GEO/08-168
Final

U.S. Army Corps of Engineers
Louisville District

Work Plan
Former Hanna City Air Force Station
Remedial Investigation/Feasibility Study/Proposed Plan/Record of Decision Project
Hanna City, Peoria County, Illinois

Prepared for
U.S. Army Corps of Engineers
Louisville District
Contract No. W912QR-04-D-0030
Delivery Order 0019

Prepared by
GEO Consultants, LLC
199 Kentucky Avenue
Kevil, Kentucky 42053

September 2008

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600 Martin Luther King Jr. Place
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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

GEO Consultants, LLC (GEO) has completed the Final Work Plan for the Former Hanna City Air Force Station Remedial Investigation/Feasibility Study/Proposed Plan/Record of Decision Project, Hanna City, Peoria County, Illinois. Notice is hereby given that an Independent Technical Review (ITR) has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the ITR, compliance with established policy, principles and procedures was verified. This included review of procedures to be used to create a product that meets the customer's needs consistent with law and existing U.S. Army Corps of Engineers policy.

Larry Copeland, P.G. ITR Team Leader	9/29/08 Date
Todd Calhoun, P.G. Project Manager	9/29/08 Date
Kim Morris Quality Assurance Manager	9/29/08 Date

Significant concerns and the explanation of the resolution are as follows:

None

As noted above, all concerns resulting from the independent technical review of the project have been considered.

Jeff Douthitt, P.E. President, GEO Consultants, LLC	9/29/08 Date

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TABLES

APPENDICES

ACRONYMS

amsl	above mean sea level
AOPC	Area of Potential Concern
ARAR	applicable or relevant and appropriate requirements
bgs	below ground surface
CDB	Capital Development Board (State of Illinois)
CELRL	U.S. Army Corps of Engineers, Louisville District
CFR	Code of Federal Regulations
COPC	Chemicals of Potential Concern
COPEC	Chemicals of Potential Ecological Concern
CSF	Cancer Slope Factor
CSM	conceptual site model
CSRM	conceptual site risk model
CSERM	conceptual site ecological risk model
DoD	Department of Defense
EHQ	Ecological Hazard Quotient
EPA	U.S. Environmental Protection Agency
EPC	Exposure Point Concentration
ERA	Ecological Risk Assessment
EU	exposure unit
ESV	ecological screening value
FAA	Federal Aviation Administration
FS	Feasibility Study
FSP	Field Sampling Plan
ft	foot or feet (length units)
GEO	GEO Consultants, LLC
HCAFS	Former Hanna City Air Force Station
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IDoC	Illinois Department of Corrections
ILCR	incremental lifetime cancer risk
IEPA	Illinois Environmental Protection Agency
MCL	maximum contaminant level
MDC	maximum detected concentration
NDAI	no DoD action identified
NOAEL	No observed adverse effect level
PA	Preliminary Assessment
PAH	polynuclear aromatic hydrocarbon
PBT	Persistent, Bioaccumulative, and Toxic
PCB	polychlorinated biphenyl
PIP	Public Involvement Plan
PP	Proposed Plan
PRG	Preliminary Remediation Goals
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QCP	Quality Control Plan
RDA	Recommended Daily Allowance
RDI	Recommended Daily Intake

RGO	Remedial Goal Option
RI	Remedial Investigation
RL	reporting limit
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RPD	Relative Percent Difference
SAP	Sampling and Analysis Plan
SLERA	screening level ecological risk assessment
SSHP	Site-Specific Safety and Health Plan
SI	Site Investigation
SSI	Supplemental Site Investigation
SOW	Statement of Work
TACO	Tiered Approach to Cleanup Objectives
TBC	To Be Considered
TRV	Toxicity Reference Value
TtEC	TetraTech EC, Inc
UCL	upper confidence level
USACE	U.S. Army Corps of Engineers
USAF	U.S. Air Force
UST	underground storage tank
VOC	volatile organic compound
WOE	Weight-of-evidence
WP	Work Plan

1. INTRODUCTION

1.1 PROJECT OBJECTIVES

The overall objective of the project described in this Work Plan (WP) is to achieve consensus regarding remedial action at the Former Hanna City Air Force Station (HCAFS), Hanna City, Peoria County, Illinois (Figures 1-1 and 1-2; all figures are provided in Appendix A). Major activities to be conducted under this project include:

- A Remedial Investigation (RI) to collect data that will supplement information from previous investigations to adequately characterize seven Areas of Potential Concern (AOPCs) (i.e., three Coal Ash Storage Areas (A, B, and C), Main Entrance, Vehicle Wash Rack, Maintenance Building, and Paint Shed), assess human health and ecological risks from potential contamination at these AOPCs, and identify AOPCs that require remedial action,

- Preparation of a Public Involvement Plan (PIP) which will address public involvement needs for all aspects of corrective action including the RI, Feasibility Study, and Proposed Plan.

- A Feasibility Study (FS) in which remedial alternatives are evaluated and an appropriate remedy selected,

- Preparation of a Proposed Plan (PP) describing the remedial alternatives considered, the preferred remedial action alternative, and the rationale behind its selection,

- Preparation of a Record of Decision (ROD) listing all facts, analyses of facts, and site-specific policy determinations considered in the course of carrying out activities in a level of detail appropriate to the site situation for the remedial alternative selected in the PP, and

- Establishment of an Administrative Record in accordance with 40 Code of Federal Regulations (CFR) 300.800-300.825 *Subpart I Administrative Record for Selection of Remedial Response*.

The work will be completed by GEO Consultants, LLC (GEO) under contract to U.S. Army Corps of Engineers (USACE), Louisville District (CELRL), Contract No. W912QR-04-D-0030, Delivery Order 0019 in compliance with the project Statement of Work (SOW), dated 05 February 2008, [U.S. Army Corps of Engineers (USACE) 2008], this WP, a Quality Control Plan (QCP, GEO 2008a), a Sampling and Analysis Plan (SAP, GEO 2008b), and a Site-Specific Safety and Health Plan (SSHP, GEO 2008c). The regulatory agency involved in this project is the Illinois Environmental Protection Agency (IEPA) and the property owners are represented by the Illinois Department of Corrections (IDoC) and Federal Aviation Administration (FAA). The executing agency for this project is USACE, CELRL.

GEO will complete the project activities in conformance with "*Remedial Investigation/Feasibility Study and Selection of Remedy Code*", 40 CFR 300.430 and U.S. Environmental Protection Agency (EPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*, EPA/540/G-89/0004, OSWER Directive 9355.3-01, October 1988 (EPA 1988).

A proposed schedule for key project activities is presented in Table 1-1; this list of activities was developed in accordance with USACE 2008. Table 1-2 shows project team members from IEPA, USACE CELRL, and GEO who will be involved in project planning and execution. The project organization structure is shown in Figure 1-3.

Table 1-1. Activities and schedule for at project activities at the HCAFS.

	Key Activities	Task Schedule*
1	Perform Remedial Investigation	August 28, 2008 – May 15, 2009
2	Prepare a Public Involvement Plan	October 8, 2009 – November 25, 2009
2	Perform a Feasibility Study	October 9, 2008 – June 24, 2009
3	Prepare a Proposed Plan	June 25, 2009- January 27, 2010 The public meeting to discuss the PP and the public review will take place from December 26, 2009 – January 27, 2010.
4	Provide decision documentation [Record of Decision (ROD)]	December 10, 2009-June 24, 2010
5	Administrative Records	Updated twice annually during the project

*All schedule dates are contingent on timely USACE and IEPA approval of project plans and reports.

Table 1-2. Project staff and qualifications

Area of Responsibility	Principal	Organization
Illinois state regulatory oversight	Christopher Hill, P.E.	IEPA Federal Facilities Unit, Bureau of Land Christopher.Hill@illinois.gov
Project Manager	Walter Perro	USACE/CELRL Louisville, KY Walter.D.Perro@usace.army.mil
Technical Manager	David Brancato, N.D., Ph.D., RPIH	USACE/CELRL Louisville, KY David.J.Brancato@usace.army.mil
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Contractor Quality Program Manager	Kim Morris	GEO Kevil, KY morrisk@geoconsultantsllc.com
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Primary Laboratory Analysis	Marcia McGinnity	Empirical Laboratories Nashville, TN MMcGinnity@EmpirLabs.com
Secondary Laboratory	Pat Letterer	CT Laboratories Baraboo, WI pletterer@ctlaboratories.com

1.2 WORK PLAN ORGANIZATION

This WP is organized as follows:

- This section (Section 1: Introduction) contains the overall project objectives, list of activities, project organization and schedule.
- Section 2: Site Background summarizes the results of previous investigations at the HCAFS and describes the current risk models used as a basis for planning the RI.
- Section 3: Task Descriptions describes tasks that will be conducted under the project activities.
- Section 4: Presents the methods to be used for the baseline human health risk assessment which will be performed as part of the RI.
- Section 5: Presents the methods to be used for the baseline ecological risk assessment which will be performed as part of the RI.
- Section 6: References contains a list of references used in the preparation of this WP.
- Appendix A contains all figures.
- Appendix B contains data tables from previous investigations.
- Appendix C contains the human health and ecological screening values
- Appendix D contains an example ecological site reconnaissance form

Other planning documents associated with this project include:

- QCP (GEO 2008a) which describes the overall project management and organization of the project.
- SAP (GEO 2008b, draft pending approval by IEPA) consisting of the Field Sampling Plan (FSP) and the Quality Assurance Project Plan (QAPP). The FSP describes the overall approach for the field investigation (e.g., sampling locations), field procedures (e.g., drilling, groundwater sample collection, etc.) and field quality control measures, while the QAPP which primarily focuses on quality control procedures to be followed in the laboratory to ensure that the quality of data generated by the RI would be acceptable for use in risk assessment.
- SSHP (GEO 2008c) which describes procedures for protecting workers and the environment during field work to be conducted as part of the RI.
- PIP (GEO 2008d, to be prepared) which will document the issues of public concern at the HCAFS, describe the objectives of the public relations activities, and how these objectives will be met.

2. SITE BACKGROUND

2.1 SITE DESCRIPTION

The HCAFS is a 42.89-acre parcel located approximately ten miles west of the city of Peoria and two miles west of Hanna City in Peoria County, Illinois (Figures 1-1 and 1-2). The property is located in Section 4 of Township 8 North, Range 6 East in the Logan Township. The site can be reached from Peoria, Illinois by traveling west on State Highway 116 (Farmington Road), through Hanna City, Illinois, then north onto the site access road.

Site history including previous and current land use are presented in Section 2.2; physical characteristics (topography, geology, hydrogeology) follows in Section 2.3; previous investigations are summarized in Section 2.4; and the current conceptual site model (CSM) is presented in Section 2.5.

2.2 SITE HISTORY

The U.S. Government acquired the property for use by the U.S. Air Force (USAF) as a radar tracking and investigation facility from 1952 to 1968. In 1968, the property was declared excess to the needs of the USAF. The property was then transferred to the General Services Administration in 1969, and the entire site was assigned to the Department of Health, Education, and Welfare. In November 1969 the property was disposed of as three separate tracts through quitclaim deeds. These transfers as well as brief descriptions of subsequent property use are described below (Tetra Tech EC Inc. or TtEC 2008):

- Tract 1, 38.456 acres (including 30 buildings), was quitclaimed to the State of Illinois. Currently, the IDoC Hanna City Work Camp occupies Tract 1 and used the facility as a minimum security prison (TtEC 2008). A recent article posted on a local website (http://centralillinoisproud.com/content/fulltext/?cid=7250) indicated that the Illinois Senate passed a bill in April 2008 that would transfer the facility to Peoria County for use as a special place for inmates with mental illness or a minimum security work release facility. The article indicated that the facility has been closed since 2002.

- Tract 2, 3.364 acres (including a water supply well, water treatment plant and lagoon, and several buildings, see property boundary in Figure 1-2) was quitclaimed to the Village of Hanna City to be used as a water supply system. The water supply well and water treatment facility was operational until 1987, when the water supply well was closed by IEPA due to elevated levels of naturally occurring radon. No operations are presently ongoing at Tract 2. As a result of previous investigations, the lagoon has been categorized as having Potentially Responsible Party (PRP) issues under CERCLA Section 9607(a)(3) and therefore will not be part of this RI.

- Tract 3, consisting of 1.03 fee acres and containing the radar tower and three related buildings (see property boundary in Figure 1-2) was transferred to the FAA. The FAA currently uses this tract of land and buildings as a navigation facility.

Surrounding land use is rural/agricultural with a few buildings in the site vicinity (TtEC 2008).

2.3 SITE PHYSICAL CHARACTERISTICS

2.3.1 Topography and surface water

The site lies on relatively flat ground with elevations ranging from approximately 740 to 756 feet above mean sea level (amsl) and is located on top of a gentle north-south trending ridge. The surface water bodies within the HCAFS include two settlement ponds (as identified in the site layout map prepared by TtEC (2008) and the water treatment lagoon, which has not been operational ever since the Hanna City Water Supply was shut down in 1987. As noted earlier, the water treatment lagoon is not being investigated in this RI due to PRP issues.

2.3.2 Regional Geology

The HCAFS lies in the Illinoisan Till Plain physiographic province. The Illinoisan and Wisconsin glacial stages formed most of the present surface materials and landforms in the area. The underlying geology is Pennsylvanian bedrock overlain by glacial deposits, which are overlain by loess (windblown silt). The Pennsylvanian age Modesto Formation bedrock in the vicinity of the site consists of shales, sandstones, and limestones with occasional thin seams of coal. This bedrock formation is approximately 180 feet thick and has low permeability. The glacial deposits in the area are part of the Glasford formation and consist of glacial outwash. These deposits are comprised of unsorted calcareous pebbly silt and clay with some localized lenses of sand and gravel and are approximately 40 to 50 feet in thickness. The loess deposits are divided into two layers. The bottom layer is the Roxana silt and consists of pinkish brown leached silt, which ranges up to five feet in thickness. The top layer is the Peoria loess and ranges up to 15 feet in thickness. It consists of tan silts with small amounts of clay and minor amounts of sand. The two layers combined range up to 20 feet in thickness (TtEC 2008).

2.3.3 Site-Specific Geology

The shallow unconsolidated stratigraphy of the site can be divided into two main units: loess deposits and glacial till (TtEC 2008). Loess comprises the uppermost 15 to 20 feet of the unconsolidated deposits and consist of tan to brown to gray mottled silt and very fine sand with some clay. Rootlets are present within the upper ten feet of the loess. The clays generally possess low to medium plasticity. Occasional thin sand lenses are also present within the loess deposits.

The loess deposits are underlain by glacial till deposits. The glacial till consists of brown to gray, moist to dry, very dense and hard clay and silt with minor amounts of gravel. The till surface slopes gently (approximately 0.17 feet/foot) to the southeast, paralleling the surface topography. The thickness of the glacial till within the site is unknown. None of borings from previous investigations penetrated bedrock. However, based on the state-wide bedrock topographic map (Herzog et al. 1994), the bedrock surface in the vicinity of the HCAFS is approximately 600 feet amsl, approximately 150 feet below ground surface (bgs).

During the initial Site Investigation (SI) performed by Parsons Engineering in 1996 (TtEC 2008), a total of ten soil samples were collected for analysis of grain size. Eight of the samples were from the loess deposits and two samples were from the glacial till. Laboratory analyses of the soils indicated that the loess deposits consist primarily of silt and clay (greater than 98 percent) with minor amounts of fine sand (1 to 2 percent). The glacial till consists primarily of silty clay (greater than 75 percent) with small amounts of sand (1 to 22 percent) and traces of gravel (up to 2 percent). The bulk density of the soils ranged from 0.57 grams per cubic centimeter (g/cm^3) to 1.96 g/cm^3 and averaged 1.29 g/cm^3. Specific gravity of the soils ranged from 2.43 g/cm^3 to 2.81 g/cm^3 and averaged 2.7 g/cm^3 (TtEC 2008).

2.3.4 Site-Specific Hydrogeology

The water table at the site ranged in depth from 4 to 10 feet bgs during the SI (1996) and 0.7 to 5 feet bgs during the Supplemental Site Investigation (SSI) (2006) (TtEC 2008). The site is located on a gentle, north-south trending ridge that forms a shallow groundwater divide. Shallow groundwater flow on the eastern portion of the site is towards the southeast and on the western portion of the site to the southwest, mimicking the surface topography. Groundwater gradients across the site averaged 0.095 feet/foot.

Groundwater appeared to be slightly mounded in the vicinity of the abandoned tile field (TtEC 2008). It is not known when the septic tank/tile field was abandoned.

The loess deposits have a low permeability and yield very little water. Hydraulic conductivities measured during investigations associated with the former USTs (Section 2.4.1) ranged from 2.25×10^{-5} to 8.8×10^{-4} cm/sec (Beling 1998c). During the probe sampling conducted as part of the SSI, recharge was observed to be adequate to yield sufficient water for collecting samples for organics and inorganics analyses (TtEC 2008).

2.4 SUMMARY OF PREVIOUS INVESTIGATIONS AT HCAFS

Following is a summary of investigations and studies performed at the site This information was adapted from TtEC 2008 as the individual reports prepared prior to the SSI were not made available for review at the time of preparation of this work plan; limited details exist. Limited information regarding the former USTs contained in the SSI report was supplemented by reports obtained from the IEPA's Leaking Underground Storage Tank (LUST) program.

2.4.1 Preliminary Assessment

In 1992, USACE, Chicago District conducted a Preliminary Assessment (PA) of the HCAFS consisting of site reconnaissance and interviews with former and current site personnel. Twelve areas of potential concern were identified that required further study. The PA report was not available for review while preparing this WP. It was referenced in TtEC (2008).

2.4.2 Underground storage tank removal

Five underground storage tanks (USTs) have been historically present at the former HCAFS: a UST near Bldg. 202 (referred to as the Control Bldg by IDoC), a UST near the Maintenance Building (Bldg. 206), a UST near Bldg. 305 (referred to as Housing Unit #3 by IDoC), a UST near Bldg. 307 (referred to as the Motor Pool by IDoC) in the Vehicle Wash Rack AOPC, and a UST within the property currently used by the FAA (see Figure 1-2 for locations). The following describes the status of each of the USTs according to available documentation obtained from the IEPA's LUST program for the Hanna City Work Camp and the FAA (both are under LPC #1430405005). Of these five tanks, only the UST near Bldg. 202 and the UST near Bldg. 307 may have been onsite at the time of the property was transferred from DoD (IDoC 1992). All four tanks listed under the Hanna City Work Camp were removed in 1993 and 1997, and the UST within the FAA property was removed by FAA in 2003.

The following summarizes information available regarding each of the former USTs.

- The 1500 gal gasoline UST near Bldg 202 (called the "Control Building" by IDoC, Figure 1-2 and Figure 2-1) may have been installed by DoD (IDoC 1992). This tank was removed by a contractor (Crawford, Murphy and Tilly, Springfield, IL) working for the State of Illinois' Capital Development Board (CDB) in 1993 (Beling 1998a). Soil samples were collected from the walls and the floor of the UST excavation in accordance with IEPA requirements and analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) (Beling 1998a). None of these chemicals were detected (detection limit 1 ug/kg) in the soil samples. Furthermore, the UST passed an integrity test immediately before the UST was removed (Beling 1998a), indicating that leaks from this UST were unlikely. Thus, the site for this UST is assumed to be closed.

- The 2000 gasoline UST near Bldg 307 (also called the "Motor Pool", in the vicinity of the Vehicle Wash Rack AOPC, see Figure 1-2 and 2-2) may have been installed by DoD (IDoC 1992). This tank was removed in 1993 by Crawford, Murphy and Till for the CDB (Beling 1998a). The last use date was believed to be December 31, 1983 (Beling 1997). After the UST was removed, soil samples were collected in October 1993 from the walls and the floor of the UST excavation in accordance with IEPA requirements and analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) (data in Beling 1998a). One soil sample at 2 ft below the tank invert contained benzene at 46 ug/kg, which was greater than the TACO criterion of 30 ug/kg (data in Beling 1998a). After additional soil was excavated, soil samples were collected again in March 1994 (presumably right after over-excavation). One of the soil samples collected at 5 ft below the tank invert did not contain any detectable levels of BTEX compounds, but the other soil sample collected at 6 ft below the tank invert contained elevated BTEX levels (benzene 7.5 mg/kg; toluene 33 mg/kg; ethylbenzene 89 mg/kg and xylene 160 mg/kg; data in Beling 1998a). No further action occurred until November 1997 when a new contractor (Beling Consultants) working for CDB installed 20-ft deep monitoring wells in and approximately 50 ft from the former tank basin to determine whether groundwater had been impacted by the residual soil contamination (Beling 1998b, well map reproduced in Figure 2-2). The following is a summary of results from soil and groundwater sampling at this former UST location from 1997-1998 reported by Beling (1998b) and Beling (1999):
  - Boring logs show that the soils in the vicinity of the former UST consist of clays down to 20 ft.
  - Soil samples for BTEX analysis were collected from the boreholes prior to monitoring well installation. BTEX was only detected in samples from the borehole drilled within the former tank basin (MP-B-1-97, see Figure 2-2 for location). The soil sample collected from 10-15 ft bgs at MP-B-1-97 had benzene at 4.8 mg/kg, ethylbenzene at 6.1 mg/kg, toluene at 13.6 mg/kg and xylene at 36.0 mg/kg.
  - The hydraulic conductivity was measured in one of the monitoring wells (MP-MW-4-97) at 7×10^{-5} cm/sec.
  - The wells were sampled for BTEX analysis every three months from April 1998 to January 1999. Groundwater samples from the monitoring well within the former tank basin (MP-MW-2-97, Figure 2-1) contained benzene during all four quarterly samples (maximum of 1.21 mg/L). None of the BTEX compounds were detected in any of the groundwater samples collected form the other wells (detection limit of 0.002 mg/L), except for one sample from MP-MW-4-97 (~50 ft south of MP-MW-2-97) at one sampling event, when a benzene concentration of 0.01 mg/L was measured.

  The monitoring results suggest that groundwater contamination from benzene is limited to within a 50-ft radius around the former tank basin. However, because of the detection (0.01 mg/L) in MP-MW-4-97 that exceeded the TACO criterion, IEPA re-classified the former UST site from Low Priority to High Priority (IEPA 1999). A Corrective Action Plan was submitted to IEPA in September 2000, where the proposed action consisted of institutional controls through deed restrictions prohibiting the placement of water supply wells within 30 radial feet from the groundwater benzene source (i.e., MP-MW-2-97, the monitoring well located within the former UST basin). IEPA rejected this plan in February 2001 because the plan did not address residual soil contamination in the former tank basin (IEPA 2001); IEPA's primary concern was the risk associated with ingestion and inhalation pathways from the residual soil contamination. No other plans or reports have been submitted to date since 2001. Thus, the former site of the UST near Bldg 307 is not closed. According to the last use date of December 31, 1983 found in Beling (1997), the UST was in use after the property was transferred from DoD and is therefore ineligible for funding from the Formerly Used Defense Sites (FUDS) program because of beneficial use by IDoC. This former UST location is not specifically being investigated in this RI.

- The 2000 gal gasohol UST near Bldg 206 (the Maintenance Building, see Figure 1-2 and 2-1) was installed by IDoC (IDoC 1992). This tank was removed by a contractor (Crawford, Murphy and Tilly, Springfield, IL) working for the CDB in 1993 (Beling 1998). Soil samples were collected from the walls and the floor of the UST excavation in accordance with IEPA requirements and analyzed for benzene, toluene, ethylbenzene, and xylene (BTEX) (Beling 1998). None of these chemicals were detected (detection limit 1 ug/kg) in the soil samples. Furthermore, the UST passed an integrity test immediately before the UST was removed (Beling 1998a), indicating that leaks from this UST were unlikely. Thus, the site for this UST is assumed to be closed.

- The former 500 gal diesel UST near Bldg 305 (Housing Unit #3, Figure 2-3) was installed by IDoC (IDoC 1992). This tank was upgraded in 1993, then removed in 1997 (Beling 1997). A surface spill associated with the tank's pipeline occurred in 1993 (Beling 1997); the spill was reported to IEPA and was assigned Incident No. 931687. Note that the same incident number was subsequently used in documentation related to the Motor Pool/Bldg 307 UST. The spill area was over-excavated to remove soil contaminated by the surface spill (Beling 1997). In 1997, groundwater monitoring wells were installed in and within 100 ft of the surface spill area. Hydraulic conductivity was measured at 8.84×10^{-4} cm/sec. One round of groundwater samples were collected for BTEX and PAH analyses; all results were below TACO criteria (Beling 1998c). Soil samples were collected from the boreholes and analyzed for BTEX and PAH compounds; all results were either below detection limits or TACO criteria. IEPA approved "No Further Remediation" for this former UST site (IEPA 1998) although the incident remains open in IEPA LUST database because of the Motor Pool/Bldg 307 UST's unresolved status.

- There is no evidence that the former 9725 gal diesel UST in the property owned by FAA was installed by DoD. This tank was abandoned in-place in the 1970s by back-filling with clean sand (Parsons 2005). The UST was removed by FAA in June 2003 but soil samples collected from the tank excavation contained PAHs that exceeded cleanup criteria. These findings were reported to the Illinois Emergency Management Agency (IEMA) and was assigned incident #20031028. A site investigation was conducted by Parsons in December 2004 wherein soil samples were collected from 20-ft boreholes in and around the former UST location and 20-ft deep groundwater monitoring wells were installed (Parsons 2005). A hydraulic conductivity of 2.25×10^{-5} cm/sec was determined through a slug test in one of the monitoring wells. PAHs and BTEX compounds were detected in some of the soil and groundwater samples collected during the December 2004 site investigation but concentrations did not exceed TACO criteria (note: the groundwater data were compared with TACO Class II criteria). IEPA approved "No Further Remediation" for this former UST site in May 2006 (IEPA 2006).

Out of the five former UST locations, only the former UST near Bldg. 307 in the vicinity of the Vehicle Wash Rack AOC has not achieved closure. Because of beneficial use by IDoC according to the last use data found in Beling (1997), the former UST site is ineligible for funding under Department of Defense's (DoD's) Defense Environmental Restoration Program - Formerly Used Defense Sites program; the tank site is therefore considered as "no DoD action identified (NDAI)" sites.

2.4.3 Site Inspection and Supplemental Site Inspection

Parsons performed a SI in 1996 at specific areas at the HCAFS and one background area (TtEC 2008). The areas include the seven AOPCs being investigated for this project (i.e., three Coal Ash Storage Areas (A, B, and C), Main Entrance, Vehicle Wash Rack, Maintenance Building, and Paint Shed), the Tile Field, the Septic Tank, and the Lagoon (see Figure 1-2 for area locations; the Lagoon is within the Former Village of Hanna City Water Supply). Soil and groundwater samples were collected from the areas using a direct push probe. Soil samples were analyzed for volatile organic compounds (VOCs), metals, PAHs, pesticides, polychlorinated biphenyls (PCBs), and basic soil parameters (percent solids, pH, moisture content, ash content, organic carbon content, bulk density and specific gravity). Groundwater samples were analyzed for VOCs, PAHs, pesticides, PCBs, and metals (total and soluble).

In response to IEPA's request for additional sampling, Tetra Tech EC (TtEC) conducted a SSI in April 2006 (TtEC 2008). Soil and groundwater samples were collected from the same areas sampled during the SI, with the exception of the Lagoon, where further investigations and activities were halted in 2002 due to Potentially Responsible Party issues stemming from its use by the Village of Hanna City as part of water supply plant operations. Soil and groundwater samples were analyzed for the same suite of compounds as the SI samples, with the exception of pesticides.

The analytical results from the SI and SSI were compared to IEPA's Tiered Approach to Cleanup Objectives (TACO, IAC Section 742) criteria. The major findings from the SI and SSI are as follows (complete data tables are included in Appendix B).

Of the pesticides analyzed during the SI, only 4,4-DDD and 4,4,-DDT were detected and only in one surface sample at levels significantly below the TACO Tier 1 Residential criteria. No pesticides were detected in any of the groundwater samples. Thus, pesticides can be ruled out as chemicals of potential concern (COPC) for the HCAFS.

PCBs were not detected in any of the groundwater and soil samples collected during the SI and SSI; detection limits for the analytical methods used were below TACO Tier 1 criteria. Thus, PCBs can be ruled out as COPCs for the HCAFS.

A number of VOCs were detected in the soil and groundwater samples collected during the SI and SSI but all measured concentrations were below the TACO Tier 1 residential criteria. Thus, VOCs can be ruled out as COPCs for the HCAFS. Note that although benzene was measured in 1998-1999 at a maximum of 1.2 mg/L in MP-MW-2-97 within the former UST location near Bldg 307 (Beling 1999), benzene was not detected in any of the groundwater samples collected during the SI and SSI. The groundwater samples closest to MP-MW-2-97 were collected from the Vehicle Wash Rack AOPC 200 to 300 ft west of MP-MW-2-97.

PAHs were detected in the soil and groundwater samples collected during the SI and SSI. None of the groundwater detections exceeded the TACO Class I groundwater criteria. However, a number of PAHs exceeded the TACO residential soil criteria for surface and subsurface soils (Table 2-1 and 2-2 respectively), mostly in the surface soil samples (0-0.5 ft bgs, Table 2-1). The PAHs with the lowest Tier 1 residential criteria are benzo(a)pyrene (see maps in Figure 2-4) and dibenzo(a,h)anthracene; the criteria were exceeded most frequently for these two compounds. PAHs are COPCs at the HCAFS because of the TACO residential criteria exceedances. Note that some of the elevated benzo(a)pyrene concentrations were measured in the vicinity of the Paint Shed, Coal Area C, and the Maintenance Building (Figure 2-4). This is also the area where a 2000 gal gasohol UST was removed in 1993 and a stock pile of contaminated soil was located, according to a map (reproduced in Figure 2-1, see Section 2.4.2) from a report describing UST removals at the Hanna City Work Camp (Beling 1998a). The report does not provide information about the source for the contaminated soil stock but other features on this map suggest that the soil might have been associated with UST removals in 1993 at the Hanna City Work Camp (see Section 2.4.2).

Of the metals measured in the surface and subsurface soil samples (Tables 2-3 and 2-4 respectively), only arsenic exceeded the TACO Tier 1 residential soil criteria (Table 2-4). These exceedances were observed in two soil subsurface soil samples collected in Coal Area Storage-A (Figure 2-5). The construction worker inhalation criterion for mercury was exceeded in one surface soil samples (Table 2-3). Concentrations of arsenic in unfiltered groundwater did not exceed the TACO Tier 1 Class I groundwater criteria (Table 2-5). Metals in unfiltered groundwater samples that exceeded TACO groundwater criteria include iron, lead, manganese, and vanadium. Filtered groundwater samples analyzed during the SI show significantly reduced aluminum concentrations when compared with the associated unfiltered groundwater samples (Table 2-6). Iron, lead, manganese and vanadium in these filtered groundwater samples are below the TACO Class I groundwater criteria (with the exception of manganese in the filtered sample from Coal Area C). Since aluminum is typically associated with suspended particulates (e.g., clay minerals), the comparative results in Table 2-6 suggest that the elevated levels of iron, lead, manganese and vanadium are likely associated with particulates in the groundwater samples. Parsons (2002) also makes a similar observation. Given the soil and groundwater results from the SI and SSI, metals are considered to be COPCs at the HCAFS.

All analytes were below TACO residential soil and Class I groundwater criteria in soil and groundwater samples collected from the Tile Field/Septic Tank. Thus, this area is no longer considered an AOPC.

In addition to collecting soil and groundwater samples, a metal detector and surface radiation survey in the Magnetron Tube Disposal Area was also conducted as part of the SI (see Figure 1-2 for location of this area). Two small anomalies were identified by the metal detector survey and may correspond to a buried metal object the size of a drum. In the areas where the anomalies were detected, hand shovels were used to excavate to a depth of approximately 4 feet below ground level. No buried objects were found. Furthermore, a surface radiation survey in this area registered dose rates that were either zero millirem/hour or within site background levels.

Table 2-1. Select PAH concentrations in surface soils (0 – 0.5 feet bgs) collected during the SI (1996, Parsons 2002) and SSI (2006; TtEC 2008). Table adapted from TtEC (2008). Only PAHs for which the TACO residential criteria were exceeded are shown in the table.

TACO Tier 1 Remediation Goals	*Benzo(a)-anthracene (ug/kg)*	*Benzo(b)-fluoranthene (ug/kg)*	*Benzo(a)-pyrene (ug/kg)*	*Indeno(1,2,3-cd)pyrene (ug/kg)*	*Dibenzo(a,h)-anthracene (ug/kg)*
Residential: Ingestion	*900*	*900*	*90*	*900*	*90*
Residential: Inhalation	---	---	---	---	---
Soil Component of GW Pathway	*2000*	*5000*	*8000*	*14,000*	*2,000*
Industrial/Commercial: Ingestion	*8000*	*8000*	*800*	*8,000*	*800*
Industrial/Commercial: Inhalation	---	---	---	---	---
Construction Worker: Ingestion	*170000*	*170000*	*17000*	*170,000*	*17,000*
Construction Worker: Inhalation	---	---	---	---	---

Field Data from Site Inspection (1996; Parsons 2002) and Supplemental Site Inspection (2006; TtEC 2008)

Sample Location	Sample ID (Depth)	Sampling Date	Benzo(a)-anthracene (ug/kg)	Benzo(b)-fluoranthene (ug/kg)	Benzo(a)-pyrene (ug/kg)	Indeno(1,2,3-cd)pyrene (ug/kg)	Dibenzo(a,h)-anthracene (ug/kg)
Site Background	**BA01 0-0.5**		<18	33	28	31	<46
Coal Storage Area A	**CA02 (0-0.5')**	07/8-15/96	**1,700**	**1,800**	**1,900**	**1,500**	**690**
Vehicle Wash Area	**VW SS01 (0-0.5')**	04/18/06	**950**	**1300**	**1100**	770	**290**
Vehicle Wash Area	**VW SS03 (0-0.5')(1)**	04/18/06	900	**1100**	**1000**	680	**220**
Vehicle Wash Area	**WR01 (0-0.5')**	07/8-15/96	300	480	**430**	430	**300**
Vehicle Wash Area	**VW SS02 (0-0.5')**	04/18/06	510	720	**600**	430	**160**
Maintenance Building	**MB SS01 (0-0.5')**	04/19/06	530	**940 M**	**850**	750	**300**
Maintenance Building	**MB SS03 (0-0.5')(1)**	04/19/06	600	810 M	**770**	720 H	**310**
Maintenance Building	**MB SS02 (0-0.5')**	04/19/06	190	360 H	**260**	220	87
Maintenance Building	**MB01 (0-0.5')**	07/8-15/96	730	800	**800**	680	**320**
Paint Shed	**PS SS01 (0-0.5')**	04/19/06	420 JD	590 M JD	**500 JD**	320 JD	**140 JD**
Paint Shed	**PS SS03 (0-0.5') (1)**	04/19/06	**8000**	**6500 M**	**7100**	**4000**	**1800**
Paint Shed	**PS01 (0-0.5')**	07/8-15/96	260	330	**400**	340	**240**
Paint Shed	**PS SS02 (0-0.5')**	04/20/06	140	220 M	**200**	140	53
Coal Storage Areas C	**CA05 (0-0.5')**	07/8-15/96	**2,700**	**3,100**	**2,700**	**2,300**	**1,400**
Coal Storage Areas B	**CA04 (0-0.5')**	07/8-15/96	360	350	**360**	300	**180**
Main Entrance	**ME SS01 (0-0.5')**	04/20/06	**5800**	**8600 M**	**5900**	**4200**	**1500**
Main Entrance	**ME03 (0-0.5')**	07/8-15/96	510	680	**630**	560	**300**
Tile Field	**TF SS01 (0-0.5')**	04/20/06	44	80 M	63	57	30 Ja
Tile Field	**TF01 (0-0.5')**	07/8-15/96	13	21	17	16	11
Tile Field	**TF SS02 (0-0.5')**	04/20/06	<44	<44	<44	<44	<44

(1)- PS SS03, MB SS03 and VW SS03 are field duplicates of PS SS01, MB SS01 and VW SS01, respectively.

M - Manually integrated compound; J - Result is an estimated value below the reporting limit; JD - Result is an estimated value due to high RPD.

H-indicates that the analyte was quantitated using peak heights rather than peak areas for both the analyte and its internal standard.

a - Concentration is below the method reporting limit. Shaded cells correspond to values that exceed the Tier 1 Residential Soil Criteria.

Table 2-2. Select PAH concentrations in subsurface soils (> 4 feet bgs) collected during the SI (1996, Parsons 2002) and SSI (2006; TtEC 2008). Table adapted from TtEC (2008). Only PAHs for which the TACO residential criteria were exceeded are shown in the table.

TACO Tier 1 Remediation Goals			*Benzo(a)-anthracene (ug/kg)*	*Benzo(b)-fluoranthene (ug/kg)*	*Benzo(a)-pyrene (ug/kg)*	*Indeno(1,2,3-cd)pyrene (ug/kg)*	*Dibenzo(a,h)-anthracene (ug/kg)*
TACO Tier 1 Remediation Goals							
Residential: Ingestion			***900***	***900***	***90***	***900***	***90***
Residential: Inhalation			---	---	---	---	---
Soil Component of GW Pathway			***2000***	***5000***	***8000***	***14,000***	***2,000***
Industrial/Commercial: Ingestion			***8000***	***8000***	***800***	***8,000***	***800***
Industrial/Commercial: Inhalation			---	---	---	---	---
Construction Worker: Ingestion			***170000***	***170000***	***17000***	***170,000***	***17,000***
Construction Worker: Inhalation			---	---	---	---	---
Field Data from Site Inspection (1996; Parsons 2002) and Supplemental Site Inspection (2006; TtEC 2008)							
Sample Location	**Sample ID (Depth)**	**Sampling Date**	**Benzo(a)-anthracene (ug/kg)**	**Benzo(b)-fluoranthene (ug/kg)**	**Benzo(a)-pyrene (ug/kg)**	**Indeno(1,2,3-cd)pyrene (ug/kg)**	**Dibenzo(a,h)-anthracene (ug/kg)**
Tile Field (TF)	**TF SB01 (4-5')**	04/20/06	<40	<40	<40	<40	<40
Tile Field (TF)	**TF SB02 (4-5')**	04/20/06	<42	<42	<42	<42	<42
Main Entrance (ME)	**ME SB01 (4-5')**	04/20/06	55	85 M	89	57	23 Ja
Vehicle Wash Area (VW)	**VW SB01 (4-5')**	04/18/06	510	730 M	**640**	460	**180**
Vehicle Wash Area (VW)	**VW SB04 (4-5')(1)**	04/18/06	400	570 M	**480**	340	**140**
Vehicle Wash Area (VW)	**VW SB02 (4-5')**	04/18/06	<42	<42	<42	<42	<42
Maintenance Building (MB)	**MB SB01 (4-5')**	04/19/06	<43	<43	<43	<43	<43
Maintenance Building (MB)	**MB SB04 (4-5')(1)**	04/19/06	<42	<42	<42	<42	<42
Maintenance Building (MB)	**MB SB02 (4-5')**	04/19/06	<42	<42	<42	<42	<42
Paint Shed (PS)	**PS SB01 (4-5')**	04/19/06	<42	<42	<42	16 Ja	<42
Paint Shed (PS)	**PS SB04 (4-5')(1)**	04/19/06	<41	<41	<41	<41	<41
Paint Shed (PS)	**PS SB02 (4-5')**	04/20/06	<42	17 Ja	19 Ja	23 Ja	23 Ja
Maintenance Building (MB)	**MB02 (5-8')**	07/8-15/96	<2	<2.5	<1	<2.4	<5
Paint Shed (PS)	**PS01 (5-8')**	07/8-15/96	<2.1	<2.7	<1.1	<2.6	<5.3
Coal Storage Areas (CA)	**CA01 (5-8')**	07/8-15/96	<2.1	1	2.9	<2.5	<5.3
Coal Storage Areas (CA)	**CA03 (5-8')**	07/8-15/96	<2	<2.6	<1	<2.5	<5.1
Coal Storage Areas (CA)	**CA07 (5-8')**	07/8-15/96	<2	0.82	1	<2.4	<5.1
Main Entrance (ME)	**ME02 (15-18')**	07/8-15/96	<2	<4.9	0.39	<2.4	<4.9
Vehicle Wash Area (VW)	**WR01 (15-18')**	07/8-15/96	<0.21	<2.6	<1	<5.2	<5.2
Tile Field (TF)	**TF01 (20-23')**	07/8-15/96	<2	<2.5	<1	<2.4	<5

(1)- PS SB04, MB SB04 and VW SB04 are field duplicates of PS SB01, MB SB01 and VW SB01, respectively.

M - Manually integrated compound; J - Result is an estimated value below the reporting limit; JD - Result is an estimated value due to high RPD.

a - Concentration is below the method reporting limit.

Shaded cells correspond to values that exceed the Tier 1 Residential Soil Criteria.

Table 2-3. Select metals concentrations in surface soils (0 – 0.5 feet bgs) collected during the SI (1996, Parsons 2002) and SSI (2006; TtEC 2008). Table adapted from TtEC (2008). Metals not shown in table did not exceed TACO Tier 1 criteria.

TACO Tier 1 Remediation Goals	***Mercury (mg/kg)***	***Arsenic (mg/kg)***	***Iron (mg/kg)***	***Lead (mg/kg)***	***Manganese (mg/kg)***	***Vanadium (mg/kg)***
Residential: Ingestion (1)	***23***	***13***	***NA***	***400***	***1,600***	***550***
Residential: Inhalation	***10***	***750***	***NA***	***NA***	***69,000***	***NA***
Soil Component of GW Pathway, Class I GW (pH = 7)	***3.3***	***29***	***NA***	***107***	***NA***	***980***
Industrial/Commercial: Ingestion (1)	***610***	***13***	***NA***	***800***	***41,000***	***14000***
Industrial/Commercial: Inhalation	***16***	***1200***	***NA***	***NA***	***91,000***	***NA***
Construction Worker: Ingestion	***61***	***61***	***NA***	***700***	***4,100***	***1400***
Construction Worker: Inhalation	***0.1***	***25000***	***NA***	***NA***	***8,700***	***NA***

Field Data from Site Inspection (1996; Parsons 2002) and Supplemental Site Inspection (2006; TtEC 2008)

Sample Location	Sample ID (Depth)	Sampling Date	Depth (ft)	pH	Mercury (mg/kg)	Arsenic (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Vanadium (mg/kg)
Site Background	**BA01 0-0.5**	07/8-15/96		6.0	<0.06	10.1	17600	32.8	1070N	35.8
Site Background	**BA01 5-8'**	07/8-15/96		7.2	<.05	9.9	24500	16.3	961N	39.4
Coal Area A (CA)	**CA SS01 (0-0.5')**	04/18/06	0.5		0.061	9.3	19000	81	930	28
Coal Area A (CA)	**CA SS02 (0-0.5')**	04/18/06	0.5		0.14	10	18000	32	950	26
Coal Area A (CA)	**CA02 (0-0.5')**	07/8-15/96	0.5	7.1	<0.05	8.10	18400	38	964	36.10
Coal Area B (CB)	**CB SS01 (0-0.5')**	04/20/06	0.5		0.036	8.0	17000	20	380	30
Coal Area B (CB)	**CB SS03 (0-0.5')(2)**	04/20/06	0.5		0.027 B	7.6	17000	17	690	32
Coal Area B (CB)	**CB SS02 (0-0.5')**	04/20/06	0.5		0.030 B	7.4	17000	11	380	27
Coal Area B (CB)	**CA04 (0-0.5')**	07/8-15/96	0.5	7.7	<0.04	5.80	12700	28.20	424	20.90
Coal Area C (CC)	**CC SB01 (0-0.5')**	04/19/06	0.5		0.0084 B	4.8	7300	15	240	13
Coal Area C (CC)	**CC SS02 (0-0.5')**	04/19/06	0.5		0.034 B	7.4	15000	93	480	21
Coal Area C (CC)	**CC SS03 (0-0.5')**	04/19/06	0.5		0.042	10	23000	14	320	34
Coal Area C (CC)	**CA05 (0-0.5')**	07/8-15/96	0.5	7.6	<0.05	8.3	18500	64.4	1110	35.9
Paint Shed (PS)	**PS01 (0-0.5')**	07/8-15/96	0.5		NS	NS	NS	27.7	NS	NS
Paint Shed (PS)	**PS SS01 (0-0.5')**	04/19/06	0.5		NS	NS	NS	20	NS	NS
Paint Shed (PS)	**PS SS03 (0-0.5')(2)**	04/19/06	0.5		NS	NS	NS	17	NS	NS
Paint Shed (PS)	**PS SS02 (0-0.5')**	04/20/06	0.5		NS	NS	NS	26	NS	NS
Vehicle Wash Area (VW)	**VW SS01 (0-0.5')**	04/18/06	0.5		0.10	8.7	20000	17	470	27
Vehicle Wash Area (VW)	**VW SS03 (0-0.5')(2)**	04/18/06	0.5		0.059	8.6	20000	17	600	26
Vehicle Wash Area (VW)	**WR01 (0-0.5')**	07/8-15/96	0.5	7.2	<0.05	8.20	18900	58.50	631	37.60
Vehicle Wash Area (VW)	**VW SS02 (0-0.5')**	04/18/06	0.5		0.036 B	11	20000	38	770	31

(1) In accordance with footnote "t" of TACO Table A, arsenic RGO is set to value in Table G, TACO Appendix A

(2)- CB SS03, PS SS03, and VW SS03 are field duplicates of CB SS01, PS SS01, and VW SS01, respectively.

NS: Not sampled; B: Result below reporting limit.; N: Spiked sample recovery not within control limits. Shaded cells indicate values that exceeded TACO Tier 1 soil criteria.

Table 2-4. Select metals concentrations in subsurface soils (> 4 feet bgs) collected during the SI (1996, Parsons 2002) and SSI (2006; TtEC 2008). Table adapted from TtEC (2008). Metals not shown in table did not exceed TACO Tier 1 criteria.

TACO Tier 1 Remediation Goals

	Mercury (mg/kg)	Arsenic (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Vanadium (mg/kg)
Residential: Ingestion (1)	*23*	*13*	*NA*	*400*	*1,600*	*550*
Residential: Inhalation	*10*	*750*	*NA*	*NA*	*69,000*	*NA*
Soil Component of GW Pathway, Class I GW (pH = 7)	*3.3*	*29*	*NA*	*107*	*NA*	*980*
Industrial/Commercial: Ingestion (1)	*610*	*13*	*NA*	*800*	*41,000*	*14000*
Industrial/Commercial: Inhalation	*16*	*1200*	*NA*	*NA*	*91,000*	*NA*
Construction Worker: Ingestion	*61*	*61*	*NA*	*700*	*4,100*	*1400*
Construction Worker: Inhalation	*0.1*	*25000*	*NA*	*NA*	*8,700*	*NA*

Field Data from Site Inspection (1996; Parsons 2002) and Supplemental Site Inspection (2006; TtEC 2008)

Sample Location	Sample ID (Depth)	Sampling Date	Depth (ft)	pH	Mercury (mg/kg)	Arsenic (mg/kg)	Iron (mg/kg)	Lead (mg/kg)	Manganese (mg/kg)	Vanadium (mg/kg)
Coal Area A (CA)	**CA SB01 (4-5')**	04/18/06	5.0		0.033 B	**18**	29000	12	650	40
Coal Area A (CA)	**CA SB02 (4-5')**	04/18/06	5.0		0.050	9.5	20000	14	960	27
Coal Area B (CB)	**CB SB01 (4-5')**	04/20/06	5.0		0.045	6.2	16000	13	360	28
Coal Area B (CB)	**CB SB04 (4-5')(2)**	04/20/06	5.0		0.048	12	25000	7.8	170	43
Coal Area B (CB)	**CB SB02 (4-5')**	04/20/06	5.0		0.050	12	37000	15	750	45
Coal Area C (CC)	**CC SB01 (4-5')**	04/19/06	5.0		0.020 B	10	19000	11	520	31
Coal Area C (CC)	**CC SB02 (4-5')**	04/19/06	5.0		0.043	11	20000	13	1000	27
Coal Area C (CC)	**CC SB03 (4-5')**	04/19/06	5.0		0.043	7.8	21000	8.9	390	28
Paint Shed (PS)	**PS SB01 (4-5')**	04/19/06	5.0		NS	NS	NS	12	NS	NS
Paint Shed (PS)	**PS SB04 (4-5')(2)**	04/19/06	5.0		NS	NS	NS	9.6	NS	NS
Paint Shed (PS)	**PS SB02 (4-5')**	04/20/06	5.0		NS	NS	NS	8.4	NS	NS
Vehicle Wash Area (VW)	**VW SB01 (4-5')**	04/18/06	5.0		0.064	10	22000	69	760	31
Vehicle Wash Area (VW)	**VW SB04 (4-5')(2)**	04/18/06	5.0		0.076	8.8	19000	48	770	30
Vehicle Wash Area (VW)	**VW SB02 (4-5')**	04/18/06	5.0		0.053	9.3	21000	15	1100	28
Coal Area A (CA)	**CA01 (5-8')**	07/8-15/96	8.0	7.8	<0.05	**14.60**	24500	12.10	806	43.50
Coal Area B (CB)	**CA03 (5-8')**	07/8-15/96	8.0	8.0	<0.05	3.90	13300	9.60	8	40.90
Coal Area C (CC)	**CA07 (5-8')**	07/8-15/96	8.0	7.9	<0.05	7.40	16600	14.20	198	27.90
Vehicle Wash Area (VW)	**WR01 (15-18')**	07/8-15/96	18.0	7.6	<0.09	6.10	20600	14.60	212	22.70

(1) In accordance with footnote "t" of TACO Table A, arsenic RGO is set to value in Table G, TACO Appendix A

(2)- CB SB04, PS SB04 and VW SB04 are field duplicates of CB SB01, PS SB01 and VW SB01, respectively.

NS: Not sampled; B: Result below reporting limit.; N: Spiked sample recovery not within control limits. Shaded cells indicate values that exceeded TACO Tier 1 soil criteria.

Table 2-5. Select metals concentrations (units of mg/L) in unfiltered groundwater samples collected during the SI (1996, Parsons 2002) and SSI (2006; TtEC 2008). Table adapted from TtEC (2008). Metals not shown in table did not exceed TACO Tier 1 criteria.

Class I Groundwater Criteria, Table E			**Mercury (mg/L)**	**Aluminum (mg/L)**	**Arsenic (mg/L)**	**Iron (mg/L)**	**Lead (mg/L)**	**Manganese (mg/L)**	**Vanadium (mg/L)**
			0.002	***NA***	***0.05***	***5.0***	***0.0075***	***0.15***	***0.049***
Field Data from SI (1996) and SSI (2006)									
Sample Location	**Sample ID**	**Sample Date**	**Mercury (mg/L)**	**Aluminum (mg/L)**	**Arsenic (mg/L)**	**Iron (mg/L)**	**Lead (mg/L)**	**Manganese (mg/L)**	**Vanadium (mg/L)**
Background	**BA01 GW01**	**7/13/96**	<0.0001	2.65	<0.0014	3.19	0.0013B	0.0402	0.0057B
Background	**BA32 GW01**	**7/13/96**	<0.0001	3.1	<0.0014	4.07	0.0068	0.0491	0.0088B
Coal Area A (CA)	**CA GW01**	04/21/06	<0.00050	6.2	0.0034 B	**7.5**	<0.0050	0.11	0.016
Coal Area A (CA)	**CA GW02**	04/21/06	<0.00050	14	<0.010	**13**	0.0062	0.12	0.027
Coal Area A (CA)	**Coal Area A**	07/8-15/96	<0.00013	29.7	0.0104	**39.7**	**0.0969**	**0.441**	**0.0673**
Coal Area B (CB)	**CB GW01**	04/26/06	<0.00050	4.9	0.0023 B	**5.4**	0.0026 B	0.10	0.013
Coal Area B (CB)	**CB GW02**	04/26/06	<0.00050	13	0.0061 B	**13**	**0.0079**	**0.48**	0.033
Coal Area B (CB)	**Coal Area B**	07/6-15/96	<0.0001	16.5	0.0116	**43.6**	**0.0434**	**0.359**	**0.0586**
Coal Area C (CC)	**CC GW01**	04/22/06	0.00012 B	59	0.018	**64**	**0.036**	**1.1**	**0.14**
Coal Area C (CC)	**CC GW02**	04/24/06	<0.00050	43	0.021	**58**	**0.021**	**0.65**	**0.12**
Coal Area C (CC)	**CC GW03**	04/22/06	<0.00050	2.2	<0.010	1.7	<0.0050	0.013	0.0055
Vehicle Wash Area (VW)	**VW GW01**	04/21/06	<0.00050	18	0.0060 B	**20**	**0.012**	**3.2**	**0.05**
Vehicle Wash Area (VW)	**VW GW02**	04/22/06	<0.00050	52	0.018	**64**	**0.025**	**0.66**	**0.14**
Vehicle Wash Area (VW)	**VW GW03**	04/22/06	<0.00050	34	0.014	**41**	**0.014**	**0.42**	**0.096**
Vehicle Wash Area (VW)	**Wash Rack**	07/8-15/96	<0.00016	36.4	0.0117	**47.1**	**0.0139**	**0.646**	**0.0912**
Paint Shed (PS)	**PS GW01**	04/24/06	NS	NS	NS	NS	**0.0077**	NS	NS
Paint Shed (PS)	**PS GW03**	04/26/06	NS	NS	NS	NS	0.0062	NS	NS
Paint Shed (PS)	**PS GW02**	04/24/06	NS	NS	NS	NS	0.0036	NS	NS
Paint Shed (PS)	**Paint Shed**	07/8-15/96	NS	NS	NS	NS	**0.0481**	NS	NS

B: analyte was detected but result was below the quantitation limit

Table 2-6. Comparison of select metals concentrations in unfiltered and filtered groundwater samples collected during the SI (1996, Parsons 2002). Table adapted from TtEC (2008). Metals not shown in table did not exceed TACO Tier 1 criteria.

		Aluminum	Arsenic	Iron	Lead	Manganese	Vanadium
TACO Class I Groundwater Remediation Objectives							
		Aluminum (ug/L)	*Arsenic (ug/L)*	*Iron (ug/L)*	*Lead (ug/L)*	*Manganese (ug/L)*	*Vanadium (ug/L)*
		NA	*50*	*5000*	*7.5*	*150*	*49*
Field Data from SI (1996)							
		Aluminum (ug/L)	**Arsenic (ug/L)**	**Iron (ug/L)**	**Lead (ug/L)**	**Manganese (ug/L)**	**Vanadium (ug/L)**
Background	Unfiltered	2650N	1.4UW	3190	1.3B	40.2	5.7B
	Filtered (0.45 μm)	21.9UN	1.4U	4.5U	1.2U	14	2.5U
Coal Area A	Unfiltered	29700	10.4	39700	96.9	441	67.3
	Filtered (0.45 μm)	21.9U	1.4U	43.2	2.8	70.4	2.5U
Coal Area C	Unfiltered	324000	174	564000	705	10500	772
	Filtered (0.45 μm)	893	1.4U	1570	4.4	290	3.9
Vehicle Wash Rack	Unfiltered	36400	11.7N	47100	13.9	646	91.2
	Filtered (0.45 μm)	21.9U	1.4UN	4.5U	1.5B	67	2.5U

Data were obtained from TtEC (2008) and Appendix D.2 of Parsons (1996).
B: analyte was detected but result was below the quantiation limit; U: analyte was not detected and value shown is the quantitation limit.
W: Post Digestion Spike for furnace AA analysis is out of control limits, while sample absorbance is <50% of spike absorbance.
N: Spiked sample recovery not within control limits.
Shaded cells indicate results that exceeded TACO Class I groundwater criteria.

2.5 CONCEPTUAL SITE RISK MODELS

Figures 2-6 and 2-7 show the conceptual site risk model (CSRM) and conceptual site ecological risk model (CSERM) for the HCAFS. These models were developed based on available site information from the SI and SSI, current and unrestricted (residential) land use. These models include sources and impacted media, transport mechanisms, exposure routes, pathways, and receptors.

The impacted media for both the CSRM and CSERM are surface soil, subsurface soil and groundwater, in accordance with the SI and SSI analytical results. The primary transport mechanisms for surface soil and subsurface soils assume that COPCs are PAHs and metals (also based on the SI and SSI results); these contaminants can be transported through air-borne and water-borne particulates with sorbed chemicals, or through dissolution in infiltrating water. The exposure routes consist of air and direct contact, and primary pathways are ingestion, inhalation and dermal contact.

The choice of current human receptors (CSRM, Figure 2-6) is based on the assumption of land use as a correctional facility. Although there is some uncertainty regarding current land use because a recent news article (http://centralillinoisproud.com/content/fulltext/?cid=7250) indicated that the Hanna City Work Camp has been closed since 1992, the same news article also stated that the State of Illinois has approved a bill to transfer the property to Peoria County for use as a minimum security work release center or special prison for mentally ill inmates. Thus, it is reasonable to assume that the HCAFS will remain a correctional facility in the foreseeable future and that current receptors that may be exposed to potential site contamination include correctional facility staff and inmates. Land use by IDoC will be verified during meetings with this government agency through the course of this project.

The CSRM (Figure 2-6) also includes resident adult and resident child receptors under an unrestricted land use scenario. It is possible that construction workers may be exposed to site soils. However soil PAH and metals concentrations are significantly lower than the TACO Tier 1 construction worker criteria for all PAHs and almost all metals (Table 2-1 to 2-4) with the exception of mercury which was above the criteria in one surface soil locations (Table 2-4). At Coal Area A, one (0.14 μg/kg) out of 3 surface soil samples exceeded the mercury TACO Tier 1 construction worker criterion (0.1 μg/kg). At the Vehicle Wash Rack, one (0.10 μg/kg) out of 4 surface soil samples was at the threshold value. These observations suggest that a site-specific risk assessment is not warranted for a construction worker receptor.

Of the environmental media that were identified as being potentially contaminated during the SI and SSI, the correctional facility staff and inmates are only likely to be exposed to surface soil (0 to 1 ft bgs) through ingestion, inhalation and dermal contact with air-borne particulates generated from the surface soil. Access to the subsurface soil can only occur through digging and excavations, activities which are assumed to be unlikely performed on a regular basis by correctional facility staff and inmates. Thus, the pathway from potentially contaminated subsurface soil (> 1 ft) to facility staff and inmates is not analyzed (Figure 2-6). The groundwater pathway is also considered possible but unlikely because drinking water for the Hanna City Work Camp was being supplied by the Illinois of America Water Company (TtEC 2008). The groundwater pathway will not be analyzed for the correctional facility staff and inmates (see Section 3.1.3 for discussion of risk assessment methods).

All pathways are analyzed for the residential receptors in the CSRM to determine risks at the HCAFS under unrestricted land use.

A generic organism receptor is assumed for the CSERM (Figure 2-7) because there is currently insufficient information available to have more specific receptors. Specific receptors will be identified if viable habitats are observed during the ecological site reconnaissance to be conducted as part of the screening level ecological risk assessment (Section 3.1.5 and Section 5). The current CSERM assumes that there are complete pathways from surface and subsurface soil to generic life forms through the ingestion, inhalation, and dermal contact however only the ingestion pathway is analyzed because the available ecological screening criteria to be used for the screening level ecological risk assessment (Section 3.1.5 and Section 5) are primarily based on toxicity data for this pathway. It is considered possible but unlikely for generic organisms to be exposed to potentially contaminated groundwater because there are no known groundwater seeps and depth to groundwater being highly variable from 4 to 10 feet bgs during SI, and 0.7 feet to 5 feet bgs during the SSI (TtEC 2008). Thus, the groundwater pathway to the generic organism is not analyzed.

Note that the CSRM and CSERM may be revised if warranted by results of the RI field investigation (Section 3.1.2) and ecological site reconnaissance (Section 5.2).

3. TASK DESCRIPTIONS

The following is a detailed description of tasks under each of the major activities to be conducted under this project at the HCAFS. The section is organized as follows:

Section 3.1, Remediation Investigation Tasks, presents methods to be used in field investigation, a summary of the methods to be used for the human health and ecological risk assessments (HHRA and SLERA), and the elements of the RI report. More details regarding the HHRA and SLERA are presented in Sections 4 and 5, respectively.

Section 3.2 Preparation of the PIP which will address which will describe the objectives of the public relations activities, and how these objectives will be met.

Section 3.3, Feasibility Study Tasks, includes the steps to be taken in identifying and evaluating remedial technologies should the results of the RI indicate that remedial action is warranted.

Section 3.4, Preparation of PP, describes the key pieces of information to be included in the PP which will be used to communicate with the public and obtain input regarding proposed remedial actions at the HCAFS.

Section 3.5, Preparation of the Decision Document, presents the outline for the Record of Decision.

Section 3.6, Administrative Records, includes the type of information to be included in this repository that will contain information relevant to selection of remedial actions at the HCAFS.

3.1 REMEDIAL INVESTIGATION TASKS

The RI tasks include field investigation, a baseline risk assessment consisting of a human health risk assessment (HHRA) and a screening level ecological risk assessment (SLERA), and preparation of the RI report. Figure 3-1 shows a flow chart for the RI tasks as well as decision points. The RI tasks are described below.

3.1.1 Technical Approach for Field Investigation and Data Quality Objectives

The objective of the RI field sampling is to collect samples to provide data that will supplement information gathered during the SI and SSI. The combined data set will be used to support a baseline risk assessment for site AOPCs to identify areas that will require remediation. The definition of exposure units for the site is described below, followed by an abbreviated data quality objectives process.

Based on the current CSRM (Figure 2-6), the site receptors under land use as a correctional facility are facility staff and inmates, while the site receptors based on unrestricted land use are resident adult and child. Exposure units (EU) are defined as the likely area in which a receptor will be affected by a potential contaminant in a given medium. For quantifying risks to residential and correctional facility receptors, Coal Storage Area A, Coal Storage Area B, Vehicle Wash Rack, and the Main Entrance will each be considered as an EU, while the Maintenance Building, Coal Storage Area C and the Paint Shed will be considered as one EU due to their proximity to each other. To obtain representative samples from each EU to supplement data from the SI and SSI, sampling zones were defined in the AOPCs (Figure 3-2), where the shape of the sampling zones with buildings (Vehicle Wash Rack, Paint Shed and Maintenance Building) were defined based on the probable area where any contaminant release would have taken place (i.e., ~100 ft from building perimeters) and where soils are exposed (i.e., unpaved). Note that the sampling zone in the Vehicle Wash Rack does not include the former UST site (Figure 2-2) because, as mentioned previously, there is evidence that the UST was used after the property was transferred from DoD. It is therefore not eligible for FUDs program funding and excluded from this RI. A square 0.5-acre zone was defined as the sampling zone for the Coal Storage Areas and Main Entrance.

For groundwater, the entire site will be considered as one exposure unit for all site receptors; groundwater samples will be collected from the Vehicle Wash Rack and Paint Shed AOPCs. The RI groundwater results will be combined with the groundwater data from the SI and SSI from the Coal Areas, Vehicle Wash Rack and Paint Shed AOPCs to arrive at exposure estimates for the groundwater pathway.

With the sampling zones defined as shown in Figure 3-2, the data quality objectives for the RI are obtained following EPA's seven-step process (EPA 2006):

Step 1: State the Problem	PAHs were detected in surface soils above TACO Tier 1 residential criteria in Coal Storage Areas A, B, C, Maintenance Building, Paint Shed and Main Entrance. Arsenic was detected in subsurface (4-5 feet bgs and 5-8 feet bgs) above TACO Tier 1 residential criteria in Coal Area A. PAHs and metals were below TACO Tier 1 criteria in deeper (> 8 feet bgs) samples. Lead was detected in unfiltered groundwater samples from the Paint Shed. Lead, iron, manganese and vanadium were detected in unfiltered groundwater samples from the Coal Areas and Vehicle Wash Rack. Elevated metals were lower (below Tier 1 criteria) in filtered (0.45 μm) samples.
Step 2: Identify the decision	Do the PAHs and metals pose unacceptable risk to site users and ecological receptors? Is remediation warranted?
Step 3: Identify inputs to the decision	• Human health screening levels (TACO Tier 1, EPA Regional, IL drinking water standards, MCLs); Ecological screening levels (ORNL benchmarks, EPA EcoSSL, EPA Region 5 ESL) • PAH and metals concentrations in Coal Storage Areas A, B, C, Vehicle Wash Rack, Maintenance Building, Paint Shed and Main Entrance surface (0-0.5 ft bgs) and subsurface (> 0.5 ft bgs) soil. • Cumulative cancer risk must be within or below the acceptable range of $1x\ 10^{-4}$ to $1x10^{-6}$; cumulative hazard index (target organ-specific) less than 1; ecological hazard quotients must be less than 1.
Step 4: Define the boundaries of the study	Coal Area C, the Paint Shed and the Maintenance Building are combined into one EU; the rest of the AOPCs will be considered each as one EU. Risks will be calculated separately from surface soil (0-0.5 ft), and subsurface soil (> 0.5 ft), and for each EU.
Step 5: Develop a Decision Rule	If cumulative risk is below the acceptable risk range of $1x10^{-6}$ and target organ-specific hazard index less than one, PAHs and metals do not pose unacceptable ecological risk, then remedial action is not needed at the HCAFS.
Step 6: Specify Tolerable Limits of Decision Errors	The sampling goal is to obtain an acceptable exposure point estimate for each EU (Figure 3-2), which will be set to the 95% UCL of the mean. Thus, the sampling goal is to have the width of two-sided 95% confidence interval around the mean be approximately equal to the standard deviation of concentrations. Using Visual Sampling Plan (http://vsp.pnl.gov/), the recommended number of samples is at least 7. ProUCL 4.0, statistical software published by the EPA for data analysis (http://www.epa.gov/esd/tsc/software.htm), recommends at least 8 data points for estimating sample means and confidence intervals.
Step 7: Develop the plan for obtaining data (Data Quality Objectives)	For the RI field investigation, enough soil samples will be collected from each AOPC such that there are a total of at least 8 data points for surface (0-0.5 ft) and subsurface (> 0.5 ft) depth intervals from the RI, SI, and SSI. Subsurface soil samples will be collected from 2-3 feet and 4-5 feet bgs. The surface sample locations will be located within the sampling zones (Figure 3-2) such that there is a uniform distribution of sample locations. The SI and SSI results indicated potential concern for the subsurface soils from the Coal Storage Areas and Vehicle Wash Rack; subsurface samples, in addition to surface samples, will be collected at these AOPCs during the RI field investigation. Additional groundwater samples will be

collected from the Coal Areas, Vehicle Wash Rack and Paint Shed AOPCs. PAH and metals analysis methods with reporting limits below human health and ecological screening criteria for as many analytes as possible will be used.

3.1.2 Field Sampling and Analysis

The RI field samples will be collected in accordance with the data quality objectives described in Section 3.1.1. Figure 3-3a shows locations for surface soil samples (0-0.5 ft bgs), and Figure 3-3b shows subsurface soil samples (2-3 and 4-5 feet bgs). The subsurface sampling depths were chosen to obtain representative samples from the maximum depth where burrowing animals and human residents can be exposed to subsurface soil (2-3 ft and 4-5 ft, respectively). Proposed sampling locations were selected by using VSP to lay out a preselected number of sampling locations on a triangular grid (Figure 3-2), then selecting the final sample locations that are positioned furthest away from the previously sampled locations. There is an option in VSP to consider historical sample locations but this was only available for randomly placed samples; a similar option was not available for regular grid sampling. The triangular grid layout was selected over random locations so that sample locations are homogenously distributed within each EU. The latter is more suitable for delineating contamination in each EU. The surface soil samples were collected in August 2008, with concurrence from C. Hill of IEPA; these sample locations are shown in Figure 3-3a.

Groundwater samples will be collected at the locations shown in Figure 3-3b. Both unfiltered and filtered samples will be collected and analyzed because previous site investigation results indicated that elevated metals may be associated with suspended particulates (Table 2-6). In addition to the metals analyses, total solids will be measured in both unfiltered and filtered groundwater samples to quantitatively assess the influence of particulates on metals concentrations.

Tables 3-1, 3-2 and 3-3 show the number of surface soil, subsurface soil, and groundwater data points collected during the SI and SSI, and proposed for the RI. These tables show that when the data sets are combined from the SI, SSI and RI, the total number of samples for a given analyte class and EU will be provide at least 8 data points for estimating Exposure Point Concentrations (EPCs).

Details regarding field sampling and analysis as well as quality control measured for field and lab procedures and data verification can be found in the project SAP (GEO 2008b).

Table 3-1. Number of existing and proposed surface soil (0-0.5 ft bgs) data points from the SI/SSI and RI at the HCAFS. Only PAH analyses will be performed on the RI surface soil samples.

		Number of Data Points		
AOPC	**COPCs (1)**	**SI/SSI**	**RI**	**Total**
Coal Area Storage A	PAH	1	7	8
Coal Area Storage B	PAH	1	7	8
Coal Area Storage C (2)	PAH	1	7	8
Main Entrance	PAH	2	6	8
Vehicle Wash Rack	PAH	3	6	9
Maintenance Building (2)	PAH	3	5	8
Paint Shed (2)	PAH	3	5	8

1 - Chemicals of potential concern (COPC) based on SI and SSI.
2- Coal Area C, Paint Shed, and Maintenance Building combined into one Exposure Unit.

Table 3-2. Number of existing and proposed subsurface soil (5.0 ft bgs > depth > 0.5 ft bgs) data points from the SI/SSI and RI at the HCAFS.

		Number of Data Points (excluding field duplicates)		
AOPC	**COPCs (1)**	**SI/SSI**	**RI (3)**	**Total**
Vehicle Wash Rack	PAH	2	12	14
Coal Area Storage A	Arsenic	2	14	16
Coal Area Storage B	Arsenic	2	14	16
Coal Area Storage C	Arsenic (2)	3	14	17

1 - Chemicals of potential concern (COPC) based on SI and SSI.
2 - Based on exceedances in Coal Area Storage A and B
3 - 6 and 7 borehole locations at Vehicle Wash Rack and each Coal Area respectively; 2 depth intervals per borehole (2-3 ft; 4-5 ft)

Table 3-3. Number of existing and proposed groundwater data points (metals) from the SI/SSI and RI at the HCAFS.

		Number of Data Points		
AOPC	**COPCs**	**SI/SSI**	**RI**	**Total**
Coal Area Storage A	metals	3	1	4
Coal Area Storage B	metals	3	1	4
Coal Area Storage C	metals	3	1	4
Vehicle Wash Rack	metals	3	3	6
Paint Shed	lead	3	4	7
Total number of groundwater data points				**25**

3.1.3 Identification of Applicable and Relevant or Appropriate Requirements and To Be Considered Information

Chemical-specific, location-specific, and (if possible) action-specific federal and state applicable and relevant or appropriate requirements (ARARs) and To Be Considered (TBC) information will be identified and included in the RI report (Section 3.1.6). The list of ARARs and TBCs for the HCAFS will be developed based on the results of the SI, SSI and RI, and with concurrence from IEPA.

3.1.4 Human Health Risk Assessment

A HHRA will be conducted for the HCAFS using data collected from the SI, SSI and field activities proposed for this RI. Because VOCs, PCBs, and pesticides have been eliminated as COPCs based on the SI and SSI results, the RI and risk assessment will focus on PAHs and metals. In accordance with the current CSM (Section 2.5), risks will be calculated for the following receptor/medium combinations:

Correctional Facility Staff / Surface Soil

Correctional Facility Inmate/ Surface Soil

Resident Adult/Surface Soil

Resident Adult/Subsurface Soil

Resident Adult/Groundwater

Resident Child/Surface Soil

Resident Child/Subsurface Soil

Resident Child/Groundwater

In accordance with EPA guidance (EPA 1997a), the HHRA will consist of the following steps: (1) data evaluation, (2) exposure assessment, (3) toxicity assessment, and (4) risk characterization. A detailed description of the HHRA is presented in Section 4.

3.1.5 Screening Level Ecological Risk Assessment

A SLERA will be conducted corresponding to Steps 1 and 2 of the EPA 8-Step Ecological Risk Assessment (ERA) process (EPA 1997a). The SLERA will consist of the following:

Step 1: Screening Level Problem Formulation and Ecological Effects Evaluation: This step includes an ecological site reconnaissance which will determine the presence of ecological resources and potential ecological receptors. Assessment endpoints will be formulated based on the findings of the site visit. Chemical data from the SI, SSI and RI will be compared with ecological screening values to produce a list of chemicals of potential ecological concern (COPECs). If COPECs are identified, this step also includes the selection of toxicity reference values (TRV) from the open literature to be used for Step 2.

Step 2: Screening Level Exposure Estimates and Risk Calculation: This step involves estimating exposure levels for each assessment endpoint using chemical data and EPA-recommended exposure assumptions (e.g., EPA 1993b), and calculation of environmental hazard quotients (EHQ) from the estimated exposure levels and TRVs for each COPEC and assessment endpoint. If EHQs are greater than 1, then there are potential ecological risks at the HCAFS and a decision will be made regarding further investigations to better quantify or remedial actions to address these potential risks.

Details regarding the SLERA are provided in Section 4.

3.1.6 Remedial Investigation Report

An RI report will be prepared to summarize information gathered during previous investigations, document the results of the field investigation conducted as part of the RI, and summarize the results of the HHRA and SLERA. The RI report will follow the outline provided in EPA (1989) and will include the following major elements:

- Introduction, including RI objectives, site description, site history, and previous investigations.
- Study Area Investigation, including a description of field activities conducted as part of the RI.
- Physical Characteristics of the Study Area, including regional and site-specific geology and hydrogeology, meteorology, topography, surface water hydrology, ecology and land use.
- Nature and Extent of Contamination, including a summary of site characterization results identify sources and delineate areas of contamination. Environmental media of concern at the HCAFS include surface soils, subsurface soils and groundwater.
- Contaminant Fate and Transport, including a discussion of potential migration routes, contaminant persistence, and a qualitative assessment of contaminant migration.
- List of ARARs and TBCs
- Baseline Risk Assessment, including a summary of statistics for analytical data, results of the exposure assessment, toxicity assessment and risk characterization for the HHRA, and results of the SLERA. Detailed risk calculations will be provided in an appendix to the RI report. If a baseline ecological risk assessment is warranted, this will be covered under a separate report.
- Summary and Conclusions, including a summary of nature and extent of contamination, fate and transport, risk assessment, as well as recommendations for further study and/or remedial action.
- Appendices to the RI report will include analytical data, data verification reports, field logs, and detailed risk calculations.

3.2 PREPARATION OF THE PUBLIC INVOLVMENT PLAN

An important component of the RI/FS process is development of a community relations program which has three main objectives (EPA 1992):

- Keep the public informed about the environmental problems at the HCAFS, potential threats, responses under consideration, and progress being made
- Give the public the opportunity to comment on and provide input to technical decisions
- Focus and resolve conflict by openly considering alternative viewpoints

Within the context of community relations, GEO has the responsibility to prepare a PIP, fact sheets, and provide technical support to community relations activities including public meeting support.

The PIP will lists various ways to encourage effective two-way communication between the community and EPA, identifies locations for information repositories and public meetings, and summarizes the conditions and history of the site including the occurrence of past community involvement. Development of the PIP includes personal interviews that EPA conducts with individuals who represent the public and includes concerned residents, state and local officials, business representatives, educators, and representatives of other community organizations.

A key value of the community relations program is that the PIP may be modified to ensure that new community concerns and questions are addressed. Revision of the PIP is based on community input to any remediation remedy that is selected for the site (including the outcome of any treatability studies), but before a remedial design has been implemented. This provision ensures that that concerned community representatives are fully engaged in the decision-making process.

3.3 FEASIBILITY STUDY TASKS

A FS will be conducted to ensure appropriate remedial alternatives are developed and evaluated such that relevant information concerning the remedial action options can be presented to a decision-maker and an appropriate remedy selected. Development of alternatives shall be fully integrated with the site characterization activities of the RI described previously. The FS will consist of the following tasks:

- Establish remedial action objectives for contaminants and media of concern, including acceptable contaminant levels derived from results of the baseline risk assessment and target risks (e.g., cancer risk below the target range of 1×10^{-4} to 1×10^{-6} and target organ HI below 1). This task also includes estimates of volume and/or areal extent of environmental media requiring remedial action. Additional field data will be collected if the data from the SI, SSI, and RI are insufficient for delineating extent of contamination in accordance with the remediation goals.

- Identify and evaluate mature and innovative technologies suitable for the site, and assemble potential technologies into a screening matrix that shows qualitative estimates of effectiveness, level of technology maturity, implementability, and cost. One of the essential components of RI/FS activities at HCAFS is for GEO to determine as early as possible the need for performing treatability studies associated with the technology selection process. Some technologies that may be selected as the preferred remediation alternatives for the HCAFS may have been demonstrated sufficiently under comparable site conditions such that a treatability study is not required. Treatability studies involving bench-scale laboratory tests to evaluate treatment effectiveness or refine the remedial design may be conducted if these can reduce uncertainties in the FS. Pilot-scale field treatability studies are typically required for less mature technologies for which treatment effectiveness under a wide range of site conditions has not been demonstrated. Pilot-scale treatability studies will be considered and proposed by GEO to USACE only if the costs and time required for conducting such tests will be offset by reduced costs in a full-scale implementation of an immature but innovative technology instead of more conventional treatment methods.

- Select most promising remedial alternatives for a detailed evaluation and comparative analysis using the nine evaluation criteria: overall protection of human health and the environment, compliance with ARARs, long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, cost, state acceptance, and community acceptance.

- Prepare a FS report which documents the remedial action objectives established for the site, the technology screening matrix, and the detailed evaluation of potential technologies. This document will provide the information needed by decision makers to select appropriate remedies for the site.

3.4 PREPARATION OF THE PROPOSED PLAN

The remedy selection process commences at the conclusion of the RI/FS process (Sections 3.1 through 3.3). The elements of this process (prior to remedy implementation) include (EPA 1999):

- Identification of the preferred alternative,
- Proposed plan (PP),
- Public comment,
- Remedy selection,
- Record of Decision (ROD).

A PP will be prepared that briefly describes the remedial alternatives analyzed, present the preferred remedial action alternative, and summarize the information relied upon to select the preferred alternative. The purpose of the PP is to supplement the RI/FS and provide the public with a reasonable opportunity to comment on the preferred alternative for remedial action, as well as alternative plans under consideration, and to participate in the selection of remedial action at a site. The PP shall also provide a summary of any formal comments received from the support agency; and provide a summary explanation of any proposed waiver from an ARAR if applicable.

3.5 PROVIDE DECISION DOCUMENTATION

The final phase of this remedy selection process, the ROD, certifies that the remedy complies with CERCLA, outlines the technical goals of the remedy, provides background information on the site, summarizes the analysis of alternatives, and explains the rationale for the remedy selected (EPA 1999). The outline of the ROD will be as follows:

(A) A description of how the selected remedy is protective of human health and the environment, explaining how the remedy eliminates, reduces, or controls exposures to human and environmental receptors;

(B) A list of federal and state requirements that are applicable or relevant and appropriate to the site that the remedy will attain;

(C) A list of the applicable or relevant and appropriate requirements of other federal and state laws that the remedy will not meet, the waiver invoked, and the justification for invoking the waiver, if applicable;

(D) A description of how the remedy is cost-effective, i.e., explaining how the remedy provides overall effectiveness proportional to its costs;

(E) A description of how the remedy utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and

(F) A discussion on whether the preference for remedies employing treatment which permanently and significantly reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants as a principal element is or is not satisfied by the selected remedy. If this preference is not satisfied, the record of decision must explain why a remedial action involving such reductions in toxicity, mobility, or volume was not selected. The ROD also shall indicate how the achievement of the remedial goals will be measured and how the goals were changed as a response to comments during the public release of the decision and how five year reviews will be achieved for contaminants left in place.

3.6 ADMINISTRATIVE RECORDS

The HCAFS Administrative Record shall be created and the management system updated twice a year. The contents of the Administrative Record will adhere to the requirements of with 40 CFR 300.800-300.825 *Subpart I Administrative Record for Selection of Remedial Response*. The Administrative Records may contain the following types of documents:

(1) Documents containing factual information, data and analysis of the factual information, and data that may form a basis for the selection of a response action. Such documents may include verified sampling data, quality control and quality assurance documentation, chain of custody forms, site inspection reports, preliminary assessment and site evaluation reports, ATSDR health assessments, documents supporting the lead agency's determination of imminent and substantial endangerment, public health evaluations, and technical and engineering evaluations. In addition, for remedial actions, such documents may include approved work plans for the RI/FS, state documentation of applicable or relevant and appropriate requirements, and the RI/FS;

(2) Guidance documents, technical literature, and site-specific policy memoranda that may form a basis for the selection of the response action. Such documents may include guidance on conducting RIs and feasibility studies, guidance on determining applicable or relevant and appropriate requirements, guidance on risk/exposure assessments, engineering handbooks, articles from technical journals, memoranda on the application of a specific regulation to a site, and memoranda on off-site disposal capacity;

(3) Documents received, published, or made available to the public under §300.815 for remedial actions, or §300.820 for removal actions. Such documents may include notice of availability of the administrative record file, community relations plan, PP for remedial action, notices of public comment periods, public comments and information received by the lead agency, and responses to significant comments;

(4) Decision documents. Such documents may include action memoranda and records of decision;

(5) Enforcement orders. Such documents may include administrative orders and consent decrees; and

(6) An index of the documents included in the administrative record file. If documents are customarily grouped together, as with sampling data chain of custody documents, they may be listed as a group in the index to the administrative record file.

4. BASELINE HUMAN HEALTH RISK ASSESSMENT

4.1 INTRODUCTION

An HHRA will be performed as part of the RI (Section 3.1) to document potential human health risks resulting from exposure to contamination in the AOPCs if no remedial action is taken. Thus, this assessment represents the risks for the "no-action" alternative in the FS. Separate assessments will be conducted for each EU as defined in Section 3.1.1 and Figure 3.2. As noted previously, each EU corresponds to one AOPC, except for Coal Storage Area C and the Paint Shed which are combined into one EU.

The methodology to be used in the HHRA will based on various EPA guidance documents and will consist of the following steps as described in the following sections:

Section 4.2: Data evaluation including the screening process used to identify chemicals of potential concern (COPCs).

Section 4.3: Exposure assessment including identification of pathways by which receptors may be exposed to contaminants, and potential intake estimates for the various combinations of receptors and pathways.

Section 4.4: Toxicity assessment, in which the potential for COPCs to cause adverse health effects in exposed individuals is evaluated.

Section 4.5: Risk characterization, in which carcinogenic and non-carcinogenic risks are quantified, chemicals associated with risks exceeding acceptable values are identified as human health chemicals of concern (COCs).

Section 4.6: Assessment of uncertainties associated with the HHRA.

Section 4.7: Derivation of remedial goal options (RGOs) for human health COCs.

4.2 DATA EVALUATION

The purpose of data evaluation is to identify COPCs for each EU which will be carried through the entire risk assessment process, and to eliminate chemicals for which no further risk evaluation will be needed. Data collected from the SI, SSI, and RI will be aggregated by location with respect to EUs (Figure 3.2) and by environmental medium (i.e., surface soil, subsurface soil and groundwater). As noted previously, surface soil is defined as soil from 0 to 1 ft bgs, while subsurface soil is defined as soil coming from depths >1 ft bgs. All of the subsurface soil samples collected during the RI will be obtained from 4-5 ft bgs; the majority of the SI and SSI soil subsurface samples were collected from 4 to 8 ft bgs with a few from 15 to 21 ft; see Table 2.2 and 2.4). According to EPA protocol (EPA 1989), only unfiltered groundwater data are to be used in the HHRA, unless specific problems with unfiltered data are noted (e.g., turbidity problems). If the filtered groundwater samples (using 0.45 μm pore filter size) collected during the RI show significantly lower contaminant concentrations and total solids (e.g, the relative percent difference (RPD) between measurements in paired filtered and unfiltered groundwater samples exceeds the RPD in field duplicates), then it is possible that the elevated contaminant concentrations are associated with particles. If this is the case, use of data from filtered samples for risk assessment will be proposed to CELRL and IEPA for approval.

The data evaluation to identify COPCs for each EU will consist of five steps: (1) a data quality assessment, (2) frequency-of-detection/weight-of-evidence (WOE) screening, (3) screening of essential human nutrients, (4) risk-based screening, and (5) background screening.

4.2.1 Data Quality Assessment

Analytical results reported from the SI, SSI and RI will be loaded into a database. A data set for each EU will then be extracted from the database so that only one result will be used for each station and depth sampled on a given date. Quality control (QC) data, such as sample splits and duplicates, and laboratory re-analyses and dilutions will not be included in the determination of COPCs for this risk assessment. No field screening data will be included in the data set for the risk assessment. Samples rejected in the validation process (i.e., those with a validation qualifier of "R") will also be excluded from the risk assessment.

4.2.2 Frequency-of-Detection/Weight-of-Evidence Screen

Chemicals in each medium for each EU will be evaluated to determine the frequency of detection. Chemicals with a qualifier of "U" or "<" and with reporting limits (RL) < twice the screening criteria (i.e., equivalent to 0.5 x RL < screening criterion) will be considered as undetected in that sample; all other results (i.e., those without a qualifier of "U" or "<", and with RLs > twice the screening criteria) will be considered as detected concentrations. Chemicals that are never detected and with 0.5 x RL < screening criterion will be eliminated from the COPC list for that particular medium.

For chemicals with at least 20 samples within an EU and a frequency of detection of less than 5%, a WOE approach will be used to determine if the chemical is EU-related. The magnitudes and locations (clustering) of the detected concentrations and potential source of the chemical will be evaluated. If the detected results for a given chemical showed no clustering, the concentrations are not substantially elevated relative to the detection limit, and the chemical was not historically used in the area under investigation, the detected results will be considered spurious, and the chemical will be eliminated from the COPC list. This analytical data screen will be applied to all organic and inorganic chemicals.

4.2.2 Essential Nutrients

Chemicals that are considered essential nutrients (i.e., calcium, chloride, iodine, iron, magnesium, potassium, phosphorus, and sodium) are an integral part of the human food supply and are often added to foods as supplements. EPA recommends that these chemicals not be evaluated as COPCs so long as they are (1) present at low concentrations (i.e., only slightly elevated above naturally occurring levels) and (2) toxic at very high doses (i.e., much higher than those that could be associated with contact at the site) (EPA 1989). Recommended daily allowance (RDA) and recommended daily intake (RDI) values are available for seven of these metals and will be used as a point of comparison.

Based on these RDA/RDI values, a receptor ingesting 100 mg of soil per day would receive less than the RDA/RDI of calcium, magnesium, phosphorous, potassium, and sodium, even if the soil consisted of the pure mineral (i.e., soil concentrations > 1,000,000 mg/kg). Receptors ingesting 100 mg of soil per day would require soil concentrations of 1,500 mg/kg of iodine and 100,000 to 180,000 mg/kg of iron to meet their RDA/RDI for these metals. Concentrations of essential nutrients will be evaluated to determine if these levels are exceeded; if these levels are not exceeded in soil, these constituents will not be considered as COPCs in this HHRA.

For groundwater, the Class I groundwater quality standards for total dissolved solids of 1200 mg/L will be used for calcium, magnesium, potassium and sodium, while the screening level for iron is 5 mg/L in accordance with TACO Appendix B Table E. If site groundwater concentrations do not exceed these levels, then the essential nutrient will be eliminated from the COPC list.

4.2.3 Risk-Based Screen

The objective of this evaluation is to identify COPCs that may pose a potentially significant risk to human health. The risk-based screening values used in this process will be conservative values published by EPA. The maximum detected concentration (MDC) of each chemical in each EU/medium will be compared against the appropriate medium-specific and chemical-specific risk-based screening value. Chemicals detected below these concentrations will be eliminated from the COPC list for that EU. Detected chemicals without risk-based screening values will not be eliminated from the COPC list based on this screening step.

Screening of soil and groundwater for the purpose of determining COPCs will be conducted using the following regulations and guidance. Soil contaminants will be compared against the lowest of the TACO Tier 1 residential, industrial, and construction worker remediation objectives, the EPA Regional residential and industrial preliminary remediation goals (PRGs, EPA 2008), and TACO Tier 1 soil component of the groundwater ingestion pathway remediation objectives for Class 1 groundwater. Groundwater contaminants will be compared against the lowest of the TACO Class I groundwater objectives, Illinois drinking water standards, and federal Maximum Contaminant Levels (MCLs). For chemicals without screening values are not available in the above resources, the following web site will consulted: http://www.epa.state.il.us/land/taco/chemicals-not-in-taco-tier-1-tables.html. If a screening level is still unavailable, the Illinois EPA will be consulted for further information. The soil and groundwater screening criteria are provided in Appendix C.

4.2.4 Background Screen

A background screen of surface and subsurface soils, consisting of a comparison of MDCs of each inorganic chemical with, if available, state-wide area background concentrations listed in TACO Subpart 742 Appendix A, Table G will be used in this HHRA. Inorganic chemicals with MDCs below the state-wide area background concentrations will be eliminated from the COPC list and discussed in the uncertainty analysis of the HHRA report.

4.2.5 Summary of Chemical of Potential Concern Screening Approach

The data set used to determine COPCs includes only data from the SI, SSI and RI. COPCs will be determined for surface soil, subsurface soil, and groundwater separately. The following assumptions that will be used in the development of COPCs for the HHRA are noted:

- Chemicals not detected in a medium will be eliminated from the COPC list (with the exception of constituents having reporting limits greater than twice the screening criterion as discussed below).

- Physical chemical data (e.g., alkalinity, pH, etc.) will not be considered to be COPCs for HCAFS.

- Chemicals detected with a frequency of <5% if there are greater than 20 data points will be evaluated with a WOE approach to determine if they can be eliminated from the COPC list.

- Essential nutrients detected at levels below their RDA/RDI-based (for soils) and TACO (for groundwater) screening levels will be eliminated from the COPC list.

- Chemicals detected at levels below their respective risk-based screening levels will be eliminated from the COPC list (with the exception of constituents that were not detected, but had reporting limits greater than twice the risk-based screening levels as discussed below).

- Results of previous background screening for soils will be used. Chemicals that are not significantly different from background will be eliminated from the COPC list.

The COPC screening process and results will be summarized in separate tables for each medium and EU; these tables (one each for surface soil, subsurface soil, and groundwater for each EU) will include

- Summary statistics, including frequency of detection, range of detected concentrations, arithmetic average concentration, and 95% upper confidence limit (UCL_{95}) on the mean concentration;

- All screening values (e.g., TACO criteria, PRGs and essential nutrient concentrations); and

- Final COPC status.

Note that when determining summary statistics for chemicals that have non-detected concentrations, a surrogate concentration of ½ of the reported non-detected concentration will be used in the calculations. Constituents with reporting limits that exceed their respective risk-screening value are special cases that will be evaluated as follows;

- Where the constituent is detected in at least one sample, the maximum detection is compared with screening levels to determine COPC status;

- Where the constituent is not detected;

  - if all RL exceed risk-based criteria then ½ the minimum reporting limit is compared with risk-based criteria to determine COPC status;
  - if any reporting limits are below the risk-based criteria, the constituent is not considered a COPC;

The result of this process is to include constituents that were not detected, but had minimum reporting limits that were in excess of 2 times their respective screening levels, as COPCs (e.g. evaluating constituent at ½ the minimum reporting level versus risk-based criteria).

The HHRA report (part of the RI report) will include a summary table and discussion presenting constituents with laboratory reporting limits that were above respective risk-based screening levels or MCLs. Additionally, summary tables for each EU showing the resulting COPCs across all media will also be presented in the HHRA report (e.g., with rows for each COPC and columns for each medium).

4.3 EXPOSURE ASSESSMENT

The objectives of the exposure assessment are to estimate the magnitude, frequency, and duration of potential human exposure to COPCs. The four primary steps of the exposure assessment are to

1. Identify current and future land use;
2. Identify potentially exposed populations, exposure media, and exposure pathways;
3. Calculate exposure point concentrations; and
4. Estimate each receptor's potential intake of each COPC from each individual medium.

The output of the exposure assessment will be used in conjunction with the output of the toxicity assessment (Section 4.4) to quantify risks and hazards to receptors in the risk characterization (Section 4.5).

4.3.1 Current and Future Land Use

As mentioned in Section 2.1, the HCAFS (excluding the tract occupied by the former Village of Hanna City Water Treatment Plant and tract occupied by the FAA) was used as a correctional facility by IDoC through 2002, and is being considered for transfer to the Peoria County government for use as a special place for inmates with mental illness or as a minimum security prison. Thus, the current use of the land as a correctional facility is expected to continue into the future.

4.3.2 Potentially Exposed Populations, Exposure Media, and Exposure Pathways

The current CSRM presented in Figure 2-3 and Section 2.5 showed potentially exposed populations, environmental media of concern, and exposure pathways. As mentioned previously, environmental media of concern at the HCAFS are surface soil (0-1 ft bgs), subsurface soil (>1 ft bgs), and shallow groundwater (i.e., in unconsolidated sediments overlying bedrock). Of the environmental media that were identified as being potentially contaminated during the SI and SSI, the correctional facility staff and inmates are only likely to be exposed to surface soil (0 to 1 ft bgs) through ingestion, inhalation and dermal contact with air-borne particulates generated from the surface soil. The groundwater pathway from correctional facility staff is also considered possible but unlikely because drinking water for the Hanna City Work Camp was being supplied by the Illinois of America Water Company (TtEC 2008). The groundwater pathway will not be analyzed for the correctional facility staff and inmates.

All pathways are analyzed for the residential receptors in the CSRM to determine risks at the HCAFS under unrestricted land use.

4.3.3 Exposure Point Concentrations

The Reasonable Maximum Exposure (RME) is an estimate of the highest exposure reasonably expected to occur at the each EU at the HCAFS. Because of the uncertainty associated with any estimate of exposure concentration, the upper confidence level (UCL) on the mean will be the recommended statistic for evaluating the RME. The EPA recommended statistical program ProUCL 4.0 (**http://www.epa.gov/esd/tsc/software.htm**) will be used to generate confidence limits on the mean. The exposure point concentration for each constituent in each medium at each EU will be the smaller value between the ProUCL recommended UCL and the maximum detected concentration.

4.3.4 Exposure Parameters and Calculations for Estimating Intakes

Standard intake equations from EPA guidance (EPA 1989; EPA 2004) for ingestion, dermal contact, and inhalation of chemicals (shown below) will be used along with the exposure parameters shown in Table 4-1 and 4.2.

Ingestion of Groundwater

Intakes for drinking water ingestion for groundwater COPCs will be estimated using equation (1):

$$\text{Chemical Intake (mg / kg − day)} = \frac{C_w \times IR_w \times EF \times ED}{BW \times AT}, \quad (1)$$

where

C_w = chemical concentration in water (mg/L),
IR_w = ingestion rate of water (L/day),
EF = exposure frequency (days/year),
ED = exposure duration (years),
BW = body weight (kg),
AT = averaging (days) for carcinogens or noncarcinogens.

Dermal contact with water

The dermal absorbed doses (DADs) from organic chemicals in groundwater will be calculated using equation (2) as follows (EPA 2004):

$$DAD\,(mg / kg - d) = \frac{DA_{event} \times EV \times EF \times ED \times SA}{BW \times AT} \quad (2)$$

where

DAD = dermal absorbed dose (mg/kg-day),

DA_{event} = absorbed dose per event in water (mg/cm^2-event),
EV = event frequency (1 event/day),
EF = exposure frequency (days/year),
ED = exposure duration (years),
SA = surface area of skin exposed (cm^2),
BW = body weight (kg),
AT = averaging time (days) for carcinogens or noncarcinogens.

For organics, DA_{event} (mg/cm^2-event) is calculated as follows:

(1) If $t_{event} \leq t^*$ then:

$DA_{event} = 2\ FA \times K_p \times C_w \times CF \times (6\ \tau_{event} \times t_{event}/\pi)^{1/2}$ and

(2) If $t_{event} > t^*$ then:

$DA_{event} = FA \times K_p \times C_w \times CF\ [\{(t_{event}/(1+B)\} + 2\ \tau_{event}\ \{(1+3B + 3B^2)/(1 + B)^2\}]$

where

DA_{event} = absorbed dose per event in water (mg/cm^2-event),
FA = fraction absorbed in water (chemical-specific, dimensionless),
K_p = permeability constant in water (chemical-specific, cm/hr),
C_w = concentration of chemical in water (mg/L),
CF = conversion factor (10^{-3} L/cm^3),
τ_{even} = lag time per event (chemical-specific, hr/event),
t_{event} = duration of event (hr/event; same value as exposure time),
B = chemical-specific constant reflecting the partitioning properties (dimensionless),
t* = chemical-specific time to reach steady-state (hour).

Values and equations for FA, K_p, t*, and B are from EPA (2004). If a K_p value is not available for an organic COPC, it is calculated using the following empirical predictive equation (EPA 2004):

$$\log\ (K_p) = -2.80 + 0.66\ \log\ (K_{ow}) - 0.0056\ MW$$

where

K_{ow} = octanol/water coefficient (chemical-specific),
MW = molecular weight (g/mole).

For inorganics, DA_{event} was calculated as follows:

$$DA_{event} = K_p \times C_w \times \mathrm{CF} \times t_{event}\ ,$$

where K_p, C_w, CF, and t_{event} are defined as shown above. Note that chemical-specific values for K_p are available from RAGS Part E (EPA 2004) for selected inorganics; if no K_p value was provided, then a default value of 0.001 cm/hr is used for this class of chemicals (EPA 2004).

Ingestion of Soil

Intakes for incidental ingestion of soil will be estimated by using Eq. (3):

$$Chemical\ \ Intake\ \ (mg/kg - day) = \frac{C_S \times IR_S \times EF \times ED \times FI}{BW \times AT}, \qquad (3)$$

where

C_s = chemical concentration in soil (mg/kg),
IR_s = ingestion rate (kg/day),
EF = exposure frequency (days/year),
ED = exposure duration (years),
FI = fraction ingested (assumed value of 1, unitless),
BW = body weight (kg),
AT = averaging time (days) for carcinogens or non-carcinogens.

Dermal Contact with Soil

The dermally absorbed dose (DAD) from chemicals in soil will be calculated using Eq. (4) from EPA 2004.

$$Chemical\ DAD\,(mg/kg-day)=\frac{DA_{event}\times EV\times EF\times ED\times SA}{BW\times AT}, \qquad (4)$$

where

DAD	=	dermal absorbed dose (mg/kg-day),
DA_{event}	=	absorbed dose per event in soil (mg/cm^2-event),
EV	=	event frequency (1 event/day),
EF	=	exposure frequency (days/year),
ED	=	exposure duration (years),
SA	=	surface area of skin exposed (cm^2),
BW	=	body weight (kg),
AT	=	averaging time (days) for carcinogens or non-carcinogens.

DA_{event} (mg/cm^2-event) is calculated as follows for soil COPCs:

$$DA_{event} = C_s \times CF \times AF \times ABS,$$

where

C_s	=	chemical concentration in soil (mg/kg),
CF	=	conversion factor (10^{-6} kg/mg),
AF	=	soil-to-skin adherence factor (mg/cm^2-event),
ABS	=	chemical-specific dermal absorption factor (unitless; see EPA 2004a).

Note that only certain chemicals have a value for the dermal absorption factor (EPA 2004); therefore, the dermal contact with soil pathway is quantified only for these specific COPCs with a value for the dermal absorption factor.

Inhalation of Soil Intake

Intakes for inhalation of soil will be calculated using Eq. (5):

$$Chemical\ Intake\,(mg/kg-day)=\frac{C_s\times IR_a\times EF\times ED\times\left(VF^{-1}+PEF^{-1}\right)}{BW\times AT}, \qquad (5)$$

where

C_s = chemical concentration in soil (mg/kg),
IR_a = inhalation rate (m^3/day),
EF = exposure frequency (days/year),
ED = exposure duration (years),
VF = chemical-specific volatilization factor (m^3/kg; see EPA 1996),
PEF = particulate emission factor (m^3/kg),
BW = body weight (kg),
AT = averaging time (days) for carcinogens or non-carcinogens.

The particulate emission factor (PEF) value used for all receptors (1.56×10^9 m^3/kg) is the calculated value for Chicago, Illinois, assuming a 0.5-acre source area (the default area) using the on-line calculator at **http://risk.lsd.ornl.gov/epa/ssl1.shtml** based on EPA (1996). Note that the chemical-specific volatilization factor (VF) for soil is only applicable for soil COPCs that are volatile organic compounds. For soil COPCs that are not VOCs, the VF^{-1} term in the inhalation equation above is zero.

A table of chemical-specific parameter values (i.e., dermal absorption factors and VFs as appropriate) and their associated references will be provided for all COPCs in the HHRA report (to be included in the RI report).

Table 4-1. Exposure Parameters for Receptors Exposed to Soil at the HCAFS.

Parameter	Units	Correctional Facility Inmate/Staff[a]	Resident Child/Adult[b]
Incidental soil ingestion			
Soil ingestion rate	kg/day	0.0001/0.0001	0.0002 [c] / 0.0001 [c]
Exposure frequency	days/year	365 [d] / 250 [d]	350/350 [c]
Exposure duration	years	15 [d] / 25 [d]	6 [c] / 30 [c]
Body weight	kg	70/70	15 [c] / 70 [c]
Carcinogen averaging time	days	25550/25550 [c]	25550/25550 [c]
Non-carcinogen averaging time	days	5475 [e] / 9125 [e]	2190 [c] / 10950 [c]
Fraction Ingested	unitless	1/1 [d]	1/1 [d]
Dermal contact with soil			
Conversion factor	kg/mg	0.000001/0.000001	0.000001/0.000001
Adherence factor	mg/cm^2-event	0.1/0.1	0.2 [f] / 0.07 [f]
Absorption fraction	unitless	Chemical-specific[g]	Chemical-specific[g]
Skin area	cm^2	5700 [f] / 5700 [f]	2800 [f] / 5700 [f]
Event frequency	events/day	1/1 [f]	1/1 [f]
Exposure frequency	days/year	365 [d] / 250 [d]	350/350 [c]
Exposure duration	years	15 [d] / 25 [d]	6 [c] / 30 [c]
Body weight	kg	70/70	15 [c] / 70 [c]
Carcinogen averaging time	days	25550/25550 [c]	25550/25550 [c]
Non-carcinogen averaging time	days	5475 [e] / 9125 [e]	2190 [c] / 10950 [c]
Inhalation of dust			
Inhalation rate	m^3/day	20/20	10[h] / 20 [c]
Particulate emission factor	m^3/kg	1.36E+09[i]	1.36E+09[i]
Exposure frequency	days/year	365 [d] / 250 [d]	350/350 [c]
Exposure duration	years	15 [d] / 25 [d]	6 [c] / 30 [c]
Body weight	kg	70/70	15 [c] / 70 [c]
Carcinogen averaging time	days	25550/25550 [c]	25550/25550 [c]
Non-carcinogen averaging time	days	5475 [e] / 9125 [e]	2190 [e] / 10950 [e]

[a] Two values shown, first value for the college student and the second value for the college faculty/staff.
[b] Two values shown, first value for the resident child and the second value for the resident adult.
[c] Source: (EPA 1991).
[d] Assumed site-specific value (Correctional Facility Inmate serving a sentence of 15 years based on mean length of stay for capital offense prisoners published by IDOC (http://www.idoc.state.il.us/subsections/reports/statistical_presentation_2004/part2.shtml#2 ; Correctional Facility Staff exposure duration set to exposure duration for industrial worker EPA (1996)).
[e] Definition of non-carcinogenic averaging time (exposure duration in years × 365 days/year).
[f] Source: (EPA 2004a), Exhibit 3-3. Parameter values for commercial/industrial gardener and resident adult gardener will be used for correctional facility inmate/staff and resident adult, respectively.
[g] Dermal absorption fraction to be obtained from Exhibit 3-4 of EPA (2004)
[h] Recommended value from (EPA 1997a) for child age 6-8.
[i] Default value in (EPA 2002).

Table 4-2. Exposure Parameters for Receptors Exposed to Groundwater at the HCAFS.

Parameter	Units	Resident Child/Adult[b]
Ingestion of drinking water		
Water ingestion rate	L/day	1 / 2
Exposure frequency	days/year	350/350 [c]
Exposure duration	years	6 [c] / 30 [c]
Body weight	kg	15 [c] / 70 [c]
Carcinogen averaging time	days	25550/25550 [c]
Noncarcinogen averaging time	days	2190 [c] / 10950 [c]
Dermal contact while showering		
Skin area	cm^2	6,600[d] / 18,000 [d]
Permeability constant	cm/hour	Chemical-specific [d]
Conversion factor	L/cm^3	0.001
Exposure time	hours/day	1.0 / 0.58[d]
Exposure frequency	days/year	350/350 [c]
Exposure duration	years	6 [c] / 30 [c]
Body weight	kg	15 [c] / 70 [c]
Carcinogen averaging time	days	25550 [c]
Noncarcinogen averaging time	days	2190[c] / 10950 [c]

[a] Only receptors under residential land use are potentially exposed to groundwater; drinking water is provided by a public water supply system to the Hanna City Work Camp (Section 2.5).
[b] Two values shown, first value for the resident child and the second value for the resident adult.
[c] Source: (EPA 1991). Definition of non-carcinogenic averaging time (exposure duration in years × 365 days/year).
[d] Source: (EPA 2004).

4.4 TOXICITY ASSESSMENT

The purpose of the toxicity assessment is to evaluate the potential for COPCs to cause adverse health effects in exposed individuals. Where possible, it provides an estimate of the relationship between the intake or dose of a COPC and the likelihood or severity of adverse health effects as a result of that exposure. Toxic effects have been evaluated extensively by EPA, as presented in EPA's *Human Health Toxicity Values in Superfund Risk Assessments* (EPA 2003a), which provides for selection of toxicity values from the following three-tiered hierarchy:

1. Tier 1 – EPA's IRIS (EPA 2007);
2. Tier 2 - EPA Provisional Peer Reviewed Toxicity Values (PPRTVs);
3. Tier 3 - Other toxicity values from additional EPA and non-EPA sources, including California EPA, Agency for Toxic Substances and Disease Registry minimum risk levels, and EPA's Health Effects Assessment Summary Tables (EPA 1997b).

Specific information regarding toxicity values for non-carcinogens and carcinogens are provided below.

4.4.1 Toxicity Information and U.S. Environmental Protection Agency Guidance for Non-Carcinogens

Non-carcinogenic effects are evaluated by comparing an exposure or intake/dose with a reference dose (RfD) or reference concentration (RfC). The RfD and RfCs are determined using available dose-response data for individual chemicals. Scientists determine the exposure concentration or intake/dose below which no adverse effects will be seen and add a safety factor (from 10 to 1,000) to determine the RfD or RfC. RfDs and RfCs are identified by scientific committees supported by EPA. The RfDs available for the COPCs present in the groundwater, surface and subsurface soil at the AOPCs in the HCAFS will be listed in the HHRA report (to be included in the RI report). Toxicity values used in the HHRA will be approved by IEPA and any conversions (i.e. RfCs used to derive inhalation RfDs) will be clearly marked for review (EPA 2003).

Chronic RfDs are developed for protection from long-term exposure to a chemical (from 7 years to a lifetime); subchronic RfDs are used to evaluate short-term exposure (from 2 weeks to 7 years) (EPA 1989). To be protective and conservative, chronic RfDs will be used for all receptors at HCAFS (subchronic RfDs are generally the same or an order of magnitude less conservative as compared to their corresponding chronic RfDs).

Toxic effects are diverse and measured in various target body organs (e.g., they range from eye irritation to kidney or liver damage). EPA is currently reviewing methods for accounting for the difference in severity of effects; however, existing RfDs do not address this issue.

4.4.2 Toxicity Information and U.S. Environmental Protection Agency Guidance for Carcinogens

For carcinogens, risks are estimated as the probability that an individual will develop cancer over a lifetime as a result of exposure to the carcinogen. Cancer risk from exposure to contamination is expressed as excess or incremental cancer risk, which is cancer occurrence in addition to normally expected rates of cancer development. Excess cancer risk will be estimated using a cancer slope factor (CSF). The CSF is defined as a plausible upper-bound estimate of the probability of a response (i.e., cancer) per unit intake of a chemical over a lifetime (EPA 1989). Chemical-specific CSFs used in the evaluation of risk from carcinogenic COPCs will be approved by IEPA and will be listed in the HHRA report (EPA 2003). Values based on conversions will be clearly marked for review.

4.4.3 Estimated Toxicity Values for Dermal Exposure

Oral and inhalation RfDs and CSFs are currently available; however, dermal values are not. Dermal RfDs and CSFs will be estimated from oral toxicity values using chemical-specific gastrointestinal absorption factors (GAFs) to calculate total absorbed dose. This conversion is necessary because most oral RfDs and CSFs are expressed as the amount of chemical administered per time and body weight; however, dermal exposure is expressed as an absorbed dose. Dermal toxicity factors will be calculated from oral toxicity factors as shown in Equations 7 and 8 below (EPA 2004a):

$$RfD_{dermal} = RfD_{oral} \times GAF \qquad (6)$$

$$CSF_{dermal} = CSF_{oral}/GAF \qquad (7)$$

Chemical-specific GAF values available from EPA (2004a) will be used whenever possible. Note, however, that some COPCs may not have GAF values provided in EPA (2004a). When quantitative data are insufficient, a default GAF value of 1.0 for organic and inorganic chemicals will be used (EPA 2004a). Per EPA guidance (EPA 2004a), dermal CSFs and RfDs are estimated from the oral toxicity values using chemical-specific GAFs to calculate the total absorbed dose only for chemicals with GAF values <0.5 (i.e., for chemicals with GAF values between 0.5 and 1, oral toxicity values are used to evaluate the dermal pathway). The chemical-specific GAFs and resulting dermal toxicity values will be shown in the HHRA report.

4.4.4 Assumptions Used in the Toxicity Assessment

The HHRA may include a COPC that does not currently have a toxicity value, but another chemical that is similar might have approved toxicity values. In these cases, toxicity values from a chemical with similar toxicological properties may be used as a surrogate. Some examples are provided below (the list is shown as an example only).

Chromium will be conservatively evaluated using toxicity values for hexavalent chromium, the most toxic form of chromium.

Benzo(*ghi*)perylene and phenanthrene will be evaluated in this HHRA using toxicity values for pyrene.

As recommended by EPA (1993) *Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons* (EPA 1993), toxicity equivalency factors (TEFs) will be applied to carcinogenic polycyclic aromatic hydrocarbons (cPAHs). The following TEFs (from EPA 1993) should be used to convert the cPAHs identified as COPCs to an equivalent concentration of benzo(*a*)pyrene.

cPAH	TEF
Benzo(*a*)pyrene	1
Benzo(*a*)anthracene	0.1
Benzo(*b*)fluoranthene	0.1
Benzo(*k*)fluoranthene	0.01
Chrysene	0.001
Dibenzo(*a,h*)anthracene	1
Indeno(*1,2,3-c,d*)pyrene	0.1

If other chemical-specific surrogate toxicity values are used, they will be discussed with Illinois EPA prior to use and will be listed in the HHRA.

4.4.5 Chemicals without U.S. Environmental Protection Agency Toxicity Values

Some COPCs at the HCAFS may not have RfDs or CSFs because the non-carcinogenic and/or carcinogenic effects of these chemicals have not yet been determined. Although these chemicals may contribute to health effects from exposure to contaminated media at the AOPCs, their effects may not be quantified at the present time. COPCs that fall into this category will be listed and discussed in the HHRA.

In the event that lead is a COPC, EPA currently recommends two models, depending upon the age of the receptor population. For children, exposure assessments will be performed using the Integrated Exposure Uptake Biokinetic Model for Lead in Children (EPA 2005). For adults, the Adult Lead Model should be used (EPA 1996). Site-specific data will be used as input to these models to obtain predictions of blood lead concentrations. The U.S. Centers for Disease Control has identified 10 µg/dL as the blood level of concern above which significant health risks occur.

4.5 RISK CHARACTERIZATION

The purpose of the risk characterization is to integrate the information obtained through the exposure and toxicity assessments to estimate potential risks and hazards. Potential carcinogenic effects are characterized by using projected intakes and chemical-specific, dose-response data (i.e., CSFs) to estimate the probability that an individual will develop cancer over a lifetime. Potential non-carcinogenic effects will be characterized by comparing projected intakes of contaminants to toxicity values (i.e., RfDs). The numerical risk and hazard estimates presented in the HHRA must be interpreted in the context of the uncertainties and assumptions associated with the risk assessment process and with the data upon which the risk estimates are based.

4.5.1 Risk characterization for carcinogens

For carcinogens, risk is expressed as the probability that an individual will develop cancer over a lifetime as a result of exposure to the carcinogen. Cancer risk from exposure to contamination is expressed as the incremental lifetime cancer risk (ILCR), or the increased chance of cancer above the normal background rate of cancer. In the United States, the background chance of contracting cancer will be a little more than 3 in 10, or 3×10^{-1} (American Cancer Society 2006). The calculated ILCRs will be compared to the range specified in the National Oil and Hazardous Substances Pollution Contingency Plan of $1x10^{-4}$ to $1x10^{-6}$, or 1-in-10,000 to 1-in-1,000,000 exposed persons developing an excess cancer (EPA 1990).

The ILCR for each EU/medium/carcinogenic COPC will be calculated using the equation below (EPA 1989):

$$ILCR = I \times CSF \qquad (8)$$

where

I = chronic daily intake or DAD calculated in the exposure assessment (mg/kg-d),
CSF = cancer slope factor $(mg/kg\text{-}d)^{-1}$.

For a given exposure pathway from each EU, the total risk to a receptor exposed to several carcinogenic COPCs is the sum of the ILCRs for each carcinogen, as shown in Equation 10 below:

$$ILCR_{total} = \Sigma ILCR_i \qquad (9)$$

where

$ILCR_{total}$ = total probability of cancer incidence associated with all carcinogenic COPCs,
$ILCR_i$ = ILCR for the i^{th} COPC.

In addition to summing risks across all carcinogenic COPCs, risks will be summed across all exposure pathways for a given environmental medium (e.g., ingestion, inhalation, and dermal contact with surface soil). Per EPA (1989) guidance, "There will be two steps required to determine whether risks or hazard indices for two or more pathways should be combined for a single exposed individual or group of individuals. The first will be to identify reasonable exposure pathway combinations. The second will be to examine whether it will be likely that the same individuals would consistently face the "reasonable maximum exposure" (RME) by more than one pathway." It is reasonable to assume that the same individual may be exposed at the RME level by multiple pathways to a given exposure medium.

4.5.2 Risk Characterization for Non-Carcinogens

In addition to developing cancer from exposure to contaminants, an individual may experience other toxic effects. The term "toxic effects" is used here to describe a wide variety of systemic effects ranging from minor irritations, such as eye irritation and headaches, to more substantial effects, such as kidney or liver disease and neurological damage. The risks associated with toxic (i.e., non-carcinogenic) chemicals will be evaluated by comparing an estimated exposure (i.e., intake or dose) from site media to an acceptable exposure expressed as an RfD. The RfD is the threshold level below which no toxic effects is expected to occur in a population, including sensitive subpopulations. The ratio of intake over the RfD is the HQ (EPA 1989) and will be calculated as:

$$HQ = I/RfD \qquad (11)$$

where

I = daily intake or DAD of a COPC (mg/kg-d),
RfD = reference dose (mg/kg-d).

The HQs for each COPC/EU will be summed to obtain a hazard index (HI) for an EU, as shown below:

$$HI = \Sigma HQ_i \qquad (12)$$

where

HI = hazard index for all toxic effects,
HQ_i = hazard quotient for the i^{th} COPC.

An HI greater than 1 has been defined as the level of concern for potential adverse non-carcinogenic health effects (EPA 1989). This approach differs from the probabilistic approach used to evaluate carcinogens. An HQ of 0.01 does not imply a 1-in-100 chance of an adverse effect but indicates only that the estimated intake will be 100 times less than the threshold level at which adverse health effects may occur. In addition to summing hazards across all COPCs, hazards will be summed across all exposure pathways for a given environmental medium.

Note that HIs are determined by assuming dose additivity for those constituents acting by the same mechanism and inducing the same effects (EPA 1989). Initially, all of the COPCs are assumed to have the same mechanism of toxicity. If the HI (across all COPCs) is below 1.0, then all target organ-specific HIs will also be below 1.0. If the HI exceeds 1.0, then HIs are calculated for each target organ. This approach provides a more accurate estimation of the potential systemic toxicity associated with exposure to the constituent mixture.

4.5.3 Identification of chemicals of concern

Carcinogenic COCs are defined for each media as those contaminants that have a total ILCR greater than 1×10^{-6} for a receptor in this HHRA. Non-carcinogenic COCs are defined for each media as those contaminants that produce an HI > 1.0 for a receptor in this HHRA.

4.5.4 Results

Risks and HQs for each EU at HCAFS will be quantified for surface soil (0 to 1 ft bgs) and groundwater COPCs for the correctional facility inmate, correctional facility staff, resident adult, and resident child. Risks and HQs will be quantified for each EU for subsurface soil (>1 ft bgs) COPCs for the Resident Adult and Resident Child only.

Detailed risk and hazard results for each receptor from each EU will be presented in the HHRA, and COCs will be identified on the tables that present the risk and hazard results. The results for each medium/receptor will be discussed, including a statement as to whether the total risks are above or below the target range of $1x10^{-4}$ to $1x10^{-6}$, and below the target organ-specific hazard of 1.0. A discussion of the significance of all identified COCs will be included. A summary table displaying total risks and hazards across all COPCs for each receptor/medium/EU combination will also be shown in the HHRA.

4.6 UNCERTAINTY ANALYSIS

Uncertainties associated with each step of the risk assessment process will be discussed in the HHRA, where possible. Uncertainties include those associated with the data evaluation process, exposure assessment, toxicity assessment and risk characterization. The uncertainty analysis will focus on site-specific factors that influence uncertainty such as land-use and data quality issues.

4.7 REMEDIAL GOAL OPTIONS

To support the remedial alternative selection process, RGOs will be developed for all chemicals identified as COCs in this HHRA. RGOs will be calculated using the methodology presented in EPA (1991) while incorporating site-specific exposure parameters applicable to the HCAFS (Table 4-1 and 4-

2). RGOs will be risk-based concentrations that may be considered in an FS to define the extent of contamination that must be remediated and help cost various alternatives. RGOs will be media- and chemical-specific concentrations and will be calculated for all COCs identified for any of the four receptors exposed to surface soil, subsurface soil and groundwater. The RGOs will be protective of human health and may or may not be protective of ecological receptors. The process for calculating RGOs for this HHRA utilizes the cancer risk or non-cancer hazard equations, rearranged to provide the concentration of a COC that will produce a specific risk or HQ.

Exposure to multiple COCs may require downward adjustment of the target risk and target HQ used to calculate final remedial levels. The target risk and target HQ will depend on several factors, including the number of carcinogenic and non-carcinogenic COCs and the target organs and toxic endpoints of these COCs. In any case, the RGOs will be based on target risks and hazards such that the cumulative exposure to an individual receptor will not exceed the target ILCR of 1E-6 and an HI of 1.

As discussed in previously, the cancer risk and non-cancer HQ are calculated as

$$\text{Risk} = (\text{Intake}) \times (\text{CSF}) \qquad (13)$$

and

$$\text{HQ} = (\text{Intake}) / (\text{RfD}). \qquad (14)$$

The pathway-specific (e.g., soil ingestion) equations for intake are provided in Section 4.3. Note that all intake equations shown in Section 4.3 include a concentration term multiplied by several other exposure parameters.

To obtain the RGO for a specific risk level (e.g., 10^{-6}), the risk equation is rearranged so that the equation is solved for Cs, the soil concentration term. Similarly, to obtain the RGO for a specific hazard level (e.g., 1.0), the hazard equation is rearranged so that the equation is solved for the concentration term.

The equations below are presented as an example for the soil ingestion pathway. Note that by using the soil ingestion intake equation from Section 4.3 and the general risk equation from Section 4.5, the risk from ingestion of soil is calculated as

$$\text{Risk}_{ing(soil)} = (C_s \times IR_s \times EF \times ED \times FI \times CSF) / (BW \times AT). \qquad (15)$$

To obtain the RGO at the 10^{-6} risk level for the ingestion of soil, a value of 10^{-6} is substituted in the equation above for $\text{Risk}_{ing(soil)}$, and the equation is rearranged to solve for C_s. Thus, the general RGO equation at the 10^{-6} risk level for the ingestion of soil is calculated as

$$\text{RGO}_{ing(soil)} \text{ at } 10^{-6} = (10^{-5} \times BW \times AT) / (IR_s \times EF \times ED \times FI \times CSF). \qquad (16)$$

A similar rearrangement of the ingestion of soil hazard equation is made, producing the general RGO equation for a 1.0 HQ for this pathway/medium:

$$\text{RGO}_{ing(soil)} \text{ at } 1.0 = (1.0 \times BW \times AT \times RfD) / (IR_s \times EF \times ED \times FI). \qquad (17)$$

For this HHRA, RGOs will be calculated for each exposure route (e.g., ingestion), as well as for the total chemical risk or hazard across all appropriate exposure routes. Carcinogenic RGOs will be calculated and presented in this HHRA at a target risk (TR) level of 10^{-6}. To obtain the carcinogenic RGO at another risk level, one should adjust the RGO at 10^{-6} accordingly, taking care to check the resulting concentration against the physical limits and maximum possible soil concentrations discussed above (e.g., 1.0E+06 mg/kg). For example, to obtain the RGO at the 10^{-5} risk level, one should multiply the RGO at the 10^{-6} risk level by 10 (and then check the result to ensure that the concentration will be physically possible). Non-carcinogenic RGOs will be calculated and presented in this HHRA for a target hazard quotient (THQ) of 1.0. To find the non-carcinogenic RGO for another HQ, one should adjust the RGO for a 1.0 HQ accordingly, taking care to check the resulting concentration against the physical limits discussed above (e.g., 1.0E+06 mg/kg). For example, to obtain the RGO for a HQ of 3.0, one should multiply the RGO for a 1.0 HQ by 3 (and then check the result to ensure that the concentration will be physically possible).

RGOs for all COCs in surface soil, subsurface soil and groundwater will be provided in tables. The HHRA will note where the EPC for a given COC is smaller than the most conservative (i.e., smallest) RGO across all pathways (the RGO based on a TR of 10^{-6} or based on a THQ of 1.0). The HHRA will also note where EPCs are below background levels.

4.8 SUMMARY AND CONCLUSIONS

A summary and conclusions will be included in the HHRA section of the RI report to summarize which media and receptors were evaluated at the AOPCs in the HCAFS, and list the major steps that were taken to generate conclusions regarding human health risks and hazards associated with contaminated media at HCAFS.

A brief summary of the risks and hazards will be presented, noting which chemicals were determined to be COCs for each AOPC/EU.

5. SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

5.1 INTRODUCTION AND SCOPE OF THE SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

The purpose of this section is to document the methods and assumptions that will be used in conducting a SLERA at the HCAFS. The scope covers EPA steps 1 through 2 (EPA 1997). In the SLERA, the soil data previously obtained during the SI and SSI, and soil data to be collected during the RI field activities will be used.

The outline of work for the SLERA consists of the following (EPA 1997):

1. Screening Level Problem Formulation: This involves defining the goal and breadth of the SLERA, with attention to how the ecological field reconnaissance findings and chemical data are used to define the environmental setting and contaminants of potential ecological concern (COPECs), mechanisms of ecotoxicity and potential ecological receptors, identification of complete exposure pathways, and selection of assessment endpoints.
2. Screening Level Ecological Effects Evaluation: This involves the selection of toxicity reference values (TRV) for each COPEC from the open literature which will be protective of communities and groups of organisms that are relevant to the HCAFS.
3. Screening Level Exposure Estimates: This involves estimating exposure levels for each generic assessment endpoint using chemical data and EPA-recommended exposure assumptions (e.g., EPA 1993b).
4. Screening Level Risk Calculation: This involves calculation of environmental hazard quotients (EHQ) from the estimated exposure levels and TRVs for each COPEC and generic assessment endpoint.

Details regarding the Screening Level Problem Formulation are presented in Section 5.2, while the Screening Level Ecological Effects Evaluation, Exposure Estimates and Risk Calculation steps are described in Section 5.3. Uncertainty and weight of evidence assessment are described in Section 5.4. Methods and results of the SLERA will be included in the RI report.

5.2 SCREENING LEVEL PROBLEM FORMULATION AND ECOLOGICAL EFFECTS EVALUATION

Problem formulation involves documenting the habitats and wildlife at the HCAFS. Problem formulation also includes determining if those resources could be at risk or in harm's way. Data evaluation involves evaluating the suitability of the chemical concentration data and organizing that chemical concentration data to reflect where organisms could be exposed, and selection of COPECs.

5.2.1 Ecological Site Reconnaissance and Determination of Assessment Endpoints

The purpose of the ecological site reconnaissance is to document habitats and any observed wildlife within the HCAFS (property boundary in Figure 1.2) and identifying any designated wetlands and any critical or sensitive habitat for threatened and endangered species. The form to use in this on-site work is found in USACE (1996) and is included in Appendix D. The location of any identified wetlands or habitats relative to the AOPCs (Figure 1-2) will be documented, as well as plants, animals, or groups of plants and animals that may be adversely affected by contaminants present at the site. In addition to habitats and species potentially present at the site, the completed site reconnaissance form and previous investigation reports (SI and SSI) will provide information needed to identify exposure pathways to potential ecological receptors. The CESRM (Figure 2-4) will be updated based on the findings from the site reconnaissance.

Once it is established that ecological resources are present, assessment endpoints will be identified. Assessment endpoints are explicit expressions of the actual environmental value to be protected, with special consideration given to ecological relevance, regulatory policy goals, societal values and susceptibility to COPECs. Based on the terrestrial nature of the AOPCs within the HCAFS, the environmental management goal will likely be the protection terrestrial populations, communities and ecosystems, with the following possible assessment endpoints:

1. Growth, survival, and reproduction of plant and soil invertebrate communities and concentrations of contaminants in their tissues at low enough such that higher trophic levels that consume them are not at risk. (Receptors: plants and earthworms).
2. Growth, survival, and reproduction of herbivorous mammal populations, and concentrations of contaminants in their tissues low enough such that higher trophic animals that consume them are not at risk. (Receptor: cottontail rabbits)
3. Growth, survival, and reproduction of worm-eating and insectivorous mammal and bird populations and concentrations of contaminants in their tissues at low enough such that higher trophic levels that consume them are not at risk. (Receptors: shrews and robins)
4. Growth, survival, and reproduction of carnivorous mammal and bird populations. (Receptors: red fox and red-tailed hawk).

5.2.2 Data Evaluation and Aggregation

As mentioned in Section 2.5, surface soil (0-0.5 ft) and subsurface soil (> 0.5 ft) are the media of concern for ecological risk at the HCAFS (Section 2.5). The soil data will be evaluated as explained in the data evaluation section of the human health risk assessment (Section 4.2). There will be one exposure unit covering the entire ~43 acre site. The SLERA EU is not the same as the HHRA EUs (Figure 3-1) because there are no reasons for subdividing the site into smaller units with respect to ecological receptors. Vertically, this unit will consist of two soil horizons: 0- to 0.5-ft depth (surface) and 0.5 ft to 3 ft depth (subsurface). Thus, soil data collected during the SI, SSI, and RI will be grouped according to these two soil horizons based on the depth from which the samples were collected. A standard statistical profile will be computed to show the frequency of detection, sample size, and the minimum, maximum, and mean concentrations. The handling of non-detected chemicals and other data-oriented activities and assumptions is discussed in the section of data management for human health risk (Section 4.2).

5.2.3 Ecological Screening Values and Identification of Contaminants of Potential Ecological Concern

Ecological screening values (ESVs) will be the lowest value from the following sources:

- Oak Ridge National Laboratory (ORNL) soil benchmarks (http://www.esd.ornl.gov/programs/ecorisk/benchmark_reports.html)
- USEPA Ecological Soil Screening Levels (EcoSSLs; http://www.epa.gov/ecotox/ecossl/)
- USEPA Region 5 Ecological Screening Levels (http://www.epa.gov/reg5rcra/ca/edql.htm)

The ESVs for PAHs and metals are provided in Appendix C. A chemical is eliminated from the COPEC list for a data group (surface or subsurface soil) under one of the following conditions:

- The chemical is not detected, and the RL for the chemical is less than twice the ESV,
- The maximum value is less than the ESV, or
- There are more than 20 samples and the detection frequency is less than 5%, and the RL for the chemical is less than twice the ESV.

A chemical for a data group is considered a COPEC under one of the following conditions:

- The chemical is not detected but the RL is greater than twice the ESV, or
- The maximum value is greater than the ESV.

Persistent, bioaccumulative, and toxic (PBT) chemicals, even if they are present at concentrations below ESVs will be retained as COPECs. The PBT compounds present at the HCAFs include mercury and PAHs; although PAHs are not considered by IEPA as PBTs, these are listed in EPA's final rule regarding PBTs (EPA 1999).

The USACE has a step to determine if the chemical is a site-related chemical. This list of any exempt chemicals will be supplied by USACE. Chemicals not used in the previous activities at the site can be eliminated. Chemicals used in previous activities at the site can also be eliminated through the other screening steps as described above.

If ecological resources were identified at the HCAFS during the site reconnaissance but none of chemicals present at the site were identified as COPECs, then the SLERA will be considered and no further assessment will be performed. Otherwise, the SLERA will proceed to the next steps as described in the following section.

5.3 SCREENING-LEVEL ECOLOGICAL EFFECTS EVALUATION, EXPOSURE ESTIMATES AND RISK CHARACTERIZATION

The potential assessment endpoints for the HCAFS listed above are shown in Table 5-1. This table also shows the sources for selecting TRVs for each of these potential endpoints, as well as the overall procedure for estimating exposure. Risk characterization will follow the hazard quotient approach; if the ecological hazard quotient (EHQ), which is based on the ratio between estimated exposure and TRV for a given chemical and ecological receptor, is less than 1 then assessment end point has been met. The EHQs and decisions rules for each assessment endpoint are presented in Table 5-1.

Table 5-1 Summary of potential assessment endpoints with corresponding measures of ecological effect, estimation of exposures, calculation of hazard quotients, and scientific/management decision points for the HCAFS.

Potential Assessment Endpoint	Measure of Ecological Effect	Exposure Estimate	Ecological Hazard Quotient and Decision Rule (Scientific/Management Decision Process)
1. Growth, survival, and reproduction of plant and soil invertebrate communities and concentrations of contaminants in their tissues at low enough such that higher trophic levels that consume them are not at risk. (Receptors: plants and earthworms).	Plant and earthwork soil toxicity benchmarks	Reasonable Maximum Exposure (RME) concentrations of COPEC in soil	If EHQ, defined as the ratios of COPEC RME concentrations in surface (and subsurface) soil to toxicity reference value (TRV) for adverse effects on plants and soil invertebrates, are less than or equal to 1, then Assessment Endpoint 1 has been met and plants and earthworms are not at risk. If the EHQs > 1, a scientific management decision point (SMDP) has been reached, at which it will be necessary to decide whether no further action, risk management of ecological resources, monitoring of the environment, further investigation or remediation is needed for the communities of plants and soil invertebrates.
2. Growth, survival, and reproduction of herbivorous mammal populations, and concentrations of contaminants in their tissues low enough such that higher trophic animals that consume them are not at risk. (Receptor: cottontail rabbits)	Chronic dietary No Observable Adverse Effect Level (NOAEL) applicable to wildlife receptors based on measured responses of similar species in laboratory studies.	Estimates of receptor home range area, body weights, feeding rates, and dietary composition, based on published measurements of endpoint species or similar species; modeled COPEC concentrations in food chain based on measured concentrations in physical media.	If EHG, defined as the ratios of estimated exposure concentrations predicted from COPEC RME concentrations in surface (and subsurface if applicable) soil to dietary limits corresponding to NOAEL TRV benchmarks for adverse effects on herbivorous mammals are less than or equal to 1, Assessment Endpoint 2 is met and the receptors are not at risk. If the EHQs > 1, a scientific management decision point (SMDP) has been reached, at which it will be necessary to decide whether no further action, risk management of ecological resources, monitoring of the environment, further investigation, or remediation is needed for populations of insectivorous mammals and birds.

** continued next page**

Table 5-1 (continued) Summary of potential assessment endpoints with corresponding measures of ecological effect, estimation of exposures, calculation of hazard quotients, and scientific/management decision points for the HCAFS.

Potential Assessment Endpoint	Measure of Ecological Effect	Exposure Estimate	Environmental Hazard Quotient and Decision Rule (Scientific/Management Decision Process)
3. Growth, survival, and reproduction of worm-eating and insectivorous mammal and bird populations and concentrations of contaminants in their tissues at low enough such that higher trophic levels that consume them are not at risk. (Receptors: shrews and robins)	Chronic dietary No Observable Adverse Effect Level (NOAEL) applicable to wildlife receptors based on measured responses of similar species in laboratory studies.	Estimates of receptor home range area, body weights, feeding rates, and dietary composition, based on published measurements of endpoint species or similar species; modeled COPEC concentrations in food chain based on measured concentrations in physical media.	If EHQs based on ratios of estimated exposure concentrations predicted from COPEC RME concentrations in surface soil to dietary limits corresponding to NOAEL TRV benchmarks for adverse effects on worm-eating and insectivorous mammals and birds is less than or equal to 1, then Assessment Endpoint 3 is met, and these receptors are not at risk. If the HQs are >1, a SMDP has been reached, at which it will be necessary to decide whether no further action, risk management of ecological resources, monitoring of the environment, further investigation, or remediation of applicable media is needed to for populations of insectivorous mammals and birds.
4. Growth, survival, and reproduction of carnivorous mammal and bird populations. (Receptors: red fox and red-tailed hawk)	Chronic dietary No Observable Adverse Effect Level (NOAEL) applicable to wildlife receptors based on measured responses of similar species in laboratory studies.	Estimates of receptor home range area, body weights, feeding rates, and dietary composition, based on published measurements of endpoint species or similar species; modeled COPEC concentrations in food chain based on measured concentrations in physical media.	If EHQs based on ratios of estimated exposure concentrations predicted from COPEC RME concentrations in surface soil to dietary limits corresponding to NOAEL TRV benchmarks for adverse effects on carnivorous mammals and birds are less than or equal to 1, then Assessment Endpoint 4 is met, and the receptors are not at risk. If the HQs are >1, a SMDP has been reached, at which it will be necessary to decide whether no further action, risk management of ecological resources, monitoring of the environment, further investigation, or remediation of applicable media is needed for populations of carnivorous mammals and birds.

5.4 UNCERTAINTY AND WEIGHT OF EVIDENCE ASSESSMENT

Uncertainties in the SLERA will include uncertainties in the screening-level problem formulation, screening-level ecological effects assessment, screening-level exposure estimate, and screening-level risk characterization. In each of the steps, the major uncertainties will be identified and discussed in the SLERA report (part of the RI report).

Weight-of-evidence (WOE) is the technical process of gathering, organizing, and evaluating various types and qualities of environmental information about the plants and animals living in the HCAFS. Throughout, there is an attempt to understand the context of any exceedances (ESV greater than estimated exposure concentration, and EHQ > 1), based on the various pieces of evidence. The WOE assessment also aims to extend the separate findings towards the holistic view of risk management. Thus, there are elements beyond the purely technical world of just risk assessment. For example, in the WOE assessment such topics are evaluated as land use and comparison of chemical risk and remedial action or physical risk. Anticipated WOE elements are:

1. Presence of functioning on-site ecosystems
2. No significant or unique ecological resources
3. Future commercial/industrial land use likely
4. Trade-off of physical habitat alteration/destruction to reduce risk from chemicals
5. Automatic protection of ecological resources from human health-driven remediation.

Together, these elements provide a holistic view and understanding of the ecological risk at the HCAFS.

5.5 SUMMARY AND CONCLUSIONS

A summary and conclusions will be included in the SLERA section of the RI report to summarize the findings of the ecological site reconnaissance, ecological resources identified at the HCAFS, potential ecological resources and assessment endpoints, list of COPECs, and COPECs for which ecological risks are indicated (i.e., EHQ > 1). The results of the SLERA will determine whether further investigation is warranted to better quantify ecological risks at the HCAFS.

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APPENDICES

APPENDIX A

Figures

Base maps: Google Earth
Coordinate System: Illinois State Plane East-feet, NAD83. Scale 1:6,000

Figure 1-1 Site vicinity map for former Hanna City Air Force Station site

U.S. Army Corps of Engineers
Louisville District

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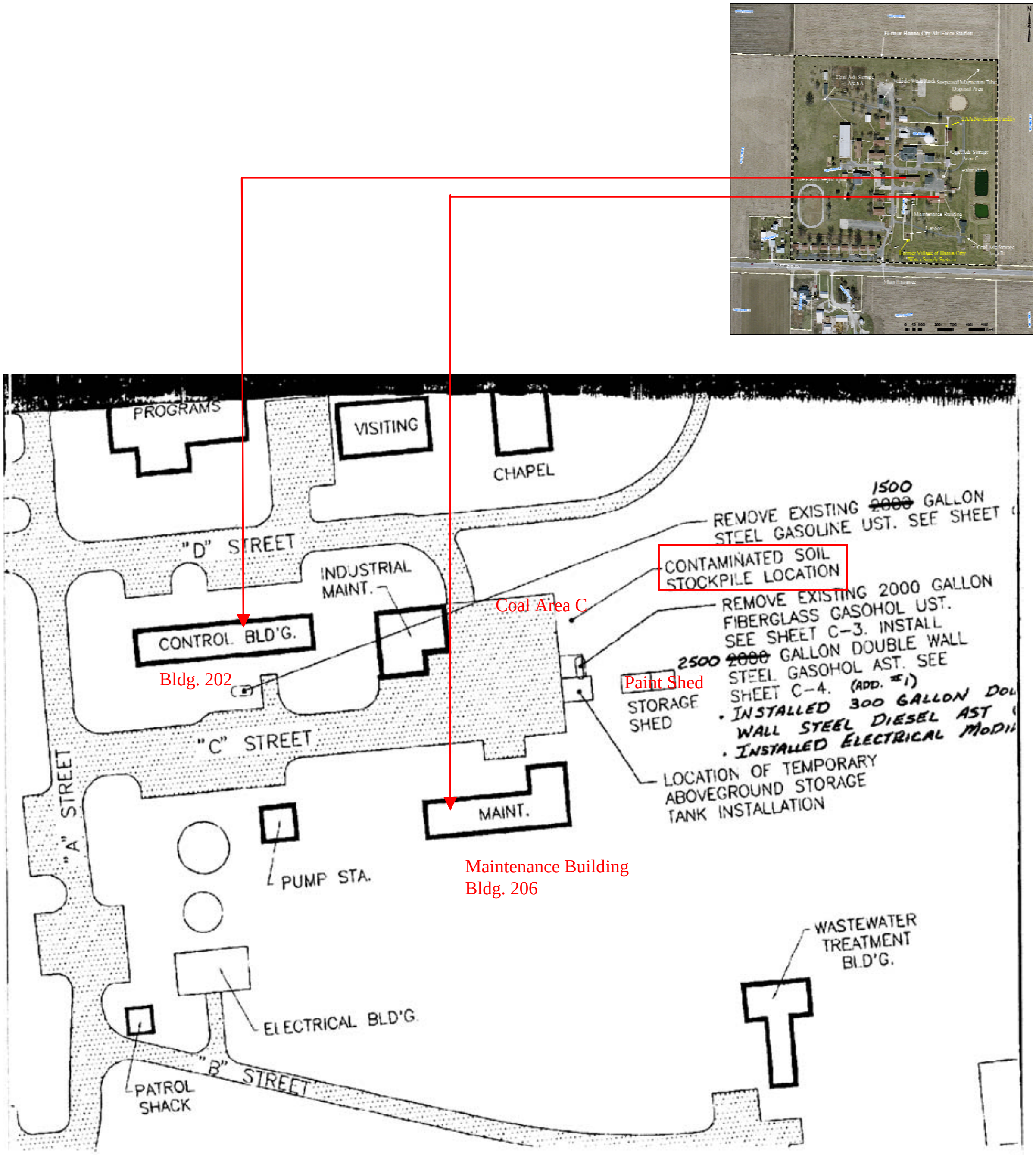
Former Hanna City Air Force Station Hanna City, Illinois

Areas (white text), building numbers (black text) are based on the HCAFS site layout drawing from TtEC (2008).
Former UST locations based on documents from IEPA L.U.S.T. program for LPC#1430405005.
Areas of Potential Concern are the Coal Ash Storage Areas A,B,C; Main Entrance; Vehicle Wash Rack; Maintenance Building and Paint Shed. These areas are marked by bright green circles.

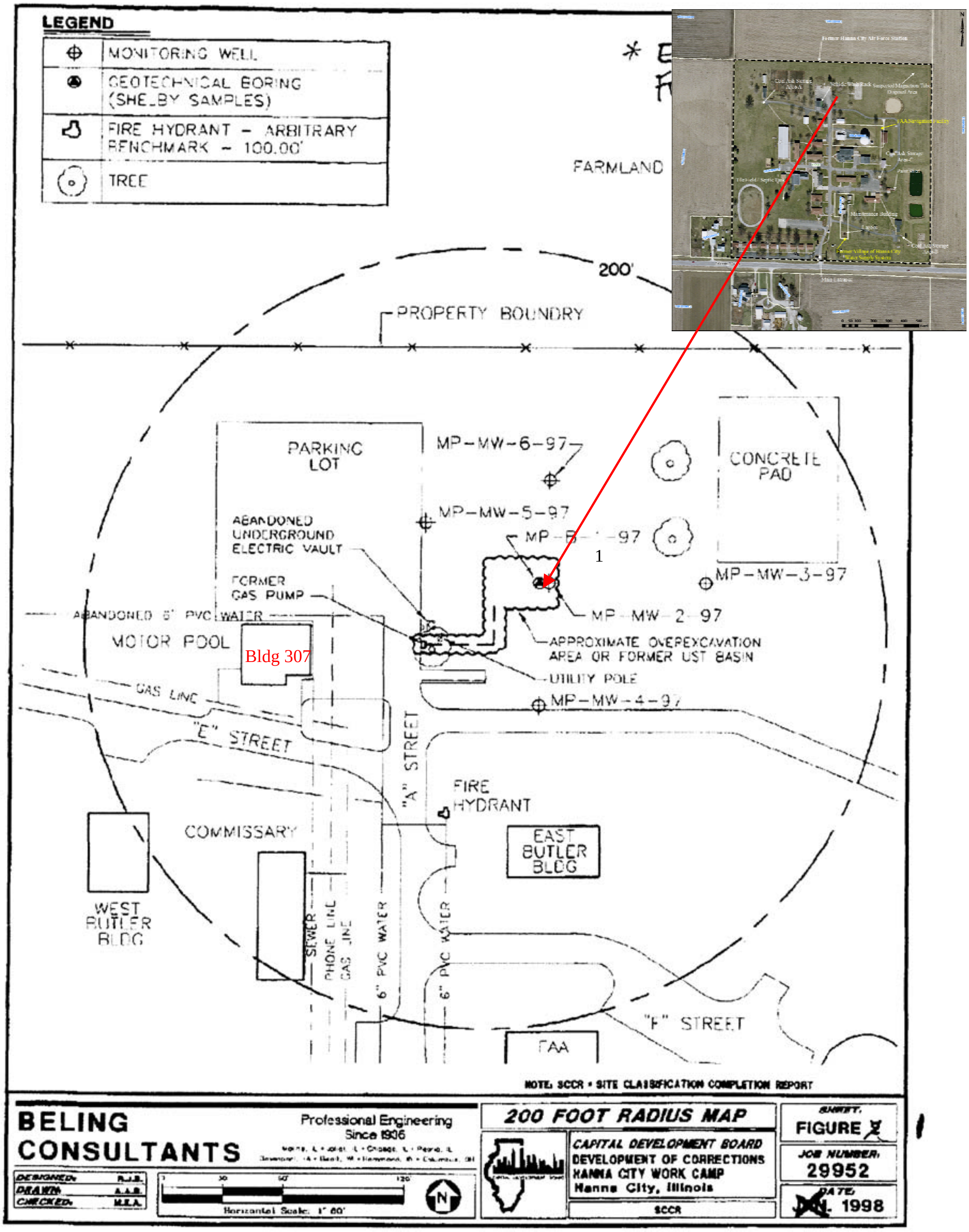
Aerial photo from Peoria County GIS, 2003.

Former Hanna City Air Force Station Hanna City, Illinois	Figure 1-2. Historical and Current Site Layout, Former Hanna City Air Force Station, Hanna City, IL
U.S. Army Corps of Engineers Louisville District	GEO Consultants, LLC *A Geological Engineering and Environmental Services Company* Kevil, Kentucky



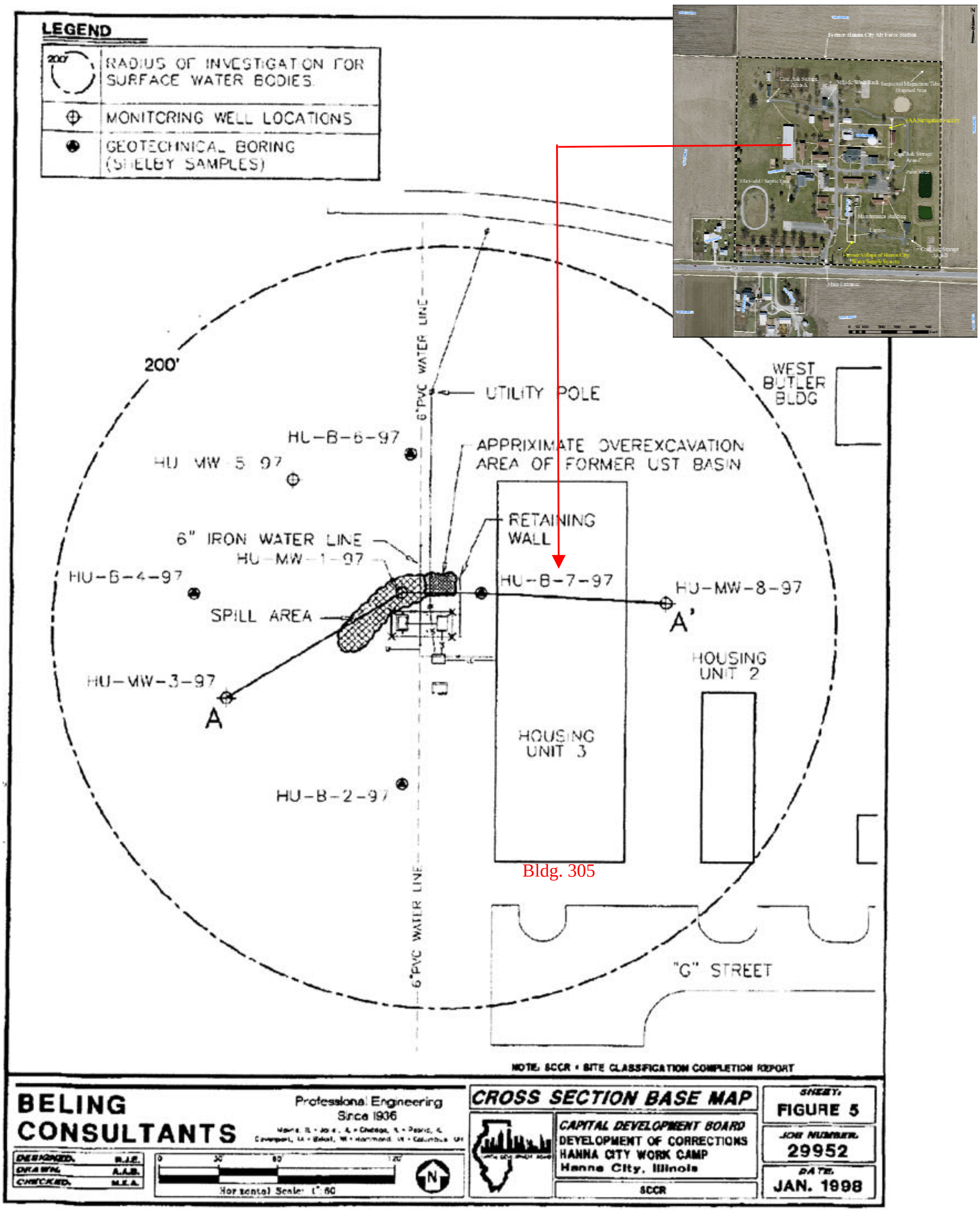
Map excerpt reproduced from 45-day Report Amendment, Hanna City Work Camp (Beling 1998a)

Former Hanna City Air Force Station **Hanna City, Illinois**	**Figure 2-1. Former UST locations near Control Building/Bldg. 202 and Maintenance Building/Bldg 206.**
U.S. Army Corps of Engineers **Louisville District**	**GEO Consultants, LLC** *A Geological Engineering and Environmental Services Company* Kevil, Kentucky



Reproduced from Site Classification Completion Report, Hanna City Work Camp (Beling 1998b)

Former Hanna City Air Force Station **Hanna City, Illinois**	**Figure 2-2. Former UST location, boreholes, and monitoring wells near Bldg. 307/Motor Pool/Vehicle Wash Rack AOC.**
U.S. Army Corps of Engineers **Louisville District**	**GEO Consultants, LLC** *A Geological Engineering and Environmental Services Company* Kevil, Kentucky



Map reproduced from Site Classification Report (Beling 1998c)

Former Hanna City Air Force Station Hanna City, Illinois	Figure 2-3. Former UST location near Bldg. 305/Housing Unit No. 3
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Former Hanna City Air Force Station **Hanna City, Illinois**	Aerial photo from Peoria County GIS, 2003.

Figure 2-4. Benzo(a)pyrene concentrations (µg/kg) in surface soil (0-0.5 ft bgs) samples at the Former HCAFS. Benzo(a)pyrene concentrations (µg/kg) in subsurface soil samples from 4-5 ft also shown where available.

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Former Hanna City Air Force Station
Hanna City, Illinois

Aerial photo from Peoria County GIS, 2003.

Figure 2-5. Arsenic concentrations (mg/kg) in subsurface (4-5 ft, and 5-8 ft bgs) soil samples from the Former HCAFS.

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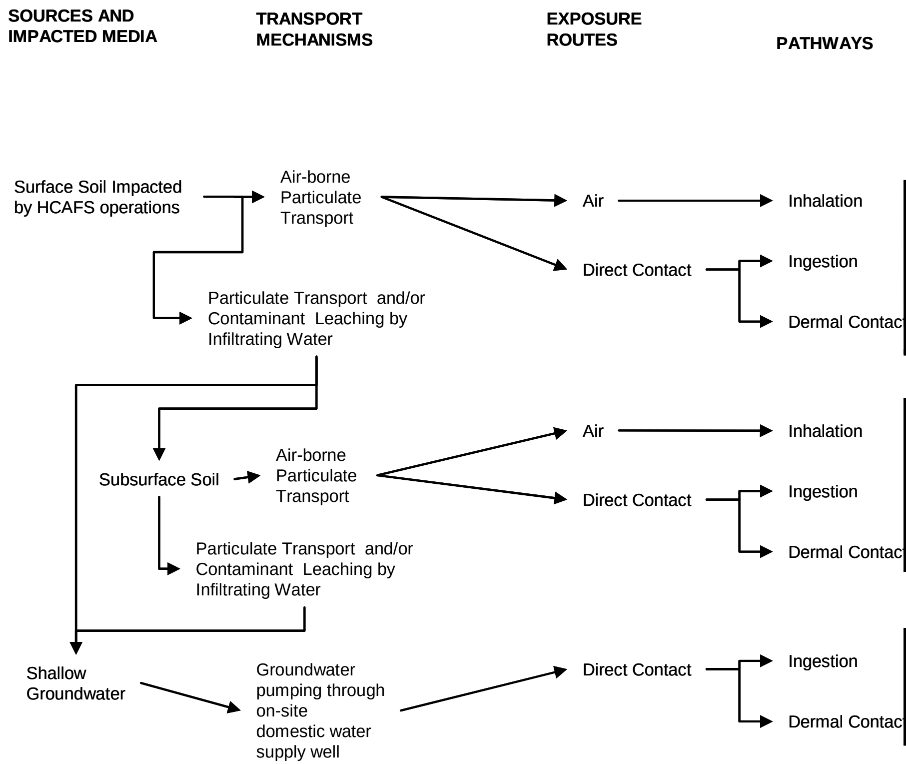

Medium	Pathway	CURRENT RECEPTORS: Correctional Facility Workers	CURRENT RECEPTORS: Correctional Facility Inmates	HYPOTHETICAL RECEPTORS: Resident Adult	HYPOTHETICAL RECEPTORS: Resident Child
Surface Soil	Inhalation	●	●	●	●
Surface Soil	Ingestion	●	●	●	●
Surface Soil	Dermal Contact	●	●	●	●
Subsurface Soil	Inhalation	- - -	- - -	●	●
Subsurface Soil	Ingestion	- - -	- - -	●	●
Subsurface Soil	Dermal Contact	- - -	- - -	●	●
Shallow Groundwater	Ingestion	- - -	- - -	○	○
Shallow Groundwater	Dermal Contact	- - -	- - -	○	○

● Pathway from impacted medium to receptor considered complete.

- - - Pathway from impacted medium to receptor considered possible but very unlikely to impossible and not analyzed.

○ Pathway from impacted medium to receptor considered possible and unlikely but analyzed under an unrestricted land use scenario.

Figure 2-6 Conceptual Site Risk Model for the Former HCAFS.

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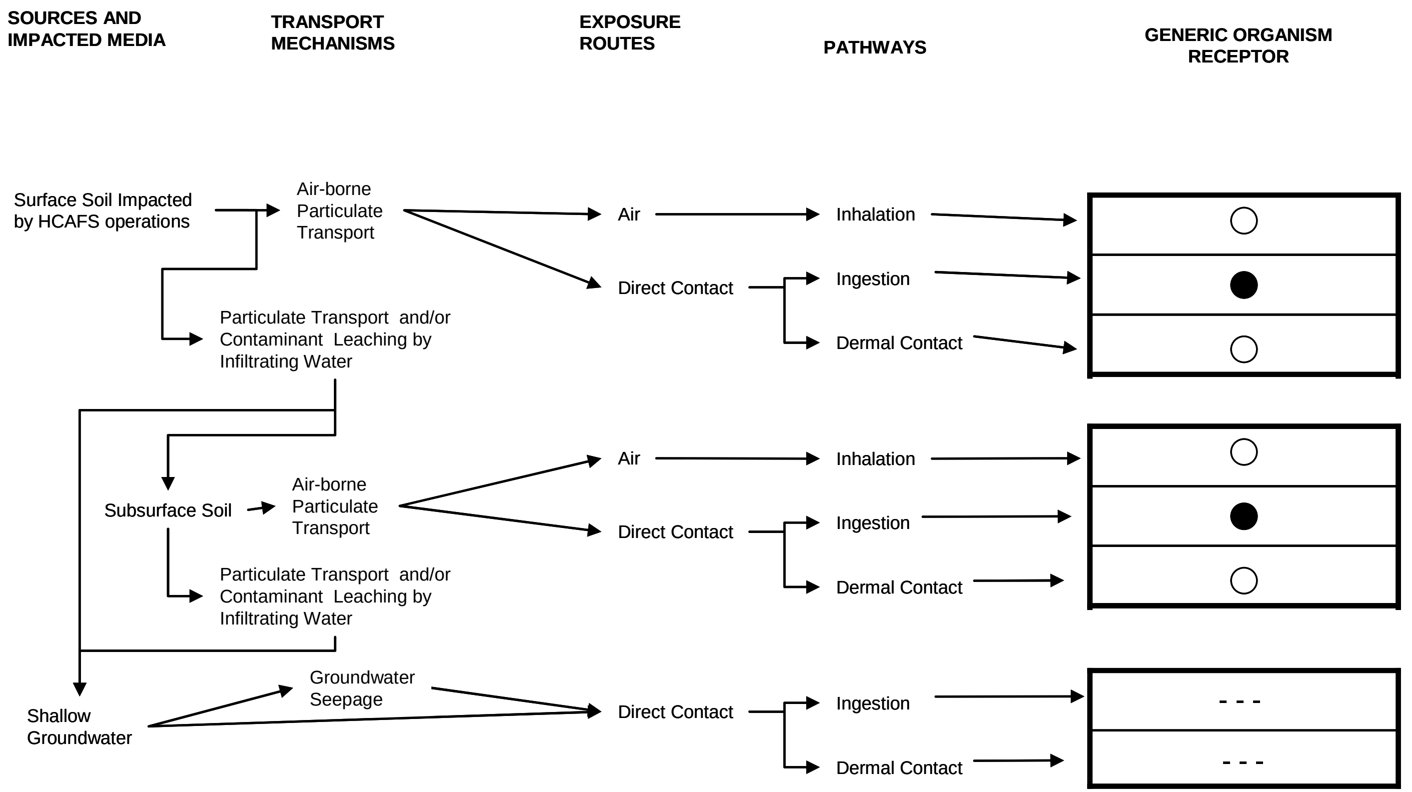
Former Hanna City Air Force Station
Hanna City, Illinois



● Pathway from impacted medium to receptor considered complete.

○ Pathway from impacted medium to receptor considered complete but not analyzed.

- - - Pathway from impacted medium to receptor considered possible but very unlikely to impossible and not analyzed.

Figure 2-7 Conceptual Site Ecological Risk Model for the Former HCAFS.

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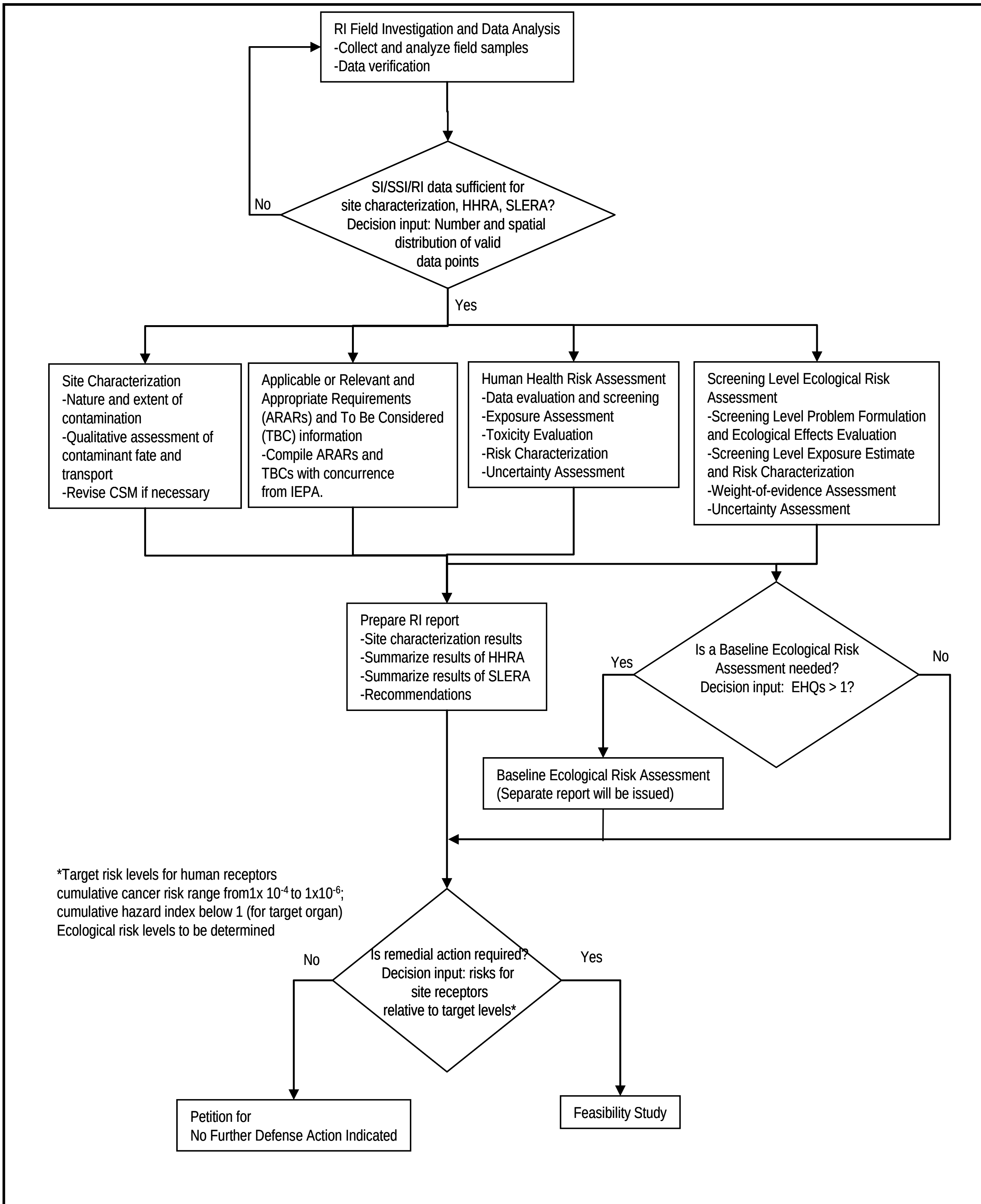
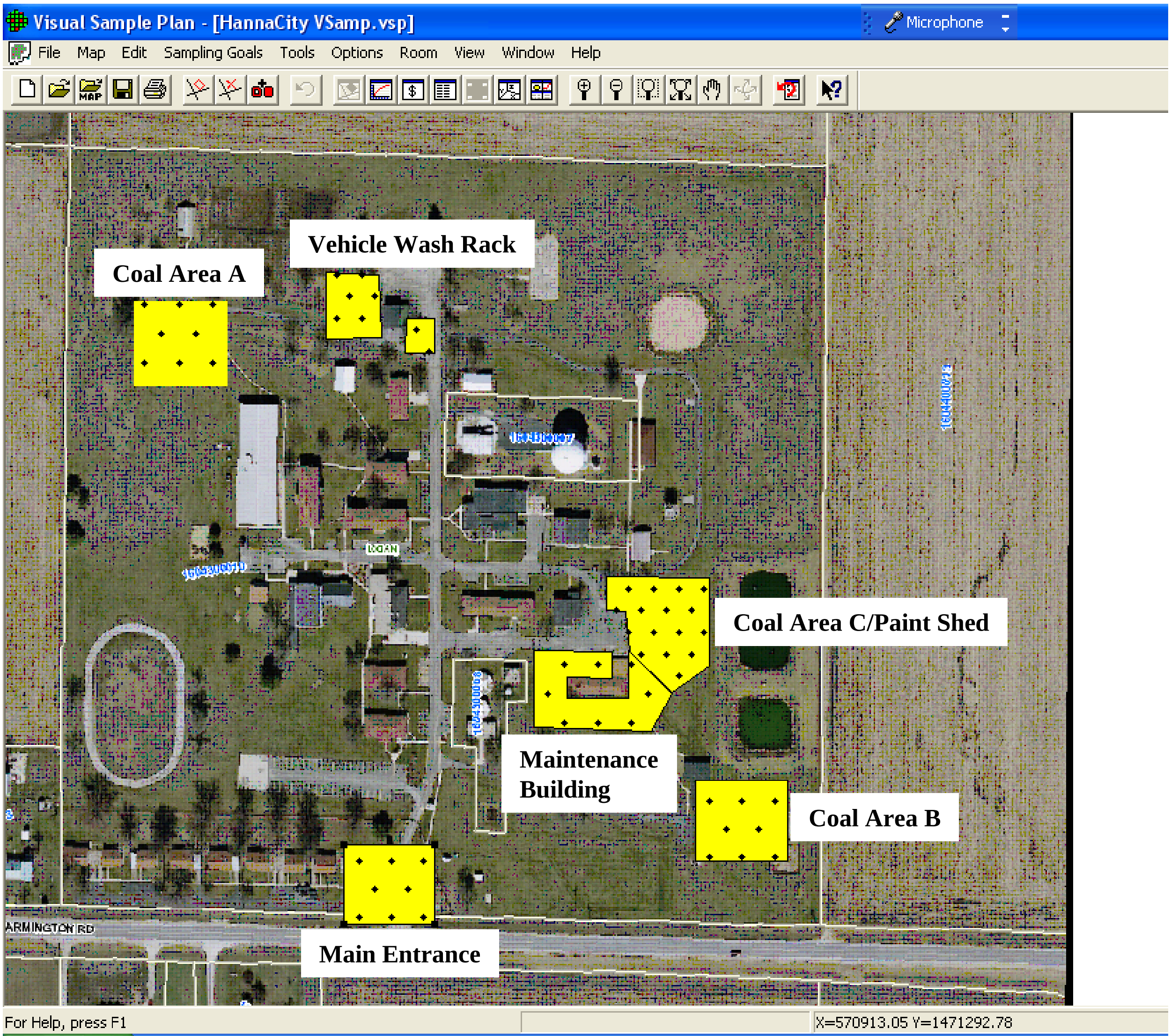
Former Hanna City Air Force Station Hanna City, Illinois



Former Hanna City Air Force Station **Hanna City, Illinois**	**Figure 3-1. Task Flow Chart and Decision Points for Remedial Investigation**
U.S. Army Corps of Engineers **Louisville District**	**GEO Consultants, LLC** *A Geological Engineering and Environmental Services Company* Kevil, Kentucky



Aerial photo from Peoria County GIS, 2003.

Figure 3-2 VSP Screen Shot showing Sample Areas (yellow) and VSP generated sample locations (black diamonds).

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Louisville District

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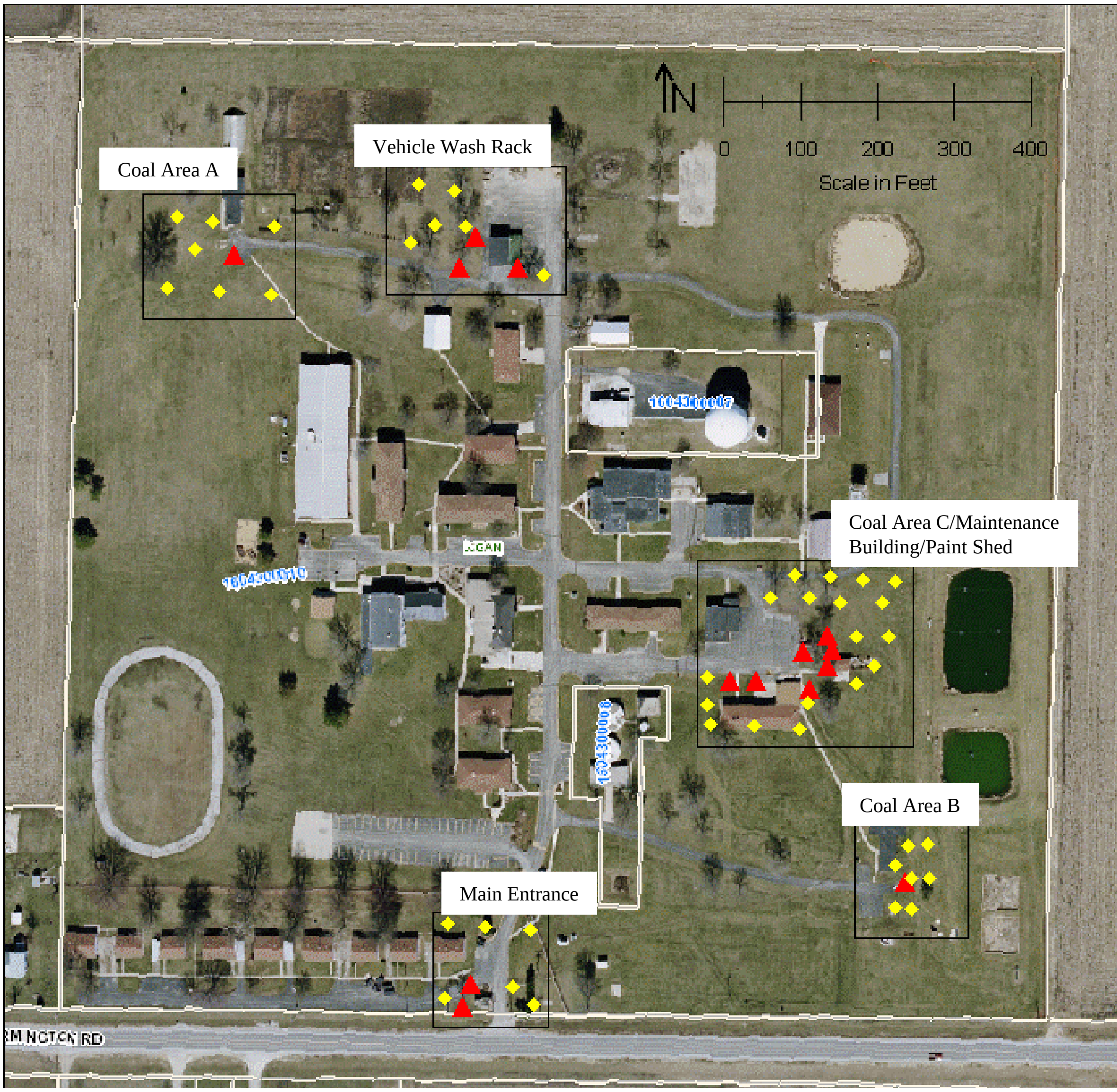

- RI surface samples collected for PAH analyses, August 2008; with concurrence from C. Hill, IEPA.
- Previous surface soil sample locations from SI (1996) and SSI (2006) analyzed for PAHs
- Exposure units for risk assessment (areas ranging from 0.5 to 1.5 acres)

Former Hanna City Air Force Station **Hanna City, Illinois**	**Figure 3-3a Surface soil sampling locations at the former HCAFS**
U.S. Army Corps of Engineers **Louisville District**	**GEO Consultants, LLC** *A Geological Engineering and Environmental Services Company* Kevil, Kentucky

- RI subsurface samples to be collected for PAH or metals analyses
- Previous subsurface soil sample locations from SI (1996) and SSI (2006) analyzed for PAHs or metals
- RI groundwater samples to be collected for metals analyses
- Previous groundwater sample locations from SS (2006) analyzed for metals
- Exposure units: risk assessment (areas ranging from 0.5 to 1.5 acres) for subsurface soil

Former Hanna City Air Force Station
Hanna City, Illinois

Figure 3-3b Subsurface soil and groundwater sampling locations at the former HCAFS

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Louisville District

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APPENDIX B

Analytical Data from SI (1996) and SSI (2006)

APPENDIX C

Human Health and Ecological Screening Levels

		Soil Screening Values									
		Efroymson et al. (1997a) Preliminary Remediation Goals for Ecological Endpoints[a]		Screening Value for Earthworms and Soil Microorganisms (Efroymson et al. 1997b)[b]							
	CAS			Benchmarks for Earthworm		Benchmarks for soil microorganism		Soil Screening values for Plants (Efroymson et al. 1997c)[c]		Ecological Screening Level (ESL)[d]	
Chemicals of Interest	Registry Number	Number (mg/kg)	Source	Number (mg/kg)	Source	Number (mg/kg)	Source	Number mg/kg mg/L	Source (Soil) (Solution)	Number (mg/kg)	Source
Inorganics											
(Target Analyte List)											
Aluminum	7429-90-5	--		--		600	LOEC	50	Soil, LOEC	--	
Antimony	7440-36-0	5	PRGs	--		--		5	Soil, LOEC	0.1423	ESL EPA Region 5 (2003)
Arsenic	7440-38-2	9.9	PRGs	60	LOEC	100	LOEC	10	Soil, NOEC	5.7	ESL EPA Region 5 (2003)
Barium	7440-39-3	283	PRGs	--		3000	LOEC	500	Soil, LOEC	1.04	ESL EPA Region 5 (2003)
Beryllium		10	PRGs							1.06	ESL EPA Region 5 (2003)
Bismuth	7440-69-9	--		--		--		20	No Soil, only Solution, LOEC	--	
Cadmium	7440-43-9	4	PRGs	20	LOEC	20	LOEC	4	Soil, LOEC	0.00222	ESL EPA Region 5 (2003)
Calcium	7440-70-2	--		--		--		--		--	
Chromium	16065-83-1	0.4	PRGs	0.4	LOEC	10	NOEC	1	Soil, LOEC	0.4	ESL EPA Region 5 (2003)
Chromium, hexavalent	18540-29-9	0.4	PRGs	0.4	LOEC	10	NOEC	1	Soil, LOEC	--	
Cobalt	7440-48-4	20	PRGs	--		1000	LOEC	20	Soil, LOEC	0.14033	ESL EPA Region 5 (2003)
Copper	7440-50-8	60	PRGs	60	LOEC	100	LOEC	100	Soil ,NOEC	5.4	ESL EPA Region 5 (2003)
Iron	7439-89-6	--		--		200	NOEC	10	No Soil, only Solution, LOEC	--	
Lead	7439-92-1	40.5	PRGs	500	NOEC	900	NOEC	50	Soil ,NOEC	0.05373	ESL EPA Region 5 (2003)
Magnesium	7439-95-4	--		--		--		--		--	
Manganese	7439-96-5	--		--		100	LOEC	500	Soil, LOEC	--	
Mercury	7439-97-6	0.00051	PRGs	0.1	LOEC	30	NOEC	0.3	Soil, LOEC	0.1	ESL EPA Region 5 (2003)
Nickel	7440-02-0	30	PRGs	200	NOEC	90	LOEC	30	Soil ,NOEC	13.6	ESL EPA Region 5 (2003)
Potassium	7440-09-7	--		--		--		--		--	
Selenium	7782-49-2	0.21	PRGs	70	LOEC	100	LOEC	1	Soil, LOEC	0.02765	ESL EPA Region 5 (2003)
Silver	7440-22-4	2	PRGs	--		50	NOEC	2	Soil, LOEC	4.04	ESL EPA Region 5 (2003)
Sodium	7440-23-5	--		--		--		--		--	
Thallium	7440-28-0	1	PRGs	--		--		1	Soil, LOEC	0.05692	ESL EPA Region 5 (2003)
Vanadium	7440-62-2	2	PRGs	--		20	LOEC	2	Soil, LOEC	1.59	ESL EPA Region 5 (2003)
Zinc	7440-66-6	8.5	PRGs	200	LOEC	100	NOEC	50	Soil, NOEC	6.62	ESL EPA Region 5 (2003)
Organic Compounds											
Acenaphthene	83-32-9	20	PRGs	--		--		20	Soil, LOEC	682	
Acenaphthylene	208-96-8	--		--		--		--		682	
Anthracene	120-12-7	--		--		--		--		1480	ESL EPA Region 5 (2003)

Chemicals of Interest	CAS Registry Number	Soil Screening Values: Efroymson et al. (1997a) Preliminary Remediation Goals for Ecological Endpoints[a] Number (mg/kg)	Source	Screening Value for Earthworms and Soil Microorganisms (Efroymson et al. 1997b)[b]: Benchmarks for Earthworm Number (mg/kg)	Source	Benchmarks for soil microorganism Number (mg/kg)	Source	Soil Screening values for Plants (Efroymson et al. 1997c)[c] Number mg/kg mg/L	Source (Soil) (Solution)	Ecological Screening Level (ESL)[d] Number (mg/kg)	Source
Benzo(a)anthracene	56-55-3	--		--		--		--		5.21	ESL EPA Region 5 (2003)
Benzo(a)pyrene	50-32-8	--		--		--		--		1.52	ESL EPA Region 5 (2003)
Benzo(b)fluoranthene	205-99-2	--		--		--		--		59.8	ESL EPA Region 5 (2003)
Benzo(ghi)perylene	191-24-2	--		--		--		--		119	ESL EPA Region 5 (2003)
Benzo(k)fluoranthene	207-08-9	--		--		--		--		148	ESL EPA Region 5 (2003)
Chrysene	218-01-9	--		--		--		--		4.73	ESL EPA Region 5 (2003)
Dibenz(a,h)anthracene	53-70-3	--		--		--		--		18.4	ESL EPA Region 5 (2003)
Fluoranthene	206-44-0	--		--		--		--		122	ESL EPA Region 5 (2003)
Fluorene	86-73-7	30	PRGs	30	LOEC	--		--		122	ESL EPA Region 5 (2003)
Naphthalene	91-20-3	--		--		--		10	No Soil, only Solution, LOEC	0.0994	ESL EPA Region 5 (2003)
Phenanthrene	85-01-8	--		--		--		--		45.7	ESL EPA Region 5 (2003)
Pyrene	129-00-0	--		--		--		--		78.5	ESL EPA Region 5 (2003)

[a] Efrroymson, R.A, G.W Suter, II, B.E. Sample, and D.S. Jones. (1997a). Preliminary Remediation Goals for Ecological Endpoints. ES/ER/TM-162/R2.

[b] Efroymson, R.A, M.E Will., and G.W Suter, 1997b Toxicological Benchmarks for Potential Contaminants of Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process
Martin Marietta Energy Systems, INC. ES/ER/TM-126/R1 Oak Ridge National Laboratory, Oak Ridge, TN

[c] Efroymson,R. A., M.E. Will, G.W. Suter , and A.C. Wooten, 1997c. Toxicological Benchmarks for Screening Contaminants of Concern for Effects on Terrestrial Plants: 1997 Revision
Lockheed Martin Energy Systems, INC. ES/ER/TM-85/R3 Oak Ridge National Laboratory, Oak Ridge, TN

[d]Ecological Screening Levels (ESL), U.S. EPA Region 5, Updated per website: http://www.epa.gov/reg5rcra/ca/edql.htm, August 2003

NOEC = No Observed Effect Concentration
LOEC = Lowest Observed Effect Concentration
Diss = Dissolved Analyte
-- = no value
PRGs = Preliminary Remediation Goals

U.S. EPA, Region 5, RCRA Ecological Screening Levels

http://www.epa.gov/reg5rcra/ca/ESL.pdf

Chemical	Water (µg/L)	Soil (mg/Kg)
Acenapthene	38	682
Acenapthylene	4840	682
Anthracene	0.035	1480
Benzo(a)anthracene	0.025	5.21
Benzo(a)pyrene	0.014	1.52
Benzo(b)fluoranthene	9.07	59.8
Benzo(g,h,i)perylene	7.64	119
Benzo(k)fluoranthene	-----	148
Chrysene	-----	4.73
Dibenzo(a,h)anthracene	-----	18.4
Fluoranthene	1.9	122
Fluorene	19	122
Indeno(1,2,3-cd)pyrene	4.31	109
Napthalene	13	0.0994
Phenathrene	3.6	45.7
Pyrene	0.3	78.5

Note: ----- = data deleted from previous table (i.e., supporting data was inadequate)

U.S. EPA, Region 5, RCRA Ecological Screening Levels
http://www.epa.gov/reg5rcra/ca/ESL.pdf

Chemical	**Water (µg/L)**	**Soil (mg/Kg)**
Aluminum	*NA*	*NA*
Antimony (Total)	80	0.142
Arsenic (Total)	148	5.7
Barium (Total)	220	1.04
Berylium (Total)	3.6	1.06
Cadmium (Total)	0.15	0.00222
Calcium	*NA*	*NA*
Chromium (Total)	42	0.4
Cobalt (Total)	24	0.14
Copper (Total)	1.58	5.4
Iron	NA	NA
Lead (Total)	1.17	0.0537
Magnesium	*NA*	*NA*
Manganese	*NA*	*NA*
Mercury (Total)	0.0013	0.1
Nickel (Total)	28.9	13.6
Potassium	*NA*	*NA*
Selenium (Total)	5	0.0276
Silver (Total)	0.12	4.04
Sodium	*NA*	*NA*
Thallium (Total)	10	0.0569
Vanadium (Total)	12	1.59
Zinc (Total)	65.7	6.62

NA = Chemical not included in U.S. EPA, Region 5, Ecological Screening Levels

U.S. EPA Ecological Soil Screening Levels (mg/Kg dry weight in soil)

http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_pah.pdf

Chemical	Plants	Soil Invertebrate	Wildlife: Avian	Wildlife: Mammalian
Low Molecular Weight Polynuclear Aromatic Hydrocarbons	*NA*	29	*NA*	100
Acenapthene				
Acenapthylene				
Anthracene				
Fluorene				
Napthalene				
Phenathrene				
High Molecular Weight Polynuclear Aromatic Hydrocarbons	*NA*	18	*NA*	1.1
Benzo(a)anthracene				
Benzo(a)pyrene				
Benzo(b)fluoranthene				
Benzo(g,h,i)perylene				
Benzo(k)fluoranthene				
Chyrsene				
Dibenzo(a,h)anthracene				
Fluoranthene				
Indeno(1,2,3-cd)pyrene				
Pyrene				

NA = Not available. Data were insufficient to derive Eco-SSL

U.S. EPA Ecological Soil Screening Levels (mg/Kg dry weight in soil)

http://www.epa.gov/ecotox/ecossl/

			Wildlife			
Chemical	**Plants**	**Soil Invertebrates**	**Avian**	**Mammalian**	**pH**	
Aluminum					<5.5	http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_aluminum.pdf
Antimony	*NA*	78	*NA*	0.27		
Arsenic	18	NA	43	46		
Barium	*NA*	330	*NA*	2000		
Berylium	*NA*	40	*NA*	21		
Cadmium	32	140	0.77	0.36		
Calcium						
Chromium^{+3}	*ND*	*ND*	26	34		
Chromium^{+6}	*ND*	*ND*	*NA*	130		
Cobalt	13	*NA*	120	230		
Copper	70	80	28	49		
Iron	?					http://www.epa.gov/ecotox/ecossl/pdf/eco-ssl_iron.pdf
Lead	120	1700	11	56		
Magnesium						
Manganese	220	450	4300	4000		
Mercury						
Nickel	38	280	210	130		
Potassium						
Selenium	0.52	4.1	1.2	0.63		
Silver	560	*NA*	4.2	14		
Sodium						
Thallium						
Vanadium	NA	NA	7.8	280		
Zinc	160	120	46	49		

NA = Not available. Data were insufficient to derive Eco-SSL

ND = Not enough data to derive Eco-SSL

Units in µg/kg

	TACO App A, Table H, Metro Areas[1]	Residential: Ingestion	Residential: Inhalation	Soil Component of GW Pathway	Industrial/ Commercial: Ingestion	Industrial/ Commercial: Inhalation	Construction Worker: Ingestion	Construction Worker: Inhalation	Region 9 Residential PRG, µg/kg
Acenaphthene	130	4700000	---	570000	120000000	---	120000000	---	3,400,000
Acenaphthylene	70	NA	NA	NA	NA	NA	NA	NA	NA
Anthracene	400	23000000	---	12000000	610000000	---	610000000	---	17,000,000
Benzo(a)-anthracene	1800	900	---	2000	8000	---	170000	---	150
Benzo(a)-pyrene	2100	90	---	8000	800	---	17000	---	15
Benzo(b)-fluoranthene	2100	900	---	5000	8000	---	170000	---	150
Benzo(k)-fluoranthene	1700	9000	---	49000	78000	---	1700000	---	NA
Chrysene	2700	88000	---	160000	780000	---	17000000	---	1500
Dibenzo(a,h)-anthracene	420	90	---	2000	800	---	17000	---	15,000
Fluoranthene	4100	3100000	---	4300000	82000000	---	82000000	---	15
Fluorene	180	3100000	---	560000	82000000	---	82000000	---	2,300,000
Indeno(1,2,3-cd)pyrene	1600	900	---	14000	8000	---	170000	---	2,300,000
Naphthalene	200	1600000	170000	12000	41000000	270000	4100000	1800	150
Phenanthrene	2500	NA	NA	NA	NA	NA	NA	NA	150,000
Pyrene	3000	2300000	---	4200000	61000000	---	61000000	---	NA

Units in μg/kg

	TACO App A, Table G, Metro Areas[1]	Residential: Ingestion	Residential: Inhalation	Soil Component of GW Pathway	Industrial/ Commercial: Ingestion	Industrial/ Commercial: Inhalation	Construction Worker: Ingestion	Construction Worker: Inhalation	Region 9 Residential PRG, μg/kg
Aluminum	9200	NA	NA	NA	NA	NA	NA	NA	77,000,000
Antimony	3.3	31	NA	3.3	820	NA	82	NA	31,000
Arsenic	13	13	750	13	13	1200	61	25000	390
Barium	122	5500	690000	122	140000	910000	14000	870000	15,000,000
Beryllium	0.56	160	1300	0.56	4100	2100	410	44000	154,374
Cadmium	0.5	78	1800	0.5	2000	2800	200	59000	160,000
Calcium	5525	Nutrient	NA	NA	Nutrient	NA	Nutrient	NA	NA
Chromium	13	230	270	13	6100	420	4100	690	230,000
Cobalt	8.9	4700	NA	8.9	120000	NA	12000	NA	NA
Copper	12	2900	NA	12	82000	NA	8200	NA	3,100,000
Iron	15900	NA	NA	15900	NA	NA	NA	NA	55,000,000
Lead	36	400	NA	36	800	NA	700	NA	400,000
Magnesium	2700	325000	NA	NA	Nutrient	NA	730000	NA	NA
Manganese	636	1600	69000	636	41000	91000	4100	8700	1,800,00
Mercury	0.06	23	10	0.06	610	16	61	0.1	23,000
Nickel	13	1600	13000	13	41000	21000	4100	440000	1,600,000
Potassium	1100	Nutrient	NA	NA	Nutrient	NA	Nutrient	NA	NA
Selenium	0.37	390	NA	0.37	10000	NA	1000	NA	390,000
Silver	0.5	390	NA	0.5	10000	NA	1000	NA	390,000
Sodium	130	Nutrient	NA	NA	Nutrient	NA	Nutrient	NA	NA
Thallium	0.42	6.3	NA	0.42	160	NA	160	NA	5100
Vanadium	25.2	550	NA	25.2	14000	NA	1400	NA	390,000
Zinc	60.2	23000	NA	60	610000	NA	61000	NA	23,000,000

	TACO Class I Groundwater Criteria, Table E (μg/L)	MCL or Max Nutrient (μg/L)
Aluminum	None	None
Antimony	6	6
Arsenic	50	10
Barium	2000	2000
Beryllium	4	4
Cadmium	5	5
Calcium	None	500000
Chromium	100	100
Cobalt	1000	None
Copper	650	1300
Iron	5000	5000
Lead	7.5	15
Magnesium	None	210000
Manganese	150	None
Mercury	2	2
Nickel	100	None
Potassium	None	1000000
Selenium	50	50
Silver	50	None
Sodium	None	250000
Thallium	2	2
Vanadium	49	None
Zinc	5000	None

APPENDIX D

Ecological Site Reconnaissance Form

ECOLOGICAL ASSESSMENT CHECKLIST

The evaluation associated with the checklist is intended to be a screening-level survey of the developed and undeveloped/ecological portions of the site. The checklist is patterned after ERAGS Appendix A - Checklist for Ecological Assessment/Sampling, June 1997 and consists of five major sections: 1 - Site Description, 2 - Terrestrial Habitat Checklist, 3 - Aquatic Habitat Checklist (non-flowing systems), 4 - Aquatic Habitat Checklist (flowing systems), and 5 - Wetlands Habitat Checklist. Answers to the checklist should reflect existing conditions and should not consider future remedial actions at the site.

In general, the checklist is designed for applicability to all sites, however, there may be unusual circumstances which require professional judgment in order to determine the need for further ecological evaluation. Sources and general information available for the identification of ecological receptors and habitats may include: the U.S. Fish and Wildlife Service (http://www.fws.gov), State Game and Fish Conservation Services, United States Geological Service (USGS), National Wetland Inventory Maps (http://nwi.fws.gov) National Audubon Society, National Biological Survey, national and local wildlife clubs, National and State Heritage Programs, State and National Parks System, and tribal organizations.

Section 1. Site Description

1. Site Name:____

Location:____

____

County/Parish:_____________________ City:_______________________

State:_____________

Type of Facility:

____

2. Latitude:______________________ Longitude:________________________

3. What is the approximate area of the site?

____

4. Is this the first site visit? Yes _____ No _____. If no, attach trip report of previous site visit(s), if available. Date(s) of previous site visit(s):______________________________

5. Please attach to the checklist USGS topographic map(s) of the site, if available.

6. Are aerial or other site photographs available? Yes ____ No ____. If yes, please attach any available photo(s) to the site map at the conclusion of this section.

7. The land use on the site is: The area surrounding the site is:

________________ mile radius

_____ % Urban _____ % Urban

_____ % Rural _____ % Rural

_____ % Residential _____ % Residential

_____ % Industrial __ light __ heavy _____ % Industrial __ light __ heavy

_____ % Agriculture _____ % Agriculture

(Crops: ______________________) (Crops: ______________________)

_____ % Recreational _____ % Recreational

(Describe; note if it is a park, etc.) (Describe; note if it is a park, etc.)

______________________________ _____________________________

______________________________ _____________________________

_____ % Undisturbed _____ % Undisturbed

_____ % Other _____ % Other

8. Has any movement of soil taken place at the site? Yes ___ No ___. If yes, please identify the most likely cause of this disturbance:

_____ Agricultural Use _____ Heavy Equipment _____ Mining

_____ Natural Events _____ Erosion _____ Other

Please describe: ____

9. Do any potentially sensitive environmental areas exist adjacent to or in proximity to the site, e.g., Federal and State parks, National and State Monuments, wetlands, prairie potholes? *Remember, flood plains and wetlands are not always obvious; do not answer "no" without confirming information.*

____

____

10. What type of facility is located at the site?
_____ Chemical_____ Manufacturing _____ Mixing _____ Waste Disposal
_____ Other (specify) ____

11. What are the suspected contaminants of concern at the site? If known, what are their maximum concentration levels?

____

____

12. Check any potential routes of off-site migration of contaminants observed at the site:
_____ Swales _____ Depressions _____ Drainage ditches
_____ Runoff _____ Windblown particulate _____ Vehicular traffic
_____ Other (specify) ____

13. If known, what is the approximate depth to the water table? __________________________

14. Is the direction of surface runoff apparent from site observations? Yes ___ No ___. If yes, to which of the following does the surface runoff discharge? Indicate all that apply.
_____ Surface water _____ Groundwater _____ Sewer _____ Collection impoundment

15. Is there a navigable waterbody or tributary to a navigable waterbody? Yes ___ No ___.

____

16. Is there a waterbody anywhere on or in the vicinity of the site? If yes, also complete Section 3: Aquatic Habitat Checklist - non-flowing systems and /or Section 4: Aquatic Habitat Checklist - flowing systems.
Yes ____ (approximate distance ________________) No _____.

17. Is there evidence of flooding? Yes _____ No _____. *Wetlands and flood plains are not always obvious; do not answer "no" without confirming information.* If yes, complete Section 5: Wetland Habitat Checklist.

____

____

18. If a field guide was used to aid any of the identifications, please provide a reference. Also, estimate the time spent identifying the fauna. (Use a blank sheet if additional space is needed for text).

____

____

19. Are any threatened and/or endangered species (plant or animal) known to inhabit the area of the site? Yes _____ No _____. *If yes, you are required to verify this information with the U.S. Fish and Wildlife Service.*
If species identities are known, please list them in the text.

____

____

20. Record weather conditions at the time this checklist was prepared:
Date: _________________
____________ Temperature ($_0$C /$_0$F) ___________ Normal daily high temperature
____________ Wind (direction/speed) ___________ Precipitation (rain,snow)
____________ Cloud cover

Section 1A. Summary of Observations and Site Setting

____
____
____
____
____
____
____

Completed by _______________________________ Affiliation _________________________
Additional Preparers ____
Site Manager ____
Date _______________________

Section 2. Terrestrial Habitat Checklist

Section 2A. Wooded

1. Are there any wooded areas on the site? Yes _____ No _____. If no, go to Section IIB: Shrub/Scrub.
2. What percentage of the area of the site is wooded? (_____ % _____ acres). Indicate the wooded area on the site map which is attached to a copy of this checklist. Please identify what information was used to determine the wooded area of the site.

____
____

3. What is the dominant type of vegetation in the wooded area?
(Circle one: Evergreen/Deciduous/Mixed) Provide a photograph if available.
Dominant plant, if known: ____
4. What is the predominant size of the trees at the site? Use diameter at breast height.
_____ 0-6 inches _____ 6-12 inches _____ > 12 inches
5. Specify type of understory present, if known. Provide a photograph, if available. __________

____
____

Section 2B. Shrub/scrub

1. Is shrub/scrub vegetation present at the site? Yes _____ No _____. If no, go to Section IIC: Open Field.
2. What percentage of the site is covered by shrub/scrub vegetation? (______ % _____ acres). Indicate the acres of shrub/scrub on the site map. Please identify what information was used to determine this area.

____
____

3. What is the dominant type of shrub/scrub vegetation, if known? Provide a photograph if available.

____

4. What is the approximate average height of the shrub/scrub vegetation?
_____ 0-2 feet _____ 2-5 feet _____ > 5 feet
5. Based on site observations, how dense is the shrub/scrub vegetation?
_____ Dense _____ patchy _____ Sparse

Section 2C. Open Field

1. Are there open (bare, barren) field areas present at the site? Yes _____ No _____. If yes, please indicate the type below:
_____ Prairie/plains _____ Savannah _____ Old field _____ Other (specify) _______

____

2. What percentage of the site is open field? (_____ % _____ acres). Indicate the open field areas on the site map.

3. What is/are the dominant plant plants? Provide a photograph if available. ________________
____
4. What is the approximate average height of the dominant plant? ___________________________
5. Describe the vegetation cover: _____ Dense _____ Sparse _____ Patchy

Section 2D. Miscellaneous

1. Are other types of terrestrial habitats present at the site, other than woods, shrub/scrub, and open field?
Yes _____ No _____. If yes, identify and describe below. _______________________________
____
____
____
____
2. Describe the terrestrial miscellaneous habitat(s) and identify these areas on the site map.
3. What observations, if any, were made at the site regarding the presence and/or absence of insects, fish, birds, mammals, etc?
____
____
4. Review the questions in Section I to determine if any additional habitat checklists should be completed for this site.
____
____
____
____

Section 3. Aquatic Habitat Checklist – Non-flowing Systems

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section 5, Wetland Habitat Checklist.

1. What type of open-water, non-flowing system is present at the site?
_____ Natural (pond or lake)
_____ Artificially created (lagoon, reservoir, canal, impoundment)
2. If known, what is the name(s) of the waterbody(ies) on or adjacent to the site?
____
3. If a waterbody is present, what are its known uses (e.g., recreation, navigation, etc.)?
____
4. What is the approximate size of the waterbody(ies)? ________________________ acre(s).
5. Is any aquatic vegetation present? Yes _____ No _____. If yes, please identify the type of vegetation present, if known.
_____ Emergent _____ Submergent _____ Floating
6. If known, what is the depth of the water? ____
7. What is the general composition of the substrate? Check all that apply.
_____ Bedrock _____ Sand _____ Muck (fine/black)
_____ Boulder (>10 in.) _____ Silt (fine) _____ Debris
_____ Cobble (2.5-10 in.) _____ Marl (shells) _____ Detritus
_____ Gravel (0.1-2.5 in.) _____ Clay (slick) _____ Concrete
_____ Other (specify) ____
8. What is the source of water in the waterbody?
_____ River/Stream/Creek _____ Groundwater _____ Other (specify) ___________________
_____ Industrial discharge _____ Surface runoff
9. Is there a discharge from the site to the waterbody? Yes _____ No _____. If yes, please describe this discharge and its path.
____
____

10. Is there a discharge from the waterbody? Yes _____ No _____. If yes, and the information is available, identify from the list below the environment into which the waterbody discharges.
_____ River/Stream/Creek _____ onsite offsite _____ Distance _________________
_____ Groundwater _____ onsite offsite _____
_____ Wetland _____ onsite offsite _____ Distance _________________
_____ Impoundment _____ onsite offsite _____
11. Identify any field measurements and observations of water quality that were made. For those parameters for which data were collected provide the measurement and the units of measure below:
__________ Area
__________ Depth (average)
__________ pH
__________ Dissolved oxygen
__________ Salinity
__________ Turbidity (clear, slightly turbid, turbid, opaque) (Secchi disk depth _____)
__________ Other (specify)
12. Describe observed color and area of coloration. ____________________________________
____
13. Mark the open-water, non-flowing system on the site map attached to this checklist.
14. What observations, if any were made at the waterbody regarding the presence and/or absence of benthic macroinvertebrates, fish, birds mammals, etc.?________________________________
____
____
____

Section 4. Aquatic Habitat Checklist – Flowing Systems

Note: Aquatic systems are often associated with wetland habitats. Please refer to Section 5, wetland Habitat Checklist.

1. What type(s) of flowing water system(s) is (are) present at the site?
_____ River _____ Stream _____ Creek
_____ Dry wash _____ Arroyo _____ Brook
_____ Artificially created _____ Intermittent stream _____ Channeling (ditch, etc,) _____ Other (specify) _________________________________
2. If known, what is the name of the waterbody? _______________________________________
3. For natural systems, are there any indicators of physical alteration (e.g., channeling, debris, etc.)? Yes _____ No _____. If yes, please describe indicators that were observed.
____
____
____
4. What is the general composition of the substrate? Check all that apply.
_____ Bedrock _____ Sand _____ Muck (fine/black)
_____ Boulder (>10 in.) _____ Silt (fine) _____ Debris
_____ Cobble (2.5-10 in.) _____ Marl (shells) _____ Detritus
_____ Gravel (0.1-2.5 in.) _____ Clay (slick) _____ Concrete
_____ Other (specify) ____
5. What is the condition of the bank (e.g., height, slope, extent of vegetative cover)? __________
____
____
6. Is the system influenced by tides? Yes _____ No _____. What information was used to make this determination?____
____
____

7. Is the flow intermittent? Yes _____ No _____. If yes, please note the information that was used in making this determination.____
____
____

8. Is there a discharge from the site to the waterbody? Yes _____ No _____. If yes, please describe the discharge and its path. ____
____
____

9. Is there a discharge from the waterbody? Yes _____ No _____. If yes, and the information is available, please identify what the waterbody discharges to and whether the discharge in onsite or off site.____
____
____

10. Identify any field measurements and observations of water quality that were made. For those parameters for which data were collected, provide the measurement and the units of measure in the appropriate space below:

__________ Width (feet)
__________ Depth (feet)
__________ Velocity (specify units)
__________ Temperature (depth of the water at which the temperature was taken)
__________ pH
__________ Dissolved oxygen
__________ Salinity
__________ Turbidity (clear, slightly turbid, turbid, opaque)
(Secchi disk depth ______________________)
__________ Other (specify) ____

11. Described observed color and area of coloration. _____________________________________
____
____

12. Is any aquatic vegetation present? Yes _____ No _____. If yes, please identify the type of vegetation present, if known.

_____ Emergent _____ Submergent _____ Floating

13. Mark the flowing water system on the attached site map.

14. What observations were made at the waterbody regarding the presence and/or absence of benthic macroinvertebrates, fish, birds, mammals, etc.?_________________________________
____
____
____

Section 5. Wetland Habitat Checklist

1. Based on observations and/or available information, are designated or know wetlands definitely present at the site? Yes _____ No _____.

Please note the sources of observations and information used (e.g., USGS Topographic maps, National Wetland Inventory, Federal or State Agency, etc.) to make this determination.
____
____
____

2. Based on the location of the site (e.g., along a waterbody, in a floodplain) and site conditions (e.g., standing water; dark, wet soils; mud cracks; debris line; water marks), are wetland habitats suspected? Yes _____ No _____. If yes, proceed with the remainder of the wetland habitat identification checklist.

3. What type(s) of vegetation are present in the wetland?
_____ Submergement _____ Emergent
_____ Shrub/scrub _____ Wooded
_____ Other (specify) ______________________________
4. Provide a general description of the vegetation present in and around the wetland (height, color, etc.). Provide a photograph of the known or suspected wetlands, if available.
____
____
____
____
5. Is standing water present. Yes ____ No ____. If yes, is this water: Fresh _____ Brackish _____
What is the approximate area of the water (sq. ft.)? ______________________________________
Please complete questions 4, 11, 12 in Checklist 3 - Aquatic Habitat -- Non-Flowing Systems.
6. Is there evidence of flooding at the site? What observations were noted?
_____ Buttressing _____ Water marks _____ Mud cracks
_____ Debris line _____ Other (describe below)
____
7. If known, what is the source of water in the wetland?
_____ Stream/River/Creek/Lake/Pond _____ Groundwater
_____ Flooding _____ Surface runoff
8. Is there a discharge from the site to a known or suspected wetland? Yes _____ No _____. If yes, please describe.____
____
____
9. Is there a discharge from the wetland? Yes _____ No _____. If yes, to what water body is the discharge released?
_____ Surface stream/River _____ Groundwater _____ Lake/pond _____ Marine
10. If a soil sample was collected, describe the appearance of the soil in the wetland area. Circle or write in the best response.
Color (blue/gray, brown, black, mottled) ____
Water content (dry, wet, saturated/unsaturated) ______________________________________
11. Mark the observed wetland area(s) on the attached site map.