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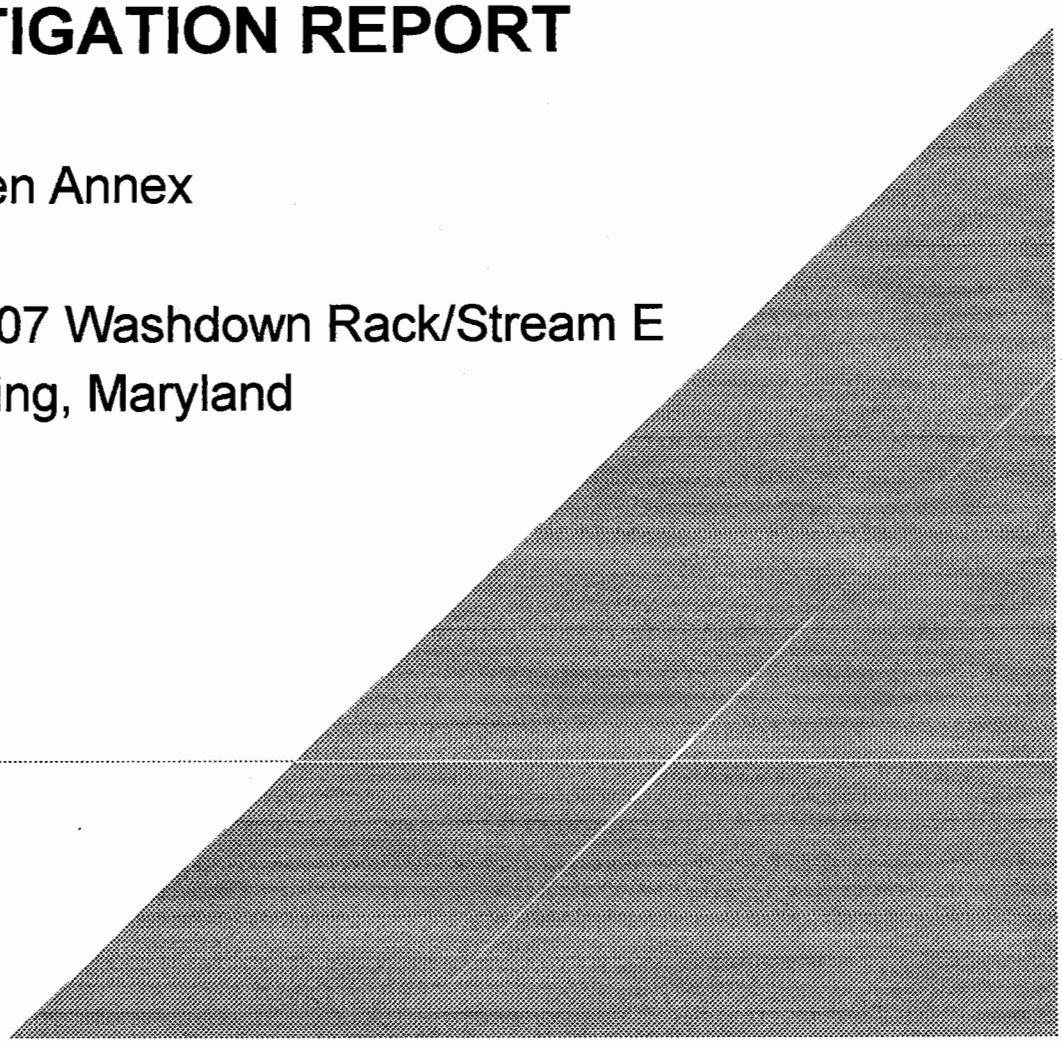
United States Army Environmental Command

DRAFT FINAL REMEDIAL INVESTIGATION REPORT

Forest Glen Annex
FTGL-05
Building 607 Washdown Rack/Stream E
Silver Spring, Maryland

February 2017



DRAFT FINAL REMEDIAL INVESTIGATION REPORT

FTGL-05

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EXECUTIVE SUMMARY

The Baltimore District of the U.S. Army Corps of Engineers (USACE) contracted AECOM under Contract No. W912DR-09-D-0019, Delivery Order 0001 to conduct a Remedial Investigation (RI) at Fort Detrick's Forest Glen Annex (FGA) in Silver Spring, Maryland. The RI was conducted for four FGA Installation Restoration Program (IRP) sites including: FTGL-02 (Ballfield/Helipad/Rubble Dump Site); FTGL-03 (Commissary Landfill); FTGL-04 (Building 511 Landfill); and FTGL-05 (Building 607 Washdown Rack [also known as Stream E]). The RI was performed within the statutory framework of the Defense Environmental Restoration Program and the Comprehensive Environmental Response, Compensation, and Liability Act. The Maryland Department of the Environment (MDE) is acting as the lead regulator. AECOM issued a "*revised draft final*" version of the RI Report since formal comments from MDE were not received prior to their period of performance ending on their task order.

The U.S. Army Environmental Command subsequently contracted the PIKA-Arcadis Joint Venture (JV) a task order under Contract No. W91ZLK-13-D-0009-0008 to complete the RI for FTGL-05. The overall objective of the FGA RI for FTGL-05 is to determine the nature and extent of contamination due to past facility operations and use these results to develop and evaluate response action alternatives that address unacceptable risk and achieve site closure requirements.

The TPP process was used by AECOM, USACE, and stakeholders at the start of the RI to aid in determining specific site objectives, data needs, and data quality objectives in order to obtain the right type, quality, and quantity of RI data to collect to meet project objectives. The specific project objectives identified for the former wash rack/Stream E site (FTGL-05) included the following:

- Characterize contaminants in stream located downgradient of the wash rack;
- Evaluate other potential upgradient contaminant sources to the stream; and
- Evaluate human health and ecological risk.

Subsequent project objectives that were identified following the completion of the draft RI Report and agreed to by the Army and MDE in 2013 to address supplemental investigation needs included the following:

- Complete additional background assessment for metals and radionuclides in media at FTGL-05; and
- Complete additional human health risk assessment based on updated exposure parameters and factors, site-specific metals and radionuclide background levels, and RESRAD risk assessment methodology for radiological constituents.

The RI characterization efforts conducted by AECOM were performed in accordance with the final approved RI Work Plan (WP) (AECOM, 2011) and RI WP Addendum (AECOM, 2014). Initial RI field investigation activities under the RI WP (AECOM, 2011) were conducted between November 2010 and

January 2012, and supplemental RI field investigations under the RI WP Addendum (AECOM, 2014) were conducted between July and September 2014.

The largest component of the RI effort was the collection of media samples for analysis to determine the presence/absence and extent of contaminants. Media sampled at FTGL-05 included surface and subsurface soil, shallow groundwater, sediment, and surface water. Laboratory testing of these samples was conducted for a broad range of analytes including volatile organic compounds (VOCs), semi volatile organic compounds, pesticides, herbicides, dioxins/furans, metals, and radionuclides. Site analytical data results were directly compared against applicable chemical- or radiological-specific screening criteria to evaluate the nature and extent of contamination, and statistically compared to background levels to determine if contaminants were site-related. The fate and transport of site contaminant exceeding screening criteria and background was then assessed.

In addition to evaluation of the nature and extent of contaminants, a baseline human health risk assessment (BHHRA) and an ecological risk assessment (ERA) were completed. The BHHRA was conducted according to the typical four-step process including hazard identification, exposure assessment, toxicity assessment, and risk characterization. No complete exposure pathway was identified for potential exposures to groundwater or subsurface soil at depths greater than 15 feet (ft) below ground surface (bgs) by any receptor. The BHHRA evaluated current and potential future reasonable maximum exposures (RME) by receptors to constituents of potential concern (COPCs) in surface soil, surface water and sediment. In addition, the BHHRA also included a separate risk evaluation of potential exposures to background inorganics and radionuclides. The human receptor groups with potentially complete exposure pathways included current and future adolescent trespasser, future outdoor industrial worker, future construction worker, and future hypothetical resident (child and adult; based on the assumption of unrestricted future use). The potential for adverse non-carcinogenic health effects and incremental lifetime cancer risks for each of the potential receptors, exposure pathways, exposure routes, and COPCs were determined in the risk characterization, including the excess lifetime cancer risk estimates from potential exposures to radionuclides (using the RESidual RADioactivity [RESRAD] dose/risk model). For each receptor, the estimated cumulative excess lifetime cancer risks from all exposures were compared to USEPA's upper acceptable cancer risk limit of 1 in 10,000 (i.e., $1x10^{-4}$ or 1E-04) and the estimated hazard indices (HI) were compared to a HI target limit of one (1), for COPCs with non-carcinogenic effects. Risk levels that are less than one excess cancer in one million people (1 x 10-6 or 1E-06) are generally considered acceptable while risks greater than one excess cancer in ten thousand people (1 x 10-4 or 1E-04) generally are considered significant (i.e., a cumulative site risk level of 1 x 10-4 is generally used as the remediation "trigger" for a site (USEPA, 1991).

For each of the receptor groups defined for current and future use scenario (current/future trespasser, future outdoor industrial worker, future construction worker, future hypothetical resident child or adult), the non-carcinogenic hazard estimates were below the HI limit of 1, indicating that adverse non-carcinogenic health effects from such exposure are unlikely. This conclusion is the same when one considers the incremental contribution from potential exposures to background inorganics.

For the current/future adolescent trespasser, future outdoor industrial worker, and future construction worker, the total excess lifetime cancer risk estimates from all COPCs (radionuclides and non-

radionuclides) and exposure pathways combined were below the cancer risk limit ($1x10^{-4}$), including the incremental contribution to risk of background exposures. For the future hypothetical resident (combined child and adult lifetime exposures), the total excess lifetime cancer risk estimate exceeds the upper end (1E-04) of USEPA's acceptable cancer risk range. Potential external radiation from radionuclides in surface soil was identified as the primary contributor to the total excess lifetime cancer risk estimate for this receptor group. Additionally, potential exposures to hexavalent chromium in surface soil via incidental ingestion and dermal contact also contributed to the cancer risk exceedance for the future hypothetical resident. However, the detected levels of all radionuclides (alpha, beta, and gamma emitters) and several inorganics including hexavalent chromium in surface soil at FTGL-05 were determined to be consistent with background and therefore, not related to any historical use or activity at this Site. Based on a separate evaluation of potential exposures to site-related COPCs (excluding background), the potential excess cancer risk estimates for all current and future receptor groups (including future hypothetical resident receptors) were within or below USEPA's acceptable excess cancer risk range of 1E-06 to 1E-04.

The ERA at FTGL-05 was conducted in accordance with USEPA's 8-Step process guidance (USEPA, 1997b) and other guidance as needed. The ERA consisted of two primary components: a conservative Tier I screening level ecological risk assessment (SERA), consisting of USEPA's Steps 1 and 2, and the conclusion that further evaluation was needed; and a Tier II baseline ecological risk assessment (BERA) consisting of the preliminary problem formulation for Step 3 (i.e., Step 3a). The results of the ERA conducted for FTLG-05 indicated only a limited potential for risk to plants and invertebrates associated with four metals and two pesticides. It is likely that these risks are overestimated and that actual risks to these receptors are lower. Based on this assessment, the likelihood of ecological effects is very minimal.

The following summarizes additional key investigation results/findings, data limitations, conclusions and recommendations.

Soils

Analytes exceedances were only identified in surface soil samples upgradient of Stream E, and not in subsurface soil. Analytes exceeding their screening criteria identified as higher than site background levels included the SVOCs benzo(a) pyrene, pesticides chlordane and heptachlor Epoxide, the metal cobalt, and Dioxin TEQ 2,3,7,8-TCCD. Detections of pesticides appear to be indicative low level contamination associated with typical pesticide application.

Shallow Groundwater

Analyte exceedances in shallow groundwater included the VOC chloroform and the metal arsenic.
The detected chloroform concentrations exceeded the tap water screening level but were below the drinking water maximum contaminant level goal. These detections were observed in monitoring well FG310 and FG311, which are upgradient of FTGL-05. The presence of these contaminants is believed to be related to FTGL-04 or other upgradient sources (on- or off-installation) and not associated with the historical releases associated with activities at FTGL-05. The source of chloroform in groundwater may potentially be due to the degradation of carbon tetrachloride present in groundwater, from historical disposal of laboratory wastes at the on-site landfills, upgradient water distribution lines, or from an offsite source

located to the east or northeast of the monitoring wells. Chloroform and arsenic have been detected throughout FTGL-04. Concentrations of chloroform and arsenic observed in FG310 and FG311 and potential risk from vapor intrusion will be evaluated in the FTGL-04 Feasibility Study

The elevated arsenic concentration in groundwater may be attributed to suspended sediments in the unfiltered samples and/or increased solubility and/or mobility of metals in the subsurface as the result of fill materials/wastes altering the natural redox conditions of the aquifer matrix towards a more reducing state.

Surface Water and Sediment

A broad range of contaminants including VOCs, SVOCs (including PAHs), metals, pesticides, and dioxins were detected in FTGL-05 sediments. PAH contamination in FTGL-05 Stream E was only present in the most upgradient samples at lower levels.

A broad range of contaminants were detected in surface water at d FTGL-05 including VOCs, the SVOC DEPH, metals, and pesticides. Elevated levels of iron and manganese were present in three most downstream samples from FTGL-05 Stream E, closest to the offsite industrial park, and also consistent with observed iron staining. Aluminum was detected at elevated concentrations in all surface water samples at Stream E. The source of this aluminum may be from the stormwater discharge since no other nearby sources in sampled media are apparent. DEHP was elevated in one sample from FTGL-05 and is likely an artifact of the surface water sampling equipment. In Stream E, elevated concentrations of the pesticide alpha BHC were detected in all samples. Five other pesticides were also detected at elevated concentrations in one or two sample locations each in Stream E, including chlordane, heptachlor, Heptachlor Epoxide, alpha endosulfan, and beta BHC.

Data Limitations and Recommendations for No Further Action

The investigations completed at Stream E site (FTGL-05) achieved the investigation objectives including the identification of site contaminants and associated risks. Additionally, the findings of the BHHRA are that the site-related hazard estimates associated with non-carcinogenic COPCs are below the risk-management threshold for all receptor groups, including current/future adolescent trespasser, future outdoor industrial worker, future construction worker, and future hypothetical resident (child and adult). Furthermore, although the excess lifetime cancer risk estimates for the future hypothetical resident (combined child and adult exposures) receptors exceeds the USEPA's range of acceptable cancer risk of 1E-06 to 1E-04 ($1x10^{-6}$ to $1x10^{-4}$), the excess risk is due to potential exposures to naturally occurring radionuclides and hexavalent chromium in shallow soils that are unrelated to historic site activities. For the current/future adolescent trespasser, future outdoor industrial worker, and construction worker receptors, the excess lifetime cancer risk estimates are below the risk management threshold for carcinogens. Based on these investigation findings, no further assessment of FTGL-05 is recommended. Given that the conclusions of the BHHRA are based on unrestricted future use, no controls or restrictions are required. Finally, the conclusions of the ERA are that a condition of unacceptable risk of adverse effects to wildlife populations does not exist at FTGL-05 and no further action is required.

Conclusions and Recommendations

Delineation of compounds has been completed, and no further investigation of environmental conditions at FTGL-05 is recommended. Based on the finding of no unacceptable risk posed by COPCs present in media at the site, it is concluded that no further action is needed for protection of human health and the environment.

No further response action is recommended for FTGL-05. It is therefore recommended that the site proceed with additional steps required to complete the CERCLA process including establishing the administrative record and public repository, performing public participation tasks, and preparation of the Decision Document.

7 SUMMARY AND CONCLUSIONS

7.1 Summary

The overall objective of the RI for site FTGL-05 was to determine the nature and extent of contamination due to past facility operations and use these results to develop and evaluate response action alternatives that address unacceptable risk and achieve site closure requirements. The TPP process was used by stakeholders at the start of the project to aid in determining specific site objectives, data needs, and DQOs in order to obtain the right type, quality, and quantity of RI data to collect to meet project objectives.

The specific project objectives identified for the former wash rack/Stream E site (FTGL-05) included the following:

- Characterize contaminants in Stream E located downgradient of the former wash rack;
- Evaluate other potential upgradient contaminant sources to Stream E; and
- Evaluate human health and ecological risk.

Subsequent project objectives that were identified following the completion of the draft RI Report and agreed to by the Army and MDE in 2013 to address supplemental investigation needs included the following:

- Complete additional background assessment for metals and radionuclides in media at site FTGL-05; and
- Complete additional human health risk assessment based on updated exposure parameters and factors, site-specific metals and radionuclide background levels, and RESRAD risk assessment methodology for radiological constituents.

Initial RI field characterization efforts were completed between November 2010 and January 2012, and supplemental RI field investigations were completed between July and September 2014.

The remainder of this section summarizes the RI findings including the nature and extent of contamination by site, fate and transport of site contaminants, and human health and ecological risk due to site-related contaminants.

7.1.1 FTGL-05 Stream Characterization.

Sediment. Eight sediment samples were collected and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxins/furans, metals, and/or radionuclides to characterize Stream E sediments and assess human health and ecological risk. Two SVOCs, benzo(a)pyrene (1 sample) and indeno(1,2,3-c,d)pyrene (1 sample), exceeded a BTAG screening benchmark or residential RSL.

Surface Water. Six surface water samples were collected and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and/or radionuclides to characterize Stream E surface water and assess human health and ecological risk. The following summarizes chemical exceedances (and number of samples) above screening criteria and background:

- One SVOC, DEHP (1 sample), exceeded the NRWQC for human health.
- Six pesticides, alpha BHC (5 samples), alpha endosulfan (1 sample), beta BHC (2 samples), chlordane (2 samples), heptachlor (2 samples), and heptachlor epoxide (1 sample), exceeded the NRWQCs for aquatic life and/or human health.
- Three metals, aluminum (6 samples), iron (3 samples), and manganese (3 samples), exceeded NRWQCs for aquatic life and/or human health.

Alpha BHC and aluminum exceedances occurred in all Stream E samples. Heptachlor and chlordane exceedances also occurred at multiple sample locations. Iron and manganese exceedances were present in the three most downstream samples closest to the offsite industrial park (**Figure 4-2**).

7.1.2 FTGL-05 Evaluation of Upgradient Contaminant Sources

Surface Soils. A total of ten surface soil samples were collected and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxins/furans, metals, and/or radionuclides to evaluate potential upgradient sources of contamination to Stream E in surface soils and assess human health and ecological risk. The following summarizes chemical exceedances (and number of samples) above screening criteria and background:

- One SVOC, benzo(a)pyrene (3 samples), exceeded the residential RSL.
- Two pesticides, chlordane (2 samples) and heptachlor epoxide (2 samples), exceeded residential RSLs.
- The dioxin 2,3,7,8-TCDD TEQ (1 sample) exceeded the residential RSL.
- One metal, cobalt (1 sample), exceeded the residential RSL.

Screening exceedances occurred in the three samples located close to the head of Stream E and benzo(a)pyrene was present in all three samples. Pesticide exceedances occurred in the two samples located at the Stream E stormwater outlet (**Figure 4-3**).

Subsurface Soils. Two subsurface soil samples were collected and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, dioxins/furans, metals, and/or radionuclides to evaluate potential upgradient sources of contamination to Stream E in subsurface soils and assess human health and ecological risk. No chemical exceedances above screening criteria and background were identified in subsurface soil at FTGL-05.

Shallow Groundwater. Four groundwater samples were collected in 2011/2012 over two rounds of sampling and analyzed for VOCs, SVOCs, pesticides, herbicides, PCBs, metals, and/or radionuclides to evaluate potential upgradient sources of contamination to Stream E in shallow groundwater and assess

human health and ecological risk. An additional round of sampling was also conducted in 2014 for metals and radionuclide analysis. The following summarizes chemical exceedances (and number of samples) above screening criteria and background:

- One VOC, chloroform (4 samples), exceeded the tap water RSL.
- One metal, arsenic (6 samples), exceeded the tap water RSL.

The highest chloroform exceedance was in monitoring well FG310. Chloroform was also found exceeding screening levels in deep monitoring well FG404 (installed for FTGL-04) that is adjacent to FG310 and in numerous wells upgradient associated with sites FTGL-03 and FTGL-04. Review of historical site activities conducted at site FTGL-05 indicates that it is unlikely that these activities contributed chloroform to shallow groundwater at wells FG310 and FG311. The chloroform detected in groundwater samples from FG310 and FG311 are likely the result of transport from upgradient sources at FTGL-04 or upgradient water distribution lines as evidenced by similar concentrations of chloroform in wells upgradient of FTGL-05 and downgradient of FTGL-04. Alternatively, an off-installation source located to the northeast of the site could be responsible as evidenced by groundwater flow direction in the area (**Figures 3-3 and 3-4**). Similar to the landfill sites, the elevated arsenic concentrations may be attributed to suspended sediments in unfiltered samples and/or increased solubility and/or mobility of metals in the subsurface as the result of fill materials/wastes creating a more reducing state (**Figure 4-4**).

7.1.3 Fate and Transport

7.1.3.1 Volatile Organic Compounds

Chloroform was observed in shallow groundwater during the RI. Chloroform tends to partition mainly into the atmosphere and groundwater, and can be relatively persistent. When released to the atmosphere, chloroform exists in the vapor phase and can be transported long distances. Chloroform may be removed from the atmosphere by wet deposition; however, it is likely to reenter by volatilization. When released to groundwater, chloroform dissolves easily in water and is expected to persist for a long time.

7.1.4 Semivolatile Organic Compounds

PAH was identified in sediment and surface soil at FTGL-05. Their presence in surface soils and sediment is consistent with their generally slow environmental degradation. PAHs are persistent and generally immobile in soil matrices under normal environmental conditions. The PAHs tend to bioaccumulate because they are non-polar. In surface water, PAHs tend to sorb to particles that either have settled to the bottom or are suspended in the water column. Generally, groundwater sample results at the sites indicate that PAHs observed in surface and subsurface soils are not mobile in the groundwater aquifer.

The phthalate ester DEHP was identified as a contaminant in surface waters at FTGL-05. Phthalate esters are used as plasticizers in plastics and surface coating materials (i.e., paint, etc.) and tend to be ubiquitous in the environment. Additionally, phthalate esters are, because of their presence in plastics (e.g., sampling tubing), a common laboratory contaminant. DEHP detections were not widespread and were not

consistently detected during each sample event which would suggest that this is likely an artifact of surface water sampling equipment that contains plastics and not an indicator of contamination.

7.1.5 Pesticides

Isolated and/or sporadic detections of pesticides and degradation by-products (e.g., alpha-BHC, delta-BHC, gamma-BHC, beta-chlordane, and dieldrin) at the FTGL-05 site does not appear to be a significant contaminant sources indicative of waste disposal but rather typical of low level contamination associated with its intended uses. Pesticides are generally persistent in the environment, primarily due to their resistance to degradation, low aqueous solubility and volatility, ability to substantially bioaccumulate in aquatic organisms (except for aldrin and BHC isomers), and very high adsorptive affinity for soils and organic matter.

7.1.6 Polychlorinated Biphenyls

Environmental behavioral characteristics of PCBs are similar to those described above for pesticides, but the sources and uses of PCBs are quite different. Due to their non-flammability, chemical stability, high boiling point, and electrical insulating properties, PCBs were used in hundreds of industrial and commercial applications. PCB compounds are very persistent in soil. These compounds demonstrate strong adsorption to soil and sediment media indicating that significant leaching to groundwater should not occur. PCB compounds may leach into the groundwater when combined with organic solvents, which demonstrate significant leaching capabilities. Adsorption of PCB compounds is elevated by increased organic, clay, and microparticle content of the soil or sediment. Biodegradation can occur under both aerobic and anaerobic conditions, but only at a slow rate. No chemical process is known to degrade PCB compounds in soil. The lower concentration of PCBs detected at FTGL-05 is expected to be persistent in the environment and may become mobilized from the sediment during erosional processes related to storm events.

7.1.7 Dioxins

Dioxin are highly persistent in the environment similar to PCBs. Dioxin is an unintentional by-product of many industrial processes. The major source of dioxin in the environment comes from waste-burning incinerators where burning chlorine-based chemical compounds with hydrocarbons forms dioxins. Dioxins are hydrophobic (water-fearing). Because these compounds are poorly soluble in water they have not been found to be a groundwater problem in the environment. These compounds are soluble in fats (e.g., lipophilic [fat-loving] and eventually work their way to the top of the food chain through storage in fat cells by bioaccumulation. Neither soil microbes nor animals are able to effectively break down the dioxins quickly. These compounds are expected to remain persistent in the environment.

7.1.8 Metals

In general, metals have a high adsorptive affinity for inorganic mineral surfaces, such as iron and manganese oxides, iron hydroxides, clays, and organic matter. Adsorption, for most metals, is highly pH-dependent, with desorption generally favored for positively charged metal ions at low pH and sorption mechanisms dominating for positively charged metal ions at higher pH conditions. Additionally, chemical speciation determines the relative degree of adsorption among different species of a particular metal. Based on

data available for site soils, sorption is a significant fate process for metals. Aerobic conditions in site surface water and shallow groundwater are likely to promote the precipitation of ferromanganese oxides and oxyhydroxides to which other metals will readily adsorb.

The metals identified in FTGL-05 media are persistent and of limited mobility within these media under normal environmental conditions. Their persistence is primarily related to cycling and removal mechanisms. Cycling mechanisms involve mineral precipitation/dissolution under fluctuating oxidizing and reducing conditions, such as may occur in the zone of water table fluctuation in an unconfined or semiconfined shallow aquifer with organic content. Removal mechanisms include processes such as mineral precipitation, adsorption, and organic anion complexation, which decrease mobility. Chemical speciation of metals in the environment results in their presence in both solid and aqueous media. However, geochemical conditions occurring near contaminant sources at the site may affect the fate reactions and behavior of these metals, resulting in increased or decreased metal concentrations in a particular medium.

7.1.9 Risk Assessment

7.1.9.1 Human Health Risk Assessment

BHHRA results for FTGL-05 were previously summarized in Section 6. The result of the BHHRA identified no risk to any current or future receptor groups based on the non-carcinogenic risk management threshold at FTGL-05. Potential external radiation exposures from radionuclides in surface soil were identified to pose a carcinogenic risk to current and future trespassers and future hypothetical residents. Additionally, incidental ingestion and dermal contact with hexavalent chromium in surface soil contributed to excess lifetime cancer risk estimates above the cancer risk management limit of 1E-05 for future hypothetical residents. However, the detected levels of all radionuclides (alpha, beta, and gamma emitters) and several inorganics including hexavalent chromium in surface soil at FTGL-05 were determined to be consistent with background and therefore, not related to any historical use or activity at this Site. Based on a separate evaluation of potential exposures to site-related COPCs (excluding those COPCs determined to be consistent with background), the potential excess lifetime cancer risk estimates for all current and future receptor groups (including current and future trespasser and future hypothetical resident receptors) were in or below the generally accepted cancer risk range.

7.1.9.2 Ecological Risk Assessment

As discussed in the summary of the SERA in Section 6.3, no significant risk of adverse effects to ecological receptors has been identified at FTGL-05.

7.2 Conclusions

This section presents key conclusions concerning site and media investigation activities, data limitations, recommendations for future work, and closure requirements for FTGL-05.

7.2.1 Soils at Site FTGL-05

As discussed in this report, soils at the FGA sites have been significantly disturbed over the past 70 years as part of installation operations and development. Soils have been cut and filled across the installation during development activities, and construction and waste materials have been used to fill low-lying areas and valleys.

Numerous COPCs were identified in soils at FTGL-05 upgradient of Stream E. VOC contamination was encountered in surface soils locally at the Site but in no case exceeded RSLs. PAH and other SVOC contamination was encountered throughout the Site but only exceed RSLs in localized areas. Similarly, two pesticides and numerous dioxins and furans were detected in surface soils upgradient of FTGL-05 but only exceeded RSLs locally at two of the ten locations sampled. Only one VOC and one PCP were detected in subsurface soils at FTGL-05 upgradient of Stream E but in no case exceeded identified RSLs. Metals occur naturally in surface and subsurface soils throughout the FGA. Arsenic and hexavalent chromium were detected above RSLs in surface and subsurface soils at FTGL-05 upgradient of Stream E. However, concentrations of each metal were within the range of background concentrations at FGA. Only cobalt was identified above both RSLs and the range of background concentrations in surface soils at FTGL-05 upgradient of Stream E. Numerous radionuclides were detected above RSVs in surface and subsurface soils at FTGL-05 upgradient of Stream E. In each case the detected values were within background values and therefore are attributed to natural conditions in site soils.

While numerous organic and inorganic compounds were identified in surface and subsurface soils at FTGL-05 upgradient of Stream E, the BHHRA and SLERA did not identify a risk to human health or the environment from site soils.

7.2.2 Groundwater at Site FTGL-05

Shallow groundwater was investigated within the areas upgradient of Stream E along the northernmost boundary of FTGL-05 to identify whether shallow groundwater contributes to potential impacts to Stream E. Numerous VOCs and one SVOC were detected in groundwater samples collected from wells at FTGL-05. Only chloroform was detected above the tap water RSL but below the MCLG. Based on a review of historical site activities conducted at site FTGL-05 it is unlikely that these activities contributed chloroform to shallow groundwater at wells FG310 and FG311. The chloroform detected in groundwater samples from FG310 and FG311 are likely the result of transport from upgradient sources at FTGL-04, off-installation sources, or upgradient distribution lines as evidenced by similar concentrations of chloroform in wells upgradient of FTGL-05 and downgradient of FTGL-04. The source of chloroform in the groundwater may also be due to the degradation of an upgradient source of carbon tetrachloride present in groundwater. . Isolated detections of carbon tetrachloride were found along the northeast portion of the FTGL-03 landfill near Linden Lane, and methylene chloride, a degradation product of chloroform, was also detected in groundwater in this area. None of the VOCs or SVOCs detected in groundwater immediately upgradient of FTGL-05 were considered risk drivers for the receptors/pathways evaluated in the risk assessment. Construction of buildings is unlikely within in the limits of FTGL-05 due to the steep topography at the site and the presence of Stream E. As such, the risk posed by chloroform to indoor air was not evaluated as part of FTGL-05. Potential risk to indoor air will be evaluated in the FTGL-04 Feasibility Study.

Arsenic, cobalt, manganese, and thallium were detected in shallow groundwater above the tap water RSL. Only arsenic exceeded background concentrations immediately upgradient of FTGL-05. Elevated arsenic concentrations were present in shallow groundwater through the FGA and may be attributed to suspended sediments in the unfiltered samples and/or increased solubility and/or mobility of metals in the subsurface as the result of fill materials/wastes from areas upgradient of FTGL-05 altering the natural redox conditions of the aquifer matrix towards a more reducing state. None of the metals detected in groundwater were identified as risk drivers for the receptors/pathways evaluated in the risk assessment.

7.2.3 Surface Water and Sediment at Site FTGL-05

As previously detailed, four VOCs were detected in surface water samples at FTGL-05 in Stream E, none of which had NRWQC screening values available for comparison. Two SVOCs were detected in one or more surface water samples with DEHP exceeding the NRWQC for human health in one sample. Seven pesticides and herbicides were detected in one or more surface water samples within Stream E with six pesticides exceeding NRWQC for aquatic life and human health. No PCBs were identified in surface water. Twenty-one metals were identified in one or more surface water samples in Stream E with four metals (aluminum, arsenic, iron, and manganese) detected at concentrations exceeding NRWQCs for aquatic life and human health in one or more samples. Aluminum, iron, and manganese were present in concentrations exceeding background in surface water. Numerous radionuclides were detected in surface water. However, since the presence of radionuclides in soils were identified as resulting from natural site conditions, these values were not compared to screening criteria.

Ten VOCs were detected in one or more of the sediment samples at FTGL-05. None of these VOCs exceeded BTAG benchmarks or RSLs. Fourteen SVOCs were detected in one or more of sediment samples at FTGL- 05. Two PAHs (benzo(a)pyrene and indeno(1,2,3-c,d)pyrene) exceeded the BTAG benchmark or residential RSL. No pesticides or herbicides were detected in sediment samples at FTGL-05. One PCB, Aroclor 1242, was detected in one sediment sample at FTGL-05 but did not exceed the residential or industrial RSLs. The sample was also analyzed for the 18 NOAA PCB congeners. All of the congeners were detected in the sediment sample but were detected at concentrations below the published RSLs. Ten dioxins and furans were detected in one or more of the three sediment samples submitted for analysis. None of the detected concentrations exceeded published RSLs. Twenty-five metals were detected in one or more of the sediment samples from FTGL-05. Six metals (arsenic, hexavalent chromium, iron, manganese, nickel and selenium) were detected at concentrations exceeding BTAG benchmarks and/or RSLs. For each, concentrations were calculated to be within the range of background values for the site. Similarly, three radionuclides were detected at concentrations exceeding residential screening values but each case were found to result from naturally occurring sources.

None of the constituents detected in surface water or sediment were identified as risk drivers for the receptors/pathways evaluated in the risk assessment.

7.2.4 Data Limitations and Recommendations for Future Work

The investigations completed at Stream E site (FTGL-05) achieved investigation objectives including the identification of site contaminants and associated risks. Additionally, risk assessment findings identified site-related risk and hazard estimates below risk management limits for all current and future receptors at FTGL-

05 for the receptors and pathways evaluated. The concentrations of some inorganics (including hexavalent chromium) and naturally occurring radionuclides in soil were determined to be comparable to background and are not attributed to historic site activities.

The results of the Tier II ERA indicated there were negligible risks associated with exposures to sediment and surface water at FTLG-05. No risk to ecological receptors from radiological exposure was identified at FTGL-05.

Based on these investigation findings, no further assessment of the site is recommended.

7.2.5 Conclusions and Recommendations

Delineation of COPCs has been completed, and no further investigations of the FTGL-05 are recommended. Media evaluated as part of the BHHRA and SERA included soil, sediment, surface water, and groundwater. The risk evaluations found no unacceptable risk posed by COPCs present in the media evaluated at the site, it is concluded that no further action is needed for protection of human health and the environment for those media. Since no further response action is recommended for soil, sediment, or surface water at FTGL-05, it is recommended that these media at the site proceed with additional steps required to complete the CERCLA process including establishing the administrative record and public repository, performing public participation tasks, and preparation of the Decision Document.

It is important to note that the indoor air pathway was not evaluated as part of the BHHRA because no buildings currently exist within the limits of FTGL-05 and construction is unlikely due to the presence of Stream E and the steep slopes adjacent to it. Chloroform concentrations in groundwater upgradient of FTGL-05 exceed applicable indoor air criteria. As such, the indoor air pathway cannot be ruled out for groundwater upgradient of FTGL-05. While chloroform is present in groundwater in wells upgradient of FTGL-05 it is unlikely due to historic activities associated with the Site. The presence of chloroform in wells upgradient of FTGL-05 but downgradient of the fill areas at sites FTGL-03 and FTGL-04 indicated that its presence in shallow groundwater is likely associated with impacts from these sites or other sources upgradient of FTGL-05. Groundwater downgradient of FTGL-03 and FTGL-04, including groundwater at the FTGL-05 well locations, will be addressed as part of follow-on activities associated with those sites. Groundwater at FTGL-04 and upgradient of FTGL-05 will proceed through the additional steps of the CERCLA process including completing a feasibility study, establishing the administrative record and public repository, performing public participation tasks, and preparation of the Decision Document.