James Rifles at Fort Totten, 1865 (Source: Library of Congress Print and Photographs Division)

NPS Preliminary Assessment / Site Inspection Report

Area of Concern at Fort Totten

EDL Number 5NCR3343

Prepared by

The Johnson Company

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Revisions and Signatures

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Signatories:

______________________________ Tammy Stidham NPS Project Manager Chief of the Division of Planning, Compliance and Geographic Information Systems	______________________________ David Birney NPS Regional Environmental Point-of-Contact
______________________________ Date	______________________________ Date

By signing above, the signatories verify that they understand and concur with the information, procedures, and recommendations presented herein.

Executive Summary

This Preliminary Assessment/Site Inspection (PA/SI) was performed for an approximately 0.75-acre Area of Concern within Fort Totten Park in northeast Washington, DC. The Park is administered by NPS and managed by nearby NPS Rock Creek Park. The Site is an approximately 0.75-acre portion of the Park in and around a former staging area used by Washington Metropolitan Area Transit Authority (WMATA) during the early 1990s for staging during construction of the Greenbelt Line and Fort Totten Station. Prior to WMATA use, the area was used by NPS as a maintenance and storage area. At present, the Site is overgrown with dense, shrub-like vegetation. While the Park is open to the public and not fenced or gated, the Site is heavily vegetated and not currently used for any recreational or other purpose. Park workers may access the Site for short periods of time, but this area is not typically maintained by Park workers.

After WMATA completed its use of the staging area, the top layer of soil in the staging area was excavated and approximately 60 yards of uncompacted fill material was placed as part of landscape restoration. During placement of the fill material, workers complained of eye and respiratory irritation. The onsite NPS representative overseeing the soil replacement work reported chemical bottles, electrical transformer reservoirs of indeterminate age, and similar materials within the fill material. WMATA removed this fill material from the staging area but reports indicate that some of the fill material spilled down a wooded slope on the northwest corner of the Site and remained in place. The source for the fill material that was placed at the Site was a property determined to have been impacted by hazardous substances.

The PA determined that contaminants associated with the historically-imported fill material may be present in Site media. Possible contaminants included chemical warfare materials (CWM); explosives and related ions; metals; volatile and semi-volatile organic compounds (VOCs and SVOCs); polycyclic aromatic hydrocarbons (PAHs); polychlorinated biphenyls (PCBs); and pesticides/herbicides.

As part of a National Park, the Site is by definition a sensitive environment. Site soil was identified as a potential medium of concern for both human and ecological receptors through ingestion and inhalation routes of exposure. However, the limited scope of human activity and the vegetation present at the Site are likely to minimize exposure to human receptors not actively involved in soil disturbing activities. Because contaminants can migrate from soil to groundwater, groundwater beneath the Site also was identified as a medium of potential concern. No evidence of groundwater seeps or springs was observed on-Site during the PA, and no potable use of groundwater was identified in the area. However, a small stream downslope (northwest) of the former staging area was identified as a potential off-Site receptor for contaminants in Site soil through overland soil transport via surface water drainage from the Site and potentially local groundwater discharge.

The SI was performed between February and June 2018 to collect Site-specific data to determine if contaminants associated with historically-imported fill material are present at the Site at concentrations that exceed screening criteria. Samples of surface soil and sediment and subsurface soil were collected from the former staging area and adjacent areas. Samples of surface soil and sediment also were collected from reference locations where Site-related impacts were not expected to have occurred.

No CWM constituents, explosives, ions, PCB Aroclors, pesticides (silvex and chlordane), or VOCs were detected at concentrations that exceeded PA/SI screening levels in any of the samples collected for the SI. Only benzo(a)pyrene and metals were identified as present in Site samples at concentrations that exceeded PA/SI screening criteria and that were statistically significantly greater than mean

concentrations in reference area samples. Metals and PAHs also were both identified as analyte groups that may be naturally-occurring or present at the Site because of related anthropogenic impacts not related to the historically-imported fill. Based on the soil and sediment sample data results and analyses, no subsurface sediment sampling or groundwater sampling was performed.

A focused HHRA was performed using Site soil data to provide additional context for Park worker concerns regarding vegetation grubbing activities in the former staging area prior to Phase 1 sampling. The HHRA identified one PAH (benzo(a)pyrene) and six metals (aluminum, arsenic, cobalt, manganese, thallium, and zirconium) as constituents of potential concern (COPCs) in Site soil. The HHRA used the conservative assumption that both Park workers and visitors were exposed to COPCs in soil through dermal contact, incidental ingestion, and inhalation of fugitive dust. Due to the nature of the Site and lack of recreational opportunity or other use, the HHRA assumed that recreational users may be present at the Site for a total of 35 days per year and that park workers may be present for one day per week, 50 weeks per year, over the course of a 25-year occupational tenure. The latter exposure scenario is substantially more conservative than the short-term Park worker presence to clear vegetation prior to Phase 1 sampling.

The HHRA concluded that concentrations of COPCs in surface soil at the Fort Totten Site resulted in risks either at or below the NPS risk points of departure for the recreational user scenario and Park worker scenario. The maximum concentration of arsenic in subsurface soil samples from the former staging area, however, resulted in an estimated risk for the recreational visitor that slightly exceeded the NPS risk point of departure. Using the mean arsenic concentration of arsenic, however, decreased the risk estimate to the NPS point of departure and further study is not deemed to be warranted

Overall, the PA/SI findings are consistent with historical information that WMATA removed the potentially-contaminated fill material from the staging area and suggest that there are no persistent impacts from contaminated fill that may have remained in this area or on the ground surface in adjacent sloped areas. SI analytes present in Site media at concentrations that exceed the PA/SI screening criteria appear consistent with local reference levels. Thus, exceedances of the ecological screening criteria identified for this PA/SI appear to be a result of local rather than contaminated conditions and thus do not warrant assessment of ecological risk under CERCLA.

This PA/SI recommends that NPS no longer evaluate the need for further response action at this Site under CERCLA.

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List of Abbreviations and Acronyms

AUES	American University Experiment Station
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COPC	Contaminant of potential concern
COPEC	Contaminant of potential ecological concern
CSM	Conceptual Site Model
CWM	Chemical warfare materials
DC	District of Columbia
DU	Decision unit
EDL	Environmental and Disposal Liabilities
EPC	Exposure Point Concentration
ESV	Ecological Screening Level
FWS	United States Fish and Wildlife Service
HHRA	Human Health Risk Assessment
ILCR	Incremental Lifetime Cancer Risk
ISM	Incremental sampling methodology
ITRC	Interstate Technology Regulatory Council
JCO	The Johnson Company, Inc.
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
NOAA	National Oceanic and Atmospheric Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan (AKA, National Contingency Plan)
NPS	National Park Service
ORP	Oxidation-reduction potential
PA	Preliminary Assessment
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
QAPP	Quality Assurance Project Plan
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan

SI	Site Inspection
SLERA	Screening Level Ecological Risk Assessment
SVFUDS	Spring Valley Formerly Used Defense Site
SVOC	Semi-volatile organic compound
TCLP	Toxicity Characteristic Leaching Procedure
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
U.S.C	United States Code
USGS	United States Geological Survey
VOC	Volatile organic compound
WMATA	Washington Metropolitan Area Transit Authority

1 Introduction

This Preliminary Assessment and Site Inspection (PA and SI, or PA/SI) of the Area of Concern ("the Site") within Fort Totten Park ("the Park") in northeast Washington, District of Columbia (DC) was performed by The Johnson Company (JCO) under contract to the National Park Service (NPS) with assistance from Park staff. A PA, which includes a site reconnaissance visit, is performed to compile existing information about a site and its surrounding area to assess what contaminants are or could be present at the site, where or how those contaminants could be moving through the environment, and the ecological resources or human populations that might be threatened by a release of hazardous substances at the site. An SI provides additional information or Site-related data to support determination of whether or not a response action is necessary.

The Park, also known as Reservation 451, is located within the Civil War Defenses of Washington and is owned by the United States. The Park is administered by NPS and managed by nearby NPS Rock Creek Park. The Site is an approximately 0.75-acre Area of Concern within the Park. Information regarding the Site is maintained at the NPS National Capital Region office at 1100 Ohio Drive SW in Washington, DC. Chief of Planning, Compliance, and GIS, Tammy Stidham, may be contacted for information regarding the Site, and additional Site information is also provided in Section 2.

The PA was initiated in May 2017 using historical materials relevant to the Site operational history that were provided to JCO by NPS. A Site reconnaissance was performed on June 19, 2017 by JCO personnel Guy Vaillancourt, Bettina Longino, and Stephanie Hunt. JCO reconnaissance personnel were escorted to the Site by Chief of Resource Management for Rock Creek Park, Nick Bartolomeo. Based on the PA, JCO prepared a Sampling and Analysis Plan (SAP) for an SI to collect Site-specific data (JCO, 2018). The SI involved four field sampling events performed between February and June 2018.

Subsequent and in addition to the SI, NPS elected to have a focused Human Health Risk Assessment (HHRA) performed using the surface and subsurface soil data from the SI. During the SI, NPS was advised of Park worker concerns regarding their grubbing activities in the former staging area to clear dense vegetation prior to Phase 1 sampling. Comprehensive analysis of subsurface soil samples from the former staging area was performed during the SI in response to these concerns, and the focused HHRA was performed subsequent to the SI to provide additional context for Park workers.

This PA/SI Report summarizes the PA, describes the components and findings of the SI, and provides the conclusions of the focused HHRA. The report then presents the overall conclusions and recommendations of this PA/SI. This report is organized as follows:

- Section 1: Introduction
- Section 2: Site Description, Operational History, and Waste Characteristics
- Section 3: Exposure Pathway and Environmental Hazard Assessment
- Section 4: Site Inspection
- Section 5: Focused HHRA
- Section 6: Conclusions and Recommendations

- Section 7: References.

Supporting information is presented in the figures, tables, and appendices referenced in these sections.

1.1 CERCLA and NPS Authority

The NPS is authorized under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 United States Code (U.S.C.) Section 9601 et seq., to respond as the lead agency to a release or a threatened release of hazardous substances and/or a release or threatened release of any pollutant or contaminant that may present an imminent and substantial danger to public health or the environment on land under NPS management.

CERCLA's implementing regulations, codified in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300, establish the framework for responding to releases and threatened releases of hazardous substances. The NCP prescribes two response action processes for responding to releases: removal actions and remedial actions. Under either process, the initial step is to perform a PA (see NCP Sections 300.410 and 300.420).

The purpose of the PA is to collect readily available information about the site and its surrounding area to evaluate whether a release or potential release of hazardous substances, pollutants, or contaminants has occurred or could occur. The PA will also provide the basis for the NPS to determine whether conditions at the Site warrant further investigation or meet the NCP criteria for no further action determination (see NCP Sections 300.410 and 300.420). Evaluations are focused on past and present practices and processes related to the storage, use, and disposal of hazardous substances at the Site. Emphasis is placed on activities that routinely or non-routinely may have led to or may lead to releases of hazardous substances into the environment. The purpose of the SI is to collect Site-related data that will either: 1) eliminate a release from further consideration because the data indicate that Site conditions pose no significant threat to human health or the environment; or 2) determine that Site conditions warrant further investigation to better characterize the release through an Environmental Evaluation/Cost Analysis or Remedial Investigation/Feasibility Study (see NCP Sections 300.410 and 300.420).

The NPS has selected the combined PA/SI assessment as the path forward to determine if hazardous substances are present at the Fort Totten Site at concentrations that may pose a potential risk to human health or the environment. By combining PA and SI activities, the site assessment process is streamlined: the combined PA/SI assessment "integrates activities typically performed during the PA (information gathering, site reconnaissance) with activities typically performed during the SI (review of data, development of field work plan, field sampling, filling data gaps) to achieve one continuous site investigation" (United States Environmental Protection Agency [USEPA], 1999).

2 Site Description, Operational History, and Waste Characteristics

This section presents Site background information including a geographic description, Site geology and hydrogeology, local hydrology, local climate, and sensitive environments. This information was sourced primarily from NPS's Scope of Work for the PA/SI, publicly available geology and hydrogeology information for the area, and the Site reconnaissance conducted by JCO personnel on June 19, 2017. This section also provides information regarding locations where waste storage, handling, disposal, and deposition may have occurred based on historical materials relevant to the Site operational history that were provided to JCO by NPS.

2.1 Site Description

The Park is approximately 40.3 acres in size and is located in the Fort Totten neighborhood of northeast Washington, DC. The Park location is shown on Figure 1. The Park is bounded by Bates Road NE to the south, Gallatin Street NE and Farragut Street NE to the north, Fort Totten Drive NE to the west, and Farragut Street NE/Brookland Avenue NE to the east. Park topography is gently rolling and varies between approximately 350 and 200 feet above mean sea level.

The Site is an approximately 0.75-acre portion of the Park in and around a former staging area. The approximate Site boundary is delineated by the dashed black line and cross-hatching on Figure 2 and includes the "Former Staging Area" and adjacent areas. The Site is located approximately 500 feet east of the intersection of Fort Totten Drive NE and Farragut Street NE/Brookland Avenue NE along Farragut Street NE/Brookland Avenue NE. Community gardens are located approximately 200 feet northwest of the Site, and the Bridges Public Charter School is located approximately 380 feet west of the Site. The Site is currently overgrown with dense, shrub-like vegetation. Photographs taken during the Site reconnaissance on June 19, 2017 are provided in Appendix A.

The following information can be used to locate the Site:

- Site name: Fort Totten Area of Concern
- Site address: Farragut Street/Brookland Ave NE, Washington, DC 20011. The Site is approximately 500 feet from the Fort Totten Drive and Farragut Street intersection on Farragut Street/Brookland Ave NE.
- The Site Environmental and Disposal Liabilities (EDL) number is 5NCR3343.
- Coordinates: Longitude and latitude 38.952132 degrees north, 77.005707 degrees west.

2.1.1 Site Geology and Hydrogeology

No soil borings have previously been completed at the Site, nor has groundwater assessment been performed. Thus, this section presents general geologic and hydrogeologic information for the Site area.

The Site is located within the Atlantic Coastal Plain physiographic province, which is underlain by a wedge-shaped sequence of sandstones, clay beds, gravel deposits, and silts that increases in thickness from west to east. Sediments eroding from the Appalachian highland areas to the west formed the province (NPS, 2008). The Park is constructed on an elliptical hill about one-half mile long and one-quarter mile wide, and the summit is one of the highest spots in the District of Columbia. The top of the three layers of the hill is Pleistocene sedimentary material, which was deposited during melting of glaciers that formed wide flooding rivers in this area. A layer of fine-grained, brown, sea-washed Miocene sand underlays the Pleistocene formation. The bottom layer is Cretaceous Patuxent formation, which consists of a light, gray-white feldspathic and quartzitic sand, often variegated with roughly spherical bodies of grayish clay. The layer, being light gray, offers sharp contrast between the upper two brown layers (Broughton, 1964).

According to the Natural Resources Conservation Service (United States Department of Agriculture [USDA], 2016), soils in the vicinity of the Site include clayey and smoothed sandy Udorthents, Christiana silt loam, and Croom gravelly sandy loam. Udorthents are moderately well drained to excessively drained soils that have been disturbed by cutting or filling, or areas that are covered by buildings and pavement. The Christian silt loam is a moderately drained soil derived from clayey fluviomarine deposits, and the Croom gravelly sandy loam is a well-drained soil derived from gravelly fluvial deposits.

Local depth to groundwater and groundwater flow directions are uncertain; there are no on-Site wells to monitor water levels. No evidence of on-Site groundwater seeps or springs was observed during the PA or SI.

2.1.2 Site Hydrology

A small stream traverses the Site downslope (northwest) of the former staging area; the approximate stream channel location is shown on Figure 2. This small stream does not appear on area maps. The closest mapped stream or river feature is an unnamed tributary to the Northwest Branch of the Anacostia River located approximately 4,500 feet northeast of the Site in Hyattsville, Maryland.

The national wetlands inventory shows one wetland area near the Site. The closest wetland to the Site is located approximately 1,800 feet southwest of the Site and is a small (0.24 acre) freshwater pond labeled as “palustrine, unconsolidated bottom, permanently flooded, diked/impounded” (Unites States Fish and Wildlife Service [FWS], 2017).

2.1.3 Local Climate

The following climatological data is summarized from National Oceanic and Atmospheric Administration (NOAA) data for Sterling, Virginia (NOAA, 2016). Normal monthly precipitation ranges between 2.62 and 3.99 inches. The driest months are December through February, and the wettest are May through September. The average temperature highs and lows are between 36 and 80°F.

2.1.4 Sensitive Environments

As part of a National Park, the Site is by definition a sensitive environment. The small stream downslope of the former staging area is a potentially sensitive receptor. In addition, community gardens are located approximately 200 feet northwest of the Site, and the Bridges Public Charter School is located approximately 380 feet west of the Site.

2.2 Operational History

Park

Fort Totten was constructed in August 1861 and occupied a high point in advance of the Soldiers’ Home, President Lincoln’s summer home. The fort mounted 20 guns and mortars (NPS, 2016a). The Park was a Union Army defensive earthwork during the Civil War and was completed in 1863 as part of the Civil War Defenses of Washington. The Park is one of 68 enclosed forts and batteries that fortified Washington by 1864. Reportedly, as early as 1872 there were plans that called for creating a continuous thread of public parks surrounded the city where the defenses had once kept watch. A planning document issued by the McMillan Commission in 1902 detailed improving the DC parks, and linking the city’s Civil War fort-parks with a grand drive. The government acquired the Civil War defenses beginning in the 1920s to realize the plan set forth by the McMillan Commission.

Site

The Site is a former staging area used by Washington Metropolitan Area Transit Authority (WMATA) and the surrounding sloped area. The NPS issued a special use permit to WMATA in 1987 that allowed WMATA to use the area for staging during construction of the Greenbelt Line and Fort Totten Station. Prior to WMATA use, the area was used by NPS as a maintenance and storage area. Length of use and area-specific activities during this time are unknown. Historical aerial photographs of the Site and surrounding area from 1943 through 2011 are provided in Appendix B. The photographs show the former staging area as cleared through approximately the mid-1990s and then as increasingly vegetated. NPS has no information regarding other historical uses, contaminant releases, or import of fill material to the Site prior to WMATA use. The 1987 special use permit required WMATA to fully restore the area to "no less than pre-construction condition" to include the removal of all foreign material.

In accordance with the permit, WMATA prepared a restoration landscape plan, which specified that all Park lands used by WMATA will be restored to no less than the pre-construction condition (NPS, 1987). After WMATA had completed its use of the staging area, a WMATA contractor excavated petroleum products and other construction-related contaminants (i.e., construction impacts) from the top layer of soil in the staging area and arranged for the placement of fill material in the excavated area. In 1992, approximately 60 yards of uncompacted fill material was placed in the staging area as part of landscape restoration. During placement of the fill material, workers complained of eye and respiratory irritation. The onsite NPS Office of Land Use Coordination representative overseeing the soil replacement work reported chemical bottles, electrical transformer reservoirs of indeterminate age, and similar materials within the fill material. WMATA subsequently removed the fill material from the staging area but reports indicate that a portion of the fill material might have remained in place, located on a wooded slope area on the northwest corner of the Park. This area of concern is identified on Figure 2.

At a February 2014 meeting attended by NPS and WMATA representatives, WMATA provided NPS with records confirming that the source of the historically-imported fill material at the Fort Totten Site was from a property at 4825 Glenbrook Road N.W. ("Glenbrook Road property") within the Spring Valley Formerly Used Defense Site (SVFUDS), a property determined under CERCLA to be impacted by the release of hazardous substances that is currently undergoing remediation by the United States Army Corps of Engineers (USACE). The Glenbrook Road property was part of a larger area known as the American University Experiment Station (AUES), where the United States government researched and tested chemical agents, equipment, and munitions. Chemical warfare materials (CWM), including mustard and Lewisite agents, adamsite, irritants, and smokes were researched and developed at the experimental station. Based on historical records, AUES waste may have been disposed at the Glenbrook Road property (Parsons, 2011) and potentially transferred as fill to the former staging area.

2.3 Waste Characteristics

No environmental sampling had been conducted at the Site prior to the 2018 SI. However, USACE and others performed numerous investigations at the off-Site property from which the historically-imported fill material placed at the Site by WMATA was sourced (the Glenbrook Road property). In addition, two soil samples targeted to the area of the Glenbrook Road property where fill was sourced for the Site were collected around the time that fill activities were occurring at the Site.

No information is available regarding sampling techniques, specific sampling locations, or sample descriptions for the two soil samples targeted to the area where fill was sourced for the Site. The first sample was collected on May 9, 1992 and submitted for analysis of 11 volatile organic compounds (VOCs), 12 semi-volatile organic compounds (SVOCs), and 8 herbicides/pesticides. The sample was analyzed using the Toxicity Characteristic Leaching Procedure (TCLP), which is a soil sample extraction method for chemical analysis designed to determine the mobility of analytes present in liquid, solid, and multiphasic wastes to assess potential chemical mobility to groundwater. Results of these analyses are provided in Tables 1 through 3.

Following complaints of eye and respiratory irritation by workers at the fill source, a second fill sample ("representative of the material") was collected for analysis. The sample was collected on May 26, 1992 and submitted for analysis of expanded lists of VOCs and SVOCs, as well as organochlorine pesticides, total polychlorinated biphenyls (PCBs), herbicides (silvex and 2,4-dichlorophenoxyacetic acid), and eight metals. Analyses were performed using standard USEPA methods. Results of these analyses are provided in Tables 1 through 4. The sample was determined to contain the herbicide silvex, two VOCs (methylene chloride and toluene), and three metals (barium, chromium, and lead) at concentrations above laboratory reporting limits.

Results from other investigations performed between 1992 and 2010 at the Glenbrook Road property are summarized in the July 2011 *Remedial Investigation Report for 4825 Glenbrook Road* ("Glenbrook Road RI") prepared for USACE (Parsons, 2011).[1] The nature of contamination identified at the Glenbrook Road property included (USACE, 2011):

- Munitions, including munitions containing chemical agents such as sulfur mustard ("mustard");
- AUES related glassware, including glassware containing chemical agent; and
- Soil contaminated with arsenic, a residual product of the chemical agents tested at the AUES.

The following "possible contaminants of potential concern (COPCs)" in soil were established during the historical sampling activities at the Glenbrook Road property (Parsons, 2011): VOCs; SVOCs; metals; total cyanide; fluoride; iodine; perchlorate; explosives; and mustard, lewisite, and associated breakdown products (thiodiglycol, oxathiane, and dithiane).

These possible COPCs were chosen as the best indicators of potential AUES activities at the property. From the above list of possible COPCs, the Glenbrook Road RI ultimately identified six metals as COPCs in soil: aluminum, arsenic, cobalt, manganese, thallium, and vanadium. The RI also concluded that low to moderate potential risks existed at the property "for encountering containerized chemical warfare material, agent breakdown products and agent contaminated soil throughout the property due to widespread distribution of burial pit contents prior to USACE investigations" (USACE, 2011).

Fill material placed at the Site by WMATA was sourced from the Glenbrook Road property. Thus, any of the groups of possible COPCs identified for the Glenbrook Road property as indicators of potential AUES activities at the property could also be possible COPCs at the Fort Totten Site. "Widespread distribution of contaminants, especially AUES associated glassware" was noted at the Glenbrook Road property as "evidence the burial pit contents were redistributed across the site prior to the current investigations"

[1] More information on remedial investigation activities conducted within the overall SVFUDS area can also be found in the *Final Site-Wide Remedial Investigation Report* prepared by USACE (USACE, 2015).

(Parsons, 2011). Burial pit contents included containerized CWM, agent breakdown products, and agent-contaminated soil (Parsons, 2011). Neither the exact source location on the Glenbrook Road property nor the level of contamination of the historically-imported fill material placed at the Fort Totten Site are known. Thus, although the Glenbrook Road property RI ultimately selected only six metals as COPCs in soil, any of the groups of possible COPCs evaluated in the Glenbrook Road property RI as indicators of potential AUES activities at the property are also possible COPCs at the Fort Totten Site. Because silvex was detected in the 1992 fill sample and electrical transformer reservoirs of indeterminate age were observed during fill placement, herbicides and PCBs also are possible COPCs at the Fort Totten Site.

3 Exposure Pathway and Environmental Hazard Assessment

This section provides an evaluation of the potentially contaminated media and associated exposure pathways and sensitive environments that are known and/or suspected at the Site. An evaluation of the potential for a hazardous substance release to each media is also presented.

3.1 Soil

Contaminants associated with historically imported fill material may be present in Site soil.

3.1.1 Potential Receptors

The Civil War Defenses of Washington, of which Fort Totten is a component, acts as a corridor of forest and natural scenery as part of a comprehensive system of parks for recreation, preservation of substantial tracts of forests, and protection of source water in and around Washington, DC (NPS, 2016b). NPS employees may work at the Park for short periods of time, and the Park is open to the public and not fenced or gated.

The limited scope of human activity and the vegetation present at the Site are likely to minimize ingestion and inhalation routes of exposure to human receptors not actively involved in soil disturbing activities at the Site. Contaminants in soil also can present a potential risk to ecological receptors, particularly those that may ingest soil during normal feeding activities, such as small mammals and birds. Additionally, animals burrowing at the Site may redistribute contaminants in soil, changing their availability to other receptors such as birds or other mammals.

3.1.2 Potential Hazardous Substance Release

The history of fill placement and removal at the former staging area may have resulted in contaminated fill material remaining at or near the ground surface in the former staging area. Additionally, NPS records suggesting that some of the fill material may have spilled down a wooded slope on the northwest corner of the Site, which also may have resulted in contaminated fill material remaining at or near the ground surface in this area.

3.2 Groundwater

Because contaminants can migrate from soil to groundwater, groundwater beneath the Site is a medium of potential concern.

3.2.1 Potential Receptors/Groundwater Use

As stated previously, depth to groundwater and groundwater flow directions beneath the Site are uncertain. No evidence of groundwater seeps or springs was observed on-Site during the PA or SI, and no potable use of groundwater was identified in the area. However, based on local topography, a small stream that traverses the Site downslope (northwest) of the former staging area may be a local discharge area for shallow groundwater.

3.2.2 Potential Hazardous Substance Release

Soluble/leachable contaminants in Site soil have the potential to impact shallow (water table) Site groundwater. Site-related contaminants dissolved in groundwater have the potential to migrate toward potential off-Site targets/receptors.

3.3 Surface Water

Persistent contamination of surface water in the small stream downslope of the former staging area as a result of the historical fill activities is highly unlikely; however, stream sediment is a medium of potential concern.

3.3.1 Potential Receptors

The small stream that traverses the Site downslope (northwest) of the former staging area is a potentially sensitive receptor.

3.3.2 Potential Hazardous Substance Release

Sediment in the small stream has the potential to have been impacted by Site-related contaminants in Site soil through overland soil transport via surface water drainage from the Site and potentially local groundwater discharge.

3.4 Air

No evidence of bare or maintained areas was observed during the Site reconnaissance. Thus, exposure to Site-related contaminants in air is unlikely for human receptors not actively involved in soil disturbing activities at the Site

3.4.1 Potential Receptors

The Site is overgrown with dense, shrub-like vegetation and is not typically accessed by Park workers or the public. Thus, potential exposure to airborne Site contaminants is unlikely and would be limited to possible exposure by receptors actively involved in soil disturbing activities at the Site.

3.4.2 Potential Hazardous Substance Release

The potential exists for contaminants in Site soil to be disturbed and carried through the air during activities at the Site that cause soil disturbance.

3.5 Assessment Findings

Figure 3 provides a preliminary pictorial conceptual site model (CSM) based on the information summarized in Sections 3.1 through 3.4. Based on the PA, a release of hazardous substances, pollutants, or contaminants may have occurred at the Site as a result of historical fill-placement activities by WMATA. Possible COPC groups identified based on the findings of the PA are listed in Table 5. The media of concern and the operation(s) suspected of generating the contaminants also are listed in Table 5. Because no environmental sampling has been conducted at the Site to determine if contaminants associated with historically imported fill material are present in Site media and if there is the potential for off-Site migration of contamination, the PA found that measured concentrations of possible COPCs in Site media of potential concern were needed.

4 Site Inspection

The PA determined that an SI was needed to provide data to determine if contaminants associated with historically imported fill material are present at the Site at concentrations that exceed screening criteria.

The following data gaps were identified by the PA:

- No sampling has been conducted to assess whether contaminants associated with the fill material originating from the Glenbrook Road property are present in any remaining fill material at the Site;
- No sampling has been conducted to assess whether contaminants associated with the fill material originating from the Glenbrook Road property have impacted a potentially sensitive receptor (the small stream downslope of the former staging area).
- No sampling has been conducted to assess whether contaminants associated with the fill material originating from the Glenbrook Road property have impacted Site groundwater.

All possible COPC groups identified based on the findings of the PA (Table 5) were chosen as preliminary COPCs for the SI. Site media identified for SI sampling were:

- Surface soil (0-0.5 feet below ground surface [bgs]);
- Surface sediment (0-0.5 feet bgs);
- Subsurface soil (0.5-2 feet bgs), if warranted by the surface soil sampling results; and
- Groundwater, if warranted by the soil and sediment sampling results.

The SAP directed that follow-on phases of sampling would be performed based on the results of the surface soil and surface sediment sampling as follows:

- Subsurface soil would be sampled for analysis of constituents that exceed project screening criteria and background/reference concentrations in surface soil samples;
- Subsurface sediment would be sampled for analysis of constituents that exceeded background/reference concentrations in surface sediment samples; and
- Groundwater would be sampled if lines of evidence such as elevated concentrations of soluble/leachable COPCs in subsurface soil, elevated concentrations of Site-related COPCs in sediment, and evidence of waste associated with historically-imported fill material were observed during the initial phase of sampling.

The phased field sampling scope completed for the SI is summarized in Section 4.1. The screening criteria established for the SI are discussed in Section 4.2. The SI analytical results are discussed in Section 4.3, and the SI findings are summarized in Section 4.4.

4.1 Scope

This section summarizes the phased scope of the SI field sampling; additional detail is available in the SAP (JCO, 2018). Decision Units (DUs) for surface and subsurface soil and surface sediment sampling identified for the SI are shown on Figure 4; discrete sampling locations for the SI are shown on Figure 4.

The DUs for surface and subsurface soil were identified based on historical Site use by WMATA and focused on areas where historically imported fill material was placed or believed to have come to be located. The former staging area was identified as one DU (SA-01), and the larger area downslope of the former staging area was split into two DUs (SA-02 and SA-03). In addition, one reference DU (SA-R) for soil was identified across Farragut Street from the three Site DUs; Site-related impacts are not expected to have occurred in this location because the area was not part of WMATA's 1987 Special Use Permit and no impact to the area was noted during fill placement activities.

The potential for Site-related COPCs to migrate from the Area of Concern to the small stream northwest of the former staging area was considered in defining the sediment DU. In this linear surface water feature, one sediment DU was identified proximate to the Area of Concern (SD-01). In addition, one reference DU of similar length was identified at an upstream location with a similar sediment type but where Site impacts are unlikely to have occurred (SD-R).

The SI sampling was performed in four phases:

Phase 1: An initial phase of sampling was performed on February 5, 2018 to collect discrete surface soil and surface sediment samples for CWM analysis:

- Three surface soil samples from the former staging area (locations CS-01 through CS-03 on Figure 5);
- Three surface soil samples from the adjacent downhill area to the northwest (locations CS-04 through CS-06 on Figure 5);
- Three surface soil samples from the adjacent downhill area to the north and northeast (locations CS-07 through CS-09 on Figure 5); and
- Three surface sediment samples from the stream northwest of the former staging area (locations CD-01 through CD-03 on Figure 5).

These discrete samples were collected in an initial mobilization because the analytical laboratory would not process incremental sampling methodology (ISM) samples containing CWM[2].

Phase 2: Following receipt of non-detect/not present results for CWM in all of the surface soil and sediment samples collected in Phase 1, a second phase of sampling was performed February 20-22, 2018 to collect the remaining planned surface soil and surface sediment samples:

[2] ISM was originally developed and applied to surface soil applications for non-volatile analyses, and ISM sample processing requires air drying of the sample. Laboratories that process ISM samples are not typically set up to air dry the large sample volumes in a fume hood, and some CWM are volatile; thus, discrete samples were collected for analysis of CWM to eliminate potential ISM processing bias and laboratory worker air exposure.

- surface soil from the former staging area and adjacent downhill areas to the northeast and northwest (ISM samples from DUs SA-01, SA-02, and SA-03, respectively, on Figure 4; and additional discrete samples from locations CS-01 through CS-09 on Figure 5);
- surface soil from a reference area (ISM samples from DU SA-R on Figure 4; and discrete samples from locations CS-R-01 through CS-R-03 on Figure 5);
- surface sediment from the stream northwest of the former staging area (ISM samples from DU SD-01 on Figure 4; and additional discrete samples from locations CD-01 through CD-03 on Figure 5); and
- surface sediment from a reference area (ISM samples from DU SD-R on Figure 4; and discrete samples from locations CD-R-01 through CD-R-03 on Figure 5).

During planning for the Phase 2 sampling, NPS learned of Park worker concerns regarding their vegetation grubbing activities in the former staging area prior to Phase 1 sampling. In response to these concerns, NPS elected to proactively collect subsurface soil samples from the former staging area irrespective of the surface soil results. As a first step of this sampling, discrete subsurface soil samples were collected during Phase 2 for laboratory analysis of CWM (locations CB-01 through CB-03 on Figure 5).

Phase 3: Following receipt of non-detect/not present results for CWM in the subsurface soil samples collected in Phase 2, a third phase of sampling was performed March 7-8, 2018 to collect subsurface ISM samples from the former staging area:

- subsurface soil from the former staging area (ISM samples from DU SB-01 on Figure 4; and additional discrete samples from locations CB-01 through CB-03 on Figure 5).

During this mobilization, all three ISM replicates samples from DU SA-01 were recollected to correct a sampling deviation during Phase 2, and one ISM replicate sample from each of SA-02, SA-03, and SA-R was recollected to replace Phase 2 samples that had been damaged in transit to the laboratory.

Phase 4: After receiving and evaluating the full data set from Phase 2, a third phase of sampling was performed June 25-27, 2018 to collect subsurface soil samples from the two DUs adjacent to the former staging area:

- subsurface soil from the adjacent downhill area to the north and northeast (ISM samples from DU SB-02 on Figure 4; and additional discrete samples from locations CS-SB02 and CB-07 through CB-09 on Figure 5); and
- subsurface soil from the adjacent downhill area to the northwest (ISM samples from DU SB-03 on Figure 4; and additional discrete samples from locations CS-SB03 and CB-04 through CB-06 on Figure 5).

Based on the Phase 2 data, the soil samples collected in Phase 4 were analyzed for a substantially reduced list of constituents compared to the analytical program for prior phases.

Because the data collected in Phases 1 through 4 did not indicate the potential for contamination of deeper soil or sediment, or a likelihood of impact to Site groundwater that would pose a potential risk to human health or the environment, no subsurface sediment sampling or groundwater sampling was needed to complete the approved SAP for the SI.

Soil and sediment samples for most analytes were collected using ISM. Each single ISM sample was composed of 30 approximately equal volume increments collected across the DU using a systematic random approach (Interstate Technology Regulatory Council [ITRC], 2012), and three replicate ISM samples (i.e., three samples composed of 30 approximately equal volume increments) were collected from each DU. Sampling and analysis procedures are fully described in the SAP and associated Quality Assurance Project Plan (QAPP) (JCO, 2018).

Discrete samples were collected for the analysis of methylmercury and oxidation-reduction potential (ORP)[3] because ISM laboratory processing could bias these results. Discrete sampling locations within each DU are shown on Figure 5.

Samples from the two reference DUs were collected from 0 to 0.5 feet bgs and analyzed only for those COPC groups that have the potential to be present in soil/sediment because they are naturally-occurring (i.e., metals) or as a consequence of non-Site-related anthropogenic influences ubiquitous in an urban environment (i.e., lead, polycyclic aromatic hydrocarbons [PAHs])

Site samples (i.e., samples from non-reference DUs) were analyzed for the each of the COPC groups listed in Table 5, with the following exceptions:

- Surface soil and surface sediment samples were not analyzed for VOCs because VOCs that may have been present in historically-imported fill material would not be expected to persist in surface soil or surface sediment.
- The analytical laboratory was unable to report the phenyl isocyanate and iodine pentafluoride as iodate; these COPCs were not on the analyte list for the SI.
- Phase 2 surface soil results for the two DUs adjacent to the former staging area (SB-02 and SB-03) were evaluated prior to performing subsurface sampling in these areas. The analyte list for the subsurface soil samples collected from these two DUs was substantially reduced as a result.

4.2 Screening Criteria

Screening criteria were established for each SI analyte in each sampled medium. When screening levels were available from multiple sources, the lowest value was used in the screening process. For example, if a USEPA Regional Screening Level (RSL) was lower than an NPS Environmental Screening Value (ESV) for soil, the RSL was used in preference to the ESV.

- Soil:
  - Human health:
    - USEPA RSLs for Residential Soil, target cancer risk of 1E-06 and target hazard quotients of 0.1 (USEPA, 2017).
  - Ecological:
    - NPS ESVs for Soil - Screening Level Ecological Risk Assessment (SLERA) Contaminant of Potential Ecological Concern (COPEC) Selection ESV, lowest ESV from Table 5: Soil ESVs for Plants and Soil Invertebrates and Table 6: Soil ESVs for Wildlife (Birds and Mammals) (NPS, 2016c). This document reviews candidate sources for ecological screening levels and selects the most appropriate ESVs.
- Sediment:

[3] ORP data were collected to support evaluation of metals data.

- Human health:
  - USEPA RSLs for Residential Soil, target cancer risk of 1E-06 and target hazard quotients of 0.1 (USEPA, 2017).
- Ecological:
  - NPS ESVs for Sediment - SLERA COPEC Selection ESV, lowest ESV from Table 3: Sediment ESVs for Aquatic Invertebrates (Freshwater) (NPS, 2016c).

Screening criteria are provided in Table 6 (surface soil), Table 7 (surface sediment), and Table 8 (subsurface soil).

4.3 Data Results and Analysis

Samples were analyzed as described in the QAPP (JCO, 2018). Samples for CWM analytes were analyzed by Edgewood Chemical Biological Center; samples for other analytes were analyzed by TestAmerica, Inc. Analytical data results are summarized in Table 6 (surface soil), Table 7 (surface sediment), and Table 8 (subsurface soil). Analytical data reports are provided in Appendix C, and analytical data validation reports prepared by ddms, Inc. are provided in Appendix D.

4.3.1 Surface Soil

All CWM constituents, PCB Aroclors, explosives and ions, herbicides (silvex and chlordane), and eight metals (antimony, beryllium, hexavalent chromium, silver, strontium, tellurium, tin, and titanium), were either not detected above laboratory reporting limits or did not exceed screening criteria in any surface soil samples at any Site DU. And, in general, the highest concentrations of metals and PAHs were in samples from the "downhill" DUs (SA-02 and SA-03) rather than the former staging area (SA-01). This finding is consistent with historical reports that the WMATA-imported fill was removed from this area following worker complaints during fill handling. Additionally, the findings at the "downhill" DUs indicate that any adverse impacts that may have occurred as a result of contaminated fill material remaining at or near the ground surface in these areas do not persist.

The remaining metals analytes (including methylmercury), one PAH (benzo(a)pyrene), one SVOC (bis(2-ethylhexyl)phthalate), and the pesticide 4,4'-DDT and its breakdown products (4,4'-DDD and 4,4'-DDE) were detected in Site surface soil samples at concentrations that exceeded PA/SI screening criteria. Consistent with the objectives laid out in the PA/SI SAP, hypothesis testing was performed to evaluate whether concentrations of these analytes were elevated relative to local reference conditions. The data analysis report is provided in Appendix E. An "alpha", or p-value, of 0.1 was used as the threshold for rejecting the null hypothesis.[4] Rejection of the null hypothesis indicated that the constituent concentration in the Site DU was determined to be statistically significantly greater than the constituent concentration in the reference area DU.[5] Because multiple comparisons were made between the reference location and the

[4] The results (p-values) of the hypothesis tests (t-tests) are tabulated in the Fort Totten Park Data Analysis Memorandum provided in Appendix E.

[5] The term "significantly greater" is used herein to describe any statistically meaningful difference in concentrations and is not indicative of the magnitude of that difference.

three separate Site DUs, a Bonferroni correction (Helsel, 2012) was applied to the results order to adjust for the inflated Type I error rate.

For the metals cyanide, selenium, and vanadium, mean reference area concentrations (SA-R samples) exceeded mean concentrations at all of the Site DUs (SA-01, SA-02, and SA-03); and for arsenic and lead, mean concentrations at each of the Site DUs were higher than in the reference area, but the differences were not statistically significant. Thus, reported concentrations of these five metals in Site surface soil are likely naturally occurring.

The data analysis identified aluminum, chromium, and thallium concentrations as statistically significantly greater in former staging area (SA-01) samples than in reference area samples (SA-R). The following metals were identified as present at statistically significantly greater concentrations in samples from one or both of the downhill DUs (SA-02 and SA-03) than in reference area samples (SA-R): aluminum, barium, cadmium, chromium, cobalt, copper, manganese, methylmercury, nickel, thallium, zinc, and zirconium.

The only PAH that exceeded the PA/SI screening criterion in Site samples was benzo(a)pyrene, and this constituent also exceeded the screening level in the reference location. Only the mean concentration of benzo(a)pyrene in samples from DU SA-03 (0.483 milligrams per kilogram [mg/kg]) was significantly greater than the mean concentration in reference samples (0.203 mg/kg). Overall, the data suggest that the presence of benzo(a)pyrene in Site samples is consistent with urban background conditions. Benzo(a) pyrene is released from anthropogenic combustion sources including vehicle exhaust and wood and coal burning.

Pesticides/herbicides were only detected in samples from the downhill DUs (SA-02 and SA-03) and the reference DU (SA-R), and the difference in magnitude between the Site and reference concentrations was marginal, suggesting their presence also is consistent with urban background conditions.

4.3.2 Surface Sediment

All CWM constituents, PCB Aroclors, explosives and ions, herbicides (silvex and chlordane), and most SVOCs and metals (including methylmercury) were either not detected above laboratory reporting limits or did not exceed screening criteria in any surface sediment samples. Only five metals (arsenic, lead, nickel, thallium, and zirconium), PAHs, and 4,4-DDT and its breakdown products were detected at concentrations exceeding their PA/SI screening criteria in surface sediment samples from SD-01. All of the analytes that exceeded PA/SI screening criteria in SD-01 sediment samples also exceeded PA/SI screening criteria in the sediment reference samples.

Similar to surface soil, hypothesis testing was performed to evaluate whether detected concentrations of analytes that exceeded PA/SI screening criteria were elevated relative to local reference sediment conditions. The analysis report is provided in Appendix E. For each metal and PAH that exceeded PA/SI criteria, the mean concentration of that metal or PAH in the reference (SD-R) samples exceeded the mean concentration in the Site (SD-01) samples. Thus, metals and PAHs detected in SD-01 sediment samples do not appear to be Site-related.

4,4’-DDT and 4,4’-DDD were detected in SD-01 samples at concentrations exceeding PA/SI screening level; however, concentrations of these pesticides in the reference (SD-R) samples exceeded the SD-01 concentrations. 4,4’-DDE concentrations in SD-01 samples also exceeded PA/SI screening levels, and the mean concentration of this pesticide in SD-01 samples (0.007 mg/kg) was statistically significantly greater, although only slightly higher, than the mean reference sample concentration (0.005 mg/kg). The analysis suggests that the presence of these constituents is consistent with urban background conditions, consistent with the conclusion for Site surface soil.

Based on the surface sediment data results and analysis, it did not appear that the fill material adversely impacted sediment in the stream downslope (northwest) of the former staging area; thus, deeper sediment sampling was deemed unnecessary for the SI.

4.3.3 Subsurface Soil

As described in Section 4.1, subsurface soil samples were collected from the former staging area to specifically address Park worker concerns regarding their subsurface intrusive activities within that area. These samples (SB-01 sample IDs in Table 8) were collected expeditiously and before results were available for surface samples from this area and thus were analyzed for the full suite of preliminary COPC groups identified for the SI. Following receipt of surface sample results for the two DUs adjacent to the former staging area, subsurface soil samples also were collected from both of these DUs (SB-02 and SB-03 sample IDs in Table 8) to complete the PA/SI scope. Based on the surface soil sample results for these DUs, subsurface soil samples from these DUs were analyzed for a substantially reduced list of constituents (metals and PAHs).

All CWM constituents, PCB Aroclors, explosives and ions, herbicides (silvex and chlordane), pesticides, VOCs, and SVOCs (including PAHs) were either not detected above laboratory reporting limits or did not exceed PA/SI screening criteria in any subsurface surface soil samples from the former staging area (SB-01). Metals were the only constituents detected above PA/SI screening concentrations in these subsurface soil samples. This finding is consistent with historical reports that the WMATA-imported fill was removed from the former staging area.

In addition to metals, a single PAH (benzo(a)pyrene) was detected above PA/SI screening concentrations in the subsurface soil samples collected from the other two Site DUs. The subsurface soil findings at the “downhill” DUs indicate that any adverse impacts that may have occurred as a result of contaminated fill material remaining at or near the ground surface in these areas do not persist.

Hypothesis testing identified the following eight metals detected above PA/SI screening concentrations in one or more subsurface samples from the former staging area (SB-01) as also present at statistically significantly higher concentrations than in reference area samples (SA-R): aluminum, arsenic, chromium, cobalt, lead, nickel, selenium, and thallium.

Based on the surface and subsurface soil data results and analysis, any adverse impacts to Site soil that may have occurred as a result of historical placement of contaminated fill did not appear to have persisted at the Site; thus, groundwater sampling was deemed unnecessary for the SI.

4.4 Findings

No CWM, explosives, PCBs, silvex, chlordane, fluoride, perchlorate, SVOCs other than bis(2-ethylhexyl)phthalate, or VOCs were detected at concentrations that exceeded PA/SI screening levels in any of the samples collected for the SI. Of all the possible COPC groups identified by the PA for additional investigation, only metals, PAHs, one SVOC (bis(2-ethylhexyl)phthalate), and 4,4’-DDT and its degradation products were detected at concentrations that exceeded PA/SI screening criteria.

Subsequent hypothesis testing identified only benzo(a)pyrene and metals as present in Site soil samples at concentrations statistically significantly greater than mean concentrations in reference area samples. It should be noted that metals and PAHs were both identified in the SAP as analyte groups that may be naturally-occurring or present at the Site because of related anthropogenic impacts not related to the historically-imported fill.

However, in response to NPS worker concerns, an HHRA was performed using the Site soil data collected during the SI to provide additional context for Park workers. The findings of this HHRA are presented in Section 5; the HHRA is provided as Appendix E.

5 Focused HHRA

Subsequent to the SI, NPS elected to have a focused HHRA performed using the surface and subsurface soil data from the SI to provide additional context for Park worker concerns regarding vegetation grubbing activities in the former staging area prior to Phase 1 sampling.

The focused HHRA was performed by JCO subcontractor Woodard & Curran in accordance with the general procedures described in the Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (USEPA, 1989), as well as other EPA risk assessment guidance documents. The HHRA included four steps:

- hazard identification, which evaluated the available environmental data and selected COPCs to be evaluated in the HHRA;
- exposure assessment, which identified who is exposed, how they are exposed, and the amount and intensity of exposure;
- dose-response assessment, which identified toxicological information for the COPCs, and
- risk characterization, which presented a numerical estimate of hazard or risk to human health.

In addition, the HHRA included an uncertainty analysis, which identified the nature, direction and, when possible, the magnitude of the uncertainty associated with the HHRA.

The maximum detected concentration among the individual replicates across the three DUs was compared to the USEPA RSL for Residential Soil (USEPA, 2017) to identify the COPCs to be evaluated. This analysis included the six metals (aluminum, arsenic, cobalt, manganese, thallium, and vanadium) ultimately identified by the Glenbrook Road RI as COPCs in soil at that property. Only benzo(a)pyrene and five metals (arsenic, cobalt, manganese, thallium, zirconium) were identified as COPCs in surface soil for the Fort Totten HHRA. These same constituents plus aluminum were identified as COPCs in subsurface soil for the Fort Totten HHRA.

Exposure Point Concentrations (EPCs) were calculated for these COPCs based on the assumption that park workers or visitors have the potential to be exposed to surface or subsurface soils within any portion of the Site. To calculate each EPC, replicates from all Site DUs were pooled together to generate a 95^{th} percentile concentration, calculated using the USEPA ProUCL program (Version 5.1.002).

As part of the HHRA, potential human receptor and exposure pathway scenarios were identified for assessment. While the Site is within a park, the Site itself is a heavily vegetated parcel that is not used for any recreational or other purpose, and exposures to soils in this area are expected to be generally minimal. However, access to the Site is unrestricted, and therefore, the potential exists that park visitors and maintenance workers (or other park staff) may occasionally visit the Site. Overall, the types of activities that are expected to occur at the Site are passive in nature, meaning that visitors or workers would have relatively little contact with site soils. There are no playgrounds or picnic areas, and dense vegetation limits access to much of the Site. Other areas within Park provide greater opportunity for local visitors to engage in active recreational pursuits. This area is not typically maintained by park workers. To be conservative, Park workers and visitors were assumed to be potentially exposed to COPCs in soil through dermal contact, incidental ingestion, and inhalation of fugitive dust.

The exposure assumptions used for the HHRA were:

- a recreational user may be present at the Site one day per week for up to eight months of the year (warmer months when a visitor is more likely to be outside), for a total of 35 days per year. Risks were calculated for a young child and adult, assuming a total 26-year exposure duration (the EPA default exposure duration for residents), assuming that neighborhood residents may access the area during their residential tenure.
- a Park worker be at the Site for one day per week, 50 weeks per year, over the course of a 25-year occupational tenure (the EPA default exposure duration).

The Park worker exposure assumption for the HHRA is substantially more conservative (i.e., greater assumed exposure duration) than the potential short-term exposure by Park workers performing grubbing activities (a maximum of 11 hours over three days, with a maximum of six hours in any single day) in the former staging area prior to the Phase 1 sampling.

The HHRA concluded that the estimated exposure to concentrations of COPCs in surface soils at the Site resulted in risks either at or below the NPS risk points of departure for both the recreational user scenario and the Park worker scenarios.

Only the exposure assumptions for a recreational user exposed to subsurface soil resulted in a calculated Incremental Lifetime Cancer Risk (ILCR) above the NPS risk point of departure, and that was for a single compound: arsenic. Concentrations of arsenic in subsurface soil samples from the former staging area resulted in a calculated ILCR for the recreational user of 2E-06, which slightly exceeds the NPS risk point of departure of 1E-06. This calculation was based on the calculated EPC for arsenic of 26.2 mg/kg, which is approximately one third greater than the maximum detected arsenic concentration in subsurface soil samples of 19 mg/kg. Using the maximum detected concentration of arsenic in subsurface soil samples as the EPC would result in an ILCR of 1.6E-06; and using the average detected arsenic concentration in subsurface soil samples of 14 mg/kg as the EPC would further decrease the ILCR to 1E-06, which is the NPS point of departure. It is important to stress that an ILCR is not a measure of actual risk; instead, this number is used to estimate the likelihood of risk and whether further action may be warranted at the Site.

6 Conclusions and Recommendations

The PA determined that contaminants associated with historically imported fill material may be present in Site media. As such, a SI was required. The SI was performed in four phases to collect Site-specific data to determine if contaminants associated with historically imported fill material are present at the Site at concentrations that exceed screening criteria. Samples of surface soil and sediment and subsurface soil were collected from the former staging area and adjacent areas. Samples of surface soil and sediment also were collected from reference locations where Site-related impacts were not expected to have occurred. Based on the soil and sediment sample data results and analyses, no subsurface sediment sampling or groundwater sampling was determined to be needed .

Only benzo(a)pyrene and metals (aluminum, barium, cadmium, chromium, cobalt, copper, manganese, methylmercury, nickel, thallium, zinc, zirconium) were identified as present in Site soil samples at concentrations that exceeded PA/SI screening criteria and that were statistically significantly greater than mean concentrations in reference area samples. All of the analytes that exceeded PA/SI screening criteria in Site sediment samples also exceeded PA/SI screening criteria in the sediment reference samples and thus did not appear to be Site-related.

A focused HHRA was performed for Site soil data from the SI to provide additional context for Park worker concerns regarding grubbing activities in the former staging area prior to Phase 1 sampling. Benzo(a)pyrene and five metals (arsenic, cobalt, manganese, thallium, zirconium) were identified as COPCs in surface soil; these same COPCs and aluminum were identified as a COPCs in subsurface soil. The HHRA used the conservative assumption that both Park workers and visitors were exposed to COPCs in soil through dermal contact, incidental ingestion, and inhalation of fugitive dust. This assumed exposure duration for the Park worker scenario was substantially more conservative (i.e., longer) than the short-term duration of vegetation grubbing activities in the former staging area prior to Phase 1 sampling.

The HHRA concluded that the estimated exposure to concentrations of COPCs in surface soils at the Fort Totten Site resulted in risks either at or below the NPS risk points of departure for the recreational user scenario and park worker scenario. The maximum concentrations of arsenic in subsurface soil samples from the former staging area, however, resulted in an ILCR for the recreational visitor that slightly exceeded the NPS risk point of departure. Using the average concentration as the EPC, however, decreased the ILCR to the NPS point of departure.

Overall, the PA/SI findings suggest that the impacted fill was removed from the former staging area. SI analytes are present in Site soil at concentrations that exceed PA/SI screening criteria; however, their presence and reported concentrations appear consistent with local reference levels. The SI data also does not indicate any persistence of contaminants that may have been associated with impacted fill on the sloped area around the perimeter of the staging area or the sediment in the small stream downslope (northwest) of the former staging area.

A definitive conclusion cannot be made at this time regarding whether the arsenic concentrations detected in subsurface samples from the former staging area are naturally-occurring. However, the observation that PAH concentrations are lower in subsurface soil in the staging area than in the other two DUs and the historical information that WMATA removed the potentially-contaminated fill material from the staging area suggest that any contamination that may have occurred at the Site from fill placed by WMATA does not persist. Because the mean arsenic concentration in the subsurface soil samples did not indicate an ILCR over 1E-06, further study is not warranted. Additionally, exceedances of the ecological screening criteria identified for this PA/SI appear to be a result of local conditions and thus do not warrant assessment of ecological risk under CERCLA.

Thus, this PA/SI recommends that NPS no longer evaluate the need for further response action at this Site under CERCLA.

7 References

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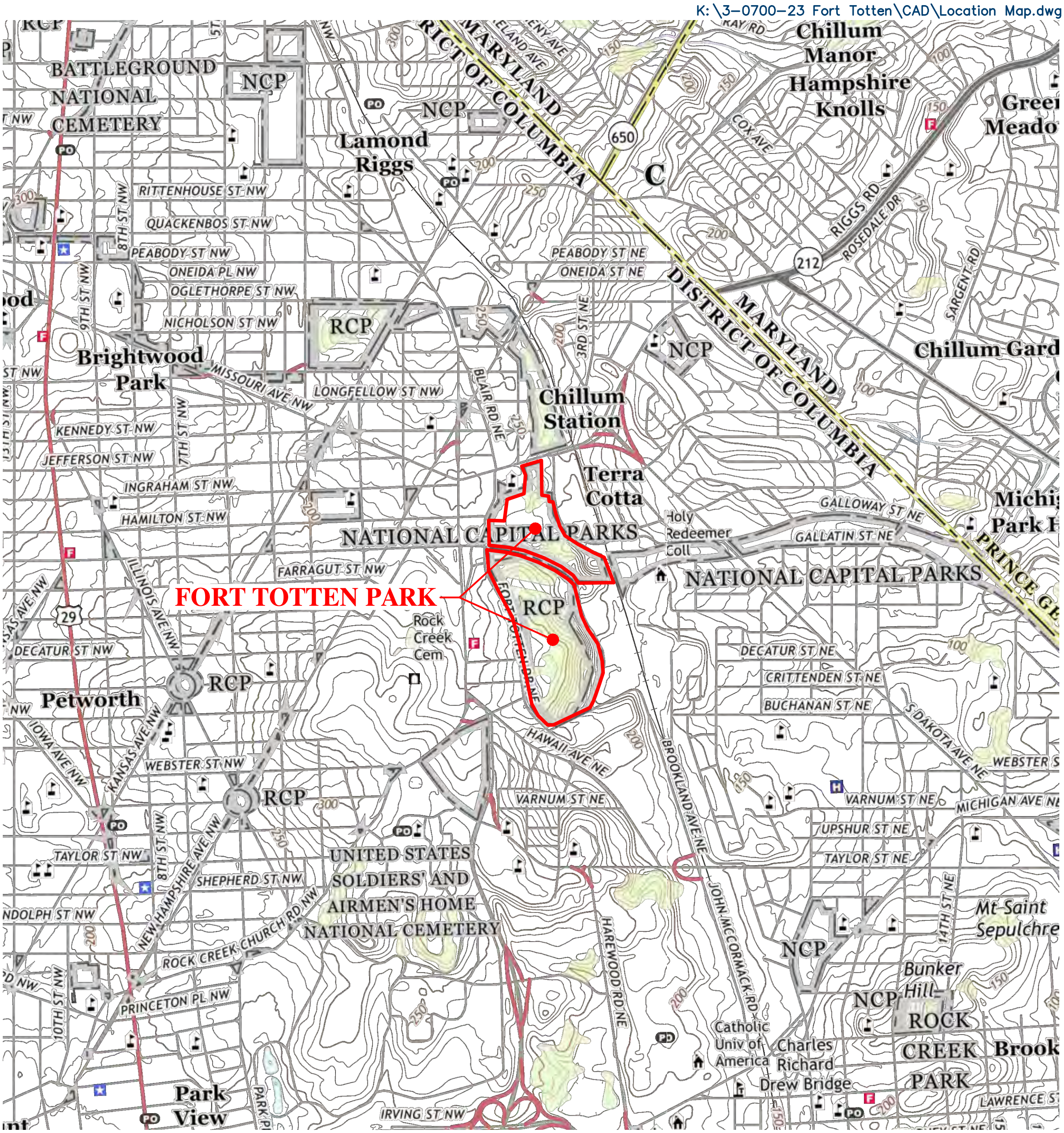
Figures

K:\3-0700-23 Fort Totten\CAD\Location Map.dwg



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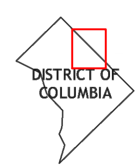
MILES

1000 0 1000 2000 3000 4000 5000 6000 7000
FEET

CONTOUR INTERVAL 10 FEET



GENERAL LOCATION

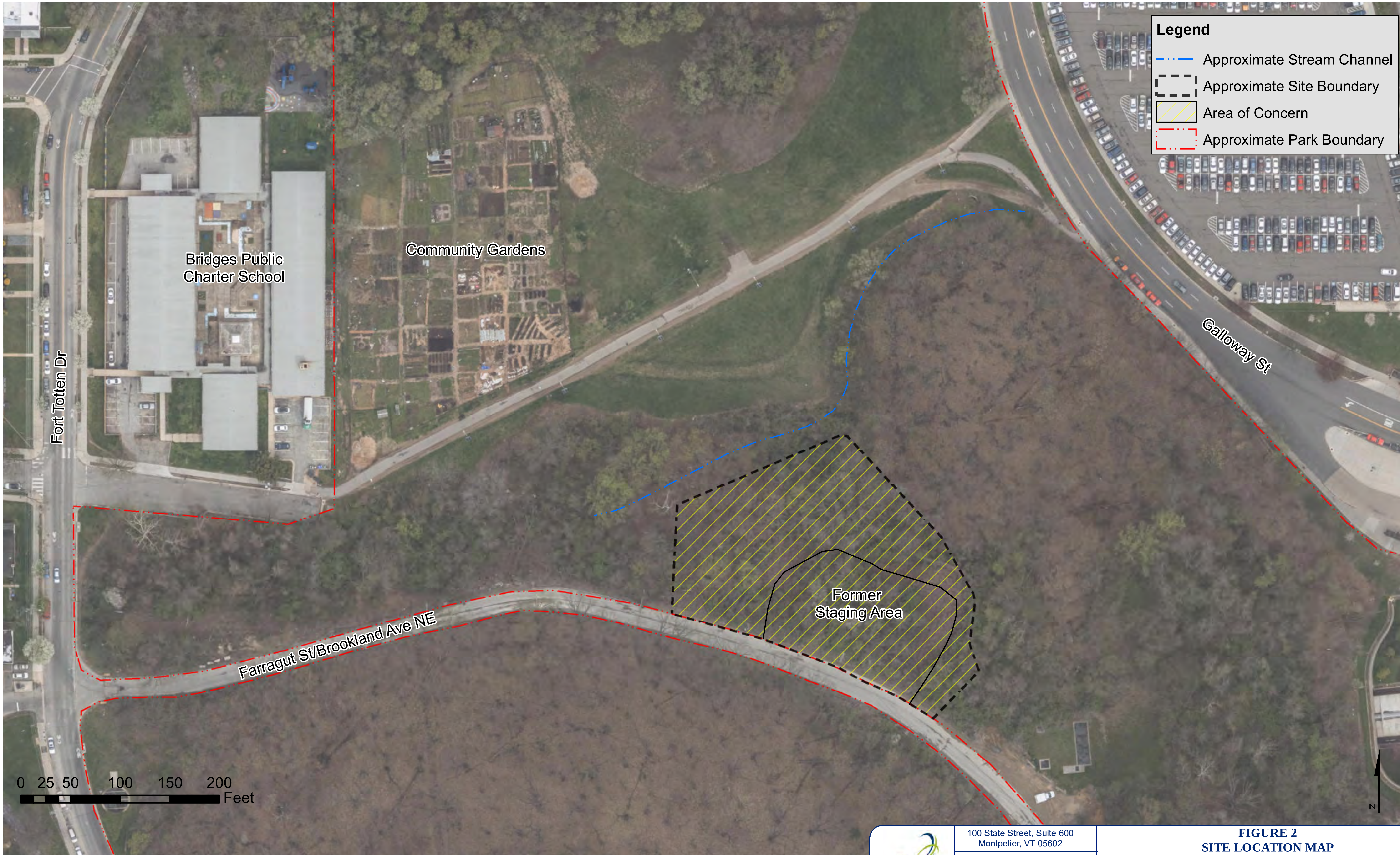
BASE MAP: USGS 7.5 Minute Topographic Quadrangle WASHINGTON WEST, DC-MD-VA 2016 & WASHINGTON EAST, DC-MD 2016

FIGURE 1: PARK LOCATION MAP
FORT TOTTEN PARK
CIVIL WAR DEFENSES OF WASHINGTON

The Johnson Company

100 State Street, Suite 600
Montpelier, VT 05602

Drawn by: TJK Date: 07/21/17
Chk'd by: SJH Date: 07/21/17
Scale: As Shown Project: 3-0700-23



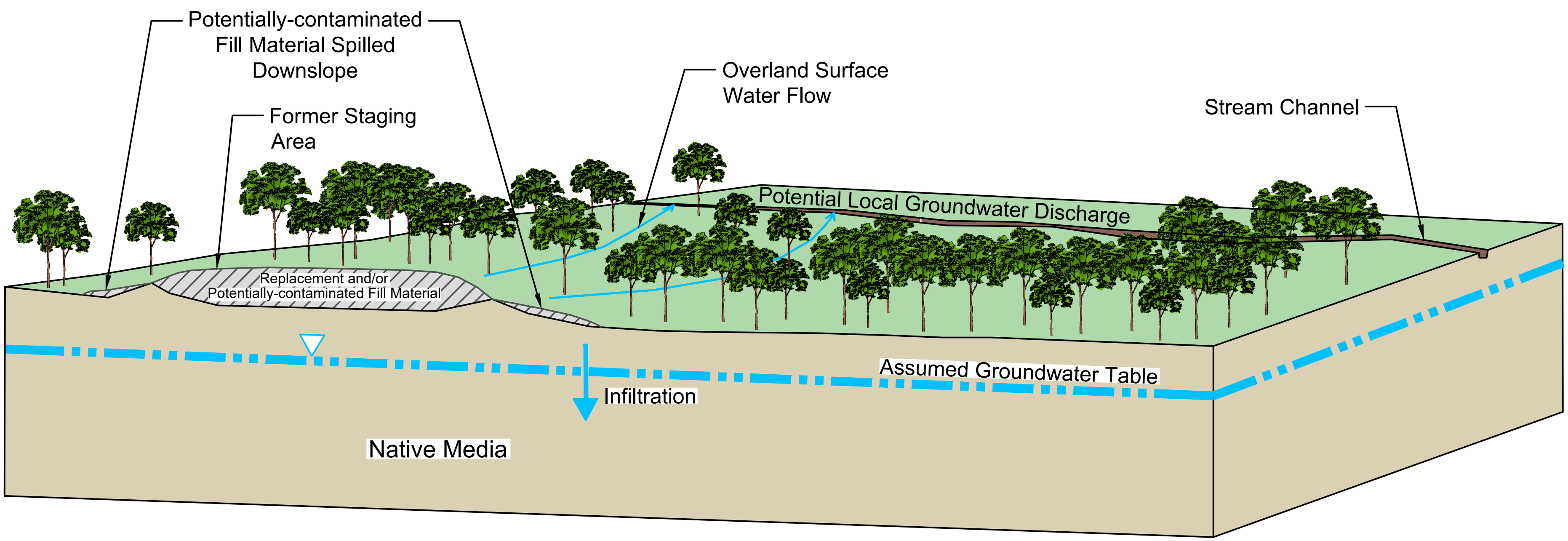
NOTE: Subsurface Soil Decision Units and Groundwater Monitoring Well Locations to be Determined Pending Surface Soil Sampling.
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

The Johnson Company

100 State Street, Suite 600
Montpelier, VT 05602

Drawn by: DEB Date: 12/04/17
Reviewed by: Date:
Scale: 1 " = 92 feet Project: 3-0700-23

FIGURE 2
SITE LOCATION MAP
FORT TOTTEN PARK
CIVIL WAR DEFENSES OF WASHINGTON



Not to Scale

FIGURE 3: PRELIMINARY ASSESSMENT CONCEPTUAL SITE MODEL FORT TOTTEN PARK CIVIL WAR DEFENSES OF WASHINGTON

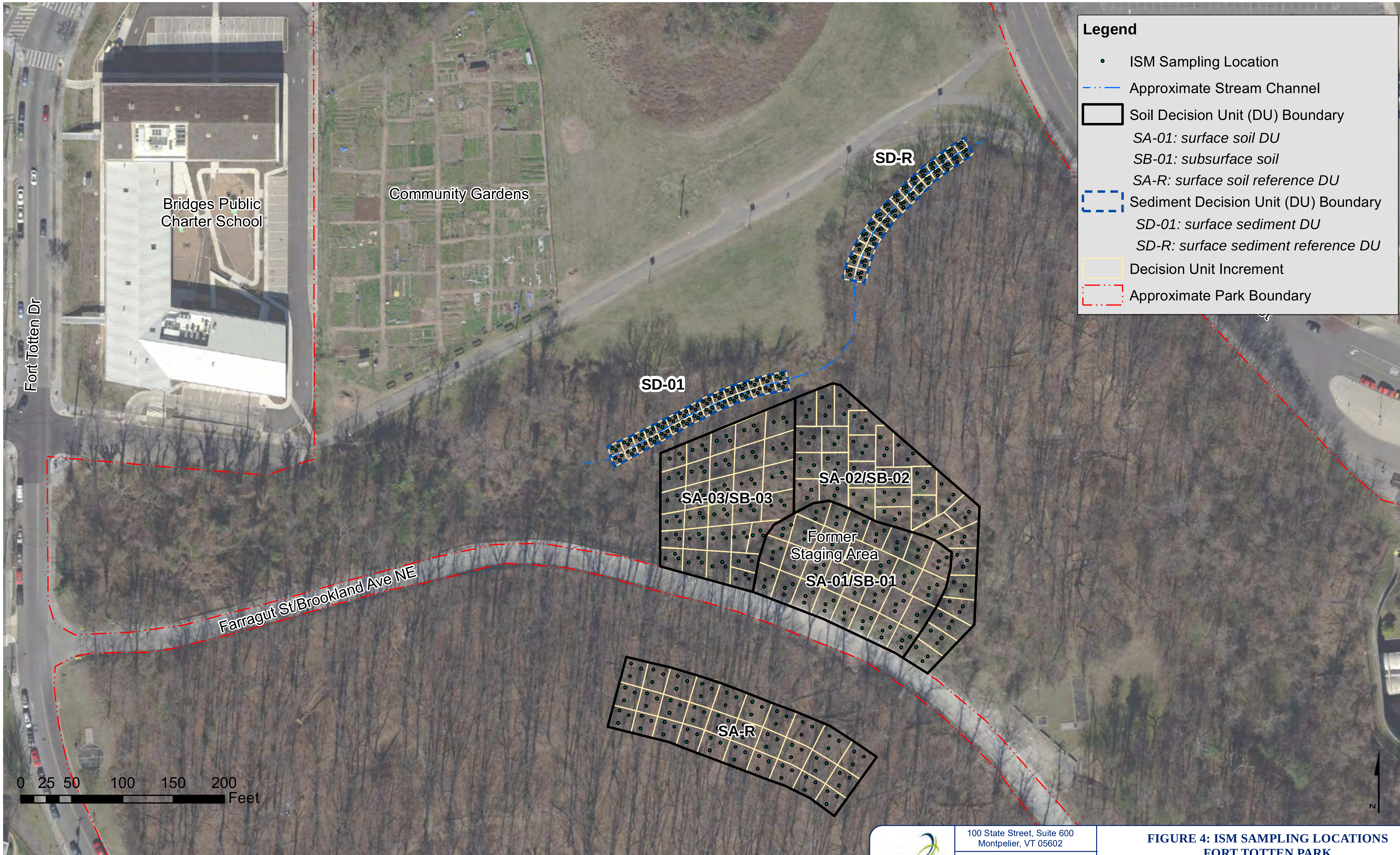
The Johnson Company

100 State Street, Suite 600
Montpelier, VT 05602

Drawn by: TEH	Date: 03/09/19
Reviewed by: BLL	Date: 03/09/19
Scale: Not to Scale	Project: 3-0700-23

K:\3-0700-23 Fort Totten\CAD\Preliminary Assessment CSM.dwg

K:\3-0700-23 Fort Totten\GIS\MXDs\Figure 4 ISM Sampling Locations.mxd



NOTE: Subsurface Soil Decision Units and Groundwater Monitoring Well Locations to be Determined Pending Surface Soil Sampling.
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

The Johnson Company

100 State Street, Suite 600
Montpelier, VT 05602

Drawn by: DEB Date: 01/28/19
Reviewed by: BLL Date: 01/28/19
Scale: 1 " = 90 feet Project: 3-0700-23

FIGURE 4: ISM SAMPLING LOCATIONS
FORT TOTTEN PARK
CIVIL WAR DEFENSES OF WASHINGTON

K:\3-0700-23 Fort Totten\GIS\MXDs\Figure 5 Discrete Sample Locations.mxd

NOTE: Subsurface Soil Decision Units and Groundwater Monitoring Well Locations to be Determined Pending Surface Soil Sampling.
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100 State Street, Suite 600
Montpelier, VT 05602

Drawn by: DEB Date: 01/28/19
Reviewed by: BLL Date: 01/28/19
Scale:1 " = 90 feet Project: 3-0700-23

FIGURE 5: DISCRETE SAMPLE LOCATIONS
FORT TOTTEN PARK
CIVIL WAR DEFENSES OF WASHINGTON

Tables

Table 1. Summary of Historical Fill Sample Results - Volatile Organic Compounds
Fort Totten Area of Concern

Sample ID	050992-1CM	052692-1CM
Sample Date	5/9/1992	5/26/1992
Analyte	Result (µg/L) (Method 8010 TCLP)	Result (µg/kg) (Method 8240)
1,1,1-Trichloroethane	NA	< 1
1,1,2,2,-Tetrachloroethane	NA	< 1
1,1,2-Trichloroethane	NA	< 1
1,1-Dichloroethane	NA	< 1
1,1-Dichloroethene	< 5	< 1
1,2-Dichloroethane	67	< 1
1,2-Dichloroethene	NA	< 1
1,2-Dichloropropane	NA	< 1
1,4-Dichlorobenzene	< 5	NA
2-Butanone	< 5	< 5
2-Hexanone	NA	< 5
4-Methyl-2-Pentanone	NA	< 1
Acetone	NA	< 2
Benzene	7	< 1
Bromodichloromethane	NA	< 1
Bromoform	NA	< 5
Bromomethane	NA	< 10
Carbon disulfide	NA	< 2
Carbon tetrachloride	60	< 1
Chlorobenzene	< 5	< 1
Chloroethane	NA	< 5
Chloroform	< 5	< 1
Choromethane	NA	< 10
cis-1,3-Dichloropropene	NA	< 1
Dibromochloromethane	NA	< 5
Ethylbenzene	NA	< 1
Methylene chloride	NA	4
Styrene	NA	< 1
Tetrachloroethene	< 5	< 1
Toluene	NA	2
trans-1,3-Dichloropropene	NA	< 1
Trichloroethene	< 5	< 1
Vinyl acetate	NA	< 1
Vinyl chloride	< 5	< 5
Xylenes, total	NA	< 5

Abbreviations:
NA = Not analyzed
TCLP = Toxicity Characteristic Leaching Procedure
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
bold = analyte detected above method reporting limit

Table 2. Summary of Historical Fill Sample Results - Semi-Volatile Organic Compounds
Fort Totten Area of Concern

Sample ID	050992-1CM	052692-1CM
Sample Date	5/9/1992	5/26/1992
Analyte	Result (µg/L) (Method 8270 TCLP)	Result (µg/kg) (Method 8270)
1,2,4-Trichlorobenzene	NA	< 100
1,2-Dichlorobenzene	NA	< 100
1,3-Dichlorobenzene	NA	< 100
1,4-Dichlorobenzene	NA	< 100
2,4,5-Trichlorophenol	< 65	< 100
2,4,6-Trichlorophenol	< 65	< 100
2,4-Dichlorophenol	NA	< 100
2,4-Dimethylphenol	NA	< 100
2,4-Dinitrophenol	NA	< 100
2,4-Dinitrotoluene	< 65	< 100
2,6-Dinitrotoluene	NA	< 100
2-Chloronaphthalene	NA	< 100
2-Chlorophenol	NA	< 100
2-Methylnaphthalene	NA	< 100
2-Methylphenol	< 65	< 100
2-Nitroaniline	NA	< 100
2-Nitrophenol	NA	< 100
3,3'-Dichlorobenzidine	NA	< 100
3-Methylphenol	< 65	NA
3-Nitroaniline	NA	< 100
4,6-Dinitro-2-methylphenol	NA	< 100
4-Bromophenyl-phenylether	NA	< 100
4-Chloro-3-methylphenol	NA	< 100
4-Chloroaniline	NA	< 100
4-Chlorophenyl-phenylether	NA	< 100
4-Methylphenol	< 65	< 100
4-Nitroaniline	NA	< 100
4-Nitrophenol	NA	< 100
Acenaphthene	NA	< 100
Acenaphthylene	NA	< 100
Anthracene	NA	< 100
Benzo[a]anthracene	NA	< 100
Benzo[a]pyrene	NA	< 100
Benzo[b]fluoranthene	NA	< 100
Benzo[g,h,i]perylene	NA	< 100
Benzo[k]fluoranthene	NA	< 100
Benzoic Acid	NA	< 100
Benzyl alcohol	NA	< 100
bis(2-Chloroethoxy)methane	NA	< 100
bis(2-Chloroethyl)ether	NA	< 100
bis(2-chloroisopropyl)ether	NA	< 100

Table 2. Summary of Historical Fill Sample Results - Semi-Volatile Organic Compounds
Fort Totten Area of Concern

Sample ID	050992-1CM	052692-1CM
Sample Date	5/9/1992	5/26/1992
Analyte	Result (µg/L) (Method 8270 TCLP)	Result (µg/kg) (Method 8270)
bis(2-Ethylhexyl)phthalate	NA	< 100
Butylbenzylphthalate	NA	< 100
Chrysene	NA	< 100
Dibenz[a,h]anthracene	NA	< 100
Dibenzofuran	NA	< 100
Diethylphthalate	NA	< 100
Dimethylphthalate	NA	< 100
Di-n-butylphthalate	NA	< 100
Di-n-octylphthalate	NA	< 100
Fluoranthene	NA	< 100
Hexachlorobenzene	< 65	< 100
Hexachlorobutadiene	< 65	< 100
Hexachlorocyclopentadiene	NA	< 100
Hexachloroethane	< 65	< 100
Indeno[1,2,3-cd]pyrene	NA	< 100
Isophorone	NA	< 100
Naphthalene	NA	< 100
Nitrobenzene	< 65	< 100
n-Nitroso-di-n-propylamine	NA	< 100
n-Nitrosodiphenylamine	NA	< 100
Pentachlorophenol	< 250	< 100
Phenanthrene	NA	< 100
Pyrene	NA	< 100
Pyridine	< 125	NA

Abbreviations:
NA = Not analyzed
TCLP = Toxicity Characteristic Leaching Procedure
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
bold = analyte detected above method reporting limit

Table 3. Summary of Historical Fill Sample Results - Pesticides, Herbicides, and Polychlorinated Biphenyls
Fort Totten Area of Concern

Sample ID	050992-1CM	052692-1CM
Sample Date	5/9/1992	5/26/1992
Organochlorine Pesticides		
Analyte	Result (µg/L) (Method 8080 TCLP)	Result (µg/kg) (Method 8270)
Aldrin	NA	< 100
A-BHC	NA	< 100
B-BHC	NA	< 100
G-BHC (lindane)	< 5	< 100
D-BHC	NA	< 100
Chlordane	< 50	< 100
4,4'-DDD	NA	< 100
4,4'-DDE	NA	< 100
4,4'-DDT	NA	< 100
Dieldren	NA	< 100
Endosulfan I	NA	< 100
Endosulfan II	NA	< 100
Endosulfan sulfate	NA	< 100
Endrin	< 5	< 100
Endrin Ketone	NA	< 100
Heptachlor	< 5	< 100
Heptachlor Epoxide	NA	< 100
Methoxychlor	< 10	NA
Chlorinated Herbicides		
Analyte	Result (µg/L) (Method 8150 TCLP)	Result (µg/kg) (Method 8150)
2,4 D	< 250	< 10
2,4,5-TP (silvex)	< 100	13
Toxaphene	< 50	NA
Total Polychlorinated Biphenyls (PCBs)		
Analyte	Result (µg/L)	Result (mg/kg) (Method 8080)
Total PCBs	NA	< 0.1

Abbreviations:
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
mg/kg = milligrams per kilogram
NA = Not analyzed
TCLP = Toxicity Characteristic Leaching Procedure
bold = analyte detected above method reporting limit

Table 4. Summary of Historical Fill Sample Results - Metals
Fort Totten Area of Concern

Sample ID	052692-1CM
Sample Date	5/26/1992
Analyte	Result (mg/kg) (Method 200.7)
Arsenic	< 10
Barium	14.5
Cadmium	< 0.5
Chromium	54
Lead	100
Mercury	< 0.1
Selenium	< 10
Silver	< 1

Abbreviation:
mg/kg = milligrams per kilogram
bold = analyte detected above method reporting limit

Table 5. Preliminary Contaminant of Potential Concern (COPC) Group Identification
Fort Totten Area of Concern

Contaminant or Contaminant Group	Media[1]	Reason Identified
Volatile organic compounds	Soil (Subsurface); groundwater[2]	"Possible COPCs" in soil chosen for the Glenbrook Road RI as the best indicators of potential AUES activities at the Glenbrook Road property (Parsons 2011). Munitions and explosives of concern, CWM, AUES-related items, and arsenic-affected soil were encountered and removed from the Glenbrook Road property during the RI (Parsons 2011).
Semi-volatile organoic compounds	Soil (surface, subsurface); sediment; groundwater	
Metals	Soil (surface, subsurface); sediment; groundwater	
Total cyanide	Soil (surface, subsurface); sediment; groundwater	
Explosives	Soil (surface, subsurface); sediment; groundwater	
Chemical warfare materials (CWM)	Soil (surface, subsurface); sediment; groundwater	
Fluoride, iodine, perchlorate	Soil (surface, subsurface); sediment; groundwater	
Herbicides	Soil (surface, subsurface); sediment; groundwater	Silvex detected in a 1992 fill source sample.
Polychlorinated Biphenyl Aroclors	Soil (surface, subsurface); sediment	NPS representative observed electrical transformer reservoirs in historically-imported fill material.

Notes:

1. Because COPCs can migrate from surface soil to subsurface soil and groundwater, the latter two media are media of potential concern. The decision to sample subsurface soil and/or groundwater will be made based on the results of the first investigation phase (surface soil and sediment sampling).

2. VOCs that may have been present in historically-imported fill material would not be expected to persist in surface soil or sediment.

Table 6. Summary of Surface Soil Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL (mg/kg)	ESV (mg/kg)	PA/SI Screening Criteria (mg/kg)	SA-01 (former staging area)			SA-02 (downhill north and northeast area)			SA-03 (downhill northwest area)			SA-R (surface soil reference area)		
Discrete Samples																
CWM (mg/kg)																
				Sample ID	CS-01a	CS-02a	CS-03a	CS-07a	CS-08a	CS-09a	CS-04a	CS-05a	CS-06a	NA		
				Sample Date	2/5/18	2/5/18	2/5/18	2/5/18	2/5/18	2/5/18	2/5/18	2/5/18	2/5/18			
1,4-Dithiane	505-29-3	78	None	78	<0.1	<0.097	<0.1	<0.096	<0.1	<0.096	<0.096	<0.097	<0.1			
1,4-Oxathiane (1,4-Thioxane)	15980-15-1	None	None	None	<0.1	<0.097	<0.1	<0.096	<0.1	<0.096	<0.096	<0.097	<0.1			
Mustard (HD)	505-60-2	None	None	None	<0.01	<0.0097	<0.01	<0.0096	<0.01	<0.0096	<0.0096	<0.0097	<0.01			
Lewisite (L)	541-25-3	0.039	None	0.039	<0.024 J	<0.023 J	<0.024 J	<0.023 J	<0.024 J	<0.023 J	<0.023 J	<0.023 J	<0.024 J			
Chloroacetophenone (CN)	532-27-4	4,300	None	4,300	<0.099	<0.097	<0.1	<0.1	<0.1	<0.1	<0.1	<0.11	<0.1			
Thiodigylcol (TDG)	111-48-8	540	None	540	<0.12	<0.12	<0.12	<0.13	<0.13	<0.12	<0.12	<0.13	<0.12			
Ricin	9009-86-3	None	None	None	negative	negative	negative	negative	negative	negative	negative	negative	negative			
ORP (mV)																
				Sample ID	CS-01B	CS-02B	CS-03B	CS-07B	CS-08B	CS-09B	CS-04B	CS-05B	CS-06B	CS-R-01B	CS-R-02B	CS-R-03B
				Sample Date	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18
Oxidation-Reduction Potential (ORP)	None	None	None	None	380 J	330 J	350 J	310 J	320 J	300 J	320 J	300 J	300 J	390 J	440 J	490 J
MeHg (mg/kg)																
				Sample ID	CS-01C	CS-02C	CS-03C	CS-07C	CS-08C	CS-09C	CS-04C	CS-05C	CS-06C	CS-R-01C	CS-R-02C	CS-R-03C
				Sample Date	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18	2/21/18
Methylmercury	22967-92-6	0.78	0.00035	0.00035	0.00031 J	0.00012 J	<0.00011 J	0.0014 J	0.0014 J	0.00046 J	0.00041 J	0.00031 J	0.00063 J	0.00011 J	<0.00013 J	<0.00013 J
Incremental Sampling Methodology (ISM) Samples																
				Sample ID	SA-01-A	SA-01-B	SA-01-C	SA-02-A	SA-02-B	SA-02-C	SA-03-A	SA-03-B	SA-03-C	SA-R-A	SA-R-B	SA-R-C
				Sample Date	3/7/18	3/8/18	3/7/18	2/22/18	2/22/18	3/8/18	2/22/18	2/22/18	3/8/18	2/22/18	2/22/18	3/8/18
Metals (mg/kg)																
Aluminum	7429-90-5	7,700	50	50	6200	5600	5800	7200	6200	6100	5600	6600	5500	4100	4600	4300
Antimony	7440-36-0	3.1	0.248	0.248	<1.0	<1.1	<1.1	<0.97 J	<0.95 J	0.2 J	<0.93	<0.91 J	<1.1	0.50 J	0.37 J	0.41 J
Arsenic	7440-38-2	0.68	0.25	0.25	6.9	4.5	5.0	16	6.6	6.0	4.8	5.7	4.7	4.6	4.0	3.7
Barium	7440-39-3	1,500	17.2	17.2	37	34	34	54	51	55	52	54	52	35	41	39
Beryllium	7440-41-7	16	2.42	2.42	0.64	0.61	0.65	0.57	0.48	0.45	0.35	0.32	0.3	0.15 J	0.18 J	0.16 J
Cadmium	7440-43-9	7.1	0.27	0.27	0.094 J	0.088 J	0.081 J	0.42	0.41	0.32	0.44	0.38	1.00	0.14 J	0.17 J	0.14 J
Chromium	7440-47-3		0.34	0.34	29	25	27	33	26	26	21	24	19 J	19	16	17
Chromium III	16065-83-1	12,000	0.83	0.83	29 J	25 J	27 J	33 J	26 J	26 J	21 J	24 J	19	19 J	16 J	17 J
Chromium VI	18540-29-9	0.3	7.21	0.3	<5.0 J	<4.9 J	<2.0 J	<4.0 J	<4.0 J	<5.3 J	<4.0 J	<8.0 J	<11 J	<8.0 J	<8.0 J	<28 J
Cobalt	7440-48-4	2.3	13	2.3	2.4	1.9	1.9	7.1	5.4	5.7	3.6	4.5	3.0	1.6	1.9	1.6
Copper	7440-50-8	310	15	15	6.4	5.2	4.4	24 J	23	20	19	21	21	13	14	12
Cyanide, Free/Weak Acid Dissociable	57-12-5	2.3	0.1	0.1	<0.50	<0.46	<0.48	0.21 J-	0.18 J-	<0.46	0.24 J-	0.22 J-	<0.46	0.64 J-	0.5 J-	0.37 J
Lead	7439-92-1	400	0.94	0.94	6.5	6.7	6.6	60	65	64	150	140	110	120	110	93
Manganese	7439-96-5	180	220	180	110	97	94	230	200	250	180	160	140	68	99	110
Mercury	7439-97-6	1.1	0.013	0.013	0.16 J+	0.073 J+	0.12 J+	0.61	0.24	0.23 J+	0.19	0.16	0.19 J+	0.24	0.21	0.23 J+
Nickel	7440-02-0	150	9.7	9.7	8.8	7.5	6.8	25	22	24	17	19	16	14	14	12
Selenium	7782-49-2	39	0.331	0.331	0.26 J	0.34 J	0.35 J	0.36 J	0.43 J	0.49 J	0.38 J	0.48 J	0.70 J	1.2	0.87 J	1.0 J
Silver	7440-22-4	39	2	2	<0.52	<0.54	<0.53	0.22 J	<0.47	<0.55	<0.47	<0.46	<0.54	0.26 J	0.19 J	0.18 J
Strontium	7440-24-6	4,700	None	4,700	9.9	9.6	7.0	14	12	13	17	16	17	8.5	8.8	9.5
Tellurium	13494-80-9	None	None	None	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Thallium	7440-28-0	0.078	0.027	0.027	0.68 J	0.43 J	0.57 J	0.95 J	0.82 J	1.2	0.76 J	0.70 J	0.68 J	0.32 J	0.30 J	0.43 J
Tin	7440-31-5	4,700	None	4,700	3.2 J	2.2 J	2.1 J	5.3	3.8 J	5.2 J	6.7	7.6	5.9	4.5 J	4.6 J	5.6
Titanium	7440-32-6	None	None	None	77	57	52	120	86	95	75	86	64	81	72	73
Vanadium	7440-62-2	39	0.714	0.714	19	16	17	26	25	25	23	25	24	27	25	23
Zinc	7440-66-6	2,300	6.62	6.62	32	30	30	110	120	85	110	110	110	31	35	32
Zirconium	7440-67-7	0.63	None	0.63	<2.5	<2.5	<2.5	<2.5	<2.5	1.4 J	1.8 J	2.1 J	1.7 J	1.3 J	1.1 J	1.5 J
PAHs (mg/kg)																
Acenaphthene	83-32-9	360	0.25	0.25	<0.0064	<0.0067	<0.0067	<0.028	0.014	0.0085	0.010	0.036	0.014	0.015	<0.028	0.011
Acenaphthylene	208-96-8	None	120	120	<0.0064	0.0088	<0.0067	0.037	0.040	0.042	0.059	0.15	0.1	0.038	0.045	0.03

Table 6. Summary of Surface Soil Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL (mg/kg)	ESV (mg/kg)	PA/SI Screening Criteria (mg/kg)	SA-01 (former staging area)			SA-02 (downhill north and northeast area)			SA-03 (downhill northwest area)			SA-R (surface soil reference area)		
Anthracene	120-12-7	1,800	6.8	6.8	<0.0064	**0.0042 J**	<0.0067	**0.031**	**0.050**	**0.033**	**0.061**	**0.14**	**0.073**	**0.035**	**0.049**	**0.027**
Benzo(a)anthracene	56-55-3	1.1	0.8	0.8	**0.0088**	**0.011**	**0.0077**	**0.13**	**0.19**	**0.13**	**0.26**	**0.55**	**0.32**	**0.15**	**0.19**	**0.12**
Benzo(a)pyrene	50-32-8	0.11	53	0.11	**0.013**	**0.017**	**0.0082**	**0.19**	**0.25**	**0.19**	**0.36**	**0.65**	**0.44**	**0.21**	**0.24**	**0.16**
Benzo(b)fluoranthene	205-99-2	1.1	18	1.1	**0.021**	**0.026**	**0.017**	**0.29**	**0.33**	**0.27**	**0.48**	**1.0**	**0.69**	**0.42**	**0.43**	**0.32**
Benzo(g,h,i)perylene	191-24-2	None	1.98	1.98	**0.012**	**0.016**	**0.0097**	**0.065**	**0.10**	**0.088**	**0.21**	**0.24**	**0.19**	**0.075**	**0.073**	**0.056**
Benzo(k)fluoranthene	207-08-9	11	62	11	**0.0091**	**0.0061 J**	**0.0047 J**	**0.090**	**0.10**	**0.091**	**0.19**	**0.32**	**0.19**	**0.12**	**0.15**	**0.085**
Chrysene	218-01-9	110	2.4	2.4	**0.014**	**0.015**	**0.014**	**0.14**	**0.21**	**0.16**	**0.29**	**0.51**	**0.33**	**0.19**	**0.23**	**0.17**
Dibenzo(a,h)anthracene	53-70-3	0.11	12	0.11	<0.0064	<0.0067	<0.0067	<0.028	**0.029**	**0.022**	**0.070**	**0.086**	**0.06**	<0.0068	<0.028	**0.017**
Fluoranthene	206-44-0	240	10	10	**0.023**	**0.027**	**0.026**	**0.23**	**0.35**	**0.25**	**0.45**	**0.89**	**0.46**	**0.40**	**0.47**	**0.3**
Fluorene	86-73-7	240	3.7	3.7	<0.0064	<0.0067	<0.0067	<0.028	**0.016**	**0.012**	**0.016**	**0.043**	**0.017**	**0.020**	**0.021 J**	**0.013**
Indeno(1,2,3-cd)pyrene	193-39-5	1.1	62	1.1	**0.010**	**0.012**	**0.0065 J**	**0.064**	**0.099**	**0.079**	**0.20**	**0.26**	**0.19**	**0.073**	**0.083**	**0.062**
Naphthalene	91-20-3	3.8	1	1	**0.0065**	**0.011**	**0.006 J**	**0.023 J**	**0.022**	**0.028**	**0.026**	**0.036**	**0.035**	**0.053**	**0.051**	**0.046**
Phenanthrene	85-01-8	None	5.5	5.5	**0.011**	**0.017**	**0.0081**	**0.095**	**0.21**	**0.12**	**0.24**	**0.40**	**0.27**	**0.21**	**0.24**	**0.16**
Pyrene	129-00-0	180	10	10	**0.017**	**0.024**	**0.018**	**0.22**	**0.34**	**0.24**	**0.37**	**0.76**	**0.43**	**0.32**	**0.34**	**0.24**
Other SVOCs (mg/kg)																
1,1'-Biphenyl	92-52-4	4.7	None	4.7	**0.0037 J**	<0.050	<0.050	<0.21	**0.0045 J**	**0.0046 J**	**0.0054 J**	**0.0068 J**	**0.0073 J**	--	--	--
2,4,5-Trichlorophenol	95-95-4	630	4	4	<0.14	<0.15	<0.15	<0.63	<0.15	<0.15	<0.15	<0.16	<0.14	--	--	--
2,4,6-Trichlorophenol	88-06-2	6.3	10	6.3	<0.14	<0.15	<0.15	<0.63	<0.15	<0.15	<0.15	<0.16	<0.14	--	--	--
2,4-Dichlorophenol	120-83-2	19	None	19	<0.14	<0.15	<0.15	<0.63	<0.15	<0.15	<0.15	<0.16	<0.14	--	--	--
2,4-Dimethylphenol	105-67-9	130	0.01	0.01	<0.14	<0.15	<0.15	<0.63	<0.15	<0.15	<0.15	<0.16	<0.14	--	--	--
2,4-Dinitrophenol	51-28-5	13	20	13	<0.31	<0.33	<0.33	<1.4 J	<0.34 J	<0.32 J	<0.33 J	<0.34 J	<0.32 J	--	--	--
2,4-Dinitrotoluene	121-14-2	1.7	6	1.7	<0.19	<0.20	<0.20	<0.84	<0.21	<0.20	<0.20	<0.21	<0.19	--	--	--
2,6-Dinitrotoluene	606-20-2	0.36	4.1	0.36	<0.19	<0.20	<0.20	<0.84	<0.21	<0.20	<0.20	<0.21	<0.19	--	--	--
2-Chloronaphthalene	91-58-7	480	None	480	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
2-Chlorophenol	95-57-8	39	0.39	0.39	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
2-Methylnaphthalene	91-57-6	24	16	16	**0.005 J**	**0.0072**	**0.0048 J**	**0.020 J**	**0.015**	**0.022**	**0.017**	**0.022**	**0.028**	--	--	--
2-Methylphenol	95-48-7	320	0.67	0.67	<0.19	<0.20	<0.20	<0.84	<0.21	<0.20	<0.20	<0.21	<0.19	--	--	--
2-Nitroaniline	88-74-4	63	5.4	5.4	<0.19	<0.20	<0.20	<0.84	<0.21	<0.20	<0.20	<0.21	<0.19	--	--	--
2-Nitrophenol	88-75-5	None	7	7	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
3/4-Methylphenol	15831-10-4	None	None	None	<0.38	<0.40	<0.40	<1.7	<0.41	<0.39	<0.40	<0.42	<0.39	--	--	--
3,3'-Dichlorobenzidine	91-94-1	1.2	None	1.2	<0.095	<0.10	<0.10	R	R	R	<0.10 R	<0.10 R	<0.096 R	--	--	--
3-Nitroaniline	99-09-2	None	None	None	<0.19	<0.20	<0.20	<0.84 J	<0.21 J	<0.20 J	<0.20 J	<0.21 J	<0.19 J	--	--	--
4,6-Dinitro-2-methylphenol	534-52-1	0.51	None	0.51	<0.14	<0.15	<0.15	<0.63 J	<0.15 J	<0.15 J	<0.15 J	<0.16 J	<0.14 J	--	--	--
4-Bromophenyl-phenylether	101-55-3	None	None	None	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
4-Chloro-3-methylphenol	59-50-7	630	None	630	<0.14	<0.15	<0.15	<0.63	<0.15	<0.15	<0.15	<0.16	<0.14	--	--	--
4-Chloroaniline	106-47-8	2.7	1	1	<0.14	<0.15	<0.15	<0.63 J	<0.15 J	<0.15 J	<0.15 J	<0.16 J	<0.14 J	--	--	--
4-Chlorophenyl-phenylether	7005-72-3	None	None	None	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
4-Nitroaniline	100-01-6	25	None	25	<0.19	<0.20	<0.20	<0.84 J	<0.21 J	<0.20 J	<0.20 J	<0.21 J	<0.19 J	--	--	--
4-Nitrophenol	100-02-7	None	7	7	<0.31	<0.33	<0.33	<1.4	<0.34	<0.32	<0.33	<0.34	<0.32	--	--	--
Acetophenone	98-86-2	780	None	780	<0.095	**0.013 J**	<0.10	<0.42	**0.0098 J**	**0.013 J**	<0.10	<0.10	**0.013 J**	--	--	--
Atrazine	1912-24-9	2.4	None	2.4	<0.19	<0.20	<0.20	<0.84	<0.21	<0.20	<0.20	<0.21	<0.19	--	--	--
Benzaldehyde	100-52-7	170	None	170	**0.014 J**	**0.015 J**	**0.013 J**	<0.42	**0.02 J**	**0.02 J**	**0.015 J**	**0.014 J**	**0.046 J**	--	--	--
Benzoic acid	65-85-0	25,000	None	25,000	<0.63	<0.66	<0.096	**0.41 J-**	**0.10 J-**	R	**0.11 J-**	**0.10 J-**	<0.096 J	--	--	--
bis(2-Chloroethoxy)methane	111-91-1	19	None	19	<0.095	<0.10	<0.10	<0.42	<0.10	<0.098	<0.10	<0.10	<0.096	--	--	--
bis(2-Chloroethyl)ether	111-44-4	0.23	None	0.23	<0.095	<0.10	<0.10	<0.42	<0.10	<0.098	<0.10	<0.10	<0.096	--	--	--
bis(2-Ethylhexyl)phthalate	117-81-7	39	0.02	0.02	**0.072**	**0.060 J**	<0.070	<0.29 J	**0.026 J-**	**0.043 J-**	**0.046 J-**	**0.030 J-**	**0.048 J-**	--	--	--
bis(2-Chloroisopropyl)ether	108-60-1	310	None	310	<0.095	<0.10	<0.10	<0.42	<0.10	<0.098	<0.10	<0.10	<0.096	--	--	--
Butylbenzylphthalate	85-68-7	290	90	90	**4.9**	**0.012 J**	<0.070	<0.29	<0.072	<0.069	<0.071	<0.073	<0.067	--	--	--
Caprolactam	105-60-2	3,100	None	3,100	<0.31	<0.33	<0.33	<1.4	<0.34	<0.32	<0.33	<0.34	<0.32	--	--	--
Carbazole	86-74-8	None	80	80	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	**0.030 J**	**0.046 J**	**0.029 J**	--	--	--
Dibenzofuran	132-64-9	7.3	6.1	6.1	<0.048	<0.050	<0.050	<0.21	**0.0087 J**	**0.0073 J**	**0.015 J**	**0.027 J**	**0.022 J**	--	--	--
Diethylphthalate	84-66-2	5,100	100	100	<0.041	<0.070	<0.023	<0.29	**0.022 J**	<0.029	**0.024 J**	<0.073	<0.032	--	--	--
Dimethylphthalate	131-11-3	None	10	10	<0.067	<0.070	<0.070	<0.29	<0.072	<0.069	<0.071	<0.073	<0.067	--	--	--
Di-n-butylphthalate	84-74-2	630	0.011	0.011	<0.067	<0.070	<0.070	<0.29	<0.072	<0.069	<0.071	<0.073	<0.067	--	--	--
Di-n-octylphthalate	117-84-0	63	0.91	0.91	<0.067	<0.070	<0.070	<0.29	<0.072	<0.069	<0.071	<0.073	<0.067	--	--	--

Table 6. Summary of Surface Soil Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL (mg/kg)	ESV (mg/kg)	PA/SI Screening Criteria (mg/kg)	SA-01 (former staging area)			SA-02 (downhill north and northeast area)			SA-03 (downhill northwest area)			SA-R (surface soil reference area)		
Diphenylamine	122-39-4	630	None	630	<0.095	<0.10	<0.10	<0.42	<0.10	<0.098	<0.10	<0.10	<0.096	--	--	--
Hexachlorobenzene	118-74-1	0.21	0.079	0.079	<0.0064	<0.0067	<0.0067	<0.028	<0.0068	<0.0065	<0.0067	<0.0069	<0.0064	--	--	--
Hexachlorobutadiene	87-68-3	1.2	None	1.2	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
Hexachlorocyclopentadiene	77-47-4	0.18	10	0.18	<0.31	<0.33	<0.33	R	R	R	R	R	R	--	--	--
Hexachloroethane	67-72-1	1.8	None	1.8	<0.048	<0.050	<0.050	<0.21 J	<0.051 J	<0.049 J	<0.051 J	<0.052 J	<0.048 J	--	--	--
Isophorone	78-59-1	570	None	570	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
Nitrobenzene	98-95-3	5.1	2.2	2.2	<0.095	<0.10	<0.10	<0.42	<0.10	<0.098	<0.10	<0.10	<0.096	--	--	--
n-Nitroso-di-n-propylamine	621-64-7	0.078	None	0.078	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
n-Nitrosodiphenylamine	86-30-6	110	20	20	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	<0.048	--	--	--
Pentachlorophenol	87-86-5	1	0.36	0.36	<0.14	<0.15	<0.15	<0.63 J	<0.15 J	<0.15 J	<0.15 J	<0.16 J	<0.14 J	--	--	--
Phenol	108-95-2	1,900	0.79	0.79	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	**0.0093 J**	--	--	--
Explosives (mg/kg)																
1,3,5-Trinitobenzene	99-35-4	220	None	220	<0.093	**<0.096 J**	<0.10	<0.10	<0.10	<0.092	<0.098	<0.099	<0.098	--	--	--
1,3-Dinitrobenzene	99-65-0	0.63	None	0.63	<0.093	**<0.096 J**	<0.10	<0.10	<0.10	<0.092	<0.098	<0.099	<0.098	--	--	--
2,4,6-Trinitrotoluene	118-96-7	3.6	None	3.6	<0.093	**<0.096 J**	<0.10	<0.10	<0.10	<0.092	<0.098	<0.099	<0.098	--	--	--
2,4-Dinitrotoluene	121-14-2	1.7	6	1.7	<0.093	**<0.096 J**	<0.10	<0.10	<0.10	<0.092	<0.098	<0.099	<0.098	--	--	--
2,6-Dinitrotoluene	606-20-2	0.36	4.1	0.36	<0.093	**<0.096 J**	<0.10	<0.10	<0.10	<0.092	<0.098	<0.099	<0.098	--	--	--
2-amino-4,6-Dinitrotoluene	35572-78-2	15	None	15	<0.093	**<0.096 J**	<0.10	<0.10	<0.10	<0.092	<0.098	<0.099	<0.098	--	--	--
4-amino-2,6-Dinitrotoluene	19406-51-0	15	None	15	<0.093	**<0.096 J**	<0.10	<0.10	<0.10	<0.092	<0.098	<0.099	<0.098	--	--	--
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	390	None	390	<0.093	**<0.096 J**	<0.10	<0.10	<0.10	<0.092	<0.098	<0.099	<0.098	--	--	--
m-Nitrotoluene	99-08-1	0.63	None	0.63	<0.19	<0.19	<0.20	<0.20	<0.20	<0.18	<0.20	<0.20	<0.20	--	--	--
Nitrobenzene	98-95-3	5.1	2.2	2.2	<0.095	**<0.29 J**	<0.30	<0.30	<0.30	<0.27	<0.30	<0.30	<0.29	--	--	--
Nitroglycerin	55-63-0	0.63	None	0.63	<1.9	**<1.9 J**	<2.0	<2.0	<2.0	<1.8	<2.0	<2.0	<2.0	--	--	--
o-Nitrotoluene	88-72-2	3.2	None	3.2	<0.19	**<0.19 J**	<0.20	<0.20	<0.20	<0.18	<0.20	<0.20	<0.20	--	--	--
p-Nitrotoluene	99-99-0	25	None	25	<0.19	**<0.19 J**	<0.20	<0.20	<0.20	<0.18	<0.20	<0.20	<0.20	--	--	--
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	6.1	None	6.1	<0.19	<0.19	<0.20	<0.20	<0.20	<0.18	<0.20	<0.20	<0.20	--	--	--
Tetryl	479-45-8	16	None	16	<0.19	<0.19	<0.20	<0.20	<0.20	<0.18	<0.20	<0.20	<0.20	--	--	--
Ions (mg/kg)																
Fluoride	16984-48-8	310	None	310	**5.0**	**4.6**	**4.4**	**2.3**	**3.3**	**2.7**	**2.5**	**3.1**	**2.8**	--	--	--
Perchlorate	14797-73-0	5.5	None	5.5	**0.00022 J**	**0.00023 J**	<0.00048	**0.00036 J+**	**0.00047 J+**	**0.00042 J+**	**0.00039 J+**	**0.00043 J+**	**0.0004 J+**	--	--	--
Pesticides/Herbicides (mg/kg)																
2,4,5-TP (silvex)	93-72-1	51	0.109	0.109	**<0.058 J**	**<0.058 J**	**<0.059 J**	<0.058 J	<0.06 J	<0.055 J	<0.059 J	<0.06 J	<0.058	<0.063 J	<0.066 J	<0.058 J
4,4'-DDT	50-29-3	1.9	0.021	0.021	<0.0047	<0.0048	<0.0048	**0.0099 NJ**	**0.037**	**0.16**	**0.1**	**0.0068**	**0.046 NJ**	**0.032 NJ**	**0.042 NJ**	**0.11 NJ**
4,4'-DDD	72-54-8	2.3	0.0063	0.0063	<0.0047	<0.0048	<0.0048	<0.0050	**0.016**	**0.023 NJ**	**0.043**	**0.0088 NJ**	**0.026 NJ**	**0.018 NJ**	**0.036 NJ**	**0.046 NJ**
4,4'-DDE	72-55-9	2	0.021	0.021	<0.0047	<0.0048	<0.0048	**0.038 NJ**	**0.023**	**0.062 NJ**	**0.15**	**0.01**	**0.031 NJ**	**0.025**	**0.039**	**0.058 NJ**
Chlordane	12789-03-6	1.70	0.22	0.22	<0.047	<0.048	<0.048	<0.050	<0.050	<0.049	**0.013 J**	<0.051	<0.049	<0.052	**0.09**	<0.049 J
PCB Aroclors (mg/kg)																
Aroclor-1016	12674-11-2	0.41	1	0.41	<0.047	<0.048	<0.048	<0.049	<0.049	<0.049	<0.049	<0.050	<0.049	--	--	--
Aroclor-1221	11104-28-2	0.20	None	0.20	<0.047	<0.048	<0.048	<0.049	<0.049	<0.049	<0.049	<0.050	<0.049	--	--	--
Aroclor-1232	11141-16-5	0.17	None	0.17	<0.047	<0.048	<0.048	<0.049	<0.049	<0.049	<0.049	<0.050	<0.049	--	--	--
Aroclor-1242	53469-21-9	0.23	0.041	0.041	<0.047	<0.048	<0.048	<0.049	<0.049	<0.049	<0.049	<0.050	<0.049	--	--	--
Aroclor-1248	12672-29-6	0.23	0.0072	0.0072	<0.047	<0.048	<0.048	<0.049	<0.049	<0.049	<0.049	<0.050	<0.049	--	--	--
Aroclor-1254	11097-69-1	0.12	0.041	0.041	<0.047	<0.048	<0.048	<0.049	<0.049	<0.049	**0.038 J+**	<0.050	<0.049	--	--	--
Aroclor-1260	11096-82-5	0.24	0.88	0.24	<0.047	<0.048	<0.048	**0.032 J**	**0.025 J**	**0.046 J**	<0.049	**0.026 J**	<0.049	--	--	--

NOTES:
J = the result is an estimated quantity
J+ = the result is an estimated quantity; the result may be biased high
J- = the result is an estimated quantity; the result may be biased low
R = data are unusable and sample results are rejected
N = the analyte has been tentatively identified or presumptively is present
Bold = analyte detected above the laboratory reporting limit
Shading = detected result exceeds PA/SI screening criterion

ABBREVIATIONS:
CWM = chemical warfare material
MeHg = methylmercury
mg/kg = milligrams per kilogram
mV = milliVolt
NA = sample not collected for that analyte
ORP = oxidation-reduction potential
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SVOC = semi-volatile organic compound
"--" = sample not analyzed for that analyte

Table 7. Summary of Surface Sediment Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL (mg/kg)	ESV (mg/kg)	PA/SI Screening Criteria (mg/kg)	SD-01 (stream downhill northeast)			SD-R (surface sediment reference area)		
Discrete Samples										
CWM (mg/kg)										
				Sample ID	**CD-01a**	**CD-02a**	**CD-03a**			
				Sample Date	**2/5/18**	**2/5/18**	**2/5/18**			
1,4-Dithiane	505-29-3	78	None	78	<0.097	<0.1	<0.099	NA		
1,4-Oxathiane (1,4-Thioxane)	15980-15-1	None	None	None	<0.097	<0.1	<0.099			
Mustard (HD)	505-60-2	None	None	None	<0.0097	<0.01	<0.0099			
Lewisite (L)	541-25-3	0.039	None	0.039	<0.023 J	<0.025 J	<0.024 J			
Chloroacetophenone (CN)	532-27-4	4300	None	4300	<0.097	<0.096	<0.098			
Thiodigylcol (TDG)	111-48-8	540	None	540	<0.13	<0.12	<0.120			
Ricin	9009-86-3	None	None	None	negative	negative	negative			
ORP (mV)										
				Sample ID	**CD-01B**	**CD-02B**	**CD-03B**	**CD-R-01B**	**CD-R-02B**	**CD-R-03B**
				Sample Date	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**
Oxidation-Reduction Potential (ORP)	None	None	None	None	**290 J**	**300 J**	**300 J**	**290 J**	**330 J**	**310 J**
MeHg (mg/kg)										
				Sample ID	**CD-01C**	**CD-02C**	**CD-03C**	**CD-R-01C**	**CD-R-02C**	**CD-R-03C**
				Sample Date	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**
Methylmercury	22967-92-6	0.78	None	0.78	**0.00057 J-**	**0.00092 J-**	**0.0003 J-**	**0.00038 J-**	**0.00049 J-**	**0.00082 J-**
Incremental Sampling Methodology (ISM) Samples										
				Sample ID	**SD-01-A**	**SD-01-B**	**SD-01-C**	**SD-R-A**	**SD-R-B**	**SD-R-C**
				Sample Date	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**	**2/21/18**
Metals (mg/kg)										
Aluminum	7429-90-5	7,700	None	7,700	**4700**	**4700**	**4500**	**5100**	**5100**	**5200**
Antimony	7440-36-0	3.1	None	3.1	<0.96	<0.96	<0.95	<0.90	**0.18 J**	<0.96
Arsenic	7440-38-2	0.68	9.79	0.68	**3.4 J-**	**3.2 J-**	**3.3 J-**	**3.5 J-**	**3.9 J-**	**3.9 J-**
Barium	7440-39-3	1,500	None	1,500	**30**	**29**	**26**	**36**	**35**	**36**
Beryllium	7440-41-7	16	None	16	**0.21 J**	**0.21 J**	**0.19 J**	**0.35**	**0.37**	**0.40**
Cadmium	7440-43-9	7.1	0.583	0.583	**0.15 J**	**0.16 J**	**0.15 J**	**0.18 J**	**0.24 J**	**0.19 J**
Chromium	7440-47-3				**14 J**	**16 J**	**20 J**	**17 J**	**19 J**	**18 J**
Chromium III	16065-83-1	12,000	None	12,000	**14 J**	**16 J**	**20 J**	**17 J**	**19 J**	**18 J**
Chromium VI	18540-29-9	0.3	None	0.3	<4.0 J	<4.0 J	<4.0 J	<4.0 J	<4.0 J	<4.0 J
Cobalt	7440-48-4	2.3	None	2.3	**2.1**	**2.1**	**2.0**	**5.8**	**6.1**	**6.2**
Copper	7440-50-8	310	28	28	**11**	**11**	**12**	**18**	**19**	**20**
Cyanide, Free/Weak Acid Dissociable	57-12-5	2.3	None	2.3	**0.27 J-**	**0.12 J-**	**0.51 J-**	**0.30 J-**	**0.21 J-**	**0.24 J-**
Lead	7439-92-1	400	35.8	35.8	**41 J**	**41 J**	**51 J**	**50 J**	**98 J**	**63 J**
Manganese	7439-96-5	180	631	180	**75**	**73**	**68**	**170**	**150**	**160**
Mercury	7439-97-6	1.1	0.18	0.18	**0.090 J**	**0.076 J**	**0.076 J**	**0.098 J**	**0.089 J**	**0.10 J**

Table 7. Summary of Surface Sediment Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL (mg/kg)	ESV (mg/kg)	PA/SI Screening Criteria (mg/kg)	SD-01 (stream downhill northeast)			SD-R (surface sediment reference area)		
Nickel	7440-02-0	150	19.5	19.5	**16**	**17**	**20**	**21**	**24**	**24**
Selenium	7782-49-2	39	None	39	**0.48 J**	**0.44 J**	**0.26 J**	<0.90	**0.23 J**	**0.30 J**
Silver	7440-22-4	39	None	39	<0.48	<0.48	<0.48	<0.45	<0.50	<0.48
Strontium	7440-24-6	4,700	None	4,700	**11**	**9.8**	**9.9**	**13**	**14**	**15**
Tellurium	13494-80-9	None	None	None	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5
Thallium	7440-28-0	0.078	None	0.078	**0.37 J**	**0.36 J**	**0.26 J**	**0.78 J**	**0.64 J**	**0.61 J**
Tin	7440-31-5	4,700	None	4,700	**3.2 J**	**2.3 J**	**2.1 J**	**2.4 J**	**2.6 J**	**2.6 J**
Titanium	7440-32-6	None	None	None	**45**	**48**	**44**	**70**	**75**	**70**
Vanadium	7440-62-2	39	None	39	**24**	**24**	**24**	**20**	**21**	**21**
Zinc	7440-66-6	2,300	98	98	**42 J-**	**41 J-**	**37 J-**	**58 J-**	**63 J-**	**71 J-**
Zirconium	7440-67-7	0.63	None	0.63	**1.2 J**	**1.3 J**	**1.5 J**	**2.5**	**2.4 J**	**2.3 J**
PAHs (mg/kg)										
Acenaphthene	83-32-9	360	4.91	4.91	**0.0065 J**	**0.023**	**0.0061 J**	**0.028**	**0.032**	**0.19**
Acenaphthylene	208-96-8	None	4.52	4.52	**0.024**	**0.023**	**0.025**	**0.13**	**0.076**	**0.074**
Anthracene	120-12-7	1,800	0.01	0.01	**0.031**	**0.062**	**0.027**	**0.15**	**0.097**	**0.35**
Benzo(a)anthracene	56-55-3	1.1	0.015	0.015	**0.15**	**0.20**	**0.11**	**0.33**	**0.28**	**0.71**
Benzo(a)pyrene	50-32-8	0.11	0.032	0.032	**0.19**	**0.24**	**0.16**	**0.55**	**0.37**	**0.79**
Benzo(b)fluoranthene	205-99-2	1.1	9.79	1.1	**0.27**	**0.37**	**0.24**	**0.79**	**0.53**	**1.2**
Benzo(g,h,i)perylene	191-24-2	None	0.016	0.016	**0.085**	**0.080**	**0.065**	**0.31**	**0.16**	**0.23**
Benzo(k)fluoranthene	207-08-9	11	9.81	9.81	**0.099**	**0.14**	**0.085**	**0.29**	**0.17**	**0.44**
Chrysene	218-01-9	110	0.026	0.026	**0.16**	**0.21**	**0.14**	**0.46**	**0.28**	**0.73**
Dibenzo(a,h)anthracene	53-70-3	0.11	0.033	0.033	**0.022**	**0.029**	**0.025**	**0.097**	**0.041**	**0.075**
Fluoranthene	206-44-0	240	0.031	0.031	**0.29**	**0.43**	**0.23**	**0.5**	**0.55**	**1.5**
Fluorene	86-73-7	240	0.01	0.01	**0.010**	**0.032**	**0.0079**	**0.032**	**0.036**	**0.25**
Indeno(1,2,3-cd)pyrene	193-39-5	1.1	0.017	0.017	**0.082**	**0.083**	**0.067**	**0.30**	**0.16**	**0.26**
Naphthalene	91-20-3	3.8	0.014	0.014	**0.025**	**0.030**	**0.029**	**0.032**	**0.042**	**0.045**
Phenanthrene	85-01-8	None	0.019	0.019	**0.12**	**0.26**	**0.094**	**0.29**	**0.33**	**1.3**
Pyrene	129-00-0	180	0.044	0.044	**0.22**	**0.29**	**0.17**	**0.41**	**0.44**	**1.2**
Other SVOCs (mg/kg)										
1,1'-Biphenyl	92-52-4	4.7	None	4.7	**0.0046 J**	**0.0069 J**	**0.0048 J**	--	--	--
2,4,5-Trichlorophenol	95-95-4	630	0.288	0.288	<0.16	<0.15	<0.16	--	--	--
2,4,6-Trichlorophenol	88-06-2	6.3	None	6.3	<0.16	<0.15	<0.16	--	--	--
2,4-Dichlorophenol	120-83-2	19	None	19	<0.16	<0.15	<0.16	--	--	--
2,4-Dimethylphenol	105-67-9	130	None	130	<0.16	<0.15	<0.16	--	--	--
2,4-Dinitrophenol	51-28-5	13	None	13	<0.34 J	<0.33 J	<0.35 J	--	--	--
2,4-Dinitrotoluene	121-14-2	1.7	None	1.7	<0.21	<0.20	<0.21	--	--	--
2,6-Dinitrotoluene	606-20-2	0.36	None	0.36	<0.21	<0.20	<0.21	--	--	--
2-Chloronaphthalene	91-58-7	480	None	480	<0.052	<0.050	<0.053	--	--	--
2-Chlorophenol	95-57-8	39	0.0272	0.0272	<0.052	<0.050	<0.053	--	--	--
2-Methylnaphthalene	91-57-6	24	4.47	4.47	**0.019**	**0.023**	**0.020**	--	--	--
2-Methylphenol	95-48-7	320	0.0119	0.0119	<0.21	<0.20	<0.21	--	--	--

Table 7. Summary of Surface Sediment Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL (mg/kg)	ESV (mg/kg)	PA/SI Screening Criteria (mg/kg)	SD-01 (stream downhill northeast)			SD-R (surface sediment reference area)		
2-Nitroaniline	88-74-4	63	None	63	<0.21	<0.20	<0.21	--	--	--
2-Nitrophenol	88-75-5	None	None	None	<0.052	<0.050	<0.053	--	--	--
3/4-Methylphenol	15831-10-4	None	None	None	<0.42	<0.40	<0.42	--	--	--
3,3'-Dichlorobenzidine	91-94-1	1.2	None	1.2	<0.10 R	<0.10 R	<0.11 R	--	--	--
3-Nitroaniline	99-09-2	None	None	None	<0.21 J	<0.20 J	<0.21 J	--	--	--
4,6-Dinitro-2-methylphenol	534-52-1	0.51	None	0.51	<0.16 J	<0.15 J	<0.16 J	--	--	--
4-Bromophenyl-phenylether	101-55-3	None	0.255	0.255	<0.052	<0.050	<0.053	--	--	--
4-Chloro-3-methylphenol	59-50-7	630	None	630	<0.16	<0.15	<0.16	--	--	--
4-Chloroaniline	106-47-8	2.7	None	2.7	<0.16 J	<0.15 J	<0.16 J	--	--	--
4-Chlorophenyl-phenylether	7005-72-3	None	None	None	<0.052	<0.050	<0.053	--	--	--
4-Nitroaniline	100-01-6	25	None	25	<0.21 J	<0.20 J	<0.21 J	--	--	--
4-Nitrophenol	100-02-7	None	None	None	<0.34	<0.33	<0.35	--	--	--
Acetophenone	98-86-2	780	None	780	<0.10	<0.10	<0.11	--	--	--
Atrazine	1912-24-9	2.4	None	2.4	<0.21 J	<0.20 J	<0.21 J	--	--	--
Benzaldehyde	100-52-7	170	None	170	<0.10 J	<0.10 J	<0.11 J	--	--	--
Benzoic acid	65-85-0	25,000	None	25,000	**0.10 J-**	**0.11 J-**	**0.11 J-**	--	--	--
bis(2-Chloroethoxy)methane	111-91-1	19	None	19	<0.10	<0.10	<0.11	--	--	--
bis(2-Chloroethyl)ether	111-44-4	0.23	None	0.23	<0.10	<0.10	<0.11	--	--	--
bis(2-Ethylhexyl)phthalate	117-81-7	39	453	39	**0.026 J**	**0.024 J**	**0.023 J**	--	--	--
bis(2-Chloroisopropyl)ether	108-60-1	310	None	310	<0.10	<0.10	<0.11	--	--	--
Butylbenzylphthalate	85-68-7	290	10.925	10.925	<0.073	<0.070	<0.074	--	--	--
Caprolactam	105-60-2	3,100	None	3,100	<0.34	<0.33	<0.35	--	--	--
Carbazole	86-74-8	None	None	None	<0.052	<0.050	<0.053	--	--	--
Dibenzofuran	132-64-9	7.3	0.3007	0.3007	**0.0094 J**	**0.023 J**	**0.013 J**	--	--	--
Diethylphthalate	84-66-2	5,100	0.6048	0.6048	<0.073	<0.070	<0.074	--	--	--
Dimethylphthalate	131-11-3	None	None	None	<0.073	<0.070	<0.074	--	--	--
Di-n-butylphthalate	84-74-2	630	1.1989	1.1989	<0.073	<0.070	<0.074	--	--	--
Di-n-octylphthalate	117-84-0	63	16.8858	16.8858	<0.073	<0.070	<0.074	--	--	--
Diphenylamine	122-39-4	630	None	630	<0.10	<0.10	<0.11	--	--	--
Hexachlorobenzene	118-74-1	0.21	None	0.21	<0.0070	<0.0067	<0.0071	--	--	--
Hexachlorobutadiene	87-68-3	1.2	0.6981	0.6981	<0.052	<0.050	<0.053	--	--	--
Hexachlorocyclopentadiene	77-47-4	0.18	None	0.18	R	R	R	--	--	--
Hexachloroethane	67-72-1	1.8	0.2136	0.2136	<0.052 J	<0.050 J	<0.053 J	--	--	--
Isophorone	78-59-1	570	None	570	<0.052	<0.050	<0.053	--	--	--
Nitrobenzene	98-95-3	5.1	None	5.1	<0.10	<0.10	<0.11	--	--	--
n-Nitroso-di-n-propylamine	621-64-7	0.078	None	0.078	<0.052	<0.050	<0.053	--	--	--
n-Nitrosodiphenylamine	86-30-6	110	0.516	0.516	<0.052	<0.050	<0.053	--	--	--
Pentachlorophenol	87-86-5	1	None	1	<0.16 J	<0.15 J	<0.16 J	--	--	--
Phenol	108-95-2	1,900	0.0012	0.0012	<0.052	<0.050	<0.053	--	--	--
Explosives (mg/kg)										
1,3,5-Trinitobenzene	99-35-4	220	None	220	<0.11	<0.096	<0.12	--	--	--
1,3-Dinitrobenzene	99-65-0	0.63	None	0.63	<0.11	<0.096	<0.12	--	--	--

Table 7. Summary of Surface Sediment Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL (mg/kg)	ESV (mg/kg)	PA/SI Screening Criteria (mg/kg)	SD-01 (stream downhill northeast)				SD-R (surface sediment reference area)		
2,4,6-Trinitrotoluene	118-96-7	3.6	None	3.6	<0.11	<0.096	<0.12		--	--	--
2,4-Dinitrotoluene	121-14-2	1.7	None	1.7	<0.11	<0.096	<0.12		--	--	--
2,6-Dinitrotoluene	606-20-2	0.36	None	0.36	<0.11	<0.096	<0.12		--	--	--
2-amino-4,6-Dinitrotoluene	35572-78-2	15	None	15	<0.11	<0.096	<0.12		--	--	--
4-amino-2,6-Dinitrotoluene	19406-51-0	15	None	15	<0.11	<0.096	<0.12		--	--	--
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	390	None	390	<0.11	<0.096	<0.12		--	--	--
m-Nitrotoluene	99-08-1	0.63	None	0.63	<0.21	<0.19	<0.24		--	--	--
Nitrobenzene	98-95-3	5.1	None	2.2	<0.32	<0.29	<0.35		--	--	--
Nitroglycerin	55-63-0	0.63	None	0.63	<2.1	<1.9	<2.4		--	--	--
o-Nitrotoluene	88-72-2	3.2	None	3.2	<0.21	<0.19	<0.24		--	--	--
p-Nitrotoluene	99-99-0	25	None	25	<0.21	<0.19	<0.24		--	--	--
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	6.1	None	6.1	<0.21	<0.19	<0.24		--	--	--
Tetryl	479-45-8	16	None	16	<0.21	<0.19	<0.24		--	--	--
Ions (mg/kg)											
Fluoride	16984-48-8	310	None	310	**1.7**	**2.0**	**1.5**		--	--	--
Perchlorate	14797-73-0	5.5	None	5.5	**0.00059**	**0.00058**	**0.00048 J**		--	--	--
Pesticides/Herbicides (mg/kg)											
2,4,5-TP (silvex)	93-72-1	51	None	51	<0.06 J	<0.061 J	<0.066		<0.061	<0.064	<0.064
4,4'-DDT	50-29-3	1.9	0.0042	0.0042	**0.0066**	**0.0070**	**0.0039 J**		**0.011**	**0.0077**	**0.012**
4,4'-DDD	72-54-8	2.3	0.0049	0.0049	**0.0044 J**	**0.0057**	<0.0049		**0.0076**	**0.0059**	**0.0057 NJ**
4,4'-DDE	72-55-9	2	0.0032	0.0032	**0.0074**	**0.0075**	**0.005 NJ**		**0.0038 J**	**0.0042 NJ**	**0.0060**
Chlordane	12789-03-6	1.7	None	1.7	<0.050	<0.050	<0.049		**0.020 J**	**0.020 J**	**0.021 J**
PCB Aroclors (mg/kg)											
Aroclor-1016	12674-11-2	0.41	None	0.41	<0.049	<0.049	<0.048		--	--	--
Aroclor-1221	11104-28-2	0.20	None	0.20	<0.049	<0.049	<0.048		--	--	--
Aroclor-1232	11141-16-5	0.17	None	0.17	<0.049	<0.049	<0.048		--	--	--
Aroclor-1242	53469-21-9	0.23	None	0.23	<0.049	<0.049	<0.048		--	--	--
Aroclor-1248	12672-29-6	0.23	None	0.23	<0.049	<0.049	<0.048		--	--	--
Aroclor-1254	11097-69-1	0.12	None	0.12	<0.049	<0.049	<0.048		--	--	--
Aroclor-1260	11096-82-5	0.24	None	0.24	<0.049	<0.049	<0.048		--	--	--

NOTES:
J = the result is an estimated quantity
J+ = the result is an estimated quantity; the result may be biased high
J- = the result is an estimated quantity; the result may be biased low
R = data are unusable and sample results are rejected
N = the analyte has been tentatively identified or presumptively is present
Bold = analyte detected above the laboratory reporting limit
Shading = detected result exceeds PA/SI screening criterion

ABBREVIATIONS:
CWM = chemical warfare material
MeHg = methylmercury
mg/kg = milligrams per kilogram
mV = milliVolt
NA = sample not collected for that analyte
ORP = oxidation-reduction potential
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SVOC = semi-volatile organic compound
"--" = sample not analyzed for that analyte

Table 8. Summary of Subsurface Soil Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL[1] (mg/kg)	ESV[2] (mg/kg)	PA/SI Screening Criteria (mg/kg)	SA-01 (former staging area)			SA-02 (downhill north and northeast area)			SA-03 (downhill northwest area)		
Discrete Samples													
CWM (mg/kg)													
				Sample ID	**CB-01a**	**CB-02a**	**CB-03a**						
				Sample Date	**2/20/18**	**2/20/18**	**2/20/18**						
1,4-Dithiane	505-29-3	78	None	78	<0.1	<0.1	<0.098	**NA**			**NA**		
1,4-Oxathiane (1,4-Thioxane)	15980-15-1	None	None	None	<0.1	<0.1	<0.098						
Mustard (HD)	505-60-2	None	None	None	<0.01	<0.01	<0.0098						
Lewisite (L)	541-25-3	0.039	None	0.039	<0.024 J	<0.024 J	<0.024 J						
Chloroacetophenone (CN)	532-27-4	4,300	None	4,300	<0.1	<0.1	<0.1						
Thiodigylcol (TDG)	111-48-8	540	None	540	<0.12	<0.13	<0.12						
Ricin	9009-86-3	None	None	None	negative	negative	negative						
ORP (mV)													
				Sample ID	**CB-01B**	**CB-02B**	**CB-03B**	**CS-SB02-01B**			**CS-SB03-01B**		
				Sample Date	**3/8/18**	**3/8/18**	**3/8/18**	**6/26/18**			**6/26/18**		
Oxidation-Reduction Potential (ORP)	None	None	None	None	**400 J**	**380 J**	**360 J**	**270 J**			**260 J**		
MeHg (mg/kg)													
				Sample ID	**CB-01C**	**CB-02C**	**CB-03C**	**CB-04C**	**CB-05C**	**CB-06C**	**CB-07C**	**CB-08C**	**CB-09C**
				Sample Date	**3/8/18**	**3/8/18**	**3/8/18**	**6/26/18**	**6/26/18**	**6/26/18**	**6/27/18**	**6/27/18**	**6/27/18**
Methylmercury	22967-92-6	0.78	0.00035	0.00035	**0.00014**	**0.000097 J**	**0.00013**	**0.00064**	**0.00037**	**0.002**	**0.00086**	**0.0014**	**0.00073**
Incremental Sampling Methodology (ISM) Samples													
				Sample ID	**SB-01-A**	**SB-01-B**	**SB-01-C**	**SB-02-A**	**SB-02-B**	**SB-02-C**	**SB-03-A**	**SB-03-B**	**SB-03-C**
				Sample Date	**3/7/18**	**3/8/18**	**3/7/18**	**6/27/18**	**6/27/18**	**6/27/18**	**6/26/18**	**6/26/18**	**6/26/18**
Metals (mg/kg)													
Aluminum	7429-90-5	7,700	50	50	**8600 J**	**7500 J**	**7200 J**	**7200 J**	**6800 J**	**6400 J**	**7000 J**	**7000 J**	**7000 J**
Antimony	7440-36-0	3.1	0.248	0.248	<1.0 J	<1.1 J	<1.0 J	--	--	--	--	--	--
Arsenic	7440-38-2	0.68	0.25	0.25	**19 J**	**9.4 J**	**14 J**	--	--	--	--	--	--
Barium	7440-39-3	1,500	17.2	17.2	**48 J**	**43 J**	**41 J**	**68 J-**	**72 J-**	**130 J-**	**48 J-**	**64 J-**	**53 J-**
Beryllium	7440-41-7	16	2.42	2.42	**0.68**	**0.67**	**0.67**	--	--	--	--	--	--
Cadmium	7440-43-9	7.1	0.27	0.27	**0.13 J**	**0.10 J**	**0.14 J**	**0.39**	**0.43**	**0.43**	**0.29**	**0.31**	**0.32**
Chromium	7440-47-3		0.34	0.34	**39 J**	**33 J**	**33 J**	**27 J**	**26 J**	**27 J**	**22 J**	**23 J**	**22 J**
Chromium III	16065-83-1	12,000	0.83	0.83	**39 J**	**33 J**	**33 J**	--	--	--	--	--	--
Chromium VI	18540-29-9	0.3	7.21	0.3	<0.93 J	<0.92 J	<1.8 J	--	--	--	--	--	--
Cobalt	7440-48-4	2.3	13	2.3	**5.0**	**3.4**	**3.4**	**6.3**	**6.9**	**5.2**	**3.4**	**4.0**	**3.5**
Copper	7440-50-8	310	15	15	**11 J**	**7.6 J**	**9.3 J**	**33 J**	**42 J**	**27 J**	**18 J**	**20 J**	**17 J**
Cyanide, Free/Weak Acid Dissociable	57-12-5	2.3	0.1	0.1	<0.48	<0.52	<0.46	--	--	--	--	--	--
Lead	7439-92-1	400	0.94	0.94	**8.7**	**7.1**	**11**	--	--	--	--	--	--
Manganese	7439-96-5	180	220	180	**150 J**	**120 J**	**120 J**	**240 J**	**290 J**	**220 J**	**130 J**	**150 J**	**150 J**
Mercury	7439-97-6	1.1	0.013	0.013	**0.76 J**	**0.27 J+**	**0.53 J+**	--	--	--	--	--	--
Nickel	7440-02-0	150	9.7	9.7	**22**	**15**	**20**	**20**	**21**	**20**	**13**	**15**	**13**
Selenium	7782-49-2	39	0.331	0.331	**0.53 J**	**0.52 J**	**0.32 J**	--	--	--	--	--	--
Silver	7440-22-4	39	2	2	<0.51	<0.54	**0.11 J**	--	--	--	--	--	--
Strontium	7440-24-6	4,700	None	4,700	**6.4**	**6.0**	**5.5**	--	--	--	--	--	--
Tellurium	13494-80-9	None	None	None	<2.5	<2.5	<2.5	--	--	--	--	--	--

Table 8. Summary of Subsurface Soil Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL[1] (mg/kg)	ESV[2] (mg/kg)	PA/SI Screening Criteria (mg/kg)	SA-01 (former staging area)			SA-02 (downhill north and northeast area)			SA-03 (downhill northwest area)		
Thallium	7440-28-0	0.078	0.027	0.027	**0.92 J**	**0.75 J**	**0.79 J**	**0.33 J**	**0.22 J**	**0.35 J**	**0.27 J**	**0.26 J**	**0.27 J**
Tin	7440-31-5	4,700	None	4,700	**6.1**	**8.7**	**4.1 J**	--	--	--	--	--	--
Titanium	7440-32-6	None	None	None	**160 J**	**100 J**	**90 J**	--	--	--	--	--	--
Vanadium	7440-62-2	39	0.714	0.714	**25**	**22**	**21**	--	--	--	--	--	--
Zinc	7440-66-6	2,300	6.62	6.62	**38**	**33**	**43**	**120**	**120**	**120**	**72**	**95**	**88**
Zirconium	7440-67-7	0.63	None	0.63	<2.5	<2.5	<2.5	**2.2 J**	**1.8 J**	**1.6 J**	**2.9**	**2.5**	**2.2 J**
VOCs (mg/kg)													
1,1,1-Trichloroethane	71-55-6	810	260	260	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	79-34-5	0.6	None	0.6	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,1,2-Trichloroethane	79-00-5	0.15	None	0.15	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	670	None	670	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,1-Dichloroethane	75-34-3	3.6	210	3.6	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,1-Dichloroethene	75-35-4	23	11	11	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,2,4-Trichlorobenzene	120-82-1	5.8	0.27	0.27	**0.031 J**	<0.31	<0.30	--	--	--	--	--	--
1,2-Dibromo-3-chloropropane	96-12-8	0.0053	None	0.0053	<0.59	<0.63	<0.59	--	--	--	--	--	--
1,2-Dibromoethane (EDB)	106-93-4	0.036	None	0.036	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,2-Dichlorobenzene	95-50-1	180	0.92	0.92	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,2-Dichloroethane	107-06-2	0.46	0.85	0.46	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,2-Dichloropropane	78-87-5	0.28	700	0.28	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,3-Dichlorobenzene	541-73-1	None	0.73	0.73	<0.29	<0.31	<0.30	--	--	--	--	--	--
1,4-Dichlorobenzene	106-46-7	2.6	0.88	0.88	<0.29	<0.31	<0.30	--	--	--	--	--	--
2-Butanone (MEK)	78-93-3	2,700	360	360	<1.2	<1.3	<1.2	--	--	--	--	--	--
2-Hexanone	591-78-6	20	0.36	0.36	<1.2	<1.3	<1.2	--	--	--	--	--	--
4-Methyl-2-pentanone (MIBK)	108-10-1	3,300	9.8	9.8	<1.2	<1.3	<1.2	--	--	--	--	--	--
Acetone	67-64-1	6,100	1.2	1.2	<1.2	<1.3	<1.2	--	--	--	--	--	--
Benzene	71-43-2	1.2	24	1.2	<0.29	<0.31	<0.30	--	--	--	--	--	--
Bromoform	75-25-2	19	None	19	<0.29	<0.31	<0.30	--	--	--	--	--	--
Bromomethane	74-83-9	0.68	None	0.68	<0.29	<0.31	<0.30	--	--	--	--	--	--
Carbon disulfide	75-15-0	77	0.82	0.82	<0.10	<0.31	<0.099	--	--	--	--	--	--
Carbon tetrachloride	56-23-5	0.65	58.6	0.65	<0.29	<0.31	<0.30	--	--	--	--	--	--
Chlorobenzene	108-90-7	28	2.4	2.4	<0.29	<0.31	<0.30	--	--	--	--	--	--
Dibromochloromethane	124-48-1	8.3	None	8.3	<0.29	<0.31	<0.30	--	--	--	--	--	--
Chloroethane	75-00-3	1,400	None	1,400	<0.29	<0.31	<0.30	--	--	--	--	--	--
Chloroform	67-66-3	0.32	8	0.32	<0.29	<0.31	<0.30	--	--	--	--	--	--
Chloromethane	74-87-3	11	None	11	<0.29	<0.31	<0.30	--	--	--	--	--	--
cis-1,2-Dichloroethene	156-59-2	16	89.6	16	<0.29	<0.31	<0.30	--	--	--	--	--	--
cis-1,3-Dichloropropene	10061-01-5	None	None	None	<0.29	<0.31	<0.30	--	--	--	--	--	--
Cyclohexane	110-82-7	650	None	650	<0.59	<0.63	<0.59	--	--	--	--	--	--
Bromodichloromethane	75-27-4	0.29	None	0.29	<0.29	<0.31	<0.30	--	--	--	--	--	--
Dichlorodifluoromethane	75-71-8	8.7	None	8.7	<0.29	<0.31	<0.30	--	--	--	--	--	--
Ethylbenzene	100-41-4	5.8	None	5.8	<0.29	<0.31	<0.30	--	--	--	--	--	--
IsoPropylbenzene	98-82-8	190	None	190	<0.29	<0.31	<0.30	--	--	--	--	--	--
Methyl acetate	79-20-9	7,800	None	7,800	<1.5	<1.6	<1.5	--	--	--	--	--	--
Methyl-tert-butyl ether (MTBE)	1634-04-4	47	None	47	<0.29	<0.31	<0.30	--	--	--	--	--	--
Methylcyclohexane	108-87-2	None	None	None	<0.59	<0.63	<0.59	--	--	--	--	--	--
Methylene chloride	75-09-2	35	2.6	2.6	<0.29	<0.31	<0.30	--	--	--	--	--	--
mp-Xylene	179601-23-1	None	None	None	<0.29	<0.31	<0.30	--	--	--	--	--	--

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Fort Totten Area of Concern

ANALYTE	CAS Number	RSL[1] (mg/kg)	ESV[2] (mg/kg)	PA/SI Screening Criteria (mg/kg)	SA-01 (former staging area)			SA-02 (downhill north and northeast area)			SA-03 (downhill northwest area)		
o-Xylene	95-47-6	65	None	65	<0.29	<0.31	<0.30	--	--	--	--	--	--
Styrene	100-42-5	600	1.2	1.2	<0.29	<0.31	<0.30	--	--	--	--	--	--
Tetrachloroethene	127-18-4	8.1	0.18	0.18	<0.29	<0.31	<0.30	--	--	--	--	--	--
Toluene	108-88-3	490	23	23	<0.29	<0.31	<0.30	--	--	--	--	--	--
trans-1,2-Dichloroethene	156-60-5	160	89.6	89.6	<0.29	<0.31	<0.30	--	--	--	--	--	--
trans-1,3-Dichloropropene	10061-02-6	None	None	None	<0.29	<0.31	<0.30	--	--	--	--	--	--
Trichloroethene	79-01-6	0.41	1.387	0.41	<0.29	<0.31	<0.30	--	--	--	--	--	--
Trichlorofluoromethane	75-69-4	2,300	52	52	<0.29	<0.31	<0.30	--	--	--	--	--	--
Vinyl chloride	75-01-4	0.059	0.12	0.059	<0.29	<0.31	<0.30	--	--	--	--	--	--
Xylenes, total	1330-20-7	58	1.4	1.4	<0.59	<0.63	<0.59	--	--	--	--	--	--
PAHs (mg/kg)													
Acenaphthene	83-32-9	360	0.25	0.25	<0.0064	<0.0067	<0.0064	**0.016**	**0.014**	**0.027**	**0.014**	**0.063**	**0.099**
Acenaphthylene	208-96-8	None	120	120	**0.0038 J**	<0.0067	<0.0064	**0.032**	**0.049**	**0.053**	**0.083**	**0.068**	**0.084**
Anthracene	120-12-7	1,800	6.8	6.8	**0.0050 J**	<0.0067	<0.0064	**0.052**	**0.061**	**0.11**	**0.069**	**0.17**	**0.2**
Benzo(a)anthracene	56-55-3	1.1	0.8	0.8	**0.012**	**0.0042 J**	**0.0037 J**	**0.17 J-**	**0.23 J-**	**0.38 J-**	**0.25 J-**	**0.44 J-**	**0.53 J-**
Benzo(a)pyrene	50-32-8	0.11	53	0.11	**0.015**	**0.0049 J**	**0.0049 J**	**0.19 J-**	**0.27 J-**	**0.4 J-**	**0.27 J-**	**0.5 J-**	**0.58 J-**
Benzo(b)fluoranthene	205-99-2	1.1	18	1.1	**0.022**	**0.0086**	**0.0085**	**0.25 J-**	**0.37 J-**	**0.55 J-**	**0.39 J-**	**0.64 J-**	**0.8 J-**
Benzo(g,h,i)perylene	191-24-2	None	1.98	1.98	**0.010**	**0.0040 J**	**0.0043 J**	**0.13**	**0.16**	**0.24**	**0.15**	**0.29**	**0.29**
Benzo(k)fluoranthene	207-08-9	11	62	11	**0.0081**	<0.0067	<0.0064	**0.1 J-**	**0.13 J-**	**0.2 J-**	**0.099 J-**	**0.2 J-**	**0.27 J-**
Chrysene	218-01-9	110	2.4	2.4	**0.014**	**0.0050 J**	**0.0058 J**	**0.19 J-**	**0.28 J-**	**0.43 J-**	**0.28 J-**	**0.49 J-**	**0.55 J-**
Dibenzo(a,h)anthracene	53-70-3	0.11	12	0.11	<0.0064	<0.0067	<0.0064	**0.038**	**0.045**	**0.072**	**0.056**	**0.092**	**0.1**
Fluoranthene	206-44-0	240	10	10	**0.029**	**0.0086**	**0.0099**	**0.31 J-**	**0.44 J-**	**0.74 J-**	**0.42 J-**	**0.91 J-**	**1.1 J-**
Fluorene	86-73-7	240	3.7	3.7	**0.0038 J**	<0.0067	<0.0064	**0.018**	**0.02**	**0.034**	**0.022**	**0.051**	**0.082**
Indeno(1,2,3-cd)pyrene	193-39-5	1.1	62	1.1	**0.010**	**0.0037 J**	**0.0038 J**	**0.110**	**0.14**	**0.21**	**0.140**	**0.26**	**0.29**
Naphthalene	91-20-3	3.8	1	1	**0.0067**	**0.007**	**0.0067**	**0.03**	**0.03**	**0.04**	**0.026**	**0.04**	**0.066**
Phenanthrene	85-01-8	None	5.5	5.5	**0.019**	**0.0052 J**	**0.0072**	**0.17 J-**	**0.21 J-**	**0.43 J-**	**0.23 J-**	**0.68 J-**	**0.72 J-**
Pyrene	129-00-0	180	10	10	**0.019**	**0.0066 J**	**0.0071**	**0.26 J-**	**0.37 J-**	**0.61 J-**	**0.38 J-**	**0.72 J-**	**0.85 J-**
Other SVOCs (mg/kg)													
1,1'-Biphenyl	92-52-4	4.7	None	4.7	<0.048	<0.050	<0.048	--	--	--	--	--	--
2,4,5-Trichlorophenol	95-95-4	630	4	4	<0.14	<0.15	<0.14	--	--	--	--	--	--
2,4,6-Trichlorophenol	88-06-2	6.3	10	6.3	<0.14	<0.15	<0.14	--	--	--	--	--	--
2,4-Dichlorophenol	120-83-2	19	None	19	<0.14	<0.15	<0.14 J	--	--	--	--	--	--
2,4-Dimethylphenol	105-67-9	130	0.01	0.01	<0.14	<0.15	<0.14	--	--	--	--	--	--
2,4-Dinitrophenol	51-28-5	13	20	13	<0.32 J	<0.33 J	<0.32 J	--	--	--	--	--	--
2,4-Dinitrotoluene	121-14-2	1.7	6	1.7	<0.19	<0.20	<0.19	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	0.36	4.1	0.36	<0.19	<0.20	<0.19	--	--	--	--	--	--
2-Chloronaphthalene	91-58-7	480	None	480	<0.048	<0.050	<0.048	--	--	--	--	--	--
2-Chlorophenol	95-57-8	39	0.39	0.39	<0.048	<0.050	<0.048	--	--	--	--	--	--
2-Methylnaphthalene	91-57-6	24	16	16	**0.0057 J**	**0.0049 J**	**0.0071**	--	--	--	--	--	--
2-Methylphenol	95-48-7	320	0.67	0.67	<0.19	<0.20	<0.19 J	--	--	--	--	--	--
2-Nitroaniline	88-74-4	63	5.4	5.4	<0.19	<0.20	<0.19	--	--	--	--	--	--
2-Nitrophenol	88-75-5	None	7	7	<0.048	<0.050	<0.048 J	--	--	--	--	--	--
3/4-Methylphenol	15831-10-4	None	None	None	<0.39	<0.40	<0.38 J	--	--	--	--	--	--
3,3'-Dichlorobenzidine	91-94-1	1.2	None	1.2	<0.097 J	<0.10 J	<0.096 J	--	--	--	--	--	--
3-Nitroaniline	99-09-2	None	None	None	<0.19	<0.20	<0.19	--	--	--	--	--	--

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4,6-Dinitro-2-methylphenol	534-52-1	0.51	None	0.51	<0.14	<0.15	<0.14	--	--	--	--	--	--
4-Bromophenyl-phenylether	101-55-3	None	None	None	<0.048	<0.050	<0.048	--	--	--	--	--	--
4-Chloro-3-methylphenol	59-50-7	630	None	630	<0.14	<0.15	<0.14	--	--	--	--	--	--
4-Chloroaniline	106-47-8	2.7	1	1	<0.14 J	<0.15 J	<0.14 J	--	--	--	--	--	--
4-Chlorophenyl-phenylether	7005-72-3	None	None	None	<0.048	<0.050	<0.048	--	--	--	--	--	--
4-Nitroaniline	100-01-6	25	None	25	<0.19	<0.20	<0.19	--	--	--	--	--	--
4-Nitrophenol	100-02-7	None	7	7	<0.32	<0.33	<0.32 J	--	--	--	--	--	--
Acetophenone	98-86-2	780	None	780	**0.016 J**	<0.10	<0.096	--	--	--	--	--	--
Atrazine	1912-24-9	2.4	None	2.4	<0.19	<0.20	<0.19	--	--	--	--	--	--
Benzaldehyde	100-52-7	170	None	170	**0.018 J**	**0.017 J**	**0.015 J**	--	--	--	--	--	--
Benzoic acid	65-85-0	25,000	None	25,000	R	R	R	--	--	--	--	--	--
bis(2-Chloroethoxy)methane	111-91-1	19	None	19	<0.097	<0.10	<0.096	--	--	--	--	--	--
bis(2-Chloroethyl)ether	111-44-4	0.23	None	0.23	<0.097	<0.10	<0.096	--	--	--	--	--	--
bis(2-Ethylhexyl)phthalate	117-81-7	39	0.02	0.02	<0.068	<0.070	<0.067	--	--	--	--	--	--
bis(2-Chloroisopropyl)ether	108-60-1	310	None	310	<0.097	<0.10	<0.096	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	290	90	90	**0.031 J**	<0.070	<0.067	--	--	--	--	--	--
Caprolactam	105-60-2	3,100	None	3,100	<0.32	<0.33	<0.32	--	--	--	--	--	--
Carbazole	86-74-8	None	80	80	<0.048	<0.050	<0.048	--	--	--	--	--	--
Dibenzofuran	132-64-9	7.3	6.1	6.1	<0.048	<0.050	<0.048	--	--	--	--	--	--
Diethylphthalate	84-66-2	5,100	100	100	<0.068	<0.07	<0.067	--	--	--	--	--	--
Dimethylphthalate	131-11-3	None	10	10	<0.068	<0.070	<0.067	--	--	--	--	--	--
Di-n-butylphthalate	84-74-2	630	0.011	0.011	<0.068	<0.070	<0.067	--	--	--	--	--	--
Di-n-octylphthalate	117-84-0	63	0.91	0.91	<0.068	<0.070	<0.067	--	--	--	--	--	--
Diphenylamine	122-39-4	630	None	630	<0.097	<0.10	<0.096	--	--	--	--	--	--
Hexachlorobenzene	118-74-1	0.21	0.079	0.079	<0.0064	<0.0067	<0.0064	--	--	--	--	--	--
Hexachlorobutadiene	87-68-3	1.2	None	1.2	<0.048	<0.050	<0.048	--	--	--	--	--	--
Hexachlorocyclopentadiene	77-47-4	0.18	10	0.18	R	R	R	--	--	--	--	--	--
Hexachloroethane	67-72-1	1.8	None	1.8	<0.048	<0.050	<0.048	--	--	--	--	--	--
Isophorone	78-59-1	570	None	570	<0.048	<0.050	<0.048	--	--	--	--	--	--
Nitrobenzene	98-95-3	5.1	2.2	2.2	<0.097	<0.10	<0.096	--	--	--	--	--	--
n-Nitroso-di-n-propylamine	621-64-7	0.078	None	0.078	<0.048	<0.050	<0.048	--	--	--	--	--	--
n-Nitrosodiphenylamine	86-30-6	110	20	20	<0.048	<0.050	<0.048	--	--	--	--	--	--
Pentachlorophenol	87-86-5	1	0.36	0.36	<0.14 J	<0.15 J	<0.14 J	--	--	--	--	--	--
Phenol	108-95-2	1,900	0.79	0.79	<0.048	<0.050	<0.048 J	--	--	--	--	--	--
Explosives (mg/kg)													
1,3,5-Trinitobenzene	99-35-4	220	None	220	<0.095	<0.098	<0.097	--	--	--	--	--	--
1,3-Dinitrobenzene	99-65-0	0.63	None	0.63	<0.095	<0.098	<0.097	--	--	--	--	--	--
2,4,6-Trinitrotoluene	118-96-7	3.6	None	3.6	<0.095	<0.098	<0.097	--	--	--	--	--	--
2,4-Dinitrotoluene	121-14-2	1.7	6	1.7	<0.095	<0.098	<0.097	--	--	--	--	--	--
2,6-Dinitrotoluene	606-20-2	0.36	4.1	0.36	<0.095	<0.098	<0.097	--	--	--	--	--	--
2-amino-4,6-Dinitrotoluene	35572-78-2	15	None	15	<0.095	<0.098	<0.097	--	--	--	--	--	--
4-amino-2,6-Dinitrotoluene	19406-51-0	15	None	15	<0.095	<0.098	<0.097	--	--	--	--	--	--
HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	2691-41-0	390	None	390	<0.095	<0.098	<0.097	--	--	--	--	--	--
m-Nitrotoluene	99-08-1	0.63	None	0.63	<0.19	<0.20	<0.19	--	--	--	--	--	--
Nitrobenzene	98-95-3	5.1	2.2	2.2	<0.28	<0.29	<0.29	--	--	--	--	--	--
Nitroglycerin	55-63-0	0.63	None	0.63	<1.9	<2.0	<1.9	--	--	--	--	--	--

Table 8. Summary of Subsurface Soil Sample Analytical Results
Fort Totten Area of Concern

ANALYTE	CAS Number	RSL[1] (mg/kg)	ESV[2] (mg/kg)	PA/SI Screening Criteria (mg/kg)	SA-01 (former staging area)			SA-02 (downhill north and northeast area)			SA-03 (downhill northwest area)		
o-Nitrotoluene	88-72-2	3.2	None	3.2	<0.19	<0.20	<0.19	--	--	--	--	--	--
p-Nitrotoluene	99-99-0	25	None	25	<0.19	<0.20	<0.19	--	--	--	--	--	--
RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	121-82-4	6.1	None	6.1	<0.19	<0.20	<0.19	--	--	--	--	--	--
Tetryl	479-45-8	16	None	16	<0.19	<0.20	<0.19	--	--	--	--	--	--
Ions (mg/kg)													
Fluoride	16984-48-8	310	None	310	**5.1**	**5.3**	**4.1**	--	--	--	--	--	--
Perchlorate	14797-73-0	5.5	None	5.5	**0.00043 J**	**0.00035 J**	**0.00041 J**	--	--	--	--	--	--
Pesticides/Herbicides (mg/kg)													
2,4,5-TP (silvex)	93-72-1	51	0.109	0.109	<0.056 J	<0.059	<0.059 J	--	--	--	--	--	--
4,4'-DDT	50-29-3	1.9	0.021	0.021	<0.0047	<0.0048	<0.0048	--	--	--	--	--	--
4,4'-DDD	72-54-8	2.3	0.0063	0.0063	<0.0047	<0.0048	<0.0048	--	--	--	--	--	--
4,4'-DDE	72-55-9	2	0.021	0.021	<0.0047	<0.0048	<0.0048	--	--	--	--	--	--
Chlordane	12789-03-6	1.70	0.22	0.22	<0.047	<0.048	<0.048	--	--	--	--	--	--
PCB Arochlors (mg/kg)													
Aroclor-1016	12674-11-2	0.41	1	0.41	<0.047	<0.048	<0.048	--	--	--	--	--	--
Aroclor-1221	11104-28-2	0.20	None	0.20	<0.047	<0.048	<0.048	--	--	--	--	--	--
Aroclor-1232	11141-16-5	0.17	None	0.17	<0.047	<0.048	<0.048	--	--	--	--	--	--
Aroclor-1242	53469-21-9	0.23	0.041	0.041	<0.047	<0.048	<0.048	--	--	--	--	--	--
Aroclor-1248	12672-29-6	0.23	0.0072	0.0072	<0.047	<0.048	<0.048	--	--	--	--	--	--
Aroclor-1254	11097-69-1	0.12	0.041	0.041	<0.047	<0.048	<0.048	--	--	--	--	--	--
Aroclor-1260	11096-82-5	0.24	0.88	0.24	<0.047	<0.048	<0.048	--	--	--	--	--	--

NOTES:
J = the result is an estimated quantity
J+ = the result is an estimated quantity; the result may be biased high
J- = the result is an estimated quantity; the result may be biased low
R = data are unusable and sample results are rejected
N = the analyte has been tentatively identified or presumptively is present
Bold = analyte detected above the laboratory reporting limit
Shading = detected result exceeds PA/SI screening criterion

ABBREVIATIONS:
CWM = chemical warfare material
MeHg = methylmercury
mg/kg = milligrams per kilogram
mV = milliVolt
NA = sample not collected for that analyte
ORP = oxidation-reduction potential
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
SVOC = semi-volatile organic compound
VOC = volatile organic compound
"--" = sample not analyzed for that analyte

Appendices

Appendix A – June 19, 2017 Site Reconnaissance Photographic Log

 Photo 1 - Dense vegetation in the Former Staging Area. Orientation: north. Date: 6/19/17. Time: 1500.	 Photo 2 - Farragut Street/Brookland Ave NE. Area of Concern to right. Orientation: west. Date: 6/19/17. Time: 1501.
 Photo 3 - Former Staging Area from Farragut Street/Brookland Ave NE. Orientation: north. Date: 6/19/17. Time: 1452.	 Photo 4 - Example of dense vegetation in the Area of Concern. Orientation: north. Date: 6/19/17. Time: 1504.

Appendix B – Historical Aerial Photographs (provided on CD only)

Appendix C – SI Analytical Data Reports (provided on CD only)

Appendix D – SI Analytical Data Validation Reports (provided on CD only)

Appendix E – Data Analysis and Focused HHRA

COMMITMENT & INTEGRITY
DRIVE RESULTS

980 Washington Street | Suite 325
Dedham, Massachusetts 02026
www.woodardcurran.com

T 800.446.5518
T 781.251.0200
F 781.251.0847

MEMORANDUM

TO: Bettina Longino, The Johnson Company

FROM: Kyle Apigian and Lisa McIntosh, Woodard & Curran

DATE: February 6, 2019

RE: Fort Totten Park Data Analysis

Objectives

This memorandum presents the results of an analysis of soil and sediment data collected from the National Park Service (NPS) Fort Totten Park in Washington D.C. The purpose of the analysis was to evaluate whether concentrations of several constituents – metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, and herbicides – were elevated relative to local reference conditions in an area where fill material had historically been placed.

Nomenclature

The area within Fort Totten Park considered the "Site" consists of three decision units:

- SA-01, also referred to as the Former Staging Area (FSA)
- SA-02, the area downhill of the FSA to the north and northeast
- SA-03, the area downhill of the FSA to the northwest
- SA-R, reference samples collected from a similar environment to the south that reportedly did not receive fill material.

Three soil samples were collected from each decision unit using Incremental Sampling Methodology (ISM), consistent with the project Sampling and Analysis Plan (SAP, The Johnson Company, 2018).

In addition, three sediment samples were collected using ISM from a decision unit (SD-01) in a stream located adjacent to the Site to the north. Sediment samples collected immediately adjacent to the Site (north of SA-03) were considered "Site" samples, while samples collected away from the Site – farther to the north and upstream of SD-01 – were considered "reference" samples.

Analytical results were compared to two different screening levels: USEPA Regional Screening Levels (RSLs) for residential soil, which are human health risk-based values, and NPS Ecological Screening Values (ESVs) for soil or sediment, as applicable. The more conservative of the two values (the RSL or the ESV) was selected as the final screening level for the Site data.

Methodology

Decision logic for constituent screening

Prior to running any hypothesis tests comparing Site concentrations to reference area concentrations, constituents were screened based on several factors to eliminate them from further consideration. The following decision logic was used to determine whether to carry a constituent through to the hypothesis testing phase:

1. Constituents that were not detected in any Site sample were eliminated from further consideration;

2. Constituents that did not exceed any screening criteria were eliminated from further consideration; and

3. Constituents for which the mean reference concentration exceeded the mean Site concentration were eliminated from further consideration.

The remaining constituents were tested using a two-sample Student's t-test assuming equal variance, as described below. The results of the screening are described in the sections below.

Hypothesis tests

Inferential statistical tests were completed for constituents that passed the screening criteria described above. Two-sample Student's t-tests assuming equal variance were used to compare Site mean concentrations to reference mean concentrations. Numerical simulation studies presented in the statistical literature (Pooler, 2017) indicate that t-tests (assuming equal variance) generally provide adequate results for Site/reference comparisons using ISM data, even with relatively small sample sizes. As indicated in the literature, t-tests are preferable to upper bound statistics (such as the Upper Tolerance Limit) for evaluating Site conditions relative to reference areas. A "one-sided" or "one-tailed" hypothesis testing approach was used; the null hypothesis tested was that Site concentrations were less than or equal to reference concentrations and the alternative hypothesis was that Site concentrations were greater than reference concentrations. One-half the detection limit was substituted for non-detect values.

An "alpha", or p-value, of 0.1 was used as the threshold for rejecting the null hypothesis, in accordance with the objectives outlined in the SAP. This indicates that, when the p-value from the t-test is less than 0.1, there is a 10% chance of finding a false positive result (that is, rejecting the null hypothesis when it should in fact be accepted). When the null hypothesis is rejected, the constituent concentration in the Site decision unit has been statistically determined to be greater than the constituent concentration in the reference area unit. The term "significantly greater" is used herein to describe any statistically meaningful difference in concentrations and is not indicative of the magnitude of that difference.

Corrections for multiple comparisons

In the case of surface soil samples, multiple comparisons were made between the reference location and the three separate Site decision units (the FSA and the two downhill locations). In order to adjust for the inflated Type I error rate that may result from multiple comparisons, a Bonferroni correction (Helsel 2012) was applied to the results from the surface soil analysis. The correction is applied by dividing the p-value selected for rejecting the null hypothesis (in this case, 0.1) by the number of comparisons (3). Therefore, in the case of soil samples, the null hypothesis was rejected if the p-value of the test was less than 0.033 (rather than 0.1).

Results: Surface Soil

Metals

- Generally speaking, the highest concentrations of metals tend to be present in the "downhill" decision units (SA-02 and SA-03).

- Eight metals were eliminated from consideration because they were not detected at any of the three Site locations, or they did not exceed screening criteria at any Site decision unit: antimony, beryllium, hexavalent chromium, silver, strontium, tellurium, tin, and titanium.

- Cyanide, selenium, and vanadium were also eliminated because mean reference area concentrations exceeded mean concentrations at all of the Site decision units (SA-01, SA-02, and SA-03).

- The following table summarizes the results of hypothesis testing (p-values of the t-tests) for the remaining 15 metals. Highlighted cells show instances where the Site concentration was significantly greater than reference ($p<0.1$, adjusted for multiple comparisons to $p<0.033$). The second table shows mean concentrations for each area:

Based on this analysis, concentrations of aluminum, chromium, and thallium are significantly greater at the FSA (SA-01) than the reference area. Concentrations of the following list of metals are significantly greater at one or both of the downhill Site decision units than in the reference area: aluminum, barium, cadmium, chromium, cobalt, copper, manganese, methylmercury, nickel, thallium, zinc, and zirconium. Mean arsenic, lead, and mercury concentrations were higher in one or more of the Site decision units than in reference areas, but the differences were not statistically significant. Mean concentrations and the results (p-values) of the t-tests are presented in the following tables:

	Mean Concentration (mg/kg)				p-values (t-test, equal variances)		
	SA-01 (FSA)	SA-02 (downhill)	SA-03 (downhill)	Reference	SA-01 (FSA) vs. reference	SA-02 (downhill) vs. reference	SA-03 (downhill) vs. reference
Aluminum	5866.7	6500.0	5900.0	4333.3	0.001	0.00234	0.007
Arsenic	5.5	9.5	5.1	4.1	0.077	0.085	0.040
Barium	35.0	53.3	52.7	38.3	n/a, ref>site	0.001	0.001
Cadmium	0.088	0.4	0.6	0.15	n/a, ref>site	0.001	0.041
Chromium	27	28.3	21.3	17.3	0.001	0.006	0.0391
Cobalt	2.1	6.1	3.7	1.7	0.066	0.001	0.006
Copper	5.3	22.3	20.3	13	n/a, ref>site	0.001	0.001
Lead	6.6	63.0	133.3	107.7	n/a, ref>site	n/a, ref>site	0.074
Manganese	100	227	160	92	0.293	0.001	0.008
Mercury	0.1	0.4	0.180	0.2	n/a, ref>site	0.174	n/a, ref>site
Methyl-mercury	0.00016	0.00045	0.00109	0.00008	0.177	0.009	0.016
Nickel	7.70	23.67	17.33	13.33	n/a, ref>site	0.0004	0.011
Thallium	0.56	0.99	0.71	0.35	0.032	0.003	0.001
Zinc	31	105	110.0	33	n/a, ref>site	0.001	0.0000002
Zirconium	1.3	1.3	1.9	1.3	n/a, site ND	n/a, ref>site	0.010

Highlighted cells represent Site concentrations of metals that are significantly greater than reference.

PAHs

- PAHs were detected in Site and reference area samples. PAHs tend to be highest in the downhill decision units, but there were few screening criteria exceedances (only for benzo(a)pyrene, and this constituent also exceeded the screening level in the reference location).
- The mean concentration of benzo(a)pyrene at the SA-03 Site decision unit (0.483 mg/kg) was significantly greater than reference (0.203 mg/kg, $p<0.02$). At the FSA, however, the reference mean was greater than the Site mean. While the mean concentration at SA-02 was slightly greater than reference – the difference was not statistically significant.

Pesticides/herbicides

- These constituents were only detected in samples from the downhill decision units and the reference area, and the difference in magnitude between the Site and reference concentrations was marginal, suggesting their presence is consistent with background conditions.

Sediment Results

General Observations

- There are no analytes that exceed screening levels in Site samples that do not also exceed screening levels at the reference location.
- The reporting limit for hexavalent chromium is higher that both the RSL and ESV screening levels.

Metals

- There were no metals that passed the decision logic criteria for constituent screening described above. For each metal, either the Site sample concentrations were non-detect, the metal concentrations did not exceed screening levels at the Site, or the reference mean was greater than the Site mean. Therefore, no hypothesis tests were run for metals constituents.

PAHs

- The mean concentrations of each PAH were greater in the reference samples than in the Site samples. Furthermore, none of the maximum PAH values was observed in the Site samples. Therefore, no hypothesis tests were run for PAH constituents.

Pesticides/Herbicides

- 2,4,5-TP and Chlordane were not detected at the Site.
- 4,4,4-DDT and 4,4'-DDD were detected at the Site at concentrations exceeding at least one screening level; however, reference concentrations of these pesticides also exceeded Site concentrations, suggesting these constituents are at background levels.
- Concentrations of 4,4'-DDE exceeded screening levels in Site samples, and the mean Site concentration of this pesticide (0.007 mg/kg) was significantly greater, although only slightly higher, than the reference concentration (0.005 mg/kg; $p < 0.07$).

Conclusions

- Surface soil: Concentrations of several metals and benzo(a)pyrene were significantly greater in the Site samples than in the reference samples. Fewer metals were significantly greater than reference in the FSA decision unit than in the downhill decision units.
- Sediment: 4,4'-DDE was the only constituent that exhibited significantly greater concentrations in the Site samples than the reference samples.

References

The Johnson Company. 2018. *Sampling and Analysis Plan for Preliminary Assessment/Site Inspection*. February, 2018.

Helsel, DR. 2012. *Statistics for Censored Environmental Data Using Minitab® and R*. Wiley, New York, 324 p.

Pooler, P.S, P.E. Goodrum, D. Crumbling, L.D. Stuchal, and S.M. Roberts. 2017. Incremental Sampling Methodology: Applications for Background Screening Assessments. Risk Analysis 38:1. 194-209.

COMMITMENT & INTEGRITY
DRIVE RESULTS
980 Washington Street | Suite 325
Dedham, Massachusetts 02026
www.woodardcurran.com
T 800.446.5518
T 781.251.0200
F 781.251.0847

MEMORANDUM

TO: Bettina Longino

FROM: Lisa McIntosh, Woodard & Curran

DATE: March 26, 2019

RE: Fort Totten Focused Human Health Risk Assessment

Introduction

Woodard & Curran conducted a focused Human Health Risk Assessment (HHRA) for an approximately 0.75-acre Area of Concern ("the Site") within Fort Totten Park ("the Park"), also known as Reservation 451, within the Civil War Defenses of Washington. The Park occupies approximately 40.3 acres and is located in northeast Washington, D.C. Figure 1, reproduced from JCO 2018 and included in Appendix A, depicts the location of the Site.

The Site was previously used as a staging area by the Washington Metropolitan Area Transit Authority (WMATA) in the early 1990s. In 1992, after WMATA completed its use of the area, they excavated the top layer of soil in the staging area and placed approximately 60 yards of uncompacted fill material. During fill placement, workers complained of eye and respiratory irritation. The source of the fill material was reportedly from a property that was part of the American University Experiment Station, where the U.S. Government researched and tested chemical agents, equipment, and munitions. WMATA reportedly removed the fill from the staging area, but some may have remained in place at the Site.

The Johnson Company recently completed a soil and sediment sampling program at the Site in support of a Preliminary Assessment/Site Inspection (PA/SI). Detected constituents included metals/metalloids, polycyclic aromatic hydrocarbons (PAHs), and pesticides/herbicides, including chlordane, 4-4'-DDT (and 4,4'-DDE and 4,4'-DDD) and the herbicide Silvex. This focused HHRA was performed using Site soil data to provide additional context for Park worker concerns regarding vegetation grubbing activities in the former staging area prior to the PA/SI sampling. This HHRA provides an assessment of potential health risks to the human receptors (including Park workers and recreational users) that could be exposed to chemical constituents in Site soils.

The focused HHRA was conducted in accordance with the general procedures described in the *Risk Assessment Guidance for Superfund (RAGS) Volume I: Human Health Evaluation Manual* (USEPA, 1989), as well as other EPA risk assessment guidance documents. The HHRA includes four steps:

- hazard identification, which evaluates the available environmental data and selects the contaminants of potential concern (COPC) that will be evaluated in the HHRA;
- exposure assessment, which identifies who is exposed, how they are exposed, and the amount and intensity of exposure;
- dose-response assessment, which identifies toxicological information for the COPCs, and
- risk characterization, which presents a numerical estimate of hazard or risk to human health.

In addition, the HHRA includes an uncertainty analysis, which identifies the nature, direction and, when possible, the magnitude of the uncertainty associated with the HHRA. The components of the HHRA are described in the following sections.

WOODARD &CURRAN

Hazard Identification

The Johnson Company recently completed a soil sampling program that consisted of the collection of discrete as well as incremental sampling methodology (ISM) soil samples. Discrete soil samples were collected for constituents that were not amenable to ISM processing (chemical warfare materials [CWM] and methylmercury). The ISM soil program consisted of sampling of soil in three site decision units (DUs) and one background/reference DU. Three surface (0-6 inches below ground surface, bgs) ISM replicates (labeled SA-01, SA-02 and SA-03) and three subsurface (6-24 inches bgs) ISM replicates (labeled as SB-01, SB-02 and SB-03) were collected from each Site DU. Decision units are shown on Figure 2, as provided by JCO and included in Appendix A.

ISM samples were analyzed for metals/metalloids, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) including PAHs, polychlorinated biphenyls (PCBs) as Aroclors, herbicides (Silvex and chlordane), perchlorate and fluoride ions, in accordance with the PA/SI sampling and analysis plan (JCO, 2018). These ISM data were used as the basis for estimating risks in this HHRA. The one exception to this is for methylmercury, for which only discrete soil samples were collected.[1] Analytical results for detected analytes in surface ISM samples are summarized on Table 1a; subsurface ISM data are summarized on Table 1b; methylmercury results are summarized on Table 1c.

The maximum detected concentrations among the individual replicates across the three DUs was compared to the USEPA Regional Screening Levels (RSL) for Residential Soil (USEPA, November 2018[2]) to select the COPCs. The RSLs are risk-based concentrations that are based on a target cancer risk of one in one million or a non-cancer hazard index of 0.1. Analytes with maximum concentrations equal to or less than the RSL were excluded as COPCs, since the risk from these constituents is anticipated to be negligible. Analytes with maximum concentrations greater than the RSL were retained as COPCs. Surrogate compounds were used for three constituents where soil RSLs were not available. The surrogate acenaphthene was used for acenaphthylene, and pyrene was used for benzo(g,h,i)perylene and phenanthrene. Constituents for which RSLs were not available and for which no suitable surrogates were identified were not carried through as COPCs but are discussed further in the Uncertainty Analysis section below. Tables 2.1 (surface soil) and 2.2 (subsurface soil) present the range of detected concentrations, frequency of detection, range of detection limits for non-detect results, RSLs, and the identification of COPCs.

Exposure Assessment

The HHRA identified potential human receptors and exposure pathways at the Site. While the Site is within a park, the Site itself is a heavily vegetated parcel that is not used for any recreational or other purpose, and exposures to soils in this area are expected to be generally minimal. However, access to the Site is unrestricted, and therefore, park visitors or maintenance workers may occasionally visit the Site. Overall, the types of activities that are expected to occur at the Site are passive in nature, meaning

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[1] Discrete samples also were collected for CWM analysis; CWM constituents were not detected in any of the samples.
[2] https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

that visitors or workers would have relatively little contact with site soils. There are no playgrounds or picnic areas, and dense vegetation limits access to much of the Site. Other areas within Fort Totten Park provide more opportunity for local visitors to engage in active recreational pursuits. This area is not typically maintained by park workers. Both park workers and visitors were assumed to be exposed to COPCs in soil through dermal contact, incidental ingestion and inhalation of fugitive dust.

Exposure point concentrations (EPCs) were calculated for the Site. Because the Site is relatively small in area, and is not an area with specific recreational opportunities, it was assumed that park workers or visitors could be exposed to surface or subsurface soils within any portion of the Site, across the three DUs – in other words, the entire Site was considered as one exposure point. Due to the limited number of samples (a total of nine replicates across three DUs per soil stratum), data from the replicates from all DUs were pooled together to calculate a 95th percentile upper confidence limit on the mean (95% UCL) concentration, calculated using the USEPA ProUCL software program (Version 5.1.002).The 95% UCL concentration is appropriately conservative as the EPC, given that receptors are expected to encounter soils over multiple events (and for the recreational scenarios, over a 26-year exposure duration) and are not expected to be preferentially exposed to any one particular DU. A summary of EPCs is presented on Table 3.1 for surface soil and Table 3.2 for subsurface soil. ProUCL outputs are presented in Appendix B.

The end product of the exposure assessment is the estimation of an average daily dose (ADD), which is the amount of chemical assumed to be absorbed by a person per day. For carcinogens, a Lifetime ADD (LADD) is calculated assuming a 70-year lifespan. The ADD and LADD are calculated for each COPC and each exposure pathway using algorithms that incorporate EPCs and receptor-specific information about certain physiological attributes (such as body weight or skin surface area) and various assumptions on exposure frequency and duration.

Table 4.1 presents the exposure assumptions used for the recreational user scenario. Due to the nature of the Site and lack of recreational opportunity or other use, the HHRA assumed that recreational users may be present at the Site one day per week for up to eight months of the year (warmer months when a visitor is more likely to be outside), for a total of 35 days per year. Risks were calculated for a young child and adult, assuming a total 26-year exposure duration (the EPA default exposure duration for residents), assuming that neighborhood residents may access the area during their residential tenure.

Table 4.2 presents exposure assumptions for the park worker scenario. The HHRA assumed that a park worker may be present at the Site for one day per week, 50 weeks per year, over the course of a 25-year occupational tenure (the EPA default exposure duration).

Dose-Response Assessment

The dose-response assessment describes the relationship between the level of exposure and the likelihood and/or severity of an adverse effect. In other words, the dose-response assessment quantifies the toxicity of each COPC using information obtained from published literature describing epidemiologic or toxicological studies. The products of the dose-response assessment are the toxicity values used to predict the likelihood of adverse health effects in identified receptors at site-specific exposure levels.

Non-carcinogenic effects, such as organ damage or reproductive effects, are evaluated by reference doses (RfDs) or reference concentrations (RfCs). RfDs and RfCs are developed based upon the assumption that there exists a threshold dose or concentration below which there will be minimal risk, if any, for adverse health effects; these values provide a benchmark for the daily dose to which humans may be subjected without an appreciable risk of deleterious effects during an average 70-year lifetime.

RfDs for oral exposure are presented in milligrams per kilogram (mg/kg) per day and RfCs for inhalation exposure are typically presented in milligrams per cubic meter (mg/m^3).

Cancer risks are evaluated using a cancer slope factor (CSF) or unit risk (UR). CSFs are upper-bound estimates of the excess risk of developing cancer as a result of a period of continuous exposure to a chemical averaged throughout the course of a 70-year lifetime and are developed based on the assumption that there is no threshold level of exposure below which adverse effects will not be seen. A CSF has units of the inverse of milligrams of chemical per kilogram of body weight per day (1/(mg/kg-day)). The inhalation UR is the 95% Upper Confidence Limit of the mean incremental lifetime cancer risk estimated to result from lifetime exposure to an agent if it is in the air at a concentration of 1 microgram per cubic meter (ug/m^3).

Tables 5.1, 5.2, 6.1, and 6.2 provide a summary of the toxicity values for non-carcinogenic and carcinogenic effects used to evaluate risks through the daily dose and exposure tables for exposure to Site soil. Toxicity information was obtained from the USEPA Integrated Risk Information System (IRIS) database (USEPA, 2019[3]), USEPA Provisional Peer-Reviewed Toxicity Values[4], Health Effects Assessment Summary Tables (HEAST, USEPA 1997), and/or other pertinent guidance.

Risk Characterization

The risk characterization combines information from the hazard identification, exposure assessment and dose-response assessment to make a conclusion on the presence or absence of risks above risk limits. Risk characterization was conducted in accordance with EPA risk assessment guidelines presented in *Risk Assessment Guidance for Superfund* (RAGS), EPA1989, and associated updates.

The potential for non-carcinogenic health effects is characterized by the Hazard Quotient (HQ), which is the ratio of the estimated average daily dose or concentration to which the receptor is exposed and the RfD or RfC:

HQ = ADD/RfD (oral/dermal pathways) or

HQ = ADE / RfC (inhalation pathway)

To account for exposures that a receptor may receive from multiple chemicals and exposure routes, chemical- and route-specific HQs are added together to calculate a cumulative noncancer risk estimate, known as the Hazard Index (HI). If the HI is less than or equal to one, then it is presumed that the concentrations of COPCs are unlikely to lead to adverse health effects. If the HI is greater than one, then it is presumed that adverse effects could occur, and that cleanup to mitigate those hazards may be warranted.

The potential for carcinogenic health effects is characterized as the Incremental Lifetime Cancer Risk (ILCR). The ILCR represents the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen associated with the Site. This represents the incremental probability of cancer specifically related to exposures at the Site and is separate from the "background" cancer incidence rate, which in the United States is currently estimated between 1 in 2 and 1 in 3, or between 33-50%, over the course of lifetime (American Cancer Society, 2018[5]). For a given chemical,

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[3] https://www.epa.gov/iris

[4] https://www.epa.gov/pprtv/provisional-peer-reviewed-toxicty-values-pprtvs-assessments

[5] American Cancer Society. *Cancer Facts & Figures 2018*. https://www.cancer.org/content/dam/cancer-org/research/cancer-facts-and-statistics/annual-cancer-facts-and-figures/2018/cancer-facts-and-figures-2018.pdf

the ILCR is the product of the lifetime average daily dose or exposure and the measure of carcinogenic potency (i.e., CSF or UR):

ILCR = LADD * CSF (oral/dermal pathways), or

ILCR = LADE * UR (inhalation pathway)

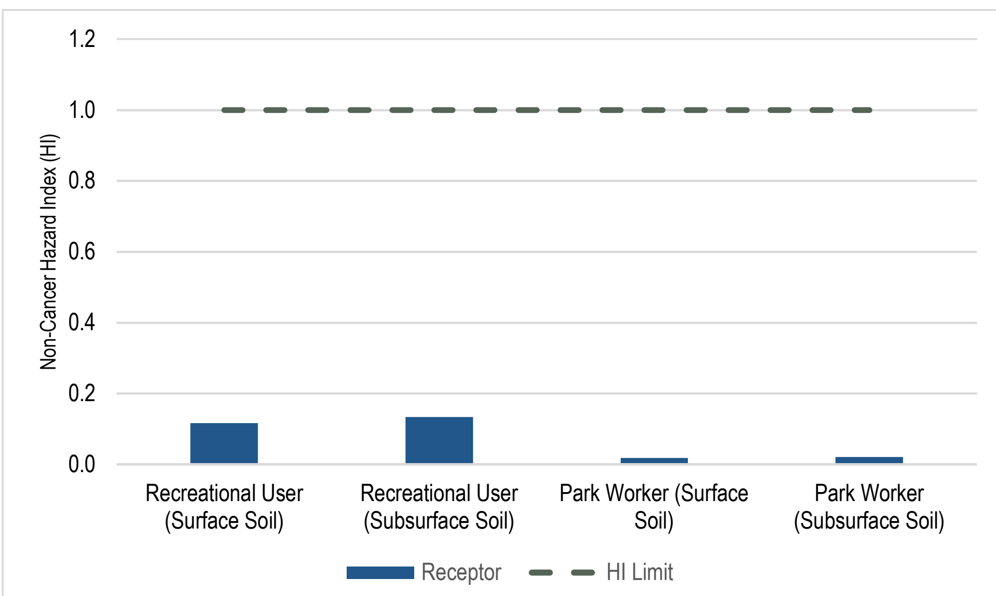
Similar to the HI approach, the ILCRs for each COPC and each exposure pathway are added together to calculate a cumulative ILCR. This cumulative ILCR is then compared to the NPS default point of departure, which is an ILCR of one in one million (expressed in scientific notation as 1E-06).

It is important to stress that neither the HI nor ILCR is a measure of *actual* risk; instead, these numbers are used to estimate the *likelihood* of risk and whether cleanup/remediation is needed.

The calculation of chemical cancer risks and non-cancer risks at the Site for each scenario are presented on Tables 7.1 through 7.4. Tables 8.1 through 8.4 present these same risk estimates, summed across each exposure pathway. Supporting tables used in the calculation of cancer and non-cancer risks are presented in Appendix C. Cumulative non-cancer hazard and cancer risks[6] for each scenario are shown in the figures below. The vertical bars represent the cumulative risk or hazard, and the horizontal green dashed lines represent the NPS risk points of departure (cancer risk of 1 x 10^{-6} and noncancer hazard index of one).

Cumulative hazard for each scenario is presented below. For all scenarios, the cumulative hazard indices are well below the hazard threshold of one.

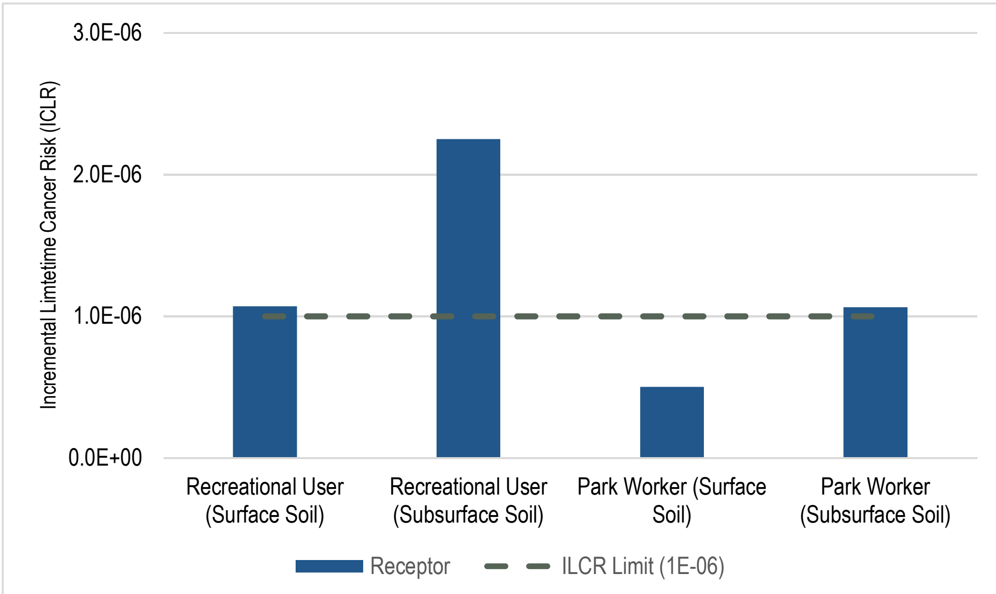
Summary of Cumulative Non-Cancer Hazards – All Scenarios



[6] Cumulative risks are rounded to one significant figure. The estimated cancer risk for the recreational user (surface soil) and park worker (subsurface soil) are 1.1E-06, just marginally over the NPS risk limit.

Cumulative cancer risks are presented below for each scenario.

Summary of Cumulative Cancer Risks – All Scenarios



For the recreational user, the cumulative ILCR is at the risk limit of 1E-06 for exposure to surface soils, but for the subsurface soil exposure scenario, the ILCR of 2E-06 exceeds the NPS risk point of departure. Cumulative risk for both of the park worker scenarios are at or below the NPS risk points of departure.

In all cases, arsenic is the primary risk driver (i.e., contributes to most of the cumulative cancer risk). Arsenic concentrations in surface soil samples across the three DUs range from 3.7 mg/kg to 16 mg/kg; concentrations in subsurface soil samples range from 9.4 mg/kg to 19 mg/kg (only subsurface soil samples from the staging area DU were analyzed for arsenic, however). In surface soils from the reference DU, arsenic concentrations ranged from 3.7 mg/kg to 4.6 mg/kg. No subsurface samples were collected from the reference DU. It is unclear whether the arsenic concentrations are related to the fill material or to natural geochemistry.

Uncertainty Analysis

The uncertainty analysis evaluates the input assumptions in the HHRA and relates their uncertainties or variabilities to the conclusions of the HHRA.

With respect to the dataset, there is low uncertainty relative to the nature, extent and concentrations of contamination. The location of impacted (historical) fill material has been characterized and soil samples have been characterized for a wide variety of constituents. The ISM samples provide a representative dataset of upper-bound average COPC concentrations across the Site. One of the larger uncertainties is that of constituents eliminated from the COPC selection process for this HHRA. Several detected constituents were not included as COPCs due to the lack of screening values and toxicity information. Exclusion of these constituents from the HHRA potentially underpredicts cumulative risk.

One of the largest uncertainties with the HHRA is that of the prediction of human activity patterns. Overall, the HHRA included conservative assumptions about exposure, assuming that visitors or park workers would routinely be exposed to this small area of the park (which is currently not used for any purpose) for relatively long durations. This approach is intended to provide an estimate of risk biased high (i.e., overpredict risk); however, if Site use changes in the future such that the Site usage is increased, then risk could be potentially under-estimated.

The dose-response values used in the calculation of HIs and ILCRs are, by design, conservative values that are protective of sensitive subpopulations. There is generally high confidence in these values, and their use is likely to overpredict risks.

Lastly, arsenic was identified as a risk driver, primarily in subsurface soils. Because there are no subsurface soil data from the reference DU, a conclusion cannot be made at this time regarding whether the arsenic concentrations detected at the Site are from the fill material or from naturally-occurring geological conditions. Furthermore, only three subsurface soil samples were analyzed for arsenic (versus nine samples analyzed for most other constituents), and because of this, there is uncertainty with regard to typical arsenic concentrations in subsurface soil in DUs beyond the staging area (samples from which were not analyzed for arsenic because arsenic concentrations in the three surface soil DUs were not statistically significantly greater than those in the reference DU). The EPC calculated for arsenic, based on the 95% UCL of 26.2 mg/kg, is approximately one-third greater than the maximum detected concentration of arsenic in subsurface soils of 19 mg/kg, and is about 60% higher than the maximum detected concentrations in surface soils (16 mg/kg). If the maximum subsurface concentration is used as the EPC, this would result in an ILCR of 1.6E-06; if the average concentration is used as EPC, then the cancer risk would decrease further to 1E-06, which is the NPS point of departure.

Conclusions

The HHRA indicates that the estimated exposure to concentrations of COPCs in surface soils at the Fort Totten Site result in risks either at or below the NPS risk points of departure for the recreational user scenario and park worker scenario. Concentrations of arsenic in subsurface soil, however, result in a calculated ICLR for the recreational user exceeding the NPS point of departure of 1E-06; however, there is uncertainty regarding whether arsenic concentrations in subsurface soil are from naturally-occurring geological conditions, and the calculation was based on a limited number of subsurface samples (three) analyzed for this COPC.

References

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Table 1A
Summary of Surface Soil Results
Fort Totten Park, Washington, D.C.

Analyte	CAS Number	SA-01-A (mg/kg)	SA-01-B (mg/kg)	SA-01-C (mg/kg)	SA-02-A (mg/kg)	SA-02-B (mg/kg)	SA-02-C (mg/kg)	SA-03-A (mg/kg)	SA-03-B (mg/kg)	SA-03-C (mg/kg)	SA-R-A (mg/kg)	SA-R-B (mg/kg)	SA-R-C (mg/kg)
		Surface Soil Samples											
		SA-01 (former staging area)			SA-02 (downhill north and northeast)			SA-03 (downhill northwest)			Reference DU		
		(mg/kg)											
Metals													
Aluminum	7429-90-5	**6200**	**5600**	**5800**	**7200**	**6200**	**6100**	**5600**	**6600**	**5500**	**4100**	**4600**	**4300**
Antimony	7440-36-0	<1.0	<1.1	<1.1	**<0.97 J**	**<0.95 J**	**0.2 J**	<0.93	<0.91 J	<1.1	**0.50 J**	**0.37 J**	**0.41 J**
Arsenic	7440-38-2	**6.9**	**4.5**	**5.0**	**16**	**6.6**	**6.0**	**4.8**	**5.7**	**4.7**	**4.6**	**4.0**	**3.7**
Barium	7440-39-3	**37**	**34**	**34**	**54**	**51**	**55**	**52**	**54**	**52**	**35**	**41**	**39**
Beryllium	7440-41-7	**0.64**	**0.61**	**0.65**	**0.57**	**0.48**	**0.45**	**0.35**	**0.32**	**0.3**	**0.15 J**	**0.18 J**	**0.16 J**
Cadmium	7440-43-9	**0.094 J**	**0.088 J**	**0.081 J**	**0.42**	**0.41**	**0.32**	**0.44**	**0.38**	**1.00**	**0.14 J**	**0.17 J**	**0.14 J**
Chromium	7440-47-3	**29**	**25**	**27**	**33**	**26**	**26**	**21**	**24**	**19 J**	**19**	**16**	**17**
Chromium III	16065-83-1	**29 J**	**25 J**	**27 J**	**33 J**	**26 J**	**26 J**	**21 J**	**24 J**	**19**	**19 J**	**16 J**	**17 J**
Cobalt	7440-48-4	**2.4**	**1.9**	**1.9**	**7.1**	**5.4**	**5.7**	**3.6**	**4.5**	**3.0**	**1.6**	**1.9**	**1.6**
Copper	7440-50-8	**6.4**	**5.2**	**4.4**	**24 J**	**23**	**20**	**19**	**21**	**21**	**13**	**14**	**12**
Cyanide, Free/Weak Acid Dissociable	57-12-5	<0.50	<0.46	<0.48	**0.21 J-**	**0.18 J-**	<0.46	**0.24 J-**	**0.22 J-**	<0.46	**0.64 J-**	**0.5 J-**	**0.37 J**
Lead	7439-92-1	**6.5**	**6.7**	**6.6**	**60**	**65**	**64**	**150**	**140**	**110**	**120**	**110**	**93**
Manganese	7439-96-5	**110**	**97**	**94**	**230**	**200**	**250**	**180**	**160**	**140**	**68**	**99**	**110**
Mercury	7439-97-6	**0.16 J+**	**0.073 J+**	**0.12 J+**	**0.61**	**0.24**	**0.23 J+**	**0.19**	**0.16**	**0.19 J+**	**0.24**	**0.21**	**0.23 J+**
Nickel	7440-02-0	**8.8**	**7.5**	**6.8**	**25**	**22**	**24**	**17**	**19**	**16**	**14**	**14**	**12**
Selenium	7782-49-2	**0.26 J**	**0.34 J**	**0.35 J**	**0.36 J**	**0.43 J**	**0.49 J**	**0.38 J**	**0.48 J**	**0.70 J**	**1.2**	**0.87 J**	**1.0 J**
Silver	7440-22-4	<0.52	<0.54	<0.53	**0.22 J**	<0.47	<0.55	<0.47	<0.46	<0.54	**0.26 J**	**0.19 J**	**0.18 J**
Strontium	7440-24-6	**9.9**	**9.6**	**7.0**	**14**	**12**	**13**	**17**	**16**	**17**	**8.5**	**8.8**	**9.5**
Thallium	7440-28-0	**0.68 J**	**0.43 J**	**0.57 J**	**0.95 J**	**0.82 J**	**1.2**	**0.76 J**	**0.70 J**	**0.68 J**	**0.32 J**	**0.30 J**	**0.43 J**
Tin	7440-31-5	**3.2 J**	**2.2 J**	**2.1 J**	**5.3**	**3.8 J**	**5.2 J**	**6.7**	**7.6**	**5.9**	**4.5 J**	**4.6 J**	**5.6**
Titanium	7440-32-6	**77**	**57**	**52**	**120**	**86**	**95**	**75**	**86**	**64**	**81**	**72**	**73**
Vanadium	7440-62-2	**19**	**16**	**17**	**26**	**25**	**25**	**23**	**25**	**24**	**27**	**25**	**23**
Zinc	7440-66-6	**32**	**30**	**30**	**110**	**120**	**85**	**110**	**110**	**110**	**31**	**35**	**32**
Zirconium	7440-67-7	<2.5	<2.5	<2.5	<2.5	<2.5	**1.4 J**	**1.8 J**	**2.1 J**	**1.7 J**	**1.3 J**	**1.1 J**	**1.5 J**
SVOCs													
PAHs													
Acenaphthene	83-32-9	<0.0064	<0.0067	<0.0067	<0.028	**0.014**	**0.0085**	**0.010**	**0.036**	**0.014**	**0.015**	<0.028	**0.011**
Acenaphthylene	208-96-8	<0.0064	**0.0088**	<0.0067	**0.037**	**0.040**	**0.042**	**0.059**	**0.15**	**0.1**	**0.038**	**0.045**	**0.03**
Anthracene	120-12-7	<0.0064	**0.0042 J**	<0.0067	**0.031**	**0.050**	**0.033**	**0.061**	**0.14**	**0.073**	**0.035**	**0.049**	**0.027**
Benzo(a)anthracene	56-55-3	**0.0088**	**0.011**	**0.0077**	**0.13**	**0.19**	**0.13**	**0.26**	**0.55**	**0.32**	**0.15**	**0.19**	**0.12**
Benzo(a)pyrene	50-32-8	**0.013**	**0.017**	**0.0082**	**0.19**	**0.25**	**0.19**	**0.36**	**0.65**	**0.44**	**0.21**	**0.24**	**0.16**
Benzo(b)fluoranthene	205-99-2	**0.021**	**0.026**	**0.017**	**0.29**	**0.33**	**0.27**	**0.48**	**1.0**	**0.69**	**0.42**	**0.43**	**0.32**
Benzo(g,h,i)perylene	191-24-2	**0.012**	**0.016**	**0.0097**	**0.065**	**0.10**	**0.088**	**0.21**	**0.24**	**0.19**	**0.075**	**0.073**	**0.056**
Benzo(k)fluoranthene	207-08-9	**0.0091**	**0.0061 J**	**0.0047 J**	**0.090**	**0.10**	**0.091**	**0.19**	**0.32**	**0.19**	**0.12**	**0.15**	**0.085**
Chrysene	218-01-9	**0.014**	**0.015**	**0.014**	**0.14**	**0.21**	**0.16**	**0.29**	**0.51**	**0.33**	**0.19**	**0.23**	**0.17**
Dibenzo(a,h)anthracene	53-70-3	<0.0064	<0.0067	<0.0067	<0.028	**0.029**	**0.022**	**0.070**	**0.086**	**0.06**	<0.0068	<0.028	**0.017**
Fluoranthene	206-44-0	**0.023**	**0.027**	**0.026**	**0.23**	**0.35**	**0.25**	**0.45**	**0.89**	**0.46**	**0.40**	**0.47**	**0.3**
Fluorene	86-73-7	<0.0064	<0.0067	<0.0067	<0.028	**0.016**	**0.012**	**0.016**	**0.043**	**0.017**	**0.020**	**0.021 J**	**0.013**
Indeno(1,2,3-cd)pyrene	193-39-5	**0.010**	**0.012**	**0.0065 J**	**0.064**	**0.099**	**0.079**	**0.20**	**0.26**	**0.19**	**0.073**	**0.083**	**0.062**
Naphthalene	91-20-3	**0.0065**	**0.011**	**0.006 J**	**0.023 J**	**0.022**	**0.028**	**0.026**	**0.036**	**0.035**	**0.053**	**0.051**	**0.046**
Phenanthrene	85-01-8	**0.011**	**0.017**	**0.0081**	**0.095**	**0.21**	**0.12**	**0.24**	**0.40**	**0.27**	**0.21**	**0.24**	**0.16**
Pyrene	129-00-0	**0.017**	**0.024**	**0.018**	**0.22**	**0.34**	**0.24**	**0.37**	**0.76**	**0.43**	**0.32**	**0.34**	**0.24**

Table 1A
Summary of Surface Soil Results
Fort Totten Park, Washington, D.C.

Analyte	CAS Number	Surface Soil Samples											
		SA-01 (former staging area)			SA-02 (downhill north and northeast)			SA-03 (downhill northwest)			Reference DU		
		SA-01-A (mg/kg)	SA-01-B (mg/kg)	SA-01-C (mg/kg)	SA-02-A (mg/kg)	SA-02-B (mg/kg)	SA-02-C (mg/kg)	SA-03-A (mg/kg)	SA-03-B (mg/kg)	SA-03-C (mg/kg)	SA-R-A (mg/kg)	SA-R-B (mg/kg)	SA-R-C (mg/kg)
		(mg/kg)											
Other SVOCs													
1,1'-Biphenyl	92-52-4	**0.0037 J**	<0.050	<0.050	<0.21	**0.0045 J**	**0.0046 J**	**0.0054 J**	**0.0068 J**	**0.0073 J**	--	--	--
2-Methylnaphthalene	91-57-6	**0.005 J**	**0.0072**	**0.0048 J**	**0.020 J**	**0.015**	**0.022**	**0.017**	**0.022**	**0.028**	--	--	--
Acetophenone	98-86-2	<0.095	**0.013 J**	<0.10	<0.42	**0.0098 J**	**0.013 J**	<0.10	<0.10	**0.013 J**	--	--	--
Benzaldehyde	100-52-7	**0.014 J**	**0.015 J**	**0.013 J**	<0.42	**0.02 J**	**0.02 J**	**0.015 J**	**0.014 J**	**0.046 J**	--	--	--
Benzoic acid	65-85-0	<0.63	<0.66	<0.096	**0.41 J-**	**0.10 J-**	R	**0.11 J-**	**0.10 J-**	<0.096 J	--	--	--
bis(2-Ethylhexyl)phthalate	117-81-7	**0.072**	**0.060 J**	<0.070	<0.29 J	**0.026 J-**	**0.043 J-**	**0.046 J-**	**0.030 J-**	**0.048 J-**	--	--	--
Butylbenzylphthalate	85-68-7	**4.9**	**0.012 J**	<0.070	<0.29	<0.072	<0.069	<0.071	<0.073	<0.067	--	--	--
Carbazole	86-74-8	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	**0.030 J**	**0.046 J**	**0.029 J**	--	--	--
Dibenzofuran	132-64-9	<0.048	<0.050	<0.050	<0.21	**0.0087 J**	**0.0073 J**	**0.015 J**	**0.027 J**	**0.022 J**	--	--	--
Diethylphthalate	84-66-2	<0.041	<0.070	<0.023	<0.29	**0.022 J**	<0.029	**0.024 J**	<0.073	<0.032	--	--	--
Phenol	108-95-2	<0.048	<0.050	<0.050	<0.21	<0.051	<0.049	<0.051	<0.052	**0.0093 J**	--	--	--
Ions													
Fluoride	16984-48-8	**5.0**	**4.6**	**4.4**	**2.3**	**3.3**	**2.7**	**2.5**	**3.1**	**2.8**	--	--	--
Perchlorate	14797-73-0	**0.00022 J**	**0.00023 J**	<0.00048	**0.00036 J+**	**0.00047 J+**	0.00042 J+	**0.00039 J+**	**0.00043 J+**	0.0004 J+	--	--	--
Pesticides/Herbicides													
4,4'-DDT	50-29-3	<0.0047	<0.0048	<0.0048	**0.0099 NJ**	**0.037**	**0.16**	**0.1**	**0.0068**	**0.046 NJ**	**0.032 NJ**	**0.042 NJ**	**0.11 NJ**
4,4'-DDD	72-54-8	<0.0047	<0.0048	<0.0048	<0.0050	**0.016**	**0.023 NJ**	**0.043**	**0.0088 NJ**	**0.026 NJ**	**0.018 NJ**	**0.036 NJ**	**0.046 NJ**
4,4'-DDE	72-55-9	<0.0047	<0.0048	<0.0048	**0.038 NJ**	**0.023**	**0.062 NJ**	**0.15**	**0.01**	**0.031 NJ**	**0.025**	**0.039**	**0.058 NJ**
Chlordane	12789-03-6	<0.047	<0.048	<0.048	<0.050	<0.050	<0.049	**0.013 J**	<0.051	<0.049	<0.052	**0.09**	<0.049 J
PCB Aroclors													
Aroclor-1254	11097-69-1	<0.047	<0.048	<0.048	<0.049	<0.049	<0.049	**0.038 J+**	<0.050	<0.049	--	--	--
Aroclor-1260	11096-82-5	<0.047	<0.048	<0.048	**0.032 J**	**0.025 J**	**0.046 J**	<0.049	**0.026 J**	<0.049	--	--	--

Notes
Only analytes detected in at least one sample are presented
Dataset provided by The Johnson Company, Inc.
Detected concentrations are presented in bold
"<" = Not detected above the presented laboratory reporting limit (LRL)
J = the result is an estimated quantity
J+ = the result is an estimated quantity; the result may be biased high
J- = the result is an estimated quantity; the result may be biased low
R = data are unusable and sample results are rejected
N = the analyte has been tentatively identified or presumptively is present

Table 1B
Summary of Subsurface Soil Results
Fort Totten Park, Washington, D.C.

Analyte	CAS Number	SB-01 (former staging area)			SB-02			SB-03		
		SB-01-A (mg/kg)	SB-01-B (mg/kg)	SB-01-C (mg/kg)	SB-02-A (mg/kg)	SB-02-B (mg/kg)	SB-02-C (mg/kg)	SB-03-A (mg/kg)	SB-03-B (mg/kg)	SB-03-C (mg/kg)
		(mg/kg)			(mg/kg)			(mg/kg)		
Metals										
Aluminum	7429-90-5	**8600 J**	**7500 J**	**7200 J**	**7200 J**	**6800 J**	**6400 J**	**7000 J**	**7000 J**	**7000 J**
Arsenic	7440-38-2	**19 J**	**9.4 J**	**14 J**	--	--	--	--	--	--
Barium	7440-39-3	**48 J**	**43 J**	**41 J**	**68 J-**	**72 J-**	**130 J-**	**48 J-**	**64 J-**	**53 J-**
Beryllium	7440-41-7	**0.68**	**0.67**	**0.67**	--	--	--	--	--	--
Cadmium	7440-43-9	**0.13 J**	**0.10 J**	**0.14 J**	**0.39**	**0.43**	**0.43**	**0.29**	**0.31**	**0.32**
Chromium	7440-47-3	**39 J**	**33 J**	**33 J**	**27 J**	**26 J**	**27 J**	**22 J**	**23 J**	**22 J**
Chromium III	16065-83-1	**39 J**	**33 J**	**33 J**	--	--	--	--	--	--
Cobalt	7440-48-4	**5.0**	**3.4**	**3.4**	**6.3**	**6.9**	**5.2**	**3.4**	**4.0**	**3.5**
Copper	7440-50-8	**11 J**	**7.6 J**	**9.3 J**	**33 J**	**42 J**	**27 J**	**18 J**	**20 J**	**17 J**
Lead	7439-92-1	**8.7**	**7.1**	**11**	--	--	--	--	--	--
Manganese	7439-96-5	**150 J**	**120 J**	**120 J**	**240 J**	**290 J**	**220 J**	**130 J**	**150 J**	**150 J**
Mercury	7439-97-6	**0.76 J**	**0.27 J+**	**0.53 J+**	--	--	--	--	--	--
Nickel	7440-02-0	**22**	**15**	**20**	**20**	**21**	**20**	**13**	**15**	**13**
Selenium	7782-49-2	**0.53 J**	**0.52 J**	**0.32 J**	--	--	--	--	--	--
Silver	7440-22-4	<0.51	<0.54	**0.11 J**	--	--	--	--	--	--
Strontium	7440-24-6	**6.4**	**6.0**	**5.5**	--	--	--	--	--	--
Thallium	7440-28-0	**0.92 J**	**0.75 J**	**0.79 J**	**0.33 J**	**0.22 J**	**0.35 J**	**0.27 J**	**0.26 J**	**0.27 J**
Tin	7440-31-5	**6.1**	**8.7**	**4.1 J**	--	--	--	--	--	--
Titanium	7440-32-6	**160 J**	**100 J**	**90 J**	--	--	--	--	--	--
Vanadium	7440-62-2	**25**	**22**	**21**	--	--	--	--	--	--
Zinc	7440-66-6	**38**	**33**	**43**	**120**	**120**	**120**	**72**	**95**	**88**
Zirconium	7440-67-7	<2.5	<2.5	<2.5	**2.2 J**	**1.8 J**	**1.6 J**	**2.9**	**2.5**	**2.2 J**
VOCs										
1,2,4-Trichlorobenzene	120-82-1	**0.031 J**	<0.31	<0.30	--	--	--	--	--	--
SVOCs										
PAHs										
Acenaphthene	83-32-9	<0.0064	<0.0067	<0.0064	**0.016**	**0.014**	**0.027**	**0.014**	**0.063**	**0.099**
Acenaphthylene	208-96-8	**0.0038 J**	<0.0067	<0.0064	**0.032**	**0.049**	**0.053**	**0.083**	**0.068**	**0.084**
Anthracene	120-12-7	**0.0050 J**	<0.0067	<0.0064	**0.052**	**0.061**	**0.11**	**0.069**	**0.17**	**0.2**
Benzo(a)anthracene	56-55-3	**0.012**	**0.0042 J**	**0.0037 J**	**0.17 J-**	**0.23 J-**	**0.38 J-**	**0.25 J-**	**0.44 J-**	**0.53 J-**
Benzo(a)pyrene	50-32-8	**0.015**	**0.0049 J**	**0.0049 J**	**0.19 J-**	**0.27 J-**	**0.4 J-**	**0.27 J-**	**0.5 J-**	**0.58 J-**
Benzo(b)fluoranthene	205-99-2	**0.022**	**0.0086**	**0.0085**	**0.25 J-**	**0.37 J-**	**0.55 J-**	**0.39 J-**	**0.64 J-**	**0.8 J-**
Benzo(g,h,i)perylene	191-24-2	**0.010**	**0.0040 J**	**0.0043 J**	**0.13**	**0.16**	**0.24**	**0.15**	**0.29**	**0.29**
Benzo(k)fluoranthene	207-08-9	**0.0081**	<0.0067	<0.0064	**0.1 J-**	**0.13 J-**	**0.2 J-**	**0.099 J-**	**0.2 J-**	**0.27 J-**
Chrysene	218-01-9	**0.014**	**0.0050 J**	**0.0058 J**	**0.19 J-**	**0.28 J-**	**0.43 J-**	**0.28 J-**	**0.49 J-**	**0.55 J-**
Dibenzo(a,h)anthracene	53-70-3	<0.0064	<0.0067	<0.0064	**0.038**	**0.045**	**0.072**	**0.056**	**0.092**	**0.1**
Fluoranthene	206-44-0	**0.029**	**0.0086**	**0.0099**	**0.31 J-**	**0.44 J-**	**0.74 J-**	**0.42 J-**	**0.91 J-**	**1.1 J-**
Fluorene	86-73-7	**0.0038 J**	<0.0067	<0.0064	**0.018**	**0.02**	**0.034**	**0.022**	**0.051**	**0.082**
Indeno(1,2,3-cd)pyrene	193-39-5	**0.010**	**0.0037 J**	**0.0038 J**	**0.110**	**0.14**	**0.21**	**0.140**	**0.26**	**0.29**
Naphthalene	91-20-3	**0.0067**	**0.007**	**0.0067**	**0.03**	**0.03**	**0.04**	**0.026**	**0.04**	**0.066**
Phenanthrene	85-01-8	**0.019**	**0.0052 J**	**0.0072**	**0.17 J-**	**0.21 J-**	**0.43 J-**	**0.23 J-**	**0.68 J-**	**0.72 J-**
Pyrene	129-00-0	**0.019**	**0.0066 J**	**0.0071**	**0.26 J-**	**0.37 J-**	**0.61 J-**	**0.38 J-**	**0.72 J-**	**0.85 J-**
Other SVOCs										
2-Methylnaphthalene	91-57-6	**0.0057 J**	**0.0049 J**	**0.0071**	--	--	--	--	--	--
Acetophenone	98-86-2	**0.016 J**	<0.10	<0.096	--	--	--	--	--	--
Benzaldehyde	100-52-7	**0.018 J**	**0.017 J**	**0.015 J**	--	--	--	--	--	--
Butylbenzylphthalate	85-68-7	**0.031 J**	<0.070	<0.067	--	--	--	--	--	--
Ions										
Fluoride	16984-48-8	**5.1**	**5.3**	**4.1**	--	--	--	--	--	--
Perchlorate	14797-73-0	**0.00043 J**	**0.00035 J**	**0.00041 J**	--	--	--	--	--	--

Notes
Only analytes detected in at least one sample are presented
Dataset provided by The Johnson Company, Inc.
Detected concentrations are presented in bold
"<" = Not detected above the presented laboratory reporting limit (LRL)
J = the result is an estimated quantity
J+ = the result is an estimated quantity; the result may be biased high
J- = the result is an estimated quantity; the result may be biased low
R = data are unusable and sample results are rejected
N = the analyte has been tentatively identified or presumptively is present

Table 1C
Summary of Methylmercury Results
Fort Totten Park, Washington, D.C.

Analyte	CAS Number	Surface Soil Samples											
		SA-01 (former staging area)			SA-03 (downhill northwest)			SA-02 (downhill north and northeast)			Reference DU		
		CS-01C	CS-02C	CS-03C	CS-04C	CS-05C	CS-06C	CS-07C	CS-08C	CS-09C	CS-R-01C	CS-R-02C	CS-R-03C
		(mg/kg)											
Methylmercury	22967-92-6	**0.00031 J**	**0.00012 J**	<0.00011 J	**0.00041 J**	**0.00031 J**	**0.00063 J**	**0.0014 J**	**0.0014 J**	**0.00046 J**	**0.00011 J**	<0.00013 J	<0.00013 J

Analyte	CAS Number	Subsurface Soil Samples								
		SB-01 (former staging area)			SB-02			SB-03		
		CB-01C	CB-02C	CB-03C	CB-04C	CB-05C	CB-06C	CB-07C	CB-08C	CB-09C
		(mg/kg)								
Methylmercury	22967-92-6	**0.00014**	**0.000097 J**	**0.00013**	**0.00064**	**0.00037**	**0.002**	**0.00086**	**0.0014**	**0.00073**

Notes
Dataset provided by The Johnson Company, Inc.
Detected concentrations are presented in bold
"<" = Not detected above the presented laboratory reporting limit (LRL)
J = the result is an estimated quantity

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL

Fort Totten Park, Washington, D.C.

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

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (N/C) (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Flag (Y/N)	Selection or Deletion (6)
Soil															
Metals															
	7429-90-5	Aluminum	5.50E+03	7.20E+03	mg/kg	SA-02-A	100.00%	All detects	7.20E+03	NA	7.70E+03	--	--	N	BSL
	7440-36-0	Antimony	2.00E-01	2.00E-01	mg/kg	SA-02-C	11.11%	0.91 - 1.1	2.00E-01	NA	3.10E+00	--	--	N	BSL
	7440-38-2	Arsenic	4.50E+00	1.60E+01	mg/kg	SA-02-A	100.00%	All detects	1.60E+01	NA	6.80E-01	--	--	**Y**	ASL
	7440-39-3	Barium	3.40E+01	5.50E+01	mg/kg	SA-02-C	100.00%	All detects	5.50E+01	NA	1.50E+03	--	--	N	BSL
	7440-41-7	Beryllium	3.00E-01	6.50E-01	mg/kg	SA-01-C	100.00%	All detects	6.50E-01	NA	1.60E+01	--	--	N	BSL
	7440-43-9	Cadmium	8.10E-02	1.00E+00	mg/kg	SA-03-C	100.00%	All detects	1.00E+00	NA	7.10E+00	--	--	N	BSL
	16065-83-1	Chromium III[7]	1.90E+01	3.30E+01	mg/kg	SA-02-A	100.00%	All detects	3.30E+01	NA	1.20E+04	--	--	N	BSL
	7440-48-4	Cobalt	1.90E+00	7.10E+00	mg/kg	SA-02-A	100.00%	All detects	7.10E+00	NA	2.30E+00	--	--	**Y**	ASL
	7440-50-8	Copper	4.40E+00	2.40E+01	mg/kg	SA-02-A	100.00%	All detects	2.40E+01	NA	3.10E+02	--	--	N	BSL
	57-12-5	Cyanide (Free)	1.80E-01	2.40E-01	mg/kg	SA-03-A	44.44%	0.46 - 0.5	2.40E-01	NA	2.30E+00	--	--	N	BSL
	7439-92-1	Lead	6.50E+00	1.50E+02	mg/kg	SA-03-A	100.00%	All detects	1.50E+02	NA	4.00E+02	--	--	N	BSL
	7439-96-5	Manganese	9.40E+01	2.50E+02	mg/kg	SA-02-C	100.00%	All detects	2.50E+02	NA	1.80E+02	--	--	**Y**	ASL
	7439-97-6	Mercury	7.30E-02	6.10E-01	mg/kg	SA-02-A	100.00%	All detects	6.10E-01	NA	1.10E+00	--	--	N	BSL
	22967-92-6	Methylmercury	1.20E-04	1.40E-03	mg/kg	CS-08C	88.89%	0.00011 - 0.00011	1.40E-03	NA	7.80E-01	--	--	N	BSL
	7440-02-0	Nickel	6.80E+00	2.50E+01	mg/kg	SA-02-A	100.00%	All detects	2.50E+01	NA	1.50E+02	--	--	N	BSL
	7782-49-2	Selenium	2.60E-01	7.00E-01	mg/kg	SA-03-C	100.00%	All detects	7.00E-01	NA	3.90E+01	--	--	N	BSL
	7440-22-4	Silver	2.20E-01	2.20E-01	mg/kg	SA-02-A	11.11%	0.46 - 0.55	2.20E-01	NA	3.90E+01	--	--	N	BSL
	7440-24-6	Strontium	7.00E+00	1.70E+01	mg/kg	SA-03-A	100.00%	All detects	1.70E+01	NA	4.70E+03	--	--	N	BSL
	7440-28-0	Thallium	4.30E-01	1.20E+00	mg/kg	SA-02-C	100.00%	All detects	1.20E+00	NA	7.80E-02	--	--	**Y**	ASL
	7440-31-5	Tin	2.10E+00	7.60E+00	mg/kg	SA-03-B	100.00%	All detects	7.60E+00	NA	4.70E+03	--	--	N	BSL
	7440-32-6	Titanium	5.20E+01	1.20E+02	mg/kg	SA-02-A	100.00%	All detects	1.20E+02	NA	--	--	--	N	NSV
	7440-62-2	Vanadium	1.60E+01	2.60E+01	mg/kg	SA-02-A	100.00%	All detects	2.60E+01	NA	3.90E+01	--	--	N	BSL
	7440-66-6	Zinc	3.00E+01	1.20E+02	mg/kg	SA-02-B	100.00%	All detects	1.20E+02	NA	2.30E+03	--	--	N	BSL
	7440-67-7	Zirconium	1.40E+00	2.10E+00	mg/kg	SA-03-B	44.44%	2.5 - 2.5	2.10E+00	NA	6.30E-01	--	--	**Y**	ASL

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL

Fort Totten Park, Washington, D.C.

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

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (N/C) (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Flag (Y/N)	Selection or Deletion (6)
Soil															
Semi-Volatile Organic Compounds															
	92-52-4	1,1'-Biphenyl	3.70E-03	7.30E-03	mg/kg	SA-03-C	66.67%	0.05 - 0.21	7.30E-03	NA	4.70E+00	--	--	N	BSL
	91-57-6	2-Methylnaphthalene	4.80E-03	2.80E-02	mg/kg	SA-03-C	100.00%	All detects	2.80E-02	NA	2.40E+01	--	--	N	BSL
	98-86-2	Acetophenone	9.80E-03	1.30E-02	mg/kg	SA-01-B	44.44%	0.095 - 0.42	1.30E-02	NA	7.80E+02	--	--	N	BSL
	100-52-7	Benzaldehyde	1.30E-02	4.60E-02	mg/kg	SA-03-C	88.89%	0.42 - 0.42	4.60E-02	NA	1.70E+02	--	--	N	BSL
	65-85-0	Benzoic acid	1.00E-01	4.10E-01	mg/kg	SA-02-A	50.00%	0.096 - 0.66	4.10E-01	NA	2.50E+04	--	--	N	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	2.60E-02	7.20E-02	mg/kg	SA-01-A	77.78%	0.07 - 0.29	7.20E-02	NA	3.90E+01	--	--	N	BSL
	85-68-7	Butylbenzylphthalate	1.20E-02	4.90E+00	mg/kg	SA-01-A	22.22%	0.067 - 0.29	4.90E+00	NA	2.90E+02	--	--	N	BSL
	86-74-8	Carbazole	2.90E-02	4.60E-02	mg/kg	SA-03-B	33.33%	0.048 - 0.21	4.60E-02	NA	--	--	--	N	NSV
	132-64-9	Dibenzofuran	7.30E-03	2.70E-02	mg/kg	SA-03-B	55.56%	0.048 - 0.21	2.70E-02	NA	7.30E+00	--	--	N	BSL
	84-66-2	Diethylphthalate	2.20E-02	2.40E-02	mg/kg	SA-03-A	22.22%	0.023 - 0.29	2.40E-02	NA	5.10E+03	--	--	N	BSL
	108-95-2	Phenol	9.30E-03	9.30E-03	mg/kg	SA-03-C	11.11%	0.048 - 0.21	9.30E-03	NA	1.90E+03	--	--	N	BSL
	83-32-9	Acenaphthene	8.50E-03	3.60E-02	mg/kg	SA-03-B	55.56%	0.0064 - 0.028	3.60E-02	NA	3.60E+02	--	--	N	BSL
	208-96-8	Acenaphthylene[8]	8.80E-03	1.50E-01	mg/kg	SA-03-B	77.78%	0.0064 - 0.0067	1.50E-01	NA	3.60E+02	--	--	N	BSL
	120-12-7	Anthracene	4.20E-03	1.40E-01	mg/kg	SA-03-B	77.78%	0.0064 - 0.0067	1.40E-01	NA	1.80E+03	--	--	N	BSL
	56-55-3	Benzo(a)anthracene	7.70E-03	5.50E-01	mg/kg	SA-03-B	100.00%	All detects	5.50E-01	NA	1.10E+00	--	--	N	BSL
	50-32-8	Benzo(a)pyrene	8.20E-03	6.50E-01	mg/kg	SA-03-B	100.00%	All detects	6.50E-01	NA	1.10E-01	--	--	**Y**	ASL
	205-99-2	Benzo(b)fluoranthene	1.70E-02	1.00E+00	mg/kg	SA-03-B	100.00%	All detects	1.00E+00	NA	1.10E+00	--	--	N	BSL
	191-24-2	Benzo(g,h,i)perylene[8]	9.70E-03	2.40E-01	mg/kg	SA-03-B	100.00%	All detects	2.40E-01	NA	1.80E+02	--	--	N	BSL
	207-08-9	Benzo(k)fluoranthene	4.70E-03	3.20E-01	mg/kg	SA-03-B	100.00%	All detects	3.20E-01	NA	1.10E+01	--	--	N	BSL
	218-01-9	Chrysene	1.40E-02	5.10E-01	mg/kg	SA-03-B	100.00%	All detects	5.10E-01	NA	1.10E+02	--	--	N	BSL
	53-70-3	Dibenzo(a,h)anthracene	2.20E-02	8.60E-02	mg/kg	SA-03-B	55.56%	0.0064 - 0.028	8.60E-02	NA	1.10E-01	--	--	N	BSL
	206-44-0	Fluoranthene	2.30E-02	8.90E-01	mg/kg	SA-03-B	100.00%	All detects	8.90E-01	NA	2.40E+02	--	--	N	BSL
	86-73-7	Fluorene	1.20E-02	4.30E-02	mg/kg	SA-03-B	55.56%	0.0064 - 0.028	4.30E-02	NA	2.40E+02	--	--	N	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	6.50E-03	2.60E-01	mg/kg	SA-03-B	100.00%	All detects	2.60E-01	NA	1.10E+00	--	--	N	BSL
	91-20-3	Naphthalene	6.00E-03	3.60E-02	mg/kg	SA-03-B	100.00%	All detects	3.60E-02	NA	3.80E+00	--	--	N	BSL
	85-01-8	Phenanthrene[8]	8.10E-03	4.00E-01	mg/kg	SA-03-B	100.00%	All detects	4.00E-01	NA	1.80E+02	--	--	N	BSL
	129-00-0	Pyrene	1.70E-02	7.60E-01	mg/kg	SA-03-B	100.00%	All detects	7.60E-01	NA	1.80E+02	--	--	N	BSL

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SURFACE SOIL

Fort Totten Park, Washington, D.C.

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

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (N/C) (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Flag (Y/N)	Selection or Deletion (6)
Soil															
Ions															
	16984-48-8	Fluoride	2.30E+00	5.00E+00	mg/kg	SA-01-A	100.00%	All detects	5.00E+00	NA	3.10E+02	--	--	N	BSL
	14797-73-0	Perchlorate	2.20E-04	4.70E-04	mg/kg	SA-02-B	88.89%	0.00048 - 0.00048	4.70E-04	NA	5.50E+00	--	--	N	BSL
Pesticides															
	50-29-3	4,4'-DDT	6.80E-03	1.60E-01	mg/kg	SA-02-C	66.67%	0.0047 - 0.0048	1.60E-01	NA	1.90E+00	--	--	N	BSL
	72-54-8	4,4'-DDD	8.80E-03	4.30E-02	mg/kg	SA-03-A	55.56%	0.0047 - 0.005	4.30E-02	NA	1.90E-01	--	--	N	BSL
	72-55-9	4,4'-DDE	1.00E-02	1.50E-01	mg/kg	SA-03-A	55.56%	0.0047 - 0.0048	1.50E-01	NA	2.00E+00	--	--	N	BSL
	12789-03-6	Chlordane	1.30E-02	1.30E-02	mg/kg	SA-03-A	11.11%	0.047 - 0.051	1.30E-02	NA	1.70E+00	--	--	N	BSL
Polychlorinated Biphenyls															
	11097-69-1	Aroclor-1254	3.80E-02	3.80E-02	mg/kg	SA-03-A	11.11%	0.047 - 0.05	3.80E-02	NA	1.20E-01	--	--	N	BSL
	11096-82-5	Aroclor-1260	2.50E-02	4.60E-02	mg/kg	SA-02-C	44.44%	0.047 - 0.049	4.60E-02	NA	2.40E-01	--	--	N	BSL

Notes

(1) Summary statistics are based on analytical results from ISM surficial soil samples collected by the Johnson Company (SA-01A, SA-01B, SA-01C; SA-02A, SA-02B, SA-02C; and SA-03A, SA-03B, SA-03C).
Methyl mercury statistics are based on discrete samples (CS-01C - CS-09C). Constituents detected at least once are presented on this table.

(2) Detection frequency is out of 9 replicates.

(3) The concentration used for screening is the maximum detected concentration among all surficial soil samples.

(4) No background values were used for the selection of COPCs.

(5) Screening Toxicity Value was derived for a Resident using USEPA's Regional Screening Level calculator using the lowest value between the noncancer and cancer-based values. May 2018. https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search.
Screening values are based on a noncancer hazard quotient of 0.1 and a cancer risk of 10^{-6}.

(6) ASL = Maximum detected concentration above screening level(s)
BSL = Maximum detected concentration below screening level(s)
NSV = No screening value available
ARAR = Applicable or Relevant and Appropriate Requirements
TBC = To be considered
COPC = Chemical of Potential Concern
NA =Not applicable
"--" = Not available
mg/kg = milligrams per kilogram

(7) Samples were analyzed for total chromium, trivalent chromium, and hexavalent chromium. Based on soil results, all chromium results were determined to be 100% trivalent chromium.

(8) The following surrogates were used for compounds without screening toxicity values:

Compound	Surrogate
Acenaphthylene	Acenaphthene
Benzo(g,h,i)perylene	Pyrene
Phenanthrene	Pyrene

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SUBSURFACE SOIL

Fort Totten Park, Washington, D.C.

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

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (N/C) (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Flag (Y/N)	Selection or Deletion (6)
Soil															
Metals															
	7429-90-5	Aluminum	6.40E+03	8.60E+03	mg/kg	SB-01-A	100.00%	All Detects	8.60E+03	NA	7.70E+03	--	--	**Y**	ASL
	7440-38-2	Arsenic	9.40E+00	1.90E+01	mg/kg	SB-01-A	100.00%	All Detects	1.90E+01	NA	6.80E-01	--	--	**Y**	ASL
	7440-39-3	Barium	4.10E+01	1.30E+02	mg/kg	SB-02-C	100.00%	All Detects	1.30E+02	NA	1.50E+03	--	--	N	BSL
	7440-41-7	Beryllium	6.70E-01	6.80E-01	mg/kg	SB-01-A	100.00%	All Detects	6.80E-01	NA	1.60E+01	--	--	N	BSL
	7440-43-9	Cadmium	1.00E-01	4.30E-01	mg/kg	SB-02-B	100.00%	All Detects	4.30E-01	NA	7.10E+00	--	--	N	BSL
	16065-83-1	Chromium III[7]	3.30E+01	3.90E+01	mg/kg	SB-01-A	100.00%	All Detects	3.90E+01	NA	1.20E+04	--	--	N	BSL
	7440-48-4	Cobalt	3.40E+00	6.90E+00	mg/kg	SB-02-B	100.00%	All Detects	6.90E+00	NA	2.30E+00	--	--	**Y**	ASL
	7440-50-8	Copper	7.60E+00	4.20E+01	mg/kg	SB-02-B	100.00%	All Detects	4.20E+01	NA	3.10E+02	--	--	N	BSL
	7439-92-1	Lead	7.10E+00	1.10E+01	mg/kg	SB-01-C	100.00%	All Detects	1.10E+01	NA	4.00E+02	--	--	N	BSL
	7439-96-5	Manganese	1.20E+02	2.90E+02	mg/kg	SB-02-B	100.00%	All Detects	2.90E+02	NA	1.80E+02	--	--	**Y**	ASL
	7439-97-6	Mercury	2.70E-01	7.60E-01	mg/kg	SB-01-A	100.00%	All Detects	7.60E-01	NA	1.10E+00	--	--	N	BSL
	22967-92-6	Methylmercury	1.00E-04	2.00E-03	mg/kg	CB-06C	100.00%	All Detects	2.00E-03	NA	7.80E-01	--	--	N	BSL
	7440-02-0	Nickel	1.30E+01	2.20E+01	mg/kg	SB-01-A	100.00%	All Detects	2.20E+01	NA	1.50E+02	--	--	N	BSL
	7782-49-2	Selenium	3.20E-01	5.30E-01	mg/kg	SB-01-A	100.00%	All Detects	5.30E-01	NA	3.90E+01	--	--	N	BSL
	7440-22-4	Silver	1.10E-01	1.10E-01	mg/kg	SB-01-C	33.33%	0.51 - 0.54	1.10E-01	NA	7.80E-01	--	--	N	BSL
	7440-24-6	Strontium	5.50E+00	6.40E+00	mg/kg	SB-01-A	100.00%	All Detects	6.40E+00	NA	4.70E+03	--	--	N	BSL
	7440-28-0	Thallium	2.20E-01	9.20E-01	mg/kg	SB-01-A	100.00%	All Detects	9.20E-01	NA	7.80E-02	--	--	**Y**	ASL
	7440-31-5	Tin	4.10E+00	8.70E+00	mg/kg	SB-01-B	100.00%	All Detects	8.70E+00	NA	4.70E+03	--	--	N	BSL
	7440-32-6	Titanium	9.00E+01	1.60E+02	mg/kg	SB-01-A	100.00%	All Detects	1.60E+02	NA	--	--	--	N	NSV
	7440-62-2	Vanadium	2.10E+01	2.50E+01	mg/kg	SB-01-A	100.00%	All Detects	2.50E+01	NA	3.90E+01	--	--	N	BSL
	7440-66-6	Zinc	3.30E+01	1.20E+02	mg/kg	SB-02-A	100.00%	All Detects	1.20E+02	NA	2.30E+03	--	--	N	BSL
	7440-67-7	Zirconium	1.60E+00	2.90E+00	mg/kg	SB-03-A	66.67%	2.5 - 2.5	2.90E+00	NA	6.30E-01	--	--	**Y**	ASL
Volatile Organic Compounds															
	120-82-1	1,2,4-Trichlorobenzene	3.10E-02	3.10E-02	mg/kg	SB-01-A	33.33%	0.3 - 0.31	3.10E-02	NA	5.80E+00	--	--	N	BSL

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SUBSURFACE SOIL

Fort Totten Park, Washington, D.C.

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

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (N/C) (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Flag (Y/N)	Selection or Deletion (6)
Soil															
Semi-Volatile Organic Compounds															
	91-57-6	2-Methylnaphthalene	4.90E-03	7.10E-03	mg/kg	SB-01-C	100.00%	All Detects	7.10E-03	NA	2.40E+01	--	--	N	BSL
	98-86-2	Acetophenone	1.60E-02	1.60E-02	mg/kg	SB-01-A	33.33%	0.096 - 0.1	1.60E-02	NA	7.80E+02	--	--	N	BSL
	100-52-7	Benzaldehyde	1.50E-02	1.80E-02	mg/kg	SB-01-A	100.00%	All Detects	1.80E-02	NA	1.70E+02	--	--	N	BSL
	85-68-7	Butylbenzylphthalate	3.10E-02	3.10E-02	mg/kg	SB-01-A	33.33%	0.067 - 0.07	3.10E-02	NA	2.90E+02	--	--	N	BSL
	83-32-9	Acenaphthene	1.40E-02	9.90E-02	mg/kg	SB-03-C	66.67%	0.0064 - 0.0067	9.90E-02	NA	3.60E+02	--	--	N	BSL
	208-96-8	Acenaphthylene[8]	3.80E-03	8.40E-02	mg/kg	SB-03-C	77.78%	0.0064 - 0.0067	8.40E-02	NA	3.60E+02	--	--	N	BSL
	120-12-7	Anthracene	5.00E-03	2.00E-01	mg/kg	SB-03-C	77.78%	0.0064 - 0.0067	2.00E-01	NA	1.80E+03	--	--	N	BSL
	56-55-3	Benzo(a)anthracene	3.70E-03	5.30E-01	mg/kg	SB-03-C	100.00%	All Detects	5.30E-01	NA	1.10E+00	--	--	N	BSL
	50-32-8	Benzo(a)pyrene	4.90E-03	5.80E-01	mg/kg	SB-03-C	100.00%	All Detects	5.80E-01	NA	1.10E-01	--	--	**Y**	ASL
	205-99-2	Benzo(b)fluoranthene	8.50E-03	8.00E-01	mg/kg	SB-03-C	100.00%	All Detects	8.00E-01	NA	1.10E+00	--	--	N	BSL
	191-24-2	Benzo(g,h,i)perylene[8]	4.00E-03	2.90E-01	mg/kg	SB-03-B	100.00%	All Detects	2.90E-01	NA	1.80E+02	--	--	N	BSL
	207-08-9	Benzo(k)fluoranthene	8.10E-03	2.70E-01	mg/kg	SB-03-C	77.78%	0.0064 - 0.0067	2.70E-01	NA	1.10E+01	--	--	N	BSL
	218-01-9	Chrysene	5.00E-03	5.50E-01	mg/kg	SB-03-C	100.00%	All Detects	5.50E-01	NA	1.10E+01	--	--	N	BSL
	53-70-3	Dibenzo(a,h)anthracene	3.80E-02	1.00E-01	mg/kg	SB-03-C	66.67%	0.0064 - 0.0067	1.00E-01	NA	1.10E-01	--	--	N	BSL
	206-44-0	Fluoranthene	8.60E-03	1.10E+00	mg/kg	SB-03-C	100.00%	All Detects	1.10E+00	NA	2.40E+02	--	--	N	BSL
	86-73-7	Fluorene	3.80E-03	8.20E-02	mg/kg	SB-03-C	77.78%	0.0064 - 0.0067	8.20E-02	NA	2.40E+02	--	--	N	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	3.70E-03	2.90E-01	mg/kg	SB-03-C	100.00%	All Detects	2.90E-01	NA	1.10E+00	--	--	N	BSL
	91-20-3	Naphthalene	6.70E-03	6.60E-02	mg/kg	SB-03-C	100.00%	All Detects	6.60E-02	NA	3.80E+00	--	--	N	BSL
	85-01-8	Phenanthrene[8]	5.20E-03	7.20E-01	mg/kg	SB-03-C	100.00%	All Detects	7.20E-01	NA	1.80E+02	--	--	N	BSL
	129-00-0	Pyrene	6.60E-03	8.50E-01	mg/kg	SB-03-C	100.00%	All Detects	8.50E-01	NA	1.80E+02	--	--	N	BSL

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - SUBSURFACE SOIL

Fort Totten Park, Washington, D.C.

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

Exposure Point	CAS Number	Chemical	Minimum Concentration (1)	Maximum Concentration (1)	Units	Location of Maximum Concentration	Detection Frequency (2)	Range of Detection Limits	Concentration Used for Screening (3)	Background Value (4)	Screening Toxicity Value (N/C) (5)	Potential ARAR/TBC Value	Potential ARAR/TBC Source	Flag (Y/N)	Selection or Deletion (6)
Soil															
Ions															
	16984-48-8	Fluoride	4.10E+00	5.30E+00	mg/kg	SB-01-B	100.00%	All Detects	5.30E+00	NA	3.10E+02	--	--	N	BSL
	14797-73-0	Perchlorate	3.50E-04	4.30E-04	mg/kg	SB-01-A	100.00%	All Detects	4.30E-04	NA	5.50E+00	--	--	N	BSL

Notes

(1) Summary statistics are based on analytical results from ISM subsurface soil samples collected by the Johnson Company (SA-01A, SA-01B, SA-01C; SA-02A, SA-02B, SA-02C; and SA-03A, SA-03B, SA-03C).
Methyl mercury statistics are based on discrete samples (CS-01C - CS-09C). Constituents detected at least once are presented on this table.

(2) See Table 1B for the number of replicates per constituent.

(3) The concentration used for screening is the maximum detected concentration among all surficial soil samples.

(4) No background values were used for the selection of COPCs.

(5) Screening Toxicity Value was derived for a Resident using USEPA's Regional Screening Level calculator using the lowest value between the noncancer and cancer-based values. May 2018. https://epa-prgs.ornl.gov/cgi-bin/chemicals/csl_search.
Screening values are based on a noncancer hazard quotient of 0.1 and a cancer risk of 10^{-6}.

(6) ASL = Maximum detected concentration above screening level(s)
BSL = Maximum detected concentration below screening level(s)
NSV = No screening value available
ARAR = Applicable or Relevant and Appropriate Requirements
TBC = To be considered
COPC = Chemical of Potential Concern
NA =Not applicable
"--" = Not available
mg/kg = milligrams per kilogram

(7) Samples were analyzed for total chromium, trivalent chromium, and hexavalent chromium. Based on soil results, all chromium results were determined to be 100% trivalent chromium.

(8) The following surrogates were used for compounds without screening toxicity values:

Compound	Surrogate
Acenaphthylene	Acenaphthene
Benzo(g,h,i)perylene	Pyrene
Phenanthrene	Pyrene

TABLE 3.1
EXPOSURE POINT CONCENTRATION SUMMARY
CENTRAL TENDENCY EXPOSURE AND REASONABLE MAXIMUM EXPOSURE
Fort Totten Park, Washington, D.C.

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (1)	Exposure Point Concentration (2)			
					Value	Units	Statistic	Rationale
Surface Soil	**Metals**							
	Arsenic	mg/kg	6.69E+00	1.19E+01	1.19E+01	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Cobalt	mg/kg	3.94E+00	6.63E+00	6.63E+00	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Manganese	mg/kg	1.62E+02	2.45E+02	2.45E+02	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Thallium	mg/kg	7.54E-01	1.08E+00	1.08E+00	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Zirconium	mg/kg	1.75E+00	2.38E+00	2.38E+00	mg/kg	95% UCL (KM Chebyshev)	95 % UCL is a conservative measure of exposure
	Semi-Volatile Organic Compounds							
	Benzo(a)pyrene	mg/kg	2.35E-01	5.53E-01	5.53E-01	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure

Notes
(1) UCLs calculated using nonparametric distribution free Chebyshev statistics. For normal distributions where nonparameteric statistics were unavailable, Kaplan Meier (KM) statistics were used.
(2) The exposure point concentration is the 95 % UCL of all surface ISM samples.
UCL = 95% UCL
mg/kg - milligrams per kilogram

TABLE 3.2

EXPOSURE POINT CONCENTRATION SUMMARY

CENTRAL TENDENCY EXPOSURE AND REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (1)	Exposure Point Concentration (2)			
					Value	Units	Statistic	Rationale
Subsurface Soil	**Metals**							
	Aluminum	mg/kg	7.19E+03	8.07E+03	8.07E+03	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Arsenic	mg/kg	1.41E+01	2.62E+01	2.62E+01	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Cobalt	mg/kg	4.57E+00	6.53E+00	6.53E+00	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Manganese	mg/kg	1.74E+02	2.63E+02	2.63E+02	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Thallium	mg/kg	4.62E-01	8.61E-01	8.61E-01	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure
	Zirconium	mg/kg	2.12E+00	2.83E+00	2.83E+00	mg/kg	95% UCL (KM Chebyshev)	95 % UCL is a conservative measure of exposure
	Semi-Volatile Organic Compounds							
	Benzo(a)pyrene	mg/kg	2.48E-01	5.62E-01	5.62E-01	mg/kg	95% UCL (Chebyshev)	95 % UCL is a conservative measure of exposure

Notes

(1) UCLs calculated using nonparametric distribution free Chebyshev statistics. For normal distributions where nonparameteric statistics were unavailable, Kaplan Meier (KM) statistics were used.

(2) The exposure point concentration is the 95 % UCL of all subsurface ISM samples.

UCL = 95% UCL

mg/kg - milligrams per kilogram

TABLE 4.1
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS: SITE RECREATIONAL USER
REASONABLE MAXIMUM EXPOSURE
Fort Totten Park, Washington, D.C.

Scenario Timeframe:	Current/Future
Medium:	Soil Surface (0-0.5') Soil Subsurface (0.5-2')
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust	Site Recreational User Child (0<6 years)	Fort Totten Park	IR_{soil}	Ingestion rate of soil	90	mg/day	USEPA 2017	1
			AF_{soil}	Soil adherence factor	0.2	mg/cm^2	USEPA 2014	2
			SA_{soil}	Skin surface area - child	2,373	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	35	days/yr	Professional judgment	4
			ED	Exposure Duration	6	years	USEPA 1989	5
			ET_{out}	Exposure time outdoors	0.5	hours/event	Professional judgment	6
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	7
			BW	Body Weight	15	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2018	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2017	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	6	years	USEPA 1989	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15
Incidental ingestion, dermal contact and inhalation of dust	Site Recreational User Adult	Fort Totten Park	IR_{soil}	Ingestion rate of soil	62	mg/day	USEPA 2017	1
			AF_{soil}	Soil adherence factor	0.07	mg/cm^2	USEPA 2014	2
			SA_{soil}	Skin surface area	6,032	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	35	days/yr	Professional judgment	4
			ED	Exposure Duration	20	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	0.5	hours/event	Professional judgment	6
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	7
			BW	Body Weight	80	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2018	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2017	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	20	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2
Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors: C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

For carcinogenic COPCs identified as having a mutagenic mode of action, an age dependent adjustment factor (ADAF) is applied for exposures to receptors ages birth through 15 (EPA 2005).

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

Mutagenic Equations:

Incidental Ingestion: Intake = EPC * IR * EF * ED * CF_1 * SF * ADAF *1/BW * 1/AT *1/CF_2

Dermal Contact: Intake = EPC * SA * AF * ABSd * EF * ED * CF_1 * SF * ADAF *1/BW * 1/AT * 1/CF_2

Inhalation: Intake = EPCair* EF * ET * ED * ADAF * 1/AT * 1/C3 * 1/C2

TABLE 4.1 Notes:

1. Soil ingestion rates are the USEPA default soil ingestion rates for children and adults (USEPA 2017).

2. The soil adherence factors (AFsoil) are the USEPA default soil adherence factors for children and adults (Exhibit 3-5 of USEPA 2004). For the passive recreational exposure, central tendency values were used.

3. The skin surface areas are the EPA-recommended default SAs for the adult and child resident (USEPA 2014) and reflect the weighted average of mean values for head, hands, formearms and lower legs (and feet, for the child).

4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. The EF assumes that a recreator may visit Fort Totten 1 days per week during the 8 warmer months of the year.

5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants.
   ED values for the park visitor reflect a total 26 year residential tenure, which is the current EPA-recommended value for residence time (USEPA 2014).

6. The exposure time (ET) is the amount of time spent outdoors. An ET of 0.5 hours per day was selected for both the adult and child visitor, based on professional judgment, given the size of the impaced area and lack of recreational opportunities at Fort Totten Park.

7. Soil ingestion parameters are reflective of the daily dose of soil. It was assumed that a recreator would be exposed to the full daily dose when at the Fort Totten site; therefore, a FS of 1.0 was used, based on professional judgment.

8. The body weights for the child and adult are the recommended default body weights in USEPA 2014.

9. PEF values were obtained from the USEPA Regional Screening Level (RSL) table, May 2018. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

10. Volatilization factors were obtained from the USEPA RSL table, May 2018. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables

11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.

12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.

13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e. See Table 4.3.

14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).

15. Soil EPC is the 95% Upper Confidence Limit (UCL) of the mean concentration for surface (0-.5') and subsurface (0.5-2') soil, based on incremental sampling methodology (ISM) analytical results.

References:

USEPA. 2018. Regional Screening Levels - Generic Tables. May 2018. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
USEPA. 2017. Exposure Factors Handbook Chapter 5 (Update): Soil and Dust Ingestion. US EPA Office of Research and Development, Washington, DC, EPA/600/R-17/384F.
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E&C 2008. Final Remedial Investigation at the Kenilworth Park South Landfill, Washington, D.C. June 2008.

TABLE 4.2
PROPOSED VALUES USED FOR DAILY INTAKE CALCULATIONS: SITE OUTDOOR WORKER
REASONABLE MAXIMUM EXPOSURE
Fort Totten Park, Washington, D.C.

Scenario Timeframe:	Current/Future
Medium:	Soil Surface (0-0.5') Soil Subsurface (0.5-2')
Exposure Medium:	Soil

Exposure Route	Receptor Population and Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Reference	
Incidental ingestion, dermal contact and inhalation of dust	Outdoor Park Worker Adult	Fort Totten Park	IR_{soil}	Ingestion rate of soil	50	mg/day	USEPA 2017	1
			AF_{soil}	Soil adherence factor	0.12	mg/cm^2	USEPA 2014	2
			SA_{soil}	Skin surface area	3,527	cm^2 / day	USEPA 2014	3
			EF	Exposure Frequency	50	days/yr	Professional judgement	4
			ED	Exposure Duration	25	years	USEPA 2014	5
			ET_{out}	Exposure time outdoors	0.5	hours/event	USEPA 2014	6
			FS	Fraction soil contact at Site	1	unitless	Professional judgment	7
			BW	Body Weight	80	kg	USEPA 2014	8
			PEF	Particulate Emission Factor	1.36E+09	m^3/kg	USEPA 2018	9
			VF	Volatilization Factor	Chemical-specific	m^3/kg	USEPA 2017	10
			AT_c	Averaging Time - cancer	70	years	USEPA 1989	11
			AT_{nc}	Averaging Time - noncancer	25	years	USEPA 2014	12
			ABSd	Dermal absorption factor	Chemical-specific	unitless	USEPA 2004	13
			RBA	Relative Bioavailability Factor	Chemical-specific	%	USEPA 2012	14
			EPC	Exposure point concentration	Chemical-specific	mg/kg	Calculated	15

Soil Average Daily Intake (ADI) and Exposure (ADE) Equations:

$ADI_{ingestion}$ (mg/kg-d) = EPCs * IR * RBA * FS * EF * ED * C1 * 1/BW * 1/AT * 1/C2

ADI_{dermal} (mg/kg-d) = EPCs * ABSd * SA * AF * EF * ED * C1* 1/BW * 1/AT * 1/C2

$ADE_{inhalation}$ (mg/m^3) = EPCair* EF * ET * ED * 1/AT * 1/C3 * 1/C2
Where EPC air = EPC soil * (1/VF + 1/PEF)

Unit conversion factors:
C1 = 0.000001 kg/mg
C2 = 365 days/yr
C3 = 24 hours/day

TABLE 4.2 Notes:

1. Soil ingestion rate is the USEPA default soil ingestion rate for an adult outdoor worker (USEPA 2017).
2. The soil adherence factor (AFsoil) is the USEPA default soil adherence factor for an adult worker (USEPA 2014).
3. The skin surface area is the EPA-recommended default SA for the adult worker (USEPA 2014).
4. The exposure frequency (EF) describes how often the exposure occurs over a given period of time. The EF that a worker conducts activities at the Site one day per week, year-round (2 weeks vacation).
5. The exposure duration (ED) describes the length of time over which the receptor comes into contact with contaminants.
   ED value for the park worker is the current EPA-recommended value for an adult worker (USEPA 2014).
6. The exposure time (ET) is the amount of time spent outdoors. An ET of 0.5 hours per day was selected, which is the EPA default for a worker (EPA 2014). Based on professional judgement, given the small size of the impacted area at Fort Totten Park.
7. Soil ingestion parameters are reflective of the daily dose of soil. It was assumed that a park worker would be exposed to the full daily dose when at the Fort Totten site; Therefore, a FS of 1.0 was used, based on professional judgment.
8. The body weight for the adult is the recommended default body weight in USEPA 2014.
9. PEF values were obtained from the USEPA Regional Screening Level (RSL) table, May 2018. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
10. Volatilization factors were obtained from the USEPA Regional Screening Level (RSL) table, May 2018. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables
11. The averaging time (AT) for cancer effects (AT_c) for all receptors is set equal to a lifetime (i.e., 70 years), as recommended in USEPA 1989.
12. The averaging time for non-cancer effects (AT_{nc}) for all receptors is set equal to the exposure duration, as recommended in USEPA 1989.
13. The dermal absorption factors (ABSd) are recommended values in Exhibit 3-4 of USEPA 2004, with updates as provided on: https://www.epa.gov/risk/risk-assessment-guidance-superfund-rags-part-e. See Table 4.3.
14. The EPA recommended default RBA value of 60% is applied to oral arsenic exposures. An RBA of 100% is used for all other constituents (USEPA 2012).
15. Soil EPC is the 95% Upper Confidence Limit (UCL) of the mean concentration for surface (0-.5') and subsurface (0.5-2') soil, based on incremental sampling methodology (ISM) analytical results.

References:

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E&C 2008. Final Remedial Investigation at the Kenilworth Park South Landfill, Washington, D.C. June 2008.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

Fort Totten Park, Washington, D.C.

Chemical of Potential Concern	Chronic/ Subchronic	Oral Reference Dose (RfD)		Oral Absorption Efficiency for Dermal (1)	Absorbed RfD for Dermal (2)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD:Target Organ(s)	
		Value	Units		Value	Units			Source(s) (3)	Date(s)
Metals										
Aluminum	Chronic	1.0E+00	(mg/kg-day)	1.0E+00	1.0E+00	(mg/kg-day)	Nervous System	100	PPRTV	1989, 1995
Arsenic	Chronic	3.0E-04	(mg/kg-day)	1.0E+00	3.0E-04	(mg/kg-day)	Cardiovascular / Skin	3	IRIS	11/08/18
Cobalt	Chronic	3.0E-04	(mg/kg-day)	1.0E+00	3.0E-04	(mg/kg-day)	Thyroid	3000	PPRTV	1956
Manganese (Non-Diet)	Chronic	2.4E-02	(mg/kg-day)	4.0E-02	9.6E-04	(mg/kg-day)	Nervous System	1	IRIS	11/08/18
Thallium (Soluble Salts)	Chronic	1.0E-05	(mg/kg-day)	1.0E+00	1.0E-05	(mg/kg-day)	Skin	3000	PPRTV	1984 , 1990
Zirconium	Chronic	8.0E-05	(mg/kg-day)	1.0E+00	8.0E-05	(mg/kg-day)	Kidney, Cardiovascular	10000	PPRTV	2012
Semi Volatile Organic Compounds										
Benzo(a)pyrene	Chronic	3.0E-04	(mg/kg-day)	1.0E+00	3.0E-04	(mg/kg-day)	Developmental	300	IRIS	11/08/18

Notes

mg/kg-day = milligrams per kilogram per day

(1) The Oral absorption efficiency for dermal was retrieved from EPA Risk Assessment Guidance for Superfund (RAGS) : Part E, 2004.

(2) The Absorbed RfD for dermal is calculated by multiplying the oral RfD by the oral absorption efficiency value (EPA RAGS : Part E, 2004).

(3) IRIS = Integrated Risk Information System. IRIS Final Assessments Search. https://cfpub.epa.gov/ncea/iris2/atoz.cfm

PPRTV = Professional Peer Reviewed Toxicity Values for Superfund. https://hhpprtv.ornl.gov/quickview/pprtv.php#pprtv_roc.

HEAST = Health Effects Assessment Summary Tables for Superfund. https://epa-heast.ornl.gov/.

EPA RSL = Environmental Protecion Agency Regional Screening Level. https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables.

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION

Fort Totten Park, Washington, D.C.

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation Reference Concentration (RfC)		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC : Target Organ(s)	
		Value	Units			Source(s) (1)	Date(s)
Metals							
Aluminum	Chronic	5.0E-03	mg/m^3	Nervous System	300	PPRTV	11/8/2018
Arsenic	Chronic	1.5E-05	mg/m^3	Developmental / Cardiovascular / Nervous / Respiratory	30	Cal EPA	1999, 2003, 2004
Cobalt	Chronic	6.0E-06	mg/m^3	Respiratory	300	PPRTV	1992
Manganese (Non-Diet)	Chronic	5.0E-05	mg/m^3	Nervous System	1000	IRIS	11/8/2018
Thallium (Soluble Salts)	-	-	-	-	-	-	-
Zirconium	Chronic	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons							
Benzo(a)pyrene	Chronic	2.0E-06	mg/m^3	Developmental	3000	IRIS	11/8/2018

Notes

mg/m^3 = milligrams per cubic meter

mg/kg/day = milligrams per kilogram per day

(1) IRIS = Integrated Risk Information System. IRIS Final Assessments Search. https://cfpub.epa.gov/ncea/iris2/atoz.cfm

PPRTV = Professional Peer Reviewed Toxicity Values for Superfund. https://hhpprtv.ornl.gov/quickview/pprtv.php#pprtv_roc.

CAL EPA = California Environmental Protection Agency. Chronic Reference Exposure Level (REL). OEHAA 2008, Technical Supporting Document for Noncancer RELs Appendix D1.

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

Fort Totten Park, Washington, D.C.

Chemical of Potential Concern	Oral Cancer Slope Factor (CSF)		Oral Absorption Efficiency for Dermal	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units	(1)	Value	Units		Source(s) (3)	Date(s)
Metals								
Aluminum	-	-	1.0E+00	-	-	Inadequate Evidence	-	-
Arsenic	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.0E+00	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	11/8/2018
Cobalt	-	-	1.0E+00	-	-	Likely	PPRTV	2008
Manganese (Non-Diet)	-	-	4.0E-02	-	-	D	IRIS	11/8/2018
Thallium (Soluble Salts)	-	-	1.0E+00	-	-	Inadequate Evidence	-	-
Zirconium	-	-	1.0E+00	-	-	Inadequate Evidence	-	-
Semi Volatile Organic Compounds								
Benzo(a)pyrene	1.0E+00	$(mg/kg\text{-}day)^{-1}$	1.0E+00	1.0E+00	$(mg/kg\text{-}day)^{-1}$	Known*	IRIS	11/8/2018

Notes

mg/kg-day = milligrams per kilogram per day

(1) The Oral absorption efficiency for dermal was retrieved from USEPA's Regional Screening Levels - Generic Tables. May 2018.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-May-2018.

(2) Absorbed cancer slope factor for dermal was calculated by dividing the oral cancer slope factor by the oral absorption efficiency value (EPA RAGS- Part E, 2004).

(3) IRIS = Integrated Risk Information System. 2018. IRIS Final Assessments Search. https://cfpub.epa.gov/ncea/iris2/atoz.cfm

PPRTV = Professional Peer Reviewed Toxicity Values for Superfund. https://hhpprtv.ornl.gov/quickview/pprtv.php#pprtv_roc.

Cancer Description (USEPA 1986)

A = Human carcinogen

B1 = Probable human carcinogen, limited human data are available

B2 = Probably human carcinogen, sufficient evidence in animals and inadequate or no evidence in humans

C = Possible human carcinogen

D = Not classifiable as to human carcinogenicity

* Cancer risk for constituents identified as having a mutagenic mode of action (MOA) is calculated by applying an age-dependent adjustment factor (ADAF) for childhood exposures from birth through 15 years. These ADAFs are summarized below (EPA 2005). COPCs with a mutagenic MOA include benzo(a)pyrene.

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION

Fort Totten Park, Washington, D.C.

Chemical of Potential Concern	Unit Risk		Weight of Evidence/ Cancer Guideline Description per USEPA IRIS	Unit Risk	
	Value	Units		Source(s)	Date(s)
Metals					
Aluminum	-	-	-	-	-
Arsenic	4.30E-03	$(ug/m^3)^{-1}$	A	IRIS	4/3/2018
Cobalt	9.00E-03	$(ug/m^3)^{-1}$	Likely	PPRTV	1992
Manganese (Non-Diet)	-	-	D	IRIS	4/3/2018
Thallium	-	-	-	-	-
Zirconium	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons					
Benzo(a)pyrene	6.00E-04	$(ug/m^3)^{-1}$	Known*	IRIS	4/3/2018

Notes

$(ug/m^3)^{-1}$ = micrograms per cubic meter

IRIS = Integrated Risk Information System. IRIS Final Assessments Search. https://cfpub.epa.gov/ncea/iris2/atoz.cfm

PPRTV = Professional Peer Reviewed Toxicity Values for Superfund. https://hhpprtv.ornl.gov/quickview/pprtv.php#pprtv_roc.

https://oehha.ca.gov/chemicals

A = Human carcinogen

B1 = Probable human carcinogen, limited human data are available

B2 = Probably human carcinogen, sufficient evidence in animals and inadequate or no evidence in humans

C = Possible human carcinogen

D = Not Classifiable as to human carcinogenicity

* Cancer risk for constituents identified as having a mutagenic mode of action (MOA) is calculated by applying an age-dependent adjustment factor (ADAF) for childhood exposures from birth through 15 years. These ADAFs are summarized below (EPA 2005). COPCs with a mutagenic MOA inclu

The ADAFs are as follows:

Year	ADAF
0-2	10
2 < 16	3
≥16	1

TABLE 7.1

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS:

REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil (Surface) 0-0.5'	Soil	Fort Totten Park	Incidental Ingenstion	Arsenic	1.2E+01	mg/kg	5.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	7.6E-07	4.1E-06	mg/kg-day	3.0E-04	mg/kg/day	1.4E-02
				Cobalt	6.6E+00	mg/kg	4.7E-07	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	3.8E-06	mg/kg-day	3.0E-04	mg/kg/day	1.3E-02
				Manganese	2.5E+02	mg/kg	1.7E-05	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	1.4E-04	mg/kg-day	2.4E-02	mg/kg/day	5.9E-03
				Thallium	1.1E+00	mg/kg	7.6E-08	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	6.2E-07	mg/kg-day	1.0E-05	mg/kg/day	6.2E-02
				Zirconium	2.4E+00	mg/kg	1.7E-07	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	1.4E-06	mg/kg-day	8.0E-05	mg/kg/day	1.7E-02
				Benzo(a)pyrene*	5.5E-01	mg/kg	*		*		4.6E-08	3.2E-07	mg/kg-day	3.0E-04	mg/kg/day	1.1E-03
			Exp. Route Total								8.0E-07					1.1E-01
			Dermal Contact	Arsenic	1.2E+01	mg/kg	1.4E-07	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	2.2E-07	1.1E-06	mg/kg-day	3.0E-04	mg/kg/day	3.6E-03
				Cobalt	6.6E+00	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Manganese	2.5E+02	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Thallium	1.1E+00	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Zirconium	2.4E+00	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Benzo(a)pyrene*	5.5E-01	mg/kg	*		*		3.7E-08	2.2E-07	mg/kg-day	3.0E-04	mg/kg/day	7.3E-04
			Exp. Route Total								2.5E-07					4.3E-03
			Inhalation	Arsenic	1.2E+01	mg/kg	1.5E-09	mg/m^3	4.3E+00	(mg/m^3)$^{-1}$	6.5E-09	1.7E-11	mg/m^3	1.5E-05	mg/m^3	1.2E-06
				Cobalt	6.6E+00	mg/kg	8.3E-10	mg/m^3	9.0E+00	(mg/m^3)$^{-1}$	7.5E-09	9.7E-12	mg/m^3	6.0E-06	mg/m^3	1.6E-06
				Manganese	2.5E+02	mg/kg	3.1E-08	mg/m^3	-	(mg/m^3)$^{-1}$	--	3.6E-10	mg/m^3	5.0E-05	mg/m^3	7.2E-06
				Thallium	1.1E+00	mg/kg	1.4E-10	mg/m^3	-	(mg/m^3)$^{-1}$	--	1.6E-12	mg/m^3	-	mg/m^3	--
				Zirconium	2.4E+00	mg/kg	3.0E-10	mg/m^3	-	(mg/m^3)$^{-1}$	--	3.5E-12	mg/m^3	-	mg/m^3	--
				Benzo(a)pyrene*	5.5E-01	mg/kg	*		*		4.4E-13	8.1E-13	mg/m^3	2.0E-06	mg/m^3	4.1E-07
			Exp. Route Total								1.4E-08					1.0E-05
		Exposure Point Total									1.1E-06					1.2E-01
	Exposure Medium Total										1.1E-06					1.2E-01
Risk From Reference											NA					NA
Risk from Site											1.1E-06					1.2E-01
							Total of Receptor Risks Across All Media				1.1E-06					1.2E-01

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

* Cancer risks for benzo(a)pyrene include a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for this compound is shown on Table 7.1A.

"-" = Not available

"-$_a$" = No dermal absorbed fraction for soil available, therefore risk for the dermal exposure pathway was not calculated.

NA = not applicable

TABLE 7.2

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS:

REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

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

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil (Subsurface) 0.5-2'	Soil	Fort Totten Park	Incidental Ingenstion	Aluminum	8.1E+03	mg/kg	5.7E-04	mg/kg-day	-	$(mg/kg-day)^{-1}$	--	4.6E-03	mg/kg-day	1.0E+00	mg/kg/day	4.6E-03
				Arsenic	2.6E+01	mg/kg	1.1E-06	mg/kg-day	1.5E+00	$(mg/kg-day)^{-1}$	1.7E-06	9.1E-06	mg/kg-day	3.0E-04	mg/kg/day	3.0E-02
				Cobalt	6.5E+00	mg/kg	4.6E-07	mg/kg-day	-	$(mg/kg-day)^{-1}$	--	3.8E-06	mg/kg-day	3.0E-04	mg/kg/day	1.3E-02
				Manganese	2.6E+02	mg/kg	1.9E-05	mg/kg-day	-	$(mg/kg-day)^{-1}$	--	1.5E-04	mg/kg-day	2.4E-02	mg/kg/day	6.3E-03
				Thallium	8.6E-01	mg/kg	6.1E-08	mg/kg-day	-	$(mg/kg-day)^{-1}$	--	5.0E-07	mg/kg-day	1.0E-05	mg/kg/day	5.0E-02
				Zirconium	2.8E+00	mg/kg	2.0E-07	mg/kg-day	-	$(mg/kg-day)^{-1}$	--	1.6E-06	mg/kg-day	8.0E-05	mg/kg/day	2.0E-02
				Benzo(a)pyrene*	5.6E-01	mg/kg	*		*		4.7E-08	3.2E-07	mg/kg-day	3.0E-04	mg/kg/day	1.1E-03
			Exp. Route Total								1.7E-06					1.2E-01
			Dermal Contact	Aluminum	8.1E+03	mg/kg	-a	mg/kg-day	-a	$(mg/kg-day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Arsenic	2.6E+01	mg/kg	3.2E-07	mg/kg-day	1.5E+00	$(mg/kg-day)^{-1}$	4.8E-07	2.4E-06	mg/kg-day	3.0E-04	mg/kg/day	8.0E-03
				Cobalt	6.5E+00	mg/kg	-a	mg/kg-day	-a	$(mg/kg-day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Manganese	2.6E+02	mg/kg	-a	mg/kg-day	-a	$(mg/kg-day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Thallium	8.6E-01	mg/kg	-a	mg/kg-day	-a	$(mg/kg-day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Zirconium	2.8E+00	mg/kg	-a	mg/kg-day	-a	$(mg/kg-day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Benzo(a)pyrene*	5.6E-01	mg/kg	*		*		3.8E-08	2.2E-07	mg/kg-day	3.0E-04	mg/kg/day	7.4E-04
			Exp. Route Total								5.2E-07					8.7E-03
				Aluminum	8.1E+03	mg/kg	1.0E-06	mg/m^3	-	$(mg/m^3)^{-1}$	--	1.2E-08	mg/m^3	5.0E-03	mg/m^3	2.4E-06
				Arsenic	2.6E+01	mg/kg	3.3E-09	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.4E-08	3.9E-11	mg/m^3	1.5E-05	mg/m^3	2.6E-06
				Cobalt	6.5E+00	mg/kg	8.2E-10	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	7.4E-09	9.6E-12	mg/m^3	6.0E-06	mg/m^3	1.6E-06
				Manganese	2.6E+02	mg/kg	3.3E-08	mg/m^3	-	$(mg/m^3)^{-1}$	--	3.9E-10	mg/m^3	5.0E-05	mg/m^3	7.7E-06
				Thallium	8.6E-01	mg/kg	1.1E-10	mg/m^3	-	$(mg/m^3)^{-1}$	--	1.3E-12	mg/m^3	-	mg/m^3	--
				Zirconium	2.8E+00	mg/kg	3.6E-10	mg/m^3	-	$(mg/m^3)^{-1}$	--	4.1E-12	mg/m^3	-	mg/m^3	--
				Benzo(a)pyrene*	5.6E-01	mg/kg	*		*		4.5E-13	8.3E-13	mg/m^3	2.0E-06	mg/m^3	4.1E-07
			Exp. Route Total								2.2E-08					1.5E-05
		Exposure Point Total									2.2E-06					1.3E-01
	Exposure Medium Total										2.2E-06					1.3E-01
Risk From Reference											NA					NA
Risk from Site											2.2E-06					1.3E-01
							Total of Receptor Risks Across All Media				2.2E-06					1.3E-01

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

* Cancer risks for benzo(a)pyrene include a receptor-specific Age-Dependent Adjustment Factor. Derivation of cancer risk for this compound is shown on Table 7.2A.

"-" = Not available

"-a" = No dermal absorbed fraction for soil available, therefore risk for the dermal exposure pathway was not calculated.

NA = Not applicable

TABLE 7.3

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS:

REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

Scenario Timeframe:	Current/Future
Receptor Population:	Outdoor Park Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil (Surface) 0-0.5'	Soil	Fort Totten Park	Incidental Ingenstion	Arsenic	1.2E+01	mg/kg	2.2E-07	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	3.3E-07	6.1E-07	mg/kg-day	3.0E-04	mg/kg/day	2.0E-03
				Cobalt	6.6E+00	mg/kg	2.0E-07	mg/kg-day	-	$(mg/kg\text{-}day)^{-1}$	--	5.7E-07	mg/kg-day	3.0E-04	mg/kg/day	1.9E-03
				Manganese	2.5E+02	mg/kg	7.5E-06	mg/kg-day	-	$(mg/kg\text{-}day)^{-1}$	--	2.1E-05	mg/kg-day	2.4E-02	mg/kg/day	8.8E-04
				Thallium	1.1E+00	mg/kg	3.3E-08	mg/kg-day	-	$(mg/kg\text{-}day)^{-1}$	--	9.2E-08	mg/kg-day	1.0E-05	mg/kg/day	9.2E-03
				Zirconium	2.4E+00	mg/kg	7.3E-08	mg/kg-day	-	$(mg/kg\text{-}day)^{-1}$	--	2.0E-07	mg/kg-day	8.0E-05	mg/kg/day	2.5E-03
				Benzo(a)pyrene	5.5E-01	mg/kg	1.7E-08	mg/kg-day	1.0E+00	$(mg/kg\text{-}day)^{-1}$	1.7E-08	4.7E-08	mg/kg-day	3.0E-04	mg/kg/day	1.6E-04
			Exp. Route Total								3.4E-07					1.7E-02
			Dermal Contact	Arsenic	1.2E+01	mg/kg	9.2E-08	mg/kg-day	1.5E+00	$(mg/kg\text{-}day)^{-1}$	1.4E-07	2.6E-07	mg/kg-day	3.0E-04	mg/kg/day	8.6E-04
				Cobalt	6.6E+00	mg/kg	-a	mg/kg-day	-a	$(mg/kg\text{-}day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Manganese	2.5E+02	mg/kg	-a	mg/kg-day	-a	$(mg/kg\text{-}day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Thallium	1.1E+00	mg/kg	-a	mg/kg-day	-a	$(mg/kg\text{-}day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Zirconium	2.4E+00	mg/kg	-a	mg/kg-day	-a	$(mg/kg\text{-}day)^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Benzo(a)pyrene	5.5E-01	mg/kg	1.9E-08	mg/kg-day	1.0E+00	$(mg/kg\text{-}day)^{-1}$	1.9E-08	5.2E-08	mg/kg-day	3.0E-04	mg/kg/day	1.7E-04
			Exp. Route Total								1.6E-07					1.0E-03
			Inhalation	Arsenic	1.2E+01	mg/kg	8.9E-12	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	3.8E-11	2.5E-11	mg/m^3	1.5E-05	mg/m^3	1.7E-06
				Cobalt	6.6E+00	mg/kg	5.0E-12	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	4.5E-11	1.4E-11	mg/m^3	6.0E-06	mg/m^3	2.3E-06
				Manganese	2.5E+02	mg/kg	1.8E-10	mg/m^3	-	$(mg/m^3)^{-1}$	--	5.1E-10	mg/m^3	5.0E-05	mg/m^3	1.0E-05
				Thallium	1.1E+00	mg/kg	8.1E-13	mg/m^3	-	$(mg/m^3)^{-1}$	--	2.3E-12	mg/m^3	-	mg/m^3	--
				Zirconium	2.4E+00	mg/kg	1.8E-12	mg/m^3	-	$(mg/m^3)^{-1}$	--	5.0E-12	mg/m^3	-	mg/m^3	--
				Benzo(a)pyrene	5.5E-01	mg/kg	4.1E-13	mg/m^3	6.0E-01	$(mg/m^3)^{-1}$	2.5E-13	1.2E-12	mg/m^3	2.0E-06	mg/m^3	5.8E-07
			Exp. Route Total								8.3E-11					1.5E-05
		Exposure Point Total									5.0E-07					1.8E-02
	Exposure Medium Total										5.0E-07					1.8E-02
Risk From Reference											NA					NA
Risk from Site											5.0E-07					1.8E-02
							Total of Receptor Risks Across All Media				5.0E-07					1.8E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

"-" = Not available

"-a" = No dermal absorbed fraction for soil available, therefore risk for the dermal exposure pathway was not calculated.

NA = Not applicable

TABLE 7.4

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS:

REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

Scenario Timeframe:	Current/Future
Receptor Population:	Outdoor Park Worker
Receptor Age:	Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
							Intake/Exposure Concentration		CSF/Unit Risk*		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
					Value	Units	Value	Units	Value	Units		Value	Units	Value	Units	
Soil (Subsurface) 0-0.2'	Soil	Fort Totten Park	Incidental Ingenstion	Aluminum	8.1E+03	mg/kg	2.5E-04	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	6.9E-04	mg/kg-day	1.0E+00	mg/kg/day	6.9E-04
				Arsenic	2.6E+01	mg/kg	4.8E-07	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	7.2E-07	1.3E-06	mg/kg-day	3.0E-04	mg/kg/day	4.5E-03
				Cobalt	6.5E+00	mg/kg	2.0E-07	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	5.6E-07	mg/kg-day	3.0E-04	mg/kg/day	1.9E-03
				Manganese	2.6E+02	mg/kg	8.0E-06	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	2.2E-05	mg/kg-day	2.4E-02	mg/kg/day	9.4E-04
				Thallium	8.6E-01	mg/kg	2.6E-08	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	7.4E-08	mg/kg-day	1.0E-05	mg/kg/day	7.4E-03
				Zirconium	2.8E+00	mg/kg	8.6E-08	mg/kg-day	-	(mg/kg-day)$^{-1}$	--	2.4E-07	mg/kg-day	8.0E-05	mg/kg/day	3.0E-03
				Benzo(a)pyrene	5.6E-01	mg/kg	1.7E-08	mg/kg-day	1.0E+00	(mg/kg-day)$^{-1}$	1.7E-08	4.8E-08	mg/kg-day	3.0E-04	mg/kg/day	1.6E-04
			Exp. Route Total								7.4E-07					1.9E-02
			Dermal Contact	Aluminum	8.1E+03	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Arsenic	2.6E+01	mg/kg	2.0E-07	mg/kg-day	1.5E+00	(mg/kg-day)$^{-1}$	3.1E-07	5.7E-07	mg/kg-day	3.0E-04	mg/kg/day	1.9E-03
				Cobalt	6.5E+00	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Manganese	2.6E+02	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Thallium	8.6E-01	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Zirconium	2.8E+00	mg/kg	-a	mg/kg-day	-a	(mg/kg-day)$^{-1}$	--	-a	mg/kg-day	-a	mg/kg/day	--
				Benzo(a)pyrene	5.6E-01	mg/kg	1.9E-08	mg/kg-day	1.0E+00	(mg/kg-day)$^{-1}$	1.9E-08	5.3E-08	mg/kg-day	3.0E-04	mg/kg/day	1.8E-04
			Exp. Route Total								3.2E-07					2.1E-03
			Inhalation	Aluminum	8.1E+03	mg/kg	6.1E-09	mg/m^3	-	(mg/m^3)$^{-1}$	--	1.7E-08	mg/m^3	5.0E-03	mg/m^3	3.4E-06
				Arsenic	2.6E+01	mg/kg	2.0E-11	mg/m^3	4.3E+00	(mg/m^3)$^{-1}$	8.4E-11	5.5E-11	mg/m^3	1.5E-05	mg/m^3	3.7E-06
				Cobalt	6.5E+00	mg/kg	4.9E-12	mg/m^3	9.0E+00	(mg/m^3)$^{-1}$	4.4E-11	1.4E-11	mg/m^3	6.0E-06	mg/m^3	2.3E-06
				Manganese	2.6E+02	mg/kg	2.0E-10	mg/m^3	-	(mg/m^3)$^{-1}$	--	5.5E-10	mg/m^3	5.0E-05	mg/m^3	1.1E-05
				Thallium	8.6E-01	mg/kg	6.5E-13	mg/m^3	-	(mg/m^3)$^{-1}$	--	1.8E-12	mg/m^3	-	mg/m^3	--
				Zirconium	2.8E+00	mg/kg	2.1E-12	mg/m^3	-	(mg/m^3)$^{-1}$	--	5.9E-12	mg/m^3	-	mg/m^3	--
				Benzo(a)pyrene	5.6E-01	mg/kg	4.2E-13	mg/m^3	6.0E-01	(mg/m^3)$^{-1}$	2.5E-13	1.2E-12	mg/m^3	2.0E-06	mg/m^3	5.9E-07
			Exp. Route Total								1.3E-10					2.1E-05
		Exposure Point Total									1.1E-06					2.1E-02
	Exposure Medium Total										1.1E-06					2.1E-02
Risk From Reference											NA					NA
Risk from Site											1.1E-06					2.1E-02
							Total of Receptor Risks Across All Media				1.1E-06					2.1E-02

(1) EPC = Exposure Point Concentration; CSF = Cancer Slope Factor; RfD = Reference Dose; RfC = Reference Concentration

(2) Cancer risk = Intake/exposure equation * CSF or Unit Risk; Hazard Index = Intake/exposure equation / RfD or RfC.

"-" = Not available

"-$_a$" = No dermal absorbed fraction for soil available, therefore risk for the dermal exposure pathway was not calculated.

NA = Not applicable

TABLE 8.1

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil (Surface) 0-0.5'	Fort Totten Park	Arsenic	7.6E-07	6.5E-09	2.2E-07	9.8E-07	Cardiovascular / Skin	1.4E-02	1.2E-06	3.6E-03	1.7E-02
			Cobalt	--	7.5E-09	--	7.5E-09	Thyroid	1.3E-02	1.6E-06	--	1.3E-02
			Manganese	--	--	--	--	Nervous System	5.9E-03	7.2E-06	--	5.9E-03
			Thallium	--	--	--	--	Skin	6.2E-02	--	--	6.2E-02
			Zirconium	--	--	--	--	Kidney, Cardiovascular	1.7E-02	--	--	1.7E-02
			Benzo(a)pyrene	4.6E-08	4.4E-13	3.7E-08	8.3E-08	Developmental	1.1E-03	4.1E-07	7.3E-04	1.8E-03
			Chemical Total	8.0E-07	1.4E-08	2.5E-07	1.1E-06		1.1E-01	1.0E-05	4.3E-03	1.2E-01
		Exposure Point Total					1.1E-06					1.2E-01
	Exposure Medium Total						1.1E-06					1.2E-01
Medium Total							1.1E-06					1.2E-01
Background Total						Receptor Background Total	NA				Receptor Background Total	NA
Site Total						Receptor Site Total	1.1E-06				Receptor Site Total	1.2E-01
Receptor Total						Receptor Risk Total	1.1E-06				Receptor HI Total	1.2E-01

Notes

"--" = Risk not calculated. See calculation of chemical cancer risk and non-cancer hazards on Table 7.1.

NA = Not applicable

TABLE 8.2

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

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

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil (Subsurface) 0.5-2'	Fort Totten Park	Aluminum	--	--	--	--	Nervous System	4.6E-03	2.4E-06	--	4.6E-03
			Arsenic	1.7E-06	1.4E-08	4.8E-07	2.2E-06	Cardiovascular / Skin	3.0E-02	2.6E-06	8.0E-03	3.8E-02
			Cobalt	--	7.4E-09	--	7.4E-09	Thyroid	1.3E-02	1.6E-06	--	1.3E-02
			Manganese	--	--	--	--	Nervous System	6.3E-03	7.7E-06	--	6.3E-03
			Thallium	--	--	--	--	Skin	5.0E-02	--	--	5.0E-02
			Zirconium	--	--	--	--	Kidney, Cardiovascular	2.0E-02	--	--	2.0E-02
			Benzo(a)pyrene	4.7E-08	4.5E-13	3.8E-08	8.5E-08	Developmental	1.1E-03	4.1E-07	7.4E-04	1.8E-03
			Chemical Total	1.7E-06	2.2E-08	5.2E-07	2.2E-06		1.2E-01	1.5E-05	8.7E-03	1.3E-01
		Exposure Point Total					2.2E-06					1.3E-01
	Exposure Medium Total						2.2E-06					1.3E-01
Medium Total							2.2E-06					1.3E-01
Background Total				Receptor Background Total			NA	Receptor Background Total				NA
Site Total				Receptor Site Total			2.2E-06	Receptor Site Total				1.3E-01
Receptor Total				Receptor Risk Total			2.2E-06	Receptor HI Total				1.3E-01

Notes

"--" = Risk not calculated. See calculation of chemical cancer risk and non-cancer hazards on Table 7.2.

NA = Not applicable

TABLE 8.3

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

Scenario Timeframe: Current/Future
Receptor Population: Park Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil (Surface) 0-0.5'	Fort Totten Park	Arsenic	3.3E-07	3.8E-11	1.4E-07	4.7E-07	Cardiovascular / Skin	2.0E-03	1.7E-06	8.6E-04	2.9E-03
			Cobalt	--	4.5E-11	--	4.5E-11	Thyroid	1.9E-03	2.3E-06	--	1.9E-03
			Manganese	--	--	--	--	Nervous System	8.8E-04	1.0E-05	--	8.9E-04
			Thallium	--	--	--	--	Skin	9.2E-03	--	--	9.2E-03
			Zirconium	--	--	--	--	Kidney, Cardiovascular	2.5E-03	--	--	2.5E-03
			Benzo(a)pyrene	1.7E-08	2.5E-13	1.9E-08	3.6E-08	Developmental	1.6E-04	5.8E-07	1.7E-04	3.3E-04
			Chemical Total	3.4E-07	8.3E-11	1.6E-07	5.0E-07		1.7E-02	1.5E-05	1.0E-03	1.8E-02
		Exposure Point Total					5.0E-07					1.8E-02
	Exposure Medium Total						5.0E-07					1.8E-02
Medium Total							5.0E-07					1.8E-02
Background Total						Receptor Background Total	NA				Receptor Background Total	NA
Site Total						Receptor Site Total	5.0E-07				Receptor Site Total	1.8E-02
Receptor Total						Receptor Risk Total	5.0E-07				Receptor HI Total	1.8E-02

Notes

"--" = Risk not calculated. See calculation of chemical cancer risk and non-cancer hazards on Table 7.3.

NA = Not applicable

TABLE 8.4

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

Fort Totten Park, Washington, D.C.

Scenario Timeframe: Current/Future
Receptor Population: Park Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil (Subsurface) 0.5-2"	Fort Totten Park	Aluminum	--	--	--	--	Nervous System	6.9E-04	3.4E-06	--	6.9E-04
			Arsenic	7.2E-07	8.4E-11	3.1E-07	1.0E-06	Cardiovascular / Skin	4.5E-03	3.7E-06	1.9E-03	6.4E-03
			Cobalt	--	4.4E-11	--	4.4E-11	Thyroid	1.9E-03	2.3E-06	--	1.9E-03
			Manganese	--	--	--	--	Nervous System	9.4E-04	1.1E-05	--	9.5E-04
			Thallium	--	--	--	--	Skin	7.4E-03	--	--	7.4E-03
			Zirconium	--	--	--	--	Kidney, Cardiovascular	3.0E-03	--	--	3.0E-03
			Benzo(a)pyrene	1.7E-08	2.5E-13	1.9E-08	3.6E-08	Developmental	1.6E-04	5.9E-07	1.8E-04	3.4E-04
			Chemical Total	7.4E-07	1.3E-10	3.2E-07	1.1E-06		1.9E-02	2.1E-05	2.1E-03	2.1E-02
		Exposure Point Total					1.1E-06					2.1E-02
	Exposure Medium Total						1.1E-06					2.1E-02
Medium Total							1.1E-06					2.1E-02
Background Total				Receptor Background Total			NA	Receptor Background Total				NA
Site Total				Receptor Site Total			1.1E-06	Receptor Site Total				2.1E-02
Receptor Total				Receptor Risk Total			1.1E-06	Receptor HI Total				2.1E-02

Notes

"--" = Risk not calculated. See calculation of chemical cancer risk and non-cancer hazards on Table 7.4.

NA = Not applicable

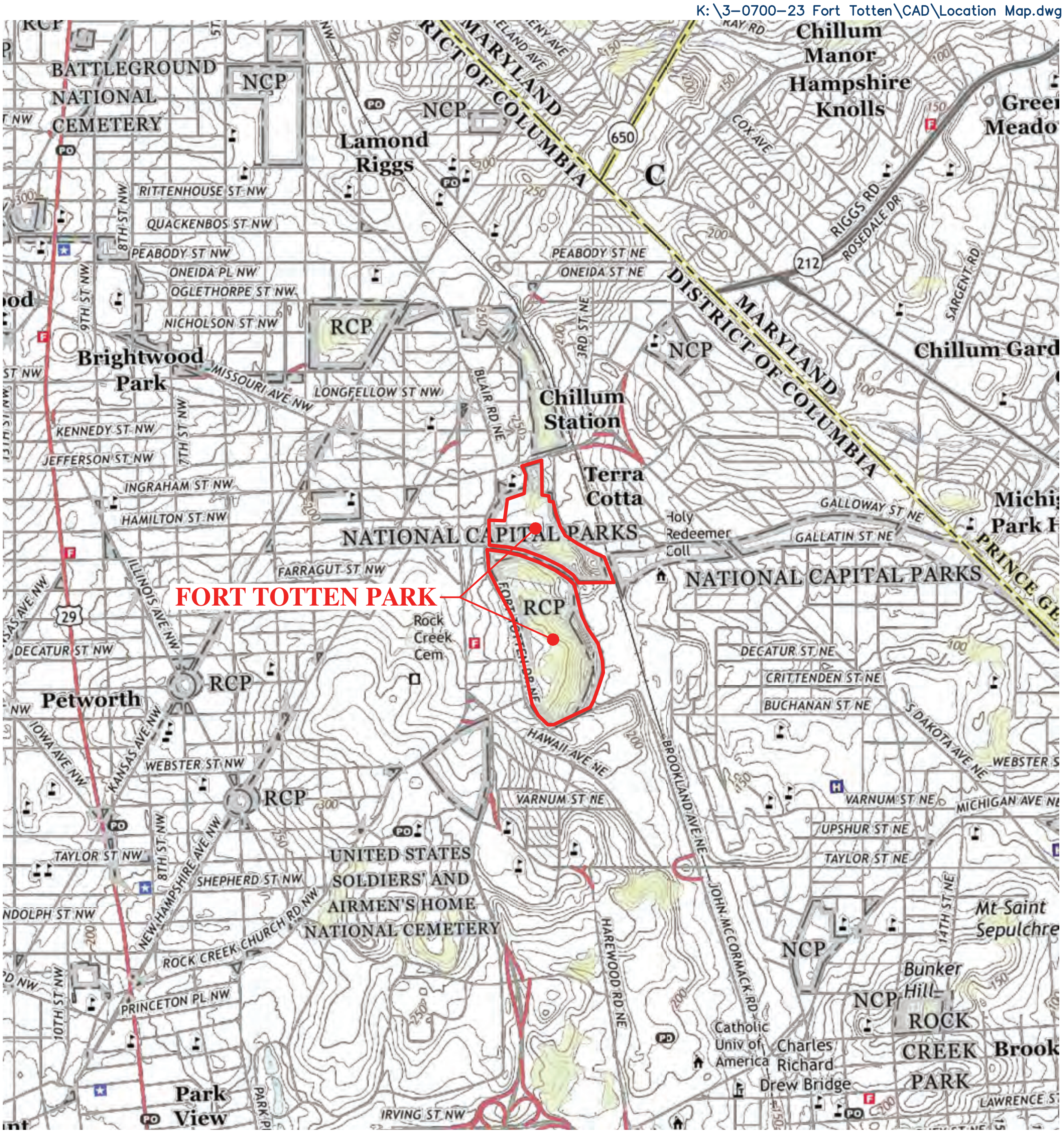
TABLE 9
SUMMARY OF RECEPTOR RISKS
VARIOUS PARK SCENARIOS
Fort Totten Park, Washington, D.C.

Receptor	Risk		Risk Drivers	
	Cancer (ILCR)	**Non-Cancer (HI)**	**Cancer**	**Non-Cancer**
#1a: Recreational User (Surface Soil) Total	1E-06	0.1	None[1]	None
#1b: Recreational User (Subsurface Soil) Total	2E-06	0.1	Arsenic	None
#2a: Park Worker (Surface Soil) Total	5E-07	0.02	None	None
#2b: Park Worker (Subsurface Soil) Total	1E-06	0.02	Arsenic	None

Notes:
Risk driver = Constituent with cumulative cancer risk greater than 1×10^{-6}, or cumulative non-cancer hazard greater than unity (1).
1. Cumulative cancer risk exceeded 1×10^{-6} across COPCs; however, cancer risk for individual constituents was less than 1×10^{-6}.

APPENDIX A – FIGURES

K:\3-0700-23 Fort Totten\CAD\Location Map.dwg



1 0.5 0 1

MILES

1000 0 1000 2000 3000 4000 5000 6000 7000

FEET

CONTOUR INTERVAL 10 FEET

GENERAL LOCATION

BASE MAP: USGS 7.5 Minute Topographic Quadrangle WASHINGTON WEST, DC-MD-VA 2016 & WASHINGTON EAST, DC-MD 2016

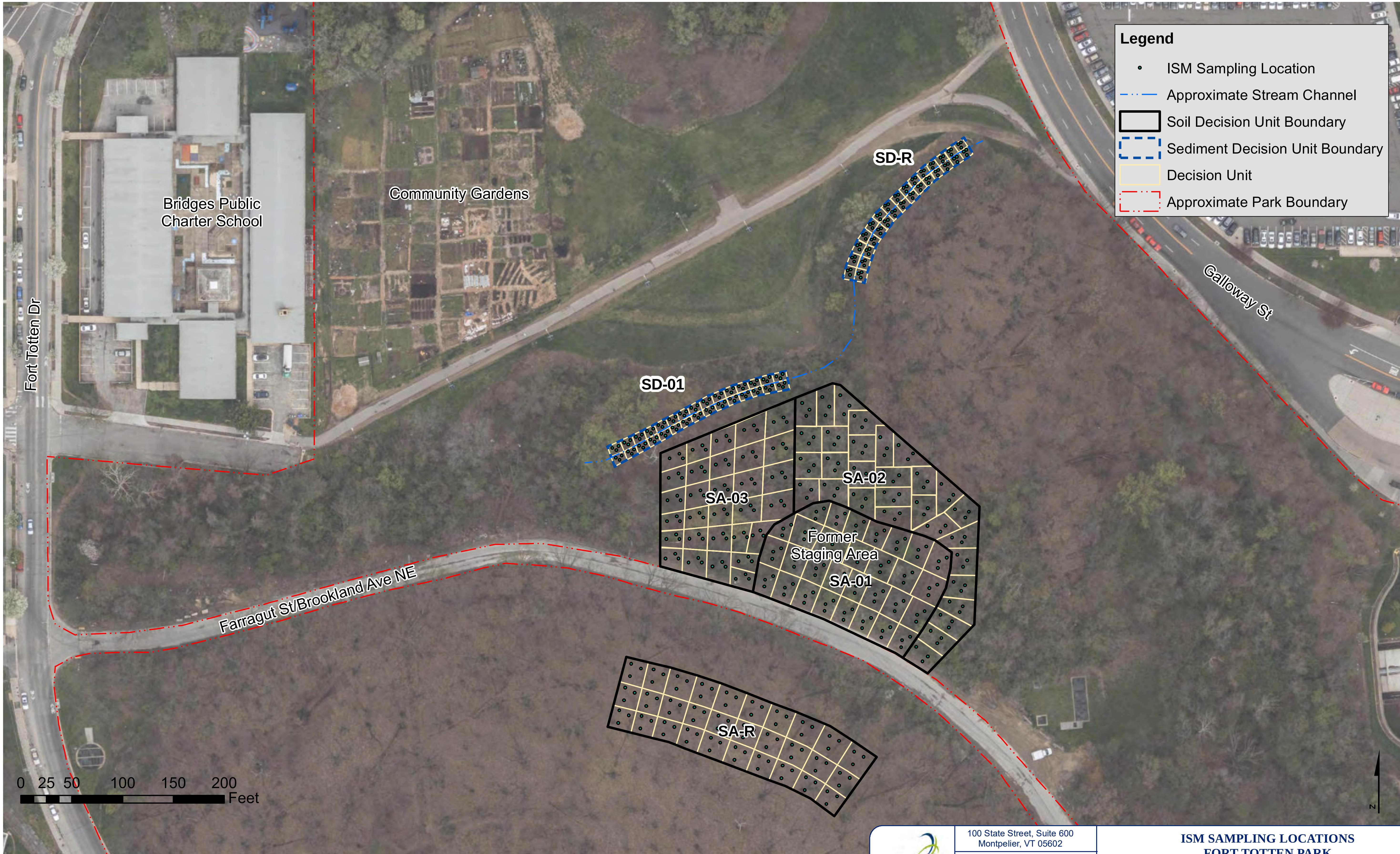
FIGURE 1: PARK LOCATION MAP
FORT TOTTEN PARK
CIVIL WAR DEFENSES OF WASHINGTON

The Johnson Company

100 State Street, Suite 600
Montpelier, VT 05602

Drawn by: TJK	Date: 07/21/17
Chk'd by: SJH	Date: 07/21/17
Scale: As Shown	Project: 3-0700-23

K:\3-0700-23 Fort Totten\GIS\MXDs\ISM Sampling Locations.mxd



NOTE: Subsurface Soil Decision Units and Groundwater Monitoring Well Locations to be Determined Pending Surface Soil Sampling.
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

The Johnson Company

100 State Street, Suite 600
Montpelier, VT 05602

Drawn by: DEB	Date: 03/01/18
Reviewed by:	Date:
Scale:1 " = 90 feet	Project: 3-0700-23

ISM SAMPLING LOCATIONS
FORT TOTTEN PARK
CIVIL WAR DEFENSES OF WASHINGTON

APPENDIX B – PROUCL OUTPUT

Appendix B-1

ProUCL Outputs - Surface Soil

Fort Totten Park, Washington, D.C.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/7/2018 3:05:09 PM
From File	For EPC_a.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	4.5	Mean	6.689
Maximum	16	Median	5.7
SD	3.595	Std. Error of Mean	1.198
Coefficient of Variation	0.537	Skewness	2.685

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.609	Shapiro Wilk GOF Test
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.365	Lilliefors GOF Test
5% Lilliefors Critical Value	0.274	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	8.917	95% Adjusted-CLT UCL (Chen-1995)	9.806
		95% Modified-t UCL (Johnson-1978)	9.096

Gamma GOF Test

A-D Test Statistic	1.132	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.723	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.305	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.28	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	6.154	k star (bias corrected MLE)	4.177
Theta hat (MLE)	1.087	Theta star (bias corrected MLE)	1.601
nu hat (MLE)	110.8	nu star (bias corrected)	75.19
MLE Mean (bias corrected)	6.689	MLE Sd (bias corrected)	3.273
		Approximate Chi Square Value (0.05)	56.22
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	52.77

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	8.946	95% Adjusted Gamma UCL (use when n<50)	9.53

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.747	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.273	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.504	Mean of logged Data	1.817
Maximum of Logged Data	2.773	SD of logged Data	0.389

Assuming Lognormal Distribution

95% H-UCL	8.888	90% Chebyshev (MVUE) UCL	9.165
95% Chebyshev (MVUE) UCL	10.34	97.5% Chebyshev (MVUE) UCL	11.96
99% Chebyshev (MVUE) UCL	15.15		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	8.66	95% Jackknife UCL	8.917
95% Standard Bootstrap UCL	8.533	95% Bootstrap-t UCL	13.94
95% Hall's Bootstrap UCL	16.19	95% Percentile Bootstrap UCL	8.989
95% BCA Bootstrap UCL	10.17		
90% Chebyshev(Mean, Sd) UCL	10.28	95% Chebyshev(Mean, Sd) UCL	11.91
97.5% Chebyshev(Mean, Sd) UCL	14.17	99% Chebyshev(Mean, Sd) UCL	18.61

Suggested UCL to Use

95% Student's-t UCL	8.917	or 95% Modified-t UCL	9.096
or 95% H-UCL	8.888		

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Cobalt

General Statistics

Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	1.9	Mean	3.944
Maximum	7.1	Median	3.6
SD	1.845	Std. Error of Mean	0.615
Coefficient of Variation	0.468	Skewness	0.472

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.929	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.14	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.088	95% Adjusted-CLT UCL (Chen-1995)	5.059
		95% Modified-t UCL (Johnson-1978)	5.104

Gamma GOF Test

A-D Test Statistic	0.282	Anderson-Darling Gamma GOF Test
5% A-D Critical Value	0.723	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.146	Kolmogorov-Smirnov Gamma GOF Test
5% K-S Critical Value	0.28	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	5.047	k star (bias corrected MLE)	3.439
Theta hat (MLE)	0.782	Theta star (bias corrected MLE)	1.147
nu hat (MLE)	90.84	nu star (bias corrected)	61.89
MLE Mean (bias corrected)	3.944	MLE Sd (bias corrected)	2.127
		Approximate Chi Square Value (0.05)	44.8
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	41.75

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5.45	95% Adjusted Gamma UCL (use when n<50)	5.848

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.933	Shapiro Wilk Lognormal GOF Test
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.137	Lilliefors Lognormal GOF Test
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	0.642	Mean of logged Data	1.27
Maximum of Logged Data	1.96	SD of logged Data	0.487

Assuming Lognormal Distribution

95% H-UCL	5.875	90% Chebyshev (MVUE) UCL	5.906
95% Chebyshev (MVUE) UCL	6.79	97.5% Chebyshev (MVUE) UCL	8.018
99% Chebyshev (MVUE) UCL	10.43		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	4.956	95% Jackknife UCL	5.088
95% Standard Bootstrap UCL	4.874	95% Bootstrap-t UCL	5.292
95% Hall's Bootstrap UCL	4.978	95% Percentile Bootstrap UCL	4.889
95% BCA Bootstrap UCL	4.944		
90% Chebyshev(Mean, Sd) UCL	5.789	95% Chebyshev(Mean, Sd) UCL	6.625
97.5% Chebyshev(Mean, Sd) UCL	7.784	99% Chebyshev(Mean, Sd) UCL	10.06

Suggested UCL to Use

95% Student's-t UCL	5.088

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

Manganese

General Statistics

Total Number of Observations	9	Number of Distinct Observations	9
		Number of Missing Observations	0
Minimum	94	Mean	162.3
Maximum	250	Median	160
SD	57.2	Std. Error of Mean	19.07
Coefficient of Variation	0.352	Skewness	0.249

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.937	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.153	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	197.8	95% Adjusted-CLT UCL (Chen-1995)	195.4
		95% Modified-t UCL (Johnson-1978)	198.1

Gamma GOF Test

A-D Test Statistic	0.276	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.722	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.167	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	8.805	k star (bias corrected MLE)	5.944
Theta hat (MLE)	18.44	Theta star (bias corrected MLE)	27.31
nu hat (MLE)	158.5	nu star (bias corrected)	107
MLE Mean (bias corrected)	162.3	MLE Sd (bias corrected)	66.58
		Approximate Chi Square Value (0.05)	84.12
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	79.85

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	206.5	95% Adjusted Gamma UCL (use when n<50)	217.5

Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.931	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.151	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.543	Mean of logged Data	5.032
Maximum of Logged Data	5.521	SD of logged Data	0.366

Assuming Lognormal Distribution

95% H-UCL	214.6	90% Chebyshev (MVUE) UCL	222.4
95% Chebyshev (MVUE) UCL	249.6	97.5% Chebyshev (MVUE) UCL	287.2
99% Chebyshev (MVUE) UCL	361.2		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	193.7	95% Jackknife UCL	197.8
95% Standard Bootstrap UCL	192	95% Bootstrap-t UCL	202.6
95% Hall's Bootstrap UCL	194.6	95% Percentile Bootstrap UCL	193
95% BCA Bootstrap UCL	193.8		
90% Chebyshev(Mean, Sd) UCL	219.5	95% Chebyshev(Mean, Sd) UCL	245.4
97.5% Chebyshev(Mean, Sd) UCL	281.4	99% Chebyshev(Mean, Sd) UCL	352

Suggested UCL to Use

95% Student's-t UCL	197.8

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

Thallium

General Statistics

Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.43	Mean	0.754
Maximum	1.2	Median	0.7
SD	0.222	Std. Error of Mean	0.074
Coefficient of Variation	0.294	Skewness	0.804

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test			
Shapiro Wilk Test Statistic	0.949	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.162	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.892	95% Adjusted-CLT UCL (Chen-1995)	0.897
		95% Modified-t UCL (Johnson-1978)	0.895

Gamma GOF Test

A-D Test Statistic	0.231	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.167	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	13.4	k star (bias corrected MLE)	9.008
Theta hat (MLE)	0.0563	Theta star (bias corrected MLE)	0.0838
nu hat (MLE)	241.2	nu star (bias corrected)	162.1
MLE Mean (bias corrected)	0.754	MLE Sd (bias corrected)	0.251
		Approximate Chi Square Value (0.05)	133.7
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	128.3

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.915	95% Adjusted Gamma UCL (use when n<50)	0.954

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.976	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.188	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-0.844	Mean of logged Data	-0.32
Maximum of Logged Data	0.182	SD of logged Data	0.293

Assuming Lognormal Distribution

95% H-UCL	0.933	90% Chebyshev (MVUE) UCL	0.976
95% Chebyshev (MVUE) UCL	1.077	97.5% Chebyshev (MVUE) UCL	1.216
99% Chebyshev (MVUE) UCL	1.49		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.876	95% Jackknife UCL	0.892
95% Standard Bootstrap UCL	0.867	95% Bootstrap-t UCL	0.935
95% Hall's Bootstrap UCL	1.068	95% Percentile Bootstrap UCL	0.871
95% BCA Bootstrap UCL	0.883		
90% Chebyshev(Mean, Sd) UCL	0.976	95% Chebyshev(Mean, Sd) UCL	1.077
97.5% Chebyshev(Mean, Sd) UCL	1.217	99% Chebyshev(Mean, Sd) UCL	1.491

Suggested UCL to Use

95% Student's-t UCL	0.892

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

Zirconium

General Statistics

Total Number of Observations	9	Number of Distinct Observations	5
Number of Detects	4	Number of Non-Detects	5
Number of Distinct Detects	4	Number of Distinct Non-Detects	1
Minimum Detect	1.4	Minimum Non-Detect	2.5
Maximum Detect	2.1	Maximum Non-Detect	2.5
Variance Detects	0.0833	Percent Non-Detects	55.56%
Mean Detects	1.75	SD Detects	0.289
Median Detects	1.75	CV Detects	0.165
Skewness Detects	-4.67E-15	Kurtosis Detects	0.912
Mean of Logged Detects	0.549	SD of Logged Detects	0.168

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.991	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.181	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Normal at 5% Significance Level

Detected Data appear Normal at 5% Significance Level

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

KM Mean	1.75	KM Standard Error of Mean	0.144
KM SD	0.25	95% KM (BCA) UCL	N/A
95% KM (t) UCL	2.018	95% KM (Percentile Bootstrap) UCL	N/A
95% KM (z) UCL	1.987	95% KM Bootstrap t UCL	N/A
90% KM Chebyshev UCL	2.183	95% KM Chebyshev UCL	2.379
97.5% KM Chebyshev UCL	2.651	99% KM Chebyshev UCL	3.186

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.221	**Anderson-Darling GOF Test**
5% A-D Critical Value	0.656	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.19	**Kolmogorov-Smirnov GOF**
5% K-S Critical Value	0.394	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	48.2	k star (bias corrected MLE)	12.22
Theta hat (MLE)	0.0363	Theta star (bias corrected MLE)	0.143
nu hat (MLE)	385.6	nu star (bias corrected)	97.73
Mean (detects)	1.75		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	1.376	Mean	1.751
Maximum	2.145	Median	1.743
SD	0.275	CV	0.157
k hat (MLE)	45.06	k star (bias corrected MLE)	30.11
Theta hat (MLE)	0.0389	Theta star (bias corrected MLE)	0.0581
nu hat (MLE)	811.1	nu star (bias corrected)	542
Adjusted Level of Significance (β)	0.0231		
Approximate Chi Square Value (542.05, α)	489.1	Adjusted Chi Square Value (542.05, β)	478.4
95% Gamma Approximate UCL (use when n>=50)	1.94	95% Gamma Adjusted UCL (use when n<50)	N/A

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	1.75	SD (KM)	0.25
Variance (KM)	0.0625	SE of Mean (KM)	0.144
k hat (KM)	49	k star (KM)	32.74
nu hat (KM)	882	nu star (KM)	589.3
theta hat (KM)	0.0357	theta star (KM)	0.0535
80% gamma percentile (KM)	2.001	90% gamma percentile (KM)	2.152
95% gamma percentile (KM)	2.282	99% gamma percentile (KM)	2.539

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (589.33, α)	534	Adjusted Chi Square Value (589.33, β)	522.9
95% Gamma Approximate KM-UCL (use when n>=50)	1.931	95% Gamma Adjusted KM-UCL (use when n<50)	1.972

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.986	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.748	Detected Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.206	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.375	Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	1.751	Mean in Log Scale	0.549
SD in Original Scale	0.277	SD in Log Scale	0.159
95% t UCL (assumes normality of ROS data)	1.923	95% Percentile Bootstrap UCL	1.894
95% BCA Bootstrap UCL	1.89	95% Bootstrap t UCL	1.932
95% H-UCL (Log ROS)	1.949		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.549	KM Geo Mean	1.732
KM SD (logged)	0.145	95% Critical H Value (KM-Log)	1.859
KM Standard Error of Mean (logged)	0.0838	95% H-UCL (KM -Log)	1.925
KM SD (logged)	0.145	95% Critical H Value (KM-Log)	1.859
KM Standard Error of Mean (logged)	0.0838		

DL/2 Statistics

DL/2 Normal		**DL/2 Log-Transformed**	
Mean in Original Scale	1.472	Mean in Log Scale	0.368
SD in Original Scale	0.317	SD in Log Scale	0.2
95% t UCL (Assumes normality)	1.669	95% H-Stat UCL	1.687

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL	2.018

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

Benzoapyrene

General Statistics

Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.0082	Mean	0.235
Maximum	0.65	Median	0.19
SD	0.219	Std. Error of Mean	0.0729
Coefficient of Variation	0.929	Skewness	0.746

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.91	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.174	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.371	95% Adjusted-CLT UCL (Chen-1995)	0.375
		95% Modified-t UCL (Johnson-1978)	0.374

Gamma GOF Test

A-D Test Statistic	0.542	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.751	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.252	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.289	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.75	k star (bias corrected MLE)	0.574
Theta hat (MLE)	0.314	Theta star (bias corrected MLE)	0.41
nu hat (MLE)	13.5	nu star (bias corrected)	10.33
MLE Mean (bias corrected)	0.235	MLE Sd (bias corrected)	0.311
		Approximate Chi Square Value (0.05)	4.152
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	3.366

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.586	95% Adjusted Gamma UCL (use when n<50)	0.723

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.838	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.303	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.274	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-4.804	Mean of logged Data	-2.245
Maximum of Logged Data	-0.431	SD of logged Data	1.678

Assuming Lognormal Distribution

95% H-UCL	7.867	90% Chebyshev (MVUE) UCL	0.889
95% Chebyshev (MVUE) UCL	1.144	97.5% Chebyshev (MVUE) UCL	1.497
99% Chebyshev (MVUE) UCL	2.191		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.355	95% Jackknife UCL	0.371
95% Standard Bootstrap UCL	0.346	95% Bootstrap-t UCL	0.403
95% Hall's Bootstrap UCL	0.396	95% Percentile Bootstrap UCL	0.352
95% BCA Bootstrap UCL	0.364		
90% Chebyshev(Mean, Sd) UCL	0.454	95% Chebyshev(Mean, Sd) UCL	0.553
97.5% Chebyshev(Mean, Sd) UCL	0.69	99% Chebyshev(Mean, Sd) UCL	0.96

Suggested UCL to Use

95% Student's-t UCL	0.371

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

Appendix B-2
ProUCL Outputs - Subsurface Soil
Fort Totten Park, Washington, D.C.

UCL Statistics for Data Sets with Non-Detects

User Selected Options	
Date/Time of Computation	ProUCL 5.111/7/2018 3:47:12 PM
From File	For EPC_c.xls
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aluminum

General Statistics

Total Number of Observations	9	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	6400	Mean	7189
Maximum	8600	Median	7000
SD	609.2	Std. Error of Mean	203.1
Coefficient of Variation	0.0847	Skewness	1.614

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.842	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.271	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	7566	95% Adjusted-CLT UCL (Chen-1995)	7640
		95% Modified-t UCL (Johnson-1978)	7585

Gamma GOF Test

A-D Test Statistic	0.638	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.72	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.26	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	166.5	k star (bias corrected MLE)	111.1
Theta hat (MLE)	43.17	Theta star (bias corrected MLE)	64.71
nu hat (MLE)	2997	nu star (bias corrected)	2000
MLE Mean (bias corrected)	7189	MLE Sd (bias corrected)	682.1
		Approximate Chi Square Value (0.05)	1897
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	1875

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	7579	95% Adjusted Gamma UCL (use when n<50)	7665

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.871	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.255	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	8.764	Mean of logged Data	8.877
Maximum of Logged Data	9.06	SD of logged Data	0.0811

Assuming Lognormal Distribution

95% H-UCL	N/A	90% Chebyshev (MVUE) UCL	7771
95% Chebyshev (MVUE) UCL	8035	97.5% Chebyshev (MVUE) UCL	8402
99% Chebyshev (MVUE) UCL	9122		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	7523	95% Jackknife UCL	7566
95% Standard Bootstrap UCL	7499	95% Bootstrap-t UCL	7824
95% Hall's Bootstrap UCL	9503	95% Percentile Bootstrap UCL	7533
95% BCA Bootstrap UCL	7633		
90% Chebyshev(Mean, Sd) UCL	7798	95% Chebyshev(Mean, Sd) UCL	8074
97.5% Chebyshev(Mean, Sd) UCL	8457	99% Chebyshev(Mean, Sd) UCL	9209

Suggested UCL to Use

95% Student's-t UCL	7566

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

Arsenic

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	9.4	Mean	14.13
Maximum	19	Median	14
SD	4.801	Std. Error of Mean	2.772
Coefficient of Variation	0.34	Skewness	0.125

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.999	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.178	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	22.23	95% Adjusted-CLT UCL (Chen-1995)	18.91
		95% Modified-t UCL (Johnson-1978)	22.26

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	12.52	k star (bias corrected MLE)	N/A
Theta hat (MLE)	1.129	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	75.12	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.994	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level

Lilliefors Test Statistic	0.202	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	2.241	Mean of logged Data	2.608
Maximum of Logged Data	2.944	SD of logged Data	0.353

Assuming Lognormal Distribution

95% H-UCL	46.2	90% Chebyshev (MVUE) UCL	22.65
95% Chebyshev (MVUE) UCL	26.51	97.5% Chebyshev (MVUE) UCL	31.86
99% Chebyshev (MVUE) UCL	42.37		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	18.69	95% Jackknife UCL	22.23
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	22.45	95% Chebyshev(Mean, Sd) UCL	26.22
97.5% Chebyshev(Mean, Sd) UCL	31.44	99% Chebyshev(Mean, Sd) UCL	41.72

Suggested UCL to Use

95% Student's-t UCL	22.23

Recommended UCL exceeds the maximum observation

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

Cobalt

General Statistics

Total Number of Observations	9	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	3.4	Mean	4.567
Maximum	6.9	Median	4
SD	1.35	Std. Error of Mean	0.45
Coefficient of Variation	0.296	Skewness	0.79

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.84	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.23	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	5.403	95% Adjusted-CLT UCL (Chen-1995)	5.433
		95% Modified-t UCL (Johnson-1978)	5.423

Gamma GOF Test

A-D Test Statistic	0.652	**Anderson-Darling Gamma GOF Test**	
5% A-D Critical Value	0.721	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.249	**Kolmogorov-Smirnov Gamma GOF Test**	
5% K-S Critical Value	0.279	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	13.86	k star (bias corrected MLE)	9.316
Theta hat (MLE)	0.329	Theta star (bias corrected MLE)	0.49
nu hat (MLE)	249.5	nu star (bias corrected)	167.7
MLE Mean (bias corrected)	4.567	MLE Sd (bias corrected)	1.496
		Approximate Chi Square Value (0.05)	138.7
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	133.2

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	5.519	95% Adjusted Gamma UCL (use when n<50)	5.749

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.848	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.237	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	1.224	Mean of logged Data	1.482
Maximum of Logged Data	1.932	SD of logged Data	0.282

Assuming Lognormal Distribution

95% H-UCL	5.588	90% Chebyshev (MVUE) UCL	5.854
95% Chebyshev (MVUE) UCL	6.439	97.5% Chebyshev (MVUE) UCL	7.252
99% Chebyshev (MVUE) UCL	8.849		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	5.307	95% Jackknife UCL	5.403
95% Standard Bootstrap UCL	5.266	95% Bootstrap-t UCL	5.666
95% Hall's Bootstrap UCL	5.449	95% Percentile Bootstrap UCL	5.3
95% BCA Bootstrap UCL	5.333		
90% Chebyshev(Mean, Sd) UCL	5.917	95% Chebyshev(Mean, Sd) UCL	6.528
97.5% Chebyshev(Mean, Sd) UCL	7.377	99% Chebyshev(Mean, Sd) UCL	9.044

Suggested UCL to Use

95% Student's-t UCL	5.403

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

Manganese

General Statistics

Total Number of Observations	9	Number of Distinct Observations	6
		Number of Missing Observations	0
Minimum	120	Mean	174.4
Maximum	290	Median	150
SD	60.64	Std. Error of Mean	20.21
Coefficient of Variation	0.348	Skewness	1.056

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.836	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.323	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data Not Normal at 5% Significance Level

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	212	95% Adjusted-CLT UCL (Chen-1995)	215.3
		95% Modified-t UCL (Johnson-1978)	213.2

Gamma GOF Test

A-D Test Statistic	0.652	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.722	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.312	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.279	Data Not Gamma Distributed at 5% Significance Level

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

Gamma Statistics

k hat (MLE)	10.49	k star (bias corrected MLE)	7.066
Theta hat (MLE)	16.63	Theta star (bias corrected MLE)	24.69
nu hat (MLE)	188.8	nu star (bias corrected)	127.2
MLE Mean (bias corrected)	174.4	MLE Sd (bias corrected)	65.63
		Approximate Chi Square Value (0.05)	102.1
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	97.41

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	217.2	95% Adjusted Gamma UCL (use when n<50)	227.8

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.87	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.292	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.274	Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.787	Mean of logged Data	5.113
Maximum of Logged Data	5.67	SD of logged Data	0.322

Assuming Lognormal Distribution

95% H-UCL	220.6	90% Chebyshev (MVUE) UCL	230.3
95% Chebyshev (MVUE) UCL	255.8	97.5% Chebyshev (MVUE) UCL	291.2
99% Chebyshev (MVUE) UCL	360.8		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	207.7	95% Jackknife UCL	212
95% Standard Bootstrap UCL	205.7	95% Bootstrap-t UCL	229.8
95% Hall's Bootstrap UCL	208.3	95% Percentile Bootstrap UCL	208.9
95% BCA Bootstrap UCL	210		
90% Chebyshev(Mean, Sd) UCL	235.1	95% Chebyshev(Mean, Sd) UCL	262.6
97.5% Chebyshev(Mean, Sd) UCL	300.7	99% Chebyshev(Mean, Sd) UCL	375.6

Suggested UCL to Use

95% Student's-t UCL	212

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

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

Thallium

General Statistics

Total Number of Observations	9	Number of Distinct Observations	8
		Number of Missing Observations	0
Minimum	0.22	Mean	0.462
Maximum	0.92	Median	0.33
SD	0.275	Std. Error of Mean	0.0915
Coefficient of Variation	0.594	Skewness	0.889

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.781	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data Not Normal at 5% Significance Level
Lilliefors Test Statistic	0.325	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	0.632	95% Adjusted-CLT UCL (Chen-1995)	0.642
		95% Modified-t UCL (Johnson-1978)	0.637

Gamma GOF Test

A-D Test Statistic	0.892	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.726	Data Not Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.294	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.281	Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	3.62	k star (bias corrected MLE)	2.488
Theta hat (MLE)	0.128	Theta star (bias corrected MLE)	0.186
nu hat (MLE)	65.17	nu star (bias corrected)	44.78
MLE Mean (bias corrected)	0.462	MLE Sd (bias corrected)	0.293
		Approximate Chi Square Value (0.05)	30.43
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	27.96

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.68	95% Adjusted Gamma UCL (use when n<50)	0.74

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.831	**Shapiro Wilk Lognormal GOF Test**	
5% Shapiro Wilk Critical Value	0.829	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.262	**Lilliefors Lognormal GOF Test**	
5% Lilliefors Critical Value	0.274	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-1.514	Mean of logged Data	-0.916
Maximum of Logged Data	-0.0834	SD of logged Data	0.554

Assuming Lognormal Distribution

95% H-UCL	0.736	90% Chebyshev (MVUE) UCL	0.716
95% Chebyshev (MVUE) UCL	0.833	97.5% Chebyshev (MVUE) UCL	0.995
99% Chebyshev (MVUE) UCL	1.314		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.613	95% Jackknife UCL	0.632
95% Standard Bootstrap UCL	0.606	95% Bootstrap-t UCL	0.675
95% Hall's Bootstrap UCL	0.565	95% Percentile Bootstrap UCL	0.616
95% BCA Bootstrap UCL	0.63		
90% Chebyshev(Mean, Sd) UCL	0.737	95% Chebyshev(Mean, Sd) UCL	0.861
97.5% Chebyshev(Mean, Sd) UCL	1.034	99% Chebyshev(Mean, Sd) UCL	1.373

Suggested UCL to Use

95% H-UCL	0.736

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

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Titanium

General Statistics

Total Number of Observations	3	Number of Distinct Observations	3
		Number of Missing Observations	0
Minimum	90	Mean	116.7
Maximum	160	Median	100
SD	37.86	Std. Error of Mean	21.86
Coefficient of Variation	0.325	Skewness	1.597

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.855	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.767	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.337	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.425	Data appear Normal at 5% Significance Level	

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		**95% UCLs (Adjusted for Skewness)**	
95% Student's-t UCL	180.5	95% Adjusted-CLT UCL (Chen-1995)	174.2
		95% Modified-t UCL (Johnson-1978)	183.9

Gamma GOF Test

Not Enough Data to Perform GOF Test

Gamma Statistics

k hat (MLE)	15.5	k star (bias corrected MLE)	N/A
Theta hat (MLE)	7.526	Theta star (bias corrected MLE)	N/A
nu hat (MLE)	93.01	nu star (bias corrected)	N/A
MLE Mean (bias corrected)	N/A	MLE Sd (bias corrected)	N/A
		Approximate Chi Square Value (0.05)	N/A
Adjusted Level of Significance	N/A	Adjusted Chi Square Value	N/A

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	N/A	95% Adjusted Gamma UCL (use when n<50)	N/A

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.882	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.767	Data appear Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.321	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.425	Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	4.5	Mean of logged Data	4.727
Maximum of Logged Data	5.075	SD of logged Data	0.306

Assuming Lognormal Distribution

95% H-UCL	292.1	90% Chebyshev (MVUE) UCL	177.6
95% Chebyshev (MVUE) UCL	205.2	97.5% Chebyshev (MVUE) UCL	243.7
99% Chebyshev (MVUE) UCL	319.1		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	152.6	95% Jackknife UCL	180.5
95% Standard Bootstrap UCL	N/A	95% Bootstrap-t UCL	N/A
95% Hall's Bootstrap UCL	N/A	95% Percentile Bootstrap UCL	N/A
95% BCA Bootstrap UCL	N/A		
90% Chebyshev(Mean, Sd) UCL	182.2	95% Chebyshev(Mean, Sd) UCL	211.9
97.5% Chebyshev(Mean, Sd) UCL	253.2	99% Chebyshev(Mean, Sd) UCL	334.2

Suggested UCL to Use

95% Student's-t UCL	180.5

Recommended UCL exceeds the maximum observation

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

Zirconium

General Statistics

Total Number of Observations	9	Number of Distinct Observations	5
Number of Detects	6	Number of Non-Detects	3
Number of Distinct Detects	5	Number of Distinct Non-Detects	1
Minimum Detect	1.6	Minimum Non-Detect	2.5
Maximum Detect	2.9	Maximum Non-Detect	2.5
Variance Detects	0.22	Percent Non-Detects	33.33%
Mean Detects	2.2	SD Detects	0.469
Median Detects	2.2	CV Detects	0.213
Skewness Detects	0.262	Kurtosis Detects	-0.416
Mean of Logged Detects	0.769	SD of Logged Detects	0.215

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use
guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest.
For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012).
Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.969	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Normal at 5% Significance Level

Lilliefors Test Statistic	0.167	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Normal at 5% Significance Level

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

KM Mean	2.117	KM Standard Error of Mean	0.162
KM SD	0.398	95% KM (BCA) UCL	2.356
95% KM (t) UCL	2.419	95% KM (Percentile Bootstrap) UCL	2.378
95% KM (z) UCL	2.384	95% KM Bootstrap t UCL	2.43
90% KM Chebyshev UCL	2.604	95% KM Chebyshev UCL	2.825
97.5% KM Chebyshev UCL	3.131	99% KM Chebyshev UCL	3.733

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	0.221	**Anderson-Darling GOF Test**	
5% A-D Critical Value	0.697	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.193	**Kolmogorov-Smirnov GOF**	
5% K-S Critical Value	0.332	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	26.24	k star (bias corrected MLE)	13.23
Theta hat (MLE)	0.0838	Theta star (bias corrected MLE)	0.166
nu hat (MLE)	314.9	nu star (bias corrected)	158.8
Mean (detects)	2.2		

Gamma ROS Statistics using Imputed Non-Detects

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

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

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

Minimum	1.6	Mean	2.113
Maximum	2.9	Median	2.181
SD	0.412	CV	0.195
k hat (MLE)	30.81	k star (bias corrected MLE)	20.61
Theta hat (MLE)	0.0686	Theta star (bias corrected MLE)	0.103
nu hat (MLE)	554.5	nu star (bias corrected)	371
Adjusted Level of Significance (β)	0.0231		
Approximate Chi Square Value (371.00, α)	327.4	Adjusted Chi Square Value (371.00, β)	318.7
95% Gamma Approximate UCL (use when n>=50)	2.395	95% Gamma Adjusted UCL (use when n<50)	2.46

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	2.117	SD (KM)	0.398
Variance (KM)	0.159	SE of Mean (KM)	0.162
k hat (KM)	28.25	k star (KM)	18.91
nu hat (KM)	508.4	nu star (KM)	340.3
theta hat (KM)	0.0749	theta star (KM)	0.112
80% gamma percentile (KM)	2.512	90% gamma percentile (KM)	2.76
95% gamma percentile (KM)	2.976	99% gamma percentile (KM)	3.41

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (340.30, α)	298.6	Adjusted Chi Square Value (340.30, β)	290.3
95% Gamma Approximate KM-UCL (use when n>=50)	2.413	95% Gamma Adjusted KM-UCL (use when n<50)	2.481

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.97	**Shapiro Wilk GOF Test**	
5% Shapiro Wilk Critical Value	0.788	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.202	**Lilliefors GOF Test**	
5% Lilliefors Critical Value	0.325	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	2.11	Mean in Log Scale	0.73
SD in Original Scale	0.411	SD in Log Scale	0.19
95% t UCL (assumes normality of ROS data)	2.365	95% Percentile Bootstrap UCL	2.328
95% BCA Bootstrap UCL	2.347	95% Bootstrap t UCL	2.423
95% H-UCL (Log ROS)	2.401		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.732	KM Geo Mean	2.08
KM SD (logged)	0.186	95% Critical H Value (KM-Log)	1.895
KM Standard Error of Mean (logged)	0.0779	95% H-UCL (KM -Log)	2.398
KM SD (logged)	0.186	95% Critical H Value (KM-Log)	1.895
KM Standard Error of Mean (logged)	0.0779		

DL/2 Statistics

DL/2 Normal		DL/2 Log-Transformed	
Mean in Original Scale	1.883	Mean in Log Scale	0.587
SD in Original Scale	0.603	SD in Log Scale	0.322
95% t UCL (Assumes normality)	2.257	95% H-Stat UCL	2.389

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

Nonparametric Distribution Free UCL Statistics

Detected Data appear Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 2.419

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

Benzoapyrene

General Statistics

Total Number of Observations	9	Number of Distinct Observations	7
		Number of Missing Observations	0
Minimum	0.0049	Mean	0.248
Maximum	0.58	Median	0.27
SD	0.216	Std. Error of Mean	0.072
Coefficient of Variation	0.87	Skewness	0.226

Note: Sample size is small (e.g., <10), if data are collected using ISM approach, you should use guidance provided in ITRC Tech Reg Guide on ISM (ITRC, 2012) to compute statistics of interest. For example, you may want to use Chebyshev UCL to estimate EPC (ITRC, 2012). Chebyshev UCL can be computed using the Nonparametric and All UCL Options of ProUCL 5.1

Normal GOF Test

Shapiro Wilk Test Statistic	0.909	**Shapiro Wilk GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data appear Normal at 5% Significance Level
Lilliefors Test Statistic	0.193	**Lilliefors GOF Test**
5% Lilliefors Critical Value	0.274	Data appear Normal at 5% Significance Level

Data appear Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.382	95% Adjusted-CLT UCL (Chen-1995)	0.373
		95% Modified-t UCL (Johnson-1978)	0.383

Gamma GOF Test

A-D Test Statistic	0.743	**Anderson-Darling Gamma GOF Test**
5% A-D Critical Value	0.761	Detected data appear Gamma Distributed at 5% Significance Level
K-S Test Statistic	0.256	**Kolmogorov-Smirnov Gamma GOF Test**
5% K-S Critical Value	0.292	Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	0.632	k star (bias corrected MLE)	0.495
Theta hat (MLE)	0.393	Theta star (bias corrected MLE)	0.501
nu hat (MLE)	11.38	nu star (bias corrected)	8.917
MLE Mean (bias corrected)	0.248	MLE Sd (bias corrected)	0.353
		Approximate Chi Square Value (0.05)	3.277
Adjusted Level of Significance	0.0231	Adjusted Chi Square Value	2.598

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50))	0.676	95% Adjusted Gamma UCL (use when n<50)	0.852

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.785	**Shapiro Wilk Lognormal GOF Test**
5% Shapiro Wilk Critical Value	0.829	Data Not Lognormal at 5% Significance Level
Lilliefors Test Statistic	0.305	**Lilliefors Lognormal GOF Test**
5% Lilliefors Critical Value	0.274	Data Not Lognormal at 5% Significance Level

Data Not Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	-5.319	Mean of logged Data	-2.363
Maximum of Logged Data	-0.545	SD of logged Data	1.992

Assuming Lognormal Distribution

95% H-UCL	37.61	90% Chebyshev (MVUE) UCL	1.304
95% Chebyshev (MVUE) UCL	1.697	97.5% Chebyshev (MVUE) UCL	2.243
99% Chebyshev (MVUE) UCL	3.314		

Nonparametric Distribution Free UCL Statistics

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

Nonparametric Distribution Free UCLs

95% CLT UCL	0.367	95% Jackknife UCL	0.382
95% Standard Bootstrap UCL	0.357	95% Bootstrap-t UCL	0.393
95% Hall's Bootstrap UCL	0.367	95% Percentile Bootstrap UCL	0.358
95% BCA Bootstrap UCL	0.358		
90% Chebyshev(Mean, Sd) UCL	0.464	95% Chebyshev(Mean, Sd) UCL	0.562
97.5% Chebyshev(Mean, Sd) UCL	0.698	99% Chebyshev(Mean, Sd) UCL	0.965

Suggested UCL to Use

95% Student's-t UCL	0.382

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

APPENDIX C – SUPPORTING TABLES FOR RISK ASSESSMENT

WOODARD &CURRAN

Appendix C-1

SUMMARY OF VALUES USED FOR DERMAL ABSORPTION FRACTION FROM SOIL

Fort Totten Park, Washington, D.C.

Contaminant of Potential Concern	CAS Number	Dermal Absorption Fraction from Soil	Source [1]
Aluminum	7429-90-5	NA	--
Arsenic	7440-38-2	0.03	USEPA 2004
Cobalt	7440-48-4	NA	--
Manganese	7439-96-5	NA	--
Thallium	7440-28-0	NA	--
Zirconium	7440-67-7	NA	--
Benzo(a)pyrene	50-32-8	0.13	USEPA 2004

NA = Not Available

1. Unless otherwise noted, values are from Exhibit 3-4, USEPA 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final. EPA/540/R/99/005.
For constituents with no available values, dermal exposure related risks from those constituents is addressed qualitatively in the uncertainty analysis, in accordance with USEPA 2004.

Appendix C-2

SUMMARY OF VOLATILIZATION AND PARTICULATE EMISSION FACTORS

Fort Totten Park, Washington, D.C.

Constituent	VF	PEF
Aluminum	NA	1.36E+09
Arsenic	NA	1.36E+09
Cobalt	NA	1.36E+09
Manganese	NA	1.36E+09
Thallium	NA	1.36E+09
Zirconium	NA	1.36E+09
Benzo(a)pyrene	NA	1.36E+09

VF = Volatilization Factor

PEF = Particulate Emission Factor

NA = Not available

USEPA. 2018. Regional Screening Levels - Generic Tables. May.
https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables