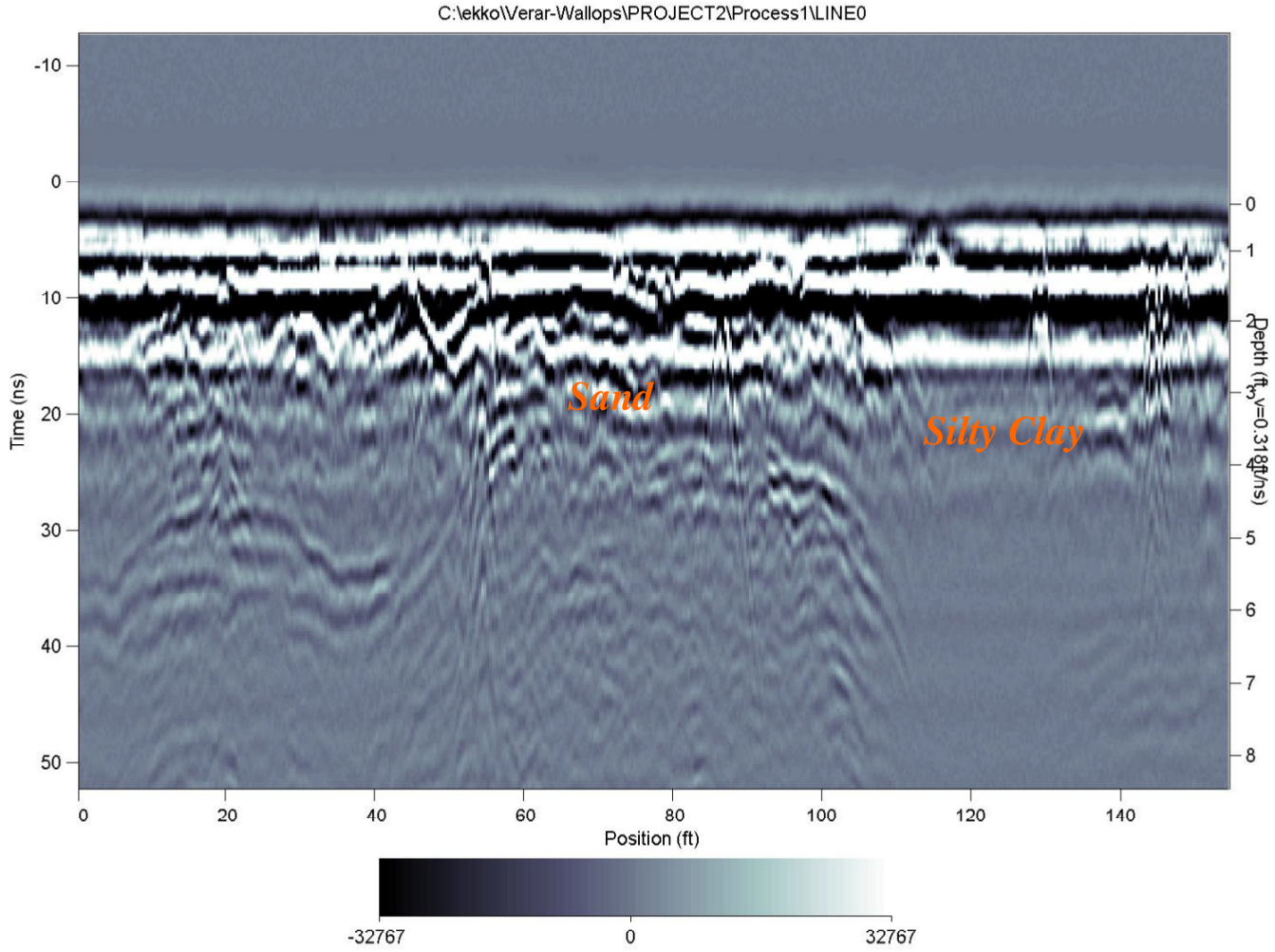
Forrest Environmental Services, Inc. Oak Hill, Virginia (703) 648-9090 www.fesinc.net	DATE: March 2007	SCALE: 1 inch = 100 feet	TITLE: ***Geophysical Boundary Map CDL Site Wallops Island, Virginia***
	DRAWN BY:	APPROVED BY:	
	JOB NO.: 07130	DWG. NO./ REV. NO.: VCDLF2.srf	CLIENT: **Versar Inc.** / FIGURE: **1**



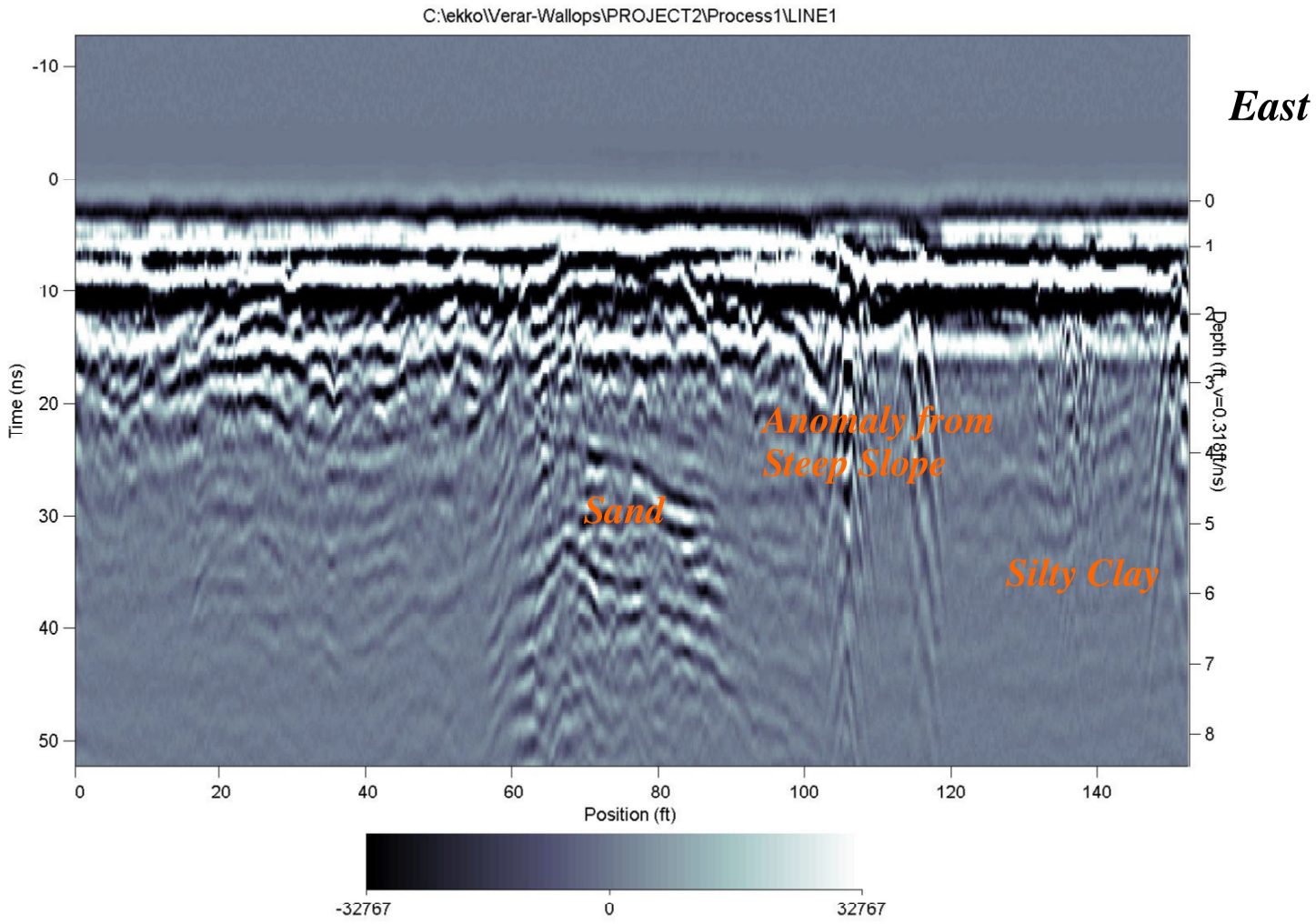
Forrest Environmental Services, Inc. Oak Hill, Virginia (703) 648-9090 www.fesinc.net	DATE: March 2007	SCALE: 1 inch = 100 feet	TITLE: ***Apparent Conductivity Contour Map CDL Site Wallops Island, Virginia***
	DRAWN BY:	APPROVED BY:	
	JOB NO.: 07130	DWG. NO./ REV. NO.: VCDLF2.srf	CLIENT: **Versar Inc.** / FIGURE: **2**



Forrest Environmental Services, Inc. Oak Hill, Virginia (703) 648-9090 www.fesinc.net	DATE: March 2007	SCALE: 1 inch = 100 feet	TITLE: ***Average Magnetic Susceptibility Contour Map CDL Site Wallops Island, Virginia***
	DRAWN BY:	APPROVED BY:	
	JOB NO.: 07130	DWG. NO./ REV. NO.: VCDLF3.srf	CLIENT: **Versar Inc.** / FIGURE: **3**



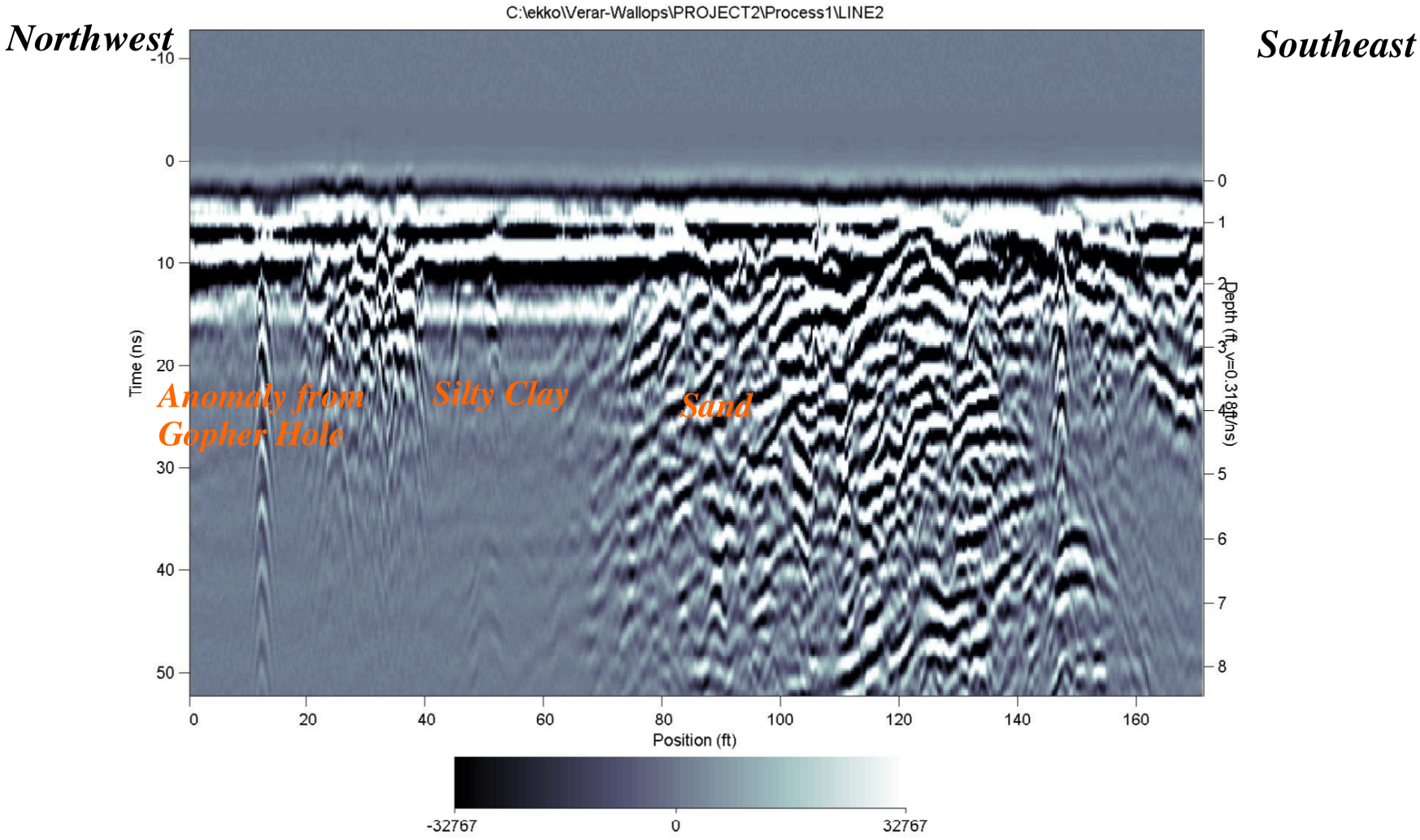
Forrest Environmental Services, Inc. Oak Hill, Virginia (703) 648-9090 www.fesinc.net	DATE: March 2007	SCALE: feet	TITLE: ***GPR Line 1*** ***CDL Site*** ***Wallops Island, Virginia***
	DRAWN BY:	APPROVED BY:	
	JOB NO.: 07130	DWG. NO./ REV. NO.: VCDLF4.	CLIENT: Versar Inc. / FIGURE: **4**



Forrest Environmental Services, Inc.

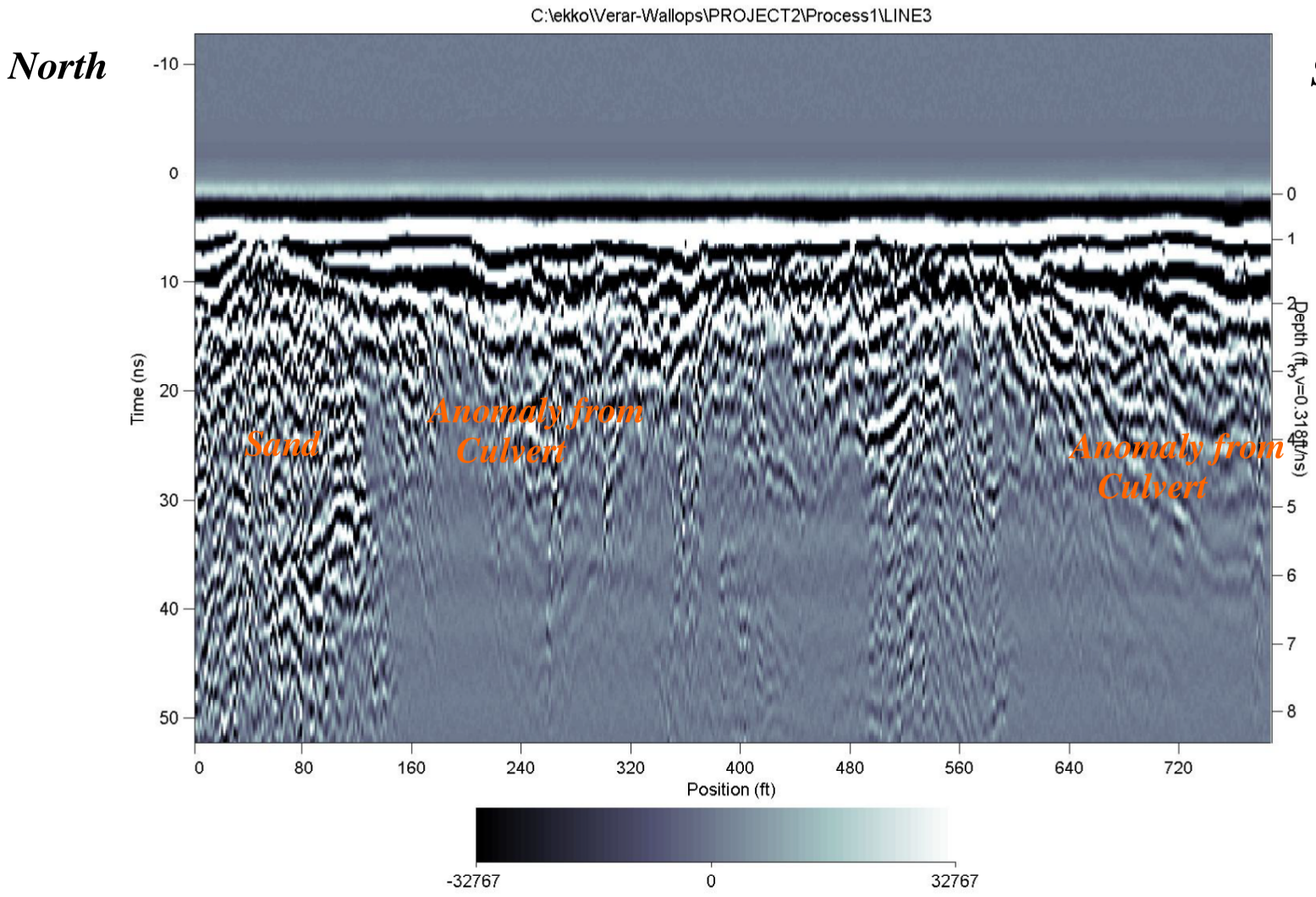
Oak Hill, Virginia
(703) 648-9090
www.fesinc.net

DATE: March 2007	SCALE: feet	TITLE: ***GPR Line 2 CDL Site Wallops Island, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 07130	DWG. NO./ REV. NO.: VCDLF5.	CLIENT: Versar Inc.	FIGURE: **5**



Forrest Environmental Services, Inc.
Oak Hill, Virginia
(703) 648-9090
www.fesinc.net

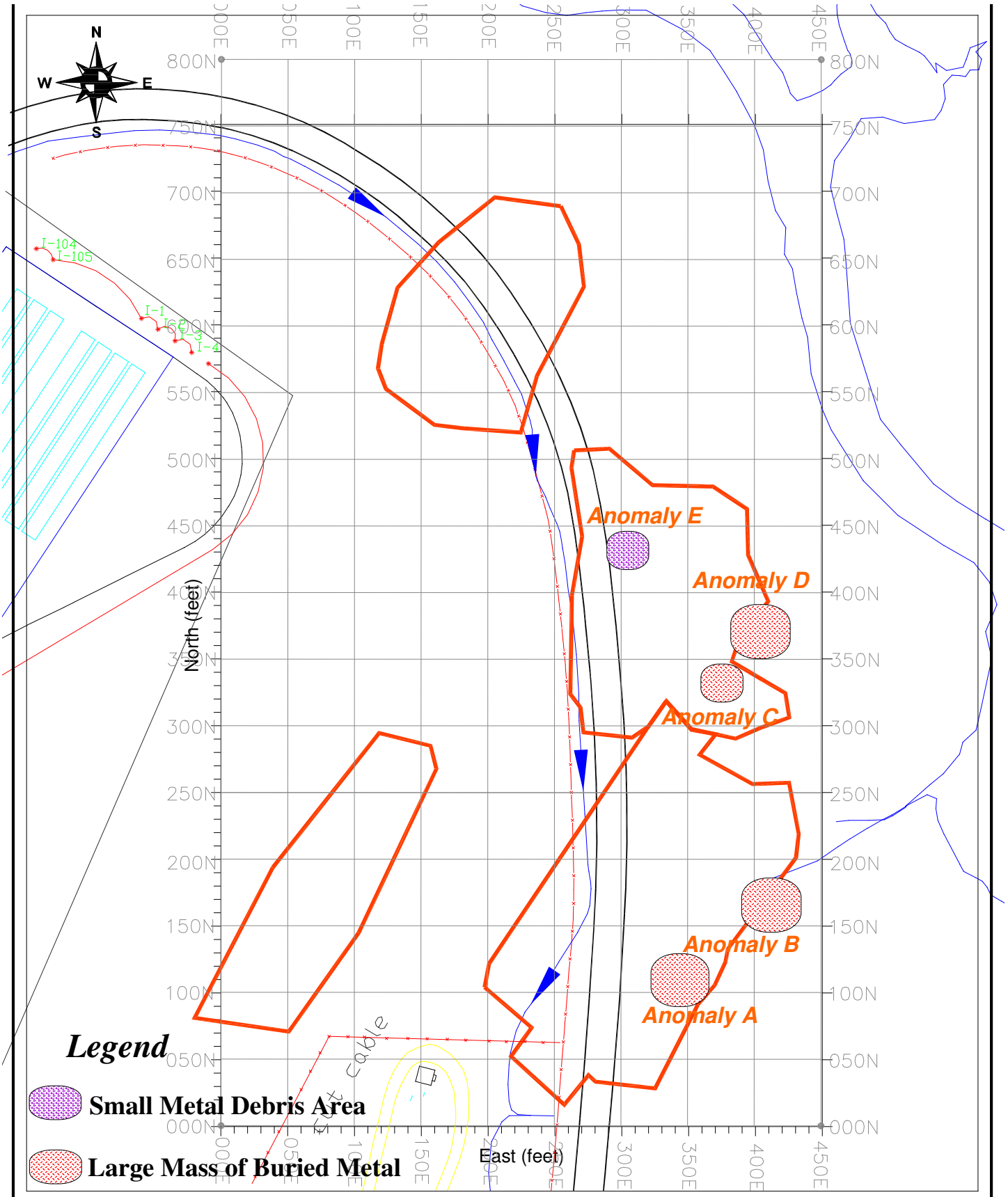
DATE: March 2007	SCALE: feet	TITLE: ***GPR Line 3 CDL Site Wallops Island, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 07130	DWG. NO./ REV. NO.: VCDLF6.	CLIENT: Versar Inc.	FIGURE: **6**



Forrest Environmental Services, Inc.

Oak Hill, Virginia
(703) 648-9090
www.fesinc.net

DATE: March 2007	SCALE: feet	TITLE: ***GPR Line 4 CDL Site Wallops Island, Virginia***	
DRAWN BY:	APPROVED BY:		
JOB NO.: 07130	DWG. NO./ REV. NO.: VCDLF7.	CLIENT: Versar Inc.	FIGURE: **7**



Forrest Environmental Services, Inc. Oak Hill, Virginia (703) 648-9090 www.fesinc.net	DATE: March 2007 DRAWN BY:	SCALE: 1 inch = 100 feet APPROVED BY:	TITLE: *Geophysical Anomaly Map* *CDL Site* *Wallops Island, Virginia*
	JOB NO.: 07130	DWG. NO./ REV. NO.: VCDLF8.srf	CLIENT: Versar Inc. / FIGURE: 8

APPENDIX B

RESULTS OF THE MIP INVESTIGATION AT THE WALLOPS CDL SITE

MIP Report
Construction Debris Landfill
NASA Flight Facility, Wallops Island, VA

May 09, 2007

"Bringing Chemistry and Contaminants Together"
For the Consulting Community

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Client: Versar, Inc. Noel Simmons
6850 Versar Center
Springfield, VA 22151

Start Date: 3/22/2007
Completed Date: 3/22/2007

Site Address: NASA Flight Facility, Wallops Island, VA
Project Name Construction Debris Landfill

Project Scope: Collected 8 Membrane Interface Probe logs from 8 boring locations from approximately surface to as deep as 39.85 feet to delineate presence and relative concentrations of contaminants in the unsaturated and saturated soils.

Project Information:

MIP-1	None.
MIP-2	None.
MIP-3	None.
MIP-4	None.
MIP-5	Spikes in conductivity most likely due to metal paint can, as tooling came out "battleship grey" and smelling like paint.
MIP-6	None.
MIP-7	None.
MIP-8	None.

MIP Boring and Confirmation Sampling Summary

Date Sampled	Time Sampled	Boring Name	Total Depth	Confirmation Samples Soil	Confirmation Samples Groundwater
Mar 22 2007	08:47	MIP-1	33.85	Not Collected	Not Collected
Mar 22 2007	09:50	MIP-2	31.15	Not Collected	Not Collected
Mar 22 2007	10:50	MIP-3	37.95	Not Collected	Not Collected
Mar 22 2007	12:42	MIP-4	26.25	Not Collected	Not Collected
Mar 22 2007	13:39	MIP-5	29.80	Not Collected	Not Collected
Mar 22 2007	15:12	MIP-6	39.85	Not Collected	Not Collected
Mar 22 2007	16:27	MIP-7	30.05	Not Collected	Not Collected
Mar 22 2007	17:29	MIP-8	27.15	Not Collected	Not Collected

Quality Control: Vironex utilizes a response test* prior to each MIP boring. A solution containing water, Trichloroethene & Toluene are mixed and transferred into a galvanized test pipe. The MIP is then lowered into the test pipe for 45 seconds and then extracted. The trip time* is then noted and entered into the FC 5000 MIP computer.

**Response Test - A test that ensures that the MIP system is working correctly.*
***Trip Time - Time it takes for the standard to enter the MIP probe, at the probe membrane, till the time a significant response is noticed on the FC 5000 Computer*

MIP Components Used:
- Geoprobe 6600
- FC 5000 MIP Computer
- Flow Control Box
- HP Gas Chromatograph
- ECD (Electron Capture Detector)
- PID (Photo Ionization Detector)
- FID (Flame Ionization Detector)
- 150' Trunk Line
- 1.75" MIP Probe
- 1.5" Drive Rods

Soil Confirmation Confirmation samples were not collected for analysis.

Qualitative Analysis (Identification): The MIP system will detect most VOC's (Volatile Organic Compounds) which have the capability of migrating through the membrane. The ECD (Electron Capture Detector) will typically detect chlorinated compounds. The PID will typically detect aromatic and double bonded compounds, typical of gasoline components and some solvents. At high concentrations the ECD, PID and FID may detect other compounds not normally associated with the detector. Physical soil samples which are prepared by EPA Method 5035, and analyzed by EPA Method 8260, may be semi correlated with the MIP responses. The MIP responses are semi-correlated with most detected compounds, even those which are not reported nor detected by EPA Method 8260.

Lithology: The conductivity of soils is different for each type of media. Finer grained sediments, such as silts or clays, will have a higher EC signal. While coarser grained sediments, sands and gravel, will have a lower EC signal. Lithology should be correlated with a physical soil sample.

Kurt M. Scarbro
Project Manager
Vironex, Inc.

Chuck Terry
Certified Geoprobe® MIP Technician
Vironex, Inc.

Client: Versar, Inc.
6850 Versar Center
Springfield, VA 22151

Start Date: 3/22/2007
Completed Date: 3/22/2007

Site Address: NASA Flight Facility, Wallops Island, VA
Project Name: Construction Debris Landfill

MIP Quality Control

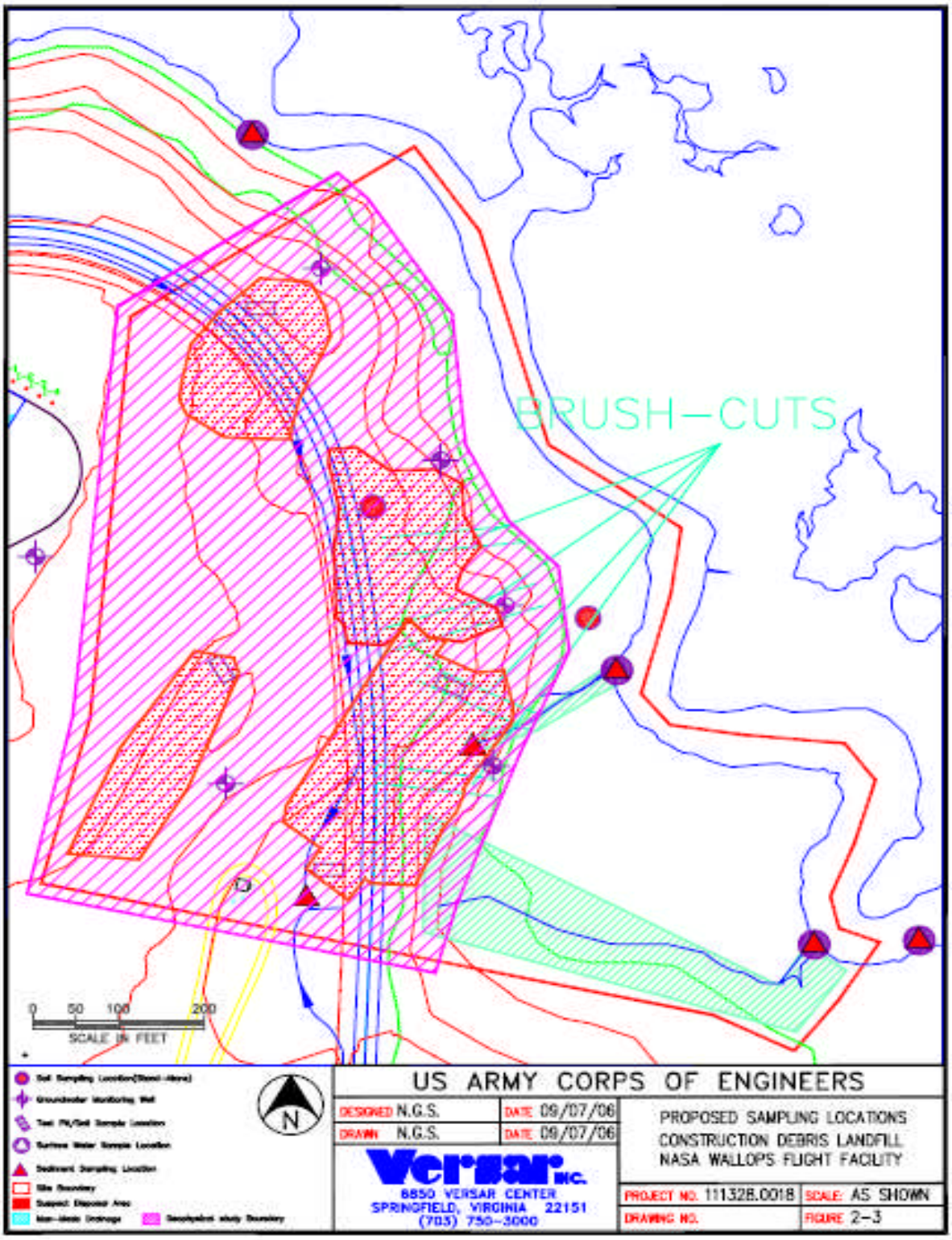
Standard Summary

Boring Name	Date	Time	Standard	PID Response	ECD Response	Pressure (PSI)	Response Time (s)
QA QC 1	Mar 22 2007	08:04	1 ppm TCE & Toluene	Yes	Yes	13.37	105
MIP-1	Mar 22 2007	08:47				14.42	105
QA QC 2	Mar 22 2007	09:41	1 ppm TCE & Toluene	Yes	Yes	14.26	90
MIP-2	Mar 22 2007	09:50				14.31	90
QA QC 3	Mar 22 2007	10:38	1 ppm TCE & Toluene	Yes	Yes	13.91	94
MIP-3	Mar 22 2007	10:50				14.00	95
QA QC 4	Mar 22 2007	11:51	1 ppm TCE & Toluene	Yes	Yes	13.59	90
MIP-4	Mar 22 2007	12:42				14.10	90
QA QC 5	Mar 22 2007	13:28	1 ppm TCE & Toluene	Yes	Yes	13.77	95
MIP-5	Mar 22 2007	13:39				14.30	95
QA QC 6	Mar 22 2007	15:07	1 ppm TCE & Toluene	Yes	Yes	13.76	85
MIP-6	Mar 22 2007	15:12				13.70	85
QA QC 7	Mar 22 2007	16:09	1 ppm TCE & Toluene	Yes	Yes	13.13	88
MIP-7	Mar 22 2007	16:27				13.46	88
QA QC 8	Mar 20 2007	14:55	1 ppm TCE & Toluene	Yes	Yes	13.10	90
MIP-8	Mar 22 2007	17:29				13.06	90

End of Day QA QC Summary

Boring Name	Date	Time	Standard	PID Response	ECD Response	Pressure (PSI)	Response Time (s)
End of Day 1	Mar 22 2007	18:17	1 ppm TCE & Toluene	Yes	Yes	13.44	90

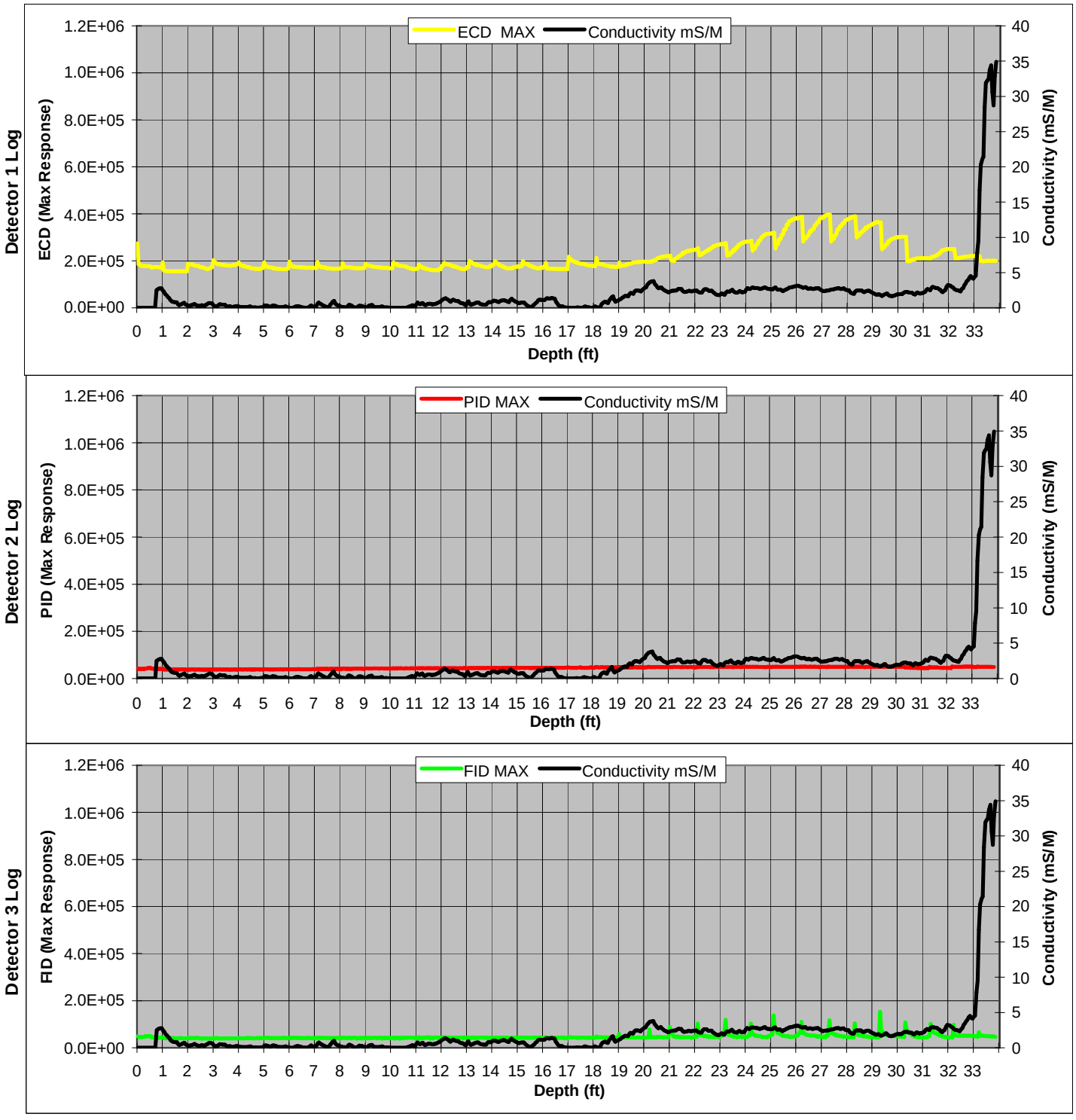
SITE MAP



Map provided by Versar.

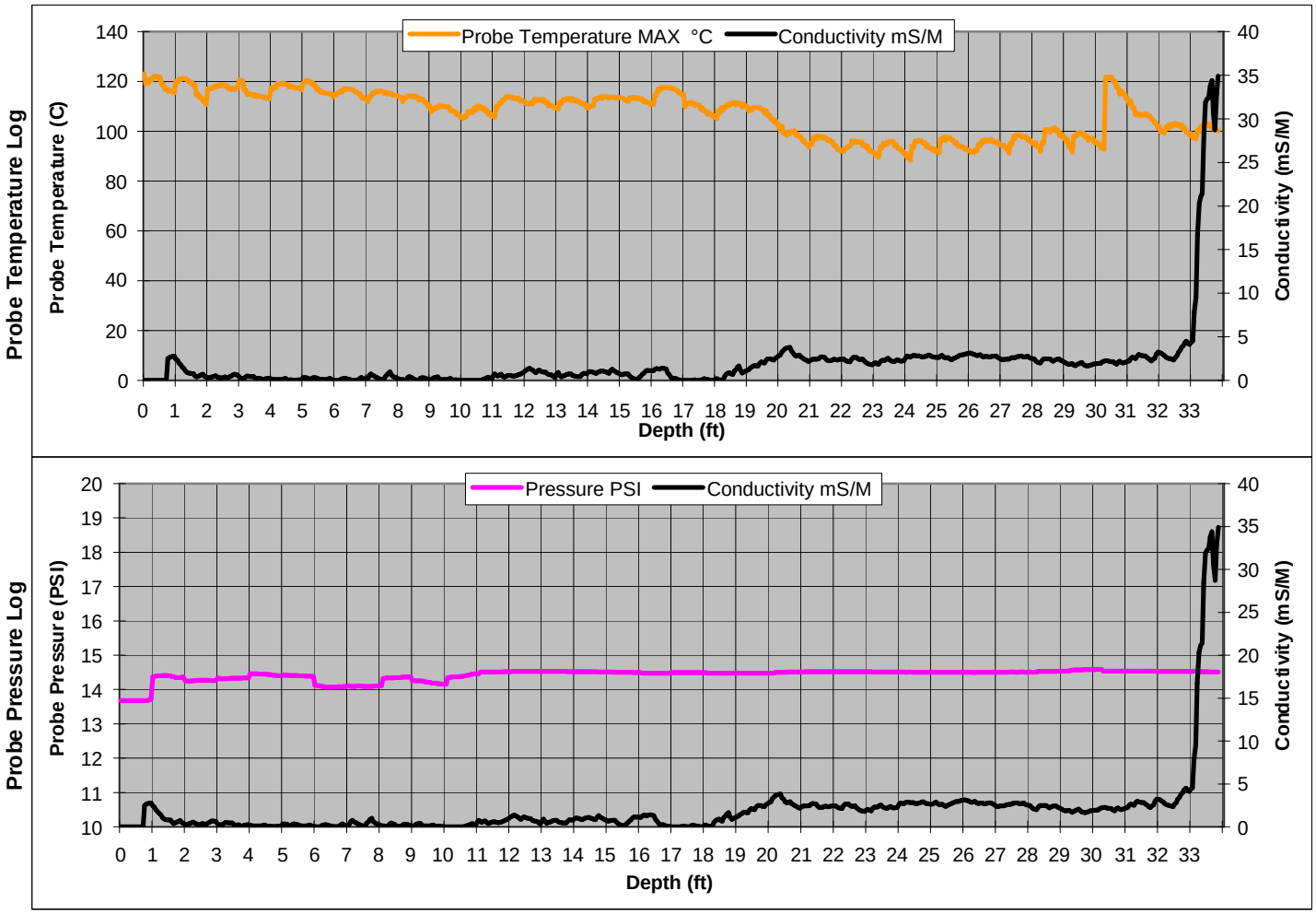
MIP Log Results by Boring - Detector Reading vs. Depth

Client:	Versar, Inc.	Boring I.D.:	MIP-1	Detector 1 :	Electron Capture (ECD)
		Date:	Mar 22 2007	Detector 2 :	Photo Ionization (PID)
		Time:	08:47	Detector 3 :	Flame Ionization (FID)



MIP Log Results by Boring - Detector Reading vs. Depth

Client:	Versar, Inc.	Boring I.D.:	MIP-1	Graph 1 :	Probe Temperature (C)
		Date:	Mar 22 2007	Graph 2 :	Probe Pressure (PSI)
		Time:	08:47		



Explanation: None.

MIP Log Results by Boring - Detector Reading vs. Depth

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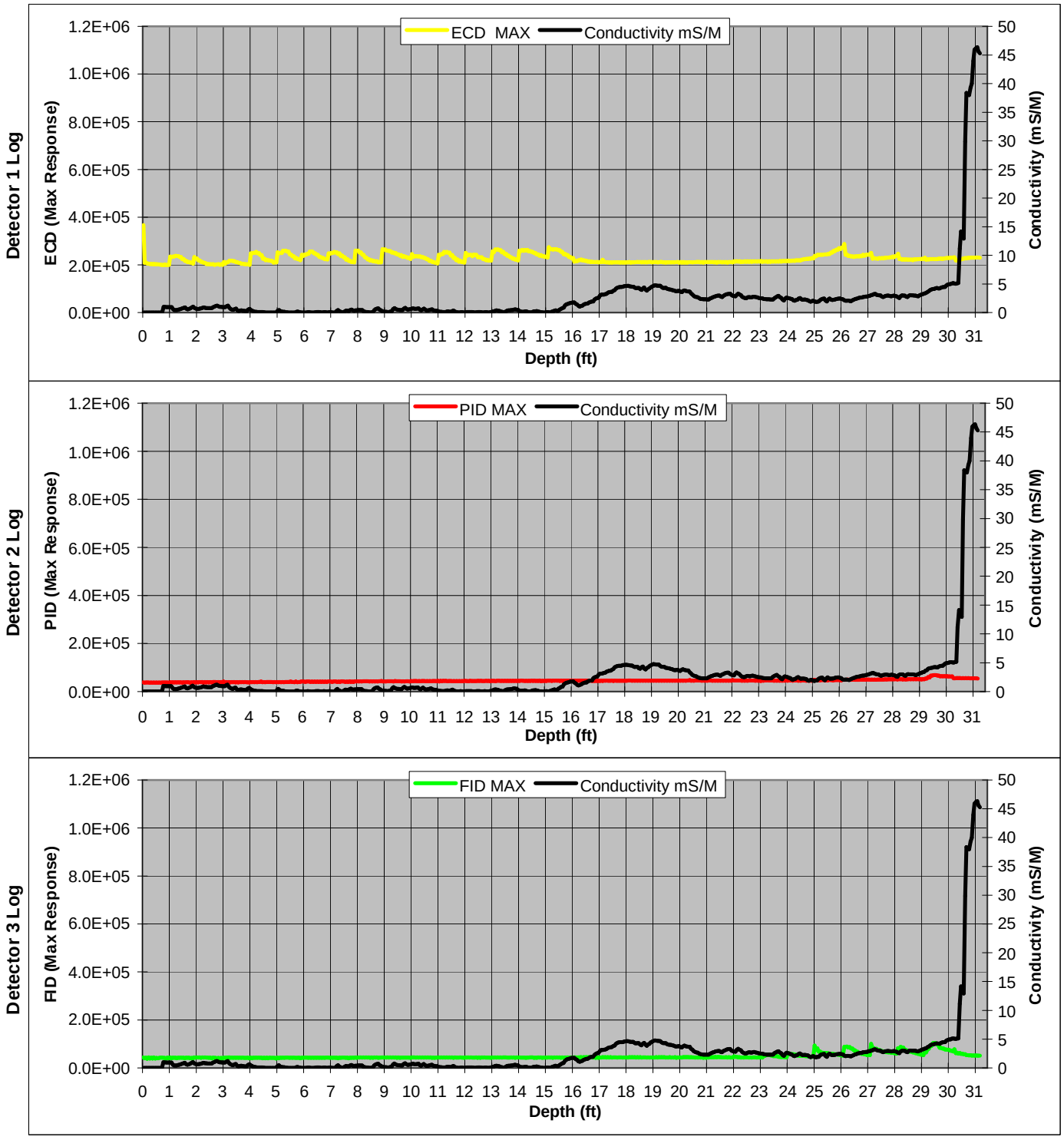
		Date:	Mar 22 2007	Detector 2 :	Photo Ionization (PID)
		Time:	09:50	Detector 3 :	Flame Ionization (FID)



MIP Log Results by Boring - Detector Reading vs. Depth

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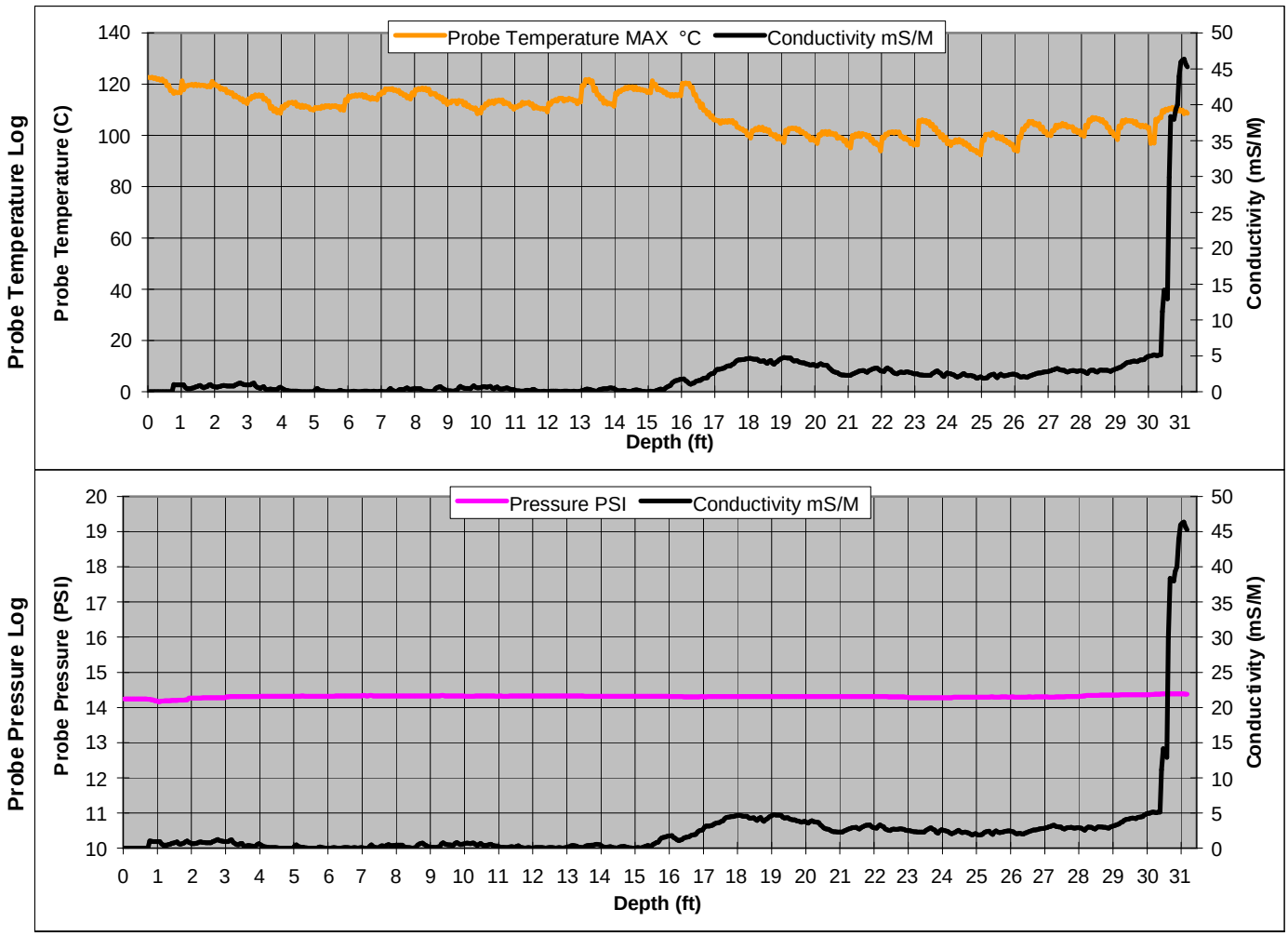
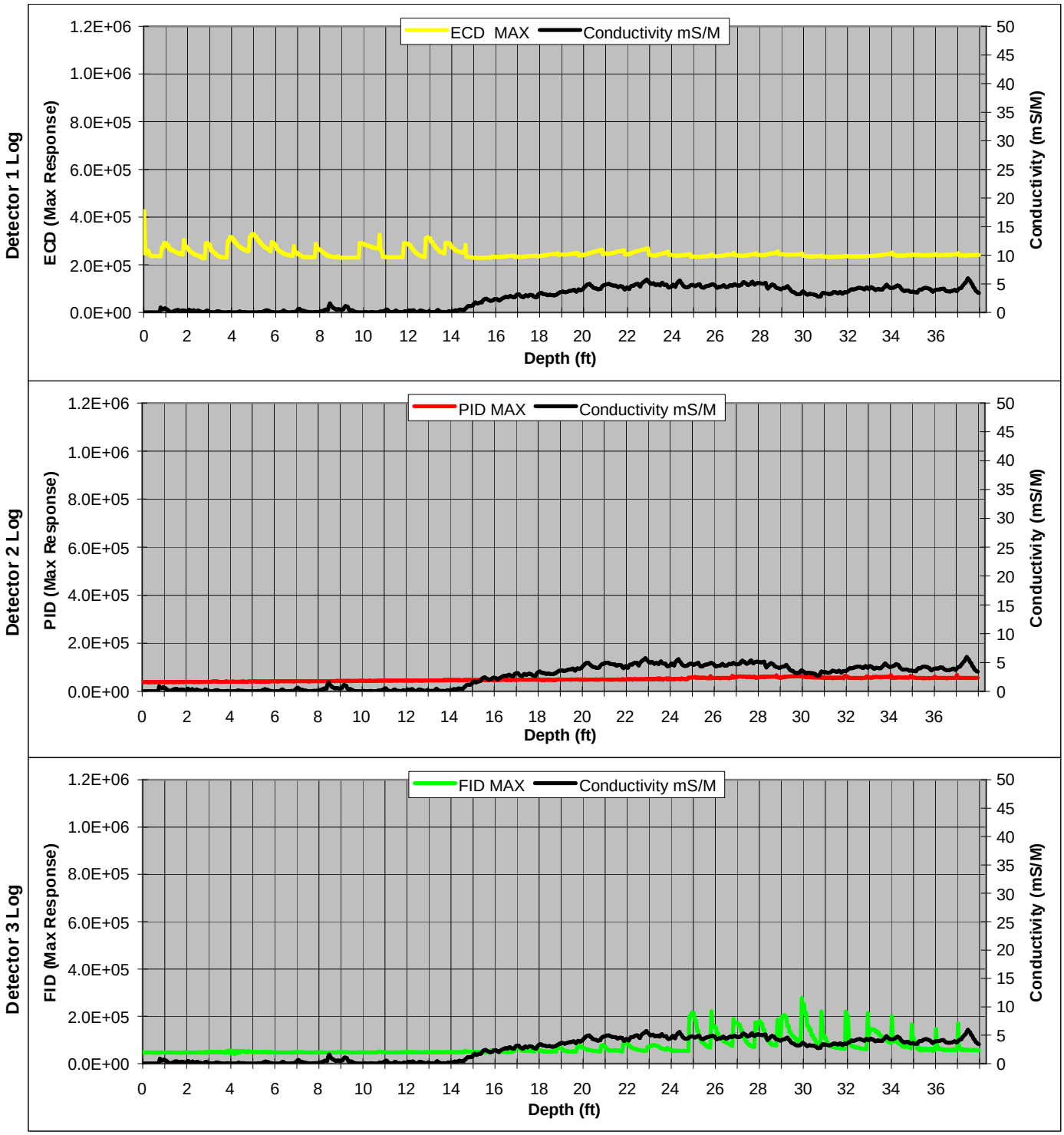
		Time:	09:50		



Explanation: None.

MIP Log Results by Boring - Detector Reading vs. Depth

Client:	Versar, Inc.	Boring I.D.:	MIP-3	Detector 1 :	Electron Capture (ECD)
		Date:	Mar 22 2007	Detector 2 :	Photo Ionization (PID)
		Time:	10:50	Detector 3 :	Flame Ionization (FID)



MIP Log Results by Boring - Detector Reading vs. Depth

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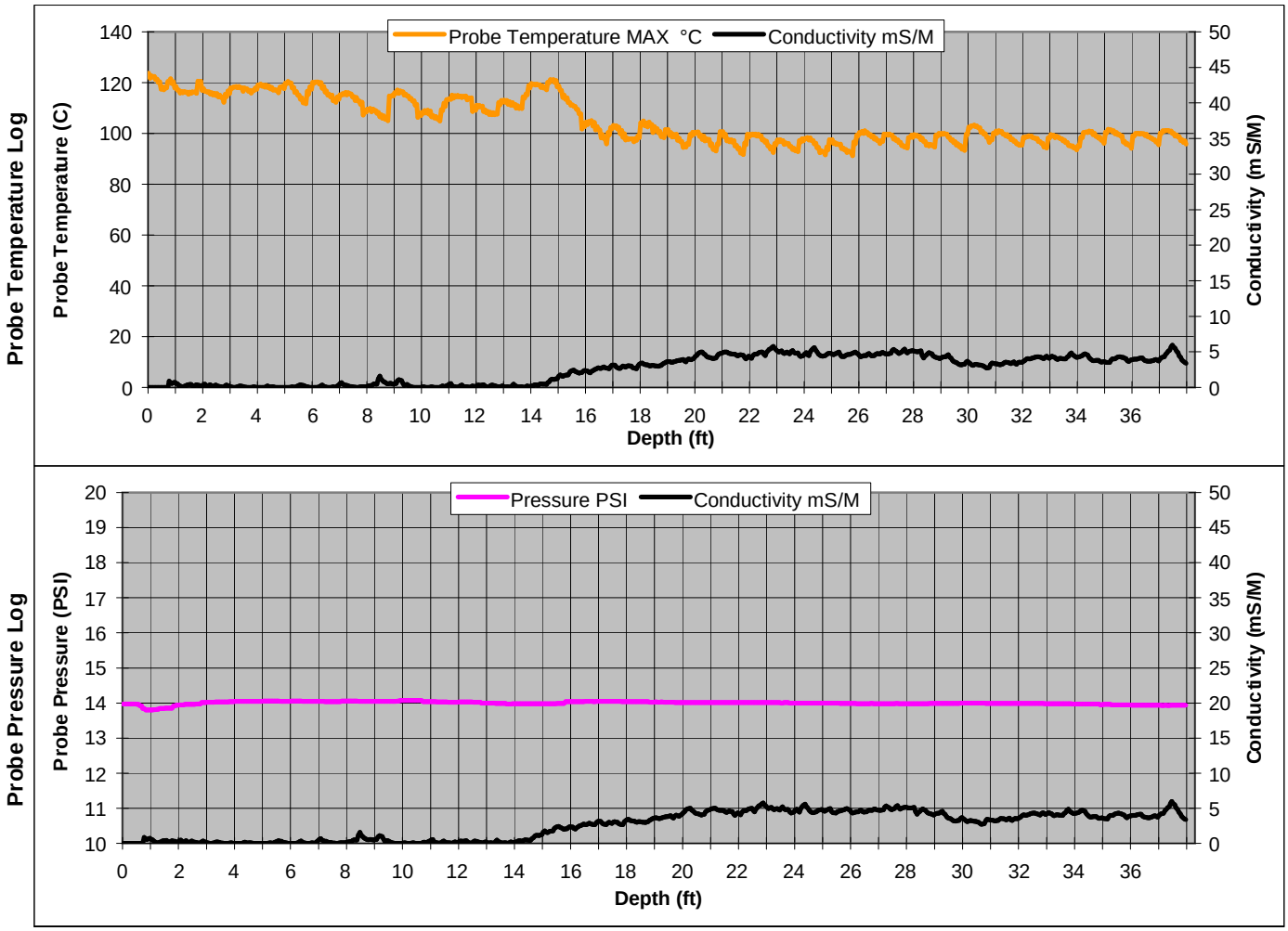
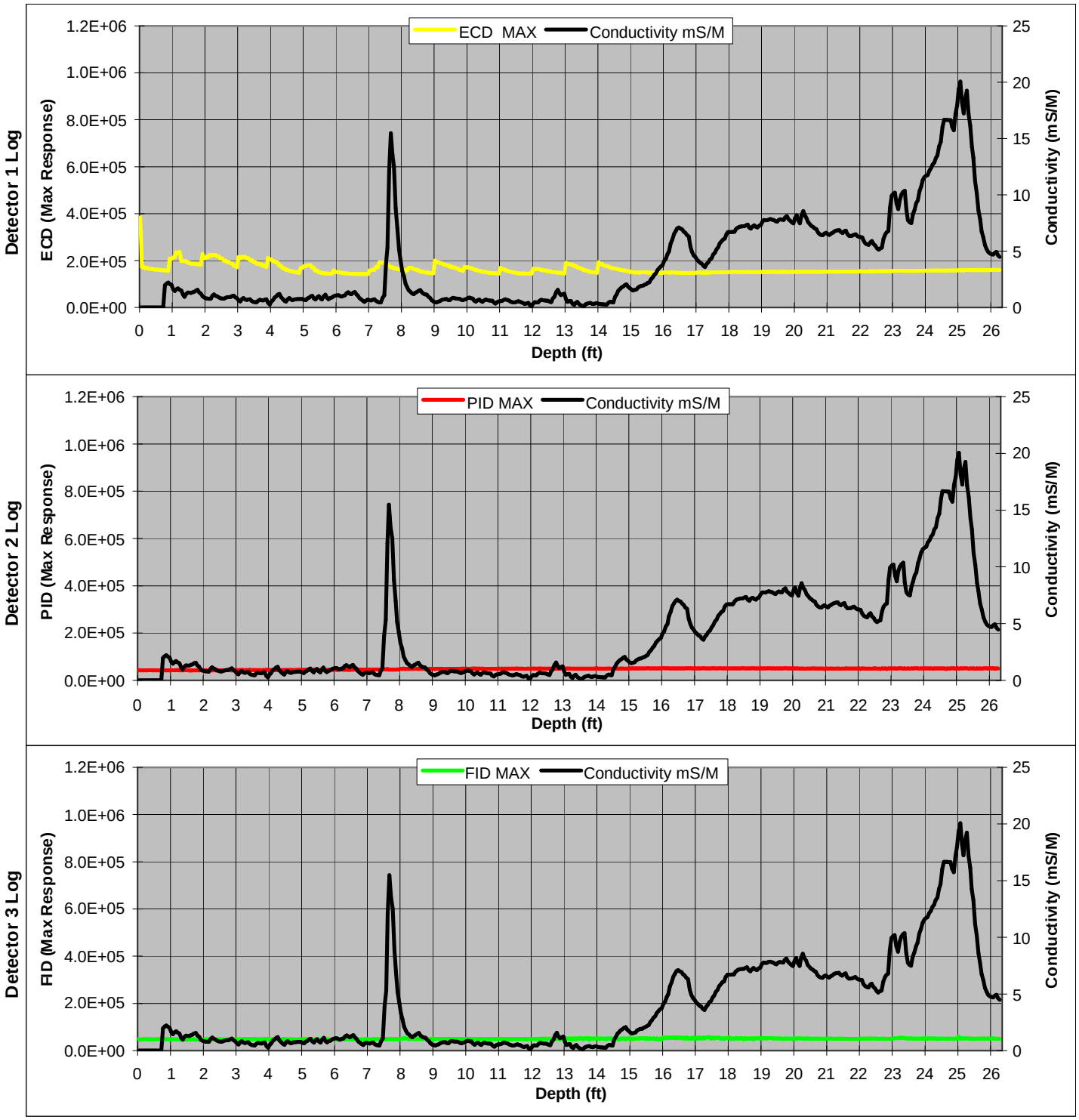
		Date:	Mar 22 2007	Graph 2 :	Probe Pressure (PSI)
		Time:	10:50		



Explanation: None.

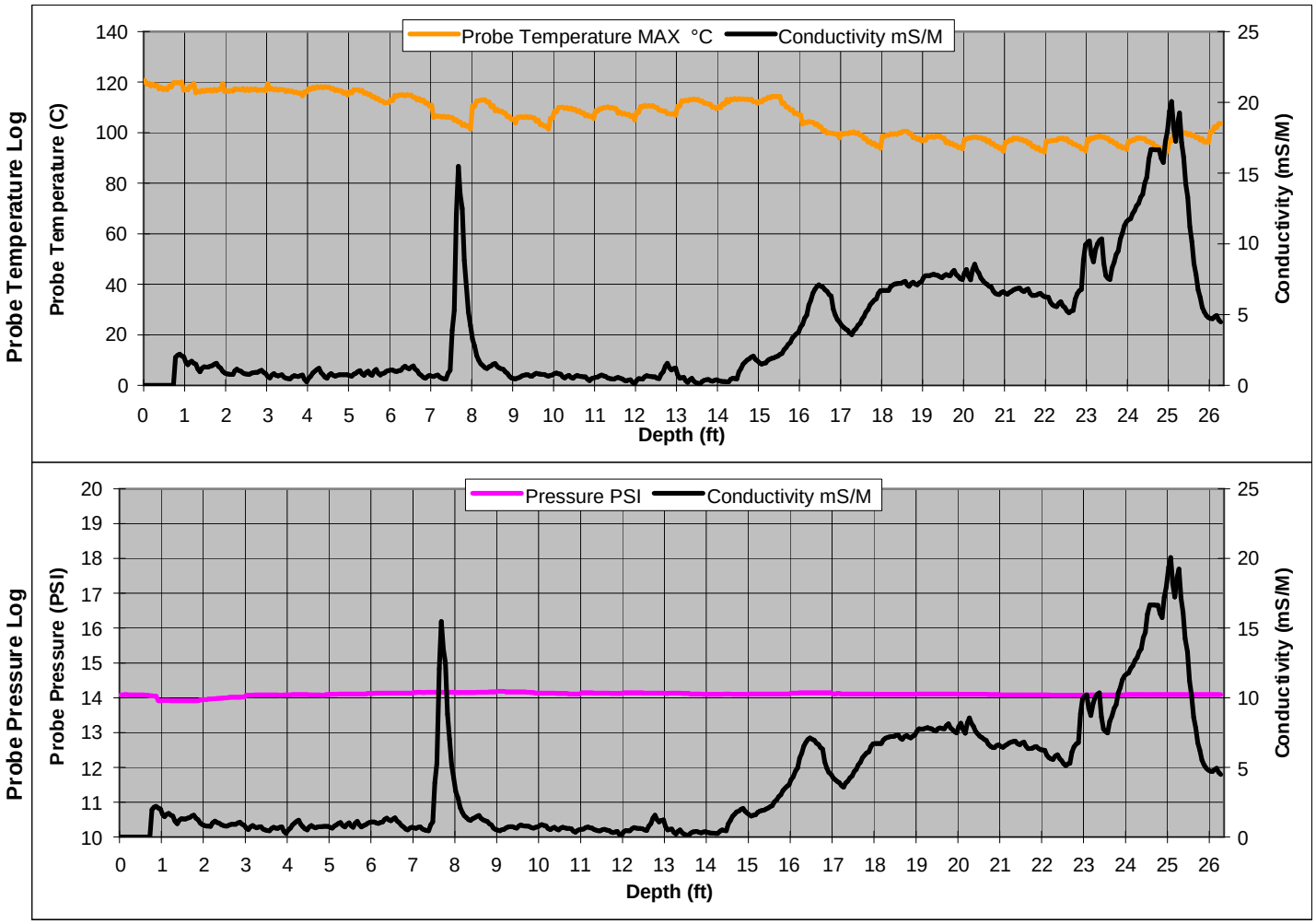
MIP Log Results by Boring - Detector Reading vs. Depth

Client:	Versar, Inc.	Boring I.D.:	MIP-4	Detector 1 :	Electron Capture (ECD)
		Date:	Mar 22 2007	Detector 2 :	Photo Ionization (PID)
		Time:	12:42	Detector 3 :	Flame Ionization (FID)



MIP Log Results by Boring - Detector Reading vs. Depth

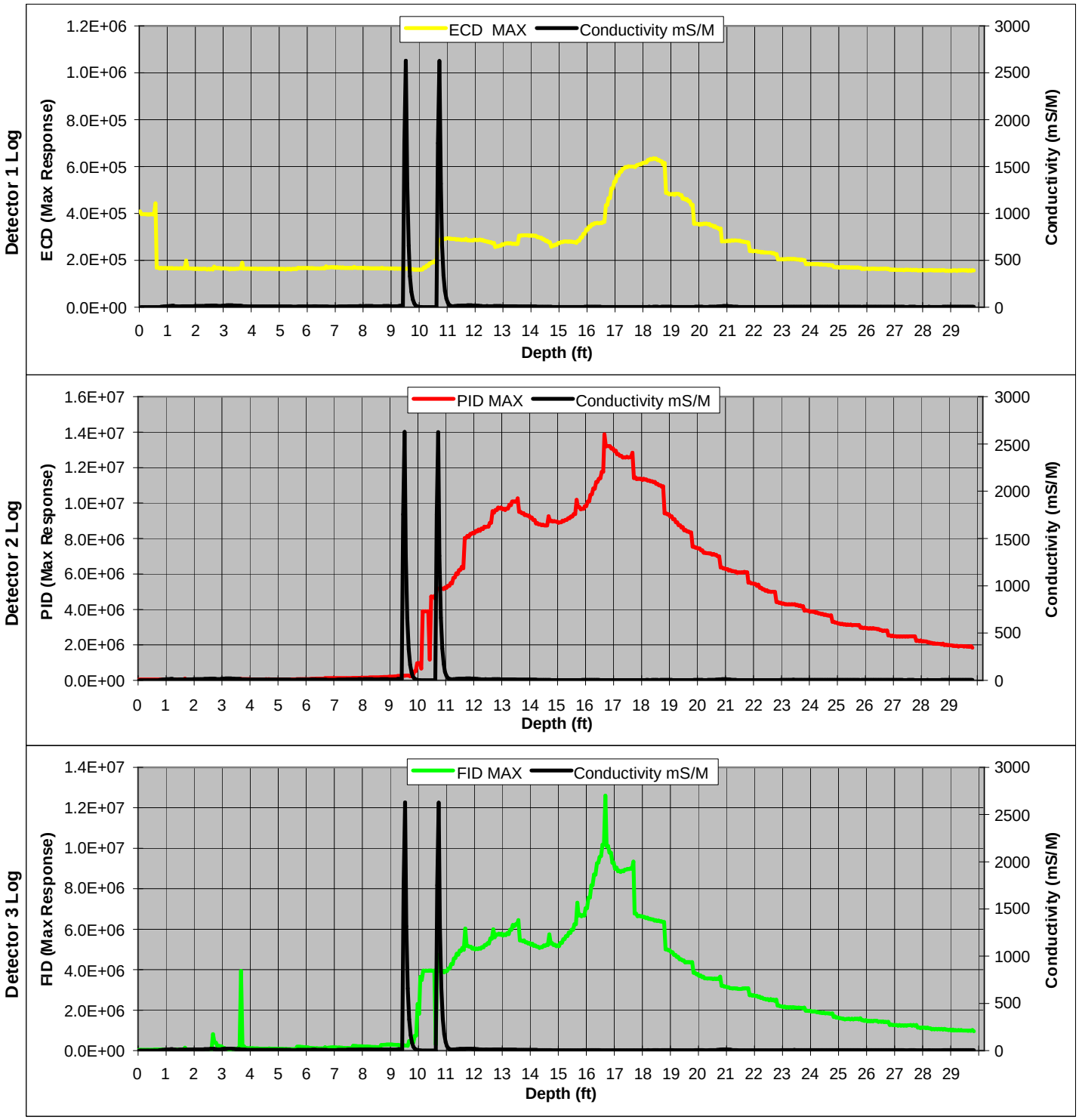
Client:	Versar, Inc.	Boring I.D.:	MIP-4	Graph 1 :	Probe Temperature (C)
		Date:	Mar 22 2007	Graph 2 :	Probe Pressure (PSI)
		Time:	12:42		



Explanation: None.

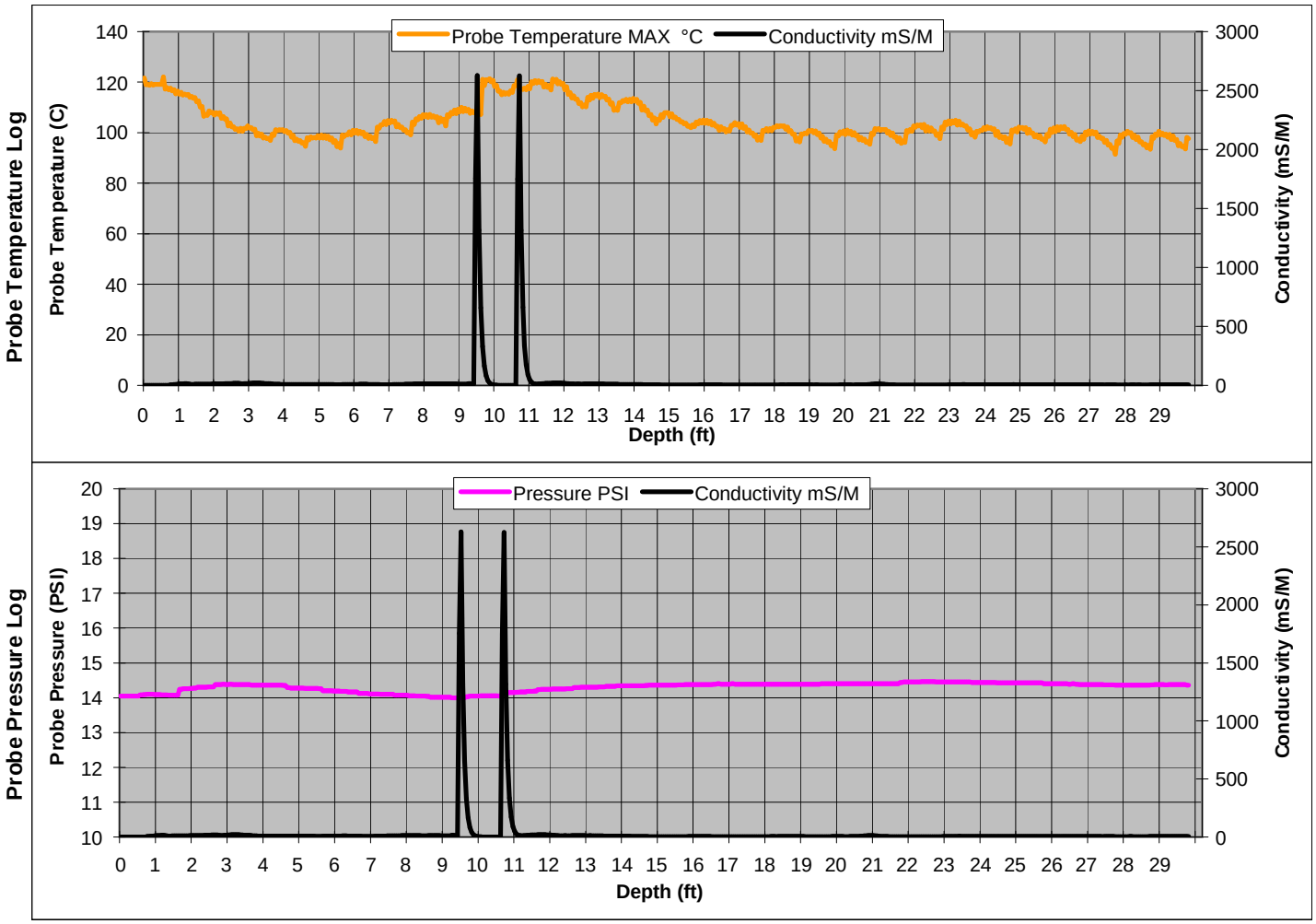
MIP Log Results by Boring - Detector Reading vs. Depth

Client:	Versar, Inc.	Boring I.D.:	MIP-5	Detector 1 :	Electron Capture (ECD)
		Date:	Mar 22 2007	Detector 2 :	Photo Ionization (PID)
		Time:	13:39	Detector 3 :	Flame Ionization (FID)



MIP Log Results by Boring - Detector Reading vs. Depth

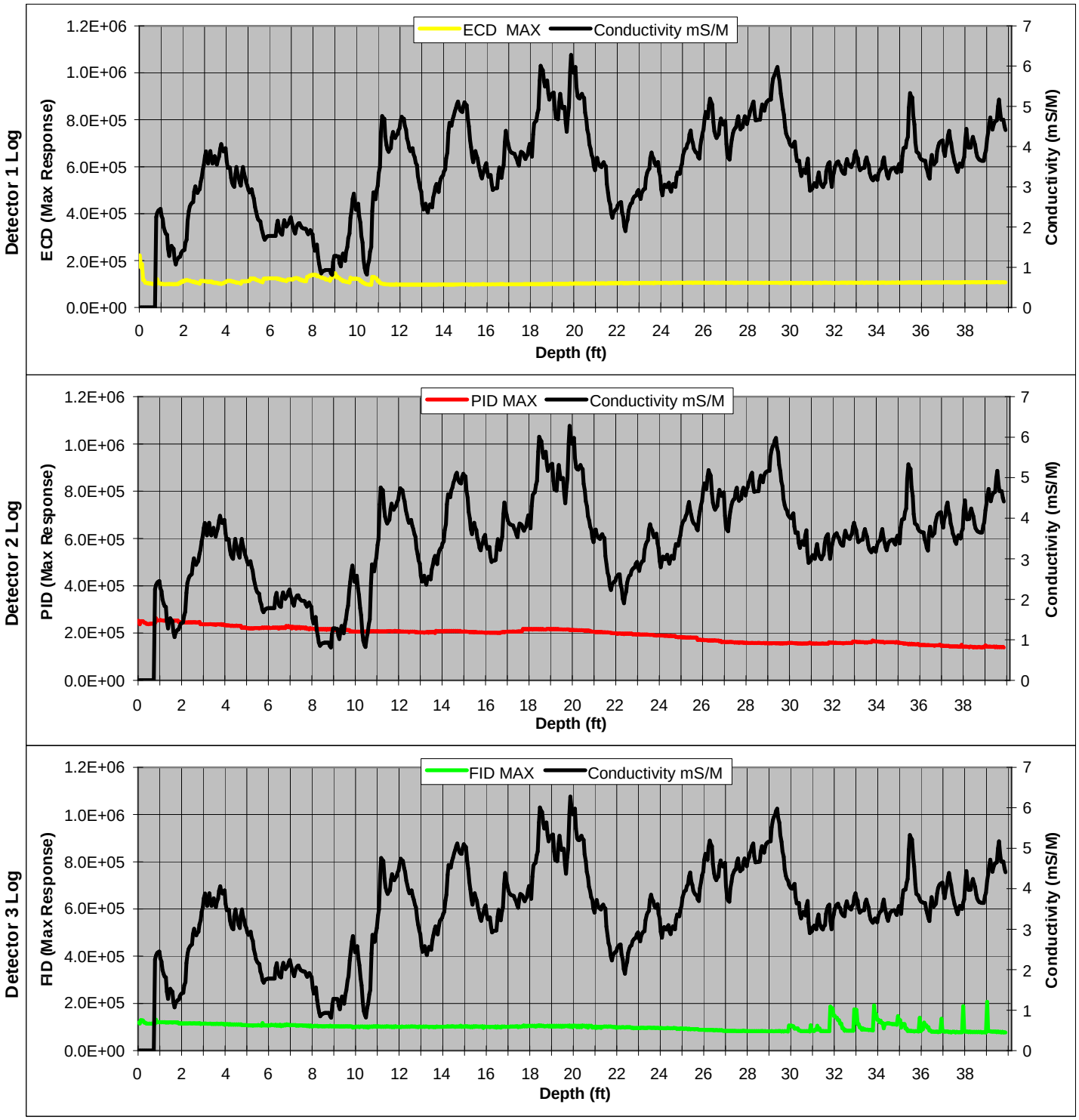
Client:	Versar, Inc.	Boring I.D.:	MIP-5	Graph 1 :	Probe Temperature (C)
		Date:	Mar 22 2007	Graph 2 :	Probe Pressure (PSI)
		Time:	13:39		



Explanation: Spikes in conductivity most likely due to metal paint can, as tooling came out "battleship grey" and smelling like paint.

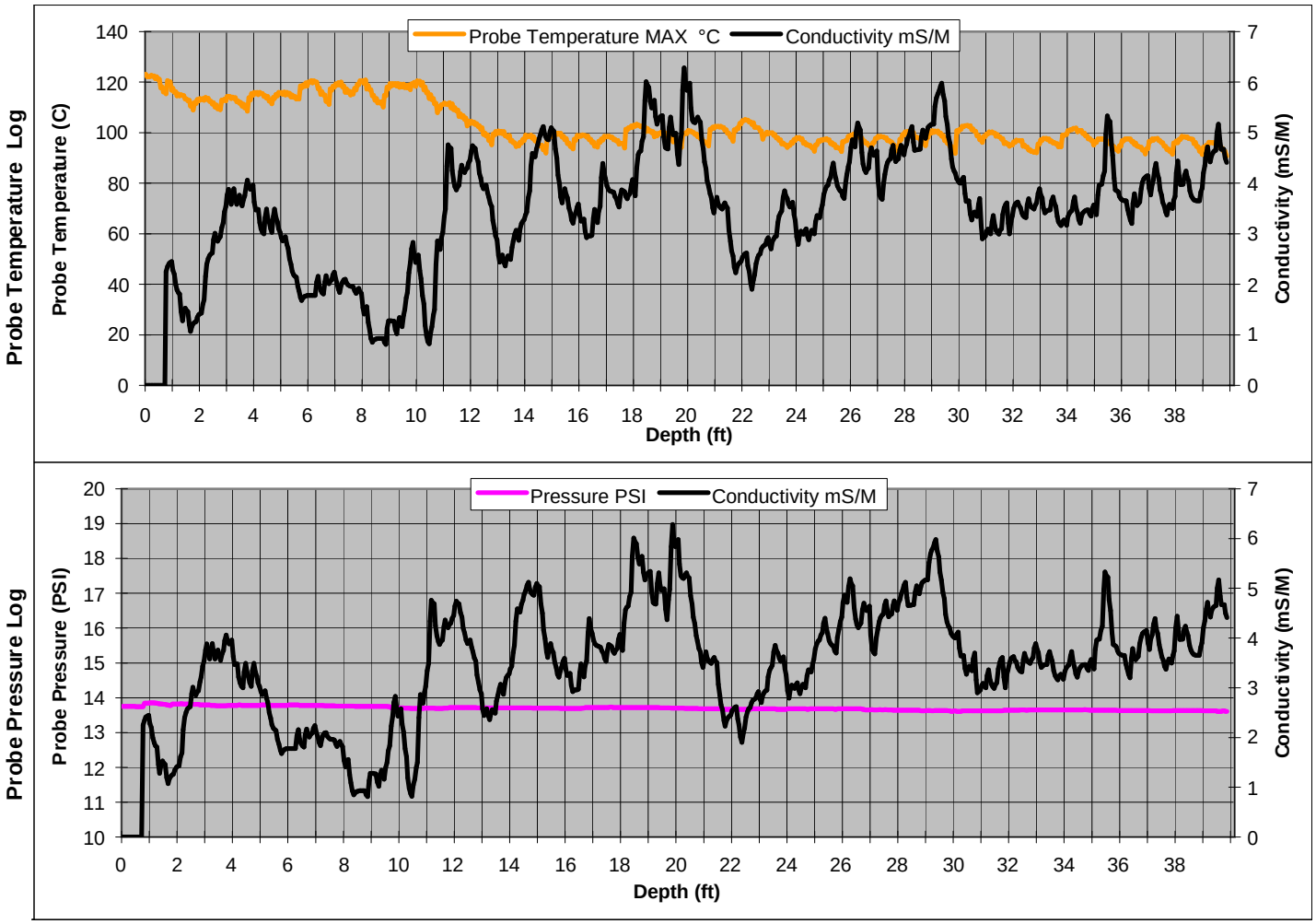
MIP Log Results by Boring - Detector Reading vs. Depth

Client:	Versar, Inc.	Boring I.D.:	MIP-6	Detector 1 :	Electron Capture (ECD)
		Date:	Mar 22 2007	Detector 2 :	Photo Ionization (PID)
		Time:	15:12	Detector 3 :	Flame Ionization (FID)



MIP Log Results by Boring - Detector Reading vs. Depth

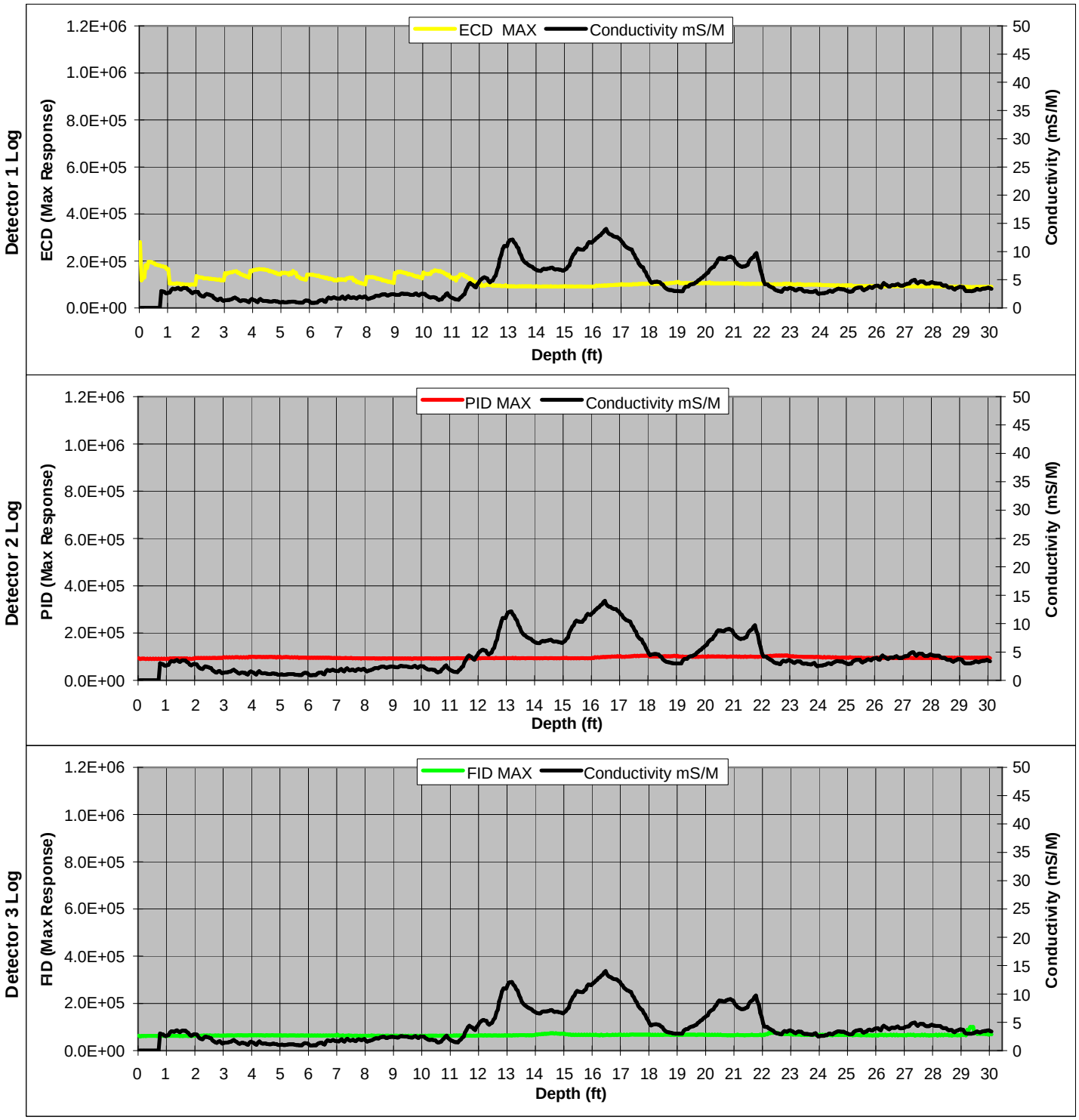
Client:	Versar, Inc.	Boring I.D.:	MIP-6	Graph 1 :	Probe Temperature (C)
		Date:	Mar 22 2007	Graph 2 :	Probe Pressure (PSI)
		Time:	15:12		



Explanation: None.

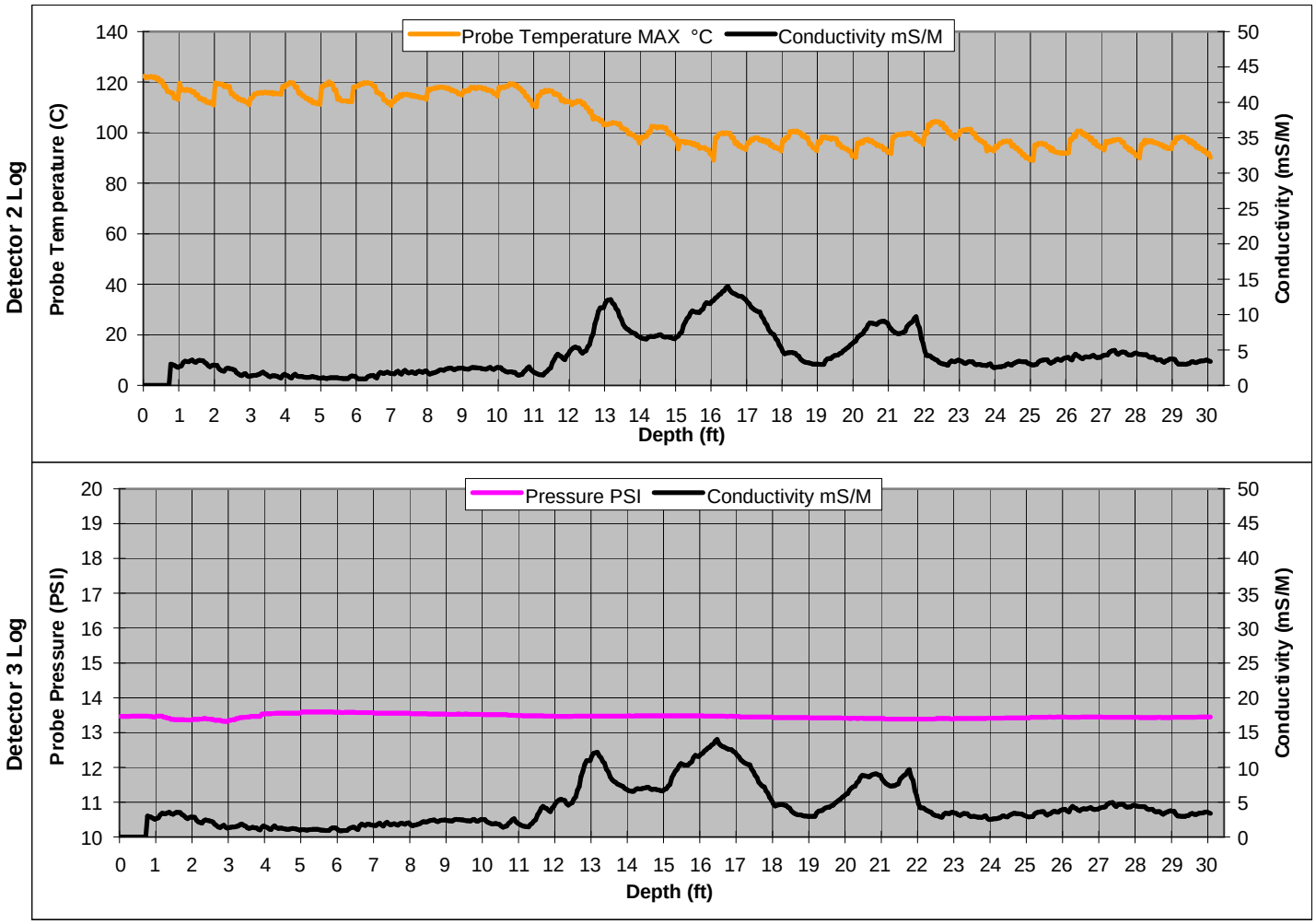
MIP Log Results by Boring - Detector Reading vs. Depth

Client:	Versar, Inc.	Boring I.D.:	MIP-7	Detector 1 :	Electron Capture (ECD)
		Date:	Mar 22 2007	Detector 2 :	Photo Ionization (PID)
		Time:	16:27	Detector 3 :	Flame Ionization (FID)



MIP Log Results by Boring - Detector Reading vs. Depth

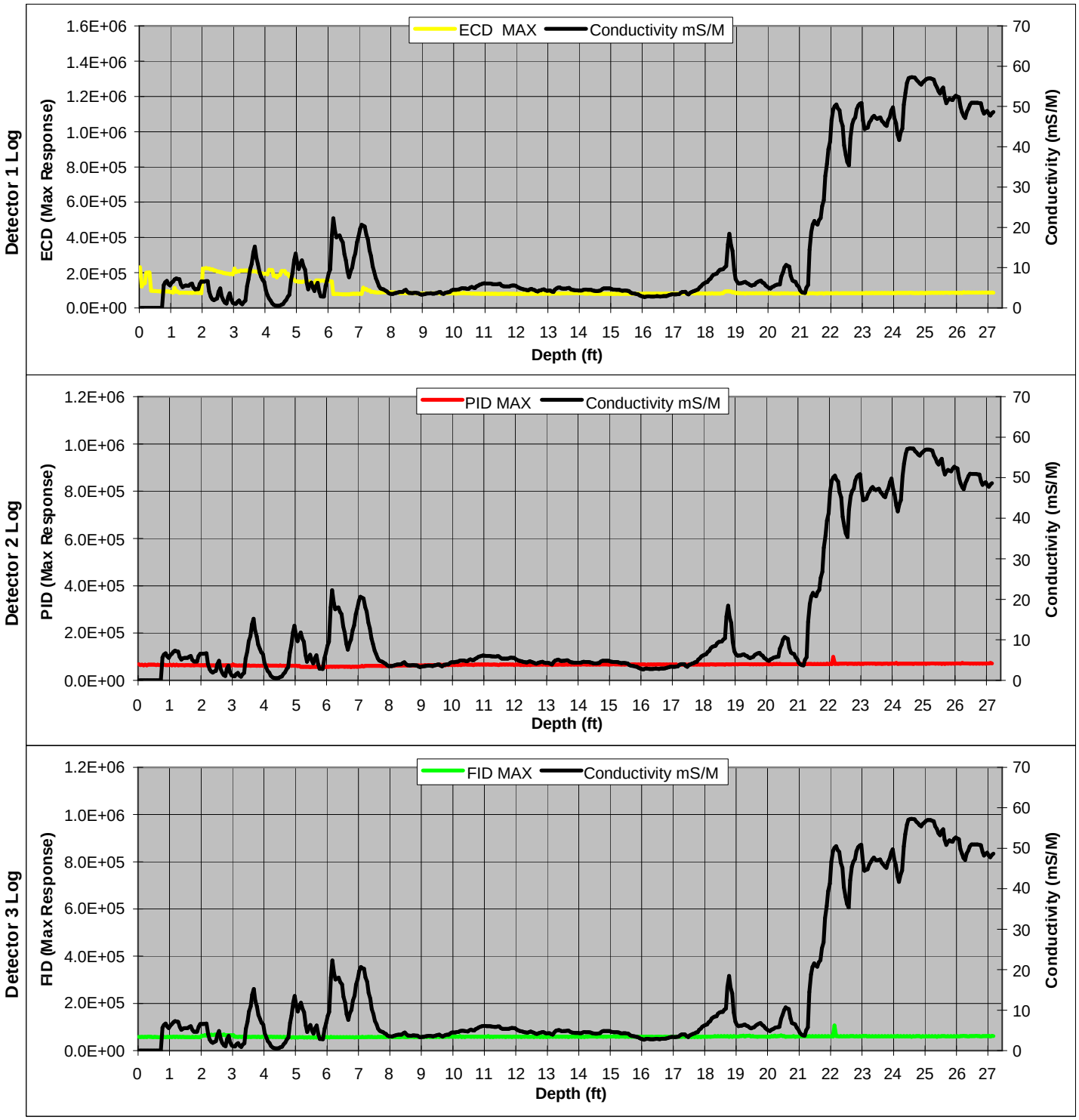
Client:	Versar, Inc.	Boring I.D.:	MIP-7	Graph 1 :	Probe Temperature (C)
		Date:	Mar 22 2007	Graph 2 :	Probe Pressure (PSI)
		Time:	16:27		



Explanation: None.

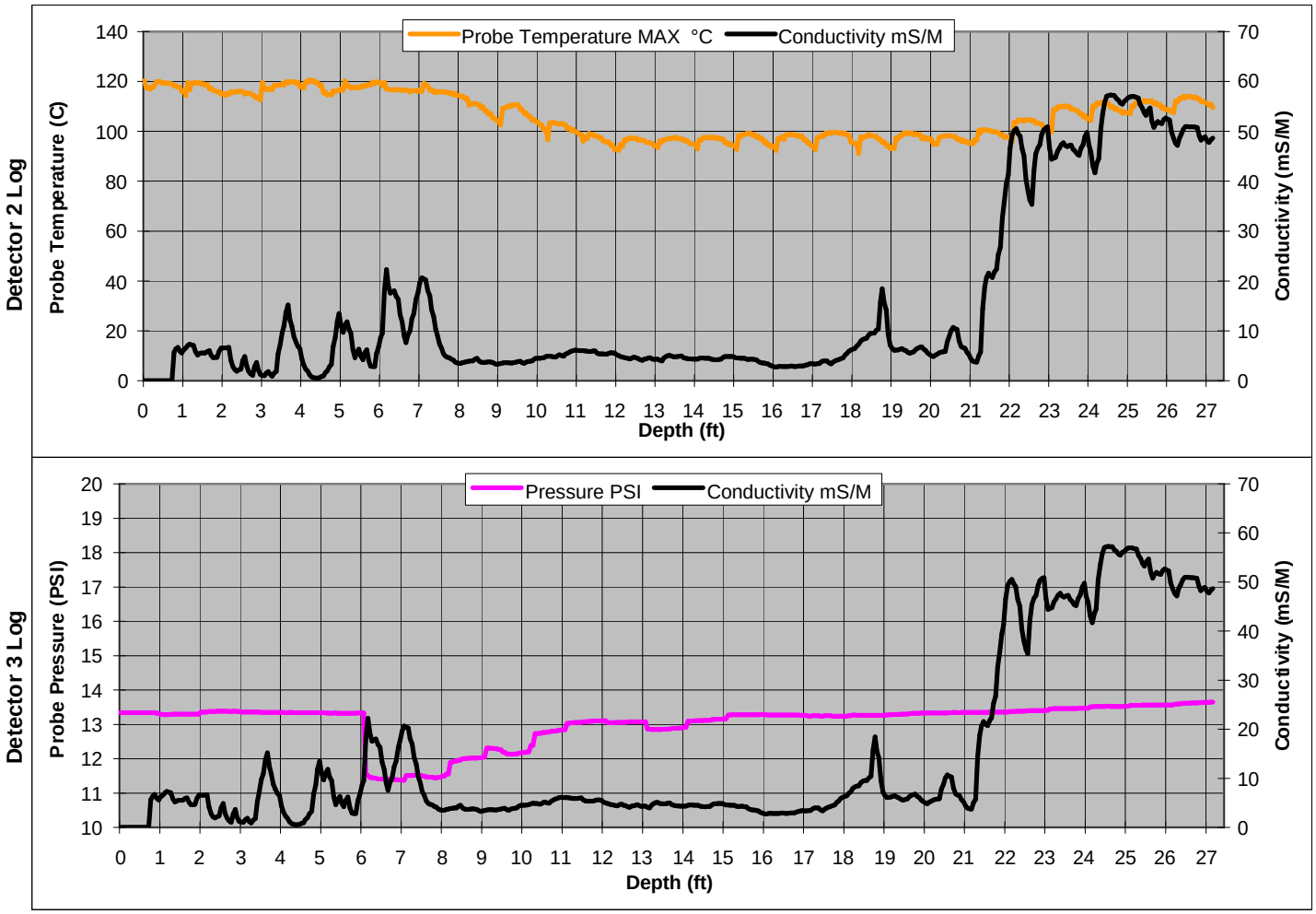
MIP Log Results by Boring - Detector Reading vs. Depth

Client:	Versar, Inc.	Boring I.D.:	MIP-8	Detector 1 :	Electron Capture (ECD)
		Date:	Mar 22 2007	Detector 2 :	Photo Ionization (PID)
		Time:	17:29	Detector 3 :	Flame Ionization (FID)



MIP Log Results by Boring - Detector Reading vs. Depth

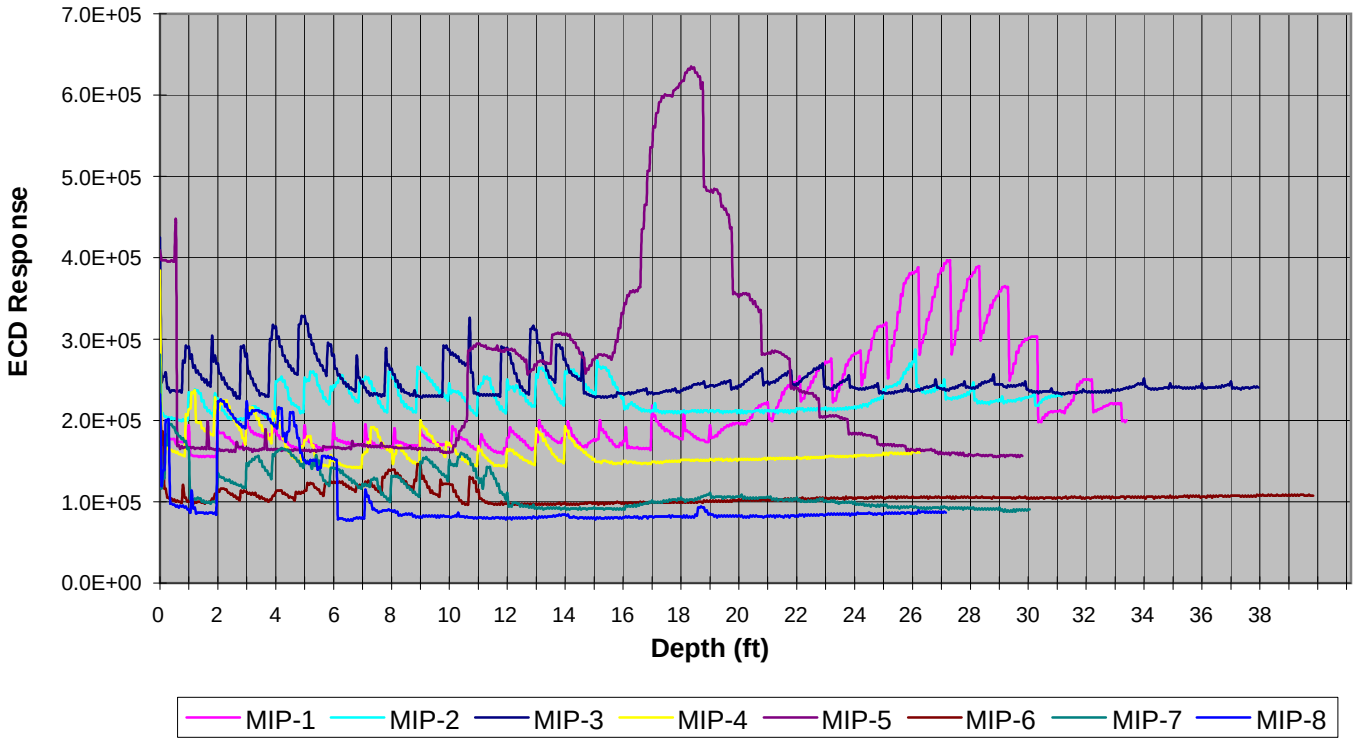
Client:	Versar, Inc.	Boring I.D.:	MIP-8	Graph 1 :	Probe Temperature (C)
		Date:	Mar 22 2007	Graph 2 :	Probe Pressure (PSI)
		Time:	17:29		



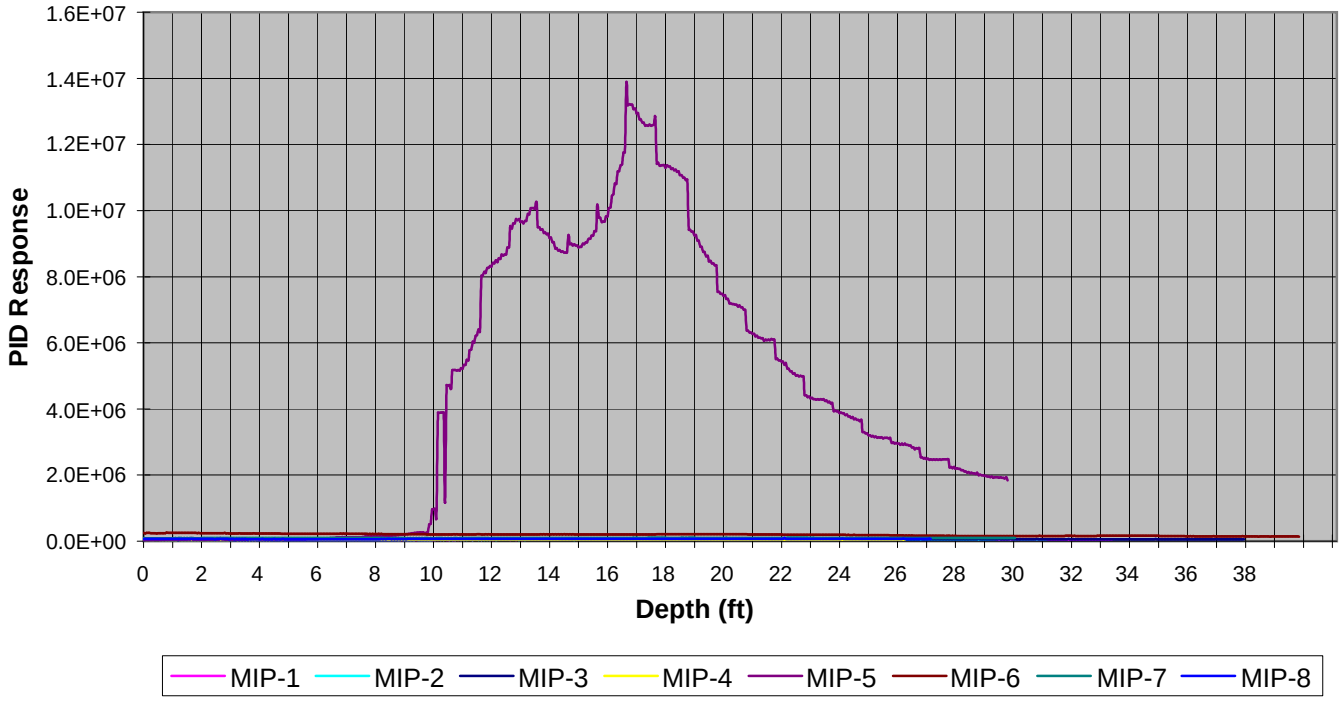
Explanation: None.

MIP Log Results by Detector - Detector Reading vs. Depth

Maximum ECD Responses

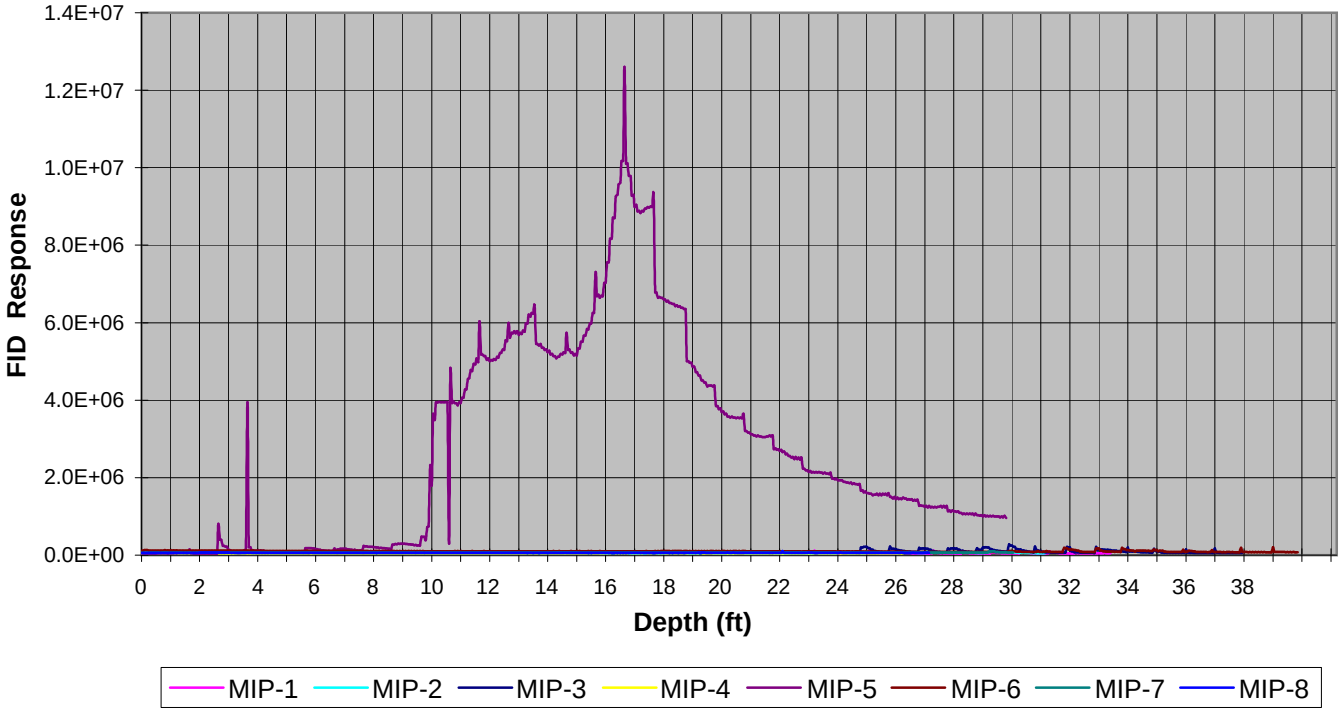


Maximum PID Responses

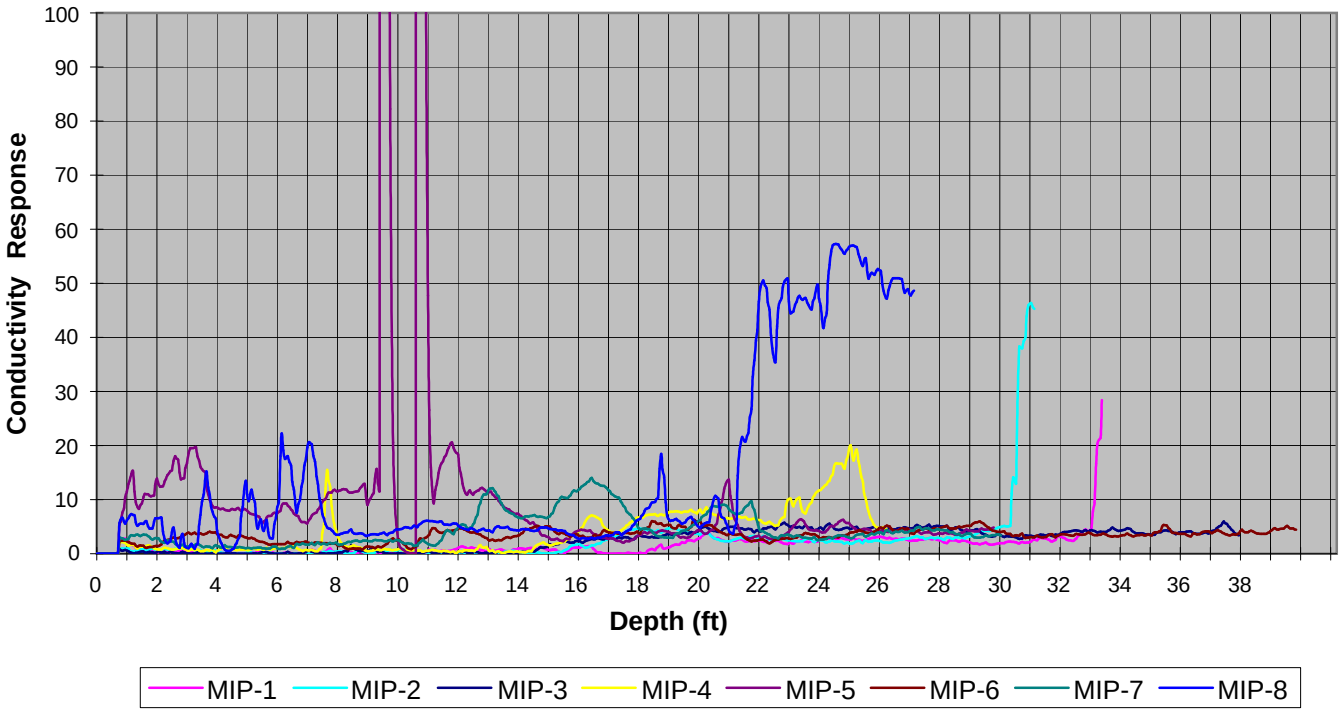


MIP Log Results by Detector - Detector Reading vs. Depth

Maximum FID Responses



Conductivity Responses



MIP Data Summary:

Background:

Data was collected at the Construction Debris Landfill site at the NASA Flight Facility in Wallops Island, Virginia using the MIP (Membrane Interface Probe) and a Geoprobe® 6600 and a dolly rig at 9 sampling locations, collecting data from the surface to as deep as 35' bgs. An ECD (Electron Capture Detector), PID (Photo Ionization Detector) and a FID (Flame Ionization Detector) were used with a Hewlett Packard 5890 Gas Chromatograph.

The objective of the MIP project is to delineate an area of concern at a former landfill. The site lithology is primarily medium grain sands. Depth to groundwater is approximately 10 to 15 feet bgs, probably less in some areas.

Contaminant Mass:

A significant ECD detection was noted from boring MIP-5 at 6.3E+5 at 18.5 feet bgs. The depth range of detection was from about 16.5 to 20.5 feet bgs. Less distinct peaks were observed from MIP-1 of about 3.7E+5 to 4.0E+5 at 24 to 28 feet bgs. No other distinct ECD detections were noted. ECD detections are an indication of halogenated compounds.

A significant PID detection was noted from boring MIP-5 at 1.4E+7 at 16.5 feet bgs. The depth range of detection was from about 10 to 19 feet bgs. No other distinct PID detections were noted. PID detections are an indication of double bonded compounds.

A significant FID detection was noted from boring MIP-5 at 1.3E+7 at 16.5 feet bgs. The depth range of detection was from about 10 to 19 feet bgs. No other distinct FID detections were noted. FID detections are an indication of combustible hydrocarbons.

Soil Conductivity:

In general, electrical conductivity (EC) responses showed values for sands throughout the borings. An anomalous spike was detected in MIP-5. MIP-8 showed increasing EC values beginning at 21 feet bgs. MIP-1 and MIP-2 also had increasing EC values at depths of 33 feet and 30 feet bgs, respectively. These were probably indicative of transitioning to silty or clayey sands with depth.

The conductivity of soils is different for each type of media. Finer grained sediments, such as silts or clays, will have a higher EC signal. While coarser grained sediments, sands and gravel, will have a lower EC signal.

MIP Data Summary:

Confirmation Samples:
No confirmation soil or groundwater samples were collected by Versar.

Summary:
The maximum ECD, PID and FID responses associated with MIP-5 correlated in magnitude, duration, and depth. The MIP-5 EC spike at 10 feet bgs and visible evidence of paint of the probe, indicated that the detection values were probably influence by this event.

APPENDIX C

WELL LOGS/AQUIFER TEST RESULTS

Boring / Well Log

VERSAR

Client: WFF - CDL
Project No.: 111328.0018
Location: CDL - inside fence
Logged By: E Willenburg
Date: 04/17/07
Drilling Co.: Fishburne, Inc.
Driller: Ed
Water Obs.: quick development; clear water

Boring No.: MW-1
Ground Elev.:
TOIC Elev.:
Total Depth: 33' TOC
Stickup: flush mount
Well Dia.: 2"
Drill. Method: HSA, split-spoon
Rig No.:

Location Sketch

Remarks:

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material (Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.)	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			0	TOPSOIL; brown, sandy, much vegetation and roots, DRY	SM					BC: 4-4-7-6 sample SB-1A
					CLAY; brown, topsoil grading to stiff clay, minor fine to coarse grained sand, poor sorting	OH					sample SB-1B
	0 ppm			-2	CLAY to SANDY CLAY; brown, increase of fine to coarse grained sand with depth, minor mottling, poor sorting	OH - CL					BC: 3-4-4-4
	0 ppm			-4	CLAY to SANDY CLAY; brown, increase of fine to coarse grained sand with depth, minor mottling, poor sorting	OH - CL					BC: 2-2-2-2
					CLAYEY SAND; orangish-brown, fine to medium grained with minor coarse fraction, poor sorting, MOIST	SC					
	0 ppm			-6	SILTY SAND; orangish-brown, medium grained with 10% coarse to very coarse grained fraction, overall increase of grain size with depth, moderate to well rounded	SM					BC: 2-2-3-3
	0 ppm			-8	CLAY; dark brown, some silt, soft / malleable, MOIST	CH					BC: 3-4-4-6
					SAND; light tan with dark tan and orange mottling, medium to very coarse grained, poor sorting, some interbedded fine grained layers, very fine grained black specks throughout	SM - SC					
				-10							

Boring / Well Log

Client: WFF - CDL

Project No.: 111328.0018

Boring No.: MW-1

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			-10	slough						BC: 5-6-6-7
					SAND; light tan with dark tan and orange mottling, medium to very coarse grained, poor sorting, some interbedded fine grained layers, layer of very coarse sand at 12', black specks end at 9.5'	SM - SC					
	0 ppm			-12	same as above	SM - SC					BC: 6-8-7-9
					same as above	SP					
	0 ppm			-14	slough						BC: 7-8-8-10
					SAND; light gray to light tan, very fine to very coarse grained with interbedding of <1/2" medium orangish-brown and 1-2" very fine grained, light gray to white sand layers, moderate sorting within layers	SP					
						SP					
					SAND; light gray to light tan, very coarse grained to granule (2-4mm) size with fine to medium grained fraction, poor sorting	SP					
	0 ppm			-16	SAND; light tan, very fine grained with 10% medium to coarse grained fraction throughout, very fine grained black specks, poor sorting						BC: 8-9-10-10
						SM					
					slough						
					SAND; light orangish-brown, fine grained, moderate sorting, moderately rounded	SP					
	0 ppm			-18	SAND; light gray, medium to coarse grained, well rounded, 10% very coarse grained fraction, some interbedded layers of fine to medium grained sands						BC: 4-6-7-8
					no recovery						
					SAND; light gray with dark orange mottling, coarse to granule (2-4mm) sized, poor to very poor sorting, MOIST	SP					
	0 ppm			-20	SAND; light gray with dark orange mottling, coarse to very coarse grained, poor to very poor sorting, MOIST	SP					BC: 7-8-8-7
	0 ppm			-22	no recovery						BC: 8-9-10-9

Boring / Well Log

Client: WFF - CDL

Project No.: 111328.0018

Boring No.: MW-1

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
					SAND; light gray with dark orange mottling, coarse grained, poor sorting, MOIST	SP					
					similar to above but overall finer grained with 10% coarse to very coarse fraction	SM					
	0 ppm			-24	slough						BC: 6-7-7-8
					SAND; light tan, very fine grained with 10% medium to coarse grained fraction throughout, very fine grained black specks, poor sorting	SM - SP			▽		DTW during sampling
					similar to above but medium to coarse grained	SP			▽		DTW during boring
	0 ppm			-26	similar to above but coarse to pebble (4-6mm) sized grains, 2" layer of very fine grained sand at 27.75'	SP					BC: 6-7-7-10
	0 ppm			-28	SAND; red-brown, FeO2 staining, coarse to very coarse grained, moderately rounded, WET	SP - SW					BC: 6-8-9-10
					SAND; light tan, fine to medium grained with 10% coarse grained fraction throughout	SP					
	0 ppm			-30	SAND; red-brown, FeO2 staining, coarse to very coarse grained, moderately rounded, moderately sorted	SP - SW					BC: 7-8-11-14
					SAND; light tan, fine to very coarse grained, more interbedding throughout of very fine grained sand with black specks, very poor sorting	SM - SP					
	0 ppm			-32	SAND; red-brown, FeO2 staining, coarse to very coarsed grained, moderately rounded, moderately sorted	SP - SW					BC: 7-8-10-11
					SAND; light tan, fine to very coarse grained to pebble (4-6mm) sized, interbedded, very poor sorting	SP					TD = 33' bgs
				-34							

Boring / Well Log

VERSAR

Client: WFF - CDL
Project No.: 111328.0018
Location: CDL - inside fence
Logged By: E Willenburg
Date: 04/17/07
Drilling Co.: Fishburne, Inc.
Driller: Ed
Water Obs.: quick development; clear water

Boring No.: MW-2
Ground Elev.:
TOIC Elev.:
Total Depth: 24' TOC
Stickup: flush mount
Well Dia.: 2"
Drill. Method: HSA, split-spoon
Rig No.:

Location Sketch

Remarks:

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material (Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.)	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			0	TOPSOIL; dark brown, some vegetation, DRY	SM					BC: 1-1-2-1 sample SB-2A sample SB-2B
					SILTY SAND; dark reddish brown, fine grained, well sorted, dry	SW					
	0 ppm			-2	slough						BC: 2-1-1-2
					SILTY SAND to SAND; medium orangish brown, fine grained, moderately sorted, minor fines, very few coarse to very coarse grains, dry	SM					
	0 ppm			-4	SILTY SAND to SAND; medium orangish brown, fine grained, moderately sorted, minor fines, very few coarse to very coarse grains, dry	SM					BC: 2-2-2-2
	0 ppm			-6	no recovery						BC: 2-3-2-3
					SILTY SAND to SAND; medium orangish brown, fine grained, moderately sorted, minor fines, very few coarse to very coarse grains, dry	SM					
					SILTY SAND to SAND; similar to above, grading to lighter color, increase in very coarse to granule fraction (15%), some fines, moderate to poor sorting, very fine grained black specks throughout, dry	SM					
	0 ppm			-8	slough						BC: 3-6-6-7
					SILTY SAND to SAND; medium tan color, some interbedding of orangish-brown 2-3" layers of silty fine grained sand, dry	SM					
				-10							

Boring / Well Log

Client: WFF - CDL

Project No.: 111328.0018

Boring No.: MW-2

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			-10	slough						BC: 4-6-6-7
					SILTY SAND to SAND; tan, fine grained, moderately sorted, some orangish-brown 1/2-1" interbedding of coarse grained, poorly sorted sand, dry	SM					
	0 ppm			-12	slough						BC: 5-6-7-6
					SILTY SAND to SAND; same as above with interbedding 1/4" about every 2-4"	SM					
	0 ppm			-14	no recovery						BC: 2-2-1-1
					SILTY SAND to SAND; tan, fine grained, moderately sorted, some orangish-brown 1/4" interlayers	SM					
									▽		DTW at sampling
					SILTY SAND to SAND; medium orangish brown, fine grained, moderately sorted, moderately rounded, dry	SM					
	0 ppm			-16	no recovery						BC: 1-1-0-0
									▽		DTW during boring
					SILTY SAND to SAND; medium orangish brown, fine grained, moderately sorted, moderately rounded, WET	SM					
	0 ppm			-18	little recovery, grading down from orangish brown (as above) to medium gray silty sand to sand (as below)	SM					BC: over 24
	0 ppm			-20	SILTY SAND TO SAND; gray, firm, well compacted, wet	SM					BC: over 12-1-2
	0 ppm			-22	SILTY SAND TO SAND; gray, firm, well compacted, wet						BC: 1-2-1-1

Boring / Well Log

Client: WFF - CDL

Project No.: 111328.0018

Boring No.: MW-2

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
						SM					*TD = 24' bgs*
	0 ppm			*-24*	SILTY SAND TO SAND; gray, firm, well compacted, wet	*SM*					*BC: 2-2-4-7*
					CLAY; greenish-gray, clean and well sorted, medium stiff; coarse, clean sand at bottom (1"), wet	*CH*					
				-26							

Boring / Well Log

VERSAR

Client: WFF - CDL
Project No.: 111328.0018
Location: CDL
Logged By: E Willenburg
Date: 04/18/07
Drilling Co.: Fishburne, Inc.
Driller: Ed
Water Obs.: quick development, clear water, slight swampy odor

Boring No.: MW-3
Ground Elev.:
TOIC Elev.:
Total Depth: 16' TOC
Stickup: metal casing, PVC s/u
Well Dia.: 2"
Drill. Method: HSA, split-spoon
Rig No.:

Location Sketch

Remarks:

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material (Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.)	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			0	TOPSOIL; clayey and sandy, medium orangish brown, poor sorting	SM					BC: 1-0-1-1 sample SB-3A; sample SB-3B
	0 ppm			-2	no recovery - hit void, about 3-6" of debris: bits of broken glass, concrete, all rusty, dark brown						BC: 1-1-1-0; DTW at sampling
	0 ppm			-4	little recovery - slough of previous debris with about 6" silty greeinsh gray clay with plant material, slight swampy odor						BC: 1-0-0-0
	0 ppm			-6	slough						BC: 1-2-2-1
					debris as above; possible slough						DTW during boring
					SILTY SAND; medium tan, fine grained, moderate sorting, semi-stiff, moist to wet	SM					
	0 ppm			-8	as above, increase in sand content	SM - SP					BC: 2-1-2-2
					SAND; light tan, fine to medium grained with 10% coarse grains, poor sorting, minor orange mottling throughout, WET	SP					
				-10							

Boring / Well Log

Client: WFF - CDL

Project No.: 111328.0018

Boring No.: MW-3

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			-10	same as above with addition of light gray mottling	SP					BC: 1-0-2-1
	0 ppm			-12	SAND to SILTY SAND; light tan, fine to medium grained, increase in fine fraction, poor sorting, orange and gray mottling, very fine grained black specks, wet	SM - SP					BC: 1-2-4-3 TD = 13' bgs backfilled hole with filter sand
				-14							

Boring / Well Log

VERSAR

Client: WFF - CDL
Project No.: 111328.0018
Location: CDL
Logged By: E Willenburg
Date: 04/18/07
Drilling Co.: Fishburne, Inc.
Driller: Ed
Water Obs.: developed to clear water, organic odor

Boring No.: MW-4
Ground Elev.:
TOIC Elev.:
Total Depth: 17' TOC
Stickup: metal casing, PVC s/u
Well Dia.: 2"
Drill. Method: HSA, split-spoon
Rig No.:

Location Sketch

Remarks:

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material (Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.)	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			0	TOPSOIL; sandy, dark brown, much plant and root material present, oyster shell fragments, tile fragments	SM					BC: 1-1-1-2 sample SB-4A
					TOPSOIL; sandy, dark brown, many roots, less to no debris with depth, some fines present	SM					sample SB-4B
	0 ppm			-2	SAND; medium to dark brown, some minor fines, fine grained, moderately sorted, DRY	SM					BC: 2-2-3-2
	0 ppm			-4	SAND; slightly clayey, orangish brown, moist	SC					BC: 2-1-1-2
					SAND; medium to dark brown, some minor fines, fine grained, moderately sorted, DRY	SM - SC					
	0 ppm			-6	no recovery						BC: 2-2-1-2
					SAND; medium brown grading to light orangish brown, some minor fines, poorly sorted	SM - SC			▽		DTW at sampling
					SAND; light orangish brown grading to medium tan, fine to medium grained with fines and 10% coarse grains, moderately rounded, poorly sorted, moist	SP - SM					
	0 ppm			-8	no recovery						BC: 3-3-3-5
					SAND; medium tan, fine to medium grained, increase in clay fraction, poorly sorted	SC			▽		DTW during boring
	522 ppm				SAND; black stained, fine to medium grained, few fines, WET at 9' bgs	SM - SC					
				-10							

Boring / Well Log

Client: WFF - CDL

Project No.: 111328.0018

Boring No.: MW-4

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	591 ppm			-10	SAND; black stained, fine to medium grained, few fines, wet	SM - SC					BC: 3-2-3-4 black staining encountered, odor present
	0-10 ppm				SAND; dark gray stained, fine to medium grained, few fines, wet	SM - SC					
	530 ppm			-12	SAND; black stained, fine to medium grained, few fines, wet	SM - SC					BC: 2-3-4-3
	10-90 ppm				SAND; dark gray to black stained, fine to medium grained, few fines, wet, possible sheen present	SM - SC					TD = 14' bgs
	200 ppm			-14	slough						BC: 1-2-1-1
					SAND; similar to above but cleaning up to a greenish gray fine grained sand with fines, WET	SM					
				-16							

Boring / Well Log

VERSAR

Client: WFF - CDL
Project No.: 111328.0018
Location: CDL
Logged By: E Willenburg
Date: 04/18/07
Drilling Co.: Fishburne, Inc.
Driller: Ed
Water Obs.: moderately clear after development, slight odor

Boring No.: MW-5
Ground Elev.:
TOIC Elev.:
Total Depth: 17' TOC
Stickup: metal casing, PVC s/u
Well Dia.: 2"
Drill. Method: HSA, split-spoon
Rig No.:

Location Sketch

Remarks:

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material (Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.)	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			0	TOPSOIL; dark brown, sandy	SM					BC: 1-1-2-2 sample SB-5A
					SAND; medium orangish brown, some fines, poorly sorted, moist	SM - SC					sample SB-5B
	0 ppm			-2	SAND; medium orangish brown, some fines, poorly sorted, moist	SM - SC					BC: 2-2-2-3
	0 ppm			-4	no recovery						BC: 1-2-3-8
					SILTY SAND to SAND; medium orangish brown, poorly sorted, moist	SM - SP					
					DEBRIS; burned material - black, vitreous texture, brittle, with red brick and broken concrete melted together						
	0 ppm			-6	little recovery - as above; red brick, concrete, black material, all melted together with 6-8mm quartz pebbles throughout; almost tar-like; no noticible accumulation of debris in augers, cuttings appear to be orangish brown silty sand				▽		BC: 9-20-9-5 DTW at sampling
	0 ppm			-8	no recovery; moist to wet material coming up in augers - silty sand, orangish brown, no odor, no obvious debris				▽		BC: 1-1-2-1 DTW during boring
				-10							

Boring / Well Log

Client: WFF - CDL

Project No.: 111328.0018

Boring No.: MW-5

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			-10	SAND; gray tan, fine grained, moderately sorted, moderately rounded, WET	*SP*					*BC: 1-1-1-1*
					SILTY CLAY; gray brown to gray black, vegetation/organic material present, peat-like, soft to medium stiff, strong swamp odor, moist	*CL - Pt*					
	0 ppm			-12	no recovery						*BC: 1-1-1-1*
					SAND; gray tan, fine grained, moderately sorted, moderately rounded; grading into stiff sandy clay, medium tan to gray, moist	*SP - CL*					*TD = 14' bgs*
	0 ppm			-14	CLAY; gray and tan, some organic matter (minimal), stiff clay, WET, hole not producing water	*OL - CL*					*BC: 1-1-1-1*
				-16							

Boring / Well Log

VERSAR

Client: WFF - CDL
Project No.: 111328.0018
Location: CDL
Logged By: E Willenburg
Date: 04/18/07
Drilling Co.: Fishburne, Inc.
Driller: Ed
Water Obs.: quick development, clear water

Boring No.: MW-6
Ground Elev.:
TOIC Elev.:
Total Depth: 24' TOC
Stickup: metal casing, PVC s/u
Well Dia.: 2"
Drill. Method: HSA, split-spoon
Rig No.:

Location Sketch

Remarks:

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material (Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.)	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			0	TOPSOIL; dark brown, sandy, vegetation (roots, plants, leaves)	SM					BC: 2-1-1-2 sample SB-6A
					no recovery						sample SB-6B
					SAND; orangish brown, fine to coarse grained, poor sorting	SP					
	0 ppm			-2	SAND; light orangish brown, fine to coarse grained with 10% very coarse grains to granuals, moderately rounded, poorly sorted, DRY	SP					BC: 2-1-2-2
	0 ppm			-4	SAND; light orangish brown, fine to coarse grained with 10% very coarse grains to granuals, moderately rounded, poorly sorted, DRY	SP					BC: 2-1-2-3
	0 ppm			-6	SAND; similar to above but increase in coarse to very coarse fraction, light tan with orange mottling, very fine grained black specks, dry	SP					BC: 2-3-3-3
	0 ppm			-8	SAND; medium to light tan, fine to medium grained, moderately sorted, 1/8-1/4" interbedded layers of brownish and orangish sands giving striped appearance, dry	SP					BC: 3-3-4-4
				-10							

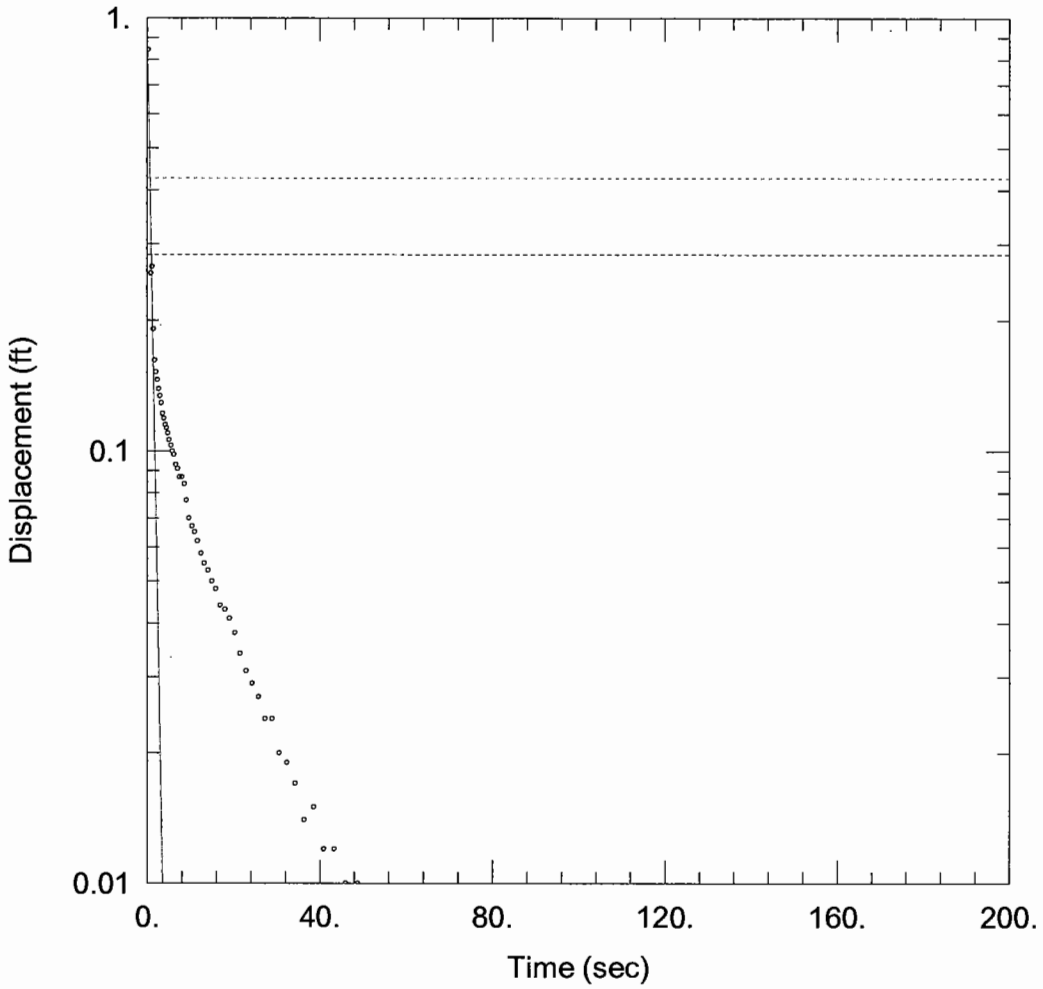
Boring / Well Log

Client: WFF - CDL

Project No.: 111328.0018

Boring No.: MW-6

Blow Counts	PID	Odor	Recovery	Depth (ft)	Description of Material Soil description, color, consistancy, moisture, plasticity/dilatancy for cohesive soils, gradation/texture for granular soils, other observations.	USCS Identification	Lithology	Smpl. Interval	Water Level	Well Construction	Additional Notes
	0 ppm			-10	SAND; medium to light tan, medium grained with minor fines, moderately sorted, interbedding of brown and orange layers (1/4-1/2"), very fine grained black specks, dry	SP - SM					*BC: 4-4-5-5*
	0 ppm			-12	SAND; light tan, fine to medium grained, moderately sorted, some minor interbedding as above, black specks, moist at 13' bgs	SP - SM					*BC: 5-5-5-6* *DTW at sampling* *DTW during boring*
	0 ppm			-14	SAND; light tan, fine to medium grained, moderately sorted, some minor interbedding as above, black specks, WET	SP - SM					*BC: 4-5-5-6*
	0 ppm			-16	SAND; light tan, fine grained, moderately to well sorted, stiff, some minor interbedding as above, black specks, WET	SP - SM					*BC: 4-6-8-10*
					SAND; light tan, fine to medium grained, moderately sorted, some minor interbedding, black specks	SP - SM					
	0 ppm			-18	SAND; light tan, fine to medium grained, moderately sorted, some minor interbedding, black specks	SP - SM					*BC: 2-3-4-5*
	0 ppm			-20	SAND; light tan, fine to medium grained, moderately sorted, some minor interbedding, black specks	SP - SM					*BC: 5-6-6-7* *TD = 21' bgs*



FALLING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-01
Test Date: 05/01/2007

AQUIFER DATA

Saturated Thickness: 25. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-01)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 8.35 ft
Casing Radius: 0.08612 ft

Static Water Column Height: 8.35 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

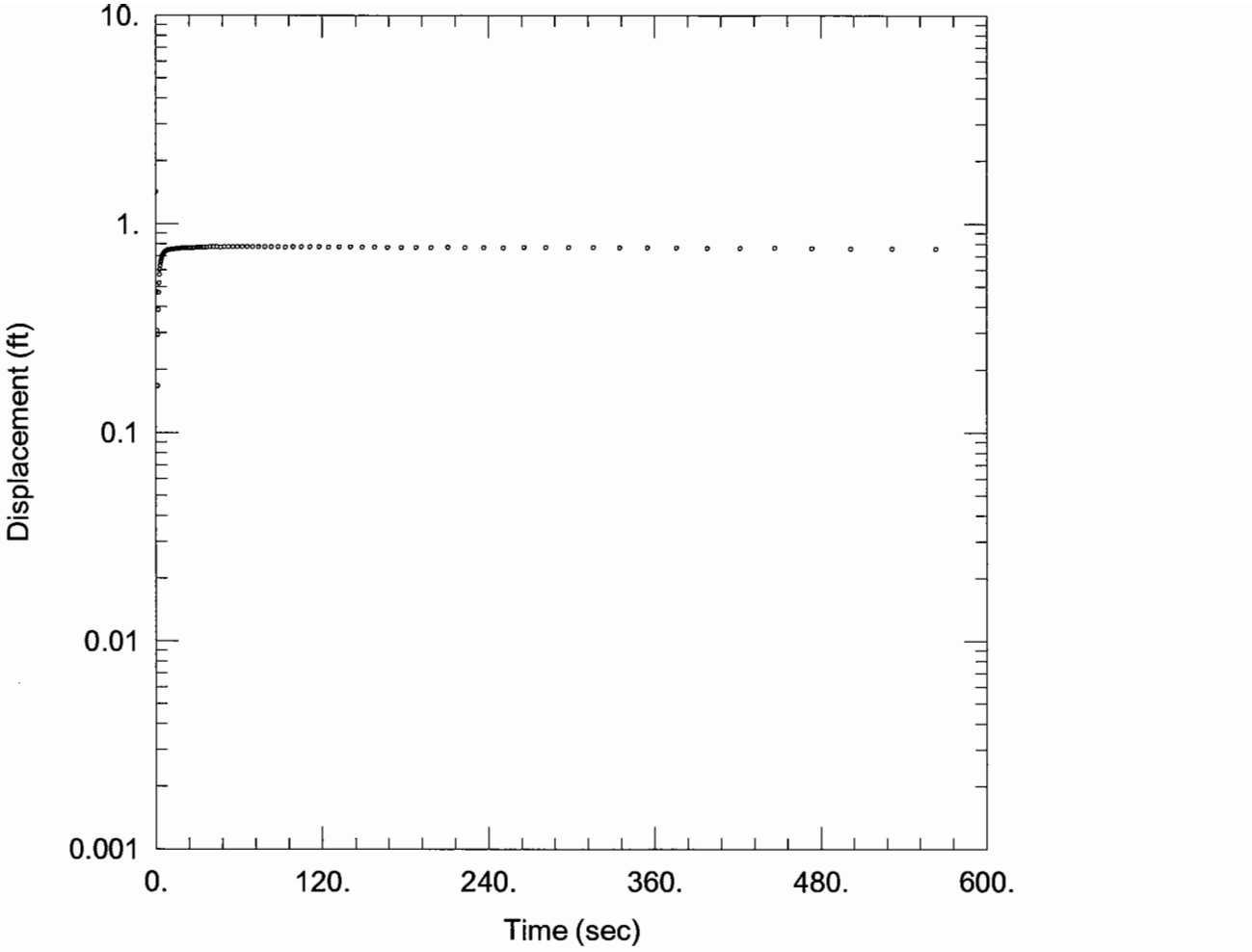
SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.03536 cm/sec

y0 = 1.152 ft



RISING HEAD SLUG TEST

PROJECT INFORMATION

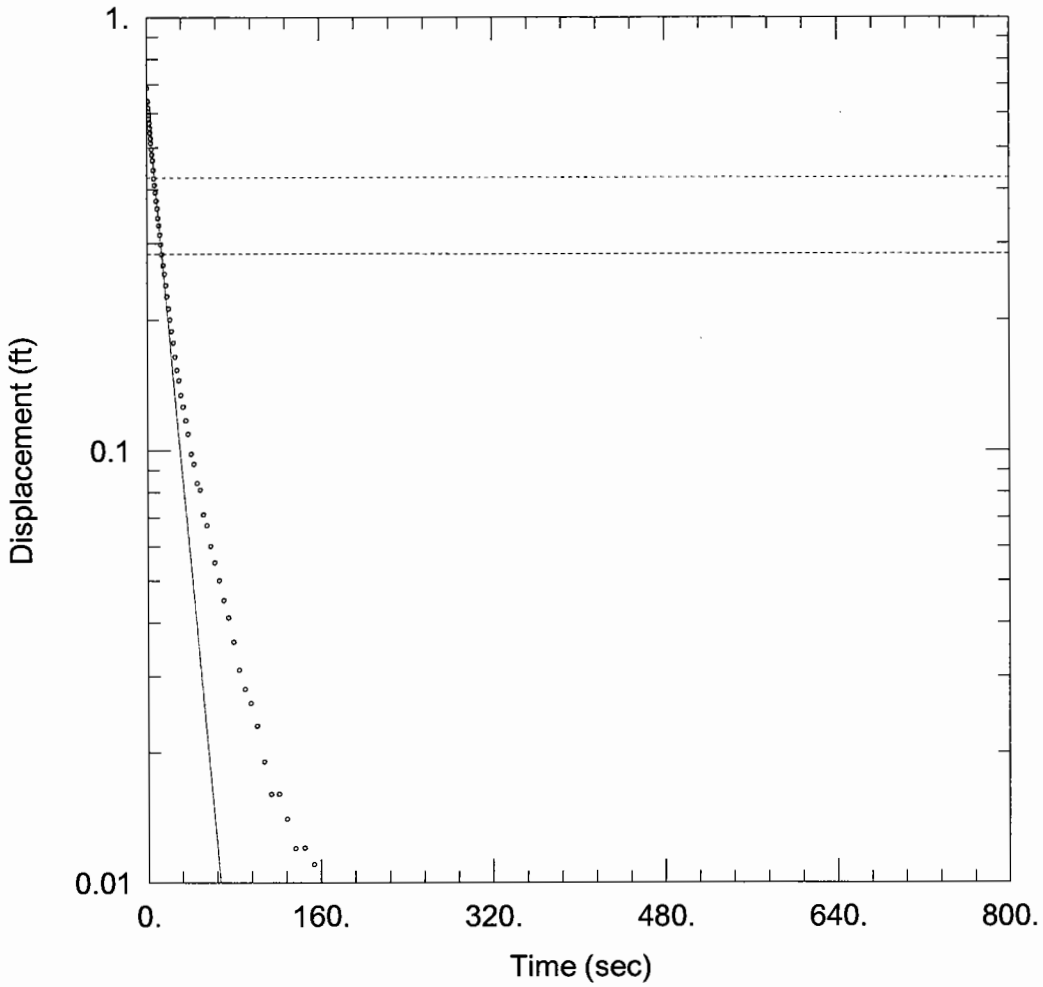
Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-01
Test Date: 05/01/2007

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-01)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 8.35 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 8.35 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft



FALLING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-02
Test Date: 05/01/2007

AQUIFER DATA

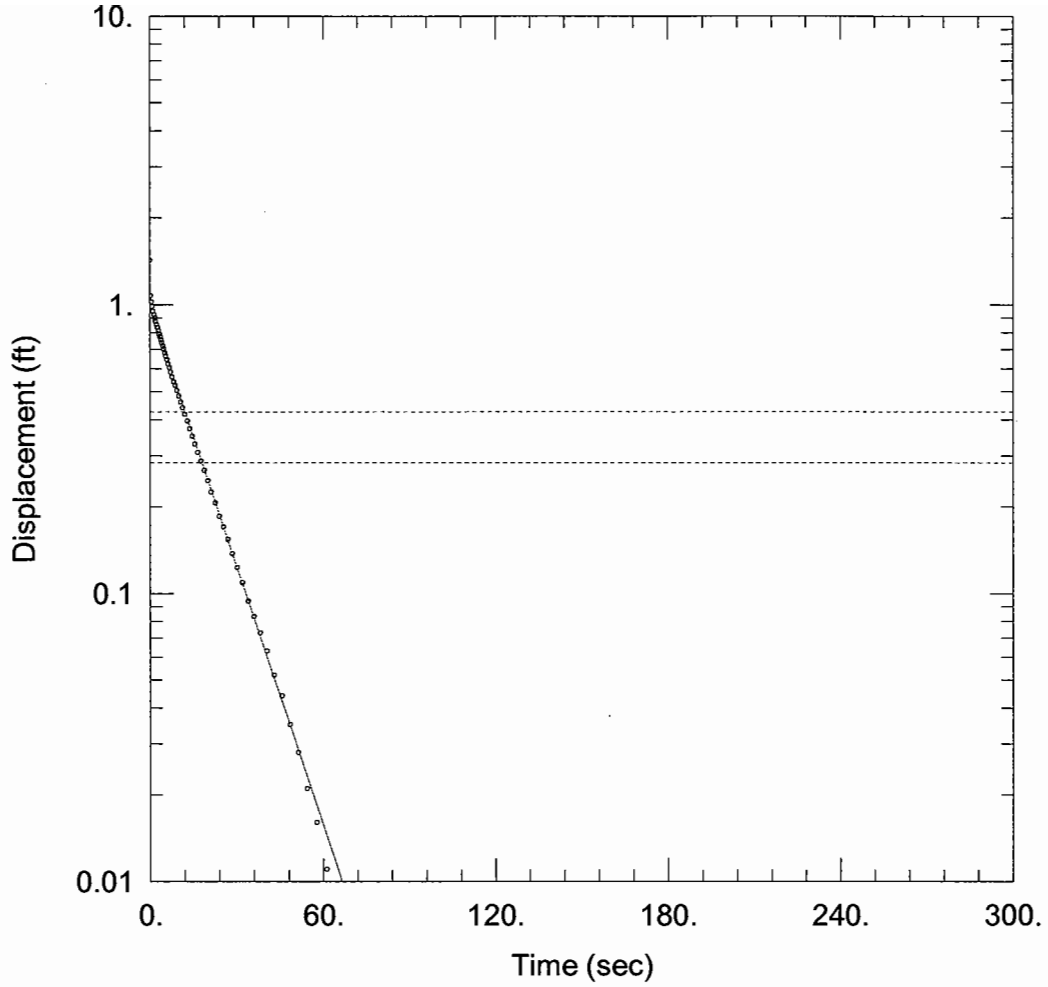
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-02)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 9.82 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 9.82 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001704 cm/sec
y0 = 0.6681 ft



RISING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-02
Test Date: 05/01/2007

AQUIFER DATA

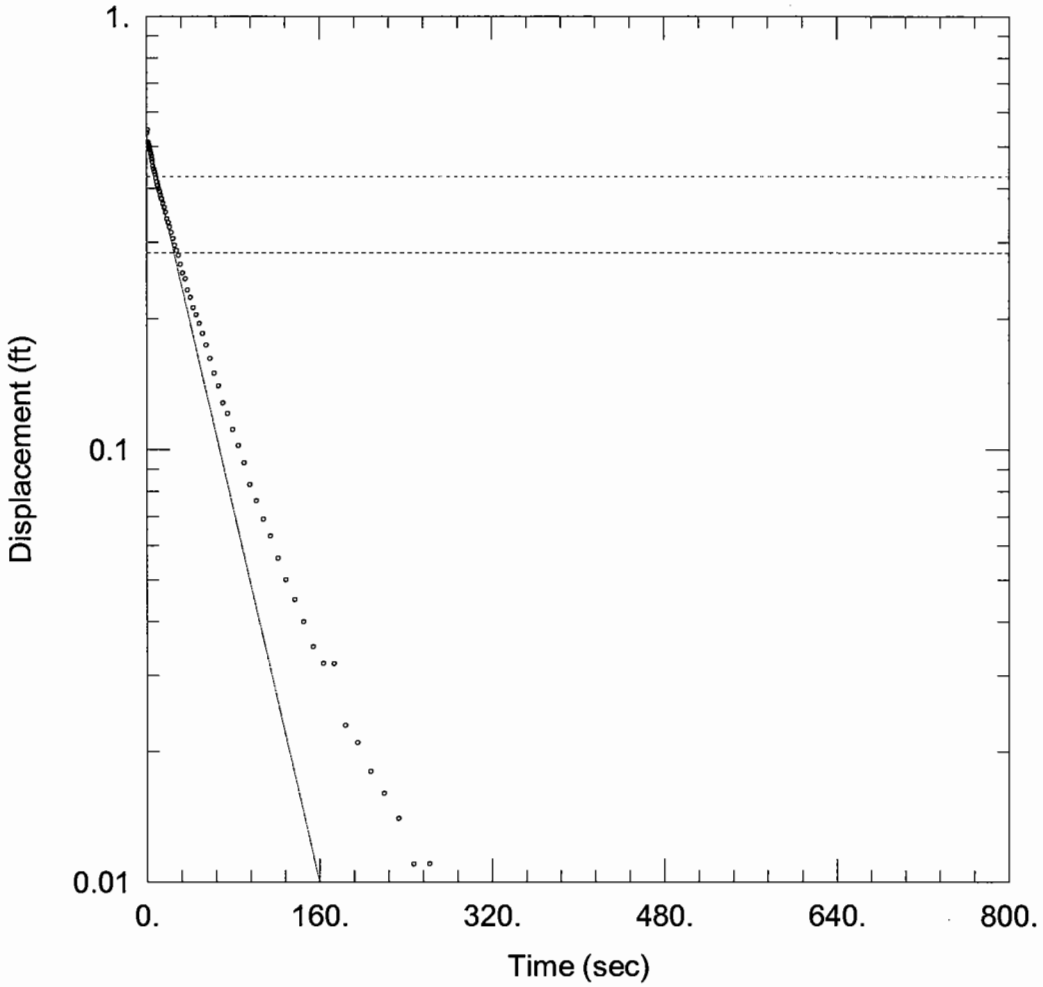
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-02)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 9.82 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 9.82 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
K = 0.001878 cm/sec
Solution Method: Bouwer-Rice
y0 = 0.9778 ft



FALLING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-03
Test Date: 04/30/2007

AQUIFER DATA

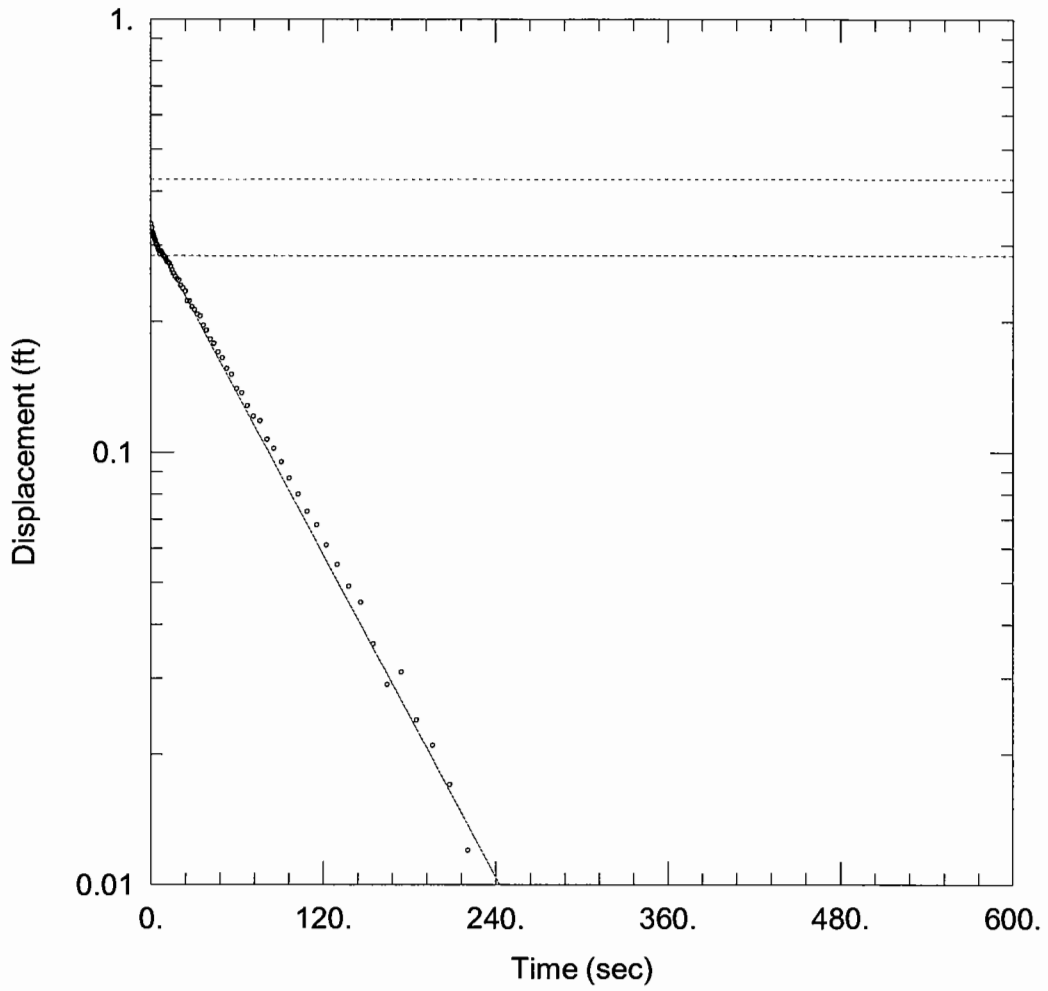
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-03)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 10.2 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 10.2 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.000684 cm/sec
y0 = 0.5336 ft



RISING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-03
Test Date: 04/30/2007

AQUIFER DATA

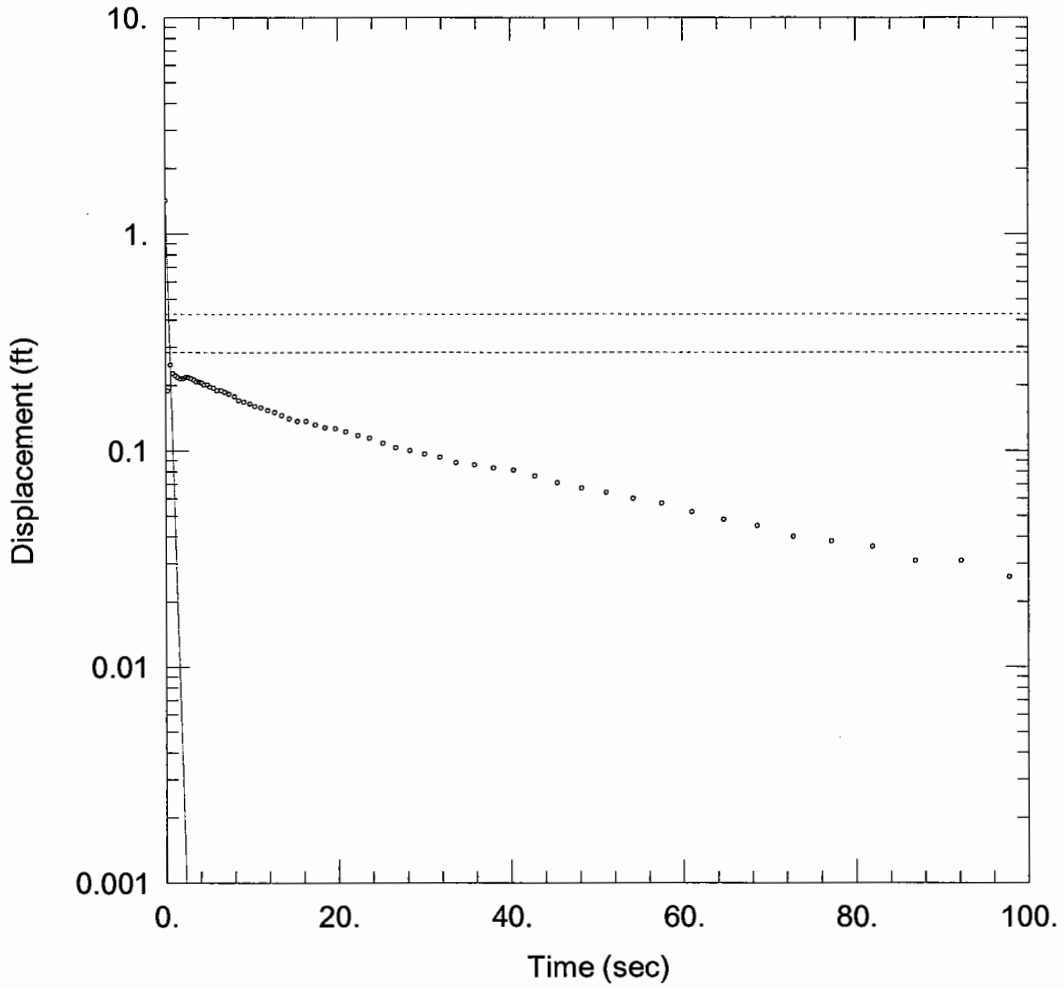
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-03)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 10.2 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 10.2 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0003934 cm/sec
y0 = 0.3226 ft



FALLING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-04
Test Date: 04/30/2007

AQUIFER DATA

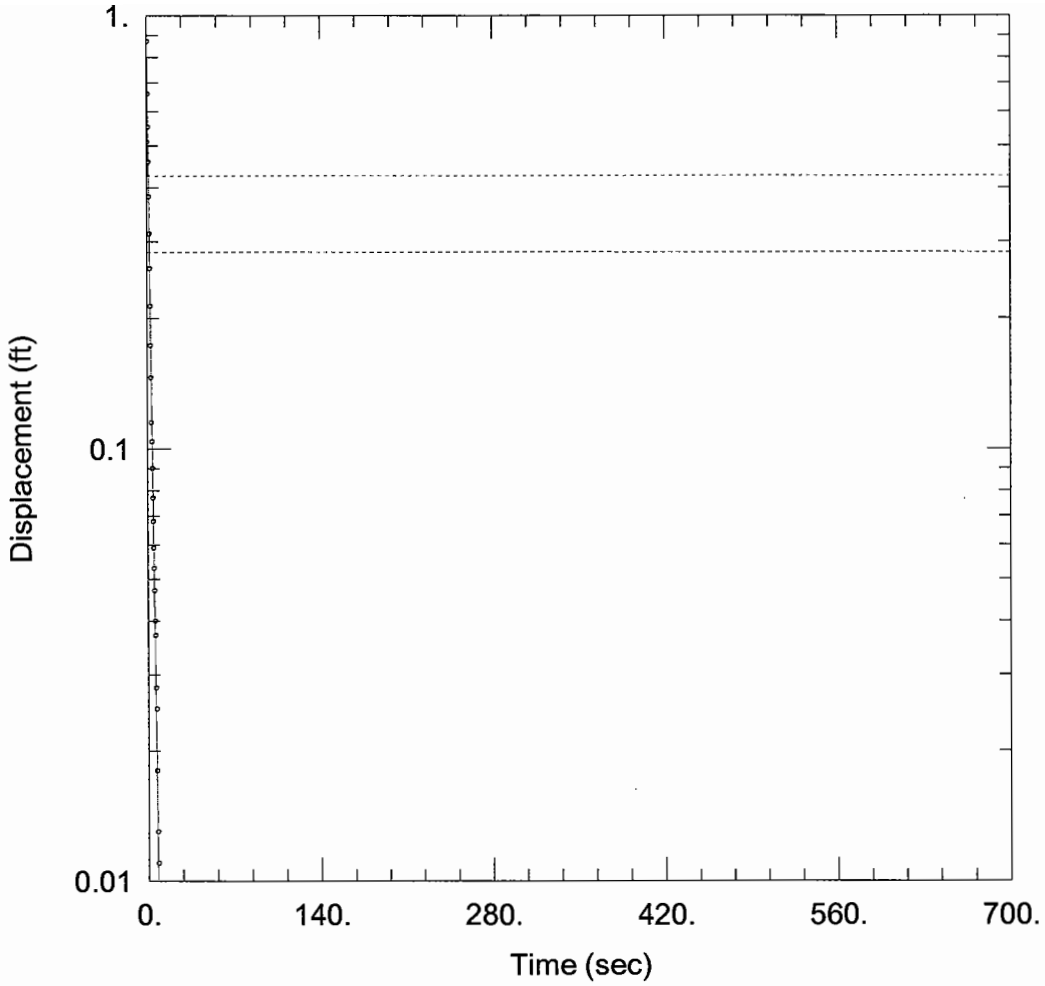
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-04)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 7.34 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 7.34 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.07919 cm/sec
y0 = 1.448 ft



RISING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-04
Test Date: 04/30/2007

AQUIFER DATA

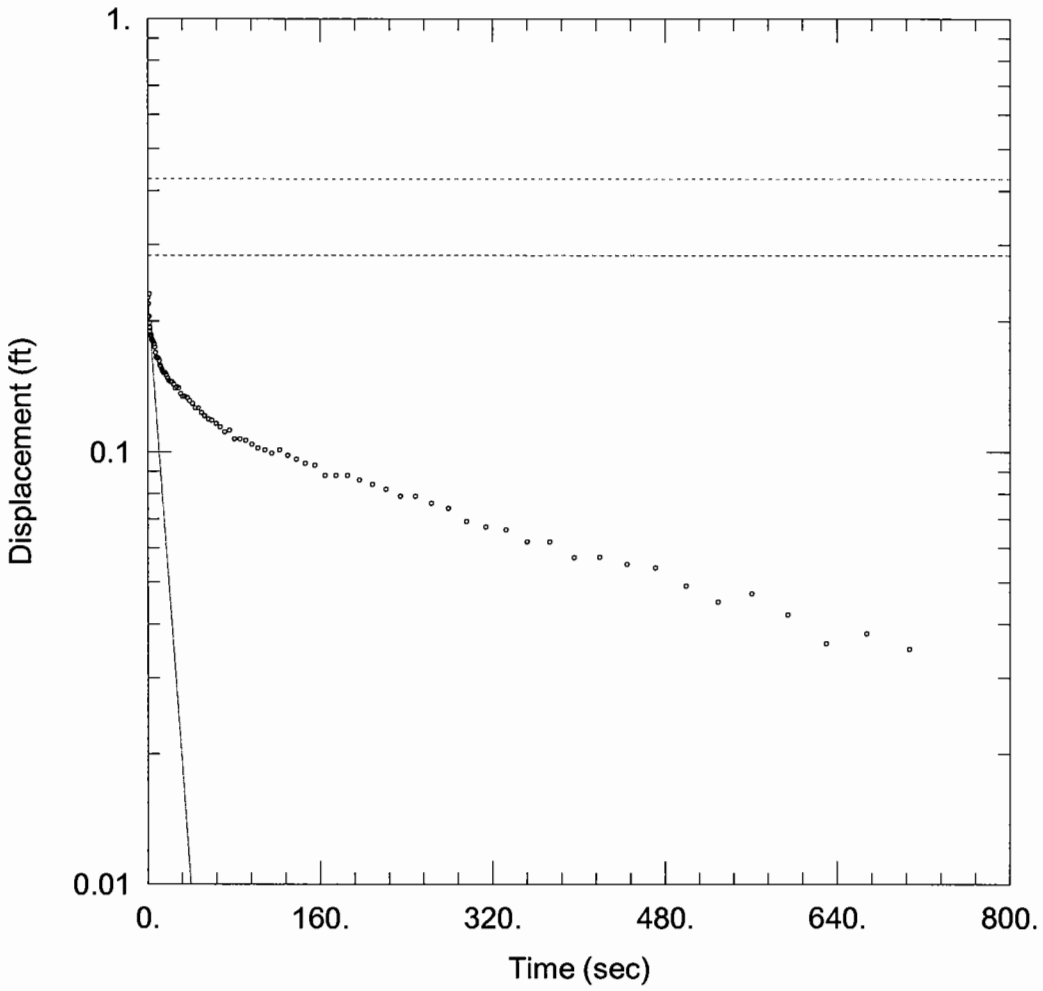
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-04)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 7.34 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 7.34 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
K = 0.01505 cm/sec
Solution Method: Bouwer-Rice
y0 = 1.097 ft



FALLING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-05
Test Date: 04/30/2007

AQUIFER DATA

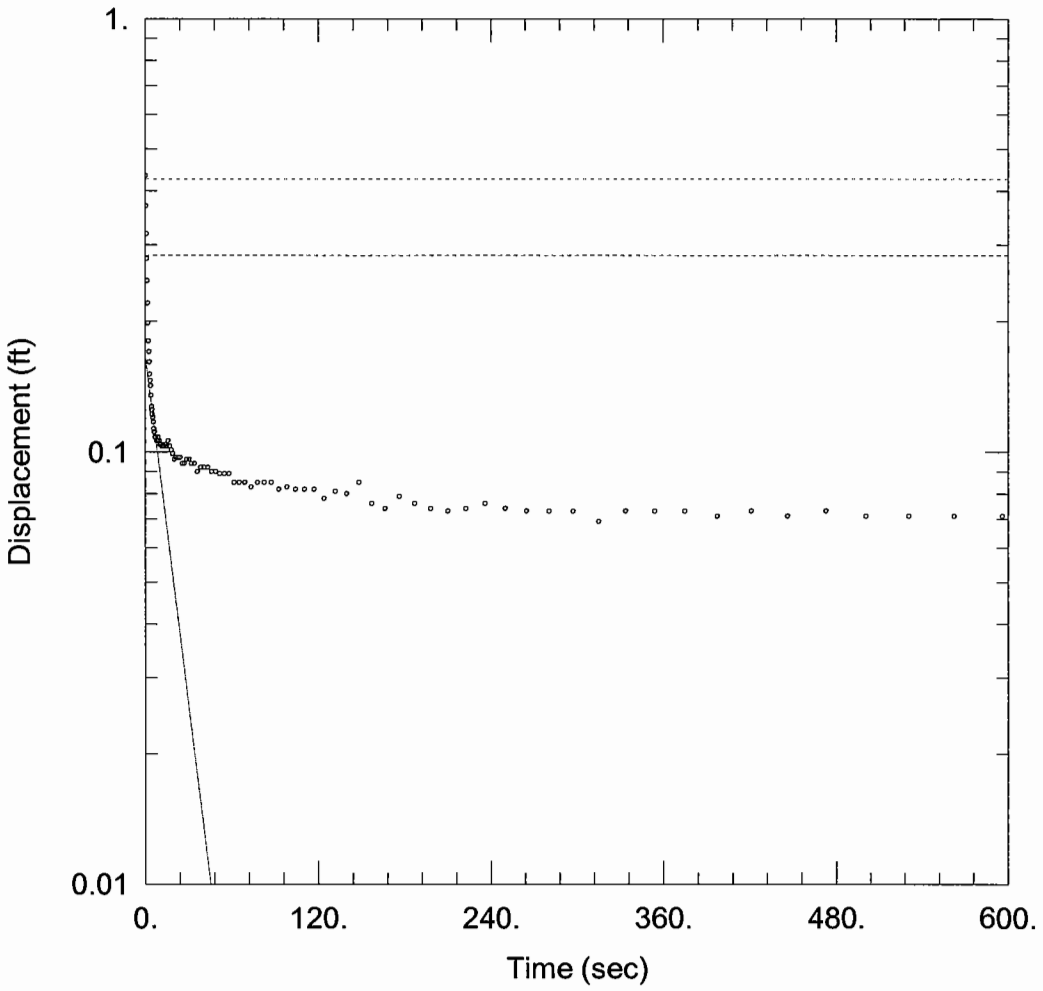
Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-05)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 7.25 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 7.25 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001976 cm/sec
y0 = 0.2273 ft



RISING HEAD SLUG TEST

PROJECT INFORMATION

Company: Versar, Inc.
Client: Wallops - CDL
Project: 111328.0018
Test Well: MW-05
Test Date: 04/30/2007

AQUIFER DATA

Saturated Thickness: 25. ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-05)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 7.25 ft
Casing Radius: 0.08612 ft
Static Water Column Height: 7.25 ft
Screen Length: 10. ft
Wellbore Radius: 0.25 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001585 cm/sec
y0 = 0.1676 ft

Well Purging and Field Water Quality Measurements Form

Date: 5/1/09

Project: Wallops | Well Number: MW-1 | Measuring Point (identify): TOC

Location: CDC - inside fence | Total Depth (ft): 33' | Pump Intake (ft below MP): @ bottom

Field Personnel: EDW | Screened Interval (ft): 23-33'

Equipment Used: Grundfos pump; generator; dedicated Teflon tubing; Horiba U-22

Time 24 hr	Water Level below MP ft	Purge Rate ~~mL/min~~ gpm	Cumulative Volume Purged ~~gal~~	Temp +/- .1 °C	Specific Conductivity +/- 3% µS/cm	pH +/- .1	Oxidation Reduction Potential +/- 10% mv	Dissolved Oxygen +/- 10% mg/L	Turbidity NTU	Comments (odor, clarity, etc…)
1028	24.76	.5		19.72	.185	6.54	102	7.02	22.1	
1033	24.78	↓		19.29	.120	5.80	137	6.76	18.0	
1038	24.77			19.47	.112	5.79	139	6.62	17.5	8.4
1043	24.78	↓		19.48	.110	5.87	136	6.58	7.6	
1048	24.78			19.63	.108	6.04	119	6.62	12.4	
1053	24.74			20.40	.106	6.45	80	6.61	26.9	pumped stopped working
		Resumed @ 1130								Started pump, was turbid again
1130	24.76			20.47	.109	6.36	90	7.05	28.7	
1135	24.76			20.53	.103	5.96	109	6.92	21.8	
		Resumed @ 1145								
11..				19.11	.103	6.48	93	7.40	22.8	
1200	24.80			18.93	.103	6.38	90	6.59	33.8	
1205				19.4	.103	6.46	86	6.59	26	
				21.47	.099	6.63	76	6.80	150	Rinsed out Horiba

Samples Collected: MW-1

Time: 1235

Comments:

Water Clarity (at time of collection): clear

Samples Collected By: ED, EW

Well Purging and Field Water Quality Measurements Form

Date: 5/1/07

Project: Wallops
Well Number: MW-1
Measuring Point (identify):
Location: COL-Inside Fence
Total Depth (ft):
Pump Intake (ft below MP):
Field Personnel: ED
Screened Interval (ft):
Equipment Used:

Time 24 hr	Water Level below MP	Purge Rate	Cumulative Volume Purged	Temp	Specific Conductivity	pH	Oxidation Reduction Potential	Dissolved Oxygen	Turbidity	Comments (odor, clarity, etc…)
	ft	mL/min	mL or L	°C	µS/cm		mv	mg/L	NTU	
1225				20.15	.099	6.48	134	6.72	1.1	
1230				20.19	.103	6.48	138	6.60	3.5	
1235				20.05	.102	6.49	141	6.63	8.7	

Samples Collected:
Water Clarity (at time of collection):
Time:
Samples Collected By:
Comments:

Well Purging and Field Water Quality Measurements Form

Date: 5/1/07

Project: WALLOPS
Location: CDL - inside fence
Field Personnel: EW
Equipment Used: Geopump; dedicated Teflon tubing; Horiba U22 Flow-Through cell/meter

Well Number: MW-2
Total Depth (ft): 24'
Screened Interval (ft): 14-24'

Measuring Point (identify): TOC
Pump Intake (ft below MP): @ bottom

Time 24 hr	Water Level below MP ft	Purge Rate ~~mL/min~~ gpm	Cumulative Volume Purged mL or L	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc...)
1300	15.39	0.3 gpm		15.37	0.086	6.83	146	6.73	17.2	
1305	15.38	"		15.37	0.085	6.10	191	5.89	45.9	rinsed out flow through cell
1315	15.39	"		15.40	0.086	6.08	203	5.77	61.9	
1320	15.39	"		15.40	0.085	6.21	199	5.82	68.9	
1325	15.39	"		15.41	0.085	6.44	191	5.83	47.3	
1330	15.39	"		15.41	0.084	6.54	189	5.76	14.2	
1335	15.39	"		15.41	0.084	6.61	190	5.69	71.0	
1340	15.39	"		15.40	0.084	6.65	190	5.76	40.8	
1345	15.39	"		15.41	0.084	6.67	192	5.76	48.0	
1350	15.39	"		15.40	0.084	6.68	194	5.76	35.8	

Samples Collected: MW-2
Time: 1350
Comments: clear water, no odor

Water Clarity (at time of collection): clear "crystal"
Samples Collected By: EW

Well Purging and Field Water Quality Measurements Form

Date: 5/2/07

Project: WALLOPS
Location: CDL
Field Personnel: EW
Equipment Used: Horiba U-22, Geopump, dedicated Teflon tubing

Well Number: MW-3
Total Depth (ft): 13'
Screened Interval (ft): 3-13'

Measuring Point (identify): TOC
Pump Intake (ft below MP): @ bottom

Time 24 hr	Water Level below MP ft	Purge Rate ~~gpm~~ ~~mL/min~~	Cumulative Volume Purged mL or L	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc...)
1110	7.2'	0.5				NM				start w/ Horiba measurements
1115	6.86'	"		16.02	0.102	6.05	142	8.61	52.9	
1120	6.94	"		15.88	0.102	6.07	157	7.72	57.4	
1125	6.92	"		16.02	0.104	6.07	167	7.42	77.0	
1130	6.9	"		15.94	0.114	6.08	172	7.40	68.5	
1135	6.82	"		15.97	0.101	6.14	176	7.29	42.0	
1140	6.74	"		16.14	0.101	6.29	171	7.16	34.6	
1145	6.68	"		16.12	0.102	6.50	163	7.27	37.3	
										parameters not stabilizing - will collect samples - we've pulled more than 3x water column volume out of well

Samples Collected: MW-3
Time: 11:50
Comments:

Water Clarity (at time of collection): clear
Samples Collected By: EW

Well Purging and Field Water Quality Measurements Form

Date: 5/2/07

Project: WALLOPS
Location: COL
Field Personnel: EW
Equipment Used: geopump, Horiba U22, dedicated teflon tubing

Well Number: MW-4
Total Depth (ft): 14'
Screened Interval (ft): 4-14'

Measuring Point (identify): TOC
Pump Intake (ft below MP): @ bottom

Time 24 hr	Water Level below MP ft	Purge Rate ~~gpm~~ mL/min	Cumulative Volume Purged mL or L	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc…)
DTW 9.89' TOC		pump	was off for a moment							
08:50	9.83'	0.5		14.41	0.192	6.52	-70	0.91	13.9	start monitoring
08:55	9.89	"		13.91	0.188	5.96	-70	0.0	14.0	
0900	9.9	"		13.89	0.188	5.90	-79	0.0	13.4	
0905	9.9	"		13.92	0.189	5.90	-87	0.0	15.2	
0910	9.89	"		13.89	0.189	6.00	-98	0.0	15.1	
0915	9.89	"		13.89	0.189	6.17	-111	0.0	15.3	
0920	9.89	"		13.86	0.190	6.31	-121	0.0	14.9	
0925	9.89	"		13.90	0.188	6.36	-125	0.0	10.8	
0930	9.9	"		13.93	0.188	6.38	-127	0.0	11.4	

Samples Collected: MW-4, MW-4D
Time: 0930
Comments:

Water Clarity (at time of collection): clear
Samples Collected By: EW

Well Purging and Field Water Quality Measurements Form

Date: 5/2/07

Project: Wallops

Location: COL

Field Personnel: EDW

Well Number: MW-05

Total Depth (ft): 14'

Screened Interval (ft): 4-14'

Measuring Point (identify): TOC

Pump Intake (ft below MP):

Equipment Used: Horiba U-22, geopump, dedicated Teflon tubing

± 3% ± 10% ± 10%

Time 24 hr	Water Level below MP ft	Purge Rate ~~mL/min~~ gpm	Cumulative Volume Purged mL or L	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc…)
120	17.0	.5 g		15.39	.643	6.58	-28	6.90	18	
930	17.0			13.69	.628	6.25	-3	5.90	25.6	
935	17.0			14.65	.627	6.34	-3	5.93	119.7	
945	14.24			14.61	.629	6.38	1	4.80	82.6	
955	13.2			14.54	.633	6.37	3	4.20	103.0	
1005	12.5			14.57	.635	6.36	5	3.81	41.2	
1010	12.2	250 mL/m		14.48	.645	6.34	-0	3.28	25.0	
1015	12.12			14.84	.616	6.35	8	3.50	8.5	
1020	11.6			14.74	.614	6.34	8	3.30	24.9	
1025	11.84			15.08	.594	6.33	14	3.43	32.5	
1030	11.78			15.27	.643	6.33	15	3.43	43.0	
1035	11.70			15.21	.651	6.32	14	3.26	21.8	
1040	11.51			15.16	.655	6.30	19	3.43	22.9	
1045				15.15	.655	6.42	23	3.44	25.1	samples collected @ 1045

Samples Collected: MW-5

Time: 1045

Comments:

Water Clarity (at time of collection):

Samples Collected By: ED

Well Purging and Field Water Quality Measurements Form

Date: 5/1/07

Project: Wallops

Well Number: MW-06

Measuring Point (identify): TOC

Location: COL

Total Depth (ft): 21'

Pump Intake (ft below MP):

Field Personnel: ED

Screened Interval (ft): 11-21'

Equipment Used: HORIBA U-22; Geopump; dedicated Teflon tubing

Time 24 hr	Water Level below MP ft	Purge Rate ~~gpm~~ mL/min	Cumulative Volume Purged mL or L	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc...)
1550	15.54	.5		16.42	.106	6.92	109	8.65	15.9	
1555	16.56			15.43	.100	5.95	224	7.11	41.0	
1605	16.56			15.53	.099	5.95	227	6.93	32.1	
1610	16.58			16.16	.100	5.96	230	6.57	20.5	
1615				16.44	.100	6.02	230	6.58	14.4	
1620	16.52			16.53	.100	6.65	198	6.59	13.0	
1625				16.83	.101	6.67	199	6.59	10.6	
1630				15.14	.099	6.08	235	7.07	23.4	
1635				15.15	.098	5.98	238	7.26	34.5	
1640	16.57			15.10	.097	5.97	239	6.87	38.1	
1645				15.09	.097	5.99	241	6.86	34.4	

Samples Collected: MW-6

Time: 1645

Comments:

Water Clarity (at time of collection):

Samples Collected By: ED

Well Purging and Field Water Quality Measurements Form

Date: 12/19/07

Project: Wallops - CDL
Well Number: MW-1
Measuring Point (identify): TOC
Location: inside fence - background
Total Depth (ft): @ TOC 33'
Pump Intake (ft below MP): @ bottom - 6 inches
Field Personnel: EW + ED
Screened Interval (ft): 23-33'
Equipment Used: horiba U-22 w/ flow cell ; grundfos (Pine), generator, teflon-lined poly tubing

Time 24 hr	Water Level below MP ft	Purge Rate mL/min	Cumulative Volume Purged (mL or L)	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc...)
0840	26.2									
0842	start	pumping								silty, brown H_2O sli sulfur odor
0845	26.22	900		15.73	0.264	5.73	106	4.90	~5*	blinking turb.
0850	26.22	450		17.96	0.262	5.86	92	4.98	~5*	empty out flow cell
0855	26.23*	700		20.05	0.264	5.86	86	4.99	245	
0900	26.24	700		18.93	0.266	5.84	100	4.99	106	
0905	26.24	700		18.55	0.264	5.82	110	4.93	84	
0910	26.24	700		18.81	0.260	5.79	115	4.95	~2.5	
0915	26.24	700		18.86	0.260	5.79	117	4.96	42.1	
0920	26.24	700		18.62	0.260	5.77	121	4.97	~~~~	42.0
0925	samples collected									
0937	26.20*									

pump keeps stalling on lower ml/min

Samples Collected: x9 bottles
Time: 0925
Comments:

Water Clarity (at time of collection): clear, slight to no odor
Samples Collected By: EW

Well Purging and Field Water Quality Measurements Form

Date: 12/18/07

Project: Wallops CDL

Location: Wallops Island

Field Personnel: ED/EW

Equipment Used:

Well Number: MW-02

Total Depth (ft):

Screened Interval (ft):

Measuring Point (identify):

Pump Intake (ft below MP):

Time 24 hr	Water Level below MP (16.85) ft	Purge Rate mL/min	Cumulative Volume Purged mL or L	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc...)
1525	16.85	300		14.65	.167	7.04	27	7.25	88.6	Water clear, no odor
1535	16.96	↓		14.76	.163	6.64	61	7.47	50.9	
1540	16.93	↓		14.88	.162	6.56	73	7.37	117.0	
1545	16.92			15.05	.162	6.51	79	7.32	138	
1550	16.92			14.91	.162	6.48	83	7.26	138	
1555	16.92			15.01	.163	6.47	86	7.29	109	
1600	16.92			14.92	.162	6.46	88	7.26	91.2	
1605	16.92			14.82	.162	6.46	89	7.29	71.2	
1610	16.92	↓		14.82	.162	6.46	92	7.22	32.7	
1615	16.92			14.88	.163	6.46	93	7.24	25.3	
1620				14.90	.162	6.45	94	7.26	27.3	Organ sampling @ 1620

Samples Collected:

Time:

Comments:

Water Clarity (at time of collection):

Samples Collected By:

Well Purging and Field Water Quality Measurements Form

Date: 12/9/07

Project: Wallops - CDL
Location: outside fence
Field Personnel: EW + EO
Equipment Used: HoriBA U-22 w/ flow cell, geopump, teflon lined poly tubing

Well Number: MW-03
Total Depth (ft): 16' @ TOC
Screened Interval (ft): 3-13 @ gs

Measuring Point (identify): TOC
Pump Intake (ft below MP): @ bottom

16 - 6.62 = 9.38 x 3 = 28.14 x .16 = 4.5 gall

Time 24 hr	Water Level below MP (ft)	Purge Rate (mL/min)	Cumulative Volume Purged (mL or L)	Temp (°C)	Specific Conductivity (µS/cm)	pH	Oxidation Reduction Potential (mv)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Comments (odor, clarity, etc...)
1035	6.62'	begin	pumping							water slight cosmp
1040	7.08'	500	2500	15.10	0.163	6.06	113	3.41	37.5	clear, no odor
1045	7.34	350		15.13	0.163	6.05	115	3.33	35.8	
1050	7.29	200		15.26	0.163	6.04	117	3.37	31.3	
1055	7.29	200		15.39	0.162	6.03	119	3.38	69.1	
1100	7.30	200		15.35	0.161	6.03	121	3.40	75.1	
1105	7.33	200		15.40	0.161	6.03	122	3.33	79.6	
1110	7.30	200		15.60	0.161	6.02	123	3.35	76.7	*adjust tubing
1115	7.30	200		15.48	0.161	6.03	124	3.43	49.0	
1120	7.30	200		15.44	0.161	6.03	125	3.40	79.6	
1125	samples taken									
1153	6.94'	=								

Samples Collected: x9 bottles and x9 dupe! = 18 total
Time: 1125
Comments: dupe taken here

Water Clarity (at time of collection): slightly cloudy
Samples Collected By: EW

Well Purging and Field Water Quality Measurements Form

Date: 12/18/07

Project: WALLOPS COL
Location: outside fence
Field Personnel: EW, ED
Equipment Used: Horiba U-22, Geopump, dedicated Teflon-lined poly tubing

Well Number: MW-04
Total Depth (ft): @TOC 17' @gs 14'
Screened Interval (ft): 4-14

Measuring Point (identify): TOC
Pump Intake (ft below MP): @ bottom

Time 24 hr	Water Level below MP ft	Purge Rate mL/min	Cumulative Volume Purged (mL) or L	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc...)
1205	10.62	begin	pumping	→						mod. sweet chemical smell water murky, slight gray color
1210	10.73	300	300	15.35	0.334	5.74	-94	0.25	543	
1215	10.73	300	600	15.29	0.325	5.71	-97	0.32	53.1	
1220	10.74	300	900	15.35	0.322	5.72	-101	0.36	24.1	
1225		300	1200							helping on MW-5
1230	10.74	300	1500	15.40	0.318	5.71	-107	0.45	44.0	
1235	10.74	300	1800	15.33	0.309	5.71	-110	0.50	48.7	water much clearer
1240	10.74	300	2100	15.31	0.310	5.72	-114	052	160	dumped out Horiba - turb. spiked
1245	10.74	300	2400	15.28	0.315	5.70	-111	1.36	19.1	
1250	10.74	300	2700	15.22	0.312	5.71	-113	0.50	21.0	
1255	10.74	300	3000	15.31	0.313	5.71	-117	0.53	15.8	
1300	10.74	300	3300	15.28	0.313	5.71	-118	0.53	8.6	
1305	Samples	taken	—	—						
1320	finished	sampling								

>TW 10.61 1324 1324

Samples Collected: x9 bottles
Time: 1305
Comments:

Water Clarity (at time of collection): clear, mod. sweet chem. odor
Samples Collected By: EW

Well Purging and Field Water Quality Measurements Form

Date: 12/18/07

Project: Wallops @ CDL
Well Number: MW 105
Measuring Point (identify):
Location: Wallops Island
Total Depth (ft):
Pump Intake (ft below MP):
Field Personnel: ED/EW
Screened Interval (ft):
Equipment Used:

Time 24 hr	Water Level below MP (10.60) ft	Purge Rate mL/min	Cumulative Volume Purged mL or L	Temp °C	Specific Conductivity µS/cm	pH	Oxidation Reduction Potential mv	Dissolved Oxygen mg/L	Turbidity NTU	Comments (odor, clarity, etc…)
1225	10.70	300		15.25	1.01	6.57	-122	0	153	slight swampy odor
1230	10.72	1	500 L	15.18	1.00	6.52	-106	0	126	orange/brown discoloration
1235	10.85	1		15.13	.97	6.50	-97	0.05	101	-color eventually clears
1240	11.3			15.01	.93	6.43	-76	1.66	70.7	
1245	11.72			15.05	.838	6.38	-85	1.20	39.1	
1250	12.5	200		14.97	.841	6.39	-108	.33	33.6	
255	13.3			5.04	.871	6.41	-117	109	135	
~~1300~~ 1300	13.6			15.05	.873	6.41	-112	.51	105	
1305	13.8			15.04	.862	6.42	-106	1.22	76.0	
1310	14.15			15.03	.854	6.41	-98	1.81	52.4	
1315	14.4			14.95	.853	6.41	-94	1.93	47.4	
1320	14.8			14.93	.835	6.41	-90	2.30	38.9	
1325	15.1			14.97	.832	6.41	-85	2.66	38.5	
1330	15.5			14.85	.828	6.42	-80	2.75	32.9	

Samples Collected: 1345 samples taken
Water Clarity (at time of collection):
Time:
Samples Collected By:
Comments:

Well Purging and Field Water Quality Measurements Form

Date: 12/18/2007

Project: Wallops CDL
Location: outside fence
Field Personnel: EW, ED
Well Number: MW-6
Total Depth (ft): ~~TOC~~ 24' @ gs 21'
Screened Interval (ft): 11-21'
Measuring Point (identify): TOC
Pump Intake (ft below MP): @ bottom
Equipment Used: Gropump, Horiba U-22, dedicated teflon-lined poly tubing

Time 24 hr	Water Level below MP (ft)	Purge Rate (mL/min)	Cumulative Volume Purged (mL or L)	Temp (°C)	Specific Conductivity (µS/cm)	pH	Oxidation Reduction Potential (mv)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Comments (odor, clarity, etc...)
0935	17.61	300	300	16.07	.190	6.44	176	5.50	186	
0940	17.61	300	600	16.08	0.194	5.98	175	5.72	81.1	
0945	17.61	300	900	16.09	0.197	5.89	175	5.61	49.1	
0950			1200		~~0.199~~	~~5.84~~				helping set up on MW-5
0955	17.62	300	1500	16.08	0.195	5.85	176	5.66	48.8	
1015	17.63	300	2100	16.40	0.195	5.83	175	5.61	16.3	time gap = helping on MW-5
1020	17.62	300	2400	16.36	0.196	5.82	175	5.67	19.2	
1025	17.62	300	2700	16.35	0.196	5.82	176	5.69	39.8	turb. spike
1030	17.62	300	3000	16.23	0.195	5.81	176	5.72	35.5	
1035	17.62	300	3300	16.32	0.194	5.82	176	5.67	38.0	SAMPLES COLLECTED
1104	17.38	—								

Samples Collected: 1035 x9 bottles
Time:
Comments:

Water Clarity (at time of collection): Crystal clear water, no odor
Samples Collected By: EW

ABN x2
PPBC x2
VOCs x3 HCL
Metals HNO3 x1
CN NaOH + Asc Acid

APPENDIX D

DATA VALIDATION REPORTS
(See Enclosed CD)

APPENDIX E

STATISTICAL ANALYSIS OF SELECTED CHEMICALS OF CONCERN

APPENDIX E

STATISTICAL ANALYSIS OF SELECTED CHEMICALS OF CONCERN
Wallops Island CDL Remedial Investigation

E.1 COMPARISON TO BACKGROUND APPROACH

The approach was to calculate a background upper tolerance limit (UTL) based upon a 95 percent population coverage at a 95 percent confidence limit and then compare this background value against the individual sample results (unit samples). The USACE has postulated that the background population, as collected by TetraTech, constitutes a homogeneous data set (as is also apparent from their treatment of the background samples) and can thus be evaluated as a data population. A 95% UTL can then be estimated based upon distribution characteristics and the variance of the data population. The USACE also expanded the background data population to include the results from SB-1 and MW-1 of the CDL RI situated adjacent to the end of the runway and upgradient to the CDL AOCs.

The background data populations were evaluated for distribution characteristics (normal and/or lognormal) to determine whether the untransformed or log-transformed data would be used to determine the mean and standard deviation. Upon calculating the mean and standard deviation, the 95% UTL was calculated using the following equation at the 0.05 level of significance:

$$95\%\ UTL \ = \ \bar{x} + K_{1-\beta,p,n} * S$$

Where K is defined as: $K = t_{n-1,1-\beta} * \sqrt{1 + 1/n}$

And:

- $\bar{x}$ = arithmetic mean of samples;
- K = confidence factor;
- t = t-value (one-tailed);
- β = confidence interval (0.05);
- p = population coverage (95%)
- n = number of samples; and
- S = standard deviation.

The USACE actually used an add-on program (XLStat 2008) to MS Excel for evaluating the population distribution characteristics using the Shapiro-Wilk and Anderson-Darling Tests and the descriptive statistics tool for determining the mean and standard deviation. For the purposes of evaluating background data, the USACE used proxy values of one-half the reporting limit value for samples reported as not detected. Upon deriving the 95% UTL, the data from individual data points (surface soil, shallow subsurface, sediment, groundwater) were compared to the 95% UTL to determine which sample results exceeded background and could conceivably a result of sources in the CDL AOCs.

APPENDIX E

STATISTICAL ANALYSIS OF SELECTED CHEMICALS OF CONCERN
Wallops Island CDL Remedial Investigation

The approach for comparison of CoCs to background followed a different approach in that there are only two locations from which background data are available. One sample is a historical value from surface water sample location WWW-MB-111 and the other is the upstream surface water sample location collected during the WFF CDL RI, which was sampled twice (May and December 2007) during the course of the RI. As such, there is an insufficient data population to evaluate distribution characteristics and calculate a 95% UTL. For the surface water comparison, then, was to pool the data from the three values and use the maximum value as the default upper threshold limit. The individual values from the remaining three surface water locations were compared to the maximum value to determine the potential for exceeding background.

E.2 RESULTS OF COMPARISON TO BACKGROUND

The worksheets included with this appendix compile all of the statistical derivations of the 95% UTLs and the comparison to background, as applicable for soil, sediment and/or groundwater results. It should be noted that for the sediment sample comparisons, there was an insufficient background data to generate a background comparison value. In that the estuarine sediments in the channels and drainages along Mosquito Creek are substantially a result of surface soil erosion, the USACE has used to background surface soil results are a surrogate for the comparing to the sediment samples. The following narrative provides a summary of the statistical comparisons to background for the selected CoCs.

E.2.1 Arsenic: (Surface Soil, Sediment, Aggregate Soil)

No surface or aggregate soil samples exceeded the background 95% Upper Threshold Limit (95% UTL) of 12/7 mg/kg for surface soils or 9.4 mg/kg for aggregate soils.

Four sediment samples exceeded the surface soil 95% UTL of 12.7 mg/kg

SD-4 – This location appears to be situated upstream of CDL AOCs and not hydraulically or depositionally connected to the AOCs.
SD-6 – This location is situated in the middle of the marsh flats and is not depositionally connected to the AOCs.
SD-8 – Same as SD-6.
SD-9 – Located at the head of a drainage that is hydraulically and depositionally connected to the Southern AOC.

E.2.2 Antimony: (Sediments)

A single sediment sample at SD-9 exceeds the BG 95% UTL and this location is hydraulically & depositionally connected to the Southern AOC.

E.2.3 Cadmium: (Sediment)

Two locations exceed BG 95% UTL for cadmium of 0.64 mg/kg.

SD-9 – Located at the head of a drainage that is hydraulically and depositionally connected to the Southern AOC.
SD-10 – Located in a drainage swale within the Southern AOC. Sample media more closely resembles surface soil sample.

E.2.4 Chromium: (Aggregate Soils)

One sample in the Central AOC exceeded the BG 95% UTL of 18.9 mg/kg

TP-6B from test pit 6

Seven samples in the Southern AOC exceeded the BG 95% UTL of 18.9 mg/kg. All excedances were associated with test pits in the AOC.

TP-3A – Surface soil from Test Pit 3
TP-3B – Subsurface soil (?? ft) from Test Pit 3
TP-3C – Deep subsurface soil (?? ft) from Test Pit 3
TP-4A – Surface soil from Test Pit 4
TP-4B – Subsurface soil (?? ft) from Test Pit 4
TP-7A – Surface soil from Test Pit 7
TP-7B – Subsurface soil (?? ft) from Test Pit 7 (max Cr of 616 mg/kg)

E.2.5 Copper: (Aggregate Soils)

No samples in the Central AOC exceeded the BG 95% UTL of 17.8 mg/kg

Eight samples in the Southern AOC exceeded the BG 95% UTL of 17.8 mg/kg. Most excedances were associated with test pits in the AOC.

SB-3A – Surface soil from Test Pit 3
TP-3A – Surface soil from Test Pit 3
TP-3B – Subsurface soil (?? ft) from Test Pit 3
TP-3C – Deep subsurface soil (?? ft) from Test Pit 3
TP-4A – Surface soil from Test Pit 4
TP-4B – Subsurface soil (?? ft) from Test Pit 4
TP-7A – Surface soil from Test Pit 7
TP-7B – Subsurface soil (?? ft) from Test Pit 7

E.2.6 DDD: (Sediments vs. BG Surface Soils)

A single sample location exceeded the BG 95% UTL of 26.5 ug/kg

SD-9 – Located at the head of a drainage that is hydraulically and depositionally connected to the Southern AOC.

E.2.7 DDE: (Sediments vs. Surface Soils)

No sample locations exceeded the BG 95% UTL of 156 ug/kg

E.2.8 DDT: (Sediments vs. Surface Soils)

No sample locations exceeded the BG 95% UTL of 11.8 ug/kg

E.2.9 Lead: (Sediments vs. BG Soils)

A single sample location exceeded the BG 95% UTL of 96.2 mg/kg

SD-9 – Located at the head of a drainage that is hydraulically and depositionally connected to the Southern AOC.

E.2.10 Mercury: (Sediments vs. BG Soils)

A single sample location exceeded the BG 95% UTL of 0.225 mg/kg

SD-9 – Located at the head of a drainage that is hydraulically and depositionally connected to the Southern AOC.

E.2.11 Silver: (Sediments vs. BG Soils)

Three sample locations exceeded the BG 95% UTL of 0.282 mg/kg

SD-6 – This location is situated in the middle of the marsh flats and is not depositionally connected to the AOCs.
SD-9 – Located at the head of a drainage that is hydraulically and depositionally connected to the Southern AOC.
SD-10 – This location is location in a grass-lined shallow drainage swale just to the west of the NOAA access road. In reality, this location is much more similar to a surface soil than a sediment sample.

E.2.12 Zinc: (Sediments vs. BG Soils)

Two sample locations exceeded the BG 95% UTL of 87.3 mg/kg

SD-2 – This location is situated at the end of a small estuarine drainage channel that is depositionally downgradient of SD-9 and is depositionally connected to the AOCs. Zinc was also identified as exceeding the BG UTL at SD-9 (see below).

SD-9 – Located at the head of a drainage that is hydraulically and depositionally connected to the Southern AOC.

E.2.13 Surface Water Comparisons: (Aluminum, Barium and Iron)

For the comparison of surface water results, it should be noted in case that in May 2007, no aluminum or iron was found to exceed their BG values and in December 2007, no barium was found to exceed the maximum BG value.

Aluminum

No aluminum sample results from May 2007 exceeded the maximum BG value of 0.360 mg/L.
SW-2 – The December 2007 result (1.1 mg/L) exceeded the maximum BG value.
SW-3 - The December 2007 result (0.43 mg/L) exceeded the maximum BG value.

Barium

SW-2 – The May 2007 result (0.028 mg/L) exceeded the maximum BG value.
No barium sample results from December 2007 exceeded the maximum BG value of 0.022 mg/L.

Iron

No iron sample results from May 2007 exceeded the maximum BG value of 0.580 mg/L.
SW-2 – The December 2007 result (1.0 mg/L) exceeded the maximum BG value.

	Arsenic BG Surface Soils			
	Sample No.	Result	Qualifier	Ln Transform Ar BG Surface Soils
1	SB-1A	4.8		1.568616
2	SS-BG-101	3.8		1.335001
3	SS-BG-102	3.9		1.360977
4	SS-BG-111	4		1.386294
5	SS-BG-103	0.78		-0.24846
6	SS-BG-104	2.6		0.955511
7	SS-BG-105	4.3		1.458615
8	SS-BG-106	2.3		0.832909
9	SS-BG-107	1.4		0.336472
10	SS-BG-108	14.2		2.653242
11	SS-BG-109	3.3		1.193922
12	SS-BG-110	5.4		1.686399

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/14/2009 at 2:48:47 PM

Data: Workbook = SoilData.xls / Sheet = Arsenic Surface Soils / Range = 'Arsenic Surface Soils'!$C$2:$C$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Result	12	0	12	0.780	14.200	4.232	3.419

Shapiro-Wilk test (Result):

W	0.717
p-value	0.001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.12%.

Anderson-Darling test (Result):

A^2	1.270
p-value	0.002
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.15%.

Ln Transformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/14/2009 at 2:52:53 PM

Data: Workbook = SoilData.xls / Sheet = Arsenic Surface Soils / Range = 'Arsenic Surface Soils'!$F$2:$F$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	with missing	without missing	Minimum	Maximum	Mean	Std. deviation
Ln Transform Ar BG Surface Soils	12	0	12	-0.248	2.653	1.210	0.718

Shapiro-Wilk test (Ln Transform Ar BG Surface Soils):

W	0.940
p-value	0.503
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 50.26%.

Anderson-Darling test (Ln Transform Ar BG Surface Soils):

A^2	0.452
p-value	0.224
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 22.36%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/14/2009 at 2:54:29 PM

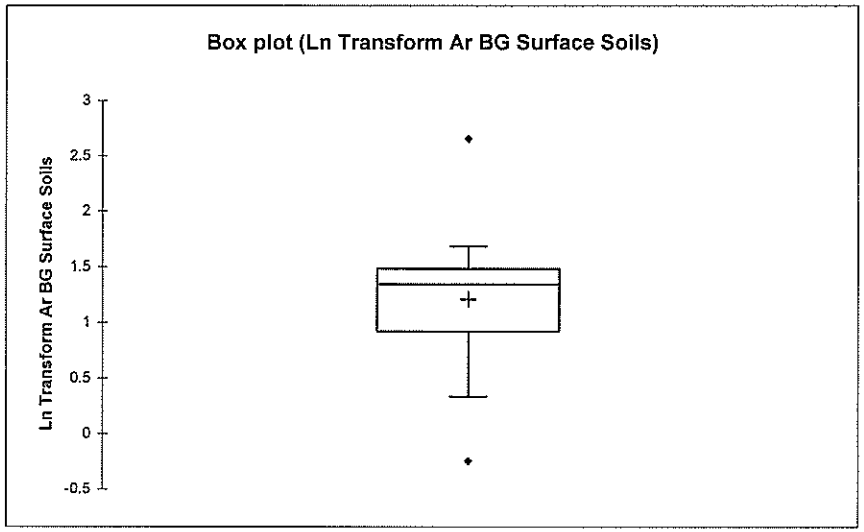
Quantitative data: Workbook = SoilData.xls / Sheet = Arsenic Surface Soils / Range = 'Arsenic Surface Soils'!$F$2:$F$14 / 12 rows and 1 column

Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Ln Transform Ar BG Surface Soils
No. of observations	12
No. of missing values	0
Sum of weights	12
Minimum	-0.248
Maximum	2.653
Freq. of minimum	1
Freq. of maximum	1
Range	2.902
1st Quartile	0.925
Median	1.348
3rd Quartile	1.486
Sum	14.519
Mean	1.210
Variance (n)	0.472
Variance (n-1)	0.515
Standard deviation (n)	0.687
Standard deviation (n-1)	0.718
Variation coefficient	0.568
Skewness (Pearson)	-0.167
Skewness (Fisher)	-0.192
Skewness (Bowley)	-0.508
Kurtosis (Pearson)	0.566
Kurtosis (Fisher)	1.632
Standard error of the mean	0.207
Lower bound on mean (95%)	0.754
Upper bound on mean (95%)	1.666
Standard error(Skewness (Fisher))	0.637
Standard error(Kurtosis (Fisher))	1.232
Mean absolute deviation	0.497
Median absolute deviation	0.280
Geometric mean	
Geometric standard deviation	
Harmonic mean	1.838

t=	1.782
K=	1.855
95% UTL=	12.7 mg/kg
95% UCL =	4.78 mg/kg
Mean =	3.35 mg/kg



Central AOC Surface Soil

Sample No.	Result	Qualifier	Exceed UTL
SB-4A	3		N
SB-4AD	2.7		N
SB-5A	3		N
TP-1A	3.5		N
TP-6A	4.7		N

Southern AOC Surface Soil

Sample No.	Result	Qualifier	Exceed UTL
SB-3A	3		N
TP-2A	7.6		N
TP-3A	7.2		N
TP-4A	4.3		N
TP-7A	6.1		N
TP-8A	2.7		N

Northern AOC Surface Soil

Sample No.	Result	Qualifier	Exceed UTL
SB-1A	4.8		N
SB-6A	1.2		N
TP-5A	2.5		N

Western AOC Surface Soil

Sample No.	Result	Qualifier	Exceed UTL
SB-1A	4.8		N
SB-2A	4.4		N
TP-8A	2.7		N

Sediment Samples

Sample No.	Result	Qualifier	Exceed UTL
SD-2	8.5		N
SD-3	8.1		N
SD-4	17		Y
SD-5	4.5		N
SD-6	13		Y
SD-7	4		N
SD-8	19		Y
SD-9	13		Y
SD-10	3		N

Arsenic BG Aggregate Soils

	Sample No.	Result	Qualifier	Ln Transform Ar BG Surface Soils
1	SB-1A	4.8		1.568615918
2	SS-BG-101	3.8		1.335001067
3	SS-BG-102	3.9		1.360976553
4	SS-BG-111	4		1.386294361
5	SS-BG-103	0.78		-0.24846136
6	SS-BG-104	2.6		0.955511445
7	SS-BG-105	4.3		1.458615023
8	SS-BG-106	2.3		0.832909123
9	SS-BG-107	1.4		0.336472237
10	SS-BG-108	14.2		2.653241965
11	SS-BG-109	3.3		1.193922468
12	SS-BG-110	5.4		1.686398954
13	SB-1B	5.5		1.704748092
14	SB-BG-101-03(	5.3		1.667706821
15	SB-BG-102-03(	4.4		1.481604541
16	SB-BG-103-03(	1.9		0.641853886
17	SB-BG-104-03(	4.5		1.504077397
18	SB-BG-105-03(	3.7		1.30833282
19	SB-BG-106-03(	3.5		1.252762968
20	SB-BG-112-03(	3.5		1.252762968
21	SB-BG-107-03(	4.7		1.547562509
22	SB-BG-108-03(	3.3		1.193922468
23	SB-BG-109-03(	1.7		0.530628251

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/14/2009 at 3:10:00 PM

Data: Workbook = SoilData.xls / Sheet = Arsenic Aggregate Soils / Range = 'Arsenic Aggregate Soils'!$C$2:$C$25 / 23 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Result	23	0	23	0.780	14.200	4.034	2.566

Shapiro-Wilk test (Result):

W	0.709
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Anderson-Darling test (Result):

A^2	1.764
p-value	0.000
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Ln Transformed Data
XLSTAT 2008.1.02 - Normality tests - on 4/14/2009 at 3:15:50 PM
Data: Workbook = SoilData.xls / Sheet = Arsenic Aggregate Soils / Range = 'Arsenic Aggregate Soils'!$F$2:$F$25 / 23 rows and 1 column
Significance level (%): 5
Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Ln Transform Ar BG Surface Soils	23	0	23	-0.248	2.653	1.244	0.571

Shapiro-Wilk test (Ln Transform Ar BG Surface Soils):

W	0.918
p-value	0.062
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 6.17%.

Anderson-Darling test (Ln Transform Ar BG Surface Soils):

A^2	0.863
p-value	0.022
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 2.24%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/14/2009 at 3:17:41 PM

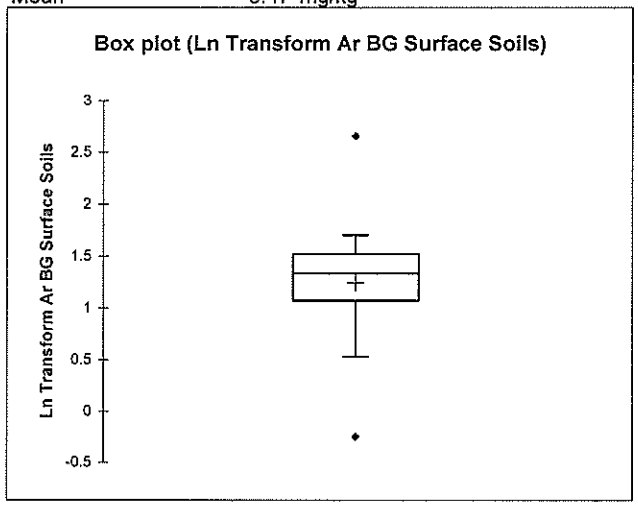
Quantitative data: Workbook = SoilData.xls / Sheet = Arsenic Aggregate Soils / Range = 'Arsenic Aggregate Soils'!$F$2:$F$25 / 23 rows and 1 column

Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	form Ar BG Surface Soils
No. of observations	23
No. of missing values	0
Sum of weights	23
Minimum	-0.248
Maximum	2.653
Freq. of minimum	1
Freq. of maximum	1
Range	2.902
1st Quartile	1.075
Median	1.335
3rd Quartile	1.526
Sum	28.605
Mean	1.244
Variance (n)	0.312
Variance (n-1)	0.326
Standard deviation (n)	0.558
Standard deviation (n-1)	0.571
Variation coefficient	0.449
Skewness (Pearson)	-0.393
Skewness (Fisher)	-0.421
Skewness (Bowley)	-0.154
Kurtosis (Pearson)	1.546
Kurtosis (Fisher)	2.258
Standard error of the mean	0.119
Lower bound on mean (95%)	0.997
Upper bound on mean (95%)	1.491
Standard error(Skewness (Fisher))	0.481
Standard error(Kurtosis (Fisher))	0.935
Mean absolute deviation	0.392
Median absolute deviation	0.213
Geometric mean	
Geometric standard deviation	
Harmonic mean	1.407

t=	1.714
K=	1.751
95% UTL=	9.4 mg/kg
95% UCL =	4.23 mg/kg
Mean =	3.47 mg/kg



Central AOC Aggregate Soil

Sample No.	Result	Qualifier	Exceed UTL
SB-4A	3		N
SB-4AD	2.7		N
SB-5A	3		N
TP-1A	3.5		N
TP-6A	4.7		N
SB-4B	1.7		N
SB-4C	0.39	U	N
SB-5B	1.7		N
TP-1B	1.8		N
TP-1C	0.96		N
TP-6B	4.8		N

Northern AOC Aggregate Soil

Sample No.	Result	Qualifier	Exceed UTL
SB-1A	4.8		N
SB-6A	1.2		N
TP-5A	2.5		N
SB-1B	5.5		N
SB-6B	2.3		N
TP-5B	1.1		N

Southern AOC AggregateSoil

Sample No.	Result	Qualifier	Exceed UTL
SB-3A	3		N
TP-2A	7.6		N
TP-3A	7.2		N
TP-4A	4.3		N
TP-7A	6.1		N
TP-8A	2.7		N
SB-3B	5		N
TP-2B	3.9		N
TP-3B	3		N
TP-3C	3.9		N
TP-3C-D	8.4		N
TP-4B	4.4		N
TP-7B	7.5		N
TP-8B	2.2		N

Western AOC AggregateSoil

Sample No.	Result	Qualifier	Exceed UTL
SB-1A	4.8		N
SB-2A	4.4		N
TP-8A	2.7		N
SB-1B	5.5		N
SB-2B	1.7		N
TP-8B	2.2		N

Antimony Surface Soils					Sediment Samples			
	Sample No.	Result	Qualifier	Data	Ln Transform Sb BG Surface Soils	Sample No.	Result	Qualifier	Exceed UTL
1	SB-1A	0.83	U	0.415	-0.8794768	SD-2	1	U	N
2	SS-BG-101	0.31		0.31	-1.1711830	SD-3	0.99	U	N
3	SS-BG-102	0.21		0.21	-1.5606477	SD-4	0.91	U	N
4	SS-BG-111	0.71		0.71	-0.3424903	SD-5	0.77	U	N
5	SS-BG-103	0.13		0.13	-2.0402208	SD-6	0.91	U	N
6	SS-BG-104	0.16		0.16	-1.8325815	SD-7	0.65	U	N
7	SS-BG-105	0.19		0.19	-1.6607312	SD-8	1.2	U	N
8	SS-BG-106	0.16		0.16	-1.8325815	SD-9	2.8		Y
9	SS-BG-107	0.18		0.18	-1.7147984	SD-10	0.88	U	N
10	SS-BG-108	0.28		0.28	-1.2729657				
11	SS-BG-109	0.29		0.29	-1.2378744				
12	SS-BG-110	0.9		0.9	-0.1053605				

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/14/2009 at 3:56:03 PM

Data: Workbook = SoilData.xls / Sheet = Antimony Surface Soils / Range = 'Antimony Surface Soils'!$E$2:$E$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	12	0	12	0.130	0.900	0.328	0.240

Shapiro-Wilk test (Data):

W	0.763
p-value	0.004
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.37%.

Anderson-Darling test (Data):

A^2	1.195
p-value	0.002
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.24%.

LN Transformed Data
XLSTAT 2008.1.02 - Normality tests - on 4/14/2009 at 3:56:58 PM
Data: Workbook = SoilData.xls / Sheet = Antimony Surface Soils / Range = 'Antimony Surface Soils'!$F$2:$F$14 / 12 rows and 1 column
Significance level (%): 5
Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Ln Transform Sb BG Surface So	12	0	12	-2.040	-0.105	-1.304	0.605

Shapiro-Wilk test (Ln Transform Sb BG Surface Soils):

W	0.908
p-value	0.203
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 20.26%.

Anderson-Darling test (Ln Transform Sb BG Surface Soils):

A^2	0.459
p-value	0.215
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 21.52%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/14/2009 at 3:57:28 PM

Quantitative data: Workbook = SoilData.xls / Sheet = Antimony Surface Soils / Range = 'Antimony Surface Soils'!$F$2:$F$14 / 12 rows and 1 column

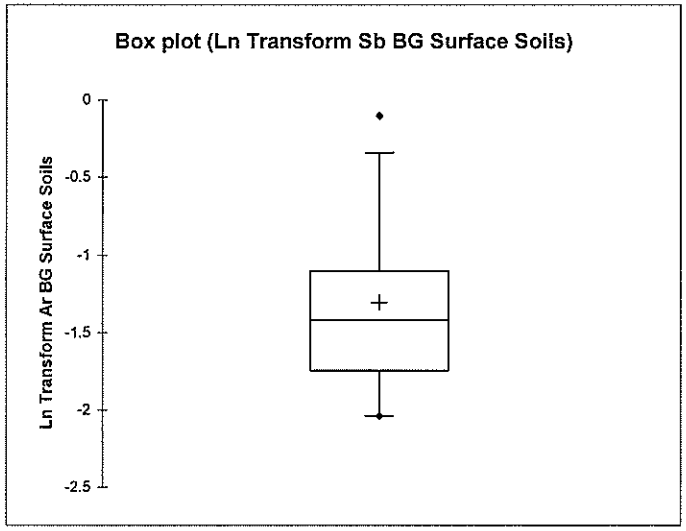
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Ln Transform Sb BG Surface Soils
No. of observations	12
No. of missing values	0
Sum of weights	12
Minimum	-2.040
Maximum	-0.105
Freq. of minimum	1
Freq. of maximum	1
Range	1.935
1st Quartile	-1.744
Median	-1.417
3rd Quartile	-1.098
Sum	-15.651
Mean	-1.304
Variance (n)	0.336
Variance (n-1)	0.366
Standard deviation (n)	0.579
Standard deviation (n-1)	0.605
Variation coefficient	-0.444
Skewness (Pearson)	0.800
Skewness (Fisher)	0.920
Skewness (Bowley)	-0.014
Kurtosis (Pearson)	-0.445
Kurtosis (Fisher)	0.026
Standard error of the mean	0.175
Lower bound on mean (95%)	-1.689
Upper bound on mean (95%)	-0.920
Standard error(Skewness (Fishe	0.637
Standard error(Kurtosis (Fisher))	1.232
Mean absolute deviation	0.469
Median absolute deviation	0.357
Geometric mean	
Geometric standard deviation	
Harmonic mean	-0.618

t=	1.782	
K=	1.855	
95% UTL=	0.83	mg/kg
95% UCL =	0.37	mg/kg
Mean =	0.27	mg/kg

Box plots:



Cadmium BG Surface Soils							
Sample No.	Result	Qualifier	Data	Ln Transform Cd BG Surface Soils	Sediment Samples		
SB-1A	0.16	U	0.08	-2.525728644	Sample No.	Result	Qualifier
SS-BG-101	0.11		0.11	-2.207274913	SD-2	0.37	
SS-BG-102	0.12	U	0.06	-2.813410717	SD-3	0.21	
SS-BG-111	0.1	U	0.05	-2.995732274	SD-4	0.18	U
SS-BG-103	0.089	U	0.0445	-3.11226609	SD-5	0.27	
SS-BG-104	0.13		0.13	-2.040220829	SD-6	0.13	U
SS-BG-105	0.21		0.21	-1.560647748	SD-7	0.23	U
SS-BG-106	0.14		0.14	-1.966112856	SD-8	0.24	U
SS-BG-107	0.12	U	0.06	-2.813410717	SD-9	1.5	
SS-BG-108	0.84		0.84	-0.174353387	SD-10	1.2	
SS-BG-109	0.11	U	0.055	-2.900422094			
SS-BG-110	0.45		0.45	-0.798507696			

Exceed
UTL
N
N
N
N
N
N
N
N
Y
Y

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/14/2009 at 5:20:35 PM

Data: Workbook = SoilData.xls / Sheet = Cadmium Surface Soils / Range = 'Cadmium Surface Soils'!$E$2:$E$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	12	0	12	0.045	0.840	0.186	0.235

Shapiro-Wilk test (Data):

W	0.643
p-value	0.000
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.02%.

Anderson-Darling test (Data):

A^2	1.790
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

LN Transformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/14/2009 at 5:20:57 PM

Data: Workbook = SoilData.xls / Sheet = Cadmium Surface Soils / Range = 'Cadmium Surface Soils'!$F$2:$F$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Ln Transform Cd BG Surface Soils	12	0	12	-3.112	-0.174	-2.159	0.922

Shapiro-Wilk test (Ln Transform Cd BG Surface Soils):

W	0.880
p-value	0.088
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 8.83%.

Anderson-Darling test (Ln Transform Cd BG Surface Soils):

A^2	0.563
p-value	0.115
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 11.50%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/14/2009 at 5:21:33 PM

Quantitative data: Workbook = SoilData.xls / Sheet = Cadmium Surface Soils / Range = 'Cadmium Surface Soils'!$F$2:$F$14 / 12 rows and 1 column

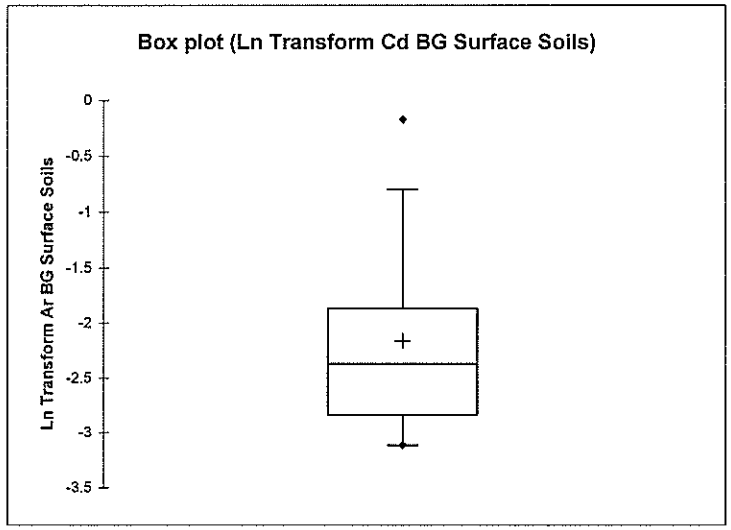
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Ln Transform Cd BG Surface Soils
No. of observations	12
No. of missing values	0
Sum of weights	12
Minimum	-3.112
Maximum	-0.174
Freq. of minimum	1
Freq. of maximum	1
Range	2.938
1st Quartile	-2.835
Median	-2.367
3rd Quartile	-1.865
Sum	-25.908
Mean	-2.159
Variance (n)	0.779
Variance (n-1)	0.850
Standard deviation (n)	0.883
Standard deviation (n-1)	0.922
Variation coefficient	-0.409
Skewness (Pearson)	0.980
Skewness (Fisher)	1.126
Skewness (Bowley)	0.034
Kurtosis (Pearson)	-0.108
Kurtosis (Fisher)	0.562
Standard error of the mean	0.266
Lower bound on mean (95%)	-2.745
Upper bound on mean (95%)	-1.573
Standard error(Skewness (Fisher))	0.637
Standard error(Kurtosis (Fisher))	1.232
Mean absolute deviation	0.709
Median absolute deviation	0.490
Geometric mean	
Geometric standard deviation	
Harmonic mean	-1.073

t=	1.782
K=	1.85476441
95% UTL=	0.64 mg/kg
95% UCL =	0.18 mg/kg
Mean =	0.12 mg/kg

Box plots:



Chromium Aggregate Soils

Sample No.	Result	Qualifier	Data	Ln Transform Cr BG Surface Soils
SB-1A	11		11	2.397895
SS-BG-101	11.8		11.8	2.468100
SS-BG-102	10.8		10.8	2.379546
SS-BG-111	10.6		10.6	2.360854
SS-BG-103	1.9		1.9	0.641854
SS-BG-104	7.3		7.3	1.987874
SS-BG-105	10.6		10.6	2.360854
SS-BG-106	6.9		6.9	1.931521
SS-BG-107	4.3		4.3	1.458615
SS-BG-108	10.2		10.2	2.322388
SS-BG-109	13.6		13.6	2.610070
SS-BG-110	18.4		18.4	2.912351
SB-1B	10		10	2.302585
SB-BG-101-0305	21		21	3.044522
SB-BG-102-0305	15		15	2.708050
SB-BG-103-0305	5.9		5.9	1.774952
SB-BG-104-0305	14.1		14.1	2.646175
SB-BG-105-0305	15.1		15.1	2.714695
SB-BG-106-0305	10.6		10.6	2.360854
SB-BG-112-0305	12.4		12.4	2.517696
SB-BG-107-0305	16.3		16.3	2.791165
SB-BG-108-0305	10.1		10.1	2.312535
SB-BG-109-0305	11.5		11.5	2.442347

Central AOC Aggregate Soil			Exceed
Sample No.	Result	Qualifier	UTL
SB-4A	10		N
SB-5A	7.6		N
TP-1A	7.9		N
TP-6A	10		N
SB-4B	8.4		N
SB-4C	3		N
SB-5B	5.3		N
TP-1B	7		N
TP-1C	5.4		N
TP-6B	20.7		Y

Southern AOC Aggregate Soil			Exceed
Sample No.	Result	Qualifier	UTL
SB-3A	10		N
TP-2A	14		N
TP-3A	50		Y
TP-4A	24		Y
TP-7A	78		Y
TP-8A	11		N
SB-3B	11		N
TP-2B	8		N
TP-3B	20		Y
TP-3C	42		Y
TP-4B	19		Y
TP-7B	616		Y
TP-8B	11		N

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 11:05:50 AM

Data: Workbook = SoilData.xls / Sheet = Chromium Aggregate Soils / Range = 'Chromium Aggregate Soils'!$E$2:$E$25 / 23 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	23	0	23	1.900	21.000	11.278	4.371

Shapiro-Wilk test (Data):

W	0.976
p-value	0.822
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 82.20%.

Anderson-Darling test (Data):

A^2	0.363
p-value	0.411
alpha	0.05

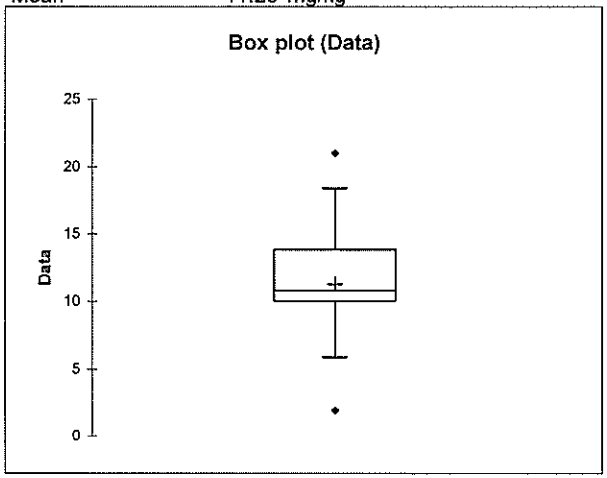
Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 41.11%.

Descriptive Statistics Data
XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 11:06:18 AM
Quantitative data: Workbook = SoilData.xls / Sheet = Chromium Aggregate Soils / Range = 'Chromium Aggregate Soils'!$E$2:$E$25 / 23 rows and 1 column
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Data
No. of observations	23
Sum of weights	23
Minimum	1.900
Maximum	21.000
Freq. of minimum	1
Freq. of maximum	1
Range	19.100
1st Quartile	10.050
Median	10.800
3rd Quartile	13.850
Sum	259.400
Mean	11.278
Variance (n)	18.273
Variance (n-1)	19.104
Standard deviation (n)	4.275
Standard deviation (n-1)	4.371
Variation coefficient	0.379
Skewness (Pearson)	0.043
Skewness (Fisher)	0.046
Skewness (Bowley)	0.605
Kurtosis (Pearson)	0.152
Kurtosis (Fisher)	0.506
Standard error of the mean	0.911
Lower bound on mean (95%)	9.388
Upper bound on mean (95%)	13.168
Standard error(Skewness (Fisher))	0.481
Standard error(Kurtosis (Fisher))	0.935
Mean absolute deviation	3.167
Median absolute deviation	2.800
Geometric mean	10.214
Geometric standard deviation	1.671
Harmonic mean	8.624

t=	1.714
K=	1.750864432
95% UTL=	18.93 mg/kg
95% UCL =	12.81 mg/kg
Mean =	11.28 mg/kg



Copper Aggregate Soil Background				
Sample No.	Result	Qualifier	Data	Ln Transform Cr BG Surface Soils
SB-1A	5.3		5.3	1.667706821
SS-BG-101	4.9		4.9	1.589235205
SS-BG-102	4.8		4.8	1.568615918
SS-BG-111	5.5		5.5	1.704748092
SS-BG-103	2.1		2.1	0.741937345
SS-BG-104	3.8		3.8	1.335001067
SS-BG-105	5.1		5.1	1.62924054
SS-BG-106	5.4		5.4	1.686398954
SS-BG-107	2.9		2.9	1.064710737
SS-BG-108	33		33	3.496507561
SS-BG-109	3.8		3.8	1.335001067
SS-BG-110	17.8		17.8	2.879198457
SB-1B	4		4	1.386294361
SB-BG-101-0305	9.6		9.6	2.261763098
SB-BG-102-0305	10.9		10.9	2.388762789
SB-BG-103-0305	3.6		3.6	1.280933845
SB-BG-104-0305	9.3		9.3	2.2300144
SB-BG-105-0305	7.2		7.2	1.974081026
SB-BG-106-0305	8.8		8.8	2.174751721
SB-BG-112-0305	6.6		6.6	1.887069649
SB-BG-107-0305	8.3		8.3	2.116255515
SB-BG-108-0305	7.2		7.2	1.974081026
SB-BG-109-0305	2.9		2.9	1.064710737

Central AOC Aggregate Soil			Exceed
Sample No.	Result	Qualifier	UTL
SB-4A	11		N
SB-4AD	6.8		N
SB-5A	8		N
TP-1A	7.4		N
TP-6A	7.2		N
SB-4B	4		N
SB-4C	1.2		N
SB-5B	3		N
TP-1B	4.3		N
TP-1C	3.5		N
TP-6B	8.6		N

Southern AOC Aggregate Soil			
Sample No.	Result	Qualifier	
SB-3A	26		Y
TP-2A	8.3		N
TP-3A	854		Y
TP-4A	193		Y
TP-7A	1790		Y
TP-8A	7.7		N
SB-3B	8.7		N
TP-2B	5.3		N
TP-3B	416		Y
TP-3C	1610		Y
TP-3C-D	3060		Y
TP-4B	119		Y
TP-7B	5100		Y
TP-8B	6.3		N

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 4:16:17 PM

Data: Workbook = SoilData.xls / Sheet = Copper Agg BG vs Agg Soil / Range = 'Copper Agg BG vs Agg Soil'!$E$3:$E$26 / 23 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	23	0	23	2.100	33.000	7.513	6.531

Shapiro-Wilk test (Data):

W	0.652
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Anderson-Darling test (Data):

A^2	2.489
p-value	< 0.0001
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

LN Transformed Data
XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 4:16:39 PM
Data: Workbook = SoilData.xls / Sheet = Copper Agg BG vs Agg Soil / Range = 'Copper Agg BG vs Agg Soil'!$G$3:$G$26 / 23 rows and 1 column
Significance level (%): 5
Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Ln Transform Cu BG Surface Soils	23	0	23	0.742	3.497	1.802	0.616

Shapiro-Wilk test (Ln Transform Cr BG Surface Soils):

W	0.952
p-value	0.321
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 32.14%.

Anderson-Darling test (Ln Transform Cr BG Surface Soils):

A^2	0.361
p-value	0.416
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 41.56%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 4:17:19 PM

Quantitative data: Workbook = SoilData.xls / Sheet = Copper Agg BG vs Agg Soil / Range = 'Copper Agg BG vs Agg Soil'!$G$3:$G$26 / 23 rows and 1 column

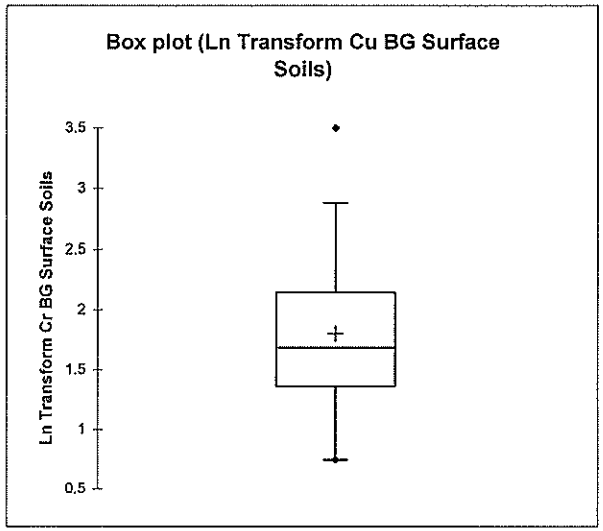
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Ln Transform Cu BG Surface Soils
No. of observations	23
No. of missing values	0
Sum of weights	23
Minimum	0.742
Maximum	3.497
Freq. of minimum	1
Freq. of maximum	1
Range	2.755
1st Quartile	1.361
Median	1.686
3rd Quartile	2.146
Sum	41.437
Mean	1.802
Variance (n)	0.362
Variance (n-1)	0.379
Standard deviation (n)	0.602
Standard deviation (n-1)	0.616
Variation coefficient	0.334
Skewness (Pearson)	0.828
Skewness (Fisher)	0.887
Skewness (Bowley)	0.170
Kurtosis (Pearson)	0.933
Kurtosis (Fisher)	1.487
Standard error of the mean	0.128
Lower bound on mean (95%)	1.535
Upper bound on mean (95%)	2.068
Standard error(Skewness (Fisher))	0.481
Standard error(Kurtosis (Fisher))	0.935
Mean absolute deviation	0.467
Median absolute deviation	0.351
Geometric mean	1.705
Geometric standard deviation	1.411
Harmonic mean	1.608

t=	1.714	
K=	1.7508644	
95% UTL=	17.80	mg/kg
95% UCL =	7.51	mg/kg
Mean =	6.06	mg/kg

Box plots:



	DDD Surface Soils Sample No.	Result	Qualifier	Data	Ln Transform DDD BG Surface Soils
	SB-1A	0.39	U	0.195	-1.63475572
	SS-BG-101	4.1	U	2.05	0.717839793
	SS-BG-102	4.2	U	2.1	0.741937345
	SS-BG-111	4.1	U	2.05	0.717839793
	SS-BG-103	3.5	U	1.75	0.559615788
	SS-BG-104	4.1	U	2.05	0.717839793
	SS-BG-105	4.2	U	2.1	0.741937345
	SS-BG-106	4.1	U	2.05	0.717839793
	SS-BG-107	79	U	39.5	3.676300672
	SS-BG-108	4.1	U	2.05	0.717839793
	SS-BG-109	3.9	U	1.95	0.667829373
Exceeds 4 X 75th Quantile	SS-BG-110	2100	U		

Sediment Samples Sample No.	Result	Qualifier	Exceed UTL
SD-2	11	U	N
SD-3	11	U	N
SD-4	19	U	N
SD-5	29	U	N
SD-6	11	U	N
SD-7	25	U	N
SD-8	19	U	N
SD-9	65		Y
SD-10	1.6	U	N

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 2:40:51 PM

Data: Workbook = SoilData.xls / Sheet = DDD Surface Soils / Range = 'DDD Surface Soils'!$E$2:$E$14 / 12 rows and 1 column

Number of removed observations: 1

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	11	0	11	0.195	39.500	5.259	11.370

Shapiro-Wilk test (Data):

W	0.380
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Anderson-Darling test (Data):

A^2	3.362
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

LN Transformed Data
XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 2:46:56 PM
Data: Workbook = SoilData.xls / Sheet = DDD SS BG vs Sed / Range = 'DDD SS BG vs Sed'!$G$2:$G$14 / 12 rows and 1 column
Number of removed observations: 1
Significance level (%): 5
Summary statistics

Summary statistics:

Variable	Observations	with missing	without missing	Minimum	Maximum	Mean	Std. deviation
Ln Transform DDD BG Surface Soi	11	0	11	-1.635	3.676	0.758	1.196

Shapiro-Wilk test (Ln Transform Cr BG Surface Soils):

W	0.651
p-value	0.000
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Anderson-Darling test (Ln Transform Cr BG Surface Soils):

A^2	2.119
p-value	< 0.0001
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Descriptive Statistics Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 2:47:34 PM

Quantitative data: Workbook = SoilData.xls / Sheet = DDD SS BG vs Sed / Range = 'DDD SS BG vs Sed'!$E$2:$E$14 / 12 rows and 1 column

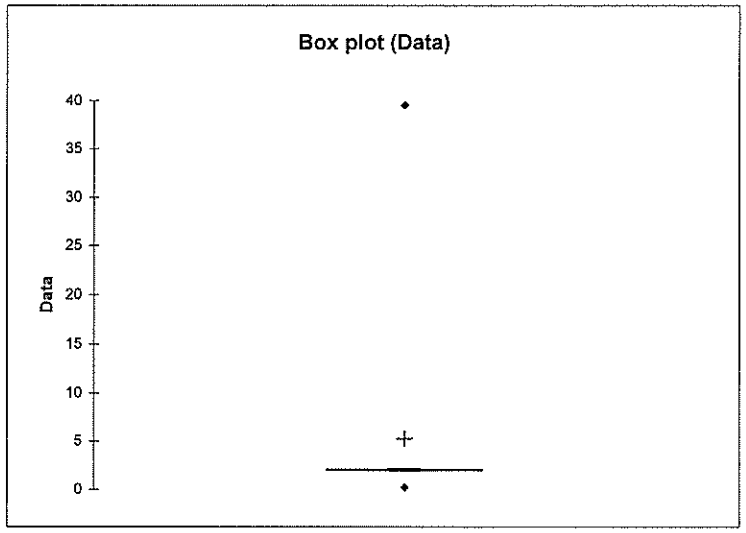
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Data
No. of observations	12
No. of missing values	1
Sum of weights	11
Minimum	0.195
Maximum	39.500
Freq. of minimum	1
Freq. of maximum	1
Range	39.305
1st Quartile	2.000
Median	2.050
3rd Quartile	2.075
Sum	57.845
Mean	5.259
Variance (n)	117.527
Variance (n-1)	129.280
Standard deviation (n)	10.841
Standard deviation (n-1)	11.370
Variation coefficient	2.062
Skewness (Pearson)	2.833
Skewness (Fisher)	3.302
Skewness (Bowley)	-0.333
Kurtosis (Pearson)	6.059
Kurtosis (Fisher)	10.931
Standard error of the mean	3.428
Lower bound on mean (95%)	-2.380
Upper bound on mean (95%)	12.897
Standard error(Skewness (Fisher))	0.661
Standard error(Kurtosis (Fisher))	1.279
Mean absolute deviation	6.226
Median absolute deviation	0.050
Geometric mean	2.135
Geometric standard deviation	3.306
Harmonic mean	1.142

t=	1.796	
K=	1.869	
95% UTL=	26.51	mg/kg
95% UCL =	10.88	mg/kg
Mean =	5.26	mg/kg

Box plots:



	DDE Surface Soils Sample No.	Result	Qualifier	Data	Ln Transform DDE BG Surface Soils
	SB-1A	0.4	U	0.2	-1.60943791
	SS-BG-101	4.1	U	2.05	0.71783979
	SS-BG-102	4.2	U	2.1	0.74193734
	SS-BG-111	6.2		6.2	1.82454929
	SS-BG-103	3.5	U	1.75	0.55961579
	SS-BG-104	4.1	U	2.05	0.71783979
	SS-BG-105	5.7		5.7	1.74046617
	SS-BG-106	6.3		6.3	1.84054963
	SS-BG-107	330		330	5.79909265
	SS-BG-108	4.1		4.1	1.41098697
	SS-BG-109	31		31	3.43398720
Exceeds 4 X 75th Quantile	SS-BG-110	5000			

Sediment Samples Sample No.	Result	Qualifier	Exceed UTL
SD-2	11	U	N
SD-3	11	U	N
SD-4	19	U	N
SD-5	29	U	N
SD-6	11	U	N
SD-7	25	U	N
SD-8	19	U	N
SD-9	149		N
SD-10	26.8		N

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 2:58:09 PM

Data: Workbook = SoilData.xls / Sheet = DDE SS vs Sed / Range = 'DDE SS vs Sed'!$E$2:$E$14 / 12 rows and 1 column

Number of removed observations: 1

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	11	0	11	0.200	330.000	35.586	98.017

Shapiro-Wilk test (Data):

W	0.401
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Anderson-Darling test (Data):

A^2	3.139
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

LN Transformed Data
XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 2:58:29 PM
Data: Workbook = SoilData.xls / Sheet = DDE SS vs Sed / Range = 'DDE SS vs Sed'!$G$2:$G$14 / 12 rows and 1 column
Number of removed observations: 1
Significance level (%): 5
Summary statistics

Summary statistics:

Variable	Observations	with missing	without missing	Minimum	Maximum	Mean	Std. deviation
Ln Transform DDE BG Surface Soi	11	0	11	-1.609	5.799	1.562	1.866

Shapiro-Wilk test (Ln Transform Cr BG Surface Soils):

W	0.895
p-value	0.163
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 16.26%.

Anderson-Darling test (Ln Transform Cr BG Surface Soils):

A^2	0.628
p-value	0.075
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 7.49%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 2:59:14 PM

Quantitative data: Workbook = SoilData.xls / Sheet = DDE SS vs Sed / Range = 'DDE SS vs Sed'!$G$2:$G$14 / 12 rows and 1 column

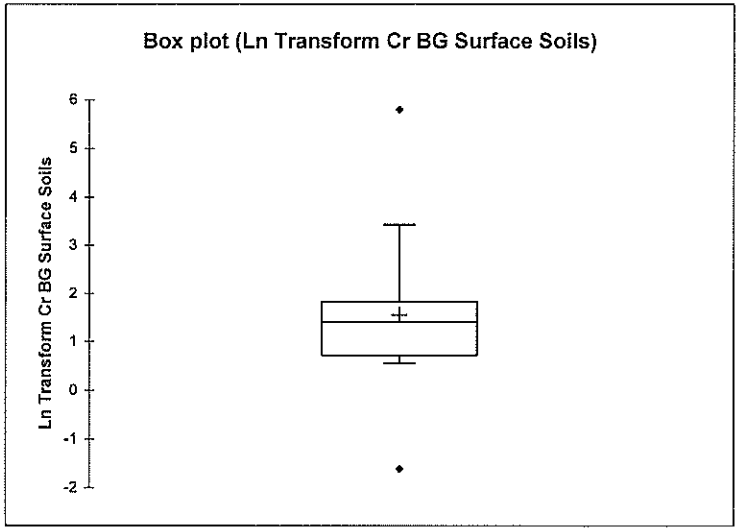
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Ln Transform DDE BG Surface Soils
No. of observations	12
No. of missing values	1
Sum of weights	11
Minimum	-1.609
Maximum	5.799
Freq. of minimum	1
Freq. of maximum	1
Range	7.409
1st Quartile	0.718
Median	1.411
3rd Quartile	1.833
Sum	17.177
Mean	1.562
Variance (n)	3.165
Variance (n-1)	3.482
Standard deviation (n)	1.779
Standard deviation (n-1)	1.866
Variation coefficient	1.139
Skewness (Pearson)	0.776
Skewness (Fisher)	0.904
Skewness (Bowley)	-0.244
Kurtosis (Pearson)	0.977
Kurtosis (Fisher)	2.462
Standard error of the mean	0.563
Lower bound on mean (95%)	0.308
Upper bound on mean (95%)	2.815
Standard error(Skewness (Fisher))	0.661
Standard error(Kurtosis (Fisher))	1.279
Mean absolute deviation	1.242
Median absolute deviation	0.693
Geometric mean	
Geometric standard deviation	
Harmonic mean	1.352

t=	1.796	
K=	1.869	
95% UTL=	155.98	mg/kg
95% UCL =	11.99	mg/kg
Mean =	4.77	mg/kg

Box plots:



	DDT Surface Soils Sample No.	Result	Qualifier	Data	Ln Transform DDT BG Surface Soils
	SB-1A	0.49		0.49	-0.71334989
	SS-BG-101	4.1	U	2.05	0.71783979
	SS-BG-102	4.2	U	2.1	0.74193734
	SS-BG-111	5		5	1.60943791
	SS-BG-103	4.2		4.2	1.43508453
	SS-BG-104	4.1	U	2.05	0.71783979
	SS-BG-105	4.2	U	2.1	0.74193734
	SS-BG-106	4.1	U	2.05	0.71783979
Exceeds 4 X 75th Quantile	SS-BG-107	540			
	SS-BG-108	4.1	U	2.05	0.71783979
	SS-BG-109	12		12	2.48490665
Exceeds 4 X 75th Quantile	SS-BG-110	15000			

Sediment Samples Sample No.	Result	Qualifier	Exceed UTL
SD-2	11	U	N
SD-3	11	U	N
SD-4	19	U	N
SD-5	29	U	N
SD-6	11	U	N
SD-7	25	U	N
SD-8	19	U	N
SD-9	13	U	N
SD-10	10.8		N

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 3:07:57 PM

Data: Workbook = SoilData.xls / Sheet = DDT SS vs Sed / Range = 'DDT SS vs Sed'!$E$2:$E$14 / 12 rows and 1 column

Number of removed observations: 2

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	10	0	10	0.490	12.000	3.409	3.271

Shapiro-Wilk test (Data):

W	0.672
p-value	0.000
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.04%.

Anderson-Darling test (Data):

A^2	1.477
p-value	0.000
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.04%.

LN Transformed Data
XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 3:08:30 PM
Data: Workbook = SoilData.xls / Sheet = DDT SS vs Sed / Range = 'DDT SS vs Sed'!$G$2:$G$14 / 12 rows and 1 column
Number of removed observations: 2
Significance level (%): 5
Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Ln Transform DDT BG Surface Soi	10	0	10	-0.713	2.485	0.917	0.822

Shapiro-Wilk test (Ln Transform DDE BG Surface Soils):

W	0.859
p-value	0.074
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.
The risk to reject the null hypothesis H0 while it is true is 7.39%.

Anderson-Darling test (Ln Transform DDE BG Surface Soils):

A^2	0.860
p-value	0.017
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 1.70%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 3:10:34 PM

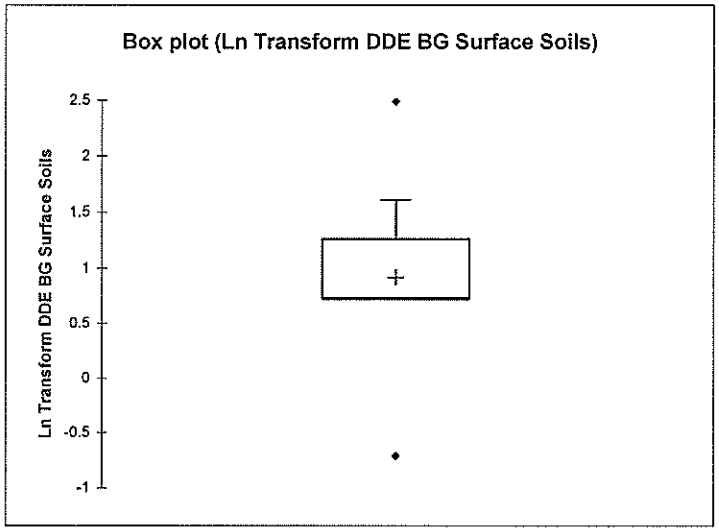
Quantitative data: Workbook = SoilData.xls / Sheet = DDT SS vs Sed / Range = 'DDT SS vs Sed'!$G$2:$G$14 / 12 rows and 1 column

Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Ln Transform DDT BG Surface Soils
No. of observations	12
No. of missing values	2
Sum of weights	10
Minimum	-0.713
Maximum	2.485
Freq. of minimum	1
Freq. of maximum	1
Range	3.198
1st Quartile	0.718
Median	0.730
3rd Quartile	1.262
Sum	9.171
Mean	0.917
Variance (n)	0.608
Variance (n-1)	0.676
Standard deviation (n)	0.780
Standard deviation (n-1)	0.822
Variation coefficient	0.850
Skewness (Pearson)	-0.011
Skewness (Fisher)	-0.013
Skewness (Bowley)	0.956
Kurtosis (Pearson)	0.625
Kurtosis (Fisher)	2.069
Standard error of the mean	0.260
Lower bound on mean (95%)	0.329
Upper bound on mean (95%)	1.505
Standard error(Skewness (Fisher))	0.687
Standard error(Kurtosis (Fisher))	1.334
Mean absolute deviation	0.556
Median absolute deviation	0.012
Geometric mean	
Geometric standard deviation	
Harmonic mean	1.165

t=	1.812
K=	1.886
95% UTL=	11.80 mg/kg
95% UCL =	3.76 mg/kg
Mean =	2.50 mg/kg



Box plots:

Iron Surface Soil Background					Sediment Samples			
Sample No.	Result	Qualifier	Data	Ln Transform Iron BG Surface Soils	Sample No.	Result	Qualifier	Exceed UTL
SB-1A	7430		7430	8.9132811	SD-2	28,600		Y
SS-BG-101	8970		8970	9.1016410	SD-3	27,500		Y
SS-BG-102	8650		8650	9.0653146	SD-4	25,000		Y
SS-BG-111	8420		8420	9.0383651	SD-5	14,100		Y
SS-BG-103	1740		1740	7.4616404	SD-6	30,800		Y
SS-BG-104	6700		6700	8.8098628	SD-7	11,500		N
SS-BG-105	9890		9890	9.1992794	SD-8	12,800		Y
SS-BG-106	7110		7110	8.8692575	SD-9	19,400		Y
SS-BG-107	3660		3660	8.2052184	SD-10	5,670		N
SS-BG-108	7450		7450	8.9159693				
SS-BG-109	10900		10900	9.2965181				
SS-BG-110	10900		10900	9.2965181				

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 4:21:34 PM

Data: Workbook = SoilData.xls / Sheet = Iron SS vs Sed / Range = 'Iron SS vs Sed'!$E$3:$E$15 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	12	0	12	1740.000	10900.000	7651.667	2723.777

Shapiro-Wilk test (Data):

W	0.908
p-value	0.201
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 20.12%.

Anderson-Darling test (Data):

A^2	0.450
p-value	0.227
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 22.69%.

Descriptive Statistics Data

XLSTAT 2008.1.02 - Descriptive statistics - on 5/21/2009 at 11:22:46 AM

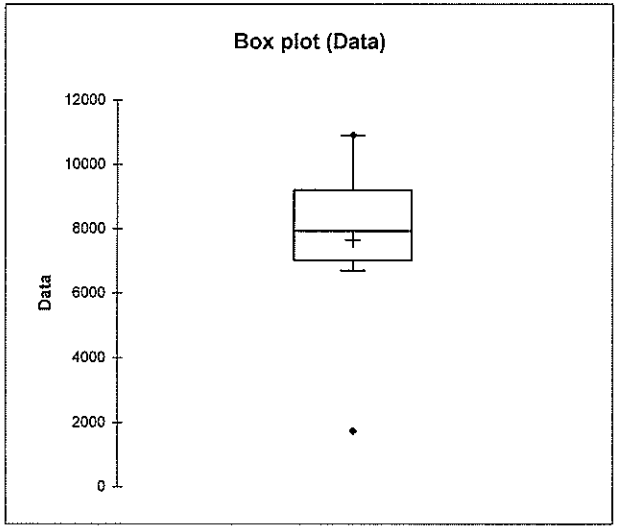
Quantitative data: Workbook = SoilData.xls / Sheet = Iron SS vs Sed / Range = 'Iron SS vs Sed'!$E$3:$E$15 / 12 rows and 1 column

Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Data
No. of observations	12
No. of missing values	0
Sum of weights	12
Minimum	1740.000
Maximum	10900.000
Freq. of minimum	1
Freq. of maximum	2
Range	9160.000
1st Quartile	7007.500
Median	7935.000
3rd Quartile	9200.000
Sum	91820.000
Mean	7651.667
Variance (n)	6800713.889
Variance (n-1)	7418960.606
Standard deviation (n)	2607.818
Standard deviation (n-1)	2723.777
Variation coefficient	0.341
Skewness (Pearson)	-0.882
Skewness (Fisher)	-1.013
Skewness (Bowley)	0.154
Kurtosis (Pearson)	0.114
Kurtosis (Fisher)	0.915
Standard error of the mean	786.287
Lower bound on mean (95%)	5921.061
Upper bound on mean (95%)	9382.272
Standard error(Skewness (Fisher))	0.637
Standard error(Kurtosis (Fisher))	1.232
Mean absolute deviation	1970.000
Median absolute deviation	1135.000
Geometric mean	6958.636
Geometric standard deviation	1.689
Harmonic mean	5890.704

t=	1.782
K=	1.855
95% UTL=	12704 mg/kg
95% UCL =	8993 mg/kg
Mean =	7652 mg/kg



Box plots:

Lead Surface Soils				Ln Transform Lead BG Surface Soils	Sediment Samples			Exceed
Sample No.	Result	Qualifier	Data		Sample No.	Result	Qualifier	UTL
SB-1A	9.2		9.2	2.2192035	SD-2	45		N
SS-BG-101	17.9		17.9	2.8848007	SD-3	20		N
SS-BG-102	13.1		13.1	2.5726122	SD-4	17		N
SS-BG-111	13.4		13.4	2.5952547	SD-5	23		N
SS-BG-103	4.9		4.9	1.5892352	SD-6	22		N
SS-BG-104	12.2		12.2	2.5014360	SD-7	8.9		N
SS-BG-105	14.7		14.7	2.6878475	SD-8	23		N
SS-BG-106	14.5		14.5	2.6741486	SD-9	97		Y
SS-BG-107	7.4		7.4	2.0014800	SD-10	22		N
SS-BG-108	124		124	4.8202816				
SS-BG-109	12.5		12.5	2.5257286				
SS-BG-110	84.8		84.8	4.4402955				

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 12:28:23 PM

Data: Workbook = SoilData.xls / Sheet = Lead Surface Soils / Range = 'Lead Surface Soils'!$E$2:$E$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	12	0	12	4.900	124.000	27.383	37.094

Shapiro-Wilk test (Data):

W	0.579
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

Anderson-Darling test (Data):

A^2	2.439
p-value	< 0.0001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

LN Transformed Data
XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 12:29:15 PM
Data: Workbook = SoilData.xls / Sheet = Lead Surface Soils / Range = 'Lead Surface Soils'!$G$2:$G$14 / 12 rows and 1 column
Significance level (%): 5
Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Ln Transform Lead BG Surface Soi	12	0	12	1.589	4.820	2.793	0.930

Shapiro-Wilk test (Ln Transform Lead BG Surface Soils):

W	0.813
p-value	0.013
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 1.32%.

Anderson-Darling test (Ln Transform Lead BG Surface Soils):

A^2	1.103
p-value	0.004
alpha	0.05

Test interpretation:
H0: The sample follows a Normal distribution.
Ha: The sample does not follow a Normal distribution.
As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.
The risk to reject the null hypothesis H0 while it is true is lower than 0.42%.

Descriptive Statistics Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 12:30:05 PM

Quantitative data: Workbook = SoilData.xls / Sheet = Lead Surface Soils / Range = 'Lead Surface Soils'!$E$2:$E$14 / 12 rows and 1 column

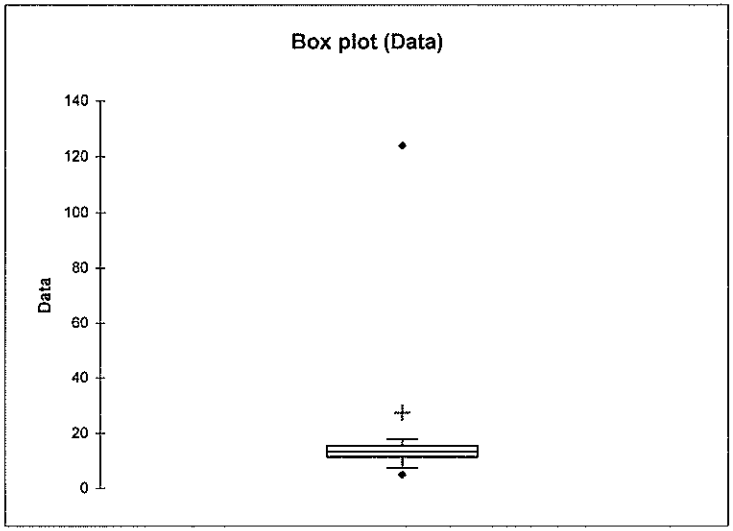
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Data
No. of observations	12
No. of missing values	0
Sum of weights	12
Minimum	4.900
Maximum	124.000
Freq. of minimum	1
Freq. of maximum	1
Range	119.100
1st Quartile	11.450
Median	13.250
3rd Quartile	15.500
Sum	328.600
Mean	27.383
Variance (n)	1261.275
Variance (n-1)	1375.936
Standard deviation (n)	35.514
Standard deviation (n-1)	37.094
Variation coefficient	1.297
Skewness (Pearson)	1.950
Skewness (Fisher)	2.241
Skewness (Bowley)	0.111
Kurtosis (Pearson)	2.174
Kurtosis (Fisher)	4.188
Standard error of the mean	10.708
Lower bound on mean (95%)	3.815
Upper bound on mean (95%)	50.951
Standard error(Skewness (Fisher))	0.637
Standard error(Kurtosis (Fisher))	1.232
Mean absolute deviation	25.672
Median absolute deviation	2.750
Geometric mean	16.325
Geometric standard deviation	2.534
Harmonic mean	12.326

t=	1.782
K=	1.855
95% UTL=	96.2 mg/kg
95% UCL =	45.7 mg/kg
Mean =	27.4 mg/kg

Box plots:



Mercury Surface Soils					Sediment Samples			Exceed
Sample No.	Result	Qualifier	Data	Ln Transform Hg BG Surface Soils	Sample No.	Result	Qualifier	UTL
SB-1A	0.061		0.061	-2.7968814	SD-2	0.1		N
SS-BG-101	0.038		0.038	-3.2701691	SD-3	0.07		N
SS-BG-102	0.045		0.045	-3.1010928	SD-4	0.038		N
SS-BG-111	0.044		0.044	-3.1235656	SD-5	0.047		N
SS-BG-103	0.016	U	0.008	-4.8283137	SD-6	0.09		N
SS-BG-104	0.079		0.079	-2.5383074	SD-7	0.052	U	N
SS-BG-105	0.049		0.049	-3.0159350	SD-8	0.12		N
SS-BG-106	0.068		0.068	-2.6882476	SD-9	0.49		Y
SS-BG-107	0.025		0.025	-3.6888795	SD-10	0.069		N
SS-BG-108	0.25		0.25	-1.3862944				
SS-BG-109	0.032		0.032	-3.4420194				
SS-BG-110	0.094		0.094	-2.3644605				

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 3:53:55 PM

Data: Workbook = SoilData.xls / Sheet = Mercury SS vs Sed / Range = 'Mercury SS vs Sed'!$E$2:$E$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	12	0	12	0.008	0.250	0.066	0.063

Shapiro-Wilk test (Data):

W	0.695
p-value	0.001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.07%.

Anderson-Darling test (Data):

A^2	1.377
p-value	0.001
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.08%.

LN Transformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 3:54:28 PM

Data: Workbook = SoilData.xls / Sheet = Mercury SS vs Sed / Range = 'Mercury SS vs Sed'!$G$2:$G$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	with missing	without missing	Minimum	Maximum	Mean	Std. deviation
Ln Transform Hg BG Surface Soils	12	0	12	-4.828	-1.386	-3.020	0.824

Shapiro-Wilk test (Ln Transform Hg BG Surface Soils):

W	0.949
p-value	0.624
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 62.36%.

Anderson-Darling test (Ln Transform Hg BG Surface Soils):

A^2	0.365
p-value	0.375
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 37.53%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 3:55:06 PM

Quantitative data: Workbook = SoilData.xls / Sheet = Mercury SS vs Sed / Range = 'Mercury SS vs Sed'!$G$2:$G$14 / 12 rows and 1 column

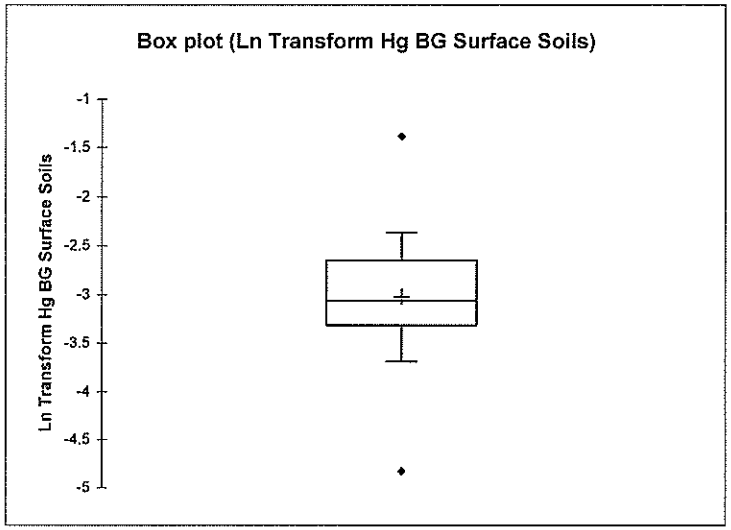
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Ln Transform Hg BG Surface Soils
No. of observations	12
No. of missing values	0
Sum of weights	12
Minimum	-4.828
Maximum	-1.386
Freq. of minimum	1
Freq. of maximum	1
Range	3.442
1st Quartile	-3.313
Median	-3.059
3rd Quartile	-2.651
Sum	-36.244
Mean	-3.020
Variance (n)	0.622
Variance (n-1)	0.679
Standard deviation (n)	0.789
Standard deviation (n-1)	0.824
Variation coefficient	-0.261
Skewness (Pearson)	-0.254
Skewness (Fisher)	-0.292
Skewness (Bowley)	0.231
Kurtosis (Pearson)	0.940
Kurtosis (Fisher)	2.227
Standard error of the mean	0.238
Lower bound on mean (95%)	-3.544
Upper bound on mean (95%)	-2.497
Standard error(Skewness (Fisher))	0.637
Standard error(Kurtosis (Fisher))	1.232
Mean absolute deviation	0.555
Median absolute deviation	0.377
Geometric mean	
Geometric standard deviation	
Harmonic mean	-2.780

t=	1.782	
K=	1.8548	
95% UTL=	0.225	mg/kg
95% UCL =	0.073	mg/kg
Mean =	0.049	mg/kg

Box plots:



Silver Surface Soils					Sediment Samples			
Sample No.	Result	Qualifier	Data	Ln Transform Ag BG Surface Soils	Sample No.	Result	Qualifier	Exceed UTL
SB-1A	0.17	U	0.085	-2.4651040	SD-2	0.24		N
SS-BG-101	0.1		0.1	-2.3025851	SD-3	0.21	U	N
SS-BG-102	0.12		0.12	-2.1202635	SD-4	0.19	U	N
SS-BG-111	0.1		0.1	-2.3025851	SD-5	0.2		N
SS-BG-103	0.089		0.089	-2.4191189	SD-6	0.41		Y
SS-BG-104	0.11		0.11	-2.2072749	SD-7	0.25	U	N
SS-BG-105	0.12		0.12	-2.1202635	SD-8	0.26	U	N
SS-BG-106	0.18		0.18	-1.7147984	SD-9	1.5		Y
SS-BG-107	0.12		0.12	-2.1202635	SD-10	0.65		Y
SS-BG-108	0.26		0.26	-1.3470736				
SS-BG-109	0.15		0.15	-1.8971200				
SS-BG-110	0.3		0.3	-1.2039728				

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 4:00:08 PM

Data: Workbook = SoilData.xls / Sheet = Silver SS vs Sed / Range = 'Silver SS vs Sed'!$F$2:$F$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	12	0	12	0.085	0.300	0.145	0.069

Shapiro-Wilk test (Data):

W	0.780
p-value	0.006
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.57%.

Anderson-Darling test (Data):

A^2	1.135
p-value	0.003
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.35%.

LN Transformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 4:00:30 PM

Data: Workbook = SoilData.xls / Sheet = Silver SS vs Sed / Range = 'Silver SS vs Sed'!$H$2:$H$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations. with missing c without missing			Minimum	Maximum	Mean	Std. deviation
Ln Transform Ag BG Surface Soils	12	0	12	-2.465	-1.204	-2.018	0.406

Shapiro-Wilk test (Ln Transform Ag BG Surface Soils):

W	0.874
p-value	0.073
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 7.27%.

Anderson-Darling test (Ln Transform Ag BG Surface Soils):

A^2	0.647
p-value	0.069
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 6.86%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 4:01:01 PM

Quantitative data: Workbook = SoilData.xls / Sheet = Silver SS vs Sed / Range = 'Silver SS vs Sed'!$H$2:$H$14 / 12 rows and 1 column

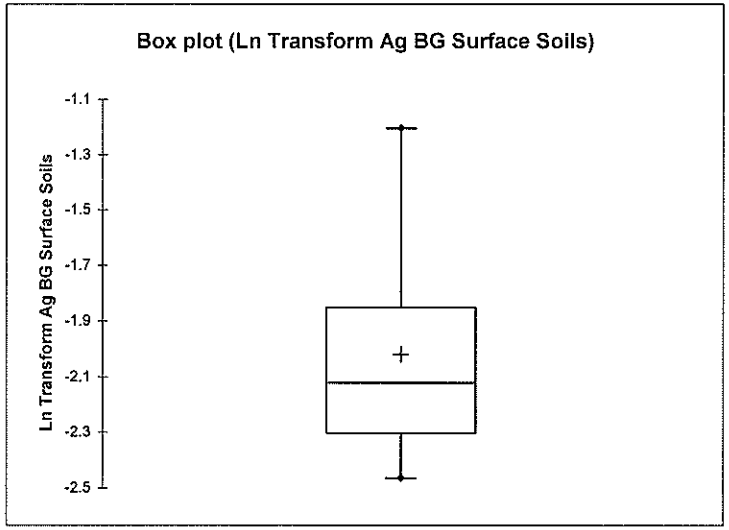
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	rm Ag BG Surface Soils
No. of observations	12
No. of missing values	0
Sum of weights	12
Minimum	-2.465
Maximum	-1.204
Freq. of minimum	1
Freq. of maximum	1
Range	1.261
1st Quartile	-2.303
Median	-2.120
3rd Quartile	-1.852
Sum	-24.220
Mean	-2.018
Variance (n)	0.151
Variance (n-1)	0.164
Standard deviation (n)	0.388
Standard deviation (n-1)	0.406
Variation coefficient	-0.192
Skewness (Pearson)	0.944
Skewness (Fisher)	1.084
Skewness (Bowley)	0.192
Kurtosis (Pearson)	-0.317
Kurtosis (Fisher)	0.230
Standard error of the mean	0.117
Lower bound on mean (95%)	-2.276
Upper bound on mean (95%)	-1.761
Standard error(Skewness (Fisher))	0.637
Standard error(Kurtosis (Fisher))	1.232
Mean absolute deviation	0.318
Median absolute deviation	0.203
Geometric mean	
Geometric standard deviation	
Harmonic mean	-1.923

t=	1.782
K=	1.8548
95% UTL=	0.282 mg/kg
95% UCL =	0.162 mg/kg
Mean =	0.133 mg/kg

Box plots:



Zinc Surface Soils					Sediment Samples			Exceed
Sample No.	Result	Qualifier	Data	Ln Transform Zg BG Surface Soils	Sample No.	Result	Qualifier	UTL
SB-1A	19		19	2.9444390	SD-2	113		Y
SS-BG-101	24.1		24.1	3.1822118	SD-3	85		N
SS-BG-102	23.7		23.7	3.1654750	SD-4	57		N
SS-BG-111	23.3		23.3	3.1484534	SD-5	60		N
SS-BG-103	4.5		4.5	1.5040774	SD-6	87		N
SS-BG-104	17		17	2.8332133	SD-7	44		N
SS-BG-105	23.4		23.4	3.1527360	SD-8	37		N
SS-BG-106	15.4		15.4	2.7343675	SD-9	324		Y
SS-BG-107	9.9		9.9	2.2925348	SD-10	72		N
SS-BG-108	49.3		49.3	3.8979241				
SS-BG-109	22.4		22.4	3.1090610				
SS-BG-110	104		104	4.6443909				

Untransformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 4:05:00 PM

Data: Workbook = SoilData.xls / Sheet = Zinc SS vs Sed / Range = 'Zinc SS vs Sed'!$E$2:$E$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	Obs. with missing data	Obs. without missing data	Minimum	Maximum	Mean	Std. deviation
Data	12	0	12	4.500	104.000	28.000	26.248

Shapiro-Wilk test (Data):

W	0.667
p-value	0.000
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.04%.

Anderson-Darling test (Data):

A^2	1.670
p-value	0.000
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is lower than the significance level alpha=0.05, one should reject the null hypothesis H0, and accept the alternative hypothesis Ha.

The risk to reject the null hypothesis H0 while it is true is lower than 0.01%.

LN Transformed Data

XLSTAT 2008.1.02 - Normality tests - on 4/15/2009 at 4:05:19 PM

Data: Workbook = SoilData.xls / Sheet = Zinc SS vs Sed / Range = 'Zinc SS vs Sed'!$G$2:$G$14 / 12 rows and 1 column

Significance level (%): 5

Summary statistics

Summary statistics:

Variable	Observations	with missing	without missing	Minimum	Maximum	Mean	Std. deviation
Ln Transform Zn BG Surface Soils	12	0	12	1.504	4.644	3.051	0.765

Shapiro-Wilk test (Ln Transform Ag BG Surface Soils):

W	0.918
p-value	0.272
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 27.23%.

Anderson-Darling test (Ln Transform Ag BG Surface Soils):

A^2	0.615
p-value	0.083
alpha	0.05

Test interpretation:

H0: The sample follows a Normal distribution.

Ha: The sample does not follow a Normal distribution.

As the computed p-value is greater than the significance level alpha=0.05, one should accept the null hypothesis H0.

The risk to reject the null hypothesis H0 while it is true is 8.33%.

Descriptive Statistics LN Transformed Data

XLSTAT 2008.1.02 - Descriptive statistics - on 4/15/2009 at 4:05:42 PM

Quantitative data: Workbook = SoilData.xls / Sheet = Zinc SS vs Sed / Range = 'Zinc SS vs Sed'!$G$2:$G$14 / 12 rows and 1 column

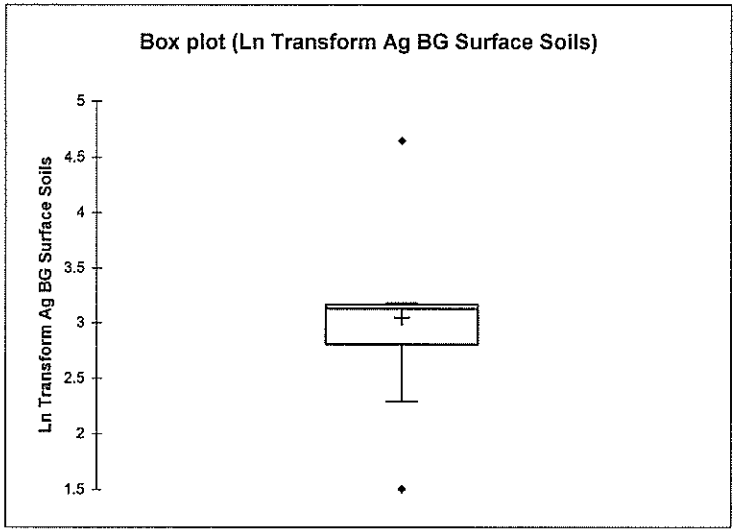
Descriptive statistics (Quantitative data)

Descriptive statistics (Quantitative data):

Statistic	Ln Transform Zn BG Surface Soils
No. of observations	12
No. of missing values	0
Sum of weights	12
Minimum	1.504
Maximum	4.644
Freq. of minimum	1
Freq. of maximum	1
Range	3.140
1st Quartile	2.809
Median	3.129
3rd Quartile	3.170
Sum	36.609
Mean	3.051
Variance (n)	0.536
Variance (n-1)	0.585
Standard deviation (n)	0.732
Standard deviation (n-1)	0.765
Variation coefficient	0.240
Skewness (Pearson)	0.102
Skewness (Fisher)	0.118
Skewness (Bowley)	-0.773
Kurtosis (Pearson)	0.774
Kurtosis (Fisher)	1.963
Standard error of the mean	0.221
Lower bound on mean (95%)	2.565
Upper bound on mean (95%)	3.537
Standard error(Skewness (Fisher))	0.637
Standard error(Kurtosis (Fisher))	1.232
Mean absolute deviation	0.491
Median absolute deviation	0.240
Geometric mean	2.955
Geometric standard deviation	1.316
Harmonic mean	2.845

t=	1.782
K=	1.855
95% UTL=	87.3 mg/kg
95% UCL =	30.8 mg/kg
Mean =	21.1 mg/kg

Box plots:



Surface Water Comparison to Background, Former Construction Debris Landfill Remedial Investigation, Wallops Flight Facility

Aluminum SW Background

	Result (ug/L)
WFF-MB-111	57
SW-1 (May 2007)	190
SW-1 (Dec 2007)	360
Max	360

Aluminum SW Unit - May 2007

	Result (ug/L)	Exceed Max BG
SW-2	210	**N**
SW-3	170	**N**
SW-4	110	**N**

Aluminum SW Unit - Dec 2007

	Result (ug/L)	Exceed Max BG
SW-2	1,100	**Y**
SW-3	430	**Y**
SW-4	140	**N**

Barium SW Background

	Result (ug/L)
WFF-MB-111	16
SW-1 (May 2007)	12
SW-1 (Dec 2007)	22
Max	22

Barium SW Unit - May 2007

	Result (ug/L)	Exceed Max BG
SW-2	28	**Y**
SW-3	15	**N**
SW-4	15	**N**

Barium SW Unit - Dec 2007

	Result (ug/L)	Exceed Max BG
SW-2	**20**	**N**
SW-3	**17**	**N**
SW-4	**17**	**N**

Iron SW Background

	Result (ug/L)
WFF-MB-111	580
SW-1 (May 2007)	340
SW-1 (Dec 2007)	470
Max	580

Iron SW Unit - May 2007

	Result (ug/L)	Exceed Max BG
SW-2	420	**N**
SW-3	380	**N**
SW-4	310	**N**

Iron SW Unit - Dec 2007

	Result (ug/L)	Exceed Max BG
SW-2	1,000	**Y**
SW-3	530	**N**
SW-4	230	**N**

APPENDIX F

HUMAN HEALTH RISK ASSESSMENT TABLES

APPENDIX F

HUMAN HEALTH RISK ASSESSMENT TABLES

APPENDIX F-1

ProUCL INPUT AND OUTPUT FILES

ProUCL Input
Central and Southern AOCs
Surface Soil

4,4'-DDD	D_4,4'-DDD	4,4'-DDE	D_4,4'-DDE	4,4'-DDT	D_4,4'-DDT	Aluminum	D_Aluminum	Antimony	D_Antimony	Arsenic	D_Arsenic	Cadmium	D_Cadmium	Chromium	D_Chromium
0.0056	1	0.119	1	0.0589	1	6960	1	2.2	0	3.5	1	0.55	0	7.9	1
0.0092	1	0.0944	1	0.2365	1	5300	1	2.65	0	2.85	1	0.545	1	68.1	1
0.0019	1	0.0159	1	0.0118	1	6870	1	2.6	0	3	1	0.23	1	7.6	1
0.0016	0	0.0347	1	0.0107	1	7490	1	2.4	0	7.6	1	0.21	1	13.5	1
0.0227	1	0.204	1	0.0908	1	19900	1	63.7	1	7.2	1	21.6	1	49.8	1
0.0509	1	0.0999	1	0.0564	1	9520	1	18	1	4.3	1	4.7	1	23.8	1
0.126	1	1.02	1	0.53	1	27300	1	11.3	1	6.1	1	11.6	1	78.3	1
0.0018	0	0.0053	1	0.0063	1	9960	1	2.7	0	3	1	1.8	1	10.2	1

ProUCL Input
Central and Southern AOCs
Surface Soil

Copper	D_Copper	Iron	D_Iron	Lead	D_Lead	Mercury	D_Mercury	Nickel	D_Nickel	Silver	D_Silver	Vanadium	D_Vanadium	Zinc	D_Zinc
7.4	1	6850	1	20.2	1	0.052	1	5.3	1	0.35	1	12.8	1	20.6	1
8.75	1	14925	1	72.55	1	0.22	1	256.1	1	0.94	1	9.9	1	121.55	1
8	1	5640	1	12.9	1	0.08	1	3.9	1	0.57	1	10.3	1	21.9	1
8.3	1	6350	1	17.5	1	0.16	1	4.8	1	0.18	1	12	1	26.7	1
854	1	45100	1	2120	1	1.8	1	51.1	1	84.5	1	51	1	4280	1
193	1	11800	1	351	1	0.18	1	15.7	1	4.3	1	16.1	1	603	1
1790	1	12300	1	573	1	0.16	1	68.4	1	24.5	1	12.8	1	708	1
26.1	1	7070	1	16.9	1	0.061	1	5.7	1	1.3	0	13.6	1	64.7	1

ProUCL Output File
Central and Southern AOCs
Surface Soil

	General UCL Statistics for Data Sets with Non-Detects
User Selected Options	
From File	I:\Newest Wallops\ProUCL Files\ProUCL Input file Soil C+S 0-0.5.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

ProUCL Output File
Central and Southern AOCs
Surface Soil

4,4'-DDD

General Statistics

Number of Valid Data	8	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	2
		Percent Non-Detects	25.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0019	Minimum Detected	-6.266
Maximum Detected	0.126	Maximum Detected	-2.071
Mean of Detected	0.0361	Mean of Detected	-4.162
SD of Detected	0.0475	SD of Detected	1.527
Minimum Non-Detect	0.0016	Minimum Non-Detect	-6.438
Maximum Non-Detect	0.0018	Maximum Non-Detect	-6.32
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	2
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	6
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	25.00%

Warning: There are only 6 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.777	Shapiro Wilk Test Statistic	0.989
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0273	Mean	-4.89
SD	0.0434	SD	1.866
95% DL/2 (t) UCL	0.0563	95% H-Stat (DL/2) UCL	0.428
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.019	Mean in Log Scale	-5.143
SD	0.0497	SD in Log Scale	2.227
95% MLE (t) UCL	0.0523	Mean in Original Scale	0.0271
95% MLE (Tiku) UCL	0.0528	SD in Original Scale	0.0435
		95% Percentile Bootstrap UCL	0.0532
		95% BCA Bootstrap UCL	0.0629
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.47	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.0767		
nu star	5.638		
A-D Test Statistic	0.228	**Nonparametric Statistics**	
5% A-D Critical Value	0.723	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.723	Mean	0.0275
5% K-S Critical Value	0.344	SD	0.0404

ProUCL Output File
Central and Southern AOCs
Surface Soil

Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0156
		95% KM (t) UCL	0.0572
Assuming Gamma Distribution		95% KM (z) UCL	0.0532
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.056
Minimum	1E-09	95% KM (bootstrap t) UCL	0.149
Maximum	0.126	95% KM (BCA) UCL	0.0555
Mean	0.027	95% KM (Percentile Bootstrap) UCL	0.0533
Median	0.0074	95% KM (Chebyshev) UCL	0.0957
SD	0.0435	97.5% KM (Chebyshev) UCL	0.125
k star	0.185	99% KM (Chebyshev) UCL	0.183
Theta star	0.146		
Nu star	2.953	Potential UCLs to Use	
AppChi2	0.359	95% KM (Chebyshev) UCL	0.0957
95% Gamma Approximate UCL	0.223		
95% Adjusted Gamma UCL	0.388		
Note: DL/2 is not a recommended method.			

ProUCL Output File
Central and Southern AOCs
Surface Soil

4,4'-DDE

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	0.0053	Minimum of Log Data	-5.24
Maximum	1.02	Maximum of Log Data	0.0198
Mean	0.199	Mean of log Data	-2.638
Median	0.0972	SD of log Data	1.611
SD	0.338		
Coefficient of Variation	1.697		
Skewness	2.629		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.593	Shapiro Wilk Test Statistic	0.975
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.425	95% H-UCL	5.648
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.691
95% Adjusted-CLT UCL	0.514	97.5% Chebyshev (MVUE) UCL	0.904
95% Modified-t UCL	0.444	99% Chebyshev (MVUE) UCL	1.323

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.46	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.433		
nu star	7.361		
Approximate Chi Square Value (.05)	2.371	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	0.396
Adjusted Chi Square Value	1.719	95% Jackknife UCL	0.425
		95% Standard Bootstrap UCL	0.387
Anderson-Darling Test Statistic	0.404	95% Bootstrap-t UCL	1.2
Anderson-Darling 5% Critical Value	0.755	95% Hall's Bootstrap UCL	1.353
Kolmogorov-Smirnov Test Statistic	0.219	95% Percentile Bootstrap UCL	0.433
Kolmogorov-Smirnov 5% Critical Value	0.307	95% BCA Bootstrap UCL	0.551
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.72
		97.5% Chebyshev(Mean, Sd) UCL	0.945
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1.388
95% Approximate Gamma UCL	0.618		
95% Adjusted Gamma UCL	0.853		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.618

ProUCL Output File
Central and Southern AOCs
Surface Soil

4,4'-DDT

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	0.0063	Minimum of Log Data	-5.067
Maximum	0.53	Maximum of Log Data	-0.635
Mean	0.125	Mean of log Data	-3.028
Median	0.0577	SD of log Data	1.564
SD	0.18		
Coefficient of Variation	1.438		
Skewness	2.041		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.714	Shapiro Wilk Test Statistic	0.943
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.246	95% H-UCL	3.012
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.435
95% Adjusted-CLT UCL	0.279	97.5% Chebyshev (MVUE) UCL	0.569
95% Modified-t UCL	0.253	99% Chebyshev (MVUE) UCL	0.83
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.486	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.258		
nu star	7.769		
Approximate Chi Square Value (.05)	2.602	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	0.23
Adjusted Chi Square Value	1.909	95% Jackknife UCL	0.246
		95% Standard Bootstrap UCL	0.22
Anderson-Darling Test Statistic	0.366	95% Bootstrap-t UCL	0.62
Anderson-Darling 5% Critical Value	0.752	95% Hall's Bootstrap UCL	0.752
Kolmogorov-Smirnov Test Statistic	0.196	95% Percentile Bootstrap UCL	0.234
Kolmogorov-Smirnov 5% Critical Value	0.306	95% BCA Bootstrap UCL	0.29
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.402
		97.5% Chebyshev(Mean, Sd) UCL	0.522
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.758
95% Approximate Gamma UCL	0.374		
95% Adjusted Gamma UCL	0.509		
Potential UCL to Use		Use 95% Approximate Gamma UCL	0.374

ProUCL Output File
Central and Southern AOCs
Surface Soil

Aluminum

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	5300	Minimum of Log Data	8.575
Maximum	27300	Maximum of Log Data	10.21
Mean	11663	Mean of log Data	9.208
Median	8505	SD of log Data	0.566
SD	7772		
Coefficient of Variation	0.666		
Skewness	1.551		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.773	Shapiro Wilk Test Statistic	0.879
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	16869	95% H-UCL	19859
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	21558
95% Adjusted-CLT UCL	17793	97.5% Chebyshev (MVUE) UCL	25933
95% Modified-t UCL	17120	99% Chebyshev (MVUE) UCL	34525
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.177	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	5357		
nu star	34.84		
Approximate Chi Square Value (.05)	22.33	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	16182
Adjusted Chi Square Value	19.84	95% Jackknife UCL	16869
		95% Standard Bootstrap UCL	15892
Anderson-Darling Test Statistic	0.674	95% Bootstrap-t UCL	30935
Anderson-Darling 5% Critical Value	0.72	95% Hall's Bootstrap UCL	46125
Kolmogorov-Smirnov Test Statistic	0.288	95% Percentile Bootstrap UCL	15975
Kolmogorov-Smirnov 5% Critical Value	0.296	95% BCA Bootstrap UCL	17341
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	23640
		97.5% Chebyshev(Mean, Sd) UCL	28823
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	39004
95% Approximate Gamma UCL	18191		
95% Adjusted Gamma UCL	20478		
Potential UCL to Use		Use 95% Approximate Gamma UCL	18191

ProUCL Output File
Central and Southern AOCs
Surface Soil

Arsenic

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	7

Raw Statistics		Log-transformed Statistics	
Minimum	2.85	Minimum of Log Data	1.047
Maximum	7.6	Maximum of Log Data	2.028
Mean	4.694	Mean of log Data	1.471
Median	3.9	SD of log Data	0.411
SD	1.979		
Coefficient of Variation	0.422		
Skewness	0.622		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.836	Shapiro Wilk Test Statistic	0.856
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	6.02	95% H-UCL	6.677
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	7.671
95% Adjusted-CLT UCL	6.009	97.5% Chebyshev (MVUE) UCL	8.964
95% Modified-t UCL	6.045	99% Chebyshev (MVUE) UCL	11.5
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.328	Data appear Normal at 5% Significance Level	
Theta Star	1.085		
nu star	69.25		
Approximate Chi Square Value (.05)	51.09	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	5.845
Adjusted Chi Square Value	47.17	95% Jackknife UCL	6.02
		95% Standard Bootstrap UCL	5.774
Anderson-Darling Test Statistic	0.595	95% Bootstrap-t UCL	6.3
Anderson-Darling 5% Critical Value	0.718	95% Hall's Bootstrap UCL	5.691
Kolmogorov-Smirnov Test Statistic	0.225	95% Percentile Bootstrap UCL	5.831
Kolmogorov-Smirnov 5% Critical Value	0.295	95% BCA Bootstrap UCL	5.919
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	7.744
		97.5% Chebyshev(Mean, Sd) UCL	9.064
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	11.66
95% Approximate Gamma UCL	6.362		
95% Adjusted Gamma UCL	6.891		
Potential UCL to Use		Use 95% Student's-t UCL	6.02

ProUCL Output File
Central and Southern AOCs
Surface Soil

Cadmium

General Statistics

Number of Valid Data	8	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	1
		Percent Non-Detects	12.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.21	Minimum Detected	-1.561
Maximum Detected	21.6	Maximum Detected	3.073
Mean of Detected	5.812	Mean of Detected	0.575
SD of Detected	8.066	SD of Detected	1.864
Minimum Non-Detect	0.55	Minimum Non-Detect	-0.598
Maximum Non-Detect	0.55	Maximum Non-Detect	-0.598

Warning: There are only 7 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.772	Shapiro Wilk Test Statistic	0.92
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	5.12	Mean	0.341
SD	7.72	SD	1.847
95% DL/2 (t) UCL	10.29	95% H-Stat (DL/2) UCL	565.8
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.35	Mean in Log Scale	0.367
SD	12.16	SD in Log Scale	1.822
95% MLE (t) UCL	8.495	Mean in Original Scale	5.128
95% MLE (Tiku) UCL	10.39	SD in Original Scale	7.714
		95% Percentile Bootstrap UCL	9.38
		95% BCA Bootstrap UCL	10.95
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.399	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	14.58		
nu star	5.581		
A-D Test Statistic	0.335	Nonparametric Statistics	
5% A-D Critical Value	0.75	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.75	Mean	5.127
5% K-S Critical Value	0.327	SD	7.217
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	2.756
		95% KM (t) UCL	10.35
Assuming Gamma Distribution		95% KM (z) UCL	9.66

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Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	10.3
Minimum	1E-09	95% KM (bootstrap t) UCL	24.42
Maximum	21.6	95% KM (BCA) UCL	9.871
Mean	5.086	95% KM (Percentile Bootstrap) UCL	9.768
Median	1.173	95% KM (Chebyshev) UCL	17.14
SD	7.745	97.5% KM (Chebyshev) UCL	22.34
k star	0.207	99% KM (Chebyshev) UCL	32.55
Theta star	24.53		
Nu star	3.317	Potential UCLs to Use	
AppChi2	0.472	95% KM (Chebyshev) UCL	17.14
95% Gamma Approximate UCL	35.72		
95% Adjusted Gamma UCL	61.25		
Note: DL/2 is not a recommended method.			

ProUCL Output File
Central and Southern AOCs
Surface Soil

Chromium

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	7.6	Minimum of Log Data	2.028
Maximum	78.3	Maximum of Log Data	4.361
Mean	32.4	Mean of log Data	3.085
Median	18.65	SD of log Data	0.969
SD	28.84		
Coefficient of Variation	0.89		
Skewness	0.787		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.825	Shapiro Wilk Test Statistic	0.878
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	51.72	95% H-UCL	119.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	81.81
95% Adjusted-CLT UCL	52.21	97.5% Chebyshev (MVUE) UCL	103.2
95% Modified-t UCL	52.19	99% Chebyshev (MVUE) UCL	145.2
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.968	Data appear Normal at 5% Significance Level	
Theta Star	33.48		
nu star	15.48		
Approximate Chi Square Value (.05)	7.599	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	49.17
Adjusted Chi Square Value	6.255	95% Jackknife UCL	51.72
		95% Standard Bootstrap UCL	47.72
Anderson-Darling Test Statistic	0.527	95% Bootstrap-t UCL	62.83
Anderson-Darling 5% Critical Value	0.73	95% Hall's Bootstrap UCL	47.5
Kolmogorov-Smirnov Test Statistic	0.229	95% Percentile Bootstrap UCL	48.44
Kolmogorov-Smirnov 5% Critical Value	0.299	95% BCA Bootstrap UCL	49.6
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	76.85
		97.5% Chebyshev(Mean, Sd) UCL	96.08
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	133.9
95% Approximate Gamma UCL	66.02		
95% Adjusted Gamma UCL	80.2		
Potential UCL to Use		Use 95% Student's-t UCL	51.72

ProUCL Output File
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Copper

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	7.4	Minimum of Log Data	2.001
Maximum	1790	Maximum of Log Data	7.49
Mean	361.9	Mean of log Data	3.891
Median	17.43	SD of log Data	2.279
SD	646.3		
Coefficient of Variation	1.786		
Skewness	1.984		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.651	Shapiro Wilk Test Statistic	0.804
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	794.8	95% H-UCL	257599
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1378
95% Adjusted-CLT UCL	909	97.5% Chebyshev (MVUE) UCL	1834
95% Modified-t UCL	821.5	99% Chebyshev (MVUE) UCL	2730
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.295	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	1228		
nu star	4.714		
Approximate Chi Square Value (.05)	1.023	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	737.8
Adjusted Chi Square Value	0.658	95% Jackknife UCL	794.8
		95% Standard Bootstrap UCL	709.8
Anderson-Darling Test Statistic	0.869	95% Bootstrap-t UCL	3635
Anderson-Darling 5% Critical Value	0.791	95% Hall's Bootstrap UCL	4549
Kolmogorov-Smirnov Test Statistic	0.308	95% Percentile Bootstrap UCL	770.6
Kolmogorov-Smirnov 5% Critical Value	0.315	95% BCA Bootstrap UCL	901.4
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1358
		97.5% Chebyshev(Mean, Sd) UCL	1789
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2635
95% Approximate Gamma UCL	1669		
95% Adjusted Gamma UCL	2592		
Potential UCL to Use		Use 95% Adjusted Gamma UCL	2592

Recommended UCL exceeds the maximum observation

ProUCL Output File
Central and Southern AOCs
Surface Soil

Iron

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	5640	Minimum of Log Data	8.638
Maximum	45100	Maximum of Log Data	10.72
Mean	13754	Mean of log Data	9.276
Median	9435	SD of log Data	0.683
SD	13109		
Coefficient of Variation	0.953		
Skewness	2.471		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.643	Shapiro Wilk Test Statistic	0.844
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	22535	95% H-UCL	27055
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	26974
95% Adjusted-CLT UCL	25704	97.5% Chebyshev (MVUE) UCL	33003
95% Modified-t UCL	23210	99% Chebyshev (MVUE) UCL	44847
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.414	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	9727		
nu star	22.62		
Approximate Chi Square Value (.05)	12.81	Nonparametric Statistics	
Adjusted Level of Significance	0.0195	95% CLT UCL	21378
Adjusted Chi Square Value	10.99	95% Jackknife UCL	22535
		95% Standard Bootstrap UCL	21032
Anderson-Darling Test Statistic	0.791	95% Bootstrap-t UCL	40473
Anderson-Darling 5% Critical Value	0.724	95% Hall's Bootstrap UCL	50485
Kolmogorov-Smirnov Test Statistic	0.238	95% Percentile Bootstrap UCL	22218
Kolmogorov-Smirnov 5% Critical Value	0.297	95% BCA Bootstrap UCL	24538
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	33956
		97.5% Chebyshev(Mean, Sd) UCL	42698
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	59868
95% Approximate Gamma UCL	24297		
95% Adjusted Gamma UCL	28326		
Potential UCL to Use		Use 95% Approximate Gamma UCL	24297

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Lead

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	12.9	Minimum of Log Data	2.557
Maximum	2120	Maximum of Log Data	7.659
Mean	398	Mean of log Data	4.426
Median	46.38	SD of log Data	1.955
SD	725.6		
Coefficient of Variation	1.823		
Skewness	2.421		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.621	Shapiro Wilk Test Statistic	0.86
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	884	95% H-UCL	47796
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1388
95% Adjusted-CLT UCL	1055	97.5% Chebyshev (MVUE) UCL	1834
95% Modified-t UCL	920.6	99% Chebyshev (MVUE) UCL	2712

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.345	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	1154		
nu star	5.519		
Approximate Chi Square Value (.05)	1.399	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	820
Adjusted Chi Square Value	0.943	95% Jackknife UCL	884
		95% Standard Bootstrap UCL	783.6
Anderson-Darling Test Statistic	0.692	95% Bootstrap-t UCL	2446
Anderson-Darling 5% Critical Value	0.777	95% Hall's Bootstrap UCL	2620
Kolmogorov-Smirnov Test Statistic	0.276	95% Percentile Bootstrap UCL	875.1
Kolmogorov-Smirnov 5% Critical Value	0.312	95% BCA Bootstrap UCL	986.8
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1516
		97.5% Chebyshev(Mean, Sd) UCL	2000
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2950
95% Approximate Gamma UCL	1570		
95% Adjusted Gamma UCL	2329		
Potential UCL to Use		Use 95% Adjusted Gamma UCL	2329

Recommended UCL exceeds the maximum observation

ProUCL Output File
Central and Southern AOCs
Surface Soil

Mercury

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	7

Raw Statistics		Log-transformed Statistics	
Minimum	0.052	Minimum of Log Data	-2.957
Maximum	1.8	Maximum of Log Data	0.588
Mean	0.339	Mean of log Data	-1.823
Median	0.16	SD of log Data	1.111
SD	0.593		
Coefficient of Variation	1.75		
Skewness	2.769		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.514	Shapiro Wilk Test Statistic	0.838
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.737	95% H-UCL	1.42
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.74
95% Adjusted-CLT UCL	0.904	97.5% Chebyshev (MVUE) UCL	0.944
95% Modified-t UCL	0.771	99% Chebyshev (MVUE) UCL	1.344
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.583	Data appear Lognormal at 5% Significance Level	
Theta Star	0.581		
nu star	9.334		
Approximate Chi Square Value (.05)	3.53	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	0.684
Adjusted Chi Square Value	2.688	95% Jackknife UCL	0.737
		95% Standard Bootstrap UCL	0.662
Anderson-Darling Test Statistic	1.09	95% Bootstrap-t UCL	2.894
Anderson-Darling 5% Critical Value	0.743	95% Hall's Bootstrap UCL	2.788
Kolmogorov-Smirnov Test Statistic	0.365	95% Percentile Bootstrap UCL	0.745
Kolmogorov-Smirnov 5% Critical Value	0.304	95% BCA Bootstrap UCL	0.958
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1.254
		97.5% Chebyshev(Mean, Sd) UCL	1.649
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2.427
95% Approximate Gamma UCL	0.897		
95% Adjusted Gamma UCL	1.177		
Potential UCL to Use		Use 95% Chebyshev (MVUE) UCL	0.74

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Nickel

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	3.9	Minimum of Log Data	1.361
Maximum	256.1	Maximum of Log Data	5.546
Mean	51.38	Mean of log Data	2.85
Median	10.7	SD of log Data	1.551
SD	86.28		
Coefficient of Variation	1.679		
Skewness	2.414		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.631	Shapiro Wilk Test Statistic	0.869
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	109.2	95% H-UCL	1003
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	152.2
95% Adjusted-CLT UCL	129.4	97.5% Chebyshev (MVUE) UCL	198.7
95% Modified-t UCL	113.5	99% Chebyshev (MVUE) UCL	290
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.44	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	116.7		
nu star	7.045		
Approximate Chi Square Value (.05)	2.196	Nonparametric Statistics	
Adjusted Level of Significance	0.0195	95% CLT UCL	101.5
Adjusted Chi Square Value	1.576	95% Jackknife UCL	109.2
		95% Standard Bootstrap UCL	98.93
Anderson-Darling Test Statistic	0.685	95% Bootstrap-t UCL	255.4
Anderson-Darling 5% Critical Value	0.757	95% Hall's Bootstrap UCL	267.9
Kolmogorov-Smirnov Test Statistic	0.273	95% Percentile Bootstrap UCL	106.9
Kolmogorov-Smirnov 5% Critical Value	0.308	95% BCA Bootstrap UCL	136.4
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	184.3
		97.5% Chebyshev(Mean, Sd) UCL	241.9
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	354.9
95% Approximate Gamma UCL	164.9		
95% Adjusted Gamma UCL	229.7		
Potential UCL to Use		Use 95% Approximate Gamma UCL	164.9

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Silver

General Statistics

Number of Valid Data	8	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	1
		Percent Non-Detects	12.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.18	Minimum Detected	-1.715
Maximum Detected	84.5	Maximum Detected	4.437
Mean of Detected	16.48	Mean of Detected	0.815
SD of Detected	31.25	SD of Detected	2.301
Minimum Non-Detect	1.3	Minimum Non-Detect	0.262
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262

Warning: There are only 7 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.623	Shapiro Wilk Test Statistic	0.92
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	14.5	Mean	0.659
SD	29.47	SD	2.175
95% DL/2 (t) UCL	34.24	95% H-Stat (DL/2) UCL	1264
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	0.631
		SD in Log Scale	2.193
		Mean in Original Scale	14.48
		SD in Original Scale	29.48
		95% Percentile Bootstrap UCL	32.85
		95% BCA Bootstrap UCL	42.93
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.29	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	56.91		
nu star	4.054		
A-D Test Statistic	0.566	Nonparametric Statistics	
5% A-D Critical Value	0.778	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.778	Mean	14.48
5% K-S Critical Value	0.334	SD	27.57
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	10.53
		95% KM (t) UCL	34.43
Assuming Gamma Distribution		95% KM (z) UCL	31.8

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Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	34.23
Minimum	1E-09	95% KM (bootstrap t) UCL	296.9
Maximum	84.5	95% KM (BCA) UCL	35
Mean	14.42	95% KM (Percentile Bootstrap) UCL	32.47
Median	0.755	95% KM (Chebyshev) UCL	60.38
SD	29.51	97.5% KM (Chebyshev) UCL	80.24
k star	0.187	99% KM (Chebyshev) UCL	119.3
Theta star	76.94		
Nu star	2.998	Potential UCLs to Use	
AppChi2	0.372	95% KM (Chebyshev) UCL	60.38
95% Gamma Approximate UCL	116.2		
95% Adjusted Gamma UCL	202.2		
Note: DL/2 is not a recommended method.			

ProUCL Output File
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Vanadium

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	7

Raw Statistics		Log-transformed Statistics	
Minimum	9.9	Minimum of Log Data	2.293
Maximum	51	Maximum of Log Data	3.932
Mean	17.31	Mean of log Data	2.691
Median	12.8	SD of log Data	0.524
SD	13.75		
Coefficient of Variation	0.794		
Skewness	2.719		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.55	Shapiro Wilk Test Statistic	0.694
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	26.52	95% H-UCL	27.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	30.17
95% Adjusted-CLT UCL	30.3	97.5% Chebyshev (MVUE) UCL	36.04
95% Modified-t UCL	27.3	99% Chebyshev (MVUE) UCL	47.57
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.131	Data do not follow a Discernable Distribution (0.05)	
Theta Star	8.123		
nu star	34.1		
Approximate Chi Square Value (.05)	21.75	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	25.31
Adjusted Chi Square Value	19.29	95% Jackknife UCL	26.52
		95% Standard Bootstrap UCL	25.01
Anderson-Darling Test Statistic	1.374	95% Bootstrap-t UCL	73.02
Anderson-Darling 5% Critical Value	0.721	95% Hall's Bootstrap UCL	71.99
Kolmogorov-Smirnov Test Statistic	0.352	95% Percentile Bootstrap UCL	26.76
Kolmogorov-Smirnov 5% Critical Value	0.296	95% BCA Bootstrap UCL	30.81
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	38.5
		97.5% Chebyshev(Mean, Sd) UCL	47.67
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	65.68
95% Approximate Gamma UCL	27.15		
95% Adjusted Gamma UCL	30.61		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	38.5

ProUCL Output File
Central and Southern AOCs
Surface Soil

Zinc

General Statistics

Number of Valid Observations	8	Number of Distinct Observations	8

Raw Statistics		Log-transformed Statistics	
Minimum	20.6	Minimum of Log Data	3.025
Maximum	4280	Maximum of Log Data	8.362
Mean	730.8	Mean of log Data	4.962
Median	93.13	SD of log Data	1.961
SD	1460		
Coefficient of Variation	1.998		
Skewness	2.637		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.563	Shapiro Wilk Test Statistic	0.895
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1709	95% H-UCL	85128
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2396
95% Adjusted-CLT UCL	2094	97.5% Chebyshev (MVUE) UCL	3168
95% Modified-t UCL	1789	99% Chebyshev (MVUE) UCL	4684
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.335	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	2182		
nu star	5.36		
Approximate Chi Square Value (.05)	1.322	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0195	95% CLT UCL	1580
Adjusted Chi Square Value	0.884	95% Jackknife UCL	1709
		95% Standard Bootstrap UCL	1512
Anderson-Darling Test Statistic	0.654	95% Bootstrap-t UCL	5216
Anderson-Darling 5% Critical Value	0.779	95% Hall's Bootstrap UCL	5153
Kolmogorov-Smirnov Test Statistic	0.253	95% Percentile Bootstrap UCL	1696
Kolmogorov-Smirnov 5% Critical Value	0.313	95% BCA Bootstrap UCL	2247
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	2982
		97.5% Chebyshev(Mean, Sd) UCL	3955
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	5869
95% Approximate Gamma UCL	2963		
95% Adjusted Gamma UCL	4432		
Potential UCL to Use		Use 95% Adjusted Gamma UCL	4432

Recommended UCL exceeds the maximum observation

ProUCL Input
Central and Southern AOCs
Aggregate Soil

4,4'-DDD	D_4,4'-DDD	4,4'-DDE	D_4,4'-DDE	4,4'-DDT	D_4,4'-DDT	Aluminum	D_Aluminum	Antimony	D_Antimony	Arsenic	D_Arsenic	Cadmium	D_Cadmium	Chromium	D_Chromium
0.0056	1	0.119	1	0.0589	1	6960	1	2.2	0	3.5	1	0.55	0	7.9	1
0.0014	0	0.0014	0	0.0014	0	8970	1	2.2	0	1.8	1	0.55	0	7	1
0.0014	0	0.0014	0	0.0014	0	6670	1	2.2	0	0.96	1	0.15	1	5.4	1
0.0092	1	0.0944	1	0.2365	1	5300	1	2.65	0	2.85	1	0.545	1	68.1	1
0.0015	0	0.0031	1	0.0024	1	8810	1	2.2	0	1.7	1	0.54	0	8.4	1
0.0257	1	0.0016	0	0.0016	0	3380	1	2.3	0	0.47	0	0.59	0	3	1
0.0019	1	0.0159	1	0.0118	1	6870	1	2.6	0	3	1	0.23	1	7.6	1
0.0015	0	0.0015	0	0.0015	0	5740	1	2.1	0	1.7	1	0.53	0	5.3	1
0.0016	0	0.0347	1	0.0107	1	7490	1	2.4	0	7.6	1	0.21	1	13.5	1
0.0015	0	0.0015	0	0.0015	0	8610	1	2.3	0	3.9	1	0.57	0	8	1
0.0227	1	0.204	1	0.0908	1	19900	1	63.7	1	7.2	1	21.6	1	49.8	1
0.0192	1	0.803	1	0.0934	1	7060	1	18.8	1	3	1	7	1	19.9	1
0.00475	1	0.03725	1	0.01265	1	66650	1	50.65	1	6.15	1	47.7	1	48.8	1
0.0509	1	0.0999	1	0.0564	1	9520	1	18	1	4.3	1	4.7	1	23.8	1
0.197	1	0.792	1	0.573	1	9000	1	11.1	1	4.4	1	3.9	1	19.1	1
0.126	1	1.02	1	0.53	1	27300	1	11.3	1	6.1	1	11.6	1	78.3	1
0.175	1	1.31	1	0.577	1	38600	1	29.5	1	7.5	1	21.1	1	616	1
0.0018	0	0.0053	1	0.0063	1	9960	1	2.7	0	3	1	1.8	1	10.2	1
0.0013	1	0.0267	1	0.0194	1	12100	1	2.5	0	5	1	0.45	1	10.9	1

ProUCL Input
Central and Southern AOCs
Aggregate Soil

Copper	D_Copper	Iron	D_Iron	Lead	D_Lead	Mercury	D_Mercury	Nickel	D_Nickel	Silver	D_Silver	Vanadium	D_Vanadium	Zinc	D_Zinc
7.4	1	6850	1	20.2	1	0.052	1	5.3	1	0.35	1	12.8	1	20.6	1
4.3	1	5210	1	3.4	1	0.014	1	4.9	1	1.1	0	9.9	1	7.4	1
3.5	1	2330	1	3	1	0.017	1	3.4	1	1.1	0	7.1	1	6.8	1
8.75	1	14925	1	72.55	1	0.22	1	256.1	1	0.94	1	9.9	1	121.55	1
4	1	6640	1	5.6	1	0.022	1	4.7	1	1.1	0	12.7	1	17.7	1
1.2	1	1390	1	7.1	1	0.037	0	1	1	1.2	0	3.6	1	2.8	1
8	1	5640	1	12.9	1	0.08	1	3.9	1	0.57	1	10.3	1	21.9	1
3	1	3520	1	3.6	1	0.025	1	2.9	1	1.1	0	7	1	7.7	1
8.3	1	6350	1	17.5	1	0.16	1	4.8	1	0.18	1	12	1	26.7	1
5.3	1	5970	1	5.4	1	0.04	1	5.1	1	1.1	0	11.8	1	16.4	1
854	1	45100	1	2120	1	1.8	1	51.1	1	84.5	1	51	1	4280	1
416	1	8680	1	1070	1	0.34	1	18	1	9	1	12	1	1190	1
2335	1	64250	1	1027	1	0.285	1	74.3	1	43.7	1	13.6	1	3335	1
193	1	11800	1	351	1	0.18	1	15.7	1	4.3	1	16.1	1	603	1
119	1	10400	1	509	1	0.19	1	10	1	2.7	1	14	1	554	1
1790	1	12300	1	573	1	0.16	1	68.4	1	24.5	1	12.8	1	708	1
5100	1	16500	1	1450	1	0.18	1	132	1	31.7	1	15.4	1	1140	1
26.1	1	7070	1	16.9	1	0.061	1	5.7	1	1.3	0	13.6	1	64.7	1
8.7	1	8600	1	7.3	1	0.091	1	6.2	1	1.2	0	16.3	1	22.1	1

ProUCL Output
Central and Southern AOCs
Aggregate Soil

General UCL Statistics for Data Sets with Non-Detects	
User Selected Options	
From File	I:\Newest Wallops\ProUCL Files\ProUCL Input file Soil C+S ALL.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

4,4'-DDD

General Statistics

Number of Valid Data	19	Number of Detected Data	12
Number of Distinct Detected Data	12	Number of Non-Detect Data	7
		Percent Non-Detects	36.84%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0013	Minimum Detected	-6.645
Maximum Detected	0.197	Maximum Detected	-1.625
Mean of Detected	0.0533	Mean of Detected	-3.996
SD of Detected	0.0711	SD of Detected	1.692
Minimum Non-Detect	0.0014	Minimum Non-Detect	-6.571
Maximum Non-Detect	0.0018	Maximum Non-Detect	-6.32
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	8
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	11
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	42.11%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.735	Shapiro Wilk Test Statistic	0.951
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0339	Mean	-5.169
SD	0.0613	SD	2.06
95% DL/2 (t) UCL	0.0583	95% H-Stat (DL/2) UCL	0.251
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0053	Mean in Log Scale	-5.214
SD	0.088	SD in Log Scale	2.139
95% MLE (t) UCL	0.0403	Mean in Original Scale	0.0339
95% MLE (Tiku) UCL	0.0453	SD in Original Scale	0.0613
		95% Percentile Bootstrap UCL	0.059
		95% BCA Bootstrap UCL	0.0637
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.493	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.108		
nu star	11.83		

ProUCL Output
Central and Southern AOCs
Aggregate Soil

A-D Test Statistic	0.421	Nonparametric Statistics	
5% A-D Critical Value	0.778	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.778	Mean	0.0341
5% K-S Critical Value	0.257	SD	0.0596
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0143
		95% KM (t) UCL	0.0589
Assuming Gamma Distribution		95% KM (z) UCL	0.0576
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0583
Minimum	1E-09	95% KM (bootstrap t) UCL	0.0756
Maximum	0.197	95% KM (BCA) UCL	0.0579
Mean	0.0381	95% KM (Percentile Bootstrap) UCL	0.0588
Median	0.0092	95% KM (Chebyshev) UCL	0.0964
SD	0.0597	97.5% KM (Chebyshev) UCL	0.123
k star	0.264	99% KM (Chebyshev) UCL	0.176
Theta star	0.144		
Nu star	10.04	Potential UCLs to Use	
AppChi2	3.967	95% KM (BCA) UCL	0.0579
95% Gamma Approximate UCL	0.0965		
95% Adjusted Gamma UCL	0.105		
Note: DL/2 is not a recommended method.			

ProUCL Output
Central and Southern AOCs
Aggregate Soil

4,4'-DDE

General Statistics			
Number of Valid Data	19	Number of Detected Data	14
Number of Distinct Detected Data	14	Number of Non-Detect Data	5
		Percent Non-Detects	26.32%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0031	Minimum Detected	-5.776
Maximum Detected	1.31	Maximum Detected	0.27
Mean of Detected	0.326	Mean of Detected	-2.427
SD of Detected	0.449	SD of Detected	1.939
Minimum Non-Detect	0.0014	Minimum Non-Detect	-6.571
Maximum Non-Detect	0.0016	Maximum Non-Detect	-6.438
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	14
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	26.32%

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.729	Shapiro Wilk Test Statistic	0.946
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.24	Mean	-3.686
SD	0.409	SD	2.72
95% DL/2 (t) UCL	0.403	95% H-Stat (DL/2) UCL	22.57
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.15	Mean in Log Scale	-3.623
SD	0.494	SD in Log Scale	2.651
95% MLE (t) UCL	0.346	Mean in Original Scale	0.241
95% MLE (Tiku) UCL	0.351	SD in Original Scale	0.409
		95% Percentile Bootstrap UCL	0.403
		95% BCA Bootstrap UCL	0.432
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.431	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.756		
nu star	12.07		
A-D Test Statistic	0.548	Nonparametric Statistics	
5% A-D Critical Value	0.796	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.796	Mean	0.241
5% K-S Critical Value	0.242	SD	0.398
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0946
		95% KM (t) UCL	0.405
Assuming Gamma Distribution		95% KM (z) UCL	0.397

ProUCL Output
Central and Southern AOCs
Aggregate Soil

Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.403
Minimum	1E-09	95% KM (bootstrap t) UCL	0.464
Maximum	1.31	95% KM (BCA) UCL	0.395
Mean	0.24	95% KM (Percentile Bootstrap) UCL	0.405
Median	0.0347	95% KM (Chebyshev) UCL	0.654
SD	0.409	97.5% KM (Chebyshev) UCL	0.832
k star	0.148	99% KM (Chebyshev) UCL	1.183
Theta star	1.622		
Nu star	5.63	**Potential UCLs to Use**	
AppChi2	1.454	95% KM (Chebyshev) UCL	0.654
95% Gamma Approximate UCL	0.931		
95% Adjusted Gamma UCL	1.059		
Note: DL/2 is not a recommended method.			

ProUCL Output
Central and Southern AOCs
Aggregate Soil

4,4'-DDT

General Statistics

Number of Valid Data	19	Number of Detected Data	14
Number of Distinct Detected Data	14	Number of Non-Detect Data	5
		Percent Non-Detects	26.32%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0024	Minimum Detected	-6.032
Maximum Detected	0.577	Maximum Detected	-0.55
Mean of Detected	0.163	Mean of Detected	-3.004
SD of Detected	0.224	SD of Detected	1.786
Minimum Non-Detect	0.0014	Minimum Non-Detect	-6.571
Maximum Non-Detect	0.0016	Maximum Non-Detect	-6.438
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	14
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	26.32%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.696	Shapiro Wilk Test Statistic	0.938
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.12	Mean	-4.111
SD	0.204	SD	2.434
95% DL/2 (t) UCL	0.201	95% H-Stat (DL/2) UCL	4.066
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0751	Mean in Log Scale	-4.11
SD	0.246	SD in Log Scale	2.448
95% MLE (t) UCL	0.173	Mean in Original Scale	0.12
95% MLE (Tiku) UCL	0.175	SD in Original Scale	0.204
		95% Percentile Bootstrap UCL	0.202
		95% BCA Bootstrap UCL	0.226
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.464	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	0.351		
nu star	12.99		
A-D Test Statistic	0.614	**Nonparametric Statistics**	
5% A-D Critical Value	0.791	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.791	Mean	0.121
5% K-S Critical Value	0.241	SD	0.198
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0472
		95% KM (t) UCL	0.202
Assuming Gamma Distribution		95% KM (z) UCL	0.198

ProUCL Output
Central and Southern AOCs
Aggregate Soil

Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.201
Minimum	1E-09	95% KM (bootstrap t) UCL	0.239
Maximum	0.577	95% KM (BCA) UCL	0.209
Mean	0.12	95% KM (Percentile Bootstrap) UCL	0.201
Median	0.0127	95% KM (Chebyshev) UCL	0.326
SD	0.204	97.5% KM (Chebyshev) UCL	0.415
k star	0.153	99% KM (Chebyshev) UCL	0.59
Theta star	0.784		
Nu star	5.812	**Potential UCLs to Use**	
AppChi2	1.545	95% KM (Chebyshev) UCL	0.326
95% Gamma Approximate UCL	0.451		
95% Adjusted Gamma UCL	0.512		

Note: DL/2 is not a recommended method.

ProUCL Output
Central and Southern AOCs
Aggregate Soil

Aluminum

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	3380	Minimum of Log Data	8.126
Maximum	66650	Maximum of Log Data	11.11
Mean	14152	Mean of log Data	9.238
Median	8810	SD of log Data	0.727
SD	15341		
Coefficient of Variation	1.084		
Skewness	2.693		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.614	Shapiro Wilk Test Statistic	0.87
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	20255	95% H-UCL	19711
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	23413
95% Adjusted-CLT UCL	22265	97.5% Chebyshev (MVUE) UCL	27844
95% Modified-t UCL	20617	99% Chebyshev (MVUE) UCL	36549
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.478	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	9573		
nu star	56.18		
Approximate Chi Square Value (.05)	39.95	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0369	95% CLT UCL	19941
Adjusted Chi Square Value	38.76	95% Jackknife UCL	20255
		95% Standard Bootstrap UCL	19916
Anderson-Darling Test Statistic	1.764	95% Bootstrap-t UCL	30651
Anderson-Darling 5% Critical Value	0.755	95% Hall's Bootstrap UCL	39924
Kolmogorov-Smirnov Test Statistic	0.305	95% Percentile Bootstrap UCL	20591
Kolmogorov-Smirnov 5% Critical Value	0.202	95% BCA Bootstrap UCL	22286
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	29493
		97.5% Chebyshev(Mean, Sd) UCL	36131
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	49170
95% Approximate Gamma UCL	19900		
95% Adjusted Gamma UCL	20514		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	29493

ProUCL Output
Central and Southern AOCs
Aggregate Soil

Antimony

General Statistics

Number of Valid Data	19	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	12
		Percent Non-Detects	63.16%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	11.1	Minimum Detected	2.407
Maximum Detected	63.7	Maximum Detected	4.154
Mean of Detected	29.01	Mean of Detected	3.16
SD of Detected	20.54	SD of Detected	0.69
Minimum Non-Detect	2.1	Minimum Non-Detect	0.742
Maximum Non-Detect	2.7	Maximum Non-Detect	0.993
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	12
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	7
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	63.16%

Warning: There are only 7 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.848	Shapiro Wilk Test Statistic	0.911
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	11.43	Mean	1.267
SD	18.19	SD	1.539
95% DL/2 (t) UCL	18.67	95% H-Stat (DL/2) UCL	25.82
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.7
		SD in Log Scale	1.264
		Mean in Original Scale	12.3
		SD in Original Scale	17.7
		95% Percentile Bootstrap UCL	19.28
		95% BCA Bootstrap UCL	20.99
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.56	**Data appear Normal at 5% Significance Level**	
Theta Star	18.6		
nu star	21.83		

ProUCL Output
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A-D Test Statistic	0.402	**Nonparametric Statistics**	
5% A-D Critical Value	0.713	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.713	Mean	17.7
5% K-S Critical Value	0.314	SD	14.42
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	3.573
		95% KM (t) UCL	23.89
Assuming Gamma Distribution		95% KM (z) UCL	23.57
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	23.49
Minimum	11.1	95% KM (bootstrap t) UCL	32.07
Maximum	63.7	95% KM (BCA) UCL	30.25
Mean	29.1	95% KM (Percentile Bootstrap) UCL	25.98
Median	29.38	95% KM (Chebyshev) UCL	33.27
SD	12.41	97.5% KM (Chebyshev) UCL	40.01
k star	5.155	99% KM (Chebyshev) UCL	53.24
Theta star	5.646		
Nu star	195.9	**Potential UCLs to Use**	
AppChi2	164.5	95% KM (t) UCL	23.89
95% Gamma Approximate UCL	34.66	95% KM (Percentile Bootstrap) UCL	25.98
95% Adjusted Gamma UCL	35.19		

Note: DL/2 is not a recommended method.

Arsenic

General Statistics

Number of Valid Data	19	Number of Detected Data	18
Number of Distinct Detected Data	15	Number of Non-Detect Data	1
		Percent Non-Detects	5.26%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.96	Minimum Detected	-0.0408
Maximum Detected	7.6	Maximum Detected	2.028
Mean of Detected	4.092	Mean of Detected	1.264
SD of Detected	2.098	SD of Detected	0.586
Minimum Non-Detect	0.47	Minimum Non-Detect	-0.755
Maximum Non-Detect	0.47	Maximum Non-Detect	-0.755

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.934	Shapiro Wilk Test Statistic	0.943
5% Shapiro Wilk Critical Value	0.897	5% Shapiro Wilk Critical Value	0.897
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.889	Mean	1.121
SD	2.223	SD	0.843
95% DL/2 (t) UCL	4.773	95% H-Stat (DL/2) UCL	6.146
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	3.85	Mean in Log Scale	1.19

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SD	2.244	SD in Log Scale	0.655
95% MLE (t) UCL	4.743	Mean in Original Scale	3.922
95% MLE (Tiku) UCL	4.741	SD in Original Scale	2.17
		95% Percentile Bootstrap UCL	4.725
		95% BCA Bootstrap UCL	4.769
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	3.046	**Data appear Normal at 5% Significance Level**	
Theta Star	1.344		
nu star	109.6		
A-D Test Statistic	0.297	**Nonparametric Statistics**	
5% A-D Critical Value	0.744	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.744	Mean	3.927
5% K-S Critical Value	0.205	SD	2.104
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.497
		95% KM (t) UCL	4.789
Assuming Gamma Distribution		95% KM (z) UCL	4.744
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	4.773
Minimum	1E-09	95% KM (bootstrap t) UCL	4.837
Maximum	7.6	95% KM (BCA) UCL	4.739
Mean	3.877	95% KM (Percentile Bootstrap) UCL	4.753
Median	3.5	95% KM (Chebyshev) UCL	6.092
SD	2.245	97.5% KM (Chebyshev) UCL	7.029
k star	0.463	99% KM (Chebyshev) UCL	8.87
Theta star	8.379		
Nu star	17.58	**Potential UCLs to Use**	
AppChi2	9.089	95% KM (t) UCL	4.789
95% Gamma Approximate UCL	7.499	95% KM (Percentile Bootstrap) UCL	4.753
95% Adjusted Gamma UCL	7.965		
Note: DL/2 is not a recommended method.			

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Cadmium

General Statistics

Number of Valid Data	19	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	6
		Percent Non-Detects	31.58%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.15	Minimum Detected	-1.897
Maximum Detected	47.7	Maximum Detected	3.865
Mean of Detected	9.307	Mean of Detected	0.888
SD of Detected	13.8	SD of Detected	1.979
Minimum Non-Detect	0.53	Minimum Non-Detect	-0.635
Maximum Non-Detect	0.59	Maximum Non-Detect	-0.528
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	11
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	8
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	57.89%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.714	Shapiro Wilk Test Statistic	0.928
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	6.455	Mean	0.203
SD	12.07	SD	1.92
95% DL/2 (t) UCL	11.26	95% H-Stat (DL/2) UCL	59.04
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	0.238
		SD in Log Scale	1.905
		Mean in Original Scale	6.473
		SD in Original Scale	12.06
		95% Percentile Bootstrap UCL	11.47
		95% BCA Bootstrap UCL	13.58
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.418	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	22.27		
nu star	10.87		
A-D Test Statistic	0.38	Nonparametric Statistics	
5% A-D Critical Value	0.795	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.795	Mean	6.458
5% K-S Critical Value	0.251	SD	11.74
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	2.804
		95% KM (t) UCL	11.32
Assuming Gamma Distribution		95% KM (z) UCL	11.07

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Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	11.26
Minimum	0.15	95% KM (bootstrap t) UCL	16.39
Maximum	47.7	95% KM (BCA) UCL	11.48
Mean	7.687	95% KM (Percentile Bootstrap) UCL	11.4
Median	3.9	95% KM (Chebyshev) UCL	18.68
SD	11.6	97.5% KM (Chebyshev) UCL	23.97
k star	0.544	99% KM (Chebyshev) UCL	34.36
Theta star	14.13		
Nu star	20.68	**Potential UCLs to Use**	
AppChi2	11.35	95% KM (BCA) UCL	11.48
95% Gamma Approximate UCL	14		
95% Adjusted Gamma UCL	14.79		
Note: DL/2 is not a recommended method.			

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Chromium

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	3	Minimum of Log Data	1.099
Maximum	616	Maximum of Log Data	6.423
Mean	53.21	Mean of log Data	2.838
Median	10.9	SD of log Data	1.266
SD	138.1		
Coefficient of Variation	2.596		
Skewness	4.174		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.365	Shapiro Wilk Test Statistic	0.892
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	108.2	95% H-UCL	93.44
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	87.58
95% Adjusted-CLT UCL	137.8	97.5% Chebyshev (MVUE) UCL	110.1
95% Modified-t UCL	113.2	99% Chebyshev (MVUE) UCL	154.3
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.499	Data do not follow a Discernable Distribution (0.05)	
Theta Star	106.6		
nu star	18.96		
Approximate Chi Square Value (.05)	10.09	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0369	95% CLT UCL	105.3
Adjusted Chi Square Value	9.526	95% Jackknife UCL	108.2
		95% Standard Bootstrap UCL	103.3
Anderson-Darling Test Statistic	2.069	95% Bootstrap-t UCL	363
Anderson-Darling 5% Critical Value	0.798	95% Hall's Bootstrap UCL	287.9
Kolmogorov-Smirnov Test Statistic	0.259	95% Percentile Bootstrap UCL	115
Kolmogorov-Smirnov 5% Critical Value	0.209	95% BCA Bootstrap UCL	146.1
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	191.3
		97.5% Chebyshev(Mean, Sd) UCL	251.1
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	368.5
95% Approximate Gamma UCL	100		
95% Adjusted Gamma UCL	105.9		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	368.5

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Copper

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	1.2	Minimum of Log Data	0.182
Maximum	5100	Maximum of Log Data	8.537
Mean	573.5	Mean of log Data	3.55
Median	8.7	SD of log Data	2.632
SD	1277		
Coefficient of Variation	2.228		
Skewness	2.91		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.529	Shapiro Wilk Test Statistic	0.869
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1082	95% H-UCL	31546
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2589
95% Adjusted-CLT UCL	1265	97.5% Chebyshev (MVUE) UCL	3439
95% Modified-t UCL	1114	99% Chebyshev (MVUE) UCL	5109
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.248	Data do not follow a Discernable Distribution (0.05)	
Theta Star	2311		
nu star	9.429		
Approximate Chi Square Value (.05)	3.588	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0369	95% CLT UCL	1055
Adjusted Chi Square Value	3.279	95% Jackknife UCL	1082
		95% Standard Bootstrap UCL	1045
Anderson-Darling Test Statistic	1.75	95% Bootstrap-t UCL	1869
Anderson-Darling 5% Critical Value	0.864	95% Hall's Bootstrap UCL	2390
Kolmogorov-Smirnov Test Statistic	0.309	95% Percentile Bootstrap UCL	1072
Kolmogorov-Smirnov 5% Critical Value	0.217	95% BCA Bootstrap UCL	1297
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1851
		97.5% Chebyshev(Mean, Sd) UCL	2404
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3489
95% Approximate Gamma UCL	1507		
95% Adjusted Gamma UCL	1649		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	3489

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Iron

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	1390	Minimum of Log Data	7.237
Maximum	64250	Maximum of Log Data	11.07
Mean	12817	Mean of log Data	9.031
Median	7070	SD of log Data	0.895
SD	15598		
Coefficient of Variation	1.217		
Skewness	2.685		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.612	Shapiro Wilk Test Statistic	0.949
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	19022	95% H-UCL	20958
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	24014
95% Adjusted-CLT UCL	21058	97.5% Chebyshev (MVUE) UCL	29161
95% Modified-t UCL	19390	99% Chebyshev (MVUE) UCL	39269
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.138	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	11262		
nu star	43.25		
Approximate Chi Square Value (.05)	29.17	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0369	95% CLT UCL	18703
Adjusted Chi Square Value	28.16	95% Jackknife UCL	19022
		95% Standard Bootstrap UCL	18573
Anderson-Darling Test Statistic	1.069	95% Bootstrap-t UCL	33399
Anderson-Darling 5% Critical Value	0.762	95% Hall's Bootstrap UCL	50543
Kolmogorov-Smirnov Test Statistic	0.191	95% Percentile Bootstrap UCL	18872
Kolmogorov-Smirnov 5% Critical Value	0.203	95% BCA Bootstrap UCL	21280
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	28415
		97.5% Chebyshev(Mean, Sd) UCL	35165
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	48422
95% Approximate Gamma UCL	19004		
95% Adjusted Gamma UCL	19685		
Potential UCL to Use		Use 95% Approximate Gamma UCL	19004

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Lead

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	3	Minimum of Log Data	1.099
Maximum	2120	Maximum of Log Data	7.659
Mean	382.9	Mean of log Data	3.884
Median	17.5	SD of log Data	2.397
SD	611.4		
Coefficient of Variation	1.597		
Skewness	1.753		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.694	Shapiro Wilk Test Statistic	0.859
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	626.1	95% H-UCL	14197
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	2173
95% Adjusted-CLT UCL	673.9	97.5% Chebyshev (MVUE) UCL	2873
95% Modified-t UCL	635.5	99% Chebyshev (MVUE) UCL	4248
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.312	Data do not follow a Discernable Distribution (0.05)	
Theta Star	1227		
nu star	11.86		
Approximate Chi Square Value (.05)	5.137	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0369	95% CLT UCL	613.6
Adjusted Chi Square Value	4.755	95% Jackknife UCL	626.1
		95% Standard Bootstrap UCL	608.5
Anderson-Darling Test Statistic	1.374	95% Bootstrap-t UCL	777.1
Anderson-Darling 5% Critical Value	0.837	95% Hall's Bootstrap UCL	686.3
Kolmogorov-Smirnov Test Statistic	0.285	95% Percentile Bootstrap UCL	618
Kolmogorov-Smirnov 5% Critical Value	0.214	95% BCA Bootstrap UCL	673.8
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	994.3
		97.5% Chebyshev(Mean, Sd) UCL	1259
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1778
95% Approximate Gamma UCL	884.3		
95% Adjusted Gamma UCL	955.4		
Potential UCL to Use		Use 99% Chebyshev (Mean, Sd) UCL	1778

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Mercury

General Statistics

Number of Valid Data	19	Number of Detected Data	18
Number of Distinct Detected Data	16	Number of Non-Detect Data	1
		Percent Non-Detects	5.26%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.014	Minimum Detected	-4.269
Maximum Detected	1.8	Maximum Detected	0.588
Mean of Detected	0.218	Mean of Detected	-2.32
SD of Detected	0.407	SD of Detected	1.234
Minimum Non-Detect	0.037	Minimum Non-Detect	-3.297
Maximum Non-Detect	0.037	Maximum Non-Detect	-3.297

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.461	Shapiro Wilk Test Statistic	0.955
5% Shapiro Wilk Critical Value	0.897	5% Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.207	Mean	-2.408
SD	0.398	SD	1.259
95% DL/2 (t) UCL	0.365	95% H-Stat (DL/2) UCL	0.481
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.12	Mean in Log Scale	-2.404
SD	0.472	SD in Log Scale	1.254
95% MLE (t) UCL	0.308	Mean in Original Scale	0.207
95% MLE (Tiku) UCL	0.311	SD in Original Scale	0.398
		95% Percentile Bootstrap UCL	0.383
		95% BCA Bootstrap UCL	0.477
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.664	Data Follow Appr. Gamma Distribution at 5% Significance Level	
Theta Star	0.328		
nu star	23.91		
A-D Test Statistic	0.826	Nonparametric Statistics	
5% A-D Critical Value	0.778	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.778	Mean	0.207
5% K-S Critical Value	0.211	SD	0.387
Data follow Appr. Gamma Distribution at 5% Significance Level		SE of Mean	0.0914
		95% KM (t) UCL	0.366
Assuming Gamma Distribution		95% KM (z) UCL	0.357
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.365
Minimum	1E-09	95% KM (bootstrap t) UCL	0.739
Maximum	1.8	95% KM (BCA) UCL	0.39

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Mean	0.206	95% KM (Percentile Bootstrap) UCL	0.383
Median	0.091	95% KM (Chebyshev) UCL	0.605
SD	0.398	97.5% KM (Chebyshev) UCL	0.778
k star	0.361	99% KM (Chebyshev) UCL	1.116
Theta star	0.571		
Nu star	13.72	**Potential UCLs to Use**	
AppChi2	6.378	95% KM (Chebyshev) UCL	0.605
95% Gamma Approximate UCL	0.443		
95% Adjusted Gamma UCL	0.476		

Note: DL/2 is not a recommended method.

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Nickel

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	1	Minimum of Log Data	0
Maximum	256.1	Maximum of Log Data	5.546
Mean	35.45	Mean of log Data	2.424
Median	5.7	SD of log Data	1.486
SD	63.62		
Coefficient of Variation	1.795		
Skewness	2.744		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.585	Shapiro Wilk Test Statistic	0.904
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	60.76	95% H-UCL	110.6
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	84.44
95% Adjusted-CLT UCL	69.27	97.5% Chebyshev (MVUE) UCL	107.7
95% Modified-t UCL	62.29	99% Chebyshev (MVUE) UCL	153.5
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.496	Data appear Lognormal at 5% Significance Level	
Theta Star	71.44		
nu star	18.86		
Approximate Chi Square Value (.05)	10.01	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0369	95% CLT UCL	59.45
Adjusted Chi Square Value	9.452	95% Jackknife UCL	60.76
		95% Standard Bootstrap UCL	58.99
Anderson-Darling Test Statistic	1.603	95% Bootstrap-t UCL	92.08
Anderson-Darling 5% Critical Value	0.798	95% Hall's Bootstrap UCL	149.5
Kolmogorov-Smirnov Test Statistic	0.278	95% Percentile Bootstrap UCL	60.78
Kolmogorov-Smirnov 5% Critical Value	0.209	95% BCA Bootstrap UCL	71.96
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	99.06
		97.5% Chebyshev(Mean, Sd) UCL	126.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	180.7
95% Approximate Gamma UCL	66.76		
95% Adjusted Gamma UCL	70.72		
Potential UCL to Use		Use 95% Chebyshev (MVUE) UCL	84.44

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Silver

General Statistics

Number of Valid Data	19	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	8
		Percent Non-Detects	42.11%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.18	Minimum Detected	-1.715
Maximum Detected	84.5	Maximum Detected	4.437
Mean of Detected	18.4	Mean of Detected	1.466
SD of Detected	26.53	SD of Detected	2.116
Minimum Non-Detect	1.1	Minimum Non-Detect	0.0953
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	12
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	7
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	63.16%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.746	Shapiro Wilk Test Statistic	0.944
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	10.9	Mean	0.615
SD	21.74	SD	1.882
95% DL/2 (t) UCL	19.55	95% H-Stat (DL/2) UCL	41.97
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	0.516
		SD in Log Scale	2.048
		Mean in Original Scale	10.93
		SD in Original Scale	21.73
		95% Percentile Bootstrap UCL	19.68
		95% BCA Bootstrap UCL	22.22
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.386	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	47.72		
nu star	8.485		
A-D Test Statistic	0.328	**Nonparametric Statistics**	
5% A-D Critical Value	0.791	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.791	Mean	10.87
5% K-S Critical Value	0.271	SD	21.18
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	5.096
		95% KM (t) UCL	19.71
Assuming Gamma Distribution		95% KM (z) UCL	19.25

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Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	19.53
Minimum	0.18	95% KM (bootstrap t) UCL	28.08
Maximum	84.5	95% KM (BCA) UCL	19.63
Mean	18.27	95% KM (Percentile Bootstrap) UCL	19.31
Median	12.51	95% KM (Chebyshev) UCL	33.08
SD	20.25	97.5% KM (Chebyshev) UCL	42.69
k star	0.625	99% KM (Chebyshev) UCL	61.58
Theta star	29.24		
Nu star	23.75	Potential UCLs to Use	
AppChi2	13.66	95% KM (BCA) UCL	19.63
95% Gamma Approximate UCL	31.77		
95% Adjusted Gamma UCL	33.4		
Note: DL/2 is not a recommended method.			

ProUCL Output
Central and Southern AOCs
Aggregate Soil

Vanadium

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	15

Raw Statistics		Log-transformed Statistics	
Minimum	3.6	Minimum of Log Data	1.281
Maximum	51	Maximum of Log Data	3.932
Mean	13.78	Mean of log Data	2.488
Median	12.7	SD of log Data	0.501
SD	9.573		
Coefficient of Variation	0.694		
Skewness	3.519		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.566	Shapiro Wilk Test Statistic	0.851
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	17.59	95% H-UCL	17.31
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	20.58
95% Adjusted-CLT UCL	19.29	97.5% Chebyshev (MVUE) UCL	23.62
95% Modified-t UCL	17.89	99% Chebyshev (MVUE) UCL	29.6
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	3.283	Data do not follow a Discernable Distribution (0.05)	
Theta Star	4.199		
nu star	124.7		
Approximate Chi Square Value (.05)	99.95	Nonparametric Statistics	
Adjusted Level of Significance	0.0369	95% CLT UCL	17.4
Adjusted Chi Square Value	98.01	95% Jackknife UCL	17.59
		95% Standard Bootstrap UCL	17.38
Anderson-Darling Test Statistic	1.475	95% Bootstrap-t UCL	21.8
Anderson-Darling 5% Critical Value	0.746	95% Hall's Bootstrap UCL	33.59
Kolmogorov-Smirnov Test Statistic	0.253	95% Percentile Bootstrap UCL	17.98
Kolmogorov-Smirnov 5% Critical Value	0.199	95% BCA Bootstrap UCL	20.19
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	23.36
		97.5% Chebyshev(Mean, Sd) UCL	27.5
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	35.64
95% Approximate Gamma UCL	17.2		
95% Adjusted Gamma UCL	17.54		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	23.36

ProUCL Output
Central and Southern AOCs
Aggregate Soil

Zinc

General Statistics

Number of Valid Observations	19	Number of Distinct Observations	19

Raw Statistics		Log-transformed Statistics	
Minimum	2.8	Minimum of Log Data	1.03
Maximum	4280	Maximum of Log Data	8.362
Mean	639.3	Mean of log Data	4.421
Median	26.7	SD of log Data	2.315
SD	1192		
Coefficient of Variation	1.865		
Skewness	2.395		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.599	Shapiro Wilk Test Statistic	0.909
Shapiro Wilk Critical Value	0.901	Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	1114	95% H-UCL	16811
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	3130
95% Adjusted-CLT UCL	1250	97.5% Chebyshev (MVUE) UCL	4130
95% Modified-t UCL	1139	99% Chebyshev (MVUE) UCL	6093
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.315	**Data appear Lognormal at 5% Significance Level**	
Theta Star	2029		
nu star	11.97		
Approximate Chi Square Value (.05)	5.209	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0369	95% CLT UCL	1089
Adjusted Chi Square Value	4.824	95% Jackknife UCL	1114
		95% Standard Bootstrap UCL	1066
Anderson-Darling Test Statistic	1.168	95% Bootstrap-t UCL	1840
Anderson-Darling 5% Critical Value	0.836	95% Hall's Bootstrap UCL	3205
Kolmogorov-Smirnov Test Statistic	0.257	95% Percentile Bootstrap UCL	1107
Kolmogorov-Smirnov 5% Critical Value	0.214	95% BCA Bootstrap UCL	1277
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1832
		97.5% Chebyshev(Mean, Sd) UCL	2347
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3361
95% Approximate Gamma UCL	1469		
95% Adjusted Gamma UCL	1587		
Potential UCL to Use		Use 99% Chebyshev (MVUE) UCL	6093

Recommended UCL exceeds the maximum observation

ProUCL Input
Northern and Western AOCs
Surface Soil

Aluminum	D_Aluminum	Arsenic	D_Arsenic	Manganese	D_Manganese	Vanadium	D_Vanadium
7760	1	4.4	1	122	1	12	1
10300	1	2.7	1	101	1	15.8	1
5110	1	1.2	1	26.2	1	6.8	1
10200	1	2.5	1	106	1	14.7	1
8870	1	4.7	1	137	1	14.4	1

ProUCL Output
Northern and Western AOCs
Surface Soil

General UCL Statistics for Data Sets with Non-Detects	
User Selected Options	
From File	C:\Human Health Risk Assessment\ProUCL Soil inputs (W+N) (0-0.5 ft).wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

ProUCL Output
Northern and Western AOCs
Surface Soil

Aluminum

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	5110	Minimum of Log Data	8.539
Maximum	10300	Maximum of Log Data	9.24
Mean	8448	Mean of log Data	9.011
Median	8870	SD of log Data	0.288
SD	2139		
Coefficient of Variation	0.253		
Skewness	-1.095		

Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 5 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.891	Shapiro Wilk Test Statistic	0.851
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	10487	95% H-UCL	12032
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	13217
95% Adjusted-CLT UCL	9520	97.5% Chebyshev (MVUE) UCL	15271
95% Modified-t UCL	10409	99% Chebyshev (MVUE) UCL	19306
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	6.767	Data appear Normal at 5% Significance Level	
Theta Star	1248		
nu star	67.67		
Approximate Chi Square Value (.05)	49.74	Nonparametric Statistics	
Adjusted Level of Significance	0.0086	95% CLT UCL	10021
Adjusted Chi Square Value	43.09	95% Jackknife UCL	10487
		95% Standard Bootstrap UCL	9875
Anderson-Darling Test Statistic	0.422	95% Bootstrap-t UCL	9907
Anderson-Darling 5% Critical Value	0.679	95% Hall's Bootstrap UCL	9612
Kolmogorov-Smirnov Test Statistic	0.211	95% Percentile Bootstrap UCL	9752
Kolmogorov-Smirnov 5% Critical Value	0.357	95% BCA Bootstrap UCL	9466
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	12617
		97.5% Chebyshev(Mean, Sd) UCL	14421
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	17964
95% Approximate Gamma UCL	11494		
95% Adjusted Gamma UCL	13266		
Potential UCL to Use		Use 95% Student's-t UCL	10487

Recommended UCL exceeds the maximum observation

ProUCL Output
Northern and Western AOCs
Surface Soil

Arsenic

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	1.2	Minimum of Log Data	0.182
Maximum	4.7	Maximum of Log Data	1.548
Mean	3.1	Mean of log Data	1.024
Median	2.7	SD of log Data	0.549
SD	1.447		
Coefficient of Variation	0.467		
Skewness	-0.116		

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If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 5 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

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Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.925	Shapiro Wilk Test Statistic	0.904
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	4.48	95% H-UCL	7.594
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	6.45
95% Adjusted-CLT UCL	4.129	97.5% Chebyshev (MVUE) UCL	7.884
95% Modified-t UCL	4.474	99% Chebyshev (MVUE) UCL	10.7
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.063	**Data appear Normal at 5% Significance Level**	
Theta Star	1.502		
nu star	20.63		
Approximate Chi Square Value (.05)	11.32	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0086	95% CLT UCL	4.165
Adjusted Chi Square Value	8.467	95% Jackknife UCL	4.48
		95% Standard Bootstrap UCL	4.057
Anderson-Darling Test Statistic	0.328	95% Bootstrap-t UCL	5.007
Anderson-Darling 5% Critical Value	0.681	95% Hall's Bootstrap UCL	5.621
Kolmogorov-Smirnov Test Statistic	0.233	95% Percentile Bootstrap UCL	4.08
Kolmogorov-Smirnov 5% Critical Value	0.358	95% BCA Bootstrap UCL	4
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	5.922
		97.5% Chebyshev(Mean, Sd) UCL	7.142
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	9.541
95% Approximate Gamma UCL	5.651		
95% Adjusted Gamma UCL	7.554		
Potential UCL to Use		Use 95% Student's-t UCL	4.48

ProUCL Output
Northern and Western AOCs
Surface Soil

Iron

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	3460	Minimum of Log Data	8.149
Maximum	8880	Maximum of Log Data	9.092
Mean	7022	Mean of log Data	8.804
Median	7640	SD of log Data	0.388
SD	2216		
Coefficient of Variation	0.316		
Skewness	-1.306		

Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 5 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Test Statistic	0.81
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	9135	95% H-UCL	11942
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	12395
95% Adjusted-CLT UCL	8034	97.5% Chebyshev (MVUE) UCL	14698
95% Modified-t UCL	9038	99% Chebyshev (MVUE) UCL	19221
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	4.015	Data appear Normal at 5% Significance Level	
Theta Star	1749		
nu star	40.15		
Approximate Chi Square Value (.05)	26.63	Nonparametric Statistics	
Adjusted Level of Significance	0.0086	95% CLT UCL	8652
Adjusted Chi Square Value	21.94	95% Jackknife UCL	9135
		95% Standard Bootstrap UCL	8491
Anderson-Darling Test Statistic	0.503	95% Bootstrap-t UCL	8452
Anderson-Darling 5% Critical Value	0.679	95% Hall's Bootstrap UCL	7980
Kolmogorov-Smirnov Test Statistic	0.245	95% Percentile Bootstrap UCL	8346
Kolmogorov-Smirnov 5% Critical Value	0.358	95% BCA Bootstrap UCL	8106
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	11342
		97.5% Chebyshev(Mean, Sd) UCL	13211
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	16883
95% Approximate Gamma UCL	10587		
95% Adjusted Gamma UCL	12850		
Potential UCL to Use		Use 95% Student's-t UCL	9135

Recommended UCL exceeds the maximum observation

ProUCL Output
Northern and Western AOCs
Surface Soil

Mercury

General Statistics

Number of Valid Observations	5	Number of Distinct Observations	5

Raw Statistics		Log-transformed Statistics	
Minimum	0.014	Minimum of Log Data	-4.269
Maximum	0.077	Maximum of Log Data	-2.564
Mean	0.0422	Mean of log Data	-3.354
Median	0.05	SD of log Data	0.725
SD	0.0259		
Coefficient of Variation	0.614		
Skewness	0.201		

Warning: A sample size of 'n' = 5 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 5 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.917	Shapiro Wilk Test Statistic	0.894
Shapiro Wilk Critical Value	0.762	Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.0669	95% H-UCL	0.178
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.102
95% Adjusted-CLT UCL	0.0624	97.5% Chebyshev (MVUE) UCL	0.128
95% Modified-t UCL	0.0671	99% Chebyshev (MVUE) UCL	0.178
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.258	**Data appear Normal at 5% Significance Level**	
Theta Star	0.0335		
nu star	12.58		
Approximate Chi Square Value (.05)	5.614	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0086	95% CLT UCL	0.0613
Adjusted Chi Square Value	3.761	95% Jackknife UCL	0.0669
		95% Standard Bootstrap UCL	0.0595
Anderson-Darling Test Statistic	0.395	95% Bootstrap-t UCL	0.0729
Anderson-Darling 5% Critical Value	0.683	95% Hall's Bootstrap UCL	0.0575
Kolmogorov-Smirnov Test Statistic	0.288	95% Percentile Bootstrap UCL	0.0602
Kolmogorov-Smirnov 5% Critical Value	0.36	95% BCA Bootstrap UCL	0.0592
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.0927
		97.5% Chebyshev(Mean, Sd) UCL	0.115
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.157
95% Approximate Gamma UCL	0.0946		
95% Adjusted Gamma UCL	0.141		
Potential UCL to Use		Use 95% Student's-t UCL	0.0669

ProUCL Input
Northern and Western AOCs
Aggregate Soil

Aluminum	D_Aluminum	Arsenic	D_Arsenic	Manganese	D_Manganese	Vanadium	D_Vanadium
7760	1	4.4	1	122	1	12	1
7010	1	1.7	1	48.8	1	7.9	1
10300	1	2.7	1	101	1	15.8	1
13300	1	2.2	1	105	1	18.4	1
5110	1	1.2	1	26.2	1	6.8	1
14300	1	2.3	1	31.3	1	16.9	1
10200	1	2.5	1	106	1	14.7	1
6520	1	1.1	1	77.4	1	7	1
8870	1	4.7	1	137	1	14.4	1
21100	1	4.8	1	132	1	32.5	1

ProUCL Output
Northern and Western AOCs
Aggregate Soil

General UCL Statistics for Data Sets with Non-Detects	
User Selected Options	
From File	I:\Newest Wallops\ProUCL Files\ProUCL Soil W-N All.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aluminum

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	5110	Minimum of Log Data	8.539
Maximum	21100	Maximum of Log Data	9.957
Mean	10447	Mean of log Data	9.171
Median	9535	SD of log Data	0.421
SD	4737		
Coefficient of Variation	0.453		
Skewness	1.323		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.895	Shapiro Wilk Test Statistic	0.981
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	13193	95% H-UCL	14133
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	16522
95% Adjusted-CLT UCL	13581	97.5% Chebyshev (MVUE) UCL	19168
95% Modified-t UCL	13298	99% Chebyshev (MVUE) UCL	24364
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.416	**Data appear Normal at 5% Significance Level**	
Theta Star	2366		
nu star	88.32		
Approximate Chi Square Value (.05)	67.65	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0267	95% CLT UCL	12911
Adjusted Chi Square Value	64.52	95% Jackknife UCL	13193
		95% Standard Bootstrap UCL	12787
Anderson-Darling Test Statistic	0.228	95% Bootstrap-t UCL	14434
Anderson-Darling 5% Critical Value	0.728	95% Hall's Bootstrap UCL	15463
Kolmogorov-Smirnov Test Statistic	0.161	95% Percentile Bootstrap UCL	12792
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL	13627
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	16977
		97.5% Chebyshev(Mean, Sd) UCL	19802
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	25353
95% Approximate Gamma UCL	13638		
95% Adjusted Gamma UCL	14301		
Potential UCL to Use		Use 95% Student's-t UCL	13193

ProUCL Output
Northern and Western AOCs
Aggregate Soil

Arsenic

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	1.1	Minimum of Log Data	0.0953
Maximum	4.8	Maximum of Log Data	1.569
Mean	2.76	Mean of log Data	0.894
Median	2.4	SD of log Data	0.53
SD	1.395		
Coefficient of Variation	0.506		
Skewness	0.529		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.878	Shapiro Wilk Test Statistic	0.922
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	3.569	95% H-UCL	4.196
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	4.834
95% Adjusted-CLT UCL	3.565	97.5% Chebyshev (MVUE) UCL	5.727
95% Modified-t UCL	3.581	99% Chebyshev (MVUE) UCL	7.481
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.058	Data appear Normal at 5% Significance Level	
Theta Star	0.902		
nu star	61.16		
Approximate Chi Square Value (.05)	44.18	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0267	95% CLT UCL	3.486
Adjusted Chi Square Value	41.68	95% Jackknife UCL	3.569
		95% Standard Bootstrap UCL	3.44
Anderson-Darling Test Statistic	0.391	95% Bootstrap-t UCL	3.674
Anderson-Darling 5% Critical Value	0.729	95% Hall's Bootstrap UCL	3.411
Kolmogorov-Smirnov Test Statistic	0.185	95% Percentile Bootstrap UCL	3.46
Kolmogorov-Smirnov 5% Critical Value	0.268	95% BCA Bootstrap UCL	3.51
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	4.683
		97.5% Chebyshev(Mean, Sd) UCL	5.516
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	7.15
95% Approximate Gamma UCL	3.821		
95% Adjusted Gamma UCL	4.05		
Potential UCL to Use		Use 95% Student's-t UCL	3.569

ProUCL Output
Northern and Western AOCs
Aggregate Soil

Iron

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	3460	Minimum of Log Data	8.149
Maximum	18700	Maximum of Log Data	9.836
Mean	8145	Mean of log Data	8.887
Median	8165	SD of log Data	0.509
SD	4415		
Coefficient of Variation	0.542		
Skewness	1.545		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.849	Shapiro Wilk Test Statistic	0.943
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	10704	95% H-UCL	12025
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	13918
95% Adjusted-CLT UCL	11170	97.5% Chebyshev (MVUE) UCL	16428
95% Modified-t UCL	10818	99% Chebyshev (MVUE) UCL	21357
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.135	Data appear Normal at 5% Significance Level	
Theta Star	2598		
nu star	62.69		
Approximate Chi Square Value (.05)	45.48	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0267	95% CLT UCL	10441
Adjusted Chi Square Value	42.94	95% Jackknife UCL	10704
		95% Standard Bootstrap UCL	10323
Anderson-Darling Test Statistic	0.367	95% Bootstrap-t UCL	11726
Anderson-Darling 5% Critical Value	0.729	95% Hall's Bootstrap UCL	22563
Kolmogorov-Smirnov Test Statistic	0.166	95% Percentile Bootstrap UCL	10424
Kolmogorov-Smirnov 5% Critical Value	0.268	95% BCA Bootstrap UCL	11174
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	14230
		97.5% Chebyshev(Mean, Sd) UCL	16863
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	22035
95% Approximate Gamma UCL	11228		
95% Adjusted Gamma UCL	11891		
Potential UCL to Use		Use 95% Student's-t UCL	10704

ProUCL Output
Northern and Western AOCs
Aggregate Soil

Mercury

General Statistics

Number of Valid Data	10	Number of Detected Data	9
Number of Distinct Detected Data	8	Number of Non-Detect Data	1
		Percent Non-Detects	10.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.013	Minimum Detected	-4.343
Maximum Detected	0.077	Maximum Detected	-2.564
Mean of Detected	0.0319	Mean of Detected	-3.644
SD of Detected	0.0224	SD of Detected	0.651
Minimum Non-Detect	0.035	Minimum Non-Detect	-3.352
Maximum Non-Detect	0.035	Maximum Non-Detect	-3.352

Warning: There are only 9 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.817	Shapiro Wilk Test Statistic	0.882
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0305	Mean	-3.685
SD	0.0216	SD	0.627
95% DL/2 (t) UCL	0.043	95% H-Stat (DL/2) UCL	0.0468
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.0185	Mean in Log Scale	-3.676
SD	0.0339	SD in Log Scale	0.622
95% MLE (t) UCL	0.0382	Mean in Original Scale	0.0306
95% MLE (Tiku) UCL	0.0523	SD in Original Scale	0.0215
		95% Percentile Bootstrap UCL	0.0421
		95% BCA Bootstrap UCL	0.0444
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.853	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	0.0172		
nu star	33.35		
A-D Test Statistic	0.628	**Nonparametric Statistics**	
5% A-D Critical Value	0.728	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.728	Mean	0.0305
5% K-S Critical Value	0.282	SD	0.0205
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.00692
		95% KM (t) UCL	0.0432
Assuming Gamma Distribution		95% KM (z) UCL	0.0419

ProUCL Output
Northern and Western AOCs
Aggregate Soil

Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.0431
Minimum	0.013	95% KM (bootstrap t) UCL	0.0509
Maximum	0.077	95% KM (BCA) UCL	0.0423
Mean	0.0314	95% KM (Percentile Bootstrap) UCL	0.0421
Median	0.0228	95% KM (Chebyshev) UCL	0.0607
SD	0.0212	97.5% KM (Chebyshev) UCL	0.0737
k star	2.115	99% KM (Chebyshev) UCL	0.0993
Theta star	0.0148		
Nu star	42.3	**Potential UCLs to Use**	
AppChi2	28.39	95% KM (Chebyshev) UCL	0.0607
95% Gamma Approximate UCL	0.0467		
95% Adjusted Gamma UCL	0.0502		
Note: DL/2 is not a recommended method.			

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Benzene	d_Benzene	1,2-Dichloroethane	d_1,2-Dichloroethane	cis-1,2-Dichloroethene	d_cis-1,2-Dichloroethene	Ethylbenzene	d_Ethylbenzene	Isopropylbenzene	d_Isopropylbenzene
1	0	1	0	1	0	1	0	2	0
1	0	1	0	1	0	1	0	2	0
7.5	0	7.5	0	48.1	1	419.5	1	49.2	1
10	0	10	0	54.5	1	548	1	68.6	1
3.7	1	8.8	1	1	0	1	0	2	0
1	0	17.6	1	1	0	1	0	2	0

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Tetrachloroethene	d_Tetrachloroethene	Toluene	d_Toluene	Trichloroethene	d_Trichloroethene	m,p-Xylene	d_m,p-Xylene	o-Xylene	d_o-Xylene	Xylene (total)	d_Xylene (total)
1	0	1	0	1	0	1	0	1	0	1	0
1	0	1	0	1	0	1	0	1	0	1	0
13.8	1	1340	1	3.35	1	1640	1	470	1	2105	1
7.9	1	1680	1	10	0	2180	1	859	1	3040	1
1	0	1	0	1	0	1	0	1	0	1	0
1	0	1	0	1	0	1	0	1	0	1	0

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

2-Methylnaphthalene	d_2-Methylnaphthalene	Naphthalene	d_Naphthalene	Arsenic	d_Arsenic	Iron	d_Iron	Manganese	d_Manganese	Mercury	d_Mercury
2	0	2	0	1.7	1	100	0	1.7	1	0.043	1
2	0	2	0	2	0	543.5	1	2.65	1	0.2	0
32.7	1	86.05	1	8.65	1	25000	1	541.5	1	0.15	1
34.4	1	81.8	1	8	1	29600	1	623	1	0.2	0
2.2	0	2.2	0	10	0	1680	1	1050	1	0.13	1
2	0	0.57	1	5.7	1	14100	1	1810	1	0.2	0

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Benzene	d_Benzene	1,2-Dichloroethane	d_1,2-Dichloroethane	cis-1,2-Dichloroethene	d_cis-1,2-Dichloroethene	Ethylbenzene	d_Ethylbenzene	Isopropylbenzene	d_Isopropylbenzene
1	0	1	0	1	0	1	0	2	0
1	0	1	0	1	0	1	0	2	0
7.5	0	7.5	0	48.1	1	419.5	1	49.2	1
10	0	10	0	54.5	1	548	1	68.6	1
3.7	1	8.8	1	1	0	1	0	2	0
1	0	17.6	1	1	0	1	0	2	0

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Tetrachloroethene	d_Tetrachloroethene	Toluene	d_Toluene	Trichloroethene	d_Trichloroethene	m,p-Xylene	d_m,p-Xylene	o-Xylene	d_o-Xylene	Xylene (total)	d_Xylene (total)
1	0	1	0	1	0	1	0	1	0	1	0
1	0	1	0	1	0	1	0	1	0	1	0
13.8	1	1340	1	3.35	1	1640	1	470	1	2105	1
7.9	1	1680	1	10	0	2180	1	859	1	3040	1
1	0	1	0	1	0	1	0	1	0	1	0
1	0	1	0	1	0	1	0	1	0	1	0

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

2-Methylnaphthalene	d_2-Methylnaphthalene	Naphthalene	d_Naphthalene	Arsenic	d_Arsenic	Iron	d_Iron	Manganese	d_Manganese	Mercury	d_Mercury
2	0	2	0	1.7	1	100	0	1.7	1	0.043	1
2	0	2	0	2	0	543.5	1	2.65	1	0.2	0
32.7	1	86.05	1	8.65	1	25000	1	541.5	1	0.15	1
34.4	1	81.8	1	8	1	29600	1	623	1	0.2	0
2.2	0	2.2	0	10	0	1680	1	1050	1	0.13	1
2	0	0.57	1	5.7	1	14100	1	1810	1	0.2	0

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Benzene

General Statistics			
Number of Valid Data	6	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	5
		Percent Non-Detects	83.33%

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 Benzene was not processed!

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

1,2-Dichloroethane

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	8.8	Minimum Detected	2.175
Maximum Detected	17.6	Maximum Detected	2.868
Mean of Detected	13.2	Mean of Detected	2.521
SD of Detected	6.223	SD of Detected	0.49
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	10	Maximum Non-Detect	2.303

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	83.33%

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	6.025	Mean	1.098
SD	6.465	SD	1.485
95% DL/2 (t) UCL	11.34	95% H-Stat (DL/2) UCL	466
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	10.27
5% K-S Critical Value	N/A	SD	3.28
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.893
		95% KM (t) UCL	14.08
Assuming Gamma Distribution		95% KM (z) UCL	13.38
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	17.15
Minimum	N/A	95% KM (bootstrap t) UCL	Infinity
Maximum	N/A	95% KM (BCA) UCL	17.6
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	18.52
SD	N/A	97.5% KM (Chebyshev) UCL	22.09
k star	N/A	99% KM (Chebyshev) UCL	29.11
Theta star	N/A		

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Nu star	N/A	Potential UCLs to Use	
AppChi2	N/A	95% KM (t) UCL	14.08
95% Gamma Approximate UCL	N/A	95% KM (% Bootstrap) UCL	N/A
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

cis-1,2-Dichloroethene

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	48.1	Minimum Detected	3.873
Maximum Detected	54.5	Maximum Detected	3.998
Mean of Detected	51.3	Mean of Detected	3.936
SD of Detected	4.525	SD of Detected	0.0883
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	17.43	Mean	0.85
SD	26.31	SD	2.391
95% DL/2 (t) UCL	39.08	95% H-Stat (DL/2) UCL	6113
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	49.17
5% K-S Critical Value	N/A	SD	2.385
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.377
		95% KM (t) UCL	51.94
Assuming Gamma Distribution		95% KM (z) UCL	51.43
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	55.17
SD	N/A	97.5% KM (Chebyshev) UCL	57.77
k star	N/A	99% KM (Chebyshev) UCL	62.87
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**51.94**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Ethylbenzene

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	419.5	Minimum Detected	6.039
Maximum Detected	548	Maximum Detected	6.306
Mean of Detected	483.8	Mean of Detected	6.173
SD of Detected	90.86	SD of Detected	0.189
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	161.6	Mean	1.595
SD	252.8	SD	3.546
95% DL/2 (t) UCL	369.6	95% H-Stat (DL/2) UCL	2.73E+09
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	440.9
5% K-S Critical Value	N/A	SD	47.89
Data not Gamma Distributed at 5% Significance Level		SE of Mean	27.65
		95% KM (t) UCL	496.6
Assuming Gamma Distribution		95% KM (z) UCL	486.4
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	561.4
SD	N/A	97.5% KM (Chebyshev) UCL	613.6
k star	N/A	99% KM (Chebyshev) UCL	716
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**496.6**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Isopropylbenzene

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	49.2	Minimum Detected	3.896
Maximum Detected	68.6	Maximum Detected	4.228
Mean of Detected	58.9	Mean of Detected	4.062
SD of Detected	13.72	SD of Detected	0.235
Minimum Non-Detect	2	Minimum Non-Detect	0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	20.3	Mean	1.354
SD	30.52	SD	2.1
95% DL/2 (t) UCL	45.41	95% H-Stat (DL/2) UCL	1167
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	52.43
5% K-S Critical Value	N/A	SD	7.23
Data not Gamma Distributed at 5% Significance Level		SE of Mean	4.174
		95% KM (t) UCL	60.84
Assuming Gamma Distribution		95% KM (z) UCL	59.3
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	70.63
SD	N/A	97.5% KM (Chebyshev) UCL	78.5
k star	N/A	99% KM (Chebyshev) UCL	93.97
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**60.84**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Tetrachloroethene

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	7.9	Minimum Detected	2.067
Maximum Detected	13.8	Maximum Detected	2.625
Mean of Detected	10.85	Mean of Detected	2.346
SD of Detected	4.172	SD of Detected	0.394
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.95	Mean	0.32
SD	5.661	SD	1.579
95% DL/2 (t) UCL	8.607	95% H-Stat (DL/2) UCL	21.99
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	8.883
5% K-S Critical Value	N/A	SD	2.199
Data not Gamma Distributed at 5% Significance Level		SE of Mean	1.269
		95% KM (t) UCL	11.44
Assuming Gamma Distribution		95% KM (z) UCL	10.97
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	14.42
SD	N/A	97.5% KM (Chebyshev) UCL	16.81
k star	N/A	99% KM (Chebyshev) UCL	21.51
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**11.44**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Toluene

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1340	Minimum Detected	7.2
Maximum Detected	1680	Maximum Detected	7.427
Mean of Detected	1510	Mean of Detected	7.313
SD of Detected	240.4	SD of Detected	0.16
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	503.7	Mean	1.976
SD	786.9	SD	4.135
95% DL/2 (t) UCL	1151	95% H-Stat (DL/2) UCL	1.96E+13
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	1397
5% K-S Critical Value	N/A	SD	126.7
Data not Gamma Distributed at 5% Significance Level		SE of Mean	73.16
		95% KM (t) UCL	1544
Assuming Gamma Distribution		95% KM (z) UCL	1517
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	1716
SD	N/A	97.5% KM (Chebyshev) UCL	1854
k star	N/A	99% KM (Chebyshev) UCL	2125
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**1544**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Trichloroethene

General Statistics			
Number of Valid Data	6	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	5
		Percent Non-Detects	83.33%

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 Trichloroethene was not processed!

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

m,p-Xylene

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1640	Minimum Detected	7.402
Maximum Detected	2180	Maximum Detected	7.687
Mean of Detected	1910	Mean of Detected	7.545
SD of Detected	381.8	SD of Detected	0.201
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	637	Mean	2.053
SD	1001	SD	4.255
95% DL/2 (t) UCL	1460	95% H-Stat (DL/2) UCL	1.44E+14
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	1730
5% K-S Critical Value	N/A	SD	201.2
Data not Gamma Distributed at 5% Significance Level		SE of Mean	116.2
		95% KM (t) UCL	1964
Assuming Gamma Distribution		95% KM (z) UCL	1921
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	2236
SD	N/A	97.5% KM (Chebyshev) UCL	2456
k star	N/A	99% KM (Chebyshev) UCL	2886
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**1964**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

o-Xylene

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	470	Minimum Detected	6.153
Maximum Detected	859	Maximum Detected	6.756
Mean of Detected	664.5	Mean of Detected	6.454
SD of Detected	275.1	SD of Detected	0.426
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	221.8	Mean	1.689
SD	364.3	SD	3.696
95% DL/2 (t) UCL	521.5	95% H-Stat (DL/2) UCL	2.26E+10
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	534.8
5% K-S Critical Value	N/A	SD	145
Data not Gamma Distributed at 5% Significance Level		SE of Mean	83.7
		95% KM (t) UCL	703.5
Assuming Gamma Distribution		95% KM (z) UCL	672.5
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	899.7
SD	N/A	97.5% KM (Chebyshev) UCL	1058
k star	N/A	99% KM (Chebyshev) UCL	1368
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**703.5**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Xylene (total)

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	2105	Minimum Detected	7.652
Maximum Detected	3040	Maximum Detected	8.02
Mean of Detected	2573	Mean of Detected	7.836
SD of Detected	661.1	SD of Detected	0.26
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	857.8	Mean	2.15
SD	1361	SD	4.406
95% DL/2 (t) UCL	1977	95% H-Stat (DL/2) UCL	1.93E+15
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.359	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	2261
5% K-S Critical Value	N/A	SD	348.5
Data not Gamma Distributed at 5% Significance Level		SE of Mean	201.2
		95% KM (t) UCL	2666
Assuming Gamma Distribution		95% KM (z) UCL	2592
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	3138
SD	N/A	97.5% KM (Chebyshev) UCL	3517
k star	N/A	99% KM (Chebyshev) UCL	4263
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**2666**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**

ProUCL Output
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Groundwater

95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

2-Methylnaphthalene

General Statistics			
Number of Valid Data	6	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	4
		Percent Non-Detects	66.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	32.7	Minimum Detected	3.487
Maximum Detected	34.4	Maximum Detected	3.538
Mean of Detected	33.55	Mean of Detected	3.513
SD of Detected	1.202	SD of Detected	0.0358
Minimum Non-Detect	2	Minimum Non-Detect	0.693
Maximum Non-Detect	2.2	Maximum Non-Detect	0.788

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	4
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	66.67%

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	11.87	Mean	1.187
SD	16.8	SD	1.802
95% DL/2 (t) UCL	25.69	95% H-Stat (DL/2) UCL	160.7
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.36	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	32.98
5% K-S Critical Value	N/A	SD	0.634
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.366
		95% KM (t) UCL	33.72
Assuming Gamma Distribution		95% KM (z) UCL	33.58
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	34.31
Minimum	N/A	95% KM (bootstrap t) UCL	Infinity
Maximum	N/A	95% KM (BCA) UCL	34.4
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	34.58
SD	N/A	97.5% KM (Chebyshev) UCL	35.27
k star	N/A	99% KM (Chebyshev) UCL	36.62
Theta star	N/A		

ProUCL Output
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Groundwater

Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**33.72**
95% Gamma Approximate UCL	N/A	**95% KM (% Bootstrap) UCL**	**N/A**
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

Naphthalene

General Statistics			
Number of Valid Data	6	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	3
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.57	Minimum Detected	-0.562
Maximum Detected	86.05	Maximum Detected	4.455
Mean of Detected	56.14	Mean of Detected	2.766
SD of Detected	48.17	SD of Detected	2.882
Minimum Non-Detect	2	Minimum Non-Detect	0.693
Maximum Non-Detect	2.2	Maximum Non-Detect	0.788

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	4
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	66.67%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.787	Shapiro Wilk Test Statistic	0.758
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	28.59	Mean	1.399
SD	42.89	SD	2.359
95% DL/2 (t) UCL	63.87	95% H-Stat (DL/2) UCL	214367
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	1.194
		SD in Log Scale	2.589
		Mean in Original Scale	28.54
		SD in Original Scale	42.93
		95% Percentile Bootstrap UCL	56.38
		95% BCA Bootstrap UCL	56.87
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data appear Normal at 5% Significance Level	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.637	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	28.36
5% K-S Critical Value	N/A	SD	39.31
Data not Gamma Distributed at 5% Significance Level		SE of Mean	19.66
		95% KM (t) UCL	67.96
Assuming Gamma Distribution		95% KM (z) UCL	60.69
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	86.66
Minimum	N/A	95% KM (bootstrap t) UCL	46.66
Maximum	N/A	95% KM (BCA) UCL	86.05
Mean	N/A	95% KM (Percentile Bootstrap) UCL	86.05
Median	N/A	95% KM (Chebyshev) UCL	114
SD	N/A	97.5% KM (Chebyshev) UCL	151.1
k star	N/A	99% KM (Chebyshev) UCL	223.9

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Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**67.96**
95% Gamma Approximate UCL	N/A	**95% KM (Percentile Bootstrap) UCL**	**86.05**
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Arsenic

General Statistics

Number of Valid Data	6	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	2
		Percent Non-Detects	33.33%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.7	Minimum Detected	0.531
Maximum Detected	8.65	Maximum Detected	2.158
Mean of Detected	6.013	Mean of Detected	1.627
SD of Detected	3.141	SD of Detected	0.753
Minimum Non-Detect	2	Minimum Non-Detect	0.693
Maximum Non-Detect	10	Maximum Non-Detect	2.303

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.9	Shapiro Wilk Test Statistic	0.811
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	5.008	Mean	1.353
SD	3.153	SD	0.883
95% DL/2 (t) UCL	7.602	95% H-Stat (DL/2) UCL	27.01

Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	1.435
		SD in Log Scale	0.698
		Mean in Original Scale	5.034
		SD in Original Scale	2.954
		95% Percentile Bootstrap UCL	6.825
		95% BCA Bootstrap UCL	6.708

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.955	Data appear Normal at 5% Significance Level
Theta Star	6.294	
nu star	7.642	

		Nonparametric Statistics	
A-D Test Statistic	0.476		
5% A-D Critical Value	0.659	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.659	Mean	5.15
5% K-S Critical Value	0.396	SD	2.983
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	1.54
		95% KM (t) UCL	8.254
Assuming Gamma Distribution		95% KM (z) UCL	7.683
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	8.567
Minimum	1.7	95% KM (bootstrap t) UCL	7.104
Maximum	8.65	95% KM (BCA) UCL	8.325
Mean	5.785	95% KM (Percentile Bootstrap) UCL	8.13
Median	6.283	95% KM (Chebyshev) UCL	11.86
SD	2.644	97.5% KM (Chebyshev) UCL	14.77
k star	2.155	99% KM (Chebyshev) UCL	20.47
Theta star	2.684		
Nu star	25.86	**Potential UCLs to Use**	
AppChi2	15.27	**95% KM (t) UCL**	**8.254**
95% Gamma Approximate UCL	9.796	**95% KM (Percentile Bootstrap) UCL**	**8.13**
95% Adjusted Gamma UCL	N/A		

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Iron

General Statistics			
Number of Valid Data	6	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	1
		Percent Non-Detects	16.67%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	543.5	Minimum Detected	6.298
Maximum Detected	29600	Maximum Detected	10.3
Mean of Detected	14185	Mean of Detected	8.74
SD of Detected	13201	SD of Detected	1.781
Minimum Non-Detect	100	Minimum Non-Detect	4.605
Maximum Non-Detect	100	Maximum Non-Detect	4.605

Warning: There are only 5 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.892	Shapiro Wilk Test Statistic	0.862
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	11829	Mean	7.935
SD	13142	SD	2.535
95% DL/2 (t) UCL	22640	95% H-Stat (DL/2) UCL	4.01E+09
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	10504	Mean in Log Scale	8.017
SD	13829	SD in Log Scale	2.382
95% MLE (t) UCL	21881	Mean in Original Scale	11834
95% MLE (Tiku) UCL	21889	SD in Original Scale	13136
		95% Percentile Bootstrap UCL	20564
		95% BCA Bootstrap UCL	21330
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.426	Data appear Normal at 5% Significance Level	
Theta Star	33269		
nu star	4.264		
A-D Test Statistic	0.421	Nonparametric Statistics	
5% A-D Critical Value	0.699	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.699	Mean	11911
5% K-S Critical Value	0.367	SD	11917
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	5439
		95% KM (t) UCL	22872
Assuming Gamma Distribution		95% KM (z) UCL	20858
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	22629
Minimum	543.5	95% KM (bootstrap t) UCL	24277
Maximum	29600	95% KM (BCA) UCL	21597
Mean	12029	95% KM (Percentile Bootstrap) UCL	21407
Median	7890	95% KM (Chebyshev) UCL	35621
SD	12934	97.5% KM (Chebyshev) UCL	45881
k star	0.441	99% KM (Chebyshev) UCL	66033
Theta star	27267		
Nu star	5.294	**Potential UCLs to Use**	
AppChi2	1.29	**95% KM (t) UCL**	**22872**
95% Gamma Approximate UCL	49352	**95% KM (Percentile Bootstrap) UCL**	**21407**
95% Adjusted Gamma UCL	89630		

Note: DL/2 is not a recommended method.

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Manganese

General Statistics

Number of Valid Observations	6	Number of Distinct Observations	6
Raw Statistics		Log-transformed Statistics	
Minimum	1.7	Minimum of Log Data	0.531
Maximum	1810	Maximum of Log Data	7.501
Mean	671.5	Mean of log Data	4.782
Median	582.3	SD of log Data	3.153
SD	686.2		
Coefficient of Variation	1.022		
Skewness	0.862		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.91	Shapiro Wilk Test Statistic	0.767
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	1236	95% H-UCL	3.69E+11
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	11229
95% Adjusted-CLT UCL	1238	97.5% Chebyshev (MVUE) UCL	15103
95% Modified-t UCL	1252	99% Chebyshev (MVUE) UCL	22711
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.303	Data appear Normal at 5% Significance Level	
Theta Star	2217		
nu star	3.634		
Approximate Chi Square Value (.05)	0.583	Nonparametric Statistics	
Adjusted Level of Significance	0.0122	95% CLT UCL	1132
Adjusted Chi Square Value	0.274	95% Jackknife UCL	1236
		95% Standard Bootstrap UCL	1086
Anderson-Darling Test Statistic	0.641	95% Bootstrap-t UCL	1465
Anderson-Darling 5% Critical Value	0.754	95% Hall's Bootstrap UCL	2076
Kolmogorov-Smirnov Test Statistic	0.328	95% Percentile Bootstrap UCL	1171
Kolmogorov-Smirnov 5% Critical Value	0.353	95% BCA Bootstrap UCL	1113
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1893
		97.5% Chebyshev(Mean, Sd) UCL	2421
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	3459
95% Approximate Gamma UCL	4187		
95% Adjusted Gamma UCL	8919		

Potential UCL to Use		**Use 95% Student's-t UCL**	**1236**

ProUCL Output
CDL - Wallops Flight Facility
Groundwater

Mercury

General Statistics			
Number of Valid Data	6	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	3
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.043	Minimum Detected	-3.147
Maximum Detected	0.15	Maximum Detected	-1.897
Mean of Detected	0.108	Mean of Detected	-2.361
SD of Detected	0.0569	SD of Detected	0.684
Minimum Non-Detect	0.2	Minimum Non-Detect	-1.609
Maximum Non-Detect	0.2	Maximum Non-Detect	-1.609

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.884	Shapiro Wilk Test Statistic	0.835
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.104	Mean	-2.332
SD	0.0362	SD	0.434
95% DL/2 (t) UCL	0.134	95% H-Stat (DL/2) UCL	0.225
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.361
		SD in Log Scale	0.586
		Mean in Original Scale	0.107
		SD in Original Scale	0.054
		95% Percentile Bootstrap UCL	0.142
		95% BCA Bootstrap UCL	0.143
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data appear Normal at 5% Significance Level	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	0.465	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.108
5% K-S Critical Value	N/A	SD	0.0464
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0328
		95% KM (t) UCL	0.174
Assuming Gamma Distribution		95% KM (z) UCL	0.162
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.182
Minimum	N/A	95% KM (bootstrap t) UCL	0.172
Maximum	N/A	95% KM (BCA) UCL	0.145
Mean	N/A	95% KM (Percentile Bootstrap) UCL	0.15
Median	N/A	95% KM (Chebyshev) UCL	0.251
SD	N/A	97.5% KM (Chebyshev) UCL	0.313
k star	N/A	99% KM (Chebyshev) UCL	0.434
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	**95% KM (t) UCL**	**0.174**
95% Gamma Approximate UCL	N/A	**95% KM (Percentile Bootstrap) UCL**	**0.15**
95% Adjusted Gamma UCL	N/A		

Warning: Recommended UCL exceeds the maximum observation
Note: DL/2 is not a recommended method.

ProUCL Input
CDL
Sediment

Arsenic	D_Arsenic	Mercury	D_Mercury
8.5	1	0.1	1
8.1	1	0.07	1
19.05	1	0.0405	1
4.5	1	0.047	1
12.9	1	0.09	1
4	1	0.21	0
18.6	1	0.12	1
13.3	1	0.49	1
3	1	0.069	1

ProUCL Output
CDL
Sediment

	General UCL Statistics for Data Sets with Non-Detects
User Selected Options	
From File	I:\Wallops\Wallops Risk Assessment 2008\Human Health Risk Assessment\ProUCL Sediment Inputs.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

ProUCL Output
CDL
Sediment

Arsenic

General Statistics

Number of Valid Observations	9	Number of Distinct Observations	9

Raw Statistics		Log-transformed Statistics	
Minimum	3	Minimum of Log Data	1.099
Maximum	19.05	Maximum of Log Data	2.947
Mean	10.22	Mean of log Data	2.137
Median	8.5	SD of log Data	0.68
SD	6.081		
Coefficient of Variation	0.595		
Skewness	0.364		

Warning: There are only 9 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.907	Shapiro Wilk Test Statistic	0.921
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	13.99	95% H-UCL	19.88
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	20.85
95% Adjusted-CLT UCL	13.81	97.5% Chebyshev (MVUE) UCL	25.38
95% Modified-t UCL	14.03	99% Chebyshev (MVUE) UCL	34.29
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	1.964	Data appear Normal at 5% Significance Level	
Theta Star	5.203		
nu star	35.34		
Approximate Chi Square Value (.05)	22.74	Nonparametric Statistics	
Adjusted Level of Significance	0.0231	95% CLT UCL	13.55
Adjusted Chi Square Value	20.63	95% Jackknife UCL	13.99
		95% Standard Bootstrap UCL	13.39
Anderson-Darling Test Statistic	0.336	95% Bootstrap-t UCL	14.41
Anderson-Darling 5% Critical Value	0.727	95% Hall's Bootstrap UCL	13.93
Kolmogorov-Smirnov Test Statistic	0.176	95% Percentile Bootstrap UCL	13.37
Kolmogorov-Smirnov 5% Critical Value	0.282	95% BCA Bootstrap UCL	13.57
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	19.05
		97.5% Chebyshev(Mean, Sd) UCL	22.88
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	30.39
95% Approximate Gamma UCL	15.88		
95% Adjusted Gamma UCL	17.5		
Potential UCL to Use		Use 95% Student's-t UCL	13.99

ProUCL Output
CDL
Sediment

Mercury

General Statistics

Number of Valid Data	9	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	1
		Percent Non-Detects	11.11%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0405	Minimum Detected	-3.206
Maximum Detected	0.49	Maximum Detected	-0.713
Mean of Detected	0.128	Mean of Detected	-2.393
SD of Detected	0.149	SD of Detected	0.771
Minimum Non-Detect	0.21	Minimum Non-Detect	-1.561
Maximum Non-Detect	0.21	Maximum Non-Detect	-1.561

Warning: There are only 8 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.589	Shapiro Wilk Test Statistic	0.854
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.126	Mean	-2.377
SD	0.139	SD	0.722
95% DL/2 (t) UCL	0.212	95% H-Stat (DL/2) UCL	0.288
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.41
		SD in Log Scale	0.723
		Mean in Original Scale	0.123
		SD in Original Scale	0.14
		95% Percentile Bootstrap UCL	0.211
		95% BCA Bootstrap UCL	0.26
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	1.096	Data appear Lognormal at 5% Significance Level	
Theta Star	0.117		
nu star	17.53		
A-D Test Statistic	0.887	Nonparametric Statistics	
5% A-D Critical Value	0.727	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.727	Mean	0.123
5% K-S Critical Value	0.299	SD	0.132
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0473
		95% KM (t) UCL	0.21
Assuming Gamma Distribution		95% KM (z) UCL	0.2
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.21
Minimum	0.0405	95% KM (bootstrap t) UCL	0.464
Maximum	0.49	95% KM (BCA) UCL	0.213
Mean	0.128	95% KM (Percentile Bootstrap) UCL	0.207
Median	0.09	95% KM (Chebyshev) UCL	0.329
SD	0.139	97.5% KM (Chebyshev) UCL	0.418
k star	1.278	99% KM (Chebyshev) UCL	0.593
Theta star	0.1		
Nu star	23.01	Potential UCLs to Use	
AppChi2	13.1	95% KM (Chebyshev) UCL	0.329
95% Gamma Approximate UCL	0.225		
95% Adjusted Gamma UCL	0.256		

Note: DL/2 is not a recommended method.

VERSAR

APPENDIX F-2

SL – SCREEN RESULTS

EExample Start Page for SL-SCREEN
Soil Vapor Intrusion Results

SL-SCREEN
Version 3.1; 02/04

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial soil conc., C_R (µg/kg)	Chemical
71432	1.00E+00	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to top of contamination, L_t (cm)	ENTER Average soil temperature, T_S (°C)	ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)
15	15	10	S		

MORE ↓

ENTER Vandose zone SCS soil type	ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)	ENTER Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)	ENTER Average vapor flow rate into bldg. (Leave blank to calcula Q_{soil} (L/m)
S	1.7	0.3	0.054	0.002	5

MORE ↓

ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)	ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1
				Used to calculate risk-based soil concentration.	

END

SL-SCREEN results for Benzene

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαϛ (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Floor-wall seam perimeter, Xcrack (cm)	Initial soil concentration used, CR (µg/kg)	Bldg. ventilation rate, Qbuilding (cm3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	1.00E+00	1.69E+04

Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. soil temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. soil temperature, HTS (atm-m3/mol)	Henry's law constant at ave. soil temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, µTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Diffusion path length, Ld (cm)
1.00E+06	4.00E-04	15	8,122	2.68E-03	1.15E-01	1.75E-04	9.16E-03	1

Convection path length, Lp (cm)	Soil-water partition coefficient, Kd (cm3/g)	Source vapor conc., Csource (µg/m3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding (µg/m3)**
15	1.18E-01	6.93E+02	0.10	8.33E+01	9.16E-03	4.00E+02	5.48E+98	4.87E-03	**3.38E+00**

Unit risk factor, URF (µg/m3)-1	Reference conc., RfC (mg/m3)
7.8E-06	3.0E-02

END

SL-SCREEN Results for 1,2-Dichloroethane

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Floor-wall seam perimeter, Xcrack (cm)	Initial soil concentration used, CR (µg/kg)	Bldg. ventilation rate, Qbuilding (cm3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	1.00E+00	1.69E+04

Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. soil temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. soil temperature, HTS (atm-m3/mol)	Henry's law constant at ave. soil temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, µTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Diffusion path length, Ld (cm)
1.00E+06	4.00E-04	15	8,522	4.56E-04	1.96E-02	1.75E-04	1.08E-02	1

Convection path length, Lp (cm)	Soil-water partition coefficient, Kd (cm3/g)	Source vapor conc., Csource (µg/m3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding (µg/m3)**
15	3.48E-02	2.83E+02	0.10	8.33E+01	1.08E-02	4.00E+02	3.51E+83	4.88E-03	**1.38E+00**

Unit risk factor, URF (µg/m3)-1	Reference conc., RfC (mg/m3)
2.6E-05	NA

END

SL-SCREEN results for Ethylbenzene

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Floor-wall seam perimeter, Xcrack (cm)	Initial soil concentration used, CR (mg/kg)	Bldg. ventilation rate, Qbuilding (cm3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	1.00E+00	1.69E+04

Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. soil temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. soil temperature, HTS (atm-m3/mol)	Henry's law constant at ave. soil temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Diffusion path length, Ld (cm)
1.00E+06	4.00E-04	15	10,155	3.17E-03	1.36E-01	1.75E-04	7.81E-03	1

Convection path length, Lp (cm)	Soil-water partition coefficient, Kd (cm3/g)	Source vapor conc., Csource (mg/m3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding (μg/m3)**
15	7.26E-01	1.75E+02	0.10	8.33E+01	7.81E-03	4.00E+02	7.13E+115	4.87E-03	**8.54E-01**

Unit risk factor, URF (mg/m3)-1	Reference conc., RfC (mg/m3)
NA	1.0E+00

END

SL-SCREEN results for Tetrachloroethene

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Floor-wall seam perimeter, Xcrack (cm)	Initial soil concentration used, CR (mg/kg)	Bldg. ventilation rate, Qbuilding (cm3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	1.00E+00	1.69E+04

Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. soil temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. soil temperature, HTS (atm-m3/mol)	Henry's law constant at ave. soil temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Diffusion path length, Ld (cm)
1.00E+06	4.00E-04	15	9,553	7.81E-03	3.36E-01	1.75E-04	7.50E-03	1

Convection path length, Lp (cm)	Soil-water partition coefficient, Kd (cm3/g)	Source vapor conc., Csource (mg/m3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding (μg/m3)**
15	3.10E-01	8.61E+02	0.10	8.33E+01	7.50E-03	4.00E+02	4.80E+120	4.86E-03	**4.19E+00**

Unit risk factor, URF (mg/m3)-1	Reference conc., RfC (mg/m3)
5.9E-06	6.0E-01

END

SL-SCREEN results for m-xylene

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαç (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Floor-wall seam perimeter, Xcrack (cm)	Initial soil concentration used, CR (mg/kg)	Bldg. ventilation rate, Qbuilding (cm3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	1.00E+00	1.69E+04

Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. soil temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. soil temperature, HTS (atm-m3/mol)	Henry's law constant at ave. soil temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Diffusion path length, Ld (cm)
1.00E+06	4.00E-04	15	10,255	2.93E-03	1.26E-01	1.75E-04	7.29E-03	1

Convection path length, Lp (cm)	Soil-water partition coefficient, Kd (cm3/g)	Source vapor conc., Csource (mg/m3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding ($\mu g/m^3$)**
15	8.14E-01	1.46E+02	0.10	8.33E+01	7.29E-03	4.00E+02	1.34E+124	4.86E-03	**7.09E-01**

Unit risk factor, URF (mg/m3)-1	Reference conc., RfC (mg/m3)
NA	1.0E-01

END

SL-SCREEN results for p-xylene

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Floor-wall seam perimeter, Xcrack (cm)	Initial soil concentration used, CR (mg/kg)	Bldg. ventilation rate, Qbuilding (cm3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	1.00E+00	1.69E+04

Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. soil temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. soil temperature, HTS (atm-m3/mol)	Henry's law constant at ave. soil temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Diffusion path length, Ld (cm)
1.00E+06	4.00E-04	15	10,248	3.06E-03	1.32E-01	1.75E-04	8.01E-03	1

Convection path length, Lp (cm)	Soil-water partition coefficient, Kd (cm3/g)	Source vapor conc., Csource (mg/m3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding ($\mu g/m^3$)**
15	7.78E-01	1.59E+02	0.10	8.33E+01	8.01E-03	4.00E+02	9.79E+112	4.87E-03	**7.72E-01**

Unit risk factor, URF (mg/m3)-1	Reference conc., RfC (mg/m3)
NA	1.0E-01

END

SL-SCREEN results for Benzo(b)fluoranthene

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	**Initial soil concentration used, C_R (µg/kg)**	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	**1.00E+00**	1.69E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. soil temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. soil temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. soil temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Diffusion path length, L_d (cm)
1.00E+06	4.00E-04	15	8,522	4.56E-04	1.96E-02	1.75E-04	1.08E-02	1

Convection path length, L_p (cm)	Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} (µg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., $C_{building}$ (µg/m^3)**
15	3.48E-02	2.83E+02	0.10	8.33E+01	1.08E-02	4.00E+02	3.51E+83	4.88E-03	**1.38E+00**

Unit risk factor, URF (µg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
2.6E-05	NA

END

SL-SCREEN results for Chrysene

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Floor-wall seam perimeter, Xcrack (cm)	Initial soil concentration used, CR (mg/kg)	Bldg. ventilation rate, Qbuilding (cm3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	1.00E+00	1.69E+04

Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. soil temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. soil temperature, HTS (atm-m3/mol)	Henry's law constant at ave. soil temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Diffusion path length, Ld (cm)
1.00E+06	4.00E-04	15	24,451	1.06E-05	4.56E-04	1.75E-04	2.59E-03	1

Convection path length, Lp (cm)	Soil-water partition coefficient, Kd (cm3/g)	Source vapor conc., Csource (mg/m3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding (μg/m^3)**
15	7.96E+02	5.73E-04	0.10	8.33E+01	2.59E-03	4.00E+02	#NUM!	4.76E-03	**2.73E-06**

Unit risk factor, URF (mg/m3)-1	Reference conc., RfC (mg/m3)
2.1E-06	NA

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαç (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Floor-wall seam perimeter, Xcrack (cm)	Initial soil concentration used, CR (mg/kg)	Bldg. ventilation rate, Qbuilding (cm3/s)
1	0.246	0.004	9.92E-08	0.998	9.90E-08	4,000	1.00E+00	1.69E+04

Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. soil temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. soil temperature, HTS (atm-m3/mol)	Henry's law constant at ave. soil temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Diffusion path length, Ld (cm)
1.00E+06	4.00E-04	15	22,115	2.90E-06	1.25E-04	1.75E-04	1.53E-03	1

Convection path length, Lp (cm)	Soil-water partition coefficient, Kd (cm3/g)	Source vapor conc., Csource (mg/m3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding ($\mu g/m^3$)**
15	8.94E+03	1.40E-05	0.10	8.33E+01	1.53E-03	4.00E+02	#NUM!	4.66E-03	**6.51E-08**

Unit risk factor, URF (mg/m3)-1	Reference conc., RfC (mg/m3)
9.7E-05	NA

END

Indoor Air from Groundwater
Benzene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,122	2.68E-03	1.15E-01	1.75E-04	1.46E-02	5.70E-04	5.14E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.15E+02	0.10	8.33E+01	1.46E-02	4.00E+02	1.08E+62	1.(			

END

Figure and Menu Opt. F-3
Tables

Indoor Air from Groundwater
1,2-Dichloroethane
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,522	4.56E-04	1.96E-02	1.75E-04	1.72E-02	7.03E-04	6.25E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.96E+01	0.10	8.33E+01	1.72E-02	4.00E+02	3.07E+52	1.22E-03	**2.39E-02**	2.6E-05	NA

END

Indoor Air from Groundwater
cis-1,2-Dichloroethene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,734	2.04E-03	8.77E-02	1.75E-04	1.22E-02	4.81E-04	4.32E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	8.77E+01	0.10	8.33E+01	1.22E-02	4.00E+02	1.47E+74	9.12E-04	**8.00E-02**	NA	3.5E-02

END

Indoor Air from Groundwater
Ethylbenzene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαζ (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	10,155	3.17E-03	1.36E-01	1.75E-04	1.24E-02	4.84E-04	4.37E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.36E+02	0.10	8.33E+01	1.24E-02	4.00E+02	6.08E+72	9.20E-04	**1.26E-01**	NA	1.0E+00

END

Indoor Air from Groundwater
Isopropylbenzene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	12,644	4.71E-03	2.03E-01	1.75E-04	1.08E-02	4.19E-04	3.78E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	2.03E+02	0.10	8.33E+01	1.08E-02	4.00E+02	9.57E+83	8.17E-04	**1.66E-01**	NA	4.0E-01

END

Indoor Air from Groundwater
Tetrachloroethene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	9,553	7.81E-03	3.36E-01	1.75E-04	1.19E-02	4.63E-04	4.18E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	3.36E+02	0.10	8.33E+01	1.19E-02	4.00E+02	6.55E+75	8.87E-04	**2.98E-01**	5.9E-06	6.0E-01

END

Indoor Air from Groundwater
Toluene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θaς (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θa,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	9,154	2.92E-03	1.26E-01	1.75E-04	1.44E-02	5.62E-04	5.07E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.26E+02	0.10	8.33E+01	1.44E-02	4.00E+02	5.55E+62	1.04E-03	**1.30E-01**	NA	4.0E-01

END

Indoor Air from Groundwater
Trichloroethene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,557	4.78E-03	2.06E-01	1.75E-04	1.31E-02	5.09E-04	4.60E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	2.06E+02	0.10	8.33E+01	1.31E-02	4.00E+02	1.25E+69	9.58E-04	**1.97E-01**	1.1E-04	4.0E-02

END

Indoor Air from Groundwater
m-xylene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	10,255	2.93E-03	1.26E-01	1.75E-04	1.16E-02	4.53E-04	4.08E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.26E+02	0.10	8.33E+01	1.16E-02	4.00E+02	9.60E+77	8.70E-04	**1.10E-01**	NA	1.0E-01

END

Indoor Air from Groundwater
p-xylene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	10,248	3.06E-03	1.32E-01	1.75E-04	1.27E-02	4.97E-04	4.49E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.32E+02	0.10	8.33E+01	1.27E-02	4.00E+02	9.67E+70	9.39E-04	**1.24E-01**	NA	1.0E-01

END

Indoor Air from Groundwater
o-Xylene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	10,404	2.04E-03	8.79E-02	1.75E-04	1.44E-02	5.66E-04	5.09E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., Cbuilding (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	8.79E+01	0.10	8.33E+01	1.44E-02	4.00E+02	5.55E+62	1.04E-03	9.14E-02	NA	1.0E-01

END

Indoor Air from Groundwater
2-Methylnaphthalene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαζ (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	16,241	1.21E-04	5.20E-03	1.75E-04	8.65E-03	4.44E-04	3.63E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding (μg/m^3)**	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	5.20E+00	0.10	8.33E+01	8.65E-03	4.00E+02	3.69E+104	7.89E-04	**4.11E-03**	NA	7.0E-02

END

Indoor Air from Groundwater
Naphthalene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαζ (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	12,913	1.52E-04	6.54E-03	1.75E-04	9.78E-03	4.62E-04	3.90E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	6.54E+00	0.10	8.33E+01	9.78E-03	4.00E+02	3.29E+92	8.38E-04	**5.47E-03**	NA	3.0E-03

END

APPENDIX F-3

GW - SCREEN RESULTS

Indoor Air from Groundwater
Benzene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαs (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,122	2.68E-03	1.15E-01	1.75E-04	1.46E-02	5.70E-04	5.14E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.15E+02	0.10	8.33E+01	1.46E-02	4.00E+02	1.08E+62	1.05E-03	**1.21E-01**	7.8E-06	3.0E-02

END

Indoor Air from Groundwater
1,2-Dichloroethane
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θaς (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,522	4.56E-04	1.96E-02	1.75E-04	1.72E-02	7.03E-04	6.25E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.96E+01	0.10	8.33E+01	1.72E-02	4.00E+02	3.07E+52	1.22E-03	**2.39E-02**	2.6E-05	NA

END

Indoor Air from Groundwater
cis-1,2-Dichloroethene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαζ (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	7,734	2.04E-03	8.77E-02	1.75E-04	1.22E-02	4.81E-04	4.32E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	8.77E+01	0.10	8.33E+01	1.22E-02	4.00E+02	1.47E+74	9.12E-04	**8.00E-02**	NA	3.5E-02

END

Indoor Air from Groundwater
Ethylbenzene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	10,155	3.17E-03	1.36E-01	1.75E-04	1.24E-02	4.84E-04	4.37E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.36E+02	0.10	8.33E+01	1.24E-02	4.00E+02	6.08E+72	9.20E-04	**1.26E-01**	NA	1.0E+00

END

Indoor Air from Groundwater
Isopropylbenzene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	12,644	4.71E-03	2.03E-01	1.75E-04	1.08E-02	4.19E-04	3.78E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	2.03E+02	0.10	8.33E+01	1.08E-02	4.00E+02	9.57E+83	8.17E-04	**1.66E-01**	NA	4.0E-01

END

Indoor Air from Groundwater
Tetrachloroethene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θaς (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	9,553	7.81E-03	3.36E-01	1.75E-04	1.19E-02	4.63E-04	4.18E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	3.36E+02	0.10	8.33E+01	1.19E-02	4.00E+02	6.55E+75	8.87E-04	**2.98E-01**	5.9E-06	6.0E-01

END

Indoor Air from Groundwater
Toluene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHϖ,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	9,154	2.92E-03	1.26E-01	1.75E-04	1.44E-02	5.62E-04	5.07E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.26E+02	0.10	8.33E+01	1.44E-02	4.00E+02	5.55E+62	1.04E-03	**1.30E-01**	NA	4.0E-01

END

Indoor Air from Groundwater
Trichloroethene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαζ (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	8,557	4.78E-03	2.06E-01	1.75E-04	1.31E-02	5.09E-04	4.60E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	2.06E+02	0.10	8.33E+01	1.31E-02	4.00E+02	1.25E+69	9.58E-04	**1.97E-01**	1.1E-04	4.0E-02

END

Indoor Air from Groundwater
m-xylene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαζ (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	10,255	2.93E-03	1.26E-01	1.75E-04	1.16E-02	4.53E-04	4.08E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.26E+02	0.10	8.33E+01	1.16E-02	4.00E+02	9.60E+77	8.70E-04	**1.10E-01**	NA	1.0E-01

END

Indoor Air from Groundwater
p-xylene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαs (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	10,248	3.06E-03	1.32E-01	1.75E-04	1.27E-02	4.97E-04	4.49E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	1.32E+02	0.10	8.33E+01	1.27E-02	4.00E+02	9.67E+70	9.39E-04	**1.24E-01**	NA	1.0E-01

END

Indoor Air from Groundwater
o-Xylene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαs (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	10,404	2.04E-03	8.79E-02	1.75E-04	1.44E-02	5.66E-04	5.09E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., Cbuilding (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	8.79E+01	0.10	8.33E+01	1.44E-02	4.00E+02	5.55E+62	1.04E-03	9.14E-02	NA	1.0E-01

END

Indoor Air from Groundwater
2-Methylnaphthalene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θαζ (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	16,241	1.21E-04	5.20E-03	1.75E-04	8.65E-03	4.44E-04	3.63E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding (μg/m^3)**	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	5.20E+00	0.10	8.33E+01	8.65E-03	4.00E+02	3.69E+104	7.89E-04	**4.11E-03**	NA	7.0E-02

END

Indoor Air from Groundwater
Naphthalene
Wallops CDL

Source-building separation, LT (cm)	Vadose zone soil air-filled porosity, θας (cm3/cm3)	Vadose zone effective total fluid saturation, Ste (cm3/cm3)	Vadose zone soil intrinsic permeability, ki (cm2)	Vadose zone soil relative air permeability, krg (cm2)	Vadose zone soil effective vapor permeability, kv (cm2)	Thickness of capillary zone, Lcz (cm)	Total porosity in capillary zone, ncz (cm3/cm3)	Air-filled porosity in capillary zone, θα,χζ (cm3/cm3)	Water-filled porosity in capillary zone, θω,χζ (cm3/cm3)	Floor-wall seam perimeter, Xcrack (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, Qbuilding (cm3/s)	Area of enclosed space below grade, AB (cm2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Zcrack (cm)	Enthalpy of vaporization at ave. groundwater temperature, ΔHω,TΣ (cal/mol)	Henry's law constant at ave. groundwater temperature, HTS (atm-m3/mol)	Henry's law constant at ave. groundwater temperature, H'TS (unitless)	Vapor viscosity at ave. soil temperature, μTΣ (g/cm-s)	Vadose zone effective diffusion coefficient, DeffV (cm2/s)	Capillary zone effective diffusion coefficient, Deffcz (cm2/s)	Total overall effective diffusion coefficient, DeffT (cm2/s)
1.69E+04	1.00E+06	4.00E-04	15	12,913	1.52E-04	6.54E-03	1.75E-04	9.78E-03	4.62E-04	3.90E-03

Diffusion path length, Ld (cm)	Convection path length, Lp (cm)	Source vapor conc., Csource (μg/m^3)	Crack radius, rcrack (cm)	Average vapor flow rate into bldg., Qsoil (cm3/s)	Crack effective diffusion coefficient, Dcrack (cm2/s)	Area of crack, Acrack (cm2)	Exponent of equivalent foundation Peclet number, exp(Pef) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	**Infinite source bldg. conc., Cbuilding** (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m3)
228	15	6.54E+00	0.10	8.33E+01	9.78E-03	4.00E+02	3.29E+92	8.38E-04	**5.47E-03**	NA	3.0E-03

END

Indoor Air from Groundwater
Mercury
Wallops CDL

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^v (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
228	0.326	0.003	9.92E-08	0.998	9.91E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
1.69E+04	1.00E+06	4.00E-04	15	15,317	2.73E-03	1.17E-01	1.75E-04	5.09E-03	2.01E-04	1.80E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
228	15	1.17E+02	0.10	8.33E+01	5.09E-03	4.00E+02	6.45E+177	4.26E-04	5.00E-02	NA	3.0E-04

END

VERSAR

APPENDIX F-4

HUMAN HEALTH RISK CALCULATIONS

Risks to Current Site Workers
Central and Southern AOCs
Surface Soil
CDL - Wallops Flight Facility

INGESTION OF SOIL

		Carcinogen			Noncarcinogen		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzo(a)anthracene	2.49E+00	7.83E-07	7.30E-01	5.72E-07	2.19E-06	-	-
Benzo(a)pyrene	1.91E+00	6.01E-07	7.30E+00	**4.39E-06**	1.68E-06	-	-
Benzo(b)fluoranthene	1.39E+00	4.37E-07	7.30E-01	3.19E-07	1.22E-06	-	-
Benzo(k)fluoranthene	1.03E+00	3.24E-07	7.30E-02	2.36E-08	9.07E-07	-	-
Chrysene	4.04E+00	1.27E-06	7.30E-03	9.28E-09	3.56E-06	-	-
Dibenz(a,h)anthracene	3.88E-01	1.22E-07	7.30E+00	8.91E-07	3.42E-07	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	1.94E-07	7.30E-01	1.42E-07	5.43E-07	-	-
DDD	9.57E-02	3.01E-08	2.40E-01	7.22E-09	8.43E-08	-	-
DDE	6.18E-01	1.94E-07	3.40E-01	6.61E-08	5.44E-07	-	-
DDT	3.74E-01	1.18E-07	3.40E-01	4.00E-08	3.29E-07	5.00E-04	6.59E-04
Aluminum	1.82E+04	5.72E-03	-	-	1.60E-02	1.00E+00	1.60E-02
Antimony	6.37E+01	2.00E-05	-	-	5.61E-05	4.00E-04	1.40E-01
Arsenic	6.02E+00	1.89E-06	1.50E+00	**2.84E-06**	5.30E-06	3.00E-04	1.77E-02
Cadmium	1.71E+01	5.39E-06	-	-	1.51E-05	5.00E-04	3.02E-02
Chromium	5.17E+01	1.63E-05	-	-	4.55E-05	3.00E-03	1.52E-02
Copper	1.79E+03	5.63E-04	-	-	1.58E-03	4.00E-02	3.94E-02
Iron	2.43E+04	7.64E-03	-	-	2.14E-02	7.00E-01	3.06E-02
Mercury	7.40E-01	2.33E-07	-	-	6.52E-07	3.00E-04	2.17E-03
Nickel	1.65E+02	5.19E-05	-	-	1.45E-04	-	-
Silver	6.04E+01	1.90E-05	-	-	5.32E-05	5.00E-03	1.06E-02
Vanadium	3.85E+01	1.21E-05	-	-	3.39E-05	5.00E-03	6.78E-03
Zinc	4.28E+03	1.35E-03	-	-	3.77E-03	3.00E-01	1.26E-02
			Carcinogenic Risk	**9.29E-06**		Hazard Index	3.22E-01

DERMAL CONTACT WITH SOIL

		Carcinogen			Noncarcinogen		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzo(a)anthracene	2.49E+00	6.72E-07	7.30E-01	4.91E-07	1.88E-06	-	-
Benzo(a)pyrene	1.91E+00	5.15E-07	7.30E+00	**3.76E-06**	1.44E-06	-	-
Benzo(b)fluoranthene	1.39E+00	3.75E-07	7.30E-01	2.74E-07	1.05E-06	-	-
Benzo(k)fluoranthene	1.03E+00	2.78E-07	7.30E-02	2.03E-08	7.78E-07	-	-
Chrysene	4.04E+00	1.09E-06	7.30E-03	7.96E-09	3.05E-06	-	-
Dibenz(a,h)anthracene	3.88E-01	1.05E-07	7.30E+00	7.64E-07	2.93E-07	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	1.66E-07	7.30E-01	1.22E-07	4.66E-07	-	-
DDD	9.57E-02	1.99E-09	2.40E-01	4.77E-10	5.56E-09	-	-
DDE	6.18E-01	1.28E-08	3.40E-01	4.36E-09	3.59E-08	-	-
DDT	3.74E-01	2.33E-08	3.40E-01	7.92E-09	6.52E-08	5.00E-04	1.30E-04
Aluminum	1.82E+04	3.78E-05	-	-	1.06E-04	1.00E+00	1.06E-04
Antimony	6.37E+01	1.32E-07	-	-	3.70E-07	4.00E-04	9.26E-04
Arsenic	6.02E+00	3.75E-07	1.50E+00	5.62E-07	1.05E-06	3.00E-04	3.50E-03
Cadmium	1.71E+01	3.56E-08	-	-	9.96E-08	5.00E-04	1.99E-04
Chromium	5.17E+01	1.07E-07	-	-	3.01E-07	3.00E-03	1.00E-04
Copper	1.79E+03	3.72E-06	-	-	1.04E-05	4.00E-02	2.60E-04
Iron	2.43E+04	5.04E-05	-	-	1.41E-04	7.00E-01	2.02E-04
Mercury	7.40E-01	1.54E-09	-	-	4.30E-09	3.00E-04	1.43E-05
Nickel	1.65E+02	3.42E-07	-	-	9.58E-07	-	-
Silver	6.04E+01	1.25E-07	-	-	3.51E-07	5.00E-03	7.02E-05
Vanadium	3.85E+01	7.99E-08	-	-	2.24E-07	5.00E-03	4.48E-05
Zinc	4.28E+03	8.88E-06	-	-	2.49E-05	3.00E-01	8.29E-05
			Carcinogenic Risk	6.02E-06		Hazard Index	5.63E-03

Risks to Current Site Workers
Central and Southern AOCs
Surface Soil
CDL - Wallops Flight Facility

INHALATION OF DUST FROM SOIL		Carcinogen			Noncarcinogen		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzo(a)anthracene	2.49E+00	1.15E-10	3.90E-01	4.49E-11	3.22E-10	-	-
Benzo(a)pyrene	1.91E+00	8.83E-11	3.90E+00	3.45E-10	2.47E-10	-	-
Benzo(b)fluoranthene	1.39E+00	6.43E-11	3.90E-01	2.51E-11	1.80E-10	-	-
Benzo(k)fluoranthene	1.03E+00	4.76E-11	3.90E-01	1.86E-11	1.33E-10	-	-
Chrysene	4.04E+00	1.87E-10	3.90E-02	7.29E-12	5.23E-10	-	-
Dibenz(a,h)anthracene	3.88E-01	1.79E-11	4.10E+00	7.36E-11	5.02E-11	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	2.85E-11	3.90E-01	1.11E-11	7.99E-11	-	-
DDD	9.57E-02	4.43E-12	-	-	1.24E-11	-	-
DDE	6.18E-01	2.86E-11	-	-	8.00E-11	-	-
DDT	3.74E-01	1.73E-11	3.40E-01	5.88E-12	4.84E-11	-	-
Aluminum	1.82E+04	8.41E-07	-	-	2.36E-06	1.43E-03	1.65E-03
Antimony	6.37E+01	2.95E-09	-	-	8.25E-09	-	-
Arsenic	6.02E+00	2.78E-10	1.51E+01	4.20E-09	7.80E-10	8.57E-06	9.10E-05
Cadmium	1.71E+01	7.93E-10	1.50E+01	1.19E-08	2.22E-09	-	-
Chromium	5.17E+01	2.39E-09	4.20E+01	1.00E-07	6.70E-09	3.00E-05	2.23E-04
Copper	1.79E+03	8.28E-08	-	-	2.32E-07	-	-
Iron	2.43E+04	1.12E-06	-	-	3.15E-06	-	-
Mercury	7.40E-01	3.42E-11	-	-	9.58E-11	-	-
Nickel	1.65E+02	7.63E-09	-	-	2.14E-08	-	-
Silver	6.04E+01	2.79E-09	-	-	7.82E-09	-	-
Vanadium	3.85E+01	1.78E-09	-	-	4.99E-09	-	-
Zinc	4.28E+03	1.98E-07	-	-	5.54E-07	-	-
			Carcinogenic Risk	1.17E-07		Hazard Index	1.96E-03
		Total Carcinogenic Risk - Soil Exposure		1.54E-05		**Total HI - Soil Exposure**	3.30E-01

Risks to Future Commercial Workers
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION OF SOIL

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	3.23E-08	5.50E-02	1.78E-09	9.05E-08	4.00E-03	2.26E-05
1,2-Dichloroethane	2.38E-01	4.16E-08	9.10E-02	3.78E-09	1.16E-07	-	-
Ethylbenzene	1.42E+00	2.48E-07	1.10E-02	2.73E-09	6.95E-07	1.10E-01	6.32E-06
Tetrachloroethene	1.37E-02	2.39E-09	5.40E-01	1.29E-09	6.70E-09	1.00E-02	6.70E-07
m,p-Xylene	2.00E+00	3.49E-07	-	-	9.78E-07	2.00E+00	4.89E-07
Xylene (total)	2.83E+00	4.94E-07	-	-	1.38E-06	2.00E-01	6.92E-06
Benzo(a)anthracene	9.05E-01	1.58E-07	7.30E-01	1.15E-07	4.43E-07	-	-
Benzo(a)pyrene	1.91E+00	3.34E-07	7.30E+00	**2.44E-06**	9.34E-07	-	-
Benzo(b)fluoranthene	1.39E+00	2.43E-07	7.30E-01	1.77E-07	6.80E-07	-	-
Benzo(k)fluoranthene	1.03E+00	1.80E-07	7.30E-02	1.31E-08	5.04E-07	-	-
Chrysene	1.43E+00	2.49E-07	7.30E-03	1.82E-09	6.98E-07	-	-
Dibenz(a,h)anthracene	3.88E-01	6.78E-08	7.30E+00	4.95E-07	1.90E-07	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	1.08E-07	7.30E-01	7.87E-08	3.02E-07	-	-
Gamma-Chlordane	3.46E-02	6.05E-09	3.50E-01	2.12E-09	1.69E-08	5.00E-04	3.39E-05
DDD	6.11E-02	1.07E-08	2.40E-01	2.56E-09	2.99E-08	-	-
DDE	6.54E-01	1.14E-07	3.40E-01	3.89E-08	3.20E-07	-	-
DDT	3.26E-01	5.70E-08	3.40E-01	1.94E-08	1.59E-07	5.00E-04	3.19E-04
Aroclor-1260	2.13E-01	3.72E-08	2.00E+00	7.44E-08	1.04E-07	2.00E-05	5.21E-03
Aluminum	2.95E+04	5.15E-03	-	-	1.44E-02	1.00E+00	1.44E-02
Antimony	2.58E+01	4.51E-06	-	-	1.26E-05	4.00E-04	3.15E-02
Arsenic	4.79E+00	8.37E-07	1.50E+00	**1.26E-06**	2.34E-06	3.00E-04	7.81E-03
Cadmium	1.17E+01	2.04E-06	-	-	5.70E-06	5.00E-04	1.14E-02
Chromium	3.69E+02	6.44E-05	-	-	1.80E-04	3.00E-03	6.01E-02
Copper	3.49E+03	6.10E-04	-	-	1.71E-03	4.00E-02	4.27E-02
Iron	1.90E+04	3.32E-03	-	-	9.30E-03	7.00E-01	1.33E-02
Mercury	6.05E-01	1.06E-07	-	-	2.96E-07	3.00E-04	9.87E-04
Nickel	8.44E+01	1.48E-05	-	-	4.13E-05	-	-
Silver	2.06E+01	3.60E-06	-	-	1.01E-05	5.00E-03	2.02E-03
Vanadium	2.34E+01	4.08E-06	-	-	1.14E-05	5.00E-03	2.29E-03
Zinc	4.28E+03	7.48E-04	-	-	2.09E-03	3.00E-01	6.98E-03
			Carcinogenic Risk	**4.72E-06**		**Hazard Index**	1.99E-01

Risks to Future Commercial Workers
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INHALATION OF INDOOR VAPOR FROM SOIL

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
COPC	RME Concentration in Indoor Air from Soil (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	6.25E-01	4.37E-02	2.73E-02	**1.19E-03**	1.22E-01	8.57E-03	**1.43E+01**
1,2-Dichloroethane	3.28E-01	2.29E-02	9.10E-02	**2.09E-03**	6.42E-02	6.86E-01	9.37E-02
Ethylbenzene	1.21E+00	8.48E-02	8.75E-03	**7.42E-04**	2.37E-01	2.86E-01	8.31E-01
Tetrachloroethene	5.74E-02	4.01E-03	2.10E-02	**8.42E-05**	1.12E-02	7.71E-02	1.46E-01
m,p-Xylene	1.54E+00	1.08E-01	-	-	3.02E-01	2.00E-01	**1.51E+00**
Xylene (total)	NA	-	-	-	-	2.86E-02	-
Benzo(a)anthracene	NA	-	3.90E-01	-	-	-	-
Benzo(a)pyrene	NA	-	3.90E+00	-	-	-	-
Benzo(b)fluoranthene	1.92E-03	1.34E-04	3.90E-01	**5.23E-05**	3.75E-04	-	-
Benzo(k)fluoranthene	NA	-	3.90E-01	-	-	-	-
Chrysene	3.90E-06	2.72E-07	3.90E-02	**1.06E-08**	7.63E-07	-	-
Dibenz(a,h)anthracene	NA	-	4.10E+00	-	-	-	-
Indeno(1,2,3-cd)pyrene	NA	-	3.90E-01	-	-	-	-
Gamma-Chlordane	NA	-	3.50E-01	-	-	2.00E-04	-
DDD	NA	-	-	-	-	-	-
DDE	4.26E-08	2.98E-09	-	-	8.33E-09	-	-
DDT	NA	-	3.40E-01	-	-	-	-
Aroclor-1260	NA	-	2.00E+00	-	-	-	-
Aluminum	NA	-	-	-	-	1.43E-03	-
Antimony	NA	-	-	-	-	-	-
Arsenic	NA	-	1.51E+01	-	-	8.57E-06	-
Cadmium	NA	-	1.50E+01	-	-	-	-
Chromium	NA	-	4.20E+01	-	-	3.00E-05	-
Copper	NA	-	-	-	-	-	-
Iron	NA	-	-	-	-	-	-
Mercury	NA	-	-	-	-	-	-
Nickel	NA	-	-	-	-	-	-
Silver	NA	-	-	-	-	-	-
Vanadium	NA	-	-	-	-	-	-
Zinc	NA	-	-	-	-	-	-
			Carcinogenic Risk	**4.16E-03**		**Hazard Index**	**1.69E+01**
		Total Carcinogenic Risk - Soil Exposure		**4.16E-03**	**Total HI - Soil Exposure**		**1.71E+01**

Risks to Future Construction Workers
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION - SOIL FUTURE CONSTRUCTION WORKERS		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	2.05E-09	5.50E-02	1.13E-10	2.87E-07	4.00E-03	7.17E-05
1,2-Dichloroethane	2.38E-01	2.63E-09	9.10E-02	2.40E-10	3.69E-07	-	-
Ethylbenzene	1.42E+00	1.57E-08	1.10E-02	1.73E-10	2.20E-06	1.10E-01	2.00E-05
Tetrachloroethene	1.37E-02	1.52E-10	5.40E-01	8.19E-11	2.12E-08	1.00E-02	2.12E-06
m,p-Xylene	2.00E+00	2.21E-08	-	-	3.10E-06	2.00E+00	1.55E-06
Xylene (total)	2.83E+00	3.13E-08	-	-	4.39E-06	2.00E-01	2.19E-05
Benzo(a)anthracene	9.05E-01	1.00E-08	7.30E-01	7.31E-09	1.40E-06	-	-
Benzo(a)pyrene	1.91E+00	2.11E-08	7.30E+00	1.54E-07	2.96E-06	-	-
Benzo(b)fluoranthene	1.39E+00	1.54E-08	7.30E-01	1.12E-08	2.15E-06	-	-
Benzo(k)fluoranthene	1.03E+00	1.14E-08	7.30E-02	8.32E-10	1.60E-06	-	-
Chrysene	1.43E+00	1.58E-08	7.30E-03	1.15E-10	2.21E-06	-	-
Dibenz(a,h)anthracene	3.88E-01	4.30E-09	7.30E+00	3.14E-08	6.01E-07	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	6.83E-09	7.30E-01	4.99E-09	9.56E-07	-	-
Gamma-Chlordane	3.46E-02	3.83E-10	3.50E-01	1.34E-10	5.36E-08	5.00E-04	1.07E-04
DDD	6.11E-02	6.76E-10	2.40E-01	1.62E-10	9.47E-08	-	-
DDE	6.54E-01	7.24E-09	3.40E-01	2.46E-09	1.01E-06	-	-
DDT	3.26E-01	3.61E-09	3.40E-01	1.23E-09	5.05E-07	5.00E-04	1.01E-03
Aroclor-1260	2.13E-01	2.36E-09	2.00E+00	4.72E-09	3.30E-07	2.00E-05	1.65E-02
Aluminum	2.95E+04	3.27E-04	-	-	4.57E-02	1.00E+00	4.57E-02
Antimony	2.58E+01	2.86E-07	-	-	4.00E-05	4.00E-04	9.99E-02
Arsenic	4.79E+00	5.30E-08	1.50E+00	7.95E-08	7.42E-06	3.00E-04	2.47E-02
Cadmium	1.17E+01	1.29E-07	-	-	1.81E-05	5.00E-04	3.61E-02
Chromium	3.69E+02	4.08E-06	-	-	5.71E-04	3.00E-03	1.90E-01
Copper	3.49E+03	3.86E-05	-	-	5.41E-03	4.00E-02	1.35E-01
Iron	1.90E+04	2.10E-04	-	-	2.95E-02	7.00E-01	4.21E-02
Mercury	6.05E-01	6.70E-09	-	-	9.38E-07	3.00E-04	3.13E-03
Nickel	8.44E+01	9.35E-07	-	-	1.31E-04	-	-
Silver	2.06E+01	2.28E-07	-	-	3.20E-05	5.00E-03	6.39E-03
Vanadium	2.34E+01	2.59E-07	-	-	3.62E-05	5.00E-03	7.24E-03
Zinc	4.28E+03	4.74E-05	-	-	6.63E-03	3.00E-01	2.21E-02
				Carcinogenic Risk 2.99E-07			Hazard Index 6.31E-01

Risks to Future Construction Workers
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

DERMAL CONTACT - SOIL FUTURE CONSTRUCTION WORKERS		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	6.14E-11	5.50E-02	3.38E-12	8.60E-09	4.00E-03	2.15E-06
1,2-Dichloroethane	2.38E-01	7.90E-11	9.10E-02	7.19E-12	1.11E-08	-	-
Ethylbenzene	1.42E+00	4.72E-10	1.10E-02	5.19E-12	6.60E-08	1.10E-01	6.00E-07
Tetrachloroethene	1.37E-02	4.55E-12	5.40E-01	2.46E-12	6.37E-10	1.00E-02	6.37E-08
m,p-Xylene	2.00E+00	6.64E-10	-	-	9.30E-08	2.00E+00	4.65E-08
Xylene (total)	2.83E+00	9.40E-10	-	-	1.32E-07	2.00E-01	6.58E-07
Benzo(a)anthracene	9.05E-01	3.91E-09	7.30E-01	2.85E-09	5.47E-07	-	-
Benzo(a)pyrene	1.91E+00	8.25E-09	7.30E+00	6.02E-08	1.15E-06	-	-
Benzo(b)fluoranthene	1.39E+00	6.00E-09	7.30E-01	4.38E-09	8.40E-07	-	-
Benzo(k)fluoranthene	1.03E+00	4.45E-09	7.30E-02	3.25E-10	6.23E-07	-	-
Chrysene	1.43E+00	6.16E-09	7.30E-03	4.50E-11	8.63E-07	-	-
Dibenz(a,h)anthracene	3.88E-01	1.68E-09	7.30E+00	1.22E-08	2.35E-07	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	2.66E-09	7.30E-01	1.94E-09	3.73E-07	-	-
Gamma-Chlordane	3.46E-02	4.60E-11	3.50E-01	1.61E-11	6.44E-09	5.00E-04	1.29E-05
DDD	6.11E-02	2.03E-11	2.40E-01	4.87E-12	2.84E-09	-	-
DDE	6.54E-01	2.17E-10	3.40E-01	7.39E-11	3.04E-08	-	-
DDT	3.26E-01	3.25E-10	3.40E-01	1.10E-10	4.55E-08	5.00E-04	9.09E-05
Aroclor-1260	2.13E-01	9.90E-10	2.00E+00	1.98E-09	1.39E-07	2.00E-05	6.93E-03
Aluminum	2.95E+04	9.80E-07	-	-	1.37E-04	1.00E+00	1.37E-04
Antimony	2.58E+01	8.57E-10	-	-	1.20E-07	4.00E-04	3.00E-04
Arsenic	4.79E+00	4.77E-09	1.50E+00	7.16E-09	6.68E-07	3.00E-04	2.23E-03
Cadmium	1.17E+01	3.87E-10	-	-	5.42E-08	5.00E-04	1.08E-04
Chromium	3.69E+02	1.22E-08	-	-	1.71E-06	3.00E-03	5.71E-04
Copper	3.49E+03	1.16E-07	-	-	1.62E-05	4.00E-02	4.06E-04
Iron	1.90E+04	6.31E-07	-	-	8.84E-05	7.00E-01	1.26E-04
Mercury	6.05E-01	2.01E-11	-	-	2.81E-09	3.00E-04	9.38E-06
Nickel	8.44E+01	2.80E-09	-	-	3.93E-07	-	-
Silver	2.06E+01	6.85E-10	-	-	9.59E-08	5.00E-03	1.92E-05
Vanadium	2.34E+01	7.76E-10	-	-	1.09E-07	5.00E-03	2.17E-05
Zinc	4.28E+03	1.42E-07	-	-	1.99E-05	3.00E-01	6.63E-05
				Carcinogenic Risk	9.13E-08		Hazard Index	1.10E-02

Risks to Future Construction Workers
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INHALATION - DUST FROM SOIL FUTURE CONSTRUCTION WORKERS	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	9.13E-14	2.73E-02	2.49E-15	1.28E-11	8.57E-03	1.49E-09
1,2-Dichloroethane	2.38E-01	1.17E-13	9.10E-02	1.07E-14	1.64E-11	6.86E-01	2.40E-11
Ethylbenzene	1.42E+00	7.01E-13	8.75E-03	6.13E-15	9.81E-11	2.86E-01	3.43E-10
Tetrachloroethene	1.37E-02	6.76E-15	2.10E-02	1.42E-16	9.46E-13	7.71E-02	1.23E-11
m,p-Xylene	2.00E+00	9.87E-13	-	-	1.38E-10	2.00E-01	6.91E-10
Xylene (total)	2.83E+00	1.40E-12	-	-	1.95E-10	2.86E-02	6.84E-09
Benzo(a)anthracene	9.05E-01	4.46E-13	3.90E-01	1.74E-13	6.25E-11	-	-
Benzo(a)pyrene	1.91E+00	9.42E-13	3.90E+00	3.67E-12	1.32E-10	-	-
Benzo(b)fluoranthene	1.39E+00	6.86E-13	3.90E-01	2.67E-13	9.60E-11	-	-
Benzo(k)fluoranthene	1.03E+00	5.08E-13	3.90E-01	1.98E-13	7.11E-11	-	-
Chrysene	1.43E+00	7.04E-13	3.90E-02	2.75E-14	9.86E-11	-	-
Dibenz(a,h)anthracene	3.88E-01	1.91E-13	4.10E+00	7.85E-13	2.68E-11	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	3.04E-13	3.90E-01	1.19E-13	4.26E-11	-	-
Gamma-Chlordane	3.46E-02	1.71E-14	3.50E-01	5.97E-15	2.39E-12	2.00E-04	1.19E-08
DDD	6.11E-02	3.01E-14	-	-	4.22E-12	-	-
DDE	6.54E-01	3.23E-13	-	-	4.52E-11	-	-
DDT	3.26E-01	1.61E-13	3.40E-01	5.47E-14	2.25E-11	-	-
Aroclor-1260	2.13E-01	1.05E-13	2.00E+00	2.10E-13	1.47E-11	-	-
Aluminum	2.95E+04	1.46E-08	-	-	2.04E-06	1.43E-03	1.43E-03
Antimony	2.58E+01	1.27E-11	-	-	1.78E-09	-	-
Arsenic	4.79E+00	2.36E-12	1.51E+01	3.57E-11	3.31E-10	8.57E-06	3.86E-05
Cadmium	1.17E+01	5.75E-12	1.50E+01	8.62E-11	8.05E-10	-	-
Chromium	3.69E+02	1.82E-10	4.20E+01	7.64E-09	2.55E-08	3.00E-05	8.48E-04
Copper	3.49E+03	1.72E-09	-	-	2.41E-07	-	-
Iron	1.90E+04	9.38E-09	-	-	1.31E-06	-	-
Mercury	6.05E-01	2.98E-13	-	-	4.18E-11	-	-
Nickel	8.44E+01	4.17E-11	-	-	5.83E-09	-	-
Silver	2.06E+01	1.02E-11	-	-	1.42E-09	-	-
Vanadium	2.34E+01	1.15E-11	-	-	1.61E-09	-	-
Zinc	4.28E+03	2.11E-09	-	-	2.96E-07	-	-
				Carcinogenic Risk 7.76E-09			**Hazard Index** 2.31E-03
				Total Carcinogenic Risk - Soil Exposure 3.98E-07			**Total HI - Soil Exposure** 6.44E-01

Risks to Future Adult Residents
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION OF SOIL FUTURE RESIDENT, ADULT		Carcinogen			Noncarcinogen		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	8.69E-08	5.50E-02	4.78E-09	2.53E-07	4.00E-03	6.34E-05
1,2-Dichloroethane	2.38E-01	1.12E-07	9.10E-02	1.02E-08	3.26E-07	-	-
Ethylbenzene	1.42E+00	6.67E-07	1.10E-02	7.34E-09	1.95E-06	1.10E-01	1.77E-05
Tetrachloroethene	1.37E-02	6.43E-09	5.40E-01	3.47E-09	1.88E-08	1.00E-02	1.88E-06
m,p-Xylene	2.00E+00	9.39E-07	-	-	2.74E-06	2.00E+00	1.37E-06
Xylene (total)	2.83E+00	1.33E-06	-	-	3.88E-06	2.00E-01	1.94E-05
Benzo(a)anthracene	9.05E-01	4.25E-07	7.30E-01	3.10E-07	1.24E-06	-	-
Benzo(a)pyrene	1.91E+00	8.97E-07	7.30E+00	6.55E-06	2.62E-06	-	-
Benzo(b)fluoranthene	1.39E+00	6.53E-07	7.30E-01	4.77E-07	1.90E-06	-	-
Benzo(k)fluoranthene	1.03E+00	4.84E-07	7.30E-02	3.53E-08	1.41E-06	-	-
Chrysene	1.43E+00	6.70E-07	7.30E-03	4.89E-09	1.95E-06	-	-
Dibenz(a,h)anthracene	3.88E-01	1.82E-07	7.30E+00	1.33E-06	5.32E-07	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	2.90E-07	7.30E-01	2.12E-07	8.45E-07	-	-
Gamma-Chlordane	3.46E-02	1.63E-08	3.50E-01	5.69E-09	4.74E-08	5.00E-04	9.48E-05
DDD	6.11E-02	2.87E-08	2.40E-01	6.89E-09	8.37E-08	-	-
DDE	6.54E-01	3.07E-07	3.40E-01	1.04E-07	8.96E-07	-	-
DDT	3.26E-01	1.53E-07	3.40E-01	5.21E-08	4.47E-07	5.00E-04	8.93E-04
Aroclor-1260	2.13E-01	1.00E-07	2.00E+00	2.00E-07	2.92E-07	2.00E-05	1.46E-02
Aluminum	2.95E+04	1.39E-02	-	-	4.04E-02	1.00E+00	4.04E-02
Antimony	2.58E+01	1.21E-05	-	-	3.53E-05	4.00E-04	8.83E-02
Arsenic	4.79E+00	2.25E-06	1.50E+00	3.37E-06	6.56E-06	3.00E-04	2.19E-02
Cadmium	1.17E+01	5.47E-06	-	-	1.60E-05	5.00E-04	3.19E-02
Chromium	3.69E+02	1.73E-04	-	-	5.05E-04	3.00E-03	1.68E-01
Copper	3.49E+03	1.64E-03	-	-	4.78E-03	4.00E-02	1.19E-01
Iron	1.90E+04	8.93E-03	-	-	2.60E-02	7.00E-01	3.72E-02
Mercury	6.05E-01	2.84E-07	-	-	8.29E-07	3.00E-04	2.76E-03
Nickel	8.44E+01	3.97E-05	-	-	1.16E-04	-	-
Silver	2.06E+01	9.68E-06	-	-	2.82E-05	5.00E-03	5.65E-03
Vanadium	2.34E+01	1.10E-05	-	-	3.20E-05	5.00E-03	6.40E-03
Zinc	4.28E+03	2.01E-03	-	-	5.86E-03	3.00E-01	1.95E-02
			Carcinogenic Risk	**1.27E-05**		**Hazard Index**	5.57E-01

Risks to Future Adult Residents
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

DERMAL CONTACT WITH SOIL

FUTURE RESIDENT, ADULT		Carcinogen			Noncarcinogen		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	3.47E-09	5.50E-02	1.91E-10	1.01E-08	4.00E-03	2.53E-06
1,2-Dichloroethane	2.38E-01	4.46E-09	9.10E-02	4.06E-10	1.30E-08	-	-
Ethylbenzene	1.42E+00	2.66E-08	1.10E-02	2.93E-10	7.76E-08	1.10E-01	7.06E-07
Tetrachloroethene	1.37E-02	2.57E-10	5.40E-01	1.39E-10	7.49E-10	1.00E-02	7.49E-08
m,p-Xylene	2.00E+00	3.75E-08	-	-	1.09E-07	2.00E+00	5.47E-08
Xylene (total)	2.83E+00	5.30E-08	-	-	1.55E-07	2.00E-01	7.73E-07
Benzo(a)anthracene	9.05E-01	2.20E-07	7.30E-01	1.61E-07	6.43E-07	-	-
Benzo(a)pyrene	1.91E+00	4.65E-07	7.30E+00	3.40E-06	1.36E-06	-	-
Benzo(b)fluoranthene	1.39E+00	3.39E-07	7.30E-01	2.47E-07	9.88E-07	-	-
Benzo(k)fluoranthene	1.03E+00	2.51E-07	7.30E-02	1.83E-08	7.32E-07	-	-
Chrysene	1.43E+00	3.48E-07	7.30E-03	2.54E-09	1.01E-06	-	-
Dibenz(a,h)anthracene	3.88E-01	9.45E-08	7.30E+00	6.90E-07	2.76E-07	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	1.50E-07	7.30E-01	1.10E-07	4.38E-07	-	-
Gamma-Chlordane	3.46E-02	2.59E-09	3.50E-01	9.08E-10	7.56E-09	5.00E-04	1.51E-05
DDD	6.11E-02	1.14E-09	2.40E-01	2.75E-10	3.34E-09	-	-
DDE	6.54E-01	1.23E-08	3.40E-01	4.17E-09	3.57E-08	-	-
DDT	3.26E-01	1.83E-08	3.40E-01	6.23E-09	5.35E-08	5.00E-04	1.07E-04
Aroclor-1260	2.13E-01	5.59E-08	2.00E+00	1.12E-07	1.63E-07	2.00E-05	8.15E-03
Aluminum	2.95E+04	5.53E-05	-	-	1.61E-04	1.00E+00	1.61E-04
Antimony	2.58E+01	4.83E-08	-	-	1.41E-07	4.00E-04	3.52E-04
Arsenic	4.79E+00	2.69E-07	1.50E+00	4.04E-07	7.85E-07	3.00E-04	2.62E-03
Cadmium	1.17E+01	2.18E-08	-	-	6.37E-08	5.00E-04	1.27E-04
Chromium	3.69E+02	6.91E-07	-	-	2.01E-06	3.00E-03	6.71E-04
Copper	3.49E+03	6.54E-06	-	-	1.91E-05	4.00E-02	4.77E-04
Iron	1.90E+04	3.56E-05	-	-	1.04E-04	7.00E-01	1.48E-04
Mercury	6.05E-01	1.13E-09	-	-	3.31E-09	3.00E-04	1.10E-05
Nickel	8.44E+01	1.58E-07	-	-	4.62E-07	-	-
Silver	2.06E+01	3.86E-08	-	-	1.13E-07	5.00E-03	2.25E-05
Vanadium	2.34E+01	4.38E-08	-	-	1.28E-07	5.00E-03	2.55E-05
Zinc	4.28E+03	8.02E-06	-	-	2.34E-05	3.00E-01	7.80E-05
				Carcinogenic Risk 5.15E-06			Hazard Index 1.30E-02

Risks to Future Adult Residents
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INHALATION OF DUST FROM SOIL FUTURE RESIDENT, ADULT		Carcinogen			Noncarcinogen		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	1.28E-11	2.73E-02	3.49E-13	3.73E-11	8.57E-03	4.35E-09
1,2-Dichloroethane	2.38E-01	1.64E-11	9.10E-02	1.50E-12	4.79E-11	6.86E-01	6.99E-11
Ethylbenzene	1.42E+00	9.81E-11	8.75E-03	8.58E-13	2.86E-10	2.86E-01	1.00E-09
Tetrachloroethene	1.37E-02	9.46E-13	2.10E-02	1.99E-14	2.76E-12	7.71E-02	3.58E-11
m,p-Xylene	2.00E+00	1.38E-10	-	-	4.03E-10	2.00E-01	2.01E-09
Xylene (total)	2.83E+00	1.95E-10	-	-	5.70E-10	2.86E-02	2.00E-08
Benzo(a)anthracene	9.05E-01	6.25E-11	3.90E-01	2.44E-11	1.82E-10	-	-
Benzo(a)pyrene	1.91E+00	1.32E-10	3.90E+00	5.14E-10	3.85E-10	-	-
Benzo(b)fluoranthene	1.39E+00	9.60E-11	3.90E-01	3.74E-11	2.80E-10	-	-
Benzo(k)fluoranthene	1.03E+00	7.11E-11	3.90E-01	2.77E-11	2.07E-10	-	-
Chrysene	1.43E+00	9.86E-11	3.90E-02	3.84E-12	2.87E-10	-	-
Dibenz(a,h)anthracene	3.88E-01	2.68E-11	4.10E+00	1.10E-10	7.82E-11	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	4.26E-11	3.90E-01	1.66E-11	1.24E-10	-	-
Gamma-Chlordane	3.46E-02	2.39E-12	3.50E-01	8.36E-13	6.97E-12	2.00E-04	3.49E-08
DDD	6.11E-02	4.22E-12	-	-	1.23E-11	-	-
DDE	6.54E-01	4.52E-11	-	-	1.32E-10	-	-
DDT	3.26E-01	2.25E-11	3.40E-01	7.66E-12	6.57E-11	-	-
Aroclor-1260	2.13E-01	1.47E-11	2.00E+00	2.94E-11	4.29E-11	-	-
Aluminum	2.95E+04	2.04E-06	-	-	5.94E-06	1.43E-03	4.16E-03
Antimony	2.58E+01	1.78E-09	-	-	5.20E-09	-	-
Arsenic	4.79E+00	3.31E-10	1.51E+01	4.99E-09	9.65E-10	8.57E-06	1.13E-04
Cadmium	1.17E+01	8.05E-10	1.50E+01	1.21E-08	2.35E-09	-	-
Chromium	3.69E+02	2.55E-08	4.20E+01	1.07E-06	7.42E-08	3.00E-05	2.47E-03
Copper	3.49E+03	2.41E-07	-	-	7.03E-07	-	-
Iron	1.90E+04	1.31E-06	-	-	3.83E-06	-	-
Mercury	6.05E-01	4.18E-11	-	-	1.22E-10	-	-
Nickel	8.44E+01	5.83E-09	-	-	1.70E-08	-	-
Silver	2.06E+01	1.42E-09	-	-	4.15E-09	-	-
Vanadium	2.34E+01	1.61E-09	-	-	4.71E-09	-	-
Zinc	4.28E+03	2.96E-07	-	-	8.62E-07	-	-
			Carcinogenic Risk	1.09E-06		Hazard Index	6.75E-03

INHALATION OF INDOOR VAPOR FROM SOIL FUTURE RESIDENT, ADULT		Carcinogen			Noncarcinogen		
COPC	RME Concentration in Soil (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	6.25E-01	5.87E-02	2.73E-02	1.60E-03	1.71E-01	8.57E-03	2.00E+01
1,2-Dichloroethane	3.28E-01	3.08E-02	9.10E-02	2.81E-03	8.99E-02	6.86E-01	1.31E-01
Ethylbenzene	1.21E+00	1.14E-01	8.75E-03	9.97E-04	3.32E-01	2.86E-01	1.16E+00
Tetrachloroethene	5.74E-02	5.39E-03	2.10E-02	1.13E-04	1.57E-02	7.71E-02	2.04E-01
m,p-Xylene	1.54E+00	1.45E-01	-	-	4.23E-01	2.00E-01	2.12E+00
Xylene (total)	NA	-	-	-	-	2.86E-02	-
Benzo(a)anthracene	NA	-	3.90E-01	-	-	-	-
Benzo(a)pyrene	NA	-	3.90E+00	-	-	-	-
Benzo(b)fluoranthene	1.92E-03	1.80E-04	3.90E-01	7.02E-05	5.25E-04	-	-
Benzo(k)fluoranthene	NA	-	3.90E-01	-	-	-	-
Chrysene	3.90E-06	3.66E-07	3.90E-02	1.43E-08	1.07E-06	-	-
Dibenz(a,h)anthracene	NA	-	4.10E+00	-	-	-	-
Indeno(1,2,3-cd)pyrene	NA	-	3.90E-01	-	-	-	-
Gamma-Chlordane	NA	-	3.50E-01	-	-	2.00E-04	-
DDD	NA	-	-	-	-	-	-
DDE	4.26E-08	4.00E-09	-	-	1.17E-08	-	-
DDT	NA	-	3.40E-01	-	-	-	-
Aroclor-1260	NA	-	2.00E+00	-	-	-	-
Aluminum	NA	-	-	-	-	1.43E-03	-
Antimony	NA	-	-	-	-	-	-
Arsenic	NA	-	1.51E+01	-	-	8.57E-06	-
Cadmium	NA	-	1.50E+01	-	-	-	-
Chromium	NA	-	4.20E+01	-	-	3.00E-05	-
Copper	NA	-	-	-	-	-	-
Iron	NA	-	-	-	-	-	-
Mercury	NA	-	-	-	-	-	-
Nickel	NA	-	-	-	-	-	-
Silver	NA	-	-	-	-	-	-
Vanadium	NA	-	-	-	-	-	-
Zinc	NA	-	-	-	-	-	-
			Carcinogenic Risk	5.59E-03		Hazard Index	2.36E+01
		Total Carcinogenic Risk - Soil Exposure		5.61E-03	Total HI - Soil Exposure		2.42E+01

Risks to Future Child Residents
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION OF SOIL

	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	2.03E-07	5.50E-02	1.12E-08	2.37E-06	4.00E-03	5.91E-04
1,2-Dichloroethane	2.38E-01	2.61E-07	9.10E-02	2.37E-08	3.04E-06	-	-
Ethylbenzene	1.42E+00	1.56E-06	1.10E-02	1.71E-08	1.82E-05	1.10E-01	1.65E-04
Tetrachloroethene	1.37E-02	1.50E-08	5.40E-01	8.11E-09	1.75E-07	1.00E-02	1.75E-05
m,p-Xylene	2.00E+00	2.19E-06	-	-	2.56E-05	2.00E+00	1.28E-05
Xylene (total)	2.83E+00	3.10E-06	-	-	3.62E-05	2.00E-01	1.81E-04
Benzo(a)anthracene	9.05E-01	9.92E-07	7.30E-01	7.24E-07	1.16E-05	-	-
Benzo(a)pyrene	1.91E+00	2.09E-06	7.30E+00	**1.53E-05**	2.44E-05	-	-
Benzo(b)fluoranthene	1.39E+00	1.52E-06	7.30E-01	1.11E-06	1.78E-05	-	-
Benzo(k)fluoranthene	1.03E+00	1.13E-06	7.30E-02	8.24E-08	1.32E-05	-	-
Chrysene	1.43E+00	1.56E-06	7.30E-03	1.14E-08	1.82E-05	-	-
Dibenz(a,h)anthracene	3.88E-01	4.25E-07	7.30E+00	**3.10E-06**	4.96E-06	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	6.76E-07	7.30E-01	4.94E-07	7.89E-06	-	-
Gamma-Chlordane	3.46E-02	3.79E-08	3.50E-01	1.33E-08	4.42E-07	5.00E-04	8.85E-04
DDD	6.11E-02	6.70E-08	2.40E-01	1.61E-08	7.81E-07	-	-
DDE	6.54E-01	7.17E-07	3.40E-01	2.44E-07	8.36E-06	-	-
DDT	3.26E-01	3.57E-07	3.40E-01	1.21E-07	4.17E-06	5.00E-04	8.34E-03
Aroclor-1260	2.13E-01	2.33E-07	2.00E+00	4.67E-07	2.72E-06	2.00E-05	1.36E-01
Aluminum	2.95E+04	3.23E-02	-	-	3.77E-01	1.00E+00	3.77E-01
Antimony	2.58E+01	2.83E-05	-	-	3.30E-04	4.00E-04	8.24E-01
Arsenic	4.79E+00	5.25E-06	1.50E+00	**7.87E-06**	6.12E-05	3.00E-04	2.04E-01
Cadmium	1.17E+01	1.28E-05	-	-	1.49E-04	5.00E-04	2.98E-01
Chromium	3.69E+02	4.04E-04	-	-	4.71E-03	3.00E-03	**1.57E+00**
Copper	3.49E+03	3.82E-03	-	-	4.46E-02	4.00E-02	**1.12E+00**
Iron	1.90E+04	2.08E-02	-	-	2.43E-01	7.00E-01	3.47E-01
Mercury	6.05E-01	6.63E-07	-	-	7.74E-06	3.00E-04	2.58E-02
Nickel	8.44E+01	9.25E-05	-	-	1.08E-03	-	-
Silver	2.06E+01	2.26E-05	-	-	2.64E-04	5.00E-03	5.27E-02
Vanadium	2.34E+01	2.56E-05	-	-	2.99E-04	5.00E-03	5.97E-02
Zinc	4.28E+03	4.69E-03	-	-	5.47E-02	3.00E-01	1.82E-01
			Carcinogenic Risk	**2.96E-05**		Hazard Index	**5.20E+00**

DERMAL CONTACT WITH SOIL

	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	1.42E-08	5.50E-02	7.81E-10	1.66E-07	4.00E-03	4.14E-05
1,2-Dichloroethane	2.38E-01	1.83E-08	9.10E-02	1.66E-09	2.13E-07	-	-
Ethylbenzene	1.42E+00	1.09E-07	1.10E-02	1.20E-09	1.27E-06	1.10E-01	1.16E-05
Tetrachloroethene	1.37E-02	1.05E-09	5.40E-01	5.68E-10	1.23E-08	1.00E-02	1.23E-06
m,p-Xylene	2.00E+00	1.53E-07	-	-	1.79E-06	2.00E+00	8.95E-07
Xylene (total)	2.83E+00	2.17E-07	-	-	2.53E-06	2.00E-01	1.27E-05
Benzo(a)anthracene	9.05E-01	9.03E-07	7.30E-01	6.59E-07	1.05E-05	-	-
Benzo(a)pyrene	1.91E+00	1.90E-06	7.30E+00	**1.39E-05**	2.22E-05	-	-
Benzo(b)fluoranthene	1.39E+00	1.39E-06	7.30E-01	1.01E-06	1.62E-05	-	-
Benzo(k)fluoranthene	1.03E+00	1.03E-06	7.30E-02	7.50E-08	1.20E-05	-	-
Chrysene	1.43E+00	1.42E-06	7.30E-03	1.04E-08	1.66E-05	-	-
Dibenz(a,h)anthracene	3.88E-01	3.87E-07	7.30E+00	**2.82E-06**	4.51E-06	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	6.15E-07	7.30E-01	4.49E-07	7.18E-06	-	-
Gamma-Chlordane	3.46E-02	1.06E-08	3.50E-01	3.72E-09	1.24E-07	5.00E-04	2.48E-04
DDD	6.11E-02	4.69E-09	2.40E-01	1.12E-09	5.47E-08	-	-
DDE	6.54E-01	5.02E-08	3.40E-01	1.71E-08	5.85E-07	-	-
DDT	3.26E-01	7.50E-08	3.40E-01	2.55E-08	8.75E-07	5.00E-04	1.75E-03
Aroclor-1260	2.13E-01	2.29E-07	2.00E+00	4.58E-07	2.67E-06	2.00E-05	1.33E-01
Aluminum	2.95E+04	2.26E-04	-	-	2.64E-03	1.00E+00	2.64E-03
Antimony	2.58E+01	1.98E-07	-	-	2.31E-06	4.00E-04	5.77E-03
Arsenic	4.79E+00	1.10E-06	1.50E+00	**1.65E-06**	1.29E-05	3.00E-04	4.29E-02
Cadmium	1.17E+01	8.94E-08	-	-	1.04E-06	5.00E-04	2.09E-03
Chromium	3.69E+02	2.83E-06	-	-	3.30E-05	3.00E-03	1.10E-02
Copper	3.49E+03	2.68E-05	-	-	3.12E-04	4.00E-02	7.81E-03
Iron	1.90E+04	1.46E-04	-	-	1.70E-03	7.00E-01	2.43E-03
Mercury	6.05E-01	4.64E-09	-	-	5.41E-08	3.00E-04	1.80E-04
Nickel	8.44E+01	6.48E-07	-	-	7.56E-06	-	-
Silver	2.06E+01	1.58E-07	-	-	1.85E-06	5.00E-03	3.69E-04
Vanadium	2.34E+01	1.79E-07	-	-	2.09E-06	5.00E-03	4.18E-04
Zinc	4.28E+03	3.28E-05	-	-	3.83E-04	3.00E-01	1.28E-03
			Carcinogenic Risk	**2.11E-05**		Hazard Index	2.12E-01

Risks to Future Child Residents
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INHALATION OF DUST FROM SOIL

	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	1.49E-11	7.80E-06	1.16E-16	1.74E-10	8.57E-03	2.03E-08
1,2-Dichloroethane	2.38E-01	1.92E-11	2.60E-05	4.99E-16	2.24E-10	6.86E-01	3.26E-10
Ethylbenzene	1.42E+00	1.14E-10	2.50E-06	2.86E-16	1.33E-09	2.86E-01	4.67E-09
Tetrachloroethene	1.37E-02	1.10E-12	5.90E-06	6.51E-18	1.29E-11	7.71E-02	1.67E-10
m,p-Xylene	2.00E+00	1.61E-10	-	-	1.88E-09	2.00E-01	9.40E-09
Xylene (total)	2.83E+00	2.28E-10	-	-	2.66E-09	2.86E-02	9.31E-08
Benzo(a)anthracene	9.05E-01	7.29E-11	1.10E-04	8.02E-15	8.51E-10	-	-
Benzo(a)pyrene	1.91E+00	1.54E-10	1.10E-03	1.69E-13	1.80E-09	-	-
Benzo(b)fluoranthene	1.39E+00	1.12E-10	1.10E-04	1.23E-14	1.31E-09	-	-
Benzo(k)fluoranthene	1.03E+00	8.30E-11	1.10E-04	9.13E-15	9.68E-10	-	-
Chrysene	1.43E+00	1.15E-10	1.10E-05	1.26E-15	1.34E-09	-	-
Dibenz(a,h)anthracene	3.88E-01	3.13E-11	1.20E-03	3.75E-14	3.65E-10	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	4.97E-11	1.10E-04	5.47E-15	5.80E-10	-	-
Gamma-Chlordane	3.46E-02	2.79E-12	1.00E-04	2.79E-16	3.25E-11	2.00E-04	1.63E-07
DDD	6.11E-02	4.92E-12	-	-	5.74E-11	-	-
DDE	6.54E-01	5.27E-11	-	-	6.15E-10	-	-
DDT	3.26E-01	2.63E-11	9.70E-05	2.55E-15	3.06E-10	-	-
Aroclor-1260	2.13E-01	1.72E-11	5.70E-04	9.78E-15	2.00E-10	-	-
Aluminum	2.95E+04	2.38E-06	-	-	2.77E-05	1.43E-03	1.94E-02
Antimony	2.58E+01	2.08E-09	-	-	2.42E-08	-	-
Arsenic	4.79E+00	3.86E-10	4.30E-03	1.66E-12	4.50E-09	8.57E-06	5.25E-04
Cadmium	1.17E+01	9.39E-10	1.80E-03	1.69E-12	1.10E-08	-	-
Chromium	3.69E+02	2.97E-08	1.20E-02	3.56E-10	3.46E-07	3.00E-05	1.15E-02
Copper	3.49E+03	2.81E-07	-	-	3.28E-06	-	-
Iron	1.90E+04	1.53E-06	-	-	1.79E-05	-	-
Mercury	6.05E-01	4.88E-11	-	-	5.69E-10	-	-
Nickel	8.44E+01	6.80E-09	-	-	7.94E-08	-	-
Silver	2.06E+01	1.66E-09	-	-	1.94E-08	-	-
Vanadium	2.34E+01	1.88E-09	-	-	2.20E-08	-	-
Zinc	4.28E+03	3.45E-07	-	-	4.02E-06	-	-
			Carcinogenic Risk	3.60E-10		Hazard Index	3.15E-02

INHALATION OF INDOOR VAPOR FROM SOIL

	Carcinogen				Noncarcinogen		
COPC	RME Concentration in Soil (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	6.25E-01	6.85E-02	2.73E-02	**1.87E-03**	7.99E-01	8.57E-03	**9.32E+01**
1,2-Dichloroethane	3.28E-01	3.60E-02	9.10E-02	**3.27E-03**	4.20E-01	6.86E-01	6.12E-01
Ethylbenzene	1.21E+00	1.33E-01	8.75E-03	**1.16E-03**	1.55E+00	2.86E-01	**5.43E+00**
Tetrachloroethene	5.74E-02	6.29E-03	2.10E-02	**1.32E-04**	7.34E-02	7.71E-02	9.51E-01
m,p-Xylene	1.54E+00	1.69E-01	-	-	1.98E+00	2.00E-01	**9.88E+00**
Xylene (total)	NA	-	-	-	-	2.86E-02	-
Benzo(a)anthracene	NA	-	3.90E-01	-	-	-	-
Benzo(a)pyrene	NA	-	3.90E+00	-	-	-	-
Benzo(b)fluoranthene	1.92E-03	2.10E-04	3.90E-01	**8.19E-05**	2.45E-03	-	-
Benzo(k)fluoranthene	NA	-	3.90E-01	-	-	-	-
Chrysene	3.90E-06	4.27E-07	3.90E-02	1.67E-08	4.98E-06	-	-
Dibenz(a,h)anthracene	NA	-	4.10E+00	-	-	-	-
Indeno(1,2,3-cd)pyrene	NA	-	3.90E-01	-	-	-	-
Gamma-Chlordane	NA	-	3.50E-01	-	-	2.00E-04	-
DDD	NA	-	-	-	-	-	-
DDE	4.26E-08	4.67E-09	-	-	5.44E-08	-	-
DDT	NA	-	3.40E-01	-	-	-	-
Aroclor-1260	NA	-	2.00E+00	-	-	-	-
Aluminum	NA	-	-	-	-	1.43E-03	-
Antimony	NA	-	-	-	-	-	-
Arsenic	NA	-	1.51E+01	-	-	8.57E-06	-
Cadmium	NA	-	1.50E+01	-	-	-	-
Chromium	NA	-	4.20E+01	-	-	3.00E-05	-
Copper	NA	-	-	-	-	-	-
Iron	NA	-	-	-	-	-	-
Mercury	NA	-	-	-	-	-	-
Nickel	NA	-	-	-	-	-	-
Silver	NA	-	-	-	-	-	-
Vanadium	NA	-	-	-	-	-	-
Zinc	NA	-	-	-	-	-	-
			Carcinogenic Risk	**6.52E-03**		Hazard Index	**1.10E+02**
		Total Carcinogenic Risk - Soil Exposure		**6.57E-03**		Total HI - Soil Exposure	**1.16E+02**

Risks to Future Site Trespassers
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION - SOIL FUTURE YOUTH TRESPASSERS		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	1.74E-09	5.50E-02	9.56E-11	2.03E-08	4.00E-03	5.07E-06
1,2-Dichloroethane	2.38E-01	2.24E-09	9.10E-02	2.03E-10	2.61E-08	-	-
Ethylbenzene	1.42E+00	1.33E-08	1.10E-02	1.47E-10	1.56E-07	1.10E-01	1.41E-06
Tetrachloroethene	1.37E-02	1.29E-10	5.40E-01	6.95E-11	1.50E-09	1.00E-02	1.50E-07
m,p-Xylene	2.00E+00	1.88E-08	-	-	2.19E-07	2.00E+00	1.10E-07
Xylene (total)	2.83E+00	2.66E-08	-	-	3.10E-07	2.00E-01	1.55E-06
Benzo(a)anthracene	9.05E-01	8.50E-09	7.30E-01	6.21E-09	9.92E-08	-	-
Benzo(a)pyrene	1.91E+00	1.79E-08	7.30E+00	1.31E-07	2.09E-07	-	-
Benzo(b)fluoranthene	1.39E+00	1.31E-08	7.30E-01	9.53E-09	1.52E-07	-	-
Benzo(k)fluoranthene	1.03E+00	9.68E-09	7.30E-02	7.06E-10	1.13E-07	-	-
Chrysene	1.43E+00	1.34E-08	7.30E-03	9.79E-11	1.56E-07	-	-
Dibenz(a,h)anthracene	3.88E-01	3.64E-09	7.30E+00	2.66E-08	4.25E-08	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	5.80E-09	7.30E-01	4.23E-09	6.76E-08	-	-
Gamma-Chlordane	3.46E-02	3.25E-10	3.50E-01	1.14E-10	3.79E-09	5.00E-04	7.58E-06
DDD	6.11E-02	5.74E-10	2.40E-01	1.38E-10	6.70E-09	-	-
DDE	6.54E-01	6.14E-09	3.40E-01	2.09E-09	7.17E-08	-	-
DDT	3.26E-01	3.06E-09	3.40E-01	1.04E-09	3.57E-08	5.00E-04	7.15E-05
Aroclor-1260	2.13E-01	2.00E-09	2.00E+00	4.00E-09	2.33E-08	2.00E-05	1.17E-03
Aluminum	2.95E+04	2.77E-04	-	-	3.23E-03	1.00E+00	3.23E-03
Antimony	2.58E+01	2.42E-07	-	-	2.83E-06	4.00E-04	7.07E-03
Arsenic	4.79E+00	4.50E-08	1.50E+00	6.75E-08	5.25E-07	3.00E-04	1.75E-03
Cadmium	1.17E+01	1.09E-07	-	-	1.28E-06	5.00E-04	2.55E-03
Chromium	3.69E+02	3.46E-06	-	-	4.04E-05	3.00E-03	1.35E-02
Copper	3.49E+03	3.28E-05	-	-	3.82E-04	4.00E-02	9.56E-03
Iron	1.90E+04	1.79E-04	-	-	2.08E-03	7.00E-01	2.98E-03
Mercury	6.05E-01	5.68E-09	-	-	6.63E-08	3.00E-04	2.21E-04
Nickel	8.44E+01	7.93E-07	-	-	9.25E-06	-	-
Silver	2.06E+01	1.94E-07	-	-	2.26E-06	5.00E-03	4.52E-04
Vanadium	2.34E+01	2.19E-07	-	-	2.56E-06	5.00E-03	5.12E-04
Zinc	4.28E+03	4.02E-05	-	-	4.69E-04	3.00E-01	1.56E-03
				Carcinogenic Risk 2.54E-07			Hazard Index 4.46E-02

Risks to Future Site Trespassers
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

DERMAL CONTACT - SOIL FUTURE YOUTH TRESPASSERS		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	2.99E-11	5.50E-02	1.64E-12	3.49E-10	4.00E-03	8.72E-08
1,2-Dichloroethane	2.38E-01	3.85E-11	9.10E-02	3.50E-12	4.49E-10	-	-
Ethylbenzene	1.42E+00	2.29E-10	1.10E-02	2.52E-12	2.68E-09	1.10E-01	2.43E-08
Tetrachloroethene	1.37E-02	2.21E-12	5.40E-01	1.20E-12	2.58E-11	1.00E-02	2.58E-09
m,p-Xylene	2.00E+00	3.23E-10	-	-	3.77E-09	2.00E+00	1.88E-09
Xylene (total)	2.83E+00	4.57E-10	-	-	5.33E-09	2.00E-01	2.67E-08
Benzo(a)anthracene	9.05E-01	1.90E-09	7.30E-01	1.39E-09	2.22E-08	-	-
Benzo(a)pyrene	1.91E+00	4.01E-09	7.30E+00	2.93E-08	4.68E-08	-	-
Benzo(b)fluoranthene	1.39E+00	2.92E-09	7.30E-01	2.13E-09	3.41E-08	-	-
Benzo(k)fluoranthene	1.03E+00	2.16E-09	7.30E-02	1.58E-10	2.52E-08	-	-
Chrysene	1.43E+00	3.00E-09	7.30E-03	2.19E-11	3.50E-08	-	-
Dibenz(a,h)anthracene	3.88E-01	8.15E-10	7.30E+00	5.95E-09	9.51E-09	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	1.30E-09	7.30E-01	9.46E-10	1.51E-08	-	-
Gamma-Chlordane	3.46E-02	2.24E-11	3.50E-01	7.83E-12	2.61E-10	5.00E-04	5.22E-07
DDD	6.11E-02	9.87E-12	2.40E-01	2.37E-12	1.15E-10	-	-
DDE	6.54E-01	1.06E-10	3.40E-01	3.59E-11	1.23E-09	-	-
DDT	3.26E-01	1.58E-10	3.40E-01	5.37E-11	1.84E-09	5.00E-04	3.69E-06
Aroclor-1260	2.13E-01	4.82E-10	2.00E+00	9.64E-10	5.62E-09	2.00E-05	2.81E-04
Aluminum	2.95E+04	4.77E-07	-	-	5.56E-06	1.00E+00	5.56E-06
Antimony	2.58E+01	4.17E-10	-	-	4.86E-09	4.00E-04	1.22E-05
Arsenic	4.79E+00	2.32E-09	1.50E+00	3.48E-09	2.71E-08	3.00E-04	9.03E-05
Cadmium	1.17E+01	1.88E-10	-	-	2.20E-09	5.00E-04	4.39E-06
Chromium	3.69E+02	5.95E-09	-	-	6.95E-08	3.00E-03	2.32E-05
Copper	3.49E+03	5.64E-08	-	-	6.58E-07	4.00E-02	1.64E-05
Iron	1.90E+04	3.07E-07	-	-	3.58E-06	7.00E-01	5.12E-06
Mercury	6.05E-01	9.77E-12	-	-	1.14E-10	3.00E-04	3.80E-07
Nickel	8.44E+01	1.36E-09	-	-	1.59E-08	-	-
Silver	2.06E+01	3.33E-10	-	-	3.89E-09	5.00E-03	7.77E-07
Vanadium	2.34E+01	3.77E-10	-	-	4.40E-09	5.00E-03	8.81E-07
Zinc	4.28E+03	6.92E-08	-	-	8.07E-07	3.00E-01	2.69E-06
			Carcinogenic Risk	4.44E-08		Hazard Index	4.47E-04

Risks to Future Site Trespassers
Central and Southern AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INHALATION - DUST FROM SOIL FUTURE YOUTH TRESPASSERS		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
COPC	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	1.85E-01	2.30E-13	2.73E-02	6.28E-15	2.68E-12	8.57E-03	3.13E-10
1,2-Dichloroethane	2.38E-01	2.96E-13	9.10E-02	2.69E-14	3.45E-12	6.86E-01	5.03E-12
Ethylbenzene	1.42E+00	1.77E-12	8.75E-03	1.54E-14	2.06E-11	2.86E-01	7.21E-11
Tetrachloroethene	1.37E-02	1.70E-14	2.10E-02	3.58E-16	1.99E-13	7.71E-02	2.58E-12
m,p-Xylene	2.00E+00	2.49E-12	-	-	2.90E-11	2.00E-01	1.45E-10
Xylene (total)	2.83E+00	3.52E-12	-	-	4.10E-11	2.86E-02	1.44E-09
Benzo(a)anthracene	9.05E-01	1.13E-12	3.90E-01	4.39E-13	1.31E-11	-	-
Benzo(a)pyrene	1.91E+00	2.37E-12	3.90E+00	9.26E-12	2.77E-11	-	-
Benzo(b)fluoranthene	1.39E+00	1.73E-12	3.90E-01	6.74E-13	2.02E-11	-	-
Benzo(k)fluoranthene	1.03E+00	1.28E-12	3.90E-01	4.99E-13	1.49E-11	-	-
Chrysene	1.43E+00	1.77E-12	3.90E-02	6.92E-14	2.07E-11	-	-
Dibenz(a,h)anthracene	3.88E-01	4.82E-13	4.10E+00	1.98E-12	5.63E-12	-	-
Indeno(1,2,3-cd)pyrene	6.17E-01	7.67E-13	3.90E-01	2.99E-13	8.95E-12	-	-
Gamma-Chlordane	3.46E-02	4.30E-14	3.50E-01	1.51E-14	5.02E-13	2.00E-04	2.51E-09
DDD	6.11E-02	7.60E-14	-	-	8.86E-13	-	-
DDE	6.54E-01	8.13E-13	-	-	9.49E-12	-	-
DDT	3.26E-01	4.05E-13	3.40E-01	1.38E-13	4.73E-12	-	-
Aroclor-1260	2.13E-01	2.65E-13	2.00E+00	5.30E-13	3.09E-12	-	-
Aluminum	2.95E+04	3.67E-08	-	-	4.28E-07	1.43E-03	2.99E-04
Antimony	2.58E+01	3.21E-11	-	-	3.74E-10	-	-
Arsenic	4.79E+00	5.95E-12	1.51E+01	8.99E-11	6.95E-11	8.57E-06	8.10E-06
Cadmium	1.17E+01	1.45E-11	1.50E+01	2.17E-10	1.69E-10	-	-
Chromium	3.69E+02	4.58E-10	4.20E+01	1.92E-08	5.34E-09	3.00E-05	1.78E-04
Copper	3.49E+03	4.34E-09	-	-	5.06E-08	-	-
Iron	1.90E+04	2.36E-08	-	-	2.76E-07	-	-
Mercury	6.05E-01	7.52E-13	-	-	8.78E-12	-	-
Nickel	8.44E+01	1.05E-10	-	-	1.22E-09	-	-
Silver	2.06E+01	2.56E-11	-	-	2.99E-10	-	-
Vanadium	2.34E+01	2.90E-11	-	-	3.39E-10	-	-
Zinc	4.28E+03	5.32E-09	-	-	6.21E-08	-	-
			Carcinogenic Risk	1.96E-08		Hazard Index	4.86E-04
		Total Carcinogenic Risk - Soil Exposure		3.18E-07	Total HI - Soil Exposure		4.55E-02

Risks to Future Site Visitors
Northern and Western AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION OF SOIL

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.03E+04	3.24E-03	-	-	9.07E-03	1.00E+00	9.07E-03
Arsenic	4.70E+00	1.48E-06	1.50E+00	2.22E-06	4.14E-06	3.00E-04	1.38E-02
Iron	8.88E+03	2.79E-03	-	-	7.82E-03	7.00E-01	1.12E-02
Mercury	7.70E-02	2.42E-08	-	-	6.78E-08	3.00E-04	2.26E-04
			Carcinogenic Risk	2.22E-06		Hazard Index	3.43E-02

DERMAL CONTACT WITH SOIL

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.03E+04	2.14E-05	-	-	5.99E-05	1.00E+00	5.99E-05
Arsenic	4.70E+00	2.93E-07	1.50E+00	4.39E-07	8.20E-07	3.00E-04	2.73E-03
Iron	8.88E+03	1.84E-05	-	-	5.16E-05	7.00E-01	7.37E-05
Mercury	7.70E-02	1.60E-10	-	-	4.48E-10	3.00E-04	1.49E-06
			Carcinogenic Risk	4.39E-07		Hazard Index	2.87E-03

INHALATION OF DUST FROM SOIL

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.03E+04	4.76E-07	-	-	1.33E-06	1.43E-03	9.34E-04
Arsenic	4.70E+00	2.17E-10	1.51E+01	3.28E-09	6.09E-10	8.57E-06	7.10E-05
Iron	8.88E+03	4.11E-07	-	-	1.15E-06	-	-
Mercury	7.70E-02	3.56E-12	-	-	9.97E-12	-	-
			Carcinogenic Risk	3.28E-09		Hazard Index	1.00E-03
		Total Carcinogenic Risk - Soil Exposure		2.66E-06		Total HI - Soil Exposure	3.81E-02

Risks to Future Site Visitors
Northern and Western AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION OF SOIL FUTURE RESIDENT, ADULT		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	6.20E-03	-	-	1.81E-02	1.00E+00	1.81E-02
Arsenic	3.57E+00	1.68E-06	1.50E+00	2.51E-06	4.89E-06	3.00E-04	1.63E-02
Iron	1.07E+04	5.03E-03	-	-	1.47E-02	7.00E-01	2.09E-02
Mercury	6.07E-02	2.85E-08	-	-	8.32E-08	3.00E-04	2.77E-04
			Carcinogenic Risk	2.51E-06		Hazard Index	5.56E-02

DERMAL CONTACT WITH SOIL FUTURE RESIDENT, ADULT		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	2.47E-05	-	-	7.21E-05	1.00E+00	7.21E-05
Arsenic	3.57E+00	2.01E-07	1.50E+00	3.01E-07	5.85E-07	3.00E-04	1.95E-03
Iron	1.07E+04	2.01E-05	-	-	5.85E-05	7.00E-01	8.36E-05
Mercury	6.07E-02	1.14E-10	-	-	3.32E-10	3.00E-04	1.11E-06
			Carcinogenic Risk	3.01E-07		Hazard Index	2.11E-03

INHALATION OF DUST FROM SOIL FUTURE RESIDENT, ADULT		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	9.11E-07	-	-	2.66E-06	1.43E-03	1.86E-03
Arsenic	3.57E+00	2.47E-10	1.51E+01	3.72E-09	7.19E-10	8.57E-06	8.39E-05
Iron	1.07E+04	7.39E-07	-	-	2.16E-06	-	-
Mercury	6.07E-02	4.19E-12	-	-	1.22E-11	-	-
			Carcinogenic Risk	3.72E-09		Hazard Index	1.94E-03

INHALATION OF INDOOR VAPOR FROM SOIL FUTURE RESIDENT, ADULT		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Indoor Air from Soil (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	NA	-	-	-	-	1.43E-03	-
Arsenic	NA	-	1.51E+01	-	-	8.57E-06	-
Iron	NA	-	-	-	-	-	-
Mercury	NA	-	-	-	-	-	-
			Carcinogenic Risk	0.00E+00		Hazard Index	0.00E+00
		Total Carcinogenic Risk - Soil Exposure		2.82E-06	Total HI - Soil Exposure		5.96E-02

Risks to Future Site Visitors
Northern and Western AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION OF SOIL FUTURE RESIDENT, CHILD	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	1.45E-02	-	-	1.69E-01	1.00E+00	1.69E-01
Arsenic	3.57E+00	3.91E-06	1.50E+00	**5.87E-06**	4.56E-05	3.00E-04	1.52E-01
Iron	1.07E+04	1.17E-02	-	-	1.37E-01	7.00E-01	1.96E-01
Mercury	6.07E-02	6.65E-08	-	-	7.76E-07	3.00E-04	2.59E-03
			Carcinogenic Risk	**5.87E-06**		**Hazard Index**	5.19E-01

DERMAL CONTACT WITH SOIL FUTURE RESIDENT, CHILD	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	1.01E-04	-	-	1.18E-03	1.00E+00	1.18E-03
Arsenic	3.57E+00	8.21E-07	1.50E+00	**1.23E-06**	9.58E-06	3.00E-04	3.19E-02
Iron	1.07E+04	8.21E-05	-	-	9.58E-04	7.00E-01	1.37E-03
Mercury	6.07E-02	4.66E-10	-	-	5.43E-09	3.00E-04	1.81E-05
			Carcinogenic Risk	**1.23E-06**		**Hazard Index**	3.45E-02

INHALATION OF DUST FROM SOIL FUTURE RESIDENT, CHILD	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	1.06E-06	-	-	1.24E-05	1.43E-03	8.68E-03
Arsenic	3.57E+00	2.88E-10	1.51E+01	4.34E-09	3.36E-09	8.57E-06	3.91E-04
Iron	1.07E+04	8.63E-07	-	-	1.01E-05	-	-
Mercury	6.07E-02	4.89E-12	-	-	5.71E-11	-	-
			Carcinogenic Risk	4.34E-09		**Hazard Index**	9.07E-03

INHALATION OF INDOOR VAPOR FROM SOIL FUTURE RESIDENT, CHILD	Carcinogen				Noncarcinogen		
Carcinogen	RME Concentration in Indoor Air from Soil (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	NA	-	-	-	-	1.43E-03	-
Arsenic	NA	-	1.51E+01	-	-	8.57E-06	-
Iron	NA	-	-	-	-	-	-
Mercury	NA	-	-	-	-	-	-
			Carcinogenic Risk	0.00E+00		**Hazard Index**	0.00E+00
		Total Carcinogenic Risk - Soil Exposure		**7.10E-06**		**Total HI - Soil Exposure**	5.62E-01

Risks to Future Site Visitors
Northern and Western AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION - SOIL FUTURE CONSTRUCTION WORKE	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	1.46E-04	-	-	2.04E-02	1.00E+00	2.04E-02
Arsenic	3.57E+00	3.95E-08	1.50E+00	5.93E-08	5.53E-06	3.00E-04	1.84E-02
Iron	1.07E+04	1.19E-04	-	-	1.66E-02	7.00E-01	2.37E-02
Mercury	6.07E-02	6.72E-10	-	-	9.41E-08	3.00E-04	3.14E-04
			Carcinogenic Risk	5.93E-08		Hazard Index	6.29E-02

DERMAL CONTACT - SOIL FUTURE CONSTRUCTION WORKE	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	4.38E-07	-	-	6.13E-05	1.00E+00	6.13E-05
Arsenic	3.57E+00	3.56E-09	1.50E+00	5.33E-09	4.98E-07	3.00E-04	1.66E-03
Iron	1.07E+04	3.56E-07	-	-	4.98E-05	7.00E-01	7.11E-05
Mercury	6.07E-02	2.02E-12	-	-	2.82E-10	3.00E-04	9.41E-07
			Carcinogenic Risk	5.33E-09		Hazard Index	1.79E-03

INHALATION - DUST FROM SOIL FUTURE CONSTRUCTION WORKE	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	6.51E-09	-	-	9.11E-07	1.43E-03	6.38E-04
Arsenic	3.57E+00	1.76E-12	1.51E+01	2.66E-11	2.47E-10	8.57E-06	2.88E-05
Iron	1.07E+04	5.28E-09	-	-	7.39E-07	-	-
Mercury	6.07E-02	2.99E-14	-	-	4.19E-12	-	-
			Carcinogenic Risk	2.66E-11		Hazard Index	6.67E-04
			Total Carcinogenic Risk - Soil Exposure	6.46E-08		Total HI - Soil Exposure	6.54E-02

Risks to Future Site Visitors
Northern and Western AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION OF SOIL

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	2.31E-03	-	-	6.45E-03	1.00E+00	6.45E-03
Arsenic	3.57E+00	6.24E-07	1.50E+00	9.35E-07	1.75E-06	3.00E-04	5.82E-03
Iron	1.07E+04	1.87E-03	-	-	5.24E-03	7.00E-01	7.48E-03
Mercury	6.07E-02	1.06E-08	-	-	2.97E-08	3.00E-04	9.90E-05
			Carcinogenic Risk	9.35E-07		Hazard Index	1.99E-02

INHALATION OF INDOOR VAPOR FROM SOIL

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Indoor Air from Soil (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	NA	-	-	-	-	1.43E-03	-
Arsenic	NA	-	1.51E+01	-	-	8.57E-06	-
Iron	NA	-	-	-	-	-	-
Mercury	NA	-	-	-	-	-	-
			Carcinogenic Risk	0.00E+00		Hazard Index	0.00E+00
		Total Carcinogenic Risk - Soil Exposure		9.35E-07		Total HI - Soil Exposure	1.99E-02

Risks to Future Site Visitors
Northern and Western AOCs
Aggregate Soil
CDL - Wallops Flight Facility

INGESTION - SOIL FUTURE YOUTH TRESPASSERS	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	1.24E-04	-	-	1.45E-03	1.00E+00	1.45E-03
Arsenic	3.57E+00	3.35E-08	1.50E+00	5.03E-08	3.91E-07	3.00E-04	1.30E-03
Iron	1.07E+04	1.01E-04	-	-	1.17E-03	7.00E-01	1.68E-03
Mercury	6.07E-02	5.70E-10	-	-	6.65E-09	3.00E-04	2.22E-05
			Carcinogenic Risk	5.03E-08		Hazard Index	4.45E-03

DERMAL CONTACT - SOIL FUTURE YOUTH TRESPASSERS	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	2.13E-07	-	-	2.49E-06	1.00E+00	2.49E-06
Arsenic	3.57E+00	1.73E-09	1.50E+00	2.59E-09	2.02E-08	3.00E-04	6.73E-05
Iron	1.07E+04	1.73E-07	-	-	2.02E-06	7.00E-01	2.88E-06
Mercury	6.07E-02	9.81E-13	-	-	1.14E-11	3.00E-04	3.81E-08
			Carcinogenic Risk	2.59E-09		Hazard Index	7.27E-05

INHALATION - DUST FROM SOIL FUTURE YOUTH TRESPASSERS	Cancer Risk Calculations				Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Aluminum	1.32E+04	1.64E-08	-	-	1.91E-07	1.43E-03	1.34E-04
Arsenic	3.57E+00	4.44E-12	4.30E-03	1.91E-14	5.18E-11	8.57E-06	6.04E-06
Iron	1.07E+04	1.33E-08	-	-	1.55E-07	-	-
Mercury	6.07E-02	7.55E-14	-	-	8.80E-13	-	-
			Carcinogenic Risk	1.91E-14		Hazard Index	1.40E-04
			Total Carcinogenic Risk - Soil Exposure	5.29E-08		Total HI - Soil Exposure	4.66E-03

Risks to Future Commercial Workers
Groundwater
CDL - Wallops Flight Facility

INGESTION - GROUNDWATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	2.59E-05	5.50E-02	1.42E-06	7.24E-05	4.00E-03	1.81E-02
1,2-Dichloroethane	14.08	9.84E-05	9.10E-02	8.95E-06	2.76E-04	-	-
cis-1,2-Dichloroethene	51.94	3.63E-04	9.10E-02	3.30E-05	1.02E-03	1.00E-02	1.02E-01
Ethylbenzene	496.6	3.47E-03	1.10E-02	3.82E-05	9.72E-03	1.10E-01	8.83E-02
Isopropylbenzene	60.84	4.25E-04	-	-	1.19E-03	1.00E-01	1.19E-02
Tetrachloroethene	11.44	8.00E-05	5.40E-01	4.32E-05	2.24E-04	1.00E-02	2.24E-02
Toluene	1544	1.08E-02	-	-	3.02E-02	8.00E-02	3.78E-01
Trichloroethene	3.35	2.34E-05	1.30E-02	3.04E-07	6.56E-05	-	-
m,p-Xylene	1964	1.37E-02	-	-	3.84E-02	2.00E+00	1.92E-02
o-Xylene	703.5	4.92E-03	-	-	1.38E-02	2.00E+00	6.88E-03
Xylene (total)	2666	1.86E-02	-	-	5.22E-02	2.00E-01	2.61E-01
2-Methylnaphthalene	33.72	2.36E-04	-	-	6.60E-04	4.00E-03	1.65E-01
Naphthalene	86.05	6.01E-04	-	-	1.68E-03	2.00E-02	8.42E-02
Arsenic	8.254	5.77E-05	1.50E+00	8.65E-05	1.62E-04	3.00E-04	5.38E-01
Iron	22872	1.60E-01	-	-	4.48E-01	7.00E-01	6.39E-01
Manganese	1236	8.64E-03	-	-	2.42E-02	1.40E-01	1.73E-01
Mercury	0.15	1.05E-06	-	-	2.94E-06	3.00E-04	9.78E-03
			Carcinogenic Risk	2.12E-04		Hazard Index	2.52E+00

INHALATION - INDOOR VAPOR FROM GROUNDWATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
	RME Concentration in Indoor Air (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	4.46E-04	1.04E-05	2.73E-02	2.84E-07	2.91E-05	8.57E-03	3.40E-03
1,2-Dichloroethane	3.36E-04	7.83E-06	9.10E-02	7.13E-07	2.19E-05	6.86E-01	3.20E-05
cis-1,2-Dichloroethene	4.15E-03	9.68E-05	-	-	2.71E-04	-	-
Ethylbenzene	6.23E-02	1.45E-03	8.75E-03	1.27E-05	4.07E-03	2.86E-01	1.42E-02
Isopropylbenzene	1.01E-02	2.35E-04	-	-	6.57E-04	-	-
Tetrachloroethene	3.41E-03	7.95E-05	2.10E-02	1.67E-06	2.23E-04	7.71E-02	2.89E-03
Toluene	2.01E-01	4.69E-03	-	-	1.31E-02	1.43E+00	9.19E-03
Trichloroethene	6.60E-04	1.54E-05	7.00E-03	1.08E-07	4.31E-05	-	-
m,p-Xylene	2.43E-01	5.65E-03	-	-	1.58E-02	2.00E-01	7.91E-02
o-Xylene	6.43E-02	1.50E-03	-	-	4.19E-03	2.00E-01	2.10E-02
Xylene (total)	NA	NA	-	-	NA	2.86E-02	-
2-Methylnaphthalene	1.38E-04	3.23E-06	-	-	9.03E-06	-	-
Naphthalene	4.71E-04	1.10E-05	-	-	3.07E-05	8.57E-04	3.59E-02
Arsenic	NA	NA	1.51E+01	-	NA	8.57E-06	-
Iron	NA	NA	-	-	NA	-	-
Manganese	NA	NA	-	-	NA	1.43E-05	-
Mercury	NA	NA	-	-	NA	-	-
			Carcinogenic Risk	1.55E-05		Hazard Index	1.66E-01
	Total Carcinogenic Risk - Groundwater Exposure			2.27E-04	Total HI - Groundwater Exposure		2.68E+00

Risks to Future Construction Workers
Groundwater
CDL - Wallops Flight Facility

INGESTION - GROUNDWATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	2.48E-09	5.50E-02	1.37E-10	3.48E-07	4.00E-03	8.69E-05
1,2-Dichloroethane	14.08	9.45E-09	9.10E-02	8.60E-10	1.32E-06	-	-
cis-1,2-Dichloroethene	51.94	3.48E-08	9.10E-02	3.17E-09	4.88E-06	1.00E-02	4.88E-04
Ethylbenzene	496.6	3.33E-07	1.10E-02	3.67E-09	4.66E-05	1.10E-01	4.24E-04
Isopropylbenzene	60.84	4.08E-08	-	-	5.71E-06	1.00E-01	5.71E-05
Tetrachloroethene	11.44	7.68E-09	5.40E-01	4.14E-09	1.07E-06	1.00E-02	1.07E-04
Toluene	1544	1.04E-06	-	-	1.45E-04	8.00E-02	1.81E-03
Trichloroethene	3.35	2.25E-09	1.30E-02	2.92E-11	3.15E-07	-	-
m,p-Xylene	1964	1.32E-06	-	-	1.84E-04	2.00E+00	9.22E-05
o-Xylene	703.5	4.72E-07	-	-	6.61E-05	2.00E+00	3.30E-05
Xylene (total)	2666	1.79E-06	-	-	2.50E-04	2.00E-01	1.25E-03
2-Methylnaphthalene	33.72	2.26E-08	-	-	3.17E-06	4.00E-03	7.92E-04
Naphthalene	86.05	5.77E-08	-	-	8.08E-06	2.00E-02	4.04E-04
Arsenic	8.254	5.54E-09	1.50E+00	8.31E-09	7.75E-07	3.00E-04	2.58E-03
Iron	22872	1.53E-05	-	-	2.15E-03	7.00E-01	3.07E-03
Manganese	1236	8.29E-07	-	-	1.16E-04	1.40E-01	8.29E-04
Mercury	0.15	1.01E-10	-	-	1.41E-08	3.00E-04	4.70E-05
			Carcinogenic Risk	2.03E-08		Hazard Index	1.21E-02

DERMAL CONTACT - GROUNDWATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	7.18E-09	5.50E-02	3.95E-10	1.00E-06	4.00E-03	2.51E-04
1,2-Dichloroethane	14.08	8.79E-09	9.10E-02	8.00E-10	1.23E-06	-	-
cis-1,2-Dichloroethene	51.94	5.86E-08	9.10E-02	5.33E-09	8.20E-06	1.00E-02	8.20E-04
Ethylbenzene	496.6	4.01E-06	1.10E-02	4.41E-08	5.62E-04	1.10E-01	5.11E-03
Isopropylbenzene	60.84	1.04E-06	-	-	1.45E-04	1.00E-01	1.45E-03
Tetrachloroethene	11.44	4.37E-08	5.40E-01	2.36E-08	6.12E-06	1.00E-02	6.12E-04
Toluene	1544	6.89E-06	-	-	9.64E-04	8.00E-02	1.21E-02
Trichloroethene	3.35	8.03E-09	1.30E-02	1.04E-10	1.12E-06	-	-
m,p-Xylene	1964	1.14E-05	-	-	1.60E-03	2.00E+00	8.00E-04
o-Xylene	703.5	5.54E-06	-	-	7.76E-04	2.00E+00	3.88E-04
Xylene (total)	2666	2.10E-05	-	-	2.94E-03	2.00E-01	1.47E-02
2-Methylnaphthalene	33.72	7.41E-07	-	-	1.04E-04	4.00E-03	2.59E-02
Naphthalene	86.05	8.17E-07	-	-	1.14E-04	2.00E-02	5.72E-03
Arsenic	8.254	3.66E-09	1.50E+00	5.48E-09	5.12E-07	3.00E-04	1.71E-03
Iron	22872	1.01E-05	-	-	1.42E-03	7.00E-01	2.03E-03
Manganese	1236	5.47E-07	-	-	7.66E-05	5.60E-03	1.37E-02
Mercury	0.15	8.30E-11	-	-	1.16E-08	3.00E-04	3.87E-05
			Carcinogenic Ris	7.98E-08		Hazard Index	8.53E-02

Risks to Future Construction Workers
Groundwater
CDL - Wallops Flight Facility

INHALATION OF VAPORS IN TRENCH - GROUNDWATER		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	2.32E-05	2.73E-02	6.33E-07	3.25E-03	8.57E-03	3.79E-01
1,2-Dichloroethane	14.08	7.48E-05	9.10E-02	**6.81E-06**	1.05E-02	6.86E-01	1.53E-02
cis-1,2-Dichloroethene	51.94	2.91E-04	-	-	4.08E-02	-	-
Ethylbenzene	496.6	2.68E-03	8.75E-03	**2.35E-05**	3.75E-01	2.86E-01	**1.31E+00**
Isopropylbenzene	60.84	3.11E-04	-	-	4.35E-02	-	-
Tetrachloroethene	11.44	4.96E-05	2.10E-02	**1.04E-06**	6.95E-03	7.71E-02	9.01E-02
Toluene	1544	8.93E-03	-	-	1.25E+00	1.43E+00	8.75E-01
Trichloroethene	3.35	1.63E-05	7.00E-03	1.14E-07	2.28E-03	-	-
m,p-Xylene	1964	1.06E-02	-	-	1.48E+00	2.00E-01	**7.42E+00**
o-Xylene	703.5	3.78E-03	-	-	5.30E-01	2.00E-01	**2.65E+00**
Xylene (total)	2666	1.43E-02	-	-	2.01E+00	2.86E-02	**7.03E+01**
2-Methylnaphthalene	33.72	1.43E-04	-	-	2.00E-02	-	-
Naphthalene	86.05	3.81E-04	-	-	5.34E-02	8.57E-04	**6.23E+01**
Arsenic	8.254	NA	1.51E+01	-	NA	8.57E-06	-
Iron	22872	NA	-	-	NA	-	-
Manganese	1236	NA	-	-	NA	1.43E-05	-
Mercury	0.15	NA	-	-	NA	-	-
				Carcinogenic Ris	**3.21E-05**		**Hazard Index**	**1.45E+02**
		Total Carcinogenic Risk - Groundwater Exposure			**3.22E-05**	**otal HI - Groundwater Exposure**		**1.45E+02**

Risks to Future Adult Residents
Groundwater
CDL - Wallops Flight Facility

INGESTION - GROUNDWATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	3.48E-05	5.50E-02	1.91E-06	1.01E-04	4.00E-03	2.53E-02
1,2-Dichloroethane	14.08	1.32E-04	9.10E-02	1.20E-05	3.86E-04	-	-
cis-1,2-Dichloroethene	51.94	4.88E-04	9.10E-02	4.44E-05	1.42E-03	1.00E-02	1.42E-01
Ethylbenzene	496.6	4.66E-03	1.10E-02	5.13E-05	1.36E-02	1.10E-01	1.24E-01
Isopropylbenzene	60.84	5.71E-04	-	-	1.67E-03	1.00E-01	1.67E-02
Tetrachloroethene	11.44	1.07E-04	5.40E-01	5.80E-05	3.13E-04	1.00E-02	3.13E-02
Toluene	1544	1.45E-02	-	-	4.23E-02	8.00E-02	5.29E-01
Trichloroethene	3.35	3.15E-05	1.30E-02	4.09E-07	9.18E-05	-	-
m,p-Xylene	1964	1.84E-02	-	-	5.38E-02	2.00E+00	2.69E-02
o-Xylene	703.5	6.61E-03	-	-	1.93E-02	2.00E+00	9.64E-03
Xylene (total)	2666	2.50E-02	-	-	7.30E-02	2.00E-01	3.65E-01
2-Methylnaphthalene	33.72	3.17E-04	-	-	9.24E-04	4.00E-03	2.31E-01
Naphthalene	86.05	8.08E-04	-	-	2.36E-03	2.00E-02	1.18E-01
Arsenic	8.254	7.75E-05	1.50E+00	1.16E-04	2.26E-04	3.00E-04	7.54E-01
Iron	22872	2.15E-01	-	-	6.27E-01	7.00E-01	8.95E-01
Manganese	1236	1.16E-02	-	-	3.39E-02	1.40E-01	2.42E-01
Mercury	0.15	1.41E-06	-	-	4.11E-06	3.00E-04	1.37E-02
			Carcinogenic Risk	2.84E-04		Hazard Index	3.52E+00

DERMAL CONTACT - GROUNDWATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	4.95E-06	5.50E-02	2.72E-07	1.44E-05	4.00E-03	3.61E-03
1,2-Dichloroethane	14.08	5.28E-06	9.10E-02	4.80E-07	1.54E-05	-	-
cis-1,2-Dichloroethene	51.94	3.57E-05	9.10E-02	3.25E-06	1.04E-04	1.00E-02	1.04E-02
Ethylbenzene	496.6	2.17E-03	1.10E-02	2.39E-05	6.33E-03	1.10E-01	5.76E-02
Isopropylbenzene	60.84	4.76E-04	-	-	1.39E-03	1.00E-01	1.39E-02
Tetrachloroethene	11.44	3.37E-05	5.40E-01	1.82E-05	9.83E-05	1.00E-02	9.83E-03
Toluene	1544	4.27E-03	-	-	1.25E-02	8.00E-02	1.56E-01
Trichloroethene	3.35	3.59E-06	1.30E-02	4.66E-08	1.05E-05	-	-
m,p-Xylene	1964	8.73E-03	-	-	2.55E-02	2.00E+00	1.27E-02
o-Xylene	703.5	3.04E-03	-	-	8.86E-03	2.00E+00	4.43E-03
Xylene (total)	2666	1.15E-02	-	-	3.36E-02	2.00E-01	1.68E-01
2-Methylnaphthalene	33.72	2.69E-04	-	-	7.85E-04	4.00E-03	1.96E-01
Naphthalene	86.05	3.61E-04	-	-	1.05E-03	2.00E-02	5.26E-02
Arsenic	8.254	4.07E-07	1.50E+00	6.11E-07	1.19E-06	3.00E-04	3.96E-03
Iron	22872	1.13E-03	-	-	3.29E-03	7.00E-01	4.70E-03
Manganese	1236	6.10E-05	-	-	1.78E-04	5.60E-03	3.17E-02
Mercury	0.15	7.40E-09	-	-	2.16E-08	3.00E-04	7.19E-05
			Carcinogenic Risk	4.67E-05		Hazard Index	7.25E-01

Risks to Future Adult Residents
Groundwater
CDL - Wallops Flight Facility

INHALATION OF VAPORS DURING SHOWERING - GROUNDWATER		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	2.01E-05	2.73E-02	5.49E-07	5.86E-05	8.57E-03	6.84E-03
1,2-Dichloroethane	14.08	1.57E-05	9.10E-02	1.43E-06	4.57E-05	6.86E-01	6.66E-05
cis-1,2-Dichloroethene	51.94	1.79E-05	-	-	5.22E-05	-	-
Ethylbenzene	496.6	1.76E-05	8.75E-03	1.54E-07	5.15E-05	2.86E-01	1.80E-04
Isopropylbenzene	60.84	1.68E-05	-	-	4.90E-05	-	-
Tetrachloroethene	11.44	1.45E-05	2.10E-02	3.05E-07	4.24E-05	7.71E-02	5.49E-04
Toluene	1544	1.87E-05	-	-	5.47E-05	1.43E+00	3.83E-05
Trichloroethene	3.35	1.61E-05	7.00E-03	1.12E-07	4.69E-05	-	-
m,p-Xylene	1964	1.75E-05	-	-	5.12E-05	2.00E-01	2.56E-04
o-Xylene	703.5	1.75E-05	-	-	5.12E-05	2.00E-01	2.56E-04
Xylene (total)	2666	1.75E-05	-	-	5.12E-05	2.86E-02	1.79E-03
2-Methylnaphthalene	33.72	1.09E-05	-	-	3.18E-05	-	-
Naphthalene	86.05	1.09E-05	-	-	3.17E-05	8.57E-04	3.69E-02
Arsenic	8.254	NA	1.51E+01	-	NA	8.57E-06	-
Iron	22872	NA	-	-	NA	-	-
Manganese	1236	NA	-	-	NA	1.43E-05	-
Mercury	0.15	NA	-	-	NA	-	-
			Carcinogenic Risk	2.55E-06		Hazard Index	4.69E-02

INHALATION - INDOOR VAPOR INTRUSION FROM GROUNDWATER		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
	RME Concentration in Indoor Air (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	4.46E-04	4.19E-05	2.73E-02	1.14E-06	1.22E-04	8.57E-03	1.43E-02
1,2-Dichloroethane	3.36E-04	3.16E-05	9.10E-02	2.87E-06	9.21E-05	6.86E-01	1.34E-04
cis-1,2-Dichloroethene	4.15E-03	3.90E-04	-	-	1.14E-03	-	-
Ethylbenzene	6.23E-02	5.86E-03	8.75E-03	5.12E-05	1.71E-02	2.86E-01	5.98E-02
Isopropylbenzene	1.01E-02	9.47E-04	-	-	2.76E-03	-	-
Tetrachloroethene	3.41E-03	3.21E-04	2.10E-02	6.73E-06	9.35E-04	7.71E-02	1.21E-02
Toluene	2.01E-01	1.89E-02	-	-	5.51E-02	1.43E+00	3.86E-02
Trichloroethene	6.60E-04	6.20E-05	7.00E-03	4.34E-07	1.81E-04	-	-
m,p-Xylene	2.43E-01	2.28E-02	-	-	6.65E-02	2.00E-01	3.32E-01
o-Xylene	6.43E-02	6.04E-03	-	-	1.76E-02	2.00E-01	8.80E-02
Xylene (total)	NA	NA	-	-	NA	2.86E-02	-
2-Methylnaphthalene	1.38E-04	1.30E-05	-	-	3.79E-05	-	-
Naphthalene	4.71E-04	4.42E-05	-	-	1.29E-04	8.57E-04	1.51E-01
Arsenic	NA	NA	1.51E+01	-	NA	8.57E-06	-
Iron	NA	NA	-	-	NA	-	-
Manganese	NA	NA	-	-	NA	1.43E-05	-
Mercury	NA	NA	-	-	NA	-	-
			Carcinogenic Risk	6.24E-05		Hazard Index	6.96E-01
	Total Carcinogenic Risk - Groundwater Exposure			3.96E-04	Total HI - Groundwater Exposure		4.99E+00

Risks to Future Child Residents
Groundwater
CDL - Wallops Flight Facility

INGESTION OF GROUNDWATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	2.03E-05	5.50E-02	**1.12E-06**	2.37E-04	4.00E-03	5.91E-02
1,2-Dichloroethane	14.08	7.72E-05	9.10E-02	**7.02E-06**	9.00E-04	-	-
cis-1,2-Dichloroethene	51.94	2.85E-04	9.10E-02	**2.59E-05**	3.32E-03	1.00E-02	3.32E-01
Ethylbenzene	496.6	2.72E-03	1.10E-02	**2.99E-05**	3.17E-02	1.10E-01	2.89E-01
Isopropylbenzene	60.84	3.33E-04	-	-	3.89E-03	1.00E-01	3.89E-02
Tetrachloroethene	11.44	6.27E-05	5.40E-01	**3.38E-05**	7.31E-04	1.00E-02	7.31E-02
Toluene	1544	8.46E-03	-	-	9.87E-02	8.00E-02	**1.23E+00**
Trichloroethene	3.35	1.84E-05	1.30E-02	2.39E-07	2.14E-04	-	-
m,p-Xylene	1964	1.08E-02	-	-	1.26E-01	2.00E+00	6.28E-02
o-Xylene	703.5	3.85E-03	-	-	4.50E-02	2.00E+00	2.25E-02
Xylene (total)	2666	1.46E-02	-	-	1.70E-01	2.00E-01	8.52E-01
2-Methylnaphthalene	33.72	1.85E-04	-	-	2.16E-03	4.00E-03	5.39E-01
Naphthalene	86.05	4.72E-04	-	-	5.50E-03	2.00E-02	2.75E-01
Arsenic	8.254	4.52E-05	1.50E+00	**6.78E-05**	5.28E-04	3.00E-04	**1.76E+00**
Iron	22872	1.25E-01	-	-	1.46E+00	7.00E-01	**2.09E+00**
Manganese	1236	6.77E-03	-	-	7.90E-02	1.40E-01	5.64E-01
Mercury	0.15	8.22E-07	-	-	9.59E-06	3.00E-04	3.20E-02
			Carcinogenic Risk	**1.66E-04**		**Hazard Index**	**8.22E+00**

DERMAL CONTACT WITH GROUNDWATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Groundwater (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	3.7	8.67E-06	5.50E-02	4.77E-07	2.73E-05	4.00E-03	6.84E-03
1,2-Dichloroethane	14.08	4.05E-05	9.10E-02	**3.68E-06**	3.35E-05	-	-
cis-1,2-Dichloroethene	51.94	9.94E-04	9.10E-02	**9.05E-05**	2.23E-04	1.00E-02	2.23E-02
Ethylbenzene	496.6	4.61E-01	1.10E-02	**5.07E-03**	1.08E-02	1.10E-01	9.85E-02
Isopropylbenzene	60.84	1.24E-02	-	-	2.37E-03	1.00E-01	2.37E-02
Tetrachloroethene	11.44	1.63E-04	5.40E-01	**8.82E-05**	1.67E-04	1.00E-02	1.67E-02
Toluene	1544	3.47E+00	-	-	2.62E-02	8.00E-02	3.28E-01
Trichloroethene	3.35	5.14E-06	1.30E-02	6.68E-08	1.79E-05	-	-
m,p-Xylene	1964	7.34E+00	-	-	4.36E-02	2.00E+00	2.18E-02
o-Xylene	703.5	1.27E+00	-	-	2.11E-02	2.00E+00	1.06E-02
Xylene (total)	2666	1.83E+01	-	-	8.00E-02	2.00E-01	4.00E-01
2-Methylnaphthalene	33.72	3.88E-03	-	-	1.34E-03	4.00E-03	3.36E-01
Naphthalene	86.05	1.33E-02	-	-	1.80E-03	2.00E-02	9.01E-02
Arsenic	8.254	2.46E-06	1.50E+00	**3.70E-06**	3.48E-06	3.00E-04	1.16E-02
Iron	22872	1.89E+01	-	-	9.65E-03	7.00E-01	1.38E-02
Manganese	1236	5.52E-02	-	-	5.21E-04	5.60E-03	9.31E-02
Mercury	0.15	1.63E-09	-	-	1.27E-07	3.00E-04	4.22E-04
			Carcinogenic Risk	**5.26E-03**		**Hazard Index**	**1.47E+00**

Risks to Future Child Residents
Groundwater
CDL - Wallops Flight Facility

INHALATION - INDOOR VAPOR INTRUSION FROM GROUNDWATER		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
	RME Concentration in Indoor Air (mg/m3)	Lifetime Average Daily Dose (mg/kg/day)	Inhalation Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Inhalation Reference Dose (mg/kg/day)	Hazard Quotient
Benzene	4.46E-04	4.89E-05	2.73E-02	**1.34E-06**	5.71E-04	8.57E-03	6.66E-02
1,2-Dichloroethane	3.36E-04	3.68E-05	9.10E-02	**3.35E-06**	4.30E-04	6.86E-01	6.27E-04
cis-1,2-Dichloroethene	4.15E-03	4.55E-04	-	-	5.31E-03	-	-
Ethylbenzene	6.23E-02	6.83E-03	8.75E-03	**5.98E-05**	7.97E-02	2.86E-01	2.79E-01
Isopropylbenzene	1.01E-02	1.10E-03	-	-	1.29E-02	-	-
Tetrachloroethene	3.41E-03	3.74E-04	2.10E-02	**7.86E-06**	4.36E-03	7.71E-02	5.66E-02
Toluene	2.01E-01	2.20E-02	-	-	2.57E-01	1.43E+00	1.80E-01
Trichloroethene	6.60E-04	7.24E-05	7.00E-03	5.07E-07	8.44E-04	-	-
m,p-Xylene	2.43E-01	2.66E-02	-	-	3.10E-01	2.00E-01	**1.55E+00**
o-Xylene	6.43E-02	7.04E-03	-	-	8.22E-02	2.00E-01	4.11E-01
Xylene (total)	NA	NA	-	-	NA	2.86E-02	-
2-Methylnaphthalene	1.38E-04	1.52E-05	-	-	1.77E-04	-	-
Naphthalene	4.71E-04	5.16E-05	-	-	6.02E-04	8.57E-04	7.03E-01
Arsenic	NA	NA	1.51E+01	-	NA	8.57E-06	-
Iron	NA	NA	-	-	NA	-	-
Manganese	NA	NA	-	-	NA	1.43E-05	-
Mercury	NA	NA	-	-	NA	-	-
			Carcinogenic Risk	**7.28E-05**		**Hazard Index**	**3.25E+00**
	Total Carcinogenic Risk - Groundwater Exposure			**5.50E-03**	**Total HI - Groundwater Exposure**		**1.29E+01**

Risks to Future Youth Site Trespassers
Sediment and Surface Water
CDL - Wallops Flight Facility

INGESTION OF SEDIMENT

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Sediment (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene chloride	9.20E-03	8.64E-11	7.50E-03	7.95E-13	1.01E-09	6.00E-02	1.68E-08
bis(2-Ethylhexyl)phthalate	1.62E+02	1.52E-06	1.40E-02	2.13E-08	1.78E-05	2.00E-02	8.88E-04
DDE	1.49E-01	1.40E-09	3.40E-01	4.76E-10	1.63E-08	-	-
Arsenic	1.40E+01	1.31E-07	1.50E+00	1.97E-07	1.53E-06	3.00E-04	5.11E-03
Mercury	3.29E-01	3.09E-09	-	-	3.61E-08	3.00E-04	1.20E-04
			Carcinogenic Risk	2.19E-07		Hazard Index	6.12E-03

DERMAL CONTACT WITH SEDIMENT

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Sediment (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene chloride	9.20E-03	1.63E-11	7.50E-03	1.22E-13	1.91E-10	6.00E-02	3.18E-09
bis(2-Ethylhexyl)phthalate	1.62E+02	2.88E-06	1.40E-02	4.03E-08	3.36E-05	2.00E-02	1.68E-03
DDE	1.49E-01	2.65E-10	3.40E-01	8.99E-11	3.09E-09	-	-
Arsenic	1.40E+01	7.45E-08	1.50E+00	1.12E-07	8.69E-07	3.00E-04	2.90E-03
Mercury	3.29E-01	5.84E-11	-	-	6.81E-10	3.00E-04	2.27E-06
			Carcinogenic Risk	1.52E-07		Hazard Index	4.58E-03

INGESTION OF SURFACE WATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Surface Water (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Arsenic	1.11E+01	1.04E-08	1.50E+00	1.56E-08	1.22E-07	3.00E-04	4.05E-04
			Carcinogenic Risk	1.56E-08		Hazard Index	4.05E-04

DERMAL CONTACT WITH SURFACE WATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Surface Water (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Arsenic	1.11E+01	1.31E-08	1.50E+00	1.97E-08	1.53E-07	3.00E-04	5.11E-04
			Carcinogenic Risk	1.97E-08		Hazard Index	5.11E-04
		Total Carcinogenic Risk - Sediment and Surface Water		4.06E-07	Total HI - Sediment and Surface Water		1.16E-02

Risks to Future Youth Site Trespassers
Sediment and Surface Water
CDL - Wallops Flight Facility

INGESTION OF SEDIMENT

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene chloride	9.20E-03	2.96E-10	7.50E-03	2.22E-12	8.64E-10	6.00E-02	1.44E-08
bis(2-Ethylhexyl)phthalate	1.62E+02	5.22E-06	1.40E-02	7.30E-08	1.52E-05	2.00E-02	7.61E-04
DDE	1.49E-01	4.80E-09	3.40E-01	1.63E-09	1.40E-08	-	-
Arsenic	1.40E+01	4.51E-07	1.50E+00	6.76E-07	1.31E-06	3.00E-04	4.38E-03
Mercury	3.29E-01	1.06E-08	-	-	3.09E-08	3.00E-04	1.03E-04
			Carcinogenic Risk	7.51E-07		Hazard Index	5.24E-03

DERMAL CONTACT WITH SEDIMENT

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene chloride	9.20E-03	6.67E-09	7.50E-03	5.00E-11	1.79E-10	6.00E-02	2.98E-09
bis(2-Ethylhexyl)phthalate	1.62E+02	1.08E-05	1.40E-02	1.51E-07	3.15E-05	2.00E-02	1.57E-03
DDE	1.49E-01	9.93E-10	3.40E-01	3.38E-10	2.90E-09	-	-
Arsenic	1.40E+01	2.80E-07	1.50E+00	4.20E-07	8.16E-07	3.00E-04	2.72E-03
Mercury	3.29E-01	2.19E-10	-	-	6.40E-10	3.00E-04	2.13E-06
			Carcinogenic Risk	5.71E-07		Hazard Index	4.30E-03

INGESTION OF SURFACE WATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Surface Water (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Arsenic	1.11E+01	3.57E-08	1.50E+00	5.36E-08	1.04E-07	3.00E-04	3.48E-04
			Carcinogenic Risk	5.36E-08		Hazard Index	3.48E-04

DERMAL CONTACT WITH SURFACE WATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Surface Water (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Arsenic	1.11E+01	4.93E-08	1.50E+00	7.40E-08	1.44E-07	3.00E-04	4.80E-04
			Carcinogenic Risk	7.40E-08		Hazard Index	4.80E-04
		Total Carcinogenic Risk - Sediment and Surface Water		1.45E-06	Total HI - Sediment and Surface Water		1.04E-02

Risks to Future Youth Site Trespassers
Sediment and Surface Water
CDL - Wallops Flight Facility

INGESTION OF SEDIMENT

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene chloride	9.20E-03	6.91E-10	7.50E-03	5.19E-12	8.07E-09	6.00E-02	1.34E-07
bis(2-Ethylhexyl)phthalate	1.62E+02	1.22E-05	1.40E-02	1.70E-07	1.42E-04	2.00E-02	7.10E-03
DDE	1.49E-01	1.12E-08	3.40E-01	3.81E-09	1.31E-07	-	-
Arsenic	1.40E+01	1.05E-06	1.50E+00	1.58E-06	1.23E-05	3.00E-04	4.09E-02
Mercury	3.29E-01	2.47E-08	-	-	2.88E-07	3.00E-04	9.61E-04
			Carcinogenic Risk	1.75E-06		Hazard Index	4.89E-02

DERMAL CONTACT WITH SEDIMENT

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Soil (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Methylene chloride	9.20E-03	1.94E-11	7.50E-03	1.45E-13	2.26E-10	6.00E-02	3.76E-09
bis(2-Ethylhexyl)phthalate	1.62E+02	3.41E-06	1.40E-02	4.77E-08	3.98E-05	2.00E-02	1.99E-03
DDE	1.49E-01	3.14E-10	3.40E-01	1.07E-10	3.66E-09	-	-
Arsenic	1.40E+01	8.83E-08	1.50E+00	1.32E-07	1.03E-06	3.00E-04	3.43E-03
Mercury	3.29E-01	6.92E-11	-	-	8.08E-10	3.00E-04	2.69E-06
			Carcinogenic Risk	1.80E-07		Hazard Index	5.43E-03

INGESTION OF SURFACE WATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Surface Water (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Arsenic	1.11E+01	4.17E-08	1.50E+00	6.26E-08	4.87E-07	3.00E-04	1.62E-03
			Carcinogenic Risk	6.26E-08		Hazard Index	1.62E-03

DERMAL CONTACT WITH SURFACE WATER

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Surface Water (ug/L)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Arsenic	1.11E+01	2.34E-08	1.50E+00	3.50E-08	2.72E-07	3.00E-04	9.08E-04
			Carcinogenic Risk	3.50E-08		Hazard Index	9.08E-04
		Total Carcinogenic Risk - Sediment and Surface Water		2.03E-06	Total HI - Sediment and Surface Water		5.69E-02

Risks to Current/Future Child Recreational Fishermen
Bluefish and Blue Crabs
CDL - Wallops Flight Facility

INGESTION OF FISH		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Bluefish (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Antimony	2.48E-01	1.53E-06	-	-	1.78E-05	4.00E-04	4.46E-02
Arsenic	1.27E+00	7.80E-06	1.50E+00	1.17E-05	9.10E-05	3.00E-04	3.03E-01
Chromium	3.80E-02	2.34E-07	-	-	2.73E-06	3.00E-03	9.11E-04
Mercury	1.02E+00	6.26E-06	-	-	7.31E-05	-	-
Selenium	1.52E+00	9.38E-06	-	-	1.09E-04	5.00E-03	2.19E-02
			Carcinogenic Risk	1.17E-05		Hazard Index	3.71E-01

INGESTION OF BLUE CRABS		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Crabs (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Arsenic	1.91E-02	3.91E-08	1.50E+00	5.87E-08	4.57E-07	3.00E-04	1.52E-03
Chromium	4.96E-02	1.02E-07	-	-	1.19E-06	3.00E-03	3.96E-04
			Carcinogenic Risk	5.87E-08		Hazard Index	1.52E-03
			Total Carcinogenic Risk	1.18E-05		Total HI	3.72E-01

Risks to Current/Future Adult Recreational Fishermen
Bluefish and Blue Crabs
CDL - Wallops Flight Facility

INGESTION OF FISH

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Bluefish (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Antimony	2.48E-01	3.93E-06	-	-	1.15E-05	4.00E-04	2.87E-02
Arsenic	1.27E+00	2.01E-05	1.50E+00	3.01E-05	5.85E-05	3.00E-04	1.95E-01
Chromium	3.80E-02	6.02E-07	-	-	1.76E-06	3.00E-03	5.86E-04
Mercury	1.02E+00	1.61E-05	-	-	4.70E-05	-	-
Selenium	1.52E+00	2.41E-05	-	-	7.04E-05	5.00E-03	1.41E-02
			Carcinogenic Risk	3.01E-05		Hazard Index	2.38E-01

INGESTION OF BLUE CRABS

		Cancer Risk Calculations			Non-Cancer Hazard Calculations		
Carcinogen	RME Concentration in Crabs (mg/kg)	Lifetime Average Daily Dose (mg/kg/day)	Oral Slope Factor (kg-day/mg)	Risk Probability	Chronic Daily Intake (mg/kg/day)	Oral Reference Dose (mg/kg/day)	Hazard Quotient
Arsenic	1.91E-02	1.01E-07	1.50E+00	1.51E-07	2.94E-07	3.00E-04	9.79E-04
Chromium	4.96E-02	2.62E-07	-	-	7.64E-07	3.00E-03	2.55E-04
			Carcinogenic Risk	1.51E-07		Hazard Index	9.79E-04
			Total Carcinogenic Risk	3.02E-05		Total HI	2.39E-01

APPENDIX F-5

ADULT LEAD MODEL (ALM) RESULTS

Calculations of Blood Lead Concentrations (PbBs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/05 EDIT RED CELLS

Exposure Variable	Description of Exposure Variable	Units	Region OR Ethnic GSDi and PbBo Data from NHANES III Analysis							
			All/All	All/White	All/Black	All/Mexican	Northeast/All	Midwest/All	South/All	West/All
PbS	Soil lead concentration	ug/g or ppm	383	383	383	383	383	383	383	383
$R_{fetal\ maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	2.1	2.1	2.2	2.3	2.0	2.2	2.1	2.1
PbB_0	Baseline PbB	ug/dL	1.5	1.5	1.8	1.7	2.0	1.5	1.4	1.4
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
IR_{S+D}	Total ingestion rate of outdoor soil and indoor dust	g/day	--	--	--	--	--	--	--	--
W_S	Weighting factor; fraction of IR_{S+D} ingested as outdoor soil	--	--	--	--	--	--	--	--	--
K_{SD}	Mass fraction of soil in dust	--	--	--	--	--	--	--	--	--
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	219	219	219	219	219	219	219	219
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	365	365	365	365	365	365	365	365
PbB_{adult}	**PbB of adult worker, geometric mean**	**ug/dL**	**2.1**	**2.0**	**2.3**	**2.3**	**2.5**	**2.1**	**1.9**	**2.0**
$PbB_{fetal,0.95}$	95th percentile PbB among fetuses of adult workers	ug/dL	6.4	6.1	7.4	7.9	7.1	6.8	5.8	6.0
PbB_t	Target PbB level of concern (e.g., 10 ug/dL)	ug/dL	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
$P(PbB_{fetal} > PbB_t)$	**Probability that fetal PbB > PbB_t, assuming lognormal distribution**	**%**	**1.2%**	**1.0%**	**2.1%**	**2.7%**	**1.6%**	**1.6%**	**0.8%**	**1.0%**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same $PbB_{fetal,0.95}$.

Lead Exposure
Construction Workers
Aggregate Soil

Calculations of Preliminary Remediation Goals (PRGs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/05 EDIT RED CELLS

Exposure Variable	Description of Exposure Variable	Units	Region OR Ethnic GSDi and PbBo Data from NHANES III Analysis							
			All/All	All/White	All/Black	All/Mexican	Northeast/All	Midwest/All	South/All	West/All
$PbB_{fetal,\ 0.95}$	95th percentile PbB in fetus	ug/dL	10	10	10	10	10	10	10	10
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	2.1	2.1	2.2	2.3	2.0	2.2	2.1	2.1
PbB_0	Baseline PbB	ug/dL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.330	0.330	0.330	0.330	0.330	0.330	0.330	0.330
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	120	120	120	120	120	120	120	120
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	365	365	365	365	365	365	365	365
PRG		**ppm**	**625**	**635**	**601**	**546**	**682**	**592**	**645**	**625**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same PRG.

Lead Exposure
Commercial Workers
Surface Soil

Calculations of Preliminary Remediation Goals (PRGs)

U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee

Version date 05/19/05 EDIT RED CELLS

Exposure Variable	Description of Exposure Variable	Units	Region OR Ethnic GSDi and PbBo Data from NHANES III Analysis							
			All/All	All/White	All/Black	All/Mexican	Northeast/All	Midwest/All	South/All	West/All
$PbB_{fetal,\ 0.95}$	95th percentile PbB in fetus	ug/dL	10	10	10	10	10	10	10	10
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
GSD_i	Geometric standard deviation PbB	--	2.1	2.1	2.2	2.3	2.0	2.2	2.1	2.1
PbB_0	Baseline PbB	ug/dL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050
$AF_{S,D}$	Absorption fraction (same for soil and dust)	--	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
$EF_{S,D}$	Exposure frequency (same for soil and dust)	days/yr	250	250	250	250	250	250	250	250
$AT_{S,D}$	Averaging time (same for soil and dust)	days/yr	365	365	365	365	365	365	365	365
PRG		**ppm**	**1,979**	**2,010**	**1,904**	**1,730**	**2,161**	**1,876**	**2,042**	**1,979**

[1] Equation 1 does not apportion exposure between soil and dust ingestion (excludes W_S, K_{SD}).
When $IR_S = IR_{S+D}$ and $W_S = 1.0$, the equations yield the same PRG.

APPENDIX G

ECOLOGICAL RISK ASSESSMENT TABLES

APPENDIX G-1

ECOLOGICAL RISK ASSESSMENT
COPEC SELECTION

Table G-1.1: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc. (mg/kg)	Max Detected Conc. (mg/kg)	Min Detection Limit (mg/kg)	Max Detection Limit (mg/kg)	Median Detection Limit (mg/kg)	Screening Benchmarks Flora[a] (mg/kg)	Invert[b] (mg/kg)	Fauna[c] (mg/kg)	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Volatile Organic Compounds															
Acetone	0	8	0	NA	NA	0.01	1.5	0.0155				ND	-	No	Laboratory artifact
Benzene	0	8	0	NA	NA	0.001	0.15	0.00155	0.1		0.1	ND	No	No	Below screening benchmark
Bromodichloromethane	0	8	0	NA	NA	0.0051	0.77	0.0077			450	ND	No	No	Below screening benchmark
Bromoform	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Bromomethane	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
2-Butanone (MEK)	0	8	0	NA	NA	0.01	1.5	0.0155				ND	-	-	
Carbon disulfide	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Carbon tetrachloride	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**	**1000**	**0.3**	**ND**	**Yes**	**Yes**	
Chlorobenzene	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.1**	**40**		**ND**	**Yes**	**Yes**	
Chloroethane	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Chloroform	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
Chloromethane	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Cyclohexane	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
1,2-Dibromo-3-chloropropane	0	8	0	NA	NA	0.01	1.5	0.0155				ND	-	-	
Dibromochloromethane	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
1,2-Dibromoethane	0	8	0	NA	NA	0.001	0.15	0.00155	5			ND	No	No	Below screening benchmark
1,2-Dichlorobenzene	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
1,3-Dichlorobenzene	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
1,4-Dichlorobenzene	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.1**	**20**		**ND**	**Yes**	**Yes**	
Dichlorodifluoromethane	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
1,1-Dichloroethane	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
1,2-Dichloroethane	0	8	0	NA	NA	0.001	0.15	0.00155			870	ND	No	No	Below screening benchmark
1,1-Dichloroethyne	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
cis-1,2-Dichloroethene	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
trans-1,2-Dichloroethene	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	

Table G-1.1: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
1,2-Dichloropropane	0	8	0	NA	NA	0.0051	0.77	0.0077		700		ND	No	No	Below screening benchmark
cis-1,3-Dichloropropene	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
trans-1,3-Dichloropropene	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Ethylbenzene	1	8	12.5%	0.00063	0.00063	0.001	0.15	0.00155	0.1	0.1		No	NA	No	Below screening benchmark
Freon 113	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
2-Hexanone	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Isopropylbenzene	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Methyl Acetate	**1**	**8**	**12.5%**	**1.19**	**1.19**	**0.0051**	**0.77**	**0.0077**				-	**NA**	**Yes**	
Methylcyclohexane	**1**	**8**	**12.5%**	**0.0025**	**0.0025**	**0.0051**	**0.77**	**0.0077**				-	**NA**	**Yes**	
Methyl Tert Butyl Ether	0	8	0	NA	NA	0.001	0.15	0.00155				ND	-	-	
4-Methyl-2-pentanone(MIBK)	0	8	0	NA	NA	0.0051	0.77	0.0077			100	ND	No	No	Below screening benchmark
Methylene chloride	0	8	0	NA	NA	0.0051	0.77	0.0077	0.3		0.3	ND	Yes	No	Laboratory artifact
Styrene	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**300**		**0.1**	**ND**	**Yes**	**Yes**	
1,1,2,2-Tetrachloroethane	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
Tetrachloroethene	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
Toluene	1	8	12.5%	0.00096	0.00096	0.001	0.15	0.00155	200	0.1		No	NA	No	Below screening benchmark
1,2,4-Trichlorobenzene	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.1**	**20**		**ND**	**Yes**	**Yes**	
1,1,1-Trichloroethane	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
1,1,2-Trichloroethane	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
Trichloroethene	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Trichlorofluoromethane	0	8	0	NA	NA	0.0051	0.77	0.0077				ND	-	-	
Vinyl chloride	**0**	**8**	**0**	**NA**	**NA**	**0.0051**	**0.77**	**0.0077**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
m,p-Xylene	1	8	12.5%	0.0035	0.0035	0.0021	0.31	0.00305	0.1		0.1	No	NA	No	Below screening benchmark
o-Xylene	1	8	12.5%	0.0014	0.0014	0.001	0.15	0.00155	0.1		0.1	No	NA	No	Below screening benchmark
Xylene (total)	1	8	12.5%	0.0049	0.0049	0.0021	0.31	0.00305	0.1		0.1	No	NA	No	Below screening benchmark

Table G-1.1: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Semi-Volatile Organic Compounds															
2-Chlorophenol	0	8	0	NA	NA	0.18	1.2	0.205	0.1		0.1	ND	Yes	Yes	
4-Chloro-3-methyl phenol	0	8	0	NA	NA	0.18	1.2	0.205				ND	-	-	
2,4-Dichlorophenol	0	8	0	NA	NA	0.18	1.2	0.205	0.1		0.1	ND	Yes	Yes	
2,4-Dimethylphenol	0	8	0	NA	NA	0.18	1.2	0.205	0.1		0.1	ND	Yes	Yes	
2,4-Dinitrophenol	0	8	0	NA	NA	0.74	4.7	0.815	0.1		0.1	ND	Yes	Yes	
4,6-Dinitro-o-cresol	0	8	0	NA	NA	0.74	4.7	0.815	0.1		0.1	ND	Yes	Yes	
2-Methylphenol	0	8	0	NA	NA	0.18	1.2	0.205	0.1		0.1	ND	Yes	Yes	
3&4-Methylphenol	0	8	0	NA	NA	0.18	1.2	0.205	0.1		0.1	ND	Yes	Yes	
2-Nitrophenol	0	8	0	NA	NA	0.18	1.2	0.205				ND	-	-	
4-Nitrophenol	0	8	0	NA	NA	0.74	4.7	0.815	0.1	7		ND	Yes	Yes	
Pentachlorophenol	0	8	0	NA	NA	0.74	4.7	0.815	5	31	2.1	ND	Yes	Yes	
Phenol	0	8	0	NA	NA	0.18	1.2	0.205	0.1	30	0.1	ND	Yes	Yes	
2,4,5-Trichlorophenol	0	8	0	NA	NA	0.18	1.2	0.205	0.1	9	0.1	ND	Yes	Yes	
2,4,6-Trichlorophenol	0	8	0	NA	NA	0.18	1.2	0.205	0.1	10	0.1	ND	Yes	Yes	
Acenaphthene	0	8	0	NA	NA	0.074	0.47	0.0815	0.1	18	1.1	ND	Yes	Yes	
Acenaphthylene	1	8	12.5%	0.158	0.158	0.074	0.47	0.0815	0.1	18	1.1	Yes	NA	Yes	
Acetophenone	0	8	0	NA	NA	0.18	1.2	0.205				ND	-	-	
Anthracene	3	8	37.5%	0.0168	0.267	0.074	0.47	0.0815	0.1	18	1.1	Yes	NA	Yes	
Atrazine	0	8	0	NA	NA	0.18	1.2	0.205				ND	-	-	
Benzo(a)anthracene	4	8	50%	0.0243	2.49	0.074	0.47	0.0815	0.1	29	100	Yes	NA	Yes	
Benzo(a)pyrene	3	8	37.5%	0.0588	1.91	0.074	0.47	0.0815	0.1	29	100	Yes	NA	Yes	
Benzo(b)fluoranthene	3	8	37.5%	0.0987	1.39	0.074	0.47	0.0815	0.1	29	100	Yes	NA	Yes	
Benzo(g,h,i)perylene	3	8	37.5%	0.0666	1.18	0.074	0.47	0.0815	0.1	29	100	Yes	NA	Yes	
Benzo(k)fluoranthene	3	8	37.5%	0.0857	1.03	0.074	0.47	0.0815	0.1	29	100	Yes	NA	Yes	
4-Bromophenyl phenyl ether	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
Butyl benzyl phthalate	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
1,1'-Biphenyl	0	8	0	NA	NA	0.074	0.47	0.0815	60			ND	No	No	Below screening benchmark

Table G-1.1: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Benzaldehyde	0	0	0												
2-Chloronaphthalene	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
4-Chloroaniline	0	8	0	NA	NA	0.18	1.2	0.205	40			ND	No	No	Below screening benchmark
Carbazole	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
Caprolactam	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
Chrysene	**4**	**8**	**50%**	**0.0191**	**4.04**	**0.074**	**0.47**	**0.0815**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
bis(2-Chloroethoxy)methane	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
bis(2-Chloroethyl)ether	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
bis(2-Chloroisopropyl)ether	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
4-Chlorophenyl phenyl ether	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
2,4-Dinitrotoluene	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
2,6-Dinitrotoluene	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
3,3'-Dichlorobenzidine	0	8	0	NA	NA	0.18	1.2	0.205				ND	-	-	
Dibenzo(a,h) anthracene	**2**	**8**	**25%**	**0.0226**	**0.388**	**0.074**	**0.47**	**0.0815**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Dibenzofuran	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
Di-n-butyl phthalate	0	8	0	NA	NA	0.074	0.47	0.0815	200			ND	No	No	Below screening benchmark
Di-n-octyl phthalate	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
Diethyl phthalate	0	8	0	NA	NA	0.074	0.47	0.0815	100			ND	No	No	Below screening benchmark
Dimethyl phthalate	0	8	0	NA	NA	0.074	0.47	0.0815		200		ND	No	No	Below screening benchmark
bis(2-Ethylhexyl)phthalate	**3**	**8**	**37.5%**	**0.0525**	**0.111**	**0.074**	**0.47**	**0.0815**				**-**	**NA**	**Yes**	
Fluoranthene	**5**	**8**	**62.5%**	**0.023**	**1.79**	**0.074**	**0.47**	**0.0815**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Fluorene	**0**	**8**	**0**	**NA**	**NA**	**0.074**	**0.47**	**0.0815**	**0.1**	**18**	**1.1**	**ND**	**Yes**	**Yes**	
Hexachlorobenzene	0	8	0	NA	NA	0.074	0.47	0.0815		1000		ND	No	No	Below screening benchmark
Hexachlorobutadiene	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
Hexachlorocyclo-pentadiene	0	8	0	NA	NA	0.74	4.7	0.815	10			ND	No	No	
Hexachloroethane	0	8	0	NA	NA	0.18	1.2	0.205				ND	-	-	

Table G-1.1: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Indeno(1,2,3-cd)pyrene	**3**	**8**	**37.5%**	**0.0613**	**0.617**	**0.074**	**0.47**	**0.0815**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Isophorone	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
2-Methylnaphthalene	0	8	0	NA	NA	0.074	0.47	0.0815		29	100	ND	No	No	Below screening benchmark
2-Nitroaniline	0	8	0	NA	NA	0.18	1.2	0.205				ND	-	-	
3-Nitroaniline	0	8	0	NA	NA	0.18	1.2	0.205	70			ND	No	No	Below screening benchmark
4-Nitroaniline	0	8	0	NA	NA	0.18	1.2	0.205	40			ND	No	No	Below screening benchmark
Naphthalene	0	8	0	NA	NA	0.074	0.47	0.0815	10	18	1.1	ND	No	No	Below screening benchmark
Nitrobenzene	0	8	0	NA	NA	0.074	0.47	0.0815		40		ND	No	No	Below screening benchmark
N-Nitroso-di-n-propylamine	0	8	0	NA	NA	0.074	0.47	0.0815				ND	-	-	
N-Nitrosodiphenylamine	0	8	0	NA	NA	0.18	1.2	0.205		20		ND	No	No	Below screening benchmark
Phenanthrene	**4**	**8**	**50%**	**0.0256**	**2.23**	**0.074**	**0.47**	**0.0815**	**0.1**	**18**	**1.1**	**Yes**	**NA**	**Yes**	
Pyrene	**5**	**8**	**62.5%**	**0.0213**	**4.74**	**0.074**	**0.47**	**0.0815**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Pesticides															
Aldrin	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
alpha-BHC	0	8	0	NA	NA	0.0015	0.016	0.00175			100	ND	No	No	Below screening benchmark
beta-BHC	0	8	0	NA	NA	0.0015	0.016	0.00175			100	ND	No	No	Below screening benchmark
delta-BHC	0	8	0	NA	NA	0.0015	0.016	0.00175			100	ND	No	No	Below screening benchmark
gamma-BHC (Lindane)	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
alpha-Chlordane	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
gamma-Chlordane	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
Dieldrin	0	8	0	NA	NA	0.0015	0.016	0.00175			0.0049	ND	No	No	Below screening benchmark
4,4'-DDD	**6**	**8**	**75%**	**0.0019**	**0.126**	**0.0015**	**0.016**	**0.00175**	**0.1**		**0.021**	**Yes**	**NA**	**Yes**	
4,4'-DDE	**8**	**8**	**100%**	**0.0053**	**1.02**	**0.0016**	**0.032**	**0.0078**	**0.1**		**0.021**	**Yes**	**NA**	**Yes**	
4,4'-DDT	**8**	**8**	**100%**	**0.0063**	**0.53**	**0.0015**	**0.016**	**0.005**	**0.1**		**0.021**	**Yes**	**NA**	**Yes**	

Table G-1.1: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Endrin	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
Endrin aldehyde	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
Endrin ketone	0	8	0	NA	NA	0.0037	0.041	0.00425	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan sulfate	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan-I	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan-II	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
Heptachlor	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
Heptachlor epoxide	0	8	0	NA	NA	0.0015	0.016	0.00175	0.1		0.1	ND	No	No	Below screening benchmark
Methoxychlor	0	8	0	NA	NA	0.0037	0.041	0.00425	0.1		0.1	ND	No	No	Below screening benchmark
Toxaphene	0	8	0	NA	NA	0.019	0.2	0.0215				ND	-	-	
Polychlorinated Biphenyls															
Aroclor 1016	0	8	0	NA	NA	0.037	0.047	0.041	0.1			ND	No	No	Below screening benchmark
Aroclor 1221	0	8	0	NA	NA	0.037	0.047	0.041	0.1			ND	No	No	Below screening benchmark
Aroclor 1232	0	8	0	NA	NA	0.037	0.047	0.041	0.1			ND	No	No	Below screening benchmark
Aroclor 1242	0	8	0	NA	NA	0.037	0.047	0.041	0.1			ND	No	No	Below screening benchmark
Aroclor 1248	0	8	0	NA	NA	0.037	0.047	0.041	0.1			ND	No	No	Below screening benchmark
Aroclor 1254	0	8	0	NA	NA	0.037	0.047	0.041	0.1			ND	No	No	Below screening benchmark
Aroclor 1260	0	8	0	NA	NA	0.037	0.047	0.041	0.1			ND	No	No	Below screening benchmark
Dioxin (TCDD-2,3,7,8)															
2,3,7,8-TCDD	**0**	**4**	**0**	**NA**	**NA**	**0.18**	**0.22**	**0.20**			**0.01**	**-**	**NA**	**Yes**	
Inorganics															
Aluminum	8	8	100%	6000	27300	22	51	25				-	NA	No	Not retained as soil pH>5.5
Antimony	**4**	**8**	**50%**	**1.1**	**63.7**	**2.2**	**5.1**	**2.5**	**0.48**	**78**	**0.27**	**Yes**	**NA**	**Yes**	
Arsenic	**8**	**8**	**100%**	**3**	**7.6**	**0.44**	**0.59**	**0.495**	**18**	**100**	**43**	**No**	**NA**	**Yes**	**Bioaccumulative**

Table G-1.1: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Barium	8	8	100%	32.2	1160	22	51	2.5	440	330	2000	Yes	NA	Yes	
Beryllium	7	8	87.5%	0.086	1.3	0.55	1.3	0.625	.01	40	21	Yes	NA	Yes	
Cadmium	7	8	87.5%	0.21	21.6	0.55	1.3	0.625	32	140	0.36	Yes	NA	Yes	
Calcium	8	8	100%	634	71900	550	1300	625				-	NA	No	Determined to be an essential nutrient
Chromium**	8	8	100%	7.6	126	1.1	1.5	1.25	0.02	10	26	Yes	NA	Yes	
Cobalt	8	8	100%	2.1	28	5.5	13	6.25	13	1000	120	Yes	NA	Yes	
Copper	8	8	100%	7.4	1790	2.8	6.4	3.1	70	80	28	Yes	NA	Yes	
Iron	8	8	100%	5640	45100	11	26	12.5				-	NA	No	Soil pH between 5-8
Lead	8	8	100%	12.9	2120	2.2	5.1	2.5	120	1700	11	Yes	NA	Yes	
Magnesium	8	8	100%	761	76700	550	1300	625				-	NA	No	Determined to be an essential nutrient
Manganese	8	8	100%	110	1490	1.7	3.9	1.85	220	450	4000	Yes	NA	Yes	
Mercury	8	8	100%	0.052	1.8	0.033	0.18	0.039	0.058	30	0.058	Yes	NA	Yes	
Nickel	8	8	100%	3.9	502	4.4	10	5	38	280	130	Yes	NA	Yes	
Potassium	8	8	100%	339	1410	550	1300	625				-	NA	No	Determined to be an essential nutrient
Selenium	2	8	25%	1.4	4.4	2.2	2.9	2.5	0.52	4.1	0.63	Yes	NA	Yes	
Silver	7	8	87.5%	0.18	84.5	1.1	2.6	1.25	560	50	4.2	Yes	NA	Yes	
Sodium	2	8	25%	103	115	1100	2600	1250				-	NA	No	Determined to be an essential nutrient
Thallium	6	8	75%	0.036	0.2	0.12	0.22	0.13	.001			Yes	NA	Yes	
Vanadium	8	8	100%	10.3	51	5.5	13	6.25	.005	20	7.8	Yes	NA	Yes	
Zinc	8	8	100%	20.6	4280	2.2	2.2	2.5	160	120	46	Yes	NA	Yes	
Cyanide	0	8	0	NA	NA	0.25	0.25	0.27			0.005	ND	Yes	Yes	

Grayed cells indicate chemical was detected
Bold = COPEC
[a] Eco-SSLs or Efroymson et al 1997a
[b] Eco-SSLs or Efroymson et al 1997b
[c] minimum of the wildlife Eco-SSLs value or EPA Region 3 1995 BTAG Screening Levels
** minimum of the values for Chromium III and VI

Table G-1.2: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc. (mg/kg)	Max Detected Conc. (mg/kg)	Min Detection Limit (mg/kg)	Max Detection Limit (mg/kg)	Median Detection Limit (mg/kg)	Screening Benchmarks: Flora (mg/kg)	Invert (mg/kg)	Fauna* (mg/kg)	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Volatile Organic Compounds															
Acetone	0	17	0.0%	NA	NA	0.0081	1.5	0.014				ND	-	No	Laboratory artifact
Benzene	1	17	5.9%	0.0024	0.0024	0.00081	0.15	0.0014	0.1	-	0.1	No	-	No	Below screening benchmark
Bromodichloromethane	0	17	0.0%	NA	NA	0.004	0.77	0.007			450	ND	No	No	Below screening benchmark
Bromoform	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Bromomethane	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
2-Butanone (MEK)	0	17	0.0%	NA	NA	0.0081	1.5	0.014				ND	-	-	
Carbon disulfide	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Carbon tetrachloride	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**	**1000**	**0.3**	**ND**	**Yes**	**Yes**	
Chlorobenzene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.1**	**40**		**ND**	**Yes**	**Yes**	
Chloroethane	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Chloroform	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
Chloromethane	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Cyclohexane	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
1,2-Dibromo-3-chloropropane	0	17	0.0%	NA	NA	0.0081	1.5	0.014				ND	-	-	
Dibromochloro methane	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
1,2-Dibromoethane	0	17	0.0%	NA	NA	0.00081	0.15	0.0014	5			ND	No	No	Below screening benchmark
1,2-Dichlorobenzene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
1,3-Dichlorobenzene	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
1,4-Dichlorobenzene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.1**	**20**		**ND**	**Yes**	**Yes**	
Dichlorodifluoro-methane	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
1,1-Dichloroethane	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
1,2-Dichloroethane	0	17	0.0%	NA	NA	0.00081	0.15	0.0014			870	ND	No	No	Below screening benchmark
1,1-Dichloroethyne	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
cis-1,2-Dichloroethene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
trans-1,2-Dichloroethene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	

Table G-1.2: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora	Invert	Fauna*	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
1,2-Dichloropropane	0	17	0.0%	NA	NA	0.004	0.77	0.007		700		ND	No	No	Below screening benchmark
cis-1,3-Dichloropropene	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
trans-1,3-Dichloropropene	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Ethylbenzene	1	17	5.9%	0.00063	0.00063	0.00081	0.15	0.0014	0.1	0.1		No	NA	No	Below screening benchmark
Freon 113	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
2-Hexanone	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Isopropylbenzene	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Methyl Acetate	**1**	**17**	**5.9%**	**1.19**	**1.19**	**0.004**	**0.77**	**0.007**				-	**NA**	**Yes**	
Methylcyclohexane	**1**	**17**	**5.9%**	**0.0025**	**0.0025**	**0.004**	**0.77**	**0.007**				-	**NA**	**Yes**	
Methyl Tert Butyl Ether	0	17	0.0%	NA	NA	0.00081	0.15	0.0014				ND	-	-	
4-Methyl-2-pentanone(MIBK)	0	17	0.0%	NA	NA	0.004	0.77	0.007			100	ND	No	No	Below screening benchmark
Methylene chloride	0	17	0.0%	NA	NA	0.004	0.77	0.007	0.3		0.3	ND	Yes	No	Laboratory artifact
Styrene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**300**		**0.1**	**ND**	**Yes**	**Yes**	
1,1,2,2-Tetrachloroethane	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
Tetrachloroethene	3	17	17.6%	0.00099	0.0137	0.004	0.77	0.007	0.3		0.3	No	NA	No	Below screening benchmark
Toluene	1	17	5.9%	0.00096	0.00096	0.00081	0.15	0.0014	200	0.1		No	NA	No	Below screening benchmark
1,2,4-Trichlorobenzene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.1**	**20**		**ND**	**Yes**	**Yes**	
1,1,1-Trichloroethane	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
1,1,2-Trichloroethane	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
Trichloroethene	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Trichlorofluoro-methane	0	17	0.0%	NA	NA	0.004	0.77	0.007				ND	-	-	
Vinyl chloride	**0**	**17**	**0.0%**	**NA**	**NA**	**0.004**	**0.77**	**0.007**	**0.3**		**0.3**	**ND**	**Yes**	**Yes**	
m,p-Xylene	1	17	5.9%	0.0035	0.0035	0.0016	0.31	0.0028	0.1		0.1	No	NA	No	Below screening benchmark
o-Xylene	1	17	5.9%	0.0014	0.0014	0.00081	0.15	0.0014	0.1		0.1	No	NA	No	Below screening benchmark
Xylene (total)	1	17	5.9%	0.0049	0.0049	0.0016	0.31	0.0028	0.1		0.1	No	NA	No	Below screening benchmark

Table G-1.2: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora	Invert	Fauna*	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Semi-Volatile Organic Compounds															
2-Chlorophenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.17**	**1.2**	**0.2**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
4-Chloro-3-methyl phenol	0	17	0.0%	NA	NA	0.17	1.2	0.2				ND	-	-	
2,4-Dichlorophenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.17**	**1.2**	**0.2**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
2,4-Dimethylphenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.17**	**1.2**	**0.2**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
2,4-Dinitrophenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.7**	**4.7**	**0.79**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
4,6-Dinitro-o-cresol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.7**	**4.7**	**0.79**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
2-Methylphenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.17**	**1.2**	**0.2**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
3&4-Methylphenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.17**	**1.2**	**0.2**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
2-Nitrophenol	0	17	0.0%	NA	NA	0.17	1.2	0.2				ND	-	-	
4-Nitrophenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.7**	**4.7**	**0.79**	**0.1**	**7**		**ND**	**Yes**	**Yes**	
Pentachlorophenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.7**	**4.7**	**0.79**	**5**	**31**	**2.1**	**ND**	**Yes**	**Yes**	
Phenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.17**	**1.2**	**0.2**	**0.1**	**30**	**0.1**	**ND**	**Yes**	**Yes**	
2,4,5-Trichlorophenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.17**	**1.2**	**0.2**	**0.1**	**9**	**0.1**	**ND**	**Yes**	**Yes**	
2,4,6-Trichlorophenol	**0**	**17**	**0.0%**	**NA**	**NA**	**0.17**	**1.2**	**0.2**	**0.1**	**10**	**0.1**	**ND**	**Yes**	**Yes**	
Acenaphthene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.07**	**0.47**	**0.079**	**0.1**	**18**	**1.1**	**ND**	**Yes**	**Yes**	
Acenaphthylene	**1**	**17**	**5.9%**	**0.158**	**0.158**	**0.07**	**0.47**	**0.079**	**0.1**	**18**	**1.1**	**Yes**	**NA**	**Yes**	
Acetophenone	0	17	0.0%	NA	NA	0.17	1.2	0.2				ND	-	-	
Anthracene	**4**	**17**	**23.5%**	**0.0168**	**0.267**	**0.07**	**0.47**	**0.079**	**0.1**	**18**	**1.1**	**Yes**	**NA**	**Yes**	
Atrazine	0	17	0.0%	NA	NA	0.17	1.2	0.2				ND	-	-	
Benzo(a)anthracene	**5**	**17**	**29.4%**	**0.0243**	**2.49**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Benzo(a)pyrene	**4**	**17**	**23.5%**	**0.0588**	**1.91**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Benzo(b)fluoranthene	**4**	**17**	**23.5%**	**0.0987**	**1.39**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Benzo(g,h,i)perylene	**4**	**17**	**23.5%**	**0.0623**	**1.18**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Benzo(k)fluoranthene	**4**	**17**	**23.5%**	**0.0857**	**1.03**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
4-Bromophenyl phenyl ether	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
Butyl benzyl phthalate	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
1,1'-Biphenyl	0	17	0.0%	NA	NA	0.07	0.47	0.079	60			ND	No	No	Below screening benchmark

Table G-1.2: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks			Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
									Flora	Invert	Fauna*				
Benzaldehyde	0	0	0.0%	NA	NA	NA	NA	NA				ND	-	-	
2-Chloronaphthalene	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
4-Chloroaniline	0	17	0.0%	NA	NA	0.17	1.2	0.2	40			ND	No	No	Below screening benchmark
Carbazole	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
Caprolactam	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
Chrysene	**5**	**17**	**29.4%**	**0.0191**	**4.04**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
bis(2-Chloroethoxy) methane	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
bis(2-Chloroethyl) ether	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
bis(2-Chloroisopropyl)ether	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
4-Chlorophenyl phenyl ether	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
2,4-Dinitrotoluene	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
2,6-Dinitrotoluene	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
3,3'-Dichlorobenzidine	0	17	0.0%	NA	NA	0.17	1.2	0.2				ND	-	-	
Dibenzo(a,h) anthracene	**3**	**17**	**17.6%**	**0.0226**	**0.388**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Dibenzofuran	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
Di-n-butyl phthalate	0	17	0.0%	NA	NA	0.07	0.47	0.079	200			ND	No	No	Below screening benchmark
Di-n-octyl phthalate	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
Diethyl phthalate	0	17	0.0%	NA	NA	0.07	0.47	0.079	100			ND	No	No	Below screening benchmark
Dimethyl phthalate	0	17	0.0%	NA	NA	0.07	0.47	0.079		200		ND	No	No	Below screening benchmark
bis(2-Ethylhexyl) phthalate	**6**	**17**	**35.3%**	**0.0519**	**0.199**	**0.07**	**0.47**	**0.079**				**-**	**NA**	**Yes**	
Fluoranthene	**6**	**17**	**35.3%**	**0.023**	**1.79**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Fluorene	**0**	**17**	**0.0%**	**NA**	**NA**	**0.07**	**0.47**	**0.079**	**0.1**	**18**	**1.1**	**ND**	**Yes**	**Yes**	
Hexachlorobenzene	0	17	0.0%	NA	NA	0.07	0.47	0.079		1000		ND	No	No	Below screening benchmark
Hexachlorobutadiene	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
Hexachlorocyclo-pentadiene	0	17	0.0%	NA	NA	0.7	4.7	0.79	10			ND	No	No	Below screening benchmark
Hexachloroethane	0	17	0.0%	NA	NA	0.17	1.2	0.2				ND	-	-	

Table G-1.2: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks			Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
									Flora	Invert	Fauna*				
Indeno(1,2,3-cd)pyrene	**4**	**17**	**23.5%**	**0.0613**	**0.617**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Isophorone	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
2-Methylnaphthalene	0	17	0.0%	NA	NA	0.07	0.47	0.079		29	100	ND	No	No	Below screening benchmark
2-Nitroaniline	0	17	0.0%	NA	NA	0.17	1.2	0.2				ND	-	-	
3-Nitroaniline	0	17	0.0%	NA	NA	0.17	1.2	0.2	70			ND	No	No	Below screening benchmark
4-Nitroaniline	0	17	0.0%	NA	NA	0.17	1.2	0.2	40			ND	No	No	Below screening benchmark
Naphthalene	0	17	0.0%	NA	NA	0.07	0.47	0.079	10	18	1.1	ND	No	No	Below screening benchmark
Nitrobenzene	0	17	0.0%	NA	NA	0.07	0.47	0.079		40		ND	No	No	Below screening benchmark
N-Nitroso-di-n-propylamine	0	17	0.0%	NA	NA	0.07	0.47	0.079				ND	-	-	
N-Nitrosodiphenylamine	0	17	0.0%	NA	NA	0.17	1.2	0.2		20		ND	No	No	Below screening benchmark
Phenanthrene	**5**	**17**	**29.4%**	**0.0256**	**2.23**	**0.07**	**0.47**	**0.079**	**0.1**	**18**	**1.1**	**Yes**	**NA**	**Yes**	
Pyrene	**6**	**17**	**35.3%**	**0.0213**	**4.74**	**0.07**	**0.47**	**0.079**	**0.1**	**29**	**100**	**Yes**	**NA**	**Yes**	
Pesticides															
Aldrin	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark
alpha-BHC	0	17	0.0%	NA	NA	0.0014	0.016	0.0016			100	ND	No	No	Below screening benchmark
beta-BHC	0	17	0.0%	NA	NA	0.0014	0.016	0.0016			100	ND	No	No	Below screening benchmark
delta-BHC	0	17	0.0%	NA	NA	0.0014	0.016	0.0016			100	ND	No	No	Below screening benchmark
gamma-BHC (Lindane)	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark
alpha-Chlordane	**1**	**17**	**5.9%**	**0.0267**	**0.0267**	**0.0014**	**0.016**	**0.0016**	**0.1**		**0.1**	**No**	**NA**	**Yes**	**Bioaccumulative**
gamma-Chlordane	**1**	**17**	**5.9%**	**0.0346**	**0.0346**	**0.0014**	**0.016**	**0.0016**	**0.1**		**0.1**	**No**	**NA**	**Yes**	**Bioaccumulative**
Dieldrin	0	17	0.0%	NA	NA	0.0014	0.016	0.0016			0.0049	ND	No	No	Below screening benchmark
4,4'-DDD	**11**	**17**	**64.7%**	**0.0013**	**0.197**	**0.0014**	**0.037**	**0.0016**	**0.1**		**0.021**	**Yes**	**NA**	**Yes**	
4,4'-DDE	**14**	**17**	**82.4%**	**0.0031**	**1.31**	**0.0014**	**0.037**	**0.0018**	**0.1**		**0.021**	**Yes**	**NA**	**Yes**	
4,4'-DDT	**14**	**17**	**82.4%**	**0.0024**	**0.577**	**0.0014**	**0.037**	**0.0017**	**0.1**		**0.021**	**Yes**	**NA**	**Yes**	
Endrin	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark

Table G-1.2: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora	Invert	Fauna*	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Endrin aldehyde	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark
Endrin ketone	0	17	0.0%	NA	NA	0.0035	0.041	0.0039	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan sulfate	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan-I	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan-II	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark
Heptachlor	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark
Heptachlor epoxide	0	17	0.0%	NA	NA	0.0014	0.016	0.0016	0.1		0.1	ND	No	No	Below screening benchmark
Methoxychlor	0	17	0.0%	NA	NA	0.0035	0.041	0.0039	0.1		0.1	ND	No	No	Below screening benchmark
Toxaphene	0	17	0.0%	NA	NA	0.018	0.2	0.02				ND	-	-	
Polychlorinated Biphenyls															
Aroclor 1016	0	17	0.0%	NA	NA	0.035	0.047	0.039	0.1			ND	No	No	Below screening benchmark
Aroclor 1221	0	17	0.0%	NA	NA	0.035	0.047	0.039	0.1			ND	No	No	Below screening benchmark
Aroclor 1232	0	17	0.0%	NA	NA	0.035	0.047	0.039	0.1			ND	No	No	Below screening benchmark
Aroclor 1242	0	17	0.0%	NA	NA	0.035	0.047	0.039	0.1			ND	No	No	Below screening benchmark
Aroclor 1248	0	17	0.0%	NA	NA	0.035	0.047	0.039	0.1			ND	No	No	Below screening benchmark
Aroclor 1254	0	17	0.0%	NA	NA	0.035	0.047	0.039	0.1			ND	No	No	Below screening benchmark
Aroclor 1260	**1**	**17**	**5.9%**	**0.213**	**0.213**	**0.035**	**0.047**	**0.039**	**0.1**			**Yes**	**NA**	**Yes**	
Dioxin (TCDD-2,3,7,8)															
2,3,7,8-TCDD	**0**	**9**	**0.0%**	**NA**	**NA**	**0.17**	**0.22**	**0.2**			**0.01**	**ND**	**Yes**	**Yes**	
Inorganics															
Aluminum	17	17	100%	5740	79300	21	75	24				-	NA	No	Not retained as soil pH>5.5
Antimony	**8**	**17**	**47.1%**	**1.1**	**63.7**	**2.1**	**7.5**	**2.4**	**0.48**	**78**	**0.27**	**Yes**	**NA**	**Yes**	
Arsenic	**17**	**17**	**100%**	**1.7**	**8.4**	**0.42**	**0.59**	**0.47**	**18**	**100**	**43**	**No**	**NA**	**Yes**	**Bioaccumulative**
Barium	**17**	**17**	**100%**	**15.9**	**1160**	**21**	**75**	**24**	**440**	**330**	**2000**	**Yes**	**NA**	**Yes**	
Beryllium	**13**	**17**	**76.5%**	**0.086**	**1.3**	**0.53**	**1.9**	**0.59**	**.010**	**40**	**21**	**Yes**	**NA**	**Yes**	

Table G-1.2: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora	Invert	Fauna*	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Cadmium	**12**	**17**	**70.6%**	**0.21**	**75.3**	**0.53**	**1.9**	**0.59**	**32**	**140**	**0.36**	**Yes**	**NA**	**Yes**	
Calcium	17	17	100%	234	71900	530	1900	590				-	NA	No	Determined to be an essential nutrient
Chromium**	**17**	**17**	**100%**	**5.3**	**616**	**1.1**	**3.8**	**1.2**	**0.02**	**10**	**26**	**Yes**	**NA**	**Yes**	
Cobalt	**17**	**17**	**100%**	**1.5**	**28**	**5.3**	**19**	**5.9**	**13**	**1000**	**120**	**Yes**	**NA**	**Yes**	
Copper	**17**	**17**	**100%**	**3**	**5100**	**2.6**	**9.4**	**3**	**70**	**80**	**28**	**Yes**	**NA**	**Yes**	
Iron	17	17	100%	3520	96200	11	38	12				-	NA	No	Soil pH between 5-8
Lead	**17**	**17**	**100%**	**3.4**	**2120**	**2.1**	**7.5**	**2.4**	**120**	**1700**	**11**	**Yes**	**NA**	**Yes**	
Magnesium	17	17	100%	346	76700	530	1900	590				-	NA	No	Determined to be an essential nutrient
Manganese	**17**	**17**	**100%**	**40.4**	**1490**	**1.6**	**5.6**	**1.8**	**220**	**450**	**4000**	**Yes**	**NA**	**Yes**	
Mercury	**17**	**17**	**100%**	**0.014**	**1.8**	**0.033**	**0.18**	**0.036**	**0.058**	**30**	**0.058**	**Yes**	**NA**	**Yes**	
Nickel	**17**	**17**	**100%**	**2.9**	**502**	**4.2**	**15**	**4.7**	**38**	**280**	**130**	**Yes**	**NA**	**Yes**	
Potassium	17	17	100%	251	1410	530	1900	590				-	NA	No	Determined to be an essential nutrient
Selenium	**4**	**17**	**23.5%**	**0.93**	**4.4**	**2.1**	**7.5**	**2.4**	**0.52**	**4.1**	**0.63**	**Yes**	**NA**	**Yes**	
Silver	**11**	**17**	**64.7%**	**0.18**	**84.5**	**1.1**	**3.8**	**1.2**	**560**	**50**	**4.2**	**Yes**	**NA**	**Yes**	
Sodium	6	17	35.3%	84.3	215	1100	3800	1200				-	NA	No	Determined to be an essential nutrient
Thallium	**11**	**17**	**64.7%**	**0.03**	**0.2**	**0.11**	**0.31**	**0.12**	**.001**			**Yes**	**NA**	**Yes**	
Vanadium	**17**	**17**	**100%**	**7**	**51**	**5.3**	**19**	**5.9**	**.005**	**20**	**7.8**	**Yes**	**NA**	**Yes**	
Zinc	**17**	**17**	**100%**	**7.4**	**4280**	**2.1**	**7.5**	**2.4**	**160**	**120**	**46**	**Yes**	**NA**	**Yes**	
Cyanide	**0**	**17**	**0.0%**	**NA**	**NA**	**0.23**	**0.32**	**0.26**			**0.005**	**ND**	**Yes**	**Yes**	

Grayed cells indicate chemical was detected
Bold = COPEC
[a] Eco-SSLs or Efroymson et al 1997a
[b] Eco-SSLs or Efroymson et al 1997b
[c] minimum of the wildlife Eco-SSLs value or EPA Region 3 1995 BTAG Screening Levels
** minimum of the values for Chromium III and VI

Table G-1.3: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc. (mg/kg)	Max Detected Conc. (mg/kg)	Min Detection Limit (mg/kg)	Max Detection Limit (mg/kg)	Median Detection Limit (mg/kg)	Screening Benchmarks Flora[a] (mg/kg)	Invert[b] (mg/kg)	Fauna[c] (mg/kg)	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Volatile Organic Compounds															
Acetone	1	5	20.0%	0.038	0.038	0.009	1.100	0.019				-	NA	No	Laboratory artifact
Benzene	0	5	0.0%	NA	NA	0.001	0.110	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Bromodichloromethane	0	5	0.0%	NA	NA	0.004	0.560	0.010			450	ND	No	No	Below screening benchmark
Bromoform	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Bromomethane	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
2-Butanone (MEK)	0	5	0.0%	NA	NA	0.009	1.100	0.019				ND	-	-	
Carbon disulfide	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Carbon tetrachloride	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3	1000	0.3	ND	No	No	Below screening benchmark
Chlorobenzene	**0**	**5**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.010**	**0.1**	**40**		**ND**	**Yes**	**Yes**	
Chloroethane	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Chloroform	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
Chloromethane	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Cyclohexane	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
1,2-Dibromo-3-chloropropane	0	5	0.0%	NA	NA	0.009	1.100	0.019				ND	-	-	
Dibromochloromethane	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
1,2-Dibromoethane	0	5	0.0%	NA	NA	0.001	0.110	0.002	5			ND	No	No	Below screening benchmark
1,2-Dichlorobenzene	**0**	**5**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.010**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
1,3-Dichlorobenzene	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
1,4-Dichlorobenzene	**0**	**5**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.010**	**0.1**	**20**		**ND**	**Yes**	**Yes**	
Dichlorodifluoromethane	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
1,1-Dichloroethane	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
1,2-Dichloroethane	0	5	0.0%	NA	NA	0.001	0.110	0.002			870	ND	No	No	Below screening benchmark
1,1-Dichloroethyne	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
cis-1,2-Dichloroethene	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark

Table G-1.3: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks			Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
									Flora[a]	Invert[b]	Fauna[c]				
trans-1,2-Dichloroethene	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
1,2-Dichloropropane	0	5	0.0%	NA	NA	0.004	0.560	0.010		700		ND	No	No	Below screening benchmark
cis-1,3-Dichloropropene	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
trans-1,3-Dichloropropene	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Ethylbenzene	0	5	0.0%	NA	NA	0.001	0.110	0.002	0.1	0.1		ND	No	No	Below screening benchmark
Freon 113	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
2-Hexanone	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Isopropylbenzene	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Methyl Acetate	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Methylcyclohexane	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Methyl Tert Butyl Ether	0	5	0.0%	NA	NA	0.001	0.110	0.002				ND	-	-	
4-Methyl-2-pentanone(MIBK)	0	5	0.0%	NA	NA	0.004	0.560	0.010			100	ND	No	No	Below screening benchmark
Methylene chloride	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
Styrene	**0**	**5**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.010**	**300**		**0.1**	**ND**	**Yes**	**Yes**	
1,1,2,2-Tetrachloroethane	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
Tetrachloroethene	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
Toluene	0	5	0.0%	NA	NA	0.001	0.110	0.002	200	0.1		ND	No	No	Below screening benchmark
1,2,4-Trichlorobenzene	**0**	**5**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.010**	**0.1**	**20**		**ND**	**Yes**	**Yes**	
1,1,1-Trichloroethane	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
1,1,2-Trichloroethane	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
Trichloroethene	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Trichlorofluoromethane	0	5	0.0%	NA	NA	0.004	0.560	0.010				ND	-	-	
Vinyl chloride	0	5	0.0%	NA	NA	0.004	0.560	0.010	0.3		0.3	ND	No	No	Below screening benchmark
m,p-Xylene	**0**	**5**	**0.0%**	**NA**	**NA**	**0.002**	**0.220**	**0.004**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	

Table G-1.3: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks			Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
									Flora[a]	Invert[b]	Fauna[c]				
o-Xylene	0	5	0.0%	NA	NA	0.001	0.110	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Xylene (total)	**0**	**5**	**0.0%**	**NA**	**NA**	**0.002**	**0.220**	**0.004**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
Semi-Volatile Organic Compounds															
2-Chlorophenol	0	5	0.0%	NA	NA	0.180	0.190	0.190	0.1		0.1	ND	No	No	Below screening benchmark
4-Chloro-3-methyl phenol	0	5	0.0%	NA	NA	0.180	0.190	0.190				ND	-	-	
2,4-Dichlorophenol	0	5	0.0%	NA	NA	0.180	0.190	0.190	0.1		0.1	ND	No	No	Below screening benchmark
2,4-Dimethylphenol	0	5	0.0%	NA	NA	0.180	0.190	0.190	0.1		0.1	ND	No	No	Below screening benchmark
2,4-Dinitrophenol	**0**	**5**	**0.0%**	**NA**	**NA**	**0.720**	**0.780**	**0.760**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
4,6-Dinitro-o-cresol	**0**	**5**	**0.0%**	**NA**	**NA**	**0.720**	**0.780**	**0.760**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
2-Methylphenol	0	5	0.0%	NA	NA	0.180	0.190	0.190	0.1		0.1	ND	No	No	Below screening benchmark
3&4-Methylphenol	0	5	0.0%	NA	NA	0.180	0.190	0.190	0.1		0.1	ND	No	No	Below screening benchmark
2-Nitrophenol	0	5	0.0%	NA	NA	0.180	0.190	0.190				ND	-	-	
4-Nitrophenol	**0**	**5**	**0.0%**	**NA**	**NA**	**0.720**	**0.780**	**0.760**	**0.1**	**7**		**ND**	**Yes**	**Yes**	
Pentachlorophenol	0	5	0.0%	NA	NA	0.720	0.780	0.760	5	31	2.1	ND	No	No	Below screening benchmark
Phenol	0	5	0.0%	NA	NA	0.180	0.190	0.190	0.1	30	0.1	ND	No	No	Below screening benchmark
2,4,5-Trichlorophenol	0	5	0.0%	NA	NA	0.180	0.190	0.190	0.1	9	0.1	ND	No	No	Below screening benchmark
2,4,6-Trichlorophenol	0	5	0.0%	NA	NA	0.180	0.190	0.190	0.1	10	0.1	ND	No	No	Below screening benchmark
Acenaphthene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	18	1.1	ND	No	No	Below screening benchmark
Acenaphthylene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	18	1.1	ND	No	No	Below screening benchmark
Acetophenone	0	5	0.0%	NA	NA	0.180	0.190	0.190				ND	-	-	
Anthracene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	18	1.1	ND	No	No	Below screening benchmark
Atrazine	0	5	0.0%	NA	NA	0.180	0.190	0.190				ND	-	-	
Benzo(a)anthracene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark

Table G-1.3: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Benzo(a)pyrene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark
Benzo(b)fluoranthene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark
Benzo(g,h,i)perylene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark
Benzo(k)fluoranthene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark
4-Bromophenyl phenyl ether	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
Butyl benzyl phthalate	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
1,1'-Biphenyl	0	5	0.0%	NA	NA	0.072	0.078	0.076	60			ND	No	No	Below screening benchmark
Benzaldehyde	1	1	100.0%	0.054	0.054	0.180	0.190	0.190				-	NA	-	
2-Chloronaphthalene	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
4-Chloroaniline	0	5	0.0%	NA	NA	0.180	0.190	0.190	40			ND	No	No	Below screening benchmark
Carbazole	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
Caprolactam	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
Chrysene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark
bis(2-Chloroethoxy)methane	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
bis(2-Chloroethyl)ether	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
bis(2-Chloroisopropyl)ether	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
4-Chlorophenyl phenyl ether	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
2,4-Dinitrotoluene	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
2,6-Dinitrotoluene	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
3,3'-Dichlorobenzidine	0	5	0.0%	NA	NA	0.180	0.190	0.190				ND	-	-	
Dibenzo(a,h) anthracene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark
Dibenzofuran	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
Di-n-butyl phthalate	0	5	0.0%	NA	NA	0.072	0.078	0.076	200			ND	No	No	Below screening benchmark
Di-n-octyl phthalate	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	

Table G-1.3: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks			Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
									Flora[a]	Invert[b]	Fauna[c]				
Diethyl phthalate	0	5	0.0%	NA	NA	0.072	0.078	0.076	100			ND	No	No	Below screening benchmark
Dimethyl phthalate	0	5	0.0%	NA	NA	0.072	0.078	0.076		200		ND	No	No	Below screening benchmark
bis(2-Ethylhexyl)phthalate	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
Fluoranthene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark
Fluorene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	18	1.1	ND	No	No	Below screening benchmark
Hexachlorobenzene	0	5	0.0%	NA	NA	0.072	0.078	0.076		1000		ND	No	No	Below screening benchmark
Hexachlorobutadiene	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
Hexachlorocyclo-pentadiene	0	5	0.0%	NA	NA	0.720	0.780	0.760	10			ND	No	No	Below screening benchmark
Hexachloroethane	0	5	0.0%	NA	NA	0.180	0.190	0.190				ND	-	-	
Indeno(1,2,3-cd)pyrene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark
Isophorone	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
2-Methylnaphthalene	0	5	0.0%	NA	NA	0.072	0.078	0.076		29	100	ND	No	No	Below screening benchmark
2-Nitroaniline	0	5	0.0%	NA	NA	0.180	0.190	0.190				ND	-	-	
3-Nitroaniline	0	5	0.0%	NA	NA	0.180	0.190	0.190	70			ND	No	No	Below screening benchmark
4-Nitroaniline	0	5	0.0%	NA	NA	0.180	0.190	0.190	40			ND	No	No	Below screening benchmark
Naphthalene	0	5	0.0%	NA	NA	0.072	0.078	0.076	10	18	1.1	ND	No	No	Below screening benchmark
Nitrobenzene	0	5	0.0%	NA	NA	0.072	0.078	0.076		40		ND	No	No	Below screening benchmark
N-Nitroso-di-n-propylamine	0	5	0.0%	NA	NA	0.072	0.078	0.076				ND	-	-	
N-Nitrosodiphenylamine	0	5	0.0%	NA	NA	0.180	0.190	0.190		20		ND	No	No	Below screening benchmark
Phenanthrene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	18	1.1	ND	No	No	Below screening benchmark
Pyrene	0	5	0.0%	NA	NA	0.072	0.078	0.076	0.1	29	100	ND	No	No	Below screening benchmark

Table G-1.3: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Pesticides															
Aldrin	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
alpha-BHC	0	5	0.0%	NA	NA	0.001	0.002	0.002			100	ND	No	No	Below screening benchmark
beta-BHC	0	5	0.0%	NA	NA	0.001	0.002	0.002			100	ND	No	No	Below screening benchmark
delta-BHC	0	5	0.0%	NA	NA	0.001	0.002	0.002			100	ND	No	No	Below screening benchmark
gamma-BHC (Lindane)	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
alpha-Chlordane	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
gamma-Chlordane	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Dieldrin	0	5	0.0%	NA	NA	0.001	0.002	0.002			0.0049	ND	No	No	Below screening benchmark
4,4'-DDD	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.021	ND	No	No	Below screening benchmark
4,4'-DDE	2	5	40.0%	0.002	0.002	0.001	0.002	0.002	0.1		0.021	No	NA	No	Below screening benchmark
4,4'-DDT	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.021	ND	No	No	Below screening benchmark
Endrin	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Endrin aldehyde	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Endrin ketone	0	5	0.0%	NA	NA	0.004	0.004	0.004	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan sulfate	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan-I	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan-II	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Heptachlor	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Heptachlor epoxide	0	5	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Methoxychlor	0	5	0.0%	NA	NA	0.004	0.004	0.004	0.1		0.1	ND	No	No	Below screening benchmark
Toxaphene	0	5	0.0%	NA	NA	0.018	0.019	0.019				ND	-	-	

Table G-1.3: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Polychlorinated Biphenyls															
Aroclor 1016	0	5	0.0%	NA	NA	0.036	0.039	0.038	0.1			ND	No	No	Below screening benchmark
Aroclor 1221	0	5	0.0%	NA	NA	0.036	0.039	0.038	0.1			ND	No	No	Below screening benchmark
Aroclor 1232	0	5	0.0%	NA	NA	0.036	0.039	0.038	0.1			ND	No	No	Below screening benchmark
Aroclor 1242	0	5	0.0%	NA	NA	0.036	0.039	0.038	0.1			ND	No	No	Below screening benchmark
Aroclor 1248	0	5	0.0%	NA	NA	0.036	0.039	0.038	0.1			ND	No	No	Below screening benchmark
Aroclor 1254	0	5	0.0%	NA	NA	0.036	0.039	0.038	0.1			ND	No	No	Below screening benchmark
Aroclor 1260	0	5	0.0%	NA	NA	0.036	0.039	0.038	0.1			ND	No	No	Below screening benchmark
Dioxin (TCDD-2,3,7,8)															
2,3,7,8-TCDD	0	0	0	NA	NA	NA	NA	NA			0.01	NA	NA	NA	
Inorganics															
Aluminum	5	5	100.0%	5110	10300	21.0	24.0	25				-	NA	No	Not retained as soil pH>5.5
Antimony	**0**	**5**	**0.0%**	**NA**	**NA**	**2.1**	**2.4**	**2.5**	**0.48**	**78**	**0.27**	**Yes**	**NA**	**Yes**	
Arsenic	**5**	**5**	**100.0%**	**1.200**	**4.700**	**0.420**	**0.470**	**0.495**	**18**	**100**	**43**	**No**	**NA**	**Yes**	**Bioaccumulative**
Barium	5	5	100.0%	11.5	33.5	21.0	24.0	2.5	440	330	2000	No	NA	No	
Beryllium	**5**	**5**	**100.0%**	**0.100**	**0.290**	**0.520**	**0.590**	**0.625**	**.01**	**40**	**21**	**Yes**	**NA**	**Yes**	
Cadmium	**2**	**5**	**40.0%**	**0.170**	**0.240**	**0.520**	**0.590**	**0.625**	**32**	**140**	**0.36**	**No**	**NA**	**Yes**	**Bioaccumulative**
Calcium	5	5	100.0%	477.0	809.0	520.0	590.0	625				-	NA	No	Determined to be an essential nutrient
Chromium**	**5**	**5**	**100.0%**	**4.8**	**11.0**	**1.0**	**1.2**	**1.25**	**0.02**	**10**	**26**	**Yes**	**NA**	**Yes**	
Cobalt	5	5	100.0%	1.2	3.3	5.2	5.9	6.25	13	1000	120	No	NA	No	Below screening benchmark
Copper	**5**	**5**	**100.0%**	**2.4**	**7.7**	**2.6**	**3.0**	**3.1**	**70**	**80**	**28**	**No**	**NA**	**Yes**	**Bioaccumulative**
Iron	5	5	100.0%	3460.0	8880.0	10.0	12.0	12.5				-	NA	No	Soil pH between 5-8
Lead	**5**	**5**	**100.0%**	**2.6**	**17.3**	**2.1**	**2.4**	**2.5**	**120**	**1700**	**11**	**Yes**	**NA**	**Yes**	
Magnesium	5	5	100.0%	384. 0	974. 0	520.0	590.0	625				-	NA	No	Determined to be an essential nutrient
Manganese	5	5	100.0%	26.2	137. 0	1.6	1.8	1.85	220	450	4000	No	NA	No	Below screening benchmark

Table G-1.3: Wallops CDL Surface Soil (0-0.5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora[a]	Invert[b]	Fauna[c]	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Mercury	**5**	**5**	**100.0%**	**0.014**	**0.077**	**0.032**	**0.039**	**0.039**	**0.058**	**30**	**0.058**	**Yes**	**NA**	**Yes**	
Nickel	**5**	**5**	**100.0%**	**2.6**	**5.8**	**4.2**	**4.7**	**5**	**38**	**280**	**130**	**No**	**NA**	**Yes**	**Bioaccumulative**
Potassium	5	5	100.0%	249. 0	518. 0	520.0	590.0	625				-	NA	No	Determined to be an essential nutrient
Selenium	**0**	**5**	**0.0%**	**NA**	**NA**	**2.1**	**2.4**	**2.5**	**0.52**	**4.1**	**0.63**	**Yes**	**NA**	**Yes**	
Silver	**0**	**5**	**0.0%**	**NA**	**NA**	**1.0**	**1.2**	**1.25**	**560**	**50**	**4.2**	**No**	**NA**	**Yes**	**Bioaccumulative**
Sodium	0	5	0.0%	NA	NA	1000. 0	1200. 0	1250				-	NA	No	Determined to be an essential nutrient
Thallium	**5**	**5**	**100.0%**	**0.049**	**0.100**	**0.100**	**0.120**	**0.13**	**.001**			**Yes**	**NA**	**Yes**	
Vanadium	**5**	**5**	**100.0%**	**6.80**	**15.8**	**5.2**	**5.9**	**6.25**	**.005**	**20**	**7.8**	**Yes**	**NA**	**Yes**	
Zinc	**5**	**5**	**100.0%**	**6.8**	**23.6**	**2.1**	**2.1**	**2.5**	**160**	**120**	**46**	**No**	**NA**	**Yes**	**Bioaccumulative**
Cyanide	**0**	**5**	**0.0%**	**NA**	**NA**	**0.230**	**0.230**	**0.27**			**0.005**	**ND**	**Yes**	**Yes**	

Grayed cells indicate chemical was detected
Bold = COPEC
[a] Eco-SSLs or Efroymson et al 1997a
[b] Eco-SSLs or Efroymson et al 1997b
[c] minimum of the wildlife Eco-SSLs value or EPA Region 3 1995 BTAG Screening Levels
** minimum of the values for Chromium III and VI

Table G-1.4: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc. (mg/kg)	Max Detected Conc. (mg/kg)	Min Detection Limit (mg/kg)	Max Detection Limit (mg/kg)	Median Detection Limit (mg/kg)	Screening Benchmarks Flora (mg/kg)	Invert (mg/kg)	Fauna* (mg/kg)	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Volatile Organic Compounds															
Acetone	1	10	10.0%	0.038	0.038	0.009	1.100	0.015				-	NA	No	Laboratory artifact
Benzene	0	10	0.0%	NA	NA	0.001	0.110	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Bromodichloromethane	0	10	0.0%	NA	NA	0.004	0.560	0.008			450	ND	No	No	Below screening benchmark
Bromoform	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Bromomethane	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
2-Butanone (MEK)	0	10	0.0%	NA	NA	0.009	1.100	0.015				ND	-	-	
Carbon disulfide	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Carbon tetrachloride	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3	1000	0.3	ND	No	No	Below screening benchmark
Chlorobenzene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.008**	**0.1**	**40**		**ND**	**Yes**	**Yes**	
Chloroethane	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Chloroform	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
Chloromethane	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Cyclohexane	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
1,2-Dibromo-3-chloropropane	0	10	0.0%	NA	NA	0.009	1.100	0.015				ND	-	-	
Dibromochloro methane	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
1,2-Dibromoethane	0	10	0.0%	NA	NA	0.001	0.110	0.002	5			ND	No	No	Below screening benchmark
1,2-Dichlorobenzene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.008**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
1,3-Dichlorobenzene	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
1,4-Dichlorobenzene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.008**	**0.1**	**20**		**ND**	**Yes**	**Yes**	
Dichlorodifluoro-methane	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
1,1-Dichloroethane	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
1,2-Dichloroethane	0	10	0.0%	NA	NA	0.001	0.110	0.002			870	ND	No	No	Below screening benchmark
1,1-Dichloroethyne	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	

Table G-1.4: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks			Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
									Flora	Invert	Fauna*				
cis-1,2-Dichloroethene	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
trans-1,2-Dichloroethene	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
1,2-Dichloropropane	0	10	0.0%	NA	NA	0.004	0.560	0.008		700		ND	No	No	Below screening benchmark
cis-1,3-Dichloropropene	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
trans-1,3-Dichloropropene	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Ethylbenzene	0	10	0.0%	NA	NA	0.001	0.110	0.002	0.1	0.1		ND	No	No	Below screening benchmark
Freon 113	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
2-Hexanone	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Isopropylbenzene	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Methyl Acetate	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Methylcyclohexane	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Methyl Tert Butyl Ether	0	10	0.0%	NA	NA	0.001	0.110	0.002				ND	-	-	
4-Methyl-2-pentanone(MIBK)	0	10	0.0%	NA	NA	0.004	0.560	0.008			100	ND	No	No	Below screening benchmark
Methylene chloride	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
Styrene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.008**	**300**		**0.1**	**ND**	**Yes**	**Yes**	
1,1,2,2-Tetrachloroethane	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
Tetrachloroethene	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
Toluene	0	10	0.0%	NA	NA	0.001	0.110	0.002	200	0.1		ND	No	No	Below screening benchmark
1,2,4-Trichlorobenzene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.004**	**0.560**	**0.008**	**0.1**	**20**		**ND**	**Yes**	**Yes**	
1,1,1-Trichloroethane	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
1,1,2-Trichloroethane	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
Trichloroethene	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	
Trichlorofluoro-methane	0	10	0.0%	NA	NA	0.004	0.560	0.008				ND	-	-	

Table G-1.4: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora	Invert	Fauna*	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Vinyl chloride	0	10	0.0%	NA	NA	0.004	0.560	0.008	0.3		0.3	ND	No	No	Below screening benchmark
m,p-Xylene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.002**	**0.220**	**0.003**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
o-Xylene	0	10	0.0%	NA	NA	0.001	0.110	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Xylene (total)	**0**	**10**	**0.0%**	**NA**	**NA**	**0.002**	**0.220**	**0.003**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
Semi-Volatile Organic Compounds															
2-Chlorophenol	0	10	0.0%	NA	NA	0.170	0.190	0.180	0.1		0.1	ND	No	No	Below screening benchmark
4-Chloro-3-methyl phenol	0	10	0.0%	NA	NA	0.170	0.190	0.180				ND	-	-	
2,4-Dichlorophenol	0	10	0.0%	NA	NA	0.170	0.190	0.180	0.1		0.1	ND	No	No	Below screening benchmark
2,4-Dimethylphenol	0	10	0.0%	NA	NA	0.170	0.190	0.180	0.1		0.1	ND	No	No	Below screening benchmark
2,4-Dinitrophenol	**0**	**10**	**0.0%**	**NA**	**NA**	**0.700**	**0.780**	**0.735**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
4,6-Dinitro-o-cresol	**0**	**10**	**0.0%**	**NA**	**NA**	**0.700**	**0.780**	**0.735**	**0.1**		**0.1**	**ND**	**Yes**	**Yes**	
2-Methylphenol	0	10	0.0%	NA	NA	0.170	0.190	0.180	0.1		0.1	ND	No	No	Below screening benchmark
3&4-Methylphenol	0	10	0.0%	NA	NA	0.170	0.190	0.180	0.1		0.1	ND	No	No	Below screening benchmark
2-Nitrophenol	0	10	0.0%	NA	NA	0.170	0.190	0.180				ND	-	-	
4-Nitrophenol	**0**	**10**	**0.0%**	**NA**	**NA**	**0.700**	**0.780**	**0.735**	**0.1**	**7**		**ND**	**Yes**	**Yes**	
Pentachlorophenol	0	10	0.0%	NA	NA	0.700	0.780	0.735	5	31	2.1	ND	No	No	Below screening benchmark
Phenol	0	10	0.0%	NA	NA	0.170	0.190	0.180	0.1	30	0.1	ND	No	No	Below screening benchmark
2,4,5-Trichlorophenol	0	10	0.0%	NA	NA	0.170	0.190	0.180	0.1	9	0.1	ND	No	No	Below screening benchmark
2,4,6-Trichlorophenol	0	10	0.0%	NA	NA	0.170	0.190	0.180	0.1	10	0.1	ND	No	No	Below screening benchmark
Acenaphthene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	18	1.1	ND	No	No	Below screening benchmark
Acenaphthylene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	18	1.1	ND	No	No	Below screening benchmark
Acetophenone	0	10	0.0%	NA	NA	0.170	0.190	0.180				ND	-	-	
Anthracene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	18	1.1	ND	No	No	Below screening benchmark
Atrazine	0	10	0.0%	NA	NA	0.170	0.190	0.180				ND	-	-	

Table G-1.4: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks			Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
									Flora	Invert	Fauna*				
Benzo(a)anthracene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
Benzo(a)pyrene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
Benzo(b)fluoranthene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
Benzo(g,h,i)perylene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
Benzo(k)fluoranthene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
4-Bromophenyl phenyl ether	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
Butyl benzyl phthalate	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
1,1'-Biphenyl	0	10	0.0%	NA	NA	0.070	0.078	0.074	60			ND	No	No	Below screening benchmark
Benzaldehyde	**1**	**1**	**100.0%**	**0.054**	**0.054**	**0.190**	**0.190**	**0.190**				**-**	**NA**	**Yes**	
2-Chloronaphthalene	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
4-Chloroaniline	0	10	0.0%	NA	NA	0.170	0.190	0.180	40			ND	No	No	Below screening benchmark
Carbazole	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
Caprolactam	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
Chrysene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
bis(2-Chloroethoxy) methane	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
bis(2-Chloroethyl) ether	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
bis(2-Chloroisopropyl)ether	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
4-Chlorophenyl phenyl ether	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
2,4-Dinitrotoluene	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
2,6-Dinitrotoluene	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
3,3'-Dichlorobenzidine	0	10	0.0%	NA	NA	0.170	0.190	0.180				ND	-	-	
Dibenzo(a,h) anthracene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
Dibenzofuran	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
Di-n-butyl phthalate	0	10	0.0%	NA	NA	0.070	0.078	0.074	200			ND	No	No	Below screening benchmark

Table G-1.4: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora	Invert	Fauna*	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Di-n-octyl phthalate	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
Diethyl phthalate	0	10	0.0%	NA	NA	0.070	0.078	0.074	100			ND	No	No	Below screening benchmark
Dimethyl phthalate	0	10	0.0%	NA	NA	0.070	0.078	0.074		200		ND	No	No	Below screening benchmark
bis(2-Ethylhexyl) phthalate	**2**	**10**	**20.0%**	**0.056**	**0.085**	**0.070**	**0.078**	**0.074**				-	**NA**	**Yes**	
Fluoranthene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
Fluorene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	18	1.1	ND	No	No	Below screening benchmark
Hexachlorobenzene	0	10	0.0%	NA	NA	0.070	0.078	0.074		1000		ND	No	No	Below screening benchmark
Hexachlorobutadiene	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
Hexachlorocyclo-pentadiene	0	10	0.0%	NA	NA	0.700	0.780	0.735	10			ND	No	No	Below screening benchmark
Hexachloroethane	0	10	0.0%	NA	NA	0.170	0.190	0.180				ND	-	-	
Indeno(1,2,3-cd)pyrene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark
Isophorone	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
2-Methylnaphthalene	0	10	0.0%	NA	NA	0.070	0.078	0.074		29	100	ND	No	No	Below screening benchmark
2-Nitroaniline	0	10	0.0%	NA	NA	0.170	0.190	0.180				ND	-	-	
3-Nitroaniline	0	10	0.0%	NA	NA	0.170	0.190	0.180	70			ND	No	No	Below screening benchmark
4-Nitroaniline	0	10	0.0%	NA	NA	0.170	0.190	0.180	40			ND	No	No	Below screening benchmark
Naphthalene	0	10	0.0%	NA	NA	0.070	0.078	0.074	10	18	1.1	ND	No	No	Below screening benchmark
Nitrobenzene	0	10	0.0%	NA	NA	0.070	0.078	0.074		40		ND	No	No	Below screening benchmark
N-Nitroso-di-n-propylamine	0	10	0.0%	NA	NA	0.070	0.078	0.074				ND	-	-	
N-Nitrosodiphenylamine	0	10	0.0%	NA	NA	0.170	0.190	0.180		20		ND	No	No	Below screening benchmark
Phenanthrene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	18	1.1	ND	No	No	Below screening benchmark
Pyrene	0	10	0.0%	NA	NA	0.070	0.078	0.074	0.1	29	100	ND	No	No	Below screening benchmark

Table G-1.4: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks			Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
									Flora	Invert	Fauna*				
Pesticides															
Aldrin	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
alpha-BHC	0	10	0.0%	NA	NA	0.001	0.002	0.002			100	ND	No	No	Below screening benchmark
beta-BHC	0	10	0.0%	NA	NA	0.001	0.002	0.002			100	ND	No	No	Below screening benchmark
delta-BHC	0	10	0.0%	NA	NA	0.001	0.002	0.002			100	ND	No	No	Below screening benchmark
gamma-BHC (Lindane)	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
alpha-Chlordane	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
gamma-Chlordane	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Dieldrin	0	10	0.0%	NA	NA	0.001	0.002	0.002			0.0049	ND	No	No	Below screening benchmark
4,4'-DDD	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.021	ND	No	No	Below screening benchmark
4,4'-DDE	2	10	20.0%	0.002	0.002	0.001	0.002	0.002	0.1		0.021		No	No	Below screening benchmark
4,4'-DDT	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.021	ND	No	No	Below screening benchmark
Endrin	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Endrin aldehyde	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Endrin ketone	0	10	0.0%	NA	NA	0.004	0.004	0.004	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan sulfate	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan-I	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Endosulfan-II	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Heptachlor	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Heptachlor epoxide	0	10	0.0%	NA	NA	0.001	0.002	0.002	0.1		0.1	ND	No	No	Below screening benchmark
Methoxychlor	0	10	0.0%	NA	NA	0.004	0.004	0.004	0.1		0.1	ND	No	No	Below screening benchmark
Toxaphene	0	10	0.0%	NA	NA	0.017	0.019	0.019				ND	-	-	

Table G-1.4: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora	Invert	Fauna*	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Polychlorinated Biphenyls															
Aroclor 1016	0	10	0.0%	NA	NA	0.035	0.039	0.037	0.1			ND	No	No	Below screening benchmark
Aroclor 1221	0	10	0.0%	NA	NA	0.035	0.039	0.037	0.1			ND	No	No	Below screening benchmark
Aroclor 1232	0	10	0.0%	NA	NA	0.035	0.039	0.037	0.1			ND	No	No	Below screening benchmark
Aroclor 1242	0	10	0.0%	NA	NA	0.035	0.039	0.037	0.1			ND	No	No	Below screening benchmark
Aroclor 1248	0	10	0.0%	NA	NA	0.035	0.039	0.037	0.1			ND	No	No	Below screening benchmark
Aroclor 1254	0	10	0.0%	NA	NA	0.035	0.039	0.037	0.1			ND	No	No	Below screening benchmark
Aroclor 1260	0	10	0.0%	NA	NA	0.035	0.039	0.037	0.1			ND	No	No	Below screening benchmark
Dioxin (TCDD-2,3,7,8)															
2,3,7,8-TCDD	0	0	0.0%	NA	NA	NA	NA	NA			0.01	ND	Yes	Yes	
Inorganics															
Aluminum	10	10	100.0%	5110	21100	21.0	24.0	23.0					NA	No	Not retained as soil pH>5.5
Antimony	**0**	**10**	**0.0%**	**NA**	**NA**	**2.1**	**2.4**	**2.3**	**0.48**	**78**	**0.27**	**ND**	**Yes**	**Yes**	
Arsenic	**10**	**10**	**100.0%**	**1.100**	**4.800**	**0.420**	**0.470**	**0.450**	**18**	**100**	**43**	**No**	**NA**	**Yes**	**Bioaccumulative**
Barium	10	10	100.0%	11.5	45.8	21.0	24.0	23.0	440	330	2000	No	NA	No	Below screening benchmark
Beryllium	**10**	**10**	**100.0%**	**0.100**	**0.330**	**0.520**	**0.590**	**0.570**	**.010**	**40**	**21**	**Yes**	**NA**	**Yes**	
Cadmium	**2**	**10**	**20.0%**	**0.170**	**0.240**	**0.520**	**0.590**	**0.570**	**32**	**140**	**0.36**	**No**	**NA**	**Yes**	**Bioaccumulative**
Calcium	10	10	100.0%	285. 0	827. 0	520.0	590.0	570.0					NA	No	Determined to be an essential nutrient
Chromium**	**10**	**10**	**100.0%**	**4.8**	**20.7**	**1.0**	**1.2**	**1.1**	**0.02**	**10**	**26**	**Yes**	**NA**	**Yes**	
Cobalt	10	10	100.0%	1.200	4.800	5.200	5.900	5.700	13	1000	120	No	NA	No	Below screening benchmark
Copper	**10**	**10**	**100.0%**	**2.4**	**8.6**	**2.6**	**3.0**	**2.8**	**70**	**80**	**28**	**No**	**NA**	**Yes**	**Bioaccumulative**
Iron	10	10	100.0%	3460.0	18700.0	10.0	12.0	11.0					NA	No	Soil pH between 5-8
Lead	**10**	**10**	**100.0%**	**2.6**	**17.3**	**2.1**	**2.40**	**2.3**	**120**	**1700**	**11**	**Yes**	**NA**	**Yes**	**Bioaccumulative**
Magnesium	10	10	100.0%	335. 0	1530.0	520.0	590.0	570.0					NA	No	Determined to be an essential nutrient
Manganese	10	10	100.0%	26.2	137. 0	1.6	1.8	1.7	220	450	4000	No	NA	No	Below screening benchmark

Table G-1.4: Wallops CDL Subsurface Soil (0-5 ft bgs) COPEC Selection for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmarks Flora	Invert	Fauna*	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Mercury	**9**	**10**	**90.0%**	**0.013**	**0.077**	**0.032**	**0.039**	**0.036**	**0.058**	**30**	**0.058**	**Yes**	**NA**	**Yes**	
Nickel	**10**	**10**	**100.0%**	**2.6**	**9.9**	**4.2**	**4.7**	**4.5**	**38**	**280**	**130**	**No**	**NA**	**Yes**	**Bioaccumulative**
Potassium	10	10	100.0%	247. 0	701. 0	520.0	590.0	570.0					NA	No	Determined to be an essential nutrient
Selenium	**0**	**10**	**0.0%**	**NA**	**NA**	**2.1**	**2.4**	**2.3**	**0.52**	**4.1**	**0.63**	**ND**	**Yes**	**Yes**	**Bioaccumulative**
Silver	**1**	**10**	**10.0%**	**0.21**	**0.21**	**1.0**	**1.2**	**1.1**	**560**	**50**	**4.2**	**No**	**NA**	**Yes**	**Bioaccumulative**
Sodium	0	10	0.0%	NA	NA	1000. 0	1200. 0	1100. 0				ND		No	Determined to be an essential nutrient
Thallium	**10**	**10**	**100.0%**	**0.029**	**0.180**	**0.100**	**0.280**	**0.115**	**.001**			**Yes**	**NA**	**Yes**	
Vanadium	**10**	**10**	**100.0%**	**6.8**	**32.5**	**5.2**	**5.9**	**5.7**	**.005**	**20**	**7.8**	**Yes**	**NA**	**Yes**	
Zinc	**10**	**10**	**100.0%**	**6.5**	**23.8**	**2.1**	**2.1**	**2.3**	**160**	**120**	**46**	**No**	**NA**	**Yes**	**Bioaccumulative**
Cyanide	**0**	**10**	**0.0%**	**NA**	**NA**	**0.220**	**0.220**	**0.235**			**0.005**	**ND**	**Yes**	**Yes**	

Grayed cells indicate chemical was detected
Bold = COPEC
[a] Eco-SSLs or Efroymson et al 1997a
[b] Eco-SSLs or Efroymson et al 1997b
[c] minimum of the wildlife Eco-SSLs value or EPA Region 3 1995 BTAG Screening Levels
** minimum of the values for Chromium III and VI

Table G-1.5: Wallops CDL Surface Water COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc. (ug/L)	Max Detected Conc. (ug/L)	Min Detection Limit (ug/L)	Max Detection Limit (ug/L)	Median Detection Limit (ug/L)	Screening Benchmark Surface Water (ug/L)	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Volatile Organic Compounds													
Acetone	0	6	0.0%	NA	NA	10	10	10	1500	ND	No	No	Below screening benchmark
Benzene	1	6	16.7%	0.77	0.77	1	1	1	110	No	NA	No	Below screening benchmark
Bromodichloromethane	0	6	0.0%	NA	NA	1	1	1		ND	-	-	
Bromoform	0	6	0.0%	NA	NA	4	4	4	320	ND	No	No	Below screening benchmark
Bromomethane	0	6	0.0%	NA	NA	2	2	2	-	ND	-	-	
2-Butanone (MEK)	0	6	0.0%	NA	NA	10	10	10	14000	ND	No	No	Below screening benchmark
Carbon disulfide	1	6	16.7%	0.24	0.24	2	2	2	0.92	No	NA	No	Below screening benchmark
Carbon tetrachloride	0	6	0.0%	NA	NA	1	1	1	13.3	ND	No	No	Below screening benchmark
Chlorobenzene	0	6	0.0%	NA	NA	1	1	1	1.3	ND	No	No	Below screening benchmark
Chloroethane	0	6	0.0%	NA	NA	1	1	1		ND	-	-	
Chloroform	0	6	0.0%	NA	NA	1	1	1	1.8	ND	No	-	Below screening benchmark
Chloromethane	0	6	0.0%	NA	NA	1	1	1		ND	-	-	
Cyclohexane	0	6	0.0%	NA	NA	5	5	5		ND	-	-	
1,2-Dibromo-3-chloropropane	0	6	0.0%	NA	NA	10	10	10		ND	-	-	
Dibromochloromethane	0	6	0.0%	NA	NA	1	1	1		ND	-	-	
1,2-Dibromoethane	0	6	0.0%	NA	NA	2	2	2		ND	-	-	
1,2-Dichlorobenzene	0	6	0.0%	NA	NA	1	1	1	0.7	ND	No	No	Below screening benchmark
1,3-Dichlorobenzene	0	6	0.0%	NA	NA	1	1	1	130	ND	No	No	Below screening benchmark
1,4-Dichlorobenzene	0	6	0.0%	NA	NA	1	1	1	26	ND	No	No	Below screening benchmark
Dichlorodifluoro methane	0	6	0.0%	NA	NA	5	5	5		ND	-	-	
1,1-Dichloroethane	0	6	0.0%	NA	NA	1	1	1	47	ND	No	No	Below screening benchmark
1,2-Dichloroethane	0	6	0.0%	NA	NA	1	1	1	100	ND	No	No	Below screening benchmark

Table G-1.5: Wallops CDL Surface Water COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmark Surface Water	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
1,1-Dichloroethyne	0	6	0.0%	NA	NA	1	1	1	25	ND	No	No	Below screening benchmark
cis-1,2-Dichloroethene	0	6	0.0%	NA	NA	1	1	1	590	ND	No	No	Below screening benchmark
trans-1,2-Dichloroethene	0	6	0.0%	NA	NA	1	1	1	970	ND	No	No	Below screening benchmark
1,2-Dichloropropane	0	6	0.0%	NA	NA	1	1	1		ND	-	-	
cis-1,3-Dichloropropene	**0**	**6**	**0.0%**	**NA**	**NA**	**1**	**1**	**1**	**0.055**	**ND**	**Yes**	**Yes**	
trans-1,3-Dichloropropene	**0**	**6**	**0.0%**	**NA**	**NA**	**1**	**1**	**1**	**0.055**	**ND**	**Yes**	**Yes**	
Ethylbenzene	0	6	0.0%	NA	NA	1	1	1	90	ND	No	No	Below screening benchmark
Freon 113	0	6	0.0%	NA	NA	5	5	5		ND	-	-	
2-Hexanone	0	6	0.0%	NA	NA	5	5	5	99	ND	No	No	Below screening benchmark
Isopropylbenzene	0	6	0.0%	NA	NA	2	2	2	2.6	ND	No	No	Below screening benchmark
Methyl Acetate	0	6	0.0%	NA	NA	5	5	5		ND	-	-	
Methylcyclohexane	0	6	0.0%	NA	NA	5	5	5		ND	-	-	
Methyl Tert Butyl Ether	0	6	0.0%	NA	NA	1	1	1	11070	ND	No	No	Below screening benchmark
4-Methyl-2-pentanone(MIBK)	0	6	0.0%	NA	NA	5	5	5	170	ND	No	No	Below screening benchmark
Methylene chloride	0	6	0.0%	NA	NA	2	2	2	98.1	ND	No	No	Below screening benchmark
Styrene	0	6	0.0%	NA	NA	5	5	5	72	ND	No	No	Below screening benchmark
1,1,2,2-Tetrachloroethane	0	6	0.0%	NA	NA	1	1	1	610	ND	No	No	Below screening benchmark
Tetrachloroethene	0	6	0.0%	NA	NA	1	1	1	111	ND	No	No	Below screening benchmark
Toluene	0	6	0.0%	NA	NA	1	1	1	2	ND	No	No	Below screening benchmark
1,2,4-Trichlorobenzene	0	6	0.0%	NA	NA	5	5	5	5	ND	No	No	Below screening benchmark
1,1,1-Trichloroethane	0	6	0.0%	NA	NA	1	1	1	11	ND	No	No	Below screening benchmark
1,1,2-Trichloroethane	0	6	0.0%	NA	NA	1	1	1	1200	ND	No	No	Below screening benchmark

Table G-1.5: Wallops CDL Surface Water COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmark Surface Water	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Trichloroethene	0	6	0.0%	NA	NA	1	1	1	21	ND	No	No	Below screening benchmark
Trichlorofluoromethane	0	6	0.0%	NA	NA	5	5	5		ND	-	-	
Vinyl chloride	0	6	0.0%	NA	NA	1	1	1	930	ND	No	No	Below screening benchmark
m,p-Xylene	0	6	0.0%	NA	NA	1	1	1	1.8	ND	No	No	Below screening benchmark
o-Xylene	0	6	0.0%	NA	NA	1	1	1	1.8	ND	No	No	Below screening benchmark
Xylene (total)	0	6	0.0%	NA	NA	1	1	1	13	ND	No	No	Below screening benchmark
Semi-Volatile Organic Compounds													
2-Chlorophenol	0	6	0.0%	NA	NA	5	5.9	5.625	24	ND	No	No	Below screening benchmark
4-Chloro-3-methyl phenol	0	6	0.0%	NA	NA	5	5.9	5.625		ND	-	-	
2,4-Dichlorophenol	0	6	0.0%	NA	NA	5	5.9	5.625	11	ND	No	No	Below screening benchmark
2,4-Dimethylphenol	0	6	0.0%	NA	NA	5	5.9	5.625		ND	-	-	
2,4-Dinitrophenol	0	6	0.0%	NA	NA	20	24	22.25		ND	-	-	
4,6-Dinitro-o-cresol	0	6	0.0%	NA	NA	20	24	22.25		ND	-	-	
2-Methylphenol	0	6	0.0%	NA	NA	5	5.9	5.625	13	ND	No	No	Below screening benchmark
3&4-Methylphenol	0	6	0.0%	NA	NA	5	5.9	5.625	543	ND	No	No	Below screening benchmark
2-Nitrophenol	0	6	0.0%	NA	NA	5	5.9	5.625	1920	ND	No	No	Below screening benchmark
4-Nitrophenol	0	6	0.0%	NA	NA	20	24	22.25	60	ND	No	No	Below screening benchmark
Pentachlorophenol	**0**	**6**	**0.0%**	**NA**	**NA**	**20**	**24**	**22.25**	**6**	**ND**	**Yes**	**Yes**	
Phenol	0	6	0.0%	NA	NA	5	5.9	5.625	4	ND	No	No	Below screening benchmark
2,4,5-Trichlorophenol	0	6	0.0%	NA	NA	5	5.9	5.625	4.9	ND	No	No	Below screening benchmark
2,4,6-Trichlorophenol	0	6	0.0%	NA	NA	5	5.9	5.625	4.9	ND	No	No	Below screening benchmark
Acenaphthene	0	6	0.0%	NA	NA	2	2.4	2.225	5.8	ND	No	No	Below screening benchmark
Acenaphthylene	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	

Table G-1.5: Wallops CDL Surface Water COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmark Surface Water	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Acetophenone	0	6	0.0%	NA	NA	5	5.9	5.625		ND	-	-	
Anthracene	**0**	**6**	**0.0%**	**NA**	**NA**	**2**	**2.4**	**2.225**	**0.012**	**ND**	**Yes**	**Yes**	
Atrazine	**0**	**6**	**0.0%**	**NA**	**NA**	**5**	**5.9**	**5.625**	**1.8**	**ND**	**Yes**	**Yes**	
Benzo(a)anthracene	**0**	**6**	**0.0%**	**NA**	**NA**	**2**	**2.4**	**2.225**	**0.018**	**ND**	**Yes**	**Yes**	
Benzo(a)pyrene	**0**	**6**	**0.0%**	**NA**	**NA**	**2**	**2.4**	**2.225**	**0.015**	**ND**	**Yes**	**Yes**	
Benzo(b)fluoranthene	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
Benzo(g,h,i)perylene	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
Benzo(k)fluoranthene	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
4-Bromophenyl phenyl ether	0	6	0.0%	NA	NA	2	2.4	2.225	1.5	ND	No	No	Below screening benchmark
Butyl benzyl phthalate	0	6	0.0%	NA	NA	2	2.4	2.225	19	ND	No	No	Below screening benchmark
1,1'-Biphenyl	0	6	0.0%	NA	NA	2	2.4	2.225	14	ND	No	No	Below screening benchmark
Benzaldehyde	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
2-Chloronaphthalene	0	6	0.0%	NA	NA	5	5.9	5.625		ND	-	-	
4-Chloroaniline	0	6	0.0%	NA	NA	5	5.9	5.625	232	ND	No	No	Below screening benchmark
Carbazole	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
Caprolactam	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
Chrysene	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
bis(2-Chloroethoxy) methane	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
bis(2-Chloroethyl) ether	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
bis(2-Chloroisopropyl)ether	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
4-Chlorophenyl phenyl ether	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
2,4-Dinitrotoluene	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
2,6-Dinitrotoluene	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
3,3'-Dichlorobenzidine	0	6	0.0%	NA	NA	5	5.9	5.625	4.5	ND	No	No	Below screening benchmark
Dibenzo(a,h) anthracene	0	6	0.0%	NA	NA	2	2.4	2.225	-	ND	-	-	
Dibenzofuran	0	6	0.0%	NA	NA	5	5.9	5.625	3.7	ND	No	No	Below screening

Table G-1.5: Wallops CDL Surface Water COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmark Surface Water	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
													benchmark
Di-n-butyl phthalate	0	6	0.0%	NA	NA	2	2.4	2.225	19	ND	No	No	Below screening benchmark
Di-n-octyl phthalate	0	6	0.0%	NA	NA	2	2.4	2.225	22	ND	No	No	Below screening benchmark
Diethyl phthalate	0	6	0.0%	NA	NA	2	2.4	2.225	210	ND	No	No	Below screening benchmark
Dimethyl phthalate	0	6	0.0%	NA	NA	2	2.4	2.225	-	ND	-	-	
bis(2-Ethylhexyl) phthalate	0	6	0.0%	NA	NA	2	2.4	2.225	16	ND	No	No	Below screening benchmark
Fluoranthene	**0**	**6**	**0.0%**	**NA**	**NA**	**2**	**2.4**	**2.225**	**0.04**	**ND**	**Yes**	**Yes**	
Fluorene	0	6	0.0%	NA	NA	2	2.4	2.225	3	ND	No	No	Below screening benchmark
Hexachlorobenzene	**0**	**6**	**0.0%**	**NA**	**NA**	**2**	**2.4**	**2.225**	**0.0003**	**ND**	**Yes**	**Yes**	
Hexachlorobutadiene	0	6	0.0%	NA	NA	2	2.4	2.225	1.3	ND	No	No	Below screening benchmark
Hexachlorocyclo-pentadiene	0	6	0.0%	NA	NA	20	24	22.25		ND	-	-	
Hexachloroethane	0	6	0.0%	NA	NA	5	5.9	5.625	12	ND	No	No	Below screening benchmark
Indeno(1,2,3-cd)pyrene	0	6	0.0%	NA	NA	2	2.4	2.225	-	ND	-	-	
Isophorone	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
2-Methylnaphthalene	1	6	16.7%	1.8	1.8	2	2.4	2.225	4.2	No	NA	No	Below screening benchmark
2-Nitroaniline	0	6	0.0%	NA	NA	5	5.9	5.625		ND	-	-	
3-Nitroaniline	0	6	0.0%	NA	NA	5	5.9	5.625		ND	-	-	
4-Nitroaniline	0	6	0.0%	NA	NA	5	5.9	5.625		ND	-	-	
Naphthalene	1	6	16.7%	1	1	2	2.4	2.225	1.1	No	NA	No	Below screening benchmark
Nitrobenzene	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
N-Nitroso-di-n-propylamine	0	6	0.0%	NA	NA	2	2.4	2.225		ND	-	-	
N-Nitrosodiphenylamine	0	6	0.0%	NA	NA	5	5.9	5.625		ND	-	-	
Phenanthrene	**0**	**6**	**0.0%**	**NA**	**NA**	**2**	**2.4**	**2.225**	**0.4**	**Yes**	**Yes**	**Yes**	
Pyrene	**0**	**6**	**0.0%**	**NA**	**NA**	**2**	**2.4**	**2.225**	**0.025**	**Yes**	**Yes**	**Yes**	

Table G-1.5: Wallops CDL Surface Water COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmark Surface Water	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Pesticides													
Aldrin	0	6	0.0%	NA	NA	0.02	0.023	0.022	3	ND	No	No	Below screening benchmark
alpha-BHC	0	6	0.0%	NA	NA	0.02	0.023	0.022	2.2	ND	No	No	Below screening benchmark
beta-BHC	0	6	0.0%	NA	NA	0.02	0.023	0.022	2.2	ND	No	No	Below screening benchmark
delta-BHC	0	6	0.0%	NA	NA	0.02	0.023	0.022	141	ND	No	No	Below screening benchmark
gamma-BHC (Lindane)	0	6	0.0%	NA	NA	0.02	0.023	0.022	0.01	ND	No	No	Below screening benchmark
alpha-Chlordane	**0**	**6**	**0.0%**	**NA**	**NA**	**0.02**	**0.023**	**0.022**	**0.0022**	**ND**	**Yes**	**Yes**	
gamma-Chlordane	**0**	**6**	**0.0%**	**NA**	**NA**	**0.02**	**0.023**	**0.022**	**0.0022**	**ND**	**Yes**	**Yes**	
Dieldrin	0	6	0.0%	NA	NA	0.02	0.023	0.022	0.056	ND	No	No	Below screening benchmark
4,4'-DDD	0	6	0.0%	NA	NA	0.02	0.023	0.022	0.011	ND	No	No	Below screening benchmark
4,4'-DDE	0	6	0.0%	NA	NA	0.02	0.023	0.022		ND	-	-	
4,4'-DDT	**0**	**6**	**0.0%**	**NA**	**NA**	**0.02**	**0.023**	**0.022**	**0.001**	**ND**	**Yes**	**Yes**	
Endrin	0	6	0.0%	NA	NA	0.02	0.023	0.022	0.036	ND	No	No	Below screening benchmark
Endrin aldehyde	0	6	0.0%	NA	NA	0.02	0.023	0.022	0.036	ND	No	No	Below screening benchmark
Endrin ketone	0	6	0.0%	NA	NA	0.05	0.058	0.05475	0.036	ND	No	No	Below screening benchmark
Endosulfan sulfate	0	6	0.0%	NA	NA	0.02	0.023	0.022	0.051	ND	No	No	Below screening benchmark
Endosulfan-I	0	6	0.0%	NA	NA	0.05	0.058	0.05475	0.051	ND	No	No	Below screening benchmark
Endosulfan-II	0	6	0.0%	NA	NA	0.02	0.023	0.022	0.051	ND	No	No	Below screening benchmark
Heptachlor	**0**	**6**	**0.0%**	**NA**	**NA**	**0.02**	**0.023**	**0.022**	**0.0019**	**ND**	**Yes**	**Yes**	
Heptachlor epoxide	**0**	**6**	**0.0%**	**NA**	**NA**	**0.02**	**0.023**	**0.022**	**0.0019**	**ND**	**Yes**	**Yes**	
Methoxychlor	**0**	**6**	**0.0%**	**NA**	**NA**	**0.02**	**0.023**	**0.022**	**0.019**	**ND**	**Yes**	**Yes**	
Toxaphene	**0**	**6**	**0.0%**	**NA**	**NA**	**0.25**	**0.29**	**0.27**	**0.0002**	**ND**	**Yes**	**Yes**	

Table G-1.5: Wallops CDL Surface Water COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmark Surface Water	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Polychlorinated Biphenyls													
Aroclor 1016	0	6	0.0%	NA	NA	0.5	0.58	0.5475	0.000074	ND	Yes	Yes	
Aroclor 1221	0	6	0.0%	NA	NA	0.5	0.58	0.5475	0.000074	ND	Yes	Yes	
Aroclor 1232	0	6	0.0%	NA	NA	0.5	0.58	0.5475	0.000074	ND	Yes	Yes	
Aroclor 1242	0	6	0.0%	NA	NA	0.5	0.58	0.5475	0.000074	ND	Yes	Yes	
Aroclor 1248	0	6	0.0%	NA	NA	0.5	0.58	0.5475	0.000074	ND	Yes	Yes	
Aroclor 1254	0	6	0.0%	NA	NA	0.5	0.58	0.5475	0.000074	ND	Yes	Yes	
Aroclor 1260	0	6	0.0%	NA	NA	0.5	0.58	0.5475	0.000074	ND	Yes	Yes	
Inorganics													
Aluminum	6	6	100%	112	1060	200	200	200	87	Yes	NA	Yes	
Antimony	1	6	16.7%	6.2	6.2	6	12	6	30	No	NA	No	Below screening benchmark
Arsenic	6	6	100%	7	11.1	2	10	10	5	Yes	NA	Yes	
Barium	6	6	100%	14.55	27.6	200	200	200	4	Yes	NA	Yes	
Beryllium	2	6	33.3%	0.43	0.52	1	1	1	0.66	No	NA	No	Below screening benchmark
Cadmium	0	6	0.0%	NA	NA	4	4	4	0.12	ND	Yes	Yes	
Calcium	6	6	100%	230000	266000	5000	5000	5000	116000	Yes	NA	No	Determined to be an essential nutrient
Chromium	2	6	33.3%	0.98	2	10	10	10	57.5	No	NA	Yes	**Bioaccumulative**
Cobalt	0	6	0.0%	NA	NA	50	50	50	23	ND	Yes	Yes	
Copper	3	6	50.0%	3.3	4.9	25	25	25	3.1	Yes	NA	Yes	
Iron	6	6	100%	228	1030	100	100	100	300	Yes	NA	Yes	
Lead	2	6	33.3%	3.1	4	3	3	3	2.5	Yes	NA	Yes	
Magnesium	6	6	100%	721000	1060000	5000	50000	5000	82000	Yes	NA	No	Determined to be an essential nutrient
Manganese	6	6	100%	20.9	43.5	15	15	15	120	No	NA	No	Below screening benchmark
Mercury	2	6	33.3%	0.0785	0.091	0.2	0.2	0.2	0.016	Yes	NA	Yes	
Nickel	1	6	16.7%	2.9	2.9	40	40	40	8.2	No	NA	Yes	**Bioaccumulative**
Potassium	6	6	100%	330000	454000	5000	10000	5000	53000	Yes	NA	No	Determined to be an essential nutrient

Table G-1.5: Wallops CDL Surface Water COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Screening Benchmark Surface Water	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Selenium	**6**	**6**	**100%**	**6.6**	**11.8**	**10**	**10**	**10**	**1**	**Yes**	**NA**	**Yes**	
Silver	**0**	**6**	**0.0%**	**NA**	**NA**	**10**	**10**	**10**	**0.23**	**ND**	**Yes**	**Yes**	
Sodium	6	6	100%	7010000	9190000	1000000	1000000	1000000	680000	Yes	NA	No	Determined to be an essential nutrient
Thallium	**0**	**6**	**0.0%**	**NA**	**NA**	**1**	**5**	**5**	**0.8**	**ND**	**Yes**	**Yes**	
Vanadium	3	6	50.0%	2.7	4.4	50	50	50	20	No	NA	No	Below screening benchmark
Zinc	0	6	0.0%	NA	NA	20	20	20	81	ND	No	No	Below screening benchmark
Cyanide	**0**	**6**	**0.0%**	**NA**	**NA**	**10**	**10**	**0.01**	**1**	**ND**	**Yes**	**Yes**	

Grayed cells indicate chemical was detected
Bold = COPEC

Table G-1.6: Wallops CDL Sediment COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc. (mg/kg)	Max Detected Conc. (mg/kg)	Min Detection Limit (mg/kg)	Max Detection Limit (mg/kg)	Median Detection Limit (mg/kg)	Sediments Screening Benchmark (mg/kg)	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Volatile Organic Compounds													
Acetone	6	10	60.0%	0.028	0.22	0.011	0.12	0.041		-	NA	No	Laboratory artifact
Benzene	0	10	0.0%	NA	NA	0.0011	0.012	0.0041		ND	No	No	Below screening benchmark
Bromodichloromethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Bromoform	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	0.654	ND	No	No	Below screening benchmark
Bromomethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
2-Butanone (MEK)	**2**	**10**	**20.0%**	**0.0388**	**0.164**	**0.011**	**0.12**	**0.041**		**ND**	**-**	**Yes**	
Carbon disulfide	**7**	**10**	**70.0%**	**0.0043**	**0.02365**	**0.0055**	**0.06**	**0.0205**	**0.00085**	**Yes**	**NA**	**Yes**	
Carbon tetrachloride	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	0.0642	ND	No	No	Below screening benchmark
Chlorobenzene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0055**	**0.06**	**0.0205**	**0.00842**	**ND**	**Yes**	**Yes**	
Chloroethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Chloroform	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Chloromethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Cyclohexane	**1**	**10**	**10.0%**	**0.01815**	**0.01815**	**0.0055**	**0.06**	**0.0205**		**-**	**NA**	**Yes**	
1,2-Dibromo-3-chloropropane	0	10	0.0%	NA	NA	0.011	0.12	0.041		ND	-	-	
Dibromochloromethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
1,2-Dibromoethane	0	10	0.0%	NA	NA	0.0011	0.012	0.0041		ND	-	-	
1,2-Dichlorobenzene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0055**	**0.06**	**0.0205**	**0.0165**	**ND**	**Yes**	**Yes**	
1,3-Dichlorobenzene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
1,4-Dichlorobenzene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	0.599	ND	No	No	Below screening benchmark
Dichlorodifluoro methane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
1,1-Dichloroethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
1,2-Dichloroethane	0	10	0.0%	NA	NA	0.0011	0.012	0.0041		ND	-	-	
1,1-Dichloroethene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	0.031	ND	No	No	Below screening benchmark
cis-1,2-Dichloroethene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
trans-1,2-Dichloroethene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
1,2-Dichloropropane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	

Table G-1.6: Wallops CDL Sediment COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Sediments Screening Benchmark	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
cis-1,3-Dichloropropene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0055**	**0.06**	**0.0205**	**0.00005**	**ND**	**Yes**	**Yes**	
trans-1,3-Dichloropropene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0055**	**0.06**	**0.0205**	**0.00005**	**ND**	**Yes**	**Yes**	
Ethylbenzene	0	10	0.0%	NA	NA	0.0011	0.012	0.0041	1.1	ND	No	No	Below screening benchmark
Freon 113	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
2-Hexanone	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Isopropylbenzene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Methyl Acetate	**1**	**10**	**10.0%**	**0.0586**	**0.0586**	**0.0055**	**0.06**	**0.0205**		-	**NA**	**Yes**	
Methylcyclohexane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Methyl Tert Butyl Ether	0	10	0.0%	NA	NA	0.0011	0.012	0.0041		ND	-	-	
4-Methyl-2-pentanone(MIBK)	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Methylene chloride	1	10	10.0%	0.0092	0.0092	0.0055	0.06	0.0205		-	NA	No	Laboratory artifact
Styrene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	0.559	ND	No	No	Below screening benchmark
1,1,2,2-Tetrachloroethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	1.36	ND	No	No	Below screening benchmark
Tetrachloroethene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	0.468	ND	No	No	Below screening benchmark
Toluene	0	10	0.0%	NA	NA	0.0011	0.012	0.0041		ND	-	-	
1,2,4-Trichlorobenzene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
1,1,1-Trichloroethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
1,1,2-Trichloroethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	1.24	ND	No	No	Below screening benchmark
Trichloroethene	0	10	0.0%	NA	NA	0.0055	0.06	0.0205	0.0969	ND	No	No	Below screening benchmark
Trichlorofluoromethane	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
Vinyl chloride	0	10	0.0%	NA	NA	0.0055	0.06	0.0205		ND	-	-	
m,p-Xylene	0	10	0.0%	NA	NA	0.0022	0.024	0.0082	0.0252	ND	No	No	Below screening benchmark
o-Xylene	0	10	0.0%	NA	NA	0.0011	0.012	0.0041		ND	-	-	
Xylene (total)	0	10	0.0%	NA	NA	0.0022	0.024	0.0082		ND	-	-	
Semi-Volatile Organic Compounds													
2-Chlorophenol	**0**	**10**	**0.0%**	**NA**	**NA**	**0.2**	**1.3**	**0.51**	**0.0312**	**ND**	**Yes**	**Yes**	

Table G-1.6: Wallops CDL Sediment COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Sediments Screening Benchmark	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
4-Chloro-3-methyl phenol	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
2,4-Dichlorophenol	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
2,4-Dimethylphenol	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
2,4-Dinitrophenol	0	10	0.0%	NA	NA	0.8	51	2.05		ND	-	-	
4,6-Dinitro-o-cresol	0	10	0.0%	NA	NA	0.8	51	2.05		ND	-	-	
2-Methylphenol	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
3&4-Methylphenol	0	10	0.0%	NA	NA	0.2	1.3	0.51	0.67	ND	No	No	Below screening benchmark
2-Nitrophenol	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
4-Nitrophenol	0	10	0.0%	NA	NA	0.8	51	2.05		ND	-	-	
Pentachlorophenol	0	10	0.0%	NA	NA	0.8	51	2.05		ND	-	-	
Phenol	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
2,4,5-Trichlorophenol	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
2,4,6-Trichlorophenol	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
Acenaphthene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.0067**	**ND**	**Yes**	**Yes**	
Acenaphthylene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.00587**	**ND**	**Yes**	**Yes**	
Acetophenone	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
Anthracene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.0469**	**ND**	**Yes**	**Yes**	
Atrazine	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
Benzo(a)anthracene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.0748**	**ND**	**Yes**	**Yes**	
Benzo(a)pyrene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.0888**	**ND**	**Yes**	**Yes**	
Benzo(b)fluoranthene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.0272**	**ND**	**Yes**	**Yes**	
Benzo(g,h,i)perylene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.17**	**ND**	**Yes**	**Yes**	
Benzo(k)fluoranthene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.24**	**ND**	**Yes**	**Yes**	
4-Bromophenyl phenyl ether	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
Butyl benzyl phthalate	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
1,1'-Biphenyl	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
Benzaldehyde	0	0	0.0%										
2-Chloronaphthalene	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
4-Chloroaniline	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	

Table G-1.6: Wallops CDL Sediment COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Sediments Screening Benchmark	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Carbazole	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
Caprolactam	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
Chrysene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.108**	**ND**	**Yes**	**Yes**	
bis(2-Chloroethoxy)methane	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
bis(2-Chloroethyl)ether	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
bis(2-Chloroisopropyl)ether	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
4-Chlorophenyl phenyl ether	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
2,4-Dinitrotoluene	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
2,6-Dinitrotoluene	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
3,3'-Dichlorobenzidine	0	10	0.0%	NA	NA	0.2	1.3	0.51	0.127	ND	-	-	
Dibenzo(a,h)anthracene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.033**	**ND**	**Yes**	**Yes**	
Dibenzofuran	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.415**	**ND**	**Yes**	**Yes**	
Di-n-butyl phthalate	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**1.16**	**ND**	**Yes**	**Yes**	
Di-n-octyl phthalate	**1**	**10**	**10.0%**	**3.08**	**3.08**	**0.08**	**5.1**	**0.205**		**-**	**NA**	**Yes**	
Diethyl phthalate	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.218**	**ND**	**Yes**	**Yes**	
Dimethyl phthalate	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
bis(2-Ethylhexyl)phthalate	**3**	**10**	**30.0%**	**0.161**	**162**	**0.08**	**5.1**	**0.205**		**-**	**NA**	**Yes**	
Fluoranthene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.113**	**ND**	**Yes**	**Yes**	
Fluorene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.0212**	**ND**	**Yes**	**Yes**	
Hexachlorobenzene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.02**	**ND**	**Yes**	**Yes**	
Hexachlorobutadiene	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
Hexachlorocyclo pentadiene	0	10	0.0%	NA	NA	0.8	51	2.05		ND	-	-	
Hexachloroethane	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
Indeno(1,2,3-cd)pyrene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.017**	**ND**	**Yes**	**Yes**	
Isophorone	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
2-Methylnaphthalene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.0202**	**ND**	**Yes**	**Yes**	
2-Nitroaniline	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	
3-Nitroaniline	0	10	0.0%	NA	NA	0.2	1.3	0.51		ND	-	-	

Table G-1.6: Wallops CDL Sediment COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Sediments Screening Benchmark	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
4-Nitroaniline	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
Naphthalene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.0346**	**ND**	**Yes**	**Yes**	
Nitrobenzene	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
N-Nitroso-di-n-propylamine	0	10	0.0%	NA	NA	0.08	5.1	0.205		ND	-	-	
N-Nitrosodiphenylamine	0	10	0.0%	NA	NA	0.2	1.3	0.51	2.68	ND	No	No	Below screening benchmark
Phenanthrene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.00076**	**ND**	**Yes**	**Yes**	
Pyrene	**0**	**10**	**0.0%**	**NA**	**NA**	**0.08**	**5.1**	**0.205**	**0.153**	**ND**	**Yes**	**Yes**	
Pesticides													
Aldrin	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.029**	**0.011**	**0.002**	**ND**	**Yes**	**Yes**	
alpha-BHC	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.006**	**ND**	**Yes**	**Yes**	
beta-BHC	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.005**	**ND**	**Yes**	**Yes**	
delta-BHC	0	10	0.0%	NA	NA	0.0096	0.0175	0.011	6.4	ND	No	No	Below screening benchmark
gamma-BHC (Lindane)	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.00032**	**ND**	**Yes**	**Yes**	
alpha-Chlordane	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.00226**	**ND**	**Yes**	**Yes**	
gamma-Chlordane	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.00226**	**ND**	**Yes**	**Yes**	
Dieldrin	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.00072**	**ND**	**Yes**	**Yes**	
4,4'-DDD	**1**	**10**	**10.0%**	**0.065**	**0.065**	**0.0096**	**0.0175**	**0.011**	**0.00122**	**Yes**	**NA**	**Yes**	
4,4'-DDE	**2**	**10**	**20.0%**	**0.0268**	**0.149**	**0.0016**	**0.0175**	**0.011**	**0.00207**	**Yes**	**NA**	**Yes**	
4,4'-DDT	**1**	**10**	**10.0%**	**0.0108**	**0.0108**	**0.0016**	**0.0175**	**0.011**	**0.00389**	**Yes**	**NA**	**Yes**	
Endrin	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.00222**	**ND**	**Yes**	**Yes**	
Endrin aldehyde	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.00222**	**ND**	**Yes**	**Yes**	
Endrin ketone	**0**	**10**	**0.0%**	**NA**	**NA**	**0.024**	**0.072**	**0.029**	**0.00222**	**ND**	**Yes**	**Yes**	
Endosulfan sulfate	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.0036**	**ND**	**Yes**	**Yes**	
Endosulfan-I	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.0029**	**ND**	**Yes**	**Yes**	
Endosulfan-II	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.014**	**ND**	**Yes**	**Yes**	
Heptachlor	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.068**	**ND**	**Yes**	**Yes**	
Heptachlor epoxide	**0**	**10**	**0.0%**	**NA**	**NA**	**0.0096**	**0.0175**	**0.011**	**0.0006**	**ND**	**Yes**	**Yes**	
Methoxychlor	**0**	**10**	**0.0%**	**NA**	**NA**	**0.024**	**0.072**	**0.029**	**0.0187**	**ND**	**Yes**	**Yes**	
Toxaphene	0	10	0.0%	NA	NA	0.12	0.36	0.14		ND	-	-	

Table G-1.6: Wallops CDL Sediment COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Sediments Screening Benchmark	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Polychlorinated Biphenyls													
Aroclor 1016	0	10	0.0%	NA	NA	0.04	0.72	0.31	0.004	ND	Yes	Yes	
Aroclor 1221	0	10	0.0%	NA	NA	0.04	0.72	0.31	0.004	ND	Yes	Yes	
Aroclor 1232	0	10	0.0%	NA	NA	0.04	0.72	0.31	0.004	ND	Yes	Yes	
Aroclor 1242	0	10	0.0%	NA	NA	0.04	0.72	0.31	0.004	ND	Yes	Yes	
Aroclor 1248	0	10	0.0%	NA	NA	0.04	0.72	0.31	0.004	ND	Yes	Yes	
Aroclor 1254	0	10	0.0%	NA	NA	0.04	0.72	0.31	0.004	ND	Yes	Yes	
Aroclor 1260	0	10	0.0%	NA	NA	0.04	0.72	0.31	0.004	ND	Yes	Yes	
Inorganics													
Aluminum	10	10	100%	7770	22300	18	34	25		-	NA	Yes	
Antimony	1	10	10.0%	2.8	2.8	1.8	3.4	2.5	2	Yes	NA	Yes	
Arsenic	10	10	100%	3	19.05	0.36	0.69	0.505	7.24	Yes	NA	Yes	
Barium	10	10	100%	21.5	85.2	18	34	25		-	NA	Yes	
Beryllium	10	10	100%	0.2	0.61	0.45	0.86	0.625		-	NA	Yes	
Cadmium	4	10	40.0%	0.21	1.5	0.45	0.86	0.625	0.68	Yes	NA	Yes	
Calcium	10	10	100%	468	16840	450	860	625		-	NA	No	Determined to be an essential nutrient
Chromium	10	10	100%	8.6	49.6	0.91	1.7	1.25	43.4	Yes	NA	Yes	
Cobalt	10	10	100%	2	9.3	4.5	8.6	6.25	50	No	NA	No	Below screening benchmark
Copper	9	10	90.0%	8.8	56.5	2.3	4.3	3.15	18.7	Yes	NA	Yes	
Iron	10	10	100%	5670	30800	14	26	19.25	20000	Yes	NA	Yes	
Lead	10	10	100%	8.9	96.9	1.8	3.4	2.5	30.2	Yes	NA	Yes	
Magnesium	10	10	100%	40.4	10900	450	860	625		-	NA	No	Determined to be an essential nutrient
Manganese	10	10	100%	58.3	243	1.4	2.6	1.9	460	No	NA	No	Below screening benchmark
Mercury	9	10	90.0%	0.036	0.49	0.036	0.21	0.0765	0.13	Yes	NA	Yes	
Nickel	10	10	100%	5.6	21.8	3.6	6.9	5.05	15.9	Yes	NA	Yes	
Potassium	10	10	100%	332	6590	450	860	625		-	NA	No	Determined to be an essential nutrient
Selenium	8	10	80.0%	1.4	1.8	1.8	3.4	2.5	2	No	NA	Yes	**Bioaccumulative**
Silver	4	10	40.0%	0.24	1.5	0.91	1.7	1.25	0.73	Yes	NA	Yes	

Table G-1.6: Wallops CDL Sediment COPEC Selection

	# of Detects	# of Samples	Percent Detected	Min Detected Conc.	Max Detected Conc.	Min Detection Limit	Max Detection Limit	Median Detection Limit	Sediments Screening Benchmark	Max detected > Screening?	½ DL > Screening?	Include as COPEC?	Rational
Sodium	10	10	100%	162	53700	1100	8400	1750		-	NA	No	Determined to be an essential nutrient
Thallium	**10**	**10**	**100%**	**0.079**	**0.28**	**0.12**	**0.63**	**0.325**		**-**	**NA**	**Yes**	
Vanadium	**10**	**10**	**100%**	**12.7**	**53.7**	**4.5**	**8.6**	**6.25**		**-**	**NA**	**Yes**	
Zinc	**10**	**10**	**100%**	**36.7**	**324**	**1.8**	**3.4**	**2.5**	**121**	**Yes**	**NA**	**Yes**	
Cyanide	**0**	**10**	**0.0%**	**NA**	**NA**	**0.53**	**1.2**	**0.61**	**0.1**	**ND**	**Yes**	**Yes**	

Grayed cells indicate chemical was detected
Bold = COPEC

VERSAR

APPENDIX G-2

SLERA RESULTS

Table G-2.1: Wallops CDL Surface Soil Screening Results for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Flora			Invertebrate			Wildlife		
						Screening Benchmark[a] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[b] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[c] (mg/kg)	HQ	% of Total HQ
VOLATILE ORGANIC COMPOUNDS														
Carbon tetrachloride	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	1000	7.70E-06	<0.01%	0.3	2.57E-02	<0.01%
Chlorobenzene	0	8	0.0%	NA	0.0077	0.1	7.70E-02	<0.01%	40	1.93E-04	<0.01%	---	NA	NA
Chloroform	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
1,2-Dichlorobenzene	0	8	0.0%	NA	0.0077	0.1	7.70E-02	<0.01%	---	NA	NA	0.1	7.70E-02	<0.01%
1,4-Dichlorobenzene	0	8	0.0%	NA	0.0077	0.1	7.70E-02	<0.01%	20	3.85E-04	<0.01%	---	NA	NA
1,1-Dichloroethane	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
cis-1,2-Dichloroethene	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
trans-1,2-Dichloroethene	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
Methyl Acetate	1	8	12.5%	1.19	0.0077	---	NA	NA	---	NA	NA	---	NA	NA
Methylcyclohexane	1	8	12.5%	0.0025	0.0077	---	NA	NA	---	NA	NA	---	NA	NA
Styrene	0	8	0.0%	NA	0.0077	300	2.57E-05	<0.01%	---	NA	NA	0.1	7.70E-02	<0.01%
1,1,2,2-Tetrachloroethane	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
Tetrachloroethene	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
1,2,4-Trichlorobenzene	0	8	0.0%	NA	0.0077	0.1	7.70E-02	<0.01%	20	3.85E-04	<0.01%	---	NA	NA
1,1,1-Trichloroethane	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
1,1,2-Trichloroethane	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
Vinyl chloride	0	8	0.0%	NA	0.0077	0.3	2.57E-02	<0.01%	---	NA	NA	0.3	2.57E-02	<0.01%
SEMI-VOLATILE ORGANIC COMPOUNDS														
2-Chlorophenol	0	8	0.0%	NA	0.205	0.1	2.05E+00	0.01%	---	NA	NA	0.1	2.05E+00	0.23%
2,4-Dichlorophenol	0	8	0.0%	NA	0.205	0.1	2.05E+00	0.01%	---	NA	NA	0.1	2.05E+00	0.23%
2,4-Dimethylphenol	0	8	0.0%	NA	0.205	0.1	2.05E+00	0.01%	---	NA	NA	0.1	2.05E+00	0.23%
2,4-Dinitrophenol	0	8	0.0%	NA	0.815	0.1	8.15E+00	0.05%	---	NA	NA	0.1	8.15E+00	0.90%
4,6-Dinitro-o-cresol	0	8	0.0%	NA	0.815	0.1	8.15E+00	0.05%	---	NA	NA	0.1	8.15E+00	0.90%
2-Methylphenol	0	8	0.0%	NA	0.205	0.1	2.05E+00	0.01%	---	NA	NA	0.1	2.05E+00	0.23%
3&4-Methylphenol	0	8	0.0%	NA	0.205	0.1	2.05E+00	0.01%	---	NA	NA	0.1	2.05E+00	0.23%
4-Nitrophenol	0	8	0.0%	NA	0.815	0.1	8.15E+00	0.05%	7	1.16E-01	0.13%	---	NA	NA
Pentachlorophenol	0	8	0.0%	NA	0.815	5	1.63E-01	<0.01%	31	2.63E-02	0.03%	2.1	3.88E-01	0.04%
Phenol	0	8	0.0%	NA	0.205	0.1	2.05E+00	0.01%	30	6.83E-03	<0.01%	0.1	2.05E+00	0.23%
2,4,5-Trichlorophenol	0	8	0.0%	NA	0.205	0.1	2.05E+00	0.01%	9	2.28E-02		0.1	2.05E+00	0.23%

Table G-2.1: Wallops CDL Surface Soil Screening Results for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Flora			Invertebrate			Wildlife		
						Screening Benchmark[a] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[b] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[c] (mg/kg)	HQ	% of Total HQ
SEMI-VOLATILE ORGANIC COMPOUNDS (CONTINUED)														
2,4,6-Trichlorophenol	0	8	0.0%	NA	0.205	0.1	2.05E+00	0.01%	10	2.05E-02	0.02%	0.1	2.05E+00	0.23%
Acenaphthene	0	8	0.0%	NA	0.0815	0.1	8.15E-01	<0.01%	18	4.53E-03	<0.01%	1.1	7.41E-02	<0.01%
Acenaphthylene	1	8	12.5%	0.158	0.0815	0.1	1.58E+00	<0.01%	18	8.78E-03	<0.01%	1.1	1.44E-01	0.02%
Anthracene	3	8	37.5%	0.267	0.0815	0.1	2.67E+00	0.02%	18	1.48E-02	0.02%	1.1	2.43E-01	0.03%
Benzo(a)anthracene	4	8	50.0%	2.49	0.0815	0.1	2.49E+01	0.14%	29	8.59E-02	0.10%	100	2.49E-02	<0.01%
Benzo(a)pyrene	3	8	37.5%	1.91	0.0815	0.1	1.91E+01	0.11%	29	6.59E-02	0.07%	100	1.91E-02	<0.01%
Benzo(b)fluoranthene	3	8	37.5%	1.39	0.0815	0.1	1.39E+01	0.08%	29	4.79E-02	0.05%	100	1.39E-02	<0.01%
Benzo(g,h,i)perylene	3	8	37.5%	1.18	0.0815	0.1	1.18E+01	0.07%	29	4.07E-02	0.05%	100	1.18E-02	<0.01%
Benzo(k)fluoranthene	3	8	37.5%	1.03	0.0815	0.1	1.03E+01	0.06%	29	3.55E-02	0.04%	100	1.03E-02	<0.01%
Chrysene	4	8	50.0%	4.04	0.0815	0.1	4.04E+01	0.23%	29	1.39E-01	0.16%	100	4.04E-02	<0.01%
Dibenzo(a,h) anthracene	2	8	25.0%	0.388	0.0815	0.1	3.88E+00	0.02%	29	1.34E-02	0.02%	100	3.88E-03	<0.01%
bis(2-Ethylhexyl)phthalate	3	8	37.5%	0.111	0.0815	---	NA	NA	---	NA	NA	---	NA	NA
Fluoranthene	5	8	62.5%	1.79	0.0815	0.1	1.79E+01	0.10%	29	6.17E-02	0.07%	100	1.79E-02	<0.01%
Fluorene	0	8	0.0%	NA	0.0815	0.1	8.15E-01	<0.01%	18	4.53E-03	<0.01%	1.1	7.41E-02	<0.01%
Indeno(1,2,3-cd)pyrene	3	8	37.5%	0.617	0.0815	0.1	6.17E+00	0.04%	29	2.13E-02	0.02%	100	6.17E-03	<0.01%
Phenanthrene	4	8	50.0%	2.23	0.0815	0.1	2.23E+01	0.13%	18	1.24E-01	0.14%	1.1	2.03E+00	0.22%
Pyrene	5	8	62.5%	4.74	0.0815	0.1	4.74E+01	0.27%	29	1.63E-01	0.19%	100	4.74E-02	<0.01%
PESTICIDES														
4,4'-DDD	6	8	75.0%	0.126	0.00175	0.1	1.26E+00	<0.01%	---	NA	NA	0.021	6.00E+00	0.66%
4,4'-DDE	8	8	100.0%	1.02	0.0078	0.1	1.02E+01	0.06%	---	NA	NA	0.021	4.86E+01	5.33%
4,4'-DDT	8	8	100.0%	0.53	0.005	0.1	5.30E+00	0.03%	---	NA	NA	0.021	2.52E+01	2.77%
DIOXINS														
2,3,7,8-TCDD	0	4	0	NA	0.20	---	NA	NA	---	NA	NA	0.01	2.00E+01	2.20%
INORGANICS														
Antimony	4	8	50.0%	63.7	2.5	0.48	1.33E+02	0.76%	78	8.17E-01	0.93%	0.27	2.36E+02	25.91%
Arsenic	8	8	100.0%	7.6	0.495	18	4.22E-01	<0.01%	100	7.60E-02	0.09%	43	1.77E-01	0.02%
Barium	8	8	100.0%	1160	2.5	440	2.64E+00	0.02%	330	3.52E+00	3.99%	2000	5.80E-01	0.06%
Beryllium	7	8	87.5%	1.3	0.625	0.01	1.30E+02	0.75%	40	3.25E-02	0.04%	21	6.19E-02	<0.01%
Cadmium	7	8	87.5%	21.6	0.625	32	6.75E-01	<0.01%	140	1.54E-01	0.18%	0.36	6.00E+01	6.59%

Table G-2.1: Wallops CDL Surface Soil Screening Results for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Flora			Invertebrate			Wildlife		
						Screening Benchmark[a] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[b] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[c] (mg/kg)	HQ	% of Total HQ
INORGANIC (CONTINUED)														
Chromium	8	8	100.0%	126	1.25	0.02	6.30E+03	36.25%	10	1.26E+01	14.32%	26	4.85E+00	0.53%
Cobalt	8	8	100.0%	28	6.25	13	2.15E+00	0.01%	1000	2.80E-02	0.03%	120	2.33E-01	0.03%
Copper	8	8	100.0%	1790	3.1	70	2.56E+01	0.15%	80	2.24E+01	25.42%	28	6.39E+01	7.02%
Lead	8	8	100.0%	2120	2.5	120	1.77E+01	0.10%	1700	1.25E+00	1.42%	11	1.93E+02	21.17%
Manganese	8	8	100.0%	1490	1.85	220	6.77E+00	0.04%	450	3.31E+00	3.76%	4000	3.73E-01	0.04%
Mercury	8	8	100.0%	1.8	0.039	0.058	3.10E+01	0.18%	30	6.00E-02	0.07%	0.058	3.10E+01	3.41%
Nickel	8	8	100.0%	502	5	38	1.32E+01	0.08%	280	1.79E+00	2.04%	130	3.86E+00	0.42%
Selenium	2	8	25.0%	4.4	2.5	0.52	8.46E+00	0.05%	4.1	1.07E+00	1.22%	0.63	6.98E+00	0.77%
Silver	7	8	87.5%	84.5	1.25	560	1.51E-01	<0.01%	50	1.69E+00	1.92%	4.2	2.01E+01	2.21%
Thallium	6	8	75.0%	0.2	0.13	0.001	2.00E+02	1.15%	---	NA	NA	---	NA	NA
Vanadium	8	8	100.0%	51	6.25	0.005	1.02E+04	58.68%	20	2.55E+00	2.90%	7.8	6.54E+00	0.72%
Zinc	8	8	100.0%	4280	2.5	160	2.68E+01	0.15%	120	3.57E+01	40.52%	46	9.30E+01	10.22%
Cyanide	0	8	0.0%	NA	0.27	---	NA	NA	---	NA	NA	0.005	5.40E+01	5.93%
						HQ Sum =1.74E+04			HQ Sum = 8.80E+01			HQ Sum = 9.11E+02		

[a] Eco-SSLs or Efroymson et al 1997a
[b] Eco-SSLs or Efroymson et al 1997b
[c]minimum of the wildlife Eco-SSLs value or EPA Region 3 1995 BTAG Screening Levels

Table G-2.2: Wallops CDL Subsurface Soil Screening Results for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Flora			Wildlife		
						Screening Benchmark[a] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[b] (mg/kg)	HQ	% of Total HQ
VOLATILE ORGANIC COMPOUNDS											
Carbon tetrachloride	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	2.33E-02	<0.01%
Chlorobenzene	0	17	0.0%	NA	0.007	0.1	7.00E-02	<0.01%	---	NA	NA
Chloroform	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	2.33E-02	<0.01%
1,2-Dichlorobenzene	0	17	0.0%	NA	0.007	0.1	7.00E-02	<0.01%	0.1	7.00E-02	<0.01%
1,4-Dichlorobenzene	0	17	0.0%	NA	0.007	0.1	7.00E-02	<0.01%	---	NA	NA
1,1-Dichloroethane	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	2.33E-02	<0.01%
cis-1,2-Dichloroethene	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	2.33E-02	<0.01%
trans-1,2-Dichloroethene	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	2.33E-02	<0.01%
Methyl Acetate	1	17	5.9%	1.19	0.007	---	NA	NA	---	NA	NA
Methylcyclohexane	1	17	5.9%	0.0025	0.007	---	NA	NA	---	NA	NA
Styrene	0	17	0.0%	NA	0.007	300	2.33E-05	<0.01%	0.1	7.00E-02	<0.01%
1,1,2,2-Tetrachloroethane	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	2.33E-02	<0.01%
Tetrachloroethene	3	17	17.6%	0.0137	0.007	0.3	4.56E-02	<0.01%	0.3	4.56E-02	<0.01%
1,2,4-Trichlorobenzene	0	17	0.0%	NA	0.007	0.1	7.00E-02	<0.01%	---	NA	NA
1,1,1-Trichloroethane	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	4.57E-02	<0.01%
1,1,2-Trichloroethane	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	2.33E-02	<0.01%
Vinyl chloride	0	17	0.0%	NA	0.007	0.3	2.33E-02	<0.01%	0.3	2.33E-02	<0.01%
SEMI-VOLATILE ORGANIC COMPOUNDS											
2-Chlorophenol	0	17	0.0%	NA	0.2	0.1	2.00E+00	<0.01%	0.1	2.00E+00	0.16%
2,4-Dichlorophenol	0	17	0.0%	NA	0.2	0.1	2.00E+00	<0.01%	0.1	2.00E+00	0.16%
2,4-Dimethylphenol	0	17	0.0%	NA	0.2	0.1	2.00E+00	<0.01%	0.1	2.00E+00	0.16%
2,4-Dinitrophenol	0	17	0.0%	NA	0.79	0.1	7.90E+00	0.02%	0.1	7.90E+00	0.65%
4,6-Dinitro-o-cresol	0	17	0.0%	NA	0.79	0.1	7.90E+00	0.02%	0.1	7.90E+00	0.65%
2-Methylphenol	0	17	0.0%	NA	0.2	0.1	2.00E+00	<0.01%	0.1	2.00E+00	0.16%
3&4-Methylphenol	0	17	0.0%	NA	0.2	0.1	2.00E+00	<0.01%	0.1	2.00E+00	0.16%
4-Nitrophenol	0	17	0.0%	NA	0.79	0.1	7.90E+00	0.02%	---	NA	NA
Pentachlorophenol	0	17	0.0%	NA	0.79	5	1.58E-01	<0.01%	2.1	3.76E-01	0.03%
Phenol	0	17	0.0%	NA	0.2	0.1	2.00E+00	<0.01%	0.1	2.00E+00	0.16%
2,4,5-Trichlorophenol	0	17	0.0%	NA	0.2	0.1	2.00E+00	<0.01%	0.1	2.00E+00	0.16%

Table G-2.2: Wallops CDL Subsurface Soil Screening Results for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Flora			Wildlife		
						Screening Benchmark[a] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[b] (mg/kg)	HQ	% of Total HQ
SEMI-VOLATILE ORGANIC COMPOUNDS (CONTINUED)											
2,4,6-Trichlorophenol	0	17	0.0%	NA	0.2	0.1	2.00E+00	<0.01%	0.1	2.00E+00	0.16%
Acenaphthene	0	17	0.0%	NA	0.079	0.1	7.90E-01	<0.01%	1.1	7.18E-02	<0.01%
Acenaphthylene	1	17	5.9%	0.158	0.079	0.1	1.58E+00	<0.01%	1.1	1.44E-01	0.01%
Anthracene	4	17	23.5%	0.267	0.079	0.1	2.67E+00	<0.01%	1.1	2.43E-01	0.02%
Benzo(a)anthracene	5	17	29.4%	2.49	0.079	0.1	2.49E+01	0.06%	100	2.49E-02	<0.01%
Benzo(a)pyrene	4	17	23.5%	1.91	0.079	0.1	1.91E+01	0.05%	100	1.91E-02	<0.01%
Benzo(b)fluoranthene	4	17	23.5%	1.39	0.079	0.1	1.39E+01	0.03%	100	1.39E-02	<0.01%
Benzo(g,h,i)perylene	4	17	23.5%	1.18	0.079	0.1	1.18E+01	0.03%	100	1.18E-02	<0.01%
Benzo(k)fluoranthene	4	17	23.5%	1.03	0.079	0.1	1.03E+01	0.02%	100	1.03E-02	<0.01%
Chrysene	5	17	29.4%	4.04	0.079	0.1	4.04E+01	0.10%	100	4.04E-02	<0.01%
Dibenzo(a,h) anthracene	3	17	17.6%	0.388	0.079	0.1	3.88E+00	<0.01%	100	3.88E-03	<0.01%
bis(2-Ethylhexyl) phthalate	6	17	35.3%	0.199	0.079	---	NA	NA	---	NA	NA
Fluoranthene	6	17	35.3%	1.79	0.079	0.1	1.79E+01	0.04%	100	1.79E-02	<0.01%
Fluorene	0	17	0.0%	NA	0.079	0.1	7.90E-01	<0.01%	1.1	7.18E-02	<0.01%
Indeno(1,2,3-cd)pyrene	4	17	23.5%	0.617	0.079	0.1	6.17E+00	0.01%	100	6.17E-03	<0.01%
Phenanthrene	5	17	29.4%	2.23	0.079	0.1	2.23E+01	0.05%	1.1	2.03E+00	0.17%
Pyrene	6	17	35.3%	4.74	0.079	0.1	4.74E+01	0.11%	100	4.74E-02	<0.01%
PESTICIDES											
alpha-Chlordane	1	17	5.9%	0.0267	0.0016	0.1	2.67E-01	<0.01%	0.1	2.67E-01	0.02%
gamma-Chlordane	1	17	5.9%	0.0346	0.0016	0.1	3.46E-01	<0.01%	0.1	3.46E-01	0.03%
4,4'-DDD	11	17	64.7%	0.197	0.0016	0.1	1.97E+00	<0.01%	0.021	9.38E+00	0.77%
4,4'-DDE	14	17	82.4%	1.31	0.0018	0.1	1.31E+01	0.03%	0.021	6.24E+01	5.14%
4,4'-DDT	14	17	82.4%	0.577	0.0017	0.1	5.77E+00	0.01%	0.021	2.75E+01	2.26%
POLYCHLORINATED BIPHENYLS											
Aroclor 1260	1	17	5.9%	0.213	0.039	0.1	2.13E+00	<0.01%	---	NA	NA
DIOXIN											
2,3,7,8-TCDD	0	9	0.0%	NA	0.2	---	NA	NA	0.01	2.00E+01	1.65%

Table G-2.2: Wallops CDL Subsurface Soil Screening Results for Central and Southern AOCs

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Flora			Wildlife		
						Screening Benchmark[a] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[b] (mg/kg)	HQ	% of Total HQ
INORGANICS											
Antimony	8	17	47.1%	63.7	2.4	0.48	1.33E+02	0.32%	0.27	2.36E+02	19.44%
Arsenic	17	17	100.0%	8.4	0.47	18	4.67E-01	<0.01%	43	1.95E-01	0.02%
Barium	17	17	100.0%	1160	24	440	2.64E+00	<0.01%	2000	5.80E-01	0.05%
Beryllium	13	17	76.5%	1.3	0.59	0.01	1.30E+02	0.31%	21	6.19E-02	<0.01%
Cadmium	12	17	70.6%	75.3	0.59	32	2.35E+00	<0.01%	0.36	2.09E+02	17.23%
Chromium**	17	17	100.0%	616	1.2	0.02	3.08E+04	73.45%	26	2.37E+01	1.95%
Cobalt	17	17	100.0%	28	5.9	13	2.15E+00	<0.01%	120	2.33E-01	0.02%
Copper	17	17	100.0%	5100	3	70	7.29E+01	0.17%	28	1.82E+02	15.01%
Lead	17	17	100.0%	2120	2.4	120	1.77E+01	0.04%	11	1.93E+02	15.88%
Manganese	17	17	100.0%	1490	1.8	220	6.77E+00	0.02%	4000	3.73E-01	0.03%
Mercury	17	17	100.0%	1.8	0.036	0.058	3.10E+01	0.07%	0.058	3.10E+01	2.56%
Nickel	17	17	100.0%	502	4.7	38	1.32E+01	0.03%	130	3.86E+00	0.32%
Selenium	4	17	23.5%	4.4	2.4	0.52	8.46E+00	0.02%	0.63	6.98E+00	0.58%
Silver	11	17	64.7%	84.5	1.2	560	1.51E-01	<0.01%	4.2	2.01E+01	1.66%
Thallium	11	17	64.7%	0.2	0.12	0.001	2.00E+02	0.48%	---	NA	NA
Vanadium	17	17	100.0%	51	5.9	0.005	1.02E+04	24.32%	7.8	6.54E+00	0.54%
Zinc	17	17	100.0%	4280	2.4	160	2.68E+01	0.06%	46	9.30E+01	7.66%
Cyanide	0	17	0.0%	NA	0.26	---	NA	NA	0.005	5.20E+01	4.28%
						HQ Sum = 4.19E+04			HQ Sum = 1.21E+03		

[a] Eco-SSLs or Efroymson et al 1997a

[b] minimum of the wildlife Eco-SSLs value or EPA Region 3 1995 BTAG Screening Levels

** minimum of the values for Chromium III and VI

Table G-2.3: Wallops CDL Wildlife to be Evaluated in Food Chain Model for Central and Southern AOCs

	Surface Soil				Subsurface Soils			
	HQ	% of HQ	Food Chain Model?	Rational	HQ	% of HQ	Food Chain Model?	Rational
VOLATILE ORGANIC COMPOUNDS								
Carbon tetrachloride	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
Chlorobenzene	NA	NA	No		2.33E-02	<0.01%	No	Screening HQ <0.1
Chloroform	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
1,2-Dichlorobenzene	**7.70E-02**	**<0.01%**	**Yes**	**Bioaccumulative**	**7.00E-02**	**<0.01%**	**Yes**	**Bioaccumulative**
1,4-Dichlorobenzene	**NA**	**NA**	**Yes**	**Bioaccumulative**	**NA**	**NA**	**Yes**	**Bioaccumulative**
1,1-Dichloroethane	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
cis-1,2-Dichloroethene	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
trans-1,2-Dichloroethene	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
Methyl Acetate	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
Methylcyclohexane	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
Styrene	7.70E-02	<0.01%	No	Screening HQ <0.1	7.00E-02	<0.01%	No	Screening HQ <0.1
1,1,2,2-Tetrachloroethane	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
Tetrachloroethene	**2.57E-02**	**<0.01%**	**Yes**	**Bioaccumulative**	**4.57E-02**	**<0.01%**	**Yes**	**Bioaccumulative**
1,2,4-Trichlorobenzene	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
1,1,1-Trichloroethane	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
1,1,2-Trichloroethane	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
Vinyl chloride	2.57E-02	<0.01%	No	Screening HQ <0.1	2.33E-02	<0.01%	No	Screening HQ <0.1
SEMI-VOLATILE ORGANIC COMPOUNDS								
2-Chlorophenol	**2.05E+00**	**0.23%**	**Yes**		**2.00E+00**	**0.16%**	**Yes**	
2,4-Dichlorophenol	**2.05E+00**	**0.23%**	**Yes**		**2.00E+00**	**0.16%**	**Yes**	
2,4-Dimethylphenol	**2.05E+00**	**0.23%**	**Yes**		**2.00E+00**	**0.16%**	**Yes**	
2,4-Dinitrophenol	**8.15E+00**	**0.90%**	**Yes**		**7.90E+00**	**0.65%**	**Yes**	
4,6-Dinitro-o-cresol	**8.15E+00**	**0.90%**	**Yes**		**7.90E+00**	**0.65%**	**Yes**	
2-Methylphenol	**2.05E+00**	**0.23%**	**Yes**		**2.00E+00**	**0.16%**	**Yes**	
3&4-Methylphenol	**2.05E+00**	**0.23%**	**Yes**		**2.00E+00**	**0.16%**	**Yes**	
4-Nitrophenol	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
Pentachlorophenol	3.88E-01	0.04%	No	Screening HQ <0.1	3.76E-01	0.03%	No	Screening HQ <0.1
Phenol	**2.05E+00**	**0.23%**	**Yes**		**2.00E+00**	**0.16%**	**Yes**	
2,4,5-Trichlorophenol	**2.05E+00**	**0.23%**	**Yes**		**2.00E+00**	**0.16%**	**Yes**	

Table G-2.3: Wallops CDL Wildlife to be Evaluated in Food Chain Model for Central and Southern AOCs

	Surface Soil				Subsurface Soils			
	HQ	% of HQ	Food Chain Model?	Rational	HQ	% of HQ	Food Chain Model?	Rational
SEMI-VOLATILE ORGANIC COMPOUNDS (CONTINUED)								
2,4,6-Trichlorophenol	2.05E+00	0.23%	Yes		2.00E+00	0.16%	Yes	
Acenaphthene	7.41E-02	<0.01%	Yes	Bioaccumulative	7.18E-02	<0.01%	Yes	Bioaccumulative
Acenaphthylene	1.44E-01	0.02%	Yes	Bioaccumulative	1.44E-01	0.01%	Yes	Bioaccumulative
Anthracene	2.43E-01	0.03%	Yes	Bioaccumulative	2.43E-01	0.02%	Yes	Bioaccumulative
Benzo(a)anthracene	2.49E-02	<0.01%	Yes	Bioaccumulative	2.49E-02	<0.01%	Yes	Bioaccumulative
Benzo(a)pyrene	1.91E-02	<0.01%	Yes	Bioaccumulative	1.91E-02	<0.01%	Yes	Bioaccumulative
Benzo(b)fluoranthene	1.39E-02	<0.01%	Yes	Bioaccumulative	1.39E-02	<0.01%	Yes	Bioaccumulative
Benzo(g,h,i)perylene	1.18E-02	<0.01%	Yes	Bioaccumulative	1.18E-02	<0.01%	Yes	Bioaccumulative
Benzo(k)fluoranthene	1.03E-02	<0.01%	Yes	Bioaccumulative	1.03E-02	<0.01%	Yes	Bioaccumulative
Chrysene	4.04E-02	<0.01%	Yes	Bioaccumulative	4.04E-02	<0.01%	Yes	Bioaccumulative
Dibenzo(a,h) anthracene	3.88E-03	<0.01%	Yes	Bioaccumulative	3.88E-03	<0.01%	Yes	Bioaccumulative
bis(2-Ethylhexyl) phthalate	NA	NA	Yes		NA	NA	Yes	
Fluoranthene	1.79E-02	<0.01%	Yes	Bioaccumulative	1.79E-02	<0.01%	Yes	Bioaccumulative
Fluorene	7.41E-02	<0.01%	Yes	Bioaccumulative	7.18E-02	<0.01%	Yes	Bioaccumulative
Indeno(1,2,3-cd)pyrene	6.17E-03	<0.01%	Yes	Bioaccumulative	6.17E-03	<0.01%	Yes	Bioaccumulative
Phenanthrene	2.03E+00	0.22%	Yes	Bioaccumulative	2.03E+00	0.17%	Yes	Bioaccumulative
Pyrene	4.74E-02	<0.01%	Yes	Bioaccumulative	4.74E-02	<0.01%	Yes	Bioaccumulative
PESTICIDES								
alpha-Chlordane	---	---	---	---	2.67E-01	0.02%	Yes	Bioaccumulative
gamma-Chlordane	---	---	---	---	3.46E-01	0.03%	Yes	Bioaccumulative
4,4'-DDD	6.00E+00	0.66%	Yes	Bioaccumulative	9.38E+00	0.77%	Yes	Bioaccumulative
4,4'-DDE	4.86E+01	5.33%	Yes	Bioaccumulative	6.24E+01	5.14%	Yes	Bioaccumulative
4,4'-DDT	2.52E+01	2.77%	Yes	Bioaccumulative	2.75E+01	2.26%	Yes	Bioaccumulative
POLYCHLORINATED BIPHENYLS								
Aroclor 1260	---	---	---	---	NA	NA	Yes	Bioaccumulative
DIOXINS								
2,3,7,8-TCDD	2.00E+01	2.20%	Yes	Bioaccumulative	2.00E+01	1.65%	Yes	Bioaccumulative

Table G-2.3: Wallops CDL Wildlife to be Evaluated in Food Chain Model for Central and Southern AOCs

	Surface Soil				Subsurface Soils			
	HQ	% of HQ	Food Chain Model?	Rational	HQ	% of HQ	Food Chain Model?	Rational
INORGANICS								
Antimony	**2.36E+02**	**25.91%**	**Yes**		**2.36E+02**	**19.44%**	**Yes**	
Arsenic	**1.77E-01**	**0.02%**	**Yes**	**Bioaccumulative**	**1.95E-01**	**0.02%**	**Yes**	**Bioaccumulative**
Barium	5.80E-01	0.06%	No	Screening HQ <0.1	5.80E-01	0.05%	No	Screening HQ <0.1
Beryllium	6.19E-02	<0.01%	No	Screening HQ <0.1	6.19E-02	<0.01%	No	Screening HQ <0.1
Cadmium	**6.00E+01**	**6.59%**	**Yes**	**Bioaccumulative**	**2.09E+02**	**17.23%**	**Yes**	**Bioaccumulative**
Chromium**	**4.85E+00**	**0.53%**	**Yes**	**Bioaccumulative**	**2.37E+01**	**1.95%**	**Yes**	**Bioaccumulative**
Cobalt	2.33E-01	0.03%	No	Screening HQ <0.1	2.33E-01	0.02%	No	Screening HQ <0.1
Copper	**6.39E+01**	**7.02%**	**Yes**	**Bioaccumulative**	**1.82E+02**	**15.01%**	**Yes**	**Bioaccumulative**
Lead	**1.93E+02**	**21.17%**	**Yes**	**Bioaccumulative**	**1.93E+02**	**15.88%**	**Yes**	**Bioaccumulative**
Manganese	3.73E-01	0.04%	No	Screening HQ <0.1	3.73E-01	0.03%	No	Screening HQ <0.1
Mercury	**3.10E+01**	**3.41%**	**Yes**	**Bioaccumulative**	**3.10E+01**	**2.56%**	**Yes**	**Bioaccumulative**
Nickel	**3.86E+00**	**0.42%**	**Yes**	**Bioaccumulative**	**3.86E+00**	**0.32%**	**Yes**	**Bioaccumulative**
Selenium	**6.98E+00**	**0.77%**	**Yes**	**Bioaccumulative**	**6.98E+00**	**0.58%**	**Yes**	**Bioaccumulative**
Silver	**2.01E+01**	**2.21%**	**Yes**	**Bioaccumulative**	**2.01E+01**	**1.66%**	**Yes**	**Bioaccumulative**
Thallium	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
Vanadium	**6.54E+00**	**0.72%**	**Yes**		**6.54E+00**	**0.54%**	**Yes**	
Zinc	**9.30E+01**	**10.22%**	**Yes**	**Bioaccumulative**	**9.30E+01**	**7.67%**	**Yes**	**Bioaccumulative**
Cyanide	**5.40E+01**	**5.93%**	**Yes**		**5.20E+01**	**4.28%**	**Yes**	

Table G-2.4: Wallops CDL Surface Soil Screening Results for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Flora			Invertebrate			Wildlife		
						Screening Benchmark[a] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[b] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[c] (mg/kg)	HQ	% of Total HQ
VOLATILE ORGANIC COMPOUNDS														
Chlorobenzene	0	10	0.0%	NA	0.008	0.1	9.50E-02	<0.01%	40	2.38E-04	<0.01%	---	NA	NA
1,2-Dichlorobenzene	0	10	0.0%	NA	0.008	0.1	9.50E-02	<0.01%	---	NA	NA	0.1	9.50E-02	0.12%
1,4-Dichlorobenzene	0	10	0.0%	NA	0.008	0.1	9.50E-02	<0.01%	20	4.75E-04	0.02%	---	NA	NA
Styrene	0	10	0.0%	NA	0.008	300	3.17E-05	<0.01%	---	NA	NA	0.1	9.50E-02	0.12%
1,2,4-Trichlorobenzene	0	10	0.0%	NA	0.008	0.1	9.50E-02	<0.01%	20	4.75E-04	0.02%	---	NA	NA
m,p-Xylene	0	10	0.0%	NA	0.003	0.1	3.80E-02	<0.01%	---	NA	NA	0.1	3.80E-02	0.05%
Xylene (total)	0	10	0.0%	NA	0.003	0.1	3.80E-02	<0.01%	---	NA	NA	0.1	3.80E-02	0.05%
SEMI-VOLATILE ORGANIC COMPOUNDS														
2,4-Dinitrophenol	0	10	0.0%	NA	0.735	0.1	7.60E+00	0.20%	---	NA	NA	0.1	7.60E+00	9.40%
4,6-Dinitro-o-cresol	0	10	0.0%	NA	0.735	0.1	7.60E+00	0.20%	---	NA	NA	0.1	7.60E+00	9.40%
4-Nitrophenol	0	10	0.0%	NA	0.735	0.1	7.60E+00	0.20%	7	1.09E-01	3.62%	---	NA	NA
Benzaldehyde	1	1	100.0%	0.054	0.190	---	NA	NA	---	NA	NA	---	NA	NA
INORGANICS														
Antimony	0	10	0.0%	NA	2.300	0.48	4.79E+00	0.12%	78	2.95E-02	0.98%	0.27	8.52E+00	10.53%
Arsenic	10	10	100.0%	4.800	0.450	18	2.61E-01	<0.01%	100	4.70E-02	1.57%	43	1.09E-01	0.14%
Beryllium	10	10	100.0%	0.330	0.570	0.01	2.90E+01	0.75%	40	7.25E-03	0.24%	21	1.38E-02	0.02%
Cadmium	2	10	20.0%	0.240	0.570	32	7.50E-03	<0.01%	140	1.71E-03	0.06%	0.36	6.67E-01	0.82%
Chromium	10	10	100.0%	20.700	1.100	0.02	5.50E+02	14.20%	10	1.10E+00	36.71%	26	4.23E-01	0.52%
Copper	10	10	100.0%	8.600	2.800	70	1.10E-01	<0.01%	80	9.63E-02	3.21%	28	2.75E-01	0.34%
Lead	10	10	100.0%	17.300	2.300	120	1.44E-01	<0.01%	1700	1.02E-02	0.34%	11	1.57E+00	1.94%
Mercury	9	10	90.0%	0.077	0.036	0.058	1.33E+00	0.03%	30	2.57E-03	0.09%	0.058	1.33E+00	1.64%
Nickel	10	10	100.0%	9.900	4.500	38	1.53E-01	<0.01%	280	2.07E-02	0.69%	130	4.46E-02	0.06%
Selenium	0	10	0.0%	NA	2.300	0.52	4.42E+00	0.11%	4.1	5.61E-01	18.72%	0.63	3.65E+00	4.51%
Silver	1	10	10.0%	0.210	1.100	560	2.14E-03	<0.01%	50	2.40E-02	0.80%	4.2	2.86E-01	0.35%
Thallium	10	10	100.0%	0.180	0.115	0.001	1.00E+02	2.58%	---	NA	NA	---	NA	NA
Vanadium	10	10	100.0%	32.500	5.700	0.005	3.16E+03	81.58%	20	7.90E-01	26.36%	7.8	2.03E+00	2.50%
Zinc	10	10	100.0%	23.800	2.300	160	1.48E-01	<0.01%	120	1.97E-01	6.56%	46	5.13E-01	0.63%
Cyanide	0	10	0.0%	NA	0.235	---	NA	NA	---	NA	NA	0.005	4.60E+01	56.87%
						HQ Sum = 3.87E+03			HQ Sum = 8.09E+01			HQ Sum =		

[a] Eco-SSLs or Efroymson et al 1997a
[b] Eco-SSLs or Efroymson et al 1997b
[c] minimum of the wildlife Eco-SSLs value or EPA Region 3 1995 BTAG Screening Levels

Table G-2.5: Wallops CDL Subsurface Soil Screening Results for Northern and Western AOCs

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Flora			Wildlife		
						Screening Benchmark[a] (mg/kg)	HQ	% of Total HQ	Screening Benchmark[b] (mg/kg)	HQ	% of Total HQ
VOLATILE ORGANIC COMPOUNDS											
Chlorobenzene	0	10	0.0%	NA	0.008	0.1	7.50E-02	<0.01%	---	NA	NA
1,2-Dichlorobenzene	0	10	0.0%	NA	0.008	0.1	7.50E-02	<0.01%	0.1	7.50E-02	0.09%
1,4-Dichlorobenzene	0	10	0.0%	NA	0.008	0.1	7.50E-02	<0.01%	---	NA	NA
Styrene	0	10	0.0%	NA	0.008	300	2.50E-05	<0.01%	0.1	7.50E-02	0.09%
1,2,4-Trichlorobenzene	0	10	0.0%	NA	0.008	0.1	7.50E-02	<0.01%	---	NA	NA
m,p-Xylene	0	10	0.0%	NA	0.003	0.1	3.00E-02	<0.01%	0.1	3.00E-02	0.04%
Xylene (total)	0	10	0.0%	NA	0.003	0.1	3.00E-02	<0.01%	0.1	3.00E-02	0.04%
SEMI-VOLATILE ORGANIC COMPOUNDS											
2,4-Dinitrophenol	0	10	0.0%	NA	0.735	0.1	7.35E+00	0.09%	0.1	7.35E+00	8.78%
4,6-Dinitro-o-cresol	0	10	0.0%	NA	0.735	0.1	7.35E+00	0.09%	0.1	7.35E+00	8.78%
4-Nitrophenol	0	10	0.0%	NA	0.735	0.1	7.35E+00	0.09%	---	NA	NA
Benzaldehyde	1	1	100.0%	0.054	0.190	---	NA	NA	---	NA	NA
bis(2-Ethylhexyl) phthalate	2	10	20.0%	0.085	0.074	---	NA	NA	---	NA	NA
INORGANICS											
Antimony	0	10	0.0%	NA	2.300	0.48	4.79E+00	0.06%	0.27	8.52E+00	10.18%
Arsenic	10	10	100.0%	4.800	0.450	18	2.67E-01	<0.01%	43	1.12E-01	0.13%
Beryllium	10	10	100.0%	0.330	0.570	0.01	3.30E+01	0.42%	21	1.57E-02	0.02%
Cadmium	2	10	20.0%	0.240	0.570	32	7.50E-03	<0.01%	0.36	6.67E-01	0.80%
Chromium	10	10	100.0%	20.700	1.100	0.02	1.04E+03	13.30%	26	7.96E-01	0.95%
Copper	10	10	100.0%	8.600	2.800	70	1.23E-01	<0.01%	28	3.07E-01	0.37%
Lead	10	10	100.0%	17.300	2.300	120	1.44E-01	<0.01%	11	1.57E+00	1.88%
Mercury	9	10	90.0%	0.077	0.036	0.058	1.33E+00	0.02%	0.058	1.33E+00	1.59%
Nickel	10	10	100.0%	9.900	4.500	38	2.61E-01	<0.01%	130	7.62E-02	0.09%
Selenium	0	10	0.0%	NA	2.300	0.52	4.42E+00	0.06%	0.63	3.65E+00	4.36%
Silver	1	10	10.0%	0.210	1.100	560	3.75E-04	<0.01%	4.2	5.00E-02	0.06%
Thallium	10	10	100.0%	0.180	0.115	0.001	1.80E+02	2.31%	---	NA	NA
Vanadium	10	10	100.0%	32.500	5.700	0.005	6.50E+03	83.53%	7.8	4.17E+00	4.98%
Zinc	10	10	100.0%	23.800	2.300	160	1.49E-01	<0.01%	46	5.17E-01	0.62%
Cyanide	0	10	0.0%	NA	0.235	---	NA	NA	0.005	4.70E+01	56.16%
						HQ Sum = 7.78E+03			HQ Sum = 8.37E+01		

[a] Eco-SSLs or Efroymson et al 1997a
[b] minimum of the wildlife Eco-SSLs value or EPA Region 3 1995 BTAG Screening Levels

Table G-2.6: Wallops CDL Wildlife to be Evaluated in Food Chain Model for Northern and Western AOCs

	Surface Soils				Subsurface Soils			
	HQ	% of HQ	Food Chain Model?	Rational	HQ	% of HQ	Food Chain Model?	Rational
VOLATILE ORGANIC COMPOUNDS								
Chlorobenzene	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
1,2-Dichlorobenzene	**9.50E-02**	**0.12%**	**Yes**	**Bioaccumulative**	**7.50E-02**	**0.09%**	**Yes**	**Bioaccumulative**
1,4-Dichlorobenzene	**NA**	**NA**	**Yes**	**Bioaccumulative**	**NA**	**NA**	**Yes**	**Bioaccumulative**
Styrene	9.50E-02	0.12%	No	Screening HQ <0.1	7.50E-02	0.09%	No	Screening HQ <0.1
1,2,4-Trichlorobenzene	**NA**	**NA**	**Yes**	**Bioaccumulative**	**NA**	**NA**	**Yes**	**Bioaccumulative**
m,p-Xylene	3.80E-02	0.05%	No	Screening HQ <0.1	3.00E-02	0.04%	No	Screening HQ <0.1
Xylene (total)	3.80E-02	0.05%	No	Screening HQ <0.1	3.00E-02	0.04%	No	Screening HQ <0.1
SEMI-VOLATILE ORGANIC COMPOUNDS								
2,4-Dinitrophenol	**7.60E+00**	**9.40%**	**Yes**		**7.35E+00**	**8.78%**	**Yes**	
4,6-Dinitro-o-cresol	**7.60E+00**	**9.40%**	**Yes**		**7.35E+00**	**8.78%**	**Yes**	
4-Nitrophenol	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
Benzaldehyde	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
bis(2-Ethylhexyl)phthalate	---	---	---	---	**NA**	**NA**	**Yes**	
INORGANICS								
Antimony	**8.52E+00**	**10.18%**	**Yes**		**8.52E+00**	**10.18%**	**Yes**	
Arsenic	**1.12E-01**	**0.13%**	**Yes**	**Bioaccumulative**	**1.12E-01**	**0.13%**	**Yes**	**Bioaccumulative**
Beryllium	1.57E-02	0.02%	No	Screening HQ <0.1	1.57E-02	0.02%	No	Screening HQ <0.1
Cadmium	**6.67E-01**	**0.80%**	**Yes**	**Bioaccumulative**	**6.67E-01**	**0.80%**	**Yes**	**Bioaccumulative**
Chromium	**7.96E-01**	**0.95%**	**Yes**	**Bioaccumulative**	**7.96E-01**	**0.95%**	**Yes**	**Bioaccumulative**
Copper	**3.07E-01**	**0.37%**	**Yes**	**Bioaccumulative**	**3.07E-01**	**0.37%**	**Yes**	**Bioaccumulative**
Lead	**1.57E+00**	**1.88%**	**Yes**	**Bioaccumulative**	**1.57E+00**	**1.88%**	**Yes**	**Bioaccumulative**
Mercury	**1.33E+00**	**1.59%**	**Yes**	**Bioaccumulative**	**1.33E+00**	**1.59%**	**Yes**	**Bioaccumulative**
Nickel	**7.62E-02**	**0.09%**	**Yes**	**Bioaccumulative**	**7.62E-02**	**0.09%**	**Yes**	**Bioaccumulative**
Selenium	**3.65E+00**	**4.36%**	**Yes**	**Bioaccumulative**	**3.65E+00**	**4.36%**	**Yes**	**Bioaccumulative**
Silver	**5.00E-02**	**0.06%**	**Yes**	**Bioaccumulative**	**5.00E-02**	**0.06%**	**Yes**	**Bioaccumulative**
Thallium	**NA**	**NA**	**Yes**		**NA**	**NA**	**Yes**	
Vanadium	**4.17E+00**	**4.98%**	**Yes**		**4.17E+00**	**4.98%**	**Yes**	
Zinc	**5.17E-01**	**0.62%**	**Yes**	**Bioaccumulative**	**5.17E-01**	**0.62%**	**Yes**	**Bioaccumulative**
Cyanide	**4.70E+01**	**56.16%**	**Yes**		**4.70E+01**	**56.16%**	**Yes**	

Table G-2.7: Wallops CDL Surface Water Screening Results

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (ug/L)	Median Detection Limit (ug/L)	Surface Water Screening Benchmark[a] (ug/L)	HQ	% of HQ
VOLATILE ORGANIC COMPOUNDS								
cis-1,3-Dichloropropene	0	6	0.0%	NA	1	0.055	1.82E+01	0.03%
trans-1,3-Dichloropropene	0	6	0.0%	NA	1	0.055	1.82E+01	0.03%
SEMI-VOLATILE ORGANIC COMPOUNDS								
Pentachlorophenol	0	6	0.0%	NA	22.25	6.0	3.71E+00	<0.01%
Anthracene	0	6	0.0%	NA	2.225	0.012	1.85E+02	0.30%
Atrazine	0	6	0.0%	NA	5.625	1.8	3.13E+00	<0.01%
Benzo(a)anthracene	0	6	0.0%	NA	2.225	0.018	1.24E+02	0.20%
Benzo(a)pyrene	0	6	0.0%	NA	2.225	0.015	1.48E+02	0.24%
Fluoranthene	0	6	0.0%	NA	2.225	0.04	5.56E+01	0.09%
Hexachlorobenzene	0	6	0.0%	NA	2.225	0.0003	7.42E+03	12.08%
Phenanthrene	0	6	0.0%	NA	2.225	0.4	5.56E+00	<0.01%
Pyrene	0	6	0.0%	NA	2.225	0.025	8.90E+01	0.14%
PESTICIDES								
alpha-Chlordane	0	6	0.0%	NA	0.022	0.0022	1.00E+01	0.02%
gamma-Chlordane	0	6	0.0%	NA	0.022	0.0022	1.00E+01	0.02%
4,4'-DDT	0	6	0.0%	NA	0.022	0.001	2.20E+01	0.04%
Heptachlor	0	6	0.0%	NA	0.022	0.0019	1.16E+01	0.02%
Heptachlor epoxide	0	6	0.0%	NA	0.022	0.0019	1.16E+01	0.02%
Methoxychlor	0	6	0.0%	NA	0.022	0.019	1.16E+00	<0.01%
Toxaphene	0	6	0.0%	NA	0.27	0.0002	1.35E+03	2.20%
POLYCHLORINATED BIPHENYLS								
Aroclor 1016	0	6	0.0%	NA	0.5475	0.000074	7.40E+03	12.05%
Aroclor 1221	0	6	0.0%	NA	0.5475	0.000074	7.40E+03	12.05%
Aroclor 1232	0	6	0.0%	NA	0.5475	0.000074	7.40E+03	12.05%
Aroclor 1242	0	6	0.0%	NA	0.5475	0.000074	7.40E+03	12.05%
Aroclor 1248	0	6	0.0%	NA	0.5475	0.000074	7.40E+03	12.05%
Aroclor 1254	0	6	0.0%	NA	0.5475	0.000074	7.40E+03	12.05%
Aroclor 1260	0	6	0.0%	NA	0.5475	0.000074	7.40E+03	12.05%

Table G-2.7: Wallops CDL Surface Water Screening Results

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (ug/L)	Median Detection Limit (ug/L)	Surface Water Screening Benchmark[a] (ug/L)	HQ	% of HQ
INORGANICS								
Aluminum	6	6	100%	1060	200	87	12.18	0.02%
Arsenic	6	6	100%	11.1	10	5	2.22	<0.01%
Barium	6	6	100%	27.6	200	4	6.90	0.01%
Cadmium	0	6	0.0%	NA	4	0.12	33.33	0.05%
Chromium	2	6	33.3%	2	10	57.5	0.03	<0.01%
Cobalt	0	6	0.0%	NA	50	23	2.17	<0.01%
Copper	3	6	50.0%	4.9	25	3.1	1.58	<0.01%
Iron	6	6	100%	1030	100	300	3.43	<0.01%
Lead	2	6	33.3%	4	3	2.5	1.60	<0.01%
Mercury	2	6	33.3%	0.091	0.2	0.016	5.69	<0.01%
Nickel	1	6	16.7%	2.9	40	8.2	0.35	<0.01%
Selenium	6	6	100%	11.8	10	1	11.80	0.02%
Silver	0	6	0.0%	NA	10	0.23	43.48	0.07%
Thallium	0	6	0.0%	NA	5	0.8	6.25	0.01%
Cyanide	0	6	0.0%	NA	0.01	1	0.01	<0.01%
						HQ Sum =	6.14E+04	

[a] EPA Region 3 1995 BTAG Screening Levels

Table G-2.8: Wallops CDL Sediment Screening Results

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Sediments Screening Benchmark[a] (mg/kg)	HQ	% of HQ
VOLATILE ORGANIC COMPOUNDS								
2-Butanone (MEK)	2	10	20.00%	0.0388	0.164	---	NA	NA
Carbon disulfide	7	10	70.00%	0.0043	0.02365	0.00085	27.82	1.32%
Chlorobenzene	0	10	0.00%	NA	NA	0.00842	2.43	0.12%
Cyclohexane	1	10	10.00%	0.01815	0.01815	---	NA	NA
1,2-Dichlorobenzene	0	10	0.00%	NA	NA	0.0165	1.24	0.06%
cis-1,3-Dichloropropene	0	10	0.00%	NA	NA	0.00005	410.00	19.51%
trans-1,3-Dichloropropene	0	10	0.00%	NA	NA	0.00005	410.00	19.51%
Methyl Acetate	1	10	10.00%	0.0586	0.0586	---	NA	NA
SEMI-VOLATILE ORGANIC COMPOUNDS								
2-Chlorophenol	0	10	0.00%	NA	0.51	0.0312	16.35	0.78%
Acenaphthene	0	10	0.00%	NA	0.205	0.0067	30.60	1.46%
Acenaphthylene	0	10	0.00%	NA	0.205	0.00587	34.92	1.66%
Anthracene	0	10	0.00%	NA	0.205	0.0572	3.58	0.17%
Benzo(a)anthracene	0	10	0.00%	NA	0.205	0.108	1.90	0.09%
Benzo(a)pyrene	0	10	0.00%	NA	0.205	0.15	1.37	0.07%
Benzo(b)fluoranthene	0	10	0.00%	NA	0.205	0.0272	7.54	0.36%
Benzo(g,h,i)perylene	0	10	0.00%	NA	0.205	0.17	1.21	0.06%
Benzo(k)fluoranthene	0	10	0.00%	NA	0.205	0.24	0.85	0.04%
Chrysene	0	10	0.00%	NA	0.205	0.166	1.23	0.06%
Dibenzo(a,h)anthracene	0	10	0.00%	NA	0.205	0.033	6.21	0.30%
Dibenzofuran	0	10	0.00%	NA	0.205	0.415	0.49	0.02%
Di-n-butyl phthalate	0	10	0.00%	NA	0.205	1.16	0.18	Yes
Di-n-octyl phthalate	1	10	10.00%	3.08	0.205	---	NA	NA
Diethyl phthalate	0	10	0.00%	NA	0.205	0.218	0.94	0.04%
bis(2-Ethylhexyl)phthalate	3	10	30.00%	162	0.205	---	NA	NA
Fluoranthene	0	10	0.00%	NA	0.205	0.113	1.81	0.09%
Fluorene	0	10	0.00%	NA	0.205	0.0212	9.67	0.46%
Hexachlorobenzene	0	10	0.00%	NA	0.205	0.02	10.25	0.49%
Indeno(1,2,3-cd)pyrene	0	10	0.00%	NA	0.205	0.017	12.06	0.57%
2-Methylnaphthalene	0	10	0.00%	NA	0.205	0.0202	10.15	0.48%
Naphthalene	0	10	0.00%	NA	0.205	0.0346	5.92	0.28%

Table G-2.8: Wallops CDL Sediment Screening Results

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Sediments Screening Benchmark[a] (mg/kg)	HQ	% of HQ
SEMI-VOLATILE ORGANIC COMPOUNDS (CONTINUED)								
Phenanthrene	0	10	0.00%	NA	0.205	0.00076	269.74	12.83%
Pyrene	0	10	0.00%	NA	0.205	0.153	1.34	0.06%
PESTICIDES								
Aldrin	0	10	0.00%	NA	0.011	0.002	5.50	0.26%
alpha-BHC	0	10	0.00%	NA	0.011	0.006	1.83	0.09%
beta-BHC	0	10	0.00%	NA	0.011	0.005	2.20	0.10%
gamma-BHC (Lindane)	0	10	0.00%	NA	0.011	0.00032	34.38	1.64%
alpha-Chlordane	0	10	0.00%	NA	0.011	0.00226	4.87	0.23%
gamma-Chlordane	0	10	0.00%	NA	0.011	0.00226	4.87	0.23%
Dieldrin	0	10	0.00%	NA	0.011	0.00072	15.28	0.73%
4,4'-DDD	1	10	10.00%	0.065	0.011	0.00122	53.28	2.53%
4,4'-DDE	2	10	20.00%	0.149	0.011	0.00207	71.98	3.42%
4,4'-DDT	1	10	10.00%	0.0108	0.011	0.00389	2.78	0.13%
Endrin	0	10	0.00%	NA	0.011	0.00222	4.95	0.24%
Endrin aldehyde	0	10	0.00%	NA	0.011	0.00222	4.95	0.24%
Endrin ketone	0	10	0.00%	NA	0.029	0.00222	13.06	0.62%
Endosulfan sulfate	0	10	0.00%	NA	0.011	0.0036	3.06	0.15%
Endosulfan-I	0	10	0.00%	NA	0.011	0.0029	3.79	0.18%
Endosulfan-II	0	10	0.00%	NA	0.011	0.014	0.79	0.04%
Heptachlor	0	10	0.00%	NA	0.011	0.068	0.16	<0.01%
Heptachlor epoxide	0	10	0.00%	NA	0.011	0.0006	18.33	0.87%
Methoxychlor	0	10	0.00%	NA	0.029	0.0187	1.55	0.07%
POLYCHLORINATED BIPHENYLS								
Aroclor 1016	0	10	0.00%	NA	0.31	0.004	77.50	3.69%
Aroclor 1221	0	10	0.00%	NA	0.31	0.004	77.50	3.69%
Aroclor 1232	0	10	0.00%	NA	0.31	0.004	77.50	3.69%
Aroclor 1242	0	10	0.00%	NA	0.31	0.004	77.50	3.69%
Aroclor 1248	0	10	0.00%	NA	0.31	0.004	77.50	3.69%
Aroclor 1254	0	10	0.00%	NA	0.31	0.004	77.50	3.69%
Aroclor 1260	0	10	0.00%	NA	0.31	0.004	77.50	3.69%

Table G-2.8: Wallops CDL Sediment Screening Results

	# of Detects	# of Samples	Percent Detected	Max Detected Conc. (mg/kg)	Median Detection Limit (mg/kg)	Sediments Screening Benchmark[a] (mg/kg)	HQ	% of HQ
INORGANICS								
Aluminum	10	10	100%	22300	25	---	NA	NA
Antimony	1	10	10.00%	2.8	2.5	2	1.40	0.07%
Arsenic	10	10	100%	19.05	0.505	7.24	2.63	0.13%
Barium	10	10	100%	85.2	25	---	NA	NA
Beryllium	10	10	100%	0.61	0.625	---	NA	NA
Cadmium	4	10	40.00%	1.5	0.625	0.68	2.21	0.10%
Chromium	10	10	100%	49.6	1.25	43.4	1.14	0.05%
Copper	9	10	90.00%	56.5	3.15	18.7	3.02	0.14%
Iron	10	10	100%	30800	19.25	20000	1.54	0.07%
Lead	10	10	100%	96.9	2.5	30.2	3.21	0.15%
Mercury	9	10	90.00%	0.49	0.0765	0.13	3.77	0.18%
Nickel	10	10	100%	21.8	5.05	15.9	1.37	0.07%
Selenium	8	10	80.00%	1.8	2.5	2	0.90	0.04%
Silver	4	10	40.00%	1.5	1.25	0.73	2.05	0.10%
Thallium	10	10	100%	0.28	0.325	---	NA	NA
Vanadium	10	10	100%	53.7	6.25	---	NA	NA
Zinc	10	10	100%	324	2.5	121	2.68	0.13%
Cyanide	0	10	0.00%	NA	0.61	0.1	6.10	0.29%
						HQ Sum =	2.10E+03	

[a] EPA Region 3 1995 BTAG Screening Levels

Table G-2.9: Wallops CDL Wildlife to be Evaluated in Aquatic Food Chain Model

	Surface Water				Sediments			
	HQ	% of HQ	Food Chain Model?	Rational	HQ	% of HQ	Food Chain Model?	Rational
VOLATILE ORGANIC COMPOUNDS								
2-Butanone (MEK)	---	---	---	---	NA	NA	Yes	
Carbon disulfide	---	---	---	---	27.82	1.32%	Yes	
Chlorobenzene	---	---	---	---	2.43	0.12%	Yes	
Cyclohexane	---	---	---	---	NA	NA	Yes	
1,2-Dichlorobenzene	---	---	---	---	1.24	0.06%	Yes	
cis-1,3-Dichloropropene	1.82E+01	0.03%	Yes		410.00	19.51%	Yes	
trans-1,3-Dichloropropene	1.82E+01	0.03%	Yes		410.00	19.51%	Yes	
Methyl Acetate	---	---	---	---	NA	NA	Yes	
SEMI-VOLATILE ORGANIC COMPOUNDS								
2-Chlorophenol	---	---	---	---	16.35	0.78%	Yes	
Pentachlorophenol	3.71E+00	<0.01%	Yes		NA	NA	---	---
Acenaphthene	---	---	---	---	30.6	1.46%	Yes	
Acenaphthylene	---	---	---	---	34.92	1.66%	Yes	
Anthracene	1.85E+02	0.30%	Yes		3.58	0.17%	Yes	
Atrazine	3.13E+00	<0.01%	Yes		NA	NA	---	---
Benzo(a)anthracene	1.24E+02	0.20%	Yes		1.9	0.09%	Yes	
Benzo(a)pyrene	1.48E+02	0.24%	Yes		1.37	0.07%	Yes	
Benzo(b)fluoranthene	---	---	---	---	7.54	0.36%	Yes	
Benzo(g,h,i)perylene	---	---	---	---	1.21	0.06%	No	Screening HQ <0.1
Benzo(k)fluoranthene	---	---	---	---	0.85	0.04%	No	Screening HQ <0.1
Chrysene	---	---	---	---	1.23	0.06%	Yes	
Dibenzo(a,h)anthracene	---	---	---	---	6.21	0.30%	Yes	
Dibenzofuran	---	---	---	---	0.49	0.02%	No	Screening HQ <0.1
Di-n-butyl phthalate	---	---	---	---	0.18	<0.01%	No	Screening HQ <0.1
Di-n-octyl phthalate	---	---	---	---	NA	NA	Yes	
Diethyl phthalate	---	---	---	---	0.94	0.04%	No	Screening HQ <0.1
bis(2-Ethylhexyl)phthalate	---	---	---	---	NA	NA	Yes	
Fluoranthene	5.56E+01	0.09%	Yes		1.81	0.09%	No	Screening HQ <0.1
Fluorene	---	---	---	---	9.67	0.46%	Yes	
Hexachlorobenzene	7.42E+03	12.08%	Yes		10.25	0.49%	Yes	

Table G-2.9: Wallops CDL Wildlife to be Evaluated in Aquatic Food Chain Model

	Surface Water				Sediments			
	HQ	% of HQ	Food Chain Model?	Rational	HQ	% of HQ	Food Chain Model?	Rational
SEMI-VOLATILE ORGANIC COMPOUNDS (CONTINUED)								
Indeno(1,2,3-cd)pyrene	---	---	---	---	12.06	0.57%	Yes	
2-Methylnaphthalene	---	---	---	---	10.15	0.48%	Yes	
Naphthalene	---	---	---	---	5.92	0.28%	Yes	
Phenanthrene	5.56E+00	<0.01%	Yes		269.74	12.83%	Yes	
Pyrene	8.90E+01	0.14%	Yes		1.34	0.06%	Yes	
PESTICIDES								
Aldrin	---	---	---	---	5.5	0.26%	Yes	
alpha-BHC	---	---	---	---	1.83	0.09%	No	Screening HQ <0.1
beta-BHC	---	---	---	---	2.2	0.10%	Yes	
gamma-BHC (Lindane)	---	---	---	---	34.38	1.64%	Yes	
alpha-Chlordane	1.00E+01	0.02%	Yes		4.87	0.23%	Yes	
gamma-Chlordane	1.00E+01	0.02%	Yes		4.87	0.23%	Yes	
Dieldrin	---	---	---	---	15.28	0.73%	Yes	
4,4'-DDD	---	---	---	---	53.28	2.53%	Yes	
4,4'-DDE	---	---	---	---	71.98	3.42%	Yes	
4,4'-DDT	2.20E+01	0.04%	Yes		2.78	0.13%	Yes	
Endrin	---	---	---	---	4.95	0.24%	Yes	
Endrin aldehyde	---	---	---	---	4.95	0.24%	Yes	
Endrin ketone	---	---	---	---	13.06	0.62%	Yes	
Endosulfan sulfate	---	---	---	---	3.06	0.15%	Yes	
Endosulfan-I	---	---	---	---	3.79	0.18%	Yes	
Endosulfan-II	---	---	---	---	0.79	0.04%	No	Screening HQ <0.1
Heptachlor	1.16E+01	0.02%	Yes		0.16	<0.01%	No	Screening HQ <0.1
Heptachlor epoxide	1.16E+01	0.02%	Yes		18.33	0.87%	Yes	
Methoxychlor	1.16E+00	<0.01%	Yes		1.55	0.07%	No	Screening HQ <0.1
Toxaphene	1.35E+03	2.20%	Yes		---	---	---	---

Table G-2.9: Wallops CDL Wildlife to be Evaluated in Aquatic Food Chain Model

	Surface Water				Sediments			
	HQ	% of HQ	Food Chain Model?	Rational	HQ	% of HQ	Food Chain Model?	Rational
POLYCHLORINATED BIPHENYLS								
Aroclor 1016	7.40E+03	12.05%	Yes		77.50	3.69%	Yes	
Aroclor 1221	7.40E+03	12.05%	Yes		77.50	3.69%	Yes	
Aroclor 1232	7.40E+03	12.05%	Yes		77.50	3.69%	Yes	
Aroclor 1242	7.40E+03	12.05%	Yes		77.50	3.69%	Yes	
Aroclor 1248	7.40E+03	12.05%	Yes		77.50	3.69%	Yes	
Aroclor 1254	7.40E+03	12.05%	Yes		77.50	3.69%	Yes	
Aroclor 1260	7.40E+03	12.05%	Yes		77.50	3.69%	Yes	
INORGANICS								
Aluminum	1.22E+01	0.02%	Yes		NA	NA	Yes	
Antimony	---	---	---	---	1.40	0.07%	Yes	
Arsenic	2.22E+00	<0.01%	Yes	Bioaccumulative	2.63	0.13%	Yes	Bioaccumulative
Barium	6.90E+00	0.01%	Yes		NA	NA	Yes	
Beryllium	---	---	---	---	NA	NA	Yes	
Cadmium	3.33E+01	0.05%	Yes	Bioaccumulative	2.21	0.10%	Yes	Bioaccumulative
Chromium	3.48 E-02	<0.01%	Yes	Bioaccumulative	1.14	0.05%	Yes	Bioaccumulative
Cobalt	2.17E+00	<0.01%	Yes		3.02	0.14%	---	---
Copper	1.58E+00	<0.01%	Yes	Bioaccumulative	1.54	0.07%	Yes	Bioaccumulative
Iron	3.43E+00	<0.01%	Yes		3.21	0.15%	Yes	
Lead	1.60E+00	<0.01%	Yes	Bioaccumulative	3.77	0.18%	Yes	Bioaccumulative
Mercury	5.69E+00	<0.01%	Yes	Bioaccumulative	1.37	0.07%	Yes	Bioaccumulative
Nickel	3.50E-01	<0.01%	Yes	Bioaccumulative	0.90	0.04%	Yes	Bioaccumulative
Selenium	1.18E+01	0.02%	Yes	Bioaccumulative	2.05	0.10%	Yes	Bioaccumulative
Silver	4.35E+01	0.07%	Yes	Bioaccumulative	NA	NA	Yes	Bioaccumulative
Thallium	6.25E+00	0.01%	Yes		NA	NA	Yes	
Vanadium	---	---	---	---	2.68	0.13%	Yes	
Zinc	---	---	---	---	6.10	0.29%	Yes	Bioaccumulative
Cyanide	1.00E-02	<0.01%	No	Screening HQ <0.1	1.40	0.07%	Yes	

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APPENDIX G-3

DATA SUMMARY

G-3.1: Summary Stats for Surface Soil
Wallops CDL Baseline Ecological Risk Assessment

Variable		Num Detects	Num Obs	All Detected and Detection Limit Observations									
				Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Volatile Organic Compounds													
1,2-Dichlorobenzene	ug/kg	0	8	5.1	770	255.3	7.7	121470	348.5	3.336	0.752	-1.819	1.365
1,4-Dichlorobenzene	ug/kg	0	8	5.1	770	255.3	7.7	121470	348.5	3.336	0.752	-1.819	1.365
Methyl Acetate	ug/kg	1	8	5.1	1190	307.8	7.7	205284	453.1	3.336	1.269	0.565	1.472
Methylcyclohexane	ug/kg	1	8	2.5	770	254.9	7.7	121707	348.9	5.782	0.751	-1.82	1.369
Tetrachloroethene	ug/kg	0	8	5.1	770	255.3	7.7	121470	348.5	3.336	0.752	-1.819	1.365
1,2,4-Trichlorobenzene	ug/kg	0	8	5.1	770	255.3	7.7	121470	348.5	3.336	0.752	-1.819	1.365
Semi-Volatile Organic Compounds													
2-Chlorophenol	ug/kg	0	8	180	1200	330	205	123800	351.9	14.83	2.818	7.957	1.066
2,4-Dichlorophenol	ug/kg	0	8	180	1200	330	205	123800	351.9	14.83	2.818	7.957	1.066
2,4-Dimethylphenol	ug/kg	0	8	180	1200	330	205	123800	351.9	14.83	2.818	7.957	1.066
2,4-Dinitrophenol	ug/kg	0	8	740	4700	1308	815	1881707	1372	74.13	2.82	7.966	1.049
4,6-Dinitro-o-cresol	ug/kg	0	8	740	4700	1308	815	1881707	1372	74.13	2.82	7.966	1.049
2-Methylphenol	ug/kg	0	8	180	1200	330	205	123800	351.9	14.83	2.818	7.957	1.066
3&4-Methylphenol	ug/kg	0	8	180	1200	330	205	123800	351.9	14.83	2.818	7.957	1.066
4-Nitrophenol	ug/kg	0	8	740	4700	1308	815	1881707	1372	74.13	2.82	7.966	1.049
Phenol	ug/kg	0	8	180	1200	330	205	123800	351.9	14.83	2.818	7.957	1.066
2,4,5-Trichlorophenol	ug/kg	0	8	180	1200	330	205	123800	351.9	14.83	2.818	7.957	1.066
2,4,6-Trichlorophenol	ug/kg	0	8	180	1200	330	205	123800	351.9	14.83	2.818	7.957	1.066
Acenaphthene	ug/kg	0	8	74	470	130.8	81.5	18817	137.2	7.413	2.82	7.966	1.049
Acenaphthylene	ug/kg	1	8	74	158	91.75	81.5	743.4	27.26	7.413	2.628	7.153	0.297
Anthracene	ug/kg	3	8	16.8	267	89	80	5971	77.27	11.86	2.048	5.207	0.868
Benzo(a)anthracene	ug/kg	4	8	24.3	2490	376.1	81.5	730266	854.6	27.13	2.823	7.977	2.272
Benzo(a)pyrene	ug/kg	3	8	58.8	1910	310.1	81.5	418086	646.6	11.86	2.826	7.99	2.085
Benzo(b)fluoranthene	ug/kg	3	8	74	1390	251.1	86	211940	460.4	14.08	2.824	7.981	1.834
Benzo(g,h,i)perylene	ug/kg	3	8	66.6	1180	217.2	81.5	151394	389.1	8.154	2.827	7.992	1.791
Benzo(k)fluoranthene	ug/kg	3	8	74	1030	202.2	83.85	111936	334.6	8.154	2.826	7.991	1.655
Chrysene	ug/kg	4	8	19.1	4040	576.8	86	1959085	1400	27.43	2.826	7.989	2.427
Dibenzo(a,h)anthracene	ug/kg	2	8	22.6	388	113.2	81.5	12795	113.1	11.12	2.608	7.197	0.999
bis(2-Ethylhexyl)phthalate	ug/kg	3	8	52.5	470	132	86	18948	137.7	17.35	2.74	7.632	1.043
Fluoranthene	ug/kg	5	8	23	1790	304.9	86	362981	602.5	80.87	2.784	7.81	1.976
Fluorene	ug/kg	0	8	74	470	130.8	81.5	18817	137.2	7.413	2.82	7.966	1.049

G-3.1: Summary Stats for Surface Soil
Wallops CDL Baseline Ecological Risk Assessment

Variable		Num Detects	Num Obs	All Detected and Detection Limit Observations									
				Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Semi-Volatile Organic Compounds (Continued)													
Indeno(1,2,3-cd)pyrene	ug/kg	3	8	61.3	617	143.5	80	36695	191.6	11.86	2.814	7.941	1.335
Phenanthrene	ug/kg	4	8	25.6	2230	336.5	81.5	586031	765.5	11.86	2.822	7.973	2.275
Pyrene	ug/kg	5	8	21.3	4740	669.3	86	2707760	1646	85.54	2.823	7.979	2.458
Pesticides													
alpha-Chlordane	ug/kg	0	8	1.5	16	3.488	1.75	25.58	5.058	0.222	2.825	7.984	1.45
gamma-Chlordane	ug/kg	0	8	1.5	16	3.488	1.75	25.58	5.058	0.222	2.825	7.984	1.45
4,4'-DDD	ug/kg	6	8	1.6	126	27.73	8.45	1857	43.1	10.01	2.127	4.566	1.554
4,4'-DDE	ug/kg	8	8	5.3	1020	204.5	109.5	113133	336.4	124.8	2.607	7.053	1.645
4,4'-DDT	ug/kg	8	8	6.3	530	129.9	57.65	33750	183.7	68.79	1.875	3.153	1.415
Polychlorinated Biphenyls													
Aroclor 1260	ug/kg	0	8	37	47	41.75	41	9.929	3.151	3.706	0.233	-0.107	0.0755
Dioxins													
2,3,7,8-TCDD	ug/kg	0	4	180	220	200	200	266.7	16.33	14.83	0	1.5	0.0816
Inorganics													
Antimony	mg/kg	4	8	1.1	63.7	13	2.65	454.7	21.32	1.483	2.437	6.171	1.64
Arsenic	mg/kg	8	8	3	7.6	4.713	3.9	3.841	1.96	1.334	0.638	-1.658	0.416
Barium	mg/kg	8	8	32.2	1160	218.2	81.9	147906	384.6	63.97	2.715	7.497	1.763
Beryllium	mg/kg	7	8	0.086	1.3	0.492	0.285	0.254	0.504	0.156	1.343	-0.114	1.025
Cadmium	mg/kg	7	8	0.21	21.6	5.181	1.28	58.95	7.678	1.572	1.777	2.652	1.482
Chromium	mg/kg	8	8	7.6	126	39.64	18.65	1842	42.91	16.16	1.424	1.29	1.083
Cobalt	mg/kg	8	8	2.1	28	7.1	3.5	77.41	8.798	1.408	2.444	6.124	1.239
Copper	mg/kg	8	8	7.4	1790	362.2	18.4	417459	646.1	15.86	1.984	3.541	1.784
Lead	mg/kg	8	8	12.9	2120	404.1	70.6	522229	722.7	82.58	2.424	6.121	1.788
Manganese	mg/kg	8	8	110	1490	387.6	262.5	207599	455.6	166	2.583	6.962	1.175
Mercury	mg/kg	8	8	0.052	1.8	0.34	0.16	0.352	0.593	0.111	2.765	7.732	1.743
Nickel	mg/kg	8	8	3.9	502	82.11	10.7	29386	171.4	9.414	2.717	7.506	2.088
Selenium	mg/kg	2	8	1.4	4.4	2.55	2.4	0.714	0.845	0.297	1.498	4.161	0.331
Silver	mg/kg	7	8	0.18	84.5	14.51	0.935	868.1	29.46	0.993	2.451	6.112	2.031
Thallium	mg/kg	6	8	0.036	0.2	0.0946	0.089	0.00283	0.0532	0.0497	1.058	1.217	0.562
Vanadium	mg/kg	8	8	10.3	51	17.36	12.8	188.2	13.72	2.446	2.727	7.56	0.79
Zinc	mg/kg	8	8	20.6	4280	733.9	105.4	2128851	1459	124.7	2.638	7.145	1.988
Cyanide	mg/kg	0	8	0.25	0.32	0.281	0.27	6.41E-04	0.0253	0.0222	0.518	-1.34	0.09

G-3.1: Summary Stats for Surface Soil
Wallops CDL Baseline Ecological Risk Assessment

G-3.2: Summary Stats for Subsurface Soil
Wallops CDL Baseline Ecological Risk Assessment

Variable		Num Detects	Num Obs	All Detected and Detection Limit Observations									
				Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Volatile Organic Compounds													
1,2-Dichlorobenzene	ug/kg	0	17	4	770	209.2	7	84918	291.4	2.817	0.87	-1.076	1.393
1,4-Dichlorobenzene	ug/kg	0	17	4	770	209.2	7	84918	291.4	2.817	0.87	-1.076	1.393
Methyl Acetate	ug/kg	1	17	4	1190	233.9	7	124738	353.2	2.817	1.484	1.8	1.51
Methylcyclohexane	ug/kg	1	17	2.5	770	209	7	85002	291.6	3.855	0.87	-1.076	1.395
Tetrachloroethene	ug/kg	3	17	0.99	770	209.2	7	84931	291.4	6.227	0.87	-1.076	1.393
1,2,4-Trichlorobenzene	ug/kg	0	17	4	770	209.2	7	84918	291.4	2.817	0.87	-1.076	1.393
Semi-Volatile Organic Compounds													
2-Chlorophenol	ug/kg	0	17	170	1200	255.3	200	59514	244	14.83	4.094	16.83	0.956
2,4-Dichlorophenol	ug/kg	0	17	170	1200	255.3	200	59514	244	14.83	4.094	16.83	0.956
2,4-Dimethylphenol	ug/kg	0	17	170	1200	255.3	200	59514	244	14.83	4.094	16.83	0.956
2,4-Dinitrophenol	ug/kg	0	17	700	4700	1016	790	904174	950.9	74.13	4.099	16.86	0.935
4,6-Dinitro-o-cresol	ug/kg	0	17	700	4700	1016	790	904174	950.9	74.13	4.099	16.86	0.935
2-Methylphenol	ug/kg	0	17	170	1200	255.3	200	59514	244	14.83	4.094	16.83	0.956
3&4-Methylphenol	ug/kg	0	17	170	1200	255.3	200	59514	244	14.83	4.094	16.83	0.956
4-Nitrophenol	ug/kg	0	17	700	4700	1016	790	904174	950.9	74.13	4.099	16.86	0.935
Phenol	ug/kg	0	17	170	1200	255.3	200	59514	244	14.83	4.094	16.83	0.956
2,4,5-Trichlorophenol	ug/kg	0	17	170	1200	255.3	200	59514	244	14.83	4.094	16.83	0.956
2,4,6-Trichlorophenol	ug/kg	0	17	170	1200	255.3	200	59514	244	14.83	4.094	16.83	0.956
Acenaphthene	ug/kg	0	17	70	470	101.6	79	9042	95.09	7.413	4.099	16.86	0.935
Acenaphthylene	ug/kg	1	17	70	158	83.29	79	402.1	20.05	7.413	3.599	13.94	0.241
Anthracene	ug/kg	4	17	16.8	267	78.44	75	2898	53.84	7.413	2.763	10.44	0.686
Benzo(a)anthracene	ug/kg	5	17	24.3	2490	219.1	76	342859	585.5	8.895	4.115	16.95	2.672
Benzo(a)pyrene	ug/kg	4	17	58.8	1910	188.2	78	197046	443.9	7.413	4.117	16.96	2.358
Benzo(b)fluoranthene	ug/kg	4	17	70	1390	161.4	79	100515	317	7.413	4.104	16.89	1.964
Benzo(g,h,i)perylene	ug/kg	4	17	62.3	1180	141.3	76	71695	267.8	7.413	4.118	16.97	1.895
Benzo(k)fluoranthene	ug/kg	4	17	70	1030	136.8	79	53065	230.4	7.413	4.111	16.93	1.683
Chrysene	ug/kg	5	17	19.1	4040	313.7	78	922556	960.5	8.895	4.119	16.98	3.062
Dibenzo(a,h)anthracene	ug/kg	3	17	22.6	388	90.09	76	6256	79.09	7.413	3.694	14.76	0.878
bis(2-Ethylhexyl)phthalate	ug/kg	6	17	51.9	470	109.6	79	9715	98.56	13.34	3.459	12.71	0.899
Fluoranthene	ug/kg	6	17	23	1790	187.1	76	172146	414.9	8.895	4.062	16.64	2.218
Fluorene	ug/kg	0	17	70	470	101.6	79	9042	95.09	7.413	4.099	16.86	0.935

G-3.2: Summary Stats for Subsurface Soil
Wallops CDL Baseline Ecological Risk Assessment

Variable		Num Detects	Num Obs	All Detected and Detection Limit Observations									
				Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Semi-Volatile Organic Compounds													
Indeno(1,2,3-cd)pyrene	ug/kg	4	17	61.3	617	106.7	75	17346	131.7	7.413	4.101	16.87	1.234
Phenanthrene	ug/kg	5	17	25.6	2230	197.8	75	274568	524	8.895	4.115	16.95	2.649
Pyrene	ug/kg	6	17	21.3	4740	358.2	76	1276281	1130	8.895	4.116	16.96	3.154
Pesticides													
alpha-Chlordane	ug/kg	1	17	1.4	26.7	3.935	1.6	46.56	6.823	0.148	2.98	8.535	1.734
gamma-Chlordane	ug/kg	1	17	1.4	34.6	4.4	1.6	72.71	8.527	0.148	3.288	11	1.938
4,4'-DDD	ug/kg	11	17	1.3	197	36.85	5.6	4120	64.19	6.227	1.88	2.245	1.742
4,4'-DDE	ug/kg	14	17	1.4	1310	272.2	53.2	178633	422.7	76.65	1.558	1.099	1.552
4,4'-DDT	ug/kg	14	17	1.4	577	136.9	19.4	45212	212.6	26.69	1.555	0.822	1.554
Polychlorinated Biphenyls													
Aroclor 1260	ug/kg	1	17	35	213	50.12	40	1771	42.09	4.448	4.085	16.78	0.84
Dioxins													
2,3,7,8-TCDD	ug/kg	0	9	170	220	194.4	200	252.8	15.9	14.83	0.00987	-0.663	0.0818
Inorganics													
Antimony	mg/kg	8	17	1.1	63.7	13.85	2.6	396.4	19.91	0.741	1.935	2.879	1.437
Arsenic	mg/kg	17	17	1.7	8.4	4.418	3.9	4.824	2.196	1.631	0.54	-0.975	0.497
Barium	mg/kg	17	17	15.9	1160	205.2	55.8	126173	355.2	59.15	2.472	4.977	1.731
Beryllium	mg/kg	13	17	0.086	1.9	0.494	0.29	0.265	0.515	0.163	1.828	2.637	1.041
Cadmium	mg/kg	12	17	0.21	75.3	8.905	0.76	341.3	18.47	0.815	3.265	11.62	2.074
Chromium	mg/kg	17	17	5.3	616	62.8	13.5	21380	146.2	9.489	3.804	15.02	2.328
Cobalt	mg/kg	17	17	1.5	28	5.194	3.2	39.47	6.282	1.334	3.363	12.23	1.209
Copper	mg/kg	17	17	3	5100	683.4	10.7	1974563	1405	11.42	2.49	6.063	2.056
Lead	mg/kg	17	17	3.4	2120	432.8	20.2	401849	633.9	24.91	1.576	1.871	1.465
Manganese	mg/kg	17	17	40.4	1490	354.2	233	186806	432.2	152.7	2.293	4.407	1.22
Mercury	mg/kg	17	17	0.014	1.8	0.233	0.16	0.173	0.416	0.147	3.728	14.67	1.79
Nickel	mg/kg	17	17	2.9	502	53.95	6.2	14623	120.9	4.893	3.572	13.55	2.241
Selenium	mg/kg	4	17	0.93	4.4	2.272	2.3	0.507	0.712	0.148	1.218	5.098	0.313
Silver	mg/kg	11	17	0.18	84.5	12.39	1.2	520.2	22.81	1.26	2.408	5.969	1.841
Thallium	mg/kg	11	17	0.03	0.2	0.0912	0.099	0.00224	0.0473	0.0652	0.572	-0.0948	0.519
Vanadium	mg/kg	17	17	7	51	14.86	12.8	92.45	9.615	2.669	3.69	14.58	0.647
Zinc	mg/kg	17	17	7.4	4280	731	64.7	1631952	1277	84.95	2.211	4.169	1.748
Cyanide	mg/kg	0	17	0.23	0.32	0.266	0.26	6.62E-04	0.0257	0.0148	0.619	-0.0413	0.0965

G-3.2: Summary Stats for Subsurface Soil
Wallops CDL Baseline Ecological Risk Assessment

G-3.3: Summary Stats for Water
Wallops CDL Baseline Ecological Risk Assessment

Variable		Num Detects	Num Obs	All Detected and Detection Limit Observations									
				Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Volatile Organic Compounds													
cis-1,3-Dichloropropene	ug/L	0	6	1	1	1	1	0	0	0	N/A	N/A	0
trans-1,3-Dichloropropene	ug/L	0	6	1	1	1	1	0	0	0	N/A	N/A	0
Semi-Volatile Organic Compounds													
Pentachlorophenol	ug/L	0	6	20	24	21.92	22.25	2.642	1.625	1.853	-0.249	-1.503	0.0742
Anthracene	ug/L	0	6	2	2.4	2.192	2.225	0.0264	0.163	0.185	-0.249	-1.503	0.0742
Atrazine	ug/L	0	6	5	5.9	5.458	5.575	0.142	0.377	0.334	-0.475	-1.726	0.0691
Benzo(a)anthracene	ug/L	0	6	2	2.4	2.192	2.225	0.0264	0.163	0.185	-0.249	-1.503	0.0742
Benzo(a)pyrene	ug/L	0	6	2	2.4	2.192	2.225	0.0264	0.163	0.185	-0.249	-1.503	0.0742
Fluoranthene	ug/L	0	6	2	2.4	2.192	2.225	0.0264	0.163	0.185	-0.249	-1.503	0.0742
Hexachlorobenzene	ug/L	0	6	2	2.4	2.192	2.225	0.0264	0.163	0.185	-0.249	-1.503	0.0742
Phenanthrene	ug/L	0	6	2	2.4	2.192	2.225	0.0264	0.163	0.185	-0.249	-1.503	0.0742
Pyrene	ug/L	0	6	2	2.4	2.192	2.225	0.0264	0.163	0.185	-0.249	-1.503	0.0742
Pesticides													
alpha-Chlordane	ug/L	0	6	0.02	0.023	0.0217	0.022	1.07E-06	0.00103	7.41E-04	-0.666	0.586	0.0477
gamma-Chlordane	ug/L	0	6	0.02	0.023	0.0217	0.022	1.07E-06	0.00103	7.41E-04	-0.666	0.586	0.0477
4,4'-DDT	ug/L	0	6	0.02	0.023	0.0217	0.022	1.07E-06	0.00103	7.41E-04	-0.666	0.586	0.0477
Heptachlor	ug/L	0	6	0.02	0.023	0.0217	0.022	1.07E-06	0.00103	7.41E-04	-0.666	0.586	0.0477
Heptachlor epoxide	ug/L	0	6	0.02	0.023	0.0217	0.022	1.07E-06	0.00103	7.41E-04	-0.666	0.586	0.0477
Methoxychlor	ug/L	0	6	0.05	0.058	0.0541	0.0548	7.64E-06	0.00276	0.00222	-0.219	0.147	0.0511
Toxaphene	ug/L	0	6	0.25	0.29	0.268	0.27	1.77E-04	0.0133	0.00741	0.44	1.335	0.0495
Polychlorinated Biphenyls													
Aroclor 1016	ug/L	0	6	0.5	0.58	0.541	0.548	7.64E-04	0.0276	0.0222	-0.219	0.147	0.0511
Aroclor 1221	ug/L	0	6	0.5	0.58	0.541	0.548	7.64E-04	0.0276	0.0222	-0.219	0.147	0.0511
Aroclor 1232	ug/L	0	6	0.5	0.58	0.541	0.548	7.64E-04	0.0276	0.0222	-0.219	0.147	0.0511
Aroclor 1242	ug/L	0	6	0.5	0.58	0.541	0.548	7.64E-04	0.0276	0.0222	-0.219	0.147	0.0511
Aroclor 1248	ug/L	0	6	0.5	0.58	0.541	0.548	7.64E-04	0.0276	0.0222	-0.219	0.147	0.0511
Aroclor 1254	ug/L	0	6	0.5	0.58	0.541	0.548	7.64E-04	0.0276	0.0222	-0.219	0.147	0.0511
Aroclor 1260	ug/L	0	6	0.5	0.58	0.541	0.548	7.64E-04	0.0276	0.0222	-0.219	0.147	0.0511

G-3.3: Summary Stats for Water
Wallops CDL Baseline Ecological Risk Assessment

Variable		Num Detects	Num Obs	All Detected and Detection Limit Observations									
				Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Inorganics													
Aluminum	ug/L	6	6	112	1060	352.7	186.5	133385	365.2	91.18	1.976	3.882	1.036
Arsenic	ug/L	6	6	7	11.1	9.233	9.25	2.607	1.615	2.224	-0.169	-1.316	0.175
Barium	ug/L	6	6	14.55	27.6	18.39	16.95	23.58	4.856	3.373	1.764	3.302	0.264
Cadmium	ug/L	0	6	4	4	4	4	0	0	0	N/A	N/A	0
Chromium	ug/L	2	6	0.98	10	7.163	10	19.42	4.406	0	-0.992	-1.735	0.615
Cobalt	ug/L	0	6	50	50	50	50	0	0	0	N/A	N/A	0
Copper	ug/L	3	6	3.3	25	14.52	14.95	132.1	11.5	14.9	-0.00807	-3.311	0.792
Iron	ug/L	6	6	228	1030	479.9	397.5	82823	287.8	165.7	1.807	3.62	0.6
Lead	ug/L	2	6	3	4	3.183	3	0.162	0.402	0	2.397	5.786	0.126
Mercury	ug/L	2	6	0.0785	0.2	0.162	0.2	0.00356	0.0596	0	-0.987	-1.76	0.369
Nickel	ug/L	1	6	2.9	40	33.82	40	229.4	15.15	0	-2.449	6	0.448
Selenium	ug/L	6	6	6.6	11.8	9.208	9.25	4.268	2.066	2.854	-0.035	-1.678	0.224
Silver	ug/L	0	6	10	10	10	10	0	0	0	N/A	N/A	0
Thallium	ug/L	0	6	1	5	3	3	4.8	2.191	2.965	0	-3.333	0.73
Cyanide	ug/L	0	6	0.01	0.01	0.01	0.01	0	0	0	N/A	N/A	0

G-3.4: Summary Stats for Sediments
Wallops CDL Baseline Ecological Risk Assessment

All Detected and Detection Limit Observations

Variable		Num Detects	Num Obs	Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Volatile Organic Compounds													
2-Butanone (MEK)	ug/kg	2	10	11	164	61.48	37.4	2254	47.48	22.83	1.378	1.298	0.772
Carbon disulfide	ug/kg	7	10	4.3	60	18.03	9.6	333.2	18.25	3.929	1.756	2.399	1.013
Chlorobenzene	ug/kg	0	10	5.5	60	26.35	20.5	247.2	15.72	11.86	1.036	1.179	0.597
Cyclohexane	ug/kg	1	10	5.5	60	24.97	18.08	249	15.78	5.189	1.329	1.754	0.632
1,2-Dichlorobenzene	ug/kg	0	10	5.5	60	26.35	20.5	247.2	15.72	11.86	1.036	1.179	0.597
cis-1,3-Dichloropropene	ug/kg	0	10	5.5	60	26.35	20.5	247.2	15.72	11.86	1.036	1.179	0.597
trans-1,3-Dichloropropene	ug/kg	0	10	5.5	60	26.35	20.5	247.2	15.72	11.86	1.036	1.179	0.597
Methyl Acetate	ug/kg	1	10	5.5	60	30.71	28	331.1	18.2	16.31	0.552	-0.646	0.593
Semi-Volatile Organic Compounds													
2-Chlorophenol	ug/kg	0	10	200	1300	658	510	117329	342.5	274.3	0.778	-0.187	0.521
Acenaphthene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Acenaphthylene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Anthracene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Benzo(a)anthracene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Benzo(a)pyrene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Benzo(b)fluoranthene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Benzo(g,h,i)perylene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Benzo(k)fluoranthene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Chrysene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Dibenzo(a,h)anthracene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Dibenzofuran	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Di-n-octyl phthalate	ug/kg	1	10	80	3080	522	205	818996	905	118.6	3.083	9.626	1.734
bis(2-Ethylhexyl)phthalate	ug/kg	3	10	161	162000	16824	205	2.60E+09	51026	58.56	3.158	9.982	3.033
Fluoranthene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Fluorene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Hexachlorobenzene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Indeno(1,2,3-cd)pyrene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Phenanthrene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137
Pyrene	ug/kg	0	10	80	5100	721.5	205	2377489	1542	107.5	3.136	9.877	2.137

G-3.4: Summary Stats for Sediments
Wallops CDL Baseline Ecological Risk Assessment

All Detected and Detection Limit Observations

Variable		Num Detects	Num Obs	Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Pesticides													
Aldrin	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
alpha-BHC	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
beta-BHC	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Gamma-BCH (Lindane)	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
alpha-Chlordane	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
gamma-Chlordane	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
4,4'-DDD	ug/kg	1	5	9.6	19	12.72	11	13.79	3.714	2.076	1.685	2.959	0.292
4,4'-DDE	ug/kg	2	6	9.6	149	37.73	15	3014	54.9	6.968	2.373	5.696	1.455
4,4'-DDT	ug/kg	1	5	9.6	19	12.28	11	14.45	3.802	0.297	2.099	4.574	0.31
Endrin	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Endrin aldehyde	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Endrin ketone	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Endosulfan sulfate	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Endosulfan-I	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Endosulfan-II	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Heptachlor	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Heptachlor epoxide	ug/kg	0	10	1.6	29	14.77	12	64.27	8.017	5.856	0.393	0.0855	0.543
Methoxychlor	ug/kg	0	10	4	72	37.25	31	404.3	20.11	15.2	0.327	-0.0666	0.54
Polychlorinated Biphenyls													
Aroclor 1016	ug/kg	0	10	40	720	373.5	310	40600	201.5	159.4	0.31	-0.11	0.539
Aroclor 1221	ug/kg	0	10	40	720	373.5	310	40600	201.5	159.4	0.31	-0.11	0.539
Aroclor 1232	ug/kg	0	10	40	720	373.5	310	40600	201.5	159.4	0.31	-0.11	0.539
Aroclor 1242	ug/kg	0	10	40	720	373.5	310	40600	201.5	159.4	0.31	-0.11	0.539
Aroclor 1248	ug/kg	0	10	40	720	373.5	310	40600	201.5	159.4	0.31	-0.11	0.539
Aroclor 1254	ug/kg	0	10	40	720	373.5	310	40600	201.5	159.4	0.31	-0.11	0.539
Aroclor 1260	ug/kg	0	10	40	720	373.5	310	40600	201.5	159.4	0.31	-0.11	0.539
Inorganics													
Aluminum	mg/kg	10	10	7770	22300	16747	17650	29578090	5439	6746	-0.391	-1.457	0.325
Antimony	mg/kg	1	10	1.8	3.4	2.68	2.6	0.224	0.473	0.297	0.038	0.649	0.177
Arsenic	mg/kg	10	10	3	19.05	10.55	9.1	29.56	5.437	5.93	0.369	-0.671	0.516
Barium	mg/kg	10	10	21.5	85.2	41.64	43.25	314	17.72	9.155	1.692	4.225	0.426
Beryllium	mg/kg	10	10	0.2	0.61	0.439	0.518	0.0315	0.177	0.137	-0.436	-1.971	0.404

G-3.4: Summary Stats for Sediments
Wallops CDL Baseline Ecological Risk Assessment

All Detected and Detection Limit Observations

Variable		Num Detects	Num Obs	Min	Max	Mean	Median	Variance	SD	MAD/ 0.675	Skewness	Kurtosis	CV
Inorganics (Continued)													
Cadmium	mg/kg	4	10	0.21	1.5	0.731	0.63	0.15	0.388	0.326	0.827	0.446	0.53
Chromium	mg/kg	10	10	8.6	49.6	31.49	30.53	207.9	14.42	20.57	-0.163	-1.465	0.458
Copper	mg/kg	9	9	8.8	56.5	23.72	20.3	207.4	14.4	2.372	1.709	3.202	0.607
Iron	mg/kg	10	10	5670	30800	20757	22525	74822601	8650	8599	-0.527	-1.116	0.417
Lead	mg/kg	10	10	8.9	96.9	29.96	22.2	658.4	25.66	11.38	2.337	5.972	0.857
Mercury	mg/kg	9	10	0.036	0.49	0.131	0.0875	0.0183	0.135	0.0378	2.493	6.616	1.033
Nickel	mg/kg	10	10	5.6	21.8	15.71	17.63	37.65	6.136	5.893	-0.529	-1.443	0.391
Selenium	mg/kg	8	10	1.4	3.4	1.91	1.75	0.343	0.586	0.222	2.204	5.08	0.307
Silver	mg/kg	4	10	0.24	1.7	1.14	1.3	0.274	0.523	0.445	-0.788	-0.79	0.459
Thallium	mg/kg	10	10	0.079	0.28	0.182	0.165	0.00495	0.0704	0.0667	0.198	-1.364	0.387
Vanadium	mg/kg	10	10	12.7	53.7	38.64	41.35	226.7	15.06	16.16	-0.434	-1.409	0.39
Zinc	mg/kg	10	10	36.7	324	95.51	78.4	7131	84.44	41.92	2.614	7.499	0.884
Cyanide	mg/kg	0	10	0.28	1.6	0.876	0.65	0.218	0.467	0.363	0.642	-1.013	0.533

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APPENDIX G-4

ProUCL INPUT AND OUTPUT DATA

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	Benzo(k)fluoranthene	29
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	bis(2-Ethylhexyl)phthalate	35
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	Methyl Acetate	3
	Methylcyclohexane	4
	Tetrachloroethene	5
	Acenaphthene	7
	Acenaphthylene	8
	Anthracene	9
	Benzo(a)anthracene	11
	Benzo(a)pyrene	13
	Benzo(b)fluoranthene	15
	Benzo(g,h,i)perylene	17
	Benzo(k)fluoranthene	19
	Chrysene	21
	Dibenzo(a,h)anthracene	23
	bis(2-Ethylhexyl)phthalate	25
	Fluoranthene	27
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	Pyrene	33
	2-Chlorophenol	35
	2,4-Dichlorophenol	36
	2,4-Dimethylphenol	37
	2,4-Dinitrophenol	38
	4,6-Dinitro-o-cresol	39
	2-Methylphenol	40
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	Arsenic	3
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	Iron	7
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	Acetone	1
	Carbon disulfide	3
	Aluminum	5
	Arsenic	6
	Barium	7
	Beryllium	8
	Chromium	9
	Cobalt	10
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APPENDIX G-4.1

Soil (0 – 0.5 ft) ProUCL Inputs

Appendix G-4.1
Soil (0-0.5') ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

1,2-Dichlorobenzene	D_1,2-Dichlorobenzene	1,4-Dichlorobenzene	D_1,4-Dichlorobenzene	Methyl Acetate	D_Methyl Acetate
5.8	0	5.8	0	5.8	0
770.0	0	770.0	0	1190.0	1
550.0	0	550.0	0	550.0	0
5.1	0	5.1	0	5.1	0
8.4	0	8.4	0	8.4	0
7.0	0	7.0	0	7.0	0
6.1	0	6.1	0	6.1	0
690.0	0	690.0	0	690.0	0

Methylcyclohexane	D_Methylcyclohexane	Tetrachloroethene	D_Tetrachloroethene	1,2,4-Trichlorobenzene	1,2,4-Trichlorobenzen
2.5	1	5.8	0	5.8	0
770.0	0	770.0	0	770.0	0
550.0	0	550.0	0	550.0	0
5.1	0	5.1	0	5.1	0
8.4	0	8.4	0	8.4	0
7.0	0	7.0	0	7.0	0
6.1	0	6.1	0	6.1	0
690.0	0	690.0	0	690.0	0

2-Chlorophenol	D_2-Chlorophenol	2,4-Dichlorophenol	D_2,4-Dichlorophenol	2,4-Dimethylphenol	D_2,4-Dimethylphenol
180.0	0	180.0	0	180.0	0
1200.0	0	1200.0	0	1200.0	0
210.0	0	210.0	0	210.0	0
200.0	0	200.0	0	200.0	0
220.0	0	220.0	0	220.0	0
200.0	0	200.0	0	200.0	0
200.0	0	200.0	0	200.0	0
230.0	0	230.0	0	230.0	0

2,4-Dinitrophenol	D_2,4-Dinitrophenol	4,6-Dinitro-o-cresol	D_4,6-Dinitro-o-cresol	2-Methylphenol	D_2-Methylphenol
740.0	0	740.0	0	180.0	0
4700.0	0	4700.0	0	1200.0	0
820.0	0	820.0	0	210.0	0
790.0	0	790.0	0	200.0	0
890.0	0	890.0	0	220.0	0
810.0	0	810.0	0	200.0	0
810.0	0	810.0	0	200.0	0
900.0	0	900.0	0	230.0	0

3&4-Methylphenol	D_3&4-Methylphenol	4-Nitrophenol	D_4-Nitrophenol	Phenol	D_Phenol
180.0	0	740	0	180.0	0
1200.0	0	4700	0	1200.0	0
210.0	0	820	0	210.0	0
200.0	0	790	0	200.0	0
220.0	0	890	0	220.0	0
200.0	0	810	0	200.0	0
200.0	0	810	0	200.0	0
230.0	0	900	0	230.0	0

2,4,5-Trichlorophenol	D_2,4,5-Trichlorophenc	2,4,6-Trichlorophenol	D_2,4,6-Trichlorophenc	Acenaphthene	D_Acenaphthene
180.0	0	180.0	0	74.0	0
1200.0	0	1200.0	0	470.0	0
210.0	0	210.0	0	82.0	0
200.0	0	200.0	0	79.0	0
220.0	0	220.0	0	89.0	0
200.0	0	200.0	0	81.0	0
200.0	0	200.0	0	81.0	0
230.0	0	230.0	0	90.0	0

Acenaphthylene	D_Acenaphthylene	Anthracene	D_Anthracene	Benzo(a)anthracene	D_Benzo(a)anthracene
74.0	0	74.0	0	74.0	0
158.0	1	267.0	1	2490.0	1
82.0	0	82.0	0	82.0	0
79.0	0	79.0	0	24.3	1
89.0	0	22.2	1	53.4	1
81.0	0	81.0	0	81.0	0
81.0	0	16.8	1	114.0	1
90.0	0	90.0	0	90.0	0

Benzo(a)pyrene	D_Benzo(a)pyrene	Benzo(b)fluoranthene	D_Benzo(b)fluoranthen	Benzo(g,h,i)perylene	D_Benzo(g,h,i)perylene
74.0	0	74.0	0	74.0	0
1910.0	1	1390.0	1	1180.0	1
82.0	0	82.0	0	82.0	0
79.0	0	79.0	0	79.0	0
58.8	1	98.7	1	85.0	1
81.0	0	81.0	0	81.0	0
106.0	1	114.0	1	66.6	1
90.0	0	90.0	0	90.0	0

Appendix G-4.1
Soil (0-0.5') ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

Benzo(k)fluoranthene	D_Benzo(k)fluoranthen	Chrysene	D_Chrysene	Dibenzo(a,h)anthracene	D_Dibenzo(a,h)anthracene
74.0	0	74.0	0	74	0
1030.0	1	4040.0	1	388	1.0
82.0	0	82.0	0	82	0
79.0	0	19.1	1	79	0
95.5	1	111.0	1	89	0
81.0	0	81.0	0	81	0
85.7	1	117.0	1	22.6	1.0
90.0	0	90.0	0	90	0

is(2-Ethylhexyl)phthalat	bis(2-Ethylhexyl)phthal	Fluoranthene	D_Fluoranthene	Indeno(1,2,3-cd)pyrene	D_Indeno(1,2,3-cd)pyrene
74.0	0	74.0	0	74.0	0.0
470.0	0	1790.0	1	617.0	1.0
82.0	0	82.0	0	82.0	0.0
79.0	0	39.9	1	79.0	0.0
111.0	1	176.0	1	63.7	1.0
97.4	1	23.0	1	81.0	0.0
52.5	1	164.0	1	61.3	1.0
90.0	0	90.0	0	90.0	0.0

Phenanthrene	D_Phenanthrene	Pyrene	D_Pyrene	alpha-Chlordane	D_alpha-Chlordane
74.0	0	74.0	0	1.5	0.0
2230.0	1	4740.0	1	1.9	0.0
82.0	0	82.0	0	1.7	0.0
26.2	1	35.3	1	1.6	0.0
25.6	1	159.0	1	1.8	0.0
81.0	0	21.3	1	1.6	0.0
83.1	1	153.0	1	16.0	0.0
90.0	0	90.0	0	1.8	0.0

gamma-Chlordane	D_gamma-Chlordane	4,4'-DDD	D_4,4'-DDD	4,4'-DDE	D_4,4'-DDE
1.5	0	5.6	1	119.0	1.0
1.9	0	11.3	1	137.0	1.0
1.7	0	1.9	1	15.9	1.0
1.6	0	1.6	0	34.7	1.0
1.8	0	22.7	1	204.0	1.0
1.6	0	50.9	1	99.9	1.0
16.0	0	126.0	1	1020.0	1.0
1.8	0	1.8	0	5.3	1.0

Appendix G-4.1
Soil (0-0.5') ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

4,4'-DDT	D_4,4'-DDT	Aroclor 1260	D_Aroclor 1260	2,3,7,8-TCDD	D_2,3,7,8-TCDD
58.9	1	37.0	0	180.0	0
274.0	1	47.0	0		
11.8	1	41.0	0		
10.7	1	39.0	0		
90.8	1	44.0	0	220.0	0
56.4	1	41.0	0	200.0	0
530.0	1	41.0	0	200.0	0
6.3	1	44.0	0		

Antimony	D_Antimony	Arsenic	D_Arsenic	Barium	D_Barium
2.2	0	3.5	1	44.1	1
1.1	1	3	1	195	1
2.6	0	3	1	33.4	1
2.4	0	7.6	1	32.2	1
63.7	1	7.2	1	1160	1
18	1	4.3	1	117	1
11.3	1	6.1	1	108	1
2.7	0	3	1	55.8	1

Beryllium	D_Beryllium	Cadmium	D_Cadmium	Chromium	D_Chromium
1.3	1	0.55	0	7.9	1
0.18	1	0.76	1	126	1
0.18	1	0.23	1	7.6	1
0.28	1	0.21	1	13.5	1
1.3	0	21.6	1	49.8	1
0.29	1	4.7	1	23.8	1
0.086	1	11.6	1	78.3	1
0.32	1	1.8	1	10.2	1

Cobalt	D_Cobalt	Copper	D_Copper	Iron	D_Iron
3.2	1	7.4	1	6850	1
28	1	10.7	1	24800	1
2.1	1	8	1	5640	1
2.5	1	8.3	1	6350	1
9.9	1	854	1	45100	1
3.8	1	193	1	11800	1
4.4	1	1790	1	12300	1
2.9	1	26.1	1	7070	1

Appendix G-4.1
Soil (0-0.5') ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

Lead	D_Lead	Manganese	D_Manganese	Mercury	D_Mercury
20.2	1	130	1	0.052	1
121	1	372	1	0.23	1
12.9	1	110	1	0.08	1
17.5	1	148	1	0.16	1
2120	1	1490	1	1.8	1
351	1	292	1	0.18	1
573	1	326	1	0.16	1
16.9	1	233	1	0.061	1

Nickel	D_Nickel	Selenium	D_Selenium	Silver	D_Silver
5.3	1	2.2	0	0.35	1
502	1	1.4	1	0.38	1
3.9	1	2.6	0	0.57	1
4.8	1	2.4	0	0.18	1
51.1	1	4.4	1	84.5	1
15.7	1	2.4	0	4.3	1
68.4	1	2.3	0	24.5	1
5.7	1	2.7	0	1.3	0

Thallium	D_Thallium	Vanadium	D_Vanadium	Zinc	D_Zinc
0.2	1	12.8	1	20.6	1
0.099	1	10.3	1	146	1
0.036	1	10.3	1	21.9	1
0.05	1	12	1	26.7	1
0.053	1	51	1	4280	1
0.12	0	16.1	1	603	1
0.12	0	12.8	1	708	1
0.079	1	13.6	1	64.7	1

Cyanide	D_Cyanide
0.25	0
0.31	0
0.3	0
0.27	0
0.32	0
0.27	0
0.26	0

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APPENDIX G-4.2

Soil (0 – 5.0 ft) ProUCL Inputs

Appendix G-4.2
Soil (0-5.0') ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

1,2-Dichlorobenzene	D_1,2-Dichlorobenzene	1,4-Dichlorobenzene	D_1,4-Dichlorobenzene	Methyl Acetate	D_Methyl Acetate
5.8	0	5.8	0	5.8	0
6.0	0	6.0	0	1190.0	1
770.0	0	770.0	0	550.0	0
490.0	0	490.0	0	5.1	0
550.0	0	550.0	0	8.4	0
480.0	0	480.0	0	7.0	0
5.1	0	5.1	0	6.1	0
4.4	0	4.4	0	690.0	0
8.4	0	8.4	0	6.0	0
5.2	0	5.2	0	490.0	0
8.6	0	8.6	0	480.0	0
7.0	0	7.0	0	4.4	0
4.0	0	4.0	0	5.2	0
6.1	0	6.1	0	4.0	0
5.4	0	5.4	0	5.4	0
690.0	0	690.0	0	510.0	0
510.0	0	510.0	0	8.6	0

Methylcyclohexane	D_Methylcyclohexane	Tetrachloroethene	D_Tetrachloroethene	2-Chlorophenol	D_2-Chlorophenol
2.5	1	5.8	0	180.0	0
770.0	0	770.0	0	170.0	0
550.0	0	550.0	0	1200.0	0
5.1	0	5.1	0	190.0	0
8.4	0	8.4	0	210.0	0
7.0	0	7.0	0	180.0	0
6.1	0	6.1	0	200.0	0
690.0	0	690.0	0	180.0	0
6.0	0	6.0	0	220.0	0
490.0	0	490.0	0	180.0	0
480.0	0	480.0	0	210.0	0
4.4	0	4.4	0	200.0	0
5.2	0	2.8	1	190.0	0
4.0	0	1.0	1	200.0	0
5.4	0	5.4	0	200.0	0
510.0	0	510.0	0	230.0	0
8.6	0	13.7	1	200.0	0

2,4-Dichlorophenol	D_2,4-Dichlorophenol	2,4-Dimethylphenol	D_2,4-Dimethylphenol	2,4-Dinitrophenol	D_2,4-Dinitrophenol
180	0	180	0	740	0
170	0	170	0	700	0
1200	0	1200	0	4700	0
190	0	190	0	760	0
210	0	210	0	820	0
180	0	180	0	720	0
200	0	200	0	790	0
180	0	180	0	740	0
220	0	220	0	890	0
180	0	180	0	730	0
210	0	210	0	840	0
200	0	200	0	810	0
190	0	190	0	750	0
200	0	200	0	810	0
200	0	200	0	800	0
230	0	230	0	900	0
200	0	200	0	780	0

4,6-Dinitro-o-cresol	D_4,6-Dinitro-o-cresol	2-Methylphenol	D_2-Methylphenol	3&4-Methylphenol	D_3&4-Methylphenol
740	0	180	0	180	0
700	0	170	0	170	0
4700	0	1200	0	1200	0
760	0	190	0	190	0
820	0	210	0	210	0
720	0	180	0	180	0
790	0	200	0	200	0
740	0	180	0	180	0
890	0	220	0	220	0
730	0	180	0	180	0
840	0	210	0	210	0
810	0	200	0	200	0
750	0	190	0	190	0
810	0	200	0	200	0
800	0	200	0	200	0
900	0	230	0	230	0
780	0	200	0	200	0

4-Nitrophenol	D_4-Nitrophenol	Phenol	D_Phenol	2,4,5-Trichlorophenol	D_2,4,5-Trichlorophenol
740	0	180	0	180	0
700	0	170	0	170	0
4700	0	1200	0	1200	0
760	0	190	0	190	0
820	0	210	0	210	0
720	0	180	0	180	0
790	0	200	0	200	0
740	0	180	0	180	0
890	0	220	0	220	0
730	0	180	0	180	0
840	0	210	0	210	0
810	0	200	0	200	0
750	0	190	0	190	0
810	0	200	0	200	0
800	0	200	0	200	0
900	0	230	0	230	0
780	0	200	0	200	0

2,4,6-Trichlorophenol	D_2,4,6-Trichlorophenol	Acenaphthene	D_Acenaphthene	Acenaphthylene	D_Acenaphthylene
180	0	74	0	74	0
170	0	70	0	158	1
1200	0	470	0	82	0
190	0	76	0	79	0
210	0	82	0	89	0
180	0	72	0	81	0
200	0	79	0	81	0
180	0	74	0	90	0
220	0	89	0	70	0
180	0	73	0	76	0
210	0	84	0	72	0
200	0	81	0	74	0
190	0	75	0	73	0
200	0	81	0	75	0
200	0	80	0	80	0
230	0	90	0	78	0
200	0	78	0	84	0

Anthracene	D_Anthracene	Benzo(a)anthracene	D_Benzo(a)anthracene	Benzo(a)pyrene	D_Benzo(a)pyrene
74	0	74	0	74	0
267	1	2490	1	1910	1
82	0	82	0	82	0
79	0	24.3	1	79	0
22.2	1	53.4	1	58.8	1
81	0	81	0	81	0
16.8	1	114	1	106	1
90	0	90	0	90	0
70	0	70	0	70	0
76	0	76	0	76	0
72	0	72	0	72	0
74	0	74	0	74	0
73	0	73	0	73	0
75	0	75	0	75	0
19.5	1	114	1	117	1
78	0	78	0	78	0
84	0	84	0	84	0

enzo(b)fluoranthei	Benzo(b)fluoranth	Benzo(g,h,i)perylene	D_Benzo(g,h,i)perylene	Benzo(k)fluoranthene	D_Benzo(k)fluoranthene
74	0	74	0	74	0
1390	1	1180	1	1030	1
82	0	82	0	82	0
79	0	79	0	79	0
98.7	1	85	1	95.5	1
81	0	81	0	81	0
114	1	66.6	1	85.7	1
90	0	90	0	90	0
70	0	70	0	70	0
76	0	76	0	76	0
72	0	72	0	72	0
74	0	74	0	74	0
73	0	73	0	73	0
75	0	75	0	75	0
133	1	62.3	1	107	1
78	0	78	0	78	0
84	0	84	0	84	0

Chrysene	D_Chrysene	Dibenzo(a,h)anthracene	D_Dibenzo(a,h)anthracene	bis(2-Ethylhexyl)phthalate	D_bis(2-Ethylhexyl)phthalate
74	0	74	0	74	0
4040	1	388	1	470	0
82	0	82	0	82	0
19.1	1	79	0	79	0
111	1	89	0	111	1
81	0	81	0	97.4	1
117	1	22.6	1	52.5	1
90	0	90	0	90	0
70	0	70	0	70	0
76	0	76	0	51.9	1
72	0	72	0	72	0
74	0	74	0	74	0
73	0	73	0	73	0
75	0	75	0	199	1
117	1	24	1	80	0
78	0	78	0	78	0
84	0	84	0	110	1

Fluoranthene	D_Fluoranthene	Indeno(1,2,3-cd)pyrene	D_Indeno(1,2,3-cd)pyrene	Phenanthrene	D_Phenanthrene
74	0	74	0	74	0
1790	1	617	1	2230	1
82	0	82	0	82	0
39.9	1	79	0	26.2	1
176	1	63.7	1	25.6	1
23	1	81	0	81	0
164	1	61.3	1	83.1	1
90	0	90	0	90	0
70	0	70	0	70	0
76	0	76	0	76	0
72	0	72	0	72	0
74	0	74	0	74	0
73	0	73	0	73	0
75	0	75	0	75	0
139	1	64.3	1	68.5	1
78	0	78	0	78	0
84	0	84	0	84	0

Pyrene	D_Pyrene	alpha-Chlordane	D_alpha-Chlordane	gamma-Chlordane	D_gamma-Chlordane
74	0	1.5	0	1.5	0
4740	1	1.9	0	1.9	0
82	0	1.7	0	1.7	0
35.3	1	1.6	0	1.6	0
159	1	1.8	0	1.8	0
21.3	1	1.6	0	1.6	0
153	1	16	0	16	0
90	0	1.8	0	1.8	0
70	0	1.4	0	1.4	0
76	0	1.5	0	1.5	0
72	0	1.5	0	1.5	0
74	0	1.5	0	1.5	0
73	0	26.7	1	34.6	1
75	0	1.5	0	1.5	0
132	1	1.6	0	1.6	0
78	0	1.6	0	1.6	0
84	0	1.7	0	1.7	0

4,4'-DDD	D_4,4'-DDD	4,4'-DDE	D_4,4'-DDE	4,4'-DDT	D_4,4'-DDT
5.6	1	119	1	58.9	1
11.3	1	137	1	274	1
1.9	1	15.9	1	11.8	1
1.6	0	34.7	1	10.7	1
22.7	1	204	1	90.8	1
50.9	1	99.9	1	56.4	1
126	1	1020	1	530	1
1.8	0	5.3	1	6.3	1
1.4	0	1.4	0	1.4	0
1.5	0	3.1	1	2.4	1
1.5	0	1.5	0	1.5	0
1.5	0	1.5	0	1.5	0
19.2	1	803	1	93.4	1
197	1	792	1	573	1
175	1	1310	1	577	1
1.3	1	26.7	1	19.4	1
6.2	1	53.2	1	18.3	1

Appendix G-4.2
Soil (0-5.0') ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

Aroclor 1260	D_Aroclor 1260	2,3,7,8-TCDD	D_2,3,7,8-TCDD	Aluminum	D_Aluminum	Cobalt	D_Cobalt
37	0	180	0	6960	1	3.2	1
47	0	170	0	6000	1	28	1
41	0	220	0	6870	1	2.1	1
39	0	180	0	7490	1	2.5	1
44	0	210	0	19900	1	9.9	1
41	0	200	0	9520	1	3.8	1
41	0	190	0	27300	1	4.4	1
44	0	200	0	9960	1	2.9	1
35	0	200	0	8970	1	2.3	1
38	0			8810	1	2	1
37	0			5740	1	1.5	1
37	0			8610	1	2.7	1
213	1			7060	1	2.6	1
37	0			9000	1	3.5	1
40	0			38600	1	5.1	1
39	0			12100	1	3.5	1
42	0			79300	1	8.3	1

Antimony	D_Antimony	Arsenic	D_Arsenic	Barium	D_Barium	Lead	D_Lead
2.2	0	3.5	1	44.1	1	20.2	1
1.1	1	3	1	195	1	121	1
2.6	0	3	1	33.4	1	12.9	1
2.4	0	7.6	1	32.2	1	17.5	1
63.7	1	7.2	1	1160	1	2120	1
18	1	4.3	1	117	1	351	1
11.3	1	6.1	1	108	1	573	1
2.7	0	3	1	55.8	1	16.9	1
2.2	0	1.8	1	19.8	1	3.4	1
2.2	0	1.7	1	29	1	5.6	1
2.1	0	1.7	1	15.9	1	3.6	1
2.3	0	3.9	1	40	1	5.4	1
18.8	1	3	1	213	1	1070	1
11.1	1	4.4	1	131	1	509	1
29.5	1	7.5	1	135	1	1450	1
2.5	0	5	1	49.1	1	7.3	1
60.8	1	8.4	1	1110	1	1070	1

Beryllium	D_Beryllium	Cadmium	D_Cadmium	Chromium	D_Chromium	Nickel	D_Nickel
1.3	1	0.55	0	7.9	1	5.3	1
0.18	1	0.76	1	126	1	502	1
0.18	1	0.23	1	7.6	1	3.9	1
0.28	1	0.21	1	13.5	1	4.8	1
1.3	0	21.6	1	49.8	1	51.1	1
0.29	1	4.7	1	23.8	1	15.7	1
0.086	1	11.6	1	78.3	1	68.4	1
0.32	1	1.8	1	10.2	1	5.7	1
0.16	1	0.55	0	7	1	4.9	1
0.19	1	0.54	0	8.4	1	4.7	1
0.1	1	0.53	0	5.3	1	2.9	1
0.33	1	0.57	0	8	1	5.1	1
0.56	0	7	1	19.9	1	18	1
0.23	1	3.9	1	19.1	1	10	1
0.6	0	21.1	1	616	1	132	1
0.4	1	0.45	1	10.9	1	6.2	1
1.9	0	75.3	1	55.9	1	76.5	1

Appendix G-4.2
Soil (0-5.0') ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

Copper	D_Copper	Iron	D_Iron	Thallium	D_Thallium
7.4	1	6850	1	0.2	1
10.7	1	24800	1	0.099	1
8	1	5640	1	0.036	1
8.3	1	6350	1	0.05	1
854	1	45100	1	0.053	1
193	1	11800	1	0.12	0
1790	1	12300	1	0.12	0
26.1	1	7070	1	0.079	1
4.3	1	5210	1	0.044	1
4	1	6640	1	0.055	1
3	1	3520	1	0.03	1
5.3	1	5970	1	0.045	1
416	1	8680	1	0.11	0
119	1	10400	1	0.11	0
5100	1	16500	1	0.12	0
8.7	1	8600	1	0.15	1
3060	1	96200	1	0.13	0

Manganese	D_Manganese	Mercury	D_Mercury	Cyanide	D_Cyanide
130	1	0.052	1	0.25	0
372	1	0.23	1	0.25	0
110	1	0.08	1	0.31	0
148	1	0.16	1	0.23	0
1490	1	1.8	1	0.3	0
292	1	0.18	1	0.25	0
326	1	0.16	1	0.27	0
233	1	0.061	1	0.26	0
40.4	1	0.014	1	0.32	0
65.4	1	0.022	1	0.23	0
45.7	1	0.025	1	0.28	0
154	1	0.04	1	0.27	0
261	1	0.34	1	0.26	0
286	1	0.19	1	0.26	0
398	1	0.18	1	0.28	0
230	1	0.091	1	0.27	0
1440	1	0.33	1	0.24	0

Selenium	D_Selenium	Silver	D_Silver
2.2	0	0.35	1
1.4	1	0.38	1
2.6	0	0.57	1
2.4	0	0.18	1
4.4	1	84.5	1
2.4	0	4.3	1
2.3	0	24.5	1
2.7	0	1.3	0
2.2	0	1.1	0
2.2	0	1.1	0
2.1	0	1.1	0
2.3	0	1.1	0
2.2	0	9	1
2.3	0	2.7	1
0.93	1	31.7	1
2.5	0	1.2	0
1.5	1	45.5	1

Appendix G-4.2
Soil (0-5.0') ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

Vanadium	D_Vanadium	Zinc	D_Zinc
12.8	1	20.6	1
10.3	1	146	1
10.3	1	21.9	1
12	1	26.7	1
51	1	4280	1
16.1	1	603	1
12.8	1	708	1
13.6	1	64.7	1
9.9	1	7.4	1
12.7	1	17.7	1
7	1	7.7	1
11.8	1	16.4	1
12	1	1190	1
14	1	554	1
15.4	1	1140	1
16.3	1	22.1	1
14.6	1	3600	1

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APPENDIX G-4.3

Surface Water Pro UCL Inputs

Appendix G-4.3
Surface Water ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

Aluminum	D_Aluminum	Arsenic	D_Arsenic	Barium	D_Barium	Iron	D_Iron
ug/l		ug/l		ug/l		ug/l	
208	1	10.9	1	27.6	1	415	1
1060	1	9.3	1	19.5	1	1030	1
165	1	9.2	1	14.8	1	380	1
433	1	7.9	1	17.1	1	525	1
118	1	11.7	1	14.7	1	308	1
138	1	7	1	16.8	1	228	1

Manganese	D_Manganes	Selenium	D_Selenium
ug/l		ug/l	
40.1	1	6.6	1
30.9	1	9.7	1
43.5	1	8.8	1
21.3	1	11.1	1
43.2	1	7.6	1
20.9	1	11.8	1

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APPENDIX G-4.4

Sediment ProUCL Inputs

Appendix G-4.4
Sediment ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

Acetone	D_Acetone	Benzene	D_Benzene
33	0	3.3	0
38.4	1	3.6	0
32.3	1	3.3	0
65	0	65	0
96.6	1	12	0
28	1	3.5	0
79	0	7.9	0
220	1	7	0
57.9	1	4.6	0
11	0	1.1	0

Carbon disulfide	D_Carbon disulfide	Cyclohexane	D_Cyclohexane
4.3	1	16	0
9.1	1	18	0
9.6	1	16	0
23.65	1	18.15	1
60	0	60	0
10.1	1	18	0
40	0	40	0
8.4	1	35	0
9.6	1	23	0
5.5	0	5.5	0

Methylene chloride	D_Methylene chloride	Di-n-octyl phthalate	D_Di-n-octyl phthalate
16	0	170	0
18	0	190	0
16	0	180	0
9.2	1	340	0
60	0	3080	1
18	0	180	0
40	0	440	0
35	0	340	0
23	0	220	0
5.5	0	80	0

4,4'-DDD	D_4,4'-DDD	4,4'-DDE	D_4,4'-DDE
9.6	0	9.6	0
11	0	11	0
11	0	11	0
19	0	19	0
29	0	29	0
11	0	11	0
25	0	25	0
19	0	19	0
13	1	149	1
1.6	0	26.8	1

Appendix G-4.4
Sediment ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

2-Butanone (MEK)	D_2-Butanone (MEK)	Aluminum	D_Aluminum	Antimony	D_Antimony
33	0	11000	1	2.5	0
36	0	22300	1	2.8	0
33	0	21900	1	2.7	0
65	0	22100	1	2.5	0
120	0	17700	1	2.5	0
35	0	22100	1	1.8	0
79	0	12200	1	3.4	0
164	1	12800	1	3.4	0
38.8	1	17600	1	2.8	1
11	0	7770	1	2.4	0

Methyl Acetate	D_Methyl Acetate	Barium	D_Barium	Beryllium	D_Beryllium
58.6	1	21.5	1	0.31	1
18	0	45.7	1	0.6	1
16	0	44.2	1	0.55	1
33	0	44.95	1	0.575	1
60	0	33.35	1	0.485	1
18	0	43	1	0.61	1
40	0	24.8	1	0.21	1
35	0	43.5	1	0.24	1
23	0	85.2	1	0.61	1
5.5	0	30.2	1	0.2	1

bis(2-Ethylhexyl)phthalate	D_bis(2-Ethylhexyl)phthalate	Chromium	D_Chromium	Cobalt	D_Cobalt
170	0	20	1	4.8	1
190	0	49.6	1	9.3	1
180	0	44.4	1	9.2	1
4360	1	47	1	9.25	1
162000	1	33.55	1	7	1
180	0	44.4	1	9.3	1
440	0	23.4	1	4.5	1
340	0	16.4	1	3	1
220	0	27.5	1	4.2	1
161	1	8.6	1	2	1

4,4'-DDT	D_4,4'-DDT	Iron	D_Iron	Lead	D_Lead
9.6	0	17600	1	12.8	1
11	0	28600	1	45.3	1
11	0	27500	1	19.7	1
19	0	28050	1	32.5	1
29	0	25650	1	16.25	1
11	0	30800	1	22.2	1
25	0	11500	1	8.9	1
19	0	12800	1	22.8	1
13	0	19400	1	96.9	1
10.8	1	5670	1	22.2	1

Appendix G-4.4
Sediment ProUCL Inputs
Wallops CDL Baseline Ecological Risk Assessment

Arsenic	D_Arsenic	Selenium	D_Selenium	Silver	D_Silver	Thallium	D_Thallium
9.7	1	1.6	1	1.2	0	0.12	1
8.5	1	1.8	1	0.24	1	0.28	1
8.1	1	1.8	1	1.4	0	0.26	1
8.3	1	1.8	1	1.3	0	0.27	1
19.05	1	1.6	1	1.3	0	0.21	1
12.9	1	1.6	1	0.41	1	0.18	1
4	1	3.4	0	1.7	0	0.15	1
18.6	1	1.4	1	1.7	0	0.15	1
13.3	1	1.7	1	1.5	1	0.12	1
3	1	2.4	0	0.65	1	0.079	1

Cadmium	D_Cadmium	Vanadium	D_Vanadium	Zinc	D_Zinc
0.62	0	30.3	1	38.5	1
0.37	1	52.1	1	113	1
0.21	1	51.1	1	85.2	1
0.63	0	51.6	1	99.1	1
0.63	0	51.9	1	55.95	1
0.45	0	53.7	1	86.7	1
0.84	0	27.5	1	44.3	1
0.86	0	23.9	1	36.7	1
1.5	1	31.6	1	324	1
1.2	1	12.7	1	71.6	1

Copper	D_Copper
35.9	1
21.9	1
18.9	1
20.4	1
11.85	1
18.9	1
8.8	1
20.3	1
56.5	1
26.6	1

Mercury	D_Mercury
0.036	1
0.1	1
0.07	1
0.085	1
0.0405	1
0.09	1
0.21	0
0.12	1
0.49	1
0.069	1

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APPENDIX G-4.5

Soil (0 – 0.5 FT) ProUCL Output

Appendix G-4.5 - Soil (0-0.5 ft) ProUCL Output

COPEC	Page
1,2-Dichlorobenzene	1
1,4-Dichlorobenzene	2
Methyl Acetate	3
Methylcyclohexane	4
Tetrachloroethene	5
2-Chlorophenol	6
2,4-Dichlorophenol	7
2,4-Dimethylphenol	8
2,4-Dinitrophenol	9
4,6-Dinitro-o-cresol	10
2-Methylphenol	11
3&4-Methylphenol	12
4-Nitrophenol	13
Phenol	14
2,4,5-Trichlorophenol	15
2,4,6-Trichlorophenol	16
Acenaphthene	17
Acenaphthylene	18
Anthracene	19
Benzo(a)anthracene	21
Benzo(a)pyrene	23
Benzo(b)fluoranthene	25
Benzo(g,h,i)perylene	27
Benzo(k)fluoranthene	29
Chrysene	31
Dibenzo(a,h)anthracene	33
bis(2-Ethylhexyl)phthalate	35
Fluoranthene	37
Indeno(1,2,3-cd)pyrene	39
Phenanthrene	41
Pyrene	43
alpha-Chlordane	45
gamma-Chlordane	46
4,4'-DDD	47
4,4'-DDE	49
4,4'-DDT	51
Aroclor 1260	53
2,3,7,8-TCDD	54
Antimony	55
Arsenic	57
Barium	59
Beryllium	61
Cadmium	63
Chromium	65

Appendix G-4.5 - Soil (0-0.5 ft) ProUCL Output

COPEC	Page
Cobalt	67
Copper	69
Iron	71
Lead	73
Manganese	75
Mercury	77
Nickel	79
Selenium	81
Silver	83
Thallium	85
Vanadium	87
Zinc	89
Cyanide	91

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	C:\Documents and Settings\chris sargent\My Documents\Wallops\BERA\0-0.5 ProUCL Input.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2-Dichlorobenzene

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,2-Dichlorobenzene was not processed!

1,4-Dichlorobenzene

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,4-Dichlorobenzene was not processed!

Methyl Acetate

General Statistics

Number of Valid Data	8	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	7
		Percent Non-Detects	87.50%

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 Methyl Acetate was not processed!

Methylcyclohexane

General Statistics

Number of Valid Data	8	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	7
		Percent Non-Detects	87.50%

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 Methylcyclohexane was not processed!

Tetrachloroethene

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Tetrachloroethene was not processed!

2-Chlorophenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2-Chlorophenol was not processed!

2,4-Dichlorophenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4-Dichlorophenol was not processed!

2,4-Dimethylphenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4-Dimethylphenol was not processed!

2,4-Dinitrophenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4-Dinitrophenol was not processed!

4,6-Dinitro-o-cresol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 4,6-Dinitro-o-cresol was not processed!

2-Methylphenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2-Methylphenol was not processed!

3&4-Methylphenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 3&4-Methylphenol was not processed!

4-Nitrophenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 4-Nitrophenol was not processed!

Phenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Phenol was not processed!

2,4,5-Trichlorophenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4,5-Trichlorophenol was not processed!

2,4,6-Trichlorophenol

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4,6-Trichlorophenol was not processed!

Acenaphthene

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Acenaphthene was not processed!

Acenaphthylene

General Statistics

Number of Valid Data	8	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	7
		Percent Non-Detects	87.50%

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 Acenaphthylene was not processed!

Anthracene

General Statistics

Number of Valid Data	8	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	5
		Percent Non-Detects	62.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	16.8	Minimum Detected	2.821
Maximum Detected	267	Maximum Detected	5.587
Mean of Detected	102	Mean of Detected	3.836
SD of Detected	142.9	SD of Detected	1.523
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	7
For all methods (except KM, DL/2, and ROS Methods),.		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	87.50%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.766	Shapiro Wilk Test Statistic	0.825
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	63.63	Mean	3.752
SD	82.77	SD	0.819
95% DL/2 (t) UCL	119.1	95% H-Stat (DL/2) UCL	175.9
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.353
		SD in Log Scale	0.907
		Mean in Original Scale	51.63
		SD in Original Scale	87.04
		95% Percentile Bootstrap UCL	112.9
		95% BCA Bootstrap UCL	113.7

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.53
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Data Distribution Test with Detected Values Only	
Data appear Lognormal at 5% Significance Level	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	50.44
SD	81.89
SE of Mean	35.5
95% KM (t) UCL	117.7
95% KM (z) UCL	108.8
95% KM (jackknife) UCL	109.3
95% KM (bootstrap t) UCL	899.5
95% KM (BCA) UCL	267
95% KM (Percentile Bootstrap) UCL	267
95% KM (Chebyshev) UCL	205.2
97.5% KM (Chebyshev) UCL	272.1
99% KM (Chebyshev) UCL	403.7
Potential UCLs to Use	
97.5% KM (Chebyshev) UCL	272.1

Warning: Recommended UCL exceeds the maximum observation

Note: DL/2 is not a recommended method.

Benzo(a)anthracene

General Statistics

Number of Valid Data	8	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	4
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	24.3	Minimum Detected	3.19
Maximum Detected	2490	Maximum Detected	7.82
Mean of Detected	670.4	Mean of Detected	4.931
SD of Detected	1214	SD of Detected	2.027
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	75.00%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.658	Shapiro Wilk Test Statistic	0.888
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	355.7	Mean	4.32
SD	862.8	SD	1.48
95% DL/2 (t) UCL	933.6	95% H-Stat (DL/2) UCL	1525
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.225
		SD in Log Scale	1.527
		Mean in Original Scale	352.1
		SD in Original Scale	864.3
		95% Percentile Bootstrap UCL	956.1
		95% BCA Bootstrap UCL	1262

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.27
Theta Star	2479
nu star	2.163
A-D Test Statistic	0.567
5% A-D Critical Value	0.691
K-S Test Statistic	0.691
5% K-S Critical Value	0.414

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	24.3
Maximum	2490
Mean	694.5
Median	718.6
SD	794.9
k star	0.557
Theta star	1247
Nu star	8.91
AppChi2	3.273
95% Gamma Approximate UCL	1891
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	354.6
SD	807.6
SE of Mean	329.8
95% KM (t) UCL	979.4
95% KM (z) UCL	897.1
95% KM (jackknife) UCL	933.4
95% KM (bootstrap t) UCL	9514
95% KM (BCA) UCL	989.9
95% KM (Percentile Bootstrap) UCL	974.7
95% KM (Chebyshev) UCL	1792
97.5% KM (Chebyshev) UCL	2414
99% KM (Chebyshev) UCL	3636

Potential UCLs to Use

95% KM (t) UCL	979.4

Benzo(a)pyrene

General Statistics

Number of Valid Data	8	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	5
		Percent Non-Detects	62.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	58.8	Minimum Detected	4.074
Maximum Detected	1910	Maximum Detected	7.555
Mean of Detected	691.6	Mean of Detected	5.431
SD of Detected	1055	SD of Detected	1.863
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	75.00%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.769	Shapiro Wilk Test Statistic	0.873
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	284.7	Mean	4.35
SD	657.1	SD	1.34
95% DL/2 (t) UCL	724.9	95% H-Stat (DL/2) UCL	662.1
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.392
		SD in Log Scale	1.316
		Mean in Original Scale	286.4
		SD in Original Scale	656.4
		95% Percentile Bootstrap UCL	747.2
		95% BCA Bootstrap UCL	759

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.478
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data appear Normal at 5% Significance Level	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	296.1
SD	610.2
SE of Mean	264.2
95% KM (t) UCL	796.7
95% KM (z) UCL	730.7
95% KM (jackknife) UCL	715.2
95% KM (bootstrap t) UCL	9890
95% KM (BCA) UCL	1910
95% KM (Percentile Bootstrap) UCL	1910
95% KM (Chebyshev) UCL	1448
97.5% KM (Chebyshev) UCL	1946
99% KM (Chebyshev) UCL	2925
Potential UCLs to Use	
95% KM (t) UCL	796.7
95% KM (Percentile Bootstrap) UCL	1910

Benzo(b)fluoranthene

General Statistics

Number of Valid Data	8	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	5
		Percent Non-Detects	62.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	98.7	Minimum Detected	4.592
Maximum Detected	1390	Maximum Detected	7.237
Mean of Detected	534.2	Mean of Detected	5.522
SD of Detected	741.2	SD of Detected	1.487
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	62.50%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.759	Shapiro Wilk Test Statistic	0.791
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	225.7	Mean	4.384
SD	471.4	SD	1.234
95% DL/2 (t) UCL	541.5	95% H-Stat (DL/2) UCL	435.2
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	2.226
		SD in Log Scale	2.843
		Mean in Original Scale	201.1
		SD in Original Scale	482.7
		95% Percentile Bootstrap UCL	534.2
		95% BCA Bootstrap UCL	576.5

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.567
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	262
SD	426.4
SE of Mean	184.6
95% KM (t) UCL	611.8
95% KM (z) UCL	565.7
95% KM (jackknife) UCL	560.9
95% KM (bootstrap t) UCL	14688
95% KM (BCA) UCL	N/A
95% KM (Percentile Bootstrap) UCL	1390
95% KM (Chebyshev) UCL	1067
97.5% KM (Chebyshev) UCL	1415
99% KM (Chebyshev) UCL	2099

Potential UCLs to Use

95% KM (BCA) UCL	N/A

Benzo(g,h,i)perylene

General Statistics

Number of Valid Data	8	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	5
		Percent Non-Detects	62.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	66.6	Minimum Detected	4.199
Maximum Detected	1180	Maximum Detected	7.073
Mean of Detected	443.9	Mean of Detected	5.238
SD of Detected	637.6	SD of Detected	1.594
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	7
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	87.50%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.762	Shapiro Wilk Test Statistic	0.813
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	191.8	Mean	4.278
SD	399.6	SD	1.167
95% DL/2 (t) UCL	459.5	95% H-Stat (DL/2) UCL	349
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.387
		SD in Log Scale	1.11
		Mean in Original Scale	196.8
		SD in Original Scale	397.5
		95% Percentile Bootstrap UCL	474.5
		95% BCA Bootstrap UCL	615.5

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.543
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Data Distribution Test with Detected Values Only	
Data appear Lognormal at 5% Significance Level	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	208.5
SD	367.3
SE of Mean	159
95% KM (t) UCL	509.8
95% KM (z) UCL	470
95% KM (jackknife) UCL	464.3
95% KM (bootstrap t) UCL	7140
95% KM (BCA) UCL	1180
95% KM (Percentile Bootstrap) UCL	1180
95% KM (Chebyshev) UCL	901.7
97.5% KM (Chebyshev) UCL	1202
99% KM (Chebyshev) UCL	1791
Potential UCLs to Use	
97.5% KM (Chebyshev) UCL	1202

Warning: Recommended UCL exceeds the maximum observation

Note: DL/2 is not a recommended method.

Benzo(k)fluoranthene

General Statistics

Number of Valid Data	8	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	5
		Percent Non-Detects	62.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	85.7	Minimum Detected	4.451
Maximum Detected	1030	Maximum Detected	6.937
Mean of Detected	403.7	Mean of Detected	5.316
SD of Detected	542.4	SD of Detected	1.405
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	75.00%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.758	Shapiro Wilk Test Statistic	0.783
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	176.8	Mean	4.307
SD	345.5	SD	1.125
95% DL/2 (t) UCL	408.2	95% H-Stat (DL/2) UCL	301.3
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.029
		SD in Log Scale	2.045
		Mean in Original Scale	154.8
		SD in Original Scale	355.8
		95% Percentile Bootstrap UCL	390.8
		95% BCA Bootstrap UCL	527.9

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.577
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only
Data appear Lognormal at 5% Significance Level

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	205
SD	311.9
SE of Mean	135
95% KM (t) UCL	460.8
95% KM (z) UCL	427.1
95% KM (jackknife) UCL	424.1
95% KM (bootstrap t) UCL	12251
95% KM (BCA) UCL	1030
95% KM (Percentile Bootstrap) UCL	1030
95% KM (Chebyshev) UCL	793.6
97.5% KM (Chebyshev) UCL	1048
99% KM (Chebyshev) UCL	1549
Potential UCLs to Use	
95% KM (BCA) UCL	1030

Chrysene

General Statistics

Number of Valid Data	8	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	4
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	19.1	Minimum Detected	2.95
Maximum Detected	4040	Maximum Detected	8.304
Mean of Detected	1072	Mean of Detected	5.181
SD of Detected	1979	SD of Detected	2.246
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	62.50%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.65	Shapiro Wilk Test Statistic	0.899
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	556.3	Mean	4.445
SD	1408	SD	1.669
95% DL/2 (t) UCL	1500	95% H-Stat (DL/2) UCL	3790
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	3.821
		SD in Log Scale	2.068
		Mean in Original Scale	541.7
		SD in Original Scale	1414
		95% Percentile Bootstrap UCL	1535
		95% BCA Bootstrap UCL	2038

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.259
Theta Star	4132
nu star	2.075
A-D Test Statistic	0.571
5% A-D Critical Value	0.696
K-S Test Statistic	0.696
5% K-S Critical Value	0.415

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.000000001
Maximum	4040
Mean	535.9
Median	9.55
SD	1417
k star	0.122
Theta star	4410
Nu star	1.944
AppChi2	0.144
95% Gamma Approximate UCL	7246
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	545.4
SD	1321
SE of Mean	539.5
95% KM (t) UCL	1568
95% KM (z) UCL	1433
95% KM (jackknife) UCL	1463
95% KM (bootstrap t) UCL	23664
95% KM (BCA) UCL	N/A
95% KM (Percentile Bootstrap) UCL	1584
95% KM (Chebyshev) UCL	2897
97.5% KM (Chebyshev) UCL	3914
99% KM (Chebyshev) UCL	5913

Potential UCLs to Use

95% KM (t) UCL	1568

Dibenzo(a,h)anthracene

General Statistics

Number of Valid Data	8	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	6
		Percent Non-Detects	75.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	22.6	Minimum Detected	3.118
Maximum Detected	388	Maximum Detected	5.961
Mean of Detected	205.3	Mean of Detected	4.539
SD of Detected	258.4	SD of Detected	2.01
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	7
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	87.50%

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1	Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	82.26	Mean	3.923
SD	123.7	SD	0.852
95% DL/2 (t) UCL	165.1	95% H-Stat (DL/2) UCL	178.9
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A

Gamma Distribution Test with Detected Values Only | **Data Distribution Test with Detected Values Only**

k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)
Theta Star	N/A	
nu star	N/A	

A-D Test Statistic	0.356
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	68.28
SD	120.8
SE of Mean	60.42
95% KM (t) UCL	182.7
95% KM (z) UCL	167.7
95% KM (jackknife) UCL	332.7
95% KM (bootstrap t) UCL	1.7977E+308
95% KM (BCA) UCL	388
95% KM (Percentile Bootstrap) UCL	388
95% KM (Chebyshev) UCL	331.6
97.5% KM (Chebyshev) UCL	445.6
99% KM (Chebyshev) UCL	669.5

Potential UCLs to Use

99% KM (Chebyshev) UCL	669.5

Warning: Recommended UCL exceeds the maximum observation

Note: DL/2 is not a recommended method.

bis(2-Ethylhexyl)phthalate

General Statistics

Number of Valid Data	8	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	5
		Percent Non-Detects	62.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	52.5	Minimum Detected	3.961
Maximum Detected	111	Maximum Detected	4.71
Mean of Detected	86.97	Mean of Detected	4.416
SD of Detected	30.61	SD of Detected	0.4
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	470	Maximum Non-Detect	6.153

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	8
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.913	Shapiro Wilk Test Statistic	0.876
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	82.3	Mean	4.19
SD	67.86	SD	0.661
95% DL/2 (t) UCL	127.8	95% H-Stat (DL/2) UCL	189.7
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.159
		SD in Log Scale	0.307
		Mean in Original Scale	66.97
		SD in Original Scale	23.51
		95% Percentile Bootstrap UCL	79.83
		95% BCA Bootstrap UCL	82.25

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.407
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data appear Normal at 5% Significance Level	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	67.27
SD	23.64
SE of Mean	10.94
95% KM (t) UCL	88
95% KM (z) UCL	85.27
95% KM (jackknife) UCL	98.23
95% KM (bootstrap t) UCL	77.6
95% KM (BCA) UCL	N/A
95% KM (Percentile Bootstrap) UCL	N/A
95% KM (Chebyshev) UCL	115
97.5% KM (Chebyshev) UCL	135.6
99% KM (Chebyshev) UCL	176.1
Potential UCLs to Use	
95% KM (t) UCL	88
95% KM (Percentile Bootstrap) UCL	N/A

Fluoranthene

General Statistics

Number of Valid Data	8	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	3
		Percent Non-Detects	37.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	23	Minimum Detected	3.135
Maximum Detected	1790	Maximum Detected	7.49
Mean of Detected	438.6	Mean of Detected	4.916
SD of Detected	758.7	SD of Detected	1.689
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	62.50%

Warning: There are only 5 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.633	Shapiro Wilk Test Statistic	0.927
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	289.5	Mean	4.464
SD	609.3	SD	1.422
95% DL/2 (t) UCL	697.6	95% H-Stat (DL/2) UCL	1570
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	4.335
		SD in Log Scale	1.508
		Mean in Original Scale	285
		SD in Original Scale	611.4
		95% Percentile Bootstrap UCL	706.1
		95% BCA Bootstrap UCL	909.4

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.349
Theta Star	1258
nu star	3.486
A-D Test Statistic	0.516
5% A-D Critical Value	0.709
K-S Test Statistic	0.709
5% K-S Critical Value	0.371

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	23
Maximum	1790
Mean	443.5
Median	313.9
SD	573.5
k star	0.591
Theta star	750.7
Nu star	9.453
AppChi2	3.603
95% Gamma Approximate UCL	1164
95% Adjusted Gamma UCL	1524

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	285.9
SD	571.5
SE of Mean	225.9
95% KM (t) UCL	714
95% KM (z) UCL	657.6
95% KM (jackknife) UCL	695.3
95% KM (bootstrap t) UCL	3047
95% KM (BCA) UCL	727.2
95% KM (Percentile Bootstrap) UCL	707.5
95% KM (Chebyshev) UCL	1271
97.5% KM (Chebyshev) UCL	1697
99% KM (Chebyshev) UCL	2534

Potential UCLs to Use

95% KM (BCA) UCL	727.2

Indeno(1,2,3-cd)pyrene

General Statistics

Number of Valid Data	8	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	5
		Percent Non-Detects	62.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	61.3	Minimum Detected	4.116
Maximum Detected	617	Maximum Detected	6.425
Mean of Detected	247.3	Mean of Detected	4.898
SD of Detected	320.1	SD of Detected	1.322
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	7
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	87.50%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.753	Shapiro Wilk Test Statistic	0.762
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	118.1	Mean	4.15
SD	201.8	SD	0.941
95% DL/2 (t) UCL	253.3	95% H-Stat (DL/2) UCL	187.3
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.489
		SD in Log Scale	0.784
		Mean in Original Scale	136.3
		SD in Original Scale	194.3
		95% Percentile Bootstrap UCL	273.1
		95% BCA Bootstrap UCL	274.2

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.6
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data do not follow a Discernable Distribution (0.05)	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	131.8
SD	183.4
SE of Mean	79.41
95% KM (t) UCL	282.3
95% KM (z) UCL	262.4
95% KM (jackknife) UCL	263.2
95% KM (bootstrap t) UCL	9527
95% KM (BCA) UCL	617
95% KM (Percentile Bootstrap) UCL	N/A
95% KM (Chebyshev) UCL	478
97.5% KM (Chebyshev) UCL	627.7
99% KM (Chebyshev) UCL	922
Potential UCLs to Use	
95% KM (BCA) UCL	617

Phenanthrene

General Statistics

Number of Valid Data	8	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	4
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	25.6	Minimum Detected	3.243
Maximum Detected	2230	Maximum Detected	7.71
Mean of Detected	591.2	Mean of Detected	4.66
SD of Detected	1093	SD of Detected	2.106
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	7
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	87.50%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.649	Shapiro Wilk Test Statistic	0.8
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	316.1	Mean	4.184
SD	773.6	SD	1.471
95% DL/2 (t) UCL	834.2	95% H-Stat (DL/2) UCL	1331
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.978
		SD in Log Scale	1.564
		Mean in Original Scale	309.3
		SD in Original Scale	776.3
		95% Percentile Bootstrap UCL	853.2
		95% BCA Bootstrap UCL	1135

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.263
Theta Star	2250
nu star	2.102
A-D Test Statistic	0.665
5% A-D Critical Value	0.694
K-S Test Statistic	0.694
5% K-S Critical Value	0.415

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	25.6
Maximum	2230
Mean	595.3
Median	559
SD	717.4
k star	0.52
Theta star	1145
Nu star	8.321
AppChi2	2.922
95% Gamma Approximate UCL	1695
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	309.8
SD	726.1
SE of Mean	296.4
95% KM (t) UCL	871.4
95% KM (z) UCL	797.3
95% KM (jackknife) UCL	829.7
95% KM (bootstrap t) UCL	11277
95% KM (BCA) UCL	859.7
95% KM (Percentile Bootstrap) UCL	861.2
95% KM (Chebyshev) UCL	1602
97.5% KM (Chebyshev) UCL	2161
99% KM (Chebyshev) UCL	3259

Potential UCLs to Use

95% KM (t) UCL	871.4

Pyrene

General Statistics

Number of Valid Data	8	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	3
		Percent Non-Detects	37.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	21.3	Minimum Detected	3.059
Maximum Detected	4740	Maximum Detected	8.464
Mean of Detected	1022	Mean of Detected	5.037
SD of Detected	2080	SD of Detected	2.111
Minimum Non-Detect	74	Minimum Non-Detect	4.304
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	62.50%

Warning: There are only 5 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.579	Shapiro Wilk Test Statistic	0.878
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	654	Mean	4.54
SD	1652	SD	1.738
95% DL/2 (t) UCL	1760	95% H-Stat (DL/2) UCL	6378
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	4.345
		SD in Log Scale	1.86
		Mean in Original Scale	647.7
		SD in Original Scale	1655
		95% Percentile Bootstrap UCL	1810
		95% BCA Bootstrap UCL	2400

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.275
Theta Star	3713
nu star	2.752
A-D Test Statistic	0.705
5% A-D Critical Value	0.731
K-S Test Statistic	0.731
5% K-S Critical Value	0.378

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	21.3
Maximum	4740
Mean	1044
Median	620.2
SD	1572
k star	0.416
Theta star	2511
Nu star	6.652
AppChi2	1.982
95% Gamma Approximate UCL	3505
95% Adjusted Gamma UCL	4950

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	649.2
SD	1547
SE of Mean	611.6
95% KM (t) UCL	1808
95% KM (z) UCL	1655
95% KM (jackknife) UCL	1757
95% KM (bootstrap t) UCL	21866
95% KM (BCA) UCL	1830
95% KM (Percentile Bootstrap) UCL	1814
95% KM (Chebyshev) UCL	3315
97.5% KM (Chebyshev) UCL	4468
99% KM (Chebyshev) UCL	6734

Potential UCLs to Use

95% KM (BCA) UCL	1830

alpha-Chlordane

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable alpha-Chlordane was not processed!

gamma-Chlordane

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable gamma-Chlordane was not processed!

4,4'-DDD

General Statistics

Number of Valid Data	8	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	2
		Percent Non-Detects	25.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.9	Minimum Detected	0.642
Maximum Detected	126	Maximum Detected	4.836
Mean of Detected	36.4	Mean of Detected	2.78
SD of Detected	47.32	SD of Detected	1.515
Minimum Non-Detect	1.6	Minimum Non-Detect	0.47
Maximum Non-Detect	1.8	Maximum Non-Detect	0.588

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	2
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	6
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	25.00%

Warning: There are only 6 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.781	Shapiro Wilk Test Statistic	0.994
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	27.51	Mean	2.044
SD	43.24	SD	1.87
95% DL/2 (t) UCL	56.48	95% H-Stat (DL/2) UCL	451.8
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	19.29	Mean in Log Scale	1.808
SD	49.58	SD in Log Scale	2.209
95% MLE (t) UCL	52.5	Mean in Original Scale	27.38
95% MLE (Tiku) UCL	53.01	SD in Original Scale	43.34
		95% Percentile Bootstrap UCL	54.56
		95% BCA Bootstrap UCL	65.89

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.479
Theta Star	75.94
nu star	5.752
A-D Test Statistic	0.202
5% A-D Critical Value	0.722
K-S Test Statistic	0.722
5% K-S Critical Value	0.344

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.000000001
Maximum	126
Mean	27.3
Median	8.45
SD	43.4
k star	0.16
Theta star	170.1
Nu star	2.567
AppChi2	0.257
95% Gamma Approximate UCL	273.1
95% Adjusted Gamma UCL	468.5

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	27.78
SD	40.28
SE of Mean	15.6
95% KM (t) UCL	57.33
95% KM (z) UCL	53.44
95% KM (jackknife) UCL	56.17
95% KM (bootstrap t) UCL	147.8
95% KM (BCA) UCL	55.54
95% KM (Percentile Bootstrap) UCL	55.03
95% KM (Chebyshev) UCL	95.78
97.5% KM (Chebyshev) UCL	125.2
99% KM (Chebyshev) UCL	183

Potential UCLs to Use

95% KM (Chebyshev) UCL	95.78

4,4'-DDE

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics

Minimum 5.3
Maximum 1020
Mean 204.5
Median 109.5
SD 336.4
Coefficient of Variation 1.645
Skewness 2.607

Log-transformed Statistics

Minimum of Log Data 1.668
Maximum of Log Data 6.928
Mean of log Data 4.316
SD of log Data 1.625

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.606
Shapiro Wilk Critical Value 0.818
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.972
Shapiro Wilk Critical Value 0.818
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 429.8

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 517.2
95% Modified-t UCL 448

Assuming Lognormal Distribution

95% H-UCL 6383
95% Chebyshev (MVUE) UCL 740.3
97.5% Chebyshev (MVUE) UCL 969.1
99% Chebyshev (MVUE) UCL 1419

Gamma Distribution Test

k star (bias corrected)	0.467
Theta Star	438.2
nu star	7.466
Approximate Chi Square Value (.05)	2.43
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	1.768
Anderson-Darling Test Statistic	0.366
Anderson-Darling 5% Critical Value	0.755
Kolmogorov-Smirnov Test Statistic	0.209
Kolmogorov-Smirnov 5% Critical Value	0.307

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	628.3
95% Adjusted Gamma UCL	863.6

Potential UCL to Use

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	400.1
95% Jackknife UCL	429.8
95% Standard Bootstrap UCL	384.5
95% Bootstrap-t UCL	1083
95% Hall's Bootstrap UCL	1280
95% Percentile Bootstrap UCL	426.1
95% BCA Bootstrap UCL	484.9
95% Chebyshev(Mean, Sd) UCL	722.8
97.5% Chebyshev(Mean, Sd) UCL	947.1
99% Chebyshev(Mean, Sd) UCL	1388

Use 95% Approximate Gamma UCL 628.3

4,4'-DDT

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics		Log-transformed Statistics	
Minimum	6.3	Minimum of Log Data	1.841
Maximum	530	Maximum of Log Data	6.273
Mean	129.9	Mean of log Data	3.898
Median	57.65	SD of log Data	1.586
SD	183.7		
Coefficient of Variation	1.415		
Skewness	1.875		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.726	Shapiro Wilk Test Statistic	0.939
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	252.9	95% H-UCL	3431
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	458.7
95% Adjusted-CLT UCL	282.7	97.5% Chebyshev (MVUE) UCL	599.6
95% Modified-t UCL	260.1	99% Chebyshev (MVUE) UCL	876.4

Gamma Distribution Test

k star (bias corrected)	0.479
Theta Star	271.2
nu star	7.662
Approximate Chi Square Value (.05)	2.541
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	1.859
Anderson-Darling Test Statistic	0.384
Anderson-Darling 5% Critical Value	0.753
Kolmogorov-Smirnov Test Statistic	0.196
Kolmogorov-Smirnov 5% Critical Value	0.306

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	391.6
95% Adjusted Gamma UCL	535.2

Potential UCL to Use

Use 95% Approximate Gamma UCL 391.6

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	236.7
95% Jackknife UCL	252.9
95% Standard Bootstrap UCL	231.7
95% Bootstrap-t UCL	663.1
95% Hall's Bootstrap UCL	825.5
95% Percentile Bootstrap UCL	245.3
95% BCA Bootstrap UCL	277.9
95% Chebyshev(Mean, Sd) UCL	413
97.5% Chebyshev(Mean, Sd) UCL	535.5
99% Chebyshev(Mean, Sd) UCL	776.1

Aroclor 1260

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Aroclor 1260 was not processed!

2,3,7,8-TCDD

General Statistics

Number of Valid Data	4	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	4
Number of Missing Values	3	Percent Non-Detects	100.00%

Warning: This data set only has 4 observations!
Data set is too small to compute reliable and meaningful statistics and estimates!
The data set for variable 2,3,7,8-TCDD was not processed!

It is suggested to collect at least 8 to 10 observations before using these statistical methods!
If possible, compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Antimony

General Statistics

Number of Valid Data	8	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	4
		Percent Non-Detects	50.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.1	Minimum Detected	0.0953
Maximum Detected	63.7	Maximum Detected	4.154
Mean of Detected	23.53	Mean of Detected	2.391
SD of Detected	27.67	SD of Detected	1.696
Minimum Non-Detect	2.2	Minimum Non-Detect	0.788
Maximum Non-Detect	2.7	Maximum Non-Detect	0.993

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	62.50%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.848	Shapiro Wilk Test Statistic	0.953
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	12.38	Mean	1.301
SD	21.68	SD	1.611
95% DL/2 (t) UCL	26.9	95% H-Stat (DL/2) UCL	131.9
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.225
		SD in Log Scale	1.669
		Mean in Original Scale	12.29
		SD in Original Scale	21.73
		95% Percentile Bootstrap UCL	25.83
		95% BCA Bootstrap UCL	28.8

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.361
Theta Star	65.19
nu star	2.887
A-D Test Statistic	0.226
5% A-D Critical Value	0.67
K-S Test Statistic	0.67
5% K-S Critical Value	0.405

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.000000001
Maximum	63.7
Mean	11.76
Median	0.55
SD	22.05
k star	0.129
Theta star	91.43
Nu star	2.058
AppChi2	0.159
95% Gamma Approximate UCL	152.5
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	12.31
SD	20.32
SE of Mean	8.295
95% KM (t) UCL	28.03
95% KM (z) UCL	25.96
95% KM (jackknife) UCL	26.28
95% KM (bootstrap t) UCL	39.78
95% KM (BCA) UCL	35.14
95% KM (Percentile Bootstrap) UCL	30.95
95% KM (Chebyshev) UCL	48.47
97.5% KM (Chebyshev) UCL	64.11
99% KM (Chebyshev) UCL	94.85

Potential UCLs to Use

95% KM (t) UCL	28.03
95% KM (Percentile Bootstrap) UCL	30.95

Arsenic

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 6

Raw Statistics		Log-transformed Statistics	
Minimum	3	Minimum of Log Data	1.099
Maximum	7.6	Maximum of Log Data	2.028
Mean	4.713	Mean of log Data	1.477
Median	3.9	SD of log Data	0.404
SD	1.96		
Coefficient of Variation	0.416		
Skewness	0.638		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.821	Shapiro Wilk Test Statistic	0.833
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	6.025	95% H-UCL	6.649
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	7.647
95% Adjusted-CLT UCL	6.019	97.5% Chebyshev (MVUE) UCL	8.922
95% Modified-t UCL	6.051	99% Chebyshev (MVUE) UCL	11.43

Gamma Distribution Test

k star (bias corrected)	4.466
Theta Star	1.055
nu star	71.45
Approximate Chi Square Value (.05)	52.99
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	48.99
Anderson-Darling Test Statistic	0.66
Anderson-Darling 5% Critical Value	0.717
Kolmogorov-Smirnov Test Statistic	0.233
Kolmogorov-Smirnov 5% Critical Value	0.295

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	6.354
95% Adjusted Gamma UCL	6.873

Potential UCL to Use

Use 95% Student's-t UCL 6.025

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	5.852
95% Jackknife UCL	6.025
95% Standard Bootstrap UCL	5.797
95% Bootstrap-t UCL	6.386
95% Hall's Bootstrap UCL	5.684
95% Percentile Bootstrap UCL	5.825
95% BCA Bootstrap UCL	5.9
95% Chebyshev(Mean, Sd) UCL	7.733
97.5% Chebyshev(Mean, Sd) UCL	9.04
99% Chebyshev(Mean, Sd) UCL	11.61

Barium

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics		Log-transformed Statistics	
Minimum	32.2	Minimum of Log Data	3.472
Maximum	1160	Maximum of Log Data	7.056
Mean	218.2	Mean of log Data	4.57
Median	81.9	SD of log Data	1.194
SD	384.6		
Coefficient of Variation	1.763		
Skewness	2.715		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.542	Shapiro Wilk Test Statistic	0.864
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	475.8	95% H-UCL	1153
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	498.6
95% Adjusted-CLT UCL	581.3	97.5% Chebyshev (MVUE) UCL	639.3
95% Modified-t UCL	497.5	99% Chebyshev (MVUE) UCL	915.7

Gamma Distribution Test

k star (bias corrected)	0.544
Theta Star	401.4
nu star	8.696
Approximate Chi Square Value (.05)	3.145
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	2.362
Anderson-Darling Test Statistic	0.906
Anderson-Darling 5% Critical Value	0.746
Kolmogorov-Smirnov Test Statistic	0.281
Kolmogorov-Smirnov 5% Critical Value	0.304

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	603.4
95% Adjusted Gamma UCL	803.2

Potential UCL to Use

Use 95% Approximate Gamma UCL 603.4

Data Distribution

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	441.8
95% Jackknife UCL	475.8
95% Standard Bootstrap UCL	432.7
95% Bootstrap-t UCL	1847
95% Hall's Bootstrap UCL	1518
95% Percentile Bootstrap UCL	470.3
95% BCA Bootstrap UCL	617.6
95% Chebyshev(Mean, Sd) UCL	810.9
97.5% Chebyshev(Mean, Sd) UCL	1067
99% Chebyshev(Mean, Sd) UCL	1571

Beryllium

General Statistics

Number of Valid Data	8	Number of Detected Data	7
Number of Distinct Detected Data	6	Number of Non-Detect Data	1
		Percent Non-Detects	12.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.086	Minimum Detected	-2.453
Maximum Detected	1.3	Maximum Detected	0.262
Mean of Detected	0.377	Mean of Detected	-1.324
SD of Detected	0.415	SD of Detected	0.831
Minimum Non-Detect	1.3	Minimum Non-Detect	0.262
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262

Warning: There are only 7 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.641	Shapiro Wilk Test Statistic	0.903
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.411	Mean	-1.213
SD	0.396	SD	0.832
95% DL/2 (t) UCL	0.676	95% H-Stat (DL/2) UCL	1.757
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.348
		SD in Log Scale	0.772
		Mean in Original Scale	0.357
		SD in Original Scale	0.388
		95% Percentile Bootstrap UCL	0.601
		95% BCA Bootstrap UCL	0.651

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	1
Theta Star	0.376
nu star	14
A-D Test Statistic	0.686
5% A-D Critical Value	0.72
K-S Test Statistic	0.72
5% K-S Critical Value	0.317

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.086
Maximum	1.3
Mean	0.376
Median	0.285
SD	0.384
k star	1.203
Theta star	0.313
Nu star	19.25
AppChi2	10.3
95% Gamma Approximate UCL	0.704
95% Adjusted Gamma UCL	0.834

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	0.357
SD	0.364
SE of Mean	0.14
95% KM (t) UCL	0.622
95% KM (z) UCL	0.587
95% KM (jackknife) UCL	0.62
95% KM (bootstrap t) UCL	1.176
95% KM (BCA) UCL	0.607
95% KM (Percentile Bootstrap) UCL	0.616
95% KM (Chebyshev) UCL	0.966
97.5% KM (Chebyshev) UCL	1.229
99% KM (Chebyshev) UCL	1.747

Potential UCLs to Use

95% KM (BCA) UCL	0.607

Cadmium

General Statistics

Number of Valid Data	8	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	1
		Percent Non-Detects	12.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.21	Minimum Detected	-1.561
Maximum Detected	21.6	Maximum Detected	3.073
Mean of Detected	5.843	Mean of Detected	0.622
SD of Detected	8.043	SD of Detected	1.833
Minimum Non-Detect	0.55	Minimum Non-Detect	-0.598
Maximum Non-Detect	0.55	Maximum Non-Detect	-0.598

Warning: There are only 7 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.774	Shapiro Wilk Test Statistic	0.931
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	5.147	Mean	0.383
SD	7.702	SD	1.827
95% DL/2 (t) UCL	10.31	95% H-Stat (DL/2) UCL	521.4
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	2.489	Mean in Log Scale	0.35
SD	10.11	SD in Log Scale	1.863
95% MLE (t) UCL	9.26	Mean in Original Scale	5.139
95% MLE (Tiku) UCL	9.952	SD in Original Scale	7.708
		95% Percentile Bootstrap UCL	9.925
		95% BCA Bootstrap UCL	10.98

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.408
Theta Star	14.31
nu star	5.716
A-D Test Statistic	0.302
5% A-D Critical Value	0.749
K-S Test Statistic	0.749
5% K-S Critical Value	0.326

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.000000001
Maximum	21.6
Mean	5.113
Median	1.28
SD	7.728
k star	0.208
Theta star	24.53
Nu star	3.334
AppChi2	0.478
95% Gamma Approximate UCL	35.67
95% Adjusted Gamma UCL	61.09

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	5.14
SD	7.21
SE of Mean	2.753
95% KM (t) UCL	10.36
95% KM (z) UCL	9.669
95% KM (jackknife) UCL	10.3
95% KM (bootstrap t) UCL	24.86
95% KM (BCA) UCL	9.354
95% KM (Percentile Bootstrap) UCL	9.795
95% KM (Chebyshev) UCL	17.14
97.5% KM (Chebyshev) UCL	22.33
99% KM (Chebyshev) UCL	32.53

Potential UCLs to Use

95% KM (Chebyshev) UCL	17.14

Chromium

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics

Minimum 7.6
Maximum 126
Mean 39.64
Median 18.65
SD 42.91
Coefficient of Variation 1.083
Skewness 1.424

Log-transformed Statistics

Minimum of Log Data 2.028
Maximum of Log Data 4.836
Mean of log Data 3.162
SD of log Data 1.089

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.798
Shapiro Wilk Critical Value 0.818
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.9
Shapiro Wilk Critical Value 0.818
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 68.38

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 72.76
95% Modified-t UCL 69.66

Assuming Lognormal Distribution

95% H-UCL 191.7
95% Chebyshev (MVUE) UCL 104.8
97.5% Chebyshev (MVUE) UCL 133.4
99% Chebyshev (MVUE) UCL 189.7

Gamma Distribution Test

k star (bias corrected)	0.772
Theta Star	51.33
nu star	12.35
Approximate Chi Square Value (.05)	5.462
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	4.359
Anderson-Darling Test Statistic	0.478
Anderson-Darling 5% Critical Value	0.734
Kolmogorov-Smirnov Test Statistic	0.232
Kolmogorov-Smirnov 5% Critical Value	0.301

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	89.67
95% Adjusted Gamma UCL	112.3

Potential UCL to Use

Use 95% Approximate Gamma UCL 89.67

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	64.59
95% Jackknife UCL	68.38
95% Standard Bootstrap UCL	62.51
95% Bootstrap-t UCL	103.4
95% Hall's Bootstrap UCL	86.11
95% Percentile Bootstrap UCL	64.93
95% BCA Bootstrap UCL	69.73
95% Chebyshev(Mean, Sd) UCL	105.8
97.5% Chebyshev(Mean, Sd) UCL	134.4
99% Chebyshev(Mean, Sd) UCL	190.6

Cobalt

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics		Log-transformed Statistics	
Minimum	2.1	Minimum of Log Data	0.742
Maximum	28	Maximum of Log Data	3.332
Mean	7.1	Mean of log Data	1.541
Median	3.5	SD of log Data	0.863
SD	8.798		
Coefficient of Variation	1.239		
Skewness	2.444		

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.619	Shapiro Wilk Test Statistic	0.833
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	12.99	95% H-UCL	18.62
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15.08
95% Adjusted-CLT UCL	15.09	97.5% Chebyshev (MVUE) UCL	18.84
95% Modified-t UCL	13.44	99% Chebyshev (MVUE) UCL	26.22

Gamma Distribution Test

k star (bias corrected)	0.918
Theta Star	7.737
nu star	14.68
Approximate Chi Square Value (.05)	7.041
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	5.757
Anderson-Darling Test Statistic	0.933
Anderson-Darling 5% Critical Value	0.731
Kolmogorov-Smirnov Test Statistic	0.334
Kolmogorov-Smirnov 5% Critical Value	0.3

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	14.8
95% Adjusted Gamma UCL	18.11

Potential UCL to Use

Use 95% H-UCL 18.62

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	12.22
95% Jackknife UCL	12.99
95% Standard Bootstrap UCL	11.97
95% Bootstrap-t UCL	53.76
95% Hall's Bootstrap UCL	39.72
95% Percentile Bootstrap UCL	12.58
95% BCA Bootstrap UCL	15.34
95% Chebyshev(Mean, Sd) UCL	20.66
97.5% Chebyshev(Mean, Sd) UCL	26.53
99% Chebyshev(Mean, Sd) UCL	38.05

Copper

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics

Minimum	7.4
Maximum	1790
Mean	362.2
Median	18.4
SD	646.1
Coefficient of Variation	1.784
Skewness	1.984

Log-transformed Statistics

Minimum of Log Data	2.001
Maximum of Log Data	7.49
Mean of log Data	3.916
SD of log Data	2.259

Warning: There are only 8 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.651
Shapiro Wilk Critical Value	0.818

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.816
Shapiro Wilk Critical Value	0.818

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	795

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	909.2
95% Modified-t UCL	821.7

Assuming Lognormal Distribution

95% H-UCL	226978
95% Chebyshev (MVUE) UCL	1366
97.5% Chebyshev (MVUE) UCL	1817
99% Chebyshev (MVUE) UCL	2703

Gamma Distribution Test

k star (bias corrected)	0.297
Theta Star	1220
nu star	4.75
Approximate Chi Square Value (.05)	1.039
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	0.67
Anderson-Darling Test Statistic	0.845
Anderson-Darling 5% Critical Value	0.79
Kolmogorov-Smirnov Test Statistic	0.311
Kolmogorov-Smirnov 5% Critical Value	0.315

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	1657
95% Adjusted Gamma UCL	2567

Data Distribution

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	737.9
95% Jackknife UCL	795
95% Standard Bootstrap UCL	722
95% Bootstrap-t UCL	3644
95% Hall's Bootstrap UCL	4547
95% Percentile Bootstrap UCL	782
95% BCA Bootstrap UCL	905.7
95% Chebyshev(Mean, Sd) UCL	1358
97.5% Chebyshev(Mean, Sd) UCL	1789
99% Chebyshev(Mean, Sd) UCL	2635

Potential UCL to Use

Use 95% Adjusted Gamma UCL 2567

Recommended UCL exceeds the maximum observation

Iron

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics

Minimum 5640
Maximum 45100
Mean 14989
Median 9435
SD 13687
Coefficient of Variation 0.913
Skewness 1.909

Log-transformed Statistics

Minimum of Log Data 8.638
Maximum of Log Data 10.72
Mean of log Data 9.34
SD of log Data 0.739

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.73
Shapiro Wilk Critical Value 0.818
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.865
Shapiro Wilk Critical Value 0.818
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 24157

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 26438
95% Modified-t UCL 24701

Assuming Lognormal Distribution

95% H-UCL 32892
95% Chebyshev (MVUE) UCL 31030
97.5% Chebyshev (MVUE) UCL 38239
99% Chebyshev (MVUE) UCL 52399

Gamma Distribution Test

k star (bias corrected)	1.312
Theta Star	11421
nu star	21
Approximate Chi Square Value (.05)	11.59
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	9.87
Anderson-Darling Test Statistic	0.684
Anderson-Darling 5% Critical Value	0.724
Kolmogorov-Smirnov Test Statistic	0.26
Kolmogorov-Smirnov 5% Critical Value	0.298

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	27156
95% Adjusted Gamma UCL	31888

Potential UCL to Use

Use 95% Approximate Gamma UCL 27156

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	22948
95% Jackknife UCL	24157
95% Standard Bootstrap UCL	22634
95% Bootstrap-t UCL	45945
95% Hall's Bootstrap UCL	62729
95% Percentile Bootstrap UCL	23175
95% BCA Bootstrap UCL	26380
95% Chebyshev(Mean, Sd) UCL	36082
97.5% Chebyshev(Mean, Sd) UCL	45209
99% Chebyshev(Mean, Sd) UCL	63137

Lead

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics

Minimum 12.9
Maximum 2120
Mean 404.1
Median 70.6
SD 722.7
Coefficient of Variation 1.788
Skewness 2.424

Log-transformed Statistics

Minimum of Log Data 2.557
Maximum of Log Data 7.659
Mean of log Data 4.49
SD of log Data 1.958

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.628
Shapiro Wilk Critical Value 0.818
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.868
Shapiro Wilk Critical Value 0.818
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 888.1

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 1058
95% Modified-t UCL 924.6

Assuming Lognormal Distribution

95% H-UCL 51949
95% Chebyshev (MVUE) UCL 1486
97.5% Chebyshev (MVUE) UCL 1965
99% Chebyshev (MVUE) UCL 2906

Gamma Distribution Test

k star (bias corrected)	0.352
Theta Star	1147
nu star	5.636
Approximate Chi Square Value (.05)	1.457
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	0.988
Anderson-Darling Test Statistic	0.621
Anderson-Darling 5% Critical Value	0.775
Kolmogorov-Smirnov Test Statistic	0.285
Kolmogorov-Smirnov 5% Critical Value	0.312

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	1563
95% Adjusted Gamma UCL	2306

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	824.3
95% Jackknife UCL	888.1
95% Standard Bootstrap UCL	795.8
95% Bootstrap-t UCL	2371
95% Hall's Bootstrap UCL	2409
95% Percentile Bootstrap UCL	874.2
95% BCA Bootstrap UCL	1081
95% Chebyshev(Mean, Sd) UCL	1518
97.5% Chebyshev(Mean, Sd) UCL	2000
99% Chebyshev(Mean, Sd) UCL	2946

Potential UCL to Use Use 95% Adjusted Gamma UCL 2306

Recommended UCL exceeds the maximum observation

Manganese

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics

Minimum 110
Maximum 1490
Mean 387.6
Median 262.5
SD 455.6
Coefficient of Variation 1.175
Skewness 2.583

Log-transformed Statistics

Minimum of Log Data 4.7
Maximum of Log Data 7.307
Mean of log Data 5.588
SD of log Data 0.827

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.616
Shapiro Wilk Critical Value 0.818
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.887
Shapiro Wilk Critical Value 0.818
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 692.8

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 809.8
95% Modified-t UCL 717.3

Assuming Lognormal Distribution

95% H-UCL 964.3
95% Chebyshev (MVUE) UCL 820.8
97.5% Chebyshev (MVUE) UCL 1021
99% Chebyshev (MVUE) UCL 1416

Gamma Distribution Test

k star (bias corrected)	1.014
Theta Star	382.2
nu star	16.23
Approximate Chi Square Value (.05)	8.122
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	6.724
Anderson-Darling Test Statistic	0.72
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.285
Kolmogorov-Smirnov 5% Critical Value	0.299

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	774.4
95% Adjusted Gamma UCL	935.4

Potential UCL to Use

Use 95% Approximate Gamma UCL 774.4

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	652.6
95% Jackknife UCL	692.8
95% Standard Bootstrap UCL	638.1
95% Bootstrap-t UCL	1384
95% Hall's Bootstrap UCL	1781
95% Percentile Bootstrap UCL	682
95% BCA Bootstrap UCL	755.3
95% Chebyshev(Mean, Sd) UCL	1090
97.5% Chebyshev(Mean, Sd) UCL	1394
99% Chebyshev(Mean, Sd) UCL	1990

Mercury

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 7

Raw Statistics

Minimum	0.052
Maximum	1.8
Mean	0.34
Median	0.16
SD	0.593
Coefficient of Variation	1.743
Skewness	2.765

Log-transformed Statistics

Minimum of Log Data	-2.957
Maximum of Log Data	0.588
Mean of log Data	-1.818
SD of log Data	1.113

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.517
Shapiro Wilk Critical Value	0.818

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.844
Shapiro Wilk Critical Value	0.818

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	0.738

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	0.904
95% Modified-t UCL	0.772

Assuming Lognormal Distribution

95% H-UCL	1.438
95% Chebyshev (MVUE) UCL	0.746
97.5% Chebyshev (MVUE) UCL	0.952
99% Chebyshev (MVUE) UCL	1.356

Gamma Distribution Test

k star (bias corrected)	0.584
Theta Star	0.582
nu star	9.352
Approximate Chi Square Value (.05)	3.541
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	2.698
Anderson-Darling Test Statistic	1.064
Anderson-Darling 5% Critical Value	0.743
Kolmogorov-Smirnov Test Statistic	0.353
Kolmogorov-Smirnov 5% Critical Value	0.304

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.899
95% Adjusted Gamma UCL	1.18

Potential UCL to Use

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	0.685
95% Jackknife UCL	0.738
95% Standard Bootstrap UCL	0.669
95% Bootstrap-t UCL	2.858
95% Hall's Bootstrap UCL	2.724
95% Percentile Bootstrap UCL	0.747
95% BCA Bootstrap UCL	0.946
95% Chebyshev(Mean, Sd) UCL	1.254
97.5% Chebyshev(Mean, Sd) UCL	1.65
99% Chebyshev(Mean, Sd) UCL	2.427

Use 95% Chebyshev (MVUE) UCL 0.746

Nickel

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics

Minimum 3.9
Maximum 502
Mean 82.11
Median 10.7
SD 171.4
Coefficient of Variation 2.088
Skewness 2.717

Log-transformed Statistics

Minimum of Log Data 1.361
Maximum of Log Data 6.219
Mean of log Data 2.934
SD of log Data 1.726

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.53
Shapiro Wilk Critical Value 0.818
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.859
Shapiro Wilk Critical Value 0.818
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 196.9

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 244
95% Modified-t UCL 206.6

Assuming Lognormal Distribution

95% H-UCL 2761
95% Chebyshev (MVUE) UCL 217.2
97.5% Chebyshev (MVUE) UCL 285.4
99% Chebyshev (MVUE) UCL 419.2

Gamma Distribution Test

k star (bias corrected)	0.358
Theta Star	229.3
nu star	5.729
Approximate Chi Square Value (.05)	1.503
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	1.024
Anderson-Darling Test Statistic	0.869
Anderson-Darling 5% Critical Value	0.773
Kolmogorov-Smirnov Test Statistic	0.259
Kolmogorov-Smirnov 5% Critical Value	0.311

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	313
95% Adjusted Gamma UCL	459.5

Potential UCL to Use

Use 95% Adjusted Gamma UCL 459.5

Data Distribution

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	181.8
95% Jackknife UCL	196.9
95% Standard Bootstrap UCL	177.6
95% Bootstrap-t UCL	814.2
95% Hall's Bootstrap UCL	737.4
95% Percentile Bootstrap UCL	198.5
95% BCA Bootstrap UCL	264.9
95% Chebyshev(Mean, Sd) UCL	346.3
97.5% Chebyshev(Mean, Sd) UCL	460.6
99% Chebyshev(Mean, Sd) UCL	685.1

Selenium

General Statistics

Number of Valid Data	8	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	6
		Percent Non-Detects	75.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.4	Minimum Detected	0.336
Maximum Detected	4.4	Maximum Detected	1.482
Mean of Detected	2.9	Mean of Detected	0.909
SD of Detected	2.121	SD of Detected	0.81
Minimum Non-Detect	2.2	Minimum Non-Detect	0.788
Maximum Non-Detect	2.7	Maximum Non-Detect	0.993

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	7
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	1
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	87.50%

Warning: Data set has only 2 Distinct Detected Values.
This may not be adequate enough to compute meaningful and reliable test statistics and estimates.
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level	
Assuming Normal Distribution	
DL/2 Substitution Method	
Mean	1.638
SD	1.121
95% DL/2 (t) UCL	2.388
Maximum Likelihood Estimate(MLE) Method	N/A
MLE method failed to converge properly	

Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	1
5% Shapiro Wilk Critical Value	N/A
Data not Lognormal at 5% Significance Level	
Assuming Lognormal Distribution	
DL/2 Substitution Method	
Mean	0.373
SD	0.455
95% H-Stat (DL/2) UCL	2.259
Log ROS Method	
Mean in Log Scale	N/A
SD in Log Scale	N/A
Mean in Original Scale	N/A
SD in Original Scale	N/A
95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.359
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Data Distribution Test with Detected Values Only	
Data do not follow a Discernable Distribution (0.05)	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	1.775
SD	0.992
SE of Mean	0.496
95% KM (t) UCL	2.715
95% KM (z) UCL	2.591
95% KM (jackknife) UCL	3.946
95% KM (bootstrap t) UCL	1.7977E+308
95% KM (BCA) UCL	4.4
95% KM (Percentile Bootstrap) UCL	4.4
95% KM (Chebyshev) UCL	3.937
97.5% KM (Chebyshev) UCL	4.873
99% KM (Chebyshev) UCL	6.711
Potential UCLs to Use	
95% KM (t) UCL	2.715
95% KM (% Bootstrap) UCL	4.4

Note: DL/2 is not a recommended method.

Silver

General Statistics

Number of Valid Data	8	Number of Detected Data	7
Number of Distinct Detected Data	7	Number of Non-Detect Data	1
		Percent Non-Detects	12.50%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.18	Minimum Detected	-1.715
Maximum Detected	84.5	Maximum Detected	4.437
Mean of Detected	16.4	Mean of Detected	0.686
SD of Detected	31.3	SD of Detected	2.382
Minimum Non-Detect	1.3	Minimum Non-Detect	0.262
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262

Warning: There are only 7 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.621	Shapiro Wilk Test Statistic	0.876
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	14.43	Mean	0.546
SD	29.51	SD	2.24
95% DL/2 (t) UCL	34.19	95% H-Stat (DL/2) UCL	1800
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	0.498
		SD in Log Scale	2.268
		Mean in Original Scale	14.4
		SD in Original Scale	29.52
		95% Percentile Bootstrap UCL	32.4
		95% BCA Bootstrap UCL	43.39

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.28
Theta Star	58.63
nu star	3.915
A-D Test Statistic	0.657
5% A-D Critical Value	0.78
K-S Test Statistic	0.78
5% K-S Critical Value	0.334

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.000000001
Maximum	84.5
Mean	14.35
Median	0.475
SD	29.55
k star	0.185
Theta star	77.44
Nu star	2.965
AppChi2	0.362
95% Gamma Approximate UCL	117.5
95% Adjusted Gamma UCL	204.6

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	14.39
SD	27.62
SE of Mean	10.55
95% KM (t) UCL	34.38
95% KM (z) UCL	31.74
95% KM (jackknife) UCL	34.17
95% KM (bootstrap t) UCL	297.7
95% KM (BCA) UCL	33.49
95% KM (Percentile Bootstrap) UCL	32.37
95% KM (Chebyshev) UCL	60.37
97.5% KM (Chebyshev) UCL	80.26
99% KM (Chebyshev) UCL	119.3

Potential UCLs to Use

95% KM (Chebyshev) UCL	60.37

Thallium

General Statistics

Number of Valid Data	8	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	2
		Percent Non-Detects	25.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.036	Minimum Detected	-3.324
Maximum Detected	0.2	Maximum Detected	-1.609
Mean of Detected	0.0862	Mean of Detected	-2.62
SD of Detected	0.0602	SD of Detected	0.61
Minimum Non-Detect	0.12	Minimum Non-Detect	-2.12
Maximum Non-Detect	0.12	Maximum Non-Detect	-2.12

Warning: There are only 6 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.816	Shapiro Wilk Test Statistic	0.95
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0796	Mean	-2.668
SD	0.0523	SD	0.523
95% DL/2 (t) UCL	0.115	95% H-Stat (DL/2) UCL	0.128
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.664
		SD in Log Scale	0.539
		Mean in Original Scale	0.0804
		SD in Original Scale	0.0526
		95% Percentile Bootstrap UCL	0.112
		95% BCA Bootstrap UCL	0.124

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	1.676
Theta Star	0.0514
nu star	20.11
A-D Test Statistic	0.347
5% A-D Critical Value	0.701
K-S Test Statistic	0.701
5% K-S Critical Value	0.334

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	0.036
Maximum	0.2
Mean	0.0864
Median	0.0808
SD	0.0509
k star	2.654
Theta star	0.0326
Nu star	42.47
AppChi2	28.53
95% Gamma Approximate UCL	0.129
95% Adjusted Gamma UCL	0.143

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	0.0805
SD	0.0499
SE of Mean	0.02
95% KM (t) UCL	0.118
95% KM (z) UCL	0.113
95% KM (jackknife) UCL	0.118
95% KM (bootstrap t) UCL	0.158
95% KM (BCA) UCL	0.114
95% KM (Percentile Bootstrap) UCL	0.112
95% KM (Chebyshev) UCL	0.168
97.5% KM (Chebyshev) UCL	0.205
99% KM (Chebyshev) UCL	0.279

Potential UCLs to Use

95% KM (t) UCL	0.118
95% KM (Percentile Bootstrap) UCL	0.112

Vanadium

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 6

Raw Statistics		Log-transformed Statistics	
Minimum	10.3	Minimum of Log Data	2.332
Maximum	51	Maximum of Log Data	3.932
Mean	17.36	Mean of log Data	2.696
Median	12.8	SD of log Data	0.52
SD	13.72		
Coefficient of Variation	0.79		
Skewness	2.727		

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.543	Shapiro Wilk Test Statistic	0.676
Shapiro Wilk Critical Value	0.818	Shapiro Wilk Critical Value	0.818
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	26.55	95% H-UCL	27.14
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	30.15
95% Adjusted-CLT UCL	30.34	97.5% Chebyshev (MVUE) UCL	35.99
95% Modified-t UCL	27.33	99% Chebyshev (MVUE) UCL	47.47

Gamma Distribution Test

k star (bias corrected)	2.157
Theta Star	8.05
nu star	34.51
Approximate Chi Square Value (.05)	22.07
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	19.59
Anderson-Darling Test Statistic	1.425
Anderson-Darling 5% Critical Value	0.721
Kolmogorov-Smirnov Test Statistic	0.355
Kolmogorov-Smirnov 5% Critical Value	0.296

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	27.15
95% Adjusted Gamma UCL	30.58

Potential UCL to Use

Use 95% Chebyshev (Mean, Sd) UCL 38.5

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	25.34
95% Jackknife UCL	26.55
95% Standard Bootstrap UCL	24.96
95% Bootstrap-t UCL	75.89
95% Hall's Bootstrap UCL	74.53
95% Percentile Bootstrap UCL	26.3
95% BCA Bootstrap UCL	28.46
95% Chebyshev(Mean, Sd) UCL	38.5
97.5% Chebyshev(Mean, Sd) UCL	47.65
99% Chebyshev(Mean, Sd) UCL	65.62

Zinc

General Statistics

Number of Valid Observations 8

Number of Distinct Observations 8

Raw Statistics

Minimum 20.6
Maximum 4280
Mean 733.9
Median 105.4
SD 1459
Coefficient of Variation 1.988
Skewness 2.638

Log-transformed Statistics

Minimum of Log Data 3.025
Maximum of Log Data 8.362
Mean of log Data 4.984
SD of log Data 1.96

Warning: There are only 8 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.564
Shapiro Wilk Critical Value 0.818
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.899
Shapiro Wilk Critical Value 0.818
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 1711

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 2096
95% Modified-t UCL 1791

Assuming Lognormal Distribution

95% H-UCL 86506
95% Chebyshev (MVUE) UCL 2447
97.5% Chebyshev (MVUE) UCL 3235
99% Chebyshev (MVUE) UCL 4784

Gamma Distribution Test

k star (bias corrected)	0.337
Theta Star	2174
nu star	5.4
Approximate Chi Square Value (.05)	1.341
Adjusted Level of Significance	0.0195
Adjusted Chi Square Value	0.899
Anderson-Darling Test Statistic	0.625
Anderson-Darling 5% Critical Value	0.779
Kolmogorov-Smirnov Test Statistic	0.229
Kolmogorov-Smirnov 5% Critical Value	0.313

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	2954
95% Adjusted Gamma UCL	4410

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	1582
95% Jackknife UCL	1711
95% Standard Bootstrap UCL	1517
95% Bootstrap-t UCL	5166
95% Hall's Bootstrap UCL	4832
95% Percentile Bootstrap UCL	1707
95% BCA Bootstrap UCL	2247
95% Chebyshev(Mean, Sd) UCL	2982
97.5% Chebyshev(Mean, Sd) UCL	3955
99% Chebyshev(Mean, Sd) UCL	5867

Potential UCL to Use Use 95% Adjusted Gamma UCL 4410

Recommended UCL exceeds the maximum observation

Cyanide

General Statistics

Number of Valid Data	8	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	8
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Cyanide was not processed!

VERSAR

APPENDIX G-4.6

Soil (0 – 5.0 ft) ProUCL Output

Appendix G-4.6 - Soil (0-5.0 ft) ProUCL Output

COPEC	Page
1,2-Dichlorobenzene	1
1,4-Dichlorobenzene	2
Methyl Acetate	3
Methylcyclohexane	4
Tetrachloroethene	5
Acenaphthene	7
Acenaphthylene	8
Anthracene	9
Benzo(a)anthracene	11
Benzo(a)pyrene	13
Benzo(b)fluoranthene	15
Benzo(g,h,i)perylene	17
Benzo(k)fluoranthene	19
Chrysene	21
Dibenzo(a,h)anthracene	23
bis(2-Ethylhexyl)phthalate	25
Fluoranthene	27
Indeno(1,2,3-cd)pyrene	29
Phenanthrene	31
Pyrene	33
2-Chlorophenol	35
2,4-Dichlorophenol	36
2,4-Dimethylphenol	37
2,4-Dinitrophenol	38
4,6-Dinitro-o-cresol	39
2-Methylphenol	40
3&4-Methylphenol	41
4-Nitrophenol	42
Phenol	43
2,4,5-Trichlorophenol	44
2,4,6-Trichlorophenol	45
Acenaphthene	46
alpha-Chlordane	47
gamma-Chlordane	48
4,4'-DDD	49
4,4'-DDE	51
4,4'-DDT	53
Aroclor 1260	55
2,3,7,8-TCDD	56
Aluminum	57
Antimony	58
Arsenic	60
Barium	61

Appendix G-4.6 - Soil (0-5.0 ft) ProUCL Output

COPEC	Page
Beryllium	62
Cadmium	64
Chromium	66
Cobalt	67
Copper	68
Iron	69
Lead	70
Manganese	71
Mercury	72
Nickel	73
Selenium	74
Silver	76
Thallium	78
Vanadium	80
Zinc	81
Cyanide	82

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

1,2-Dichlorobenzene

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,2-Dichlorobenzene was not processed!

1,4-Dichlorobenzene

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 1,4-Dichlorobenzene was not processed!

Methyl Acetate

General Statistics

Number of Valid Data	17	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	16
		Percent Non-Detects	94.12%

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 Methyl Acetate was not processed!

Methylcyclohexane

General Statistics

Number of Valid Data	17	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	16
		Percent Non-Detects	94.12%

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 Methylcyclohexane was not processed!

Tetrachloroethene

General Statistics

Number of Valid Data	17	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	14
		Percent Non-Detects	82.35%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.99	Minimum Detected	-0.0101
Maximum Detected	13.7	Maximum Detected	2.617
Mean of Detected	5.83	Mean of Detected	1.212
SD of Detected	6.875	SD of Detected	1.323
Minimum Non-Detect	4.4	Minimum Non-Detect	1.482
Maximum Non-Detect	770	Maximum Non-Detect	6.646

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	17
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	0
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	100.00%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.854	Shapiro Wilk Test Statistic	0.986
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution

DL/2 Substitution Method	
Mean	105.1
SD	145.4
95% DL/2 (t) UCL	166.6
Maximum Likelihood Estimate(MLE) Method	N/A

MLE method failed to converge properly

Assuming Lognormal Distribution

DL/2 Substitution Method	
Mean	2.721
SD	2.29
95% H-Stat (DL/2) UCL	13465
Log ROS Method	
Mean in Log Scale	0.68
SD in Log Scale	0.536
Mean in Original Scale	2.483
SD in Original Scale	2.911
95% Percentile Bootstrap UCL	3.858
95% BCA Bootstrap UCL	4.621

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.311
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	2.968
SD	3.502
SE of Mean	1.442
95% KM (t) UCL	5.485
95% KM (z) UCL	5.339
95% KM (jackknife) UCL	5.696
95% KM (bootstrap t) UCL	7.829
95% KM (BCA) UCL	13.7
95% KM (Percentile Bootstrap) UCL	N/A
95% KM (Chebyshev) UCL	9.252
97.5% KM (Chebyshev) UCL	11.97
99% KM (Chebyshev) UCL	17.31

Potential UCLs to Use

95% KM (t) UCL	5.485
95% KM (Percentile Bootstrap) UCL	N/A

Note: DL/2 is not a recommended method.

Acenaphthene

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Acenaphthene was not processed!

Acenaphthylene

General Statistics

Number of Valid Data	17	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	16
		Percent Non-Detects	94.12%

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 Acenaphthylene was not processed!

Anthracene

General Statistics

Number of Valid Data	17	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	13
		Percent Non-Detects	76.47%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	16.8	Minimum Detected	2.821
Maximum Detected	267	Maximum Detected	5.587
Mean of Detected	81.38	Mean of Detected	3.62
SD of Detected	123.8	SD of Detected	1.317
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.12%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.647	Shapiro Wilk Test Statistic	0.711
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	48.79	Mean	3.647
SD	56.79	SD	0.574
95% DL/2 (t) UCL	72.84	95% H-Stat (DL/2) UCL	70.42
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.216
		SD in Log Scale	0.635
		Mean in Original Scale	36.24
		SD in Original Scale	59.59
		95% Percentile Bootstrap UCL	64.76
		95% BCA Bootstrap UCL	80.17

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.358
Theta Star	227.2
nu star	2.865
A-D Test Statistic	0.83
5% A-D Critical Value	0.67
K-S Test Statistic	0.67
5% K-S Critical Value	0.405

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	16.8
Maximum	267
Mean	84.36
Median	85.9
SD	53.86
k star	2.389
Theta star	35.32
Nu star	81.21
AppChi2	61.45
95% Gamma Approximate UCL	111.5
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	34.06
SD	58.27
SE of Mean	16.37
95% KM (t) UCL	62.63
95% KM (z) UCL	60.98
95% KM (jackknife) UCL	59.66
95% KM (bootstrap t) UCL	368.1
95% KM (BCA) UCL	64.66
95% KM (Percentile Bootstrap) UCL	77.74
95% KM (Chebyshev) UCL	105.4
97.5% KM (Chebyshev) UCL	136.3
99% KM (Chebyshev) UCL	196.9

Potential UCLs to Use

95% KM (BCA) UCL	64.66

Benzo(a)anthracene

General Statistics

Number of Valid Data	17	Number of Detected Data	5
Number of Distinct Detected Data	4	Number of Non-Detect Data	12
		Percent Non-Detects	70.59%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	24.3	Minimum Detected	3.19
Maximum Detected	2490	Maximum Detected	7.82
Mean of Detected	559.1	Mean of Detected	4.892
SD of Detected	1080	SD of Detected	1.757
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	14
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	82.35%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.586	Shapiro Wilk Test Statistic	0.86
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	191.8	Mean	4.018
SD	592.8	SD	1.056
95% DL/2 (t) UCL	442.8	95% H-Stat (DL/2) UCL	155.7
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	3.855
		SD in Log Scale	1.134
		Mean in Original Scale	186.6
		SD in Original Scale	594.2
		95% Percentile Bootstrap UCL	473.5
		95% BCA Bootstrap UCL	623.1

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.313
Theta Star	1784
nu star	3.134
A-D Test Statistic	0.768
5% A-D Critical Value	0.718
K-S Test Statistic	0.718
5% K-S Critical Value	0.374

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	24.3
Maximum	2490
Mean	568.1
Median	580.9
SD	543.2
k star	1.118
Theta star	507.9
Nu star	38.03
AppChi2	24.91
95% Gamma Approximate UCL	867.4
95% Adjusted Gamma UCL	907.8

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	191.9
SD	575.2
SE of Mean	156.2
95% KM (t) UCL	464.6
95% KM (z) UCL	448.8
95% KM (jackknife) UCL	444.5
95% KM (bootstrap t) UCL	3378
95% KM (BCA) UCL	533.3
95% KM (Percentile Bootstrap) UCL	484.7
95% KM (Chebyshev) UCL	872.8
97.5% KM (Chebyshev) UCL	1167
99% KM (Chebyshev) UCL	1746

Potential UCLs to Use

97.5% KM (Chebyshev) UCL	1167

Benzo(a)pyrene

General Statistics

Number of Valid Data	17	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	13
		Percent Non-Detects	76.47%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	58.8	Minimum Detected	4.074
Maximum Detected	1910	Maximum Detected	7.555
Mean of Detected	548	Mean of Detected	5.264
SD of Detected	908.4	SD of Detected	1.557
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	14
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	82.35%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.656	Shapiro Wilk Test Statistic	0.797
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	158.6	Mean	4.034
SD	452	SD	0.976
95% DL/2 (t) UCL	350	95% H-Stat (DL/2) UCL	125.6
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	4.034
		SD in Log Scale	0.989
		Mean in Original Scale	159
		SD in Original Scale	451.9
		95% Percentile Bootstrap UCL	376.7
		95% BCA Bootstrap UCL	495.3

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.315
Theta Star	1739
nu star	2.521
A-D Test Statistic	0.714
5% A-D Critical Value	0.677
K-S Test Statistic	0.677
5% K-S Critical Value	0.408

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	1910
Mean	128.9
Median	1E-09
SD	460.6
k star	0.0766
Theta star	1684
Nu star	2.603
AppChi2	0.265
95% Gamma Approximate UCL	1265
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	173.9
SD	434.4
SE of Mean	121.6
95% KM (t) UCL	386.3
95% KM (z) UCL	374
95% KM (jackknife) UCL	341.5
95% KM (bootstrap t) UCL	3716
95% KM (BCA) UCL	N/A
95% KM (Percentile Bootstrap) UCL	500.6
95% KM (Chebyshev) UCL	704.1
97.5% KM (Chebyshev) UCL	933.6
99% KM (Chebyshev) UCL	1384

Potential UCLs to Use

97.5% KM (Chebyshev) UCL	933.6

Benzo(b)fluoranthene

General Statistics

Number of Valid Data	17	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	13
		Percent Non-Detects	76.47%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	98.7	Minimum Detected	4.592
Maximum Detected	1390	Maximum Detected	7.237
Mean of Detected	433.9	Mean of Detected	5.364
SD of Detected	637.5	SD of Detected	1.255
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	13
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	76.47%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.65	Shapiro Wilk Test Statistic	0.72
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	131.7	Mean	4.057
SD	325.7	SD	0.926
95% DL/2 (t) UCL	269.7	95% H-Stat (DL/2) UCL	113.9
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.454
		SD in Log Scale	2.336
		Mean in Original Scale	103.2
		SD in Original Scale	334.6
		95% Percentile Bootstrap UCL	259.8
		95% BCA Bootstrap UCL	347.2

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.375
Theta Star	1158
nu star	2.999
A-D Test Statistic	0.814
5% A-D Critical Value	0.669
K-S Test Statistic	0.669
5% K-S Critical Value	0.404

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	1390
Mean	258.4
Median	115.2
SD	426.9
k star	0.316
Theta star	817.9
Nu star	10.74
AppChi2	4.411
95% Gamma Approximate UCL	629.4
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	177.6
SD	303.2
SE of Mean	84.92
95% KM (t) UCL	325.8
95% KM (z) UCL	317.3
95% KM (jackknife) UCL	301.1
95% KM (bootstrap t) UCL	3316
95% KM (BCA) UCL	1390
95% KM (Percentile Bootstrap) UCL	404.3
95% KM (Chebyshev) UCL	547.7
97.5% KM (Chebyshev) UCL	707.9
99% KM (Chebyshev) UCL	1023

Potential UCLs to Use

95% KM (BCA) UCL	1390

Benzo(g,h,i)perylene

General Statistics

Number of Valid Data	17	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	13
		Percent Non-Detects	76.47%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	62.3	Minimum Detected	4.132
Maximum Detected	1180	Maximum Detected	7.073
Mean of Detected	348.5	Mean of Detected	4.962
SD of Detected	554.4	SD of Detected	1.414
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.12%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.645	Shapiro Wilk Test Statistic	0.709
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	111.6	Mean	3.963
SD	275.6	SD	0.84
95% DL/2 (t) UCL	228.4	95% H-Stat (DL/2) UCL	98.58
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.298
		SD in Log Scale	0.733
		Mean in Original Scale	128.4
		SD in Original Scale	271.2
		95% Percentile Bootstrap UCL	260.1
		95% BCA Bootstrap UCL	328.5

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.337
Theta Star	1035
nu star	2.694
A-D Test Statistic	0.826
5% A-D Critical Value	0.673
K-S Test Statistic	0.673
5% K-S Critical Value	0.406

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	62.3
Maximum	1180
Mean	354.4
Median	361.7
SD	242.1
k star	2.09
Theta star	169.6
Nu star	71.06
AppChi2	52.65
95% Gamma Approximate UCL	478.3
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	131.4
SD	262.2
SE of Mean	73.45
95% KM (t) UCL	259.6
95% KM (z) UCL	252.2
95% KM (jackknife) UCL	245.9
95% KM (bootstrap t) UCL	3383
95% KM (BCA) UCL	1180
95% KM (Percentile Bootstrap) UCL	265.4
95% KM (Chebyshev) UCL	451.5
97.5% KM (Chebyshev) UCL	590.1
99% KM (Chebyshev) UCL	862.2

Potential UCLs to Use

95% KM (BCA) UCL	1180

Benzo(k)fluoranthene

General Statistics

Number of Valid Data	17	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	13
		Percent Non-Detects	76.47%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	85.7	Minimum Detected	4.451
Maximum Detected	1030	Maximum Detected	6.937
Mean of Detected	329.6	Mean of Detected	5.155
SD of Detected	467	SD of Detected	1.192
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	14
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	82.35%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.647	Shapiro Wilk Test Statistic	0.701
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	107.2	Mean	4.008
SD	238.9	SD	0.837
95% DL/2 (t) UCL	208.3	95% H-Stat (DL/2) UCL	97.66
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.963
		SD in Log Scale	1.925
		Mean in Original Scale	79.72
		SD in Original Scale	247.6
		95% Percentile Bootstrap UCL	195.5
		95% BCA Bootstrap UCL	261.9

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.394
Theta Star	836.8
nu star	3.15
A-D Test Statistic	0.843
5% A-D Critical Value	0.668
K-S Test Statistic	0.668
5% K-S Critical Value	0.403

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	1030
Mean	194.6
Median	96.07
SD	316
k star	0.215
Theta star	903.5
Nu star	7.325
AppChi2	2.351
95% Gamma Approximate UCL	606.5
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	143.1
SD	221.8
SE of Mean	62.12
95% KM (t) UCL	251.5
95% KM (z) UCL	245.2
95% KM (jackknife) UCL	234.1
95% KM (bootstrap t) UCL	2910
95% KM (BCA) UCL	1030
95% KM (Percentile Bootstrap) UCL	310.3
95% KM (Chebyshev) UCL	413.8
97.5% KM (Chebyshev) UCL	531
99% KM (Chebyshev) UCL	761.1

Potential UCLs to Use

95% KM (BCA) UCL	1030

Chrysene

General Statistics

Number of Valid Data	17	Number of Detected Data	5
Number of Distinct Detected Data	4	Number of Non-Detect Data	12
		Percent Non-Detects	70.59%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	19.1	Minimum Detected	2.95
Maximum Detected	4040	Maximum Detected	8.304
Mean of Detected	880.8	Mean of Detected	5.098
SD of Detected	1767	SD of Detected	1.954
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	13
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	76.47%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.573	Shapiro Wilk Test Statistic	0.835
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	286.4	Mean	4.078
SD	967.8	SD	1.191
95% DL/2 (t) UCL	696.2	95% H-Stat (DL/2) UCL	212
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	3.205
		SD in Log Scale	1.615
		Mean in Original Scale	267.3
		SD in Original Scale	973
		95% Percentile Bootstrap UCL	737.6
		95% BCA Bootstrap UCL	984.9

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.29
Theta Star	3035
nu star	2.902
A-D Test Statistic	0.853
5% A-D Critical Value	0.726
K-S Test Statistic	0.726
5% K-S Critical Value	0.376

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	1E-09
Maximum	4040
Mean	550.3
Median	91.03
SD	1314
k star	0.242
Theta star	2272
Nu star	8.235
AppChi2	2.872
95% Gamma Approximate UCL	1578
95% Adjusted Gamma UCL	1777

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	272.5
SD	942.6
SE of Mean	255.6
95% KM (t) UCL	718.8
95% KM (z) UCL	693
95% KM (jackknife) UCL	641.7
95% KM (bootstrap t) UCL	59578
95% KM (BCA) UCL	1036
95% KM (Percentile Bootstrap) UCL	804.7
95% KM (Chebyshev) UCL	1387
97.5% KM (Chebyshev) UCL	1869
99% KM (Chebyshev) UCL	2816

Potential UCLs to Use

97.5% KM (Chebyshev) UCL	1869

Dibenzo(a,h)anthracene

General Statistics

Number of Valid Data	17	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	14
		Percent Non-Detects	82.35%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	22.6	Minimum Detected	3.118
Maximum Detected	388	Maximum Detected	5.961
Mean of Detected	144.9	Mean of Detected	4.086
SD of Detected	210.6	SD of Detected	1.624
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.12%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.753	Shapiro Wilk Test Statistic	0.766
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	57.83	Mean	3.74
SD	85.29	SD	0.602
95% DL/2 (t) UCL	93.94	95% H-Stat (DL/2) UCL	67.74
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.402
		SD in Log Scale	0.685
		Mean in Original Scale	47.33
		SD in Original Scale	87.94
		95% Percentile Bootstrap UCL	89.25
		95% BCA Bootstrap UCL	112

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	0.592
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data do not follow a Discernable Distribution (0.05)	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	44.75
SD	85.81
SE of Mean	25.5
95% KM (t) UCL	89.27
95% KM (z) UCL	86.69
95% KM (jackknife) UCL	82.24
95% KM (bootstrap t) UCL	1650
95% KM (BCA) UCL	388
95% KM (Percentile Bootstrap) UCL	388
95% KM (Chebyshev) UCL	155.9
97.5% KM (Chebyshev) UCL	204
99% KM (Chebyshev) UCL	298.4
Potential UCLs to Use	
97.5% KM (Chebyshev) UCL	204

bis(2-Ethylhexyl)phthalate

General Statistics

Number of Valid Data	17	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	11
		Percent Non-Detects	64.71%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	51.9	Minimum Detected	3.949
Maximum Detected	199	Maximum Detected	5.293
Mean of Detected	103.6	Mean of Detected	4.532
SD of Detected	53.89	SD of Detected	0.511
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	470	Maximum Non-Detect	6.153

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	17
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: There are only 6 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.866	Shapiro Wilk Test Statistic	0.9
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	73.11	Mean	4.068
SD	60.37	SD	0.629
95% DL/2 (t) UCL	98.67	95% H-Stat (DL/2) UCL	109.4
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.178
		SD in Log Scale	0.401
		Mean in Original Scale	71.53
		SD in Original Scale	39.02
		95% Percentile Bootstrap UCL	86.84
		95% BCA Bootstrap UCL	94.21

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	2.489
Theta Star	41.64
nu star	29.87
A-D Test Statistic	0.4
5% A-D Critical Value	0.699
K-S Test Statistic	0.699
5% K-S Critical Value	0.333

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	51.9
Maximum	199
Mean	97.88
Median	96.92
SD	33.28
k star	8.561
Theta star	11.43
Nu star	291.1
AppChi2	252.5
95% Gamma Approximate UCL	112.8
95% Adjusted Gamma UCL	114.5

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	71.49
SD	39.08
SE of Mean	10.7
95% KM (t) UCL	90.18
95% KM (z) UCL	89.1
95% KM (jackknife) UCL	89.15
95% KM (bootstrap t) UCL	98.1
95% KM (BCA) UCL	115.2
95% KM (Percentile Bootstrap) UCL	111.7
95% KM (Chebyshev) UCL	118.1
97.5% KM (Chebyshev) UCL	138.3
99% KM (Chebyshev) UCL	178

Potential UCLs to Use

95% KM (t) UCL	90.18
95% KM (Percentile Bootstrap) UCL	111.7

Fluoranthene

General Statistics

Number of Valid Data	17	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	11
		Percent Non-Detects	64.71%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	23	Minimum Detected	3.135
Maximum Detected	1790	Maximum Detected	7.49
Mean of Detected	388.7	Mean of Detected	4.919
SD of Detected	689.5	SD of Detected	1.51
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	13
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	76.47%

Warning: There are only 6 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.583	Shapiro Wilk Test Statistic	0.915
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	162.1	Mean	4.098
SD	422.3	SD	1.053
95% DL/2 (t) UCL	340.9	95% H-Stat (DL/2) UCL	157.4
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	3.879
		SD in Log Scale	1.173
		Mean in Original Scale	155.4
		SD in Original Scale	424.4
		95% Percentile Bootstrap UCL	353.6
		95% BCA Bootstrap UCL	462.7

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.408
Theta Star	953.2
nu star	4.893
A-D Test Statistic	0.655
5% A-D Critical Value	0.73
K-S Test Statistic	0.73
5% K-S Critical Value	0.347

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	1790
Mean	373.5
Median	367.1
SD	405.8
k star	0.331
Theta star	1128
Nu star	11.26
AppChi2	4.744
95% Gamma Approximate UCL	886.5
95% Adjusted Gamma UCL	976.2

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	157.5
SD	411.1
SE of Mean	109.3
95% KM (t) UCL	348.4
95% KM (z) UCL	337.3
95% KM (jackknife) UCL	337.6
95% KM (bootstrap t) UCL	1204
95% KM (BCA) UCL	435.5
95% KM (Percentile Bootstrap) UCL	357.4
95% KM (Chebyshev) UCL	634.1
97.5% KM (Chebyshev) UCL	840.2
99% KM (Chebyshev) UCL	1245

Potential UCLs to Use

95% KM (t) UCL	348.4

Indeno(1,2,3-cd)pyrene

General Statistics

Number of Valid Data	17	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	13
		Percent Non-Detects	76.47%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	61.3	Minimum Detected	4.116
Maximum Detected	617	Maximum Detected	6.425
Mean of Detected	201.6	Mean of Detected	4.715
SD of Detected	277	SD of Detected	1.14
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.12%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.634	Shapiro Wilk Test Statistic	0.647
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	77.08	Mean	3.905
SD	139.5	SD	0.68
95% DL/2 (t) UCL	136.1	95% H-Stat (DL/2) UCL	78.02
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	4.376
		SD in Log Scale	0.546
		Mean in Original Scale	102.8
		SD in Original Scale	132.9
		95% Percentile Bootstrap UCL	166.5
		95% BCA Bootstrap UCL	202.5

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.411
Theta Star	490.2
nu star	3.29
A-D Test Statistic	0.933
5% A-D Critical Value	0.667
K-S Test Statistic	0.667
5% K-S Critical Value	0.403

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data

Minimum	61.3
Maximum	617
Mean	206.6
Median	209.2
SD	120.4
k star	3.099
Theta star	66.66
Nu star	105.4
AppChi2	82.69
95% Gamma Approximate UCL	263.3
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method

Mean	95.68
SD	130.3
SE of Mean	36.51
95% KM (t) UCL	159.4
95% KM (z) UCL	155.7
95% KM (jackknife) UCL	152.6
95% KM (bootstrap t) UCL	2916
95% KM (BCA) UCL	N/A
95% KM (Percentile Bootstrap) UCL	161.7
95% KM (Chebyshev) UCL	254.8
97.5% KM (Chebyshev) UCL	323.7
99% KM (Chebyshev) UCL	458.9

Potential UCLs to Use

95% KM (BCA) UCL	N/A

Phenanthrene

General Statistics

Number of Valid Data	17	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	12
		Percent Non-Detects	70.59%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	25.6	Minimum Detected	3.243
Maximum Detected	2230	Maximum Detected	7.71
Mean of Detected	486.7	Mean of Detected	4.573
SD of Detected	974.9	SD of Detected	1.834
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.12%

Warning: There are only 5 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.575	Shapiro Wilk Test Statistic	0.783
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	170.5	Mean	3.924
SD	530.9	SD	1.016
95% DL/2 (t) UCL	395.3	95% H-Stat (DL/2) UCL	136.5
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.871
		SD in Log Scale	1.049
		Mean in Original Scale	169.1
		SD in Original Scale	531.3
		95% Percentile Bootstrap UCL	425
		95% BCA Bootstrap UCL	560.9

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	0.296
Theta Star	1645
nu star	2.959
A-D Test Statistic	0.876
5% A-D Critical Value	0.724
K-S Test Statistic	0.724
5% K-S Critical Value	0.375
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	25.6
Maximum	2230
Mean	505.6
Median	525
SD	489.4
k star	1.013
Theta star	498.9
Nu star	34.46
AppChi2	22.03
95% Gamma Approximate UCL	790.8
95% Adjusted Gamma UCL	829.9

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data appear Lognormal at 5% Significance Level	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	171.8
SD	515
SE of Mean	140
95% KM (t) UCL	416.3
95% KM (z) UCL	402.1
95% KM (jackknife) UCL	397.9
95% KM (bootstrap t) UCL	4532
95% KM (BCA) UCL	436.8
95% KM (Percentile Bootstrap) UCL	432
95% KM (Chebyshev) UCL	782.1
97.5% KM (Chebyshev) UCL	1046
99% KM (Chebyshev) UCL	1565
Potential UCLs to Use	
97.5% KM (Chebyshev) UCL	1046

Pyrene

General Statistics

Number of Valid Data	17	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	11
		Percent Non-Detects	64.71%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	21.3	Minimum Detected	3.059
Maximum Detected	4740	Maximum Detected	8.464
Mean of Detected	873.4	Mean of Detected	5.011
SD of Detected	1895	SD of Detected	1.889
Minimum Non-Detect	70	Minimum Non-Detect	4.248
Maximum Non-Detect	90	Maximum Non-Detect	4.5

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	13
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	4
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	76.47%

Warning: There are only 6 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.525	Shapiro Wilk Test Statistic	0.857
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	333.2	Mean	4.13
SD	1136	SD	1.253
95% DL/2 (t) UCL	814.4	95% H-Stat (DL/2) UCL	244.1
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	3.793
		SD in Log Scale	1.423
		Mean in Original Scale	323.6
		SD in Original Scale	1139
		95% Percentile Bootstrap UCL	869.5
		95% BCA Bootstrap UCL	1152

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	0.3
Theta Star	2914
nu star	3.597
A-D Test Statistic	0.927
5% A-D Critical Value	0.755
K-S Test Statistic	0.755
5% K-S Critical Value	0.354
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	4740
Mean	876.6
Median	894.2
SD	1098
k star	0.296
Theta star	2958
Nu star	10.08
AppChi2	3.99
95% Gamma Approximate UCL	2214
95% Adjusted Gamma UCL	2456

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data appear Lognormal at 5% Significance Level	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	326.6
SD	1104
SE of Mean	293.4
95% KM (t) UCL	838.9
95% KM (z) UCL	809.2
95% KM (jackknife) UCL	808.7
95% KM (bootstrap t) UCL	9188
95% KM (BCA) UCL	891.1
95% KM (Percentile Bootstrap) UCL	876.4
95% KM (Chebyshev) UCL	1606
97.5% KM (Chebyshev) UCL	2159
99% KM (Chebyshev) UCL	3246
Potential UCLs to Use	
97.5% KM (Chebyshev) UCL	2159

2-Chlorophenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2-Chlorophenol was not processed!

2,4-Dichlorophenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4-Dichlorophenol was not processed!

2,4-Dimethylphenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4-Dimethylphenol was not processed!

2,4-Dinitrophenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4-Dinitrophenol was not processed!

4,6-Dinitro-o-cresol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 4,6-Dinitro-o-cresol was not processed!

2-Methylphenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2-Methylphenol was not processed!

3&4-Methylphenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 3&4-Methylphenol was not processed!

4-Nitrophenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 4-Nitrophenol was not processed!

Phenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Phenol was not processed!

2,4,5-Trichlorophenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4,5-Trichlorophenol was not processed!

2,4,6-Trichlorophenol

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,4,6-Trichlorophenol was not processed!

Acenaphthene

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Acenaphthene was not processed!

General UCL Statistics for Data Sets with Non-Detects

User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

alpha-Chlordane

General Statistics

Number of Valid Data	17	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	16
		Percent Non-Detects	94.12%

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 alpha-Chlordane was not processed!

gamma-Chlordane

General Statistics

Number of Valid Data	17	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	16
		Percent Non-Detects	94.12%

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 gamma-Chlordane was not processed!

4,4'-DDD

General Statistics

Number of Valid Data	17	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	6
		Percent Non-Detects	35.29%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.3	Minimum Detected	0.262
Maximum Detected	197	Maximum Detected	5.283
Mean of Detected	56.1	Mean of Detected	2.924
SD of Detected	73.73	SD of Detected	1.746
Minimum Non-Detect	1.4	Minimum Non-Detect	0.336
Maximum Non-Detect	1.8	Maximum Non-Detect	0.588

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	7
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	10
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	41.18%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.746	Shapiro Wilk Test Statistic	0.944
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	36.57	Mean	1.801
SD	64.35	SD	2.089
95% DL/2 (t) UCL	63.82	95% H-Stat (DL/2) UCL	305
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	7.9	Mean in Log Scale	1.753
SD	91.19	SD in Log Scale	2.167
95% MLE (t) UCL	46.51	Mean in Original Scale	36.57
95% MLE (Tiku) UCL	51.69	SD in Original Scale	64.35
		95% Percentile Bootstrap UCL	61.88
		95% BCA Bootstrap UCL	71.33

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.472
Theta Star	118.9
nu star	10.38
A-D Test Statistic	0.426
5% A-D Critical Value	0.776
K-S Test Statistic	0.776
5% K-S Critical Value	0.268

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	197
Mean	39.65
Median	6.2
SD	62.98
k star	0.279
Theta star	141.9
Nu star	9.501
AppChi2	3.632
95% Gamma Approximate UCL	103.7
95% Adjusted Gamma UCL	115.5

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	36.76
SD	62.32
SE of Mean	15.85
95% KM (t) UCL	64.44
95% KM (z) UCL	62.83
95% KM (jackknife) UCL	63.8
95% KM (bootstrap t) UCL	89.35
95% KM (BCA) UCL	64.55
95% KM (Percentile Bootstrap) UCL	62.08
95% KM (Chebyshev) UCL	105.9
97.5% KM (Chebyshev) UCL	135.8
99% KM (Chebyshev) UCL	194.5

Potential UCLs to Use

95% KM (BCA) UCL	64.55

4,4'-DDE

General Statistics

Number of Valid Data	17	Number of Detected Data	14
Number of Distinct Detected Data	14	Number of Non-Detect Data	3
		Percent Non-Detects	17.65%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	3.1	Minimum Detected	1.131
Maximum Detected	1310	Maximum Detected	7.178
Mean of Detected	330.3	Mean of Detected	4.533
SD of Detected	446.4	SD of Detected	1.932
Minimum Non-Detect	1.4	Minimum Non-Detect	0.336
Maximum Non-Detect	1.5	Maximum Non-Detect	0.405

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	14
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	17.65%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.737	Shapiro Wilk Test Statistic	0.949
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	272.1	Mean	3.678
SD	422.7	SD	2.58
95% DL/2 (t) UCL	451.1	95% H-Stat (DL/2) UCL	12715
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	218	Mean in Log Scale	3.743
SD	471.1	SD in Log Scale	2.481
95% MLE (t) UCL	417.5	Mean in Original Scale	272.2
95% MLE (Tiku) UCL	413.1	SD in Original Scale	422.7
		95% Percentile Bootstrap UCL	439.2
		95% BCA Bootstrap UCL	474.8

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.441
Theta Star	748.3
nu star	12.36
A-D Test Statistic	0.467
5% A-D Critical Value	0.793
K-S Test Statistic	0.793
5% K-S Critical Value	0.242

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	1310
Mean	272
Median	53.2
SD	422.8
k star	0.155
Theta star	1757
Nu star	5.263
AppChi2	1.275
95% Gamma Approximate UCL	1122
95% Adjusted Gamma UCL	1321

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	272.5
SD	409.8
SE of Mean	103.2
95% KM (t) UCL	452.6
95% KM (z) UCL	442.2
95% KM (jackknife) UCL	451.1
95% KM (bootstrap t) UCL	524
95% KM (BCA) UCL	462.8
95% KM (Percentile Bootstrap) UCL	440.7
95% KM (Chebyshev) UCL	722.2
97.5% KM (Chebyshev) UCL	916.7
99% KM (Chebyshev) UCL	1299

Potential UCLs to Use

95% KM (Chebyshev) UCL	722.2

4,4'-DDT

General Statistics

Number of Valid Data	17	Number of Detected Data	14
Number of Distinct Detected Data	14	Number of Non-Detect Data	3
		Percent Non-Detects	17.65%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	2.4	Minimum Detected	0.875
Maximum Detected	577	Maximum Detected	6.358
Mean of Detected	165.9	Mean of Detected	3.941
SD of Detected	224.7	SD of Detected	1.777
Minimum Non-Detect	1.4	Minimum Non-Detect	0.336
Maximum Non-Detect	1.5	Maximum Non-Detect	0.405

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	14
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	17.65%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.703	Shapiro Wilk Test Statistic	0.942
5% Shapiro Wilk Critical Value	0.874	5% Shapiro Wilk Critical Value	0.874
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	136.7	Mean	3.191
SD	212.7	SD	2.315
95% DL/2 (t) UCL	226.8	95% H-Stat (DL/2) UCL	2547
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	109.6	Mean in Log Scale	3.212
SD	237	SD in Log Scale	2.286
95% MLE (t) UCL	209.9	Mean in Original Scale	136.8
95% MLE (Tiku) UCL	207.6	SD in Original Scale	212.7
		95% Percentile Bootstrap UCL	222.5
		95% BCA Bootstrap UCL	239.9

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.469
Theta Star	353.4
nu star	13.14
A-D Test Statistic	0.601
5% A-D Critical Value	0.79
K-S Test Statistic	0.79
5% K-S Critical Value	0.241

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	577
Mean	136.6
Median	19.4
SD	212.8
k star	0.159
Theta star	861.4
Nu star	5.392
AppChi2	1.337
95% Gamma Approximate UCL	550.7
95% Adjusted Gamma UCL	646.4

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	137
SD	206.2
SE of Mean	51.89
95% KM (t) UCL	227.6
95% KM (z) UCL	222.4
95% KM (jackknife) UCL	226.5
95% KM (bootstrap t) UCL	261.2
95% KM (BCA) UCL	223.9
95% KM (Percentile Bootstrap) UCL	225.9
95% KM (Chebyshev) UCL	363.2
97.5% KM (Chebyshev) UCL	461.1
99% KM (Chebyshev) UCL	653.4

Potential UCLs to Use

95% KM (Chebyshev) UCL	363.2

Aroclor 1260

General Statistics

Number of Valid Data	17	Number of Detected Data	1
Number of Distinct Detected Data	1	Number of Non-Detect Data	16
		Percent Non-Detects	94.12%

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 Aroclor 1260 was not processed!

2,3,7,8-TCDD

General Statistics

Number of Valid Data	9	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	9
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable 2,3,7,8-TCDD was not processed!

Aluminum

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 17

Raw Statistics

Minimum 5740
Maximum 79300
Mean 16011
Median 8970
SD 18510
Coefficient of Variation 1.156
Skewness 2.899

Log-transformed Statistics

Minimum of Log Data 8.655
Maximum of Log Data 11.28
Mean of log Data 9.347
SD of log Data 0.726

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.574
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.799
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 23849

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 26768
95% Modified-t UCL 24375

Assuming Lognormal Distribution

95% H-UCL 22573
95% Chebyshev (MVUE) UCL 26578
97.5% Chebyshev (MVUE) UCL 31746
99% Chebyshev (MVUE) UCL 41896

Gamma Distribution Test

k star (bias corrected) 1.392
Theta Star 11501
nu star 47.33
Approximate Chi Square Value (.05) 32.54
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 31.26

Anderson-Darling Test Statistic 1.939
Anderson-Darling 5% Critical Value 0.754
Kolmogorov-Smirnov Test Statistic 0.321
Kolmogorov-Smirnov 5% Critical Value 0.213
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 23287
95% Adjusted Gamma UCL 24243

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 23395
95% Jackknife UCL 23849
95% Standard Bootstrap UCL 23201
95% Bootstrap-t UCL 37594
95% Hall's Bootstrap UCL 48313
95% Percentile Bootstrap UCL 23845
95% BCA Bootstrap UCL 28321
95% Chebyshev(Mean, Sd) UCL 35579
97.5% Chebyshev(Mean, Sd) UCL 44046
99% Chebyshev(Mean, Sd) UCL 60678

Potential UCL to Use

Use 95% Chebyshev (Mean, Sd) UCL 35579

Antimony

General Statistics

Number of Valid Data	17	Number of Detected Data	8
Number of Distinct Detected Data	8	Number of Non-Detect Data	9
		Percent Non-Detects	52.94%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.1	Minimum Detected	0.0953
Maximum Detected	63.7	Maximum Detected	4.154
Mean of Detected	26.79	Mean of Detected	2.8
SD of Detected	23.34	SD of Detected	1.283
Minimum Non-Detect	2.1	Minimum Non-Detect	0.742
Maximum Non-Detect	2.7	Maximum Non-Detect	0.993

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	10
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	7
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	58.82%

Warning: There are only 8 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.847	Shapiro Wilk Test Statistic	0.869
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	13.23	Mean	1.402
SD	20.3	SD	1.602
95% DL/2 (t) UCL	21.82	95% H-Stat (DL/2) UCL	38.41
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	1.511
		SD in Log Scale	1.543
		Mean in Original Scale	13.43
		SD in Original Scale	20.17
		95% Percentile Bootstrap UCL	21.77
		95% BCA Bootstrap UCL	23.95

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.81
Theta Star	33.08
nu star	12.96
A-D Test Statistic	0.322
5% A-D Critical Value	0.733
K-S Test Statistic	0.733
5% K-S Critical Value	0.301

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1.1
Maximum	63.7
Mean	26.78
Median	26.74
SD	15.48
k star	1.952
Theta star	13.72
Nu star	66.35
AppChi2	48.61
95% Gamma Approximate UCL	36.56
95% Adjusted Gamma UCL	37.8

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	13.19
SD	19.72
SE of Mean	5.112
95% KM (t) UCL	22.11
95% KM (z) UCL	21.6
95% KM (jackknife) UCL	21.45
95% KM (bootstrap t) UCL	28.02
95% KM (BCA) UCL	27.91
95% KM (Percentile Bootstrap) UCL	25.91
95% KM (Chebyshev) UCL	35.47
97.5% KM (Chebyshev) UCL	45.11
99% KM (Chebyshev) UCL	64.05

Potential UCLs to Use

95% KM (t) UCL	22.11
95% KM (Percentile Bootstrap) UCL	25.91

Arsenic

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 13

Raw Statistics

Minimum 1.7
Maximum 8.4
Mean 4.418
Median 3.9
SD 2.196
Coefficient of Variation 0.497
Skewness 0.54

Log-transformed Statistics

Minimum of Log Data 0.531
Maximum of Log Data 2.128
Mean of log Data 1.362
SD of log Data 0.524

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.907
Shapiro Wilk Critical Value 0.892
Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.93
Shapiro Wilk Critical Value 0.892
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 5.348

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 5.368
95% Modified-t UCL 5.359

Assuming Lognormal Distribution

95% H-UCL 5.865
95% Chebyshev (MVUE) UCL 6.985
97.5% Chebyshev (MVUE) UCL 8.087
99% Chebyshev (MVUE) UCL 10.25

Gamma Distribution Test

k star (bias corrected) 3.512
Theta Star 1.258
nu star 119.4
Approximate Chi Square Value (.05) 95.18
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 92.92

Anderson-Darling Test Statistic 0.423
Anderson-Darling 5% Critical Value 0.743
Kolmogorov-Smirnov Test Statistic 0.13
Kolmogorov-Smirnov 5% Critical Value 0.21
Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Normal at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 5.542
95% Adjusted Gamma UCL 5.678

Nonparametric Statistics

95% CLT UCL 5.294
95% Jackknife UCL 5.348
95% Standard Bootstrap UCL 5.279
95% Bootstrap-t UCL 5.544
95% Hall's Bootstrap UCL 5.314
95% Percentile Bootstrap UCL 5.294
95% BCA Bootstrap UCL 5.282
95% Chebyshev(Mean, Sd) UCL 6.74
97.5% Chebyshev(Mean, Sd) UCL 7.744
99% Chebyshev(Mean, Sd) UCL 9.718

Potential UCL to Use

Use 95% Student's-t UCL 5.348

Barium

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 17

Raw Statistics

Minimum 15.9
Maximum 1160
Mean 205.2
Median 55.8
SD 355.2
Coefficient of Variation 1.731
Skewness 2.472

Log-transformed Statistics

Minimum of Log Data 2.766
Maximum of Log Data 7.056
Mean of log Data 4.436
SD of log Data 1.248

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.533
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.909
Shapiro Wilk Critical Value 0.892
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 355.6

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 402.1
95% Modified-t UCL 364.2

Assuming Lognormal Distribution

95% H-UCL 477.5
95% Chebyshev (MVUE) UCL 427.8
97.5% Chebyshev (MVUE) UCL 538.9
99% Chebyshev (MVUE) UCL 757.2

Gamma Distribution Test

k star (bias corrected) 0.602
Theta Star 340.9
nu star 20.46
Approximate Chi Square Value (.05) 11.19
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 10.48

Anderson-Darling Test Statistic 1.438
Anderson-Darling 5% Critical Value 0.782
Kolmogorov-Smirnov Test Statistic 0.227
Kolmogorov-Smirnov 5% Critical Value 0.218
Data not Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 346.9
95% Jackknife UCL 355.6
95% Standard Bootstrap UCL 347.8
95% Bootstrap-t UCL 974.9
95% Hall's Bootstrap UCL 1162
95% Percentile Bootstrap UCL 350.5
95% BCA Bootstrap UCL 416.6
95% Chebyshev(Mean, Sd) UCL 580.7
97.5% Chebyshev(Mean, Sd) UCL 743.2
99% Chebyshev(Mean, Sd) UCL 1062

Assuming Gamma Distribution

95% Approximate Gamma UCL 375.1
95% Adjusted Gamma UCL 400.7

Potential UCL to Use

Use 95% Chebyshev (MVUE) UCL 427.8

Beryllium

General Statistics

Number of Valid Data	17	Number of Detected Data	13
Number of Distinct Detected Data	12	Number of Non-Detect Data	4
		Percent Non-Detects	23.53%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.086	Minimum Detected	-2.453
Maximum Detected	1.3	Maximum Detected	0.262
Mean of Detected	0.311	Mean of Detected	-1.428
SD of Detected	0.311	SD of Detected	0.681
Minimum Non-Detect	0.56	Minimum Non-Detect	-0.58
Maximum Non-Detect	1.9	Maximum Non-Detect	0.642

Note: Data have multiple DLs - Use of KM Method is recommended
For all methods (except KM, DL/2, and ROS Methods),
Observations < Largest ND are treated as NDs

Number treated as Non-Detect	17
Number treated as Detected	0
Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.596	Shapiro Wilk Test Statistic	0.92
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.366	Mean	-1.266
SD	0.32	SD	0.711
95% DL/2 (t) UCL	0.502	95% H-Stat (DL/2) UCL	0.604
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.445
		SD in Log Scale	0.591
		Mean in Original Scale	0.29
		SD in Original Scale	0.272
		95% Percentile Bootstrap UCL	0.414
		95% BCA Bootstrap UCL	0.47

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	1.644
Theta Star	0.189
nu star	42.73
A-D Test Statistic	0.795
5% A-D Critical Value	0.743
K-S Test Statistic	0.743
5% K-S Critical Value	0.239

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.086
Maximum	1.3
Mean	0.314
Median	0.29
SD	0.269
k star	2.232
Theta star	0.141
Nu star	75.87
AppChi2	56.81
95% Gamma Approximate UCL	0.419
95% Adjusted Gamma UCL	0.433

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	0.296
SD	0.274
SE of Mean	0.0723
95% KM (t) UCL	0.422
95% KM (z) UCL	0.415
95% KM (jackknife) UCL	0.422
95% KM (bootstrap t) UCL	0.584
95% KM (BCA) UCL	0.427
95% KM (Percentile Bootstrap) UCL	0.428
95% KM (Chebyshev) UCL	0.611
97.5% KM (Chebyshev) UCL	0.747
99% KM (Chebyshev) UCL	1.015

Potential UCLs to Use

95% KM (BCA) UCL	0.427

Cadmium

General Statistics

Number of Valid Data	17	Number of Detected Data	12
Number of Distinct Detected Data	12	Number of Non-Detect Data	5
		Percent Non-Detects	29.41%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.21	Minimum Detected	-1.561
Maximum Detected	75.3	Maximum Detected	4.321
Mean of Detected	12.39	Mean of Detected	1.186
SD of Detected	21.25	SD of Detected	1.912
Minimum Non-Detect	0.53	Minimum Non-Detect	-0.635
Maximum Non-Detect	0.57	Maximum Non-Detect	-0.562

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	8
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	9
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	47.06%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.616	Shapiro Wilk Test Statistic	0.955
5% Shapiro Wilk Critical Value	0.859	5% Shapiro Wilk Critical Value	0.859
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	8.825	Mean	0.456
SD	18.51	SD	1.968
95% DL/2 (t) UCL	16.66	95% H-Stat (DL/2) UCL	61.2
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	0.463
		SD in Log Scale	1.973
		Mean in Original Scale	8.832
		SD in Original Scale	18.51
		95% Percentile Bootstrap UCL	16.9
		95% BCA Bootstrap UCL	21.64

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.416
Theta Star	29.79
nu star	9.98
A-D Test Statistic	0.321
5% A-D Critical Value	0.789
K-S Test Statistic	0.789
5% K-S Critical Value	0.259

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	75.3
Mean	9.057
Median	1.8
SD	18.42
k star	0.255
Theta star	35.54
Nu star	8.664
AppChi2	3.126
95% Gamma Approximate UCL	25.11
95% Adjusted Gamma UCL	28.16

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	8.831
SD	17.96
SE of Mean	4.549
95% KM (t) UCL	16.77
95% KM (z) UCL	16.31
95% KM (jackknife) UCL	16.67
95% KM (bootstrap t) UCL	30.74
95% KM (BCA) UCL	17.66
95% KM (Percentile Bootstrap) UCL	17.2
95% KM (Chebyshev) UCL	28.66
97.5% KM (Chebyshev) UCL	37.24
99% KM (Chebyshev) UCL	54.09

Potential UCLs to Use

95% KM (Chebyshev) UCL	28.66

Chromium

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 17

Raw Statistics

Minimum 5.3
Maximum 616
Mean 62.8
Median 13.5
SD 146.2
Coefficient of Variation 2.328
Skewness 3.804

Log-transformed Statistics

Minimum of Log Data 1.668
Maximum of Log Data 6.423
Mean of log Data 3.052
SD of log Data 1.277

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.42
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.866
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 124.7

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 156.1
95% Modified-t UCL 130.2

Assuming Lognormal Distribution

95% H-UCL 129
95% Chebyshev (MVUE) UCL 112.5
97.5% Chebyshev (MVUE) UCL 142.1
99% Chebyshev (MVUE) UCL 200.1

Gamma Distribution Test

k star (bias corrected) 0.51
Theta Star 123
nu star 17.35
Approximate Chi Square Value (.05) 8.926
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 8.298

Anderson-Darling Test Statistic 1.812
Anderson-Darling 5% Critical Value 0.792
Kolmogorov-Smirnov Test Statistic 0.272
Kolmogorov-Smirnov 5% Critical Value 0.22
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 122.1
95% Adjusted Gamma UCL 131.3

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 121.1
95% Jackknife UCL 124.7
95% Standard Bootstrap UCL 118.9
95% Bootstrap-t UCL 369.1
95% Hall's Bootstrap UCL 325.9
95% Percentile Bootstrap UCL 130
95% BCA Bootstrap UCL 169.1
95% Chebyshev(Mean, Sd) UCL 217.4
97.5% Chebyshev(Mean, Sd) UCL 284.3
99% Chebyshev(Mean, Sd) UCL 415.7

Potential UCL to Use

Use 99% Chebyshev (Mean, Sd) UCL 415.7

Cobalt

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 16

Raw Statistics

Minimum 1.5
Maximum 28
Mean 5.194
Median 3.2
SD 6.282
Coefficient of Variation 1.209
Skewness 3.363

Log-transformed Statistics

Minimum of Log Data 0.405
Maximum of Log Data 3.332
Mean of log Data 1.321
SD of log Data 0.709

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.535
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.865
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 7.854

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 9.028
95% Modified-t UCL 8.061

Assuming Lognormal Distribution

95% H-UCL 7.207
95% Chebyshev (MVUE) UCL 8.504
97.5% Chebyshev (MVUE) UCL 10.13
99% Chebyshev (MVUE) UCL 13.34

Gamma Distribution Test

k star (bias corrected) 1.422
Theta Star 3.653
nu star 48.35
Approximate Chi Square Value (.05) 33.39
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 32.09

Anderson-Darling Test Statistic 1.522
Anderson-Darling 5% Critical Value 0.753
Kolmogorov-Smirnov Test Statistic 0.253
Kolmogorov-Smirnov 5% Critical Value 0.212
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 7.522
95% Adjusted Gamma UCL 7.826

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 7.7
95% Jackknife UCL 7.854
95% Standard Bootstrap UCL 7.667
95% Bootstrap-t UCL 12.92
95% Hall's Bootstrap UCL 15.86
95% Percentile Bootstrap UCL 8.059
95% BCA Bootstrap UCL 9.271
95% Chebyshev(Mean, Sd) UCL 11.84
97.5% Chebyshev(Mean, Sd) UCL 14.71
99% Chebyshev(Mean, Sd) UCL 20.35

Potential UCL to Use

Use 95% Chebyshev (Mean, Sd) UCL 11.84

Copper

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 17

Raw Statistics

Minimum 3
Maximum 5100
Mean 683.4
Median 10.7
SD 1405
Coefficient of Variation 2.056
Skewness 2.49

Log-transformed Statistics

Minimum of Log Data 1.099
Maximum of Log Data 8.537
Mean of log Data 3.911
SD of log Data 2.594

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.571
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.858
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 1278

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 1464
95% Modified-t UCL 1313

Assuming Lognormal Distribution

95% H-UCL 51417
95% Chebyshev (MVUE) UCL 3307
97.5% Chebyshev (MVUE) UCL 4395
99% Chebyshev (MVUE) UCL 6533

Gamma Distribution Test

k star (bias corrected) 0.26
Theta Star 2626
nu star 8.848
Approximate Chi Square Value (.05) 3.235
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 2.889

Anderson-Darling Test Statistic 1.436
Anderson-Darling 5% Critical Value 0.855
Kolmogorov-Smirnov Test Statistic 0.275
Kolmogorov-Smirnov 5% Critical Value 0.228
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 1869
95% Adjusted Gamma UCL 2093

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 1244
95% Jackknife UCL 1278
95% Standard Bootstrap UCL 1210
95% Bootstrap-t UCL 2318
95% Hall's Bootstrap UCL 2026
95% Percentile Bootstrap UCL 1268
95% BCA Bootstrap UCL 1471
95% Chebyshev(Mean, Sd) UCL 2169
97.5% Chebyshev(Mean, Sd) UCL 2812
99% Chebyshev(Mean, Sd) UCL 4074

Potential UCL to Use

Use 99% Chebyshev (Mean, Sd) UCL 4074

Iron

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 17

Raw Statistics

Minimum 3520
Maximum 96200
Mean 16566
Median 8600
SD 22840
Coefficient of Variation 1.379
Skewness 3.076

Log-transformed Statistics

Minimum of Log Data 8.166
Maximum of Log Data 11.47
Mean of log Data 9.265
SD of log Data 0.84

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.552
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.869
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 26238

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 30094
95% Modified-t UCL 26926

Assuming Lognormal Distribution

95% H-UCL 24935
95% Chebyshev (MVUE) UCL 28660
97.5% Chebyshev (MVUE) UCL 34731
99% Chebyshev (MVUE) UCL 46658

Gamma Distribution Test

k star (bias corrected) 1.069
Theta Star 15496
nu star 36.35
Approximate Chi Square Value (.05) 23.55
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 22.47

Anderson-Darling Test Statistic 1.616
Anderson-Darling 5% Critical Value 0.761
Kolmogorov-Smirnov Test Statistic 0.269
Kolmogorov-Smirnov 5% Critical Value 0.214
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 25570
95% Adjusted Gamma UCL 26796

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 25678
95% Jackknife UCL 26238
95% Standard Bootstrap UCL 25388
95% Bootstrap-t UCL 50577
95% Hall's Bootstrap UCL 60897
95% Percentile Bootstrap UCL 26949
95% BCA Bootstrap UCL 30842
95% Chebyshev(Mean, Sd) UCL 40712
97.5% Chebyshev(Mean, Sd) UCL 51160
99% Chebyshev(Mean, Sd) UCL 71683

Potential UCL to Use

Use 95% Chebyshev (Mean, Sd) UCL 40712

Lead

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 16

Raw Statistics

Minimum 3.4
Maximum 2120
Mean 432.8
Median 20.2
SD 633.9
Coefficient of Variation 1.465
Skewness 1.576

Log-transformed Statistics

Minimum of Log Data 1.224
Maximum of Log Data 7.659
Mean of log Data 4.193
SD of log Data 2.388

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.737
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.87
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 701.2

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 748.4
95% Modified-t UCL 711

Assuming Lognormal Distribution

95% H-UCL 24300
95% Chebyshev (MVUE) UCL 2844
97.5% Chebyshev (MVUE) UCL 3764
99% Chebyshev (MVUE) UCL 5571

Gamma Distribution Test

k star (bias corrected) 0.333
Theta Star 1298
nu star 11.33
Approximate Chi Square Value (.05) 4.79
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 4.352

Anderson-Darling Test Statistic 0.992
Anderson-Darling 5% Critical Value 0.829
Kolmogorov-Smirnov Test Statistic 0.27
Kolmogorov-Smirnov 5% Critical Value 0.225
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 1024
95% Adjusted Gamma UCL 1127

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 685.6
95% Jackknife UCL 701.2
95% Standard Bootstrap UCL 679.3
95% Bootstrap-t UCL 841.4
95% Hall's Bootstrap UCL 758.3
95% Percentile Bootstrap UCL 691.7
95% BCA Bootstrap UCL 738.9
95% Chebyshev(Mean, Sd) UCL 1103
97.5% Chebyshev(Mean, Sd) UCL 1393
99% Chebyshev(Mean, Sd) UCL 1963

Potential UCL to Use

Use 99% Chebyshev (Mean, Sd) UCL 1963

Manganese

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 17

Raw Statistics

Minimum 40.4
Maximum 1490
Mean 354.2
Median 233
SD 432.2
Coefficient of Variation 1.22
Skewness 2.293

Log-transformed Statistics

Minimum of Log Data 3.699
Maximum of Log Data 7.307
Mean of log Data 5.374
SD of log Data 1

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.628
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.944
Shapiro Wilk Critical Value 0.892
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 537.2

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 588.9
95% Modified-t UCL 546.9

Assuming Lognormal Distribution

95% H-UCL 693.4
95% Chebyshev (MVUE) UCL 740.3
97.5% Chebyshev (MVUE) UCL 912.8
99% Chebyshev (MVUE) UCL 1252

Gamma Distribution Test

k star (bias corrected) 0.984
Theta Star 360.1
nu star 33.44
Approximate Chi Square Value (.05) 21.22
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 20.2

Anderson-Darling Test Statistic 0.826
Anderson-Darling 5% Critical Value 0.763
Kolmogorov-Smirnov Test Statistic 0.212
Kolmogorov-Smirnov 5% Critical Value 0.214
Data follow Appr. Gamma Distribution at 5% Significance Level

Data Distribution

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 526.6
95% Jackknife UCL 537.2
95% Standard Bootstrap UCL 521.1
95% Bootstrap-t UCL 950.9
95% Hall's Bootstrap UCL 1626
95% Percentile Bootstrap UCL 529.7
95% BCA Bootstrap UCL 606.8
95% Chebyshev(Mean, Sd) UCL 811.1
97.5% Chebyshev(Mean, Sd) UCL 1009
99% Chebyshev(Mean, Sd) UCL 1397

Assuming Gamma Distribution

95% Approximate Gamma UCL 558.3
95% Adjusted Gamma UCL 586.4

Potential UCL to Use

Use 95% Approximate Gamma UCL 558.3

Mercury

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 15

Raw Statistics		Log-transformed Statistics	
Minimum	0.014	Minimum of Log Data	-4.269
Maximum	1.8	Maximum of Log Data	0.588
Mean	0.233	Mean of log Data	-2.206
Median	0.16	SD of log Data	1.199
SD	0.416		
Coefficient of Variation	1.79		
Skewness	3.728		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.477	Shapiro Wilk Test Statistic	0.964
Shapiro Wilk Critical Value	0.892	Shapiro Wilk Critical Value	0.892
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	0.409	95% H-UCL	0.552
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.516
95% Adjusted-CLT UCL	0.496	97.5% Chebyshev (MVUE) UCL	0.647
95% Modified-t UCL	0.424	99% Chebyshev (MVUE) UCL	0.906

Gamma Distribution Test		Data Distribution
k star (bias corrected)	0.694	Data Follow Appr. Gamma Distribution at 5% Significance Level
Theta Star	0.335	
nu star	23.59	
Approximate Chi Square Value (.05)	13.54	**Nonparametric Statistics**
Adjusted Level of Significance	0.0346	95% CLT UCL 0.399
Adjusted Chi Square Value	12.74	95% Jackknife UCL 0.409
		95% Standard Bootstrap UCL 0.393
Anderson-Darling Test Statistic	0.78	95% Bootstrap-t UCL 0.843
Anderson-Darling 5% Critical Value	0.775	95% Hall's Bootstrap UCL 1.029
Kolmogorov-Smirnov Test Statistic	0.182	95% Percentile Bootstrap UCL 0.417
Kolmogorov-Smirnov 5% Critical Value	0.217	95% BCA Bootstrap UCL 0.531
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL 0.673
		97.5% Chebyshev(Mean, Sd) UCL 0.863
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL 1.237
95% Approximate Gamma UCL	0.405	
95% Adjusted Gamma UCL	0.431	

Potential UCL to Use	
Use 95% Approximate Gamma UCL	0.405

Nickel

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 17

Raw Statistics

Minimum 2.9
Maximum 502
Mean 53.95
Median 6.2
SD 120.9
Coefficient of Variation 2.241
Skewness 3.572

Log-transformed Statistics

Minimum of Log Data 1.065
Maximum of Log Data 6.219
Mean of log Data 2.679
SD of log Data 1.502

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.466
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.853
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 105.2

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 129.3
95% Modified-t UCL 109.4

Assuming Lognormal Distribution

95% H-UCL 166.5
95% Chebyshev (MVUE) UCL 113.5
97.5% Chebyshev (MVUE) UCL 145.4
99% Chebyshev (MVUE) UCL 208

Gamma Distribution Test

k star (bias corrected) 0.44
Theta Star 122.5
nu star 14.97
Approximate Chi Square Value (.05) 7.241
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 6.684

Anderson-Darling Test Statistic 1.734
Anderson-Darling 5% Critical Value 0.801
Kolmogorov-Smirnov Test Statistic 0.264
Kolmogorov-Smirnov 5% Critical Value 0.221
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 111.5
95% Adjusted Gamma UCL 120.8

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 102.2
95% Jackknife UCL 105.2
95% Standard Bootstrap UCL 99.05
95% Bootstrap-t UCL 249.4
95% Hall's Bootstrap UCL 271.3
95% Percentile Bootstrap UCL 107.1
95% BCA Bootstrap UCL 142
95% Chebyshev(Mean, Sd) UCL 181.8
97.5% Chebyshev(Mean, Sd) UCL 237.1
99% Chebyshev(Mean, Sd) UCL 345.8

Potential UCL to Use

Use 99% Chebyshev (Mean, Sd) UCL 345.8

Selenium

General Statistics

Number of Valid Data	17	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	13
		Percent Non-Detects	76.47%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.93	Minimum Detected	-0.0726
Maximum Detected	4.4	Maximum Detected	1.482
Mean of Detected	2.058	Mean of Detected	0.538
SD of Detected	1.581	SD of Detected	0.664
Minimum Non-Detect	2.1	Minimum Non-Detect	0.742
Maximum Non-Detect	2.7	Maximum Non-Detect	0.993

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	16
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	1
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	94.12%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.769	Shapiro Wilk Test Statistic	0.882
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.378	Mean	0.244
SD	0.791	SD	0.339
95% DL/2 (t) UCL	1.713	95% H-Stat (DL/2) UCL	1.838
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.319
		SD in Log Scale	0.388
		Mean in Original Scale	1.5
		SD in Original Scale	0.814
		95% Percentile Bootstrap UCL	1.855
		95% BCA Bootstrap UCL	1.99

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.886
Theta Star	2.322
nu star	7.087
A-D Test Statistic	0.506
5% A-D Critical Value	0.66
K-S Test Statistic	0.66
5% K-S Critical Value	0.397

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.93
Maximum	4.4
Mean	2.057
Median	2.053
SD	0.702
k star	9.139
Theta star	0.225
Nu star	310.7
AppChi2	270.9
95% Gamma Approximate UCL	2.36
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Normal at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	1.46
SD	0.773
SE of Mean	0.258
95% KM (t) UCL	1.911
95% KM (z) UCL	1.885
95% KM (jackknife) UCL	1.929
95% KM (bootstrap t) UCL	1.97
95% KM (BCA) UCL	1.874
95% KM (Percentile Bootstrap) UCL	2.012
95% KM (Chebyshev) UCL	2.586
97.5% KM (Chebyshev) UCL	3.073
99% KM (Chebyshev) UCL	4.03

Potential UCLs to Use

95% KM (t) UCL	1.911
95% KM (Percentile Bootstrap) UCL	2.012

Silver

General Statistics

Number of Valid Data	17	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	6
		Percent Non-Detects	35.29%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.18	Minimum Detected	-1.715
Maximum Detected	84.5	Maximum Detected	4.437
Mean of Detected	18.52	Mean of Detected	1.388
SD of Detected	26.74	SD of Detected	2.202
Minimum Non-Detect	1.1	Minimum Non-Detect	0.0953
Maximum Non-Detect	1.3	Maximum Non-Detect	0.262

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	10
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	7
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	58.82%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.748	Shapiro Wilk Test Statistic	0.92
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	12.18	Mean	0.702
SD	22.91	SD	1.987
95% DL/2 (t) UCL	21.89	95% H-Stat (DL/2) UCL	75.33
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	0.577
		SD in Log Scale	2.139
		Mean in Original Scale	12.17
		SD in Original Scale	22.92
		95% Percentile Bootstrap UCL	22.33
		95% BCA Bootstrap UCL	25.24

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.37
Theta Star	50.03
nu star	8.142
A-D Test Statistic	0.386
5% A-D Critical Value	0.796
K-S Test Statistic	0.796
5% K-S Critical Value	0.272

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.18
Maximum	84.5
Mean	16.53
Median	9
SD	22.06
k star	0.507
Theta star	32.6
Nu star	17.24
AppChi2	8.841
95% Gamma Approximate UCL	32.22
95% Adjusted Gamma UCL	34.67

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	12.11
SD	22.27
SE of Mean	5.665
95% KM (t) UCL	22
95% KM (z) UCL	21.43
95% KM (jackknife) UCL	21.83
95% KM (bootstrap t) UCL	31.44
95% KM (BCA) UCL	21.77
95% KM (Percentile Bootstrap) UCL	21.58
95% KM (Chebyshev) UCL	36.8
97.5% KM (Chebyshev) UCL	47.49
99% KM (Chebyshev) UCL	68.47

Potential UCLs to Use

95% KM (BCA) UCL	21.77

Thallium

General Statistics

Number of Valid Data	17	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	6
		Percent Non-Detects	35.29%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.03	Minimum Detected	-3.507
Maximum Detected	0.2	Maximum Detected	-1.609
Mean of Detected	0.0765	Mean of Detected	-2.75
SD of Detected	0.0536	SD of Detected	0.596
Minimum Non-Detect	0.11	Minimum Non-Detect	-2.207
Maximum Non-Detect	0.13	Maximum Non-Detect	-2.04

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	15
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	88.24%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.79	Shapiro Wilk Test Statistic	0.919
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.0704	Mean	-2.778
SD	0.0433	SD	0.474
95% DL/2 (t) UCL	0.0887	95% H-Stat (DL/2) UCL	0.0965
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.813
		SD in Log Scale	0.502
		Mean in Original Scale	0.0689
		SD in Original Scale	0.0444
		95% Percentile Bootstrap UCL	0.0879
		95% BCA Bootstrap UCL	0.0928

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	2.21
Theta Star	0.0346
nu star	48.62
A-D Test Statistic	0.632
5% A-D Critical Value	0.734
K-S Test Statistic	0.734
5% K-S Critical Value	0.257

Data follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	0.03
Maximum	0.2
Mean	0.0769
Median	0.0651
SD	0.0432
k star	3.565
Theta star	0.0216
Nu star	121.2
AppChi2	96.79
95% Gamma Approximate UCL	0.0964
95% Adjusted Gamma UCL	0.0987

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data Follow Appr. Gamma Distribution at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	0.0687
SD	0.0441
SE of Mean	0.0119
95% KM (t) UCL	0.0895
95% KM (z) UCL	0.0883
95% KM (jackknife) UCL	0.0894
95% KM (bootstrap t) UCL	0.101
95% KM (BCA) UCL	0.0893
95% KM (Percentile Bootstrap) UCL	0.0881
95% KM (Chebyshev) UCL	0.121
97.5% KM (Chebyshev) UCL	0.143
99% KM (Chebyshev) UCL	0.187

Potential UCLs to Use

95% KM (Percentile Bootstrap) UCL	0.0881

Vanadium

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 14

Raw Statistics

Minimum 7
Maximum 51
Mean 14.86
Median 12.8
SD 9.615
Coefficient of Variation 0.647
Skewness 3.69

Log-transformed Statistics

Minimum of Log Data 1.946
Maximum of Log Data 3.932
Mean of log Data 2.597
SD of log Data 0.402

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.5
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.76
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 18.93

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 20.92
95% Modified-t UCL 19.28

Assuming Lognormal Distribution

95% H-UCL 17.69
95% Chebyshev (MVUE) UCL 20.77
97.5% Chebyshev (MVUE) UCL 23.49
99% Chebyshev (MVUE) UCL 28.84

Gamma Distribution Test

k star (bias corrected) 4.221
Theta Star 3.52
nu star 143.5
Approximate Chi Square Value (.05) 116.8
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 114.3

Anderson-Darling Test Statistic 1.943
Anderson-Darling 5% Critical Value 0.742
Kolmogorov-Smirnov Test Statistic 0.301
Kolmogorov-Smirnov 5% Critical Value 0.21
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 18.25
95% Adjusted Gamma UCL 18.66

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 18.69
95% Jackknife UCL 18.93
95% Standard Bootstrap UCL 18.65
95% Bootstrap-t UCL 26.96
95% Hall's Bootstrap UCL 35.72
95% Percentile Bootstrap UCL 19.11
95% BCA Bootstrap UCL 21.88
95% Chebyshev(Mean, Sd) UCL 25.02
97.5% Chebyshev(Mean, Sd) UCL 29.42
99% Chebyshev(Mean, Sd) UCL 38.06

Potential UCL to Use

Use 95% Student's-t UCL 18.93
or 95% Modified-t UCL 19.28

Zinc

General Statistics

Number of Valid Observations 17

Number of Distinct Observations 17

Raw Statistics

Minimum 7.4
Maximum 4280
Mean 731
Median 64.7
SD 1277
Coefficient of Variation 1.748
Skewness 2.211

Log-transformed Statistics

Minimum of Log Data 2.001
Maximum of Log Data 8.362
Mean of log Data 4.783
SD of log Data 2.197

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.622
Shapiro Wilk Critical Value 0.892
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.89
Shapiro Wilk Critical Value 0.892
Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 1272

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 1418
95% Modified-t UCL 1300

Assuming Lognormal Distribution

95% H-UCL 18180
95% Chebyshev (MVUE) UCL 3471
97.5% Chebyshev (MVUE) UCL 4573
99% Chebyshev (MVUE) UCL 6736

Gamma Distribution Test

k star (bias corrected) 0.342
Theta Star 2135
nu star 11.64
Approximate Chi Square Value (.05) 4.993
Adjusted Level of Significance 0.0346
Adjusted Chi Square Value 4.544

Anderson-Darling Test Statistic 0.996
Anderson-Darling 5% Critical Value 0.827
Kolmogorov-Smirnov Test Statistic 0.241
Kolmogorov-Smirnov 5% Critical Value 0.225
Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 1705
95% Adjusted Gamma UCL 1873

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL 1241
95% Jackknife UCL 1272
95% Standard Bootstrap UCL 1219
95% Bootstrap-t UCL 2176
95% Hall's Bootstrap UCL 3732
95% Percentile Bootstrap UCL 1233
95% BCA Bootstrap UCL 1429
95% Chebyshev(Mean, Sd) UCL 2081
97.5% Chebyshev(Mean, Sd) UCL 2666
99% Chebyshev(Mean, Sd) UCL 3814

Potential UCL to Use

Use 99% Chebyshev (Mean, Sd) UCL 3814

Cyanide

General Statistics

Number of Valid Data	17	Number of Detected Data	0
Number of Distinct Detected Data	0	Number of Non-Detect Data	17
		Percent Non-Detects	100.00%

Warning: All observations are Non-Detects (NDs), therefore all statistics and estimates should also be NDs!
Specifically, sample mean, UCLs, UPLs, and other statistics are also NDs lying below the largest detection limit!
The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

The data set for variable Cyanide was not processed!

VERSAR

APPENDIX G-4.7

Surface Water ProUCL Output

Appendix G-4.7 - Surface Water ProUCL Output

COPEC	Page
Aluminum	1
Arsenic	3
Barium	5
Iron	7
Manganese	9
Selenium	11

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	J:\COMMON\Wallops Risk Assessment 2008\2008 Data\ProUCL Data\ProUCL SW Input.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aluminum

General Statistics

Number of Valid Observations	6	Number of Distinct Observations	6

Raw Statistics		Log-transformed Statistics	
Minimum	118	Minimum of Log Data	4.771
Maximum	1060	Maximum of Log Data	6.966
Mean	353.7	Mean of log Data	5.53
Median	186.5	SD of log Data	0.838
SD	364.4		
Coefficient of Variation	1.03		
Skewness	1.983		

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.722	Shapiro Wilk Test Statistic	0.875
Shapiro Wilk Critical Value	0.788	Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	653.5	95% H-UCL	1375
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	827.5
95% Adjusted-CLT UCL	727.1	97.5% Chebyshev (MVUE) UCL	1041
95% Modified-t UCL	673.5	99% Chebyshev (MVUE) UCL	1460

Gamma Distribution Test

k star (bias corrected)	0.923
Theta Star	383.3
nu star	11.07
Approximate Chi Square Value (.05)	4.622
Adjusted Level of Significance	0.0122
Adjusted Chi Square Value	3.242
Anderson-Darling Test Statistic	0.578
Anderson-Darling 5% Critical Value	0.707
Kolmogorov-Smirnov Test Statistic	0.303
Kolmogorov-Smirnov 5% Critical Value	0.337

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	847.2
95% Adjusted Gamma UCL	1208

Potential UCL to Use

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	598.4
95% Jackknife UCL	653.5
95% Standard Bootstrap UCL	574.7
95% Bootstrap-t UCL	2457
95% Hall's Bootstrap UCL	1943
95% Percentile Bootstrap UCL	611.8
95% BCA Bootstrap UCL	697.3
95% Chebyshev(Mean, Sd) UCL	1002
97.5% Chebyshev(Mean, Sd) UCL	1283
99% Chebyshev(Mean, Sd) UCL	1834

Use 95% Approximate Gamma UCL 847.2

Arsenic

General Statistics

Number of Valid Observations 6

Number of Distinct Observations 6

Raw Statistics

Minimum	7
Maximum	11.7
Mean	9.333
Median	9.25
SD	1.765
Coefficient of Variation	0.189
Skewness	0.0792

Log-transformed Statistics

Minimum of Log Data	1.946
Maximum of Log Data	2.46
Mean of log Data	2.218
SD of log Data	0.192

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.963
Shapiro Wilk Critical Value	0.788

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.963
Shapiro Wilk Critical Value	0.788

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	10.79

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	10.54
95% Modified-t UCL	10.79

Assuming Lognormal Distribution

95% H-UCL	11.17
95% Chebyshev (MVUE) UCL	12.53
97.5% Chebyshev (MVUE) UCL	13.91
99% Chebyshev (MVUE) UCL	16.62

Gamma Distribution Test

k star (bias corrected)	16.64
Theta Star	0.561
nu star	199.7
Approximate Chi Square Value (.05)	168
Adjusted Level of Significance	0.0122
Adjusted Chi Square Value	157.4
Anderson-Darling Test Statistic	0.227
Anderson-Darling 5% Critical Value	0.697
Kolmogorov-Smirnov Test Statistic	0.168
Kolmogorov-Smirnov 5% Critical Value	0.332

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	11.09
95% Adjusted Gamma UCL	11.84

Potential UCL to Use

Use 95% Student's-t UCL 10.79

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	10.52
95% Jackknife UCL	10.79
95% Standard Bootstrap UCL	10.45
95% Bootstrap-t UCL	11.03
95% Hall's Bootstrap UCL	11.13
95% Percentile Bootstrap UCL	10.4
95% BCA Bootstrap UCL	10.37
95% Chebyshev(Mean, Sd) UCL	12.47
97.5% Chebyshev(Mean, Sd) UCL	13.83
99% Chebyshev(Mean, Sd) UCL	16.5

Barium

General Statistics

Number of Valid Observations 6

Number of Distinct Observations 6

Raw Statistics

Minimum	14.7
Maximum	27.6
Mean	18.42
Median	16.95
SD	4.832
Coefficient of Variation	0.262
Skewness	1.783

Log-transformed Statistics

Minimum of Log Data	2.688
Maximum of Log Data	3.318
Mean of log Data	2.889
SD of log Data	0.235

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.796
Shapiro Wilk Critical Value	0.788

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.85
Shapiro Wilk Critical Value	0.788

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	22.39

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	23.2
95% Modified-t UCL	22.63

Assuming Lognormal Distribution

95% H-UCL	23.08
95% Chebyshev (MVUE) UCL	26.07
97.5% Chebyshev (MVUE) UCL	29.39
99% Chebyshev (MVUE) UCL	35.92

Gamma Distribution Test

k star (bias corrected)	10.3
Theta Star	1.787
nu star	123.6
Approximate Chi Square Value (.05)	98.96
Adjusted Level of Significance	0.0122
Adjusted Chi Square Value	90.99
Anderson-Darling Test Statistic	0.535
Anderson-Darling 5% Critical Value	0.697
Kolmogorov-Smirnov Test Statistic	0.268
Kolmogorov-Smirnov 5% Critical Value	0.332

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	23.01
95% Adjusted Gamma UCL	25.02

Potential UCL to Use

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	21.66
95% Jackknife UCL	22.39
95% Standard Bootstrap UCL	21.35
95% Bootstrap-t UCL	28.82
95% Hall's Bootstrap UCL	38.16
95% Percentile Bootstrap UCL	21.57
95% BCA Bootstrap UCL	22.65
95% Chebyshev(Mean, Sd) UCL	27.02
97.5% Chebyshev(Mean, Sd) UCL	30.74
99% Chebyshev(Mean, Sd) UCL	38.04

Use 95% Student's-t UCL 22.39

Iron

General Statistics

Number of Valid Observations 6

Number of Distinct Observations 6

Raw Statistics

Minimum 228
Maximum 1030
Mean 481
Median 397.5
SD 287
Coefficient of Variation 0.597
Skewness 1.813

Log-transformed Statistics

Minimum of Log Data 5.429
Maximum of Log Data 6.937
Mean of log Data 6.055
SD of log Data 0.516

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.816
Shapiro Wilk Critical Value 0.788
Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.953
Shapiro Wilk Critical Value 0.788
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 717.1

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 766.4
95% Modified-t UCL 731.5

Assuming Lognormal Distribution

95% H-UCL 903.4
95% Chebyshev (MVUE) UCL 911.5
97.5% Chebyshev (MVUE) UCL 1100
99% Chebyshev (MVUE) UCL 1471

Gamma Distribution Test

k star (bias corrected)	2.255
Theta Star	213.3
nu star	27.06
Approximate Chi Square Value (.05)	16.2
Adjusted Level of Significance	0.0122
Adjusted Chi Square Value	13.26
Anderson-Darling Test Statistic	0.352
Anderson-Darling 5% Critical Value	0.699
Kolmogorov-Smirnov Test Statistic	0.22
Kolmogorov-Smirnov 5% Critical Value	0.333

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	803.5
95% Adjusted Gamma UCL	981.5

Potential UCL to Use

Use 95% Student's-t UCL 717.1

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	673.7
95% Jackknife UCL	717.1
95% Standard Bootstrap UCL	652.2
95% Bootstrap-t UCL	1037
95% Hall's Bootstrap UCL	1670
95% Percentile Bootstrap UCL	678.5
95% BCA Bootstrap UCL	729.2
95% Chebyshev(Mean, Sd) UCL	991.7
97.5% Chebyshev(Mean, Sd) UCL	1213
99% Chebyshev(Mean, Sd) UCL	1647

Manganese

General Statistics

Number of Valid Observations 6

Number of Distinct Observations 6

Raw Statistics

Minimum	20.9
Maximum	43.5
Mean	33.32
Median	35.5
SD	10.51
Coefficient of Variation	0.315
Skewness	-0.344

Log-transformed Statistics

Minimum of Log Data	3.04
Maximum of Log Data	3.773
Mean of log Data	3.46
SD of log Data	0.342

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.836
Shapiro Wilk Critical Value	0.788

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.822
Shapiro Wilk Critical Value	0.788

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	41.96

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	39.73
95% Modified-t UCL	41.86

Assuming Lognormal Distribution

95% H-UCL	47.93

95% UCLs (Adjusted for Skewness)

95% Chebyshev (MVUE) UCL	53.67
97.5% Chebyshev (MVUE) UCL	62.45
99% Chebyshev (MVUE) UCL	79.7

Gamma Distribution Test

k star (bias corrected)	5.605
Theta Star	5.944
nu star	67.26
Approximate Chi Square Value (.05)	49.39
Adjusted Level of Significance	0.0122
Adjusted Chi Square Value	43.91
Anderson-Darling Test Statistic	0.564
Anderson-Darling 5% Critical Value	0.698
Kolmogorov-Smirnov Test Statistic	0.268
Kolmogorov-Smirnov 5% Critical Value	0.332

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	45.38
95% Adjusted Gamma UCL	51.04

Potential UCL to Use

Use 95% Student's-t UCL 41.96

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	40.37
95% Jackknife UCL	41.96
95% Standard Bootstrap UCL	39.63
95% Bootstrap-t UCL	41.16
95% Hall's Bootstrap UCL	37.67
95% Percentile Bootstrap UCL	39.63
95% BCA Bootstrap UCL	39.18
95% Chebyshev(Mean, Sd) UCL	52.01
97.5% Chebyshev(Mean, Sd) UCL	60.1
99% Chebyshev(Mean, Sd) UCL	75.99

Selenium

General Statistics

Number of Valid Observations 6

Number of Distinct Observations 6

Raw Statistics

Minimum	6.6
Maximum	11.8
Mean	9.267
Median	9.25
SD	2.004
Coefficient of Variation	0.216
Skewness	-0.0445

Log-transformed Statistics

Minimum of Log Data	1.887
Maximum of Log Data	2.468
Mean of log Data	2.206
SD of log Data	0.223

Warning: A sample size of 'n' = 6 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!
If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 6 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set,
the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.967
Shapiro Wilk Critical Value	0.788

Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.963
Shapiro Wilk Critical Value	0.788

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	10.91

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	10.6
95% Modified-t UCL	10.91

Assuming Lognormal Distribution

95% H-UCL	11.48
95% Chebyshev (MVUE) UCL	12.94
97.5% Chebyshev (MVUE) UCL	14.53
99% Chebyshev (MVUE) UCL	17.65

Gamma Distribution Test

k star (bias corrected)	12.55
Theta Star	0.738
nu star	150.6
Approximate Chi Square Value (.05)	123.2
Adjusted Level of Significance	0.0122
Adjusted Chi Square Value	114.3
Anderson-Darling Test Statistic	0.204
Anderson-Darling 5% Critical Value	0.697
Kolmogorov-Smirnov Test Statistic	0.173
Kolmogorov-Smirnov 5% Critical Value	0.332

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	11.32
95% Adjusted Gamma UCL	12.21

Potential UCL to Use

Use 95% Student's-t UCL 10.91

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	10.61
95% Jackknife UCL	10.91
95% Standard Bootstrap UCL	10.48
95% Bootstrap-t UCL	10.88
95% Hall's Bootstrap UCL	10.54
95% Percentile Bootstrap UCL	10.48
95% BCA Bootstrap UCL	10.4
95% Chebyshev(Mean, Sd) UCL	12.83
97.5% Chebyshev(Mean, Sd) UCL	14.38
99% Chebyshev(Mean, Sd) UCL	17.41

VERSAR

APPENDIX G-4.8

Sediment ProUCL Output

Appendix G-4.8 - Sediment ProUCL Output

COPEC	Page
Acetone	1
Carbon disulfide	3
Aluminum	5
Arsenic	6
Barium	7
Beryllium	8
Chromium	9
Cobalt	10
Copper	11
Iron	13
Lead	14
Mercury	15
Selenium	17
Thallium	19
Vanadium	20
Zinc	21

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	J:\COMMON\Wallops Risk Assessment 2008\2008 Data\ProUCL Data\ProUCL Sediment Input.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Acetone

General Statistics

Number of Valid Data	10	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	4
		Percent Non-Detects	40.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	28	Minimum Detected	3.332
Maximum Detected	220	Maximum Detected	5.394
Mean of Detected	78.87	Mean of Detected	4.08
SD of Detected	73.57	SD of Detected	0.785
Minimum Non-Detect	11	Minimum Non-Detect	2.398
Maximum Non-Detect	79	Maximum Non-Detect	4.369

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	8
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	80.00%

Warning: There are only 6 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.758	Shapiro Wilk Test Statistic	0.905
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	56.72	Mean	3.614
SD	62.48	SD	0.983
95% DL/2 (t) UCL	92.94	95% H-Stat (DL/2) UCL	132.8
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	3.662
		SD in Log Scale	0.847
		Mean in Original Scale	56.36
		SD in Original Scale	62.29
		95% Percentile Bootstrap UCL	89.89
		95% BCA Bootstrap UCL	108.6

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	1.054
Theta Star	74.84
nu star	12.65
A-D Test Statistic	0.464
5% A-D Critical Value	0.705
K-S Test Statistic	0.705
5% K-S Critical Value	0.336

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1E-09
Maximum	220
Mean	67.56
Median	51.17
SD	60.73
k star	0.257
Theta star	263.4
Nu star	5.131
AppChi2	1.213
95% Gamma Approximate UCL	285.8
95% Adjusted Gamma UCL	377.9

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	60.2
SD	57.07
SE of Mean	19.86
95% KM (t) UCL	96.61
95% KM (z) UCL	92.87
95% KM (jackknife) UCL	94.79
95% KM (bootstrap t) UCL	178.2
95% KM (BCA) UCL	98.11
95% KM (Percentile Bootstrap) UCL	95.43
95% KM (Chebyshev) UCL	146.8
97.5% KM (Chebyshev) UCL	184.2
99% KM (Chebyshev) UCL	257.8

Potential UCLs to Use

95% KM (t) UCL	96.61

Carbon disulfide

General Statistics

Number of Valid Data	10	Number of Detected Data	7
Number of Distinct Detected Data	6	Number of Non-Detect Data	3
		Percent Non-Detects	30.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	4.3	Minimum Detected	1.459
Maximum Detected	23.65	Maximum Detected	3.163
Mean of Detected	10.68	Mean of Detected	2.256
SD of Detected	6.046	SD of Detected	0.497
Minimum Non-Detect	5.5	Minimum Non-Detect	1.705
Maximum Non-Detect	60	Maximum Non-Detect	4.094

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	10
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: There are only 7 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.729	Shapiro Wilk Test Statistic	0.856
5% Shapiro Wilk Critical Value	0.803	5% Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	12.75	Mean	2.32
SD	8.816	SD	0.734
95% DL/2 (t) UCL	17.86	95% H-Stat (DL/2) UCL	29.87
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	2.164
		SD in Log Scale	0.468
		Mean in Original Scale	9.674
		SD in Original Scale	5.321
		95% Percentile Bootstrap UCL	12.2
		95% BCA Bootstrap UCL	13.43

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	2.741
Theta Star	3.896
nu star	38.37
A-D Test Statistic	0.765
5% A-D Critical Value	0.71
K-S Test Statistic	0.71
5% K-S Critical Value	0.313

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	4.3
Maximum	23.65
Mean	10.4
Median	9.6
SD	5.312
k star	3.625
Theta star	2.868
Nu star	72.49
AppChi2	53.89
95% Gamma Approximate UCL	13.99
95% Adjusted Gamma UCL	14.75

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only

Data appear Lognormal at 5% Significance Level

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	9.881
SD	5.645
SE of Mean	2.156
95% KM (t) UCL	13.83
95% KM (z) UCL	13.43
95% KM (jackknife) UCL	13.77
95% KM (bootstrap t) UCL	17.7
95% KM (BCA) UCL	14.27
95% KM (Percentile Bootstrap) UCL	13.86
95% KM (Chebyshev) UCL	19.28
97.5% KM (Chebyshev) UCL	23.34
99% KM (Chebyshev) UCL	31.33

Potential UCLs to Use

95% KM (BCA) UCL	14.27

Aluminum

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 9

Raw Statistics

Minimum 7770
Maximum 22300
Mean 16747
Median 17650
SD 5439
Coefficient of Variation 0.325
Skewness -0.391

Log-transformed Statistics

Minimum of Log Data 8.958
Maximum of Log Data 10.01
Mean of log Data 9.67
SD of log Data 0.368

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.871
Shapiro Wilk Critical Value 0.842
Data appear Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.865
Shapiro Wilk Critical Value 0.842
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 19900

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 19349
95% Modified-t UCL 19864

Assuming Lognormal Distribution

95% H-UCL 21803
95% Chebyshev (MVUE) UCL 25459
97.5% Chebyshev (MVUE) UCL 29194
99% Chebyshev (MVUE) UCL 36530

Gamma Distribution Test

k star (bias corrected) 6.437
Theta Star 2602
nu star 128.7
Approximate Chi Square Value (.05) 103.5
Adjusted Level of Significance 0.0267
Adjusted Chi Square Value 99.61

Anderson-Darling Test Statistic 0.607
Anderson-Darling 5% Critical Value 0.726
Kolmogorov-Smirnov Test Statistic 0.23
Kolmogorov-Smirnov 5% Critical Value 0.267
Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 20825
95% Adjusted Gamma UCL 21645

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 19576
95% Jackknife UCL 19900
95% Standard Bootstrap UCL 19434
95% Bootstrap-t UCL 19615
95% Hall's Bootstrap UCL 19130
95% Percentile Bootstrap UCL 19640
95% BCA Bootstrap UCL 19250
95% Chebyshev(Mean, Sd) UCL 24244
97.5% Chebyshev(Mean, Sd) UCL 27487
99% Chebyshev(Mean, Sd) UCL 33859

Potential UCL to Use

Use 95% Student's-t UCL 19900

Arsenic

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 10

Raw Statistics

Minimum 3
Maximum 19.05
Mean 10.55
Median 9.1
SD 5.437
Coefficient of Variation 0.516
Skewness 0.369

Log-transformed Statistics

Minimum of Log Data 1.099
Maximum of Log Data 2.947
Mean of log Data 2.212
SD of log Data 0.602

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.931
Shapiro Wilk Critical Value 0.842
Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 13.7

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 13.59
95% Modified-t UCL 13.73

Gamma Distribution Test

k star (bias corrected) 2.615
Theta Star 4.033
nu star 52.29
Approximate Chi Square Value (.05) 36.68
Adjusted Level of Significance 0.0267
Adjusted Chi Square Value 34.42

Anderson-Darling Test Statistic 0.312
Anderson-Darling 5% Critical Value 0.73
Kolmogorov-Smirnov Test Statistic 0.181
Kolmogorov-Smirnov 5% Critical Value 0.268
Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 15.03
95% Adjusted Gamma UCL 16.02

Potential UCL to Use

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.92
Shapiro Wilk Critical Value 0.842
Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

95% H-UCL 17.62
95% Chebyshev (MVUE) UCL 19.84
97.5% Chebyshev (MVUE) UCL 23.79
99% Chebyshev (MVUE) UCL 31.54

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 13.37
95% Jackknife UCL 13.7
95% Standard Bootstrap UCL 13.26
95% Bootstrap-t UCL 14.16
95% Hall's Bootstrap UCL 14.04
95% Percentile Bootstrap UCL 13.41
95% BCA Bootstrap UCL 13.47
95% Chebyshev(Mean, Sd) UCL 18.04
97.5% Chebyshev(Mean, Sd) UCL 21.28
99% Chebyshev(Mean, Sd) UCL 27.65

Use 95% Student's-t UCL 13.7

Barium

General Statistics

Number of Valid Observations	10	Number of Distinct Observations	10

Raw Statistics		Log-transformed Statistics	
Minimum	21.5	Minimum of Log Data	3.068
Maximum	85.2	Maximum of Log Data	4.445
Mean	41.64	Mean of log Data	3.659
Median	43.25	SD of log Data	0.386
SD	17.72		
Coefficient of Variation	0.426		
Skewness	1.692		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.813	Shapiro Wilk Test Statistic	0.92
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	51.91	95% H-UCL	54.61
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	63.84
95% Adjusted-CLT UCL	54.06	97.5% Chebyshev (MVUE) UCL	73.5
95% Modified-t UCL	52.41	99% Chebyshev (MVUE) UCL	92.49

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	5.17	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	8.054		
nu star	103.4		
Approximate Chi Square Value (.05)	80.94	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0267	95% CLT UCL	50.86
Adjusted Chi Square Value	77.49	95% Jackknife UCL	51.91
		95% Standard Bootstrap UCL	50.23
Anderson-Darling Test Statistic	0.53	95% Bootstrap-t UCL	56.02
Anderson-Darling 5% Critical Value	0.727	95% Hall's Bootstrap UCL	96.16
Kolmogorov-Smirnov Test Statistic	0.253	95% Percentile Bootstrap UCL	50.98
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL	53.49
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	66.06
		97.5% Chebyshev(Mean, Sd) UCL	76.63
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	97.39
95% Approximate Gamma UCL	53.2		
95% Adjusted Gamma UCL	55.56		

Potential UCL to Use	
Use 95% Approximate Gamma UCL	53.2

Beryllium

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 9

Raw Statistics

Minimum	0.2
Maximum	0.61
Mean	0.439
Median	0.518
SD	0.177
Coefficient of Variation	0.404
Skewness	-0.436

Log-transformed Statistics

Minimum of Log Data	-1.609
Maximum of Log Data	-0.494
Mean of log Data	-0.914
SD of log Data	0.473

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.81
Shapiro Wilk Critical Value	0.842

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.799
Shapiro Wilk Critical Value	0.842

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	0.542

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	0.523
95% Modified-t UCL	0.541

Assuming Lognormal Distribution

95% H-UCL	0.632
95% Chebyshev (MVUE) UCL	0.736
97.5% Chebyshev (MVUE) UCL	0.863
99% Chebyshev (MVUE) UCL	1.112

Gamma Distribution Test

k star (bias corrected)	4.025
Theta Star	0.109
nu star	80.51
Approximate Chi Square Value (.05)	60.84
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	57.87
Anderson-Darling Test Statistic	0.929
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.256
Kolmogorov-Smirnov 5% Critical Value	0.267

Data follow Appr. Gamma Distribution at 5% Significance Level

Data Distribution

Data Follow Appr. Gamma Distribution at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	0.581
95% Adjusted Gamma UCL	0.611

Nonparametric Statistics

95% CLT UCL	0.531
95% Jackknife UCL	0.542
95% Standard Bootstrap UCL	0.525
95% Bootstrap-t UCL	0.532
95% Hall's Bootstrap UCL	0.513
95% Percentile Bootstrap UCL	0.525
95% BCA Bootstrap UCL	0.519
95% Chebyshev(Mean, Sd) UCL	0.683
97.5% Chebyshev(Mean, Sd) UCL	0.789
99% Chebyshev(Mean, Sd) UCL	0.997

Potential UCL to Use

Use 95% Approximate Gamma UCL 0.581

Chromium

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 9

Raw Statistics

Minimum	8.6
Maximum	49.6
Mean	31.49
Median	30.53
SD	14.42
Coefficient of Variation	0.458
Skewness	-0.163

Log-transformed Statistics

Minimum of Log Data	2.152
Maximum of Log Data	3.904
Mean of log Data	3.327
SD of log Data	0.565

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.926
Shapiro Wilk Critical Value	0.842

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	39.84

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	38.73
95% Modified-t UCL	39.8

Gamma Distribution Test

k star (bias corrected)	3.024
Theta Star	10.41
nu star	60.49
Approximate Chi Square Value (.05)	43.6
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	41.12
Anderson-Darling Test Statistic	0.371
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.218
Kolmogorov-Smirnov 5% Critical Value	0.268

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	43.68
95% Adjusted Gamma UCL	46.31

Potential UCL to Use

Use 95% Student's-t UCL 39.84

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.9
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

95% H-UCL	50.54
95% Chebyshev (MVUE) UCL	57.66
97.5% Chebyshev (MVUE) UCL	68.72
99% Chebyshev (MVUE) UCL	90.45

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	38.99
95% Jackknife UCL	39.84
95% Standard Bootstrap UCL	38.33
95% Bootstrap-t UCL	39.31
95% Hall's Bootstrap UCL	38.13
95% Percentile Bootstrap UCL	38.63
95% BCA Bootstrap UCL	38.05
95% Chebyshev(Mean, Sd) UCL	51.36
97.5% Chebyshev(Mean, Sd) UCL	59.96
99% Chebyshev(Mean, Sd) UCL	76.85

Cobalt

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 9

Raw Statistics

Minimum 2
Maximum 9.3
Mean 6.255
Median 5.9
SD 2.884
Coefficient of Variation 0.461
Skewness -0.112

Log-transformed Statistics

Minimum of Log Data 0.693
Maximum of Log Data 2.23
Mean of log Data 1.715
SD of log Data 0.544

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.856
Shapiro Wilk Critical Value 0.842
Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 7.927

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 7.721
95% Modified-t UCL 7.921

Gamma Distribution Test

k star (bias corrected) 3.133
Theta Star 1.996
nu star 62.67
Approximate Chi Square Value (.05) 45.46
Adjusted Level of Significance 0.0267
Adjusted Chi Square Value 42.92

Anderson-Darling Test Statistic 0.583
Anderson-Darling 5% Critical Value 0.729
Kolmogorov-Smirnov Test Statistic 0.246
Kolmogorov-Smirnov 5% Critical Value 0.268
Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 8.623
95% Adjusted Gamma UCL 9.133

Potential UCL to Use

Use 95% Student's-t UCL 7.927

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.873
Shapiro Wilk Critical Value 0.842
Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

95% H-UCL 9.751
95% Chebyshev (MVUE) UCL 11.19
97.5% Chebyshev (MVUE) UCL 13.29
99% Chebyshev (MVUE) UCL 17.42

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 7.755
95% Jackknife UCL 7.927
95% Standard Bootstrap UCL 7.67
95% Bootstrap-t UCL 7.866
95% Hall's Bootstrap UCL 7.55
95% Percentile Bootstrap UCL 7.62
95% BCA Bootstrap UCL 7.665
95% Chebyshev(Mean, Sd) UCL 10.23
97.5% Chebyshev(Mean, Sd) UCL 11.95
99% Chebyshev(Mean, Sd) UCL 15.33

Copper

General Statistics

Number of Valid Observations	9	Number of Distinct Observations	8
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	8.8	Minimum of Log Data	2.175
Maximum	56.5	Maximum of Log Data	4.034
Mean	23.72	Mean of log Data	3.028
Median	20.3	SD of log Data	0.545
SD	14.4		
Coefficient of Variation	0.607		
Skewness	1.709		

Warning: There are only 9 Values in this data
Note: It should be noted that even though bootstrap methods may be performed on this data set, the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.808	Shapiro Wilk Test Statistic	0.936
Shapiro Wilk Critical Value	0.829	Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	32.64	95% H-UCL	37.37
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	42.47
95% Adjusted-CLT UCL	34.53	97.5% Chebyshev (MVUE) UCL	50.66
95% Modified-t UCL	33.1	99% Chebyshev (MVUE) UCL	66.75

Gamma Distribution Test

k star (bias corrected)	2.594
Theta Star	9.142
nu star	46.69
Approximate Chi Square Value (.05)	32.01
Adjusted Level of Significance	0.0231
Adjusted Chi Square Value	29.47
Anderson-Darling Test Statistic	0.512
Anderson-Darling 5% Critical Value	0.725
Kolmogorov-Smirnov Test Statistic	0.27
Kolmogorov-Smirnov 5% Critical Value	0.281

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	34.59
95% Adjusted Gamma UCL	37.58

Potential UCL to Use

Use 95% Approximate Gamma UCL 34.59

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	31.61
95% Jackknife UCL	32.64
95% Standard Bootstrap UCL	31.33
95% Bootstrap-t UCL	43.9
95% Hall's Bootstrap UCL	83.87
95% Percentile Bootstrap UCL	31.64
95% BCA Bootstrap UCL	34.7
95% Chebyshev(Mean, Sd) UCL	44.64
97.5% Chebyshev(Mean, Sd) UCL	53.69
99% Chebyshev(Mean, Sd) UCL	71.48

Iron

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 10

Raw Statistics

Minimum 5670
Maximum 30800
Mean 20757
Median 22525
SD 8650
Coefficient of Variation 0.417
Skewness -0.527

Log-transformed Statistics

Minimum of Log Data 8.643
Maximum of Log Data 10.34
Mean of log Data 9.831
SD of log Data 0.543

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.912
Shapiro Wilk Critical Value 0.842
Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 25771

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 24769
95% Modified-t UCL 25695

Gamma Distribution Test

k star (bias corrected) 3.375
Theta Star 6150
nu star 67.5
Approximate Chi Square Value (.05) 49.59
Adjusted Level of Significance 0.0267
Adjusted Chi Square Value 46.93

Anderson-Darling Test Statistic 0.54
Anderson-Darling 5% Critical Value 0.729
Kolmogorov-Smirnov Test Statistic 0.235
Kolmogorov-Smirnov 5% Critical Value 0.268
Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 28253
95% Adjusted Gamma UCL 29853

Potential UCL to Use

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.854
Shapiro Wilk Critical Value 0.842
Data appear Lognormal at 5% Significance Level

Assuming Lognormal Distribution

95% H-UCL 32570
95% Chebyshev (MVUE) UCL 37403
97.5% Chebyshev (MVUE) UCL 44410
99% Chebyshev (MVUE) UCL 58174

Data Distribution

Data appear Normal at 5% Significance Level

Nonparametric Statistics

95% CLT UCL 25256
95% Jackknife UCL 25771
95% Standard Bootstrap UCL 24923
95% Bootstrap-t UCL 25208
95% Hall's Bootstrap UCL 24651
95% Percentile Bootstrap UCL 24945
95% BCA Bootstrap UCL 24775
95% Chebyshev(Mean, Sd) UCL 32680
97.5% Chebyshev(Mean, Sd) UCL 37839
99% Chebyshev(Mean, Sd) UCL 47974

Use 95% Student's-t UCL 25771

Lead

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 9

Raw Statistics

Minimum	8.9
Maximum	96.9
Mean	29.96
Median	22.2
SD	25.66
Coefficient of Variation	0.857
Skewness	2.337

Log-transformed Statistics

Minimum of Log Data	2.186
Maximum of Log Data	4.574
Mean of log Data	3.17
SD of log Data	0.669

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.714
Shapiro Wilk Critical Value	0.842

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.947
Shapiro Wilk Critical Value	0.842

Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	44.83

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	49.71
95% Modified-t UCL	45.83

Assuming Lognormal Distribution

95% H-UCL	51.76
95% Chebyshev (MVUE) UCL	56.54
97.5% Chebyshev (MVUE) UCL	68.45
99% Chebyshev (MVUE) UCL	91.85

Gamma Distribution Test

k star (bias corrected)	1.697
Theta Star	17.65
nu star	33.94
Approximate Chi Square Value (.05)	21.62
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	19.92
Anderson-Darling Test Statistic	0.558
Anderson-Darling 5% Critical Value	0.734
Kolmogorov-Smirnov Test Statistic	0.269
Kolmogorov-Smirnov 5% Critical Value	0.269

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	47.03
95% Adjusted Gamma UCL	51.03

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Nonparametric Statistics

95% CLT UCL	43.3
95% Jackknife UCL	44.83
95% Standard Bootstrap UCL	42.45
95% Bootstrap-t UCL	70.23
95% Hall's Bootstrap UCL	103.9
95% Percentile Bootstrap UCL	44.55
95% BCA Bootstrap UCL	51.24
95% Chebyshev(Mean, Sd) UCL	65.32
97.5% Chebyshev(Mean, Sd) UCL	80.63
99% Chebyshev(Mean, Sd) UCL	110.7

Potential UCL to Use

Use 95% Approximate Gamma UCL 47.03

Mercury

General Statistics

Number of Valid Data	10	Number of Detected Data	9
Number of Distinct Detected Data	9	Number of Non-Detect Data	1
		Percent Non-Detects	10.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.036	Minimum Detected	-3.324
Maximum Detected	0.49	Maximum Detected	-0.713
Mean of Detected	0.122	Mean of Detected	-2.43
SD of Detected	0.14	SD of Detected	0.756
Minimum Non-Detect	0.21	Minimum Non-Detect	-1.561
Maximum Non-Detect	0.21	Maximum Non-Detect	-1.561

Warning: There are only 9 Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.574	Shapiro Wilk Test Statistic	0.863
5% Shapiro Wilk Critical Value	0.829	5% Shapiro Wilk Critical Value	0.829
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.121	Mean	-2.413
SD	0.133	SD	0.715
95% DL/2 (t) UCL	0.197	95% H-Stat (DL/2) UCL	0.249
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.444
		SD in Log Scale	0.714
		Mean in Original Scale	0.118
		SD in Original Scale	0.133
		95% Percentile Bootstrap UCL	0.198
		95% BCA Bootstrap UCL	0.241

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	1.186
Theta Star	0.103
nu star	21.34
A-D Test Statistic	0.941
5% A-D Critical Value	0.733
K-S Test Statistic	0.733
5% K-S Critical Value	0.283
Data not Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	0.036
Maximum	0.49
Mean	0.122
Median	0.0875
SD	0.132
k star	1.354
Theta star	0.0904
Nu star	27.07
AppChi2	16.21
95% Gamma Approximate UCL	0.204
95% Adjusted Gamma UCL	0.224

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data appear Lognormal at 5% Significance Level	
Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	0.118
SD	0.127
SE of Mean	0.0426
95% KM (t) UCL	0.196
95% KM (z) UCL	0.188
95% KM (jackknife) UCL	0.195
95% KM (bootstrap t) UCL	0.385
95% KM (BCA) UCL	0.201
95% KM (Percentile Bootstrap) UCL	0.2
95% KM (Chebyshev) UCL	0.303
97.5% KM (Chebyshev) UCL	0.384
99% KM (Chebyshev) UCL	0.542
Potential UCLs to Use	
95% KM (Chebyshev) UCL	0.303

Selenium

General Statistics

Number of Valid Data	10	Number of Detected Data	8
Number of Distinct Detected Data	4	Number of Non-Detect Data	2
		Percent Non-Detects	20.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.4	Minimum Detected	0.336
Maximum Detected	1.8	Maximum Detected	0.588
Mean of Detected	1.663	Mean of Detected	0.505
SD of Detected	0.141	SD of Detected	0.0873
Minimum Non-Detect	2.4	Minimum Non-Detect	0.875
Maximum Non-Detect	3.4	Maximum Non-Detect	1.224

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	10
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	0
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	100.00%

Warning: There are only 4 Distinct Detected Values in this data
Note: It should be noted that even though bootstrap may be performed on this data set
the resulting calculations may not be reliable enough tp draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.862	Shapiro Wilk Test Statistic	0.854
5% Shapiro Wilk Critical Value	0.818	5% Shapiro Wilk Critical Value	0.818
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.62	Mean	0.475
SD	0.193	SD	0.129
95% DL/2 (t) UCL	1.732	95% H-Stat (DL/2) UCL	1.943
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	0.505
		SD in Log Scale	0.077
		Mean in Original Scale	1.661
		SD in Original Scale	0.124
		95% Percentile Bootstrap UCL	1.721
		95% BCA Bootstrap UCL	1.716

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	95.94
Theta Star	0.0173
nu star	1535
A-D Test Statistic	0.56
5% A-D Critical Value	0.715
K-S Test Statistic	0.715
5% K-S Critical Value	0.294
Data appear Gamma Distributed at 5% Significance Level	
Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	1.4
Maximum	1.8
Mean	1.668
Median	1.69
SD	0.125
k star	133.2
Theta star	0.0125
Nu star	2663
AppChi2	2544
95% Gamma Approximate UCL	1.746
95% Adjusted Gamma UCL	1.76

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only	
Data appear Normal at 5% Significance Level	

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	1.663
SD	0.132
SE of Mean	0.0498
95% KM (t) UCL	1.754
95% KM (z) UCL	1.744
95% KM (jackknife) UCL	1.755
95% KM (bootstrap t) UCL	1.745
95% KM (BCA) UCL	1.733
95% KM (Percentile Bootstrap) UCL	1.733
95% KM (Chebyshev) UCL	1.879
97.5% KM (Chebyshev) UCL	1.973
99% KM (Chebyshev) UCL	2.158
Potential UCLs to Use	
95% KM (t) UCL	1.754
95% KM (Percentile Bootstrap) UCL	1.733

Thallium

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 8

Raw Statistics		Log-transformed Statistics	
Minimum	0.079	Minimum of Log Data	-2.538
Maximum	0.28	Maximum of Log Data	-1.273
Mean	0.182	Mean of log Data	-1.778
Median	0.165	SD of log Data	0.415
SD	0.0704		
Coefficient of Variation	0.387		
Skewness	0.198		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.927	Shapiro Wilk Test Statistic	0.939
Shapiro Wilk Critical Value	0.842	Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	0.223	95% H-UCL	0.247
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	0.288
95% Adjusted-CLT UCL	0.22	97.5% Chebyshev (MVUE) UCL	0.334
95% Modified-t UCL	0.223	99% Chebyshev (MVUE) UCL	0.424
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.943	**Data appear Normal at 5% Significance Level**	
Theta Star	0.0368		
nu star	98.86		
Approximate Chi Square Value (.05)	76.92	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0267	95% CLT UCL	0.219
Adjusted Chi Square Value	73.56	95% Jackknife UCL	0.223
		95% Standard Bootstrap UCL	0.216
Anderson-Darling Test Statistic	0.305	95% Bootstrap-t UCL	0.223
Anderson-Darling 5% Critical Value	0.728	95% Hall's Bootstrap UCL	0.216
Kolmogorov-Smirnov Test Statistic	0.17	95% Percentile Bootstrap UCL	0.218
Kolmogorov-Smirnov 5% Critical Value	0.267	95% BCA Bootstrap UCL	0.219
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	0.279
		97.5% Chebyshev(Mean, Sd) UCL	0.321
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	0.403
95% Approximate Gamma UCL	0.234		
95% Adjusted Gamma UCL	0.244		
Potential UCL to Use		Use 95% Student's-t UCL	0.223

Vanadium

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 10

Raw Statistics

Minimum	12.7
Maximum	53.7
Mean	38.64
Median	41.35
SD	15.06
Coefficient of Variation	0.39
Skewness	-0.434

Log-transformed Statistics

Minimum of Log Data	2.542
Maximum of Log Data	3.983
Mean of log Data	3.566
SD of log Data	0.478

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic	0.841
Shapiro Wilk Critical Value	0.842

Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic	0.829
Shapiro Wilk Critical Value	0.842

Data not Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL	47.37

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL	45.77
95% Modified-t UCL	47.26

Assuming Lognormal Distribution

95% H-UCL	56.16
95% Chebyshev (MVUE) UCL	65.34
97.5% Chebyshev (MVUE) UCL	76.68
99% Chebyshev (MVUE) UCL	98.94

Gamma Distribution Test

k star (bias corrected)	4.131
Theta Star	9.353
nu star	82.63
Approximate Chi Square Value (.05)	62.68
Adjusted Level of Significance	0.0267
Adjusted Chi Square Value	59.67
Anderson-Darling Test Statistic	0.763
Anderson-Darling 5% Critical Value	0.729
Kolmogorov-Smirnov Test Statistic	0.3
Kolmogorov-Smirnov 5% Critical Value	0.267

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL	50.94
95% Adjusted Gamma UCL	53.51

Data Distribution

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

95% CLT UCL	46.47
95% Jackknife UCL	47.37
95% Standard Bootstrap UCL	46.07
95% Bootstrap-t UCL	46.67
95% Hall's Bootstrap UCL	45.46
95% Percentile Bootstrap UCL	45.67
95% BCA Bootstrap UCL	44.99
95% Chebyshev(Mean, Sd) UCL	59.39
97.5% Chebyshev(Mean, Sd) UCL	68.37
99% Chebyshev(Mean, Sd) UCL	86.02

Potential UCL to Use

Use 95% Student's-t UCL 47.37

or 95% Modified-t UCL 47.26

Zinc

General Statistics

Number of Valid Observations 10

Number of Distinct Observations 10

Raw Statistics

Minimum 36.7
Maximum 324
Mean 95.51
Median 78.4
SD 84.44
Coefficient of Variation 0.884
Skewness 2.614

Log-transformed Statistics

Minimum of Log Data 3.603
Maximum of Log Data 5.781
Mean of log Data 4.335
SD of log Data 0.645

Relevant UCL Statistics

Normal Distribution Test

Shapiro Wilk Test Statistic 0.658
Shapiro Wilk Critical Value 0.842
Data not Normal at 5% Significance Level

Lognormal Distribution Test

Shapiro Wilk Test Statistic 0.902
Shapiro Wilk Critical Value 0.842
Data appear Lognormal at 5% Significance Level

Assuming Normal Distribution

95% Student's-t UCL 144.5

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL 163
95% Modified-t UCL 148.1

Assuming Lognormal Distribution

95% H-UCL 158.8
95% Chebyshev (MVUE) UCL 175.5
97.5% Chebyshev (MVUE) UCL 211.8
99% Chebyshev (MVUE) UCL 283

Gamma Distribution Test

k star (bias corrected) 1.736
Theta Star 55
nu star 34.73
Approximate Chi Square Value (.05) 22.25
Adjusted Level of Significance 0.0267
Adjusted Chi Square Value 20.53

Anderson-Darling Test Statistic 0.64
Anderson-Darling 5% Critical Value 0.734
Kolmogorov-Smirnov Test Statistic 0.215
Kolmogorov-Smirnov 5% Critical Value 0.269
Data appear Gamma Distributed at 5% Significance Level

Data Distribution

Data appear Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

95% Approximate Gamma UCL 149.1
95% Adjusted Gamma UCL 161.6

Nonparametric Statistics

95% CLT UCL 139.4
95% Jackknife UCL 144.5
95% Standard Bootstrap UCL 138.3
95% Bootstrap-t UCL 213.5
95% Hall's Bootstrap UCL 317.8
95% Percentile Bootstrap UCL 143.9
95% BCA Bootstrap UCL 161.6
95% Chebyshev(Mean, Sd) UCL 211.9
97.5% Chebyshev(Mean, Sd) UCL 262.3
99% Chebyshev(Mean, Sd) UCL 361.2

Potential UCL to Use

Use 95% Approximate Gamma UCL 149.1

VERSAR

APPENDIX G-5

ECOLOGICAL RISK ASSESSMENT CALCULATIONS

VERSAR

APPENDIX G-5a

TERRESTRIAL RISK CALCULATIONS

Table G-5a.1
Exposures and HQs for Grasses and Forbs Due to Contact with COPECs in Soil (0-0.5 ft)
Wallops CDL

Chemical	0-0.5ft Soil (mg/kg)	TRV (mg/kg)	HQ
VOCs			
Methyl Acetate	1.19E+00	—	—
Methylcyclohexane	2.50E-03	—	—
SVOCs			
Acenaphthylene	1.58E-01	2.00E+01	7.90E-03
Anthracene	2.67E-01	1.00E-01	2.67E+00
Benzo(a)anthracene	2.49E+00	1.00E-01	2.49E+01
Benzo(a)pyrene	1.91E+00	1.00E-01	1.91E+01
Benzo(b)fluoranthene	1.39E+00	1.00E-01	1.39E+01
Benzo(g,h,i)perylene	1.18E+00	1.00E-01	1.18E+01
Benzo(k)fluoranthene	1.03E+00	1.00E-01	1.03E+01
Chrysene	4.04E+00	1.00E-01	4.04E+01
Dibenzo(a,h)anthracene	3.88E-01	1.00E-01	3.88E+00
bis(2-Ethylhexyl)phthalate	1.11E-01	—	—
Fluoranthene	7.27E-01	1.00E-01	7.27E+00
Indeno(1,2,3-cd)pyrene	6.17E-01	1.00E-01	6.17E+00
Phenanthrene	2.23E+00	1.00E-01	2.23E+01
Pyrene	1.82E+00	1.00E-01	1.82E+01
Pesticides			
4,4'-DDD	9.58E-02	1.00E-01	9.58E-01
4,4'-DDE	6.28E-01	1.00E-01	6.28E+00
4,4'-DDT	3.92E-01	1.00E-01	3.92E+00
Metals			
Antimony	6.37E+01	5.00E+00	1.27E+01
Arsenic	6.03E+00	1.80E+01	3.35E-01
Barium	6.03E+02	5.00E+02	1.21E+00
Beryllium	6.07E-01	1.00E+01	6.07E-02
Cadmium	1.71E+01	3.20E+01	5.36E-01
Chromium	8.97E+01	1.00E+00	8.97E+01
Cobalt	1.86E+01	1.30E+01	1.43E+00
Copper	1.79E+03	7.00E+01	2.56E+01
Lead	2.12E+03	1.20E+02	1.77E+01
Manganese	7.74E+02	2.20E+02	3.52E+00
Mercury	7.46E-01	3.00E-01	2.49E+00
Nickel	4.60E+02	3.80E+01	1.21E+01
Selenium	4.40E+00	5.20E-01	8.46E+00
Silver	6.04E+01	5.60E+02	1.08E-01
Thallium	1.18E-01	1.00E+00	1.18E-01
Vanadium	3.85E+01	2.00E+00	1.93E+01
Zinc	4.28E+03	1.60E+02	2.68E+01

Table G-5a.2
Exposures and HQs for Trees Due to Contact with
COPECs in Soil (0-5 ft)
Wallops CDL

Chemical	0-0.5ft Soil (mg/kg)	TRV (mg/kg)	HQ
VOCs			
Methyl Acetate	1.19E+00	---	---
Methylcyclohexane	2.50E-03	---	---
SVOCs			
Acenaphthylene	1.58E-01	2.00E+01	7.90E-03
Anthracene	2.67E-01	1.00E-01	2.67E+00
Benzo(a)anthracene	2.49E+00	1.00E-01	2.49E+01
Benzo(a)pyrene	1.91E+00	1.00E-01	1.91E+01
Benzo(b)fluoranthene	1.39E+00	1.00E-01	1.39E+01
Benzo(g,h,i)perylene	1.18E+00	1.00E-01	1.18E+01
Benzo(k)fluoranthene	1.03E+00	1.00E-01	1.03E+01
Chrysene	1.87E+00	1.00E-01	1.87E+01
Dibenzo(a,h)anthracene	3.88E-01	1.00E-01	3.88E+00
bis(2-Ethylhexyl)phthalate	9.02E-02	---	---
Fluoranthene	3.48E-01	1.00E-01	3.48E+00
Indeno(1,2,3-cd)pyrene	6.17E-01	1.00E-01	6.17E+00
Phenanthrene	1.05E+00	1.00E-01	1.05E+01
Pyrene	2.16E+00	1.00E-01	2.16E+01
Pesticides			
alpha-Chlordane	2.67E-02	1.00E-01	2.67E-01
gamma-Chlordane	3.46E-02	1.00E-01	3.46E-01
4,4'-DDD	6.33E-02	1.00E-01	6.33E-01
4,4'-DDE	7.22E-01	1.00E-01	7.22E+00
4,4'-DDT	3.63E-01	1.00E-01	3.63E+00
Polychlorinated Biphenyls			
Aroclor 1260	2.13E-01	4.00E+01	5.33E-03
Metals			
Antimony	2.21E+01	5.00E+00	4.42E+00
Arsenic	5.35E+00	1.80E+01	2.97E-01
Barium	4.28E+02	5.00E+02	8.56E-01
Beryllium	4.42E-01	1.00E+01	4.42E-02
Cadmium	2.87E+01	3.20E+01	8.96E-01
Chromium	4.16E+02	1.00E+00	4.16E+02
Cobalt	1.18E+01	1.30E+01	9.11E-01
Copper	4.07E+03	7.00E+01	5.82E+01
Lead	1.96E+03	1.20E+02	1.64E+01
Manganese	5.58E+02	2.20E+02	2.54E+00
Mercury	4.05E-01	3.00E-01	1.35E+00
Nickel	3.46E+02	3.80E+01	9.10E+00
Selenium	4.40E+00	5.20E-01	8.46E+00
Silver	2.23E+01	5.60E+02	3.99E-02
Thallium	8.87E-02	1.00E+00	8.87E-02
Vanadium	1.93E+01	2.00E+00	9.64E+00
Zinc	3.81E+03	1.60E+02	2.38E+01

Table G-5a.3
Exposures and HQs for Soil Invertebrates Due to Contact with COPECs in Soil (0-0.5 ft)
Wallops CDL

Chemical	0-0.5ft Soil (mg/kg)	TRV (mg/kg)	HQ
VOCs			
Methyl Acetate	1.19E+00	---	---
Methylcyclohexane	2.50E-03	---	---
SVOCs			
Acenaphthylene	1.58E-01	1.80E+01	8.78E-03
Anthracene	2.67E-01	1.80E+01	1.48E-02
Benzo(a)anthracene	2.49E+00	2.90E+01	8.59E-02
Benzo(a)pyrene	1.91E+00	2.90E+01	6.59E-02
Benzo(b)fluoranthene	1.39E+00	2.90E+01	4.79E-02
Benzo(g,h,i)perylene	1.18E+00	2.90E+01	4.07E-02
Benzo(k)fluoranthene	1.03E+00	2.90E+01	3.55E-02
Chrysene	4.04E+00	2.90E+01	1.39E-01
Dibenzo(a,h)anthracene	3.88E-01	2.90E+01	1.34E-02
bis(2-Ethylhexyl)phthalate	1.11E-01	—	—
Fluoranthene	7.27E-01	2.90E+01	2.51E-02
Fluorene	#REF!	1.80E+01	#REF!
Indeno(1,2,3-cd)pyrene	6.17E-01	2.90E+01	2.13E-02
Phenanthrene	2.23E+00	1.80E+01	1.24E-01
Pyrene	1.82E+00	2.90E+01	6.29E-02
Pesticides			
4,4'-DDD	9.58E-02	—	—
4,4'-DDE	6.28E-01	—	—
4,4'-DDT	3.92E-01	—	—
Metals			
Antimony	6.37E+01	7.80E+01	8.17E-01
Arsenic	6.03E+00	1.00E+02	6.03E-02
Barium	6.03E+02	3.30E+02	1.83E+00
Beryllium	6.07E-01	4.00E+01	1.52E-02
Cadmium	1.71E+01	1.40E+02	1.22E-01
Chromium	8.97E+01	1.00E+01	8.97E+00
Cobalt	1.86E+01	1.00E+03	1.86E-02
Copper	1.79E+03	8.00E+01	2.24E+01
Lead	2.12E+03	1.70E+03	1.25E+00
Manganese	7.74E+02	4.50E+02	1.72E+00
Mercury	7.46E-01	3.00E+01	2.49E-02
Nickel	4.60E+02	2.80E+02	1.64E+00
Selenium	4.40E+00	4.10E+00	1.07E+00
Silver	6.04E+01	5.00E+01	1.21E+00
Thallium	1.18E-01	—	—
Vanadium	3.85E+01	2.00E+01	1.93E+00
Zinc	4.28E+03	1.20E+02	3.57E+01

Table G-5a.4
Exposures and HQs for Am. Robin Due to Ingestion of
COPECs in Soil (0-0.5 ft) and Invertebrates
Wallops CDL

Chemical	0-0.5 ft Soil (mg/kg)	Invert Tissue Concentration (mg/kg)	Body Weight (kg)	Soil Ingestion Rate (kg/d)	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Rate (kg/d)	Food Ingestion Dose (mg/kg-day)	Site Presence Index (SPI)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs													
Methyl Acetate	1.19E+00	1.19E+00	8.06E-02	1.18E-02	1.74E-1	7.17E-02	1.06E+0	1	1.23E+0	---	---	---	---
Methylcyclohexane	2.50E-03	2.50E-03	8.06E-02	1.18E-02	3.65E-4	7.17E-02	2.23E-3	1	2.59E-3	---	---	---	---
SVOCs													
Acenaphthylene	1.58E-01	3.62E+00	8.06E-02	1.18E-02	2.31E-2	7.17E-02	3.22E+0	1	3.24E+0	---	---	---	---
Anthracene	2.67E-01	6.46E-01	8.06E-02	1.18E-02	3.90E-2	7.17E-02	5.75E-1	1	6.14E-1	---	---	---	---
Benzo(a)anthracene	2.49E+00	3.96E+00	8.06E-02	1.18E-02	3.63E-1	7.17E-02	3.52E+0	1	3.89E+0	---	---	---	---
Benzo(a)pyrene	1.91E+00	2.54E+00	8.06E-02	1.18E-02	2.79E-1	7.17E-02	2.26E+0	1	2.54E+0	---	---	---	---
Benzo(b)fluoranthene	1.39E+00	3.61E+00	8.06E-02	1.18E-02	2.03E-1	7.17E-02	3.22E+0	1	3.42E+0	---	---	---	---
Benzo(g,h,i)perylene	1.18E+00	3.47E+00	8.06E-02	1.18E-02	1.72E-1	7.17E-02	3.09E+0	1	3.26E+0	---	---	---	---
Benzo(k)fluoranthene	1.03E+00	2.68E+00	8.06E-02	1.18E-02	1.50E-1	7.17E-02	2.38E+0	1	2.53E+0	---	---	---	---
Chrysene	4.04E+00	9.25E+00	8.06E-02	1.18E-02	5.90E-1	7.17E-02	8.23E+0	1	8.82E+0	---	---	---	---
Dibenzo(a,h)anthracene	3.88E-01	8.96E-01	8.06E-02	1.18E-02	5.66E-2	7.17E-02	7.98E-1	1	8.54E-1	---	---	---	---
bis(2-Ethylhexyl)phthalate	1.11E-01	1.11E-01	8.06E-02	1.18E-02	1.62E-2	7.17E-02	9.88E-2	1	1.15E-1	1.10	11.00	1.05E-01	1.05E-02
Fluoranthene	7.27E-01	2.21E+00	8.06E-02	1.18E-02	1.06E-1	7.17E-02	1.97E+0	1	2.07E+0	---	---	---	---
Indeno(1,2,3-cd)pyrene	6.17E-01	1.76E+00	8.06E-02	1.18E-02	9.01E-2	7.17E-02	1.57E+0	1	1.66E+0	---	---	---	---
Phenanthrene	2.23E+00	3.84E+00	8.06E-02	1.18E-02	3.25E-1	7.17E-02	3.41E+0	1	3.74E+0	---	---	---	---
Pyrene	1.82E+00	3.19E+00	8.06E-02	1.18E-02	2.66E-1	7.17E-02	2.84E+0	1	3.11E+0	---	---	---	---
Pesticides													
4,4'-DDD	9.58E-02	6.22E-01	8.06E-02	1.18E-02	1.40E-2	7.17E-02	5.54E-1	1	5.68E-1	0.0028	0.0280	2.03E+02	2.03E+01
4,4'-DDE	6.28E-01	7.91E+00	8.06E-02	1.18E-02	9.17E-2	7.17E-02	7.04E+0	1	7.13E+0	0.0028	0.0280	2.55E+03	2.55E+02
4,4'-DDT	3.92E-01	3.71E+00	8.06E-02	1.18E-02	5.72E-2	7.17E-02	3.30E+0	1	3.36E+0	0.0028	0.0280	1.20E+03	1.20E+02
Metals													
Antimony	6.37E+01	6.37E+01	8.06E-02	1.18E-02	9.30E+0	7.17E-02	5.67E+1	1	6.60E+1	---	---	---	---
Arsenic	6.03E+00	8.58E-01	8.06E-02	1.18E-02	8.79E-1	7.17E-02	7.64E-1	1	1.64E+0	5.14	12.84	3.20E-01	1.28E-01
Barium	6.03E+02	5.49E+01	8.06E-02	1.18E-02	8.81E+1	7.17E-02	4.89E+1	1	1.37E+2	20.80	41.70	6.58E+00	3.28E+00
Beryllium	6.07E-01	2.73E-02	8.06E-02	1.18E-02	8.86E-2	7.17E-02	2.43E-2	1	1.13E-1	---	---	---	---
Cadmium	1.71E+01	7.93E+01	8.06E-02	1.18E-02	2.50E+0	7.17E-02	7.06E+1	1	7.31E+1	1.45	20.00	5.04E+01	3.65E+00
Chromium	8.97E+01	2.74E+01	8.06E-02	1.18E-02	1.31E+1	7.17E-02	2.44E+1	1	3.75E+1	1.00	5.00	3.75E+01	7.50E+00
Cobalt	1.86E+01	2.27E+00	8.06E-02	1.18E-02	2.72E+0	7.17E-02	2.02E+0	1	4.74E+0	---	---	---	---
Copper	1.79E+03	9.22E+02	8.06E-02	1.18E-02	2.61E+2	7.17E-02	8.20E+2	1	1.08E+3	47.00	61.70	2.30E+01	1.75E+01
Lead	2.12E+03	3.89E+02	8.06E-02	1.18E-02	3.09E+2	7.17E-02	3.46E+2	1	6.55E+2	1.13	11.30	5.80E+02	5.80E+01
Manganese	7.74E+02	4.16E+01	8.06E-02	1.18E-02	1.13E+2	7.17E-02	3.70E+1	1	1.50E+2	977.00	9770	1.54E-01	1.54E-02
Mercury	7.46E-01	4.87E-01	8.06E-02	1.18E-02	1.09E-1	7.17E-02	4.34E-1	1	5.43E-1	0.0064	0.06	8.48E+01	8.48E+00
Nickel	4.60E+02	8.03E+00	8.06E-02	1.18E-02	6.71E+1	7.17E-02	7.15E+0	1	7.42E+1	77.40	107.00	9.59E-01	6.94E-01
Selenium	4.40E+00	2.75E+00	8.06E-02	1.18E-02	6.42E-1	7.17E-02	2.45E+0	1	3.09E+0	0.50	1.00	6.18E+00	3.09E+00
Silver	6.04E+01	1.23E+02	8.06E-02	1.18E-02	8.81E+0	7.17E-02	1.10E+2	1	1.19E+2	---	---	---	---
Thallium	1.18E-01	2.60E-02	8.06E-02	1.18E-02	1.72E-2	7.17E-02	2.31E-2	1	4.03E-2	---	---	---	---
Vanadium	3.85E+01	1.62E+00	8.06E-02	1.18E-02	5.62E+0	7.17E-02	1.44E+0	1	7.06E+0	11.40	114.00	6.19E-01	6.19E-02
Zinc	4.28E+03	1.33E+03	8.06E-02	1.18E-02	6.25E+2	7.17E-02	1.18E+3	1	1.81E+3	14.50	131.00	1.25E+02	1.38E+01

Table G-5a.5
Exposures and HQs for Meadow Vole Due to Ingestion of
COPECs in Soil (0-0.5 ft) and Plants
Wallops CDL

Chemical	0-0.5 ft Soil (mg/kg)	Plant Conc. (mg/kg)	Body Weight (kg)	Soil Ingestion Rate (kg/d)	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Rate (kg/d)	Food Ingestion Dose (mg/kg-day)	Site Presence Index (SPI)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs													
Methyl Acetate	1.19E+00	1.19E+00	0.039	1.09E-4	3.33E-03	3.41E-03	1.04E-01	1	1.07E-01	---	---	---	---
Methylcyclohexane	2.50E-03	2.50E-03	0.039	1.09E-4	7.00E-06	3.41E-03	2.19E-04	1	2.26E-04	---	---	---	---
SVOCs													
Acenaphthylene	1.58E-01	7.40E-02	0.039	1.09E-4	4.42E-04	3.41E-03	6.48E-03	1	6.92E-03	---	---	---	---
Anthracene	2.67E-01	1.33E-01	0.039	1.09E-4	7.48E-04	3.41E-03	1.16E-02	1	1.24E-02	---	---	---	---
Benzo(a)anthracene	2.49E+00	1.15E-01	0.039	1.09E-4	6.97E-03	3.41E-03	1.00E-02	1	1.70E-02	---	---	---	---
Benzo(a)pyrene	1.91E+00	2.39E-01	0.039	1.09E-4	5.35E-03	3.41E-03	2.09E-02	1	2.63E-02	0.91	9.09	2.89E-02	2.89E-03
Benzo(b)fluoranthene	1.39E+00	4.31E-01	0.039	1.09E-4	3.89E-03	3.41E-03	3.77E-02	1	4.16E-02	---	---	---	---
Benzo(g,h,i)perylene	1.18E+00	4.79E-01	0.039	1.09E-4	3.30E-03	3.41E-03	4.19E-02	1	4.52E-02	---	---	---	---
Benzo(k)fluoranthene	1.03E+00	1.19E-01	0.039	1.09E-4	2.88E-03	3.41E-03	1.04E-02	1	1.33E-02	---	---	---	---
Chrysene	4.04E+00	1.53E-01	0.039	1.09E-4	1.13E-02	3.41E-03	1.34E-02	1	2.47E-02	---	---	---	---
Dibenzo(a,h)anthracene	3.88E-01	5.04E-02	0.039	1.09E-4	1.09E-03	3.41E-03	4.41E-03	1	5.50E-03	---	---	---	---
bis(2-Ethylhexyl)phthalate	1.11E-01	1.11E-01	0.039	1.09E-4	3.11E-04	3.41E-03	9.71E-03	1	1.00E-02	16.60	166.00	6.04E-04	6.04E-05
Fluoranthene	7.27E-01	3.64E-01	0.039	1.09E-4	2.04E-03	3.41E-03	3.18E-02	1	3.39E-02	---	---	---	---
Indeno(1,2,3-cd)pyrene	6.17E-01	6.79E-02	0.039	1.09E-4	1.73E-03	3.41E-03	5.94E-03	1	7.67E-03	---	---	---	---
Phenanthrene	2.23E+00	1.39E+00	0.039	1.09E-4	6.24E-03	3.41E-03	1.22E-01	1	1.28E-01	---	---	---	---
Pyrene	1.82E+00	1.31E+00	0.039	1.09E-4	5.11E-03	3.41E-03	1.15E-01	1	1.20E-01	---	---	---	---
Pesticides													
4,4'-DDD	9.58E-02	1.39E-02	0.039	1.09E-4	2.68E-04	3.41E-03	1.22E-03	1	1.48E-03	1.34	6.72	1.11E-03	2.21E-04
4,4'-DDE	6.28E-01	5.72E-02	0.039	1.09E-4	1.76E-03	3.41E-03	5.00E-03	1	6.76E-03	1.34	6.72	5.05E-03	1.01E-03
4,4'-DDT	3.92E-01	4.01E-02	0.039	1.09E-4	1.10E-03	3.41E-03	3.51E-03	1	4.60E-03	1.34	6.72	3.43E-03	6.85E-04
Metals													
Antimony	6.37E+01	1.94E+00	0.039	1.09E-4	1.78E-01	3.41E-03	1.70E-01	1	3.48E-01	0.11	1.14	3.05E+00	3.07E-01
Arsenic	6.03E+00	2.26E-01	0.039	1.09E-4	1.69E-02	3.41E-03	1.98E-02	1	3.67E-02	0.11	1.15	3.22E-01	3.20E-02
Barium	6.03E+02	9.41E+01	0.039	1.09E-4	1.69E+00	3.41E-03	8.24E+00	1	9.93E+00	9.00	33.30	1.10E+00	2.98E-01
Beryllium	6.07E-01	4.05E-01	0.039	1.09E-4	1.70E-03	3.41E-03	3.55E-02	1	3.72E-02	1.11	11.10	3.35E-02	3.35E-03
Cadmium	1.71E+01	2.93E+00	0.039	1.09E-4	4.80E-02	3.41E-03	2.56E-01	1	3.04E-01	1.62	16.20	1.88E-01	1.88E-02
Chromium	8.97E+01	3.68E+00	0.039	1.09E-4	2.51E-01	3.41E-03	3.22E-01	1	5.73E-01	5.51	22.07	1.04E-01	2.60E-02
Cobalt	1.86E+01	1.39E-01	0.039	1.09E-4	5.21E-02	3.41E-03	1.21E-02	1	6.43E-02	---	---	---	---
Copper	1.79E+03	3.73E+01	0.039	1.09E-4	5.01E+00	3.41E-03	3.26E+00	1	8.28E+00	25.50	33.60	3.25E-01	2.46E-01
Lead	2.12E+03	1.95E+01	0.039	1.09E-4	5.94E+00	3.41E-03	1.70E+00	1	7.64E+00	13.44	134.35	5.68E-01	5.69E-02
Manganese	7.74E+02	6.13E+01	0.039	1.09E-4	2.17E+00	3.41E-03	5.37E+00	1	7.53E+00	148.00	477.00	5.09E-02	1.58E-02
Mercury	7.46E-01	3.14E-01	0.039	1.09E-4	2.09E-03	3.41E-03	2.75E-02	1	2.96E-02	2.18	21.80	1.36E-02	1.36E-03
Nickel	4.60E+02	1.06E+01	0.039	1.09E-4	1.29E+00	3.41E-03	9.29E-01	1	2.22E+00	67.18	134.35	3.30E-02	1.65E-02
Selenium	4.40E+00	2.61E+00	0.039	1.09E-4	1.23E-02	3.41E-03	2.28E-01	1	2.41E-01	0.34	0.55	7.16E-01	4.34E-01
Silver	6.04E+01	8.45E-01	0.039	1.09E-4	1.69E-01	3.41E-03	7.40E-02	1	2.43E-01	---	---	---	---
Thallium	1.18E-01	4.72E-04	0.039	1.09E-4	3.30E-04	3.41E-03	4.13E-05	1	3.72E-04	---	---	---	---
Vanadium	3.85E+01	1.87E-01	0.039	1.09E-4	1.08E-01	3.41E-03	1.63E-02	1	1.24E-01	0.33	3.27	3.80E-01	3.79E-02
Zinc	4.28E+03	4.96E+02	0.039	1.09E-4	1.20E+01	3.41E-03	4.34E+01	1	5.54E+01	268.70	537.40	2.06E-01	1.03E-01

Table G-5a.6
Exposures and HQs for Shrew Due to Ingestion of
COPECs in Soil (0-5 ft) and Invertebrates
Wallops CDL

Chemical	0-0.5 ft Soil (mg/kg)	0-5 ft Soil 95 UCL (mg/kg)	Invert Tissue Concentration (mg/kg)	Body Weight (kg)	Soil Ingestion Rate (kg/d)	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Rate (kg/d)	Food Ingestion Dose (mg/kg-day)	Site Presence Index (SPI)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs														
Methyl Acetate	1.19E+00	1.19E+00	1.19E+00	1.74E-02	1.09E-04	7.46E-03	3.64E-03	2.49E-01	1	2.56E-01	---	---	---	---
Methylcyclohexane	2.50E-03	2.50E-03	2.50E-03	1.74E-02	1.09E-04	1.57E-05	3.64E-03	5.23E-04	1	5.38E-04	---	---	---	---
SVOCs														
Acenaphthylene	1.58E-01	1.58E-01	3.62E+00	1.74E-02	1.09E-04	9.91E-04	3.64E-03	7.56E-01	1	7.57E-01	---	---	---	---
Anthracene	2.67E-01	2.67E-01	6.46E-01	1.74E-02	1.09E-04	1.67E-03	3.64E-03	1.35E-01	1	1.37E-01	---	---	---	---
Benzo(a)anthracene	2.49E+00	2.49E+00	3.96E+00	1.74E-02	1.09E-04	1.56E-02	3.64E-03	8.27E-01	1	8.43E-01	---	---	---	---
Benzo(a)pyrene	1.91E+00	1.91E+00	2.54E+00	1.74E-02	1.09E-04	1.20E-02	3.64E-03	5.31E-01	1	5.43E-01	1.190	11.890	4.56E-01	4.57E-02
Benzo(b)fluoranthene	1.39E+00	1.39E+00	3.61E+00	1.74E-02	1.09E-04	8.72E-03	3.64E-03	7.55E-01	1	7.64E-01	---	---	---	---
Benzo(g,h,i)perylene	1.18E+00	1.18E+00	3.47E+00	1.74E-02	1.09E-04	7.40E-03	3.64E-03	7.25E-01	1	7.32E-01	---	---	---	---
Benzo(k)fluoranthene	1.03E+00	1.03E+00	2.68E+00	1.74E-02	1.09E-04	6.46E-03	3.64E-03	5.60E-01	1	5.66E-01	---	---	---	---
Chrysene	4.04E+00	1.87E+00	9.25E+00	1.74E-02	1.09E-04	1.17E-02	3.64E-03	1.93E+00	1	1.95E+00	---	---	---	---
Dibenzo(a,h)anthracene	3.88E-01	3.88E-01	8.96E-01	1.74E-02	1.09E-04	2.43E-03	3.64E-03	1.87E-01	1	1.90E-01	---	---	---	---
bis(2-Ethylhexyl)phthalate	1.11E-01	9.02E-02	1.11E-01	1.74E-02	1.09E-04	5.65E-04	3.64E-03	2.32E-02	1	2.38E-02	21.800	218.000	1.09E-03	1.09E-04
Fluoranthene	7.27E-01	3.48E-01	2.21E+00	1.74E-02	1.09E-04	2.18E-03	3.64E-03	4.62E-01	1	4.64E-01	---	---	---	---
Indeno(1,2,3-cd)pyrene	6.17E-01	6.17E-01	1.76E+00	1.74E-02	1.09E-04	3.87E-03	3.64E-03	3.69E-01	1	3.73E-01	---	---	---	---
Phenanthrene	2.23E+00	1.05E+00	3.84E+00	1.74E-02	1.09E-04	6.56E-03	3.64E-03	8.02E-01	1	8.08E-01	---	---	---	---
Pyrene	1.82E+00	2.16E+00	3.19E+00	1.74E-02	1.09E-04	1.35E-02	3.64E-03	6.67E-01	1	6.81E-01	---	---	---	---
Pesticides														
alpha-Chlordane	NA	2.67E-02	0.00E+00	1.74E-02	1.09E-04	1.67E-04	3.64E-03	0.00E+00	1	1.67E-04	5.500	10.900	3.04E-05	1.54E-05
gamma-Chlordane	NA	3.46E-02	0.00E+00	1.74E-02	1.09E-04	2.17E-04	3.64E-03	0.00E+00	1	2.17E-04	5.500	10.900	3.94E-05	1.99E-05
4,4'-DDD	9.58E-02	6.33E-02	6.22E-01	1.74E-02	1.09E-04	3.97E-04	3.64E-03	1.30E-01	1	1.30E-01	1.760	8.790	7.41E-02	1.48E-02
4,4'-DDE	6.28E-01	7.22E-01	7.91E+00	1.74E-02	1.09E-04	4.53E-03	3.64E-03	1.65E+00	1	1.66E+00	1.760	8.790	9.42E-01	1.89E-01
4,4'-DDT	3.92E-01	3.63E-01	3.71E+00	1.74E-02	1.09E-04	2.28E-03	3.64E-03	7.75E-01	1	7.77E-01	1.760	8.790	4.41E-01	8.84E-02
Polychlorinated Biphenyls														
Aroclor 1260	NA	2.13E-01	0.00E+00	1.74E-02	1.09E-04	1.34E-03	3.64E-03	0.00E+00	1	1.34E-03	0.540	2.700	2.47E-03	4.95E-04
Metals														
Antimony	6.37E+01	2.21E+01	6.37E+01	1.74E-02	1.09E-04	1.39E-01	3.64E-03	1.33E+01	1	1.35E+01	0.146	1.487	9.21E+01	9.05E+00
Arsenic	6.03E+00	5.35E+00	8.58E-01	1.74E-02	1.09E-04	3.35E-02	3.64E-03	1.79E-01	1	2.13E-01	0.150	1.498	1.42E+00	1.42E-01
Barium	6.03E+02	4.28E+02	5.49E+01	1.74E-02	1.09E-04	2.68E+00	3.64E-03	1.15E+01	1	1.42E+01	11.800	43.500	1.20E+00	3.25E-01
Beryllium	6.07E-01	4.42E-01	2.73E-02	1.74E-02	1.09E-04	2.77E-03	3.64E-03	5.71E-03	1	8.48E-03	1.450	14.500	5.85E-03	5.85E-04
Cadmium	1.71E+01	2.87E+01	7.93E+01	1.74E-02	1.09E-04	1.80E-01	3.64E-03	1.66E+01	1	1.67E+01	2.120	21.200	7.90E+00	7.90E-01
Chromium	8.97E+01	4.16E+02	2.74E+01	1.74E-02	1.09E-04	2.61E+00	3.64E-03	5.73E+00	1	8.34E+00	7.210	28.880	1.16E+00	2.89E-01
Cobalt	1.86E+01	1.18E+01	2.27E+00	1.74E-02	1.09E-04	7.42E-02	3.64E-03	4.75E-01	1	5.49E-01	---	---	---	---
Copper	1.79E+03	4.07E+03	9.22E+02	1.74E-02	1.09E-04	2.55E+01	3.64E-03	1.93E+02	1	2.18E+02	33.400	44.000	6.53E+00	4.96E+00
Lead	2.12E+03	1.96E+03	3.89E+02	1.74E-02	1.09E-04	1.23E+01	3.64E-03	8.12E+01	1	9.36E+01	17.580	175.830	5.32E+00	5.32E-01
Manganese	7.74E+02	5.58E+02	4.16E+01	1.74E-02	1.09E-04	3.50E+00	3.64E-03	8.69E+00	1	1.22E+01	193.000	624.000	6.32E-02	1.95E-02
Mercury	7.46E-01	4.05E-01	4.87E-01	1.74E-02	1.09E-04	2.54E-03	3.64E-03	1.02E-01	1	1.04E-01	2.860	28.600	3.65E-02	3.65E-03
Nickel	4.60E+02	3.46E+02	8.03E+00	1.74E-02	1.09E-04	2.17E+00	3.64E-03	1.68E+00	1	3.85E+00	87.910	175.830	4.38E-02	2.19E-02
Selenium	4.40E+00	4.40E+00	2.75E+00	1.74E-02	1.09E-04	2.76E-02	3.64E-03	5.74E-01	1	6.02E-01	0.440	0.725	1.37E+00	8.30E-01
Silver	6.04E+01	2.23E+01	1.23E+02	1.74E-02	1.09E-04	1.40E-01	3.64E-03	2.58E+01	1	2.59E+01	---	---	---	---
Thallium	1.18E-01	8.87E-02	2.60E-02	1.74E-02	1.09E-04	5.56E-04	3.64E-03	5.43E-03	1	5.98E-03	---	---	---	---
Vanadium	3.85E+01	1.93E+01	1.62E+00	1.74E-02	1.09E-04	1.21E-01	3.64E-03	3.38E-01	1	4.59E-01	0.428	4.285	1.07E+00	1.07E-01
Zinc	4.28E+03	3.81E+03	1.33E+03	1.74E-02	1.09E-04	2.39E+01	3.64E-03	2.78E+02	1	3.02E+02	351.700	703.300	8.57E-01	4.29E-01

Table G-5a.7
Exposures and HQs for Red-tailed Hawk Due to Ingestion of COPECs in Soil (0-0.5 ft) and Sm. Mammals
Wallops CDL

Chemical	0-0.5 ft Soil (mg/kg)	Sm. Mammal Tissue Conc. (mg/kg)	Body Weight (kg)	Soil Ingestion Rate (kg/d)	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Rate (kg/d)	Food Ingestion Dose (mg/kg-day)	Site Presence Index (SPI)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg day)	NOAEL HQ	LOAEL HQ
VOCs													
Methyl Acetate	1.19E+00	1.19E+00	1.204	2.42E-3	2.39E-03	4.25E-02	4.20E-02	4.22E-02	1.87E-03	---	---	---	---
Methylcyclohexane	2.50E-03	2.50E-03	1.204	2.42E-3	5.03E-06	4.25E-02	8.83E-05	4.22E-02	3.93E-06	---	---	---	---
SVOCs													
Acenaphthylene	1.58E-01	0.00E+00	1.204	2.42E-3	3.18E-04	4.25E-02	0.00E+00	4.22E-02	1.34E-05	---	---	---	---
Anthracene	2.67E-01	0.00E+00	1.204	2.42E-3	5.37E-04	4.25E-02	0.00E+00	4.22E-02	2.27E-05	---	---	---	---
Benzo(a)anthracene	2.49E+00	0.00E+00	1.204	2.42E-3	5.01E-03	4.25E-02	0.00E+00	4.22E-02	2.11E-04	---	---	---	---
Benzo(a)pyrene	1.91E+00	0.00E+00	1.204	2.42E-3	3.84E-03	4.25E-02	0.00E+00	4.22E-02	1.62E-04	---	---	---	---
Benzo(b)fluoranthene	1.39E+00	0.00E+00	1.204	2.42E-3	2.80E-03	4.25E-02	0.00E+00	4.22E-02	1.18E-04	---	---	---	---
Benzo(g,h,i)perylene	1.18E+00	0.00E+00	1.204	2.42E-3	2.37E-03	4.25E-02	0.00E+00	4.22E-02	1.00E-04	---	---	---	---
Benzo(k)fluoranthene	1.03E+00	0.00E+00	1.204	2.42E-3	2.07E-03	4.25E-02	0.00E+00	4.22E-02	8.74E-05	---	---	---	---
Chrysene	4.04E+00	0.00E+00	1.204	2.42E-3	8.13E-03	4.25E-02	0.00E+00	4.22E-02	3.43E-04	---	---	---	---
Dibenzo(a,h)anthracene	3.88E-01	0.00E+00	1.204	2.42E-3	7.81E-04	4.25E-02	0.00E+00	4.22E-02	3.29E-05	---	---	---	---
bis(2-Ethylhexyl)phthalate	1.11E-01	1.11E-01	1.204	2.42E-3	2.23E-04	4.25E-02	3.92E-03	4.22E-02	1.75E-04	1.10	11.00	1.59E-04	1.59E-05
Fluoranthene	7.27E-01	0.00E+00	1.204	2.42E-3	1.46E-03	4.25E-02	0.00E+00	4.22E-02	6.17E-05	---	---	---	---
Indeno(1,2,3-cd)pyrene	6.17E-01	0.00E+00	1.204	2.42E-3	1.24E-03	4.25E-02	0.00E+00	4.22E-02	5.23E-05	---	---	---	---
Phenanthrene	2.23E+00	0.00E+00	1.204	2.42E-3	4.49E-03	4.25E-02	0.00E+00	4.22E-02	1.89E-04	---	---	---	---
Pyrene	1.82E+00	0.00E+00	1.204	2.42E-3	3.67E-03	4.25E-02	0.00E+00	4.22E-02	1.55E-04	---	---	---	---
Pesticides													
alpha-Chlordane	---	2.67E-02	1.204	2.42E-3	0.00E+00	4.25E-02	9.43E-04	4.22E-02	3.97E-05	0.20	1.10	1.99E-04	3.61E-05
gamma-Chlordane	---	3.46E-02	1.204	2.42E-3	0.00E+00	4.25E-02	1.22E-03	4.22E-02	5.15E-05	0.20	1.10	2.58E-04	4.68E-05
4,4'-DDD	9.58E-02	4.63E-01	1.204	2.42E-3	1.93E-04	4.25E-02	1.63E-02	4.22E-02	6.97E-04	0.0028	0.0280	2.49E-01	2.49E-02
4,4'-DDE	6.28E-01	3.09E+01	1.204	2.42E-3	1.26E-03	4.25E-02	1.09E+00	4.22E-02	4.61E-02	0.0028	0.0280	1.65E+01	1.65E+00
4,4'-DDT	3.92E-01	1.61E+00	1.204	2.42E-3	7.88E-04	4.25E-02	5.67E-02	4.22E-02	2.42E-03	0.0028	0.0280	8.65E-01	8.65E-02
Polychlorinated Biphenyls													
Aroclor 1260	---	2.13E-01	1.204	2.42E-3	0.00E+00	4.25E-02	7.52E-03	4.22E-02	3.17E-04	0.42	1.8000	7.60E-04	1.76E-04
Metals													
Antimony	6.37E+01	1.33E-01	1.204	2.42E-3	1.28E-01	4.25E-02	4.68E-03	4.22E-02	5.60E-03	---	---	---	---
Arsenic	6.03E+00	3.42E-02	1.204	2.42E-3	1.21E-02	4.25E-02	1.21E-03	4.22E-02	5.62E-04	5.14	12.84	1.09E-04	4.38E-05
Barium	6.03E+02	7.06E-01	1.204	2.42E-3	1.21E+00	4.25E-02	2.49E-02	4.22E-02	5.22E-02	20.80	41.70	2.51E-03	1.25E-03
Beryllium	6.07E-01	2.03E-02	1.204	2.42E-3	1.22E-03	4.25E-02	7.16E-04	4.22E-02	8.17E-05	---	---	---	---
Cadmium	1.71E+01	1.39E+00	1.204	2.42E-3	3.45E-02	4.25E-02	4.90E-02	4.22E-02	3.52E-03	1.45	20.00	2.43E-03	1.76E-04
Chromium	8.97E+01	1.94E+01	1.204	2.42E-3	1.80E-01	4.25E-02	6.85E-01	4.22E-02	3.65E-02	1.00	5.00	3.65E-02	7.29E-03
Cobalt	1.86E+01	5.25E-01	1.204	2.42E-3	3.75E-02	4.25E-02	1.85E-02	4.22E-02	2.36E-03	---	---	---	---
Copper	1.79E+03	2.56E+01	1.204	2.42E-3	3.60E+00	4.25E-02	9.03E-01	4.22E-02	1.90E-01	47.00	61.70	4.04E-03	3.08E-03
Lead	2.12E+03	3.19E+01	1.204	2.42E-3	4.27E+00	4.25E-02	1.12E+00	4.22E-02	2.27E-01	1.13	11.30	2.01E-01	2.01E-02
Manganese	7.74E+02	1.59E+01	1.204	2.42E-3	1.56E+00	4.25E-02	5.60E-01	4.22E-02	8.93E-02	977.00	9770	9.14E-05	9.14E-06
Mercury	7.46E-01	7.46E-01	1.204	2.42E-3	1.50E-03	4.25E-02	2.63E-02	4.22E-02	1.17E-03	0.0064	0.06	1.83E-01	1.83E-02
Nickel	4.60E+02	1.36E+01	1.204	2.42E-3	9.25E-01	4.25E-02	4.80E-01	4.22E-02	5.92E-02	77.40	107.00	7.65E-04	5.53E-04
Selenium	4.40E+00	1.15E+00	1.204	2.42E-3	8.85E-03	4.25E-02	4.06E-02	4.22E-02	2.09E-03	0.50	1.00	4.17E-03	2.09E-03
Silver	6.04E+01	2.41E-01	1.204	2.42E-3	1.21E-01	4.25E-02	8.52E-03	4.22E-02	5.48E-03	---	---	---	---
Thallium	1.18E-01	1.18E-01	1.204	2.42E-3	2.37E-04	4.25E-02	4.17E-03	4.22E-02	1.86E-04	---	---	---	---
Vanadium	3.85E+01	4.74E-01	1.204	2.42E-3	7.75E-02	4.25E-02	1.67E-02	4.22E-02	3.97E-03	11.40	114.00	3.48E-04	3.48E-05
Zinc	4.28E+03	1.42E+02	1.204	2.42E-3	8.61E+00	4.25E-02	5.00E+00	4.22E-02	5.74E-01	14.50	131.00	3.96E-02	4.38E-03

Table G-5a.8
Exposures and HQs for Red Fox Due to Ingestion of
COPECs in Soil (0-0.5 ft) and Sm. Mammals
Wallops CDL

Chemical	0-0.5 ft Soil (mg/kg)	Sm. Mammal Tissue Conc. (mg/kg)	Body Weight (kg)	Soil Ingestion Rate (kg/d)	Soil Ingestion Dose (mg/kg-day)	Food Ingestion Rate (kg/d)	Food Ingestion Dose (mg/kg-day)	Site Presence Index (SPI)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
VOCs													
Methyl Acetate	1.19E+00	1.19E+00	4.13	1.62E-2	4.66E-03	5.78E-01	1.67E-01	3.62E-03	6.20E-04	—	—	—	—
Methylcyclohexane	2.50E-03	2.50E-03	4.13	1.62E-2	9.80E-06	5.78E-01	3.50E-04	3.62E-03	1.30E-06	—	—	—	—
SVOCs													
Acenaphthylene	1.58E-01	0.00E+00	4.13	1.62E-2	6.19E-04	5.78E-01	0.00E+00	3.62E-03	2.24E-06	---	—	---	—
Anthracene	2.67E-01	0.00E+00	4.13	1.62E-2	1.05E-03	5.78E-01	0.00E+00	3.62E-03	3.79E-06	---	—	---	—
Benzo(a)anthracene	2.49E+00	0.00E+00	4.13	1.62E-2	9.76E-03	5.78E-01	0.00E+00	3.62E-03	3.53E-05	—	---	—	---
Benzo(a)pyrene	1.91E+00	0.00E+00	4.13	1.62E-2	7.49E-03	5.78E-01	0.00E+00	3.62E-03	2.71E-05	0.29	2.86	9.34E-05	9.48E-06
Benzo(b)fluoranthene	1.39E+00	0.00E+00	4.13	1.62E-2	5.45E-03	5.78E-01	0.00E+00	3.62E-03	1.97E-05	—	—	---	—
Benzo(g,h,i)perylene	1.18E+00	0.00E+00	4.13	1.62E-2	4.63E-03	5.78E-01	0.00E+00	3.62E-03	1.67E-05	---	—	---	—
Benzo(k)fluoranthene	1.03E+00	0.00E+00	4.13	1.62E-2	4.04E-03	5.78E-01	0.00E+00	3.62E-03	1.46E-05	—	---	—	---
Chrysene	4.04E+00	0.00E+00	4.13	1.62E-2	1.58E-02	5.78E-01	0.00E+00	3.62E-03	5.73E-05	—	---	—	—
Dibenzo(a,h)anthracene	3.88E-01	0.00E+00	4.13	1.62E-2	1.52E-03	5.78E-01	0.00E+00	3.62E-03	5.51E-06	---	—	—	---
bis(2-Ethylhexyl)phthalate	1.11E-01	1.11E-01	4.13	1.62E-2	4.35E-04	5.78E-01	1.55E-02	3.62E-03	5.78E-05	5.20	52.00	1.11E-05	1.11E-06
Fluoranthene	7.27E-01	0.00E+00	4.13	1.62E-2	2.85E-03	5.78E-01	0.00E+00	3.62E-03	1.03E-05	---	—	---	—
Indeno(1,2,3-cd)pyrene	6.17E-01	0.00E+00	4.13	1.62E-2	2.42E-03	5.78E-01	0.00E+00	3.62E-03	8.75E-06	---	—	---	—
Phenanthrene	2.23E+00	0.00E+00	4.13	1.62E-2	8.74E-03	5.78E-01	0.00E+00	3.62E-03	3.16E-05	—	---	—	---
Pyrene	1.82E+00	0.00E+00	4.13	1.62E-2	7.15E-03	5.78E-01	0.00E+00	3.62E-03	2.59E-05	—	---	—	—
Pesticides													
alpha-Chlordane	---	2.67E-02	4.13	1.62E-2	0.00E+00	5.78E-01	3.74E-03	3.62E-03	1.35E-05	1.30	2.60	1.04E-05	5.20E-06
gamma-Chlordane	---	3.46E-02	4.13	1.62E-2	0.00E+00	5.78E-01	4.84E-03	3.62E-03	1.75E-05	1.30	2.60	1.35E-05	6.74E-06
4,4'-DDD	9.58E-02	4.63E-01	4.13	1.62E-2	3.75E-04	5.78E-01	6.48E-02	3.62E-03	2.36E-04	0.42	2.11	5.61E-04	1.12E-04
4,4'-DDE	6.28E-01	3.09E+01	4.13	1.62E-2	2.46E-03	5.78E-01	4.33E+00	3.62E-03	1.57E-02	0.42	2.11	3.73E-02	7.43E-03
4,4'-DDT	3.92E-01	1.61E+00	4.13	1.62E-2	1.54E-03	5.78E-01	2.25E-01	3.62E-03	8.19E-04	0.42	2.11	1.95E-03	3.88E-04
Polychlorinated Biphenyls													
Aroclor 1260	---	2.13E-01	4.13	1.62E-2	0.00E+00	5.78E-01	2.98E-02	3.62E-03	1.08E-04	0.09	0.04	1.20E-03	2.70E-03
Metals													
Antimony	6.37E+01	1.33E-01	4.13	1.62E-2	2.50E-01	5.78E-01	1.86E-02	3.62E-03	9.71E-04	0.04	0.36	2.70E-02	2.72E-03
Arsenic	6.03E+00	3.42E-02	4.13	1.62E-2	2.36E-02	5.78E-01	4.78E-03	3.62E-03	1.03E-04	0.04	0.36	2.86E-03	2.86E-04
Barium	6.03E+02	7.06E-01	4.13	1.62E-2	2.37E+00	5.78E-01	9.88E-02	3.62E-03	8.92E-03	2.80	10.50	3.19E-03	8.49E-04
Beryllium	6.07E-01	2.03E-02	4.13	1.62E-2	2.38E-03	5.78E-01	2.84E-03	3.62E-03	1.89E-05	0.35	3.50	5.40E-05	5.40E-06
Cadmium	1.71E+01	1.39E+00	4.13	1.62E-2	6.72E-02	5.78E-01	1.94E-01	3.62E-03	9.46E-04	0.51	5.09	1.86E-03	1.86E-04
Chromium	8.97E+01	1.94E+01	4.13	1.62E-2	3.52E-01	5.78E-01	2.71E+00	3.62E-03	1.11E-02	1.73	6.94	6.42E-03	1.60E-03
Cobalt	1.86E+01	5.25E-01	4.13	1.62E-2	7.30E-02	5.78E-01	7.35E-02	3.62E-03	5.30E-04	---	---	---	---
Copper	1.79E+03	2.56E+01	4.13	1.62E-2	7.02E+00	5.78E-01	3.58E+00	3.62E-03	3.84E-02	8.00	10.60	4.80E-03	3.62E-03
Lead	2.12E+03	3.19E+01	4.13	1.62E-2	8.31E+00	5.78E-01	4.46E+00	3.62E-03	4.62E-02	4.22	42.25	1.10E-02	1.09E-03
Manganese	7.74E+02	1.59E+01	4.13	1.62E-2	3.04E+00	5.78E-01	2.22E+00	3.62E-03	1.90E-02	46.00	150.00	4.14E-04	1.27E-04
Mercury	7.46E-01	7.46E-01	4.13	1.62E-2	2.92E-03	5.78E-01	1.04E-01	3.62E-03	3.89E-04	0.69	6.90	5.63E-04	5.63E-05
Nickel	4.60E+02	1.36E+01	4.13	1.62E-2	1.80E+00	5.78E-01	1.90E+00	3.62E-03	1.34E-02	21.12	42.25	6.35E-04	3.17E-04
Selenium	4.40E+00	1.15E+00	4.13	1.62E-2	1.72E-02	5.78E-01	1.61E-01	3.62E-03	6.45E-04	0.11	0.17	6.09E-03	3.71E-03
Silver	6.04E+01	2.41E-01	4.13	1.62E-2	2.37E-01	5.78E-01	3.38E-02	3.62E-03	9.79E-04	---	---	---	---
Thallium	1.18E-01	1.18E-01	4.13	1.62E-2	4.63E-04	5.78E-01	1.65E-02	3.62E-03	6.15E-05	---	---	---	---
Vanadium	3.85E+01	4.74E-01	4.13	1.62E-2	1.51E-01	5.78E-01	6.63E-02	3.62E-03	7.86E-04	0.10	1.03	7.63E-03	7.63E-04
Zinc	4.28E+03	1.42E+02	4.13	1.62E-2	1.68E+01	5.78E-01	1.98E+01	3.62E-03	1.33E-01	84.50	169.00	1.57E-03	7.84E-04

Table G-5a.9
Summary of HQs for Terrstrial Wildlife
Wallops CDL

Chemical	Grasses	Trees	Soil Invertebrates	Am. Robin		Meadow Vole		Short-tailed Shrew		Red-tailed Hawk		Red Fox	
	HQ	HQ	HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
VOCs													
Methyl Acetate	---	---	---	---	---	---	---	---	---	---	---	---	---
Methylcyclohexane	---	---	---	---	---	---	---	---	---	---	---	---	---
SVOCs													
Acenaphthylene	7.90E-03	7.90E-03	8.78E-03	---	---	---	---	---	---	---	---	---	---
Anthracene	2.67E+00	2.67E+00	1.48E-02	---	---	---	---	---	---	---	---	---	---
Benzo(a)anthracene	2.49E+01	2.49E+01	8.59E-02	---	---	---	---	---	---	---	---	---	---
Benzo(a)pyrene	1.91E+01	1.91E+01	6.59E-02	---	---	2.89E-02	2.89E-03	4.56E-01	4.57E-02	---	---	9.34E-05	9.48E-06
Benzo(b)fluoranthene	1.39E+01	1.39E+01	4.79E-02	---	---	---	---	---	---	---	---	---	---
Benzo(g,h,i)perylene	1.18E+01	1.18E+01	4.07E-02	---	---	---	---	---	---	---	---	---	---
Benzo(k)fluoranthene	1.03E+01	1.03E+01	3.55E-02	---	---	---	---	---	---	---	---	---	---
Chrysene	4.04E+01	1.87E+01	1.39E-01	---	---	---	---	---	---	---	---	---	---
Dibenzo(a,h)anthracene	3.88E+00	3.88E+00	1.34E-02	---	---	---	---	---	---	---	---	---	---
bis(2-Ethylhexyl)phthalate	---	---	---	1.05E-01	1.05E-02	6.04E-04	6.04E-05	1.09E-03	1.09E-04	1.59E-04	1.59E-05	1.11E-05	1.11E-06
Fluoranthene	7.27E+00	3.48E+00	2.51E-02	---	---	---	---	---	---	---	---	---	---
Indeno(1,2,3-cd)pyrene	6.17E+00	6.17E+00	2.13E-02	---	---	---	---	---	---	---	---	---	---
Phenanthrene	2.23E+01	1.05E+01	1.24E-01	---	---	---	---	---	---	---	---	---	---
Pyrene	1.82E+01	2.16E+01	6.29E-02	---	---	---	---	---	---	---	---	---	---
Pesticides													
alpha-Chlordane	NA	2.67E-01	NA	NA	NA	NA	NA	3.04E-05	1.54E-05	1.99E-04	3.61E-05	1.04E-05	5.20E-06
gamma-Chlordane	NA	3.46E-01	NA	NA	NA	NA	NA	3.94E-05	1.99E-05	2.58E-04	4.68E-05	1.35E-05	6.74E-06
4,4'-DDD	9.58E-01	6.33E-01	---	2.03E+02	2.03E+01	1.11E-03	2.21E-04	7.41E-02	1.48E-02	2.49E-01	2.49E-02	5.61E-04	1.12E-04
4,4'-DDE	6.28E+00	7.22E+00	---	2.55E+03	2.55E+02	5.05E-03	1.01E-03	9.42E-01	1.89E-01	1.65E+01	1.65E+00	3.73E-02	7.43E-03
4,4'-DDT	3.92E+00	3.63E+00	---	1.20E+03	1.20E+02	3.43E-03	6.85E-04	4.41E-01	8.84E-02	8.65E-01	8.65E-02	1.95E-03	3.88E-04
Polychlorinated Biphenyls													
Aroclor 1260	NA	5.33E-03	NA	NA	NA	NA	NA	2.47E-03	4.95E-04	7.60E-04	1.76E-04	1.20E-03	2.70E-03
Metals													
Antimony	1.27E+01	4.42E+00	8.17E-01	---	---	3.05E+00	3.07E-01	9.21E+01	9.05E+00	---	---	2.70E-02	2.72E-03
Arsenic	3.35E-01	2.97E-01	6.03E-02	3.20E-01	1.28E-01	3.22E-01	3.20E-02	1.42E+00	1.42E-01	1.09E-04	4.38E-05	2.86E-03	2.86E-04
Barium	1.21E+00	8.56E-01	1.83E+00	6.58E+00	3.28E+00	1.10E+00	2.98E-01	1.20E+00	3.25E-01	2.51E-03	1.25E-03	3.19E-03	8.49E-04
Beryllium	6.07E-02	4.42E-02	1.52E-02	---	---	3.35E-02	3.35E-03	5.85E-03	5.85E-04	---	---	5.40E-05	5.40E-06
Cadmium	5.36E-01	8.96E-01	1.22E-01	5.04E+01	3.65E+00	1.88E-01	1.88E-02	7.90E+00	7.90E-01	2.43E-03	1.76E-04	1.86E-03	1.86E-04
Chromium	8.97E+01	4.16E+02	8.97E+00	3.75E+01	7.50E+00	1.04E-01	2.60E-02	1.16E+00	2.89E-01	3.65E-02	7.29E-03	6.42E-03	1.60E-03
Cobalt	1.43E+00	9.11E-01	1.86E-02	---	---	---	---	---	---	---	---	---	---
Copper	2.56E+01	5.82E+01	2.24E+01	2.80E+01	1.75E+01	3.25E-01	2.46E-01	6.53E+00	4.96E+00	4.04E-03	3.08E-03	4.80E-03	3.62E-03
Lead	1.77E+01	1.64E+01	1.25E+00	5.80E+02	5.80E+01	5.68E-01	5.69E-02	5.32E+00	5.32E-01	2.01E-01	2.01E-02	1.10E-02	1.09E-03
Manganese	3.52E+00	2.54E+00	1.72E+00	1.54E-01	1.54E-02	5.09E-02	1.58E-02	6.32E-02	1.95E-02	9.14E-05	9.14E-06	4.14E-04	1.27E-04
Mercury	2.49E+00	1.35E+00	2.49E-02	8.48E+01	8.48E+00	1.36E-02	1.36E-03	3.65E-02	3.65E-03	1.83E-01	1.83E-02	5.63E-04	5.63E-05
Nickel	1.21E+01	9.10E+00	1.64E+00	9.59E-01	6.94E-01	3.30E-02	1.65E-02	4.38E-02	2.19E-02	7.65E-04	5.53E-04	6.35E-04	3.17E-04
Selenium	8.46E+00	8.46E+00	1.07E+00	6.18E+00	3.09E+00	7.16E-01	4.34E-01	1.67E+00	8.30E-01	4.17E-03	2.09E-03	6.09E-03	3.71E-03
Silver	1.08E-01	3.99E-02	1.21E+00	---	---	---	---	---	---	---	---	---	---
Thallium	1.18E-01	8.87E-02	---	---	---	---	---	---	---	---	---	---	---
Vanadium	1.93E+01	9.64E+00	1.93E+00	6.19E-01	6.19E-02	3.80E-01	3.79E-02	1.07E+00	1.07E-01	3.48E-04	3.48E-05	7.63E-03	7.63E-04
Zinc	2.68E+01	2.38E+01	3.57E+01	1.25E+02	1.38E+01	2.06E-01	1.03E-01	8.57E-01	4.29E-01	3.96E-02	4.38E-03	1.57E-03	7.84E-04
Total VOCs	1.81E+02	1.47E+02	6.85E-01	1.05E-01	1.05E-02	2.95E-02	2.95E-03	4.57E-01	4.58E-02	1.59E-04	1.59E-05	1.05E-04	1.06E-05
Total Pesticides	1.12E+01	1.21E+01	0.00E+00	3.95E+03	3.95E+02	9.59E-03	1.91E-03	1.46E+00	2.92E-01	1.76E+01	1.76E+00	3.99E-02	7.94E-03
PCBs as Aroclors and Dioxin/Furans	NA	5.33E-03	NA	NA	NA	NA	NA	2.47E-03	4.95E-04	7.60E-04	1.76E-04	1.20E-03	2.70E-03

VERSAR

APPENDIX G-5b

AQUATIC RISK CALCULATIONS

Table G-5b.1
Exposures and HQs for Aquatic Life Due to Contact with COPECs in Water
Wallops CDL

	Surface Water EPC (ug/L)	TRV (ug/L)	HQ
Inorganics			
Aluminum	8.47E+02	8.70E+01	9.74E+00
Arsenic	1.08E+01	3.60E+01	3.00E-01
Barium	2.24E+01	4.00E+00	5.60E+00
Chromium	2.00E+00	1.10E+01	1.82E-01
Copper	4.90E+00	6.00E+00	8.17E-01
Iron	7.17E+02	3.00E+02	2.39E+00
Lead	4.00E+00	9.30E+00	4.30E-01
Mercury	9.10E-02	7.70E-01	1.18E-01
Nickel	2.90E+00	8.20E+00	3.54E-01
Selenium	1.09E+01	5.00E+00	2.18E+00

EPC - Exposure point concentration.
HQ - Hazard quotient.
mg/kg - Milligrams per kilogram.
TRV - Toxicity reference value.
COPEC - Chemical of potential ecological concern.

Table G-5b.2
Exposures and HQs for Benthic Invertebrates Due to Contact with COPECs in Sediments
Wallops CDL

	Sediments EPC (mg/kg)	TRV (mg/kg)	HQ
Volatile Organic Compounds			
2-Butanone (MEK)	1.64E-01	—	—
Carbon disulfide	1.43E-02	8.50E-04	1.68E+01
Cyclohexane	1.82E-02	—	—
Methyl Acetate	5.86E-02	—	—
Semi-Volatile Organic Compounds			
Di-n-octyl phthalate	3.08E+00	---	---
bis(2-Ethylhexyl)phthalate	1.62E+02	1.82E-01	8.90E+02
Pesticides			
4,4'-DDD	6.50E-02	4.88E-03	1.33E+01
4,4'-DDE	1.49E-01	3.16E-03	4.72E+01
4,4'-DDT	1.08E-02	4.16E-03	2.60E+00
Inorganics			
Aluminum	1.99E+04	---	---
Antimony	2.80E+00	2.00E+00	1.40E+00
Arsenic	1.37E+01	9.80E+00	1.40E+00
Barium	5.32E+01	---	---
Beryllium	5.81E-01	---	---
Cadmium	1.50E+00	9.90E-01	1.52E+00
Chromium	3.98E+01	4.34E+01	9.18E-01
Copper	3.46E+01	3.16E+01	1.09E+00
Iron	2.58E+04	2.00E+04	1.29E+00
Lead	4.70E+01	3.58E+01	1.31E+00
Mercury	3.03E-01	1.80E-01	1.68E+00
Nickel	1.93E+01	2.27E+01	8.48E-01
Selenium	1.75E+00	2.00E+00	8.77E-01
Silver	1.50E+00	1.00E+00	1.50E+00
Thallium	2.23E-01	---	---
Vanadium	4.74E+01	---	---
Zinc	1.49E+02	1.21E+02	1.23E+00

A dash indicates the absence of an applicable TRV and corresponding calculated HQ.
Shaded cells indicate HQs greater than 1.

EPC	-	Exposure point concentration.
HQ	-	Hazard quotient.
mg/kg	-	Milligrams per kilogram.
TRV	-	Toxicity reference value.
COPEC	-	Chemical of potential ecological concern.

Table G-5b.3
Exposures and HQs for Great Blue Heron Due to Ingestion of
COPECs in Sediment and Fish
Wallops CDL

	Sediment EPC (mg/kg)	Fish Tissue Concentration (mg/kg)	Body Weight (kg)	Sediment Ingestion Rate (kg/d)	Sediment Ingestion Dose (mg/kg-day)	Food Ingestion Rate (kg/d)	Food Ingestion Dose (mg/kg-day)	Site Presence Index (SPI)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
Volatile Organic Compounds													
2-Butanone (MEK)	1.64E-01	---	2.20E+00	7.93E-03	5.90E-4	3.97E-01	0.00E+00	1	5.90E-4	---	---	---	---
Carbon disulfide	1.43E-02	---	2.20E+00	7.93E-03	5.14E-5	3.97E-01	0.00E+00	1	5.14E-5	---	---	---	---
Cyclohexane	1.82E-02	---	2.20E+00	7.93E-03	6.53E-5	3.97E-01	0.00E+00	1	6.53E-5	---	---	---	---
Methyl Acetate	5.86E-02	---	2.20E+00	7.93E-03	2.11E-4	3.97E-01	0.00E+00	1	2.11E-4	---	---	---	---
Semi-Volatile Organic Compounds													
Di-n-octyl phthalate	3.08E+00	---	2.20E+00	7.93E-03	1.11E-2	3.97E-01	0.00E+00	1	1.11E-2	---	---	---	---
bis(2-Ethylhexyl)phthalate	1.62E+02	---	2.20E+00	7.93E-03	5.83E-1	3.97E-01	0.00E+00	1	5.83E-1	1.10E+0	1.10E+1	1.30E-1	1.30E-2
Pesticides													
4,4'-DDD	6.50E-02	---	2.20E+00	7.93E-03	2.34E-4	3.97E-01	0.00E+00	1	2.34E-4	3.00E-3	2.80E-2	6.32E-4	1.28E-4
4,4'-DDE	1.49E-01	---	2.20E+00	7.93E-03	5.36E-4	3.97E-01	0.00E+00	1	5.36E-4	3.00E-3	2.80E-2	1.45E-3	2.93E-4
4,4'-DDT	1.08E-02	---	2.20E+00	7.93E-03	3.89E-5	3.97E-01	0.00E+00	1	3.89E-5	3.00E-3	2.80E-2	1.05E-4	2.12E-5
Inorganics													
Aluminum	1.99E+04	2.29E+00	2.20E+00	7.93E-03	7.16E+1	3.97E-01	4.12E-01	1	7.21E+1	4.45E+1	1.10E+2	1.62E+0	6.57E-1
Antimony	2.80E+00	---	2.20E+00	7.93E-03	1.01E-2	3.97E-01	0.00E+00	1	1.01E-2	---	---	---	---
Arsenic	1.37E+01	1.23E+00	2.20E+00	7.93E-03	4.93E-2	3.97E-01	2.21E-01	1	2.71E-1	5.10E+0	1.28E+1	5.31E-2	2.12E-2
Barium	5.32E+01	1.42E+01	2.20E+00	7.93E-03	1.92E-1	3.97E-01	2.55E+00	1	2.74E+0	2.08E+1	4.17E+1	1.32E-1	6.58E-2
Beryllium	5.81E-01	---	2.20E+00	7.93E-03	2.09E-3	3.97E-01	0.00E+00	1	2.09E-3	---	---	---	---
Cadmium	1.50E+00	---	2.20E+00	7.93E-03	5.40E-3	3.97E-01	0.00E+00	1	5.40E-3	1.45E+0	2.00E+1	3.72E-3	2.70E-4
Chromium	3.98E+01	3.80E-02	2.20E+00	7.93E-03	1.43E-1	3.97E-01	6.84E-03	1	1.50E-1	1.00E+0	5.00E+0	1.50E-1	3.01E-2
Copper	3.46E+01	3.48E+00	2.20E+00	7.93E-03	1.25E-1	3.97E-01	6.26E-01	1	7.51E-1	4.70E+1	6.17E+1	1.60E-2	1.22E-2
Iron	2.58E+04	7.17E-01	2.20E+00	7.93E-03	9.28E+1	3.97E-01	1.29E-01	1	9.29E+1	---	---	---	---
Lead	4.70E+01	3.60E-04	2.20E+00	7.93E-03	1.69E-1	3.97E-01	6.48E-05	1	1.69E-1	1.13E+0	1.13E+1	1.50E-1	1.50E-2
Mercury	3.03E-01	1.02E+00	2.20E+00	7.93E-03	1.09E-3	3.97E-01	1.83E-01	1	1.84E-1	4.50E-1	9.00E-1	4.09E-1	2.04E-1
Nickel	1.93E+01	2.26E-01	2.20E+00	7.93E-03	6.93E-2	3.97E-01	4.07E-02	1	1.10E-1	7.74E+1	1.07E+2	1.42E-3	1.03E-3
Selenium	1.75E+00	1.41E+00	2.20E+00	7.93E-03	6.31E-3	3.97E-01	2.53E-01	1	2.60E-1	5.00E-1	1.00E+0	5.19E-1	2.60E-1
Silver	1.50E+00	---	2.20E+00	7.93E-03	5.40E-3	3.97E-01	0.00E+00	1	5.40E-3	---	---	---	---
Thallium	2.23E-01	---	2.20E+00	7.93E-03	8.03E-4	3.97E-01	0.00E+00	1	8.03E-4	---	---	---	---
Vanadium	4.74E+01	---	2.20E+00	7.93E-03	1.71E-1	3.97E-01	0.00E+00	1	1.71E-1	1.14E+1	1.14E+2	1.50E-2	1.50E-3
Zinc	1.49E+02	---	2.20E+00	7.93E-03	5.37E-1	3.97E-01	0.00E+00	1	5.37E-1	1.45E+1	1.31E+2	3.70E-2	4.10E-3

Table G-5b.4
Exposures and HQs for River Otter Due to Ingestion of
COPECs in Sediment and Fish
Wallops CDL

	Sediment EPC (mg/kg)	Fish Tissue Concentration (mg/kg)	Body Weight (kg)	Sediment Ingestion Rate (kg/d)	Sediment Ingestion Dose (mg/kg-day)	Food Ingestion Rate (kg/d)	Food Ingestion Dose (mg/kg-day)	Site Presence Index (SPI)	Total Ingestion Dose (mg/kg-day)	Chronic NOAEL TRV (mg/kg-day)	LOAEL TRV (mg/kg-day)	NOAEL HQ	LOAEL HQ
Volatile Organic Compounds													
2-Butanone (MEK)	1.64E-01	---	6.73	1.80E-2	4.39E-4	9.00E-01	0.00E+00	1.46E-02	6.41E-6	8.10E+2	2.09E+3	7.91E-9	3.06E-9
Carbon disulfide	1.43E-02	---	6.73	1.80E-2	3.82E-5	9.00E-01	0.00E+00	1.46E-02	5.58E-7	---	---	---	---
Cyclohexane	1.82E-02	---	6.73	1.80E-2	4.85E-5	9.00E-01	0.00E+00	1.46E-02	7.09E-7	---	---	---	---
Methyl Acetate	5.86E-02	---	6.73	1.80E-2	1.57E-4	9.00E-01	0.00E+00	1.46E-02	2.29E-6	---	---	---	---
Semi-Volatile Organic Compounds													
Di-n-octyl phthalate	3.08E+00	---	6.73	1.80E-2	8.24E-3	9.00E-01	0.00E+00	1.46E-02	1.20E-4	---	---	---	---
bis(2-Ethylhexyl)phthalate	1.62E+02	---	6.73	1.80E-2	4.33E-1	9.00E-01	0.00E+00	1.46E-02	6.33E-3	4.50E+0	4.50E+1	1.41E-3	1.41E-4
Pesticides													
4,4'-DDD	6.50E-02	---	6.73	1.80E-2	1.74E-4	9.00E-01	0.00E+00	1.46E-02	2.54E-6	3.70E-1	1.83E+0	6.86E-6	1.39E-6
4,4'-DDE	1.49E-01	---	6.73	1.80E-2	3.99E-4	9.00E-01	0.00E+00	1.46E-02	5.82E-6	3.70E-1	1.83E+0	1.57E-5	3.18E-6
4,4'-DDT	1.08E-02	---	6.73	1.80E-2	2.89E-5	9.00E-01	0.00E+00	1.46E-02	4.22E-7	3.70E-1	1.83E+0	1.14E-6	2.31E-7
Inorganics													
Aluminum	1.99E+04	2.29E+00	6.73	1.80E-2	5.32E+1	9.00E-01	3.06E-1	1.46E-02	7.82E-1	4.78E-1	4.78E+0	1.64E+0	1.64E-1
Antimony	2.80E+00	---	6.73	1.80E-2	7.49E-3	9.00E-01	0.00E+00	1.46E-02	1.09E-4	3.10E-2	3.09E-1	3.53E-3	3.54E-4
Arsenic	1.37E+01	1.23E+00	6.73	1.80E-2	3.66E-2	9.00E-01	1.64E-1	1.46E-02	2.94E-3	3.10E-2	3.12E-1	9.48E-2	9.42E-3
Barium	5.32E+01	1.42E+01	6.73	1.80E-2	1.42E-1	9.00E-01	1.90E+0	1.46E-02	2.98E-2	2.50E+0	9.10E+0	1.19E-2	3.27E-3
Beryllium	5.81E-01	---	6.73	1.80E-2	1.55E-3	9.00E-01	0.00E+00	1.46E-02	2.27E-5	3.00E-1	3.00E+0	7.57E-5	7.57E-6
Cadmium	1.50E+00	---	6.73	1.80E-2	4.01E-3	9.00E-01	0.00E+00	1.46E-02	5.86E-5	4.41E-1	4.41E+0	1.33E-4	1.33E-5
Chromium	3.98E+01	3.80E-02	6.73	1.80E-2	1.07E-1	9.00E-01	5.08E-3	1.46E-02	1.63E-3	1.50E+0	6.01E+0	1.09E-3	2.71E-4
Copper	3.46E+01	3.48E+00	6.73	1.80E-2	9.25E-2	9.00E-01	4.65E-1	1.46E-02	8.15E-3	7.00E+0	9.20E+0	1.16E-3	8.86E-4
Iron	2.58E+04	7.17E-01	6.73	1.80E-2	6.89E+1	9.00E-01	9.59E-2	1.46E-02	1.01E+0	---	---	---	---
Lead	4.70E+01	3.60E-04	6.73	1.80E-2	1.26E-1	9.00E-01	4.81E-5	1.46E-02	1.84E-3	3.66E+0	3.66E+1	5.02E-4	5.02E-5
Mercury	3.03E-01	1.02E+00	6.73	1.80E-2	8.10E-4	9.00E-01	1.36E-1	1.46E-02	2.00E-3	5.90E-1	5.90E+0	3.39E-3	3.39E-4
Nickel	1.93E+01	2.26E-01	6.73	1.80E-2	5.15E-2	9.00E-01	3.02E-2	1.46E-02	1.19E-3	1.83E+1	3.66E+1	6.53E-5	3.26E-5
Selenium	1.75E+00	1.41E+00	6.73	1.80E-2	4.69E-3	9.00E-01	1.88E-1	1.46E-02	2.82E-3	9.10E-2	1.51E-1	3.10E-2	1.87E-2
Silver	1.50E+00	---	6.73	1.80E-2	4.01E-3	9.00E-01	0.00E+00	1.46E-02	5.86E-5	---	---	---	---
Thallium	2.23E-01	---	6.73	1.80E-2	5.96E-4	9.00E-01	0.00E+00	1.46E-02	8.71E-6	3.00E-3	3.40E-2	2.90E-3	2.56E-4
Vanadium	4.74E+01	---	6.73	1.80E-2	1.27E-1	9.00E-01	0.00E+00	1.46E-02	1.85E-3	8.90E-2	8.92E-1	2.08E-2	2.08E-3
Zinc	1.49E+02	---	6.73	1.80E-2	3.99E-1	9.00E-01	0.00E+00	1.46E-02	5.83E-3	7.32E+1	1.46E+2	7.96E-5	3.98E-5

Table G-5b.5
Summary of HQs for Aquatic Wildlife
Wallops CDL

	Aquatic Life	Aquatic Inverts	Great Blue Heron		River Otter	
	HQ	HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Volatile Organic Compounds						
2-Butanone (MEK)	NA	—	---	---	7.91E-09	3.06E-09
Carbon disulfide	NA	1.68E+01	—	---	---	---
Cyclohexane	NA	—	—	---	---	---
Methyl Acetate	NA	---	—	---	---	---
Semi-Volatile Organic Compounds						
Di-n-octyl phthalate	NA	—	---	---	---	—
bis(2-Ethylhexyl)phthalate	NA	8.90E+02	1.30E-01	1.30E-02	1.41E-03	1.41E-04
Pesticides						
4,4'-DDD	NA	1.33E+01	6.32E-04	1.28E-04	6.86E-06	1.39E-06
4,4'-DDE	NA	4.72E+01	1.45E-03	2.93E-04	1.57E-05	3.18E-06
4,4'-DDT	NA	2.60E+00	1.05E-04	2.12E-05	1.14E-06	2.31E-07
Inorganics						
Aluminum	9.74E-00	---	1.62E+00	6.57E-01	1.64E+00	1.64E-01
Antimony	NA	1.40E+00	---	—	3.53E-03	3.54E-04
Arsenic	3.00E-01	1.40E+00	5.31E-02	2.12E-02	9.48E-02	9.42E-03
Barium	5.60E+00	---	1.32E-01	6.58E-02	1.19E-02	3.27E-03
Beryllium	NA	---	---	---	7.57E-05	7.57E-06
Cadmium	NA	1.52E+00	3.72E-03	2.70E-04	1.33E-04	1.33E-05
Chromium	1.82E-01	9.18E-01	1.50E-01	3.01E-02	1.09E-03	2.71E-04
Copper	8.17E-01	1.09E+00	1.60E-02	1.22E-02	1.16E-03	8.86E-04
Iron	2.89E+00	1.29E+00	—	---	---	—
Lead	4.30E-01	1.31E+00	1.50E-01	1.50E-02	5.02E-04	5.02E-05
Mercury	1.18E-01	1.68E+00	4.09E-01	2.04E-01	3.39E-03	3.39E-04
Nickel	3.54E-01	8.48E-01	1.42E-03	1.03E-03	6.53E-05	3.26E-05
Selenium	2.18E+00	8.77E-01	5.19E-01	2.60E-01	3.10E-02	1.87E-02
Silver	NA	1.50E+00	---	---	---	—
Thallium	NA	---	---	---	2.90E-03	2.56E-04
Vanadium	NA	---	1.50E-02	1.50E-03	2.08E-02	2.08E-03
Zinc	NA	1.23E+00	3.70E-02	4.10E-03	7.96E-05	3.98E-05
Total VOCs	0.00E+00	9.07E+02	1.30E-01	1.30E-02	1.41E-03	1.41E-04
Total Pesticides	0.00E+00	6.31E+01	2.19E-03	4.42E-04	2.37E-05	4.80E-06