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FINAL RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) FACILITY INVESTIGATION (RFI) REPORT FOR SOLID WASTE MANAGEMENT UNIT (SWMU) 25 HIGHWAY 58 DUMP SITE A NAVAL SUPPORT ACTIVITY CRANE INDIANA
9/1/2014
TETRA TECH, INC.

FINAL
Resource Conservation and Recovery Act Facility Investigation Report
for the
Highway 58 Dump Site A (SWMU 25)

Naval Support Activity Crane
Crane, Indiana

Naval Facilities Engineering Command Mid-Atlantic

Contract Number N62470-08-D-1001
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FINAL
RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION REPORT FOR THE HIGHWAY 58 DUMP SITE A (SWMU 25)

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LIST OF ACRONYMS

ºC	degrees Celsius
°F	degrees Fahrenheit
ACH	Air changes per hour
ADAF	Age Dependent Adjustment Factor
amsl	above mean sea level
ATSDR	Agency for Toxic Substances and Disease Registry
AVS	Acid-volatile sulfide
BAF	bioaccumulation factor
BBP	Butyl benzyl phthalate
bgs	below ground surface
BRAC	Base Realignment and Closure
Cal EPA	California Environmental Protection Agency
CCME	Canadian Council of Ministers of the Environment
CDI	Chronic Daily Intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	chemical of concern
COPC	chemical of potential concern
CSF	Cancer Slope Factor
CSM	conceptual site model
CTE	Central Tendency Exposure
CTO	Contract Task Order
DA_{event}	absorbed dose per event
DAF	Dilution attenuation factor
DBP	Di-n-butyl phthalate
DCHP	Dicyclohexyl phthalate
DEP	Di-ethyl-phthalate
DI	deionized
DIOP	Dioctyl phthalate
DO	dissolved oxygen
DNOP	Di-n-octyl-phthalate
DOP	Dissolved organic phosphorus
DPN	N-nitrosodi-n-propylamine

DPT	direct-push technology
EcoSSL	Ecological Soil Screening Level
EEQ	Ecological Effect Quotient
EMR	Environmental Monitoring Reports
EPC	Exposure Point Concentration
EPD	Environmental Protection Department
ERA	Ecological Risk Assessment
EU	Exposure Unit
FOD	frequency of detection
FOL	Field Operations Leader
FTMR	Field Task Modification Request
g/L	grams per liter
GSL	Groundwater screening level
HASP	Health and Safety Plan
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IA	Installation Assessment
IAS	Initial Assessment Study
IDEM	Indiana Department of Environmental Management
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic Model
ILCR	Incremental Lifetime Cancer Risk
IM	Interim measure
IRIS	Integrated Risk Information System
IUR	Inhalation Unit Risk
Kd	soil water partition coefficient
Koc	organic matter water partition coefficient
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL	milliliter
NA	Not Applicable
NACIP	Naval Assessment and Control of Installation Pollutants
NAVFAC	Naval Facilities Engineering Command
NCEA	National Center for Environmental Assessment
NEESA	Naval Energy and Environmental Support Activity

NELAP	National Environmental Laboratory Accreditation Program
NFA	No Further Action
NIRIS	Naval Installation Restoration Information Solution
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observable Adverse Effects Level
NOEC	No Observed Effects Concentration
NSA	Naval Support Activity
NTU	nephelometric turbidity unit
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
ORNL	Oak Ridge National Laboratory
ORP	oxidation-reduction potential
OSWER	Office of Solid Waste and Emergency Response
PAH	polycyclic aromatic hydrocarbon
PAL	Project Action Limit
PCP	pentachlorophenol
PEF	Particulate Emission Factor
PPRTV	Provisional Peer Reviewed Toxicity Value
PID	photoionization detector
PPE	personal protective equipment
ppm	part per million
PSL	Project Screening Level
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
RAGS	Risk assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RDA	Recommended Daily Allowance
RDI	Recommended Daily Intake
RfC	Reference Concentration
RfD	Reference Doses
RFI	RCRA Facility Investigation
RISC	Risk Integrated System Closure
RME	Reasonable Maximum Exposure
RPD	Relative Percent Difference
RSL	Regional Screening Level
RTI	RTI Laboratories, Inc.
%R	Percent Recovery

SAP	Sampling and Analysis Plan
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SERA	Screening Ecological Risk Assessment
SIM	selected ion monitoring
SOP	Standard Operating Procedure
SSL	Soil Screening Level
SVOC	Semi-volatile Organic Compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TCL	Target Compound List
TEL	Threshold Effects Level
TOM	Task Order Manager
UCL	Upper Confidence Limit
UFP-SAP	Uniform Federal Policy for Sampling and Analysis Plan
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UTL	Upper tolerance limit
µg/kg	microgram per kilogram
µg/L	microgram per liter
µm	micrometer
VDEQ	Virginia Department of Environmental Quality
VF	Volatilization factor
VISL	Vapor intrusion screening level
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

This report documents the Resource Conservation and Recovery Act (RCRA) Phase III Facility Investigation (RFI) for Solid Waste Management Unit (SWMU) 25, (Highway 58 Dump Site A), located at the Naval Support Activity (NSA), Crane, Indiana. Tetra Tech, Inc. (Tetra Tech) prepared this report for the Naval Facilities Engineering Command (NAVFAC) Midwest under Contract Task Order (CTO) F27L, Comprehensive Long-Term Environmental Action Navy (CLEAN), Contract Number N62470-08-D-1001.

PURPOSE OF RFI REPORT

This report summarizes the RFI fieldwork conducted July 11-14, 2011 and October/November, 2012 to investigate potential soil and groundwater contamination at Dump Site A, along Highway 58. Data collected during the RFI were used to meet the following objectives:

- Determine the nature and extent of contamination, if any, within soil and groundwater at NSA Crane SWMU 25 Dump Site A.
- Conduct a baseline human health risk assessment (HHRA).
- Conduct a screening level ecological risk assessment (ERA).
- Prepare a RFI Report for submittal to the Navy.

Dump Site A was a disposal area that received paper, concrete, pipe, scrap metal, paint thinners, and oil. In 1995 and 1996, an Interim Measure (IM) was conducted at SWMU 25 Dump Site A. The objective of the IM was to remove debris and incidental soil excavated with the debris. SWMU 25 Dump Site A had two dump areas. A larger area was approximately 39 feet by 150 feet, and a second area was approximately 25 feet by 10 feet. All debris was removed from the smaller dump site area. However, additional debris discovered during the IM at the larger dump site area was left in place because it may have been used as backfill to support Highway 58. It was recommended that SWMU 25 revert back to the RFI process beginning with soil borings along both sides of Highway 58 to determine the need for further remediation.

Soil was analyzed for potential contaminants that could have been present as a result of the buried debris. A summary of receptor-specific human health risk and hazards, ecological risks, and recommendations are provided in Table ES-1.

HUMAN HEALTH RISK ASSESSMENT CONCLUSIONS

Potential receptors under current and future land use are industrial workers, construction workers, and adolescent trespassers. Potential receptors under future land use are hypothetical child and adult residents. Although future land use is likely to be the same as current land use, the potential future receptors were evaluated in the baseline HHRA primarily for decision-making purposes.

The following COPCs were selected for direct contact to soil:

- Surface soil – arsenic, chromium, iron, and benzo(a)pyrene.
- Subsurface soil – arsenic, cobalt, iron, and manganese.
- Groundwater – aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, nickel, thallium, vanadium, and naphthalene.

The following COPCs were selected for migration from soil to groundwater:

- Surface soil – arsenic, chromium, and iron.
- Subsurface soil – arsenic, cobalt, iron, manganese.

No COPCs were selected for groundwater for vapor intrusion.

Quantitative estimates of noncarcinogenic and carcinogenic risks (HIs and ILCRs, respectively) were developed for potential human receptors. Under the RME scenario, the medium-specific HI for subsurface soil estimated for construction workers exceeded unity (1) due to manganese (HQ = 2) via the inhalation pathway; however, considerable uncertainty is associated with the RfC used for manganese for the construction worker. Hazard indices calculated on a target organ-specific basis in subsurface soil for on-base residents (children and future land use) do not exceed 1. .Medium-specific HIs for groundwater exceeded 1 for both child and adult residents; the medium-specific HIs were 141 and 41, respectively. Metals were the primary contributors to target organ-specific HIs exceeding 1 for residential receptors. HIs were less than or equal to 1 on a target organ-specific basis for all other media/receptors evaluated.

Under the CTE scenario, the medium-specific HIs for groundwater exceeded 1 for both child and adult residents; the medium-specific HIs were 93 and 27, respectively. Metals were the primary contributors to target organ-specific His exceeding 1 for residential receptors. HIs were less than or equal to 1 on a target organ-specific basis for all other media/receptors evaluated.

Under the RME scenario, ILCRs for all receptors exposed to surface soil and subsurface soil and for construction workers exposed to groundwater were less than or within USEPA's and IDEM's target risk range of 1×10^{-6} to 1×10^{-4}. However, ILCRs for child, adult, and lifelong residents exposed to groundwater exceeded the target risk range; medium-specific ILCRs for these receptors were 3×10^{-3}, 2×10^{-3}, and 5×10^{-3}, respectively. The primary risk contributors for residents exposed to groundwater were arsenic and chromium.

Under the CTE scenario, ILCRs for all receptors exposed to surface soil and subsurface soil and for construction workers and adult residents exposed to groundwater were less than or within USEPA's and IDEM's target risk range of 1×10^{-6} to 1×10^{-4}. However, ILCRs for child, adult, and lifelong residents exposed to groundwater exceeded the target risk range; medium-specific ILCRs for these receptors were 2×10^{-3}, 3×10^{-4}, and 2×10^{-3}, respectively. The primary risk contributors for residents exposed to groundwater were arsenic and chromium

Lead, which is evaluated differently than other metals, was not selected as a COPC in any medium. Therefore, adverse human health effects due to lead are not anticipated.

The elevated metal concentrations that resulted in an estimated unacceptable RME and CTE level of human health risk was attributed to turbid groundwater samples and are likely to be grossly overestimated. Collection of turbid samples was unavoidable despite efforts to minimize the turbidity and to thus mimic the groundwater conditions to which a resident would be exposed. The attribution of elevated metals concentrations to turbidity was supported by dissolved metal concentrations that were significantly less than the total metal concentrations.

ECOLOGICAL ASSESSMENT CONCLUSIONS

Several SVOCs and metals were detected in soil samples from SWMU 25. Thirteen SVOCs and two metals were selected as COPCs because screening levels were not available for plants or invertebrates or both. Six metals were selected as COPCs because they were detected at a maximum concentration that resulted in an ecological effects quotient (EEQ) greater than 1.0 for plants or invertebrates or both.

Soil Invertebrates

Five SVOCs and two metals were selected as COPCs because screening levels were not available. Four metals were selected as COPCs because they were detected at a maximum concentration that resulted in an EEQ greater than 1.0.

Upon further evaluation of these chemicals through Step 3a of the Navy Three-Tiered Ecological Risk Assessment Flow Chart, it was determined that none of the COPCs present an unacceptable level of risk to any ecological receptor.

RECOMMENDATIONS

The purpose of this RFI is explained above. The RFI objectives were designed to identify possible contaminant releases that require further investigation or pose a threat to human health or the environment. Sites that do not require further investigation and do not pose an unacceptable risk to human health and the environment may be designated as no further action (NFA) sites, and may be eliminated from further consideration.

Based on the results of the RFI risk calculations, consideration of the limited potential for residential use, and consideration of the elevated risk due to groundwater samples that do not represent realistic human exposure, NFA is recommended for SWMU 25 – Highway 58 Dump Site A.

TABLE ES-1

SUMMARY OF RECEPTOR-SPECIFIC HUMAN HEALTH RISKS AND HAZARDS, ECOLOGICAL RISKS, AND RECOMMENDATIONS
SWMU 25 - RFI REPORT
NSA CRANE
CRANE, INDIANA

Receptor Population	Environmental Medium	Overall Carcinogenic Risk (Human)	Overall Hazard Index (Human)	Overall Risk (Ecological)	Critical Pathways and Chemicals of Concern	Recommendations
Construction Workers (current and future land use)	Surface Soil	4E-06	0.4	NA	NA	NFA
Industrial Workers (current and future land use)	Surface Soil	1E-05	0.1	NA	NA	NFA
Adolescent Trespasser (current and future land use)	Surface Soil	1E-06	0.02	NA	NA	NFA
On-base Residents (Children) (future land use)	Surface Soil	9E-05	1	NA	NA	NFA
On-base Residents (Adult) (future land use)	Surface Soil	2E-05	0.2	NA	NA	NFA
On-base Residents (Lifelong) (future land use)	Surface Soil	1E-04	NA	NA	NA	NFA
Construction Workers (current and future land use)	Subsurface Soil	7E-07	2	NA	Inhalation of subsurface soil - manganese(1)	NFA
Industrial Workers (current and future land use)	Subsurface Soil	6E-06	0.2	NA	NA	NFA
Adolescent Trespasser (current and future land use)	Subsurface Soil	4E-07	0.03	NA	NA	NFA
On-base Residents (Children) (future land use)	Subsurface Soil	2E-05	2(2)	NA	NA(2)	NFA
On-base Residents (Adult) (future land use)	Subsurface Soil	8E-06	0.3	NA	NA	NFA
On-base Residents (Lifelong) (future land use)	Subsurface Soil	3E-05	NA	NA	NA	NFA

TABLE ES-1

SUMMARY OF RECEPTOR-SPECIFIC HUMAN HEALTH RISKS AND HAZARDS, ECOLOGICAL RISKS, AND RECOMMENDATIONS
SWMU 25 - RFI REPORT
NSA CRANE
CRANE, INDIANA

Receptor Population	Environmental Medium	Overall Carcinogenic Risk (Human)	Overall Hazard Index (Human)	Overall Risk (Ecological)	Critical Pathways and Chemicals of Concern	Recommendations
Construction Workers (current and future land use)	Groundwater	6E-07	0.1	NA	NA	NFA
On-base Residents (Children) (future land use)	Groundwater	3E-03	141	NA	Ingestion of groundwater - aluminum, arsenic, chromium, cobalt, iron, manganese, nickel, and thallium	NFA(3)
On-base Residents (Adult) (future land use)	Groundwater	2E-03	41	NA	Ingestion of groundwater - aluminum, arsenic, cobalt, iron, manganese, and thallium	NFA(3)
On-base Residents (Lifelong) (future land use)	Groundwater	5E-03	NA	NA	Ingestion of groundwater - arsenic and chromium	NFA(3)
Terrestrial Plants and Invertebrates	Surface Soil	NA	NA	Acceptable	NA	NFA
Mammals and Birds	Surface Soil	NA	NA	NA	NA	NA

NA = Not applicable.
NFA = No further action.

COPC = Chemical of potential concern.

1 - Considerable uncertainty is associated with the reference concentration used for manganese for the construction worker (see human health risk assessment).
2 - Although the hazard index exceeds 1, hazard indices calculated on a target organ-specific basis do not exceed 1. Therefore, no chemicals of concern were identified.

1.0 INTRODUCTION

Tetra Tech has prepared this Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Report for the Solid Waste Management Unit (SWMU) 25 (Highway 58 Dump Site A) for Naval Support Activity (NSA) Crane, located in Crane, Indiana, through the Naval Facilities Engineering Command (NAVFAC) Midwest. This RFI was performed under Contract Task Order (CTO) F27L for the Comprehensive Long-Term Environmental Action Navy (CLEAN), Contract Number N62470-08-D-1001.

SWMU 25 is a heavily wooded-site approximately 11 acres in size, which was a disposal area that received paper, concrete, pipe, scrap metal, paint thinners, and oil. In 1995 and 1996, an Interim Measure (IM) at SWMU 25 Dump Site A removed debris and incidental soil excavated with the debris (Morrison-Knudsen, 1999). SWMU 25 Dump Site A contained two dump areas: a larger area approximately 39 feet by 150 feet and a smaller area approximately 25 feet by 10 feet. All debris was removed from the smaller area. However, additional debris discovered at the larger area was left in place because it may have been used as backfill to support Highway 58. Of the 11 acres of SWMU 25, the potentially impacted area is 0.3 acres. The IM report recommended that the Navy complete an RFI for SWMU 25 to determine the need for further remediation.

This RFI investigation includes soil and groundwater samples collected July 2011 (Round 1) and groundwater samples collected October/November 2012 (Round 2). The five existing SWMU 25 monitoring wells were redeveloped and Round 1 groundwater samples were collected to determine if contamination from Dump Site A had migrated into groundwater. During monitoring well redevelopment and sampling, Tetra Tech discovered two monitoring wells had bent casings, which prevented the wells from being sampled according to the United States Environmental Protection Agency (USEPA)-approved Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) (Tetra Tech, 2011). In 2012, the two compromised wells were abandoned and a new monitoring well was installed midway between the two abandoned wells. Round 2 groundwater samples were collected from the existing three wells and the newly installed well. Data from all soil samples and groundwater samples considered representative of the site were used in human health and ecological risk assessments.

1.1 PURPOSE

This RFI report describes SWMU 25 site investigation activities and presents the results and interpretation. This investigation provides concentrations of organic [semi-volatile organic compounds (SVOCs)] and inorganic (metals) chemicals measured in surface soils, subsurface soils, and groundwater at SWMU 25. In addition, human health and ecological risks associated with SWMU 25 were evaluated

in a baseline human health risk assessment (HHRA) and a screening-level ecological risk assessment (SERA). The risk assessments were performed using all soil data and some of the groundwater data collected during the 2011 and 2012 field investigations. Round 1 groundwater data collected from the two damaged wells (25MW04 and 25MW05) and Rounds 1 and 2 groundwater data collected from the upgradient well (25MW01) were not used in the HHRA.

1.2 SITE BACKGROUND

1.2.1 Site Location and Description

NSA Crane is located in a rural, sparsely populated region of south-central Indiana, approximately 75 miles southwest of Indianapolis, 60 miles northwest of Louisville, Kentucky, and immediately east of Burns City and Crane Village, Indiana. A site location map of the NSA Crane facility is provided as Figure 1-1. NSA Crane encompasses approximately 62,463 acres or approximately 98 square miles of the northern portion of Martin County and smaller portions of Greene, Daviess, and Lawrence Counties.

SWMU 25, the Highway 58 Dump Site A, is contained within the central portion of NSA Crane, slightly north of the center of Sec. 26, T5N, R4W (Dunbar, April 1982, Hydrogeologic Investigation of NWSC Crane), between Highway 45 and the Salvage Yard on Highway 58. A small creek is located approximately 150 feet east of SWMU 25 that drains into Turkey Creek, which eventually drains into the East Fork of the White River and then to the Wabash River to the southwest. The location of SWMU 25 within the drainage basins of NSA Crane is shown in Figure 1-2.

1.2.2 Site History

SWMU 25 is located in a heavy wooded area. The dumping took place in two areas: a larger area approximately 39 feet by 150 feet and a smaller area approximately 25 feet by 10 feet. During the IM action in 1995, a visual inspection of Dump Site A indicated scattered debris consisting of transite siding and pipe, various sizes of concrete pipe and block, metal cans, caps, drums, blocks of roofing tar, chunks of cast concrete, metal pipe, cast metal drains, and electrical porcelain insulators. No odors were detected during the initial site walk. During debris clean up, workers used metal detectors to confirm the removal of metallic cans, drums, and debris. Metal debris as deep as 2 feet below ground surface (bgs) was detected and removed during initial site activities. At the larger dump area, inert (concrete-filled) hardware, such as 12.75 inch warheads (Hedgehogs), had been used as filler apparently to prevent erosion adjacent to Highway 58.The IM report recommended that the Navy complete an RFI for SWMU 25 to determine the need for further remediation. As part of the RFI, the IM report recommended

collection of soil borings under Highway 58 to determine whether debris used as support for the road contaminated the surrounding soil.

In designing the RFI sampling program, the potential impact to local traffic from collecting soil borings beneath Highway 58 was considered. The IM recommendation to "conduct further sampling under the road" was assumed to be a general description to include the road and the narrow area of soil between the western-most berm of Highway 58 and the western edge of the previous IM soil removal (See Figure 1-3, Site Features). This narrow area of soil was not sampled in the IM. Based on the IM report, this area represents the general location of the additional debris left in place during the IM. Because this additional debris could potentially contain contamination, it was the initial focus of the RFI. Based on the IM sampling results, the project team reviewed the need to conduct further investigation directly under the road in an effort to minimize the potential impact to local traffic. The data showed the soil underneath the road was probably not contaminated. A decision was made not to sample under the road because of the disruption to site operations that would be incurred.

SWMU 25 has not been used as a dump site since the IM conducted in 1995 and 1996. Contaminants investigated in the RFI to be potentially present at SWMU 25 in soil and groundwater were SVOCs and metals.

1.3 PREVIOUS INVESTIGATIONS

Confirmation sampling during the IM indicated that with only a few exceptions, the remaining soil contained concentrations of contaminants below cleanup levels identified in RCRA Corrective Action Guidance Human Data Quality Levels for RFI Projects (USEPA, 1994). The corresponding cleanup levels for arsenic, beryllium, and cobalt were not attained at all locations. Samples collected from the off-site soil borrow source confirmed that levels of arsenic, beryllium, and cobalt greater than cleanup levels are naturally present in soils in the surrounding area (Tetra Tech 2001). The target cleanup levels for the IM were taken from "RCRA Corrective Action Guidance Human Data Quality Levels for RFI Projects," (USEPA, 1994), as site-specific risk-based cleanup levels had not been developed for NSA Crane. One confirmation sample from the smaller dump area contained concentrations of benzo(a)pyrene, benzo(g,h)perylene, dibenz(a,h)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and chrysene in excess of these interim cleanup levels. All debris was removed from the smaller dump site area. However, additional debris discovered during the IM at the larger dump site area was left in place because it may have been used as backfill to support Highway 58.

1.4 REPORT ORGANIZATION

Section 1.0 of the report is the introduction, including the purpose, site background, site description, site history, previous investigations, and report organization. Section 2.0 describes the study area field sampling activities and data collection procedures. Section 3.0 discusses data presentation and data quality review. Section 4.0 describes the physical characteristics of SWMU 25. Section 5.0 presents an evaluation of the nature and extent of contamination detected at SWMU 25 in this field investigation. Section 6.0 presents a discussion on the fate and transport of the contaminants and the conceptual site model. Section 7.0 identifies the chemicals of concern (COCs) and presents the results of the HHRA. Section 8.0 presents the results of the SERA. Section 9.0 presents the conclusions and recommendations. The information included in each appendix is summarized below:

- Appendix A – SWMU 25 Photographs and FTMR

- Appendix B – SWMU 25 Field Forms
  - B.1 – SWMU 25 Boring and Soil Log Sheets
  - B.2 – SWMU 25 Groundwater Log Sheets
  - B.3 – SWMU 25 Historical Hydrogeologic Information
  - B.4 – SWMU 25 Field Notes
  - B.5 – SWMU 25 Calibration Logs
  - B.6 – SWMU 25 Chains of Custody (Rounds 1 and 2)

- Appendix C - Analytical Data
  C.1 – SWMU 25 Analytical Data for Surface Soil
  C.2 – SWMU 25 Analytical Data for Subsurface Soil
  C.3 – SWMU 25 Analytical Data for Groundwater, Round 1
  C.4 – SWMU 25 Analytical Data for Groundwater, Round 2

- Appendix D - Data Quality Review

- Appendix E - Supporting Documentation for the Human Health Risk Assessment

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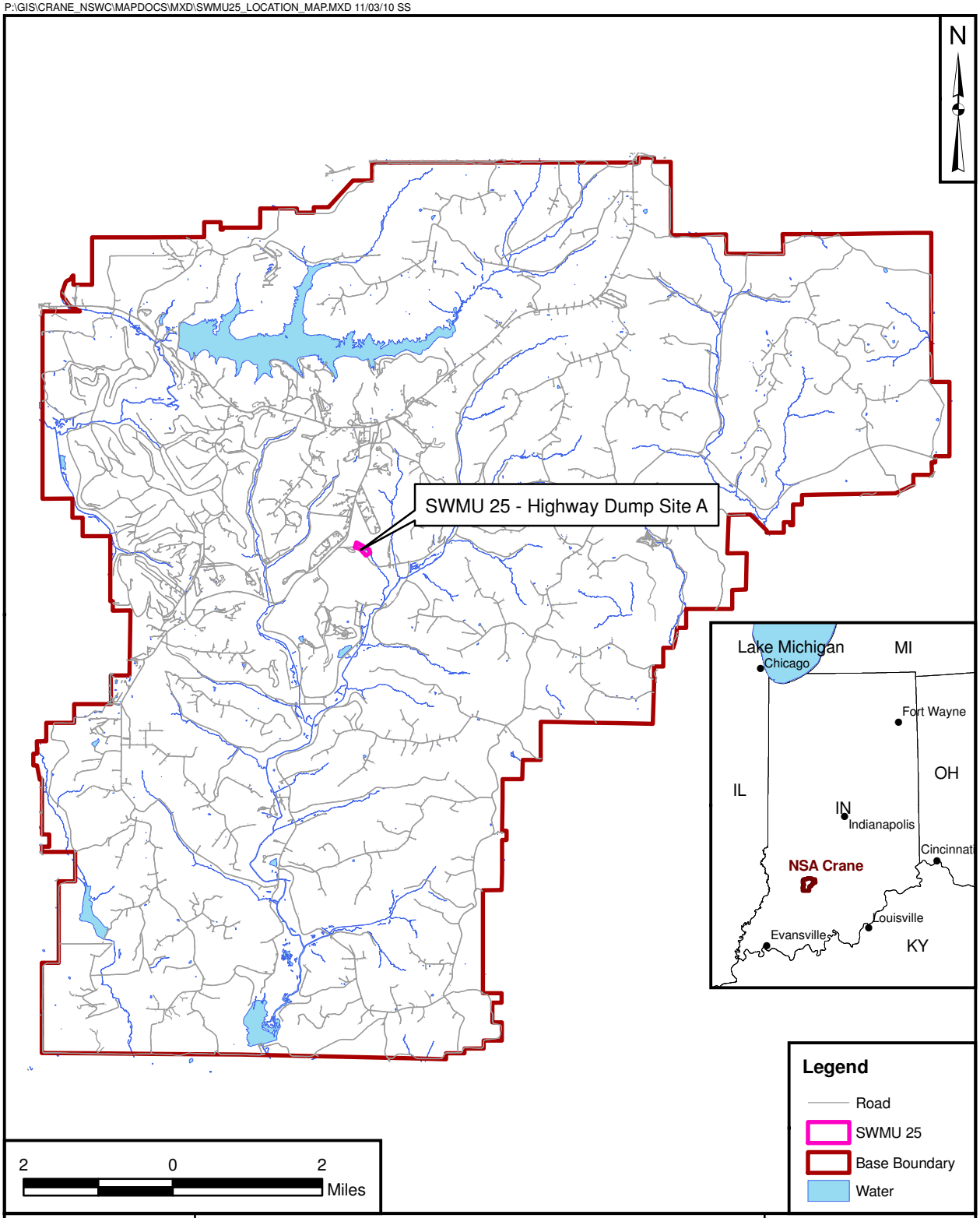

DRAWN BY S. STROZ	DATE 11/03/10	TETRA TECH	CONTRACT NUMBER CTO F27L
CHECKED BY E. BERKLITE	DATE 8/1/11	BASE AND SITE LOCATION MAP SWMU 25 - HIGHWAY DUMP SITE A NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
REVISED BY	DATE		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 1-1 / REV 0

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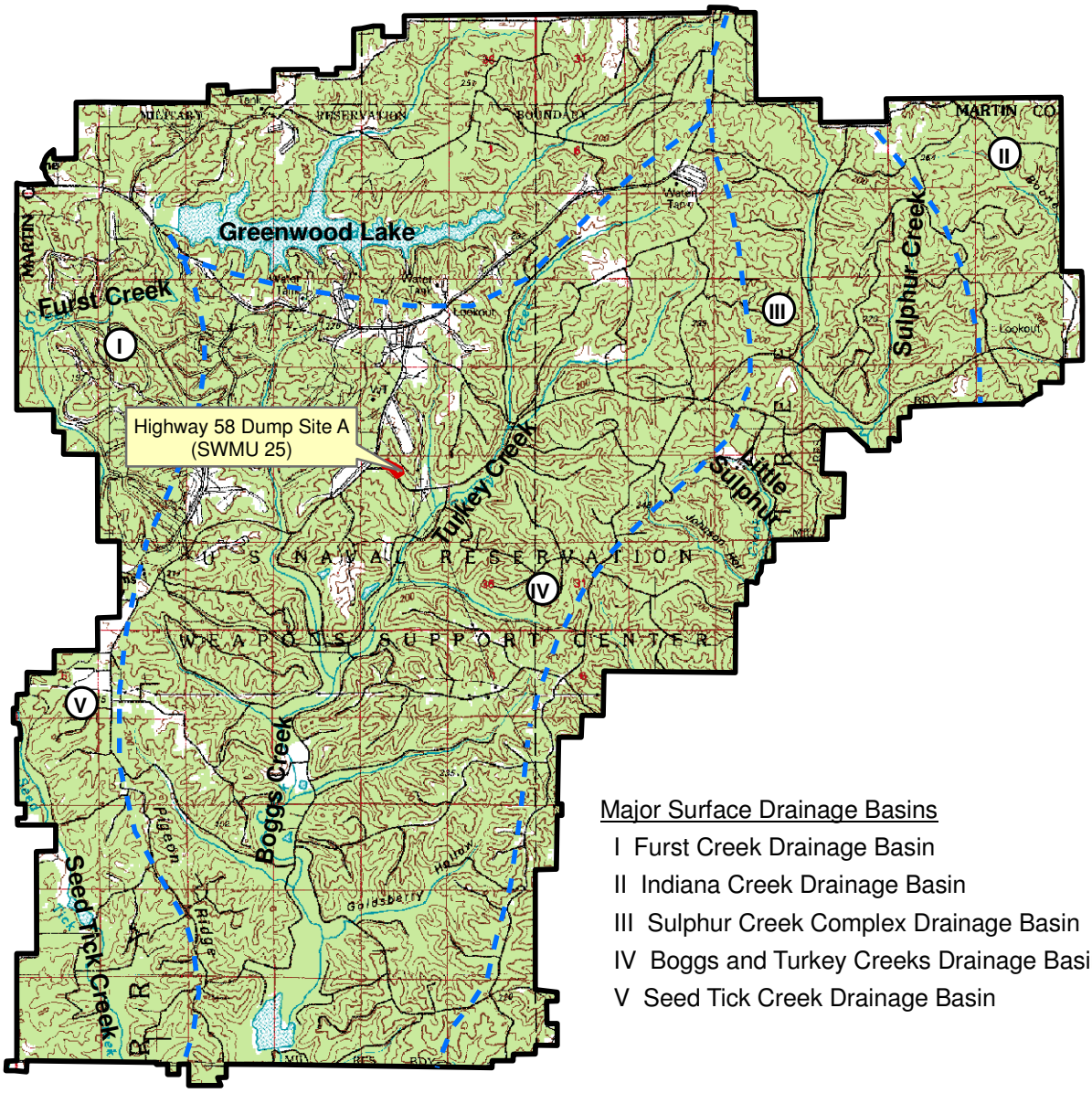

Major Surface Drainage Basins

I Furst Creek Drainage Basin

II Indiana Creek Drainage Basin

III Sulphur Creek Complex Drainage Basin

IV Boggs and Turkey Creeks Drainage Basin

V Seed Tick Creek Drainage Basin

SOURCE:
Initial Assessment of Study of Naval Weapons Support Center Crane, Indiana.
Naval Energy and Environmental Support Activity, May 1983.

2 0 2 Miles

Legend

SWMU Boundary

DRAWN BY K. MOORE	DATE 8/1/11	TETRA TECH	CONTRACT NUMBER 7448	CTO NUMBER F27L
CHECKED BY E. BERKLITE	DATE 8/1/11	SWMU 25 HIGHWAY DUMP SITE A LOCATION AND DRAINAGE BASINS NSA CRANE CRANE, INDIANA	APPROVED BY ___	DATE ___
REVISED BY ___	DATE ___		APPROVED BY ___	DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 1-2	REV 0

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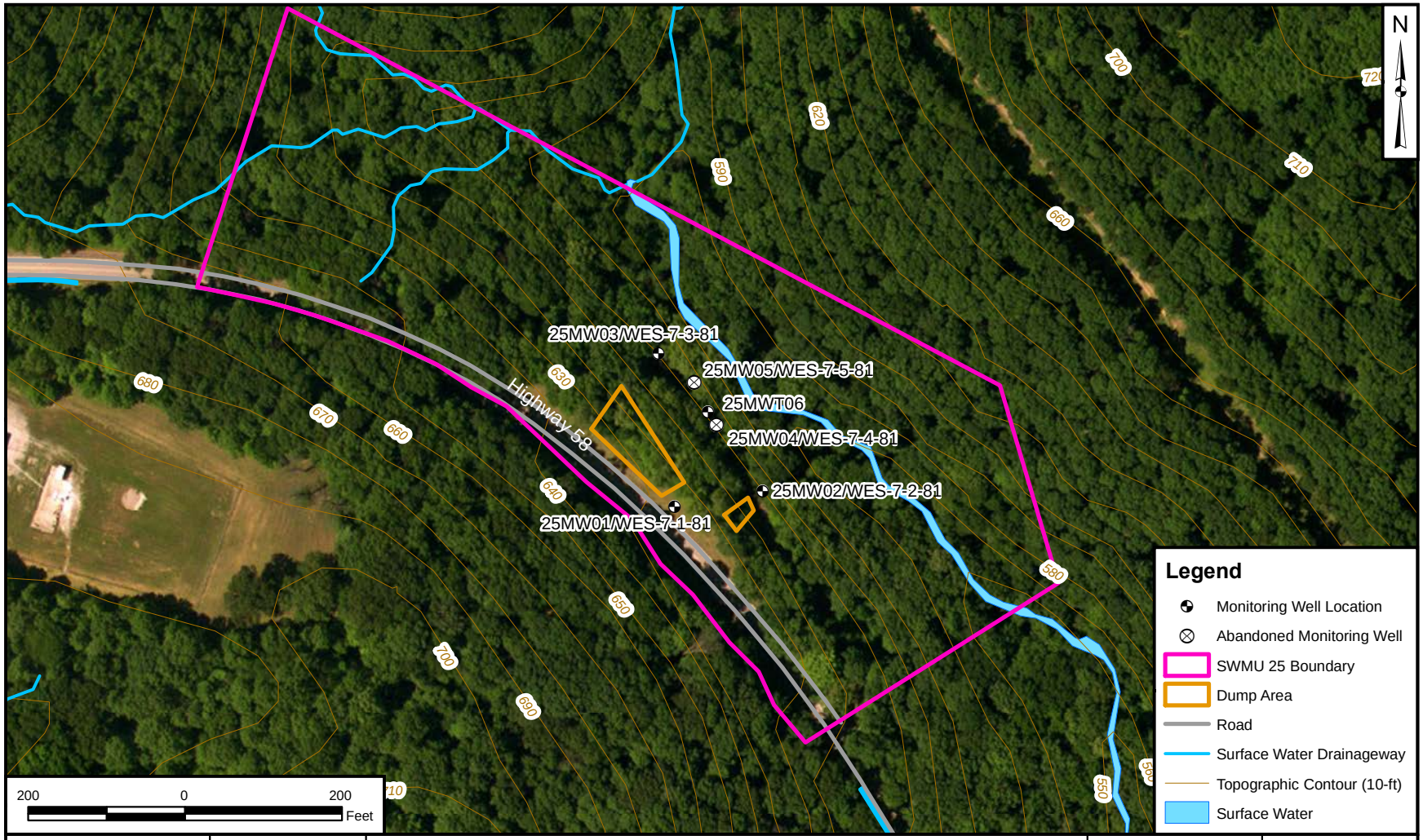

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S. STROZ	12/06/10
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J. DUCAR	6/21/12
REVISED BY	DATE
D. COUCH	02/12/13
SCALE	
AS NOTED	

NAVFAC

HIGHWAY DUMP SITE A FEATURES
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
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FIGURE NO.	REV
FIGURE 1-3	0

2.0 FIELD INVESTIGATION

This section presents sampling activities and documentation procedures used during the 2011 and 2012 field investigations of SWMU 25, Highway 58 Dump Site A, at NSA Crane.

2.1 OVERVIEW

RFI field activities were conducted in two rounds; Round 1 took place during the week of July 11, 2011.. This round consisted of soil and sediment sampling and development and/sampling of all existing wells. Round 2 took place during the period October 23 to November 1, 2012 and consisted of abandonment of two wells, installation of one new well, and purging and sampling of all SWMU 25 wells. All work performed during 2011 was conducted in accordance with the procedures and methodologies described in the UFP-SAP (Tetra Tech, 2011). Work performed in 2012 was conducted in accordance with this UFP-SAP and Field Task Modification Request (FTMR) No. 1, dated June 19, 2012. Standard Operating Procedures (SOPs) that governed the field work are included in Appendix H of the approved UFP-SAP (Tetra Tech, 2011) and in the FTMR, which is included as Appendix A of this document. Photographs and copies of field forms and field notes are provided in Appendices A and B of this document.

2.2 MOBILIZATION / DEMOBILIZATION

Following approval of the UFP-SAP (Tetra Tech, 2011), Tetra Tech personnel began mobilization activities for Round 1. All field team members reviewed the approved UFP-SAP, associated appendices, and the Health and Safety Plan (HASP) prior to the start of project activities. In addition, the Field Operations Leader (FOL) held daily meetings before each shift to familiarize personnel with the scope of field activities and health and safety issues.

Prior to the initiation of Round 1 fieldwork, the FOL arrived at the site and began on-site mobilization activities. These activities included coordination with base personnel and utility clearance of all proposed boring locations through the NSA Crane Public Works Office. At the conclusion of field activities, the FOL oversaw the decontamination and demobilization of all equipment. For Round 2 a similar preparation, execution, and conclusion of fieldwork occurred.

2.3 SUBSURFACE INVESTIGATION METHODOLOGIES AND PROCEDURES

2.3.1 Soil Boring Installation

All soil borings were installed in 2011 in accordance with SOP-05 and logged in accordance with SOP-07 of the UFP-SAP (Tetra Tech, 2011). No soil borings were installed in 2012. Drilling methods used, along with boring date, boring depth, and depth intervals for soil sampling are presented in Table 2-1.

Eleven (11) soil borings were installed in Round 1; eight were installed using direct-push technology (DPT) and three were installed using hand augering methods (see Table 2-1).

2.3.1.1 Direct-Push Technology Borings

The DPT method involves advancing sampling tools hydraulically and/or mechanically downward into the ground to the desired depth. Soil samples were collected from borings for chemical analyses and for lithologic logging purposes. All samples were screened with a photoionization detector (PID) immediately upon opening of the Macro-Core®. No PID readings were greater than background levels. Soil sample collection methods are provided in Section 2.6.1.

DPT was used to complete 8 of the 11 soil borings at SWMU 25 (25SB001 – 25SB008). Figure 2-1 shows the locations of all soil borings completed as part of the RFI. DPT soil borings were advanced to a total depth of 10 feet or to refusal. Actual sample depths for SWMU 25 soil samples are listed in Table 2-1.

2.3.1.2 Hand Augering

Hand augering was used to advance boreholes and collect soil samples at three (25SB009 – 25SB011) of the 11 soil boring locations (see Table 2-1). The hand auger consisted of a stainless steel bucket auger (6½ inches long and 3¼ inches in diameter), and a 4-foot-long steel extension rod with a cross handle. Hand augering was used at the locations where shallow bedrock refusal occurred, and consequently, samples were collected from depths less than 2 feet bgs. Soil sample collection methods are provided in Section 2.6.1. All samples were screened with a PID immediately upon retrieval from the borehole. No PID readings were greater than background levels.

2.3.2 Borehole and Sample Logging

A Tetra Tech geologist maintained a log for each boring in accordance with SOP-07 (Borehole and Soil Sample Logging) of the UFP-SAP (Tetra Tech, 2011). The boring logs in Appendix B.1 contain the following information:

- Boring number
- Date(s) of drilling
- Name of geologist logging the boring
- Name of drilling company
- Sample number and type
- Sample depth
- Sample recovery and sample interval
- Soil density or cohesiveness
- Soil color
- Unified Soil Classification System (USCS) material descriptions
- Bedrock type and description
- Location of boring
- Drilling problems or deviations from the project-specific approved SAP (if applicable)
- Screening instrument readings

In addition, depths of changes in lithology, sample moisture observations, drilling methods, and total depth of each borehole were included on each log, as well as any other pertinent observations. No PID readings were greater than background levels; therefore, none were recorded

2.3.3 Borehole Abandonment

All DPT soil borings at SWMU 25 were backfilled with drill cuttings and, where applicable, bentonite chips were added and hydrated in accordance with the manufacturer's specifications. The ground surface at all boring locations was restored to its original condition. Additionally, soil collected using the hand auger was returned to its original location.

2.4 MONITORING WELL DEVELOPMENT

All existing monitoring wells were redeveloped in 2011 by surging and pumping methods to remove fine-grained material from the well screen and the sand pack that surrounds the well screen. Appendix B.2 presents the monitoring well development logs. If the well was pumped dry, Tetra Tech personnel waited

20 to 30 minutes, noted the rate of recharge, and then pumped the well dry at least three times to maximize the amount of fine-grained material removed. Development continued and was considered complete when one of the following was achieved:

- the purge water quality met standards specified in the UFP-SAP, as feasibility allowed, for the conditions of the well.
- five well volumes were removed.
- the well was pumped dry three times.

Wells were redeveloped using one of three surging and purging methods: surge block/Whale® pump, bailer, or the foot valve (Waterra) method. The surge block/Whale® pump was the preferred method and was used for clearing fines then the bailer was used to develop the well. The bailer and the foot valve (Waterra) method were used where the conditions of the wells (compromised by bends and cracks in the pipe) that did not allow the use of the surge block method. The surge block/Whale® pump method consisted of inserting a 2-inch surge block into the well and surging over the length of the saturated screen for a minimum of 5 minutes. Immediately after surging, the Whale® pump was lowered into the well and the well was pumped in accordance with SOP-12 of the UFP-SAP (Tetra Tech, 2011). The bailer method consisted of purging the well over the length of the saturated screen and removing water and fine-grained materials. The foot valve (Waterra) method involved attaching a decontaminated foot valve to new dedicated ¾-inch polyethylene tubing, extending the tubing and foot valve to the bottom of the well, and surging and purging by moving the tubing up and down. On the downward stroke, the ball in the foot valve lifts and the tubing fills with water; on the upward stroke, the ball is set and surged groundwater is forced out of the tubing and into a purge water bucket. Wells 25MW04 and 25MW05 both contained bent well casings, which prevented the bottom of the water table from being reached. These wells were abandoned and 25MWT06 was developed as a replacement to 25MW04 and 25MW05 in between the two abandoned wells.

Section 2.14 describes the disposal of all investigation-derived waste (IDW) including development fluids. Water-quality parameters [pH, specific conductivity, temperature, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity], pumping rates, volumes of groundwater removed, recharge rates, and water levels were recorded on monitoring well development records. Monitoring well development records for RFI field activities are presented in Appendix B.2 – Groundwater Log Sheets, and B.4 – Field Notes. Historical hydrogeologic information for SWMU 25 is provided in Appendix B.3.

2.5 FIELD TASK MODIFICATION

In 2011 (Round 1), Tetra Tech discovered damage to two of the monitoring wells (25MW04/WES-7-4-81 and 25MW05/WES-7-5-81), apparently caused by land subsidence. The polyvinyl chloride (PVC) well casings were bent, and well 25MW04/WES-7-4-81 had 9 feet of sediment at the bottom, indicating the well casing may have been broken or cracked. Groundwater samples collected during Round 1 from these two wells were very turbid. It was determined that data from these wells were not representative of surrounding groundwater conditions, and installation of a new well was required.

Based on the questionable data quality of the two groundwater samples collected from wells 25MW04/WES-7-4-81 and 25MW05/WES-7-5-81, the following was implemented in 2012, in accordance with the original UFP-SAP and FTMR Number 1:

- Wells 25MW04 and 25MW05 were abandoned in accordance with Indiana Department of Environmental Management (IDEM) guidelines specified in Policy Number: WASTE-053-NPD (Drilling Procedures and Monitoring Well Construction Guidelines); http://www.in.gov/idem/files/nrpd_waste-0053.pdf.

- A new monitoring well (25MWT06) was installed between wells 25MW04 and 25MW05 in accordance with SOP 16 (provided in Appendix A as part of FTMR Number 1). On October 23, 2012, the new monitoring well was installed and screened at the same depth as the two abandoned wells. On October 25, 2012, the new well was developed using the surge block/Whale® pump method. The horizontal and vertical locations of the newly installed well were surveyed by a registered Indiana land surveyor.

- An additional round of synoptic water level measurements and groundwater sampling was conducted on the three existing wells (25MW01 to 25MW03) and the new well 25MWT06 in 2012 (Round 2).

- Samples were collected from each well and analyzed for total and dissolved metals, and SVOCs. The new monitoring well was installed and screened at the same depth as the abandoned wells. The horizontal and vertical locations of the newly installed wells were surveyed by a registered Indiana land surveyor.

2.6 SAMPLING OPERATIONS

This section discusses the methodology for all soil and groundwater sampling performed at SWMU 25. Table 2-2 provides a summary of all samples collected. All samples were analyzed for SVOCs [including

pentaclorophenol (PCP) and N-nitrosodi-n-propylamine (DPN)] and metals. Refusal was encountered in some borings before the targeted sampling depth was reached. Table 2-3 provides the rationale for why proposed samples were not collected at several locations.

2.6.1 Soil Sampling

Twenty-two (22) soil samples and two duplicate samples were collected from 11 soil borings in 2011. Soil samples were collected in accordance with SOP-05 of the UFP-SAP (see Section 2.7 for sample collection deviations). Figure 2-1 presents the soil boring locations. Soil sample log sheets are included in Appendix B.1.

2.6.1.1 Surface Soil Sampling

In 2011, surface soil samples were collected from the ground surface to 2 feet bgs using DPT or hand augering methods. Upon retrieval, all samples were screened for the presence of volatile organic compounds (VOCs) using a PID. No PID readings were greater than background levels; therefore, readings were not recorded on the boring logs and/or soil sample log sheets (see Appendix B.1). Surface soil samples were homogenized and placed in the required containers. One surface soil sample was collected from each of the 11 soil borings and analyzed for SVOCs and Appendix IX metals.

2.6.1.2 Subsurface Soil Sampling

Eleven subsurface soil samples were collected from designated depth intervals in 2011. Upon retrieval, all subsurface soil samples were screened for the presence of VOCs using a PID. The results of this screening were recorded on the soil sample log sheets. Samples were homogenized, and soil to be analyzed for SVOCs and Appendix IX metals was placed into the required containers. Subsurface sample intervals for SWMU 25 are listed in Table 2-1. If advancement of the DPT tooling was refused, sampling stopped at the affected location.

2.6.2 Groundwater Well Purging and Sampling

Approximately 1 to 2 days following redevelopment, purging and stabilization of wells prior to sampling was accomplished using low-flow techniques in accordance with SOP-13 of the UFP-SAP. Sampling was accomplished in accordance with SOP-14 of the UFP-SAP.

Prior to sampling, wells were purged using a bladder pump, since the static water level and well depth were beyond the specifications for a peristaltic pump. Recharge information was obtained during well development. In general, bladder pumps were used to sample wells with a static water level greater than

28 feet bgs. Two wells, 25MW04 and 25MW05, were sampled via Waterra® tubing as described in Section 2.4. The water recovered from these wells was very turbid and it was presumed that the well casings had been damaged (possibly through slope settlement) and were likely compromised. Consequently, the representativeness of the groundwater samples collected from these wells is questionable. Due to the extreme turbidity, the groundwater samples were collected at these locations using a peristaltic pump and filtered with a 40 micrometer (µm) pore size filter and placed into the required containers.

Groundwater quality parameters including pH, specific conductance, temperature, DO, and ORP were measured during purging at 5- to 10-minute intervals using an YSI Model 600 series multi-parameter water-quality meter and flow-through cell. Longer intervals were used for slower pumping wells. Turbidity readings were measured using a LaMotte 2020 turbidity meter. Water levels and pumping rates were also measured during purging at 5- to 10-minute intervals. Purging continued until the minimum purge volume (well volume plus the extraction tubing volume) and groundwater quality parameters stabilized. If water quality parameters did not stabilize within 4 hours of purging, sampling was initiated and this information was recorded on the low-flow purge data sheet.

Monitoring wells were sampled with the same pump (peristaltic or bladder) and tubing used during well purging. Immediately following the purging process and before sampling, the temperature, pH, specific conductance, DO, ORP, and turbidity were measured and recorded on the groundwater sample log sheet (see Appendix B.2). Groundwater samples were analyzed for SVOCs and Appendix IX metals (both total and dissolved).

Sample containers were filled by allowing the pump discharge to flow gently down the inside of the container with minimal turbulence. Samples designated for SVOC analysis were collected in 500 milliliter (mL) amber glass containers, and samples designated for metals analyses were collected in 100 mL plastic containers. Samples with turbidity values greater than 10 nephelometric turbidity units (NTUs) were field filtered for dissolved metals analyses prior to sample preservation using a 0.45 µm in-line filter. All pertinent field data, including sampling method, purge information, pump intake depth, and well location, were recorded on the low-flow purge data sheet and the groundwater sample log sheets (See Appendix B.2). See Figure 2-1 for all groundwater sampling locations.

2.7 DEVIATIONS FROM THE SWMU 25 UFP-SAP

Deviations from the SWMU 25 UFP-SAP are explained below and summarized in Table 2-3:

- The three borings located on the southwest side of Highway 58 (i.e., 25SB009, 25SB010, and 25SB011) were hand augered instead of being completed via DPT because of shallow boring refusal (2 feet bgs) upon encountering bedrock. Only surface soil samples were collected at these three boring locations.

- Three soil sample collection depths were proposed, one surface (0 to 2 feet bgs) and two subsurface (2 to 6 feet bgs and 6 to 10 feet bgs), to a total depth of 10 feet bgs at each soil boring location. At seven of the eleven borings, bedrock was shallower than 10 feet bgs; therefore, the total number of samples collected was reduced. One surface and one subsurface soil sample were collected at soil boring locations 25SB001, 25SB003, and 25SB005. Only a surface soil sample was collected at soil boring locations 25SB002, 25SB009, 25SB010, and 25SB011. Four soil borings (i.e., 25SB004, 25SB006, 25SB007, and 25SB008) had a total depth of 10 feet bgs; therefore, at each of these locations one surface and two subsurface samples were collected.

- Monitoring wells WES-7-4-81/25MW04 and WES-7-5-81/25MW05 were discovered to have been compromised (well riser was bent). Alternative methods were used for both redevelopment and groundwater sample collection (Waterra®). Although groundwater quality parameters were not achieved prior to sample collection at these two wells, the goal of gathering information of the general quality of the groundwater in these two locations was met for select physicochemical parameters such as pH and temperature. The chemical target analyte concentration data for these two wells is not useful for assessing potential human health risks and was not used in the risk assessment described in this report (see Section 7.0).

2.8 FIELD SAMPLE DOCUMENTATION

Sample documentation consisted of the completion of boring logs, matrix-specific sample log sheets, sample bottle tags, chain-of-custody records, FTMR forms, equipment calibration log sheets, field logbooks, and health and safety documentation. Field documentation was completed per SOP-03 (Tetra Tech, 2011). The sample log sheets contain information such as sample location and sample ID, container requirements and analyses to be performed, sample type, time, date, and method of sample collection. Equipment calibration log sheets are discussed in Section 2.11.1 and presented in Appendix B.5. Sample log sheets are presented in Appendix B.1 and B.2. Chain-of-custody records (see Appendix B.6) were used to track each sample from collection to receipt and analysis at the laboratory.

2.9 SAMPLE HANDLING, PACKAGING, AND SHIPPING

Sample handling activities included the selection of sample containers and preservatives, meeting allowable holding times, tracking sample custody, and maintaining samples at the appropriate storage temperature. Sampling containers were sealed in Ziploc plastic bags, and glass containers were wrapped in plastic bubble wrap to minimize the possibility of breakage during transport. The sample containers were then placed in a cooler lined with a large plastic garbage bag. The cooler was packed with a cushioning material (bubble wrap) to prevent container breakage. Samples were cooled immediately after collection with ice placed over the sample containers. A temperature blank was placed in each cooler prior to shipment. The plastic garbage bag tied and the chain-of-custody form was sealed in a Ziploc® bag and taped to the inside of the cooler lid. A signed and dated custody seal was applied to each end of the cooler and then covered with strapping tape to provide a tamper-evident seal. A Federal Express air bill was applied to the shipping cooler. Tetra Tech personnel maintained custody of the samples until they were relinquished to Federal Express. The Federal Express tracking number (airbill number) was recorded on the chain-of-custody form, and the sender's copy of the airbill was maintained for shipment tracking, if needed. All samples were shipped to the laboratory for overnight delivery and were received within sample holding times. Sample bottle tags were removed from each sample bottle by laboratory personnel and forwarded to the NSA Crane EPD.

2.10 QUALITY CONTROL SAMPLES

Quality Assurance/Quality Control (QA/QC) samples were collected and generated during sampling activities to monitor both field and laboratory procedures. These procedures are detailed in the approved UFP-SAP (Tetra Tech, 2011). QA/QC samples included field duplicates, equipment rinsate blanks, and temperature blanks. Field duplicate results are presented in Appendix C. The types of QA/QC samples are briefly described below:

- Field Duplicates - Field duplicates consisted of two samples collected independently at the same soil sampling location or groundwater monitoring well. Field duplicates were collected at the rate of 1 in 20 during field investigation activities per medium, and were used to assess the overall precision of the sampling and analysis program.

- Equipment Rinsate Blanks - Equipment rinsate blanks were obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through or over sample collection equipment (hand auger and Macro-Core®) after decontamination and before use. However, when pre-cleaned, dedicated, or disposable sampling equipment was used (no decontamination was required), one equipment rinsate blank was collected as a batch blank.

- Temperature blanks - Temperature blanks were used to determine if samples were adequately cooled during shipment. Temperature blanks consisted of analyte-free water poured into a clean sample container at the site or supplied by the fixed-based laboratory. One temperature blank was submitted to the laboratory in each cooler, and the temperature was checked upon receipt at the laboratory.

2.11 FIELD INSTRUMENT MEASUREMENTS

Field measurements taken and recorded during sampling included water temperature, pH, specific conductance, ORP, DO, turbidity, and groundwater level. Ambient air measurements of organic vapors in the breathing zone were recorded during intrusive field investigation activities, and organic vapors emanating from site sources, such as soil samples and well casings, were monitored. Instruments used during field activities to obtain these measurements included:

- PID
- YSI Model 600 series, multi-parameter water-quality meter
- LaMotte 2020 turbidity meter
- M-scope water-level indicator

2.11.1 Equipment Calibration

Instruments used in the field were calibrated daily prior to use according to manufacturers' requirements and in accordance with applicable SOPs. Equipment calibration logs are presented in Appendix B.5.

2.11.2 Field Investigation Preventive Maintenance Procedures/Schedule

The specific preventive maintenance procedures followed for field equipment were those recommended by the equipment manufacturers.

An appropriate maintenance check was performed daily on each piece of equipment. Critical spare parts were kept on site to reduce downtime. Spare parts included batteries, a DO-probe membrane kit (membranes and a bottle of solution), and air particle filters for the PID. Back-up instruments and equipment were available on site or were shipped within 1 day via overnight courier to avoid delays in the field schedule.

2.12 DECONTAMINATION

The non-dedicated, non-disposable equipment involved in field sampling activities was decontaminated before beginning work, during drilling and sampling activities, and at the completion of RFI activities in accordance with SOP-04 of the UFP-SAP. This equipment included the DPT rig, down-hole drilling tools, hand augers, and soil and water sampling equipment.

2.12.1 Major Equipment

All down-hole equipment, including down-hole drilling tools, were steam cleaned with high-pressure hot water prior to beginning work, between borings, and at the conclusion of each drilling shift.

All decontamination activities took place at a predetermined area within NSA Crane.

2.12.2 Sampling Equipment

All non-dedicated (reusable) equipment used for collecting samples was decontaminated before field sampling, between sample collections, and at the end of each sampling event. This equipment included stainless-steel trowels, stainless-steel mixing bowls, bladder pumps, etc. The decontamination steps were:

- Potable water and phosphate-free detergent wash (scrub if necessary)
- Potable water rinse
- Deionized (DI) water rinse
- Air dry (if possible)
- Wrap in aluminum foil (if not to be used immediately)

An isopropanol rinse was not necessary because no oily residue was evident on the sampling equipment.

Field analytical equipment such as pH, conductivity, and temperature probes were rinsed first with analyte-free water prior to making measurements. Water level measurement devices were rinsed with DI water.

2.13 WATER- LEVEL MEASUREMENTS

Water-level measurements were obtained from each monitoring well prior to development and purging. In addition, complete synoptic rounds of water levels were taken at all the wells as shown in Table 2-4.

Measurements were taken with an electrical water-level indicator (M-scope) using the top of the riser pipe as the reference point to determine water depth for monitoring wells. All measurements were taken in accordance with the UFP-SAP (Tetra Tech, 2011). A mark was placed at the top of the riser pipe to ensure that measurements were taken from a consistent reference point. Water-level measurements were recorded to the nearest 0.01 foot on groundwater level measurement forms, which are provided in Appendix B.2.

2.14 FIELD CORRECTIVE ACTION

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or "out of quality control" performance that can affect data quality; or modifying procedures to address unexpected/unusual field conditions encountered.

No nonconformances or suspected deficiencies occurred during any part of the field investigation; however, minor deviations from the approved UFP-SAP occurred and are described in Section 2.7 and summarized in Table 2-3.

2.15 INVESTIGATION-DERIVED WASTE (IDW) HANDLING

The field investigations generated several types of potentially contaminated wastes including personal protective equipment (PPE), decontamination fluids from the DPT rig and sampling equipment, DPT Macro-Core® plastic sleeves, well development and purge water, and soil cuttings. Management of each residue was performed as follows:

PPE, Pump Tubing, and DPT Plastic Sleeves – All PPE, tubing, and plastic sleeves were decontaminated, double-bagged, and placed in NSA Crane trash receptacles (i.e., dumpsters).

Well Development Water and Purge Water, Drill and Sampling Equipment Decontamination Fluids – All well development and purge water and equipment decontamination fluids were collected and discharged to the NSA Crane-permitted waste treatment plant.

Waste Cuttings, Cores, and Rock from Drilling Activities – For each boring, the cuttings produced were scanned for VOCs. VOC readings were at background levels for all borings, so cuttings were used as backfill since all borings terminated above the water table. Any remaining cuttings were spread on the ground in the immediate vicinity of the boring.

Additional requirements for IDW handling can be found in SOP-06 contained in Appendix D of the UFP-SAP.

2.16 SITE MANAGEMENT AND FACILITY SUPPORT

The FOL was designated as the lead in coordinating all day-to-day activities during the investigation. The FOL ensured that all field team members (including subcontractors) were familiar with the approved UFP-SAP and the HASP. Additionally, the FOL was responsible for all sampling, QA/QC and field documentation requirements, and field change orders. The FOL reported to the Task Order Manager (TOM) on a daily basis regarding the status of fieldwork.

All site preparation, mobilization/demobilization, and sampling activities were coordinated through NSA Crane personnel.

2.17 RECORDKEEPING

Various hardcover, bound record books were maintained for each field activity in accordance with SOP-03 of the UFP-SAP. The Master Site Logbook served as the overall record of field activities. Information recorded daily in the Master Site Logbook included daily field activities, weather conditions, identity of and arrival and departure times of personnel, management issues, etc. Various field notebooks were also maintained. Copies of field log books are presented in Appendix B.4.

The FOL maintained and secured all field records. One week after completion of field activities, all field records, chain-of-custody forms, sample log sheets, field forms, logbooks, and notebooks were docketed and incorporated in the central project file.

TABLE 2-1

BORING DATES AND DEPTHS
SWMU 25 - HIGHWAY 58 DUMP SITE A
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

Boring Number	Total Depth (feet bgs)	Installation Method	Date Installed	Depth Interval(s) of Soil Samples (feet bgs)
25SB001	5	DPT	11-Jul-11	0-2, 2-5
25SB002	2	DPT	11-Jul-11	0-2
25SB003	5.5	DPT	11-Jul-11	0-2, 2-6
25SB004	10	DPT	11-Jul-11	0-2, 2-6, 6-10
25SB005	6	DPT	12-Jul-11	0-2, 2-6
25SB006	10	DPT	12-Jul-11	0-2, 2-6, 6-10
25SB007	10	DPT	12-Jul-11	0-2, 2-6, 6-10
25SB008	10	DPT	12-Jul-11	0-2, 2-6, 6-10
25SB009	2	HA	11-Jul-11	0-2
25SB010	2	HA	11-Jul-11	0-2
25SB011	2	HA	11-Jul-11	0-2

Notes:
DPT = Direct Push Technology
HA = Hand Auger
bgs = below ground surface

TABLE 2-2

SAMPLING SUMMARY
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

Sample Identification	Depth (feet bgs)	SVOCs	METALs	*Field Parameters
SURFACE				
25SS001 to 25SS011				
25SS001-0002	0 to 2.0	X	X	PID
25SS002-0002	0 to 2.0	X	X	PID
25SS003-0002	0 to 2.0	X	X	PID
25SS004-0002	0 to 2.0	X	X	PID
25SS005-0002	0 to 2.0	X	X	PID
25SS006-0002	0 to 2.0	X	X	PID
25SS007-0002	0 to 2.0	X	X	PID
25SS008-0002	0 to 2.0	X	X	PID
25SS009-0002	0 to 2.0	X	X	PID
25SS010-0002	0 to 2.0	X	X	PID
25SS011-0002	0 to 2.0	X	X	PID
SUBSURFACE				
25SB01 to 25SB11				
25SB001-0206	2.0 to 6.0	X	X	PID
25SB003-0206	2.0 to 6.0	X	X	PID
25SB004-0206	2.0 to 6.0	X	X	PID
25SB004-0610	6.0 to 10.0	X	X	PID
25SB005-0206	2.0 to 6.0	X	X	PID
25SB006-0206	2.0 to 6.0	X	X	PID
25SB006-0610	6.0 to 10.0	X	X	PID
25SB007-0206	2.0 to 6.0	X	X	PID
25SB007-0610	6.0 to 10.0	X	X	PID
25SB008-0206	2.0 to 6.0	X	X	PID
25SB008-0610	6.0 to 10.0	X	X	PID
25FD071111-01 (25SB04-0002)	0 to 2.0	X	X	PID
25FD071111-02 (25SB04-0206)	2.0 to 6.0	X	X	PID

Notes:
bgs - below ground surface
SVOCs - Semi-volatile Organic Carbons
PID - Photoionization detector
*All PID readings were below background.

GROUNDWATER	**Round 1**	
Sample Identification	**SVOCs**	**Metals**
25GW718101	X	X
25GW728101	X	X
25GW738101	X	X
25GW748101	X	X
25GW758101	X	X
25FD71311-01 (duplicate of 25GW738101)	X	X
25RB71511-01	X	X
25RB71511-02	X	X
GROUNDWATER	**Round 2**	
Sample Identification	**SVOCs**	**Metals**
25MW718102	X	X
25MW728102	X	X
25MW738102	X	X
25MWT1061202	X	X
FD110112-01 (duplicate of 25MW718102)	X	X

TABLE 2-3

SAMPLE DEVIATION
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

SOIL	
Boring Location	**Reason For Not Collecting Sample**
25SB0010610	Boring Refusal
25SB0020206	Boring Refusal
25SB0020610	Boring Refusal
25SB0030610	Boring Refusal
25SB0050206	Boring Refusal
25SB0090206	Boring Refusal
25SB0090610	Boring Refusal
25SB0100206	Boring Refusal
25SB0100610	Boring Refusal
25SB0110206	Boring Refusal
25SB0110610	Boring Refusal

GROUNDWATER	
Monitoring Well Location	**Reason for deviating from SOP**
25GW7481	Well compromised
25GW7581	Well compromised

TABLE 2-4

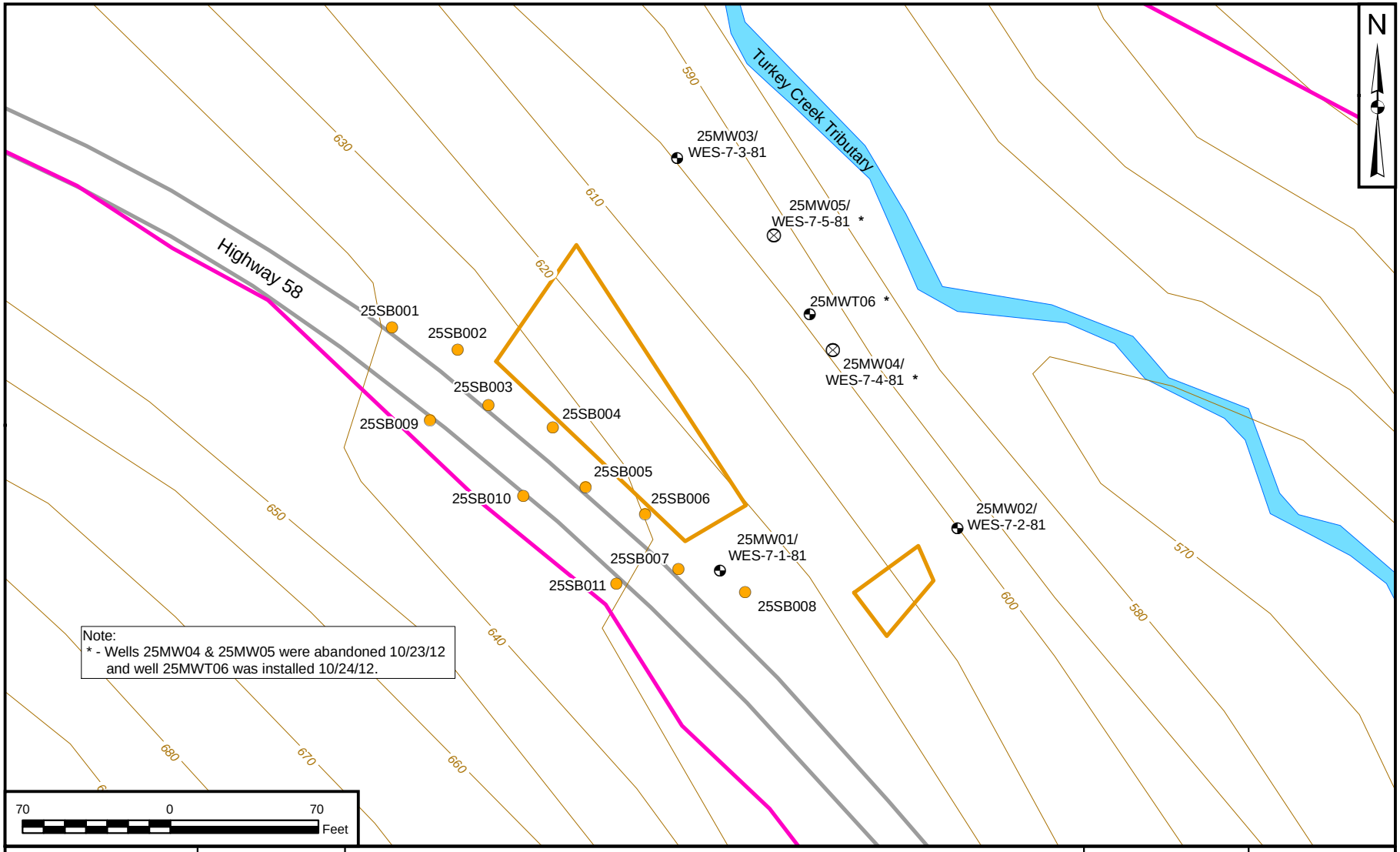
MONITORING WELL CONSTRUCTION INFORMATION AND WATER LEVEL MEASUREMENTS
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

Well Number	Installation Date	Northing (NAD83)	Easting (NAD83)	Ground Elevation	Top of Riser Elevation	Total Depth[1]	Screened Interval		Water-Bearing Zone	Depth to Water - Measured July 11-12, 2011	Depth to Water - Measured October 31, 2012	Water Elevation
							Top	Bottom				
		(feet)	(feet)	(feet amsl)	(feet amsl)	(feet bgs)	(feet amsl)	(feet amsl)		(feet brp)	(feet brp)	(feet amsl)
25MW01 / 25GW7181	7/1/1981	1309481.8748	3026477.4923	629.54	632.54	41.50	602.52	593.34	Plz	21.50	NA	611.04
25MW02 / 25GW7281	7/2/1981	1309501.8480	3026589.9319	601.89	604.89	35.00	581.62	572.27	Plz	36.04	NA	568.85
25MW03 / 25GW7381	7/3/1981	1309677.4027	3026457.1627	597.02	600.02	38.00	573.62	564.30	Plz	29.23	NA	570.79
25MW04 / 25GW7481*	7/4/1981	1309586.5393	3026531.0978	595.80	598.80	39.00	571.49	562.16	Plz	28.10	NA	570.70
25MW05 / 25GW7581*	7/5/1981	1309640.9423	3026503.1591	593.73	596.73	39.00	569.43	560.08	Plz	26.20	NA	570.53
25MW01 / 25MW718102	7/1/1981	1309482.24	3026477.59	628.92	631.92	45.50	601.90	592.72	Plz	NA	27.90	604.02
25MW02 / 25MW728102	7/2/1981	1309502.34	3026589.88	601.93	604.93	44.33	581.66	572.31	Plz	NA	36.75	568.18
25MW03 / 25MW738102	7/3/1981	1309677.80	3026457.35	596.06	599.06	39.02	567.00	555.42	Plz	NA	32.55	566.51
25MWT06 / 25MWT1061202	10/23/2012	1309603.34	3026520.06	594.24	597.28	43.48	583.49	574.17	Plz	NA	29.06	568.22

Notes:

1 = Total depth of boring; total depth of well may be less.
* Well was damaged. This well was abandoned in Round 2
amsl = Above mean sea level (NAVD88).
bgs = Below ground surface.
brp = Below reference point (top of riser for monitoring wells).
NA = not applicable
NM = not measured
NAVD88 = North American Vertical Datum of 1988
Plz = Lower Pennsylvanian water-bearing zone

PGH P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU25_HIGHWAY58_SAMPLOCS.MXD 02/12/13 JEE



DRAWN BY	DATE
J. ENGLISH	12/02/10
CHECKED BY	DATE
J. LUCAS	02/12/13
REVISED BY	DATE
J. ENGLISH	02/12/13
SCALE	
AS NOTED	

SOIL SAMPLING AND WELL LOCATIONS
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
3116	F27L
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 2-1	0

3.0 DATA PRESENTATION AND QUALITY

This section describes the data and summarizes the data quality for the field investigation performed during the week of July 11-15, 2011; October 23, 24, and 31, 2012; and November 1, 2012. Data presentation is provided in Section 3.1; data quality is described in Section 3.2.

3.1 DATA PRESENTATION

Section 2.0 describes RFI data collection. RTI Laboratories, Inc. (RTI) analyzed samples collected July 11-15, 2011. Empirical Laboratories, LLC (Empirical) analyzed samples collected in October and November 2012. Table 2-2 summarizes these samples. Tetra Tech conducted data validation and quality review as described in Section 3.2. The subsections below present descriptions of available background data and SWMU 25 site data.

3.1.1 Background Data Set Descriptions

Prior to the RFI, soil samples were collected and analyzed as part of the Basewide Background Soil Investigation, which established metals concentration representative of the entire NSA Crane complex (Tetra Tech, 2001). All metals likely to be included in NSA Crane environmental investigations were analyzed in the Basewide Background Soil Investigation. This investigation provided background soil data that can be used to determine whether observed metals concentrations in SWMU soils are similar to background concentrations.

In the Basewide Background Soil Investigation, soil samples were classified into Soil Groups that uniquely represent the chemical and physical soil characteristics that distinguish NSA Crane soils. Those characteristics are:

- Geological parent material (referred to as Depositional Environment in Tetra Tech, 2001)
- Depth (surface or subsurface)
- Grain size

For SWMU 25, there is one Depositional Environment (Pennsylvanian) and two depths (surface and subsurface). In the subsurface there are three distinct grain sizes. Tables 3-1 and 3-2 of this RFI report present summaries of NSA Crane background data. These tables were taken from the Basewide Background Soil Investigation Report (Tetra Tech, 2001). Table 3-1 summarizes the background soil samples collected (Alluvial, Mississippian, and Pennsylvanian surface soil) at NSA Crane, the number of

samples analyzed, depth (surface or subsurface), and the gross grain size classification. Table 3-2 presents the metals analyzed and the simple summary statistics for each soil type.

More recently, data from upgradient wells across NSA Crane (Tetra Tech, 2013) were reviewed and used to compile a set of metals concentration data that represent typical background conditions in groundwater. This review is documented in an unpublished technical memorandum so the groundwater background data are included in this report where pertinent.

3.1.1.1 SWMU 25 Surface Soil Background Concentrations

After chemical analyses and extensive statistical testing, one distinct soil group emerged that represents SWMU 25 background surface soils (Tetra Tech, 2001):

- Soil Group 3 – Alluvial, Mississippian, and Pennsylvanian surface soil

Table 3-2 presents the data associated with this soil group, as described in Section 3.1.1, above.

3.1.1.2 SWMU 25 Subsurface Soil Background Concentrations

Similar to surface soils, two distinct soil groups that represent SWMU 25 background subsurface soils (Tetra Tech, 2001):

- Soil Group 8 – Pennsylvanian Subsurface Clay and Silt
- Soil Group 9 – Pennsylvanian Subsurface Sand

Table 3-2 presents the data associated with these soil groups, as described in Section 3.1.1, above.

3.1.1.3 SWMU 25 Groundwater Upgradient Concentrations

For mobile environmental media such as surface water, sediment, and groundwater, “background” concentrations are represented by upgradient locations and data. These locations represent concentrations of chemicals that are unaffected by SWMU operations. Although monitoring well 25MW01 in an upgradient location relative to the remaining onsite monitoring wells, the groundwater from this well location could be within the influence of the former dump activities, therefore its use as an upgradient well for evaluating levels of contamination in downgradient wells was used cautiously.

3.1.1.4 NSA Crane Basewide Groundwater Upgradient Conditions

The NSA Crane Basewide groundwater evaluation (Tetra Tech, 2013) provides a basis for determining whether groundwater conditions at a particular SWMU were impacted by site operations. The background groundwater evaluation provides data on metals concentrations in groundwater in the Pennsylvanian-age aquifer at NSA Crane not impacted by site operations at SWMUs. In accordance with RCRA (USEPA, 1989a) and risk assessment guidance (USEPA, 1989b), if site concentrations are not significantly greater than background concentrations, it may be inferred that an operationally-related release of those contaminants has not occurred, and the site investigation is often terminated at that point if inorganics are the only issue. The basewide data sets establish a statistically-based data set of concentrations of inorganic constituents in groundwater in Pennsylvanian-age bedrock.

Table 3-3 presents summary statistics for basewide NSA Crane upgradient groundwater. The statistics of greatest significance are the maximum detected concentrations and the upper tolerance limits (UTLs). Maximum detected concentration is the maximum observed value in all upgradient Pennsylvanian wells used for the study. UTLs represent the values above which a background concentration would be expected in five percent or less of the background data. Any value observed at SWMU 25 that exceeds a UTL may represent site-related contamination, especially if the site concentration exceeds the maximum observed basewide upgradient concentration.

3.1.2 SWMU 25 Data Set Descriptions

3.1.2.1 SWMU 25 Surface and Subsurface Soil Site Data

In the July 2011 RFI Investigation, select surface and subsurface soil samples were collected for metals and SVOCs analyses as described in Section 2.0. The chemicals of potential concern (COPCs) for the SWMU 25 RFI were developed using initial characterization and confirmation samples from the 1997 SWMU 25 IM. As described in the UFP-SAP for the SWMU 25 RFI, the target analytes for the IM included an extensive list of Appendix IX compounds (> 200 compounds) associated with VOCs, SVOCs, pesticides, PCBs, metals, dioxins, and furans (Tetra Tech, 2011). Based on IM soil results, the compounds detected most consistently in soil and associated with exceedances of IM Cleanup Levels were metals, SVOCs including polycyclic aromatic hydrocarbons (PAHs),. These three compound groups were selected for evaluation during the SWMU 25 RFI. During development of the SWMU 25 RFI work plan, the list of relevant COPCs was reduced to a list of compounds that appeared to be most prevalent and had a history of exceeding Cleanup Levels at the site, based on IM sampling results (Tetra Tech, 2011). The focused RFI soil sampling and analysis conducted at SWMU 25 during 2011 and 2012 was

designed to determine the presence of metals and SVOCs contamination in backfill materials along Highway 58 and to delineate the extent of SVOC and metals contamination in soil.

Some surface and subsurface soil samples were not collected as scheduled, but all scheduled samples were collected when possible. Deviations from sampling procedures are explained in Section 2.7 and summarized in Table 2-3. Appendices C-1 and C-2 contain surface and subsurface soil data generated during the RFI investigation, respectively. The Nature and Extent of Contamination is further described in Section 5.0.

3.1.2.2 SWMU 25 Groundwater Site Data

Some groundwater samples were collected at or near SWMU 25 to support another environmental investigation. Those samples were not used to characterize SWMU 25 conditions for this investigation because the data are nearly a decade old. During groundwater sample collection for this RFI, turbidity values were generally high, except at the upgradient well (25MW01). The Round 1 samples collected for metals analyses were not used in the HHRA due to the turbid conditions of the well. Several samples have turbidity values greater than 10 NTUs and some have values greater than 100 NTUs. Appendix B.2 presents the turbidity data collected during the RFI. Appendix C.3 presents groundwater data generated during July 2011 and Appendix C.4 presents groundwater data generated during the October/November 2012 RFI investigations. A comparison of SWMU 25 groundwater metals concentrations to NSA Crane background UTLs and maximum metals concentrations listed in Table 3-3 for Pennsylvanian aquifer background indicates that several metal concentrations in several samples exceed both the UTL and the maximum upgradient value. Initially, this suggested there is a metals contamination problem in SWMU 25 groundwater. Further investigation, however, revealed that the concentrations greater than UTL or maximum upgradient value are associated with turbid samples. The comparison of turbid SWMU 25 metals concentrations to basewide upgradient concentrations is not a valid comparison because contaminant concentrations in turbid samples are biased high.

3.1.2.3 Hexavalent Chromium Concentrations

Two different species of chromium are commonly encountered in environmental investigations. Hexavalent chromium, the more soluble species, is much more toxic than trivalent chromium. When this RFI was planned, the potential for detecting hexavalent chromium in groundwater was considered to be low because this site has no history of hexavalent chromium use or release. Additionally, the potential for hexavalent chromium to be present in SWMU 25 groundwater can be evaluated using known relationships between chromium metal species concentrations and the measured pH and oxidation-reduction potential (Eh).

When the stabilities of various chromium species are plotted on a two-dimensional diagram of Eh versus pH, there is a region of Eh and pH values over which each species predominates. Figure 3-1 depicts these regions for various chromium species and highlights the region for hexavalent chromium as an orange colored area. Eh values (shown as E_{SHE}) are plotted on the y-axis and pH values are plotted on the x-axis. Solid black lines separate the various stability regions for each species. Figure 3-1 is a representative diagram. Different versions of this diagram can be found readily in the scientific literature and on the internet.

At Eh values less than those in the orange colored region of Figure 3-1, non-hexavalent chromium species predominate. The most common non-hexavalent species encountered in environmental media is trivalent chromium. On Figure 3-1, there are four red-colored dots depicting typical SWMU 25 groundwater Eh and pH conditions as measured during the RFI. All of these dots are well within a trivalent chromium region (for Cr_2O_3), indicating that hexavalent chromium is effectively non-existent in SWMU 25 groundwater and all of the total chromium is effectively trivalent chromium.

One caveat is notable, though not significant in this case. Figure 3-1 depicts the stability of various chromium species under conditions of thermodynamic equilibrium. That is, the reduction of hexavalent chromium to less oxidized chromium is complete and no more hexavalent chromium will be reduces unless geochemical conditions change or additional chromium is added to or removed from the system. Most environmental systems are not likely to be at equilibrium with regard to chromium speciation, unless a release of chromium, if it had occurred, had occurred years earlier. In the case of SWMU 25 there is no reason to expect a release of chromium occurred and if it did, the amount of chromium released was likely to have been small. This, coupled with the strong thermodynamic tendency for all hexavalent chromium to have converted to trivalent chromium, is reason to assert that hexavalent chromium is virtually non-existent at SWMU 25. For these reasons, the total chromium concentrations have been treated as trivalent chromium.

3.2 DATA QUALITY

This section summarizes the data quality for the July 2011 and October/November 2012 RFI Investigation data sets. A tabulation of data quality characteristics and detailed QC data review for this investigation are presented in Appendix D of this report.

Based on the reviews in Appendix D, the following can be summarized about SWMU 25 data quality. Sample collection and analysis completeness was satisfactory with a few insignificant exceptions (See Appendix D). The RFI Investigation data are also of sufficient quality to support this RFI, except for

results that were classified as "rejected" during data validation and results associated with turbid samples collected from abandoned wells 25MW04 and 25MW05. Because samples from 25MW04 and 25MW05 are not considered to be representative of site conditions, the chemical analysis results for those samples are not presented in this report. Some information obtained from those locations, such as boring log information, was useful for documenting physical site conditions and was included in this report.

Detection limits for some analytes exceeded target levels. The exceedances are considered to be typical of environmental investigations and did not have any significant adverse effect on data use because they did not affect chemicals of primary interest or occurred infrequently, etc. The general data quality is summarized below. Significant deficiencies and limiting data quality characteristics to be considered when using the data are noted below.

3.2.1 SWMU 25 Rejected Analytical Data

- **Surface Soil**: The results for two analytes (1,1-biphenyl and acetophenone) were reported as UR in several surface soil samples because of low analytical sensitivity (Appendix C.2). The non-detect levels, however, were well below the applicable risk-based screening values. These chemicals would have been detectable if the concentrations had approached the screening value concentrations. Results from 3 of the 12 benzaldehyde and 4 of the 12 caprolactam results were reported as UR.

- **Subsurface Soil**: Four analytes (1,1-biphenyl and acetophenone, benzaldehyde, and caprolactam) were reported as UR in at least one subsurface soil sample. Most of the situations involved acetophenone alone.

- **GW**: Fourteen phenol results were qualified as UR (non-detected, estimated) in well 25MW01 during RFI Round 1 because of low analytical sensitivity. All four of the acetophenone, benzaldehyde and caprolactam results from Round 1 were qualified as UR. The analytical performance improved in Round 2 as is evident from having no data rejections for these chemicals during Round 2. The analytical performance also improved for phenol analysis as is evident from only one sample out of the five Round 2 samples having rejected phenol results.

The risk assessors reviewed the rejected analytical results. The phenols would have been detectable at concentrations within the typical risk ranges considered to be acceptable at environmental sites. This means that if phenols were present at concentrations near the upper end of the tolerable risk range, they would have been detectable. Because there were no detections of phenols in surface or subsurface soil, it is very unlikely phenols are present in the groundwater. Also, there is no previous evidence or history

of these chemicals being present at SWMU 25. For example, during the IM at SWMU 25, soil was characterized at the start of the IM and during the confirmation stage. Soils were analyzed for phenols and all results were less than the relevant screening concentration and reported by the laboratory at concentrations less than the method detection limit.

The rejected non-detected results for acetophenone, benzaldehyde, and caprolactam are at least two orders of magnitude less than their current Regional Screening Levels (RSLs). These compounds would have to be detected at concentrations significantly greater than their detection limits to present a human health risk. The rejected non-detected results were 5 UR micrograms/liter (µg/L) for 1,1-biphenyl in Round 1. In Round 2, the non-detect level was half of this value and still bi-phenyl was not detected and the non-detect results were not rejected. Unless 1,1-biphenyl was detected at concentrations significantly greater than its RSL, it would most likely not be retained as a COPC in a human health risk assessment. Since 1,1-biphenyl has not been detected in soil or at detectable concentrations in groundwater it does not present a human health risk at SWMU 25. Therefore, the risk assessor concluded that resampling for these compounds is not required.

TABLE 3-1

SUMMARY OF SOIL SAMPLES COLLECTED FOR CHEMICAL ANALYSIS
NSA CRANE
CRANE, INDIANA

Depositional Environment	Surface or Subsurface Soil	Gross Grain Size Classification	Number of Samples Sent for Chemical Analysis
ALLUVIUM	SS		5
ALLUVIUM	SB	CLAY	3
ALLUVIUM	SB	SAND	4
ALLUVIUM	SB	SILT	5
LOESS/GLACIAL	SS		5
LOESS/GLACIAL	SB	CLAY	5
LOESS/GLACIAL	SB	SAND	3
LOESS/GLACIAL	SB	SILT	5
MISSISSIPPIAN	SS		5
MISSISSIPPIAN	SB	CLAY	4
MISSISSIPPIAN	SB	SAND	3
MISSISSIPPIAN	SB	SILT	5
PENNSYLVANIAN	SS		5
PENNSYLVANIAN	SB	CLAY	4
PENNSYLVANIAN	SB	SAND	1
PENNSYLVANIAN	SB	SILT	5
Total Number of Samples Sent for Chemical Analysis			67

Notes:
SS - surface soil
SB - subsurface soil

TABLE 3-2

MINIMUM DETECTABLE DIFFERENCE IN MG/KG BETWEEN SITE AND BACKGROUND DATA
BASEWIDE BACKGROUND REPORT
NSA CRANE
CRANE, INDIANA

SOIL GROUP (1)	Soil Group 1	Soil Group 2	Soil Group 3	Soil Group 4	Soil Group 5	Soil Group 6	Soil Group 7	Soil Group 8	Soil Group 9	SWMU 25 MINIMUM SCREENING CRITERIA	SWMU 25 SAMPLING PARAMETERS
SOIL TYPES(2)	LS	LBC/LBL/LBS	AS/MS/PS	ABL/ABS	ABC	MBC/MBS	MBL	PBC/PBL	PBS		
METAL (mg/kg)											METAL (mg/kg)
ALUMINUM	3,054	2,967	3,490	1,996	9,477	4,302	2,633	2,589	5,430	7700	ALUMINUM
ANTIMONY	0.03	3.37	1.68	0.25	0.36	1.10	0.10	3.78	0.38	NA	ANTIMONY
ARSENIC	1.50	1.91	2.57	2.65	3.67	2.00	1.32	2.39	2.90	0.026	ARSENIC
BARIUM	27.2	20.9	38.7	12.7	52.7	22.3	33.4	20.0	24.8	330	BARIUM
BERYLLIUM	0.12	0.20	0.16	0.09	0.53	0.16	0.19	0.14	0.14	16	BERYLLIUM
CADMIUM	0.05	0.05	1.07	0.05	0.31	1.05	0.81	0.20	0.14	0.36	CADMIUM
CALCIUM	321	207	10,814	220	327	434	2,683	347	54.00	NA	CALCIUM
CHROMIUM	2.48	6.14	4.54	3.96	11.33	5.00	6.26	4.47	7.70	0.017	CHROMIUM
COBALT	3.74	2.33	6.13	3.92	5.70	1.80	2.73	2.86	8.80	2.3	COBALT
COPPER	2.42	4.60	3.35	1.16	4.53	4.44	5.99	4.57	5.60	28	COPPER
IRON	3,593	6,662	7,779	6,122	21,043	6,724	2,360	8,316	11,300	5500	IRON
LEAD	2.33	1.74	4.15	2.04	5.70	2.20	2.11	2.67	11.70	11	LEAD
LITHIUM	1.98	5.96	6.02	2.87	11.52	8.03	3.30	11.51	8.60	NA	LITHIUM
MAGNESIUM	336	575	512	276	810	634	734	497	654	NA	MAGNESIUM
MANGANESE	536	130	896	258	1,014	98	601	151	327	180	MANGANESE
MERCURY	0.02	0.02	0.02	0.03	0.02	0.003	0.02	0.04	0.02	100	MERCURY
NICKEL	3.11	2.88	3.18	1.58	4.02	3.40	3.33	4.39	4.60	38	NICKEL
POTASSIUM	308	261	352	165	1,143	331	218	233	353	NA	POTASSIUM
SELENIUM	0.12	0.05	0.15	0.07	0.65	0.12	0.09	0.21	0.28	0.52	SELENIUM
SILVER	0.01	0.01	0.02	0.005	0.078	0.01	7.7E-10	0.02	0.05	4.2	SILVER
SODIUM	5.40	62.49	8.97	1.69	96.8	79.0	9.98	71.2	1.15	NA	SODIUM
STRONTIUM	3.50	3.73	17.07	1.54	1.29	7.77	3.89	4.19	5.40	NA	STRONTIUM
THALLIUM	0.04	0.05	0.05	0.03	0.18	0.07	0.06	0.05	0.09	0.0569	THALLIUM
THORIUM	1.06	1.47	1.27	0.82	0.00	2.10	1.16	1.61	0.22	NA	THORIUM
TIN	0.03	0.07	0.13	0.04	2.44	0.16	0.06	0.07	4.90	NA	TIN
VANADIUM	6.41	8.11	8.83	3.49	10.49	8.36	5.30	8.58	14.10	7.8	VANADIUM
ZINC	13.8	9.91	12.8	5.64	19.8	11.1	10.3	11.3	11.4	46	ZINC

Notes:
1 - No statistical analysis was done for soil groups 5 and 9 because only one sample is in this data set.
2 - Collective soil types within a soil group (see Figure 4-1 of Basewide Background Report for additional information)
Highlight indicates exceedance of minimum screening criteria

ABC = Alluvial subsurface clay soil
ABL = Alluvial subsurface silt soil
ABS = Alluvial subsurface sand soil
AS = Alluvial surface soil
LBC = Loess/glacial subsurface clay soil
LBL = Loess/glacial subsurface Loess soil
LBS = Loess/glacial subsurface sand soil
LS = Loess/glacial surface soil
MBC = Mississippian residual subsurface clay soil
MBL = Mississippian residual subsurface silt soil
MBS = Mississippian residual subsurface sand soil
MS = Mississippian residual surface sand soil
PBC = Pennsylvania residual subsurface clay soil
PBL = Pennsylvania residual subsurface silt soil
PBS = Pennsylvania residual subsurface sand soil

TABLE 3-3

SUMMARY STATISTICS
BASEWIDE PENNSYLVANIAN BEDROCK BACKGROUND GROUNDWATER EVALUATION
NSA CRANE, INDIANA
CRANE, INDIANA

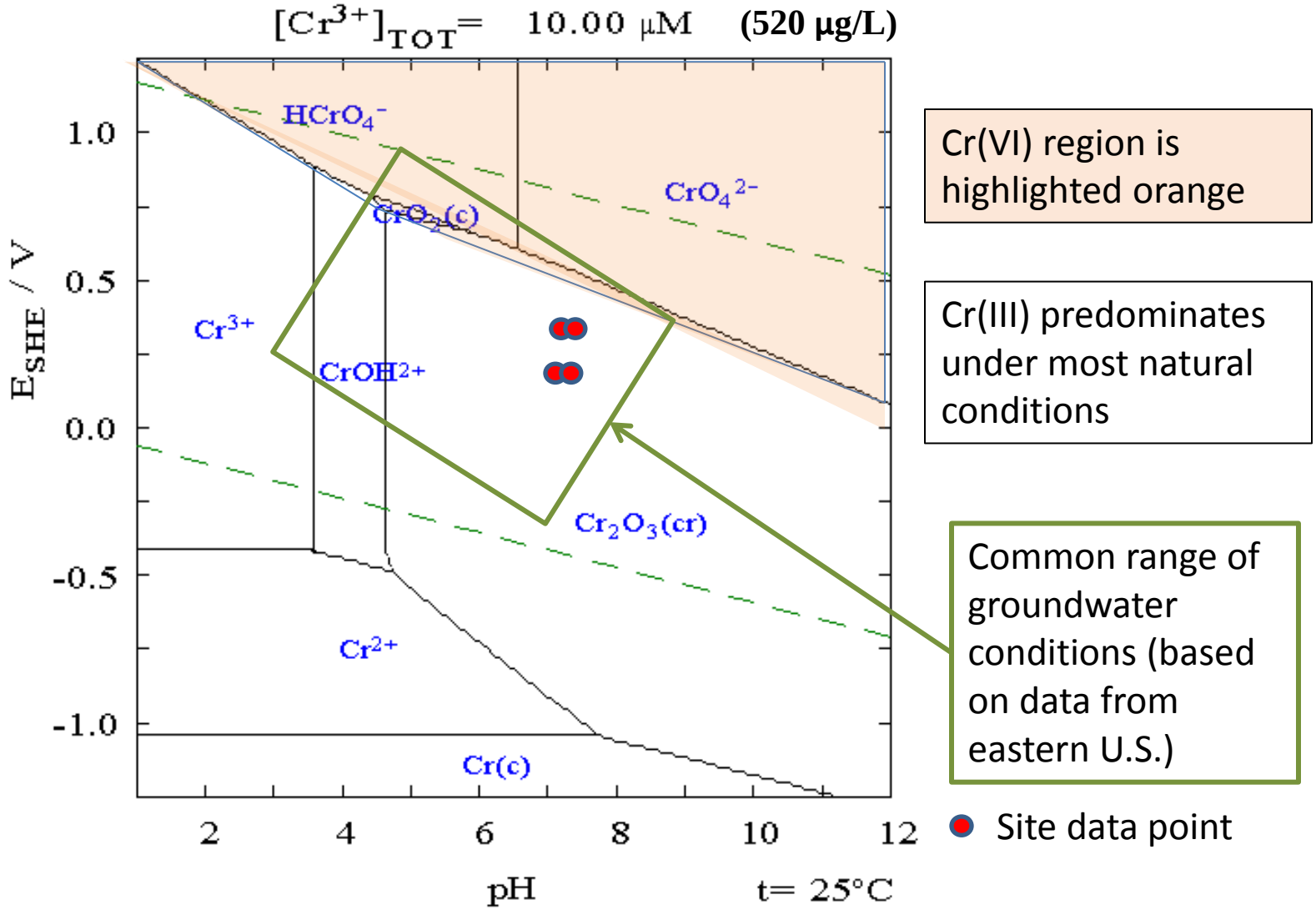
PARAMETER[1]	FOD	RANGE OF DETECTION LIMITS	MINIMUM DETECTED CONCENTRATION	MAXIMUM DETECTED CONCENTRATION	DATA DISTRIBUTION[2]	UTL[3,4]
ALUMINUM	19/28	8.3 - 200	28.5	8,500	Log-Normal	6,183
ANTIMONY	1/28	0.02 - 4	2.9	2.9	Assumed Nonparametric	NA [5]
ARSENIC	12/29	0.16 - 3.2	0.66	15.2	Assumed Nonparametric	9.1
BARIUM	27/29	12.8 - 15.6	13.2	97.5	Log-Normal	96.9
BERYLLIUM	6/28	0.02 - 1.8	0.1	3.01	Assumed Nonparametric	2.0 [6]
CADMIUM	3/29	0.039 - 1	0.08	0.9	Assumed Nonparametric	0.55 [6]
CALCIUM	28/28	NA	7,190	216,000	Log-Normal	216,000
CHROMIUM	9/29	0.17 - 5	0.58	26.2	Assumed Nonparametric	14.6 [6]
COBALT	21/28	1 - 3	2	64.4	Nonparametric	65.5
COPPER	17/28	0.12 - 2.1	0.67	21.6	Log-Normal	14.6
IRON	25/28	61.7 - 344	12.7	41,800	Log-Normal	34,500
LEAD	4/29	0.157 - 2.5	0.54	15.5	Assumed Nonparametric	9.0 [6]
MAGNESIUM	28/28	NA	2,950	229,000	Log-Normal	229,000
MANGANESE	27/28	566 - 566	6.89	5940	Log-Normal	4,470
MERCURY	2/29	0.007 - 0.2	0.16	0.39	Assumed Nonparametric	NA [5]
NICKEL	24/28	10 - 10	1.56	131	Log-Normal	135
POTASSIUM	22/28	3,390 - 5,000	403	5,380	Nonparametric	6,450
SELENIUM	7/29	0.04 - 2.5	0.33	4.1	Assumed Nonparametric	2.7 [6]
SILVER	0/29	0.028 - 3	NA	NA	Assumed Nonparametric	NA [5]
SODIUM	28/28	NA	10,100	165,000	Log-Normal	165,000
THALLIUM	1/28	0.04 - 5	0.08	0.08	Assumed Nonparametric	NA [5]
TIN	0/24	0.048 - 190	NA	NA	Assumed Nonparametric	NA [5]
VANADIUM	5/28	0.06 - 3	2.1	17.9	Assumed Nonparametric	11.4 [6]
ZINC	23/28	1.1 - 10	2.16	161	Log-Normal	140

NOTES
(1) Results for total metals (i.e., unfiltered samples)in micrograms per liter (µg/L).
(2) Data distribution determined using Shapiro Wilk Test with a 5-percent significance level.
(3) UTLs are presented using three significant figures if the value is greater than 10; otherwise, two significant figures are presented.
(4) UTLs were calculated using ProUCL, Version 4.1.1. For assumed nonparametric distributions, the 95-percent KM UTL is presented.
(5) There are only one or two detectable concentrations. Computing summary statistics is not appropriate.
(6) ProUCL warns that there may not be enough detectable concentrations for the calculations to be reliable enough to draw conclusions.

Rationale for UTL Selected from ProUCL Output
If all concentrations were detectable and data distributions are not Normal, use Nonparametric 95-percent UTL with 95-percent Coverage.
If any results are non-detect, use 95-percent Kaplain Meier UTL with 95-percent Coverage.

FOD = Frequency of detection.
KM = Kaplan-Meier.
UTL = Upper tolerance limit.
NA = Not applicable.

Figure 3-1. Chromium Speciation Diagram



4.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

4.1 PHYSIOGRAPHY AND TOPOGRAPHY

NSA Crane is located in the unglaciated area of the Crawford Uplands Physiographic Province. This province is a rugged, highly vegetated, dissected plateau bounded by the Mitchell Plain Physiographic Province to the east and the Wabash Lowland Physiographic Province to the west (Tetra Tech, 2001). The Mitchell Plain is a low, dissected limestone plateau with sinkholes and karst topographic features. The boundary between the Crawford Upland and the Mitchell Plain is marked by the highly irregular, eastern-facing Chester Escarpment. Springs, caverns, caves, and other solution weathering features can be found along this escarpment and on the eastern edge of the NSA Crane facility. The boundary between the Crawford Upland and the Wabash Lowland near the western boundary of NSA Crane is gradual (Tetra Tech, 2001). The terrain is predominantly rolling with moderately incised stream valleys throughout and occasional flat areas in the central and northern portions of NSA Crane (Figure 4-1). The elevations across NSA Crane range from about 500 feet above mean sea level (amsl) to about 850 feet amsl. Topographic relief in the Crawford Upland generally ranges from 100 to 350 feet. Greater relief exists in the eastern part of NSA Crane near the Chester Escarpment (Tetra Tech, 2001).

The Highway 58 Dump Site A (SWMU 25) is located in the central portion of NSA Crane (Figure 1-1), on the northeast side of Highway 58, which runs through the center of the facility. Ridge crests generally lie at elevations of 750 to 800 feet amsl. Natural surface drainage at NSA Crane is dendritic and defines four drainage basins. Dump Site A is located in Draining Area IV, which occupies the central portion of the facility. Surface drainage in the immediate area of Dump Site A empties into Turkey Creek. All surface drainage from NSA Crane empties into the fork of the White River south of the installation [Final Interim Measures Report (Morrison Knudson, 1999)]. Highway 58 runs in an east-west direction in the center of the Boggs and Turkey Creeks Drainage Basin (Drainage Area IV). Dump Site A lies on the north-east side of Highway 58 and drains towards a tributary of Turkey Creek that runs along the northeast boundary of the site (Figure 1-2).

SWMU 25 is approximately 8 acres in size. Dumping took place in two areas: a larger area approximately 39 feet by 150 feet and a smaller area approximately 25 feet by 10 feet. There are no buildings located at SWMU 25. Highway 58 borders the dump site to the west and Turkey Creek tributary borders the dump site to the east. The dump site is on the edge of a hillside and the elevation ranges about 75 feet, from 645 feet amsl southwest on Highway 58 trending northeasterly to an elevation of 570 feet amsl to the northeast along the Turkey creek tributary (Figure 1-3). The land surface slopes steeply downward at a relatively even 33 percent slope from Highway 58 down to the Turkey Creek tributary.

4.2 METEOROLOGY

NSA Crane is located in a warm, temperate climatic zone. In general, the summers are warm and humid, and winters are mild with occasional short cold periods. The temperature ranges from an average maximum July temperature of 89 degrees Fahrenheit (°F) to an average minimum January temperature of 26°F. Precipitation is fairly evenly distributed throughout the calendar year; the maximum precipitation occurs during the spring and early summer. The total average annual precipitation at the facility is 44 inches and consists of 42 inches of rain and 15 inches of snow. The average relative humidity ranges from 40 to 90 percent in summer and 60 to 90 percent in winter. Long-term climatological records for the area (Indianapolis International Airport) indicate that the monthly prevailing wind direction is from the southwest from April through December and from the northwest during January through March [National Oceanic and Atmospheric Administration (NOAA), 1988]. The annual prevailing wind direction for the region is from the southwest, and the annual average wind speed for the area is about 9.6 miles per hour. Figure 4-2 is a wind rose based on data from the National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center and presents a summarize of the mean wind direction and wind speed distribution at the Indianapolis International Airport over a 5-year period (1985 to 1989).

4.3 SURFACE WATER HYDROLOGY

All surface drainage in the western portion of the Highway 58 Dump Site drains eastward into the Turkey Creek tributary that flows southeastward and eventually drains into Turkey Creek (Figure 1-2). Surface water sampling has not been performed at this SWMU. Surface water was present in the tributary at the time of the RFI investigation.

4.4 GEOLOGY

NSA Crane is underlain by unconsolidated deposits of Quaternary (Pleistocene) age and residual soil derived from Pennsylvanian and Mississippian bedrock. The unconsolidated deposits are limited to small floodplains and are composed of alluvial, colluvial, and paludal (marshland) silt, sand, and gravel; lacustrine clay, silt, and sand; and outwash plain gravel, sand, and silt. The remainder of NSA Crane surficial deposits consist of residual clays and silt from the Pennsylvanian Raccoon Creek Group and Mississippian Stephensport and West Baden Groups with small areas of Quaternary clay, silt, and sand (Lacustrine deposits). The bedrock units beneath the facility, primarily Raccoon Creek and Stephensport Groups containing predominantly sandstone and shale, reportedly dip gently from the Cincinnati Arch to the Illinois Basin in the southwest (Morrison Knudson, 1999). Based on boring logs collected from the facility, the major soil type is a 2- to 3-inch-thick surface layer of brown to tan organic clay loam underlain

by clay intermixed with silts and sand. Occasionally, a clay hardpan occurs between 25 and 32 inches below the surface (Morrison Knudson, 1999).

For this RFI investigation, eleven (11) soil borings were installed using direct-push technology DPT and hand auger methods along Highway 58 (see Table 2-1). Eleven surface soil samples and 11 subsurface samples were collected. Bedrock was encountered as shallow as 2 feet bgs or not encountered before boring termination at 10 feet bgs. Cross-Sections were developed for SWMU 25 using the 11 borings (See Appendix B.1) installed at the site during the RFI investigation and historic boring logs (See Appendix B.3 Historical Hydrogeologic Investigation). Figure 4-3 shows the cross-section locations.

Cross-Section A to A' (Figure 4-4) runs northwest to southeast and illustrates the subsurface beneath all borings installed on the east side of Highway 58. Figure 4-4 shows the Sandy Clay overburden grading to bedrock.

Cross-Section B to B' (Figure 4-5) runs southwest to northeast and illustrates the subsurface beneath boring 25SB09 installed on the west side of Highway 58, across Highway 58 to 25SB03 and the larger former Dump Area to 25MW05 (25GW7581). Figure 4-5 shows the Sandy Clay overburden, the location of the former fill area, and the inferred slope of the bedrock across SWMU 25.

Cross-Section C to C' (Figure 4-6) runs southwest to northeast and illustrates the subsurface beneath boring 25SB10 installed on the west side of Highway 58, across Highway 58 to 25SB05 and the larger former Dump Area to 25MW04 (25GW7481). Figure 4-6 shows the Sandy Clay overburden, the location of the former fill area, and the inferred slope of the bedrock across SWMU 25.

Cross-Section D to D' (Figure 4-7) runs west to east and illustrates the subsurface beneath boring 25SB11 installed on the west side of Highway 58, across Highway 58 to 25SB07 and 25MW01 (25GW7181), near the smaller former Dump Area to 25MW02 (25GW7281). Figure 4-7 shows the Sandy Clay overburden, the location of the former fill area, and the inferred slope of the bedrock across SWMU 25.

Cross-Section E to E' (Figure 4-8) runs southwest to northeast and illustrates the subsurface beneath boring 25SB04 installed on the east side of Highway 58 to the new well 25MWT06. Figure 4-8 shows the Sandy Clay overburden and the inferred slope of the bedrock across SWMU 25.

4.5 SOILS

Figure 4-1 illustrates the surficial inferred depositional environment for SWMU 25 as Residual Soil derived from Pennsylvanian bedrock/colluviums. The soils geology is classified as Raccoon Creek Group and undifferentiated (P) and Sandstone-dominated horizon of Lower Pennsylvanian (Ps).

The geologic overburden materials that underlie the SWMU 25 ridge include natural unconsolidated soil materials and bedrock (Lower Pennsylvanian). Natural unconsolidated materials are residual soils formed as a result of weathering of the underlying Raccoon Creek Group. The residual soils consist predominantly of fine materials, including varying amounts of clay, silt, and sand. Geology Overburden at the Highway 58 Dump Site A ranges in thickness from less than 2 feet to 18.5 feet. Soil samples collected from the overburden along Highway 58 ranged from 2 feet bgs to termination of the boring at 10 feet bgs.

4.6 HYDROGEOLOGY

In general, groundwater in the unglaciated portion of southwestern Indiana is present in surficial unconsolidated aquifers and underlying bedrock aquifers are generally isolated from one another vertically by less permeable shale units. Groundwater enters the aquifers through outcrops and infiltration, and flows by gravity down the dip of the strata or locally in directions controlled by the potentiometric gradient. Regionally, groundwater is expected to flow towards the southwestward-dipping bedrock with a gradient approaching the dip. Locally, water-level measurements from wells generally show that groundwater flow direction agreed with local surface drainage. Seasonal fluctuations in the water table are expected to be slight because precipitation is generally well distributed throughout the year. The groundwater wells at SWMU 25 are identified as Lower Pennsylvanian water-bearing zone (Plz). The Plz wells represent deeper groundwater underneath the Upper Zone and Middle Zone wells (Tetra Tech, 2001).

Five monitoring wells were installed around the dump site perimeter as shown in Figure 2-1. Geology Overburden at the Highway 58 Dump Site A ranges in thickness from less than 2 feet to 18.5 feet. Limestone, sandstone, and shale from the Hansfield Formation of the Raccoon Creek Group (Appendix B.3 Historical Hydrogeologic Investigation) underlie the overburden. Boring 25MW02 (25GW7281) was drilled to a depth of 35 feet and beneath the overburden 12 feet of reddish brown, very stiff, dense, weathered, gravelly clay shale was encountered. This clay shale, at a depth of 15.5 feet, grades into a soft, weathered, brown to dark gravelly, occasionally limonitic, shale. From a depth of 20 feet, sandstone and shale are thinly interbedded in nearly equal proportions and at the end of the boring, where the shale content declines to around 10 percent. The sandstone is light grey to dark grey, fine-grained, and moderately hard, while the shale is dark grey to black and soft. These geologic units

were represented in various amounts in the historical borings/monitoring wells installed at SWMU 25. Appendix B.3 Historical Hydrogeologic Investigation presents boring and groundwater data from the historical borings and monitoring wells installed.

Round 1 groundwater sampling was conducted in July 2011. Groundwater at the Highway 58 Dump Site A was encountered in fractures in the sandstone. Figure 4-9 is the groundwater elevation map developed for the groundwater data collected during Round 1. Groundwater flows in a northeasterly direction, following topographic contours, from Highway 58 towards a Turkey Creek tributary. Groundwater elevations between the upgradient and the downgradient monitoring wells ranged from approximately 611 to 568 feet amsl, a difference of 43 feet. The groundwater hydraulic gradient was calculated graphically at approximately 0.36 feet/feet from groundwater elevations measured within the SWMU 25 monitoring wells (Figure 4-9). Slug tests were not performed on monitoring wells during the 2011 Round 1 sampling at SWMU 25.

As discussed previously in Section 2, a new well (25MWT06) was installed in October 2012 after wells 25MW04 and 25MW05 were abandoned. Figure 4-10 is the groundwater elevation map developed for the groundwater data collected during Round 2. Similar to Round 1, the groundwater during Round 2 flows in a northeasterly direction, following topographic contours, from Highway 58 towards a Turkey Creek tributary. Groundwater elevations between the upgradient and the downgradient monitoring wells ranged from approximately 604 to 567 feet amsl, a difference of 37 feet. The groundwater hydraulic gradient was calculated graphically at approximately 0.36 feet/feet from groundwater elevations measured within the SWMU 25 monitoring wells (Figure 4-10). Slug tests were not performed on monitoring wells during the 2012 Round 2 sampling at SWMU 25.

4.7 DEMOGRAPHY AND LAND USE

The economic base of communities surrounding NSA Crane is in transition from agriculture, mining, and quarrying to manufacturing and service industries. The patterns of settlement, population statistics, and median income are similar throughout the region. Because most of the region is covered by vegetation, the area is classified as rural.

There is no state or local planning within the vicinity of NSA Crane. The only zoning and land use regulations are in the municipalities in the region. None of the municipalities are close enough to impact NSA Crane. None of the areas adjacent to NSA Crane are zoned, and zoning is not anticipated in the near future. No known land use or community actions are being considered or proposed at this time.

4.8 ECOLOGY

NSA Crane is a heavily forested facility situated within the Western Mesophytic Forest Region, Hill Section, and Beech-Maple Forest Region (Braun, 1950). Lindsey et al. (1970) further subdivided the area of the installation into the south-central Oak and Mixed Woods Division, including the Beech-Maple and the Beech-Oak-Maple-Hickory sub-elements. Deam (1940) classified the portion of Martin County in which the facility is located as consisting of Chestnut Oak Upland based on the dominant floral components at that time. More recently, Kuchler (1964) mapped this portion of Indiana and classified it as belonging to two distinct vegetation classes, the Oak-Hickory and the Beech-Maple forest components of the Broadleaf Forest Classification. This latter classification most closely resembles the current floristic components observed at the facility.

NSA Crane contains old agricultural fields in various stages of biological succession. Openings on dry upland sites contain almost pure stands of grasses with some clumps of woody plants such as persimmon, sassafras, and sumac. Areas that tend to be wetter have river birch, willow, sycamore, and cottonwood. Hillside communities include hickory, white and black oak, red maple, sugar maple, tulip poplar, ash, and beech [Naval Energy and Environmental Support Activity (NEESA), 1983]. Cleared areas at the facility have various stages of grassland, oldfield, and scrub/shrub vegetational forms present. Dominant tree species include black oak, white oak, pignut hickory, and yellow poplar. These stands are relatively young, with the average tree diameter ranging from 6 to 12 inches. No scrubs or shrubs are present in these areas, and leaf litter, limbs, and fallen saplings cover the understory.

The wildlife habitats and vegetation types present at NSA Crane (including many stages of forest succession, streams, ponds, Greenwood Lake, and grassy open spaces) support a diverse terrestrial and aquatic fauna. The abundance of wildlife is mainly due to the mixture of landforms and vegetation types that occur over the installation. Also, the lack of agricultural pressures has enhanced wildlife abundance and served to provide an installation-wide "wildlife enclosure" condition. There is an adequate amount of forage materials, concealment opportunities, and shelter locations to support a highly diverse wildlife community at the site.

Terrestrial habitats (i.e., wooded and grassy areas) near the sites may provide shelter and food sources for various species of mammals such as white-tailed deer, coyote, red fox, rabbits, raccoons, and mice and for birds such as ducks, geese, wild turkey, bobwhite quail, red-tailed hawks, and American robins.

The white-tailed deer is the most conspicuous large, wild mammal at the installation. Other mammals include opossum, raccoon, rabbits, mice, bats, chipmunks, squirrels, beaver, groundhogs, gray fox,

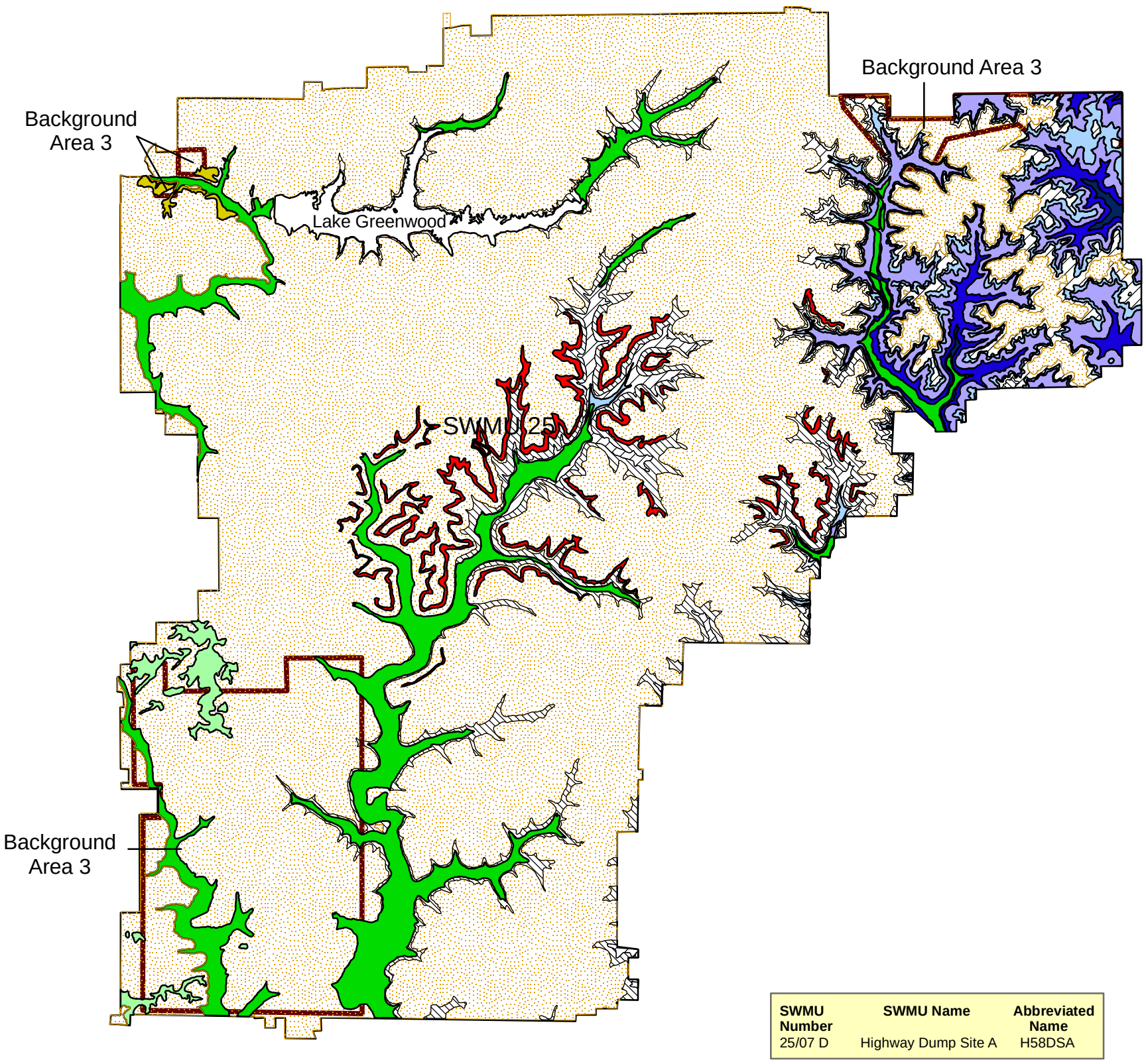
coyotes, and long-tailed weasel. Fox, coyotes, and hawks are carnivores whose presence indicates a healthy ecosystem, with smaller mammals present to provide a food source (NEESA, 1983).

The birds at NSA Crane are diverse. Previous studies identified over 100 species present at the facility during breeding seasons (Hengeveld, 1987). Because the facility is largely forested, the species consist predominantly of those that frequent wooded habitat types. Species of waterfowl also use the facility, especially in the vicinity of Greenwood Lake (Figure 1-2). A large number of bird species frequent the non-forested grassland, oldfield, and scrub/shrub vegetation present over portions of NSA Crane. The bird population includes a number of threatened, endangered, or species of special concern that use NSA Crane as their home range. These species include the bald eagle, osprey, sharp-shinned hawk, red-shouldered hawk, broad-winged hawk, black and white warbler, hooded warbler, and worm-eating warbler (Brown & Root Environmental, 1997).

Previous studies conducted at NSA Crane (Nelson et al., 1987) identified 21 amphibian species and 22 reptilian species, including skinks, lizards, snakes, and turtles.

A total of 46 distinct fish species were collected from the installation during a 1987 inventory of fish fauna at NSA Crane. Other than Greenwood Lake, the 1987 study observed that the greatest number of individual fish species was recorded from the largest stream, Boggs Creek, and that the smallest number of species was recorded from Turkey Creek. Boggs Creek contained 29 species, including eight species of fish characteristic of large river-type systems. This included long-nose gar, paddlefish, bowfin, gizzard shad, ribbon shiner, big mouth buffalo, channel catfish, and flathead catfish. By contrast, the Turkey Creek survey yielded 16 species of fish, none of which were unusual to the area.

PGH P:\GIS\CRANE_NSWC\MXD\SWMU25_SURFICIAL_GEOLOGY.MXD 8/2/11 KM



SWMU Number	SWMU Name	Abbreviated Name
25/07 D	Highway Dump Site A	H58DSA

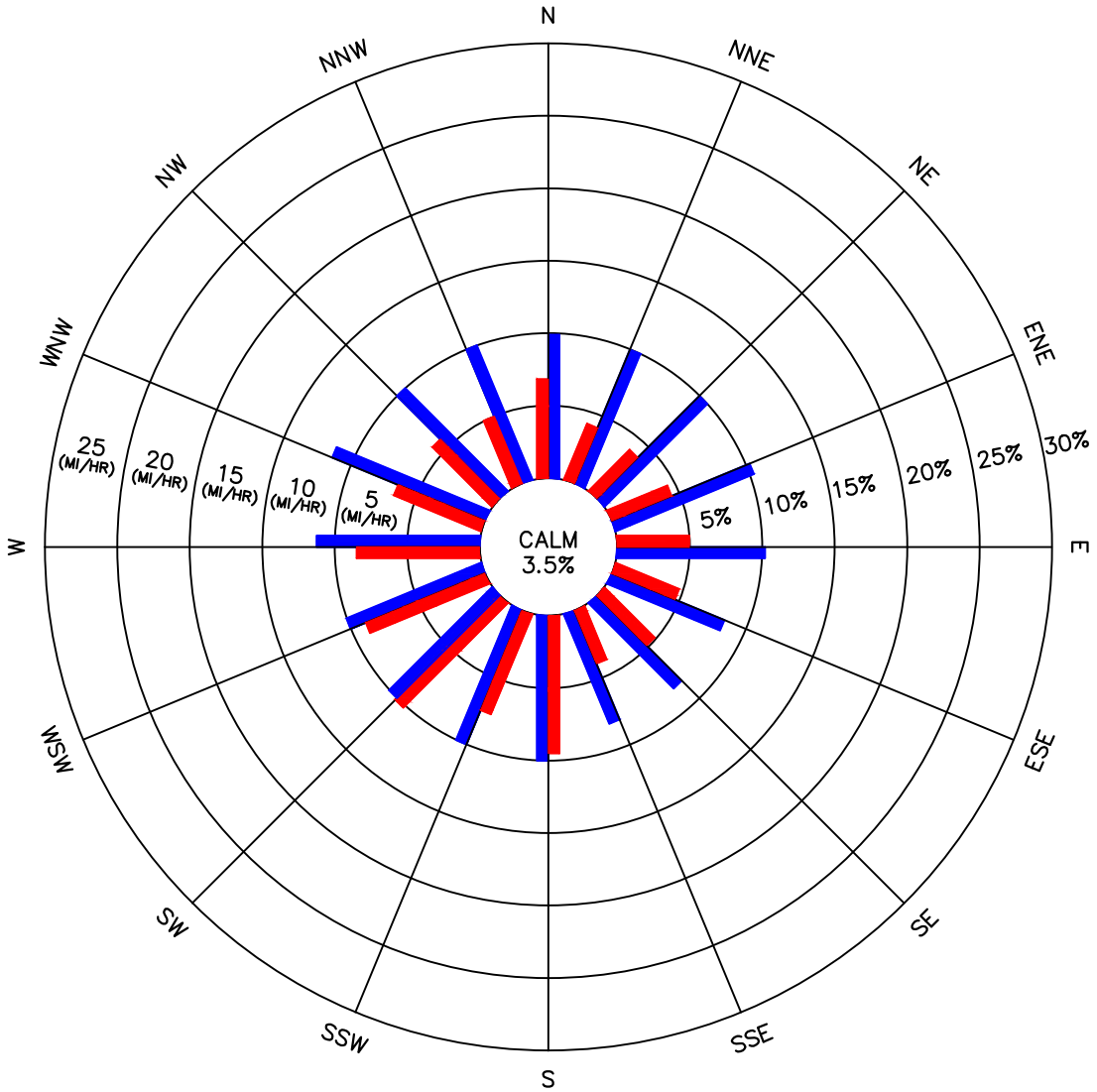
Inferred Depositional Environment		Explanation of Geology
Alluvium	Qal	*Alluvium*
Loess/Glacial Outwash	Ql	*Loess*
	Qo	*Glacial Outwash*
Residual Soil derived from Pennsylvanian bedrock/colluvium	P	*Raccoon Creek Group and undifferentiated*
	Ps	*Sandstone-dominated horizon of Lower Pennsylvanian*
Residual soil derived from Mississippian bedrock/colluvium	M6	*Glenn Dean Ls, Hardinsburg Fm, Haney Ls, Indian Springs Shale Mbr, and undifferentiated*
	M5	*Sandstone member of the Big Clifty Fm*
	M4	*Beech Creek Ls*
	M3	*Elwren Fm, Reelsville Ls, upper Sample Fm, and undifferentiated*
	M2	*Lower part of Sample Fm, Beaver Bend Ls, Bethel Fm, and undifferentiated*
	M1	*Paoli Ls, Ste Genevieve Ls, and undifferentiated*

Select Solid Waste Management Units (SWMUs; Refer to Table 2-2 for a description of each SWMU)

Outline of Background Areas

8,000 0 8,000 Feet

DRAWN BY	DATE	TETRA TECH	CONTRACT NUMBER	CTO NUMBER
K. MOORE	8/2/11		0087	F27L
CHECKED BY	DATE	SURFICIAL GEOLOGY	APPROVED BY	DATE
E. BERKLITE	8/2/11	SWMU 25 HIGHWAY DUMP SITE A	—	—
REVISED BY	DATE	NSA CRANE	APPROVED BY	DATE
—	—	CRANE, INDIANA	—	—
SCALE			FIGURE NO.	REV
AS NOTED			FIGURE 4-1	0



LEGEND:

WIND DIRECTION FREQUENCY (PERCENT)
(DIRECTION FROM WHICH THE WIND IS BLOWING)

MEAN WIND SPEED (MI/HR)
DATA SOURCE: INDIANAPOLIS, INDIANA AIRPORT
PERIOD OF RECORD: 1985–1989
43,824 OBSERVATIONS

DRAWN BY ND	DATE 6/21/12	WIND ROSE SWMU 25 – HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	CTO NO. F27L
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 4–2 / SIZE A / REV. 0

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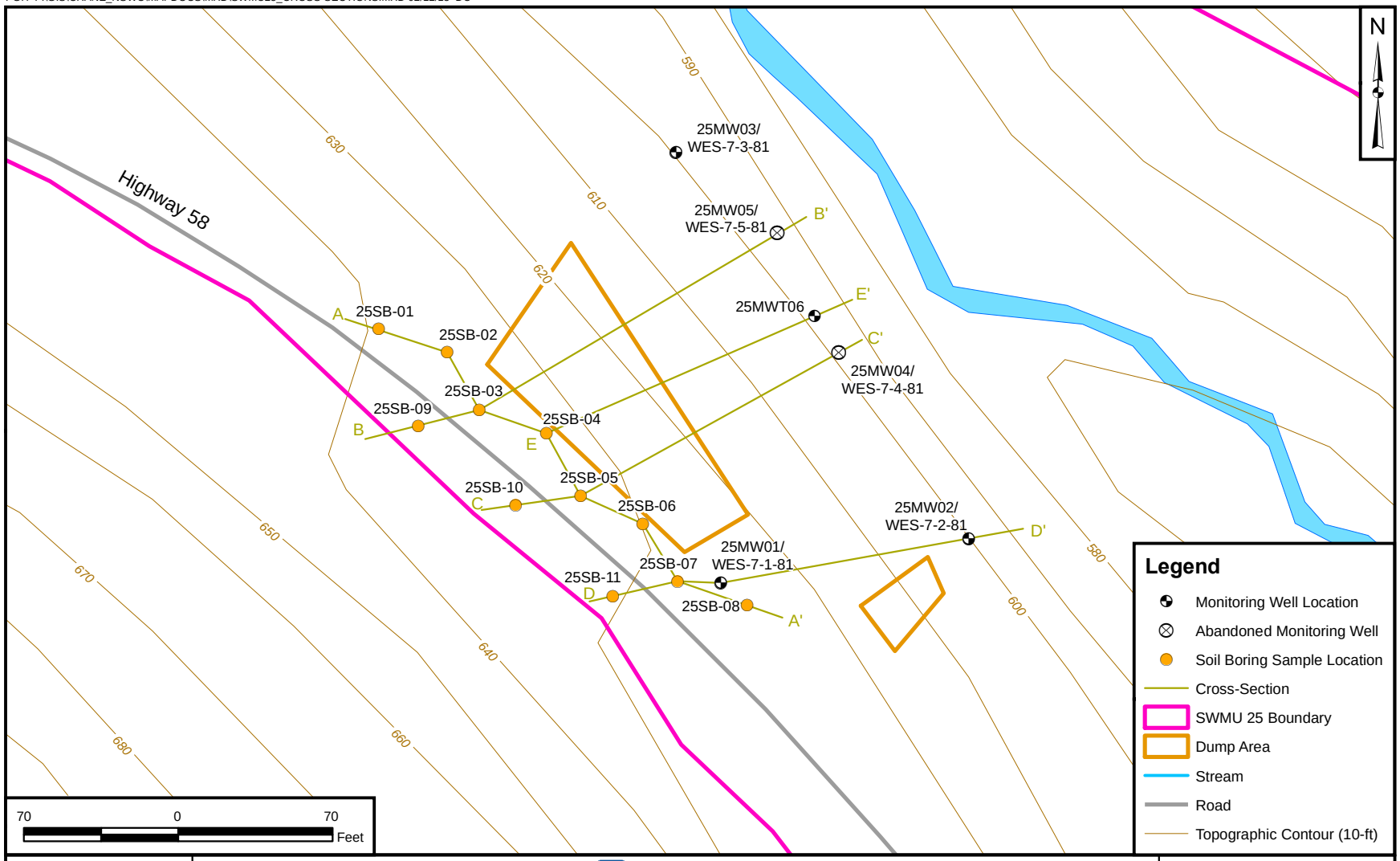
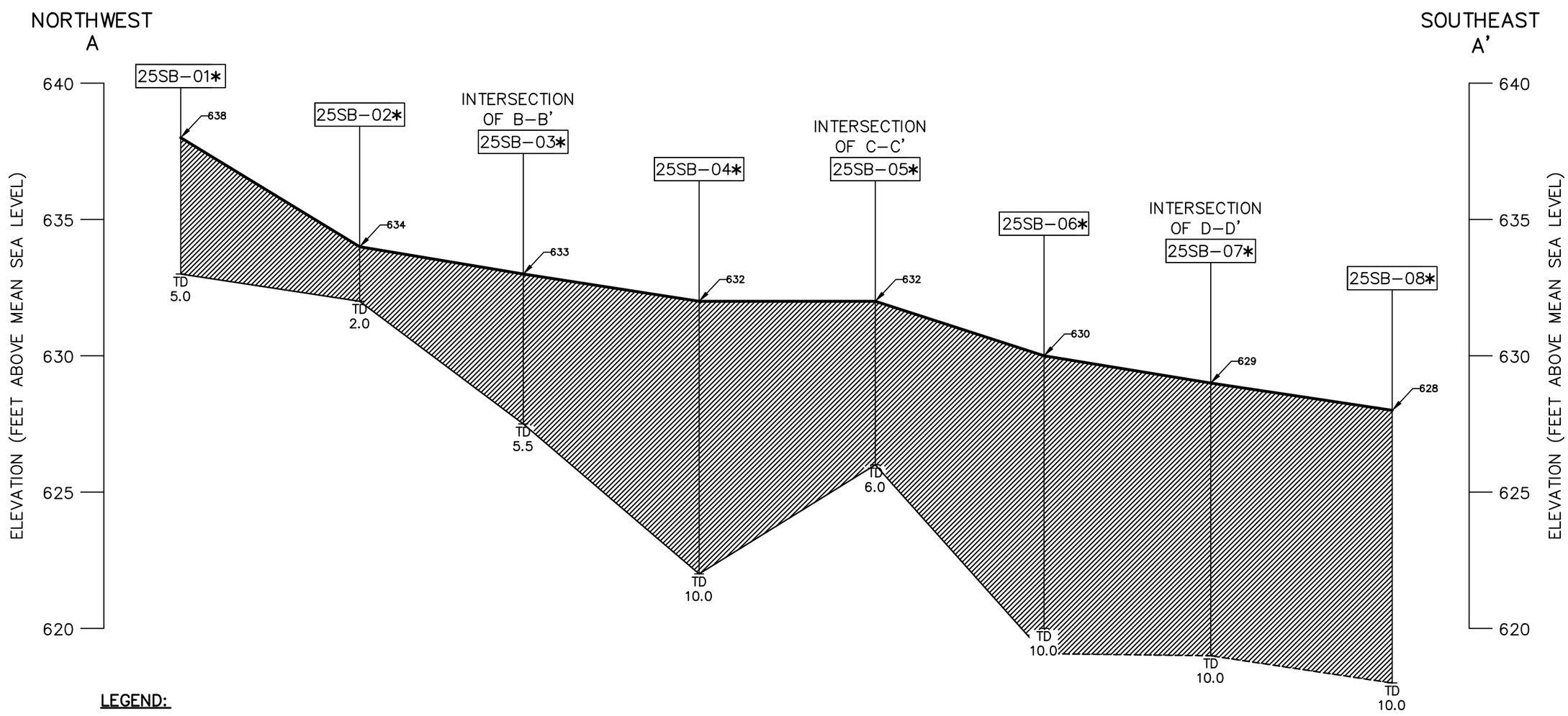


DRAWN BY J. ENGLISH	DATE 12/02/10	TETRA TECH	CONTRACT NUMBER CTO F27L
CHECKED BY J. LUCAS	DATE 02/12/13	CROSS-SECTION LOCATIONS SWMU 25 - HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	APPROVED BY ___ DATE ___
REVISED BY D. COUCH	DATE 02/12/12		APPROVED BY ___ DATE ___
SCALE AS NOTED			FIGURE NO. FIGURE 4-3 REV 0



LEGEND:

MONITORING WELL OR BORING NUMBER — 25SB-01

GROUND SURFACE ELEVATION — 638

LITHOLOGIC CONTACT (INFERRED BETWEEN BORINGS)

TOTAL DEPTH OF WELL OR BORING (FT BGS) — TD 5.0

* ELEVATIONS ESTIMATED BASED ON TOPOGRAPHIC MAP

INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS

TOP OF BEDROCK

TOP OF BEDROCK (INFERRED)

0 20 40
HORIZONTAL SCALE: 1" = 20'

0 4 8
VERTICAL SCALE: 1" = 4'

DRAWN BY ND	DATE 8-1-11	GEOLOGICAL CROSS SECTION A-A' SWMU 25 HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	CONTRACT NO. 3116
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED		NAVFAC	DRAWING NO. FIGURE 4-4 / SIZE B / REV. 0

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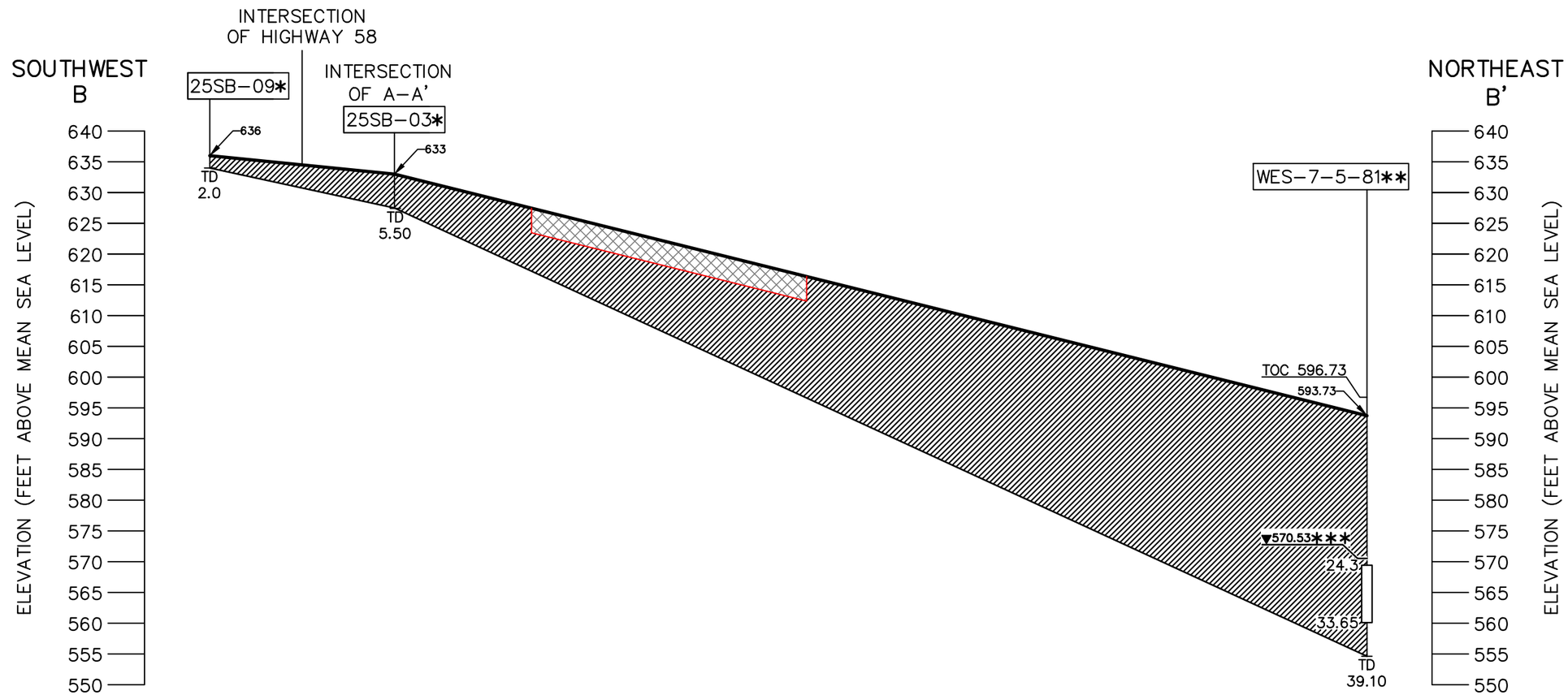

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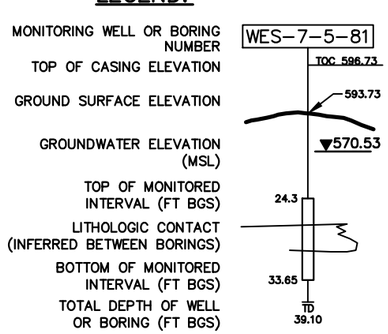

* ELEVATIONS ESTIMATED BASED ON TOPOGRAPHIC MAP

** SURVEY ELEVATION

*** GROUNDWATER ELEVATION FROM 7/12/11 SURVEY

INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS

SWMU 25 HIGHWAY 58 DUMP SITE A (DUMP AREA)

TOP OF BEDROCK

0 20 40
HORIZONTAL SCALE: 1" = 20'

0 20 40
VERTICAL SCALE: 1" = 20'

DRAWN BY ND	DATE 8–1–11	GEOLOGICAL CROSS SECTION B–B' SWMU 25 HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	CONTRACT NO. 3116
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4–5 / SIZE B / REV. 0

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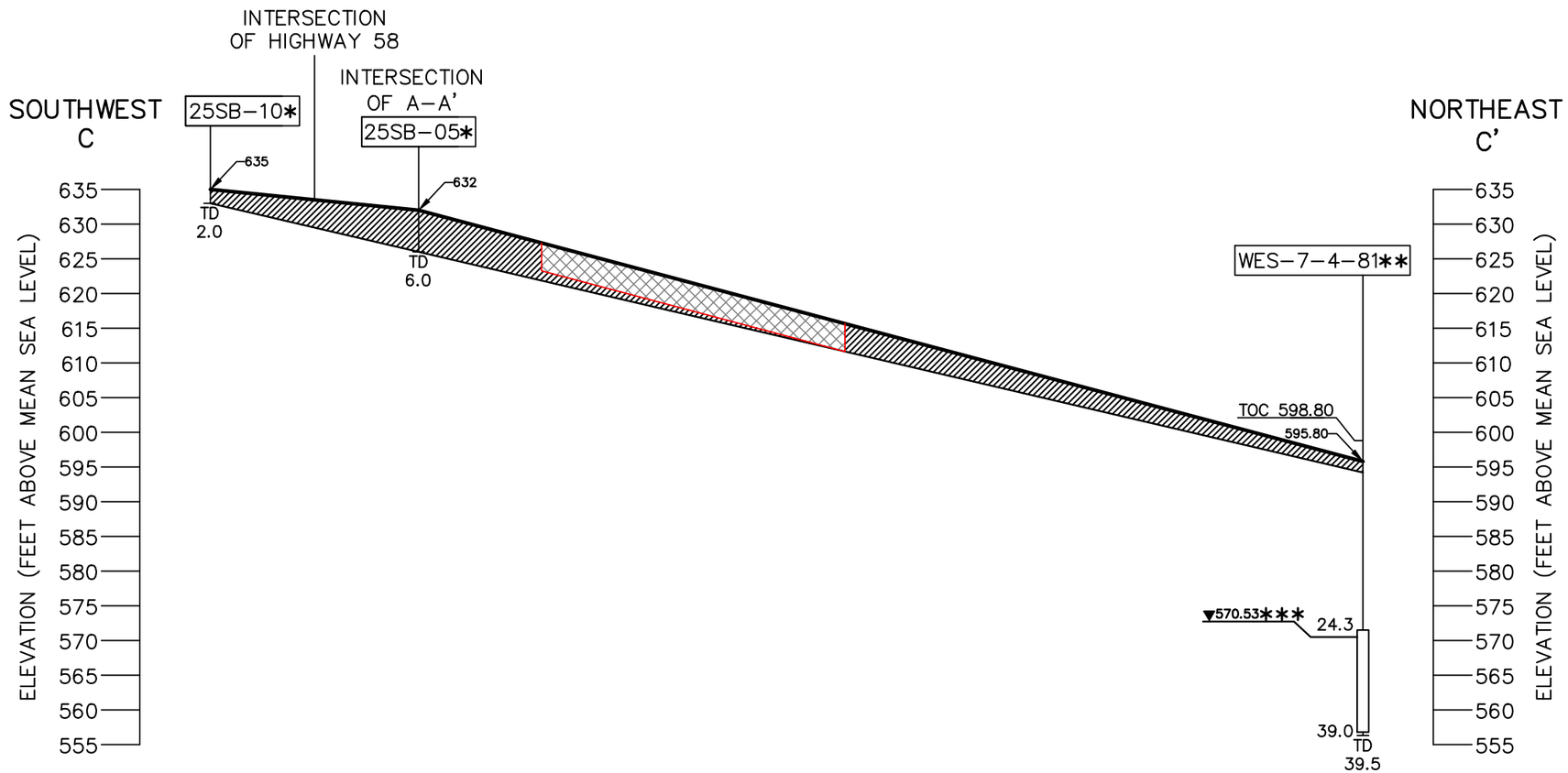

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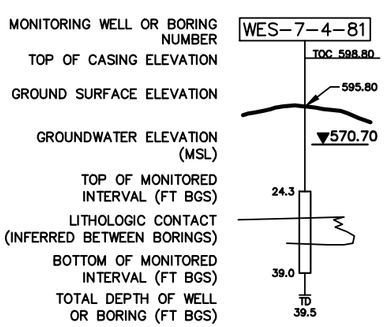

* ELEVATIONS ESTIMATED BASED ON TOPOGRAPHIC MAP

** SURVEY ELEVATION

*** GROUNDWATER ELEVATION FROM 7/12/11 SURVEY

INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS

SWMU 25 HIGHWAY 58 DUMP SITE A (DUMP AREA)

TOP OF BEDROCK

0 20 40
HORIZONTAL SCALE: 1" = 20'

0 20 40
VERTICAL SCALE: 1" = 20'

DRAWN BY ND	DATE 8–1–11	GEOLOGICAL CROSS SECTION C–C' SWMU 25 HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	CONTRACT NO. 3116
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4–6 / SIZE B / REV. 0

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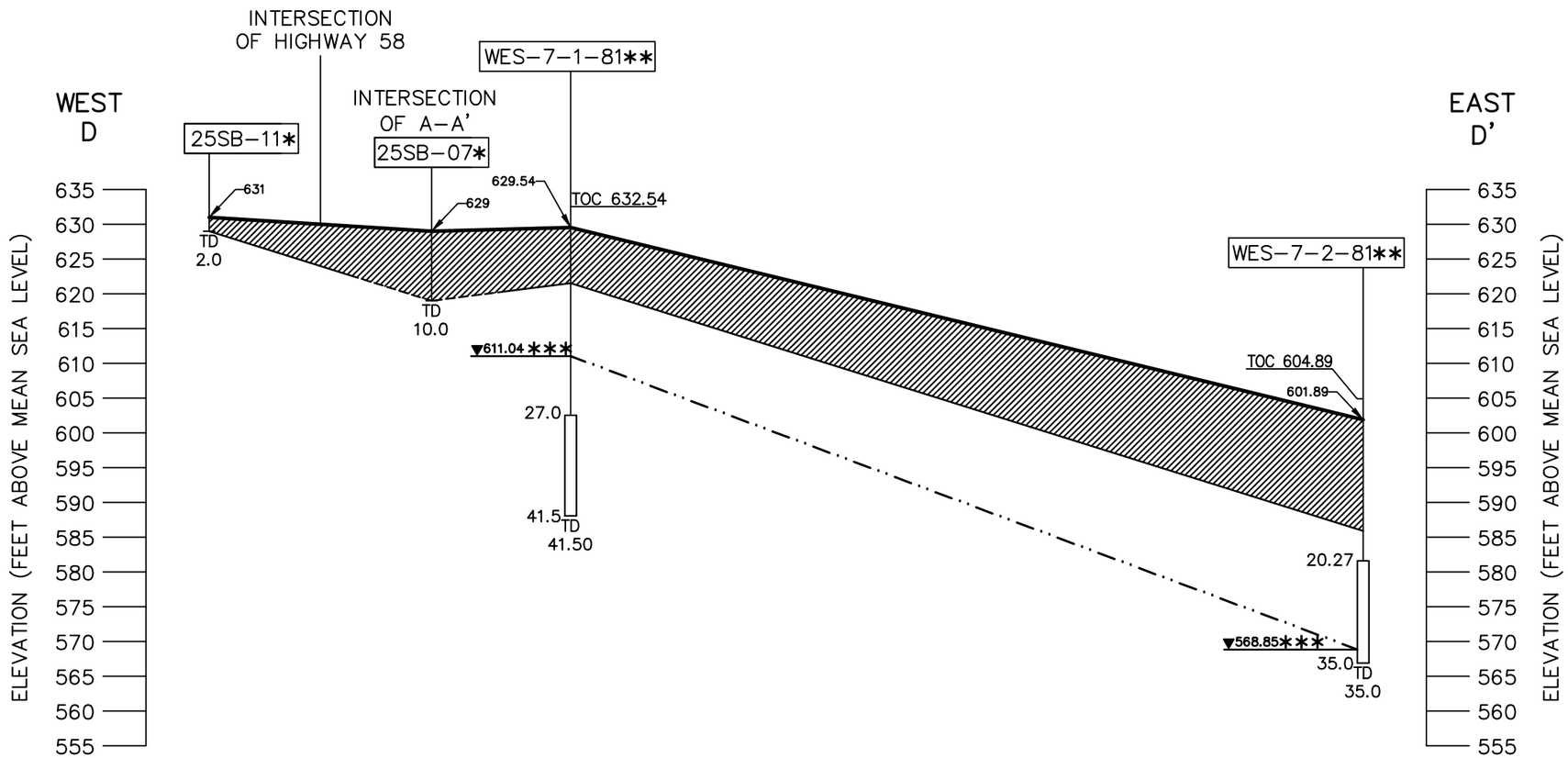

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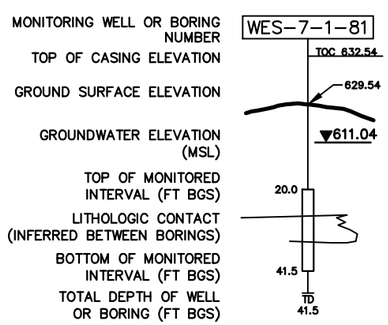

* ELEVATIONS ESTIMATED BASED ON TOPOGRAPHIC MAP

** SURVEY ELEVATION

*** GROUNDWATER ELEVATION FROM 7/12/11 SURVEY

INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS

TOP OF BEDROCK

TOP OF BEDROCK (INFERRED)

GROUNDWATER POTENTIOMETRIC SURFACE

0 20 40
HORIZONTAL SCALE: 1" = 20'

0 20 40
VERTICAL SCALE: 1" = 20'

DRAWN BY ND	DATE 8/1/11	GEOLOGICAL CROSS SECTION D-D' SWMU 25 HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	CONTRACT NO. 3116
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-7 / SIZE B / REV. 0

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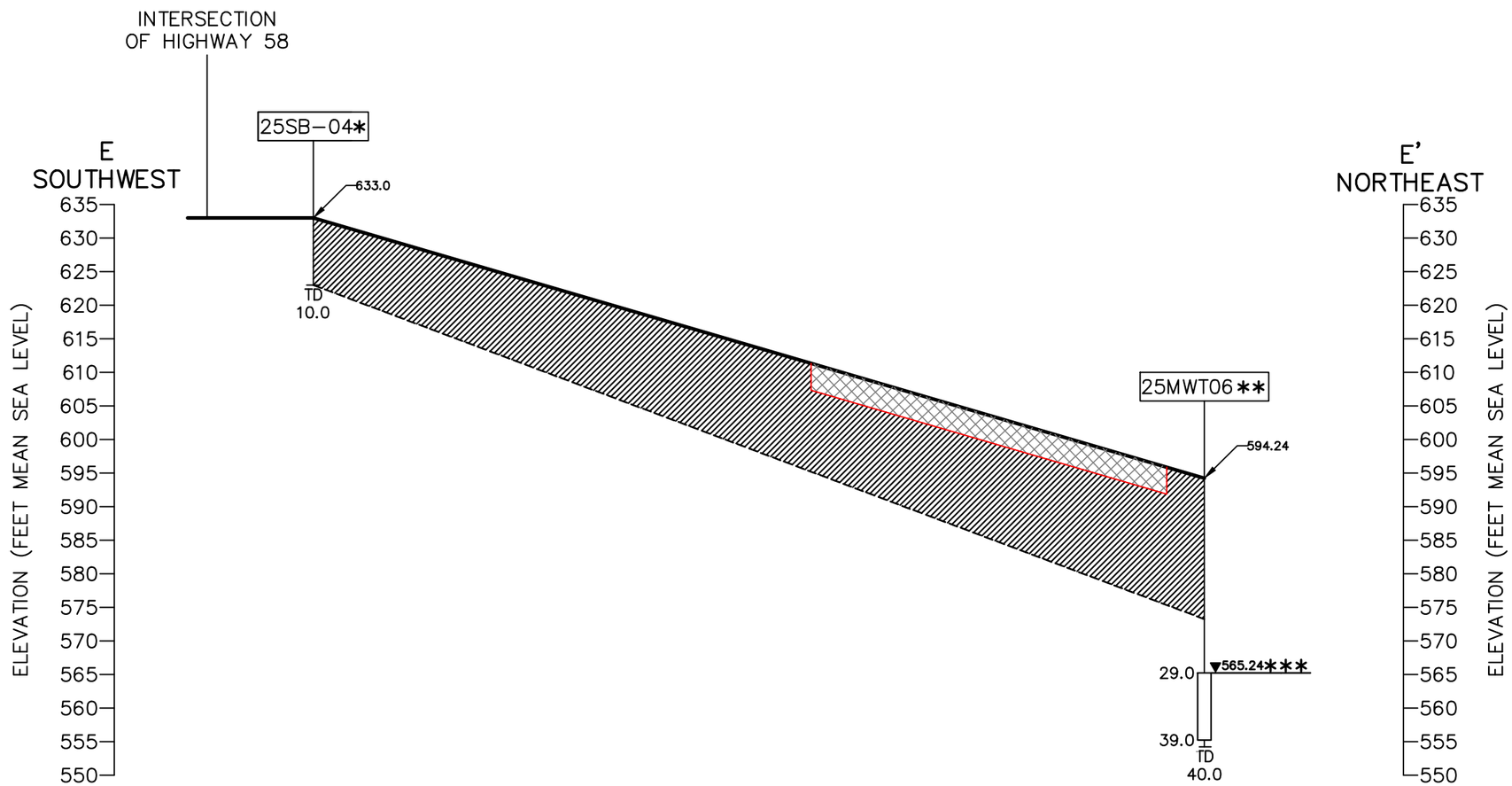

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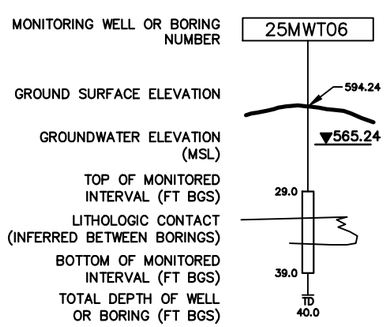

* ELEVATIONS ESTIMATED BASED ON TOPOGRAPHIC MAP

** SURVEY ELEVATION

*** GROUNDWATER ELEVATION FROM 10/31/12 SURVEY

INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS

SWMU 25 HIGHWAY 58 DUMP SITE A (DUMP AREA)

---- TOP OF BEDROCK (INFERRED)

0 20 40
HORIZONTAL SCALE: 1" = 20'

0 20 40
VERTICAL SCALE: 1" = 20'

DRAWN BY NN	DATE 2/6/13	GEOLOGICAL CROSS SECTION E-E' SWMU 25 HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	CONTRACT NO. 3116
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-8 SIZE B REV. 0

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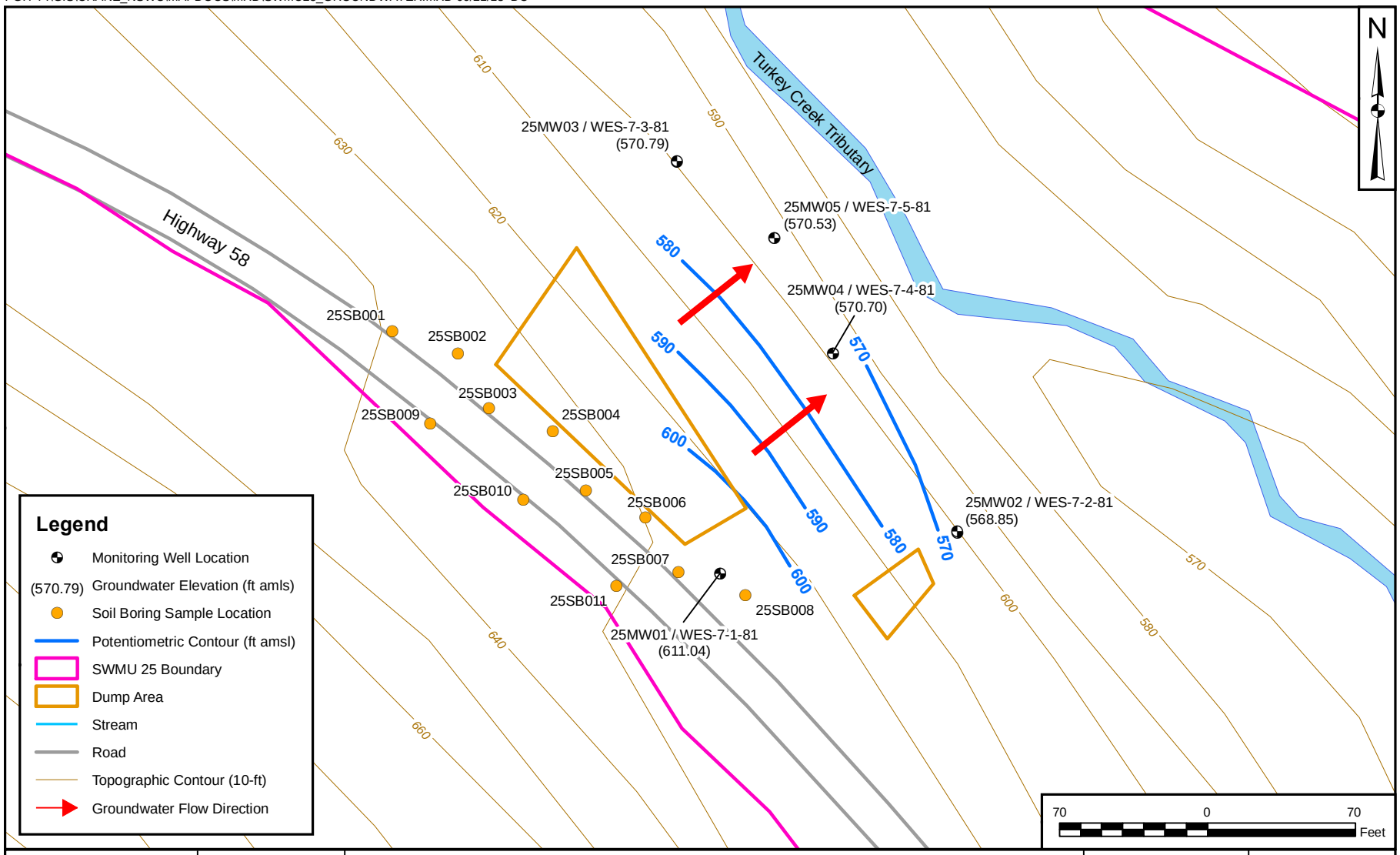

DRAWN BY	DATE
J. ENGLISH	12/02/10
CHECKED BY	DATE
J. DUCAR	06/21/13
REVISED BY	DATE
D. COUCH	06/21/13
SCALE	
AS NOTED	

GROUNDWATER ELEVATIONS - ROUND 1
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
3116	F27L
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 4-9	0

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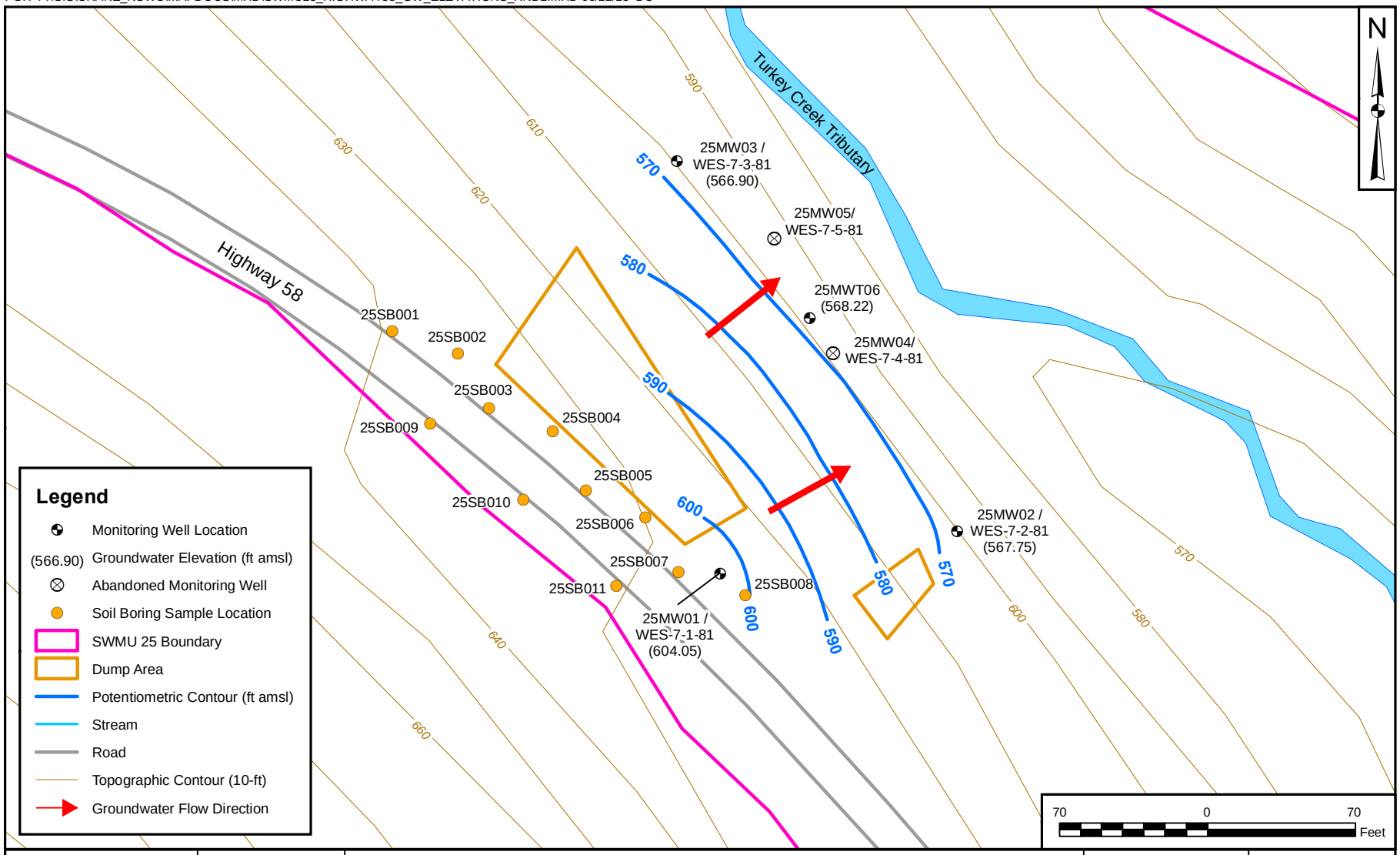

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J. ENGLISH	01/29/13
CHECKED BY	DATE
J. LUCAS	06/21/13
REVISED BY	DATE
D. COUCH	06/21/13
SCALE	
AS NOTED	

NAVFAC

GROUNDWATER ELEVATIONS - ROUND 2
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
3116	F27L
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
FIGURE 4-10	0

5.0 NATURE AND EXTENT OF CONTAMINATION

5.1 BACKGROUND

The following subsections discuss the field and analytical data generated during the SWMU 25 RFI investigation at NSA Crane. Figure 1-1 shows the base and general site location and Figure 1-3 shows SWMU 25 site features. Figure 2-1 shows the RFI soil and groundwater sampling locations.

As part of the data validation process, Tetra Tech personnel evaluated RFI analytical data for both data integrity and defensibility. RTI, located in Livonia, Michigan, analyzed samples collected during Round 1 of the investigation for Target Analyte List (TAL) metals and Target Compound List (TCL) SVOCs (including low level PAHs). Empirical, located in Nashville, Tennessee, analyzed samples collected during Round 2 of the investigation for TAL metals and TCL SVOCs (including low level PAHs). Detectable concentrations of target analytes in soil and groundwater samples are discussed in this section.

5.2 SOIL CONTAMINATION

Results of soil samples collected during the SWMU 25 RFI were used to characterize the site and conduct a baseline HHRA and SERA. Soil project screening levels (PSLs) were set at the lowest matrix-specific, risk-based or regulatory human health screening criteria appropriate for the site. The original PSL references for surface and subsurface soil for this investigation were presented in Worksheet #15 in the SWMU 25 UFP-SAP (Tetra Tech, 2011). Revised PSLs based on current USEPA and IDEM screening criteria and basewide background metals concentrations are presented in tables in Section 7.0, Section 8.0, and Appendix C.

Sections 7.0 discusses the selection of human health COPCs and Section 8.0 discusses the selection of ecological COPCs.

5.2.1 Surface Soil

Table 5-1 presents statistical summary results for the 11 surface soil samples. The frequencies of detection (FODs), as well as minimum and maximum detections, are identified in the table. Table 5-2 summarizes the positive detections for SWMU 25 surface soil samples. Concentrations that exceeded the minimum regulatory screening criteria are shaded. Detailed soil analytical results are provided in Appendix C. Discussions of these detections and exceedances in surface soil are presented below.

5.2.1.1 Metals

Elevated concentrations of metals were detected in all 11 surface soil samples (Table 5-2). If the background value was greater than or equal to the risk-based screening criteria, a metal was not selected as a COPC unless its concentration exceeded the background value. If the background concentration was less than either the minimum ecological risk assessment (ERA) or minimum HHRA screening criterion, the metal was selected as a COPC if the concentration in any sample exceeded the ERA or HHRA criterion. COPCs were segregated according to whether their sample concentration exceeded one or both of the ERA and HHRA criteria. This COPC selection process identifies those metals likely to present human health and ecological risks. Sections 7.0 and 8.0 provide more detail regarding this COPC selection process. The metals selected as COPCs in surface soil are: arsenic (HHRA and ERA), cadmium (ERA only), chromium (HHRA and ERA), iron (HHRA only), lead (ERA only), selenium (ERA only). Aluminum, cobalt, manganese, thallium, vanadium, and zinc concentrations did not exceed their respective background values; therefore, these metals were not selected as COPCs even though concentrations exceeded ERA and/or HHRA criteria.

Figure 5-1 shows the locations of exceedances of the minimum regulatory screening criteria for metals in surface soil. The surface soil samples with the highest metals concentrations were collected from borings 25SB001, 25SB005, 25SB008, 25SB009, 25SB0010, and 25SB011. Borings 25SB009, 25SB0010, and 25SB011 are located west of Highway 58; and borings 25SB001, 25SB005, and 25SB008 are located east of the highway, between the road and the larger dump site. The surface soil samples from borings 25SB002, 25SB003, 25SB004, 25SB006, and 25SB007, located along the western edge of the larger dump site, exhibited lower concentrations of metals.

5.2.1.2 SVOCs (Including Low Level PAHs)

The only SVOC detected in surface soil samples at concentrations above the minimum regulatory screening criteria was one of the PAHs, benzo(a)pyrene (Table 5-2). It was detected above the minimum regulatory screening criterion (HHRA) of 15 µg/kg in the following 5 of the 11 surface soil samples:

- 25SS0010002 (16 µg/kg)
- 25SS0030002 (55 µg/kg)
- 25SS0050002 (35 µg/kg)
- 25SS0060002 (19 J µg/kg)
- 25SS0070002 (54 µg/kg)

Figure 5-2 shows the locations of these samples. With the exception of the sample collected from soil boring 25SB001 (25SS0010002), these samples were collected from borings located directly adjacent to the larger dump area, east of Highway 58. No surface soil samples contained SVOC concentrations that exceeded ERA risk-based PSLs.

5.2.2 Subsurface Soil

Table 5-3 presents the statistical summary results for the 11 subsurface soil samples. The FODs, as well as minimum and maximum detections, are identified in the table. Table 5-4 summarizes positive detections for SWMU 25 subsurface soil samples. Concentrations that exceeded the minimum regulatory screening criteria are shaded. Figure 5-3 shows soil sample locations. Appendix C provides detailed soil analytical results. Discussions of these detections and exceedances in subsurface soil are presented below.

5.2.2.1 Metals

Elevated concentrations of metals were detected in all 11 subsurface soil samples (Table 5-4). COPC selection was carried out similar to the process described for surface soil in Section 5.2.1.1. The metals selected as COPCs in subsurface soil are: arsenic, cobalt, iron, and manganese. Aluminum, chromium, and thallium concentrations did not exceed their respective background values; therefore, these metals were not selected as COPCs even though concentrations exceeded HHRA criteria.

Figure 5-3 shows the locations of exceedances of the regulatory screening criteria for metals in subsurface soil. The subsurface soil samples with the highest metal concentrations were collected from borings 25SB004, 25SB005, 25SB007, and 25SB008, all of which are located east of the highway between the road and the larger dump site area. Cobalt, iron, and manganese each had just one exceedance of their respective background values and arsenic concentrations in three samples exceeded the arsenic background value. This low number of exceedances indicates subsurface soil metals concentrations may represent background concentrations. However, the cobalt, iron, and manganese exceedances all occurred in the same sample, 25SB0070610, which indicates this one sample has metal concentrations greater than the background concentration range. The arsenic concentration in this sample did not exceed the arsenic background value. The arsenic background exceedances are only slightly greater than the background value, which indicates that a localized, but slightly elevated, background arsenic level is present at SWMU 25.

5.2.2.2 SVOCs (Including Low Level PAHs)

Table 5-4 shows that five SVOCs (including three PAHs and two phthalate esters) were detected above laboratory detection limits in subsurface soil samples. However, no subsurface soil samples contained concentrations of SVOCs above the minimum regulatory screening criteria; therefore, no SVOCs were selected as COPCs.

5.3 GROUNDWATER

Results of groundwater samples collected during the SWMU 25 RFI were used to characterize the site and conduct a baseline HHRA. Groundwater PSLs were set at the lowest matrix-specific, risk-based or regulatory human health screening criteria appropriate for the site. The original PSL references for groundwater for this investigation were presented in Worksheet #15 in the SWMU 25 UFP-SAP (Tetra Tech, 2011). Revised PSLs based on current USEPA and IDEM screening criteria are presented in tables in Appendix C.

Table 5-5 presents the statistical summary of SWMU 25 Round 1 groundwater results. The FODs, as well as minimum and maximum detections, are identified in the table. Table 5-6 summarizes positive detections for Round 1 groundwater samples. Tables 5-7 and 5-8 present similar data for Round 2. Concentrations that exceeded the minimum regulatory screening criteria are shaded. Figure 2-1 shows groundwater sample locations. Appendix C provides detailed groundwater analytical results. The SWMU 25 SAP indicated that the upgradient well (25MW01) would be used to determine background groundwater metals concentrations; however, this well may not be upgradient from site contaminants. Therefore, the possibility that this well does not represent groundwater conditions unaffected by the SWMU 25 operations was considered when interpreting site-related contamination. Discussions of analyte detections and screening level exceedances in groundwater are presented below.

5.3.1 Dissolved Metals - Round 1

Table 5-6 presents the concentrations of detected dissolved metals in Round 1 (July 2011) groundwater samples. Depending on location, concentrations of dissolved arsenic, chromium, cobalt, iron, manganese, and nickel exceeded minimum regulatory screening values; Figure 5-4 shows the locations of these exceedances. Data for wells 25MW04 and 25MW05 are not shown because they are not representative of site conditions (see Section 3.0).

5.3.2 Total Metals - Round 1

Table 5-6 indicates that total metals were detected in all Round 1 (July 2011) groundwater samples. Concentrations of total arsenic, chromium, cobalt, iron, manganese, and nickel exceeded minimum regulatory screening levels in at least one groundwater sample during Round 1 but because of the turbidity problems, Round 1 data from 25MW04 and 25MW05 were not used to delineate the extent of contamination or to select HHRA COPCs. Included in Table 5-6 are recently developed basewide Pennsylvanian Aquifer groundwater upper tolerance limits, (UTLs) for metals (Tetra Tech, 2013). Only manganese exeeded background and the screening criteria. The turbidity of the Round 1 samples that exceeded background was at wells 25MW01, 25MW02, and 25MW03, with respective turbidity values of 5.6, 23, and 157 NTUs.

Figure 5-4 shows the locations of exceedances of the regulatory screening criteria for total metals in groundwater in Round 1. Data from monitoring wells 25MW04 and 25MW05 are not included because of the previously described excessive turbidity problems and well casing integrity issues for these monitoring points.

5.3.3 SVOCs (Including Low Level PAHs) - Round 1

Table 5-6 indicates that no SVOCs were detected above the regulatory screening criteria in valid Round 1 (July 2011) groundwater samples.

5.3.4 Dissolved Metals - Round 2

Table 5-8 presents the concentrations of detected dissolved metals in Round 2 (November 2012) groundwater samples. Depending on location, concentrations of dissolved arsenic, cobalt, iron, manganese, nickel, and thallium exceeded minimum regulatory screening values; Figure 5-5 shows the locations of these exceedances. The maximum dissolved metal concentrations were predominantly detected in the sample collected from monitoring well 25MW01.

5.3.5 Total Metals - Round 2

Table 5-8 indicates that total metals were detected in all four Round 2 (November 2012) groundwater samples. Concentrations of total aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, nickel, thallium, and vanadium exceeded minimum regulatory screening criteria in at least one groundwater sample during Round 2. The elevated metals detections in 25MW02 Round 2 compared to Round 1 appear to be related to the increased turbidity (270 NTUs versus 23 NTUs). Included in

Table 5-8 are the recently developed basewide Pennsylvanian Aquifer groundwater UTLs) for metals (Tetra Tech, 2013). Also evident from a review of Table 5-8 is that, even though a comparison of dissolved metals concentrations to the basewide UTLS is not a valid comparison, the dissolved metals exhibit dramatically fewer exceedances of UTLs, as expected. This is interpreted to be a result of having removed suspended solids through filtration prior to measurement of the dissolved metals concentrations.

Figure 5-5 shows the locations of the exceedances of the regulatory screening criteria for total metals in groundwater in Round 2. Maximum total metals concentrations were predominantly detected in the sample collected from monitoring well 25MW02. Given the high level of turbidity associated with most of the samples (See Appendix B.2), it is apparent that elevated metal concentrations are associated with turbidity, which is most likely of geologic origin (i.e., comprised of suspended silt/clay particles with adsorbed metals). This is especially evident when the dissolved metals concentrations are compared to total metals concentrations for the same sampling location. For example, the total iron concentration for sample 25MW738102 collected from 25MW03 was 27,500 µg/L whereas the dissolved iron concentration was 169 µg/L.

5.3.6 SVOCs (Including Low Concentration Level PAHs) - Round 2

Table 5-8 indicates that three SVOCs (including two PAHs and one phthalate ester) were detected above laboratory detection limits, with only one PAH (naphthalene) detected above the regulatory screening criteria in two of the four Round 2 (November 2012) groundwater samples. The samples that exceeded regulatory screening criterion for naphthalene (0.14 µg/L) were collected from monitoring well 25MW03 (0.169 J µg/L) and the new well 25MWT06 (0.157 J µg/L), located directly downgradient of the larger dump area. Figure 5-6 shows the locations of the exceedances of the regulatory screening criteria for SVOCs in groundwater in Round 2.

5.4 SUMMARY OF NATURE AND EXTENT OF CONTAMINATION

5.4.1 Soil

The soils from the overburden along Highway 58 ranged from 2 feet bgs (on the southwest side of Highway 58) to 10 feet bgs (northeast side of Highway 58). Surface soil samples were collected from 0 to 2 feet bgs. Subsurface soil samples collected ranged from 2 feet bgs to as deep as 10 feet bgs. Eleven surface and 11 subsurface soil samples were collected and analyzed (See Table 2-2).

5.4.1.1 Surface Soil

A comparison of surface soil data to the minimum HHRA and ERA regulatory screening criteria (Sections 5.2.1.1 and 5.2.1.2) identified a number of exceedances:

- Concentrations of arsenic (HHRA and ERA), cadmium (ERA only), chromium (HHRA and ERA), iron (HHRA only), lead (ERA only), and selenium (ERA only) exceeded the minimum regulatory screening values and background values in surface soil samples. .

- Concentrations of one SVOC, benzo(a)pyrene (HHRA only), exceeded the minimum regulatory screening values in surface soil samples.

5.4.1.2 Subsurface Soil

A comparison of subsurface soil data to the minimum HHRA regulatory screening criteria (Sections 5.2.2.1 and 5.2.2.2) identified a number of exceedances:

- Concentrations of arsenic, cobalt, iron, and manganese exceeded the minimum regulatory screening values and background values in subsurface soil samples.

- SVOC concentrations did not exceed the minimum regulatory screening values in any subsurface soil sample.

5.4.2 Groundwater - Round 1

Groundwater was collected from five previously installed monitoring wells around the dump perimeter, as shown on Figure 2-1.

A comparison of groundwater results to the minimum HHRA regulatory screening criteria (Sections 5.3.1, 5.3.2, and 5.3.3) identified a number of exceedances:

- Concentrations of dissolved arsenic, chromium, cobalt, iron, manganese, and nickel exceeded the minimum regulatory screening values in groundwater.

- Concentrations of total arsenic, chromium, cobalt, iron, manganese, and nickel exceeded the minimum regulatory screening values in groundwater.

- Concentrations of SVOCs did not exceed the minimum regulatory screening values in groundwater.

5.4.3 Groundwater - Round 2

Groundwater was collected from three previously installed monitoring wells and one new temporary well around the dump perimeter, as shown on Figure 2-1. Figure 4-9 presents the Round 2 groundwater elevation map.

A comparison of groundwater results to the regulatory screening criteria (Sections 5.3.4, 5.3.5, and 5.3.6) identified a number of exceedances:

- Concentrations of dissolved arsenic, cobalt, iron, manganese, nickel, and thallium exceeded the minimum regulatory screening values in groundwater.

- Concentrations of total aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, nickel, thallium, and vanadium exceeded the minimum regulatory screening values in groundwater.

- One SVOC (naphthalene) exceeded the minimum regulatory screening values in groundwater samples at two downgradient monitoring well locations, 25MW03 and 25MWT06.

TABLE 5-1

FREQUENCY OF DETECTION IN SURFACE SOIL
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Result	Minimum Qualifier	Maximum Res	Maximum Qualifier	Human Health Screening Value	Location of Maximum Detect	Sample of Maximum Detect	Minimum Nondetect	Maximum Nondetect	Average of Positive Results	Overall Average	Standard Deviation
METALS (MG/KG)													
ALUMINUM	11/11	5200	J	20000	J	7,700	25SB001	25SS0010002			9545.45	9545.45	4518.04
ARSENIC	11/11	4.2	J	24		3.4	25SB010	25SS0100002			11.96	11.96	6.48
BARIUM	11/11	28	J	87	J	1,500	25SB001	25SS0010002			62.00	62.00	19.93
BERYLLIUM	10/11	0.34	J	0.82		16	25SB005	25SS0050002	0.36	0.36	0.64	0.60	0.19
CADMIUM	9/11	0.31		0.76		7	25SB005	25SS0050002	0.23	0.24	0.45	0.39	0.19
CHROMIUM	11/11	7.9		29		11.8	25SB005	25SS0050002			18.54	18.54	6.04
COBALT	11/11	1.9	J	21		2	25SB011	25SS0110002			10.04	10.04	5.59
COPPER	11/11	9.1		18		310	25SB001	25SS0010002			13.55	13.55	2.72
IRON	11/11	8200	J	63000		5,500	25SB009	25SS0090002			28654.55	28654.55	13922.38
LEAD	11/11	6.4		53		400	25SB005	25SS0050002			21.85	21.85	11.73
MANGANESE	11/11	110	J	1600		180	25SB011	25SS0110002			571.82	571.82	425.18
MERCURY	11/11	0.006	J	0.056		1	25SB001	25SS0010002			0.03	0.03	0.01
NICKEL	11/11	7.1		24		150	25SB011	25SS0110002			13.60	13.60	4.39
SELENIUM	3/11	0.57	J	1.4	J	39	25SB009	25SS0090002	0.37	0.75	0.91	0.45	0.36
SILVER	11/11	0.02	J	0.12	J	12	25SB005	25SS0050002			0.06	0.06	0.03
THALLIUM	11/11	0.11	J	0.3	J	0.078	25SB008	25SS0080002			0.18	0.18	0.06
VANADIUM	11/11	7.9		40		39	25SB008	25SS0080002			23.90	23.90	9.53
ZINC	11/11	24		81	J	2,300	25SB005	25SS0050002			45.36	45.36	16.30
MISCELLANEOUS PARAMETERS (%)													
PERCENT MOISTURE	11/11	13		20		NC	25SB001	25SS0010002			15.73	15.73	2.15
SEMIVOLATILES (UG/KG)													
ACENAPHTHYLENE	3/11	12	J	30	J	82,000	25SB003	25SS0030002	7.7	20	23.67	10.47	9.88
ANTHRACENE	2/11	10		12		840,000	25SB005	25SS0050002	7.7	15	11.00	5.60	2.90
BENZO(A)ANTHRACENE	5/11	13		42		150	25SB003	25SS0030002	19	20	29.20	18.68	12.83
BENZO(A)PYRENE	5/11	16		55		15	25SB003	25SS0030002	7.7	20	35.80	19.00	19.98
BENZO(B)FLUORANTHENE	5/11	19		64		150	25SB007	25SS0070002	7.7	20	44.00	22.72	23.93
BENZO(G,H,I)PERYLENE	5/11	13		53		170,000	25SB007	25SS0070002	7.7	8.2	30.00	15.81	17.37
BENZO(K)FLUORANTHENE	4/11	13	J	32		1,500	25SB007	25SS0070002	7.7	20	26.00	12.72	11.75
BIS(2-ETHYLHEXYL)PHTHALATE	4/11	14	J	35	J	22,000	25SB007	25SS0070002	19	39	21.75	15.14	7.78
BUTYL BENZYL PHTHALATE	1/11	8	J	8	J	4,000	25SB005	25SS0050002	8	39	8.00	9.55	4.06
CARBAZOLE	1/11	8	J	8	J	NC	25SB005	25SS0050002	19	99	8.00	17.82	15.95
CHRYSENE	5/11	13		44		15,000	25SB003	25SS0030002	7.7	8.2	31.60	16.54	16.72
DI-N-BUTYL PHTHALATE	1/11	11	J	11	J	94,000	25SB005	25SS0050002	19	39	11.00	10.91	2.88
DIETHYL PHTHALATE	1/11	8	J	8	J	34,000	25SB005	25SS0050002	19	39	8.00	10.64	3.01
FLUORANTHENE	5/11	11		52		230,000	25SB007	25SS0070002	7.7	20	36.60	19.36	19.72
INDENO(1,2,3-CD)PYRENE	3/11	18		38		150	25SB007	25SS0070002	7.7	40	29.33	13.83	12.59
PHENANTHRENE	4/11	15		25		170,000	25SB007	25SS0070002	7.7	20	21.50	10.92	8.90
PYRENE	5/11	12		55		170,000	25SB007	25SS0070002	7.7	20	39.60	20.72	21.02

Associated Samples:
25SS0010002
25SS0020002
25SS0030002
25SS0040002
25SS0050002
25SS0060002
25SS0070002
25SS0080002
25SS0090002
25SS0100002
25SS0110002

Notes:
J = Value is estimated.
ug/kg = Microgram per kilogram.

TABLE 5-2

POSITIVE HITS IN SURFACE SOIL
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA	IDEM	ERA	MIN	25SB001		25SB002		25SB003		25SB004				25SB005	
SAMPLE ID					25SS0010002		25SS0020002		25SS0030002		25SS0040002		25SS0040002-D		25SS0050002	
SAMPLE DATE					20110711		20110711		20110711		20110711		20110711		20110712	
SAMPLE CODE					NORMAL		NORMAL		NORMAL		NORMAL		DUP		NORMAL	
MATRIX					SO		SO		SO		SO		SO		SO	
SAMPLE TYPE					NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
SUBMATRIX					SS		SS		SS		SS		SS		SS	
TOP DEPTH					0		0		0		0		0		0	
BOTTOM DEPTH					2		2		2		2		2		2	
METALS (UG/KG)																
ALUMINUM	7,700,000	100,000,000	NC	7,700,000	20,000,000	J	11,000,000	J	10,000,000	J	5,200,000	J	5,100,000	J	6,500,000	J
ARSENIC	26	5,500	18,000	26	9,600	J	4,700	J	9,300	J	4,200	J	10,000	J	23,000	J
BARIUM	1,500,000	1,700,000	330,000	330,000	87,000	J	65,000	J	52,000	J	28,000	J	30,000	J	67,000	J
BERYLLIUM	16,000	63,000	21,000	16,000	630		580		690		360	U	330		820	
CADMIUM	7,000	7,500	360	360	450		430		240	U	230	U	290		760	
CHROMIUM	11.8	120	26,000	11.8	21,000		15,000		21,000		7,900		9,300		29,000	
COBALT	2,300	4,300	13,000	2,300	6,400	J	10,000	J	4,700	J	1,900	J	1,200	J	9,400	J
COPPER	310,000	920,000	28,000	28,000	18,000		11,000		14,000		11,000		9,800		16,000	
IRON	5,400,000	5,600,000	NC	5,400,000	29,000,000	J	17,000,000	J	27,000,000	J	8,200,000	J	9,900,000	J	38,000,000	J
LEAD	280,000	270,000	11,000	11,000	18,000		24,000		13,000		6,400		7,600		53,000	
MANGANESE	180,000	420,000	220,000	180,000	310,000	J	510,000	J	200,000	J	110,000	J	43,000	J	590,000	J
MERCURY	660	2,100	100	100	56		34	J	6	J	16	J	24	J	30	J
NICKEL	150,000	390,000	38,000	38,000	13,000		13,000		11,000		7,100		11,000		16,000	
SELENIUM	8,000	5,300	520	520	540	U	540	U	370	U	450	U	340	U	480	U
SILVER	12,000	12,000	4,200	4,200	77	J	52	J	33	J	40	J	48	J	120	J
THALLIUM	78	1,100	56.9	56.9	300	J	170	J	150	J	110	J	90	J	140	J
VANADIUM	39,000	550,000	7,800	7,800	35,000		18,000		22,000		7,900		9,400		31,000	
ZINC	2,300,000	5,900,000	46,000	46,000	58,000	J	43,000	J	38,000	J	24,000	J	24,000	J	81,000	J
MISCELLANEOUS PARAMETERS (%)																
PERCENT MOISTURE	NC	NC	NC	NC	20		16		13		13		12		16	
SEMIVOLATILES (UG/KG)																
ACENAPHTHYLENE	82,000	82,000	29,000	29,000	8.4	UJ	8	UJ	30	J	7.7	UJ	7.6	UJ	12	J
ANTHRACENE	840,000	860,000	29,000	29,000	8.4	U	8	U	15	U	7.7	U	7.6	U	12	
BENZO(A)ANTHRACENE	150	2,100	1,100	150	13		20	U	42		19	U	19	U	31	
BENZO(A)PYRENE	15	210	1,100	15	16		8	U	55		7.7	U	7.6	U	35	
BENZO(B)FLUORANTHENE	150	2,100	1,100	150	19		8	U	62		7.7	U	7.6	U	45	
BENZO(G,H,I)PERYLENE	170,000	NC	1,100	1,100	13		8	U	43		7.7	U	7.6	U	19	
BENZO(K)FLUORANTHENE	1,500	21,000	1,100	1,100	12	U	8	U	32		7.7	U	7.6	U	27	
BIS(2-ETHYLHEXYL)PHTHALATE	22,000	29,000	925	925	21	UJ	20	UJ	39	UJ	19	UJ	19	UJ	20	J
BUTYL BENZYL PHTHALATE	4,000	41,000	239	239	21	U	20	U	39	U	19	U	19	U	8	J
CARBAZOLE	NC	NC	NC	NC	21	UJ	20	UJ	39	UJ	19	UJ	19	UJ	8	J
CHRYSENE	15,000	210,000	1,100	1,100	13		8	U	44		7.7	U	7.6	U	35	
DIETHYL PHTHALATE	94,000	90,000	24,800	24,800	21	U	20	U	39	U	19	U	19	U	8	J
DI-N-BUTYL PHTHALATE	34,000	34,000	150	150	21	U	20	U	39	U	19	U	19	U	11	J
FLUORANTHENE	230,000	1,400,000	29,000	29,000	11		8	U	49		7.7	U	7.6	U	42	
INDENO(1,2,3-CD)PYRENE	150	2,100	1,100	150	8.4	U	8	U	32		7.7	U	7.6	U	18	
PHENANTHRENE	170,000	NC	29,000	29,000	8.4	U	8	U	23		7.7	U	7.6	U	23	
PYRENE	170,000	190,000	1,100	1,100	12		8	U	50		7.7	U	7.6	U	43	

TABLE 5-2

POSITIVE HITS IN SURFACE SOIL
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA	IDEM	ERA	MIN	25SB006		25SB007		25SB008		25SB009		25SB010		25SB011	
SAMPLE ID					25SS0060002		25SS0070002		25SS0080002		25SS0090002		25SS0100002		25SS0110002	
SAMPLE DATE					20110712		20110712		20110712		20110711		20110711		20110711	
SAMPLE CODE					NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
MATRIX					SO		SO		SO		SO		SO		SO	
SAMPLE TYPE					NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
SUBMATRIX					SS		SS		SS		SS		SS		SS	
TOP DEPTH					0		0		0		0		0		0	
BOTTOM DEPTH					2		2		2		2		2		2	
METALS (UG/KG)																
ALUMINUM	7,700,000	100,000,000	NC	7,700,000	9,500,000	J	8,900,000	J	15,000,000	J	7,600,000		5,500,000		5,800,000	
ARSENIC	26	5,500	18,000	26	8,900	J	12,000	J	8,900	J	12,000		24,000		15,000	
BARIUM	1,500,000	1,700,000	330,000	330,000	79,000	J	61,000	J	86,000		40,000		40,000		77,000	
BERYLLIUM	16,000	63,000	21,000	16,000	800		650		610	J	730	J	340	J	570	J
CADMIUM	7,000	7,500	360	360	340		310		660		420		320		390	
CHROMIUM	11.8	120	26,000	11.8	14,000		15,000		26,000		20,000		14,000		21,000	
COBALT	2,300	4,300	13,000	2,300	18,000	J	10,000	J	12,000		11,000		6,000		21,000	
COPPER	310,000	920,000	28,000	28,000	9,100		12,000		17,000		14,000		14,000		13,000	
IRON	5,400,000	5,600,000	NC	5,400,000	19,000,000	J	27,000,000	J	29,000,000	J	63,000,000		26,000,000		32,000,000	
LEAD	280,000	270,000	11,000	11,000	24,000		16,000		20,000		19,000		26,000		21,000	
MANGANESE	180,000	420,000	220,000	180,000	960,000	J	560,000	J	770,000	J	460,000		220,000		1,600,000	
MERCURY	660	2,100	100	100	9.5	J	29		39		31	J	35	J	34	J
NICKEL	150,000	390,000	38,000	38,000	13,000		13,000		17,000		13,000		9,500	J	24,000	
SELENIUM	8,000	5,300	520	520	550	U	640	U	750	U	1,400	J	770	J	570	J
SILVER	12,000	12,000	4,200	4,200	98	J	33	J	42	J	20	J	40	J	51	J
THALLIUM	78	1,100	56.9	56.9	190	J	150	J	300	J	150	J	130	J	170	J
VANADIUM	39,000	550,000	7,800	7,800	19,000		18,000		40,000		19,000		20,000		33,000	
ZINC	2,300,000	5,900,000	46,000	46,000	41,000	J	45,000	J	44,000	J	60,000		24,000		41,000	J
MISCELLANEOUS PARAMETERS (%)																
PERCENT MOISTURE	NC	NC	NC	NC	16		13		16		16		16		18	
SEMIVOLATILES (UG/KG)																
ACENAPHTHYLENE	82,000	82,000	29,000	29,000	20	U	29	J	20	UJ	8	UJ	8	UJ	8.2	UJ
ANTHRACENE	840,000	860,000	29,000	29,000	8	U	10		8	U	8	U	8	U	8.2	U
BENZO(A)ANTHRACENE	150	2,100	1,100	150	20		40		20	U	20	U	20	U	20	U
BENZO(A)PYRENE	15	210	1,100	15	19	J	54		20	U	8	U	8	U	8.2	U
BENZO(B)FLUORANTHENE	150	2,100	1,100	150	30	J	64		20	U	8	U	8	U	8.2	U
BENZO(G,H,I)PERYLENE	170,000	NC	1,100	1,100	8	UJ	53		22		8	U	8	U	8.2	U
BENZO(K)FLUORANTHENE	1,500	21,000	1,100	1,100	13	J	32		20	U	8	U	8	U	8.2	U
BIS(2-ETHYLHEXYL)PHTHALATE	22,000	29,000	925	925	14	J	35	J	18	J	20	U	20	U	20	U
BUTYL BENZYL PHTHALATE	4,000	41,000	239	239	8	U	19	U	8	U	20	U	20	U	20	U
CARBAZOLE	NC	NC	NC	NC	99	U	19	UJ	99	U	20	U	20	U	20	U
CHRYSENE	15,000	210,000	1,100	1,100	23		43		8	U	8	U	8	U	8.2	U
DIETHYL PHTHALATE	94,000	90,000	24,800	24,800	20	U	19	U	20	U	20	U	20	U	20	U
DI-N-BUTYL PHTHALATE	34,000	34,000	150	150	20	UJ	19	U	20	U	20	U	20	U	20	U
FLUORANTHENE	230,000	1,400,000	29,000	29,000	29		52		20	U	8	U	8	U	8.2	U
INDENO(1,2,3-CD)PYRENE	150	2,100	1,100	150	40	UJ	38		40	U	8	U	8	U	8.2	U
PHENANTHRENE	170,000	NC	29,000	29,000	15		25		20	U	8	U	8	U	8.2	U
PYRENE	170,000	190,000	1,100	1,100	38		55		20	U	8	U	8	U	8.2	U

TABLE 5-3

FREQUENCY OF DETECTION IN SUBSURFACE SOIL
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Min Res	Min Qual	Max Res	Max Qual	Location of Max Detect	Sample of Max Detect	Minimum Nondetect	Maximum Nondetect	Average of Positive Results	Overall Average	Standard Deviation
METALS (UG/KG)												
ALUMINUM	11/11	4700000	J	12000000	J	25SB004	25SB0040206			7000000.00	7000000.00	2509980.08
ARSENIC	11/11	1600		14000	J	25SB005	25SB0050206			7727.27	7727.27	4584.34
BARIUM	11/11	19000	J	380000	J	25SB007	25SB0070610			69909.09	69909.09	103847.44
BERYLLIUM	9/11	390		1800		25SB007	25SB0070610	370	400	727.78	630.45	478.82
CADMIUM	4/11	230		380		25SB008	25SB0080206	150	270	285.00	170.45	99.38
CHROMIUM	11/11	4700		26000		25SB007	25SB0070610			13954.55	13954.55	6163.66
COBALT	11/11	1000	J	23000	J	25SB007	25SB0070610			6272.73	6272.73	6279.98
COPPER	11/11	5900		23000		25SB007	25SB0070610			11000.00	11000.00	4546.21
IRON	11/11	6200000	J	130000000	J	25SB007	25SB0070610			32018181.82	32018181.82	35164806.79
LEAD	11/11	6200		54000		25SB007	25SB0070610			15554.55	15554.55	13217.21
MANGANESE	11/11	82000	J	2600000	J	25SB007	25SB0070610			440000.00	440000.00	733499.56
MERCURY	10/11	9	J	39	J	25SB004	25SB0040206	12	12	20.00	18.73	9.49
NICKEL	11/11	4700		52000		25SB007	25SB0070610			13163.64	13163.64	13356.07
SELENIUM	1/11	420	J	420	J	25SB008	25SB0080610	370	870	420.00	284.55	81.96
SILVER	10/11	26	J	120	J	25SB007	25SB0070610	73	73	54.40	52.77	24.94
THALLIUM	10/11	86	J	270	J	25SB007	25SB0070610	93	93	144.60	135.68	57.14
VANADIUM	11/11	3400		29000		25SB007	25SB0070206			15881.82	15881.82	7358.64
ZINC	11/11	12000	J	110000	J	25SB007	25SB0070610			34000.00	34000.00	27221.32
MISCELLANEOUS PARAMETERS (%)												
PERCENT MOISTURE	11/11	9		21		25SB007	25SB0070206			15.09	15.09	3.33
SEMIVOLATILES (UG/KG)												
BENZO(A)ANTHRACENE	1/11	8		8		25SB005	25SB0050206	18	21	8	9.68	0.72
BENZO(A)PYRENE	1/11	10		10		25SB005	25SB0050206	7.4	8.5	10	4.50	1.83
BENZO(B)FLUORANTHENE	1/11	12		12		25SB005	25SB0050206	7.4	8.5	12	4.69	2.43
BIS(2-ETHYLHEXYL)PHTHALATE	4/11	19	J	300	J	25SB005	25SB0050206	18	21	94	40.45	86.43
DIETHYL PHTHALATE	1/11	16	J	16	J	25SB001	25SB0010206	18	21	16	10.36	1.92

Associated Samples:
25SB0010206
25SB0030206
25SB0040206
25SB0040610
25SB0050206
25SB0060206
25SB0060610
25SB0070206
25SB0070610
25SB0080206
25SB0080610

Notes:

J = Value is estimated.
ug/kg = Microgram per kilogram.

TABLE 5-4

POSITIVE HITS IN SUBSURFACE SOIL
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA	IDEM	MIN	Background Value	25SB001	25SB003	25SB004			25SB005	25SB006		25SB007		25SB008	
SAMPLE ID					25SB0010206	25SB0030206	25SB0040206	25SB0040206-D	25SB0040610	25SB0050206	25SB0060206	25SB0060610	25SB0070206	25SB0070610	25SB0080206	25SB0080610
SAMPLE DATE					20110711	20110711	20110712	20110711	20110711	20110712	20110712	20110712	20110712	20110711	20110712	20110712
SAMPLE CODE					NORMAL	NORMAL	NORMAL	DUP	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
MATRIX					SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO	SO
SAMPLE TYPE					NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX					SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB	SB
TOP DEPTH					2	2	2	2	6	2	2	6	2	6	2	6
BOTTOM DEPTH					6	6	6	6	10	6	6	10	6	10	6	10
METALS (UG/KG)																
ALUMINUM	7,700,000	100,000,000	7,700,000	20,600,000	**11,000,000 J**	4,700,000 J	**12,000,000 J**	**13,000,000 J**	5,400,000 J	7,000,000 J	**7,800,000 J**	4,700,000 J	**7,800,000 J**	4,800,000 J	6,300,000 J	5,500,000
ARSENIC	26	5,500	26	12,483	**5,900 J**	**2,600 J**	**5,000 J**	**8,500 J**	**10,000 J**	**14,000 J**	**5,800 J**	**9,500 J**	**14,000 J**	**3,600 J**	**13,000 J**	**1,600**
BARIUM	1,500,000	1,700,000	1,500,000	115,439	28,000 J	49,000 J	55,000 J	110,000 J	31,000 J	49,000 J	66,000 J	19,000 J	33,000 J	380,000 J	36,000	23,000
BERYLLIUM	16,000	63,000	16,000	NA	440	370 U	400 U	820 J	390	640	480	1,200	750	1,800	400 J	450
CADMIUM	7,000	7,500	7,000	829	270 U	190 U	230 U	680 J	230	290	210 U	150 U	190 U	230 U	380	240
CHROMIUM	11.8	120	11.8	32,976	**18,000**	**7,800**	**18,000**	**22,000**	**10,000**	**13,000**	**15,000**	**4,700**	**20,000**	**26,000**	**11,000**	**10,000**
COBALT	2,300	4,300	2,300	21,212	2,200 J	2,100 J	**4,400 J**	**12,000 J**	**2,800 J**	**9,900 J**	**9,100 J**	1,000 J	**4,500 J**	**23,000 J**	**2,800**	**7,200**
COPPER	310,000	920,000	310,000	33,283	9,400	5,900	10,000	14,000	10,000	12,000	6,900	14,000	9,100	23,000	9,700	11,000
IRON	5,400,000	5,600,000	5,400,000	60,200,000	**22,000,000 J**	**8,000,000 J**	**32,000,000 J**	**23,000,000 J**	**18,000,000 J**	**29,000,000 J**	**17,000,000 J**	**6,200,000 J**	**55,000,000 J**	**130,000,000 J**	**13,000,000 J**	**22,000,000**
LEAD	280,000	270,000	270,000	19,649	14,000	6,200	15,000 J	29,000 J	7,200	16,000	11,000	9,900	17,000	54,000	11,000	9,800
MANGANESE	180,000	420,000	180,000	703,636	94,000 J	110,000 J	**390,000 J**	**1,200,000 J**	140,000 J	**440,000 J**	**530,000 J**	82,000 J	**200,000 J**	**2,600,000 J**	84,000 J	170,000
MERCURY	660	2,100	660	178	23 J	16 J	39 J	39	16 J	16 J	21 J	9 J	9 J	12 U	26 J	25 J
NICKEL	150,000	390,000	150,000	29,649	6,800	4,700	8,400	14,000	8,800	13,000	8,900	7,400	17,000	52,000	5,800	12,000
SELENIUM	8,000	5,300	5,300	1,067	480 U	460 U	500 U	610 U	560 U	600 U	370 U	380 U	870 U	570 U	630 U	420 J
SILVER	12,000	12,000	12,000	143	42 J	63 J	61 J	55 J	55 J	53 J	38 J	46 J	40 J	120 J	26 J	73 U
THALLIUM	78	1,100	78	332	**140 J**	93 U	**130 J**	**220 J**	**86 J**	**140 J**	**120 J**	**100 J**	**170 J**	**270 J**	**170 J**	**120 J**
VANADIUM	39,000	550,000	39,000	69,144	21,000	11,000	24,000	29,000	12,000	18,000	19,000	3,400	29,000	17,000	11,000	9,300
ZINC	2,300,000	5,900,000	2,300,000	83,334	20,000 J	15,000 J	26,000 J	310,000 J	39,000 J	41,000 J	25,000 J	12,000 J	41,000 J	110,000 J	17,000	28,000
MISCELLANEOUS PARAMETERS (%)																
PERCENT MOISTURE	NC	NC	NC	NA	16	14	15	17	12	14	20	9	21	16	14	15
SEMIVOLATILES (UG/KG)																
BENZO(A)ANTHRACENE	150	2,100	NC	NA	20 U	19 U	20 U	20 U	19 U	8	21 U	18 U	21 U	20 U	19 U	20 U
BENZO(A)PYRENE	15	210	NC	NA	7.9 U	7.8 U	7.8 U	8 U	7.6 U	10	8.4 U	7.4 U	8.5 U	8 U	7.8 U	7.9 U
BENZO(B)FLUORANTHENE	150	2,100	NC	NA	7.9 U	7.8 U	7.8 U	8 U	7.6 U	12	8.4 U	7.4 U	8.5 U	8 U	7.8 U	7.9 U
BIS(2-ETHYLHEXYL)PHTHALATE	22,000	29,000	NC	NA	24 J	19 UJ	19 J	18 J	33 J	300 J	21 UJ	18 UJ	21 UJ	20 UJ	19 UJ	20 U
DIETHYL PHTHALATE	94,000	90,000	NC	NA	16 J	19 U	20 U	20 U	19 U	19 U	21 U	18 U	21 U	20 U	19 U	20 U

Notes:
DUP = duplicate
HHRA = human health risk assessment value. Lowest of USEPA Regional Screening Level (RSL) for residential exposures to soil and Soil Screening Level (SSL) for migration from soil to groundwater (November 2012).
RSL is based on a cancer risk of 1E-6 or hazard index of 0.1. SSL is based on a dilution attenuation factor (DAF) of 20.
IDEM = Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013). Value is lower of direct contact screening level from residential exposures to soil and migration from soil to groundwater screening level. Direct contact screening level is based on a cancer risk of 1E-5 or hazard index of 1. Migration to groundwater value is based on a DAF of 20.
J = Value is estimated.
MIN = minimum detection limit value
NC = No criteria.
SB = subsurface sample
SO = soil
U = Analyte not detected at the reporting limit.
UJ = Numerical detection limit for the undetected result is estimated.
ug/kg = Microgram per kilogram.
Shaded cells and boldface font indicate that the concentration is greater than the minimum screening criterion.

TABLE 5-5

FREQUENCY OF DETECTION IN GROUNDWATER
ROUND 1
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Min Res	Min Qual	Max Res	Max Qual	Location of Max Detect	Sample of Max Detect	Minimum Nondetect	Maximum Nondetect	Average of Positive Results	Overall Average	Standard Deviation
TOTAL METALS (UG/L)												
ALUMINUM	3	39	J	190	J	25MW03	25GW738101			96.67	96.67	81.57
ARSENIC	3	2		2		25MW03	25GW738101	1.2	1.5	2.00	1.12	0.77
BARIUM	3	9.3	J	120		25MW01	25GW718101			79.77	79.77	61.23
CADMIUM	3	0.46		0.46		25MW02	25GW728101	0.24	0.44	0.46	0.27	0.17
CHROMIUM	3	1.8	J	1.8	J	25MW03	25GW738101	0.5	0.57	1.80	0.78	0.88
COBALT	3	3.9		20		25MW02	25GW728101			10.43	10.43	8.47
COPPER	3	1.4	J	2.3		25MW03	25GW738101			1.83	1.83	0.45
IRON	3	3300		5500		25MW01	25GW718101			4233.33	4233.33	1137.25
LEAD	3	0.97		2.4		25MW03	25GW738101	0.32	0.32	1.69	1.18	1.13
MANGANESE	3	810	J	6100	J	25MW01	25GW718101			2770.00	2770.00	2898.91
NICKEL	3	9.2	J	54	J	25MW01	25GW718101			37.40	37.40	24.55
VANADIUM	3	0.27	J	2.9	J	25MW03	25GW738101	0.2	0.2	1.59	1.09	1.57
ZINC	3	7.4	J	72		25MW01	25GW718101			32.13	32.13	34.86
DISSOLVED METALS (UG/L)												
ALUMINUM	2	1.7	J	4.3	J	25MW03	25GW738101			3.00	3.00	1.84
ARSENIC	2	0.41	J	0.85		25MW03	25GW738101			0.63	0.63	0.31
BARIUM	2	8	J	90		25MW03	25GW738101			49.00	49.00	57.98
CHROMIUM	2	2.6	J	3.9	J	25MW02	25GW728101			3.25	3.25	0.92
COBALT	2	2.4		18		25MW02	25GW728101			10.20	10.20	11.03
COPPER	2	0.61	J	0.91	J	25MW02	25GW728101			0.76	0.76	0.21
IRON	2	2400		2400		25MW02	25GW728101	50	50	2400.00	1212.50	1679.38
MANGANESE	2	570		1200		25MW02	25GW728101			885.00	885.00	445.48
NICKEL	2	6		42		25MW02	25GW728101			24.00	24.00	25.46
VANADIUM	2	0.89	J	1	J	25MW02	25GW728101			0.95	0.95	0.08
ZINC	2	2.2	J	16	J	25MW02	25GW728101			9.10	9.10	9.76

Associated Samples:
25GW718101
25GW728101
25GW738101

TABLE 5-6

POSITIVE HITS IN GROUNDWATER
ROUND 1
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	Min	25MW01	25MW02	25MW03		GW BKG	Exceeds BKG?
SAMPLE ID				25GW718101	25GW728101	25GW738101	25GW738101-D		
SAMPLE DATE				20110713	20110714	20110713	20110714		
SAMPLE CODE				NORMAL	NORMAL	NORMAL	DUP		
MATRIX				GW	GW	GW	GW		
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL		
SUBMATRIX				NA	NA	NA	NA		
DISSOLVED METALS (UG/L)									
ALUMINUM	1600	16000	1600	NA	1.7 J	4.3 J	NA	6183	No
ARSENIC	0.045	10	0.045	NA	0.41 J	0.85	NA	9.1	No
BARIUM	290	2000	290	NA	8 J	90	NA	96.9	No
CHROMIUM	0.031	0.31	0.031	NA	3.9 J	2.6 J	NA	14.6	No
COBALT	0.47	4.7	0.47	NA	18	2.4	NA	65.5	No
COPPER	62	1300	62	NA	0.91 J	0.61 J	NA	14.6	No
IRON	1100	11000	1100	NA	2400	50 U	NA	34500	No
MANGANESE	32	320	32	NA	1200	570	NA	4470	No
NICKEL	30	300	30	NA	42	6	NA	135	No
VANADIUM	7.8	78	7.8	NA	1 J	0.89 J	NA	11.4	No
ZINC	470	4700	470	NA	16 J	2.2 J	NA	140	No
TOTAL METALS (UG/L)									
ALUMINUM	1600	16000	1600	61 J	39 J	190 J	76 J	6183	No
ARSENIC	0.045	10	0.045	1.2 U	1.5 U	2	1 U	9.1	No
BARIUM	290	2000	290	120	9.3 J	110	120	96.9	No
BERYLLIUM	1.6	4	1.6	0.2 U	0.2 U	0.2 U	0.1 J	2	No
CADMIUM	0.69	5	0.69	0.44 U	0.46	0.24 U	0.42 U	0.55	No
CHROMIUM	0.031	0.31	0.031	0.57 U	0.5 U	1.8 J	0.65 U	14.6	No
COBALT	0.47	4.7	0.47	7.4	20	3.9	9.2	65.5	No
COPPER	62	1300	62	1.8 J	1.4 J	2.3	2.2	14.6	No
IRON	1100	11000	1100	5500	3300	3900	5200	34500	No
LEAD	NC	15	15	0.97	0.32 U	2.4	1.2	9	No
MANGANESE	32	320	32	6100 J	1400 J	810 J	5600 J	4470	>BKG and MIN
NICKEL	30	300	30	54 J	49 J	9.2 J	53 J	135	No
VANADIUM	7.8	78	7.8	0.2 UJ	0.27 J	2.9 J	0.2 UJ	11.4	No
ZINC	470	4700	470	72	17 J	7.4 J	81	140	No
SEMIVOLATILES (UG/L)									
BIS(2-ETHYLHEXYL)PHTHALATE	4.8	6	4.8	0.5 U	0.5 U	0.5 U	0.76 J	NA	NA

Notes:
BKG = Basewide Upgradient Total Metal Upper Tolerance Limit for the Pennsylvanian aquifer (95 percent coverage with 95 percent confidence).
DUP = duplicate
GW = Groundwater Sample
J = Value is estimated.
NC = No criteria available.
RSL = USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
IDEM = Indiana Department of Environmental Management (IDEM), Risk Closure Guide RCG) (IDEM, March 2013).
U = Analyte not detected at the reporting limit.
ug/L = Microgram per Liter.
Shaded cells indicate that the concentration is greater than the screening criterion.

TABLE 5-7

FREQUENCY OF DETECTION IN GROUNDWATER
ROUND 2
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Min Res	Min Qual	Max Res	Max Qual	Location of Max Detect	Sample of Max Detect	Minimum Nondetect	Maximum Nondetect	Average of Positive Results	Overall Average	Standard Deviation
DISSOLVED METALS (UG/L)												
ALUMINUM	4/4	119		165		25MW03	25MW738102			144.75	144.75	19.05037182
ARSENIC	1/4	1.5	J	1.5	J	25MWT06	25MWT1061202	1.5	1.5	1.5	0.9375	0.375
BARIUM	4/4	8.66	J	127		25MW01	25MW718102-D			64.565	64.565	48.26779016
CALCIUM	4/4	46700		94700		25MW02	25MW728102			76925	76925	21588.01751
COBALT	3/4	4.51		16.8		25MWT06	25MWT1061202	2.5	2.5	9.79	7.655	6.700997438
IRON	3/4	169		4760		25MW01	25MW718102	15	15	2073	1556.625	2148.952589
MAGNESIUM	4/4	10200		69900		25MW01	25MW718102			30412.5	30412.5	27083.03205
MANGANESE	4/4	318		4810		25MW01	25MW718102-D			1733.25	1733.25	2063.082382
NICKEL	4/4	7.66		47.7		25MW01	25MW718102-D			27.465	27.465	17.01833031
POTASSIUM	4/4	1040	J	5300		25MW01	25MW718102			2431.25	2431.25	1917.708594
SODIUM	4/4	11000		65600		25MW01	25MW718102			29125	29125	23507.9242
THALLIUM	1/4	1.96	J	2.38		25MW01	25MW718102	1	1	2.17	0.9175	0.835
ZINC	4/4	2.51	J	35.5		25MW01	25MW718102-D			15.21	15.21	14.87553472
FIELD												
TEMPERATURE (DEG C)	4/4	9.9		15.1		25MW03	25MW738102			12.725	12.725	2.572126228
DISSOLVED OXYGEN (MG/L)	4/4	2.84		10.6		25MW02	25MW728102			6.0675	6.0675	3.318848947
SPECIFIC CONDUCTANCE (MS/CM)	4/4	0.001		1.59		25MW01	25MW718102			0.68175	0.68175	0.662522641
OXIDATION REDUCTION POTENTIAL (MV)	4/4	-8		108		25MW02	25MW728102			50.5	50.5	61.99731177
TURBIDITY (NTU)	4/4	2.6		388		25MW03	25MW738102			170.9	170.9	188.9907582
PH (S.U.)	4/4	7.1		7.4		25MW03	25MW738102			7.23	7.23	0.12489996
METALS (UG/L)												
ALUMINUM	4/4	179		5630		25MW03	25MW738102			2410.375	2410.375	2631.640217
ARSENIC	3/4	2.11	J	127		25MW02	25MW728102	1.5	1.5	47.57	35.865	61.02945109
BARIUM	4/4	53.9		138		25MW01	25MW718102			92.475	92.475	36.97164454
BERYLLIUM	2/4	0.329	J	0.873	J	25MW02	25MW728102	0.5	0.5	0.601	0.4255	0.300648743
CADMIUM	1/4	1.09	J	1.09	J	25MW02	25MW728102	0.5	0.5	1.09	0.46	0.42
CHROMIUM	4/4	1.22	J	85.4		25MW03	25MW738102	1	1	29.4	29.4	39.0908992
COBALT	4/4	8.67		149		25MW02	25MW728102			46.195	46.195	68.66252229
COPPER	2/4	9.96		18.8		25MW02	25MW728102	2	2	14.38	7.69	8.526374767
IRON	4/4	3330		146000		25MW02	25MW728102			45565	45565	67843.31679
LEAD	2/4	9.67		14.5		25MW02	25MW728102	0.75	0.75	12.085	6.23	7.042455774
MANGANESE	4/4	972		7440		25MW02	25MW728102			3773	3773	3059.175706
NICKEL	4/4	35.7		398		25MW02	25MW728102			137.75	137.75	174.0117716
THALLIUM	2/4	2.13		3.56	J	25MW02	25MW728102	1	1	2.86	1.68	1.477565565
VANADIUM	3/4	1.76	J	31.3		25MW03	25MW738102	2.5	2.5	19.65333333	15.0525	15.79925183
ZINC	4/4	20.4		190		25MW02	25MW728102			74.3625	74.3625	77.90311691
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)												
2-METHYLNAPHTHALENE	1/4	0.0933	J	0.0933	J	25MWT06	25MWT1061202	0.0926	0.1	0.0933	0.0601125	0.022137915
BIS(2-ETHYLHEXYL)PHTHALATE	1/4	0.493	J	0.493	J	25MW03	25MW738102	0.463	0.5	0.493	0.3084375	0.123118908
NAPHTHALENE	4/4	0.0545	J	0.169	J	25MW03	25MW738102			0.116925	0.116925	0.055070462

Associated Samples:
25MW718102
25MW718102-D (& avg)
25MW728102
25MW738102
25MWT1061202

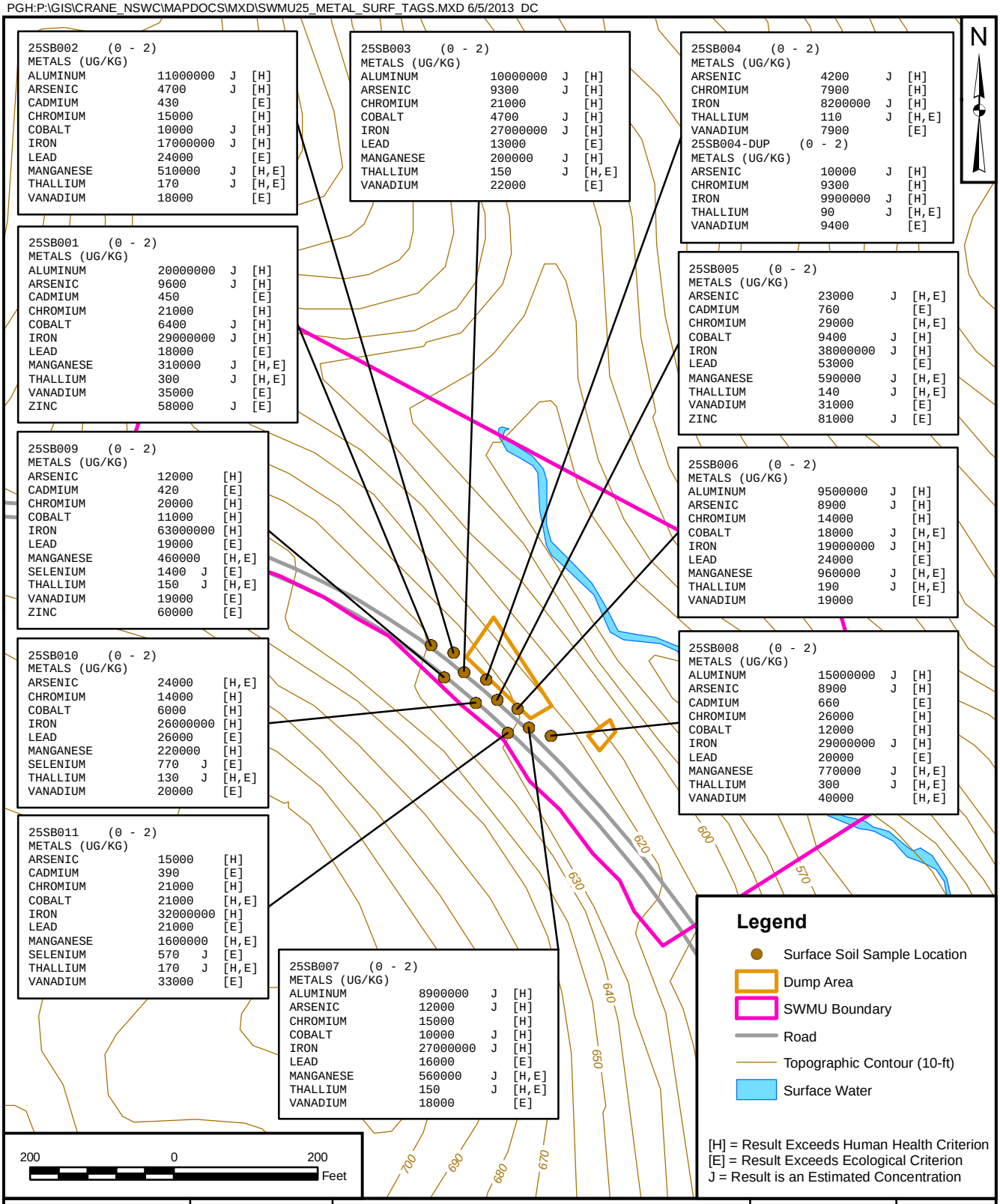
TABLE 5-8

POSITIVE HITS IN GROUNDWATER
ROUND 2
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION				25MW01		25MW02	25MW03	25MWT06	
SAMPLE ID				25MW718102	25MW718102-D	25MW728102	25MW738102	25MWT1061202	
SAMPLE DATE				20121101	20121101	20121101	20121101	20121031	
SAMPLE CODE	RSL	IDEM	Min	ORIG	DUP	NORMAL	NORMAL	NORMAL	GW BKG
MATRIX				GW	GW	GW	GW	GW	
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	
SUBMATRIX				NA	NA	NA	NA	NA	
DISSOLVED METALS (UG/L)									
ALUMINUM	1600	16000	1600	140	154	148	165	119	6183
ARSENIC	0.045	10	0.045	1.5 U	1.5 U	1.5 U	1.5 U	1.5 J	9.1
BARIUM	290	2000	290	125	127	8.66 J	67.9	55.7	96.9
CALCIUM	NC	NC	NC	92200	87600	94700	76400	46700	216000
COBALT	0.47	4.7	0.47	7.84	8.28	4.51	2.5 U	16.8	65.5
IRON	1100	11000	1100	4760	4520	15 U	169	**1410**	34500
MAGNESIUM	NC	NC	NC	69900	69600	26400	10200	15300	229000
MANGANESE	32	320	32	4630	4810	318	395	1500	4470
NICKEL	30	300	30	**45.3**	**47.7**	20.3	7.66	**35.4**	135
POTASSIUM	NC	NC	NC	5300	5130	1300	1040 J	2170	6450
SODIUM	NC	NC	NC	65600	61400	11000	18200	23800	165000
THALLIUM	0.016	2	0.016	2.38	**1.96 J**	1 U	1 U	1 U	NA
ZINC	470	4700	470	35.1	35.5	5.53	2.51 J	17.5	140
TOTAL METALS (UG/L)									
ALUMINUM	1600	16000	1600	262	179	**3490**	5630	301	6183
ARSENIC	0.045	10	0.045	1.5 U	1.5 U	127	13.6	2.11 J	9.1
BARIUM	290	2000	290	138	136	72	107	53.9	96.9
BERYLLIUM	1.6	4	1.6	0.5 U	0.5 U	0.873 J	0.329 J	0.5 U	2
CADMIUM	0.69	5	0.69	0.5 U	0.5 U	**1.09 J**	0.5 U	0.5 U	0.55
CHROMIUM	0.031	0.31	0.031	1.22 J	1 U	27	85.4	4.34	14.6
COBALT	0.47	4.7	0.47	8.67	8.97	149	9.16	17.8	65.5
COPPER	62	1300	62	2 U	2 U	18.8	9.96	2 U	14.6
IRON	1100	11000	1100	5730	5130	146000	27500	3330	34500
LEAD	NC	15	15	0.75 U	0.75 U	14.5	9.67	0.75 U	9
MANGANESE	32	320	32	5130	5130	7440	972	1550	4470
NICKEL	30	300	30	**48.4**	**49.8**	398	**68.2**	**35.7**	135
THALLIUM	0.016	2	0.016	2.19	2.13	3.56 J	1 U	1 U	NA
VANADIUM	7.8	78	7.8	2.5 U	2.5 U	25.9	31.3	1.76 J	11.4
ZINC	470	4700	470	51	42.5	190	40.3	20.4	140
POLYCYCLIC AROMATIC HYDROCARBONS (UG/L)									
2-METHYLNAPHTHALENE	2.7	27	2.7	0.0926 U	0.1 U	0.1 U	0.098 U	0.0933 J	NA
BIS(2-ETHYLHEXYL)PHTHALATE	4.8	6	4.8	0.463 U	0.5 U	0.5 U	0.493 J	0.5 U	NA
NAPHTHALENE	0.14	1.4	0.14	0.0844 J	0.09 J	0.0545 J	0.169 J	0.157 J	NA

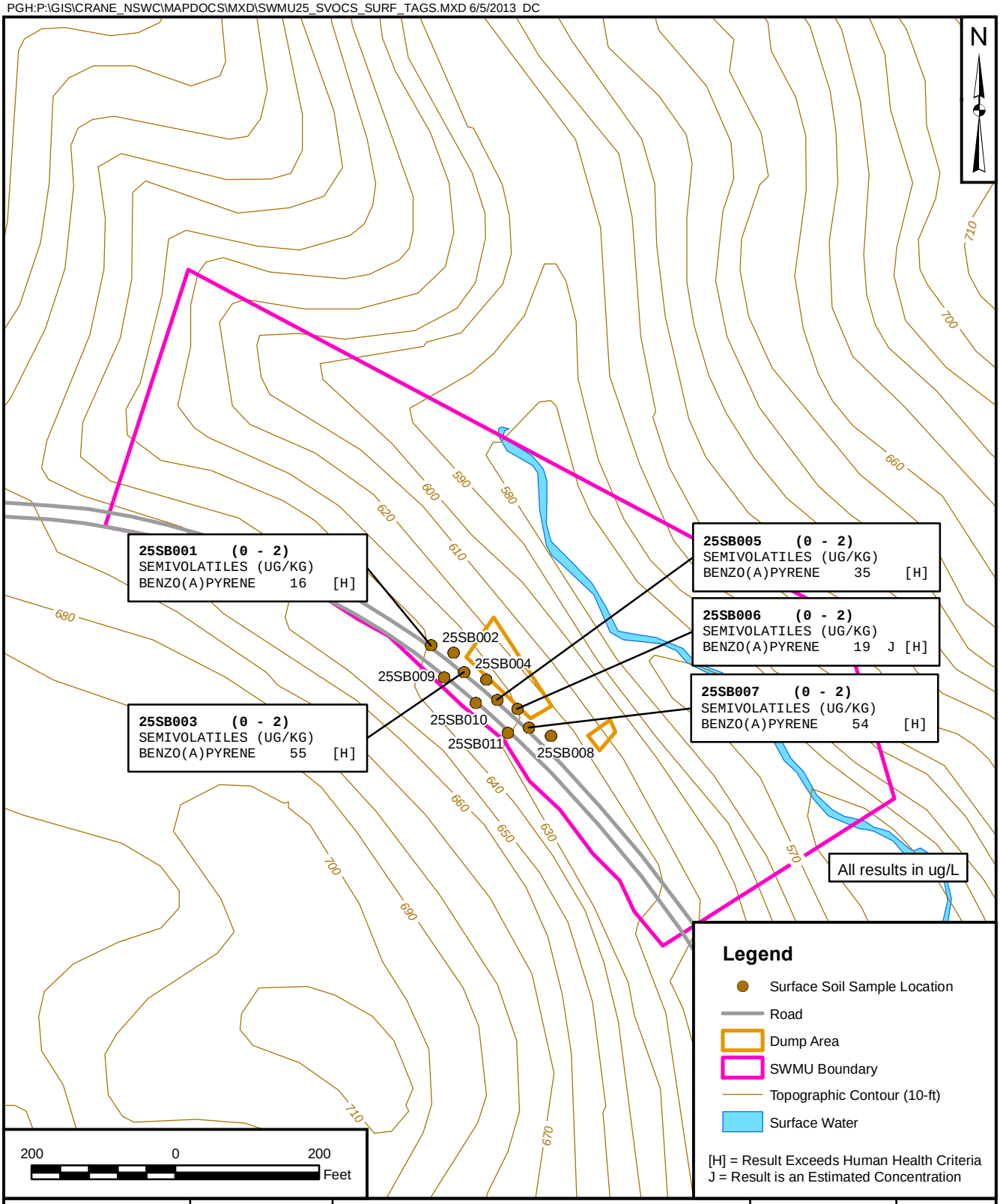
Notes:
BKG = Basewide Upgradient Total Metal Upper Tolerance Limit for the Pennsylvanian aquifer (95 percent coverage with 95 percent confidence).
DUP = duplicate
GW = Groundwater Sample
J = Value is estimated.
NC = No criteria available.
RSL = USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
IDEM = Indiana Department of Environmental Management (IDEM), Risk Closure Guide (RCG) (IDEM, March 2013).
U = Analyte not detected at the reporting limit.
ug/L = Microgram per Liter.
Shaded cells indicate that the concentration is greater than the screening criterion.

PGH:P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU25_METAL_SURF_TAGS.MXD 6/5/2013 DC



DRAWN BY	DATE	METALS EXCEEDING MINIMUM REGULATORY SCREENING VALUES IN SURFACE SOIL SWMU 25 - HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	CONTRACT NUMBER	CTO NUMBER
J. NOVAK	03/13/12		3116	F27L
CHECKED BY	DATE		APPROVED BY	DATE
M. TRAXLER	6/5/2013		E. BERKLITE	6/5/2013
REVISED BY	DATE		APPROVED BY	DATE
D. COUCH	6/5/2013		___	___
SCALE AS NOTED			FIGURE NO. FIGURE 5-1	REV 0

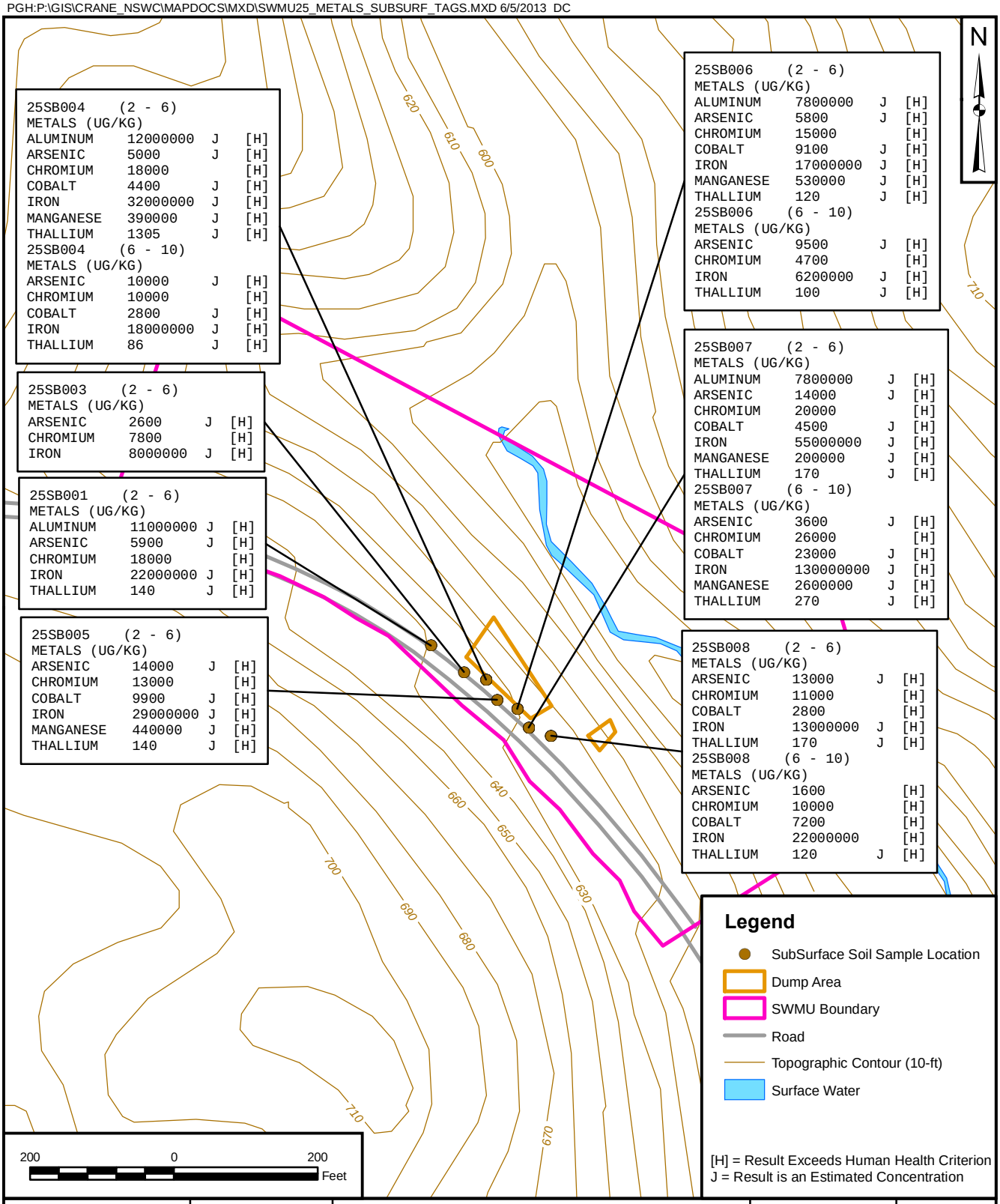
PGH:P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU25_SVOCS_SURF_TAGS.MXD 6/5/2013 DC



DRAWN BY	DATE	CONTRACT NUMBER	CTO NUMBER
J. NOVAK	03/13/12	3116	F27L
CHECKED BY	DATE	APPROVED BY	DATE
J. DUCAR	6/5/2013	E. BERKLITE	6/5/2013
REVISED BY	DATE	APPROVED BY	DATE
D. COUCH	6/5/2013	___	___
SCALE AS NOTED		FIGURE NO. 5 - 2	REV 0

SVOCS EXCEEDING MINIMUM REGULATORY SCREENING VALUES IN SURFACE SOIL
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

PGH:P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU25_METALS_SUBSURF_TAGS.MXD 6/5/2013 DC



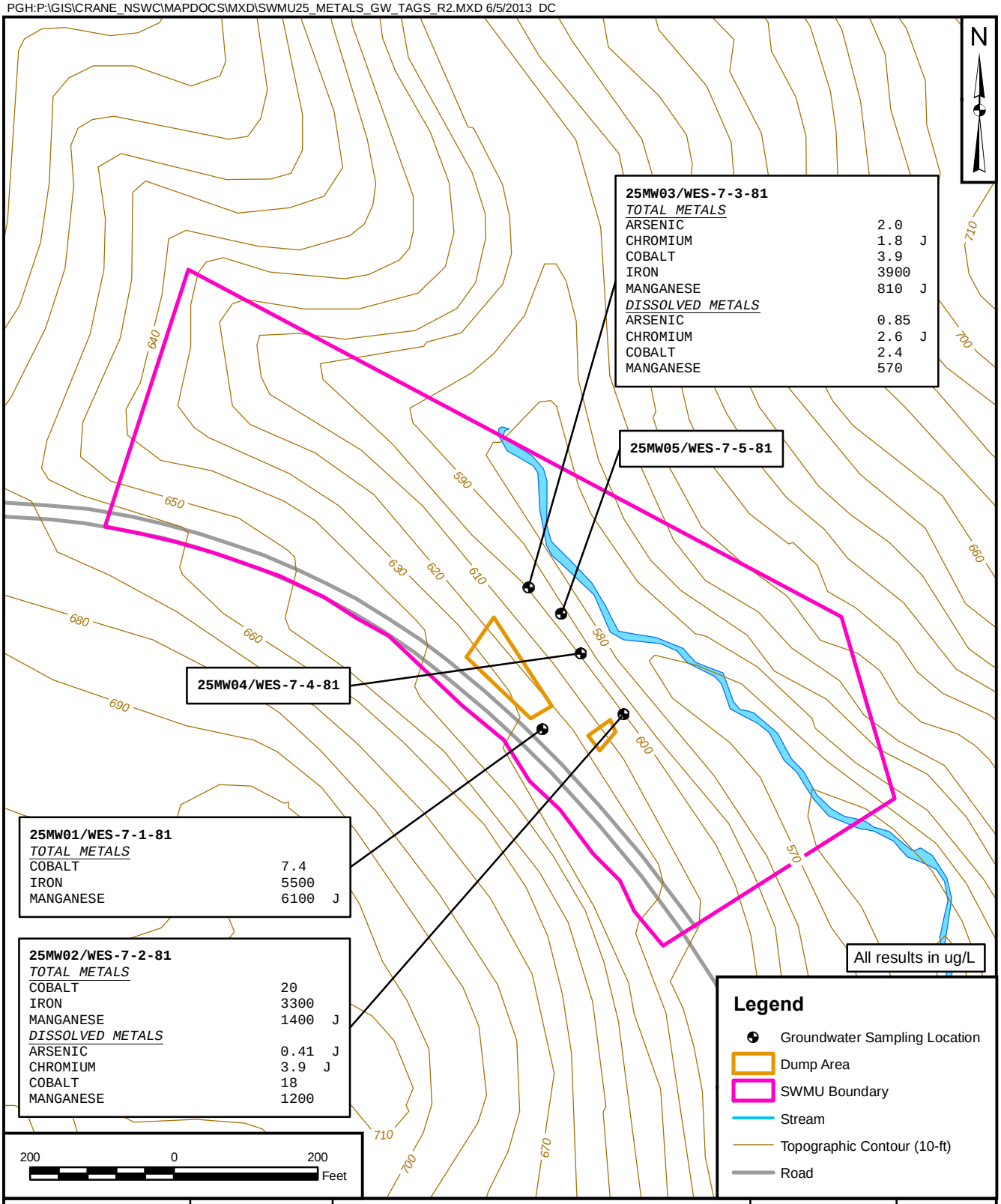
DRAWN BY	DATE
J. NOVAK	03/13/12
CHECKED BY	DATE
M. TRAXLER	6/5/2013
REVISED BY	DATE
D. COUCH	6/5/2013
SCALE AS NOTED	

NAVFAC

METALS EXCEEDING REGULATORY SCREENING VALUES IN SUBSURFACE SOIL
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
3116	F27L
APPROVED BY	DATE
E. BERKLITE	6/5/2013
APPROVED BY	DATE
FIGURE NO.	REV
FIGURE 5-3	0

PGH:P:\GIS\CRANE_NSWC\MAPDOCS\MXD\SWMU25_METALS_GW_TAGS_R2.MXD 6/5/2013 DC



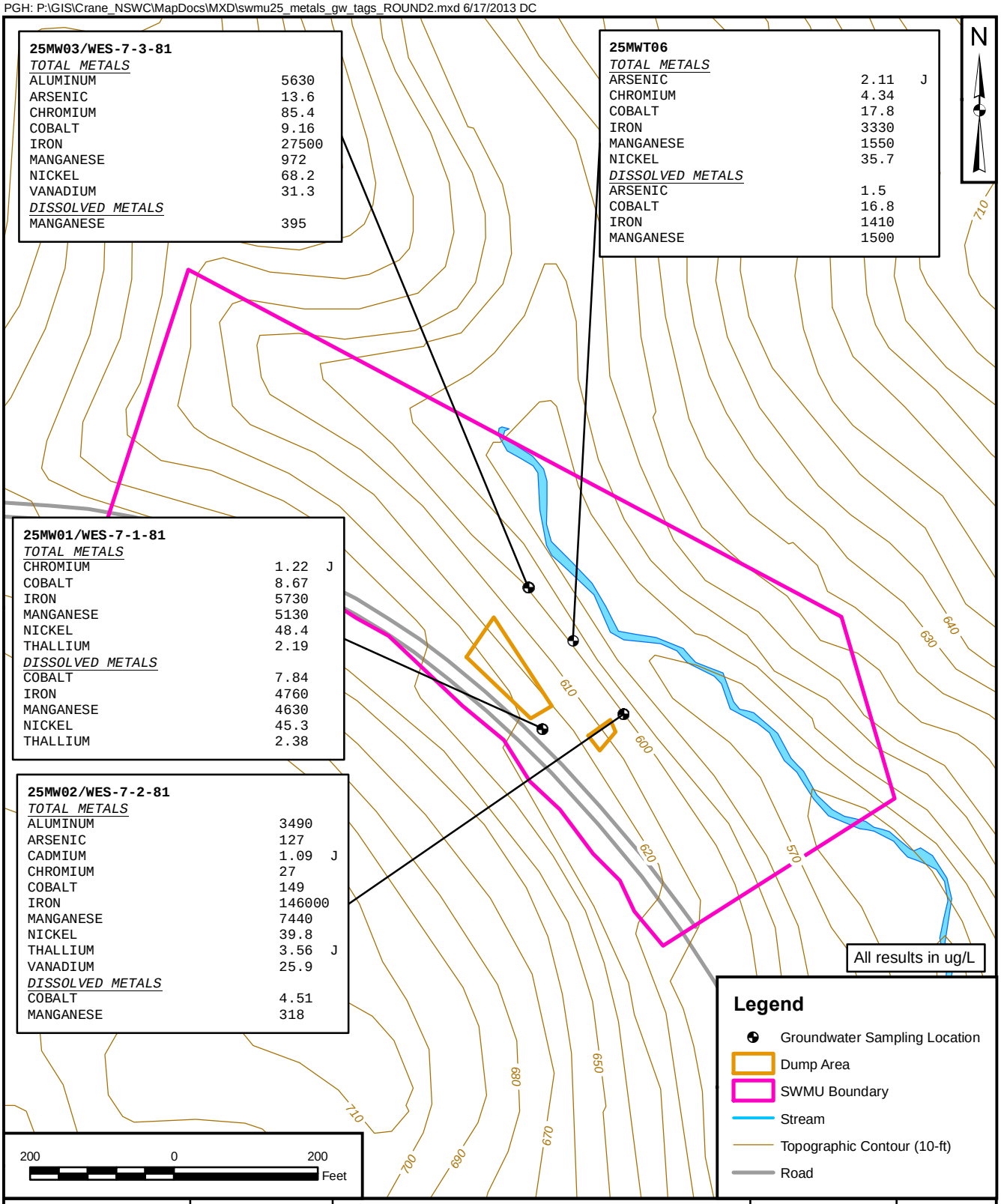
DRAWN BY	DATE
J. NOVAK	03/13/12
CHECKED BY	DATE
J. DUCAR	6/5/2013
REVISED BY	DATE
D. COUCH	6/5/2013
SCALE AS NOTED	

NAVFAC

METALS EXCEEDING REGULATORY SCREENING VALUES IN GROUNDWATER
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
3116	F27L
APPROVED BY	DATE
E. BERKLITE	6/5/2013
APPROVED BY	DATE
___	___
FIGURE NO.	REV
5-4	0

PGH: P:\GIS\Crane_NSWC\MapDocs\MXD\swmu25_metals_gw_tags_ROUND2.mxd 6/17/2013 DC



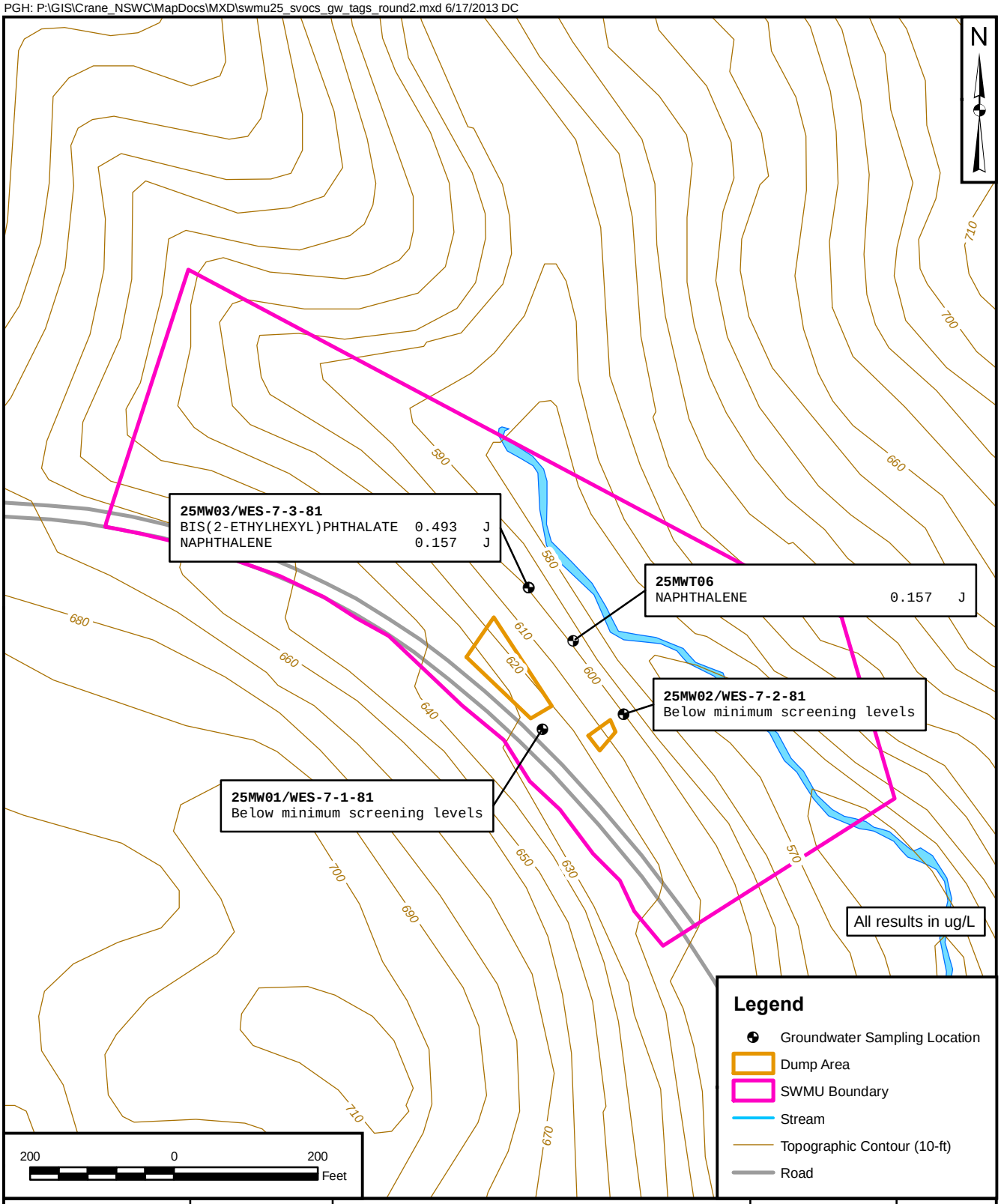
DRAWN BY	DATE
D. COUCH	2/12/13
CHECKED BY	DATE
J. DUCAR	6/17/2013
REVISED BY	DATE
D. COUCH	6/17/2013
SCALE AS NOTED	

NAVFAC

METALS EXCEEDING REGULATORY SCREENING VALUES IN ROUND 2 GROUNDWATER
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
3116	F27L
APPROVED BY	DATE
—	—
APPROVED BY	DATE
—	—
FIGURE NO.	REV
5-5	0

PGH: P:\GIS\Crane_NSWC\MapDocs\MXD\swmu25_svocs_gw_tags_round2.mxd 6/17/2013 DC



DRAWN BY	DATE	CONTRACT NUMBER	CTO NUMBER
D. COUCH	02/12/13	3116	F27L
CHECKED BY	DATE	APPROVED BY	DATE
J. LUCAS	6/17/2013	—	—
REVISED BY	DATE	APPROVED BY	DATE
D. COUCH	6/17/2013	—	—
SCALE AS NOTED		FIGURE NO. 5-6	REV 0

SVOCs EXCEEDING REGULATORY SCREENING VALUES IN ROUND 2 GROUNDWATER
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

6.0 CONCEPTUAL SITE MODEL, CONTAMINANT TRANSPORT, AND ATTENUATION

This section describes contaminant movement between environmental media of the two major contaminant groups (SVOCs and metals) detected in environmental media at SWMU 25. Historical site operations SVOCs and metals can be attributed to historical site operations or that. SVOCs detected at SWMU 25 can be further subdivided into PAHs, phthalate esters, and herbicides. The information presented in this section is to be used to:

- Provide information on the chemical and physical properties, which affect the mobility, migration, biodegradation, and persistence of the principal COPCs at SWMU 25.
- Assist in health and ecological risk assessments presented in Sections 7.0 and 8.0.
- Assist in risk management decisions.
- Assess whether movement of contaminants among environmental media will result in significant future changes to exposure point concentrations or significant exposure to receptors not currently exposed or at locations not currently contaminated.
- Assess whether the potential exists for contaminant concentrations to decrease over time in various media.
- Present a conceptual site model (CSM) that identifies contamination sources, contaminant migration pathways, and potential receptors.

6.1 PROPERTIES AFFECTING MOBILITY, ATTENUATION, AND PERSISTENCE

COPCs present at SWMU 25 are divided into four groups: PAHs, phthalate esters, herbicides, and metals. Numerous COPCs identified in Sections 7.0 and 8.0 were detected frequently at low concentrations and were determined not to pose a significant risk (please see Sections 7.0 and 8.0 for COPCs dismissed as COCs). The only 2 groups selected as COPCs were identified to be PAHs and metals. Section 6.0 concentrates on the COPCs that are considered to be COCs. The primary chemical and biological factors affecting the mobility, migration, biodegradation, and persistence of these chemicals are solubility, adsorption/desorption, biodegradation, photolysis, and plant uptake. These processes and their effects on fate and transport are discussed in the following sections.

6.1.1 Mobility

The Naval Assessment and Control of Installation Pollutants (NACIP) Study divides groundwater at NSA into two regimes: one associated with soil/alluvial cover and the other associated with the bedrock. This study reports that shallow groundwater is generally transient, occurring during high precipitation periods. Free water within alluvial deposits is likely to percolate into bedrock or discharge into intermittent streams through alluvial deposits or bedrock contacts with the stream bed.

The well-developed drainage network and level of precipitation at NSA Crane promote run-off of pollutants deposited on the surface at the site. Numerous streams and fine grained alluvial material increase the erosional potential of areas in which wastes are disposed.

6.1.2 Solubilities and Adsorption/Desorption Properties

PAHs

PAHs have very low solubilities, vapor pressures, and Henry's Law constants, and high K_{oc}s (soil organic carbon-water partition coefficient) and K_{ow}s (soil octanol-water partition coefficient). The soil organic carbon-water partitioning coefficient (K_{oc}s) is the ratio of the mass of a chemical that is adsorbed in the soil per unit mass of organic carbon in the soil per the equilibrium chemical concentration in solution. The octanol-water partition coefficient (K_{ow}s) is the ratio of the concentration of a chemical in octanol and in water at equilibrium and at a specified temperature. Octanol is an organic solvent that is used as a surrogate for natural organic matter. The low molecular weight PAHs (e.g., naphthalene) may volatilize from water, and the high molecular weight PAHs (e.g., benzo(a)pyrene, benzo(a)anthracene, etc.) are less likely to volatilize. PAHs in soil are much more likely to bind to soil and be transported via mass transport mechanisms than go into solution or volatilize. PAHs are subject to degradation via aerobic bacteria, but may be relatively persistent in the absence of microbial populations or macronutrients such as phosphorus and nitrogen [Agency for Toxic Substances and Disease Registry (ATSDR, 1995)].

Metals

Most metals have moderate to high solubilities and generally have low to moderate affinities for sorbing to organic carbon and soil. However, some of the metals analyzed in this RFI do have high affinities for sorbing to soil (e.g., aluminum, beryllium, chromium, lead, and vanadium). For these metals, dissolved concentrations in groundwater are low and the rates of migration through surface water, soil, and groundwater systems in the dissolved phase should be very slow or insignificant. The remaining metals have moderate affinities for sorption to soil and can therefore move through the environment more quickly

than the COPCs listed above. However, sorption and, in some cases, solubility constraints impede their mobility and migration rates. The equilibrium distribution coefficient, K_d, is a measure of relative affinity of a chemical to water and a solid sorbent.

The K_ds of metals are intermediate to high in value and indicate that metals should be relatively immobile. Because of lower pH values in the soils, bedrock, and groundwater, the solubilities of most metals are generally higher than would be expected at near-neutral pH values. The natural soils and groundwater associated with the Pennsylvanian-age rocks in southern Indiana are slightly too strongly acidic because:

- The Pennsylvanian shales, coals, and sandstone units typically contain pyrite, which forms sulfuric acid when oxidized.
- The near-surface rocks have undergone chemical and physical weathering through a very long period of geologic time, which has allowed the oxidation of pyrite and leaching and removal of any carbonate minerals that may have once been present in the rocks.
- The residual soils and near-surface rock units have been subjected to acid rain in recent decades.

In addition, the K_d values of most of the metals are depressed from their normal values under these conditions. Therefore, the concentrations of metals that exceed screening levels, as described in Section 5.0, may be due in large part to the lower pH values that are naturally prevalent.

Another factor that greatly affects the solubilities and mobilities of iron, manganese, chromium, and arsenic is the valence state of the metal, which is controlled by oxidation-reduction reactions. Each of these metals has more than one valence state that is stable in nature. The oxidation-reduction conditions of the soil, bedrock, groundwater, or surface water systems where these metals reside controls the valence states of the metals. Iron and manganese are much more soluble and mobile under reduction conditions, where the reduced forms of these metals (Fe^{+2}, Mn^{+2}) are most prevalent. Chromium is more soluble and mobile under oxidizing conditions (i.e., surface soils and surface waters), where the oxidized ionic species (Cr^{+6}) should be most prevalent.

Literature values and regulatory guidance values for solubilities, organic matter-water partition coefficients (K_{oc}), soil-water partition coefficients (K_d), and biodegradation rates are summarized in Tables 6-1 and 6-2. These values are based on field investigations, laboratory experiments, and theoretical calculations that are described in scientific literature. In most instances, the values found for each parameter for each chemical have a wide range. Therefore, the parameter values listed in Tables 6-1 and 6-2 may not be

accurate or entirely applicable to the SWMU 25 setting, but are useful for comparing the relative mobilities and biodegradation potential of COPCs.

6.1.3 Biodegradation

PAHs

Studies of land spreading applications, where solid waste is placed in thin layers onto the surface of the land or incorporated into the surface layers of the soil, have indicated that PAHs are highly amenable to microbial degradation in soil, with the rate of degradation influenced by temperature, pH, oxygen concentrations, initial chemical concentrations, and moisture. Photolysis, hydrolysis, and oxidation are not relevant fate processes for the degradation of PAHs in soil (ATSDR, 1995).

PAHs are degraded in water by photo-oxidation, chemical oxidation, and biodegradation. PAHs do not contain functional groups that are susceptible to hydrolytic action, and hydrolysis is considered to be an insignificant degradation mechanism. The rate of photodegradation is influenced by water depth, turbidity, and temperature. Benzo(a)pyrene is reported to be resistant to photodegradation. PAHs may also be oxidized by chlorination and ozonation and may be metabolized by microbes under oxygenated conditions (ATSDR, 1995).

N-nitrosodi-n-propylamine (DPN)

DPN is apparently not commercially produced in any significant quantity but has been found as a contaminant in the substituted dinitrotrifluarin herbicides and has been detected in effluent from a textile plant. If released to the surface of soils, DPN will rapidly volatilize. In soil, DPN is not expected to sorb strongly to organic matter; thus, may leach into groundwater. In general, DPN is not expected to be persistent in soils because of removal by volatilization and biodegradation. If released to water, DPN will have a slight tendency to sorb to suspended organic matter, biota, and sediments. Bioconcentration will not be significant. Significant volatilization of DPN from water will probably not occur, except possibly from shallow rivers. Photolysis may be the most important degradative process for DPN in water. The rate of biodegradation cannot be assessed and hydrolysis is probably not important. In the atmosphere, DPN probably will rapidly photolyze. DPN has been found in wastewater, secondary effluent from textile plants, in soils treated with the herbicide trifluralin, in the breathing zone of workers mixing and applying trifluralin, and in cooked fish (Florida Spectrum Environmental Services, 2013).

Metals

Small, ionic species, such as certain metals, have high aqueous solubilities and tend to be more bioavailable. Metals concentrations in interstitial water (i.e., pore water) have been correlated with biological effects. For several divalent metals in sediments, acid-volatile sulfide (AVS) appears to have a strong influence on cationic activity and toxicity (USEPA, 2000).

6.1.4 Plant Uptake

Bioconcentration of PAHs, and metals in aquatic organisms is greater for higher molecular weight compounds than lower molecular weight compounds. PAHs can bioaccumulate in receptors from ingesting water, sediments, or lower organisms in the food chain.

6.2 CONCEPTUAL SITE MODEL AND MIGRATION OF CONTAMINANTS

Figure 6-1 presents a schematic diagram of migration pathways that contaminants may take from the site. Table 2-2 presents an overall summary of chemical analyses performed on the samples collected from SWMU 25. Chemicals that exceeded the project action limit (PAL) were identified as COPCs to be evaluated in Section 7.0, which is the HHRA. Table 6-1 presents the physical and chemical properties of organic site contaminants that were detected at SWMU 25:

PAHs

- Benzo(a)pyrene

Table 6-2 presents the physical and chemical properties of inorganic site chemicals that were detected at SWMU 25:

Metals

- Aluminum
- Arsenic
- Cadmium
- Chromium
- Cobalt
- Iron
- Manganese

- Nickel
- Thallium
- Vanadium

These summaries are intended to present the overall picture of which chemicals are migrating, which ones are the most widespread, and which ones have the potential to migrate further.

6.2.1 Historical Operations and Releases

Dump Site A was a disposal area that received paper, concrete, pipe, scrap metal, paint thinners, and oil. In 1995 and 1996, an IM was conducted at SWMU 25 Dump Site A to remove debris and incidental soil excavated with the debris. SWMU 25 Dump Site A contained two dump areas: a larger area approximately 39 feet by 150 feet and the second area approximately 25 feet by 10 feet. Visual inspection of Dump Site A indicated scattered debris consisting of transite siding and pipe, various sizes of concrete pipe and block, metal cans, caps, drums, blocks of roofing tar, chunks of cast concrete, metal pipe, cast metal drains, and electrical porcelain insulators. No odors were detected during the initial site walk.

During debris clean-up, workers used metal detectors to confirm the removal of metallic cans, drums, and debris. Metal debris as deep as 2 feet bgs was detected and removed during initial site activities. At the larger dump area, inert (concrete-filled) hardware, such as 12.75 inch warheads (Hedgehogs), had been used as filler apparently to prevent erosion adjacent to Highway 58.

Confirmation sampling during the IM indicated that, with a few exceptions, remaining soil contained concentrations of contaminants below RCRA Corrective Action Guidance Human Data Quality Levels for RFI Projects (USEPA, 1994) cleanup levels. The corresponding cleanup levels for arsenic, beryllium, and cobalt were not attained at all locations. Samples collected from off-site soil borrow confirmed that levels of arsenic, beryllium, and cobalt greater than cleanup levels are naturally present in soils in the surrounding area. The target cleanup levels for this IM were taken from "RCRA Corrective Action Guidance Human Data Quality Levels for RFI Projects," June 18, 1994, as site-specific risk-based cleanup levels had not been developed for NSA Crane. One confirmation sample from the smaller dump area had concentrations of benzo(a)pyrene, benzo(g,h)perylene, dibenz(a,h)anthracene, benzo(b)fluoranthene, benzo(k)fluor-anthene, indeno(1,2,3-cd)pyrene, and chrysene in excess of the interim cleanup levels.

All debris was removed from the smaller dump site area. However, additional debris discovered during the IM at the larger dump site area was left in place because it may have been used as backfill to support Highway 58. The IM recommended that SWMU 25 revert to the RFI process, beginning with collecting soil borings under the road to determine the need for further remediation.

6.3 CONTAMINANT FATE AND TRANSPORT

This section focuses on some of the fate and transport issues associated with the major types of contaminants detected at SWMU 25.

6.3.1 Conceptual Physical Model and Hydrology

The surficial inferred depositional environment for SWMU 25 is classified as Residual Soil derived from Pennsylvanian bedrock/colluviums. The soils geology is classified as Raccoon Creek Group and undifferentiated (P) and Sandstone-dominated horizon of Lower Pennsylvanian (Ps).

The geologic overburden materials that underlie the SWMU 25 ridge include natural unconsolidated soil materials and bedrock (Lower Pennsylvanian). Natural unconsolidated materials are residual soils formed from weathering of the underlying Raccoon Creek Group. The residual soils consist predominantly of fine materials, including varying amounts of clay, silt, and sand. The soils from the overburden along Highway 58 ranged from 2 feet bgs to 10 feet bgs. The soil pH values at SWMU 25 are expected to fall in the 5 to 8 range.

The potential for contamination in soil and groundwater could result from materials buried in the subsurface soil. After release to the soil, contamination may serve as a source of contamination to groundwater and possibly result in a complete exposure pathway to human receptors who could in the future consume groundwater. The dump site is located in a rural with no remote nearby residential locations.

The dump site is along a hillside with an intermittent stream located at the base of the hill. The stream drains into Turkey Creek which then drains into the Boggs Creek watershed. SWMU 25 is characterized by well-developed dendritic surface drainage. Groundwater flow at NSA Crane is generally parallel to surface drainage. Groundwater at SWMU 25 flows in a northeasterly direction.

The chemicals detected were the group of semi-volatile compounds known as PAHs and metals. The solubilities and adsorption/desorption properties of the chemicals were discussed in Section 6.1.2,

biodegradation was discussed in Section 6.1.3, and plant uptake was discussed in Section 6.1.4. Contaminant fate and transport of these SVOCs are discussed below.

6.3.2 Semi-Volatile Organic Compounds

6.3.2.1 PAHs

PAHs are generally considered to be fairly immobile in the environment; they are large molecules with high K_{oc}s and low solubilities when compared to VOCs. These compounds generally do not migrate vertically through soil. Instead, they are more likely to adhere to soil particles and be transported with the soil particles via surface runoff and erosional processes.

N-nitrosodi-n-propylamine (DPN)

DPN released to the surface of soils will rapidly volatilize; thus, DPN will probably not be persistent in aerobic soils. The low estimated soil adsorption coefficient (Koc) for DPN indicates that it will probably not adsorb to organic matter and will be mobile in soil. DPN was also shown to be resistant to hydrolysis in aqueous solutions. Therefore, hydrolysis is probably not an important degradative mechanism for DPN in soil.

In water, DPN will have a slight tendency to sorb to sediments, suspended organic matter, and biota. Significant volatilization of DPN from water will probably not occur, except possibly from shallow rivers. Photolysis may be the most important degradative process for DPN in water (90% degradation in 8 hours). The major photoproduct is n-propylamine; di-n-propylamine is also formed. Although the data are inconsistent, biodegradation may also be an important degradative process for DPN (Florida Spectrum Environmental Services, 2013).

6.3.2.4 Metals

Metals can become part of the sediment mass through precipitation (e.g., carbonates, sulfides, phosphates, hydroxyl complexes) or adsorption (e.g., clay, sediment organic matter). In most cases a radical change in the sediment geochemistry (falling pH, change in redox) may result in their resuspension as ions. Some metals (e.g., arsenic, cadmium, lead, selenium, zinc) bioaccumulate, while others do not (e.g., copper, nickel). Atmospheric mercury deposited into surface water can undergo biotransformation in sediments to highly bioaccumulative and toxic methyl mercury (CLU-IN, 2013).

6.4 SUMMARY OF CONCEPTUAL SITE MODEL

Figure 6-1 is a schematic diagram of the conceptual flow and transport model for SWMU 25. Dump Site A was a disposal area that received paper, concrete, pipe, scrap metal, paint thinners, and oil. The following is a summary of the conceptualized aspects of contaminant migration, fate, and persistence at SWMU 25:

- An IM conducted in 1995 and 1996 removed debris and incidental soil excavated with the debris from two dump sites at SWMU 25.

- The upper zone of groundwater has been contaminated with PAHs, phthalates, herbicides, and metals.

- The groundwater wells at SWMU 25 are identified as Plz - Lower Pennsylvanian water-bearing zone. The Plz wells represent deeper groundwater underneath the Upper Zone and Middle Zone wells (Tetra Tech, 2001). Nearly all groundwater is flowing laterally away from bedrock toward the upper slopes of the ridge. Some of this groundwater may seep into the gullies and streams at the bottom of the slope and some of the contaminated groundwater may be taken up by trees and other vegetation and transpired. Thus, natural phytoremediation may be playing a part in controlling and reducing the rate of contaminants reaching the base of the ridge and entering the tributary stream.

- Fourteen PAHs, four phthalates, and eighteen metals were detected in surface soils.

- Three PAHs, two phthalates, and eighteen metals were detected in subsurface soils.

- Herbicides were not detected in soils.

- One phthalate, two herbicides, and sixteen metals migrated through the soil and were detected in groundwater. PAHs were not detected in groundwater.

- The overall concentrations of PAHs, phthalates, and herbicides in soil and groundwater appear to be minimal. Available evidence suggests that elevated metal concentrations in groundwater are not site related, but are caused by the natural oxidation, weathering, and leaching of the Pennsylvanian rock units coupled with the unavoidable turbidity of groundwater samples. Metals concentrations in groundwater samples are nothing more than a reflection of suspended geologic matter in the samples.

- The only groups of COPCs that were identified for SWMU 25 included PAHs and metals.

TABLE 6-1

PHYSICAL AND CHEMICAL PROPERTIES OF ORGANIC SITE CONTAMINANTS
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical	Specific Gravity[1] (@ 20/4°C)[2]	Vapor Pressure (mm Hg @ 20°C)[1]	Water Solubility (mg/L @ 20°C)[1]	Octanol/Water Partition Coefficient[3]	Organic Carbon Partition Coefficient[2]	Henry's Law Constant (atm-m3/mole)[3]	Bioconcentration Factor (mg/kg/mg/L)[2]	Mobility Index log[(solubility*VP)/K_{oc}]
PAHs								
Acenaphthylene	1.02	2.30E-02	1.61E+01	1.17E+04	2.00E+03	1.14E-04	3.80E+02	-3.73
Anthracene	1.283 (25/4°C)	1.95E-4 (25°C)	1.29E+0 (25°C)	2.82E+04	2.95E+04 (10)	8.6E-5 (25°C)	4.70E+03	-8.07
Benzo(a)anthracene	1.274	5.00E-09	1.0E-02 (24°C)	4.07E+05	3.98E+05(4)	6.60E-07	5.30E+04	-15.90
Benzo(a)pyrene	1.351	5.00E-09	3.8E-03 (25°C)	9.55E+05	1.02E+06(4)	4.9E-7 (25°C)	1.40E+05	-16.73
Benzo(b)fluoranthene	NA	5.00E-07	1.2E-03 (25°C)	3.72E+06	1.23E+06(4)	1.20E-05	1.40E+05	-15.31
Benzo(g,h,i)perylene	NA	1.00E-10	2.6E-4 (25°C)	1.70E+07	1.60E+06	1.4E-7 (25°C)	3.50E+05	-19.79
Benzo(k)fluoranthene	NA	9.59E-11	5.5E-4 (25°C)	6.92E+06	1.23E+06 (10)	1.04E-03	1.40E+05	-19.37
Bis(2-ethylhexyl)phthalate	0.9861[2]	7.23E-08	3.40E-01	2.00E+07	7.30E+00	1.51E+07	1.02E-07	3.1E+02[6]
Carbazole	1.1	1.37E-06	7.48E+00	3.89E+03	3.39E+03	1.53E-08	5.01E+02	-8.52
Chrysene	1.274 (20°C)	6.3E-9 (25°C)	6E-3 (25°C)	4.07E+05	3.98E+05 (10)	1.05E-6 (25°C)	5.30E+04	-16.02
Fluoranthene	1.252	5.0E-6 (25°C)	2.65E-1 (25°C)	2.14E+05	1.07E+05 (10)	6.5E-6 (25°C)	1.20E+04	-10.91
Indeno(1,2,3-cd)pyrene	NA	1E-10 (25°C)	6.20E-02	4.57E+07	3.47E+06 (10)	6.95E-8 (25°C)	3.50E+05	-17.75
Phenanthrene	0.980 (4°C)	1E+0 (118.2°C)	8.16E-1 (21°C)	2.88E+04	1.40E+04	3.93E-5 (25°C)	4.70E+03	-4.23
Pyrene	1.271 (23/4°C)	2.5E+0 (200°C)	1.6E-1 (26°C)	1.51E+05	1.05E+05 (10)	5.1E-6 (25°C)	1.20E+04	-5.42
PHTHALATE ESTERS								
Butylbenzylphthalate	1.113	8.60E-06	7.10E-01	6.92E+04	5.75E+04	1.26E-06	7.72E+02	-9.97
Diethylphthalate	1.1175	5E-2 (70°C)	1.08E+3 (25°C)	9.12E+02	2.88E+02 (10)	8.46E-07	1.07E+02	-0.73
Di-n-butylphthalate	1.047 (20/20°C)	1E-1 (115°C)	4E+2 (25°C)	1.58E+05	3.39E+04 (10)	2.8E-7 (25°C)	4.70E+04	-2.93
HERBICIDES								
n-nitroso-di-n-propylamine	0.9163	3.89E-01	1.30E+04	2.45E+01	2.75E+02	5.38E-06	NA	1.26
Pentachlorophenol	NA	1.10E-4 (25°C) (13)	1.4E+1 (25°C) (13)	5.12E+00 (13)	5.92E+02 (16)	2.45E-8 (25°C)	1.09E+02 (18)	-5.58E+00

NA = Not available.

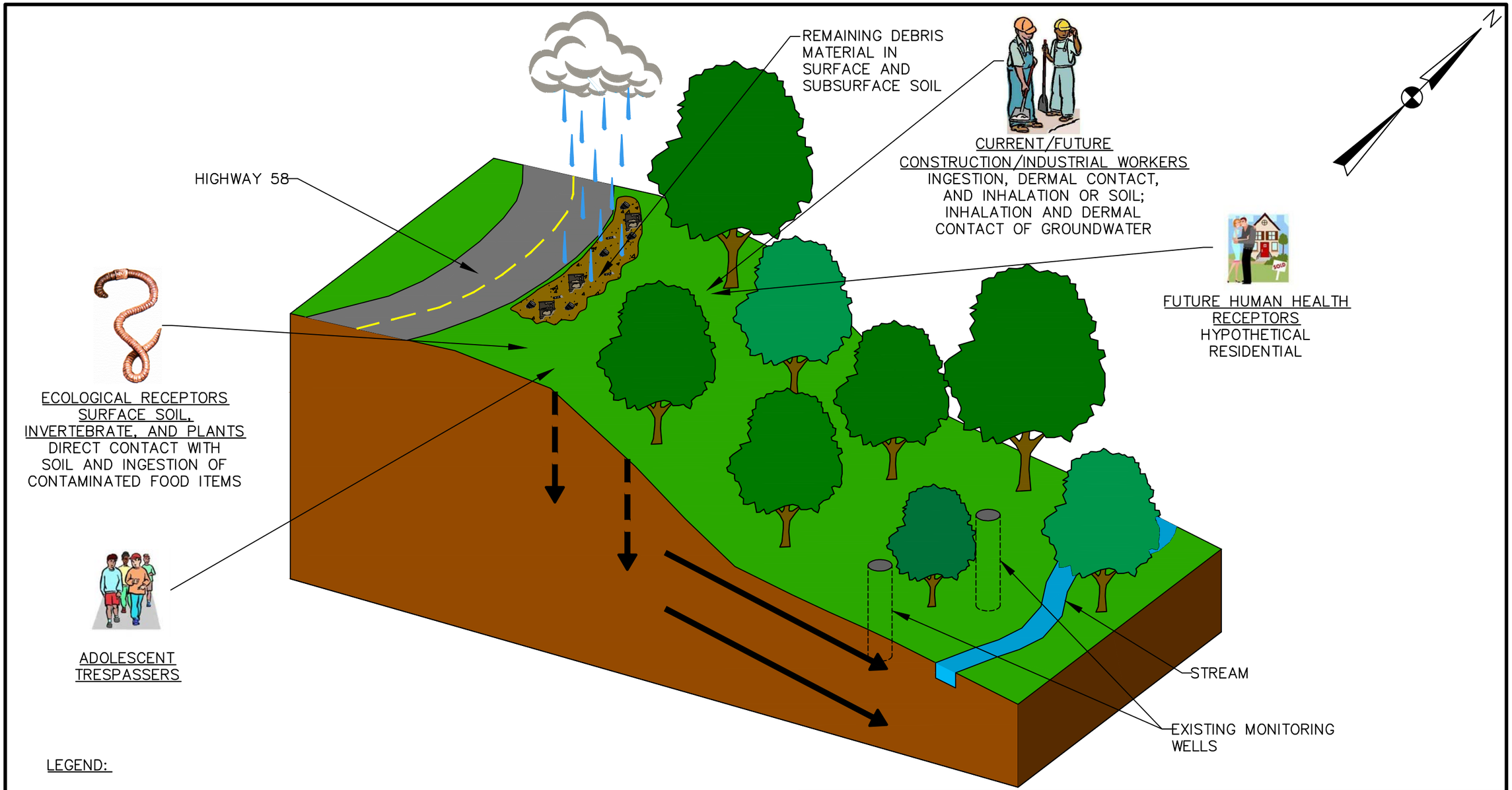
1 US EPA, 1992c.
2 (20/4°C) indicates that density of the chemical was measured at 20°C, whereas, density of water was measured at 4°C. Numbers in parentheses indicate that densities were measured at given temperatures.
3 Mabey et al., 1982.
4 US EPA, 1996. Soil Screening Guidance.
5 Lyman et al., 1990, Equation 5-3. Handbook of Chemical Property Estimation Methods.
6 Syracuse Research Corporation. Online Database: Interactive Physical Properties Database Demo. www.esc.syrres.com/efdb.htm. Web site last updated October 17, 2001.
7 Howard, 1989. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume 1.
8 Lyman et al., 1990. Eq. 5-2.
7 Verschueren, 1983. Handbook of Environmental Data of Organic Chemicals.
5 ATSDR, October 1989. Toxicity Profile for Xylenes.
9 Lyman et al., 1990. Equation 4-5
11 Chlordane data used.
12 Endosulfan II data used.
14 U.S. EPA, September, 2000. Exposure and Human Health Reassessment of 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds. EPA/600/P-00/001BC. Draft Final Report. Part I, Volume 3. National Center for Environmental Assessment. Washington, DC.
15 MacKay, Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals.
16 ORNL Risk Assessment Information System
17 U.S. EPA, September 1985. Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites.
18 U.S. EPA, August 1999. Screening Level Ecological Risk Assessment Protocol for Hazardous Waster Combustion Facilities, Appendix C Media-to-Receptor Bioconcentration Factors (BCFs).

TABLE 6-2

PHYSICAL AND CHEMICAL PROPERTIES OF INORGANIC SITE CHEMICALS
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical	Molecular Weight (g/mol)[1]	Specific Gravity (20/4 °C)[1]	Vapor Pressure (25 °C) (mm Hg)[1]	Solubility (25 °C) (mg/L)[1]	Henry's Law Constant (25 °C) (atm-m^3/mol)[1]	Bioconcentration Factor (L/kg)[2]
Aluminum	26.98[5]	2.708 (20 °C)[5]	NA	NA	NA	6600
Arsenic	74.9216	5.727 (14 °C)	1 (372 °C)	insoluble	NA	8700
Barium	137.33	3.51 (20 °C)	10 (1049 °C)	hydrolyzes	NA	700[3]
Beryllium	9.01218	1.85 (20 °C)	1 (1520 °C)	insoluble	NA	19
Cadmium	112.41	8.642 (UT)	NA	insoluble	NA	200000
Chromium	51.996	7.2 (28 °C)	1 (1616 °C)	insoluble	NA	150
Cobalt	58.9332	8.9 (UT)	30 (2375 °C)	insoluble	NA	2500[3]
Copper	63.546	8.92 (UT)	1 (1628 °C)	insoluble	NA	6100
Iron	55.85[2]	7.9[2]	NA[2]	NA[2]	NA[2]	1200[3]
Lead	207.2	11.2960 (16 °C)	1 (970 °C)	insoluble	NA	17000
Manganese	54.938[4]	7.2[4]	NA	decomposes[4]	NA	25000[3]
Mercury	200.59	13.5939	100 (260 C)	0.056	1.14E-02 (UT)	86000
Nickel	58.69	8.9 (UT)	1 (1800 °C)	insoluble	NA	110
Selenium	78.96	4.81 (20/4+1 °C)	NA	NA	NA	320
Silver	107.87	10.5	1 (1310 °C)	insoluble	NA	28
Thallium	204.383	11.85 (UT)	1 (825 C)	insoluble	NA	130
Vanadium	50.9415	5.96 (UT)	NA	insoluble	NA	NA
Zinc	65.38	7.14 (UT)	1 (487 °C)	insoluble	NA	15000

1 USEPA, Handbook of RCRA Ground-Water Monitoring Constituents: Chemical and Physical Properties, September 1992.
2 USEPA, Superfund Chemical Data Matrix, 2004 Update (greater of environmental or food chain bioconcentration factor)
3 Saltwater value
4 Clement Associates, Chemical, Physical, and Biological Properties of Compounds Present at Hazardous Waste Sites, September 1985.
5 The Condensed Chemical Dictionary, Van Nostrand Reinhold Company, New York 1971.
UT There is no reference temperature available.
NA Not available.



LEGEND:

INFILTRATION TO GROUNDWATER

GROUNDWATER FLOW

DRAWN BY ND DATE 1/5/11	NAVFAC	CONCEPTUAL SITE MODEL SWMU 25 HIGHWAY DUMP SITE A NSA CRANE CRANE, INDIANA	CONTRACT NO. 3116
CHECKED BY J. LUCAS DATE 1/5/11			OWNER NO.
REVISED BY DATE			APPROVED BY DATE
SCALE NOT TO SCALE			DRAWING NO. FIGURE 6–1 REV. 0

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7.0 HUMAN HEALTH RISK ASSESSMENT

This section presents the HHRA for Highway 58 Dump Site A (SWMU 25) at NSA Crane. This HHRA determined the threat posed by detected concentrations of chemicals within the study areas to potential human receptors under current and/or future land use. To estimate potential risks to human receptors, the HHRA assumed that no actions would be taken to control contaminant releases.

The following current Navy, USEPA, and IDEM guidance documents were used to develop the framework for the baseline HHRA:

- Conducting Human Health Risk Assessments Under the Environmental Restoration Program (Navy, 2001).
- U.S. Navy Human Health Risk Assessment Guidance (Navy, 2008).
- Risk Assessment Guidance for Superfund: Volume I, Human Health Evaluation Manual (Part A) (USEPA, 1989b).
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors (USEPA, 1991).
- Distribution of Preliminary Review Draft: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure (USEPA, 1993b).
- Exposure Factors Handbook (USEPA, 1997a).
- Exposure Factors Handbook: 2011 Edition (USEPA, 2011).
- Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002a).
- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) (USEPA, 2004).
- Guidelines for Carcinogen Risk Assessment (USEPA, 2005a).

- Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005b).

- Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment) (USEPA, 2009).

- Risk Integrated System of Closure. User's Guide and Technical Resource Guidance Document (IDEM, 2012).

The HHRA is structured and reported according to the guidelines of the Risk Assessment Guidance for Superfund (RAGS) (USEPA, 2001).

A HHRA consists of five components: data evaluation, exposure assessment, toxicity assessment, risk characterization, and uncertainty analysis. Sections 7.1 through 7.5 contain detailed discussions of the five components of the HHRA.

To evaluate potential risks, three major aspects of chemical contamination and environmental fate and transport must be considered: (1) contaminants with toxic characteristics must be found in environmental media and be released by either natural processes or human action; (2) potential exposure points must exist; and (3) human receptors must be present at the point of exposure. Risk is a function of both toxicity and exposure. If a site is missing any one of these factors, the exposure pathway is incomplete and no potential risks to human receptors exist at the site.

7.1 DATA EVALUATION

Data evaluation is the first component of a baseline HHRA. During data evaluation, analytical data for each media are compiled and evaluated to develop a medium-specific list of COPCs. Potential human health risks for site media are then quantitatively determined from this list of COPCs.

This HHRA includes all 11 surface and 11 subsurface soil samples collected in July 2011 (Round 1), two of the five groundwater samples collected in July 2011 (Round 1), and three of the five groundwater samples collected in October/November 2012 (Round 2). Five existing groundwater wells were sampled during the first round of groundwater sampling: 25MW01 (upgradient well), 25MW02, 25MW03, 25MW04, and 25MW05. Two of these wells, 25MW04 and 25MW05, were found to be damaged and groundwater sample data from these wells was not considered representative of site groundwater because of high turbidity levels. Therefore, the HHRA does not include the first round of sample data from wells 25MW04

and 25MW05. Prior to collecting Round 2 groundwater samples, wells 25MW04 and 25MW05 were abandoned and a new well, 25MWT06, was installed midway between wells 25MW04 and 25MW05. The newly installed well (25MWT06) and the three remaining wells (25MW01, 25MW02, and 25MW03) were sampled during Round 2. Sample data from the upgradient well (25MW01) were used to determine background concentrations; neither round of sample data from 25MW01 was used in the HHRA. The HHRA includes the first round of sample data from wells 25MW02 and 25MW03 and the second round of sample data from wells 25MW02, 25MW03, and 25MWT06. Surface soil, subsurface soil, and groundwater samples were analyzed for SVOCs and Appendix IX metals. Samples used in this HHRA are listed on the COPC selection tables (Tables 7-3 to 7-8) and in Appendix E.1. Section 5.0 discusses the nature and extent of contamination.

7.1.1 Derivation of Screening Criteria

USEPA RSLs (2012a) and IDEM screening levels (IDEM, 2013) were used to identify COPCs for this RFI. The RSLs are based on exposure pathways with generally accepted methods, models, and assumptions (i.e., ingestion, dermal contact, and inhalation) for specific land-use conditions and do not consider ecological receptors. The screening concentrations based on the RSLs correspond to a systemic hazard quotient (HQ) of 0.1 for noncarcinogens or an incremental lifetime cancer risk (ILCR) of 1×10^{-6} for carcinogens. The RSLs for noncarcinogens are based on an HQ of 1. To account for the potential cumulative effects of several chemicals affecting the same target organ or producing the same adverse noncarcinogenic effect, the screening concentrations used in the selection of COPCs were based on an HQ of 0.1.

IDEM screening levels for soil are based on USEPA RSLs but are not necessarily the same as USEPA RSLs. IDEM screening levels for direct contact correspond to systemic HQ of 1 (for noncarcinogens) or an ILCR of 1×10^{-5} (for carcinogens). The USEPA RSLs for carcinogens corresponds to an ILCR of 1×10^{-6}. The IDEM screening levels for soil can also be based on the soil saturation limit or capped at 100,000 milligrams/kilogram (mg/kg) (direct contact) or 1,000,000 mg/kg (migration from soil to groundwater).

Screening Levels for Soil

Screening concentrations based on the following sources were used to select COPCs for surface and subsurface soil:

- USEPA RSLs for Residential Soil (USEPA, 2012a).
- IDEM residential soil screening levels (IDEM, 2013).

Because of the different exposure scenarios for potential human receptors, COPCs were identified for surface and subsurface soil. Surface soil was defined as soil collected from 0 to 2 feet bgs. Subsurface soil was defined as soil collected from depths greater than 2 feet bgs.

Maximum chemical concentrations in soil were also compared to USEPA risk-based soil screening levels (SSLs) for groundwater protection and to IDEM screening levels for migration from soil to groundwater. SSLs for migration from soil to groundwater and IDEM screening levels were used to select COPCs for migration from soil to groundwater, not to select COPCs for direct contact exposure. The SSLs presented in the USEPA RSL table are based on a dilution attenuation factor of 1 (DAF_1), which is conservative and assumes that no reduction in concentration occurs as the contaminant moves from the source to groundwater. For COPC selection for migration from soil to groundwater, USEPA SSLs were multiplied by a factor of 20 to represent a dilution attenuation factor of 20 (DAF_{20}). A DAF_{20} is assumed to be more accurate at most sites (USEPA, 1996). The IDEM screening levels for migration from soil to groundwater are based on a DAF of 20, so no adjustment was made to these values. Chemicals with concentrations exceeding the DAF_{20} SSLs/IDEM screening levels may migrate from soil to groundwater in sufficient quantities to pose groundwater quality problems.
Table 7-1 presents the risk-based screening levels used to select COPCs for soil.

Screening Levels for Groundwater

Screening levels based on the following sources were used to select COPCs for groundwater:

- USEPA RSLs for tap water (USEPA, 2012a).
- USEPA MCLs (USEPA, 2012b).
- IDEM tap water screening levels for groundwater (IDEM, 2013).
- USEPA groundwater screening levels for vapor intrusion (USEPA, 2013).
- IDEM screening levels for vapor exposure (IDEM, 2013).

Screening levels from USEPA Vapor Intrusion Screening Level (VISL) Calculator Version 3.0 (USEPA, 2013) were used for evaluating vapor intrusion from groundwater to indoor air. The screening levels correspond to a target cancer risk level of 1×10^{-6} or a HQ of 0.1 for carcinogens and noncarcinogens, respectively. The Groundwater Screening Level for Vapor (GSL_{vapor}) values identify chemical concentrations in groundwater that may adversely affect the indoor air quality of a building overlying groundwater containing VOC contamination. The GSL_{vapor} values assume a subsurface attenuation factor of 0.001 from groundwater concentrations to indoor air concentrations.

Table 7-2 presents the screening criteria used to select COPCs for groundwater.

Screening Levels for Chromium

Chromium speciation was not performed on soil or groundwater samples collected at the site. To be conservative, screening levels for hexavalent chromium were used to select COPCs, although, as discussed in Section 3.0, it is very unlikely hexavalent chromium is present at the site.

Screening Levels for Lead

Guidance from the USEPA Office of Prevention, Pesticides, and Toxic Substances (OPPTS) and Office of Solid Waste and Emergency Response (OSWER) recommends 400 mg/kg as the lowest screening level for lead-contaminated soil in a residential setting where children are frequently present (USEPA, 1994). To be conservative, 400 mg/kg was used as the screening level for soil COPC selection. However, guidance from the USEPA Technical Review Workgroup for Lead indicates, “a reasonable screening level for soil lead at commercial/industrial (i.e., non-residential) sites is 800 mg/kg,” for a typical non-contact-intensive worker (USEPA, 2012c). This value is also the current USEPA RSL for soil under an industrial land use scenario (USEPA, 2012a). The Safe Drinking Water Act (SDWA) action level of 15 µg/L (USEPA, 2012b) will be used as the screening level for lead in groundwater.

Chemicals without Toxicity Criteria

Because of the lack of toxicity criteria, risk-based COPC screening levels are not available for some chemicals [e.g., acenaphthylene, benzo(g,h,i)perylene, and phenanthrene]. For COPC screening, acenaphthene was used as a surrogate for acenaphthylene, and pyrene was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene.

Background Evaluation

In accordance with Navy policy (Navy, 2004), chemicals present at background concentrations were not retained as COPCs in this HHRA. As indicated above, COPCs were selected based on a toxicity screen (comparison of site concentrations to screening levels); however, an additional step is involved for selecting metals of potential concern. Metals concentrations at a site are compared to concentrations detected in background samples. If the maximum concentration of a metal detected in site soil was less than the representative background concentration, that metal was not retained as a COPC. However, chemicals present at concentrations exceeding risk-based screening criteria but not selected as COPCs based on background evaluations are further discussed in the risk characterization section (Section 7.4).

The development of the representative basewide background soil concentrations is discussed in the Final Basewide Background Soil Investigation Report for NSWC Crane (Tetra Tech, 2001). A 95-percent upper tolerance limit (UTL_{95}) was selected as the representative background concentration, in accordance with the SAP (Tetra Tech, 2011). As discussed in the Basewide Background Report, soil background samples were collected for nine soil groups. In this HHRA, maximum concentrations in SWMU 25 surface soil were compared to the UTL_{95} for Group 1 (loess/glacial surface soil), and maximum concentrations in SWMU 25 subsurface soil were compared to the UTL_{95} for Group 8 (Pennsylvania residual subsurface clay soil/Pennsylvania residual subsurface silt soil). Background values used for soil comparisons are presented in the COPC selection tables for surface soil and subsurface soil (Tables 7-3 through 7-6). Data from the upgradient groundwater monitoring well (25MW01) was used to represent background groundwater concentrations, even though, as described in Section 3.1.1.3, this well may be influenced by former dump activities.

Chemicals present at background levels were eliminated as site-related COPCs following Navy Policy on the Use of Background Chemical Levels (Navy, 2004). This document also presents the Navy's interpretation of USEPA guidance on background levels (USEPA, 2002b), and details the methodology for evaluating background under the Navy's Environmental Restoration and Base Realignment and Closure (BRAC) programs. USEPA accepts Navy policy as not contradicting the USEPA guidance (USEPA, 2002b). Navy policy applies to both the screening-level and baseline risk assessments and requires the following:

1. A clear and concise understanding of chemicals released from a site, thus ensuring the Navy is focusing on remediating the release.

2. Use of background data in the screening-level risk assessment.

    a. Comparison of site chemical levels to risk-based screening criteria.
    b. Comparison of site chemical levels to background concentrations.
    c. Identification of site-related COPCs based on screening criteria comparisons AND background comparisons. Site-related COPCs are those chemicals with concentrations exceeding risk-based screening criteria AND background concentrations. To the extent possible, site-related COPCs are further evaluated quantitatively in the baseline risk assessment. (Non-site-related COPCs are further discussed in the risk characterization sections of the baseline risk assessments.)

3. The consideration of background in the baseline risk assessment.

    a. Calculation of risk estimates for site-related COPCs only.
    b. Evaluation of non-site-related COPCs in the risk characterization section only (e.g., the qualitative evaluation of chemicals detected at concentrations exceeding screening criteria but less than background concentrations). The Navy considers this evaluation to be consistent with USEPA's Role of Background in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Cleanup Program (USEPA, 2002b).

4. Selection of site cleanup remedial goals at levels not less than background levels. Additionally, cleanup levels should not be developed for chemicals not identified as COCs. As defined in the Navy guidance, COCs are site-related COPCs found to be the risk drivers in the baseline risk assessment, and that may pose unacceptable human health or ecological risks.

7.1.2 Decision Rules for Establishing COPCs

The following decision rules were used to select initial lists of COPCs for SWMU 25:

- A chemical detected in soil was selected as a COPC for soil if any detected concentration exceeded the screening level for soil. For inorganics, the chemical was only retained as a COPC if the concentration exceeding the screening level was also greater than the corresponding UTL_{95} (representative background concentration).

- A chemical detected in groundwater was selected as a COPC for groundwater if the maximum detected concentration in any on-site monitoring well exceeded screening levels for tap water. For inorganics, the chemical was only retained as a COPC if the concentration exceeding the screening level was also greater than the corresponding upgradient concentrations in 25MW01.

7.1.3 COPCs Selected for HHRA

COPCs were selected for surface soil, subsurface soil, and groundwater using the risk-based COPC screening levels described in Section 7.1.1. The following subsections discuss the chemicals identified as COPCs and the rationale for their selection. Section 5.0 discusses nature and extent of the chemicals detected in site media. Tables 7-3 through 7-8 present COPC selection information for each medium. Table 7-9 presents chemicals retained as COPCs. Appendix E.2 includes RAGS Part D tables for COPC selection.

7.1.3.1 Surface Soil

Direct Contact

Table 7-3 presents a comparison of maximum detected surface soil concentrations to adjusted USEPA residential RSLs and IDEM residential screening levels for direct contact with soil. The following chemicals had maximum detected concentrations that exceeded direct contact COPC screening levels and background values (for metals), and were retained as COPCs for surface soil at SWMU 25:

- Metals (arsenic, chromium, iron).
- Benzo(a)pyrene.

Concentrations of iron and benzo(a)pyrene were less than the IDEM residential screening levels for direct contact with soil, but exceeded screening levels based on USEPA criteria. Concentrations of arsenic and chromium exceeded the IDEM residential screening level and the screening level based on USEPA criteria.

Maximum concentrations of aluminum, cobalt, manganese, thallium, and vanadium in surface soil exceeded adjusted USEPA RSLs but were less than background values. Therefore, these metals were not retained as COPCs. The risk characterization section (Section 7.4) discusses chemicals excluded from COPC selection based on background.

Soil to Groundwater

Table 7-4 presents a comparison of maximum detected surface soil concentrations to USEPA SSLs and IDEM residential screening levels for migration from soil to groundwater. The following chemicals had maximum detected concentrations in surface soil that exceeded the screening levels for migration from surface soil to groundwater and background values, and were retained as COPCs for surface soil at SWMU 25:

- Metals (arsenic, chromium, and iron).

Concentrations of arsenic, chromium, and iron exceeded both the IDEM and USEPA criteria for migration from soil to groundwater.

Maximum concentrations of cobalt and manganese in surface soil exceeded USEPA SSLs and IDEM residential screening levels for migration from soil to groundwater and the maximum concentration of

thallium in surface soil exceeded USEPA criteria for migration to groundwater; however, concentrations of these metals were less than the respective background values. Therefore, these metals were not retained as COPCs.

7.1.3.2 Subsurface Soil

Table 7-5 presents a comparison of maximum detected subsurface soil concentrations to adjusted USEPA residential RSLs and IDEM residential screening levels for direct contact with soil. The following chemicals had maximum detected concentrations that exceeded direct contact COPC screening levels and background values, and were retained as COPCs for subsurface soil at SWMU 25:

- Metals (arsenic, cobalt, iron, and manganese).

Maximum concentrations of arsenic, iron, and manganese exceeded both the adjusted USEPA RSLs and IDEM screening levels. The maximum concentration of cobalt exceeded the adjusted USEPA RSL but did not exceed the IDEM criterion.

Maximum concentrations of aluminum and thallium in subsurface soil exceeded adjusted USEPA RSLs, and the maximum concentration of chromium in subsurface soil exceeded both the adjusted USEPA RSL and the IDEM residential screening level; however, concentrations of these metals were less than background values. Therefore, these metals were not retained as COPCs. The risk characterization section (Section 7.4) discusses chemicals excluded from COPC selection based on background.

Table 7-6 presents a comparison of maximum detected subsurface soil concentrations to USEPA SSLs and IDEM residential screening levels for migration from soil to groundwater. The following chemicals had maximum detected concentrations in subsurface soil that exceeded the screening levels for migration from soil to groundwater and background values, and were retained as COPCs for subsurface soil at SWMU 25:

- Metals (arsenic, cobalt, iron, and manganese).

Maximum concentrations of arsenic, cobalt, iron, and manganese exceeded both USEPA SSLs and IDEM residential screening levels for migration to groundwater.

The maximum concentration of chromium in subsurface soil exceeded USEPA SSLs and IDEM residential screening levels for migration of soil to groundwater, and the maximum concentration of thallium in subsurface soil exceeded the USEPA criterion for migration to groundwater; however, the

maximum concentrations of these metals were less than background values. Therefore, these metals were not retained as COPCs.

7.1.3.3 Groundwater

Table 7-7 presents a comparison of maximum detected groundwater concentrations to adjusted USEPA RSLs and IDEM screening levels for tap water. The following chemicals were detected at maximum concentrations exceeding direct contact COPC screening levels and were retained as COPCs for groundwater at SWMU 25:

- Total Metals (aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, nickel, thallium, and vanadium).
- Dissolved Metals (arsenic, chromium, and cobalt).
- SVOCs (naphthalene).

Concentrations of arsenic, chromium, cobalt, iron, manganese nickel, and thallium exceeded IDEM screening levels for tap water and adjusted USEPA RSLs in the unfiltered (total metals) groundwater samples. The remaining total metals COPC concentrations exceeded adjusted USEPA RSLs only in the unfiltered groundwater samples. The maximum concentration of naphthalene exceeded the adjusted USEPA RSL. Concentrations of iron, manganese, and nickel in the filtered (dissolved) groundwater samples also exceeded at least one of the screening levels, however the maximum detected concentrations of these chemicals were less than corresponding upgradient concentrations in 25MW01. Therefore, these metals were not retained as COPCs.

Table 7-8 presents a comparison of maximum detected groundwater concentrations to USEPA and IDEM criteria for vapor intrusion. Concentrations of all chemicals were below the screening levels for vapor intrusion. Therefore, no COPCs were selected for vapor intrusion for SWMU 25.

7.1.3.4 Summary

Table 7-9 summarizes the chemicals retained as COPCs for surface soil, subsurface soil, and groundwater at SWMU 25. RAGS Part D tables for COPC selection are included in Appendix E.2.

7.2 EXPOSURE ASSESSMENT

The exposure assessment portion of a risk assessment defines and evaluates, quantitatively or qualitatively, the type and magnitude of human exposure to the chemicals present at or migrating from a

site. The exposure assessment is designed to depict the physical setting of the site, to identify potentially exposed populations and applicable exposure pathways, to calculate concentrations of COPCs to which receptors might be exposed, and to estimate chemical intakes under the identified exposure scenarios.

Actual or potential exposures at SWMU 25 were determined using the most likely pathways of contaminant release and transport, as well as human activity patterns. A complete exposure pathway has three components: a source of chemicals that can be released to the environment, a route of contaminant transport through an environmental medium, and an exposure or contact point for a human receptor.

7.2.1 Conceptual Site Model

A CSM facilitates consistent and comprehensive evaluation of potential risks to human health by identifying the pathways by which human receptors may be exposed to contaminated environmental media. A CSM depicts the relationships among the following elements, which are necessary for defining complete exposure pathways:

- Site sources of contamination
- Contaminant release mechanisms and transport/migration pathways
- Exposure routes
- Potential receptors

These elements of the CSM establish the manner and degree to which a potential receptor may be exposed to chemicals present at the site. The degree of risk incurred by a potential receptor varies according to the means of exposure, the duration of exposure, and the specific chemical to which the receptor is exposed.

Section 6.0 presents a discussion of the site location, sources of contamination, contaminant release mechanisms, and transport and migration pathways for SWMU 25. Table 7-10 provides a site-specific summary of the potential receptors evaluated for SWMU 25. Table 7-11 summarizes exposure routes addressed quantitatively for each human receptor. Figure 7-1 illustrates the CSM for the SWMU 25 HHRA. Figure 7-1 differs from the CSM figure in Section 6.0 (Figure 6-1) in that Figure 7-1 includes only the potential human health receptors evaluated in the HHRA and the potential exposure pathways for these receptors, while Figure 6-1 includes a visual conceptual site model demonstrating current conditions of the site relative to groundwater, where the monitoring wells are located, and sensitive receptors that could be exposed to contaminated media.

Potential Current and Future Receptors of Concern and Exposure Pathways

NSA Crane is an active military installation and will remain active for the foreseeable future. Current site receptors include industrial or construction workers and adolescent trespassers. However, for purposes of completeness, the baseline risk assessment considered receptor exposure under residential and industrial land use scenarios. Based on current and potential future land use, the following potential receptors may be exposed to contaminated environmental media at SWMU 25:

- **Construction Workers** – A plausible receptor under current or future land use. No construction activities are currently planned for the study area. However, this receptor could be exposed to surface and subsurface soils (incidental ingestion; dermal contact), and air (inhalation) if excavation activities were to occur in the future. Construction workers could also be exposed to groundwater (dermal contact) and air (inhalation of volatiles from groundwater) while excavating in a trench.

- **Industrial Workers** – A plausible receptor under current and future land use. This includes adult military or civilian personnel assigned to routine daily work tasks in the SWMU 25 area. This receptor could be exposed to surface soil (incidental ingestion; dermal contact) and air (inhalation). Industrial worker exposure to subsurface soil is unlikely; however, because future construction could potentially bring subsurface soil to the surface, exposure to subsurface soil via incidental ingestion, dermal contact, and inhalation was evaluated for this receptor to aid in risk management decisions. Industrial workers could also be exposed to volatiles migrating from groundwater through building foundations and impacting indoor air quality; however, no COPCs were identified for vapor intrusion. Therefore, the vapor intrusion pathway was not further evaluated in this HHRA.

- **Trespassers** – A plausible receptor under current or future land use. Trespassing is assumed to be limited to adolescents only and is assumed to occur on an infrequent basis. This receptor may be exposed to potentially contaminated surface soil (incidental ingestion and dermal contact), and air (inhalation). Trespasser exposure to subsurface soil is unlikely; however, because future construction could potentially bring subsurface soil to the surface, exposure to subsurface soil via incidental ingestion, dermal contact, and inhalation was evaluated for this receptor to aid in risk management decisions. Direct contact with groundwater is not anticipated for this receptor. Although not anticipated, any potential exposure for adult trespassers that could occur is expected to be similar to the exposure assumed for adolescent trespassers. Therefore, the potential risks associated with adult trespassers can be inferred from the calculated risks for the adolescent trespasser and were not calculated in this HHRA.

- **On-Base Residents** – Given the anticipated future land use for much of SWMU 25 (commercial/industrial), residents are a very unlikely future receptor. However, the hypothetical future residential scenario is typically evaluated in a risk assessment for decision-making purposes. For example, if the HHRA estimates minimal risks to residential receptors the need for deed restrictions at a site may be eliminated prior to site closure. The HHRA assumes that a hypothetical resident may be exposed to surface soil (ingestion; dermal contact; inhalation). Receptor exposure to subsurface soil would only occur if subsurface soil was excavated and deposited on existing surface soil. Although this is an unlikely scenario, it is included in this HHRA to assist risk managers in assessing the need for deed restrictions. It is assumed that residents would be exposed to groundwater used as a drinking source (ingestion, dermal contact, and inhalation of vapors). Hypothetical residents could also be exposed to volatiles migrating from groundwater through building foundations and impacting indoor air quality; however, no COPCs were identified for vapor intrusion. Therefore, the vapor intrusion pathway was not further evaluated in this HHRA.

7.2.2 Central Tendency Exposure versus Reasonable Maximum Exposure

Traditionally, exposures evaluated in the HHRA were based on the concept of a reasonable maximum exposure (RME) only, which is defined as "the maximum exposure that is reasonably expected to occur at a site" (USEPA, 1989b). However, subsequent risk assessment guidance (USEPA, 1992) indicates an HHRA should address an average case or central tendency exposure (CTE).

The SWMU 25 HHRA evaluates both RME and CTE scenarios to fully characterize potential exposures. The available CTE evaluation guidance (USEPA, 1993b) is limited. Therefore, professional judgment was used to define CTE conditions for a particular receptor at SWMU 25.

7.2.3 Exposure Point Concentrations

The exposure point concentration (EPC), which is calculated for COPCs only, is an estimate of the chemical concentration within an exposure unit (EU). The EPC is assumed to be the concentration to which the receptor is exposed and is used to estimate exposure intakes. An EU is the area over which receptor activity is expected to occur.

The following guidelines were used to calculate EPCs:

- For surface soil, subsurface soil, and groundwater, the 95-percent upper confidence limit (UCL) on the arithmetic mean, which was based on the distribution of the data set, was selected as the EPC.

EPCs were calculated using USEPA's ProUCL software Version 4.1.01 (USEPA, 2010) and following USEPA's Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites (USEPA, 2002a). If ProUCL was unable to calculate an UCL (if there were less than five samples or four positive detections in a data set) or if the 95-percent UCL exceeded the maximum detected concentration, then the maximum detected concentration was used as the EPC.

- Non-detected values were evaluated in accordance with the ProUCL guidance.

- The same EPCs were used to evaluate both RME and CTE scenarios.

Table 7-12 summarizes the EPCs used in this HHRA. ProUCL Outputs are included in Appendix E.3. RAGS Part D Tables for the EPCs are presented in Appendix E.2.

7.2.4 Chemical Intake Estimation

This section presents the methodologies and techniques used to estimate exposure intakes. Intakes for the identified potential receptor groups were calculated using current USEPA risk assessment guidance and are presented in the risk assessment spreadsheets. Risk assessment results are presented using USEPA RAGS Part D table format. Tables 13 and 14 present exposure assumptions for the RME and CTE scenarios, respectively. These exposure assumptions are based on current USEPA risk assessment guidance.

Noncarcinogenic intakes were estimated using the concept of an average annual exposure. Carcinogenic intakes were calculated as incremental lifetime exposures, which assume a life expectancy of 70 years. The exposure assumptions reflect current USEPA guidance. The majority of the exposure assumptions used to estimate chemical intakes were based on default assumptions described in several USEPA guidance documents (e.g., USEPA 1989b, 1991, 1997a, and 2004). The following paragraphs discuss the non-default receptor-specific exposure assumptions used in the risk assessment.

7.2.4.1 Incidental Ingestion of Soil

Direct physical contact with soil may result in the incidental ingestion of chemicals. Chemical intake for the incidental ingestion of soil is estimated in the following manner (USEPA, 1989b):

$$\text{Intake} = \frac{(C_s)(IR)(FI)(EF)(ED)(CF)}{(BW)(AT)}$$

where:

Intake	=	intake of chemical from soil (mg/kg/day)
C_s	=	concentration of chemical in soil (mg/kg)
IR	=	ingestion rate (mg/day)
FI	=	fraction ingested from contaminated source (dimensionless)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
CF	=	conversion factor (1×10^{-6} kg/mg)
BW	=	body weight [kilograms (kg)]
AT	=	averaging time (days);

Note: for noncarcinogens, AT = ED x 365 days/yr, and
for carcinogens, AT = 70 yr x 365 days/yr

In most cases, USEPA default exposure assumptions were used to estimate chemical intakes from incidental ingestion of soil; Tables 7-13 and 7-14 summarize exposure assumptions. The following paragraph briefly discusses the non-default receptor-specific exposure assumptions for incidental ingestion of soil that were used in the HHRA.

The selected exposure frequency assumptions consider anticipated receptor activities at SWMU 25. It is assumed that construction workers assigned to future excavation projects at SWMU 25 are exposed to soil for 5 days a week over 30 weeks (150 days a year) for 1 year under the RME scenario. The exposure frequency for the CTE scenario was assumed to be 50 percent of the RME, or 75 days a year. Adolescent trespassers are assumed to be exposed to soil 1 day per week during the summer months (26 days per year) under the RME scenario, and one day every other week (13 days per year) under the CTE scenario for 10 years.

7.2.4.2 Dermal Contact with Soil

Direct physical contact with soil may result in the dermal absorption of chemicals. Exposure associated with dermal contact with soil is estimated in the following manner (USEPA, 2004):

$$\text{Intake} = \frac{(C_s)(SA)(AF)(ABS)(CF)(EF)(ED)}{(BW)(AT)}$$

where:

Intake	=	amount of chemical absorbed during contact with soil (mg/kg/day)
C_s	=	concentration of chemical in soil (mg/kg)

SA	=	skin surface area available for contact [square centimeters (cm^2)/day]
AF	=	skin adherence factor (mg/cm^2)
ABS	=	absorption factor (dimensionless)
CF	=	conversion factor (1×10^{-6} kg/mg)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (year)
BW	=	body weight (kg)
AT	=	averaging time (days);

Note: for noncarcinogens, AT = ED x 365 days/year, and
for carcinogens, AT = 70 years x 365 days/year

In most cases, USEPA default exposure assumptions were used to estimate chemical intakes from dermal contact with soil; Tables 7-13 and 7-14 summarize exposure assumptions. The following paragraphs briefly discuss non-default receptor-specific exposure assumptions for dermal contact with soil that were used in the HHRA.

Surface area of exposed skin available for dermal contact with soil was determined on a receptor-specific basis because surface area of exposed skin corresponds with assumed human activities and clothing worn during exposure events. With the exception of the skin surface area recommended for adolescent trespassers, all of the skin surface areas presented in Tables 7-13 and 7-14 are based on USEPA default values. USEPA guidance (USEPA, 1997a and 2004) was used to develop the skin surface area available for contact for the adolescent trespasser. For an adolescent trespasser, it was assumed that 25 percent of the body surface area was exposed to surface soil (i.e., 3,280 cm^2). This value represents the 50th-percentile area presented in Table 6-4 of the Exposure Factors Handbook (USEPA, 1997a).

The same exposure frequencies and durations recommended for evaluating incidental ingestion of soil were used to estimate chemical intakes for dermal contact with soil. The soil adherence factors presented are from Exhibits 3.3 and 3.5 of RAGS Part E. Values of 0.03 and 0.13 were used as the chemical-specific dermal absorption factors for arsenic and benzo(a)pyrene, respectively. Other metals selected as COPCs in soil were not evaluated for dermal contact exposure because RAGS Part E does not provide absorption factors for metals other than arsenic and cadmium.

7.2.4.3 Inhalation of Air Containing Fugitive Dust/Volatiles Emitted from Soil

Exposure concentrations from inhalation of both particulates and vapors/gases are calculated using the following equation (USEPA, 2009):

$$EC = \frac{(C_{air})(ET)(EF)(ED)}{AT \times 24\ hrs/day}$$

where:

EC	=	exposure concentration [mg/cubic meter (m^3)]
C_{air}	=	concentration of chemical in air (mg/m^3)
ET	=	exposure time (hours/day)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
AT	=	averaging time (hours);

Note: for noncarcinogens, AT = ED x 365 days/yr, and
for carcinogens, AT = 70 yr x 365 days/yr

In some cases, USEPA default exposure assumptions were used to estimate exposure concentration from inhalation of fugitive dusts/volatile emissions from surface and subsurface soil; Tables 7-13 and 7-14 summarize exposure assumptions. The same exposure frequencies and durations used to estimate incidental ingestion of soil intakes were used to estimate exposure via inhalation of fugitive dust/volatile emissions from surface and subsurface soil.

Procedures in USEPA Soil Screening Guidance (USEPA, 2002c) were used to calculate concentrations of chemicals in air resulting from soil emissions. Chemical concentrations in air were calculated as follows:

$$C_{air} = C_{soil} \times \left[\frac{1}{PEF} + \frac{1}{VF}\right]$$

where:

C_{air}	=	chemical concentration in air (mg/m^3)
C_{soil}	=	chemical concentration in soil (mg/kg)
PEF	=	Particulate emission factor (m^3/kg)
VF	=	volatilization factor (m^3/kg)

No volatile chemicals were retained as COPCs in surface and subsurface soil; therefore, the above equation reduces to:

$$C_{air} = C_{soil} \times \left[\frac{1}{PEF}\right]$$

The particulate emissions factor (PEF) relates the chemical concentration in soil to the chemical concentration of dust particles in air. A PEF value of 1.316 x 10^{+9} was used for the SWMU 25 HHRA (USEPA, 2002c). Because air emissions resulting from fugitive dust emissions settings will be different than dust emissions generated during construction activities, a separate PEF was used for construction activities. The PEF for construction workers (1.34 x 10^{+6} m^3/kg) was calculated using the equations presented in the supplemental SSL guidance document (USEPA, 2002c). Appendix E.4 presents a sample calculation for PEF for construction workers.

7.2.4.4 Direct Ingestion of Groundwater

Direct ingestion of groundwater is expected to be limited to a future hypothetical residential scenario. Incidental ingestion of groundwater by construction workers during excavation activities is expected to be negligible and therefore is not quantitatively evaluated in this HHRA. Intakes associated with ingestion of groundwater were evaluated using the following equation (USEPA, 1989b):

$$\text{Intake} = \frac{(C_W)(CF)(IR_W)(EF)(ED)}{(BW)(AT)}$$

where:

Intake	=	Intake of chemical from groundwater (mg/kg/day)
C_w	=	concentration of chemical in groundwater (µg/L)
CF	=	conversion factor (0.001 mg/µg)
IR_w	=	ingestion rate for groundwater (L/day)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
BW	=	body weight (kg)
AT	=	averaging time (days);

Note: for noncarcinogens, AT = ED x 365 days/yr,
for carcinogens, AT = 70 yrs x 365 days/yr

In most cases, USEPA default exposure assumptions were used to evaluate residential exposures to groundwater. Tables 7-13 and 7-14 summarize the receptor-specific exposure assumptions used to estimate chemical intakes from ingestion of groundwater.

7.2.4.5 Dermal Contact with Groundwater

Hypothetical residential receptors were assumed to use groundwater for domestic purposes (e.g., bathing, showering, and dish washing) that can result in dermal exposure. Construction workers could contact groundwater while in an excavation trench. The following equation was used to assess exposures resulting from dermal contact with groundwater (USEPA, 2004):

$$DAD = \frac{(DA_{event})(EV)(ED)(EF)(SA)}{(BW)(AT)}$$

where:

DAD	=	dermally absorbed dose of chemical from water (mg/kg/day)
DA_{event}	=	dermally absorbed dose per event (mg/cm^2-event)
EV	=	event frequency (events/day)
ED	=	exposure duration (yr)
EF	=	exposure frequency (days/yr)
SA	=	skin surface area available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days);

Note: for noncarcinogens, AT = ED x 365 days/yr, and
for carcinogens, AT = 70 yrs x 365 days/yr

In most cases, USEPA default exposure assumptions were used to estimate chemical intakes from dermal contact with groundwater; Tables 7-13 and 7-14 summarize exposure assumptions.

There are no USEPA or IDEM default exposure assumptions for exposures to groundwater by construction workers. Consequently, values were derived based on site-specific information and professional judgment. It was assumed that the construction worker will be exposed to groundwater 4 hours per day for 30 days a year under the RME scenario, and 4 hours per day for 15 days a year under the CTE scenario. A shorter exposure frequency is recommended for a construction worker exposed to groundwater than for exposure to soil because it is unlikely that a construction worker will have direct contact with groundwater on a daily basis during a construction project.

Dermal intakes for residents exposed to groundwater assumed total body exposure on a daily basis. For construction workers exposed to groundwater, the exposed surface area available for contact was based on assumed activities and was similar to the assumptions outlined for dermal contact with soil.

The absorbed dose per event (DA_{event}) was estimated using a non-steady-state approach for organic compounds, and a traditional steady-state approach for inorganics. For organics, the following equations apply:

$$\text{If } t_{event} < t^*, \text{ then}: DA_{event} = (2)(K_p)(FA)(C_w)(CF)\left(\sqrt{\frac{6\,\tau\, t_{event}}{\pi}}\right)$$

$$\text{If } t_{event} > t^*, \text{ then}: DA_{event} = (K_p)(FA)(C_w)(CF)\left(\frac{t_{event}}{1+B} + 2\tau\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right)$$

where:

t_{event}	=	duration of event (hour/event)
t*	=	time to reach steady-state conditions (hour)
K_p	=	permeability coefficient from water through skin (cm/hour)
FA	=	chemical-specific fraction absorbed (dimensionless)
C_w	=	concentration of chemical in water (mg/L)
τ	=	lag time (hour)
π	=	Pi (dimensionless; equal to 3.1416)
CF	=	conversion factor (0.001 L/cm^3)
B	=	Dimensionless ratio of the permeability of the stratum corneum relative to the permeability across the viable epidermis (dimensionless)

Values for the chemical-specific parameters (t*, K_p, FA,τ, and B) were obtained from the current dermal guidance (USEPA, 2004, Exhibit B-3) and are presented in Table 7-15. If published values were not available for a particular compound, they were calculated using equations provided in the USEPA dermal guidance.

The following steady-state equation was used to estimate DA_{event} for inorganics:

$$DA_{event} = (K_p)(C_W)(t_{event})$$

The dermal permeability coefficient (K_p) values recommended in the USEPA dermal guidance (USEPA, 2004) were used to calculate DA_{event} for inorganic COPCs.

7.2.4.6 Inhalation of Volatiles in Groundwater

If groundwater contains volatiles, exposure may also result in chemical intake through inhalation if groundwater is used as a domestic water supply or is exposed during construction activities. This exposure route is plausible for residential receptors that may be exposed while showering, bathing, washing dishes, etc. or for construction workers contacting shallow groundwater during excavation activities. For residential receptors, chemical intakes from inhalation exposure while showering due to volatilization of COPCs in groundwater were estimated using a mass transfer model developed specifically for this exposure route, in combination with an air intake estimation model. The mass transfer model accounts for inhalation during and after a shower while the receptor remains in a closed bathroom. The method used is as follows (USEPA, 1989b; Foster and Chrostowski, 1987; USEPA, 2009):

$$EC = (S)(ET)(K)(EF)(ED)/(AT)(R_a)(CFs)$$

$$K = D_s + \frac{\exp(-R_a \times D_t)}{R_a} - \frac{\exp\left[R_a \times (D_s - D_t)\right]}{R_a}$$

where:

EC	=	exposure concentration (mg/m^3)
S	=	volatile chemical generation rate ($\mu g/m^3$-min-shower)
ET	=	exposure time (hours/day)
K	=	mass-transfer coefficient (min)
EF	=	exposure frequency (showers/yr)
ED	=	exposure duration (yr)
AT	=	averaging time or period of exposure (hours) for noncarcinogens, AT = ED×365 days per year×24 hours per day; for carcinogens, AT = 70 years×365 days per year x24 hours per day
R_a	=	air-exchange rate (min^{-1})
CFs	=	conversion factors ($1x10^{+3}$ µg/mg and 1,440 min/day)
D_s	=	shower duration (min)
D_t	=	total time in bathroom (min)

The estimated volatile chemical generation rate is based on two-phase film theory. The model uses contaminant-specific mass transfer coefficients, Henry's Law Constants, droplet diameter, drop time, viscosity, temperature, etc. Appendix E.4 contains a sample calculation. The same exposure frequencies and durations used to estimate intake for dermal contact with groundwater were used to evaluate chemical intakes for inhalation of volatiles from domestic groundwater use.

Inhalation exposures for the construction worker were estimated using an air intake estimation model, as follows (USEPA, 2009):

$$EC = \frac{(C_{air})(ET)(EF)(ED)}{(AT)(24hrs/day)}$$

where:

EC	=	exposure concentration (mg/m^3)
C_{air}	=	chemical concentration in air (mg/m^3)
ET	=	exposure time (hours/day)
EF	=	exposure frequency (days/yr)
ED	=	exposure duration (yr)
AT	=	averaging time (days)
		for noncarcinogens, AT = ED×365 days per year
		for carcinogens, AT = 70 years×365 days per year

Construction workers may be exposed to COPCs that have volatilized from groundwater when an excavation exposes the shallow water table. The same exposure frequencies and times used to estimate intake from dermal contact with groundwater were used to estimate intake from inhalation of volatiles from groundwater during construction.

No well-established models are available for estimating migration of volatiles from groundwater into a construction or utility trench. To estimate the EPCs for air in a construction trench, the HHRA used an approach suggested by the Virginia Department of Environmental Quality (VDEQ) (2013), which is based on a combination of a vadose zone model (to estimate volatilization of gases from contaminated groundwater into a trench) and a box model (to estimate contaminant dispersion from the air inside the trench to the above-ground atmosphere). The VDEQ methodology is described in the following paragraphs.

The airborne concentration of a contaminant in a trench can be estimated using the following equation:

$$C_{air} = C_{GW} \times VF$$

where:

C_{air}	=	contaminant concentration in air in the trench ($\mu g/m^3$)

C_{GW}	=	concentration of contaminant in groundwater (µg/L)
VF	=	volatilization factor (L/m^3)

An excavation was assumed to be no more than 15 feet bgs. If the depth to groundwater at a site is less than 15 feet, the VDEQ model assumes that a worker would encounter groundwater when digging an excavation or trench. The worker would be directly exposed to groundwater and to contaminants in the air inside the trench due to volatilization from groundwater pooling in the trench bottom.

The following equation is used to calculate the volatilization factor (VF) for a trench less than 15 feet deep:

$$VF = (Ki \times A \times F \times 10^{-3} \times 10^{4} \times 3{,}600)/(ACH \times V)$$

where:

Ki	=	contaminant's overall mass-transfer coefficient (cm/s)
A	=	trench area (m^2)
F	=	fraction of floor through which contaminant can enter (unitless)
ACH	=	air changes per hour (h^{-1}) = 360 h^{-1}
V	=	trench volume (m^3)
10^{-3}	=	conversion factor (L/cm^3)
10^4	=	conversion factor (cm^2/m^2)
3,600	=	conversion factor (seconds/hour)

Studies of urban canyons suggest that if the ratio of trench width relative to wind direction and trench depth is less than or equal to one, a circulation cell(s) will be created in the trench, limiting the degree of gas exchanged with the atmosphere. Thus, measured building ventilation rates lead to an assumption of two air changes per hour (ACH). If the width-to-depth ratio of the trench is greater than one, the air exchange between the trench and above-ground atmosphere is unrestricted, based on the ratio of trench depth to average wind speed, so the ACH is assumed to be 360. The exposure assessment in this HHRA assumes that the width-to-trench depth ratio is greater than one; thus, the ACH is set at 360.
K_i is calculated using the following equation:

$$K_i = 1/\{(1/k_iL) + [(RT)/(H_i\ k_iG)]\}$$

where:

	=	containment's overall mass-transfer coefficient (cm/s)

k_iL	=	liquid-phase mass-transfer coefficient of i (cm/s)
R	=	ideal gas-constant (atm-m^3/mole-°K) = 8.2 x 10^{-5}
T	=	average system absolute-temperature (°K) (Default = 298°K)
H_i	=	Henry's Law Constant of i (atm-m^3/mole)
k_iG	=	gas-phase mass-transfer coefficient of i (cm/s)

Formulae for calculating k_iL and k_iG are as follows:

$$k_iL = (MWO_2/MW_i)^{0.5} \times (T/298) \times kL,O_2$$

where:

k_iL	=	liquid-phase mass-transfer coefficient of component i (cm/s)
MWO_2	=	molecular weight of oxygen (g/mole)
MW_i	=	molecular weight of component i (g/mole)
kL,O_2	=	liquid-phase mass-transfer coefficient of oxygen at 25°C (cm/s) = 0.002 cm/s
k_iG	=	$(MWH_2O/MW_i)^{0.335} \times (T/298)^{1.005\times} kG,H_2O$

where:

k_iG	=	gas-phase mass-transfer coefficient of component i (cm/s)
MWH_2O	=	molecular weight of water (g/mole)
kG,H_2O	=	gas-phase mass-transfer coefficient of water vapor at 25°C (cm/s) = 0.833 cm/s (USEPA, 1988)

Chemical properties were obtained from the USEPA RSL Table (2012a) and are presented in Table 7-16.

7.2.4.7 Assessing Cancer Risks from Early Life Exposures

USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005b) recommends adjusting the toxicity of carcinogenic chemicals that are mutagenic when evaluating early-life exposures. The guidance recommends using age-dependent adjustment factors (ADAFs) combined with age-specific exposure estimates when assessing cancer risks. In the absence of chemical-specific data, the supplemental guidance recommends the following default adjustments, which reflect that cancer risks are generally higher from early-life exposures than from similar exposures later in life:

- For exposures before 2 years of age (i.e., spanning a 2-year interval from the first day of birth until a child's second birthday), a 10-fold adjustment.

- For exposures between 2 and 16 years of age (i.e., spanning a 14-year time interval from a child's second birthday until their sixteenth birthday), a three-fold adjustment.

- For exposures after turning 16 years of age, no adjustment.

The adjustments were applied using the same method used by Oak Ridge National Laboratory (ORNL) in the development of RSLs. Adolescents were evaluated as one age group, ages 6 to 16 years. Children were evaluated as two age groups: ages 0 to 2 years and ages 2 to 6 years. Adults were evaluated as two age groups: ages 6 to 16 and greater than 16 years old (i.e., ages 16 to 30). Using this approach, the intakes for child and adult adolescent trespassers and hypothetical residents were calculated as follows:

$$\text{Intake}_{\text{Child}} = \text{Intake}_{(\text{ages } 0 - 2 \text{ years})} \times 10 + \text{Intake}_{(\text{ages } 2 - 6 \text{ years})} \times 3$$

$$\text{Intake}_{\text{Adolescent}} = \text{Intake}_{(\text{ages } 6\text{-}16 \text{ years})} \times 3$$

$$\text{Intake}_{\text{Adult}} = \text{Intake}_{(\text{ages } 6 - 16 \text{ years})} \times 3 + \text{Intake}_{(\text{ages} > 16 \text{ years})}$$

The above approach was used only for those chemicals identified as mutagenic in the ORNL screening table [e.g., hexavalent chromium, benzo(a)pyrene]. Appendix E.4 contains sample calculations.

7.2.4.8 Summary of Exposure Parameters

A summary of exposure input parameters for all exposure pathways is presented in Tables 7-13 and 7-14 for the identified potential receptor groups at SWMU 25. In general, this HHRA used standard default parameters (e.g., USEPA, 1989b, 1991, 1997a, and 2004), which combine mid-range and upper-end exposure factors, to assess RME conditions. This HHRA used mid-range exposure factors presented in current risk assessment guidance to assess CTE conditions (USEPA, 1989b and 1993).

7.3 TOXICITY ASSESSMENT

The toxicity assessment weighs the evidence regarding the potential for chemical exposure to produce adverse effects in exposed receptors. Also, when possible, the assessment estimates the relationship between chemical exposure and the increased likelihood and/or severity of adverse effects. Quantitative estimates of the relationship between the magnitude and type of exposures and the severity or probability of human health effects are defined for the identified constituents of concern. Quantitative toxicity values determined during this component of the risk assessment are integrated with exposure assessment outputs to characterize the potential occurrence of adverse health effects for each receptor group.

The reference dose (RfD) is the toxicity value used to evaluate noncarcinogenic health effects for ingestion and dermal exposures. The reference concentration (RfC) is used to evaluate noncarcinogenic health effects for inhalation exposures. The RfD and RfC estimate a daily exposure level for a human population that is unlikely to pose an appreciable risk during a portion or for all of a human lifetime. It is based on a review of animal and/or human toxicity data, with adjustments for various data uncertainties. Carcinogenic effects are quantified using the cancer slope factor (CSF) for ingestion and dermal exposures, and inhalation unit risks (IURs) for inhalation exposure that are plausible upper-bound estimates of the probability of the development of cancer per unit intake of the chemical over a lifetime. These are typically based on dose-response data from human and/or animal studies.

7.3.1 Toxicity Criteria for Oral and Inhalation Exposures

This HHRA obtained oral RfDs and CSFs as well as inhalation RfCs and IURs from the following primary USEPA literature sources (USEPA, 2003b):

- Tier 1 - Integrated Risk Information System (IRIS).

- Tier 2 - USEPA Provisional Peer Reviewed Toxicity Values (PPRTVs) – The Office of Research and Development/National Center for Environmental Assessment (NCEA) Superfund Health Risk Technical Support Center develops PPRTVs on a chemical-specific basis when requested by USEPA's Superfund program.

- Tier 3 - Other Toxicity Values – These sources include but are not limited to California Environmental Protection Agency (Cal EPA) toxicity values, ATSDR values, and the Annual Health Effects Assessment Summary Tables (HEAST) (USEPA, 1997b).

Although toxicity criteria can be found in several toxicological sources, USEPA's Integrated Risk Information System (IRIS) online database is the preferred source for toxicity values. USEPA continuously updates this database and verifies all presented values. Tables 7-17 through 7-20 present the toxicity criteria for the chemicals selected as COPCs.

7.3.2 Toxicity Criteria for Dermal Exposure

RfDs and CSFs in the scientific literature are typically expressed as "administered" (i.e., not absorbed) doses. Therefore, these values are considered inappropriate for estimating risks associated with dermal exposures. Oral dose response parameters based on administered doses must be adjusted to absorbed doses before they can be compared to estimated dermal exposure intakes.

When oral absorption is essentially complete (i.e., 100 percent), an absorbed dose is equivalent to the administered dose, and therefore no toxicity adjustment is necessary. Conversely, when the gastrointestinal absorption of a chemical is poor (e.g., 1 percent), the absorbed dose is smaller than the administered dose; thus, toxicity factors based on absorbed dose should be adjusted to account for the difference in the absorbed dose relative to the administered dose. USEPA recommends a 50 percent absorption cut-off to reflect the intrinsic variability in analyzing absorption studies (USEPA, 2004). Therefore, the adjustment from administered to absorbed dose was only performed when the chemical-specific gastrointestinal absorption efficiency was less than 50 percent. The adjustment from administered to absorbed dose was made using chemical-specific gastrointestinal absorption efficiencies published in numerous guidance documents [e.g., USEPA 2004 (the primary reference), IRIS, ATSDR toxicological profiles, etc.], using the following equations:

$$RfD_{dermal} = (RfD_{oral})(ABS_{GI})$$

$$CSF_{dermal} = (CSF_{oral}) / (ABS_{GI})$$

where: ABS_{GI} = absorption efficiency in the gastrointestinal tract
RfD_{dermal} = RfD for the dermal route of exposure
RfD_{oral} = RfD for the oral route of exposure
CSF_{dermal} = CSF for the dermal route of exposure
CSF_{oral} = CSF of the oral route of exposure

As noted above, oral toxicity criteria (e.g., RfDs, CSFs) must be adjusted to allow quantitative evaluation of the dermal route of exposure in the baseline risk assessment. An explanation of the adjustment and steps to complete this adjustment are presented in Appendix A of USEPA's RAGS Part A.

7.3.3 Toxicity Criteria for Benzo(a)pyrene

USEPA's Guidelines for Carcinogen Risk Assessment (USEPA, 2005a), and Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005b) specify the use of ADAFs for carcinogens that are mutagenic. Benzo(a)pyrene is considered a mutagenic chemical. No chemical-specific ADAFs have been derived for benzo(a)pyrene; therefore, the following default ADAFs were used: 10 for ages 0 to 2, 3 for ages 2 to 16, and 1 (no adjustment) for ages 16 to 70. The ADAFs were used in evaluating exposures to benzo(a)pyrene for adolescent trespassers and hypothetical residents using the approach presented in Section 7.2.4.7.

7.3.4 Toxicity Criteria for Chromium

Toxicity criteria are available for different forms of chromium (trivalent and hexavalent). Hexavalent chromium is considered more toxic than trivalent chromium. In the absence of speciating the chromium into its different valence states, it is conservatively assumed that all the chromium present in SWMU 25 samples is hexavalent chromium. Hexavalent chromium has carcinogenic and noncarcinogenic toxicity factors. However, hexavalent chromium is a mutagenic carcinogen. USEPA Guidelines for Carcinogen Risk Assessment (USEPA, 2005a), and Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005b) specify the use of ADAFs for mutagenic carcinogens. No chemical-specific ADAF is available for hexavalent chromium; therefore, USEPA's default ADAFs are applied to the carcinogenic toxicity factors for hexavalent chromium. The following default ADAFs should be applied: 10 for ages 0 to 2, 3 for ages 2 to 16, and 1 (no adjustment) for ages 16 to 70. The ADAFs were used in evaluating exposures to chromium for adolescent trespassers and hypothetical residents using the approach presented in Section 7.2.4.7. Noncarcinogenic effects are evaluated like all noncarcinogens in accordance with USEPA's risk assessment guidance (USEPA, 1989b).

7.4 RISK CHARACTERIZATION

This section characterizes human health risks associated with potential exposures to COPCs at SWMU 25. This section quantitatively determines potential risks (noncarcinogenic and carcinogenic) for human receptors resulting from exposures outlined in the exposure assessment. Section 7.4.1 outlines the methods used to quantitatively estimate the type and magnitude of potential risks for human receptors. Section 7.4.2 summarizes the risk characterization for SWMU 25.

7.4.1 Quantitative Analysis of Constituents

Quantitative estimates of risk for chemicals were calculated according to risk assessment methods outlined in USEPA guidance (USEPA, 1989b). Lifetime cancer risks are expressed in the form of dimensionless probabilities, referred to as ILCRs, based on CSFs and IURs. Noncarcinogenic risk estimates are presented in the form of HQs that are determined through a comparison of intakes with published RfDs and RfCs.

ILCR estimates for ingestion and dermal exposures were generated for each COPC using estimated exposure intakes and published CSFs, as follows:

$$\text{ILCR} = (\text{Estimated Exposure Intake})(\text{CSF})$$

ILCR estimates for inhalation exposures were generated for each COPC using estimated exposure concentrations and published IURs, as follows:

$$ILCR = (IUR)(Exposure\ Concentration)(1{,}000\ \mu g/mg)$$

An ILCR of 1×10^{-6} indicates that the exposed receptor has a one-in-one-million chance of developing cancer under the defined exposure scenario. Alternatively, such a risk may be interpreted as representing one additional case of cancer in an exposed population of one million people.

Noncarcinogenic risks were assessed using the concept of HQs and HIs. The HQ for a COPC is the ratio of the estimated intake to the RfD, and is calculated for ingestion and dermal exposures as follows:

$$HQ = (Estimated\ Exposure\ Intake)/(RfD)$$

For inhalation exposures, HQ is calculated as follows:

$$HQ = (Exposure\ Concentration)/(RfC)$$

An HI was generated by summing the individual HQs for all COPCs. The HI is not a mathematical prediction of the severity of toxic effects, and therefore is not a true "risk"; it is simply a numerical indicator of the possibility of the occurrence of noncarcinogenic (threshold) effects.

7.4.1.1 Comparison of Quantitative Risk Estimates to Benchmarks

To interpret the quantitative risks and aid risk managers in determining the need for remediation at a site, quantitative risk estimates were compared to typical risk benchmarks. Calculated ILCRs were interpreted using the USEPA's "target risk range" ($1x10^{-6}$ to $1x10^{-4}$), and HIs were evaluated using a value of 1.

USEPA has defined the range of $1x10^{-6}$ to $1x10^{-4}$ as the ILCR "target risk range" for most hazardous waste facilities addressed under CERCLA and RCRA. IDEM has defined this same risk range for the non-default evaluation under their Risk Integrated System Closure (RISC) program. Individual or cumulative ILCRs greater than $1x10^{-4}$ will typically not be considered as protective of human health, and ILCRs less than $1x10^{-6}$ will typically be regarded as protective. Risk management decisions are necessary when the ILCR is within the $1x10^{-4}$ to $1x10^{-6}$ cancer risk range.

A hazard index (HI) exceeding unity (1) indicates that there may be potential noncarcinogenic health risks associated with exposure. If an HI exceeds unity, a segregation of target organ effects associated with exposure to COPCs is typically performed. Only those chemicals that affect the same target organ(s) or exhibit similar critical effect(s) are regarded as truly additive. Consequently, it may be possible for a cumulative HI to exceed 1, but no adverse health effects are anticipated if the COPCs do not affect the same target organ or exhibit the same critical effect.

7.4.2 Results of the Risk Characterization

This section summarizes the results of the SWMU 25 risk characterization. Quantitative risk estimates for potential human receptors are developed for chemicals detected in soils and groundwater. Section 7.5 provides a discussion of the uncertainties associated with the risk estimates. Sections 7.2 and 7.3 provide the methodology used to calculate risks presented in this section. Potential cancer risks and HIs were calculated for current/future construction workers, industrial workers, adolescent trespassers, and hypothetical residents under the RME and CTE scenarios, and are summarized in Tables 7-21 and 7-22. Appendix E.4 presents sample calculations, and the results of the risk assessment in RAGS Part D format are included in Appendix E.2.

7.4.2.1 Noncarcinogenic Risks

RME Scenario

Table 7-21 presents the HIs estimated for the RME scenario for SWMU 25. Cumulative HIs estimated for industrial workers and adolescent trespassers were less than unity (1), indicating that adverse noncarcinogenic health effects are not anticipated for these receptors under the defined exposure conditions. Additionally, HIs for surface soil under the RME scenario are less than or equal to unity for all receptors evaluated.

HIs for subsurface soil are less than unity for industrial workers, adolescent trespassers, and adult residents. The HI for subsurface soil estimated for child residents exceeds unity, but target organ-specific HIs are less than or equal to 1, indicating that adverse effects are not anticipated. The HI for subsurface soil estimated for construction workers exceeded unity. Manganese (HQ = 2) was the primary risk contributor via the inhalation pathway. However, considerable uncertainty is associated with the RfC used for manganese for construction workers (see Section 7.5).

The HI for groundwater estimated for construction workers is less than 1; however, HIs for child and adult residents exposed to COPCs in groundwater exceed 1. The HI for groundwater estimated for child

residents was 141, and the HI for groundwater estimated for adult residents was 41. Metals were the primary contributors.

CTE Scenario

Table 7-22 presents the HIs estimated for the CTE scenario at SWMU 25. Cumulative HIs estimated for construction workers, industrial workers, and adolescent trespassers were less than unity (1), indicating that adverse noncarcinogenic health effects are not anticipated for these receptors under the defined exposure conditions. HIs for surface and subsurface soil under the CTE scenario are less than or equal to unity for all receptors evaluated.

The HI for groundwater under the CTE scenario is less than unity for construction workers; however, HIs for child and adult residents exposed to COPCs in groundwater exceed 1. The HI for groundwater estimated for child residents was 93, and the HI for groundwater estimated for adult residents was 27. Metals were the primary contributors.

7.4.2.2 Carcinogenic Risks

RME Scenario

Table 7-21 presents the ILCRs for the RME scenario at SWMU 25. Cumulative ILCRs for construction workers, industrial workers, and adolescent trespassers were less than or within USEPA's and IDEM's target risk range of $1x10^{-4}$ to $1x10^{-6}$. ILCRs for these receptors, as well as child, adult, and lifelong residents exposed to COPCs in surface soil and subsurface soil, were within USEPA's and IDEM's target risk range.

ILCRs for hypothetical child, adult, and lifelong residents exposed to COPCs in groundwater exceeded USEPA's and IDEM's target risk range. The ILCRs for groundwater were $3x10^{-3}$, $2x10^{-3}$, and $5x10^{-3}$ for child, adult, and lifelong residents, respectively. Arsenic and chromium in groundwater were the main risk contributors for these receptors.

CTE Scenario

Table 7-22 presents the ILCRs for the CTE scenario at SWMU 25. Cumulative ILCRs for construction workers, industrial workers, and adolescent trespassers were less than or within USEPA's and IDEM's target risk range of $1x10^{-4}$ to $1x10^{-6}$. ILCRs for these receptors as well as child, adult, and lifelong residents exposed to COPCs in surface soil and subsurface soil were also less than or within USEPA's and IDEM's target risk range.

ILCRs for hypothetical child, adult, and lifelong residents exposed to COPCs in groundwater exceeded USEPA's and IDEM's target risk range. The ILCRs for groundwater were $2x10^{-3}$, $3x10^{-4}$, and $2x10^{-3}$ for child, adult, and lifelong residents, respectively. Arsenic and chromium in groundwater were the main risk contributors for these receptors.

7.4.2.3 Risks for Chemicals within Background Levels

As discussed in Section 7.1, chemicals detected at maximum concentrations exceeding COPC screening levels but below background concentrations were not retained as COPCs and were not evaluated in the risk assessment presented in Sections 7.4.2.1 through 7.4.2.3. Aluminum, cobalt, manganese, thallium, and vanadium were within background levels in surface soil. Aluminum, chromium, and thallium were within background levels in subsurface soil. No chemical was eliminated as a COPC in groundwater on the basis of being within background levels. Table 7-23 presents the cancer risks and HIs associated with these metals. Appendix E.5 presents RAGS Part D tables for these chemicals. Also included in Table 7-23 is a comparison of the cancer risks and HIs for exposures to surface soil and subsurface soil based on site-related COPCs.

Medium-specific HIs calculated on a target organ-specific basis are less than or equal to 1 for metals within background concentrations in surface and subsurface soil for all receptors except construction workers exposed to surface soil. The target organ-specific HI for construction workers exposed to surface soil exceeds 1 primarily because of manganese via the inhalation pathway; however, as discussed in Section 7.5, the RfC used for manganese for the construction worker is subject to considerable uncertainty. Medium-specific ILCRs for all receptors exposed to chemicals present at background concentrations were less than or within the USEPA and IDEM target risk range for surface soil and subsurface soil.

7.5 UNCERTAINTY ANALYSIS

There is uncertainty associated with all aspects of the baseline human health risk assessment. This section presents a summary of the uncertainties, including a discussion of how they may affect the final risk numbers.

Uncertainty in the selection of COPCs is related to: the current status of the predictive databases; the grouping of samples; the numbers, types, and distributions of samples; and the procedures used to include or exclude constituents as COPCs. Uncertainty associated with the exposure assessment includes the values used as input variables for a given intake route or scenario, the assumptions made to

determine EPCs, and the predictions regarding future land use and population characteristics. Uncertainty in the toxicity assessment includes the quality of the existing toxicity data needed to support dose-response relationships, and the weight-of-evidence used to determine the carcinogenicity of COPCs. Uncertainty in risk characterization includes that associated with exposure to multiple chemicals, and the cumulative uncertainty from combining conservative assumptions made in earlier steps of the risk assessment process.

Whereas there are various sources of uncertainty, the direction of uncertainty can be influenced by the assumptions made throughout the risk assessment, including selection of COPCs and selection of values for dose-response relationships. Throughout the entire risk assessment, assumptions are biased toward a margin of safety so that the final calculated risks are overestimated.

Generally, risk assessments carry two types of uncertainty: measurement and informational uncertainty. Measurement uncertainty refers to the usual variance that accompanies scientific measurements. For example, this type of uncertainty is associated with analytical data collected for each site. The risk assessment reflects the accumulated variances of the individual values used.

Informational uncertainty stems from inadequate availability of information needed to complete the toxicity and exposure assessments. Often, this gap is significant, such as the absence of information on the effects of human exposure to low doses of a chemical, on the biological mechanism of action of a chemical, or the behavior of a chemical in soil.

Once the risk assessment is complete, the results must be reviewed and evaluated to identify the type and magnitude of uncertainty involved. Reliance on results from a risk assessment without consideration of uncertainties, limitations, and assumptions inherent in the process can be misleading. For example, to account for uncertainties in the development of exposure assumptions, conservative estimates must be used to ensure that the particular assumptions made are protective of sensitive subpopulations or the individuals with maximum exposure. If a number of conservative assumptions are combined in an exposure model, the resulting calculations can propagate the uncertainties associated with those assumptions, thereby producing a much larger uncertainty for the final results. This uncertainty is biased toward over-predicting both carcinogenic and noncarcinogenic risks. Thus, both the results of the risk assessment and the uncertainties associated with those results must be considered when making risk management decisions.

This interpretation is especially relevant when the risks exceed the point of departure for defining "acceptable" risk. For example, when risks calculated using a high degree of uncertainty are less than an

acceptable risk level (i.e., $1x10^{-6}$ to $1x10^{-4}$), the interpretation of no significant risk is typically straightforward. However, when risks calculated using a high degree of uncertainty exceed acceptable risk levels (i.e., $1x10^{-4}$), a conclusion can be difficult unless uncertainty is considered.

7.5.1 Uncertainty in Data Evaluation

Issues related to uncertainty in the data evaluation include the usability of the existing database, the COPC screening levels used, the absence of screening levels for some chemicals detected in the site media, and the metals data for groundwater. The remainder of this section provides a brief discussion of the uncertainty in the data evaluation.

Usability of Existing Databases

All the data used in the HHRA were validated. The qualification of data during the formal data validation process is not expected to compromise the results of the baseline HHRA. Analytical data qualified as estimated were used even though the reported positive concentrations or sample-specific quantitation limits may be somewhat imprecise. The use of estimated data adds to the uncertainty associated with the risk assessment; however, the associated uncertainty is expected to be negligible compared to the other uncertainties inherent in the risk evaluation process (i.e., uncertainties with land uses, exposure scenarios, toxicological criteria, etc.). Rejected data (i.e., qualified as “R” during data validation) were not used in the quantitative risk assessment. Elimination of data qualified as “R” may increase uncertainty in the risk assessment. Because all data have been validated, the uncertainty in the calculated risks associated with the data is minimal.

COPC Screening Levels

The use of risk-based screening values based on conservative land use scenarios (i.e., residential land use for soil and ingestion of tap water for groundwater) corresponding to ILCRs of $1x10^{-6}$ and HQs of 0.1 ensured that all the significant contributors to risk from a site were evaluated. Eliminating chemicals present at concentrations that correspond to ILCRs less than $1x10^{-6}$ and HQs less than 0.1 should not have affected the final conclusions of the risk assessment because those chemicals were not expected to cause a potential health concern at the detected concentrations.

Surrogate Screening Levels

USEPA RSLs are currently not available for acenaphthylene, benzo(g,h,i)perylene, and phenanthrene. In the COPC screening, acenaphthene was used as a surrogate for acenaphthylene, and pyrene was selected as a surrogate for benzo(g,h,i)perylene and phenanthrene. Applying the toxicity values of one

compound to another compound increases the uncertainty in the risk assessment for both the selection of COPCs and the calculated risks. The direction of the uncertainty is not known.

Metals Data for Groundwater

Total metals results were used to assess receptor risks in this HHRA, and several metals were primary risk drivers for residents exposed to groundwater. However, there is uncertainty for the total metals results because of the possibility of sample turbidity influencing the results. Of the metals selected as COPCs in groundwater, the following were not selected as COPCs in the filtered groundwater samples: aluminum, cadmium, and vanadium. Additionally, the maximum concentrations of aluminum, arsenic, chromium, iron, and vanadium in the total metals fraction exceeded the maximum detected results for these metals in the filtered metals fraction by more than one order of magnitude. The comparison of total metals results to filtered metals results indicates that sample turbidity may be influencing some of the metals results in groundwater.

Cancer risks and hazard indices for exposures to groundwater based on dissolved concentrations of metals are presented in Tables 7-24 and 7-25 for the RME and CTE scenarios, respectively. Cancer risks for hypothetical lifetime residents exceed USEPA's target risk range, but only because chromium is evaluated as hexavalent chromium. HIs for hypothetical child and adult residents under the RME scenario and child resident under the CTE scenario exceed the acceptable level of 1. Cobalt is the major contributor to the HI for exposure to dissolve metals in groundwater.

7.5.2 Uncertainty in the Exposure Assessment

Uncertainty in the exposure assessment arises from land use assumptions, the methods used to calculate EPCs, the selection of receptors and scenarios, and the selection of exposure parameters. Each of these is discussed below.

Land Use

The current land use patterns at NSA Crane are well established, thereby limiting the uncertainty associated with land use assumptions. Land use at SWMU 25 is currently limited and is expected to be limited in the future, as long as NSA remains open (industrial workers and construction workers are the only current and likely future receptors). To be conservative, risks to potential current and future adolescent trespassers and hypothetical residents were estimated for the site. Future recreational use is not expected at the site because it is located adjacent to the highway.

Exposure Point Concentrations

Uncertainty is associated with calculating the EPC using the 95-percent UCL of the mean concentration. As a result of using the 95-percent UCL, the estimations of potential risk for the RME scenario are most likely overstated because this is a representation of the upper limit that potential receptors would be exposed to over the entire exposure period. The maximum concentration was used as the EPC if there were fewer than five samples or four positive detections in a data set, or if the 95-percent UCL exceeded the maximum concentration. As a result, the maximum concentration was used as the EPC for several groundwater COPCs. Using the maximum concentration tends to overestimate potential risks because receptors are assumed to be continuously exposed to the maximum concentration for the entire exposure period.

Exposure Routes and Receptor Identification

Receptor groups and exposure routes of potential concern were selected based on current land use observed at the site and the anticipated future land use. Therefore, the uncertainty associated with exposure route and potential receptors selection is minimal because these factors are well defined.

The vapor intrusion pathway was considered as a possible exposure pathway for SWMU 25. Note that vapor intrusion was considered only for hypothetical future structures. No buildings currently exist in the SWMU 25 area study area.

Exposure Parameters

Each exposure factor (for RME and CTE scenarios) selected for use in the risk assessment has some associated uncertainty. Generally, exposure factors are based on surveys of physiological parameters and lifestyle profiles across the United States. The attributes and activities studied in these surveys generally have a broad distribution. To avoid underestimation of exposure, in most cases the USEPA guidelines (USEPA, 1991 and 1993) on the RME receptor were used, which generally specify the use of the 95th percentile for most parameters. Therefore, the selected values for the RME receptor represent the upper bound of the observed or expected habits of the majority of the population.

Generally, uncertainty can be assessed quantitatively for many assumptions made in determining factors for calculating exposures and intakes. Many of these parameters were determined from statistical analyses on human population characteristics. Often, the database used to summarize a particular exposure parameter (i.e., body weight) is quite large. Consequently, the values chosen for such variables in the RME scenario have low uncertainty.

Many of the exposure parameters used to calculate exposures and risks in this report are selected from a distribution of possible values, including USEPA guidance (1991 and 1993b) and dermal guidance (USEPA, 1997a and 2004). For the RME scenario, the value representing the 95th percentile is generally selected for each parameter to ensure that the assessment bounds the actual risks from a postulated exposure. This risk number is used in risk management decisions, but does not indicate what a more average or typical exposure might be, or what risk range might be expected for individuals in the exposed population.

To address these issues, USEPA has suggested the use of the CTE receptor, whose intake variables are often set at approximately the 50th percentile of the distribution (USEPA, 1992). The risks for this receptor seek to incorporate the range of uncertainty associated with various intake assumptions. Some of the parameters presented in this risk assessment were estimated using professional judgment, although USEPA does provide limited guidance for the CTE evaluation (USEPA, 1993).

7.5.3 Uncertainty in the Toxicological Evaluation

Uncertainty associated with the toxicity assessment is related to the hazard assessment and dose-response evaluations for the COPCs. The hazard assessment characterizes the likelihood that a chemical that induces adverse effects in animals will also induce adverse effects in humans. Hazard assessment of carcinogenicity is evaluated as a weight-of-evidence determination, using USEPA methods. Positive animal cancer test data suggest that humans contain tissue(s) that may manifest a carcinogenic response; however, the animal data cannot necessarily be used to predict the target tissue in humans.

Uncertainty in hazard assessment arises from the nature and quality of animal and human data. Uncertainty is reduced when similar effects are observed across species, strain, sex, and exposure route; when the magnitude of the response is clearly dose related; when pharmacokinetic data indicate a similar fate in humans and animals; when postulated mechanisms of toxicity are similar for humans and animals; and when the chemical of concern is structurally similar to other chemicals for which toxicity is more completely characterized.

Uncertainty in the dose-response evaluation includes the determination of a CSF for the carcinogenic assessment. Uncertainty is introduced from interspecies (animal to human) extrapolation, which, in the absence of quantitative pharmacokinetic or mechanistic data, is usually based on consideration of interspecies differences in basal metabolic rate. Uncertainty also results from intraspecies variation. Most toxicity experiments are performed with animals that are very similar in age and genotype, so

intragroup biological variation is minimal, but the human population of concern may reflect a great deal of heterogeneity, including unusual sensitivity or tolerance to the COPC. Even toxicity data from human occupational exposure reflect a bias, because only those individuals sufficiently healthy to attend work regularly (the "healthy worker effect") and those not unusually sensitive to the chemical are likely to be occupationally exposed. Finally, uncertainty arises from the quality of the key study from which the quantitative estimate is derived, and the database. For cancer effects, uncertainty associated with dose-response factors is mitigated by assuming the 95-percent upper bound for the slope factor. Another source of uncertainty in carcinogenic assessment is the method by which data from high doses in animal studies are extrapolated to the dose range expected for environmentally exposed humans. The linearized multistage model, which is used in nearly all quantitative estimations of human risk from animal data, is based on a nonthreshold assumption of carcinogenesis. Evidence suggests, however, that epigenetic carcinogens, as well as many genotoxic carcinogens, have a threshold below which they are noncarcinogenic. Therefore, the use of the linearized multistage model is conservative for chemicals that exhibit a threshold for carcinogenicity.

Use of Chronic Toxicity Values for Construction Workers

Under the guidelines established by the Superfund program, exposures to construction workers of one year or less are classified as subchronic exposures. Risks for noncarcinogenic effects associated with subchronic exposures should incorporate toxicity values for subchronic and not chronic effects. Subchronic toxicity values used in this HHRA were obtained from USEPA's PPRTV internet site. Also, ATSDR Minimal Risk Levels (MRLs) were used as subchronic toxicity values when PPRTV values were not available. Unfortunately, subchronic toxicity values are not as widely available as chronic values. Therefore, chronic toxicity values were used when subchronic toxicity values were not available. As discussed below, the lack of subchronic toxicity values is a significant source of uncertainty for receptors anticipated to have limited exposure durations (i.e., construction workers).

Construction worker HIs for subsurface soil exceeded 1 primarily because of manganese via the inhalation exposure route. The toxicity criteria used to calculate the manganese HI for the construction worker included an RfC of 5×10^{-5} mg/m^3 (from USEPA's IRIS). This RfC is for chronic exposures [i.e., long-term exposures extending over a period of time (7 or more years)]; for the construction worker scenario, subchronic toxicity values are more appropriate because the exposure duration assumed for the construction worker is 1 year (i.e., the assumed length of a typical construction project). However, a subchronic RfC for manganese is not currently available from IRIS or other USEPA literature sources cited in the hierarchy specified in USEPA guidance (USEPA, 2003b). The fact that the EPC calculated for manganese in subsurface soil (897 mg/kg) is less than the current residential soil RSL (1,800 mg/kg),

and yet still results in a HQ exceeding 1 for manganese is evidence that the construction worker HQ for manganese is likely overestimated.

The chronic RfC for manganese used in this baseline risk assessment was developed in 1993 by USEPA. However, in September 2012, ATSDR published a more recent RfC for manganese: $3x10^{-1}$ mg/m^3 (ATSDR, 2012). If the RfC value developed by ATSDR (i.e., $3x10^{-1}$ mg/m^3) is used to calculate potential risk, soil HIs for the construction worker would not exceed 1 on a target organ-specific basis. Therefore, the toxicity criteria used for manganese are a significant source of uncertainty.

Uncertainty in the Toxicity Criteria for Chromium

Toxicity criteria are available for different forms of chromium, which is considered more toxic in the hexavalent state. The following table compares the maximum total chromium concentrations reported for SWMU 25 to available USEPA RSLs:

Environmental Medium (Maximum Concentration)	USEPA RSL Residential Scenario (Assuming Hexavalent Chromium)	USEPA RSL - Residential Scenario (Assuming Trivalent Chromium)
Surface soil: 29 mg/kg	0.29 mg/kg	120,000 mg/kg
Subsurface soil: 26 mg/kg (< background value)		
Groundwater: 85.4 µg/L (for unfiltered metals)	0.031 µg/L	16,000 µg/L

No hexavalent chromium data are available for SWMU 25 for either soil or groundwater. Therefore, toxicity criteria for hexavalent chromium were conservatively used for total chromium, and risks calculated for chromium are likely overestimated. Chromium was selected as a COPC for surface soil and groundwater. However, chromium was not a primary risk driver in soil for any receptor. Therefore, the conclusions of the HHRA are not affected by assuming total chromium in soil is present in the hexavalent form. Chromium in groundwater was found to be a primary carcinogenic risk driver for residents. Although as discussed in Section 3.0, it is very unlikely hexavalent chromium is present in soil and groundwater at the site. Regardless of the toxicity criteria used for chromium in groundwater, the medium-specific ILCRs for child, adult, and lifelong residents under both the RME and CTE scenarios would still exceed USEPA's target risk range. Therefore, although the risk estimates for chromium are likely overestimated by assuming all chromium is present in the hexavalent state, risk assessment conclusions are not affected by this assumption.

7.5.4 Uncertainty in the Risk Characterization

Uncertainty in risk characterization resulted from assumptions made regarding additivity of effects from exposure to multiple COPCs from various exposure routes. High uncertainty exists when summing noncancer risks for several substances across different exposure pathways. This assumes that each substance has a similar effect and/or mode of action. Even when compounds affect the same target organs, they may have different mechanisms of action or differ in their fate in the body, so additivity may not have been an appropriate assumption. However, the assumption of additivity was considered acceptable because in most cases it represented a conservative estimate of risk.

Risks to any individual may also have been overestimated by summing multiple assumed exposure pathway risks for any single receptor. Although every effort was made to develop reasonable scenarios, not all individual receptors may have been exposed via all pathways considered.

Additionally, the risk characterization did not consider antagonistic or synergistic effects. Little or no information was available to determine the potential for antagonism or synergism for COPCs. Because chemical-specific interactions could not be predicted, the likelihood for risks to be over-predicted or under-predicted could not be defined, but the methodology used was based on current USEPA guidance.

7.6 SUMMARY AND CONCLUSIONS

This section summarizes the results of the baseline HHRA for SWMU 25, which characterized the potential risks to likely human receptors under current and potential future land use. Potential receptors under current and future land use are industrial workers, construction workers, and adolescent trespassers. Potential receptors under future land use are hypothetical child and adult residents. Although future land use is likely to be the same as current land use, the potential future receptors were evaluated in the baseline HHRA primarily for decision-making purposes.

The following COPCs were selected for direct contact:

- Surface soil – arsenic, chromium, iron, and benzo(a)pyrene.
- Subsurface soil – arsenic, cobalt, iron, and manganese.
- Groundwater – aluminum, arsenic, cadmium, chromium, cobalt, iron, manganese, nickel, thallium, vanadium, and naphthalene.

The following COPCs were selected for migration from soil to groundwater:

- Surface soil – arsenic, chromium, and iron.

- Subsurface soil – arsenic, cobalt, iron, manganese.

No COPCs were selected for groundwater for vapor intrusion.

Quantitative estimates of noncarcinogenic and carcinogenic risks (HIs and ILCRs, respectively) were developed for potential human receptors. Under the RME scenario, the medium-specific HI for subsurface soil estimated for construction workers exceeded unity (1) because of manganese (HQ = 2) via the inhalation pathway; however, considerable uncertainty is associated with the RfC used for manganese for the construction worker. Medium-specific HIs for groundwater exceeded 1 for both child and adult residents; the medium-specific HIs were 141 and 41, respectively. Metals were the primary contributors to target organ-specific HIs exceeding 1 for residential receptors. HIs were less than or equal to 1 on a target organ-specific basis for all other media/receptors evaluated.

Under the CTE scenario, the medium-specific HIs for groundwater exceeded 1 for both child and adult residents; the medium-specific HIs were 93 and 27, respectively. Metals were the primary contributors to target organ-specific His exceeding 1 for residential receptors. HIs were less than or equal to 1 on a target organ-specific basis for all other media/receptors evaluated.

Under the RME scenario, ILCRs for all receptors exposed to surface soil and subsurface soil and for construction workers exposed to groundwater were less than or within USEPA's and IDEM's target risk range of $1x10^{-6}$ to $1x10^{-4}$. However, ILCRs for child, adult, and lifelong residents exposed to groundwater exceeded the target risk range: medium-specific ILCRs for these receptors were $3x10^{-3}$, $2x10^{-3}$, and $5x10^{-3}$, respectively. The primary risk contributors for residents exposed to groundwater were arsenic and chromium.

Under the CTE scenario, ILCRs for all receptors exposed to surface soil and subsurface soil and for construction workers exposed to groundwater were less than or within USEPA's and IDEM's target risk range of $1x10^{-6}$ to $1x\ 0^{-4}$. However, ILCRs for child, adult, and lifelong residents exposed to groundwater exceeded the target risk range: medium-specific ILCRs for these receptors were $2x10^{-3}$, $3x10^{-4}$, and $2x10^{-3}$, respectively. The primary risk contributors for residents exposed to groundwater were arsenic and chromium.

TABLE 7-1

HUMAN HEALTH SCREENING CRITERIA FOR SOIL
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

CAS Number	Chemical	USEPA Regional Screening Levels[1]		Indiana Department of Environmental Management[2]	
		Adjusted Residential Soil RSL	Groundwater Protection SSL	Soil Direct	Migration to Groundwater
Metals (mg/kg)					
7429-90-5	Aluminum	7,700 N	460,000	100,000 L	480,000 N
7440-38-2	Arsenic	0.39 C	0.026	5.5 C	5.9 M
7440-39-3	Barium	1,500 N	2,400	21,000 M	1,700 N
7440-41-7	Beryllium	16 N	260	220 N	63 M
7440-43-9	Cadmium	7 N	10.4	98 N	7.5 M
7440-47-3	Chromium	0.29 C[3]	0.0118 [3]	4.1 C[3]	0.12 C[3]
7440-48-4	Cobalt	2.3 N	4.2	32 N	4.3 N
7440-50-8	Copper	310 N	440	4,300 N	920 M
7439-89-6	Iron	5,500 N	5,400	77,000 N	5,600 N
7439-92-1	Lead	400	280 [4]	400 N	270 M
7439-96-5	Manganese	180 N	420	2,500 N	420 N
7439-97-6	Mercury	2.3 N[5]	0.66	32 N	2.1 M
7440-02-0	Nickel	150 N	400	2,100 N	390 N
7782-49-2	Selenium	39 N	8.0	550 N	5.3 M
7440-22-4	Silver	39 N	12	550 N	12 N
7440-28-0	Thallium	0.078 N	0.22	1.1 N	2.9 M
7440-62-2	Vanadium	39 N	1,560	550 N	1,600 N
7440-66-6	Zinc	2,300 N	5,800	32,000 N	5,900 N
Semivolatile Organic Compounds (ug/kg)					
208-96-8	Acenaphthylene	340,000 N[6]	82,000 [6]	4,800,000 N	82,000 N
120-12-7	Anthracene	1,700,000 N	840,000	24,000,000 N	860,000 N
56-55-3	Benzo(a)anthracene	150 C	200	2,100 C	2,100 C
50-32-8	Benzo(a)pyrene	15 C	70	210 C	4,700 M
205-99-2	Benzo(b)fluoranthene	150 C	700	2,100 C	7,000 C
191-24-2	Benzo(g,h,i)perylene	170,000 N[7]	190,000 [7]	NA	NA
207-08-9	Benzo(k)fluoranthene	1,500 C	7,000	21,000 C	68,000 C
117-81-7	Bis(2-ethylhexyl)phthalate	35,000 C	22,000	490,000 C	29,000 M
85-68-7	Butyl Benzyl Phthalate	260,000 C	4,000	3,600,000 N	41,000 C
86-74-8	Carbazole	NA	NA	NA	NA
218-01-9	Chrysene	15,000 C	22,000	210,000 C	210,000 C
84-66-2	Diethyl Phthalate	4,900,000 N	94,000	69,000,000 N	90,000 N
84-74-2	Di-n-butyl Phthalate	610,000 N	34,000	8,500,000 N	34,000 N
206-44-0	Fluoranthene	230,000 N	1,400,000	3,200,000 N	1,400,000 N
193-39-5	Indeno(1,2,3-cd)pyrene	150 C	4,000	2,100 C	40,000 C
85-01-8	Phenanthrene	170,000 N[7]	190,000 [7]	NA	NA
129-00-0	Pyrene	170,000 N	190,000	2,400,000 N	190,000 N

Notes:
1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1. Soil screening levels (SSLs) for groundwater protection are risk-based SSLs multiplied by 20 to represent a dilution attenuation factor (DAF) of 20.
2 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
3 - Value is for hexavalent chromium.
4 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.
5 - Value is for mercuric chloride (and other mercury salts).
6 - Value is for acenaphthene.
7 - Value is for pyrene.

C = Carcinogenic.
CAS = Chemical Abstracts Service.
L = Capped at 100,000 mg/kg (soil direct contact only).
M = Based on MCL (migration to ground water).
MCL = Maximum Contaminant Level.
mg/kg = Milligram per kilogram.
N = Noncarcinogenic.
R = Capped at 1,000,000 mg/kg (migration to ground water only).
S = Soil saturation concentration.
SSL = Soil screening level.
ug/kg = Microgram per kilogram.
USEPA = United States Environmental Protection Agency

TABLE 7-2

HUMAN HEALTH SCREENING CRITERIA FOR GROUNDWATER
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

CAS Number	Chemical	Adjusted USEPA RSL - Tap Water[1]	USEPA MCL[2]	IDEM Groundwater Residential[3]	USEPA Groundwater Volatilization Criterion[4]	IDEM Vapor Exposure Residential[3]
Inorganics (ug/L)						
7429-90-5	Aluminum	1,600 N	NA	16,000 N	NA	NA
7440-38-2	Arsenic	0.045 C	10	10 M	NA	NA
7440-39-3	Barium	290 N	2,000	2,000 M	NA	NA
7440-41-7	Beryllium	1.6 N	4	4 M	NA	NA
7440-43-9	Cadmium	0.69 N	5	5 M	NA	NA
7440-70-2	Calcium	NA	NA	NA	NA	NA
7440-47-3	Chromium	0.031 C[5]	100	0.31 C[5]	NA	NA
7440-48-4	Cobalt	0.47 N	NA	4.7 N	NA	NA
7440-50-8	Copper	62 N	1,300	1,300 N	NA	NA
7439-89-6	Iron	1,100 N	NA	11,000 N	NA	NA
7439-92-1	Lead	NA	15	15 M	NA	NA
7439-95-4	Magnesium	NA	NA	NA	NA	NA
7439-96-5	Manganese	32 N	NA	320 N	NA	NA
7440-02-0	Nickel	30 N	NA	300 N	NA	NA
7440-09-7	Potassium	NA	NA	NA	NA	NA
7440-23-5	Sodium	NA	NA	NA	NA	NA
7440-28-0	Thallium	0.016 N	2	2 M	NA	NA
7440-62-2	Vanadium	7.8 N	NA	78 N	NA	NA
7440-66-6	Zinc	470 N	NA	4,700 N	NA	NA
Semivolatile Organic Compounds (ug/L)						
91-57-6	2-Methylnaphthalene	2.7 N	NA	27 N	NA	NA
117-81-7	Bis(2-ethylhexyl)phthalate	4.8 C	6	6 M	NA	NA
91-20-3	Naphthalene	0.14 C	NA	1.4 C	4.0 C	91 C

Notes:
1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
2 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, April 2012).
3 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
4 - USEPA Vapor Intrusion Screening Level (VISL) Calculator, Version 3.0. November 2012 RSLs. Values correspond to a target cancer risk level of 1E-6 or HI = 0.1 and an attenuation factor of 0.001.
5 - Value is for hexavalent chromium.

C = Carcinogenic.
CAS = Chemical Abstracts Service.
M = Set to maximum contaminant limit (MCL; ground water only).
MCL = Maximum Contaminant Level.
N = Noncarcinogenic.
ug/L = Microgram per liter.
USEPA = United States Environmental Protection Agency.

TABLE 7-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	Adjusted USEPA RSL - Residential Soil[4]	IDEM Residential Direct Contact[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
SWMU 25	**Metals**													
	7429-90-5	Aluminum	5,200,000 J	20,000,000 J	ug/kg	25SS0010002	11/11	-	20,000,000	22,800,000	**7,700,000 N**	100,000,000 L	No	BKG
	7440-38-2	**Arsenic**	4,200 J	24,000	ug/kg	25SS0100002	11/11	-	24,000	**10,600**	**390 C**	**5,500 C**	**Yes**	ASL
	7440-39-3	Barium	28,000 J	87,000 J	ug/kg	25SS0010002	11/11	-	87,000	262,000	1,500,000 N	21,000,000 M	No	BSL, BKG
	7440-41-7	Beryllium	340 J	820	ug/kg	25SS0050002	10/11	360 - 360	820	1,030	16,000 N	220,000 N	No	BSL, BKG
	7440-43-9	Cadmium	310	760	ug/kg	25SS0050002	9/11	230 - 240	760	NA	7,000 N	98,000 N	No	BSL
	7440-47-3	**Chromium**	7,900	29,000	ug/kg	25SS0050002	11/11	-	29,000	**22,200**	**290 C[7]**	**4,100 C[7]**	**Yes**	ASL
	7440-48-4	Cobalt	1,900 J	21,000	ug/kg	25SS0110002	11/11	-	21,000	27,400	**2,300 N**	32,000 N	No	BKG
	7440-50-8	Copper	9,100	18,000	ug/kg	25SS0010002	11/11	-	18,000	**17,700**	310,000 N	4,300,000 N	No	BSL
	7439-89-6	**Iron**	8,200,000 J	63,000,000	ug/kg	25SS0090002	11/11	-	63,000,000	**27,100,000**	**5,500,000 N**	77,000,000 N	**Yes**	ASL
	7439-92-1	Lead	6,400	53,000	ug/kg	25SS0050002	11/11	-	53,000	**23,000**	400,000	400,000 N	No	BSL
	7439-96-5	Manganese	110,000 J	1,600,000	ug/kg	25SS0110002	11/11	-	1,600,000	5,450,000	**180,000 N**	2,500,000 N	No	BKG
	7439-97-6	Mercury	6 J	56	ug/kg	25SS0010002	11/11	-	56	108	2,300 N[8]	32,000 N	No	BSL, BKG
	7440-02-0	Nickel	7,100	24,000	ug/kg	25SS0110002	11/11	-	24,000	26,200	150,000 N	2,100,000 N	No	BSL, BKG
	7782-49-2	Selenium	570 J	1,400 J	ug/kg	25SS0090002	3/11	370 - 750	1,400	NA	39,000 N	550,000 N	No	BSL
	7440-22-4	Silver	20 J	120 J	ug/kg	25SS0050002	11/11	-	120	**105**	39,000 N	550,000 N	No	BSL
	7440-28-0	Thallium	110 J	300 J	ug/kg	25SS0010002, 25SS0080002	11/11	-	300	412	**78 N**	1,100 N	No	BKG
	7440-62-2	Vanadium	7,900	40,000	ug/kg	25SS0080002	11/11	-	40,000	49,700	**39,000 N**	550,000 N	No	BKG
	7440-66-6	Zinc	24,000 J	81,000 J	ug/kg	25SS0050002	11/11	-	81,000	135,000	2,300,000 N	32,000,000 N	No	BSL, BKG
	Semivolatile Organic Compounds													
	208-96-8	Acenaphthylene	12 J	30 J	ug/kg	25SS0030002	3/11	7.7 - 20	30	NA	340,000 N[9]	4,800,000 N	No	BSL
	120-12-7	Anthracene	10	12	ug/kg	25SS0050002	2/11	7.7 - 15	12	NA	1,700,000 N	24,000,000 N	No	BSL
	56-55-3	Benzo(a)anthracene	13	42	ug/kg	25SS0030002	5/11	19 - 20	42	NA	150 C	2,100 C	No	BSL
	50-32-8	**Benzo(a)pyrene**	16	55	ug/kg	25SS0030002	5/11	7.7 - 20	55	NA	**15 C**	210 C	**Yes**	ASL
	205-99-2	Benzo(b)fluoranthene	19	64	ug/kg	25SS0070002	5/11	7.7 - 20	64	NA	150 C	2,100 C	No	BSL
	191-24-2	Benzo(g,h,i)perylene	13	53	ug/kg	25SS0070002	5/11	7.7 - 8.2	53	NA	170,000 N[10]	NA	No	BSL
	207-08-9	Benzo(k)fluoranthene	13 J	32	ug/kg	25SS0030002, 25SS0070002	4/11	7.7 - 20	32	NA	1,500 C	21,000 C	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	14 J	35 J	ug/kg	25SS0070002	4/11	19 - 39	35	NA	35,000 C	490,000 C	No	BSL
	85-68-7	Butyl Benzyl Phthalate	8 J	8 J	ug/kg	25SS0050002	1/11	8 - 39	8	NA	260,000 C	3,600,000 N	No	BSL
	86-74-8	Carbazole	8 J	8 J	ug/kg	25SS0050002	1/11	19 - 99	8	NA	NA	NA	No	BSL
	218-01-9	Chrysene	13	44	ug/kg	25SS0030002	5/11	7.7 - 8.2	44	NA	15,000 C	210,000 C	No	BSL
	84-66-2	Diethyl Phthalate	8 J	8 J	ug/kg	25SS0050002	1/11	19 - 39	8	NA	4,900,000 N	69,000,000 N	No	BSL
	84-74-2	di-n-Butyl Phthalate	11 J	11 J	ug/kg	25SS0050002	1/11	19 - 39	11	NA	610,000 N	8,500,000 N	No	BSL
	206-44-0	Fluoranthene	11	52	ug/kg	25SS0070002	5/11	7.7 - 20	52	NA	230,000 N	3,200,000 N	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	18	38	ug/kg	25SS0070002	3/11	7.7 - 40	38	NA	150 C	2,100 C	No	BSL
	85-01-8	Phenanthrene	15	25	ug/kg	25SS0070002	4/11	7.7 - 20	25	NA	170,000 N[10]	NA	No	BSL
	129-00-0	Pyrene	12	55	ug/kg	25SS0070002	5/11	7.7 - 20	55	NA	170,000 N	2,400,000 N	No	BSL

TABLE 7-3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - 95% Upper Tolerance Limit (UTL) for Group 1 Soil. Tetra Tech, 2001: Final Base-Wide Background Soil Investigation Report for NSWC Crane.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is greater than background.
7 - Value is for hexavalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).
9 - Value is for acenaphthene.
10 - Value is for pyrene.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25SS0010002
25SS0020002
25SS0030002
25SS0040002
25SS0050002
25SS0060002
25SS0070002
25SS0080002
25SS0090002
25SS0100002
25SS0110002

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000 mg/kg (soil direct contact only).
M = Based on MCL (migration to ground water).
N = Noncarcinogen
NA = Not Applicable/Not Available
ug/kg = Microgram per kilogram

Rationale Codes:

For selection as a COPC:
ASL = Above Screening Level and background

For elimination as a COPC:
BKG = Less than background concentration
BSL = Below COPC Screening Level

TABLE 7-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	USEPA SSL - Groundwater Protection[4]	IDEM Migration to Groundwater[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
SWMU 25	**Metals**													
	7429-90-5	Aluminum	5,200,000 J	20,000,000 J	ug/kg	25SS0010002	11/11	-	20,000,000	22,800,000	460,000,000	480,000,000 N	No	BSL, BKG
	7440-38-2	**Arsenic**	4,200 J	24,000	ug/kg	25SS0100002	11/11	-	24,000	**10,600**	**26**	**5,900 M**	**Yes**	ASL
	7440-39-3	Barium	28,000 J	87,000 J	ug/kg	25SS0010002	11/11	-	87,000	262,000	2,400,000	1,700,000 N	No	BSL, BKG
	7440-41-7	Beryllium	340 J	820	ug/kg	25SS0050002	10/11	360 - 360	820	1,030	260,000	63,000 M	No	BSL, BKG
	7440-43-9	Cadmium	310	760	ug/kg	25SS0050002	9/11	230 - 240	760	NA	10,400	7,500 M	No	BSL
	7440-47-3	**Chromium**	7,900	29,000	ug/kg	25SS0050002	11/11	-	29,000	**22,200**	**11.8 [7]**	**120 C[7]**	**Yes**	ASL
	7440-48-4	Cobalt	1,900 J	21,000	ug/kg	25SS0110002	11/11	-	21,000	27,400	**4,200**	**4,300 N**	No	BKG
	7440-50-8	Copper	9,100	18,000	ug/kg	25SS0010002	11/11	-	18,000	**17,700**	440,000	920,000 M	No	BSL
	7439-89-6	**Iron**	8,200,000 J	63,000,000	ug/kg	25SS0090002	11/11	-	63,000,000	**27,100,000**	**5,400,000**	**5,600,000 N**	**Yes**	ASL
	7439-92-1	Lead	6,400	53,000	ug/kg	25SS0050002	11/11	-	53,000	**23,000**	280,000 [8]	270,000 M	No	BSL
	7439-96-5	Manganese	110,000 J	1,600,000	ug/kg	25SS0110002	11/11	-	1,600,000	5,450,000	**420,000**	**420,000 N**	No	BKG
	7439-97-6	Mercury	6 J	56	ug/kg	25SS0010002	11/11	-	56	108	660	2,100 M	No	BSL, BKG
	7440-02-0	Nickel	7,100	24,000	ug/kg	25SS0110002	11/11	-	24,000	26,200	400,000	390,000 N	No	BSL, BKG
	7782-49-2	Selenium	570 J	1,400 J	ug/kg	25SS0090002	3/11	370 - 750	1,400	NA	8,000	5,300 M	No	BSL
	7440-22-4	Silver	20 J	120 J	ug/kg	25SS0050002	11/11	-	120	**105**	12,000	12,000 N	No	BSL
	7440-28-0	Thallium	110 J	300 J	ug/kg	25SS0010002, 25SS0080002	11/11	-	300	412	**220**	2,900 M	No	BKG
	7440-62-2	Vanadium	7,900	40,000	ug/kg	25SS0080002	11/11	-	40,000	49,700	1,560,000	1,600,000 N	No	BSL, BKG
	7440-66-6	Zinc	24,000 J	81,000 J	ug/kg	25SS0050002	11/11	-	81,000	135,000	5,800,000	5,900,000 N	No	BSL, BKG
	Semivolatile Organic Compounds													
	208-96-8	Acenaphthylene	12 J	30 J	ug/kg	25SS0030002	3/11	7.7 - 20	30	NA	82,000 [9]	82,000 N	No	BSL
	120-12-7	Anthracene	10	12	ug/kg	25SS0050002	2/11	7.7 - 15	12	NA	840,000	860,000 N	No	BSL
	56-55-3	Benzo(a)anthracene	13	42	ug/kg	25SS0030002	5/11	19 - 20	42	NA	200	2,100 C	No	BSL
	50-32-8	Benzo(a)pyrene	16	55	ug/kg	25SS0030002	5/11	7.7 - 20	55	NA	70	4,700 M	No	BSL
	205-99-2	Benzo(b)fluoranthene	19	64	ug/kg	25SS0070002	5/11	7.7 - 20	64	NA	700	7,000 C	No	BSL
	191-24-2	Benzo(g,h,i)perylene	13	53	ug/kg	25SS0070002	5/11	7.7 - 8.2	53	NA	190,000 [10]	NA	No	BSL
	207-08-9	Benzo(k)fluoranthene	13 J	32	ug/kg	25SS0030002, 25SS0070002	4/11	7.7 - 20	32	NA	7,000	68,000 C	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	14 J	35 J	ug/kg	25SS0070002	4/11	19 - 39	35	NA	22,000	29,000 M	No	BSL
	85-68-7	Butyl Benzyl Phthalate	8 J	8 J	ug/kg	25SS0050002	1/11	8 - 39	8	NA	4,000	41,000 C	No	BSL
	86-74-8	Carbazole	8 J	8 J	ug/kg	25SS0050002	1/11	19 - 99	8	NA	NA	NA	No	BSL
	218-01-9	Chrysene	13	44	ug/kg	25SS0030002	5/11	7.7 - 8.2	44	NA	22,000	210,000 C	No	BSL
	84-66-2	Diethyl Phthalate	8 J	8 J	ug/kg	25SS0050002	1/11	19 - 39	8	NA	94,000	90,000 N	No	BSL
	84-74-2	di-n-Butyl Phthalate	11 J	11 J	ug/kg	25SS0050002	1/11	19 - 39	11	NA	34,000	34,000 N	No	BSL
	206-44-0	Fluoranthene	11	52	ug/kg	25SS0070002	5/11	7.7 - 20	52	NA	1,400,000	1,400,000 N	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	18	38	ug/kg	25SS0070002	3/11	7.7 - 40	38	NA	4,000	40,000 C	No	BSL
	85-01-8	Phenanthrene	15	25	ug/kg	25SS0070002	4/11	7.7 - 20	25	NA	190,000 [10]	NA	No	BSL
	129-00-0	Pyrene	12	55	ug/kg	25SS0070002	5/11	7.7 - 20	55	NA	190,000	190,000 N	No	BSL

TABLE 7-4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - 95% Upper Tolerance Limit (UTL) for Group 1 Soil. Tetra Tech, 2001: Final Base-Wide Background Soil Investigation Report for NSWC Crane.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. Soil screening levels (SSLs) for groundwater protection are risk-based SSLs multiplied by 20 to represent a dilution attenuation factor (DAF) of 20.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is greater than background.
7 - Value is for hexavalent chromium.
8 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.
9 - Value is for acenaphthene.
10 - Value is for pyrene.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25SS0010002
25SS0020002
25SS0030002
25SS0040002
25SS0050002
25SS0060002
25SS0070002
25SS0080002
25SS0090002
25SS0100002
25SS0110002

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
M = Based on MCL (migration to ground water).
N = Noncarcinogen
NA = Not Applicable/Not Available
R = Capped at 1,000,000 mg/kg (migration to ground water only).
ug/kg = Microgram per kilogram

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and background

For elimination as a COPC:
BKG = Less than background concentration
BSL = Below COPC Screening Level

TABLE 7-5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(2)	Background Value(3)	Adjusted USEPA RSL - Residential Soil(4)	IDEM Residential Direct Contact(5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
SWMU 25	**Metals**													
	7429-90-5	Aluminum	4,700,000 J	12,000,000 J	ug/kg	25SB0040206	11/11	-	12,000,000	20,600,000	**7,700,000 N**	100,000,000 L	No	BKG
	7440-38-2	**Arsenic**	1,600	14,000 J	ug/kg	25SB0050206, 25SB0070206	11/11	-	14,000	**12,500**	**390 C**	**5,500 C**	**Yes**	ASL
	7440-39-3	Barium	19,000 J	380,000 J	ug/kg	25SB0070610	11/11	-	380,000	**115,000**	1,500,000 N	21,000,000 M	No	BSL
	7440-41-7	Beryllium	390	1,800	ug/kg	25SB0070610	9/11	370 - 400	1,800	NA	16,000 N	220,000 N	No	BSL
	7440-43-9	Cadmium	230	380	ug/kg	25SB0080206	4/11	150 - 270	380	829	7,000 N	98,000 N	No	BSL, BKG
	7440-47-3	Chromium	4,700	26,000	ug/kg	25SB0070610	11/11	-	26,000	33,000	**290 C(7)**	**4,100 C(7)**	No	BKG
	7440-48-4	**Cobalt**	1,000 J	23,000 J	ug/kg	25SB0070610	11/11	-	23,000	**21,200**	**2,300 N**	32,000 N	**Yes**	ASL
	7440-50-8	Copper	5,900	23,000	ug/kg	25SB0070610	11/11	-	23,000	33,300	310,000 N	4,300,000 N	No	BSL, BKG
	7439-89-6	**Iron**	6,200,000 J	130,000,000 J	ug/kg	25SB0070610	11/11	-	130,000,000	**60,200,000**	**5,500,000 N**	**77,000,000 N**	**Yes**	ASL
	7439-92-1	Lead	6,200	54,000	ug/kg	25SB0070610	11/11	-	54,000	**19,600**	400,000	400,000 N	No	BSL
	7439-96-5	**Manganese**	82,000 J	2,600,000 J	ug/kg	25SB0070610	11/11	-	2,600,000	**704,000**	**180,000 N**	**2,500,000 N**	**Yes**	ASL
	7439-97-6	Mercury	9 J	39 J	ug/kg	25SB0040206	10/11	12 - 12	39	178	2,300 N(8)	32,000 N	No	BSL, BKG
	7440-02-0	Nickel	4,700	52,000	ug/kg	25SB0070610	11/11	-	52,000	**29,600**	150,000 N	2,100,000 N	No	BSL
	7782-49-2	Selenium	420 J	420 J	ug/kg	25SB0080610	1/11	370 - 870	420	1,070	39,000 N	550,000 N	No	BSL, BKG
	7440-22-4	Silver	26 J	120 J	ug/kg	25SB0070610	10/11	73 - 73	120	143	39,000 N	550,000 N	No	BSL, BKG
	7440-28-0	Thallium	86 J	270 J	ug/kg	25SB0070610	10/11	93 - 93	270	332	**78 N**	1,100 N	No	BKG
	7440-62-2	Vanadium	3,400	29,000	ug/kg	25SB0070206	11/11	-	29,000	69,100	39,000 N	550,000 N	No	BSL, BKG
	7440-66-6	Zinc	12,000 J	110,000 J	ug/kg	25SB0070610	11/11	-	110,000	**83,300**	2,300,000 N	32,000,000 N	No	BSL
	Semivolatile Organic Compounds													
	56-55-3	Benzo(a)anthracene	8	8	ug/kg	25SB0050206	1/11	18 - 21	8	NA	150 C	2,100 C	No	BSL
	50-32-8	Benzo(a)pyrene	10	10	ug/kg	25SB0050206	1/11	7.4 - 8.5	10	NA	15 C	210 C	No	BSL
	205-99-2	Benzo(b)fluoranthene	12	12	ug/kg	25SB0050206	1/11	7.4 - 8.5	12	NA	150 C	2,100 C	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	19 J	300 J	ug/kg	25SB0050206	4/11	18 - 21	300	NA	35,000 C	490,000 C	No	BSL
	84-66-2	Diethyl Phthalate	16 J	16 J	ug/kg	25SB0010206	1/11	18 - 21	16	NA	4,900,000 N	69,000,000 N	No	BSL

TABLE 7-5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - 95% Upper Tolerance Limit (UTL) for Group 8 Soil. Tetra Tech, 2001: Final Base-Wide Background Soil Investigation Report for NSWC Crane.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is greater than background.
7 - Value is for hexavalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25SB0010206
25SB0030206
25SB0040206
25SB0040610
25SB0050206
25SB0060206
25SB0060610
25SB0070206
25SB0070610
25SB0080206
25SB0080610

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000 mg/kg (soil direct contact only).
N = Noncarcinogen
NA = Not Applicable/Not Available
ug/kg = Microgram per kilogram

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and background

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 7-6

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SUBSURFACE SOIL TO GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	USEPA SSL - Groundwater Protection[4]	IDEM Migration to Groundwater[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
SWMU 25	**Metals**													
	7429-90-5	Aluminum	4,700,000 J	12,000,000 J	ug/kg	25SB0040206	11/11	-	12,000,000	20,600,000	460,000,000	480,000,000 N	No	BSL, BKG
	7440-38-2	**Arsenic**	1,600	14,000 J	ug/kg	25SB0050206, 25SB0070206	11/11	-	14,000	**12,500**	**26**	**5,900 M**	**Yes**	ASL
	7440-39-3	Barium	19,000 J	380,000 J	ug/kg	25SB0070610	11/11	-	380,000	**115,000**	2,400,000	1,700,000 N	No	BSL
	7440-41-7	Beryllium	390	1,800	ug/kg	25SB0070610	9/11	370 - 400	1,800	NA	260,000	63,000 M	No	BSL
	7440-43-9	Cadmium	230	380	ug/kg	25SB0080206	4/11	150 - 270	380	829	10,400	7,500 M	No	BSL, BKG
	7440-47-3	Chromium	4,700	26,000	ug/kg	25SB0070610	11/11	-	26,000	33,000	**11.8 [7]**	**120 C[7]**	No	BKG
	7440-48-4	**Cobalt**	1,000 J	23,000 J	ug/kg	25SB0070610	11/11	-	23,000	**21,200**	**4,200**	**4,300 N**	**Yes**	ASL
	7440-50-8	Copper	5,900	23,000	ug/kg	25SB0070610	11/11	-	23,000	33,300	440,000	920,000 M	No	BSL, BKG
	7439-89-6	**Iron**	6,200,000 J	130,000,000 J	ug/kg	25SB0070610	11/11	-	130,000,000	**60,200,000**	**5,400,000**	**5,600,000 N**	**Yes**	ASL
	7439-92-1	Lead	6,200	54,000	ug/kg	25SB0070610	11/11	-	54,000	**19,600**	280,000 [8]	270,000 M	No	BSL
	7439-96-5	**Manganese**	82,000 J	2,600,000 J	ug/kg	25SB0070610	11/11	-	2,600,000	**704,000**	**420,000**	**420,000 N**	**Yes**	ASL
	7439-97-6	Mercury	9 J	39 J	ug/kg	25SB0040206	10/11	12 - 12	39	178	660	2,100 M	No	BSL, BKG
	7440-02-0	Nickel	4,700	52,000	ug/kg	25SB0070610	11/11	-	52,000	**29,600**	400,000	390,000 N	No	BSL
	7782-49-2	Selenium	420 J	420 J	ug/kg	25SB0080610	1/11	370 - 870	420	1,070	8,000	5,300 M	No	BSL, BKG
	7440-22-4	Silver	26 J	120 J	ug/kg	25SB0070610	10/11	73 - 73	120	143	12,000	12,000 N	No	BSL, BKG
	7440-28-0	Thallium	86 J	270 J	ug/kg	25SB0070610	10/11	93 - 93	270	332	**220**	2,900 M	No	BKG
	7440-62-2	Vanadium	3,400	29,000	ug/kg	25SB0070206	11/11	-	29,000	69,100	1,560,000	1,600,000 N	No	BSL, BKG
	7440-66-6	Zinc	12,000 J	110,000 J	ug/kg	25SB0070610	11/11	-	110,000	**83,300**	5,800,000	5,900,000 N	No	BSL
	Semivolatile Organic Compounds													
	56-55-3	Benzo(a)anthracene	8	8	ug/kg	25SB0050206	1/11	18 - 21	8	NA	200	19,000 C	No	BSL
	50-32-8	Benzo(a)pyrene	10	10	ug/kg	25SB0050206	1/11	7.4 - 8.5	10	NA	70	8,200 M	No	BSL
	205-99-2	Benzo(b)fluoranthene	12	12	ug/kg	25SB0050206	1/11	7.4 - 8.5	12	NA	700	57,000 C	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	19 J	300 J	ug/kg	25SB0050206	4/11	18 - 21	300	NA	22,000	3,600,000 M	No	BSL
	84-66-2	Diethyl Phthalate	16 J	16 J	ug/kg	25SB0010206	1/11	18 - 21	16	NA	94,000	450,000 N	No	BSL

TABLE 7-6

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SUBSURFACE SOIL TO GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - 95% Upper Tolerance Limit (UTL) for Group 8 Soil. Tetra Tech, 2001: Final Base-Wide Background Soil Investigation Report for NSWC Crane.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. Soil screening levels (SSLs) for groundwater protection are risk-based SSLs multiplied by 20 to represent a dilution attenuation factor (DAF) of 20.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is greater than background.
7 - Value is for hexavalent chromium.
8 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25SB0010206
25SB0030206
25SB0040206
25SB0040610
25SB0050206
25SB0060206
25SB0060610
25SB0070206
25SB0070610
25SB0080206
25SB0080610

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
M = Based on MCL (migration to ground water).
N = Noncarcinogen
NA = Not Applicable/Not Available
R = Capped at 1,000,000 mg/kg (migration to ground water only).
ug/kg = Microgram per kilogram

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and background

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 7-7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	Adjusted USEPA RSL - Tap Water[4]	USEPA MCL[5]	IDEM Groundwater Residential[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
SWMU 25	**Metals**														
	7429-90-5	**Aluminum**	39 J	5,630	ug/L	25MW738102	5/5	-	5,630	**262**	**1,600 N**	NA	16,000 N	**Yes**	ASL
	7440-38-2	**Arsenic**	2	127	ug/L	25MW728102	4/5	1.5	127	**ND**	**0.045 C**	**10**	**10 M**	**Yes**	ASL
	7440-39-3	Barium	9.3 J	110	ug/L	25GW738101	5/5	-	110	138	290 N	2,000	2,000 M	No	BSL, BKG
	7440-41-7	Beryllium	0.329 J	0.873 J	ug/L	25MW728102	2/5	0.2-0.5	0.873	**ND**	1.6 N	4	4 M	No	BSL
	7440-43-9	**Cadmium**	0.46	1.09 J	ug/L	25MW728102	2/5	0.24-0.5	1.09	**ND**	**0.69 N**	5	5 M	**Yes**	ASL
	7440-47-3	**Chromium**	1.8 J	85.4	ug/L	25MW738102	4/5	0.5	85.4	**1.22**	**0.031 C[8]**	100	**0.31 C[8]**	**Yes**	ASL
	7440-48-4	**Cobalt**	3.9	149	ug/L	25MW728102	5/5	-	149	**8.67**	**0.47 N**	NA	**4.7 N**	**Yes**	ASL
	7440-50-8	Copper	1.4 J	18.8	ug/L	25MW728102	4/5	2	18.8	**1.8**	62 N	1,300	1,300 N	No	BSL
	7439-89-6	**Iron**	3,300	146,000	ug/L	25MW728102	5/5	-	146,000	**5,730**	**1,100 N**	NA	**11,000 N**	**Yes**	ASL
	7439-92-1	Lead	2.4	14.5	ug/L	25MW728102	3/5	0.32-0.75	14.5	**0.97**	NA	15	15 M	No	BSL
	7439-96-5	**Manganese**	810 J	7,440	ug/L	25MW728102	5/5	-	7,440	**6,100**	**32 N**	NA	**320 N**	**Yes**	ASL
	7440-02-0	**Nickel**	9.2 J	398	ug/L	25MW728102	5/5	-	398	**54**	**30 N**	NA	**300 N**	**Yes**	ASL
	7440-28-0	**Thallium**	3.56 J	3.56 J	ug/L	25MW728102	1/5	0.2-1	3.56	**2.19**	**0.016 N**	**2**	**2 M**	**Yes**	ASL
	7440-62-2	**Vanadium**	0.27 J	31.3	ug/L	25MW738102	5/5	-	31.3	**ND**	**7.8 N**	NA	78 N	**Yes**	ASL
	7440-66-6	Zinc	7.4 J	190	ug/L	25MW728102	5/5	-	190	**72**	470 N	NA	4,700 N	No	BSL
	Dissolved Metals														
	7429-90-5	Aluminum	1.7 J	165	ug/L	25MW738102	5/5	-	165	**140**	1,600 N	NA	16,000 N	No	BSL
	7440-38-2	**Arsenic**	0.41 J	1.5 J	ug/L	25MWT1061202	3/5	1.5	1.5	**ND**	**0.045 C**	10	10 M	**Yes**	ASL
	7440-39-3	Barium	8 J	90	ug/L	25GW738101	5/5	-	90	125	290 N	2,000	2,000 M	No	BSL, BKG
	7440-70-2	Calcium	46,700	94,700	ug/L	25MW728102	3/3	-	94,700	**92,200**	NA	NA	NA	No	NUT
	7440-47-3	**Chromium**	2.6 J	3.9 J	ug/L	25GW728101	2/5	1	3.9	**ND**	**0.031 C[8]**	100	**0.31 C[8]**	**Yes**	ASL
	7440-48-4	**Cobalt**	2.4	18	ug/L	25GW728101	4/5	2.5	18	**7.84**	**0.47 N**	NA	**4.7 N**	**Yes**	ASL
	7440-50-8	Copper	0.61 J	0.91 J	ug/L	25GW728101	2/5	2	0.91	**ND**	62 N	1,300	1,300 N	No	BSL
	7439-89-6	Iron	169	2,400	ug/L	25GW728101	3/5	15-50	2,400	4,760	**1,100 N**	NA	11,000 N	No	BKG
	7439-95-4	Magnesium	10,200	26,400	ug/L	25MW728102	3/3	-	26,400	69,900	NA	NA	NA	No	NUT, BKG
	7439-96-5	Manganese	318	1,500	ug/L	25MWT1061202	5/5	-	1,500	4,630	**32 N**	NA	**320 N**	No	BKG
	7440-02-0	Nickel	6	42	ug/L	25GW728101	5/5	-	42	45.3	**30 N**	NA	300 N	No	BKG
	7440-09-7	Potassium	1,040 J	2,170	ug/L	25MWT1061202	3/3	-	2,170	5,300	NA	NA	NA	No	NUT, BKG
	7440-23-5	Sodium	11,000	23,800	ug/L	25MWT1061202	3/3	-	23,800	65,600	NA	NA	NA	No	NUT, BKG
	7440-62-2	Vanadium	0.89 J	1 J	ug/L	25GW728101	2/5	2.5	1	**ND**	7.8 N	NA	78 N	No	BSL
	7440-66-6	Zinc	2.2 J	17.5	ug/L	25MWT1061202	5/5	-	17.5	35.1	470 N	NA	4,700 N	No	BSL, BKG
	Semivolatile Organic Compounds														
	91-57-6	2-Methylnaphthalene	0.0933 J	0.0933 J	ug/L	25MWT1061202	1/5	0.098-0.2	0.0933	**ND**	2.7 N	NA	27 N	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	0.493 J	0.493 J	ug/L	25MW738102	1/5	0.5	0.493	**ND**	4.8 C	6	6 M	No	BSL
	91-20-3	**Naphthalene**	0.0545 J	0.169 J	ug/L	25MW738102	3/5	0.2	0.169	**0.084**	**0.14 C**	NA	1.4 C	**Yes**	ASL

TABLE 7-7

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - The maximum detected concentration from the upgradient well (MW2501) is presented.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
5 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, April 2012).
6 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Value is for hexavalent chromium.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25GW728101
25MW728102
25GW738101
25MW738102
25MWT1061202

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
M = Set to maximum contaminant limit (MCL).
N = Noncarcinogen
NA = Not Applicable/Not Available
ND = Not detected
ug/L = Microgram per liter

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level

For elimination as a COPC:
BKG = Less than background concentration
BSL = Below COPC Screening Level
NUT = Essential Nutrient

TABLE 7-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER VAPOR INTRUSION
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(2)	Background Value(3)	USEPA Groundwater Volatilization Criterion(4)	IDEM Vapor Exposure Residential(5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
SWMU 25	**Metals**													
	7429-90-5	Aluminum	39 J	5,630	ug/L	25MW738102	5/5	-	5,630	262	NA	NA	No	NTX
	7440-38-2	Arsenic	2	127	ug/L	25MW728102	4/5	1.5	127	ND	NA	NA	No	NTX
	7440-39-3	Barium	9.3 J	110	ug/L	25GW738101	5/5	-	110	138	NA	NA	No	NTX, BKG
	7440-41-7	Beryllium	0.329 J	0.873 J	ug/L	25MW728102	2/5	0.2-0.5	0.873	ND	NA	NA	No	NTX
	7440-43-9	Cadmium	0.46	1.09 J	ug/L	25MW728102	2/5	0.24-0.5	1.09	ND	NA	NA	No	NTX
	7440-47-3	Chromium	1.8 J	85.4	ug/L	25MW738102	4/5	0.5	85.4	1.22	NA	NA	No	NTX
	7440-48-4	Cobalt	3.9	149	ug/L	25MW728102	5/5	-	149	8.67	NA	NA	No	NTX
	7440-50-8	Copper	1.4 J	18.8	ug/L	25MW728102	4/5	2	18.8	1.8	NA	NA	No	NTX
	7439-89-6	Iron	3,300	146,000	ug/L	25MW728102	5/5	-	146,000	5,730	NA	NA	No	NTX
	7439-92-1	Lead	2.4	14.5	ug/L	25MW728102	3/5	0.32-0.75	14.5	0.97	NA	NA	No	NTX
	7439-96-5	Manganese	810 J	7,440	ug/L	25MW728102	5/5	-	7,440	6,100	NA	NA	No	NTX
	7440-02-0	Nickel	9.2 J	398	ug/L	25MW728102	5/5	-	398	54	NA	NA	No	NTX
	7440-28-0	Thallium	3.56 J	3.56 J	ug/L	25MW728102	1/5	0.2-1	3.56	2.19	NA	NA	No	NTX
	7440-62-2	Vanadium	0.27 J	31.3	ug/L	25MW738102	5/5	-	31.3	ND	NA	NA	No	NTX
	7440-66-6	Zinc	7.4 J	190	ug/L	25MW728102	5/5	-	190	72	NA	NA	No	NTX
	Dissolved Metals													
	7429-90-5	Aluminum	1.7 J	165	ug/L	25MW738102	5/5	-	165	140	NA	NA	No	NTX
	7440-38-2	Arsenic	0.41 J	1.5 J	ug/L	25MWT1061202	3/5	1.5	1.5	ND	NA	NA	No	NTX
	7440-39-3	Barium	8 J	90	ug/L	25GW738101	5/5	-	90	125	NA	NA	No	NTX, BKG
	7440-70-2	Calcium	46,700	94,700	ug/L	25MW728102	3/3	-	94,700	92,200	NA	NA	No	NTX
	7440-47-3	Chromium	2.6 J	3.9 J	ug/L	25GW728101	2/5	1	3.9	ND	NA	NA	No	NTX
	7440-48-4	Cobalt	2.4	18	ug/L	25GW728101	4/5	2.5	18	7.84	NA	NA	No	NTX
	7440-50-8	Copper	0.61 J	0.91 J	ug/L	25GW728101	2/5	2	0.91	ND	NA	NA	No	NTX
	7439-89-6	Iron	169	2,400	ug/L	25GW728101	3/5	15-50	2,400	4,760	NA	NA	No	NTX, BKG
	7439-95-4	Magnesium	10,200	26,400	ug/L	25MW728102	3/3	-	26,400	69,900	NA	NA	No	NTX, BKG
	7439-96-5	Manganese	318	1,500	ug/L	25MWT1061202	5/5	-	1,500	4,630	NA	NA	No	NTX, BKG
	7440-02-0	Nickel	6	42	ug/L	25GW728101	5/5	-	42	45.3	NA	NA	No	NTX, BKG
	7440-09-7	Potassium	1,040 J	2,170	ug/L	25MWT1061202	3/3	-	2,170	5,300	NA	NA	No	NTX, BKG
	7440-23-5	Sodium	11,000	23,800	ug/L	25MWT1061202	3/3	-	23,800	65,600	NA	NA	No	NTX, BKG
	7440-62-2	Vanadium	0.89 J	1 J	ug/L	25GW728101	2/5	2.5	1	ND	NA	NA	No	NTX
	7440-66-6	Zinc	2.2 J	17.5	ug/L	25MWT1061202	5/5	-	17.5	35.1	NA	NA	No	NTX, BKG
	Semivolatile Organic Compounds													
	91-57-6	2-Methylnaphthalene	0.0933 J	0.0933 J	ug/L	25MWT1061202	1/5	0.098-0.2	0.0933	ND	NA	NA	No	NTX
	117-81-7	Bis(2-ethylhexyl)phthalate	0.493 J	0.493 J	ug/L	25MW738102	1/5	0.5	0.493	ND	NA	NA	No	NTX
	91-20-3	Naphthalene	0.0545 J	0.169 J	ug/L	25MW738102	3/5	0.2	0.169	0.084	4.0 C	91 C	No	BSL

TABLE 7-8

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER VAPOR INTRUSION
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - The maximum detected concentration from the upgradient well (MW2501) is presented.
4 - Calculated using USEPA's Vapor Intrusion Screening Level (VISL) calculator Version 3.0 (USEPA, March 2013) and toxicity criteria from USEPA's November 2012 Regional Screening Level table. Values correspond to a target cancer risk level of 1E-06 or HQ = 0.1 and an attenuation factor of 0.001.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, July 2012).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25GW728101
25MW728102
25GW738101
25MW738102
25MWT1061202

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
NA = Not Applicable/Not Available
ug/L = Microgram per liter

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level

For elimination as a COPC:
BKG = Less than background concentration
BSL = Below COPC Screening Level
NTX = No toxicity criteria

TABLE 7-9

CHEMICALS RETAINED AS COPCs
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical	Surface Soil		Subsurface Soil		Groundwater	
	Direct Contact	Soil to Groundwater	Direct Contact	Soil to Groundwater	Direct Contact	Vapor Intrusion
Inorganics						
Aluminum					E	
Arsenic	E, I	E, I	E, I	E, I	E, I	
Cadmium					E	
Chromium[1]	E, I	E, I			E, I	
Cobalt			E	E, I	E, I	
Iron	E	E, I	E, I	E, I	E, I	
Manganese			E, I	E, I	E, I	
Nickel					E, I	
Thallium					E, I	
Vanadium					E	
Semivolatile Organic Compounds						
Benzo(a)pyrene	E					
Naphthalene					E	

1 - Chromium was evaluated using screening criteria for hexavalent chromium.

E - Chemical exceeded USEPA screening criteria and was retained as a COPC.
I - Chemical exceeded IDEM screening criteria and was retained as a COPC.

TABLE 7-10

SELECTION OF EXPOSURE PATHWAYS
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil	Surface Soil	SWMU 25	Construction Workers	Adult	Ingestion Dermal	Quant Quant	Construction workers may have contact with surface soil during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	Quant Quant	Industrial workers may contact surface soil during normal work activities.
				Trespassers	Adolescents	Ingestion Dermal	Quant Quant	Trespassers may contact surface soil while at the site.
		Air	SWMU 25	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to fugitive dust and volatile emissions from surface soil during excavation activities.
				Industrial Worker	Adult	Inhalation	Quant	Industrial workers may be exposed to fugitive dust and volatile emissions from surface soil during work activities.
				Trespassers	Adolescents	Inhalation	Quant	Adolescent trespassers may be exposed to fugitive dust and volatile emissions from surface soil while at the site.
	Subsurface Soil	Subsurface Soil	SWMU 25	Construction Workers	Adult	Ingestion Dermal	Quant Quant	Construction workers may have contact with subsurface soil during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	Quant Quant	Although exposure to subsurface soil by industrial workers is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
				Trespassers	Adolescents	Ingestion Dermal	Quant Quant	Adolescent trespassers are not expected to be exposed to subsurface soil; however, this scenario is included to aid in future risk management decisions.
		Air	SWMU 25	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to fugitive dust and volatile emissions from subsurface soil during excavation activities.
				Industrial Worker	Adult	Inhalation	Quant	Although exposure to subsurface soil by industrial workers is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
				Trespassers	Adolescents	Inhalation	Quant	Adolescent trespassers are not expected to be exposed to fugitive dust and volatile emissions from subsurface soil; however, this scenario is included to aid in future risk management decisions.
	Groundwater	Groundwater	SWMU 25	Construction Workers	Adult	Ingestion Dermal	None Quant	Construction workers may have dermal contact with groundwater during excavation activities; incidental ingestion of groundwater is not anticipated for this receptor.
				Industrial Worker	Adult	Ingestion Dermal	None None	Industrial workers are not expected to have contact with groundwater.
				Trespassers	Adolescents	Ingestion Dermal	None None	Adolescent trespassers are not expected to be exposed to groundwater.
		Air	SWMU 25	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to COPCs that volatilized from groundwater during excavation activities.
				Industrial Worker	Adult	Inhalation	None	Industrial workers are not expected to be exposed to chemicals that have volatilized from groundwater.
				Trespassers	Adolescents	Inhalation	None	Adolescent trespassers are not expected to be exposed to chemicals that have volatilized from groundwater.
			Vapor Intrusion	Industrial Worker	Adult	Inhalation	None	No COPCs were identified in groundwater for the vapor intrusion pathway.

TABLE 7-10

SELECTION OF EXPOSURE PATHWAYS
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface Soil	Surface Soil	SWMU 25	Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
		Air	SWMU 25	Residents	Child	Inhalation	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
					Adult	Inhalation	Quant	
	Subsurface Soil	Subsurface Soil	SWMU 25	Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
	Subsurface Soil	Air	SWMU 25	Residents	Child	Inhalation	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
					Adult	Inhalation	Quant	
	Groundwater	Groundwater	SWMU 25	Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
		Air	SWMU 25	Residents	Child	Inhalation	Quant	
					Adult	Inhalation	Quant	
			Vapor Intrusion	Residents	Child	Inhalation	None	No COPCs were identified in groundwater for the vapor intrusion pathway.
					Adult	Inhalation	None	

Notes:
COPC = Chemical of Potential Concern.
Quant = Quantitative.

TABLE 7-11

RECEPTORS AND EXPOSURE ROUTES FOR QUANTITATIVE EVALUATION
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptors	Exposure Routes
Construction Workers (current/future land use)	• Soil ingestion (surface and subsurface soil) • Soil dermal contact (surface and subsurface soil) • Inhalation of air/dust/emissions (surface and subsurface soil) • Groundwater dermal contact (during excavation) • Inhalation of volatiles from groundwater (during excavation)
Industrial Worker (current/future land use)	• Soil ingestion (surface soil, subsurface soil)(1) • Soil dermal contact (surface soil, subsurface soil)(1) • Inhalation of air/dust/emissions (surface soil, subsurface soil)(1)(2)
Adolescent Trespassers (7 to 16 years) (current/future land use)	• Soil ingestion (surface soil, subsurface soil)(1) • Soil dermal contact (surface soil, subsurface soil)(1) • Inhalation of air/dust/emissions (surface soil, subsurface soil)(1)
On-Site Residents (Child and Adult) (future land use)	• Soil ingestion (surface soil, subsurface soil)(1) • Soil dermal contact (surface soil, subsurface soil)(1) • Inhalation of air/dust/emissions (surface soil, subsurface soil)(1) • Direct ingestion of groundwater • Groundwater dermal contact (during showering/bathing) • Inhalation of volatiles from groundwater (during showering/bathing)(2)

1 – Although exposure to subsurface soil is unlikely for industrial workers, adolescent trespassers, and on-site residents, these scenarios are included to aid in future risk management decisions.
2 – Vapor intrusion was not evaluated for industrial workers and residents because no COPCs were identified for vapor intrusion.

COPC = Chemical of Potential Concern

TABLE 7-12

EXPOSURE POINT CONCENTRATIONS
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical	Surface Soil (mg/kg)	Subsurface Soil (mg/kg)	Groundwater (ug/L)
Inorganics			
Aluminum	NA	NA	5,630(1)
Arsenic	15.5(2)	10.2(2)	62.2(5)
Cadmium	NA	NA	1.09(1)
Chromium	21.8(2)	NA	71(6)
Cobalt	NA	10.7(4)	117(7)
Iron	36,300(2)	54,500(4)	146,000(1)
Manganese	NA	897(4)	5,390(2)
Nickel	NA	NA	317(7)
Thallium	NA	NA	3.56(1)
Vanadium	NA	NA	19.3(3)
Semivolatile Organic Compounds			
Benzo(a)pyrene	0.034(3)	NA	NA
Naphthalene	NA	NA	0.169(1)

Notes:
1 - Maximum detected concentration
2 - 95% Student's-t UCL
3 - 95% KM (t) UCL
4 - 95% Approximate Gamma UCL
5 - 95% KM (BCA) UCL
6 - 95% KM (Chebyshev) UCL
7 - 95% Chebyshev (Mean, Sd) UCL

RAGS Part D tables for the exposure point concentrations and ProUCL printouts are included in Appendix E.

mg/kg = milligram per kilogram
NA = Not applicable, not a COPC for this medium.
UCL = Upper confidence limit
ug/L = microgram per liter

TABLE 7-13

SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE INDIANA

Parameter Code	Exposure Parameter	Construction Worker	Industrial Worker	Adolescent Trespasser	On-Site Child Resident	On-Site Adult Resident
All Exposures						
ED	Exposure Duration (years)	1[1]	25[3]	10[4]	6[3]	24[3]
BW	Body Weight (kg)	70[5]	70[3]	43[5]	15[3]	70[3]
AT-N	Averaging Time (Non-Cancer) (days)	365[5]	9,125[5]	3,650[5]	2,190[5]	8,760[5]
AT-C	Averaging Time (Cancer) (days)	25,550[5]	25,550[5]	25,550[5]	25,550[5]	25,550[5]
Incidental Ingestion/Dermal Contact with Soil						
C_{soil}	Exposure concentration for soil (mg/kg)	95% UCL[2]	95% UCL[2]	95% UCL[2]	95% UCL[2]	95% UCL[2]
IR	Ingestion Rate (mg/day)	330[6]	100[3]	100[3]	200[3]	100[3]
EF	Exposure Frequency (days/year)	150[7]	250[3]	26[8]	350[3]	350[3]
FI	Fraction Ingested (unitless)	1[6]	1[3]	1[3]	1[3]	1[3]
SA	Skin Surface Available for Contact (cm^2)	3,300[6]	3,300[9]	3,280[10]	2,800[9]	5,700[9]
AF	Soil to Skin Adherence Factor (mg/cm^2/event)	0.3[6]	0.2[9]	0.2[9]	0.2[9]	0.07[9]
ABS	Absorption Factor (unitless)	chemical-specific[9]	chemical-specific[9]	chemical-specific[9]	chemical-specific[9]	chemical-specific[9]
CF	Conversion Factor (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06
Inhalation Fugitive Dust/Volatile Emissions from Soil						
C_{air}	Exposure concentration for air (mg/m^3)	calculated[6]	calculated[6]	calculated[6]	calculated[6]	calculated[6]
ET	Exposure Time (hours/day)	8[6]	8[6]	4[1]	24[6]	24[6]
EF	Exposure Frequency (days/year)	150[7]	250[3]	26[8]	350[3]	350[3]
PEF	Particulate Emission Factor (m^3/kg)	1.34E+06[6]	1.316E+09[6]	1.316E+09[6]	1.316E+09[6]	1.316E+09[6]
Ingestion/Dermal Contact with Groundwater						
C_{gw}	Exposure concentration for groundwater (ug/L)	95% UCL[2]	NA	NA	95% UCL[2]	95% UCL[2]
IR	Ingestion Rate (L/day)	NA	NA	NA	1.5[13]	2[5]
EF	Exposure Frequency (days/year)	30[11]	NA	NA	350[3]	350[3]
ET/t_{event}	Exposure Time (hours/day)/ Event Duration (hours/event)	4[11]	NA	NA	1[9]	0.58[9]
EV	Event Frequency (events/day)	1[11]	NA	NA	1[9]	1[1]
SA	Skin Surface Available for Contact (cm^2)	3,300[6]	NA	NA	6,600[12]	18,000[12]
--	Kp (cm/hour), t* (hour/event), t (hour), and B (unitless)	chemical-specific[9]	NA	NA	chemical-specific[12]	chemical-specific[12]

TABLE 7-13

SUMMARY OF EXPOSURE INPUT PARAMETERS - REASONABLE MAXIMUM EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE INDIANA

Parameter Code	Exposure Parameter	Construction Worker	Industrial Worker	Adolescent Trespasser	On-Site Child Resident	On-Site Adult Resident
Inhalation of Volatiles from Groundwater						
C_{air}	Exposure concentration for air (mg/m^3)	Calculated(14)	NA	NA	Calculated(15)	Calculated(15)
ET	Exposure Time (hours/day)	4(1)	NA	NA	1(9)	0.58(9)
EF	Exposure Frequency (days/year)	30(1)	NA	NA	350(3)	350(3)
VF	Volatilization Factor (L/m^3)	Calculated(14)	NA	NA	NA	NA

Notes:
1 - Professional judgment.
2 - USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
3 - USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.
4 - Adolescents ages 7 to 16 years old.
5 - USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
6 - USEPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9365.4-24.
7 - Assumes a 30 week construction project over one year.
8 - Assume one day a week in warm weather months for reasonable maximum exposure and every other week for central tendency exposure.
9 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. PA/540/R/99/005.
10 - Assume 25 percent of total body surface area is exposed, USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002Fa.
11 - Professional judgment. Assumes construction workers are only exposed to groundwater water during part of the construction project.
12 - Assume 50 percent of total body surface area is exposed, USEPA, 2004.
13 - USEPA, 1997. Exposure Factors Handbook. National Center for Environmental Assessment, Washington, D.C. EPA/600/P-95/002Fa. August.
14 - VDEQ, May 2013. Virginia Department of Environmental Quality
http://www.deq.state.va.us/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance.aspx
15 - Foster and Chrostowski, 1987 (Showering Model).

TABLE 7-14

SUMMARY OF EXPOSURE INPUT PARAMETERS - CENTRAL TENDENCY EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE INDIANA

Parameter Code	Exposure Parameter	Construction Worker	Industrial Worker	Adolescent Trespasser	On-Site Child Resident	On-Site Adult Resident
All Exposures						
ED	Exposure Duration (years)	1[1]	9[3]	10[4]	2[3]	7[3]
BW	Body Weight (kg)	70[5]	70[3]	43[3]	15[3]	70[3]
AT-N	Averaging Time (Non-Cancer) (days)	365[5]	3,285[5]	3,650[5]	730[5]	2,555[5]
AT-C	Averaging Time (Cancer) (days)	25,550[5]	25,550[5]	25,550[5]	25,550[5]	25,550[5]
Incidental Ingestion/Dermal Contact with Soil						
C_{soil}	Exposure concentration for soil (mg/kg)	95% UCL[2]	95% UCL[2]	95% UCL[2]	95% UCL[2]	95% UCL[2]
IR	Ingestion Rate (mg/day)	165[6]	50[3]	50[3]	100[3]	50[3]
EF	Exposure Frequency (days/year)	75[6]	219[3]	13[7]	234[3]	234[3]
FI	Fraction Ingested (unitless)	1[8]	1[3]	1[3]	1[3]	1[3]
SA	Skin Surface Available for Contact (cm^2)	3,300[8]	3,300[9]	3,280[10]	2,800[9]	5,700[9]
AF	Soil to Skin Adherence Factor (mg/cm^2/event)	0.1[9]	0.02[9]	0.04[9]	0.04[9]	0.01[9]
ABS	Absorption Factor (unitless)	chemical-specific[9]	chemical-specific[9]	chemical-specific[9]	chemical-specific[9]	chemical-specific[9]
CF	Conversion Factor (kg/mg)	1E-06	1E-06	1E-06	1E-06	1E-06
Inhalation Fugitive Dust/Volatile Emissions from Soil						
C_{air}	Exposure concentration for air (mg/m^3)	calculated[8]	calculated[8]	calculated[8]	calculated[8]	calculated[8]
ET	Exposure Time (hours/day)	8[11]	8[11]	2[6]	24[8]	24[8]
EF	Exposure Frequency (days/year)	75[6]	219[3]	13[7]	234[3]	234[3]
PEF	Particulate Emission Factor (m^3/kg)	1.34E+06[8]	1.316E+09[8]	1.316E+09[8]	1.316E+09[8]	1.316E+09[8]
Ingestion/Dermal Contact with Groundwater						
C_{gw}	Exposure concentration for groundwater (ug/L)	95% UCL[1]	NA	NA	95% UCL[1]	95% UCL[1]
IR	Ingestion Rate (L/day)	NA	NA	NA	1.5[12]	2[5]
EF	Exposure Frequency (days/year)	15[6]	NA	NA	234[3]	234[3]
ET/t_{event}	Exposure Time (hours/day)/ Event Duration (hours/event)	4[6]	NA	NA	0.33[9]	0.25[9]
EV	Event Frequency (events/day)	1[1]	NA	NA	1[1]	1[1]
SA	Skin Surface Available for Contact (cm^2)	3,300[8]	NA	NA	6,600[9]	18,000[9]
--	Kp (cm/hour), t* (hour/event), t (hour), and B (unitless)	chemical-specific[9]	NA	NA	chemical-specific[9]	chemical-specific[9]

TABLE 7-14

SUMMARY OF EXPOSURE INPUT PARAMETERS - CENTRAL TENDENCY EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE INDIANA

Parameter Code	Exposure Parameter	Construction Worker	Industrial Worker	Adolescent Trespasser	On-Site Child Resident	On-Site Adult Resident
Inhalation of Volatiles from Groundwater						
C_{air}	Exposure concentration for air (mg/m^3)	Calculated(13)	NA	NA	Calculated(14)	Calculated(14)
ET	Exposure Time (hours/day)	4(1)	NA	NA	0.33(9)	0.25(9)
EF	Exposure Frequency (days/year)	15(1)	NA	NA	234(3)	234(3)
VF	Volatilization Factor (L/m^3)	Calculated(13)	NA	NA	NA	NA

Notes:
1 - Professional judgment.
2 - USEPA, 2002. Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
3 - USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
4 - Adolescents ages 7 to 16 years old.
5 - USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
6 - Central tendency exposure is assumed to be one-half the reasonable maximum exposure value.
7 - Assume 1 day a week in warm weather months for RME and every other week for CTE.
8 - USEPA, 2002: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9365.4-24.
9 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. PA/540/R/99/005.
10 - Assume 25 percent of total body surface area is exposed, USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.
11 - Assume an 8-hour work shift.
12 - USEPA, 1997. Exposure Factors Handbook. National Center for Environmental Assessment, Washington, D.C. EPA/600/P-95/002Fa. August.
13 - VDEQ, May 2013. Virginia Department of Environmental Quality
http://www.deq.state.va.us/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance.aspx
14 - Foster and Chrostowski, 1987 (Showering Model).

TABLE 7-15

INTERMEDIATE VARIABLES FOR CALCULATING $DA_{(EVENT)}$
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Medium	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Inorganics												
Aluminum	Groundwater	NA	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Arsenic	Soil, Groundwater	0.03	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Cadmium	Groundwater	NA	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Chromium	Soil, Groundwater	0	1	2.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Cobalt	Soil, Groundwater	0	1	4.00E-04	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Iron	Soil, Groundwater	0	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Manganese	Soil, Groundwater	0	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Nickel	Groundwater	NA	1	2.00E-04	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Thallium	Groundwater	NA	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Vanadium	Groundwater	NA	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Semivolatile Organic Compounds												
Benzo(a)pyrene	Soil	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Groundwater	NA	1	4.7E-02	cm/hr	(1)	hr	5.6E-01	hr	1.3E+00	hr	2.0E-01

Notes:
All values are from USEPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.

1 - T(event) for the construction worker is 4 hours for RME and CTE. T(event) for the child resident is 1 hour for RME and 0.33 hour for CTE. T(event) for the adult resident is 0.58 hour for RME and 0.25 hour for CTE.
FA = Fraction absorbed water
Kp = Dermal permeability coefficient of a compound in water
T(event) = Event duration
Tau = Lag time
T* = Time to reach steady-state
B = Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis
cm/hr = centimeters per hour
hr = hour
NA = Not applicable for this medium.
$DA_{(event)}$ = absorbed dose per event

TABLE 7-16

CHEMICAL PROPERTIES FOR VOLATILIZATION FROM SOIL/GROUNDWATER TO OUTDOOR AIR MODELS
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical	Molecular Weight (g/mole)	Organic Carbon Partition Coefficient (cm^3/g)	Air Diffusivity (cm^2/sec)	Water Diffusivity (cm^2/sec)	Solubility Limit (mg/L)	Henry's Law Constant	
						(Dimensionless)	(atm-m^3/mol)
Naphthalene	1.28E+02	1.54E+03	6.00E-02	8.40E-06	3.10E+01	1.80E-02	4.40E-04

Source:
USEPA, 2012: USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites, November 2012.

TABLE 7-17

NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Inorganics										
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	CNS	100	PPRTV	10/23/2006
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	5/20/2013
Cadmium[3]	Chronic	5.0E-04	mg/kg/day	0.05	2.5E-05	mg/kg/day	Kidney	10/1	Cal EPA	9/2009
Chromium[4]	Subchronic	2.0E-02	mg/kg/day	0.025	5.0E-04	mg/kg/day	None Reported	100/3	HEAST	9/1997
	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	None Reported	300/3	IRIS	5/20/2013
Cobalt	Subchronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Thyroid	NA	PPRTV	8/25/2008
	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Thyroid	NA	PPRTV	8/25/2008
Iron	Subchronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	PPRTV	9/11/2006
	Chronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	PPRTV	9/11/2006
Manganese[5]	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1	IRIS	5/20/2013
Nickel	Chronic	2.0E-02	mg/kg/day	0.04	8.0E-04	mg/kg/day	Body Weight	300/1	IRIS	5/20/2013
Thallium	Subchronic	4.0E-05	mg/kg/day	1	4.0E-05	mg/kg/day	Skin	1/1000	PPRTV	10/2010
	Chronic	1.0E-05	mg/kg/day	1	1.0E-05	mg/kg/day	Skin	NA	PPRTV	10/8/2010
Vanadium	Chronic	5.0E-03	mg/kg/day	1	5.0E-03	mg/kg/day	Kidney	300	RSL	11/2012
Semivolatile Organic Compounds										
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Subchronic	6.0E-01	mg/kg/day	1	6.0E-01	mg/kg/day	Central Nervous System	90/1	ATSDR	9/2005
	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRIS	5/20/2013

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 - Value is for cadmium - water.
4 - Value is for hexavalent chromium.
5 - Adjusted IRIS value in accordance with recommendations on IRIS.

Definitions:
ATSDR = Agency for Toxic Substances and Disease Registry
Cal EPA = California Environmental Protection Agency
CNS = Central nervous system
CVS = Cardiovascular system
GS = Gastrointestinal system
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not available
PPRTV = Provisional Peer Reviewed Toxicity Value
RfD = Reference dose
RSL = USEPA Regional Screening Level Table, November 2012

TABLE 7-18

NON-CANCER TOXICITY DATA -- INHALATION
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Inorganics									
Aluminum	Chronic	5.0E-03	mg/m^3	1.4E-03	(mg/kg/day)	CNS	300	PPRTV	10/23/2006
Arsenic	Chronic	1.5E-05	mg/m^3	4.3E-06	(mg/kg/day)	NA	NA	Cal EPA	9/2009
Cadmium	Chronic	2.0E-05	mg/m^3	5.7E-06	(mg/kg/day)	Respiratory	NA	ATSDR	9/2008
Chromium[2]	Chronic	1.0E-04	mg/m^3	2.9E-05	(mg/kg/day)	Respiratory	300/1	IRIS	5/20/2013
Cobalt	Subchronic	2.0E-05	mg/m^3	5.7E-06	(mg/kg/day)	Respiratory	NA	PPRTV	8/25/2008
	Chronic	6.0E-06	mg/m^3	1.7E-06	(mg/kg/day)	Respiratory	NA	PPRTV	8/25/2008
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.0E-05	mg/m^3	1.4E-05	(mg/kg/day)	CNS	1000/1	IRIS	5/20/2013
Nickel	Subchronic	2.0E-04	mg/m^3	5.7E-05	(mg/kg/day)	Respiratory	30/1	ATSDR	9/2005
	Chronic	9.0E-05	mg/m^3	2.6E-05	(mg/kg/day)	Respiratory	30/1	ATSDR	9/2005
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds									
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	3.0E-03	mg/m3	8.6E-04	(mg/kg/day)	Respiratory System	3000/1	IRIS	5/20/2013

Notes:
1 - Extrapolated RfD = RfC*$20m^3$/day / 70 kg.
2 - Value is for hexavalent chromium.

Definitions:
ATSDR = Agency for Toxic Substances and Disease Registry
Cal EPA = California Environmental Protection Agency
CNS = Central Nervous System
IRIS = Integrated Risk Information System
NA = Not Applicable
PPRTV = Provisional Peer Reviewed Toxicity Value
RfC = Reference concentration
RfD = Reference dose

TABLE 7-19

CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Inorganics								
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	5/20/2013
Cadmium	NA	NA	NA	NA	NA	B1 / Probable human carcinogen	IRIS	5/20/2013
Chromium[3][4]	5.0E-01	$(mg/kg/day)^{-1}$	0.025	2.0E+01	$(mg/kg/day)^{-1}$	A / Known human carcinogen	NJDEP	4/8/2009
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	D (Not classifiable as to human carcinogenicity)	IRIS	5/20/2013
Nickel	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds								
Benzo(a)pyrene[4]	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/20/2013
Naphthalene	NA	NA	NA	NA	NA	Carcinogenic potential cannot be determined	IRIS	5/20/2013

Notes:
1 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.
3 - Value is for hexavalent chromium.
4 - Hexavalent chromium and benzo(a)pyrene are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Definitions:
CSF = Cancer Slope Factor
IRIS = Integrated Risk Information System.
NA = Not Available.
NJDEP = New Jersey Department of Environmental Protection, Derivation of Ingestion-Based Soil Remediation Criterion for Cr+6 Based on the NTP Chronic Bioassay Data for Sodium Dichromate Dihydrate, April 8, 2009.

TABLE 7-20

CANCER TOXICITY DATA -- INHALATION
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Inorganics							
Aluminum	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	5/20/2013
Cadmium	1.8E-03	$(ug/m^3)^{-1}$	6.3E+00	$(mg/kg/day)^{-1}$	B1 / Probable human carcinogen	IRIS	5/20/2013
Chromium[2][3]	8.4E-02	$(ug/m^3)^{-1}$	2.9E+02	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	5/20/2013
Cobalt	9.0E-03	$(ug/m^3)^{-1}$	3.2E+01	$(mg/kg/day)^{-1}$	NA	PPRTV	8/25/2008
Iron	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	5/20/2013
Nickel	2.6E-04	$(ug/m^3)^{-1}$	9.1E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA	9/2009
Thallium	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds							
Benzo(a)pyrene[3]	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	Cal EPA	9/2009
Naphthalene	3.4E-05	$(ug/m^3)^{-1}$	1.2E-01	$(mg/kg/day)^{-1}$	Carcinogenic potential cannot be determined	Cal EPA(2)	8/2004

Notes:

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

2 - Value is for hexavalent chromium.

3 - Hexavalent chromium and benzo(a)pyrene are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Definitions:

Cal EPA = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.

Cal EPA(2) = Air Toxic Hot Spots: Adoption of a Unit Risk Value for Naphthalene, August 2004.

CSF = Cancer Slope Factor.

IRIS = Integrated Risk Information System.

NA = Not Available.

PPRTV = Provisional Peer Reviewed Toxicity Value.

TABLE 7-21

SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Workers	Surface Soil	Incidental Ingestion	1E-06	--	--	--	0.2	--
		Dermal Contact	6E-08	--	--	--	0.009	--
		Inhalation	3E-06	--	--	Chromium	0.2	--
		Total	4E-06	--	--	Chromium	0.4	--
	Subsurface Soil	Incidental Ingestion	4E-07	--	--	--	0.3	--
		Dermal Contact	4E-08	--	--	--	0.006	--
		Inhalation	2E-07	--	--	--	2	Manganese
		Total	7E-07	--	--	--	2	Manganese
	Groundwater	Dermal Contact	6E-07	--	--	--	0.1	--
		Inhalation	3E-11	--	--	--	0.00002	--
		Total	6E-07	--	--	--	0.1	--
		Total Surface Soil + Groundwater	5E-06			Total Surface Soil + Groundwater	0.5	
		Total Subsurface Soil + Groundwater	1E-06			Total Subsurface Soil + Groundwater	2	
Industrial Workers	Surface Soil	Incidental Ingestion	1E-05	--	--	Arsenic, Chromium	0.1	--
		Dermal Contact	2E-06	--	--	Arsenic	0.01	--
		Inhalation	1E-07	--	--	--	0.0004	--
		Total	1E-05	--	--	Arsenic, Chromium	0.1	--
	Subsurface Soil	Incidental Ingestion	5E-06	--	--	Arsenic	0.2	--
		Dermal Contact	1E-06	--	--	--	0.007	--
		Inhalation	9E-09	--	--	--	0.004	--
		Total	6E-06	--	--	Arsenic	0.2	--
Adolescent Trespassers	Surface Soil	Incidental Ingestion	1E-06	--	--	--	0.02	--
		Dermal Contact	1E-07	--	--	--	0.002	--
		Inhalation	7E-09	--	--	--	0.00002	--
		Total	1E-06	--	--	--	0.02	--
	Subsurface Soil	Incidental Ingestion	4E-07	--	--	--	0.03	--
		Dermal Contact	7E-08	--	--	--	0.001	--
		Inhalation	2E-10	--	--	--	0.0002	--
		Total	4E-07	--	--	--	0.03	--

TABLE 7-21

SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Child Residents	Surface Soil	Incidental Ingestion	9E-05	--	Arsenic, Chromium	--	1	--
		Dermal Contact	3E-06	--	--	Arsenic	0.06	--
		Inhalation	6E-07	--	--	--	0.002	--
		Total	9E-05	--	Arsenic, Chromium	Benzo(a)pyrene	1	--
	Subsurface Soil	Incidental Ingestion	2E-05	--	Arsenic	--	2	Target Organs HI < 1
		Dermal Contact	1E-06	--	--	--	0.04	--
		Inhalation	9E-09	--	--	--	0.01	--
		Total	2E-05	--	Arsenic	--	2	Target Organs HI < 1
	Groundwater	Incidental Ingestion	2E-03	Arsenic, Chromium	--	--	138	Nickel, Aluminum, Manganese, Arsenic, Iron, Chromium, Thallium, Cobalt
		Dermal Contact	6E-04	Chromium	--	Arsenic	4	Manganese
		Inhalation	2E-08	--	--	--	--	--
		Total	3E-03	Arsenic, Chromium	--	--	141	Nickel, Aluminum, Manganese, Arsenic, Iron, Chromium, Thallium, Cobalt
		Total Surface Soil + Groundwater	3E-03			Total Surface Soil + Groundwater	142	
		Total Subsurface Soil + Groundwater	3E-03			Total Subsurface Soil + Groundwater	143	
Adult Residents	Surface Soil	Incidental Ingestion	2E-05	--	--	Arsenic, Chromium	0.2	--
		Dermal Contact	1E-06	--	--	--	0.008	--
		Inhalation	9E-07	--	--	--	0.002	--
		Total	2E-05	--	--	Arsenic, Chromium	0.2	--
	Subsurface Soil	Incidental Ingestion	7E-06	--	--	Arsenic	0.3	--
		Dermal Contact	9E-07	--	--	--	0.006	--
		Inhalation	4E-08	--	--	--	0.01	--
		Total	8E-06	--	--	Arsenic	0.3	--
	Groundwater	Incidental Ingestion	1E-03	Arsenic, Chromium	--	--	39	Aluminum, Manganese, Arsenic, Iron, Thallium, Cobalt
		Dermal Contact	3E-04	Chromium	--	Arsenic	1	--
		Inhalation	4E-08	--	--	--	--	--
		Total	2E-03	Arsenic, Chromium	--	--	41	Aluminum, Manganese, Arsenic, Iron, Thallium, Cobalt
		Total Surface Soil + Groundwater	2E-03			Total Surface Soil + Groundwater	41	
		Total Subsurface Soil + Groundwater	2E-03			Total Subsurface Soil + Groundwater	41	

TABLE 7-21

SUMMARY OF CANCER RISKS AND HAZARD INDICES
REASONABLE MAXIMUM EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Lifelong Residents (Child + Adult)	Surface Soil	Incidental Ingestion	1E-04	--	Arsenic, Chromium	Benzo(a)pyrene	NA	--
		Dermal Contact	4E-06	--	--	Arsenic	NA	--
		Inhalation	1E-06	--	--	--	NA	--
		Total	1E-04	--	Arsenic, Chromium	Benzo(a)pyrene	NA	--
	Subsurface Soil	Incidental Ingestion	2E-05	--	Arsenic	--	NA	--
		Dermal Contact	2E-06	--	--	Arsenic	NA	--
		Inhalation	4E-08	--	--	--	NA	--
		Total	3E-05	--	Arsenic	--	NA	--
	Groundwater	Incidental Ingestion	4E-03	Arsenic, Chromium	--	--	NA	--
		Dermal Contact	8E-04	Chromium	--	Arsenic	NA	--
		Inhalation	6E-08	--	--	--	NA	--
		Total	5E-03	Arsenic, Chromium	--	--	NA	--
		Total Surface Soil + Groundwater	5E-03			Total Surface Soil + Groundwater	NA	
		Total Subsurface Soil + Groundwater	5E-03			Total Subsurface Soil + Groundwater	NA	

Notes:
HI = Hazard index
NA = Not applicable

TABLE 7-22

SUMMARY OF CANCER RISKS AND HAZARD INDICES
CENTRAL TENDENCY EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Workers	Surface Soil	Incidental Ingestion	2E-07	--	--	--	0.05	--
		Dermal Contact	1E-08	--	--	--	0.002	--
		Inhalation	1E-06	--	--	--	0.1	--
		Total	2E-06	--	--	--	0.2	--
	Subsurface Soil	Incidental Ingestion	1E-07	--	--	--	0.07	--
		Dermal Contact	6E-09	--	--	--	0.0010	--
		Inhalation	1E-07	--	--	--	1.0	--
		Total	2E-07	--	--	--	1	--
	Groundwater	Dermal Contact	3E-07	--	--	--	0.06	--
		Inhalation	2E-11	--	--	--	0.00001	--
		Total	3E-07	--	--	--	0.06	--
		Total Surface Soil + Groundwater	2E-06			Total Surface Soil + Groundwater	0.2	
		Total Subsurface Soil + Groundwater	5E-07			Total Subsurface Soil + Groundwater	1	
Industrial Workers	Surface Soil	Incidental Ingestion	2E-06	--	--	--	0.05	--
		Dermal Contact	5E-08	--	--	--	0.0009	--
		Inhalation	4E-08	--	--	--	0.0003	--
		Total	2E-06	--	--	--	0.05	--
	Subsurface Soil	Incidental Ingestion	8E-07	--	--	--	0.08	--
		Dermal Contact	3E-08	--	--	--	0.0006	--
		Inhalation	3E-09	--	--	--	0.003	--
		Total	9E-07	--	--	--	0.08	--
Adolescent Trespassers	Surface Soil	Incidental Ingestion	3E-07	--	--	--	0.005	--
		Dermal Contact	1E-08	--	--	--	0.0002	--
		Inhalation	2E-09	--	--	--	0.000005	--
		Total	3E-07	--	--	--	0.005	--
	Subsurface Soil	Incidental Ingestion	9E-08	--	--	--	0.008	--
		Dermal Contact	7E-09	--	--	--	0.0001	--
		Inhalation	5E-11	--	--	--	0.00005	--
		Total	1E-07	--	--	--	0.008	--

TABLE 7-22

SUMMARY OF CANCER RISKS AND HAZARD INDICES
CENTRAL TENDENCY EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Child Residents	Surface Soil	Incidental Ingestion	1E-05	--	--	Arsenic, Chromium	0.5	--
		Dermal Contact	1E-07	--	--	--	0.007	--
		Inhalation	2E-07	--	--	--	0.001	--
		Total	1E-05	--	--	Arsenic, Chromium	0.5	--
	Subsurface Soil	Incidental Ingestion	2E-06	--	--	Arsenic	0.8	--
		Dermal Contact	6E-08	--	--	--	0.005	--
		Inhalation	2E-09	--	--	--	0.010	--
		Total	2E-06	--	--	Arsenic	0.8	--
	Groundwater	Incidental Ingestion	2E-03	Arsenic, Chromium	--	--	92	Aluminum, Manganese, Arsenic, Iron, Chromium, Thallium, Cobalt
		Dermal Contact	1E-04	--	Chromium	--	0.8	--
		Inhalation	8E-10	--	--	--	0.0003	--
		Total	2E-03	Arsenic, Chromium	--	--	93	Aluminum, Manganese, Arsenic, Iron, Chromium, Thallium, Cobalt
		Total Surface Soil + Groundwater	2E-03			Total Surface Soil + Groundwater	93	
		Total Subsurface Soil + Groundwater	2E-03			Total Subsurface Soil + Groundwater	94	
Adult Residents	Surface Soil	Incidental Ingestion	2E-06	--	--	--	0.05	--
		Dermal Contact	4E-08	--	--	--	0.0008	--
		Inhalation	1E-07	--	--	--	0.001	--
		Total	2E-06	--	--	--	0.05	--
	Subsurface Soil	Incidental Ingestion	7E-07	--	--	--	0.08	--
		Dermal Contact	2E-08	--	--	--	0.0005	--
		Inhalation	7E-09	--	--	--	0.010	--
		Total	7E-07	--	--	--	0.10	--
	Groundwater	Incidental Ingestion	3E-04	Arsenic	Chromium	--	26	Manganese, Arsenic, Iron, Thallium, Cobalt
		Dermal Contact	2E-05	--	Chromium	--	0.4	--
		Inhalation	2E-09	--	--	--	0.0002	--
		Total	3E-04	Arsenic	Chromium	--	27	Manganese, Arsenic, Iron, Thallium, Cobalt
		Total Surface Soil + Groundwater	3E-04			Total Surface Soil + Groundwater	27	
		Total Subsurface Soil + Groundwater	3E-04			Total Subsurface Soil + Groundwater	27	

TABLE 7-22

SUMMARY OF CANCER RISKS AND HAZARD INDICES
CENTRAL TENDENCY EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks > 10^{-4}	Chemicals with Cancer Risks > 10^{-5} and ≤ 10^{-4}	Chemicals with Cancer Risks > 10^{-6} and ≤ 10^{-5}	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Lifelong Residents (Child + Adult)	Surface Soil	Incidental Ingestion	1E-05	--	--	Arsenic, Chromium	NA	--
		Dermal Contact	2E-07	--	--	--	NA	--
		Inhalation	3E-07	--	--	--	NA	--
		Total	1E-05	--	--	Arsenic, Chromium	NA	--
	Subsurface Soil	Incidental Ingestion	3E-06	--	--	Arsenic	NA	--
		Dermal Contact	9E-08	--	--	--	NA	--
		Inhalation	9E-09	--	--	--	NA	--
		Total	3E-06	--	--	Arsenic	NA	--
	Groundwater	Incidental Ingestion	2E-03	Arsenic, Chromium	--	--	NA	--
		Dermal Contact	1E-04	--	Chromium	--	NA	--
		Inhalation	2E-09	--	--	--	NA	--
		Total	2E-03	Arsenic, Chromium	--	--	NA	--
		Total Surface Soil + Groundwater	2E-03			Total Surface Soil + Groundwater	NA	
		Total Subsurface Soil + Groundwater	2E-03			Total Subsurface Soil + Groundwater	NA	

Notes:
HI = Hazard index
NA = Not applicable

TABLE 7-23

RISKS ASSOCIATED WITH CHEMICALS WITHIN BACKGROUND LEVELS
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Reasonable Maximum Exposures	
	ILCR	HI
CURRENT/FUTURE CONSTRUCTION WORKERS		
Surface Soil		
Site Risk[1]	4E-06	0.4
Background Risk[2]	2E-07	2
Site + Background Risk[3]	4E-06	2
Subsurface Soil		
Site Risk	7E-07	2
Background Risk	2E-06	0.1
Site + Background Risk	3E-06	2
Groundwater	6E-07	0.1
Site Totals		
Total Surface Soil and Groundwater	5E-06	0.5
Total Subsurface Soil and Groundwater	1E-06	2
Site and Background Totals		
Total Surface Soil and Groundwater	5E-06	2
Total Subsurface Soil and Groundwater	4E-06	2
CURRENT/FUTURE INDUSTRIAL WORKERS		
Surface Soil		
Site Risk	1E-05	0.1
Background Risk	7E-09	0.1
Site + Background Risk	1E-05	0.2
Subsurface Soil		
Site Risk	6E-06	0.2
Background Risk	3E-06	0.03
Site + Background Risk	9E-06	0.2
CURRENT/FUTURE ADOLESCENT TRESPASSERS		
Surface Soil		
Site Risk	1E-06	0.02
Background Risk	2E-10	0.02
Site + Background Risk	1E-06	0.04
Subsurface Soil		
Site Risk	4E-07	0.03
Background Risk	6E-07	0.005
Site + Background Risk	1E-06	0.04

TABLE 7-23

RISKS ASSOCIATED WITH CHEMICALS WITHIN BACKGROUND LEVELS
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Reasonable Maximum Exposures	
	ILCR	HI
HYPOTHETICAL CHILD RESIDENTS		
Surface Soil		
Site Risk	9E-05	1
Background Risk	7E-09	2
Site + Background Risk	9E-05	3
Subsurface Soil		
Site Risk	2E-05	2
Background Risk	5E-05	0.4
Site + Background Risk	7E-05	2
Groundwater	3E-03	141
Site Totals		
Total Surface Soil and Groundwater	3E-03	142
Total Subsurface Soil and Groundwater	3E-03	143
Site and Background Totals		
Total Surface Soil and Groundwater	3E-03	144
Total Subsurface Soil and Groundwater	3E-03	143

HYPOTHETICAL ADULT RESIDENTS		
Surface Soil		
Site Risk	2E-05	0.2
Background Risk	3E-08	0.2
Site + Background Risk	2E-05	0.4
Subsurface Soil		
Site Risk	8E-06	0.3
Background Risk	8E-06	0.04
Site + Background Risk	2E-05	0.3
Groundwater	2E-03	41
Site Totals		
Total Surface Soil and Groundwater	2E-03	41
Total Subsurface Soil and Groundwater	2E-03	41
Site and Background Totals		
Total Surface Soil and Groundwater	2E-03	41
Total Subsurface Soil and Groundwater	2E-03	41

TABLE 7-23

RISKS ASSOCIATED WITH CHEMICALS WITHIN BACKGROUND LEVELS
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Reasonable Maximum Exposures	
	ILCR	HI
HYPOTHETICAL LIFELONG RESIDENTS		
Surface Soil		
Site Risk	1E-04	NA
Background Risk	4E-08	NA
Site + Background Risk	1E-04	NA
Subsurface Soil		
Site Risk	3E-05	NA
Background Risk	6E-05	NA
Site + Background Risk	9E-05	NA
Groundwater	5E-03	NA
Site Totals		
Total Surface Soil and Groundwater	5E-03	NA
Total Subsurface Soil and Groundwater	5E-03	NA
Site and Background Totals		
Total Surface Soil and Groundwater	5E-03	NA
Total Subsurface Soil and Groundwater	5E-03	NA

Notes:
ILCR = Incremental Lifetime Cancer Risk
HI = Hazard Index
1 - Cancer risk or hazard index from only site-related chemicals detected at concentrations exceeding screening levels.
2 - Cancer risk or hazard index from only chemicals present within background levels detected at concentrations exceeding screening levels. Aluminum, cobalt, manganese, thallium, and vanadium were within background levels in surface soil. Aluminum, chromium, and thallium were within background levels in subsurface soil.
3 - Cancer risk or hazard index from all chemicals detected at concentrations exceeding screening levels.

TABLE 7-24

SUMMARY OF CANCER RISKS AND HAZARD INDICES - DISSOLVED METALS IN GROUNDWATER
REASONABLE MAXIMUM EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Workers	Groundwater	Dermal Contact	4E-08	--	--	--	0.0004	--
		Inhalation	3E-11	--	--	--	0.00002	--
		Total	4E-08	--	--	--	0.0004	--
Child Residents	Groundwater	Incidental Ingestion	1E-04	--	Arsenic, Chromium	--	6	Cobalt
		Dermal Contact	3E-05	--	Chromium	--	0.06	--
		Inhalation	2E-08	--	--	--	0.002	--
		Total	1E-04	--	Arsenic, Chromium	--	6	Cobalt
Adult Residents	Groundwater	Incidental Ingestion	5E-05	--	Arsenic, Chromium	--	2	Cobalt
		Dermal Contact	1E-05	--	--	Chromium	0.02	--
		Inhalation	4E-08	--	--	--	0.001	--
		Total	7E-05	--	Arsenic, Chromium	--	2	Cobalt
Lifelong Residents (Child + Adult)	Groundwater	Incidental Ingestion	2E-04	--	Arsenic, Chromium	--	NA	--
		Dermal Contact	4E-05	--	--	Chromium	NA	--
		Inhalation	6E-08	--	--	--	NA	--
		Total	2E-04	Chromium	Arsenic	--	NA	--

Notes:
HI = Hazard index
NA = Not applicable

TABLE 7-25

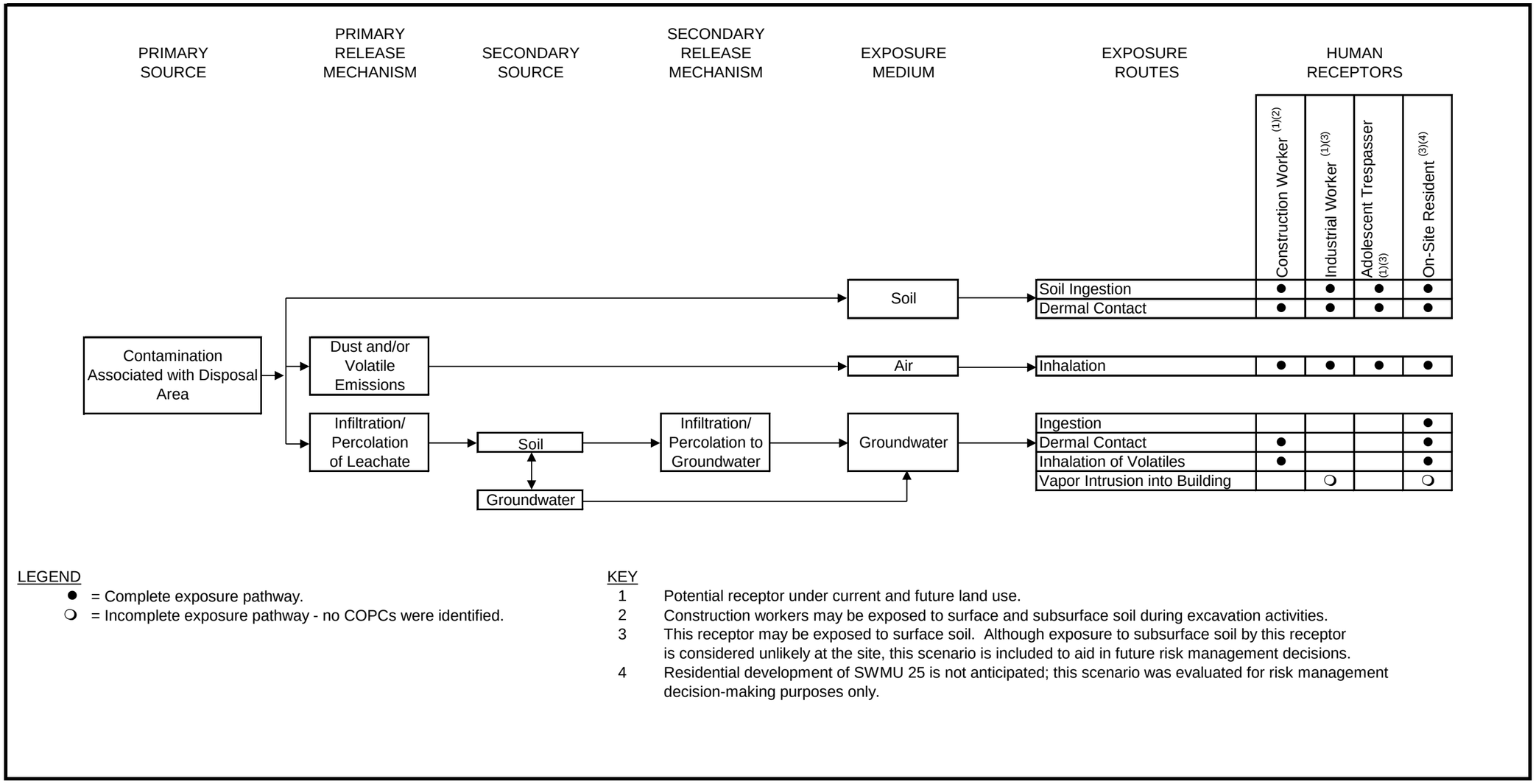
SUMMARY OF CANCER RISKS AND HAZARD INDICES - DISSOLVED METALS IN GROUNDWATER
CENTRAL TENDENCY EXPOSURES
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Receptor	Medium	Exposure Route	Cancer Risk	Chemicals with Cancer Risks $> 10^{-4}$	Chemicals with Cancer Risks $> 10^{-5}$ and $\leq 10^{-4}$	Chemicals with Cancer Risks $> 10^{-6}$ and $\leq 10^{-5}$	Hazard Index	Chemicals Contributing to an Target Organ HI > 1
Construction Workers	Groundwater	Dermal Contact	2E-08	--	--	--	0.0002	--
		Inhalation	2E-11	--	--	--	0.00001	--
		Total	2E-08	--	--	--	0.0002	--
Child Residents	Groundwater	Incidental Ingestion	7E-05	--	Chromium	Arsenic	4	Cobalt
		Dermal Contact	7E-06	--	--	Chromium	0.01	--
		Inhalation	8E-10	--	--	--	0.0003	--
		Total	8E-05	--	Chromium	Arsenic	4	Cobalt
Adult Residents	Groundwater	Incidental Ingestion	1E-05	--	--	Arsenic, Chromium	1	--
		Dermal Contact	1E-06	--	--	--	0.005	--
		Inhalation	2E-09	--	--	--	0.0002	--
		Total	1E-05	--	--	Arsenic, Chromium	1	--
Lifelong Residents (Child + Adult)	Groundwater	Incidental Ingestion	8E-05	--	Arsenic, Chromium	--	NA	--
		Dermal Contact	8E-06	--	--	Chromium	NA	--
		Inhalation	2E-09	--	--	--	NA	--
		Total	9E-05	--	Arsenic, Chromium	--	NA	--

Notes:
HI = Hazard index
NA = Not applicable

FIGURE 7-1

CONCEPTUAL SITE MODEL FOR HUMAN HEALTH RISK ASSESSMENT
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA



LEGEND
- ● = Complete exposure pathway.
- ❍ = Incomplete exposure pathway - no COPCs were identified.

KEY
1. Potential receptor under current and future land use.
2. Construction workers may be exposed to surface and subsurface soil during excavation activities.
3. This receptor may be exposed to surface soil. Although exposure to subsurface soil by this receptor is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
4. Residential development of SWMU 25 is not anticipated; this scenario was evaluated for risk management decision-making purposes only.

8.0 ECOLOGICAL RISK ASSESSMENT

This ERA for SWMU 25 Highway Dump Site A evaluates the potential for adverse ecological impacts due to site-related contamination. This goal was accomplished by identifying COPCs detected at concentrations that exceeded screening levels, identifying the locations of these exceedances, and concluding whether or not further investigation and/or remedial action at SWMU 25 NSA Crane was warranted from an ecological perspective.

8.1 INTRODUCTION

The screening-level ERA was completed in accordance with the following guidance documents:

- Department of Navy (Navy) Environmental Policy Memorandum 97-04: Use of Ecological Risk Assessments dated May 16, 1997 (Navy, 1997).
- Navy Policy for Conducting Ecological Risk Assessments (Navy, 1999).
- Final Guidelines for Ecological Risk Assessment (USEPA, 1998).
- Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (USEPA, 1997).

This ERA consisted of Steps 1, 2, and 3a of the eight-step ecological risk evaluation process discussed in USEPA guidance (USEPA, 1997 and 1998) and the Navy Policy for Conducting ERAs (Navy, 1999). The first two steps comprised the screening-level ERA, and corresponds with Tier 1 of the Navy Policy (Navy, 1999), where conservative exposure estimates are compared to screening-level and threshold toxicity values. Step 3a was the first step of the ERA and consisted of refining the Tier 1 assumptions following Steps 1 and 2 to focus the ERA process on the chemicals of greatest concern at the site. Step 3a corresponds with the first part of Tier 2 of the Navy Policy (Navy, 1999). Steps 3b through 7, which are conducted if additional ecological investigations are necessary, were not conducted for this ERA because risks were determined to be acceptable. Aspects of Step 8, risk management, are addressed throughout the ERA process, in cooperation with Region 5 regulators.

A schematic diagram of the general risk assessment process is provided on Figure 8-1.

8.2 TIER 1, STEP 1: SCREENING-LEVEL PROBLEM FORMULATION

The screening-level problem formulation is the first step of the ERA and includes identification of potential receptor groups, COPCs, and the mechanisms for contaminant fate, transport, and toxicity. The complete exposure pathways that exist at a site are determined at this point to facilitate receptor selection. The problem formulation process enables the risk assessor to identify the ecological resources to be protected (known as assessment endpoints), the measures used to evaluate risks to those resources (known as measurement endpoints) and the chemicals, geographic areas, and environmental media relevant to the risk assessment.

As part of receptor identification, site habitats and potential ecological receptors, as they apply to ecological risk, are described in the following subsections.

8.2.1 Environmental Setting

8.2.1.1 Basewide Environmental Setting

A biological characterization of NSA Crane, including a list of plants and animals found at the facility, is presented in the Installation Assessment (IA) (Army, 1978) and the Initial Assessment Study (IAS) (NEESA, 1983), and is summarized in the Environmental Monitoring Reports (EMRs) (Halliburton NUS, 1992a and 1992b). A list of species that may inhabit NSA Crane and are protected under the United States Endangered Species Act, Indiana Department of Natural Resources Heritage Data Center, or by the United States Fish and Wildlife Service (USFWS) is summarized in the RCRA Facility Permit and below. The following paragraphs briefly summarize the environmental setting at the base.

Eighty percent of NSA Crane's approximately 63,000 acres is classified as Central Hardwoods Forest of the United States (NEESA, 1983). In addition, some former agricultural fields are in various stages of succession. Open spaces on dry upland sites contain almost pure stands of grasses with some clumps of woody plants such as persimmon, sassafras, and sumac. Wetter sites have river birch, willow, sycamore, and cottonwood. Hillside communities have mostly hickory, white and black oak, red maple, sugar maple, tulip poplar, ash, and beech (NEESA, 1983).

The great variety of habitats at NSA Crane (i.e., many stages of forest succession, streams, ponds, Lake Greenwood, grassy open spaces) lead to great diversity of animal species (NEESA, 1983). These species include but are not limited to mammals such as white-tailed deer, beaver, coyote, hawks, red fox, rabbits, raccoons, and mice; birds such as ducks, geese, wild turkey, bobwhite quail, red-tailed hawks, and American robins; as well as various amphibians, reptiles, fish, and invertebrates.

Six main creeks receive drainage in five separate drainage basins at NSA Crane: First Creek, Sulphur Creek, Little Sulphur Creek, Boggs Creek, Turkey Creek, and Seed Tick Creek. There are also many smaller streams, creeks, and drainage ditches located at the facility, along with several small man-made ponds and one large lake (Lake Greenwood). Lake Greenwood is the source of potable water for NSA Crane. Surface water from the facility eventually discharges to the East Fork of the White River, which is located south of the facility.

Threatened and Endangered Species

The Endangered Species Management Plan for NSA Crane (Comarco Systems, 2000) identified the federal and state threatened and endangered species and species of special concern potentially present at the facility. Information included in the Endangered Species Management Plan was obtained from studies and surveys conducted by the Navy and other agencies and groups such as universities and research institutions. A small subset of these studies include the inventory of neotropical migratory birds, mist net and radio telemetry surveys for the Indiana bat, bobcat trapping, rattlesnake survey, Purdue University wildlife studies, and several fish surveys and bird counts. These studies and others that were used in compiling the list of endangered species present at NSA Crane are described in more detail in the Endangered Species Management Plan (Comarco Systems, 2000) and below.

The Indiana bat is the only federally threatened or endangered species documented to occur at NSA Crane. No mist nets were located at SWMU 25 during the mist net and radio telemetry surveys for the Indiana bat; however, two mist net sites were located approximately 1 mile east of SWMU 25 and 1.5 miles southwest of SWMU 25 (ESI, 2005). In June 2005, one Indiana bat was captured at the location east of SWMU 25 and no Indiana bats were captured at the location southwest of SWMU 25.

The USFWS issued a notice in the Federal Register (72 FR 37346 et seq.) on July 9, 2007, that effective August 8, 2007, the American bald eagle would be removed from the Federal List of Endangered and Threatened Wildlife and Plants. The American bald eagle is still protected by the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. The bald eagle is known to be present at Lake Greenwood, approximately 2.5 miles north of SWMU 25.

In addition, a number of state endangered and federal and state species of concern have been listed for NSA Crane (Comarco Systems, 2000). The state endangered species list includes two mammals (bobcat and Indiana bat), one reptile (timber rattlesnake), and several birds (bald eagle, osprey, northern harrier,

sedge wren, loggerhead shrike, yellow-crowned night-heron, Virginia rail, king rail, and Henslow's sparrow).

8.2.1.2 Site-Specific Environmental Setting

SWMU 25 Highway Dump Site A is located in the central-northwest portion of NSA Crane. SWMU 25 is a heavily wooded site covering approximately 11 acres; however, the potentially impacted portion of the SWMU (the area adjacent to Highway 58 where debris was left in place after an IM), is only about 0.3 acres.

Lake Greenwood is located approximately 2.5 miles north of the site. A small creek, with intermittent flow, is located approximately 200 feet east of SWMU 25 that drains into Turkey Creek, which eventually drains into the East Fork of the White River.

8.2.2 Potential Sources of Contamination

Debris was buried at the site in two dump areas adjacent to Highway 58. Debris disposed of at the site included paper, concrete, pipe, scrap metal, paint thinners, and oil. A 1995-1995 IM removed metal debris as deep as 2 feet bgs. Some debris was left in place, such as concrete-filled hardware used as backfill to support Highway 58.

8.2.3 Physical and Chemical Characteristics

SVOCs and metals were detected in soil samples from SWMU 25. Physical and chemical characteristics of contaminants may affect their mobility, transport, and bioavailability in the environment. These characteristics include bioaccumulation factors (BAFs), K_{OC}s, and K_{OW}s. See Section 6.0 for an overview of contaminant movement in environmental media at SWMU 25. .

8.2.4 Potential Exposure Pathways

Section 1 of this report presents detailed descriptions of operational history, previous investigations, and the potential sources of contamination for SWMU 25. Chemicals may have been directly deposited to surface soil or may have leached into soil from debris buried at the site.

Several groups of terrestrial ecological receptors can be exposed to contaminants in surface soil. Invertebrates such as earthworms are exposed to contaminants as they move through the soil and ingest soil particles while searching for food. Plants are exposed to contaminants via direct contact as

contaminants are absorbed through the roots. After absorption through roots, contaminants are translocated to different parts of the plants (e.g., leaves, seeds). These pathways are evaluated in the ERA.

Small mammals may be exposed to contaminants in soil via several exposure routes. They may be exposed by direct contact as they search for food or burrow into the soil. Exposure of terrestrial wildlife to contaminants in the soil via dermal contact is unlikely to represent a major exposure pathway because fur, feathers, and chitinous exoskeletons are expected to minimize transfer of contaminants across dermal tissue. Therefore, the dermal pathway was not evaluated in the ERA. Small mammals also may be exposed to contaminants in soil via incidental ingestion of soil and ingestion of plants and/or invertebrates that have accumulated contaminants. Larger predatory species such as the red fox and red-tailed hawk can be indirectly exposed to soil contaminants by ingesting small mammals that have accumulated contaminants from soil. Because the potentially impacted portion of the site is very small, mammals and birds would only obtain a small portion of their diet from the site so these pathways are not evaluated in the ERA.

Terrestrial receptors are not substantially exposed to subsurface soils, so that pathway was not evaluated in the ERA. For this project, the surface soil depth interval was 0 to 2 feet bgs.

8.2.5 Assessment Endpoints and Measurement Endpoints

Assessment endpoints are explicit expressions of the environmental value to be protected (USEPA, 1997). These endpoints are selected based on habitats present, migration pathways of probable contaminants, and relevant exposure routes for receptors. Measurement endpoints are estimates of measurable biological impacts (e.g., mortality, growth, and reproduction) that are used to evaluate the assessment endpoints. Table 8-1 presents the assessment endpoints and measurement endpoints used to evaluate SWMU 25 data.

8.2.5.1 Assessment Endpoints

Based on forested habitat present at SWMU 25 and the chemicals present at the site, the assessment endpoints include protection of the following groups of receptors from adverse effects of contaminants on their growth, survival, and reproduction:

- Terrestrial vegetation
- Soil invertebrates

The following paragraphs discuss the above assessment endpoints.

Terrestrial Vegetation: Terrestrial vegetation at SWMU 25 consists of grasses, shrubs, and trees. They serve as a food source and provide shade and cover for many organisms, and help to prevent soil erosion, among other important functions. They can accumulate certain contaminants that can then be transferred to higher trophic-level organisms that consume plants.

Soil Invertebrates: Soil invertebrates are present in soil at SWMU 25. They aid in the formation of soil and the redistribution and decomposition of organic matter in the soil, and they serve as a food source for higher trophic-level organisms. They also can accumulate bioaccumulative contaminants that can then be transferred to higher trophic-level organisms that consume soil invertebrates.

8.2.5.2 Measurement Endpoints

The following measurement endpoints were used to evaluate the assessment endpoints in the ERA:

- Soil screening values - Mortality, growth, and reproduction of plants and soil invertebrates were evaluated by comparing the measured concentrations of chemicals in surface soil to screening values designed to be protective of ecological receptors.

8.2.5.3 Selection of Receptor Species

Many receptors in SWMU 25 soil can be grouped into general categories, such as invertebrates and vegetation. This is a reflection of the nature of the threshold values, effects values, or criteria typically used to characterize risk for such organisms.

8.2.6 Conceptual Site Model

A CSM in ERA problem formulation is a written description of predicted relationships between ecological entities and the stressors to which they may be exposed (USEPA, 1998). The CSM consists of two primary components: predicted relationships among stressor, exposure, and assessment endpoint response, and a diagram that illustrates the relationships (USEPA, 1998). At SWMU 25, the primary source of chemicals is from buried debris. SVOCs and metals may have been released to the environment by direct deposition and leaching from buried debris. The primary stressors to ecological receptors are contaminants in surface soil. The primary receptors for contaminants in surface soil are plants and soil invertebrates. Figure 8-2 represents the ecological CSM for SWMU 25.

8.3 TIER 1, STEP 2: SCREENING-LEVEL EXPOSURE ESTIMATE AND RISK QUOTIENTS

8.3.1 Ecological Effects Evaluation

The preliminary ecological effects evaluation investigates the relationship between the magnitude of chemical exposure and the nature and magnitude of adverse effects resulting from exposure. In addition to being a toxicological evaluation, it may also include descriptions of apparent effects seen during the site visit (e.g., stressed vegetation). Toxicity thresholds are usually expressed in units of concentration when the medium of concern is in intimate contact with the receptor, such as soil for soil invertebrates.

8.3.2 Exposure Characterization

As the first step in the ecological effects evaluation, COPCs were selected by comparing contaminant concentrations in surface soil to ecological screening levels. For surface soil, chemical concentrations were compared to USEPA Ecological Soil Screening Levels (Eco SSLs) (USEPA, 2007a and supporting documents) because they are the most current screening levels. If USEPA Eco SSLs were not available, Region 5 soil ESLs (USEPA, 2003a) were used next, followed by the values from Canadian Soil Quality Guidelines (Canadian Council of Ministers of the Environment [CCME], 1999a-c, 2001, 2010) and the Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for plants (Efroymson et al., 1997a) and invertebrates (Efroymson et al., 1997b). Note that because most of the Region 5 ESLs are based on risks to mammals; screening levels specific to plants or invertebrates from other sources were used preferentially for those endpoints, when available. Table 8-2 presents the SSLs for plants and invertebrates for each chemical and the sources of each value.

8.3.3 Risk Characterization

An Ecological Effects Quotient (EEQ) approach was used to characterize the risk to ecological receptors. This approach characterizes potential effects by comparing exposure concentrations with effects data. The EEQs for terrestrial receptors were calculated as follows:

$$EEQ = \frac{Css}{SSSL}$$

where: EEQ = Ecological Effects Quotient (unitless)

C_{ss} = Contaminant concentration in surface soil (µg/kg)

SSSL = Surface soil screening level (µg/kg)

An EEQ of greater than 1.0 indicates potential risk. Such values do not necessarily indicate that an effect will occur but only that a low (i.e., conservative) threshold has been exceeded.

8.3.4 Tier 1, Step 2: Selection of Contaminants of Potential Concern

Table 8-3 provides the results of the COPC selection for surface soil. The following rules were used to select COPCs for SWMU 25:

- A contaminant was selected as a COPC for risks to terrestrial plants and soil invertebrates if the maximum detected concentration in surface soil exceeded the associated screening level or a screening level was not available.

- Calcium, magnesium, potassium, and sodium were not selected as COPCs because they are naturally occurring, essential nutrients that can be tolerated by living systems at high concentrations. No evidence indicates that these chemicals are related to site operations, and they are not considered hazardous chemicals.

Contaminants retained as COPCs were further evaluated as part of Step 3a of the eight-step ERA process.

8.3.4.1 Terrestrial Plants

Eleven SVOCs and two metals were selected as COPCs because screening levels were not available. Four metals were selected as COPCs because they were detected at a maximum concentration that resulted in an EEQ greater than 1.0.

8.3.4.2 Soil Invertebrates

Five SVOCs and two metals were selected as COPCs because screening levels were not available. Four metals were selected as COPCs because they were detected at a maximum concentration that resulted in an EEQ greater than 1.0.

8.4 TIER 2, STEP 3A – COPC REFINEMENT

Step 3a consists of refining the conservative exposure assumptions/concentrations used to evaluate potential risks to ecological receptors and re-evaluating the analytical data using benchmarks that are more appropriate for the assessment endpoints. The Step 3a refinement determines which chemicals

contribute to potentially unacceptable levels of ecological risk, and eliminates from further consideration COPCs initially selected because of the use of very conservative exposure scenarios but that are not likely causing a significant risk. The Step 3a evaluation can also eliminate chemicals from further evaluation for certain groups of receptors that are not at significant risk. For example, a chemical might not be retained as a COPC in soil for plants based on low risks to plants but the same chemical might be retained as a COPC based on risks to invertebrates. This is important because if the site proceeds to a baseline ERA (BERA), the studies in the BERA should only focus on the receptors that are at potential risk.

For chemicals evaluated further in Step 3a, the following factors were used, as appropriate, to determine if the risks are great enough to warrant additional evaluations (i.e., proceed to a BERA, develop cleanup levels, proceed to a Corrective Measures Study [CMS]). All of these factors may not be discussed for each chemical and/or receptor group.

- Magnitude of criterion exceedance: Although the magnitude of risks may not relate directly to the magnitude of a criterion exceedance, the magnitude of the criterion exceedance may be one item used in a lines-of-evidence approach to determine the need for further site evaluation. The greater the criterion exceedance, the greater the probability that an unacceptable risk exists.

- Frequency of chemical detection and spatial distribution: A chemical detected at a low frequency typically is of less concern than a chemical detected at a higher frequency if, concentrations and spatial areas are similar. All else being equal, chemicals detected frequently were given greater consideration than those detected relatively infrequently. In addition, the spatial distribution of a chemical may be evaluated to determine the area that a sample represents.

- Contaminant bioavailability: Many contaminants (especially inorganics) are present in the environment in forms that are typically not bioavailable. Bioavailability of site contaminants was considered when evaluating receptor exposure. Contaminants with generally less bioavailability are considered to be less toxic than more bioavailable contaminants, all other factors being equal.

- Alternate benchmarks: Alternate benchmarks are other toxicity values that can be used to further evaluate risks to specific groups of ecological receptors (e.g., plants, invertebrates). These benchmarks are used to evaluate risks to chemicals that do not have established screening levels or whose screening values are very conservative and may not be specific to the endpoint being evaluated. They can also be used to present another line of evidence regarding whether the chemical is likely to impact ecological receptors.

- Background: Concentrations of chemicals in surface soil were compared to background concentration data. Based on comparison of site data to UTLs for Group 1 surface soil samples from Crane Basewide Background Report (Tetra Tech, 2001), concentrations of aluminum, barium, beryllium, cobalt, manganese, mercury, nickel, thallium, vanadium, and zinc were determined to be similar to background. Therefore, these metals were eliminated as COPCs in surface soil and were not further evaluated.

Table 8-4 presents a summary of the Step 3a evaluation for terrestrial plants and soil invertebrates. The following sections present a detailed discussion of the Step 3a evaluation.

8.4.1 Tier 2, Step 3a: Terrestrial Plants

Several PAHs were selected as COPCs because screening levels were not available. An Eco SSL is not available for plants for PAHs; however, data presented on Table 3.1 in the Eco SSL document for PAHs (USEPA, 2007e) show that PAHs are typically not toxic to plants except at high soil concentrations with the lowest listed EC_{50} of 30,000 µg/kg (Mitchell et al., 1988). The EC_{50} is the concentration when a 50% sublethal response impacts a specific species. All PAH concentrations at SWMU 25 are well below this value. Also, PAH concentrations are less than the CCME anthracene screening value (2,500 µg/kg), which is the lowest screening levels for any of the PAHs (see Table 8-2) (CCME, 2010). It does not appear that PAH concentrations in soil at SWMU 25 are likely to impact plants because all detected concentrations are significantly less than these benchmarks. Therefore, PAHs were eliminated as COPCs.

Bis(2-ethylhexyl)phthalate and butyl benzyl phthalate were initially selected as COPCs because screening levels were not available. Bis(2-ethylhexyl)phthalate was detected in four of 11 samples at a maximum concentration of 35 µg/kg. Butyl benzyl phthalate was detected in only one of 11 samples at a concentration of 8 µg/kg. Concentrations of these phthalates were well below screening values available for other phthalates (100,000 µg/kg for diethyl phthalate and 200,000 µg/kg for di-n-butyl phthalate); therefore, adverse effects to plants are not expected. Therefore, bis(2-ethylhexyl)phthalate and butyl benzyl phthalate were eliminated as COPCs for plants.

Carbazole was initially selected as a COPC because a screening level was not available. Carbazole was detected in only one of 11 samples at a concentration of 8 µg/kg, but is structurally similar to some other PAHs, such as fluorene. Because of the low frequency of detection and relatively low detected concentration of carbazole, especially compared to the screening level for fluorene, adverse effects to

plants from carbazole are not expected. Also, because the site is vegetated, it does not appear that carbazole concentrations in soil are impacting plants. For these reasons, carbazole was eliminated as a COPC for plants.

Arsenic was initially selected as a COPC because its maximum concentration (24,000 µg/kg) exceeded the screening level (18,000 µg/kg). Arsenic concentrations exceeded its screening level in 2 of 11 samples (SB005 and SB010) located on opposite sides of Highway 58. Arsenic also exceeded its background UTL in several samples. The average site concentration (12,000 µg/kg) of arsenic was less than its screening level. Although risks to plants in this area cannot be ruled out, the area that is potentially impacted is very small; SB005 and SB010 are bounded within 35 to 40 feet by the road, the excavation area, or samples with arsenic concentrations below the screening level. Also, no stressed vegetation was observed to indicate that plants are being impacted. For these reasons, arsenic was eliminated as a COPC.

Iron was initially selected as a COPC for plants because soil sample pH values, which the screening level is based on, were not available. Concentrations of iron exceeded its background UTL (27,100,000 µg/kg) in five of 11 samples, although the average aluminum concentration at the site (28,700,000 µg/kg) only slightly exceeded the background UTL. Although pH data are not available, it is not likely that iron at the site is present in a highly bioavailable form. This is because the availability of ferrous vs. ferric iron is dependent on the soil-water status of a particular environment (among other factors) and oxidized environments (upland or well-aerated soils) promote the precipitation of ferric-oxide compounds, which are not available to plants for uptake (USEPA, 2003). The soil at the site would be considered upland soils. Also, no stressed vegetation was observed to indicate that plants are being impacted. For these reasons, iron was eliminated as a COPC.

Selenium was initially selected as a COPC because its maximum concentration (1400 µg/kg) exceeded the screening level (520 µg/kg). A background UTL was not available for selenium. Selenium was detected in three of 11 samples. Concentrations of selenium exceeded its screening level in all detected samples and detection limits for several nondetected results were also slightly greater than its screening level. The average selenium concentration was less than its screening level. In soil, the phytoavailability of selenium is several times greater for selenate (Se+6) than for selenite (Se+4), while elemental selenium is largely unavailable (CCME, 2009). Based on the relatively low levels of selenium, and based on the potential source (concrete filled hardware), it is likely that selenium is present in elemental form. Also, because the site is vegetated, it does not appear that selenium concentrations in soil are impacting plants at SWMU 25. For these reasons, selenium was eliminated as a COPC.

8.4.2 Tier 2, Step 3a: Soil Invertebrates

Carbazole and iron were eliminated as COPCs for soil invertebrates for reasons similar to those presented above.

Screening levels were not available for phthalates analyzed at SWMU 25, including bis(2-ethylhexyl)phthalate, butyl benzyl phthalate, di-n-butyl phthalate, and diethyl phthalate. There is an earthworm screening level for dimethylphthatate of 200,000 µg/kg (Efryomson et al., 1997b). Butyl benzyl phthalate, di-n-butyl phthalate, and diethyl phthalate were detected infrequently in only 1 of 11 samples at maximum concentrations of 8 to 11 µg/kg. Bis(2-ethylhexyl)phthalate was detected in 4 of 11 samples at a maximum concentration of 35 µg/kg. Because of the relatively low concentrations (especially compared to the screening level for dimethylphthatate) and/or the low frequency of detection, adverse effects to soil invertebrates from phthalates are not expected and they were eliminated as COPCs.

Arsenic was initially selected as a COPC because its maximum concentration (24,000 µg/kg) exceeded its screening level (17,000 µg/kg). Arsenic exceeded its screening level in 2 of 11 samples located on opposite sides of Highway 58. Arsenic also exceeded its background UTL in several samples. The average site concentration (12,000 µg/kg) of arsenic was less than its screening level. The selected screening level (17,000 µg/kg), is based on yield reduction in spinach (CCME, 1999). The No Observed Effects Concentration for arsenic, which was based on one earthworm study, was 50,000 µg/kg (CCME, 2001). Also, the ORNL benchmark for soil invertebrates is 60,000 µg/kg (Efryomson et al., 1997b). All SWMU 25 arsenic concentrations were much lower than these values. Therefore, adverse effects to soil invertebrates from arsenic are not expected and arsenic was eliminated as a COPC.

Chromium was initially selected as a COPC because its maximum concentration (29,000 µg/kg) exceeded its screening level (400 µg/kg). Chromium exceeded its background UTL in only two samples. The average chromium concentration was less than its background value. The Region 5 ESL for chromium is 0.4 mg/kg, which is a screening benchmark for hexavalent chromium. This value is overly conservative, as it is well below background levels. A more appropriate benchmark is the Canadian Soil Quality Guideline of 78,000 µg/kg (CCME, 1999a), based on protection of plants and soil invertebrates because it is based on a more robust data set. All concentrations of chromium were less than this benchmark. For these reasons, chromium was eliminated as a COPC.

8.5 ECOLOGICAL RISK UNCERTAINTY ANALYSIS

This section discusses some of the uncertainties associated with the SWMU 25 ERA.

8.5.1 Uncertainty in Assessment Endpoints and Measurement Endpoints

Measurement endpoints were used to evaluate the assessment endpoints selected for the ERA. For the ERA, the measurement endpoints were not the same as the assessment endpoints. Measurement endpoints were used to predict effects to the assessment endpoints by selecting surrogate species to be evaluated. Mammals and birds were not selected as assessment endpoints because the potentially impacted area is very small. Based on low chemical concentration (many were within background levels), lack of highly bioaccumulative chemicals, and the very small potentially impacted area, it is not likely that mammals or birds would be impacted at the site

As discussed in Section 8.2.1.1, several endangered and threatened species or species of special concern are present at NSA Crane and potentially may inhabit SWMU 25. Risks to these species were not specifically calculated, so the uncertainties of not calculating risks to these species are presented here. Unacceptable risks to the bobcat, bald eagle, northern harrier, and osprey are not expected because habitat is not available. The bobcat's home range is significantly larger than SWMU 25. The bald eagle and osprey require open water habitat, which is not available at SWMU 25, but is available in Lake Greenwood located approximately 2.5 miles from the site. The northern harrier prefers wetlands habitat, which are not available at SWMU 25. However, there is uncertainty with this conclusion because risks were not quantitatively evaluated.

Loggerhead shrikes and the sedge wren consume mostly aboveground insects such as caterpillars, beetles, spiders, and flies. Based on the very small size of SWMU 25, it is not likely that they would obtain a significant amount of their food from the site so potential impacts are not likely. As mentioned in Section 8.2.1.1, the Indiana bat has not been found at SWMU 25; however, one Indiana bat was captured at the mist net site one mile from SWMU 25.

Finally, there are uncertainties in risks to reptiles because there is a lack of exposure factors for reptiles and a lack of reptile toxicity data for the detected chemicals. As discussed in Section 8.2.1.1, one threatened reptilian species is listed as potentially present at NSA Crane. Based on the preferred habitat of the timber rattlesnake and the ecology of SWMU 25, this species likely does not inhabit SWMU 25.

8.5.2 Uncertainty in Exposure Characterization

There is uncertainty in the chemical data collected at the site, because measured levels of chemicals are only estimates of true site chemical concentrations. At SWMU 25, samples were collected in areas suspected to have high contaminant concentrations (the dump areas), so predicted doses are probably higher than actual doses. Actual exposure of ecological receptors to chemical concentrations at

SWMU 25 is likely overestimated. In particular, wildlife species with large home ranges are unlikely to obtain all of their food from the most contaminated areas at SWMU 25.

8.5.3 Uncertainty in Ecological Effects Data

Uncertainty exists in the ecological effects data, including the screening levels. Several of the screening levels are very conservative, and typically are based on studies where the bioavailability of the chemical is much greater than it is in the environment. Also, toxicity data was not available or was limited for some chemicals.

8.5.4 Uncertainty in Risk Characterization

Risks are possible if an EEQ is greater than or equal to 1.0, regardless of the magnitude of the EEQ. Therefore, the magnitude of effects to ecological receptors cannot be inferred based on the magnitude of the EEQ. Rather, an EEQ greater than 1.0 simply indicates that the dose used to derive the toxicity reference value was exceeded.

Finally, there is uncertainty in how the predicted risks to a species at a site translate into risk to the population in the area as a whole.

8.6 ECOLOGICAL RISK SUMMARY AND CONCLUSIONS

This ERA evaluated SWMU 25 surface soil. Based on the initial screening of the chemical data, several chemicals were selected as COPCs in surface soil because they were detected at concentrations that exceeded conservative screening levels, they had EEQs greater than 1.0 in the conservative food chain model, or because they did not have screening levels. These chemicals were then further evaluated to refine the list of COPCs, and to better characterize risks to ecological receptors. Based on the risk refinement evaluation, no chemicals were retained as COPCs to terrestrial plants and soil invertebrates.

TABLE 8-1

ASSESSMENT ENDPOINTS AND MEASUREMENT ENDPOINTS
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Assessment Endpoint	Measurement Endpoint
Adverse effects on the survival, reproduction, and/or growth of soil invertebrates	• Survival, growth, and/or reproduction of soil invertebrates were evaluated by comparing the measured concentrations of chemicals in the surface soil to invertebrate soil screening levels.
Adverse effects on the survival, reproduction, and/or growth of terrestrial plants	• Survival, growth, and/or reproduction of terrestrial plants were evaluated by comparing the measured concentrations of chemicals in the surface soil to plant soil screening levels.

TABLE 8-2

SOIL SCREENING LEVELS
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Parameter	Ecological Soil Screening Level			
	Plant		Invertebrate	
	Value	Source	Value	Source
METALS (UG/KG)				
ALUMINUM	NA[1]	NA	NA[1]	NA
ARSENIC	18000	Eco SSL	17000	CCME
BARIUM	500000	ORNL	330000	Eco SSL
BERYLLIUM	10000	ORNL	40000	Eco SSL
CADMIUM	32000	Eco SSL	140000	Eco SSL
CHROMIUM	78000	CCME	400	Region 5
COBALT	13000	Eco SSL	1000000	ORNL[2]
COPPER	70000	Eco SSL	80000	Eco SSL
IRON	NA[3]	NA	200000	ORNL[2]
LEAD	120000	Eco SSL	1700000	Eco SSL
MANGANESE	220000	Eco SSL	450000	Eco SSL
MERCURY	12000	CCME	100	Region 5
NICKEL	38000	Eco SSL	280000	Eco SSL
SELENIUM	520	Eco SSL	4100	Eco SSL
SILVER	560000	Eco SSL	50000	ORNL[2]
THALLIUM	1000	ORNL	NA	NA
VANADIUM	130000	CCME	130000	CCME
ZINC	160000	Eco SSL	120000	Eco SSL
SEMIVOLATILES (UG/KG)				
ACENAPHTHYLENE	20000	ORNL[4]	29000	Eco SSL
ANTHRACENE	2500	CCME	29000	Eco SSL
BENZO(A)ANTHRACENE	NA	NA	18000	Eco SSL
BENZO(A)PYRENE	20000	CCME	18000	Eco SSL
BENZO(B)FLUORANTHENE	NA	NA	18000	Eco SSL
BENZO(G,H,I)PERYLENE	NA	NA	18000	Eco SSL
BENZO(K)FLUORANTHENE	NA	NA	18000	Eco SSL
BIS(2-ETHYLHEXYL)PHTHALATE	NA	NA	NA	NA
BUTYL BENZYL PHTHALATE	NA	NA	NA	NA
CARBAZOLE	NA	NA	NA	NA
CHRYSENE	NA	NA	18000	Eco SSL
DI-N-BUTYL PHTHALATE	200000	ORNL	NA	NA
DIETHYL PHTHALATE	100000	ORNL	NA	NA
FLUORANTHENE	50000	CCME	29000	Eco SSL
INDENO(1,2,3-CD)PYRENE	NA	NA	18000	Eco SSL
PHENANTHRENE	NA	NA	29000	Eco SSL
PYRENE	NA	NA	18000	Eco SSL

Ecological Screening Level sources used in the order of preference:
EcoSSL - EPA Ecological Soil Screening Levels (USEPA, 2005a-f, 2006, 2007b-g)
Region 5 - USEPA Region 5 Ecological Screening Levels (USEPA, 2003)
CCME - Canadian Soil Quality Guidelines (CCME, 1999a-c, 2001, 2010)
ORNL - Oak Ridge National Laboratory Toxicological Benchmarks for plants and invertebrates (Efroymson et al., 1997a, 1997b)

NA - Not available.

Footnotes:
1 - Only considered a COPC when the soil pH is less than 5.5.
2 - Value for microorganisms.
3 - Not expected to be toxic to plants with a soil pH between 5 and 8.
4 - Acenaphthene used as surrogate.

TABLE 8-3

SURFACE SOIL COPC SELECTION
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Concentration	Maximum Concentration	Sample of Maximum Detection	Averge of Positive Results(1)	Average of All Results(2)	Background Concentration(3)	Ecological Screening Level(4)		Ecological Effects Quotient(5)		Deletion or Selection of COPCs for Invertebrates/Plants	
								Plant	Invertebrate	Plant	Invertebrate	COPC (yes/no)?	Rationale
METALS (UG/KG)													
ALUMINUM	11/11	5200000 J	20000000 J	25SS0010002	9550000	9550000	22800000	NA	NA	**NA**	**NA**	**YES**	NSL
ARSENIC	11/11	4200 J	24000	25SS0100002	12000	12000	10600	18000	17000	**1.3**	**1.4**	**YES**	ASL
BARIUM	11/11	28000 J	87000 J	25SS0010002	62000	62000	262000	500000	330000	0.17	0.26	NO	BSL
BERYLLIUM	10/11	340 J	820	25SS0050002	642	600	1030	10000	40000	0.082	0.021	NO	BSL
CADMIUM	9/11	310	760	25SS0050002	453	392	NA	32000	140000	0.024	0.005	NO	BSL
CHROMIUM	11/11	7900	29000	25SS0050002	18500	18500	22200	78000	400	0.37	**72.5**	**YES**	ASL
COBALT	11/11	1900 J	21000	25SS0110002	10000	10000	27400	13000	1000000	**1.6**	0.021	**YES**	ASL
COPPER	11/11	9100	18000	25SS0010002	13600	13600	17700	70000	80000	0.26	0.23	NO	BSL
IRON	11/11	8200000 J	63000000	25SS0090002	28700000	28700000	27100000	NA	200000	**NA**	**315**	**YES**	ASL, NSL
LEAD	11/11	6400	53000	25SS0050002	21900	21900	23000	120000	1700000	0.44	0.031	NO	BSL
MANGANESE	11/11	110000 J	1600000	25SS0110002	572000	572000	5450000	220000	450000	**7.3**	**3.6**	**YES**	ASL
MERCURY	11/11	6 J	56	25SS0010002	29.0	29.0	108	12000	100	0.0047	0.56	NO	BSL
NICKEL	11/11	7100	24000	25SS0110002	13600	13600	26200	38000	280000	0.63	0.086	NO	BSL
SELENIUM	3/11	570 J	1400 J	25SS0090002	913	445	NA	520	4100	**2.7**	0.34	**YES**	ASL
SILVER	11/11	20 J	120 J	25SS0050002	55.1	55.1	105	560000	50000	0.00021	0.0024	NO	BSL
THALLIUM	11/11	110 J	300 J	25SS0010002; 25SS0080002	178	178	412	1000	NA	0.30	**NA**	**YES**	NSL
VANADIUM	11/11	7900	40000	25SS0080002	23900	23900	49700	130000	130000	0.31	0.31	NO	BSL
ZINC	11/11	24000 J	81000 J	25SS0050002	45400	45400	135000	160000	120000	0.51	0.68	NO	BSL
SEMIVOLATILES (UG/KG)													
ACENAPHTHYLENE	3/11	12 J	30 J	25SS0030002	23.7	10.5	NA	20000	29000	0.0015	0.0010	NO	BSL
ANTHRACENE	2/11	10	12	25SS0050002	11.0	5.6	NA	2500	29000	0.0048	0.00041	NO	BSL
BENZO(A)ANTHRACENE	5/11	13	42	25SS0030002	29.2	18.7	NA	NA	18000	**NA**	0.0023	**YES**	NSL
BENZO(A)PYRENE	5/11	16	55	25SS0030002	35.8	19.0	NA	20000	18000	0.0028	0.0031	NO	BSL
BENZO(B)FLUORANTHENE	5/11	19	64	25SS0070002	44.0	22.7	NA	NA	18000	**NA**	0.0036	**YES**	NSL
BENZO(G,H,I)PERYLENE	5/11	13	53	25SS0070002	30.0	15.8	NA	NA	18000	**NA**	0.0029	**YES**	NSL
BENZO(K)FLUORANTHENE	4/11	13 J	32	25SS0030002; 25SS0070002	26.0	12.7	NA	NA	18000	**NA**	0.0018	**YES**	NSL
BIS(2-ETHYLHEXYL)PHTHALATE	4/11	14 J	35 J	25SS0070002	21.8	15.1	NA	NA	NA	**NA**	**NA**	**YES**	NSL
BUTYL BENZYL PHTHALATE	1/11	8 J	8 J	25SS0050002	8.0	9.5	NA	NA	NA	**NA**	**NA**	**YES**	NSL
CARBAZOLE	1/11	8 J	8 J	25SS0050002	8.0	17.8	NA	NA	NA	**NA**	**NA**	**YES**	NSL
CHRYSENE	5/11	13	44	25SS0030002	31.6	16.5	NA	NA	18000	**NA**	0.0024	**YES**	NSL
DI-N-BUTYL PHTHALATE	1/11	11 J	11 J	25SS0050002	11.0	10.9	NA	200000	NA	0.00006	**NA**	**YES**	NSL
DIETHYL PHTHALATE	1/11	8 J	8 J	25SS0050002	8.0	10.6	NA	100000	NA	0.00008	**NA**	**YES**	NSL
FLUORANTHENE	5/11	11	52	25SS0070002	36.6	19.4	NA	50000	29000	0.0010	0.0018	NO	BSL
INDENO(1,2,3-CD)PYRENE	3/11	18	38	25SS0070002	29.3	13.8	NA	NA	18000	**NA**	0.0021	**YES**	NSL
PHENANTHRENE	4/11	15	25	25SS0070002	21.5	10.9	NA	NA	29000	**NA**	0.00086	**YES**	NSL
PYRENE	5/11	12	55	25SS0070002	39.6	20.7	NA	NA	18000	**NA**	0.0031	**YES**	NSL

Ecological effects quotients are shaded if the maximum detected concentration exceeds a screening level or a screening level is not available.
Other cells are shaded if the chemical is retained as a COPC for plants or invertebrates.
Footnotes:
1 - Average of detected concentrations only.
2 - Average of all analytical results including one-half of the detection limit for non-detects.
3 - Upper Tolerance Limit for Group 1 surface soil samples from Crane Basewide Background Report (Tetra Tech, 2001).
4 - Sources of ecological screening levels are presented in Table 8-2.
5 - Ecological Effects Quotients (EEQs) were calculated by dividing the maximum detected concentration by the ecological screening level. Values are unitless.

TABLE 8-4

STEP 3A EVALUATION FOR RISKS TO PLANTS AND INVERTEBRATES
SURFACE SOIL COPCs
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern (COPC)	Frequency of Detection	Maximum Detected Concentration	Screening Level[1]		Maximum EEQ[2]		Step 3a Evaluation[3]				Risk Determination (Acceptable/ Unacceptable)	Retained as a COPC?	
							Alternate Benchmark		Step 3a Factors Considered in Evaluation				
			Plants	Invertebrates	Plants	Invertebrates	Value	Source	Plants	Invertebrates		Plants	Invertebrates
METALS (UG/KG)													
ALUMINUM	11/11	20000000	NA	NA	NA	NA	NA	NA	Consistent with background.		Acceptable	No	No
ARSENIC	11/11	24000	18000	17000	1.3	1.4	NA	NA	Exceeded screening level in two samples. Average site concentration less than screening level. Vegetated site.	Exceeded screening level in two samples. Average site concentration less than screening level. Concentrations less than NOEC for earthworms.	Acceptable	No	No
CHROMIUM	11/11	29000	78000	400	0.37	72.5	78	CCME	Not a COPC for plants.	Less than alternate benchmark.	Acceptable	No	No
COBALT	11/11	21000	13000	1000000	1.6	0.021	NA	NA	Consistent with background.	Not a COPC for invertebrates.	Acceptable	No	No
IRON	11/11	63000000	NA	200000	NA	315	NA	NA	Limited bioavailability.		Acceptable	No	No
MANGANESE	11/11	1600000	220000	450000	7.3	3.6	NA	NA	Consistent with background.		Acceptable	No	No
SELENIUM	3/11	1400	520	4100	2.7	0.34	NA	NA	Average site concentration less than screening level. Likely present as elemental selenium which is largely not bioavailable.	Not a COPC for invertebrates.	Acceptable	No	No
THALLIUM	11/11	300	1000	NA	0.30	NA	NA	NA	Not a COPC for plants.	Consistent with background.	Acceptable	No	No
SEMIVOLATILES (UG/KG)													
BENZO(A)ANTHRACENE	5/11	42	NA	18000	NA	0.0023	NA	NA	Maximum concentration less than benchmarks for other PAHs.	Not a COPC for invertebrates.	Acceptable	No	No
BENZO(B)FLUORANTHENE	5/11	64	NA	18000	NA	0.0036	NA	NA		Not a COPC for invertebrates.	Acceptable	No	No
BENZO(G,H,I)PERYLENE	5/11	53	NA	18000	NA	0.0029	NA	NA		Not a COPC for invertebrates.	Acceptable	No	No
BENZO(K)FLUORANTHENE	4/11	32	NA	18000	NA	0.0018	NA	NA		Not a COPC for invertebrates.	Acceptable	No	No
BIS(2-ETHYLHEXYL)PHTHALATE	4/11	35	NA	NA	NA	NA	NA	NA	Maximum concentration less than benchmarks for other phthalates.	Low concentration compared to benchmarks for invertebrates for other SVOCs. Also, relatively low frequency of detection.	Acceptable	No	No
BUTYL BENZYL PHTHALATE	1/11	8	NA	NA	NA	NA	NA	NA			Acceptable	No	No
CARBAZOLE	1/11	8	NA	NA	NA	NA	NA	NA	Low concentration compared to benchmarks for plants and invertebrates for other SVOCs. Also, relatively low frequency of detection.		Acceptable	No	No
CHRYSENE	5/11	44	NA	18000	NA	0.0024	NA	NA	Maximum concentration less than benchmarks for other PAHs.	Not a COPC for invertebrates.	Acceptable	No	No
DI-N-BUTYL PHTHALATE	1/11	11	200	NA	0.055	NA	NA	NA	Not a COPC for plants.	Low concentration compared to benchmarks for invertebrates for other SVOCs. Also, relatively low frequency of detection.	Acceptable	No	No
DIETHYL PHTHALATE	1/11	8	100	NA	0.080	NA	NA	NA	Not a COPC for plants.		Acceptable	No	No
INDENO(1,2,3-CD)PYRENE	3/11	38	NA	18000	NA	0.0021	NA	NA	Maximum concentration less than benchmarks for other PAHs.	Not a COPC for invertebrates.	Acceptable	No	No
PHENANTHRENE	4/11	25	NA	29000	NA	0.00086	NA	NA		Not a COPC for invertebrates.	Acceptable	No	No
PYRENE	5/11	55	NA	18000	NA	0.0031	NA	NA		Not a COPC for invertebrates.	Acceptable	No	No

Footnotes:

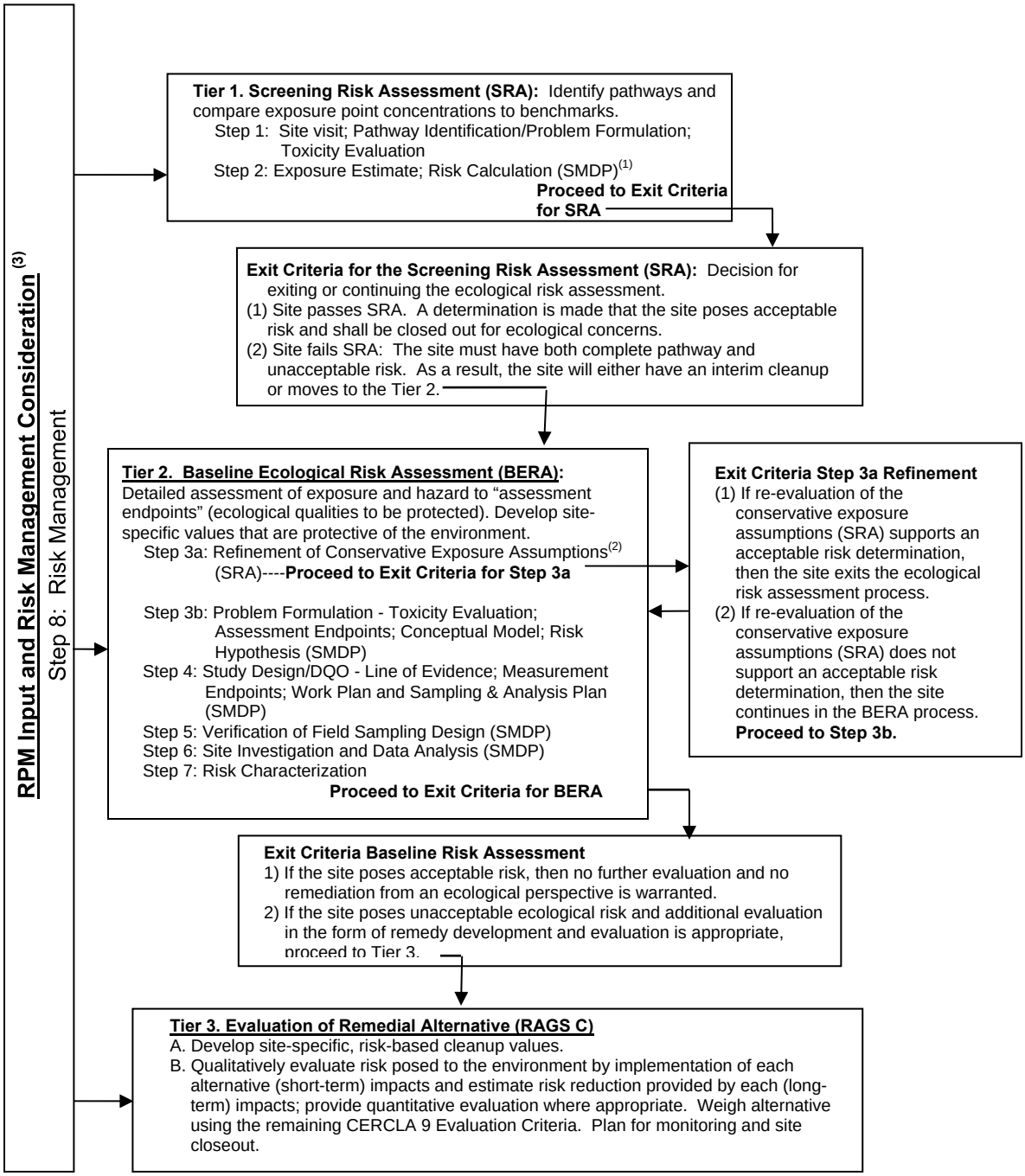
1 Sources of ecological screening levels presented in Table 8-2.
2 Maximum detection divided by screening level.
3 See Section 8.4 for a more detailed Step 3a evaluation.

Acronyms:

CCME = Canadian Council of Ministers of the Environment
COPC = Chemical of Potential Concern
EEQ = Ecological Effects Quotient
NA = Not Available or Not Applicable

FIGURE 8-1

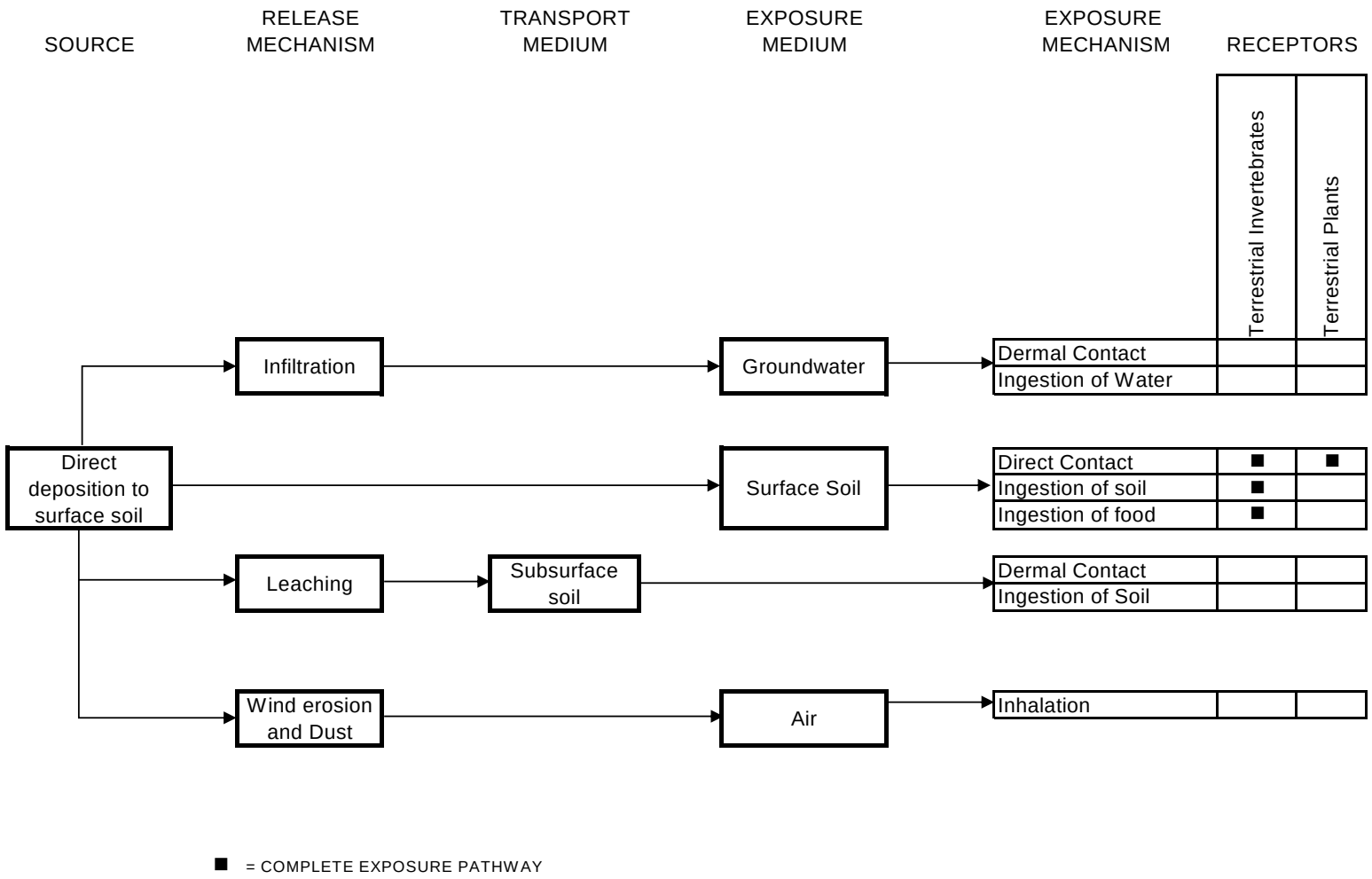
NAVY ECOLOGICAL RISK ASSESSMENT TIERED APPROACH
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA



Notes: 1 See USEPA's 8 Steps ERA Process for requirements for each Scientific Management Decision Point (SMDP).
2 Refinement includes but is not limited to background, bioavailability, detection frequency, etc.
3 Risk management is incorporated throughout the tiered approach.

FIGURE 8-2

CONCEPTUAL SITE MODEL FOR ECOLOGICAL RISK ASSESSMENT
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA



Blank space indicates incomplete exposure pathway or relatively insignificant or not applicable potential exposure.

9.0 CONCLUSIONS AND RECOMMENDATIONS

Potential contaminants originally identified for investigation at SWMU 25 spanned a wide range of organic and inorganic chemicals with various physicochemical properties. Early investigations narrowed the potentially significant contaminants to metals and SVOCs. Risks to various human and ecological receptors from exposure to potential site-related contaminants in soil and groundwater have been evaluated. Hypothetical future residents using groundwater as potable water were determined to be potentially exposed to an unacceptable level of risk from exposure to the groundwater, however, it is unlikely that a resident would use the turbid groundwater as potable water. Risks for all other receptors were found to be acceptable. Confirmation sampling during the SWMU 25 IM indicated that site-related soil contaminant concentrations were reduced to concentrations less than the cleanup levels established in RCRA Corrective Action Guidance Human Data Quality Levels for RFI Projects (USEPA, 1994) with the exception of arsenic, beryllium, and cobalt. Removal of the metal contaminant source from soil should have reduced groundwater metal concentrations to more acceptable levels because the dumped materials in the soil were the source of groundwater contamination. This contaminant source removal with persistent elevated metal concentrations creates an inconsistency that is difficult to explain unless other factors are considered. Therefore, a weight of evidence argument is provided below to place the estimated risks into perspective.

Human health risks were estimated by sampling environmental media, measuring contaminant concentrations in the media, and translating the measured contaminant concentrations into risk estimates (e.g., potential for adverse risk to human health) based on models that relate receptor exposure to risk. The accuracy of the risk estimates depends in part on how adequate the analytical results represent true exposure point concentrations. When samples or analyses are not representative of the intended environmental media, the risk estimates are likely to be skewed.

Despite efforts to obtain samples representative of groundwater that a resident could be exposed to, the groundwater samples collected at SWMU 25 were turbid and very likely do not that represent true exposure for human receptors. The chemical analytical results for some of these samples were dismissed as not being representative of typical groundwater samples both because the samples displayed excessive turbidity and because the sampled wells were apparently compromised. Other groundwater samples displayed elevated turbidity levels, but the casings of the wells from which those samples were drawn were not compromised, and the associated data were retained for risk evaluation despite the turbidity. The analytical data from turbid samples yielded elevated metal concentrations suggesting that human exposure to metal contaminants in groundwater could be unacceptable for the most sensitive receptors evaluated. The turbidity, however, is associated with suspended solids (colloidal

clays and other metal-bearing minerals) from geologic materials. The detection of elevated metal concentrations in turbid groundwater samples is therefore expected. Furthermore, human residents typically do not drink such turbid water; therefore, the elevated metal concentrations represent much higher metal concentration exposures than would normally be expected to be ingested, inhaled, or dermally contacted by a presumed future resident residing within the limits for SWMU 25. The association of elevated metal concentrations with turbidity was confirmed when metal concentrations from turbid samples were compared with metal concentrations from the same samples after filtering the samples to remove the turbidity. The results showed significant decreases in the maximum concentrations of metals. The magnitude of the decrease can be illustrated by comparison of the maximum concentrations of total and dissolved metals to the NSA Crane Pennsylvanian Aquifer Background UCLs. The maximum concentrations of nine total metals exceed the background UCLs. No maximum concentrations of dissolved metals exceed background.

Other confounding factors are also important. For example, samples collected from off-site virgin soil borrow confirmed that levels of arsenic, greater than environmental cleanup levels are naturally present in soils in the area surrounding SWMU 25. This is likely to explain the elevated concentrations observed in both upgradient and downgradient groundwater monitoring wells (Morrison Knudsen, 1999). In addition, SWMU 25 is located on the edge of a hillside adjacent to Highway 58. The land surface slopes steeply downward from Highway 58 down to the Turkey Creek tributary. This slope is about 33 percent. Future residential use of the SWMU 25 site is considered to be unlikely due to the steep slope of the property, which would tend to limit or more likely prevent human exposure to metals in the groundwater within and near SWMU 25, especially for those receptors who were identified as having an unacceptable exposure risk. The risks to these receptors would be significantly less than the calculated risks generated as part of the SWMU 25 HHRA.

Based on these observations, which constitute a significant weight of evidence, a recommendation of no further action (NFA) is appropriate for SWMU 25

TABLE 9-1

COMPARISON OF GROUNDWATER TOTAL AND DISSOLVED CONCENTRATIONS TO PENNSYLVANIAN AQUIFER BACKGROUND UCLS
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CAS Number	Chemical	Minimum Concentration	Maximum Concentration	PA Aquifer 95% UCL	Units	Sample of Maximum Concentration	Exceeds PA Aquifer 95% UCL?
Total Metals							
7429-90-5	Aluminum	39 J	5,630	6,183.0	µg/L	25MW738102	No
7440-38-2	Arsenic	2	**127**	9.1	µg/L	25MW728102	Yes
7440-39-3	Barium	9.3 J	110	96.9	µg/L	25GW738101	Yes
7440-41-7	Beryllium	0.329 J	0.873 J	2.0	µg/L	25MW728102	No
7440-43-9	Cadmium	0.46	**1.09 J**	0.6	µg/L	25MW728102	Yes
7440-47-3	Chromium	1.8 J	**85.4**	14.6	µg/L	25MW738102	Yes
7440-48-4	Cobalt	3.9	**149**	65.5	µg/L	25MW728102	Yes
7440-50-8	Copper	1.4 J	18.8	14.6	µg/L	25MW728102	Yes
7439-89-6	Iron	3,300	**146,000**	34,500.0	µg/L	25MW728102	Yes
7439-92-1	Lead	2.4	14.5	9.0	µg/L	25MW728102	Yes
7439-96-5	Manganese	810 J	**7,440**	4,470.0	µg/L	25MW728102	Yes
7440-02-0	Nickel	9.2 J	**398**	135.0	µg/L	25MW728102	Yes
7440-28-0	Thallium	3.56 J	3.56 J		µg/L	25MW728102	NA
7440-62-2	Vanadium	0.27 J	31.3		µg/L	25MW738102	NA
7440-66-6	Zinc	7.4 J	**190**	11.4	µg/L	25MW728102	Yes
Dissolved Metals							
7429-90-5	Aluminum	1.7 J	165	6,183.0	µg/L	25MW738102	No
7440-38-2	Arsenic	0.41 J	1.5 J	9.1	µg/L	25MWT1061202	No
7440-39-3	Barium	8 J	90	96.9	µg/L	25GW738101	No
7440-70-2	Calcium	46,700	94,700		µg/L	25MW728102	NA
7440-47-3	Chromium	2.6 J	3.9 J	14.6	µg/L	25GW728101	No
7440-48-4	Cobalt	2.4	18	65.5	µg/L	25GW728101	No
7440-50-8	Copper	0.61 J	0.91 J	14.6	µg/L	25GW728101	No
7439-89-6	Iron	169	2,400	34,500.0	µg/L	25GW728101	No
7439-95-4	Magnesium	10,200	26,400		µg/L	25MW728102	NA
7439-96-5	Manganese	318	1,500	4,470.0	µg/L	25MWT1061202	No
7440-02-0	Nickel	6	42	135.0	µg/L	25GW728101	No
7440-09-7	Potassium	1,040 J	2,170		µg/L	25MWT1061202	NA
7440-23-5	Sodium	11,000	23,800		µg/L	25MWT1061202	NA
7440-62-2	Vanadium	0.89 J	1 J	11.4	µg/L	25GW728101	No
7440-66-6	Zinc	2.2 J	17.5	140.0	µg/L	25MWT1061202	No

Associated Samples:
25GW728101
25MW728102
25GW738101
25MW738102
25MWT1061202

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APPENDIX A

SWMU 25 PHOTOGRAPHS

Figure 1. NSA Crane Highway 58 looking northwest. SWMU 25 Dump Site A located off right side of Highway 58 and down over the road berm.

Figure 2. NSA Crane Highway 58 looking northwest. SWMU 25 Dump Site A located off right side of Highway 58 and down over the side of the road berm.

Figure 3. NSA Crane Highway 58 looking northwest. SWMU 25 Dump Site A located on hillside off right side of Highway 58.

Figure 4. View of SWMU 25 Highway 58 Dump Site A Area below Highway 58.

Figure 5. Looking northeast down hillside from Highway 58 toward former Dump Site A Area and downgradient groundwater wells.

Figure 6. Looking northeast down hillside from Highway 58 toward former Dump Site A Area and downgradient groundwater wells.

TETRA TECH
FIELD TASK MODIFICATION REQUEST FORM

NSA Crane **Project/Installation Name**	F27L, 112G03116 **CTO & Project Number**	01 **Task Mod. Number**
UFP-SAP **Modification To (e.g. Work Plan)**	SWMU 25 **Site/Sample Location**	06/19/2012 **Date**

Activity Description: Installation of one monitoring well (25MWT06), abandonment of two monitoring wells (25MW04 and 25MW05), and conducting one round of groundwater sampling from wells 25MW01 – 25MW03, and 25MWT06.

Reason for Change: Wells 25MW04 and 25MW05 have been damaged (bent casings) and could not be sampled properly.

Recommended Disposition: Tetra Tech will install one monitoring well (25MWT06), abandon two monitoring wells (25MW04 and 25MW05), and conduct one round of groundwater sampling from wells 25MW01 – 25MW03, 25MWT06.

Sr. Project Geologist (Signature) — Date: 7/2/2012

Approved Disposition:

Project/Task Order Manager (Signature) — Date: 7/2/2012

Distribution:

Program/Project File –
Project/Task Order Manager –
Field Operations Leader –

Other:

FIELD TASK MODIFICATION REQUEST NO. 01

SWMU 25
NSA CRANE
CRANE, INDIANA

Groundwater sampling was conducted at NSA Crane SWMU 25 during July 2011. Two of the monitoring wells (25MW04/WES-7-4-81 and 25MW05/WES-7-5-81) were found to be compromised. After an evaluation of the data for these two wells, a determination was made that the data is not representative, and the installation of a new well is recommended. The following presents a discussion of SWMU 25 history and groundwater sampling, including tables and figures from the current SWMU 25 Draft RFI, and specific recommendations for future action to obtain representative data.

SITE BACKGROUND

SWMU 25, Highway 58 Dump Site A, was a disposal area that received paper, concrete, pipe, scrap metal, paint thinners, and oil. In 1995 and 1996, an Interim Measure (IM) was conducted at SWMU 25. The objective of the IM was to remove debris and incidental soil excavated with the debris. SWMU 25 Dump Site A consists of two discrete dump areas. A larger area, approximately 150 feet by 39 feet, and a second smaller area, approximately 25 feet by 10 feet. All debris was removed from the smaller dump site area during the IM. However, additional debris discovered during the IM at the larger dump site area was left in place because it appeared to have been used as backfill to support Highway 58. Based on this, it was recommended that SWMU 25 revert back to the RFI process beginning with soil borings along both sides of Highway 58 to determine if there is a need for further remediation.

As part of this RFI, 11 soil and 5 groundwater samples were collected within the SWMU 25 boundary, including one up gradient and four down gradient of SWMU 25. The samples were collected and analyzed for semi-volatile organic compounds (SVOCs) and metals, as presented in the SAP. All soil samples were able to be collected in accordance with the SAP sampling protocols. However, groundwater samples could only be collected in accordance with the SAP from three of the five wells. Two down gradient wells (25MW04 and 25MW05) could not be sampled properly due to bent casings, which prohibited a pump from being lowered into the well for low-flow sample collection. Therefore, only grab samples (no purging) were able to be collected with the use of tubing and a foot valve from these two wells, resulting in very turbid samples.

Figure 1 presents the locations of the soil borings and monitoring wells. Figure 2 presents the groundwater flow map.

GROUNDWATER ANALYTICAL RESULTS

The groundwater samples were analyzed for SVOCs and Appendix IX total metals. Wells with turbidity values above 10 NTU were also analyzed for dissolved metals.

Table 1 presents the groundwater analytical data summary for positive hits and exceedances of minimum screening criterion.

Total Metals

Total metals were detected in all five groundwater samples. The regulatory screening values in groundwater total analyses were exceeded for the following metals: aluminum, arsenic, beryllium, cadmium, chromium, cobalt, iron, lead, manganese, nickel, thallium, and zinc.

The locations of the exceedances of the regulatory screening criteria for total metals in groundwater are shown on Figure 3. The maximum total metal concentrations were predominantly detected in samples collected from monitoring wells 25MW04 and 25MW05.

Dissolved Metals

Dissolved metals were analyzed in 4 of the 5 groundwater samples. The locations of the exceedances of the regulatory screening criteria for dissolved metals in groundwater are shown on Figure 3. Similar to the total metals analyses, the maximum dissolved metal concentrations were predominantly detected in samples collected from in monitoring wells 25MW04 and 25MW05 which were subsequently determined to be unrepresentative samples.

SVOCs

SVOCs were detected in only one of the 5 groundwater samples. This sample was collected from monitoring well 25MW04, which is one of the compromised wells. The regulatory screening values in groundwater were only exceeded for the SVOCs n-nitroso-di-n-propylamine (DPN) and pentachlorophenol (PCP).

The location of the exceedances of the regulatory screening criteria for SVOCs in groundwater is shown on Figure 4.

GROUNDWATER DATA

As discussed above, both wells 25MW04 and 25MW05 show apparent damage from land subsidence, and the structural integrity of both wells has been seemingly compromised. The casings are bent in both wells, and well 25MW04 had 9 feet of sediment at the bottom, indicating the well casing may be broken/cracked as well. The groundwater samples collected from these two wells were very turbid, and not comparable to the groundwater samples collected from the other three site wells. The data from these two samples is not believed to be representative of actual aquifer quality conditions. Based on this information, Tetra Tech does not believe the data from these two wells should be used in making risk-based decisions for the site.

RECOMMENDATIONS

Based on the questionable data quality of the two groundwater samples collected from wells 25MW04 and 25MW05, the following are recommended to be implemented:

- Abandon wells 25MW04 and 25MW05 in accordance with Indiana Department of Natural Resources (IDNR) guidelines as specified in SOP-18 (see Appendix B).

- Install a new monitoring well (25MWT06) located equidistant between wells 25MW04 and 25MW05, and conduct one additional round of groundwater sampling from the three existing wells (25MW01 to 25MW03) and the one new well. Wells should be developed at least twenty-four hours before sampling takes place. Figure 5 presents the location of the proposed new well. The well will be installed in accordance with IDEM Policy Number: WASTE-053-NPD, Drilling Procedures and Monitoring Well Construction Guidelines (March, 2009) (http://www.in.gov/idem/files/nrpd_waste-0053.pdf).
- All samples would be analyzed for total and dissolved metals (regardless of turbidity value) and SVOCs (including PCP and DPN). The new monitoring well will be installed and screened at the same depth as the abandoned wells.

- Develop the newly installed well in accordance with IDEM Policy WASTE-053-NPD.

- Conduct one round of synoptic water level measurements for all SWMU 25 wells.

- Collect one round of groundwater samples from the three existing wells and one newly installed well.

- Analyze the samples for total and dissolved metals (regardless of turbidity value) and SVOCs (including PCP and DPN).

Attachment A presents the boring logs and well construction diagrams for the two wells to be abandoned. Attachment B presents the Standard Operating Procedures (SOPs) for well installation, lithologic logging and well abandonment.

TABLE 1

POSITIVE HITS IN GROUNDWATER
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INIDIANA

LOCATION	PSL	PSL REFERENCE	25MW01	25MW02	25MW03		25MW04	25MW05
SAMPLE ID			25GW718101	25GW728101	25GW738101	25GW738101-D	25GW748101	25GW758101
SAMPLE DATE			20110713	20110714	20110713	20110714	20110714	20110714
SAMPLE CODE			NORMAL	NORMAL	NORMAL	DUP	NORMAL	NORMAL
MATRIX			GW	GW	GW	GW	GW	GW
SAMPLE TYPE			NORMAL	NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
DISSOLVED METALS (µg/L)								
ALUMINUM	3700	T-RSL	NA	1.7 J	4.3 J	NA	2.2 J	3.2 J
ARSENIC	0.045	T-RSL	NA	**0.41 J**	**0.85**	NA	**14**	**1.3**
BARIUM	730	T-RSL	NA	8 J	90	NA	39	34
CHROMIUM	0.043	T-RSL	NA	**3.9 J**	**2.6 J**	NA	**3.2 J**	**2.5 J**
COBALT	1.1	T-RSL	NA	**18**	**2.4**	NA	**47**	**250**
COPPER	150	T-RSL	NA	0.91 J	0.61 J	NA	0.42 U	0.34 U
IRON	2600	T-RSL	NA	2400	50 U	NA	**4200**	100
MANGANESE	88	T-RSL	NA	**1200**	**570**	NA	**1800**	**15000**
NICKEL	73	T-RSL	NA	42	6	NA	**130**	63
VANADIUM	18	T-RSL	NA	1 J	0.89 J	NA	0.98 J	0.58 J
ZINC	1100	T-RSL	NA	16 J	2.2 J	NA	20 J	55
TOTAL METALS (µg/L)								
ALUMINUM	3700	T-RSL	61 J	39 J	190 J	76 J	920 J	**16000 J**
ARSENIC	0.045	T-RSL	1.2 U	1.5 U	**2**	1 U	**32**	**10**
BARIUM	730	T-RSL	120	9.3 J	110	120	200	240
BERYLLIUM	4	G-DCL	0.2 U	0.2 U	0.2 U	0.1 J	0.74	**16**
CADMIUM	1.8	T-RSL	0.44 U	0.46	0.24 U	0.42 U	0.85	**13**
CHROMIUM	0.043	T-RSL	0.57 U	0.5 U	**1.8 J**	0.65 U	**2 J**	**7**
COBALT	1.1	T-RSL	**7.4**	**20**	**3.9**	**9.2**	**370**	**870**
COPPER	150	T-RSL	1.8 J	1.4 J	2.3	2.2	11	37
IRON	2600	T-RSL	**5500**	**3300**	**3900**	**5200**	**56000**	**28000**
LEAD	15	T-RSL	0.97	0.32 U	2.4	1.2	8.8	**23**
MANGANESE	88	T-RSL	**6100 J**	**1400 J**	**810 J**	**5600 J**	**11000 J**	**30000 J**
NICKEL	73	T-RSL	54 J	49 J	9.2 J	53 J	**1100 J**	**150 J**
SELENIUM	18	T-RSL	1 U	1 U	1 U	1 U	1.2 U	12
THALLIUM	2	G-DCL	0.29 U	0.2 U	0.2 U	0.2 U	0.2 U	**2.4 J**
VANADIUM	18	T-RSL	0.2 UJ	0.27 J	2.9 J	0.2 UJ	3.3 J	9.9 J
ZINC	1100	T-RSL	72	17 J	7.4 J	81	**1200**	980
SEMIVOLATILES (µg/L)								
BIS(2-ETHYLHEXYL)PHTHALATE	4.8	T-RSL	0.5 U	0.5 U	0.5 U	0.76 J	0.35 J	0.73 J
N-NITROSO-DI-N-PROPYLAMINE	0.0096	T-RSL	0.5 U	0.5 U	0.5 U	0.5 U	**1.4 J**	0.5 U
PENTACHLOROPHENOL	0.17	T-RSL	2.5 UR	2.5 UJ	2.5 UJ	2.5 UR	**2.2 J**	2.5 UR

Notes:
DUP = duplicate
GW = Groundwater Sample
J = Value is estimated
G-DCL = IDEM Groundwater Default Closure Level (May, 2009).
NA = Not analyzed
PSL = Project Screening Level
T-RSL = USEPA Regions 3, 6, and 9 Regional Screening Level for Soil, Tapwater, adjusted to 1/10 of value for noncarcinogens (November, 2010
U = Analyte not detected at the reporting limit
UJ = Numerical detection limit for the undetected result is estimated
µg/L = Microgram per Liter
Shaded cells and boldface font indicate that the concentration is greater than the minimum screening criterion.

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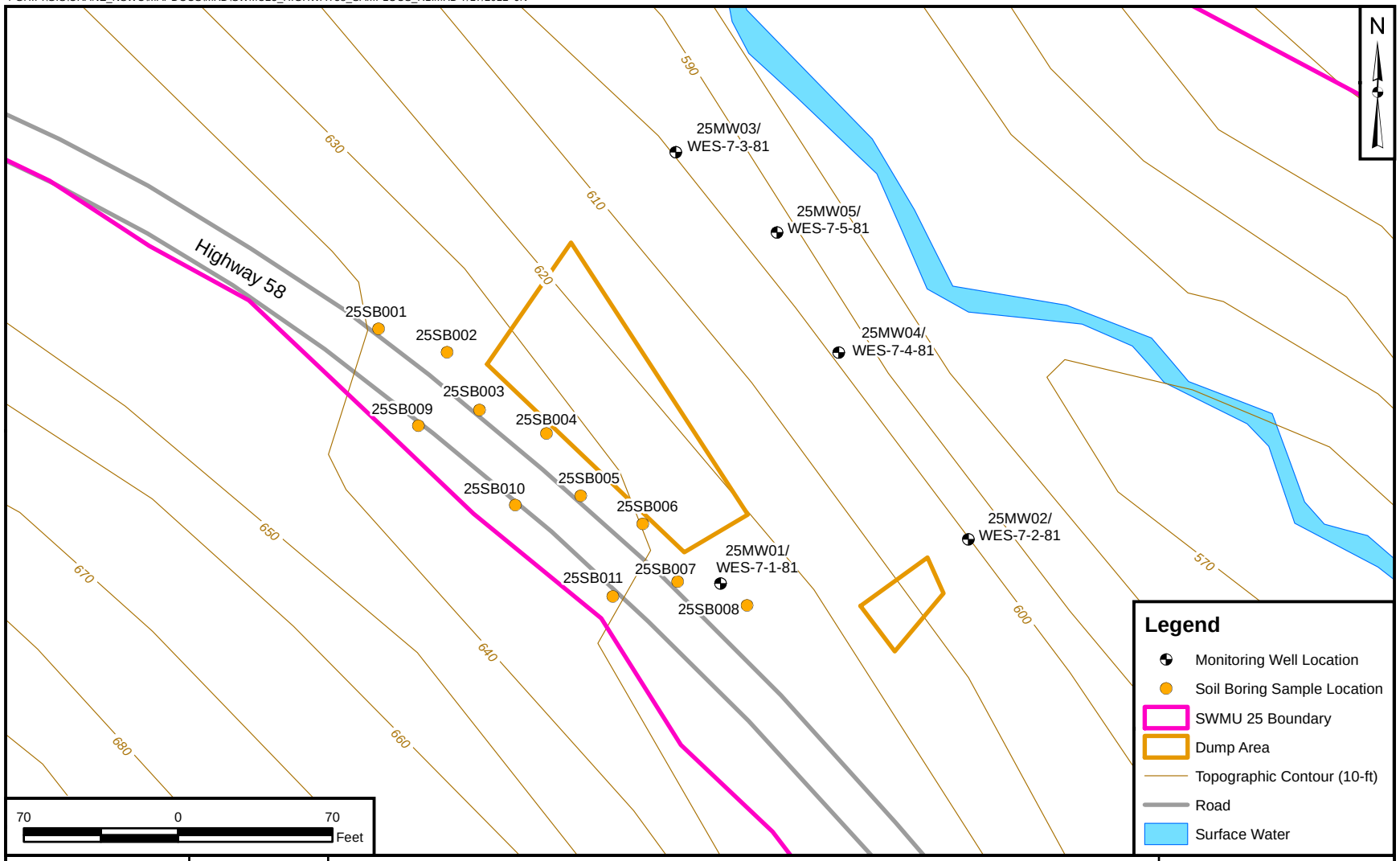

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CHECKED BY J. DUCAR	DATE 7/17/2012	
REVISED BY K. MOORE	DATE 7/17/2012	
SCALE AS NOTED		

SOIL SAMPLING AND WELL LOCATIONS
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER CTO F27L	
APPROVED BY ___	DATE ___
APPROVED BY ___	DATE ___
FIGURE NO. FIGURE 1	REV 0

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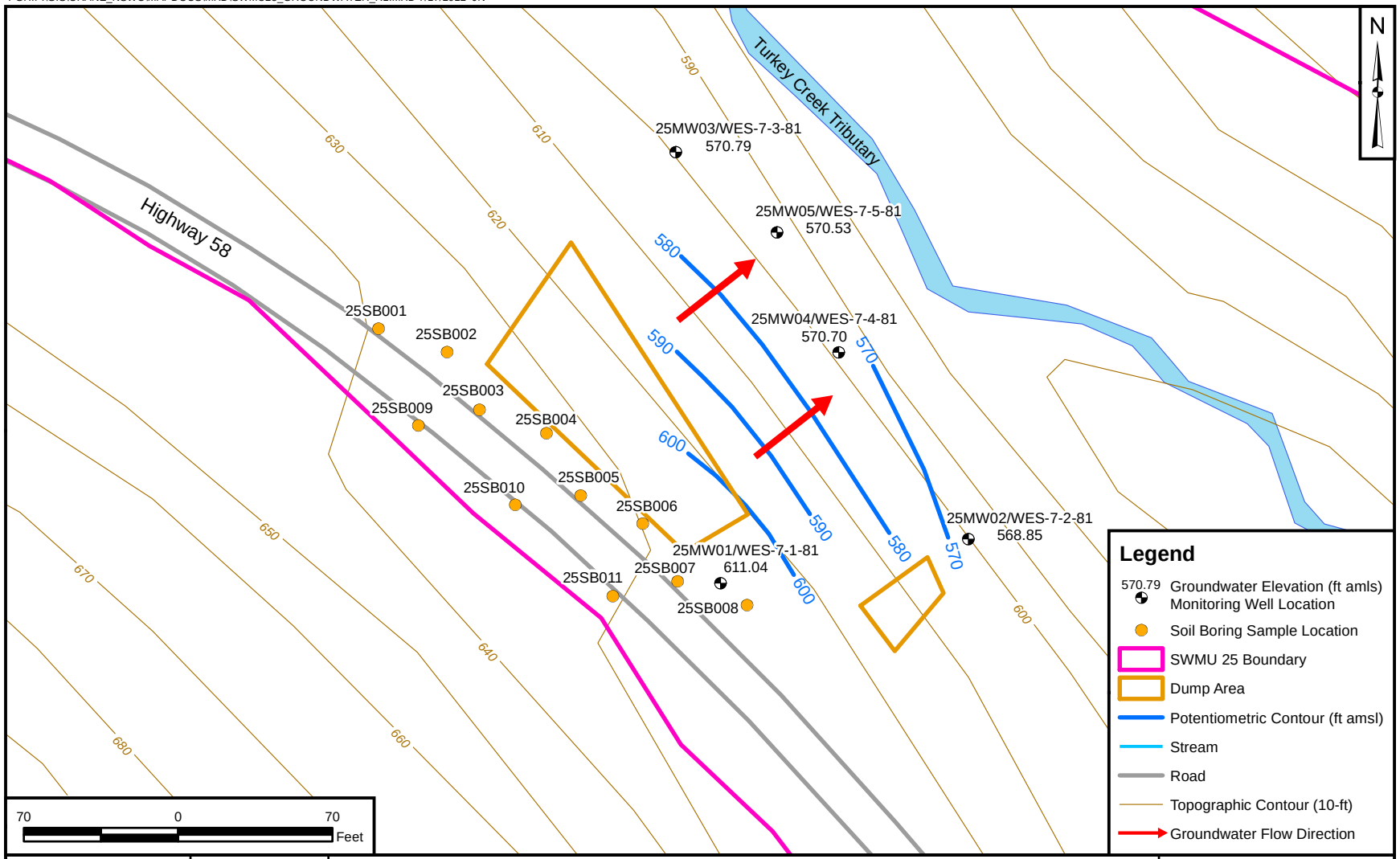

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J. DUCAR	7/17/2012
REVISED BY	DATE
J. NOVAK	7/17/2012
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NAVFAC

GROUNDWATER ELEVATION MAP
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	
CTO F27L	
APPROVED BY	DATE
___	___
APPROVED BY	DATE
___	___
FIGURE NO.	REV
FIGURE 2	0

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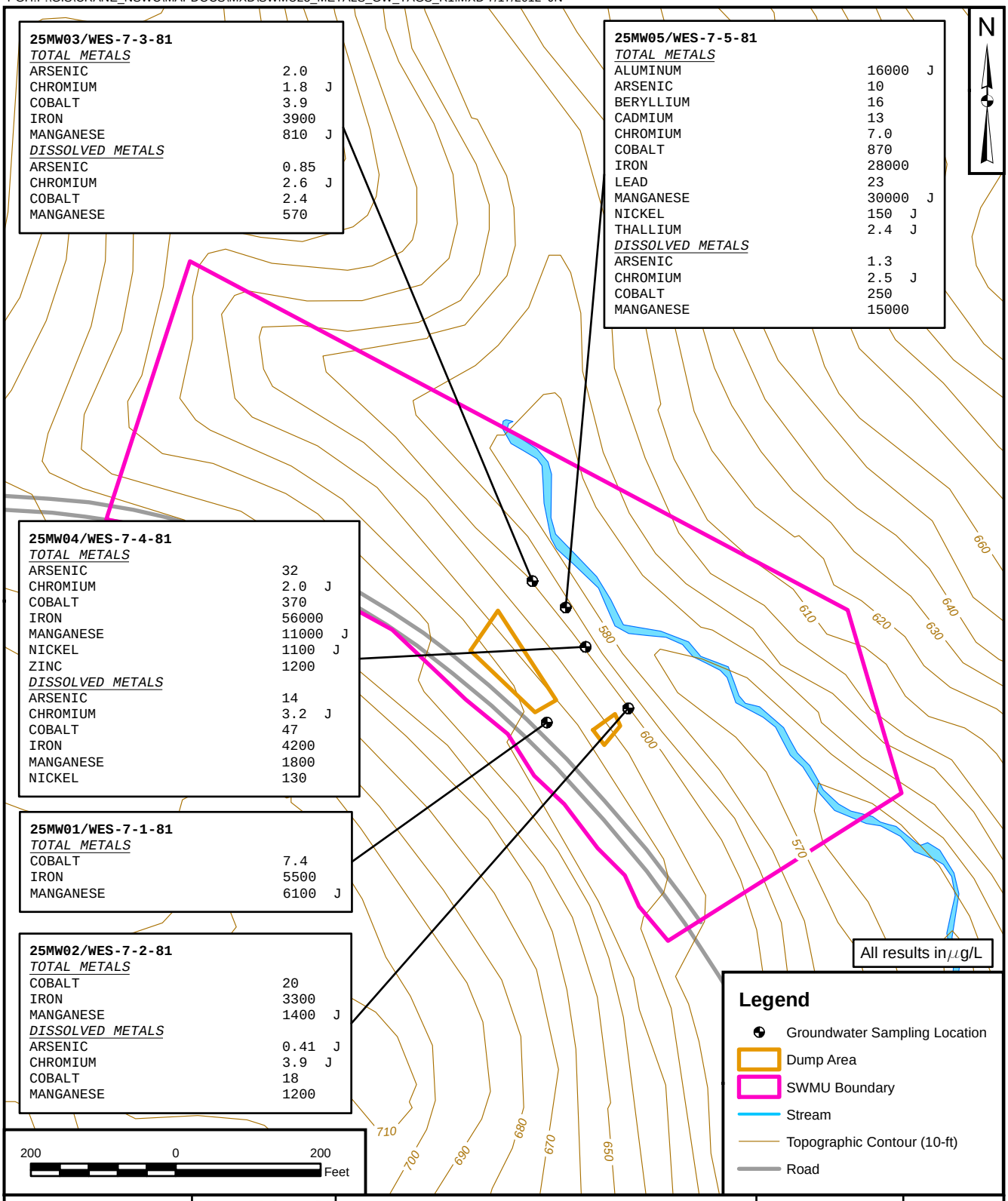

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CHECKED BY	DATE
J. DUCAR	7/17/2012
REVISED BY	DATE
J. NOVAK	7/17/2012
SCALE AS NOTED	

NAVFAC

METALS EXCEEDING REGULATORY SCREENING VALUES IN GROUNDWATER
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	CTO NUMBER
—	F27L
APPROVED BY	DATE
—	—
APPROVED BY	DATE
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FIGURE NO.	REV
FIGURE 3	0

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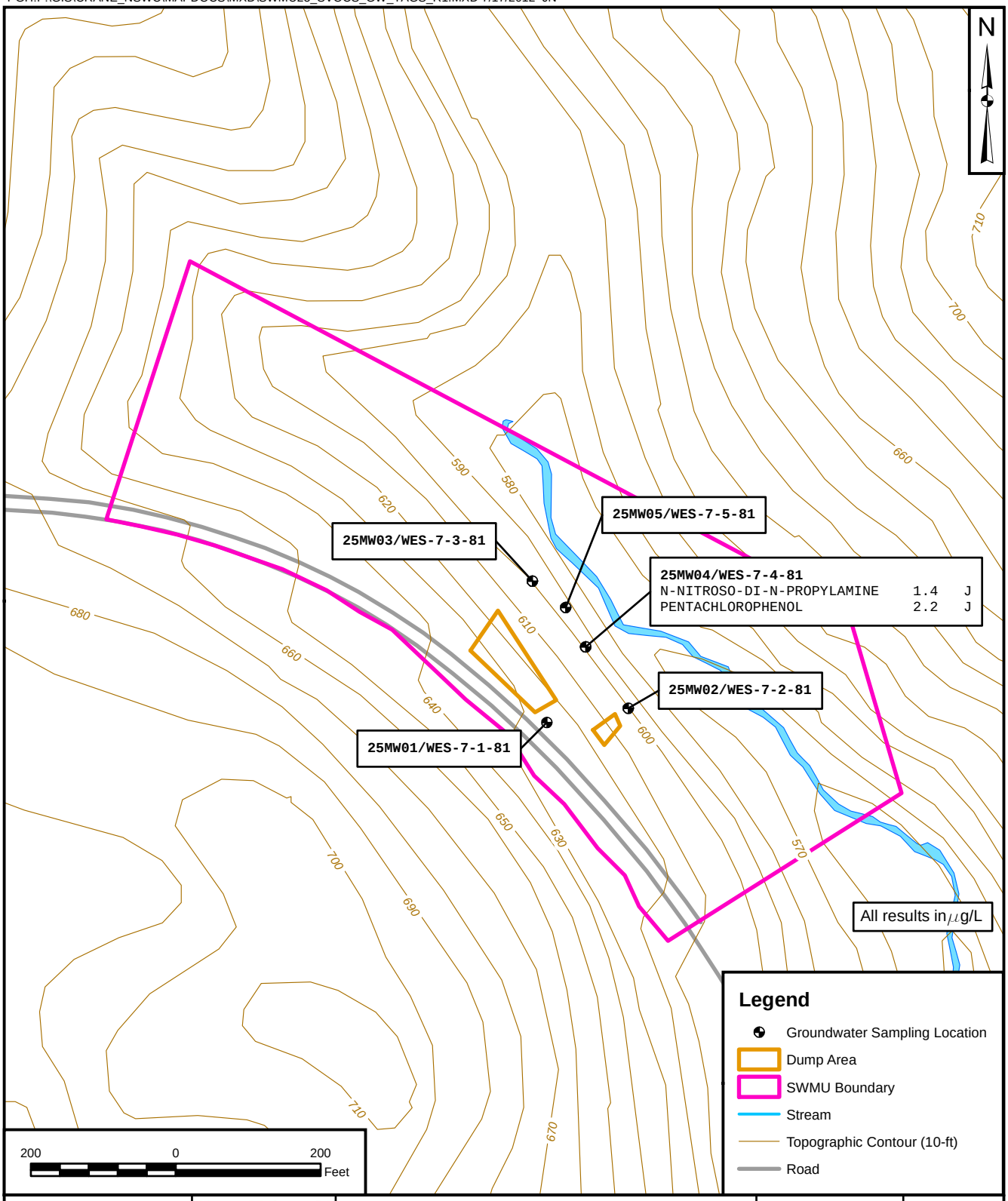

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CHECKED BY	DATE	APPROVED BY	DATE
J. DUCAR	7/17/2012	—	—
REVISED BY	DATE	APPROVED BY	DATE
J. NOVAK	7/17/2012	—	—
SCALE AS NOTED		FIGURE NO. FIGURE 4	REV 0

SVOCs EXCEEDING REGULATORY SCREENING VALUES IN GROUNDWATER
SWMU 25 - HIGHWAY 58 DUMP SITE A
NSA CRANE
CRANE, INDIANA

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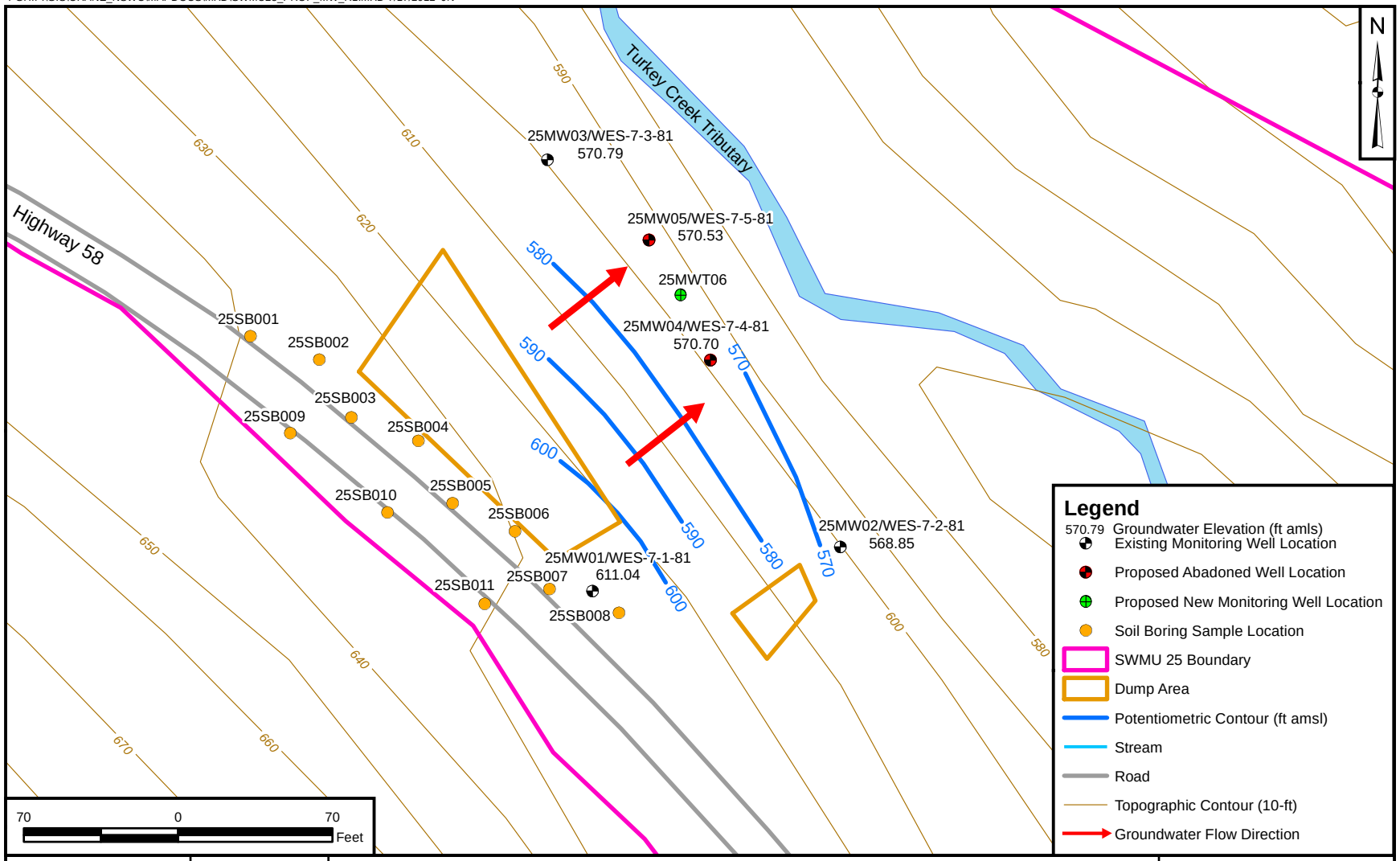

DRAWN BY K. MOORE	DATE 6/20/12	PROPOSED MONITORING WELL INSTALLATION AND ABANDONDMENT LOCATIONS SWMU 25 - HIGHWAY 58 DUMP SITE A NSA CRANE CRANE, INDIANA	CONTRACT NUMBER CTO F27L
CHECKED BY J. DUCAR	DATE 7/17/2012		APPROVED BY ___ DATE ___
REVISED BY J. NOVAK	DATE 7/17/2012		APPROVED BY ___ DATE ___
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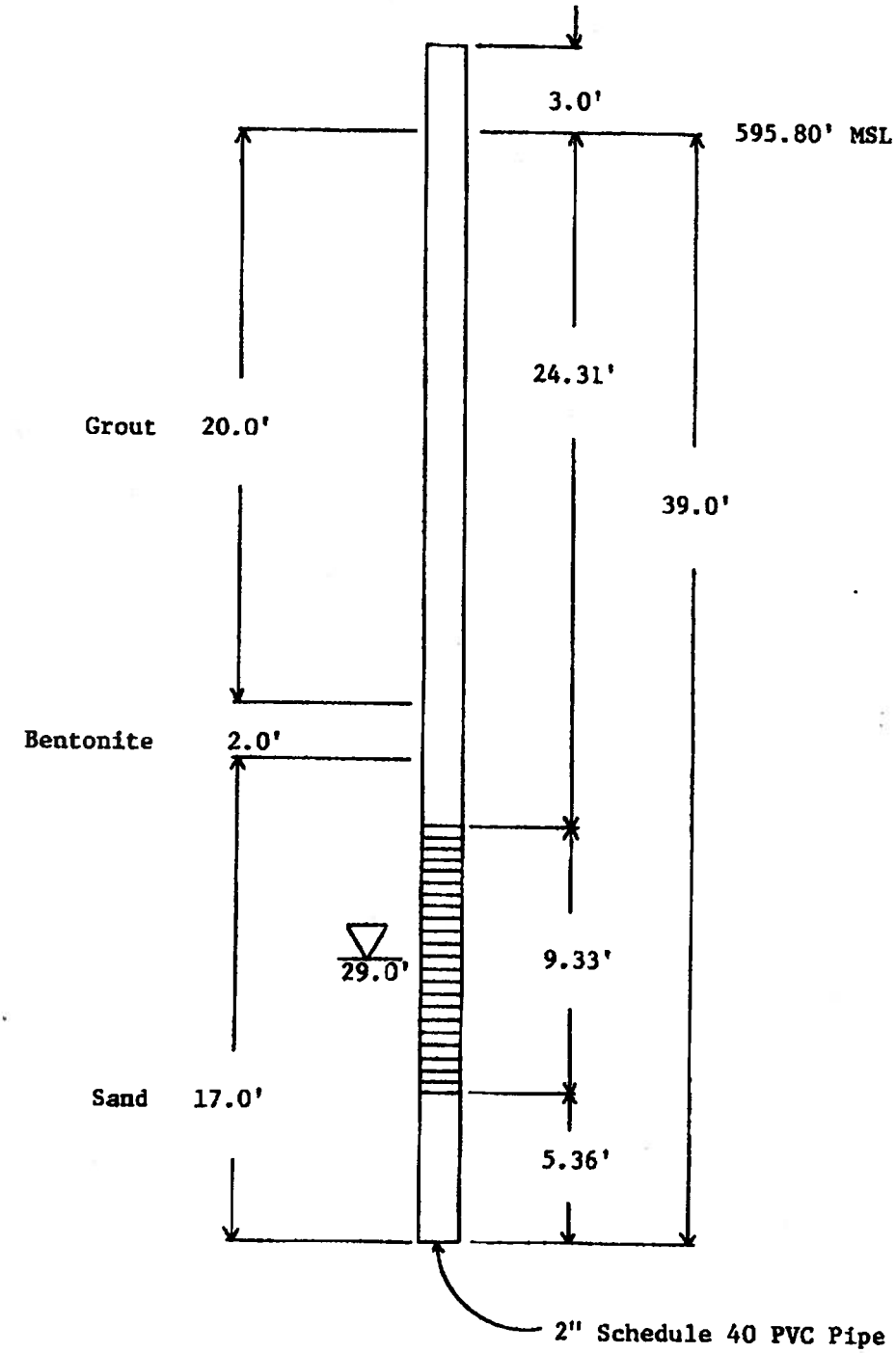
ATTACHMENT A

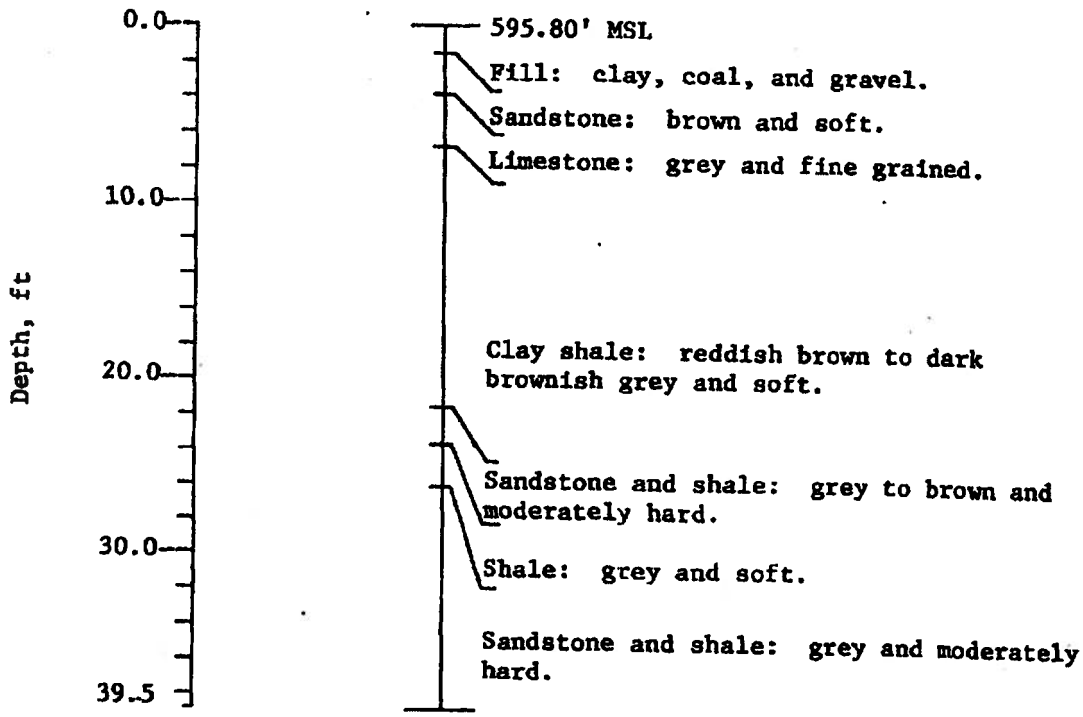
25MW04 AND 25MW05 SOIL BORING LOGS AND WELL CONSTRUCTION DIAGRAMS



Well screen

Water depth at time of drilling

NWSC, Crane, Indiana
Highway 58 Dump Site A
Well Completion
Boring Number: WES-7-4-81

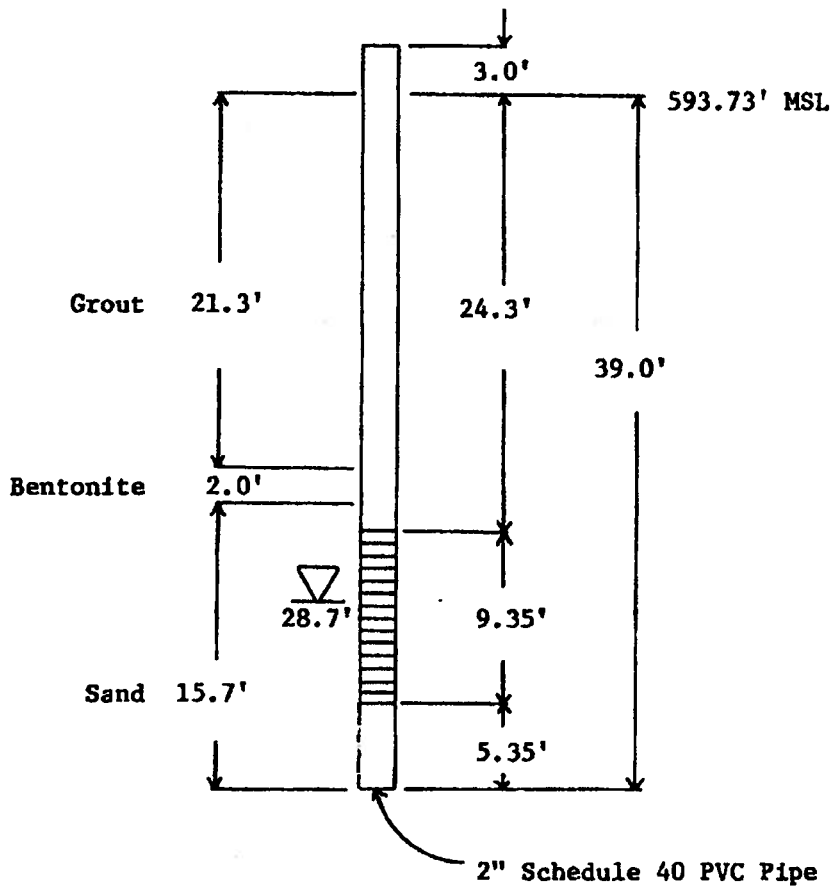


NWSC, Crane, Indiana

Highway 58 Dump Site A

Lithology

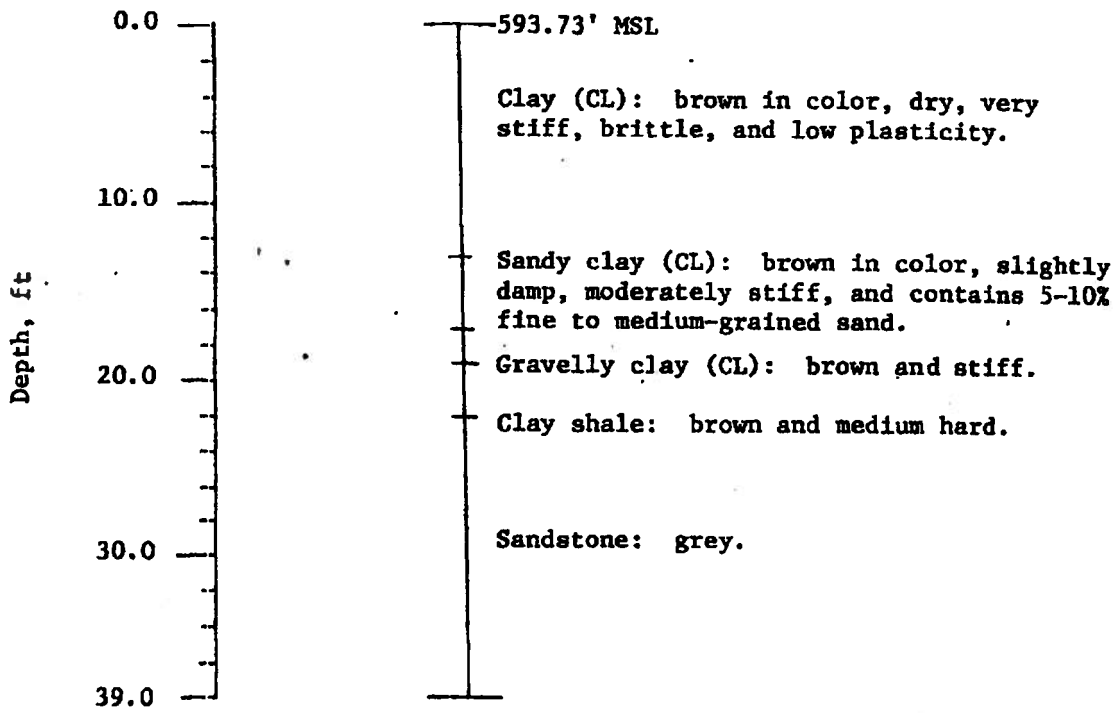
Boring Number: WES-7-4-81



Well screen

Water depth at time of drilling

NWSC, Crane, Indiana
Highway 58 Dump Site A
Well Completion
Boring Number: WES-7-5-81



NWSC, Crane, Indiana
Highway 58 Dump Site A
Lithology
Boring Number: WES-7-5-81

ATTACHMENT B

MONITORING WELL INSTALLATION AND ABANDONMENT SOPs

STANDARD OPERATING PROCEDURE
SOP-16

MONITORING WELL INSTALLATION

1.0 PURPOSE

This procedure provides general guidance and information pertaining to proper design and installation of ground water monitoring wells for the collection of groundwater samples in the upper water-bearing zone. The methods described herein are specific for monitoring well construction at the NSA Crane facility. Guidelines by South Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM, 1997) and the State of Indiana regulatory requirements in Article 16 Water Well Drillers of Chapter 310 of the Indiana Annotated Codes (310 IAC 16) should be consulted.

2.0 RESPONSIBILITIES

Driller - The driller provides adequate and operable equipment, sufficient quantities of materials, and an experienced and efficient labor force capable of performing all phases of proper monitoring well installation and construction. The drilling contractor personnel must have all the health and safety training required to perform the work, as specified in the health and safety plan. The driller is also responsible for obtaining, in advance, any required permits for drilling and monitoring well installation and construction.

Field Geologist - The field geologist supervises and documents well installation and construction performed by the driller and ensures that the screen interval for each monitoring well is properly placed to provide representative groundwater data from the monitored interval. Geotechnical engineers, field technicians, or other suitable trained personnel may also serve in this capacity.

3.0 REQUIRED EQUIPMENT/ITEMS

The following list includes equipment and items required for monitoring well installation:

Health and safety equipment as required by the HASP and the site safety officer.

Well drilling and installation equipment with associated materials (typically supplied by the driller).

Hydrogeologic equipment (weighted engineer's tape, water-level indicator, retractable engineer's rule, electronic calculator, clipboard, mirror and flashlight for observing downhole activities, paint and ink marker for marking monitoring wells, sample jars, well installation forms, boring logs, soil sample log forms, chain-of-custody records, sample coolers with ice, and a field notebook).

4.0 WELL DESIGN AND CONSTRUCTION

Overburden well borings will be drilled using minimum 4-inch inside diameter hollow-stem augers to the desired depth of each well boring. Rotary drilling with a roller bit and water wash or air rotary drilling can be used to extend the shallow well borings to allow well installation in the upper water-bearing zone. In no cases will the Mississippian Elwren Shale Formation be completely penetrated unless a steel casing is installed and grouted in place at the top of the Elwren Formation.

Bedrock monitoring well borings will be drilled using hollow-stem auger or rotary drilling techniques until the bedrock is reached. For shallow bedrock wells (i.e., those monitoring the upper water-bearing zone in bedrock) where no overburden soil contamination is present, a temporary 6-inch, steel casing will be installed to isolate the overburden while the upper bedrock is drilled. For wells to be installed in the upper water-bearing zone where soil contamination is known to be present, a 6-inch-diameter steel casing will be installed 3- to 5-into to the top of competent bedrock and will be grouted with cement-bentonite slurry in a manner to ensure that the entire annulus between the casing and borehole is sealed. Diamond coring (NX) or air rotary drilling will be initiated after the grout is allowed to cure for a minimum of 24 hours.

For wells using diamond coring, the coring will proceed from the bottom of the casing to the full depth of the boring. Once the coring has been completed and the core has been logged (see SOP-17), then the hole will be reamed out with a minimum 5-inch-diameter air rotary bit.

For wells using air rotary drilling in those cases where coring is not anticipated, the drilling will be performed through the casing after the grout has sufficiently set. These borings will be logged using the rock chips and dust blown up the boring by the return air of the drill bit (see SOP-17). The borehole will then be cleaned out using compressed air from the drill bit. The air rotary equipment must have a filter on the compressed air line going to the borehole to prevent oil and other organics from being introduced.

All monitoring wells will be constructed of Schedule 40, flush-joint-threaded, 2-inch inside diameter polyvinyl chloride (PVC) riser pipe and flush joint threaded, factory slotted well screen with a threaded end cap. The well screens will be factory slotted to 0.010-inch size. Each section of well casing and

screen will be National Sanitation Foundation (NSF) approved. Well screens will be 10 feet long but may be longer or shorter based on the subsurface conditions that are encountered. A PVC cap will be placed on the bottom and will also be flush threaded. Other means of joining casings using glue, gaskets, pop rivets, or screws are not allowed. The screen will pass no more than 10 percent of the pack material or in-situ aquifer material.

Monitoring wells will be installed immediately upon completion of drilling or packer testing, if performed. A well screen section with bottom cap and the proper amount of riser pipe will be assembled and lowered down the borehole. Centralizers will be used as necessary to ensure that the casing and screen are centered and are aligned straight. The sand pack will be extended from 0.5 foot below the well screen to 2.0 feet above the top of the well screen. Clean silica sand of U.S. Standard Sieve Size No. 10 to 20 will be used.

A minimum 3-foot-thick bentonite pellet seal will be installed above the filter pack and allowed to hydrate for a minimum of 3 hours before grout is added above the seal. Only 100 percent, certified pure sodium bentonite will be used for well construction. The depths of backfill materials will be constantly monitored during well installation using a weighted stainless-steel or fiberglass tape measure.

The remaining annulus above the hydrated bentonite seal will be backfilled to the surface using a tremie pipe, with a 20:1 cement/bentonite grout. A maximum of 10 gallons of water per 94-pound bag of Type 1 cement will be used. The grout mixture should be blended in an above-ground rigid container or mixer to produce a thick lump-free mixture. This grout mixture will also be used for placement of steel casings in deep wells.

Bentonite expands by absorbing water and provides a seal between the screened interval and the overlying portion of the annular space and formation. Cement-bentonite grout is placed on top of the bentonite pellets extending to the surface. The grout effectively seals the well and eliminates the possibility for surface infiltration reaching the screened interval. Grouting also replaces material removed during drilling and prevents hole collapse and subsidence around the well. A tremie pipe should be used to introduce grout from the bottom of the hole upward to prevent bridging and to provide a better seal. However, in shallow boreholes that do not collapse, it may be more practical to pour the grout from the surface without a tremie pipe.

When the well is completed and grouted to the surface, a protective steel surface casing is placed over the top of the riser pipe. The finished well casing will extend at least 2 feet above the ground level. This casing will have a cap that can be locked to prevent vandalism. A vent hole will be provided in the cap to

allow venting of gases and maintain atmospheric pressure as water levels rise or fall in the well. The protective casing has a larger diameter than the riser pipe and is set into the wet cement grout over the well upon completion or can be placed between the steel casing and the riser pipe in the case of deep monitoring well borings. In addition, one hole is drilled just above the cement collar through the protective casing, which acts as a weep hole for the flow of water that may enter the annulus during well development, purging, or sampling. In traffic areas or high visibility areas, a flush-to-grade protective may be installed over the top of the riser pipe.

5.0 DOCUMENTATION OF FIELD ACTIVITIES

A critical part of monitoring well installation is recording of significant details and events in the site logbook, on field forms, and in a field logbook. Details of borehole logging are contained in SOP-07.

6.0 ATTACHMENTS

1. Bedrock Monitoring Well Sheet
2. Overburden Monitoring Well Sheet

ATTACHMENT 1

BEDROCK MONITORING WELL SHEET

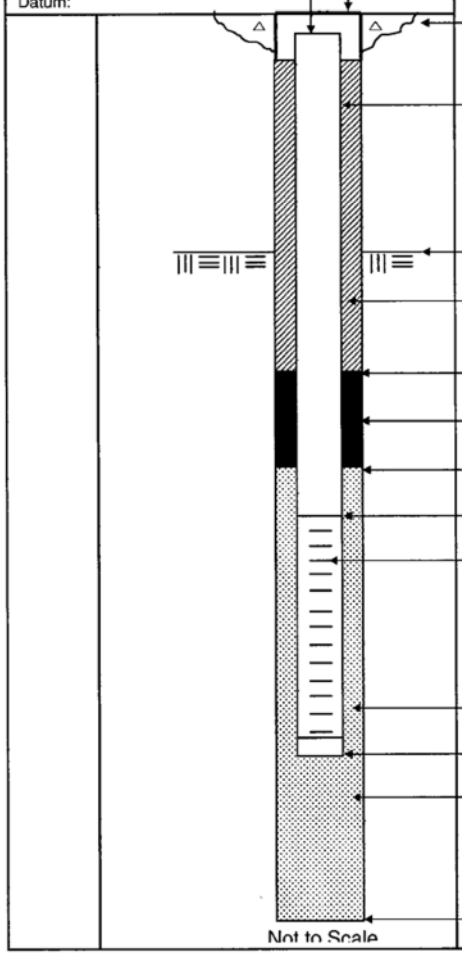
Tetra Tech NUS, Inc.

WELL No.: _____

MONITORING WELL SHEET

PROJECT:		DRILLING Co.:		BORING No.:	
PROJECT No.:		DRILLER:		DATE COMPLETED:	
SITE:		DRILLING METHOD:		NORTHING:	
GEOLOGIST:		DEV. METHOD:		EASTING:	

Ground Elevation =
Datum:



Elevation / Depth of Top of Riser: ____ / ____

Elevation / Height of Top of Surface Casing: ____ / ____

I.D. of Surface Casing: _____

Type of Surface Casing: _____

Type of Surface Seal: _____

I.D. of Riser: _____

Type of Riser: _____

Borehole Diameter: _____

Elevation / Depth Top of Rock: ____ / ____

Type of Backfill: _____

Elevation / Depth of Seal: ____ / ____

Type of Seal: _____

Elevation / Depth of Top of Filter Pack: ____ / ____

Elevation / Depth of Top of Screen: ____ / ____

Type of Screen: _____

Slot Size x Length: _____

I.D. of Screen: _____

Type of Filter Pack: _____

Elevation / Depth of Bottom of Screen: ____ / ____

Elevation / Depth of Bottom of Filter Pack: ____ / ____

Type of Backfill Below Well: _____

Elevation / Total Depth of Borehole: ____ / ____

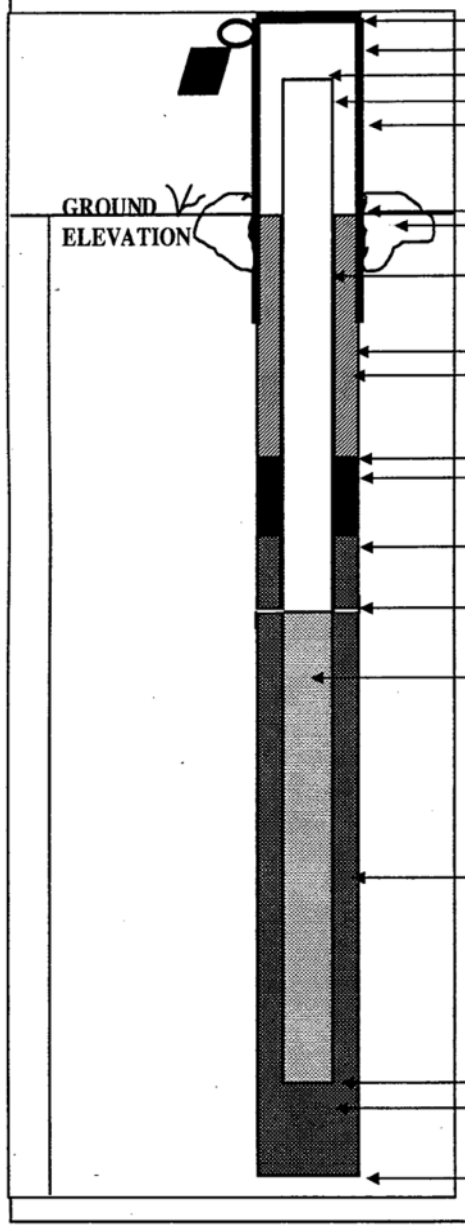
ATTACHMENT 2

OVERBURDEN MONITORING WELL SHEET

BORING NO.: _____

Tetra Tech NUS, Inc. **OVERBURDEN MONITORING WELL SHEET**

PROJECT:	NIROP FRIDLEY	DRILLING Co.:		BORING No.:	
PROJECT No.:	7842 CTO 0057	DRILLER:		DATE COMPLETED:	
SITE:	ANOKA PARK	DRILLING METHOD:		NORTHING:	
GEOLOGIST:		DEV. METHOD:		EASTING:	



ELEVATION OF TOP OF SURFACE CASING: _____
STICK -UP TOP OF SURFACE CASING: _____
ELEVATION OF TOP OF RISER PIPE: _____
RISER STICK-UP ABOVE GROUND SURFACE: _____
I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

GROUND ELEVATION: _____
TYPE OF SURFACE SEAL: _____

RISER PIPE I.D.: 2"
TYPE OF RISER PIPE: CARBON STEEL

BOREHOLE DIAMETER: _____
TYPE OF SEAL: _____

ELEVATION / DEPTH OF SEAL: /
TYPE OF SEAL: BENTONITE CHIPS

ELEVATION / DEPTH TOP OF FILTER PACK: /

ELEVATION / DEPTH TOP OF SCREEN: /

TYPE OF SCREEN: CARBON STEEL

SLOT SIZE X LENGTH: 10 SLOT x

I.D. OF SCREEN: 2"

TYPE OF FILTER PACK: SILICA SAND
(No. 10-20 U.S. STANDARD SEIVE SIZE)

ELEVATION / DEPTH BOTTOM OF SCREEN: /
ELEVATION / DEPTH BOTTOM OF FILTER PACK: /
TYPE OF BACKFILL BELOW WELL: _____
ELEVATION / DEPTH OF BOREHOLE: /

STANDARD OPERATING PROCEDURE
SOP-17

DRILLING AND GEOLOGIC LOGGING OF BOREHOLES IN BEDROCK

1.0 PURPOSE

This procedure describes the methods and equipment necessary to drill bedrock borings and identify the equipment, sequence of events, and appropriate methods necessary to obtain rock cores and prepare boring logs during drilling activities. Up to four types of drilling activities and equipment will be used to drill holes and install monitoring wells at the NSA Crane facility:

- Auger drilling with continuous split-spoon sampling will be used to drill through the overburden material.

- Diamond coring equipment will be used to core through the bedrock. NX or similar size diamond core barrels will be used to collect 2- to 3-inch-diameter continuous rock core. These cores will be used to describe the lithologic characteristics and fracture distributions in the bedrock. Diamond coring is relatively slow and more expensive compared to the air rotary method of drilling, so one hole per subarea is proposed to be cored.

- Air-rotary or rotosonic drilling will be used to advance the boreholes not cored. The holes need to be a minimum of 5 inches in diameter in order to install a 2-inch-diameter monitoring well. Air rotary may also be used to deepen well borings in the event bedrock is encountered before the desired well boring depth is reached.

- Rotary drilling with a roller bit and water wash may be used to complete well borings in the event that bedrock is encountered before the desired well boring depth is reached.

2.0 RESPONSIBILITIES

Field Operations Leader (FOL) - The FOL is responsible for coordinating all on-site personnel and for providing technical assistance, when required. The FOL, or designee, will coordinate and lead all activities and will ensure the availability and maintenance of all materials and equipment. The FOL is responsible for the completion of all field activities and field and chain-of-custody documentation. The

FOL will assume custody of all samples and will ensure the proper handling and shipping of samples. The FOL is a highly experienced environmental professional who will report directly to the Tt Task Order Manager (TOM). Specific FOL responsibilities include the following:

- Function as a communications link among field staff members, the site quality assurance/quality control advisor, site safety officer, the site manager, and the TOM.
- Oversee the mobilization and demobilization of all field equipment and subcontractors.
- Coordinate and manage the field technical staff.
- Adhere to the work schedules provided by the TOM.
- Maintain the site logbook and field recordkeeping.
- Initiate field task modification requests, when necessary.
- Identify and resolve problems in the field, resolve difficulties in consultation with the NSA Crane Site Manager, implement and document corrective action procedures, and provide communication between the field team and upper management.

Field Geologist - The field geologist is responsible for ensuring that standard and approved drilling procedures are followed. The field geologist will generate a detailed boring log for each borehole. This log will include a description of geologic materials, samples (if any), method of sampling, and other pertinent information and observations that may be obtained during drilling.

Determination of the exact location for borings is the responsibility of the field geologist. The final location for drilling must be properly documented on the boring log. The general area in which the borings are to be located will be shown on a site map included in the QAPP.

Drilling Subcontractor - The subcontractor operates under the supervision of the FOL. He or she is responsible for obtaining all drilling permits and clearances and supplying all services (including labor), equipment, and material required to perform the drilling, testing, and well installation program, as well as maintenance and quality control of such required equipment except as stated in signed and approved subcontracts.

The driller must report any major technical problems encountered in the field to the FOL within 24 hours of determination and must provide advance written notification of any changes in field procedures, describing and justifying such changes. No such changes will be made unless requested and authorized in writing by the FOL (with the concurrence of the project manager). Depending on the subcontract, the project manager may need to obtain written authorization from appropriate administrative personnel before approving any changes.

The drilling subcontractor is responsible for following decontamination procedures specified for drilling and coring equipment specified in the project plan documents. The FOL will oversee the in-field equipment decontamination procedures to confirm compliance with the appropriate SOP and specific requirements of the NSA Crane Environmental Department. Upon completion of the work, the driller is responsible for demobilizing all equipment, cleaning up any materials deposited on site during drilling operations, and properly backfilling any open borings.

3.0 PROCEDURES

3.1 General

The purpose of drilling boreholes is

- To determine the type, thickness, and certain physical and chemical properties of the soil, water, and rock strata that underlie the site.
- To install monitoring wells or piezometers.

All drilling and sampling equipment will be cleaned between samples and borings using appropriate decontamination procedures as outlined in SOP-04. Unless otherwise specified, it is generally advisable to drill borings at "clean" locations first and at the most contaminated locations last to reduce the risk of spreading contamination between locations. All borings must be logged by the site geologist as they proceed.

3.2 Rock Coring

Drilling is done by rotating and applying downward pressure to the drill rods and drill bit. The drill bit is a circular, hollow, diamond-studded bit attached to the outer core barrel in a double-tube core barrel. The use of single-tube core barrels is not recommended because the rotation of the barrel erodes the sample and limits its use for detailed geological evaluation. Water or air is circulated down through the drill rods and annular space between the core barrel tubes to cool the bit and remove the cuttings. The bit cuts a

core out of the rock that rises into an inner barrel mounted inside the outer barrel. The inner core barrel and rock core are removed by lowering a wire line with a coupling into the drill rods, latching onto the inner barrel, and withdrawing the inner barrel. A less efficient variation of this method utilizes a core barrel that cannot be removed without pulling all the drill rods. This variation is practical only if fewer than 50 feet of core is required. When coring rock, the speed of the drill and the drilling pressure, amount and pressure of water, and length of run can be varied to give the maximum recovery from the rock being drilled.

Advantages of core drilling include

- Undisturbed rock cores can be recovered for examination and/or testing.
- In formations in which the cored hole will remain open without casing, water from the rock fractures may be recovered from the well without the installation of a well screen and gravel pack.
- Formation logging is extremely accurate.
- Drill rigs are relatively small and mobile.

Disadvantages include

- Water or air is needed for drilling.
- Coring is slower than rotary drilling (and more expensive).
- Depth to water cannot accurately be determined if water is used for drilling.
- The size of the borehole is limited.

This drilling method is useful if accurate determinations of rock lithology are desired or if open wells are to be installed into bedrock. To install monitoring wells in coreholes, the hole will be reamed out to the proper size after boring, using air rotary drilling methods. Rock coring enables a detailed assessment of borehole conditions to be made, showing precisely all lithologic changes and characteristics. Because coring is an expensive drilling method, it is commonly used for shallow studies of 500 feet or less or for specific intervals in the drill hole that require detailed logging and/or analyzing. Rock coring can, however, proceed for thousands of feet continuously, depending on the size of the drill rig, and can yield better quality data than air-rotary drilling, although at a substantially reduced drilling rate.

Borehole diameter can be drilled to various sizes, depending on the information needed. NX, or a similar size (2- to 3-inch-diameter core recovery), may be used.

Begin the core drilling using a double-tube swivel-core barrel of the desired size. After drilling no more than 10-feet (3-meters), remove the core barrel from the hole and take out the core. If the core blocks the flow of the drilling fluid during drilling, remove the core barrel immediately.

Since rock structures and the occurrence of bedding planes, porosity type and distribution, and fracture patterns are among the most important items to be detected and described, take special care to obtain and record these features. If such broken zones or cavities prevent further advance of the boring, one of the following three steps shall be taken: cement the hole, ream and case, or case and advance with the next smaller size core barrel, as conditions warrant.

3.3 Rock Core Management and Labeling

When the core barrel has been recovered, the rock core will be carefully removed from the barrel, placed in a core tray (previously labeled "top" and "bottom" to avoid confusion), classified, and measured for percentage of recovery as well as the rock quality designation (RQD). Each core will be described, classified, and logged using a uniform system (Sections 4.0 and 5.0 of this SOP).

Rock cores will be placed in the sequence of recovery in well-constructed wooden or cardboard boxes provided by the drilling contractor. Rock cores from two different borings will not be placed in the same core box. The core boxes will be constructed to accommodate at least 20 linear feet of core in rows of approximately 5 feet each. Wood partitions will be placed at the end of each core run. The depth from the surface of the boring to the top and bottom of the drill run and run number will be marked on the wooden partitions with indelible ink. These blocks will serve to separate successive core runs and indicate depth intervals for each run. The order of placing cores will be the same in all core boxes. Rock core will be placed in the box so that, when the box is open, with the inside of the lid facing the observer, the top of the cored interval contained within the box is in the upper left corner of the box and the bottom of the cored interval is in the lower right corner of the box. The top and bottom of each core obtained and their true depths will be clearly and permanently marked on each box. The width of each row must be compatible with the core diameter to prevent lateral movement of the core in the box. Similarly, an empty space in a row will be filled with an appropriate filler material or spacers to prevent longitudinal movement of the core in the box.

The inside and outside of the core-box lid will be marked by indelible ink to show all pertinent data about the box's contents. At a minimum, the following information will be included:

- Project name
- Project number
- Boring number
- Run numbers
- Footage (depths)
- Recovery
- RQD (%)
- Box number and total number of boxes for that boring (Example: Box 5 of 7)
- Contact person's name and telephone number

For easy retrieval when core boxes are stacked, the sides and ends of the box will also be labeled and will include project number, boring number, top and bottom depths of core, and box number.

Before final closing of the core box, a photograph will be taken of the recovered core and the labeling on the inside cover will be taken. If moisture content is not critical, the core shall be wetted and wiped clean for the photograph. (This will help to show true colors and bedding features in the cores.)

3.4 Air Rotary Drilling

Air-rotary drilling is a method of drilling where the drill rig simultaneously turns and exerts a downward pressure on the drilling rods and bit while circulating compressed air down the inside of the drill rods, around the bit, and out the annulus of the borehole. Air circulation serves to both cool the bit and remove the cuttings from the borehole.

Advantages of this method include

- The drilling rate is high (even in rock).
- The cost per foot of drilling is relatively low.
- Air-rotary rigs are common in most areas.
- No drilling fluid is required (except when water is injected to keep down dust).
- The borehole diameter is large to allow room for proper well installation procedures.

Disadvantages to using this method include

- Formations must be logged from the cuttings that are blown to the surface and thus the depths of materials logged are approximate.

- Air blown into the formation during drilling may "bind" the formation and impede well development and natural groundwater flow.

- In-situ samples cannot be taken, unless the hole is cased.

- Air-rotary drill rigs are large and heavy.

- Large amounts of investigation-derived waste (IDW) may be generated that may require containerization, sampling, and off-site disposal.

3.5 Rotosonic Drilling

The rotosonic drilling method employs a high frequency vibrational and low speed rotational motion coupled with down pressure to advance the cutting edge of a drill string. This produces a uniform borehole while providing a continuous, undisturbed core sample of both unconsolidated and most bedrock formations. Rotosonic drilling advances a 4-inch diameter to 12-inch diameter core barrel for sampling and can advance up to a 12-inch diameter outer casing for the construction of standard and telescoped monitoring wells. During drilling, the core barrel is advanced ahead of the outer barrel in increments as determined by the site geologist and depending upon type of material, degree of subsurface contamination and sampling objectives. The outer casing can be advanced at the same time as the inner drill string and core barrel, or advanced down over the inner drill rods and core barrel, or after the core barrel has moved ahead to collect the undisturbed sample and has been pulled out of the borehole. The outer casing can be advanced dry in most cases, or can be advanced with water or air depending upon the formations being drilled, the depth and diameter of the hole, or requirements of the project.

Advantages of this method include:

- Sampling and well installation are faster as compared to other drilling methods.

- Continuous sampling, with larger sample volume as compared to split-spoon sampling.

- The ability to drill through difficult formations such as cobbles or boulders, hard till and bedrock.

- Reduction of IDW by an average of 70 to 80 percent.

- Well installations are quick and controlled by elimination of potential bridging of annular materials during well installation, due to the ability to vibrate the outer casing during removal.

Disadvantages include:

- The cost for rotosonic drilling as compared to other methods are generally higher. However, the net result can be a significant savings considering reduced IDW and shortened project duration.

- Rotosonic drill rigs are large and need ample room to drill, however, rotosonic units can be placed on the ground or placed on an A TV.

- There are a limited number of rotosonic drilling contractors at the present time.

4.0 GEOLOGIC DESCRIPTION OF BOREHOLES IN ROCK

These procedures provide descriptions of the standard techniques for borehole and sample logging. These logging techniques will be used for each boring to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist or engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

The classification of soil and rocks is one of the most important jobs of the field geologist or engineer. To maintain a consistent flow of information, it is imperative that the field geologist or engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

4.1 Required Field Forms and Equipment

When logging soil and rock samples, the geologist or engineer should be equipped with the following:

Rock hammer
Knife
Camera
10% Dilute hydrochloric acid (HCl)
Ruler (marked in tenths and hundredths of feet)

Hand lens

Writing utensil with indelible ink

Field logbook

Disposable medical-grade gloves (e.g., latex, nitrile)

Soil/rock classification sheets

4.2 Classification of Rocks

Sedimentary rocks are by far the predominant type exposed at the earth's surface and are the only type present at NSA Crane. In classifying a sedimentary rock, the following hierarchy will be noted: Rocks are grouped into three main divisions: sedimentary, igneous, and metamorphic. The following basic names are applied to the types of rocks found in sedimentary sequences:

Sandstone - Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.

Siltstone - Made up of granular materials between 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.

Claystone - Very fine-grained rock made up of particle less than 1/256 mm in diameter. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.

Shale - A fissile, very fine-grained rock with particles less than 1/256 mm in diameter. Fractures along bedding planes.

Limestone - Rock made up predominantly of calcite ($CaCO_3$, which is mainly fossilized animal and plant debris). Effervesces strongly upon the application of dilute hydrochloric acid.

Coal – A very dark colored rock consisting mainly of organic (mainly fossilized plant debris) remains.

Others - Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record.

The local abundance of any of these rock types is dependent upon the depositional history of the area. Conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

4.2.1 Rock Type

As described above, there are numerous types of sedimentary rocks. In most cases, a rock will be a combination of several grain types; therefore, a modifier such as "sandy siltstone" or a "silty sandstone" can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifying descriptions can include carbonaceous, calcareous, siliceous, fossiliferous, etc.

Grain size is the basis for the classification of clastic (sandstones, siltstones, and shales) sedimentary rocks. The Udden-Wentworth classification will be assigned to sedimentary rocks (shown below). The individual boundaries are slightly different than the USGS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse-grained rocks. Alternatively, the division between siltstone and shale may be measurable in the field by the use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a shale.

GRAIN SIZE CLASSIFICATION FOR ROCKS

Particle Name	Grain Size Diameter
Cobbles	> 64 mm
Pebbles	4 - 64 mm
Granules	2 - 4 mm
Very Coarse Sand	1 - 2 mm
Coarse Sand	0.5 - 1 mm
Medium Sand	0.25 - 0.5 mm
Fine Sand	0.125 - 0.25 mm
Very Fine Sand	0.0625 - 0.125 mm
Silt	0.0039 - 0.0625 mm
After Wentworth, 1922	

4.2.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples will be classified while wet, when possible, and air-cored samples will be scraped clean of cuttings prior to color classifications. Soil colors will be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

4.2.3 Bedding Thickness

The bedding thickness designations listed below will also be used for rock classification.

BEDDING THICKNESS CLASSIFICATION

Thickness (metric)	Thickness (Approximate English Equivalent)	Classification
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick bedded
10 cm - 30 cm	4" - 1.0'	Medium bedded
3 cm - 10 cm	1" - 4"	Thin bedded
1 cm - 3 cm	2/5" - 1"	Very thin bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly laminated
< 1 mm	<1/32"	Micro laminated

(Ingram, 1954)

4.2.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock that occupies the zone between the lowest soil horizon and firm bedrock).

Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.

Medium hard - No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.

Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage of the words "scratch" and "gouge." A scratch will be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), and a gouge is much deeper.

4.2.5 Fracturing

Method of Calculating RQD
(After Deere, 1966)

Fractures should also be noted.

$$RQD\ \% = r/l \times 100$$

r = Total length of all pieces of the lithologic unit being measured that are greater than 4 inches in length and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.

l = Total length of the coring run.

4.2.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

Fresh - The rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.

Slight - The rock has some staining that may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration. Oxidation and weathering may affect the degree of fracturing or brokenness of a rock. After eliminating drilling breaks, the average spacing of natural breaks is calculated and the fracturing is described by the following terms:

Very broken (V. BR.) - Less than 2-inch spacing between fractures
Broken (BR.) - 2-inch to 1-foot spacing between fractures
Blocky (BL.) - 1- to 3-foot spacing between fractures

Massive (M.) - 3- to 10-foot spacing between fractures

The structural integrity of the rock can be approximated by calculating the rock quality designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run to obtain a percentage.

Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with a hammer.

Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

4.2.7 Other Characteristics

The following items will be included in the rock description:

Description of contact between two rock units. These can be sharp or gradational.

- Stratification (parallel, cross stratified).
- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic).
- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs will be neat so it can be reproduced on a copy machine for report presentation. The data will be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

4.2.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

Seam - Thin (12 inches or less), probably continuous layer.

Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."

Few - Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."

Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."

Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

4.2.9 Abbreviations

Abbreviations may be used in the description of a rock. However, they will be kept at a minimum. Following are some of the abbreviations that may be used:

C	-	Coarse	Lt	-	Light	Yl	-	Yellow
Med	-	Medium	BR	-	Broken	Or	-	Orange
F	-	Fine	BL	-	Blocky	SS	-	Sandstone
V	-	Very	M	-	Massive	Sh	-	Shale
Sl	-	Slight	Br	-	Brown	LS	-	Limestone
Occ	-	Occasional	Bl	-	Black	Fgr	-	Fine-grained
Tr	-	Trace						

5.0 BORING LOGS AND DOCUMENTATION

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections will be used to complete the logs. A sample boring log is attached at the end of this SOP.

The field geologist or engineer will use this example as a guide in completing each boring log. Each boring log will be fully described by the geologist or engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided either on the

back of the boring log or on a separate sheet, for field use. All data will be written directly on the boring log. Additional notes may be entered in a field notebook if more space is needed.

5.1 Remarks Column

The following information will be entered under the "Remarks" column and will include, but is not limited to, the following:

- Moisture - Estimate moisture content using the following terms: dry, moist, wet, and saturated. These terms are determined by the individual. Whatever method is used to determine moisture should be consistent throughout the log.

- Angularity - Describe angularity of coarse-grained particles using the terms angular, subangular, subrounded, or rounded. Refer to ASTM D 2488 or the Earth Manual for criteria for these terms.

- Particle shape - flat, elongated, or flat and elongated.

- Maximum particle size or dimension.

- Water-level observations.

- Reaction with HCl - none, weak, or strong.

Additional comments:

- Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.

- Indicate odor and photoionization detector (PID) readings.

- Indicate any change in lithology by drawing a line through the lithology change column and indicate the depth. This will help when cross-sections are subsequently constructed.

- At the bottom of the page, indicate type of rig, drilling method, hammer size and drop, and any other useful information (i.e., borehole size, casing set, changes in drilling method).

- Vertical lines shall be drawn in the Material Description column from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines will be drawn if there is a change in lithology, then vertical lines will be drawn to that point.

- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.2 Rock Classification

Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate core run number, RQD percent, and core recovery under the appropriate columns.

Indicate lithology change by drawing a line at the appropriate depth, as explained above.

Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.

Enter color as determined while the core sample is wet; if the sample is cored by air, the core is to be scraped clean before the color is described.

Enter rock type. For sedimentary rocks, use terms as described in Section 4.2. Again, be consistent in classification. Use modifiers and additional terms as needed.

Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M, as explained in Section 4.2.6 and as noted on the back of the boring log.

The following information will be entered under the remarks column. Items will include but are not limited to the following:

- Indicate depths of joints, fractures, and breaks and also approximate to horizontal angle (such as high, low) (i.e., 70° angle from horizontal, high angle).
- Indicate calcareous zones, description of any cavities or vugs.
- Indicate any loss or gain of drill water.

- Indicate drop of drill tools or change in color of drill water.

Remarks at the bottom of boring log will include

- Type and size of core obtained
- Depth casing was set
- Type of rig used

As a final check, the boring log will include the following:

- Vertical lines will be drawn as explained for soil classification to indicate consistency of bedrock material.

- If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that will be followed when logging cuttings are as follows:

- Obtain cutting samples at approximately 5-foot intervals, sieve the cuttings (if mud rotary drilling) to obtain a cleaner sample, place the sample into a small sample bottle or ziplock bag for future reference, and label the jar or bag (i.e., hole number, depth, date, etc.). Cuttings will be closely examined to determine general lithology.

- Note any change in color of drilling fluid or cuttings to estimate changes in lithology.

- Note drop or chattering of drilling tools or a change in the rate of drilling to determine fracture locations or lithologic changes.

- Observe loss or gain of drilling fluids or air (if air rotary methods are used) to identify potential fracture zones.

- Record this and any other useful information onto the boring log.

This logging provides a general description of subsurface lithology, and adequate information can be obtained through careful observation of the drilling process. It is recommended that split-barrel and rock core sampling methods be used at selected boring locations during the field investigation to provide detailed information to supplement the less-detailed data generated through borings drilled using air and mud rotary methods.

5.4 Review

Upon completion of the borings logs, copies will be made and reviewed. Items to be reviewed include

- Checking for consistency of all logs
- Checking for conformance to the guideline
- Checking to see that all information is entered in their respective columns and spaces

Originals of the boring logs will be retained in the project files.

7.0 ATTACHMENTS

1. Boring Log

References

Deere, D.U. and Miller, R.P., (1966). Engineering Classification and Index Properties for Intact Rock, Air Force Weapons Lab. Tech. Report AFWL-TR-65-116, Kirtland Base, New Mexico.

Wentworth, C.K., 1922. A Scale of Grade and Class Terms for Caustic Sediments: Jour. Geology, v. 30, p. 377-392.

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ATTACHMENT 1

BORING LOG

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: _____ BORING No.: _____
PROJECT NUMBER: _____ DATE: _____
DRILLING COMPANY: _____ GEOLOGIST: _____
DRILLING RIG: _____ DRILLER: _____

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	MATERIAL DESCRIPTION: Color	MATERIAL DESCRIPTION: Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	PID/FID Reading (ppm): Sampler BZ	PID/FID Reading (ppm): Borehole**	PID/FID Reading (ppm): Driller BZ**

* When rock coring, enter rock brokeness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: _____

Converted to Well: Yes _____ No _____ Well I.D. #: _____

STANDARD OPERATING PROCEDURE
SOP-18

MONITORING WELL ABANDONMENT

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes the standard procedures and technical guidance on monitoring well abandonment. The application of and adherence to this SOP must comply with Indiana, local, and Federal regulatory requirements.

2.0 FIELD FORMS AND EQUIPMENT

Bentonite and /or Cement
Trash Pump
Gasoline
Tremie-Pipe and Hosing
55-gallon Drum(s)
Slurry Mixing Equipment (e.g., Shovel)
Jackhammer, air compressor, etc. (as needed for pad removal)
Saw
Knife
Weighted Engineer's Tape
Water-level Indicator
Retractable Engineer's Rule
Electronic Calculator
Clipboard
Mirror and Flashlight for Observing Downhole Activities
Boring Logs
Field Notebook
Writing Instrument (preferably black pen with indelible ink)
Well Abandonment Form: An example of this form is attached.

3.0 RESPONSIBILITIES

A field geologist or engineer is responsible for supervising all activities and assuring that each well is properly and completely abandoned.

4.0 WELL ABANDONMENT PROCEDURES

4.1 General

Well abandonment is conducted to eliminate physical hazards, prevent groundwater contamination, prevent intermixing of aquifer waters, and conserve aquifer yield and hydrostatic head. A Licensed/Certified Well Driller in the State of Indiana is required to complete/oversight of this activity.

4.2 Material for Sealing

Acceptable sealing materials include sodium-base bentonite clay. These materials are defined as follows:

- Bentonite slurry (which can include polymers to retard swelling), when applied as a heavy mud-laden fluid under pressure, has most of the advantages of cement grout, but under some conditions may be carried away into the surrounding formation. A bentonite clay mixture shall be composed of not less than 2 pounds of clay per gallon of water. Bentonite clay may not be used where it will come in contact with water of a pH below 5.0 or total dissolved solids (TDS) content greater than 1,000 mg/L, or both.

- Pelletized bentonite or coarse-grade crushed bentonite (312 IAC 13-10-2(e)(6)).

Organic material may not be used and fill material may be required to be disinfected or certified clean prior to use. Spent drilling muds or drill cuttings are not to be used to seal a well.

4.3 Procedures for Sealing Wells

4.3.1 Preliminary Considerations

Several factors should be considered to determine the appropriate well abandonment method. These factors include:

- Conditions of the well.

- Details of well construction, including casing material, diameter of casing, depth of the well, and well plumbness.
- Obstructions within the well that may interfere with filling or sealing.
- Hydrogeologic setting.
- Level of contamination and the zone or zones where it occurs.

4.3.2 Inner Well Casing Removal

The well's inner casing should be attempted to be removed prior to sealing activities. If the borehole is unstable and subject to cave-in, sealing material will be emplaced simultaneously during casing removal. If the well is not grouted, casing may be pulled with hydraulic jacks or a drilling rig.

Degraded wells may not permit casing removal by pulling. Also, the casing material may dictate whether a casing can be removed intact. Stainless steel will have a higher tensile strength than PVC and may hold together while pulling the casing; PVC well casing may break under pulling and may need to be overdrilled to remove it.

Well casings can also be removed by overdrilling. Wells can be overdrilled with larger diameter hollow steam or solid stem augers or direct rotary techniques, using air or mud. Augers used for overdrilling should be at least 2 inches larger in diameter than the diameter of the well casing. If well casing is in poor condition or is grouted in place, the casing may be ripped or perforated and filled and pressure grouted in place.

The depth of the well and well plumbness may limit casing removal depending on whether a casing is pulled or overdrilled. In some cases, inner well casings can be left in-place if they are properly sealed.

In addition, the outer protective steel casing (stick-up or flushmount) and well pad may be removed, and the well pad area restored to pre-well installation conditions (i.e., area backfilled to grade with clean fill material, regraded, reseeded, etc.).

4.3.3 Well Sealing Procedures

Abandoned wells shall be filled with the appropriate sealing material placed from the bottom of the well upward. When cement grout or bentonite slurry is used, it shall be placed in continuous operation using a pump, hosing and tremie pipe. Sealing material shall be placed in the interval or intervals to be sealed by methods that prevent bridging, free fall or dilution.

If the tremie-pipe method cannot be used (e.g., bent casing), the well may be abandoned by slowly pouring bentonite pellets or chips into the well from the bottom to the surface. The depth of the bentonite shall be checked periodically with the use of a weighted engineer's tape to assure the casing is being filled properly.

5.0 DOCUMENTATION OF FIELD ACTIVITIES

A critical part of monitoring well abandonment is recordkeeping of significant details and events in the site logbook, on field forms, and in a field logbook.

In addition, the driller (subcontractor) shall submit a report of well abandonment to NAVFAC Crane for submittal to the Indiana Department of Natural Resources (IDNR) describing in detail the specific methods used to abandon the well not later than thirty (30) days after the completion of well plugging/abandonment operations. The report must:

(1) be on a form provided by IDNR (State Form 35680); and

(2) include an affidavit that:
   (A) certifies that the well was plugged in accordance with Indiana Code 14-37-8 (Chapter 8. Plugging and Abandonment); and
   (B) is signed by the person who performed the well plugging operations and the well owner or operator.

The well abandonment report shall be submitted to:

DNR Division of Water
Water Rights & Use Section
402 W. Washington Street, Room W264
Indianapolis, IN 46204

The Division's phone number is (317) 232-4160 or toll-free (877) 928-3755.

6.0 ATTACHMENTS

1. Tetra Tech Monitoring Well Abandonment Form

7.0 REFERENCES

Indiana Department of Environmental Management, 2009. Drilling Procedures and Monitoring Well Construction Guidelines, Policy Number: WASTE-053-NPD, March 17, 2009.

Indiana Department of Natural Resources. Office of Code Revision Indiana Legislative Services Agency, IC 14-37-8, Chapter 8. Plugging and Abandonment.

Indiana Department of Natural Resources. Office of Code Revision Indiana Legislative Services Agency, IC 312 IAC 13, Rule 10.

U.S. EPA, February 1990. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.

ATTACHMENT 1
MONITORING WELL ABANDONMENT FORM

Project Name: _____ Job Number: _____
Site Location/ _____ Client: _____
Address: _____ Address: _____
_____

WELL INFORMATION

Well Number: _____ Static Water Level: _____
Well Diameter: _____ Well Depth: _____
Casing Material:_____ Screen Length: _____

Reason for Abandonment: _____

METHOD OF ABANDONMENT

In-Situ Grouting: _____ Casing Removal & Grouting: _____ Overdrill & Grouting: _____
Other (Explain): _____

Type and Amount of Plugging Material _____
and Date(s) of Installation: _____
Final Surface Conditions: _____

Additional Notes/Comments:

_____
_____

Inspected by (Contractor): _____ Date: _____
Address: _____
_____

Approved by (Tt Representative): _____ Date: _____
Address: _____
_____

APPENDIX B

SWMU 25 FIELD FORMS

B.1 SWMU 25 BORING AND SOIL LOG SHEETS

B.2 SWMU 25 GROUNDWATER LOG SHEETS

B.3 SWMU 25 HISTORICAL HYDROLOGICAL INFORMATION

B.4 SWMU 25 FIELD NOTES

B.5 SWMU 25 CALIBRATION LOGS

B.6 SWMU 25 CHAIN OF CUSTODY (ROUNDS 1 AND 2)

B.1 SWMU 25 BORING AND SOIL LOG SHEETS

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 25 Cleanup
PROJECT NUMBER: 112G03114
DRILLING COMPANY: Mehan
DRILLING RIG: AMS 75-ATV-DPT

BORING No.: SB01 (25)
DATE: 7-11-11
GEOLOGIST: EB
DRILLER: G. Stone

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
X	0		60%		Moist	Red	Dk Brown topsoil		Dense				
X	1					Brown	Sandy Clay						
X	2				Dry				Loose				
X	3					Tan	Some pebbles		Hard				
X	4					Tan							
	5						Refusal						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 25 – Crane
PROJECT NUMBER: 113G03116
DRILLING COMPANY: MTCAL
DRILLING RIG: AMS 95 – DPT

BORING No.: 25SB02
DATE: 7-11-11
GEOLOGIST: EB
DRILLER: G. Stone

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0	X		30%		Moist	Dark Brown	Topsoil	OL	Hard				
1	X					Brown	V. Fine Sandy clay						
2							Refusal						
3													
4													
5													

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 25 - Crane
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Micah
DRILLING RIG: AMS95-DPT

BORING No.: 25SB03
DATE: 7-11-11
GEOLOGIST: EB
DRILLER: G. Stone

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							Topsoil - 0						
0	X		100%		Dense	Brown	V. Fine Sandy Clay	CL					
1	X				Loose		Some pebbles-						
2	X				Moist	Tan	bedrock pieces						
3	X												
4	X												
5							Refusal at 5.5-						
6													

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU25-Crane
PROJECT NUMBER: 112603116
DRILLING COMPANY: Micah
DRILLING RIG: AMS 95-DPT

BORING No.: 25 SB04
DATE: 7-11-11
GEOLOGIST: EB
DRILLER: Micah-G. Stone

Depth Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0			50%		Moist, Dense	Pi Brown	V. Fine Sandy Clay some bedrock pebbles	CL					
1													
2													
3						Tan							
4													
5			30%										
6						Brown							
7						Tan							
8													
9													
10							End of boring (Bedrock not encountered)						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks:

Drilling Area Background (ppm):

Converted to Well: Yes ____ No ✓ Well I.D. #:

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 25- Crane
PROJECT NUMBER: 112G03116
DRILLING COMPANY: MTCAH
DRILLING RIG: AMS 95-DPT

BORING No.: 25SB05
DATE: 7-12-11
GEOLOGIST: EB
DRILLER: G. Stone

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0	X		30%		Moist	Dk Brown	Sandy Clayey Topsoil						
1	X		↓		Loose	Brown	w. Fine sandy clay	CL					
2	X		↓		Dense	Tan	↓						
3	X		↓		↓	↓	↓						
4	X		↓		↓	↓	↓						
5	X		↓		↓	↓	↓						
6							Refusal at 5.9'						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU – Crane
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Micah
DRILLING RIG: AMS 95-DPT

BORING No.: 25SB06
DATE: 7-18-11
GEOLOGIST: EB
DRILLER: G. Stone

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0	X		50%		Loose		Brown Sandy clayey Topsoil		Moist				
1	X				Hard	Orange	Sandstone Pieces		Dry				
					Tan/Brown	Dense	V. Fine Sandy clay	CL					
2	X												
3	X												
4	X												
5	X		60%			Brown							
6	X					Tan							
7	X												
8	X					Gray	(weathered) w/ bedrock pieces						
9	X												
10													

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU25 – Crane
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Micah
DRILLING RIG: AMS 25 – DPT

BORING No.: 25 SB07
DATE: 7-18-11
GEOLOGIST: EB
DRILLER: G. Stone

Depth Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0			60%		Loose	D. Brown	Topsoil – Sandy – Clayey		moist				
1					Loose	Tan	V. Fine Sandy Clay	CL	dry				
2													
3													
4													
5			60%			Tan							
6													
7													
8							with gray						
9							bedrock pieces						
10													

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): _____

Converted to Well: Yes _____ No ✓ Well I.D. #: _____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 25-Crane
PROJECT NUMBER: 112G0316
DRILLING COMPANY: Micah
DRILLING RIG: AMS 95 - DPT

BORING No.: 25SB08
DATE: 7-12-11
GEOLOGIST: EB
DRILLER: Micah - G. Stone

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0			60%		Loose	Brown	Topsoil-Sandy clayey V. F. fine sandy Clay		Moist				
1						Brown		CL	Dry				
2					Dense	Tan							
3													
4													
5			70%										
6													
7													
8						Gray							
9							some bedrock pieces						
10													

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 25 - Crane
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Micah
DRILLING RIG: ~~AMS95-DPT~~ Hand Auger

BORING No.: 25SB#09
DATE: 7-11-11
GEOLOGIST: EB
DRILLER:

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0	X		100%				Gravel - Fill						
1	X		1				V. Fine Sand & Clay	CL					
2							Refusal						
3													
4													
5													

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU25-Crane
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Micah
DRILLING RIG: ~~AMS 25 DPT~~ Hand Auger

BORING No.: 25SB10
DATE: 7-11-11
GEOLOGIST: EB
DRILLER: G. Stone

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
0	X		100%				Gravel - Fill Material		Moist				
1	X		1				V. Fine Sandy Clay	CL	1				
2							Refusal						
3													
4													
5													

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: _____

Drilling Area Background (ppm): ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: SWMU 25 - Crane
PROJECT NUMBER: N2603116
DRILLING COMPANY: Micah
DRILLING RIG: AMS 9500 TR - Hand Auger TRACK DRILL

BORING No.: SB-01
DATE: 7-11-11
GEOLOGIST: E. Berthlite
DRILLER: G. Stone

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
							1st 6" Gravel/Fill						
X	0		100%		Moist	Red	Vr Fine Sandy Clay	CL					
X	1				Loose/	Brown	some pebbles						
	2				Dense	Gray	Refusal - Limestone						

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ____ No X Well I.D. #: ____

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25-Crane
Project No.: 112G0346

[X] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type: 25SS001 0002 / 25SB001 0206

Sample ID No.: 25SB001 0206
Sample Location: 25SB01
Sampled By: E.B.
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-11-4 Time: 1515 Method: DPT Monitor Reading (ppm): 0	0-2	Red-Brown	Sandy Clay

COMPOSITE SAMPLE DATA: Sub Surface

Date: 7-11-4	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method: DPT	1525	2-5'	tan	Sandy Clay, some pebbles
Monitor Readings (Range in ppm): 0				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkhite

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25-Crane
Project No.: 112603116

[] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type: 255B

Sample ID No.: 25SB0020010
Sample Location: ~~25SB0020010~~
Sampled By: EB
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-11-11 Time: 1545 Method: DPT Monitor Reading (ppm): 0	0-2'	Brown	V. Fine Sandy Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkbite

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU-Crane
Project No.: ~~25~~ 112603116

[X] Surface Soil
[X] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type: 25SS0030002 / 25SB0030206

Sample ID No.: 25SB03
Sample Location:
Sampled By: EB
C.O.C. No.:

Type of Sample:
[ ] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

Date: 7-11-11
Time: 1600
Method: DPT
Monitor Reading (ppm): 0

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
0-2	D. Brown	V. Fine Sandy Clay

~~COMPOSITE SAMPLE DATA:~~ SUBSURFACE

Date: 7-11-11
Method: DPT
Monitor Readings (Range in ppm): 0

Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
1615	2-5.5	tan	Moist, V. Fine Sandy Clay with bedrock pieces

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkhite

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25-Crane
Project No.: 112G03116

[X] Surface Soil
[X] Subsurface Soil
[ ] Sediment
[ ] Other: 25SS004 0002
[ ] QA Sample Type: 25SB004 0206
25SB004 0610

Sample ID No.: 25SB04
Sample Location:
Sampled By: EB
C.O.C. No.:

Type of Sample:
[ ] Low Concentration
[ ] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-11-11 Time: 1630 Method: DPT Monitor Reading (ppm): 0	0-2'	Brown	V. Fine Sandy Clay, Moist

~~COMPOSITE SAMPLE DATA:~~ SUBSURFACE

Date: 7-11-11	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:	DPT	2-6	Tan/Brown	V. Fine Sandy Clay, Moist with bedrock pebbles
1640	1650	6-10'		
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle If Applicable:

MS/MSD

Duplicate ID No.: 25FD071111-01-0002
25FD071111-02-0206

Signature(s): Ellen Berkette

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25 - Crane
Project No.: 112603116

[X] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other: 25SS0050002
[] QA Sample Type: 25SB0050206

Sample ID No.: 25SB05
Sample Location:
Sampled By: EB / KL
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

Date: 7-12-11
Time: 0900
Method: DPT
Monitor Reading (ppm): 0

Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
0-2'	Dr. Brown	Sandy Clayey Topsoil - moist
		V. Fine Sandy Clay - Dry

~~COMPOSITE SAMPLE DATA:~~ Sub-surface

Date: 7-12-11
Method: DPT
Monitor Readings (Range in ppm): 0

Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
0910	2-5.9'	Brown/Tan	V. Fine Sandy Clay - Dry

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkette

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25 - Crane
Project No.: 112603116

[X] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 25SB06
Sample Location:
Sampled By: EB
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

25SS0060002
25SB0060206
25SB0060610

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-12-11 Time: 0920 Method: DPT Monitor Reading (ppm): 0	0-2'	0-6" 6"-2"	Topsoil - Sandy Clayey - Brown Sandstone pieces - orange - dry

~~COMPOSITE SAMPLE DATA:~~ SUBSURFACE

Date: 7-12-11	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	0930	2-6'	Brown/Tan	V. Fine Sandy Clay dry
Method: DPT	0940	6-10'	Tan/Gray	↓ Bedrock pieces
Monitor Readings (Range in ppm): 0				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:
YES	

Signature(s): Ellen Berkstite

0002
&
0206

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SMWU 25-Crane
Project No.: 112G0316

Sample ID No.: 25SB07
Sample Location:
Sampled By: EB/KS
C.O.C. No.:

[X] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other: 25SS0070002
[] QA Sample Type: 25SB0070206
25SB0070610

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-12-11	0-2'	Brown	Topsoil - Sandy Clayey - moist
Time: 0945		Tan	V. Fine Sandy Clay dry
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA: Subsurface

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-12-11	0950	2-6'	Tan	V. Fine Sandy Clay - dry
Method: DPT	0955	6-10'	Tan	1 w/ gray bedrock pieces
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkebile

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25 - Crane
Project No.: 112603446

Sample ID No.: 25SB08
Sample Location:
Sampled By: EB
C.O.C. No.:

[X] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other: R5550080002
[] QA Sample Type: 25SB0080206
25SB0080610

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-12-11 Time: 1000 Method: DPT Monitor Reading (ppm): 0	0-2	Brown	0-6" moist topsoil, sandy clay 6"-2' V. Fine Sandy Clay

~~COMPOSITE SAMPLE DATA:~~ Subsurface

Date: 7-12-11	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	1005	2-6	tan	V. Fine Sandy Clay dry
Method: DPT	1010	6-10	Gray	w/ bedrock pieces
Monitor Readings (Range in ppm): 0				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkelite

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25 - Crane
Project No.: 112G03116

[X] Surface Soil
[ ] Subsurface Soil
[ ] Sediment
[ ] Other:
[ ] QA Sample Type:

Sample ID No.: 25SB09
Sample Location:
Sampled By: EB
C.O.C. No.:

Type of Sample:
[ ] Low Concentration
[ ] High Concentration

25S50090002

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-11-11 Time: 1710 Method: Hand Auger Monitor Reading (ppm): 0	0-2'	Black to Brown	Top 6" Fill Gravel (Concrete) 6"-2' V. Fine Sandy Clay

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berklite

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25
Project No.: 112603116

[X] Surface Soil
[X] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

Sample ID No.: 25SB10
Sample Location:
Sampled By: EB
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

25S50100002

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-11-11 Time: 1655 Method: ~~DPT~~ Hand Auger Monitor Reading (ppm): 0	0-2'	Black to Brown	Top 6" Fill Gravel + Silt moist 6"-2' V. Fine Sandy Clay

COMPOSITE SAMPLE DATA:

Date:	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
	~~1655~~			
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkette

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: SWMU 25 - Crane
Project No.: 112603116

[X] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other:
[] QA Sample Type:

25SS0110002

Sample ID No.: 25SB009
Sample Location: 25SS0110002
Sampled By: E. Berkbite
C.O.C. No.:

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date: 7-11-11 Time: 1500 Method: DPT Monitor Reading (ppm): 0	0-2'	Red-Brown	Moist, V. Fine Sandy Clay, Some pebbles

COMPOSITE SAMPLE DATA:

	Time	Depth	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s): Ellen Berkbite

Tetra Tech

BORING LOG

PROJECT NAME: SWMU 25 Dump site A
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Chase Environmental
DRILLING RIG:

BORING No.: 25MWT06
DATE: 10/23/12
GEOLOGIST: Kevin Losekamp
DRILLER: John Barton

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1		4/3	1.5/		Soft	BRN	Silty Clay	CL					
		6/6	/2.0										
S-2		3/2	2.0/										
		2/	/2.0										
S-3	5	3/50/5	1.0/1.0		Bl. Stiff	DK BRN	Sandy Clay	CL					
				Bedrock			Some S.S. Seams						
							No recovery.						
							All overburden.						
	10						HSA to 21'						
	15												
	20												
				21'									
					m. Hard	BRN	Sandstone						
				23'					Little moisture less dust				
					m. Soft	Gray	Shale		Gi				
	25												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): NA

Remarks: 6" hole in bedrock. HSA 5'. Competent bedrock at 21'.

Converted to Well: Yes x No _____ Well I.D. #: _____

Tetra Tech

BORING LOG

PROJECT NAME: SWMU 25 Dump site A
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Chase Environmental
DRILLING RIG:

BORING No.: 25MWT06
DATE: 10/23/12
GEOLOGIST: Kevin Losekamp
DRILLER: John Barton

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	25												
					m. Hard	gray	Sandstone						
					m Hard	gray	Shale / Sandstone						
	30			29	m. Hard	gray	Sandstone		water at 29.0' after sitting for 10 min. at 40'				
	35												
				39									
	40												
				EOB									
	45												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Sand 25-40, Screen 29-39, Bentonite 23-25

Drilling Area Background (ppm): NA

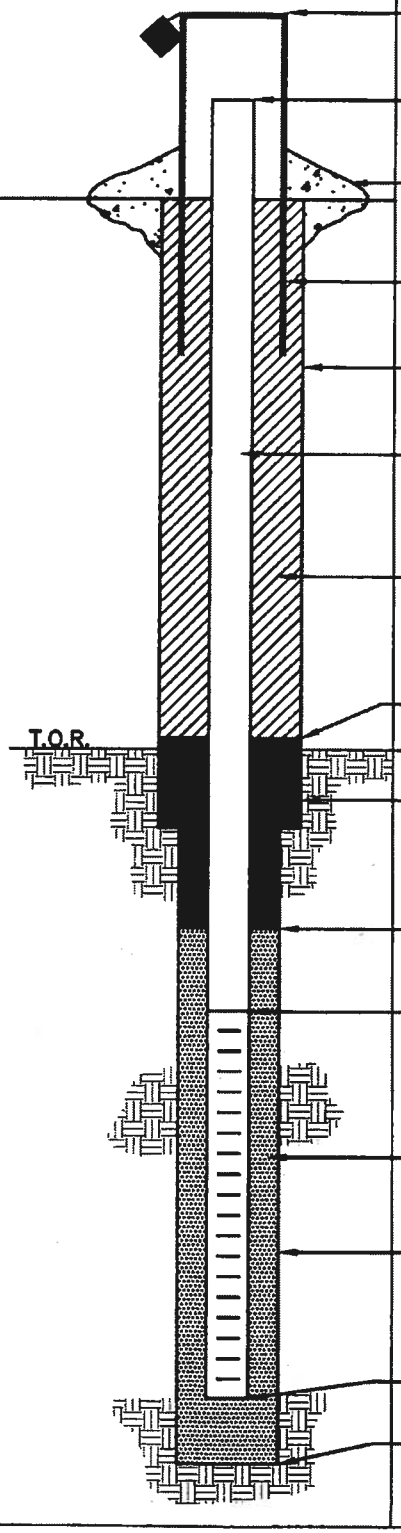
Converted to Well: Yes x No _____ Well I.D. #: _____

WELL NO.: 25MWT06

Tetra Tech

BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT Swmu 25	LOCATION NSA Crane	DRILLER John Barton
PROJECT NO. 112G03116	BORING 25MWT06	DRILLING METHOD Air Rotary
DATE BEGUN 10-23-12	DATE COMPLETED 10-24-12	DEVELOPMENT METHOD 12v sub / surge
FIELD GEOLOGIST K. Loserkamp		
GROUND ELEVATION	DATUM	



ELEVATION/HEIGHT OF TOP OF SURFACE CASING: 136"

ELEVATION/HEIGHT TOP OF RISER: 134"

TYPE OF SURFACE SEAL: ~~4'x4'x6"~~ 2x2x6" Concrete pad + 2 bollards

I.D. OF SURFACE CASING: 6" steel

DIAMETER OF HOLE: 4"

RISER PIPE I.D.: 2"

TYPE OF RISER PIPE: 2" PVC

TYPE OF BACKFILL: grout slurry

ELEVATION/DEPTH TOP OF SEAL: 123

ELEVATION/DEPTH TOP OF BEDROCK: 21

TYPE OF SEAL: Bentonite

ELEVATION/DEPTH TOP OF SAND: 125

ELEVATION/DEPTH TOP OF SCREEN: 129

TYPE OF SCREEN: PVC

SLOT SIZE x LENGTH: .020 x 10'

I.D. SCREEN: 2"

TYPE OF SAND PACK: 20/40 Silica

DIAMETER OF HOLE IN BEDROCK: 6"

CORE/REAM: —

ELEVATION/DEPTH BOTTOM SCREEN: 139

ELEVATION/DEPTH BOTTOM OF SAND: 140

ELEVATION/DEPTH BOTTOM OF HOLE: 140

BACKFILL MATERIAL BELOW SAND: NA

ACAD: FORM_MWNBR.dwg 07/28/99 INL

B.2 SWMU 25 GROUNDWATER LOG SHEETS

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: SWMU 25
Project No.: 112G03116
Location: Crane, Indiana
Personnel: Kevin / John / Ellen
Weather Conditions: 90+°F
Measuring Device: Water Level Meter
Tidally Influenced: Yes ___ No X
Remarks: See Field Book Notes

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of ~~Free Product~~ (feet)* Sediment	Groundwater Elevation (feet)*	Comments
7-1-81	7-11-11	6:15	TOC/Redevelopment	44.5	24.50	.5 ft		
7-3-81	7-12-11	1550		~~30.88~~	29.23	sediment unknown quantity		
7-5-81	7-12-11	1552		41.40	26.20			
7-4-81	7-12-11	1555		28.30*	28.10			18' to obstruction
7-2-81	7-12-11	1600		44.40	36.04			
7-1-81	7-13-11	1440	TOC/Pre-sample collection	44.75	24.50			readings after sampling
7-3-81	7-13-11	1600		38.75	29.25			
7-2-81	7-13-11	1640		44.60	36.00			
7-4-81	7-14-11	0900		37.90	36.30			
7-5-81	7-14-11	0915		41.10	26.18			

* All measurements to the nearest 0.01 foot

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of ___

Well: 7-1-81
Site: SWMU 25
Date Installed: 7-1-81
Date Developed: 7-11-11
Dev. Method: Whaler
Pump Type: _____

Depth to Bottom (ft.): 45.1 ft BC
Static Water Level Before (ft.): 24.5
Static Water Level After (ft.): 28.1
Screen Length (ft.): ~ 10 ft
Specific Capacity: _____
Casing ID (in.): 2

Responsible Personnel: John Floyd / Kevin Losekamp
Drilling Co.: NA
Project Name: SWMU 25
Project Number: 112G03116

*See Field Notes

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)
6:10	.5 ft	3.26	24.5					cloudy
6:35	.5 ft	7.0	27.2					cloudy
7:15	.5 ft	10.5	28.1					cloudy

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Well: 7-2-81
Site: SWMU25
Date Installed: 7-2-81
Date Developed: 7-12-11
Dev. Method: Bailer
Pump Type:

Depth to Bottom (ft.): 44.40
Static Water Level Before (ft.): 36.04
Static Water Level After (ft.): 36.04
Screen Length (ft.): ~10 feet
Specific Capacity:
Casing ID (in.): 2 in

Responsible Personnel: E. Berkhire
Drilling Co.: NA
Project Name: SWMU 25
Project Number: 112603116

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units ~~MS/C~~)	Turbidity (NTU)	Remarks (odor, color, etc.)
1658	<.1'	10	36.04'	20.61	6.59	0.620	12	Bail 5 gallons well went dry; 15 min recharge - bailed 4 more gal; well went dry - 1' bale then took readings

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of ___

Well: 7-3-81
Site: SWMU25
Date Installed: 7-3-81
Date Developed: 7-12-4
Dev. Method: Bailer
Pump Type:

Depth to Bottom (ft.): 38.88'
Static Water Level Before (ft.): 29.23'
Static Water Level After (ft.): Same
Screen Length (ft.): ~10 feet
Specific Capacity:
Casing ID (in.): 2'

Responsible Personnel: E. Berkfite
Drilling Co.: ~~Mieak~~ (NA)
Project Name: SWMU25
Project Number: 112603116

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units mS/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)
1550	0.5'	9	29.23'	21.50	6.79	0.612	27	slightly cloudy, no odor
								well went dry after
								bailing 6 gallons,
								slowly recharged after
								15 minutes and bailed
								3 more gallons, before
								well went dry again.
								Water was clear
								and >5 well volumes
								removed.

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of ___

Well: 7-4-81
Site: SWMU 25
Date Installed: 7-4-81
Date Developed: 7-12-11
Dev. Method: Waterra/Bailer
Pump Type:

Depth to Bottom (ft.): 28.30* (9' of sediment)
Static Water Level Before (ft.): 28.10
Static Water Level After (ft.): Same
Screen Length (ft.): ~10'
Specific Capacity:
Casing ID (in.): 2"

Responsible Personnel: E. Berktite
Drilling Co.: NA
Project Name: SWMU 25
Project Number: 112G0316

*See Field Notes

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)
1555	9'	2 gal.						

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of _____

Well: 7-5-81
Site: SWMU 25
Date Installed: 7-5-81
Date Developed: 7-12-81
Dev. Method: Bailer/Wattera
Pump Type: _____

Depth to Bottom (ft.): 41.40'
Static Water Level Before (ft.): 26.20'
Static Water Level After (ft.): same
Screen Length (ft.): ~10'
Specific Capacity: _____
Casing ID (in.): 2"

Responsible Personnel: DICKSON
Drilling Co.: ~~MICAH~~ NA
Project Name: SWMU 25
Project Number: 112603116

* See Field Notes

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)
1552		7 gallons						

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane -SWMU25 **WELL ID.:** WES-7-1-81/ 25MW01
PROJECT NUMBER: 112G03116 **DATE:** 7/13/2011

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	Salinity % or ppt	Comments
14:00	24.50	200	5.97	1.49	31.0	2.9	16.0	82	NA	Total Depth = 44.75 feet below TOC
14:10	24.50	200	6.03	1.46	23.1	2.9	16.0	76	NA	
14:15	24.50	200	6.02	1.46	23.3	2.1	16.0	70	NA	
14:25	24.50	200	6.00	1.47	11.1	2.9	14.2	58	NA	
14:30	24.50	200	6.00	1.45	6.0	2.5	14.0	49	NA	
14:35	24.50	200	6.00	1.46	5.0	2.2	14.0	48	NA	
14:40	24.50	200	6.10	1.46	5.6	1.9	14.0	48	NA	

SIGNATURE(S): EB for KL

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane -SWMU25 **WELL ID.:** WES-7-2-81/ 25MW02
PROJECT NUMBER: 112G03116 **DATE:** 7/13/2011

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	Salinity % or ppt	Comments
18:50	36.00	200	7.00	0.608	100	8.4	16.5	138	NA	Total Depth = 44.60 feet below TOC
19:00	36.00	200	6.50	0.673	26	1.6	13.44	44	NA	
19:05	36.00	200	6.42	0.66	25	1.6	13.4	22	NA	
19:15	36.00	200	6.40	0.64	23	1.6	13.4	21	NA	

SIGNATURE(S): EB for KL

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane -SWMU25
PROJECT NUMBER: 112G03116
WELL ID.: WES-7-3-81/ 25MW03
DATE: 7/13/2011

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	Salinity % or ppt	Comments
16:00	29.25	200	6.67	0.573	808	1.3	14.5	181	NA	Total Depth = 38.75 feet below TOC
16:20	29.25	200	7.00	0.563	800	2.14	14.7	182	NA	
16:30	29.25	200	6.80	0.556	800	0.77	14.7	152	NA	
16:45	29.25	200	6.90	0.543	293	1.0	14.3	-6	NA	
17:00	29.25	200	6.80	0.542	160	0.98	14.4	-6.5	NA	
17:10	29.25	200	6.80	0.539	158	1.0	14.3	-6	NA	
17:15	29.25	200	6.90	0.540	157	0.98	14.4	-7	NA	

SIGNATURE(S): EB for KL

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane -SWMU25 **WELL ID.:** WES-7-4-81/ 25MW04
PROJECT NUMBER: 112G03116 **DATE:** 7/14/2011

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	Salinity % or ppt	Comments
9:00	36.30	NA	NA	NA	NA	NA	NA	NA	NA	Well Compromised
										Attempted to place pump
										down well, but casing is
										bent approx. 18 feet bgs.
										Tried wattera with surge
										block, but could not get
										past bent and cracked
										pipe. Will attempt to grab
										a groundwater sample with
										a smaller diameter wattera
										with no surger.
										Purged and collected in a bucket
										enough water for bottleware.
										Filtered groundwater with a
										40 micron filter and peristaleic
										pump. Did not take readings
										as water was so turbid.
										Well compromised but will
										collect sample to get an idea
										of the groundwater quality
										in the vicinity of the well for
										future considerations.
										Total Depth = 37.90 below TOC

SIGNATURE(S): KL and EB

LOW FLOW PURGE DATA SHEET

PROJECT SITE NAME: NSA Crane -SWMU25 **WELL ID.:** WES-7-5-81/ 25MW05
PROJECT NUMBER: 112G03116 **DATE:** 7/14/2011

Time (Hrs.)	Water Level (Ft. below TOC)	Flow (mL/Min.)	pH (S.U.)	S. Cond. (mS/cm)	Turb. (NTU)	DO (mg/L)	Temp. (Celcius)	ORP mV	Salinity % or ppt	Comments
9:15	26.18	NA	NA	NA	NA	NA	NA	NA	NA	Well Compromised
										See notes on 25MW04
										Total Depth = 41.10

SIGNATURE(S): KL and EB

PAGE 5 OF 5

Tetra Tech

MONITORING WELL DEVELOPMENT RECORD

Well: 25MWT06
Site: Sumv 25
Date Installed: 10/23/12
Date Developed: 10/25/12
Dev. Method: Sub Surge/pump
Pump Type: 12V sub

Depth to Bottom (ft.): 43.6
Static Water Level Before (ft.): 28.65
Static Water Level After (ft.):
Screen Length (ft.): 10'
Specific Capacity: 2.41
Casing ID (in.): 2"

Responsible Personnel: K.Losekamp
Drilling Co.: Chase Environmental
Project Name: SWMU 25
Project Number: 112G03116

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)
1315	.2'	0	28.65	–	–	–	–	Start
1317	.2'	1	31.31	16.7	5.71	.061	>1000	very gray
1321	0	7	39.17	14.7	5.91	.088	>1000	gray
1325	0	10	42.87	14.1	5.61	.081	>1000	Lt gray
1405	0	12	32.11	15.1	5.81	.089	>1000	Bailer Dk gray
1415	0	16	35.77	14.71	6.10	.112	>1000	gray

pump malfunction switch to bailer

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

Event: GW Sampling
Project Site Name: SWMU 25 - NSA Crane
Project No.: 112G03116

Sample ID:	25MW718102	**Sampled By:**	CR
QA/QC Duplicate ID:	FD110112-01	**Sample Date:**	11/01/12
MS/MSD Collected:		**Sample Time:**	1155

WELL INFORMATION:

Well ID :	25MW01	**Purge Date:**	11/01/12
Well Diameter (in):	2	**Static Water Level (ft-BTOR):**	28.15
Top of Screen (ft-BTOR):	3	**PID Monitor Reading:**	NA
Bottom of Screen (ft-BTOR):	44.5	**Purge Method:**	
Total Well Depth (ft-BTOR):	45.5	**Sample Method:**	

EQUIPMENT INFORMATION:

Water Quality Instrument:	Horiba U-52 (Field Environmental - 64015)	**Pump Controller:**	
Turbidity Meter:			

PURGE DATA:

Time (Hrs)	H^20 Level (ft-BTOR)	Flow mL / min.	Color	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
1050	27.9	300	--	--	--	--	--	--	--	NA	
1100	27.72	300	Mostly Clear - Slight Brown	7.4	1.31	4.31	149	9	-1	NA	
1110	27.9	300	Clear	7.3	0.599	4.4	67	7.9	-1	NA	
1120	28.04	300	Clear	8.1	0.249	5.5	56	8.4	-17	NA	
1130	27.99	300	Clear	8	0.002	10.7	23.5	8.6	37	NA	
1140	28.01	300	Clear	7.95	0.003	10.5	6.4	9.3	24	NA	
1145	28.06	300	Clear	7	1.35	6.2	2.7	9.5	-6	NA	
1155	28.15	300	Clear	7.1	1.59	6.2	2.6	9.9	-8	NA	

FINAL PURGE / SAMPLE DATA:

Start Purge	End Purge	Total (min.)	Total Vol. (gal. / L.)	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
1050	1155	65	19.5 L	7.1	1.59	6.2	2.6	9.9	-8	NA	

ANALYSIS, PRESERVATION AND BOTTLE REQUIRMENTS

Analysis	Method	Preservative	Number	Vol.	Bottle Type	Collected
SVOCs	SW-846 8270C	Cool to 4°C	2	1 liter	amber glass	X
TAL Metals	SW-846 6010B, 7470A	HNO^3, Cool to 4°C	1	250 ml	PE	X
Dissolved Metals	SW-846 6010B, 7470A	HNO^3, Cool to 4°C	1	250 ml	PE	X

OBSERVATIONS / NOTES:

Field Duplicate - FD-110112-01

Signature(s): *Chris Rumer*

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

Event:	GW Sampling
Project Site Name:	SWMU 25 - NSA Crane
Project No.:	112G03116

Sample ID:	25MW728102	**Sampled By:**	CR
QA/QC Duplicate ID:		**Sample Date:**	11/01/12
MS/MSD Collected:		**Sample Time:**	1420

WELL INFORMATION:

Well ID :	25MW02	**Purge Date:**	11/01/12
Well Diameter (in):	2	**Static Water Level (ft-BTOR):**	38.2
Top of Screen (ft-BTOR):		**PID Monitor Reading:**	NA
Bottom of Screen (ft-BTOR):		**Purge Method:**	Grundfos 2
Total Well Depth (ft-BTOR):	44	**Sample Method:**	Grundfos 2

EQUIPMENT INFORMATION:

Water Quality Instrument:	Horiba U-52 (Field Environmental - 64015)	**Pump Controller:**	
Turbidity Meter:			

PURGE DATA:

Time (Hrs)	H^20 Level (ft-BTOR)	Flow mL / min.	Color	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
840	--	300	--	--	--	--	--	--	--	--	--
850	37.9	300	Mostly Clear - Slight Brown	7.5	0.567	5.34	93	10.9	94	NA	
855	38.8	300	Mostly Clear - Slight Brown	7.4	0.822	4.95	81	11.9	101	NA	
900	38.8	300	Mostly Clear - Slight Brown	7.3	0.509	4.1	123	13.6	25	NA	
905	38.9	300	Mostly Clear - Slight Brown	7.4	0.819	5.9	104	8.9	10	NA	
920	42	300	Brown	7.5	--	--	560	--	--	NA	See Below

FINAL PURGE / SAMPLE DATA:

Start Purge	End Purge	Total (min.)	Total Vol. (gal. / L.)	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
840	920	40	12 L	7.2	0.001	10.6	270	14.7	108	NA	

ANALYSIS, PRESERVATION AND BOTTLE REQUIRMENTS

Analysis	Method	Preservative	Number	Vol.	Bottle Type	Collected
SVOCs	SW-846 8270C	Cool to 4°C	2	1 liter	amber glass	X
TAL Metals	SW-846 6010B, 7470A	HNO^3, Cool to 4°C	1	250 ml	PE	X
Dissolved Metals	SW-846 6010B, 7470A	HNO^3, Cool to 4°C	1	250 ml	PE	X

OBSERVATIONS / NOTES:

There was approximately 6 feet of water when beginning to purge. As turbidity continued to decrease, the pump was not able to pump water. The well dried and needed to re-charge. Kevin Losekamp (FOL) spoke to Tom Brent and Tom said to allow the well to recharge for a bit and then turn the pump back on and collect a grab sample. In addition, the Horiba at sample time read a turbidity of 270 NTU, but this did not seem representative with as brown as the water appeared. Brian Richard for Empirical Laboratories, LLC was notified of this.

Signature(s): *Chris Rumer*

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

Event:	GW Sampling
Project Site Name:	SWMU 25 - NSA Crane
Project No.:	112G03116

Sample ID:	25MW738102	**Sampled By:**	CR
QA/QC Duplicate ID:		**Sample Date:**	11/01/12
MS/MSD Collected:		**Sample Time:**	1320

WELL INFORMATION:

Well ID :	25MW03	**Purge Date:**	10/31/12
Well Diameter (in):	2	**Static Water Level (ft-BTOR):**	
Top of Screen (ft-BTOR):		**PID Monitor Reading:**	NA
Bottom of Screen (ft-BTOR):		**Purge Method:**	Grundfos 2
Total Well Depth (ft-BTOR):	38.8	**Sample Method:**	Grundfos 2

EQUIPMENT INFORMATION:

Water Quality Instrument:	Horiba U-52 (Field Environmental - 64015)	**Pump Controller:**	
Turbidity Meter:			

PURGE DATA:

Time (Hrs)	H^20 Level (ft-BTOR)	Flow mL / min.	Color	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
1445	32.2	300	Light Brown	--	--	--	--	--	--	NA	
1455	32.1	300	Mostly Clear - Some Brown	7.5	0.569	2.48	275	14.3	91	NA	
1505	32.9	300	Mostly Clear - Some Brown	7.55	0.569	2.02	177	14.8	90	NA	
1515	32.9	300	Mostly Clear - Slight Brown	7.6	0.534	3.47	115	14.2	66	NA	
1535	36.5	300	Mostly Clear - Some Brown	7.7	0.5	4.45	245*	12.7	9	NA	
1545	36.3	300	Mostly Clear - Slight Brown	7.6	0.497	4.12	170	13.9	-4	NA	
1605	35.9	200	Mostly Clear to Light Brown	7.7	0.553	4.85	440*	10.9	45	NA	
1615	36	200	Mostly Clear to Light Brown	7.5	0.455	4.9	335*	10.3	108	NA	

FINAL PURGE / SAMPLE DATA:

Start Purge	End Purge	Total (min.)	Total Vol. (gal. / L.)	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
1445	1615	90	27 L	7.4	0.604	2.84	388	15.1	100	NA	

ANALYSIS, PRESERVATION AND BOTTLE REQUIRMENTS

Analysis	Method	Preservative	Number	Vol.	Bottle Type	Collected
SVOCs	SW-846 8270C	Cool to 4°C	2	1 liter	amber glass	X
TAL Metals	SW-846 6010B, 7470A	HNO^3, Cool to 4°C	1	250 ml	PE	X
Dissolved Metals	SW-846 6010B, 7470A	HNO^3, Cool to 4°C	1	250 ml	PE	X

OBSERVATIONS / NOTES:

There was approximately 6 feet of water when beginning to purge. As turbidity continued to decrease, the pump was not able to pump water. The well dried and needed to re-charge. Kevin Losekamp (FOL) spoke to Tom Brent and Tom said to allow the well to recharge for a bit and then turn the pump back on and collect a grab sample. Brian Richard for Empirical Laboratoires, LLC was notified of this.

Signature(s): *Chris Rumer*

GROUNDWATER SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

Event:	GW Sampling
Project Site Name:	SWMU 25 - NSA Crane
Project No.:	112G03116

Sample ID:	25MWT1061202			**Sampled By:**	CR
QA/QC Duplicate ID:	N/A			**Sample Date:**	10/31/12
MS/MSD Collected:	N/A	N/A		**Sample Time:**	1405

WELL INFORMATION:

Well ID :	25MW06	**Purge Date:**	10/31/12
Well Diameter (in):	2	**Static Water Level (ft-BTOR):**	
Top of Screen (ft-BTOR):		**PID Monitor Reading:**	NA
Bottom of Screen (ft-BTOR):		**Purge Method:**	Grundfos 2
Total Well Depth (ft-BTOR):	44.5	**Sample Method:**	Grundfos 2

EQUIPMENT INFORMATION:

Water Quality Instrument:	Horiba U-52 (Field Environmental - 64015)	**Pump Controller:**	
Turbidity Meter:			

PURGE DATA:

Time (Hrs)	H^20 Level (ft-BTOR)	Flow mL / min.	Color	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
1045	29.6	300	Milky White	5.95	0.614	6.79	> 800	12.38	224	NA	
1055	29.6	300	Milky White	6.66	0.292	5.43	> 800	11.45	200	NA	
1105	29.7	300	Milky White	6.69	0.631	4.93	> 800	11.51	145	NA	
1115	29.7	300	Milky White	6.84	0.673	5.85	> 800	9.75	124	NA	
1125	29.7	300	Milky White	6.66	0.529	5.92	> 800	9.87	147	NA	
1135	29.7	300	Milky White	6.67	0.694	5.1	> 800	10.4	90	NA	
1145	30	300	Milky White	6.66	0.653	3.03	> 800	10.6	84	NA	
1155	31.2	300	Milky White	6.64	0.695	4.93	760	10.5	65	NA	
1205	31.2	300	Milky White	6.66	0.362	5.31	> 800	10.1	83	NA	
1215	31.2	300	Milky White	6.7	0.602	4.75	750	12.8	43	NA	
1225	31.1	300	Milky White	6.63	0.284	5.35	617	11.9	62	NA	Clearing
1235	31	300	Clear/White	6.83	0.643	4.87	365	11	35	NA	

FINAL PURGE / SAMPLE DATA:

Start Purge	End Purge	Total (min.)	Total Vol. (gal. / L.)	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
1045	1405	200	60 L	7.22	0.532	4.63	23	11.2	2	NA	

ANALYSIS, PRESERVATION AND BOTTLE REQUIRMENTS

Analysis	Method	Preservative	Number	Vol.	Bottle Type	Collected
SVOCs	SW-846 8270C	Cool to 4°C	2	1 liter	amber glass	X
TAL Metals	SW-846 6010B, 7470A	HNO^3, Cool to 4°C	1	250 ml	PE	X
Dissolved Metals	SW-846 6010B, 7470A	HNO^3, Cool to 4°C	1	250 ml	PE	X

OBSERVATIONS / NOTES:

Signature(s): *Chris Rumer*

Time (Hrs)	H^20 Level (ft-BTOR)	Flow mL / min.	Color	pH (S.U.)	S.C. (mS/cm)	DO (mg/L)	Turbidity (NTU)	Temp. (C°)	ORP (mV)	Salinity (% or ppt)	Other
1245	30.9	300	Clear to White	6.7	0.555	4.83	245	10.7	64	NA	
1255	30.8	300	Clear to White	6.9	0.417	4.95	187	10.5	67	NA	
1305	30.9	300	Mostly Clear - Some Haze	7.1	0.571	5.13	128	10.1	54	NA	
1315	30.9	300	Mostly Clear - Some Haze	7	0.591	4.85	110	10.6	15	NA	
1325	31	300	Mostly Clear	6.9	0.571	4.94	82	10.8	33	NA	
1335	31	300	Mostly Clear	7.22	0.399	4.83	62	10.9	29	NA	
1345	31	300	Mostly Clear	7.25	0.548	4.93	27	11.1	6	NA	
1355	31	300	Mostly Clear	7.22	0.537	4.88	25.5	11.2	1	NA	
1405	31	300	Mostly Clear	7.22	0.532	4.63	23	11.2	2	NA	

B.3 SWMU 25 HISTORICAL HYDROLOGICAL INFORMATION

1001
N00164.AR.000006
NSWC CRANE
5090.3a

HYDROGEOLOGIC INVESTIGATION OF WASTE DISPOSAL SITES AT THE NAVAL WEAPONS SUPPORT CENTER, CRANE, INDIANA

by

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USAE Waterways Experiment Station
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Prepared for
Naval Weapons Support Center
Crane, Indiana

April 1982

Summary

The Naval Weapons Support Center (NWSC) identified areas on its installation where contaminated materials have been buried and determined that a groundwater monitoring network at each area was required to identify any subsurface contamination which might have resulted from these disposal areas. The NWSC requested the Waterways Experiment Station (WES) to install a groundwater monitoring system around each identified disposal site. A total of 13 groundwater monitoring networks; 83 monitoring wells; were installed in 11 sites throughout the NWSC. Each site contained from 5 to 15 monitoring wells with the number of wells dependent on the area of each site, the number of groundwater flow patterns encountered, or the number of disposal areas per site.

The WES conducted a soil sampling and drilling program to define the hydrogeologic characteristics and to locate and install the monitoring wells at each site. The sampling and drilling program identified two sites where the water table was encountered in the unconsolidated overburden and in the remaining sites, the water table was encountered in fractures in sedimentary rocks at depths of less than 10 ft to a maximum depth of 121 ft. The direction of groundwater flow varied, but generally conformed with the surface flow at each site. Overburden thickness at the sites ranges from less than 1 ft to more than 40 ft with soil types of predominantly clay, silt, and sand. The rock underlying the overburden consists of sandstone, shale, limestone, and interbedded coal seams of Pennsylvanian and Mississippian age.

WORKING DRAFT

PREFACE

This study was performed by personnel of the Geotechnical Laboratory (GL) of the U. S. Army Engineer Waterways Experiment Station. Funding for this study was authorized by Military Interdepartmental Purchase Request (MIPR) Number N00164-IMP-04575 dated 6 June 1981 and amended 22 October 1981.

The field work was conducted during the period 17 August 1981 to 1 December 1981. Soil testing and data reduction were performed from January 1982 to April 1982 and report preparation was accomplished during this same period. The drilling was performed by the Exploration Group (EG), Engineering Geology and Rock Mechanics Division (EGRMD), GL, under the supervision of Mr. Joseph B. Dunbar, Engineering Geology Applications Group (EGAG) of the EGRMD. The physical soil tests were performed by the Soil Testing Facility, GL. Messrs. Jerald D. Broughton and Dale L. Barefoot, EGAG, assisted in data compilation and analysis. Mr. Dunbar prepared the report.

The study was conducted under the direct supervision of Mr. John H. Shamburger, Chief, EGAG, and Mr. Mark A. Vispi, Chief, EG, and under the general supervision of Dr. Don C. Banks, Chief, EGRMD, and Drs. William F. Marcuson III and Paul F. Hadala, Chief and Assistant Chief, GL, respectively.

Special acknowledgment is extended to Mrs. Cathy Andrews and Mr. Eric Foster of the Naval Weapons Support Center for their assistance during the study.

Commander and Director of WES during the conduct of the study was COL Tilford C. Creel, CE. The Technical Director was Mr. F. R. Brown.

WORKING DRAFT

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WORKING DRAFT

WES-6-15-81 was not used in contour construction since the water level fell below the screened portion shortly after installation. Groundwater data for this site are presented in Appendix D.

Physical and chemical test

Laboratory classification of soil samples ranged from clayey sand (SC) to clay (CL and CH). These soils are brown to tan. Soil permeability for a clay (CL) soil (sample 2, boring 14) was calculated to be 2.77×10^{-6} cm/sec and this soil composes 79 percent of the samples from this site. Appendix E presents the physical and chemical tests results.

Highway 58 Dump Site A

Location

The Highway 58 Dump Site A is located slightly north of the center of Sec. 26, T5N, R4W (Figure 4) and lies between Highway 45 and the NWSC Salvage Yard on Highway 58. Five monitoring wells were installed around the dump perimeter as shown in Figure 38.

Geology

Overburden at the Highway 58 Dump Site A ranges in thickness from less than 2 ft to 18.5 ft. Limestone, sandstone, and shale from the Mansfield Formation of the Raccoon Creek Group (Table 1) underlie the overburden. Boring WES-7-2-81 was drilled to a depth of 35 ft and beneath the overburden encountered 12 ft of a reddish brown, very stiff, dense, weathered gravelly clay shale. This clay shale at a depth of 15.5 ft grades into a soft, weathered, brown to dark grey, occasionally limonitic shale. From a depth of 20 ft, sandstone and shale are thinly interbedded in nearly equal proportions and at the end of the boring, the shale content declines to around 10 percent. The sandstone is light grey to dark grey, fine-grained, and moderately hard while the shale is dark grey to black and soft. Cross section A-A' (Figure 39) presents boring and groundwater data from 4 borings. Boring logs are presented in Appendixes A and B.

Groundwater

Groundwater at the Highway 58 Dump Site A was encountered in fractures in the sandstone. Groundwater elevations between the up gradient and the down gradient monitoring wells range from 606 to 570 ft MSL, a difference of 36 ft.

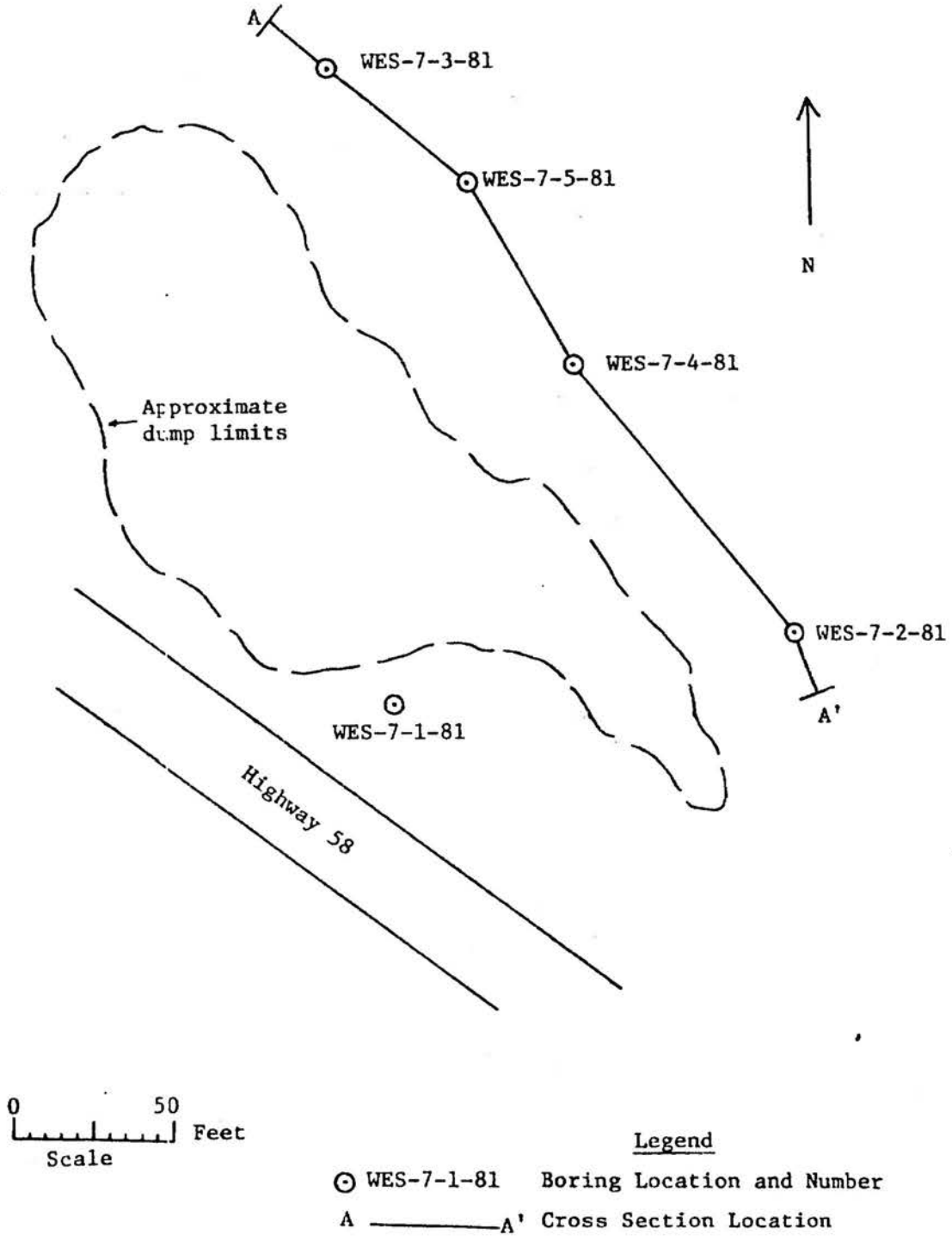


Figure 38. Well Locations and Cross Section Locations of Highway 58 Dump Site A

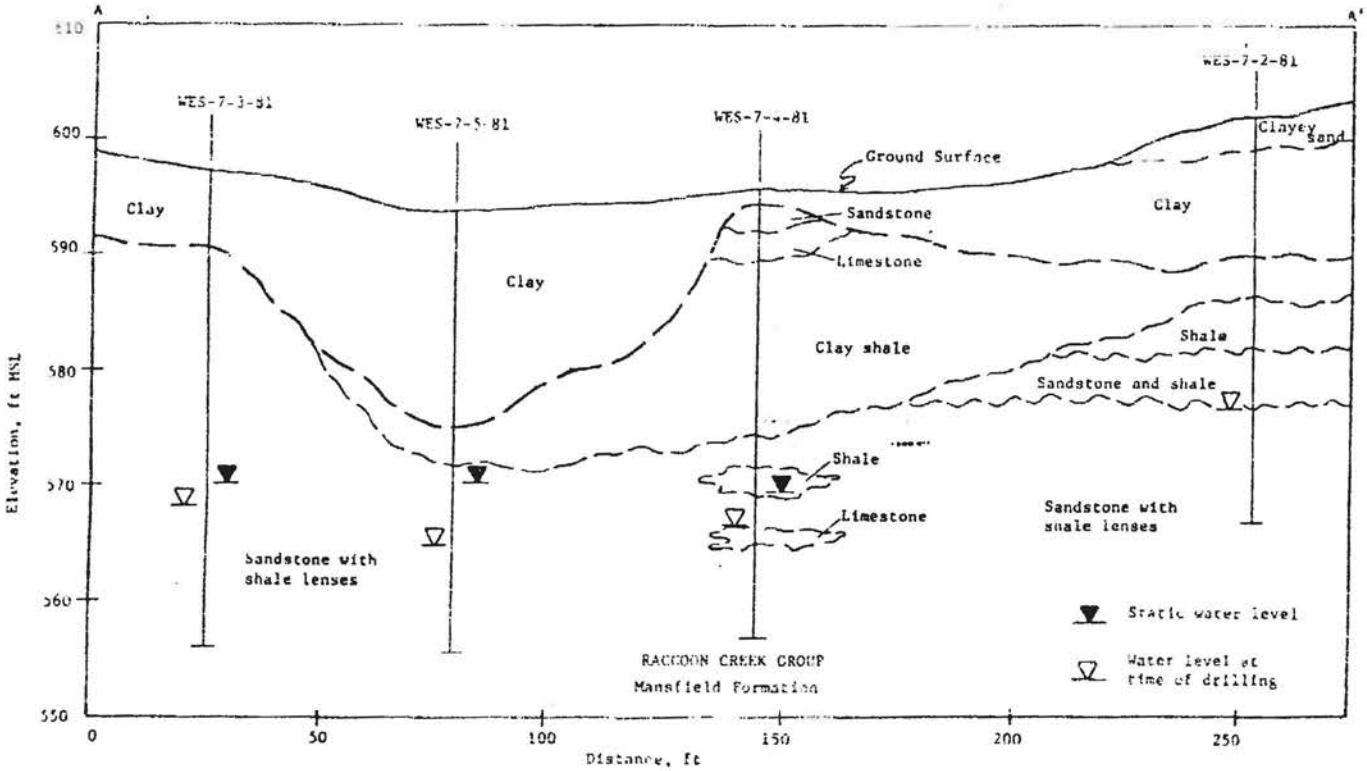
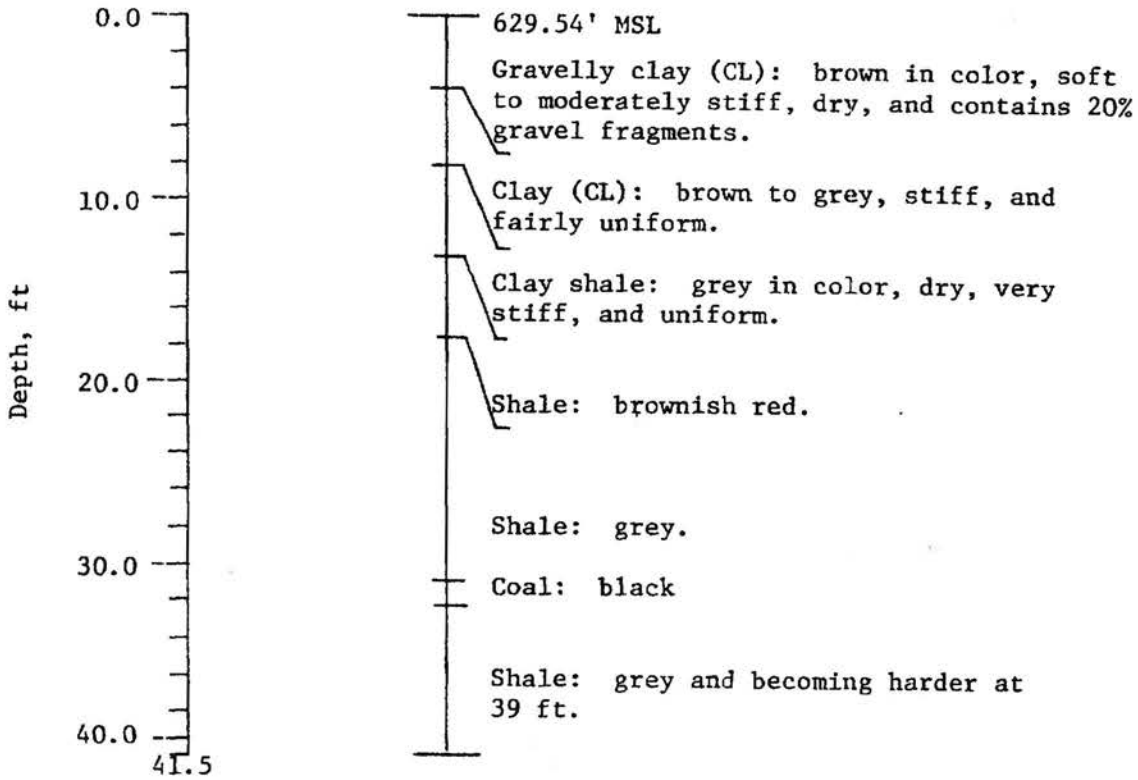


Figure 19. Geological Cross Section A-A' of Highway 58 Dump Site A

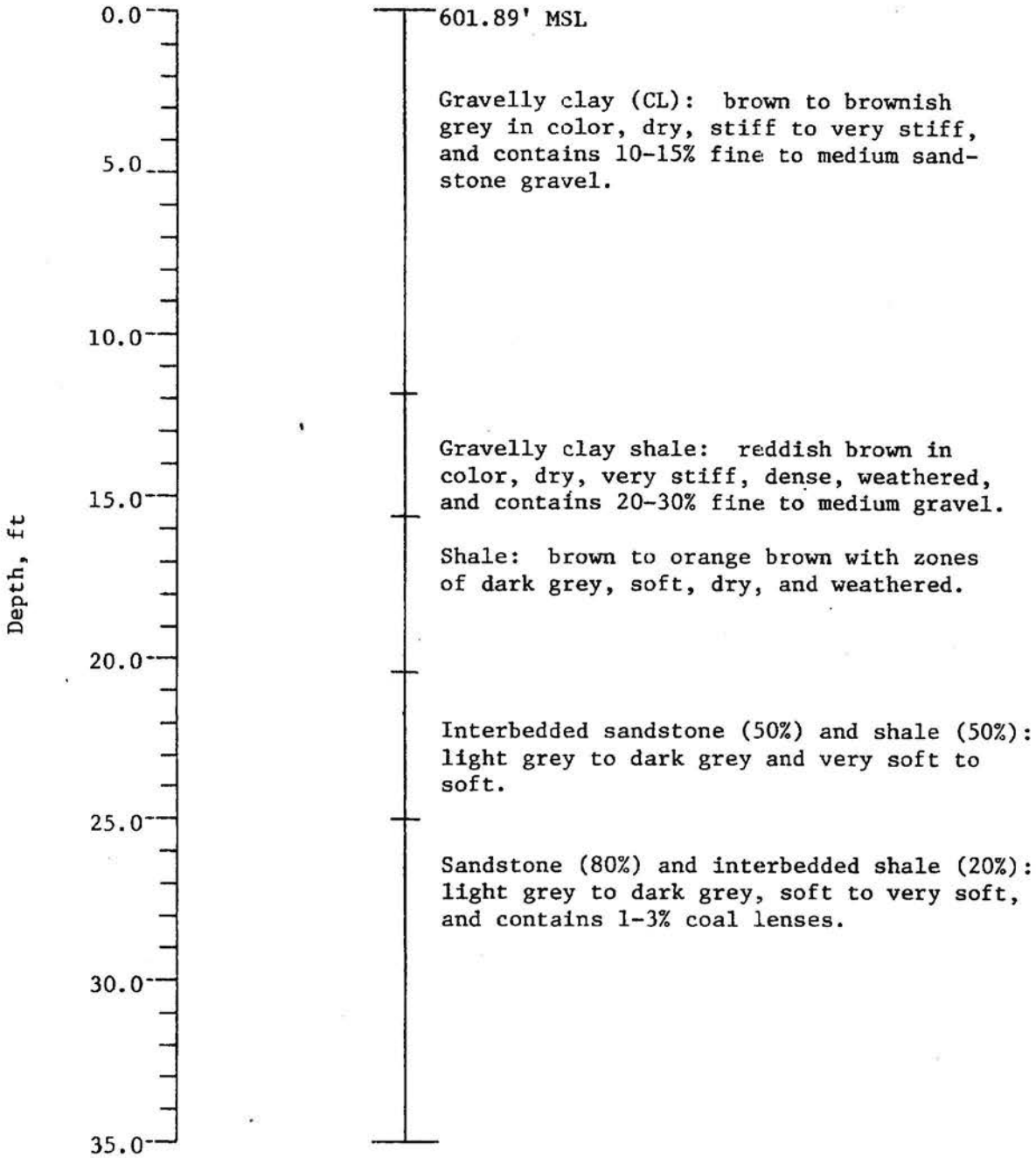


NWSC, Crane, Indiana

Highway 58 Dump Site A

Lithology

Boring Number: WES-7-1-81

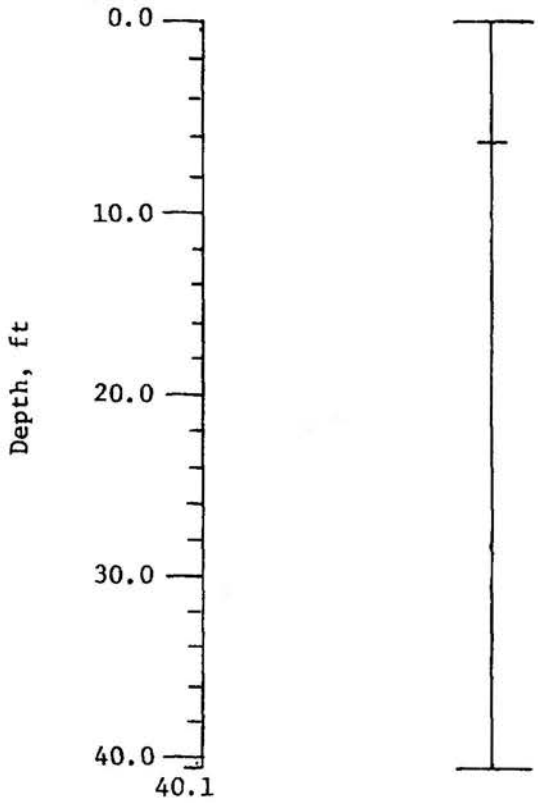


NWSC, Crane, Indiana

Highway 58 Dump Site A

Lithology

Boring Number: WES-7-2-81

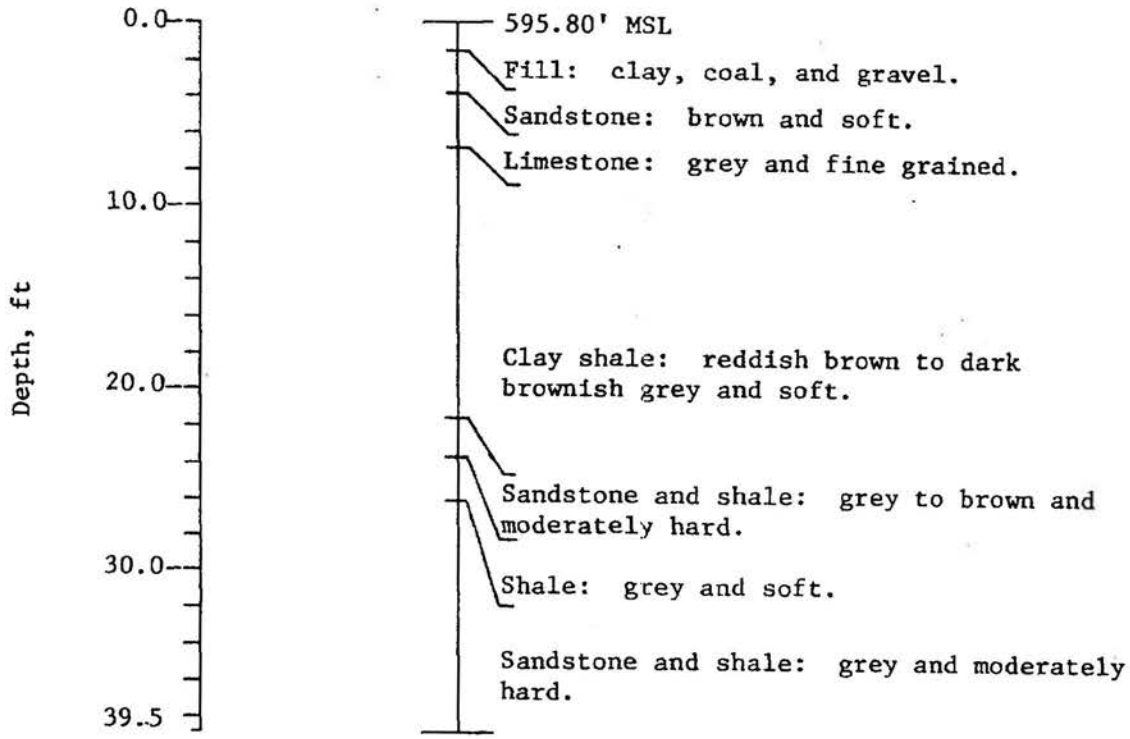


597.02' MSL

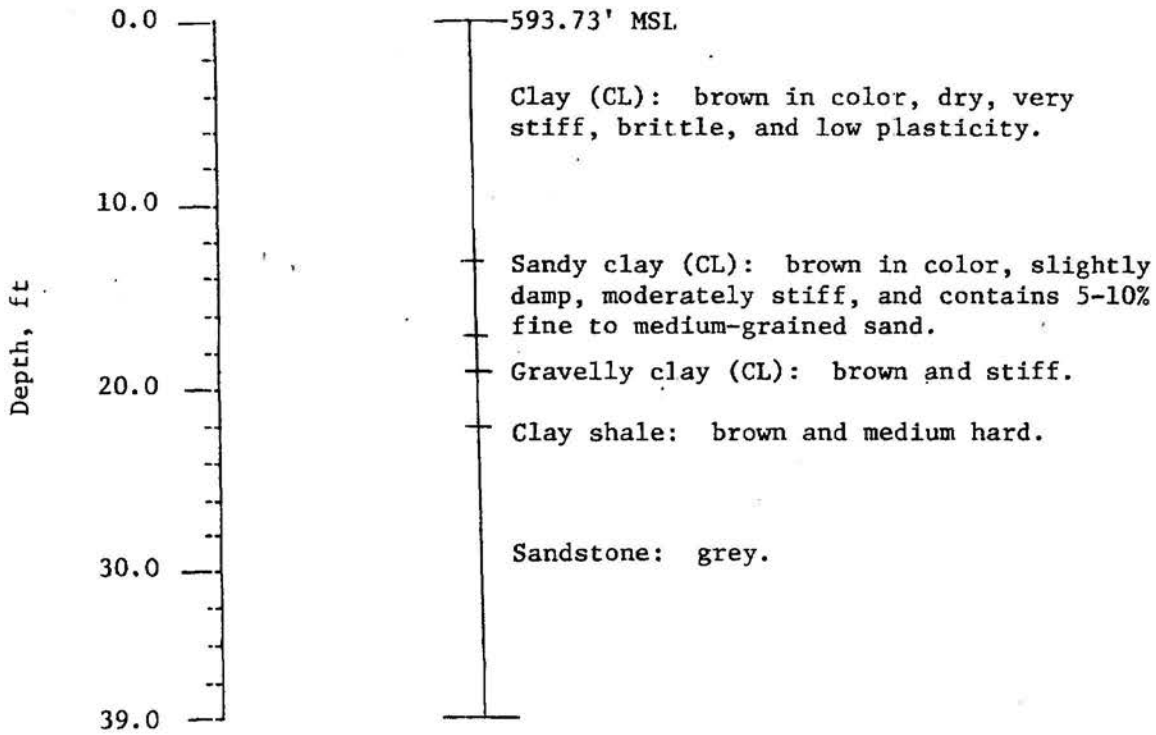
Gravelly clay (CL): brown in color, very stiff, dry, and contains fine to medium sandstone gravel.

Shale and sandstone.

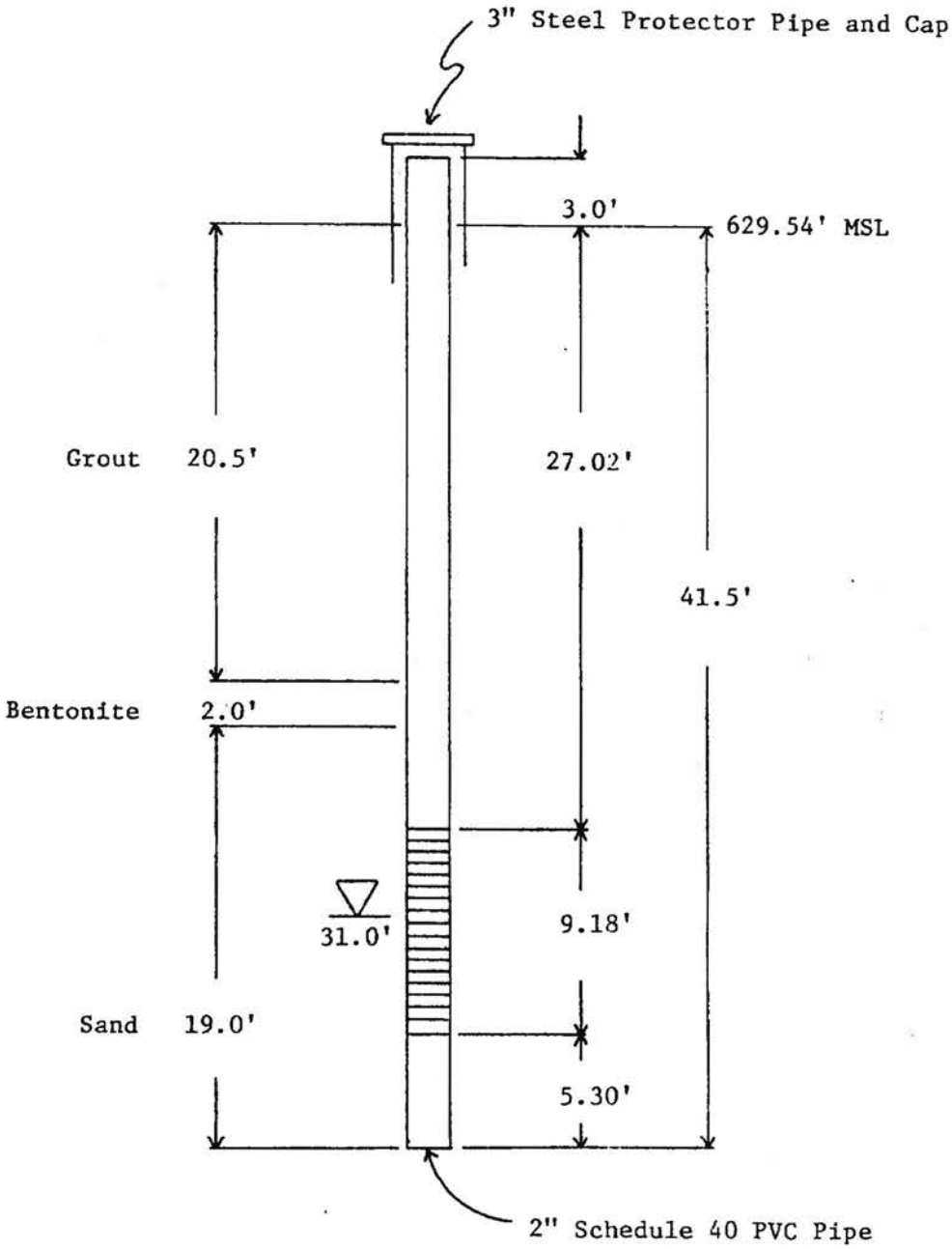
NWSC, Crane, Indiana
Highway 58 Dump Site A
Lithology
Boring Number: WES-7-3-81



NWSC, Crane, Indiana
Highway 58 Dump Site A
Lithology
Boring Number: WES-7-4-81



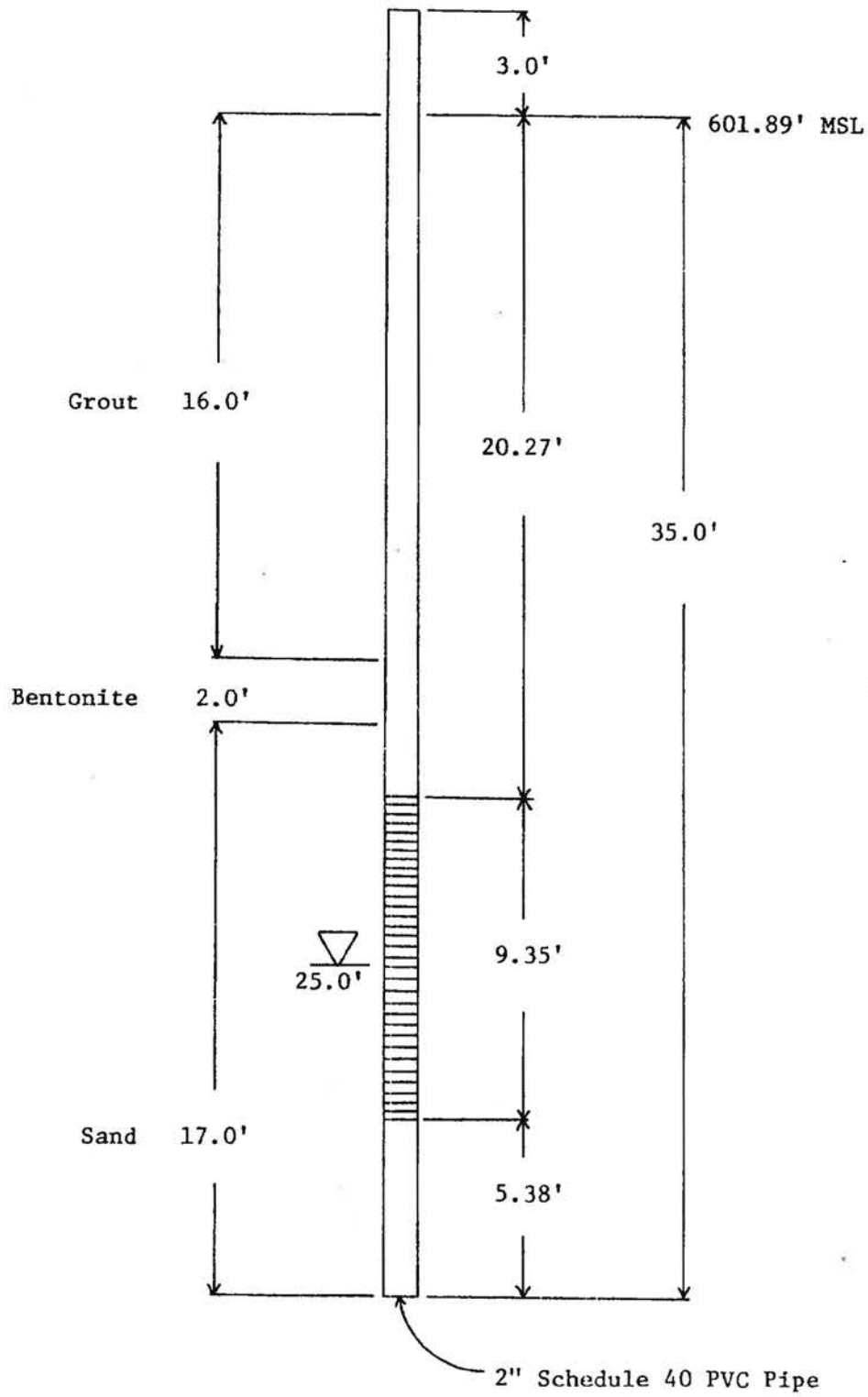
NWSC, Crane, Indiana
Highway 58 Dump Site A
Lithology
Boring Number: WES-7-5-81



Well screen

Water depth at time of drilling

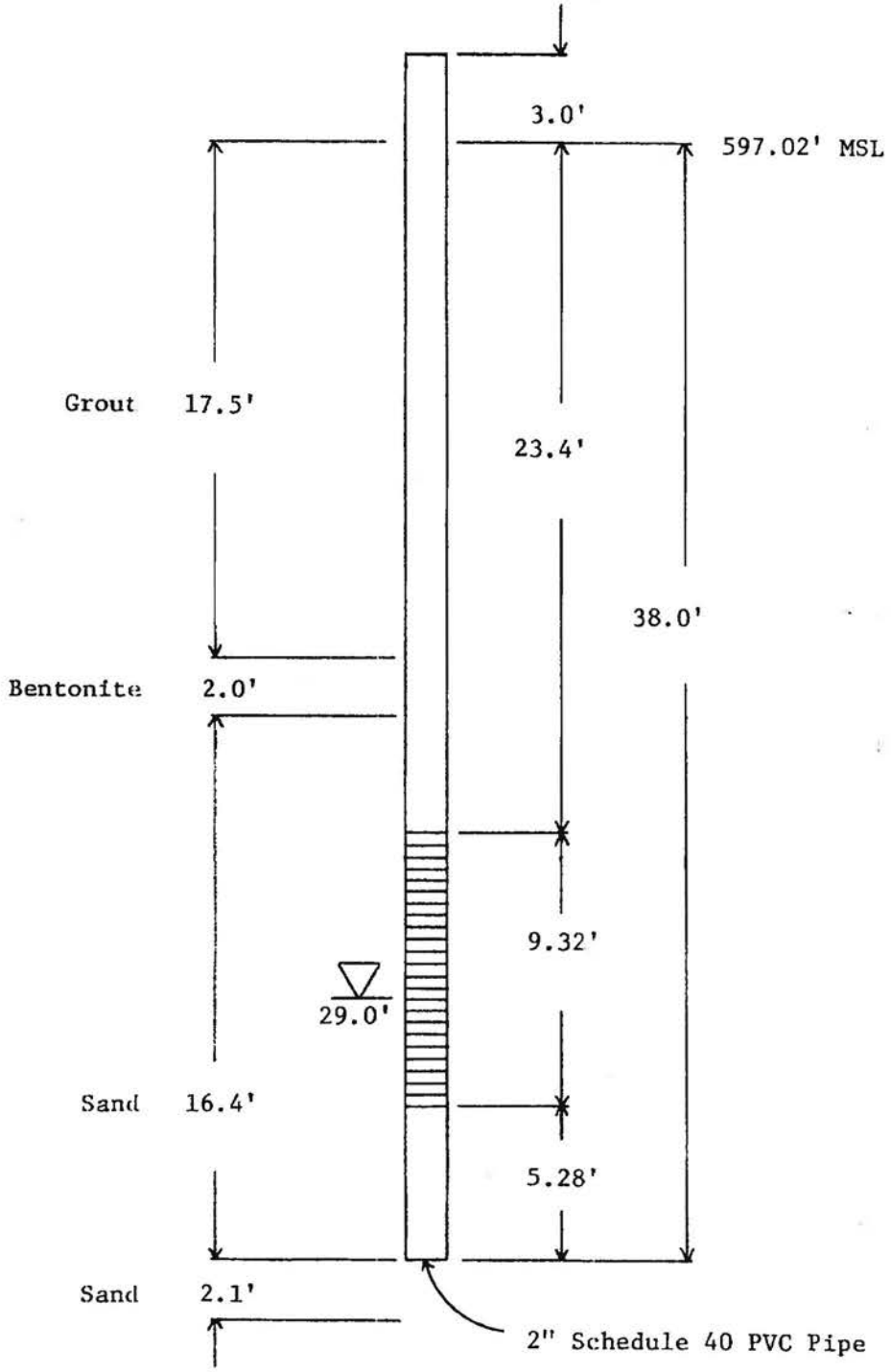
NWSC, Crane, Indiana
Highway 58 Dump Site A
Well Completion
Boring Number: WES-7-1-81



Well screen

Water depth at time of drilling

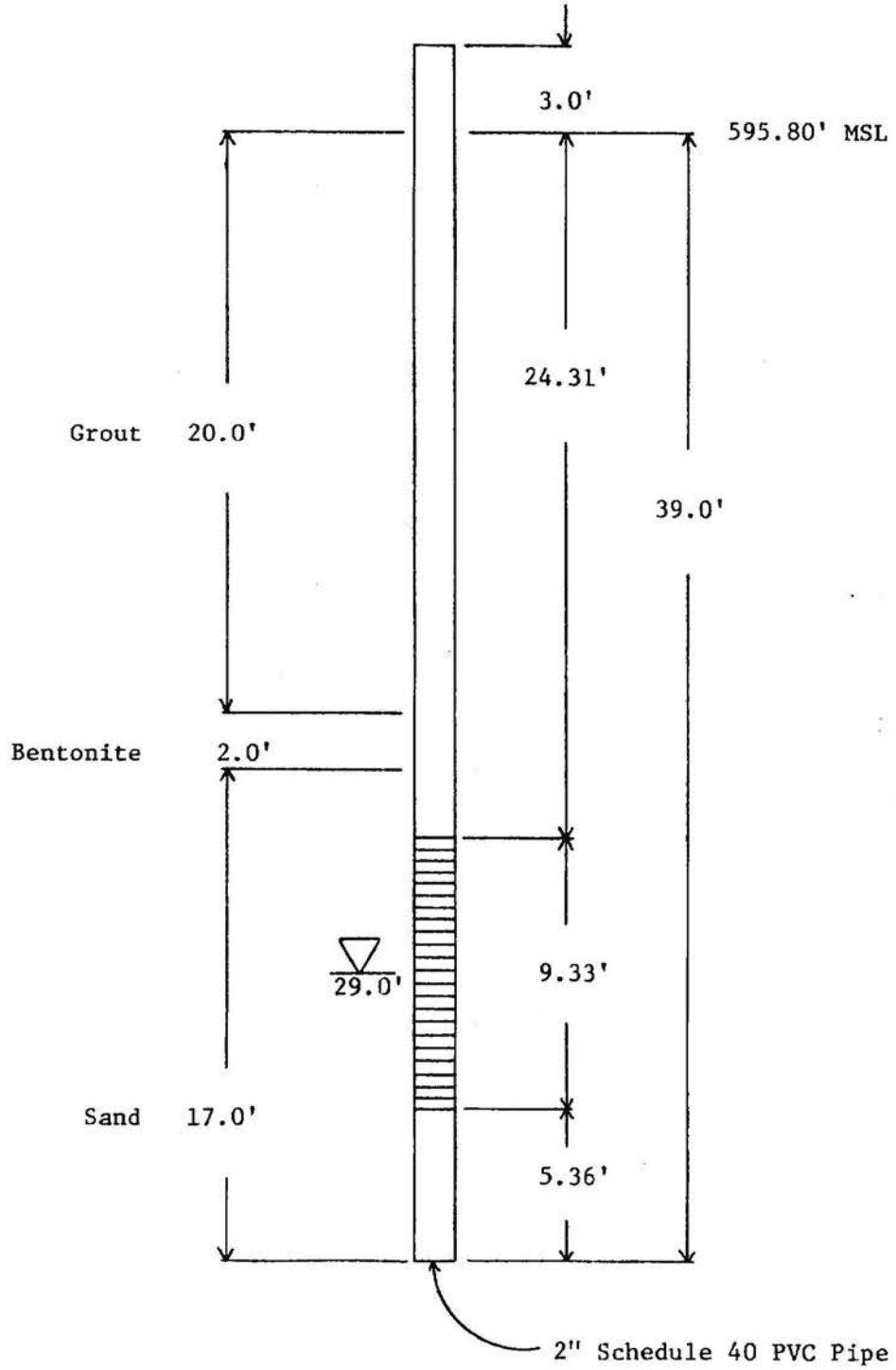
NWSC, Crane, Indiana
Highway 58 Dump Site A
Well Completion
Boring Number: WES-7-2-81



Well screen

Water depth at time of drilling

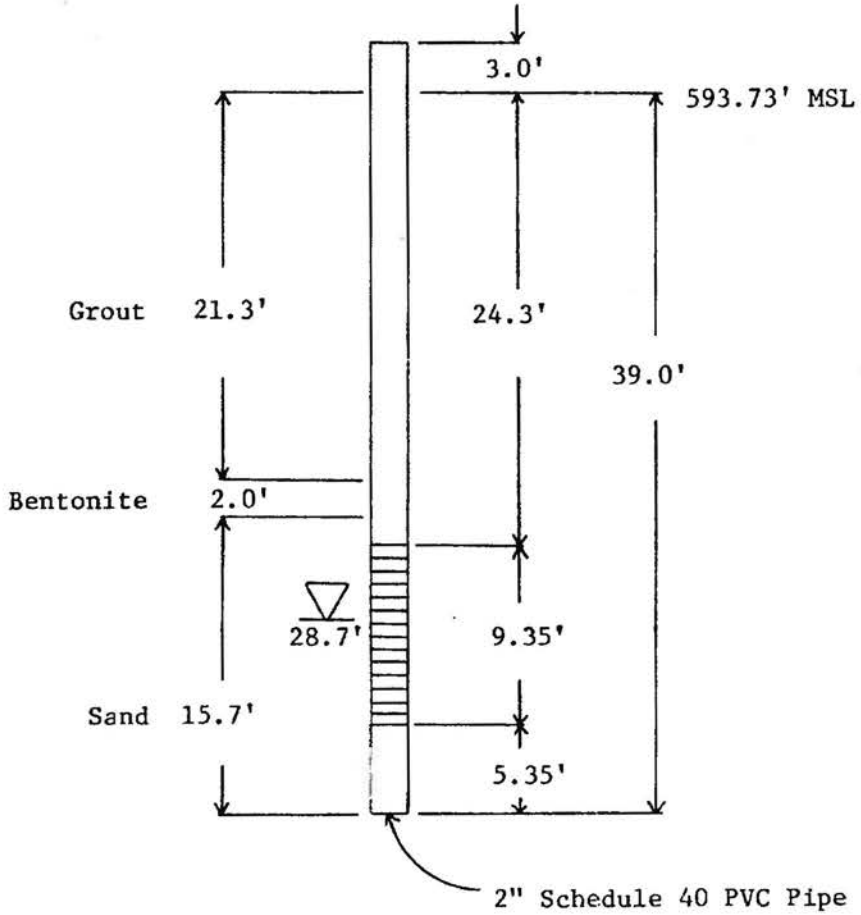
NWSC, Crane, Indiana
Highway 58 Dump Site A
Well Completion
Boring Number: WES-7-3-81



Well screen

Water depth at time of drilling

NWSC, Crane, Indiana
Highway 58 Dump Site A
Well Completion
Boring Number: WES-7-4-81



Well screen

Water depth at time of drilling

NWSC, Crane, Indiana
Highway 58 Dump Site A
Well Completion
Boring Number: WES-7-5-81

Groundwater Elevations

Highway 58 Dump Site A

Boring Number: WES-7-1-81

Top of Pipe Elevation: 632.54 ft MSL

Screen Interval: 602.52 to 593.34 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
6 Oct 81	4:32	25.35	607.19	
7 Oct 81	4:55	25.43	607.11	
8 Oct 81	10:25	25.45	607.09	
9 Oct 81	3:42	25.35	607.22	
10 Oct 81	11:38	25.39	607.15	
11 Oct 81	12:43	25.44	607.10	
12 Oct 81	8:15	25.60	606.94	
19 Oct 81	10:36	25.53	607.01	
26 Oct 81	9:15	25.68	606.86	
2 Nov 81	8:46	25.90	606.64	
9 Nov 81	4:37	25.90	606.64	
16 Nov 81	12:46	25.73	606.81	Blew dry
23 Nov 81	12:02	25.73	606.81	
29 Nov 81	11:38	25.79	606.75	

Groundwater Elevations

Highway 58 Dump Site A

Boring Number: WES-7-2-81

Top of Pipe Elevation: 604.89 ft MSL

Screen Interval: 581.62 to 572.27 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
6 Oct 81	4:35	27.09	577.80	
7 Oct 81	5:00	28.63	576.26	
8 Oct 81	10:49	30.00	574.89	
9 Oct 81	3:49	30.78	574.11	
10 Oct 81	11:44	31.00	573.89	
11 Oct 81	12:50	31.70	573.19	
12 Oct 81	8:18	31.96	572.93	
19 Oct 81	10:41	32.60	572.29	
26 Oct 81	9:25	32.68*	572.21	
2 Nov 81	8:53	32.85*	572.04	
9 Nov 81	4:50	32.80*	572.09	
16 Nov 81	12:55	33.38*	571.51	Blew water from well
23 Nov 81	12:13	33.32*	571.57	
29 Nov 81	11:42	33.26*	571.63	

* Water level below screen

Groundwater Elevations

Highway 58 Dump Site A

Boring Number: WES-7-3-81

Top of Pipe Elevation: 600.02 ft MSL

Screen Interval: 573.62 to 564.30 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
7 Oct 81	4:58	27.99	572.03	
8 Oct 81	10:46	29.76	570.26	
9 Oct 81	3:44	29.76	570.26	
10 Oct 81	11:41	29.68	570.34	
11 Oct 81	12:45	29.89	570.13	
12 Oct 81	8:23	29.89	570.13	
13 Oct 81	8:51	29.93	570.09	
19 Oct 81	10:45	30.03	569.99	
26 Oct 81	9:05	29.65	570.37	
2 Nov 81	8:48	29.93	570.09	
9 Nov 81	4:39	30.06	569.96	
16 Nov 81	12:49	29.48	570.54	
23 Nov 81	12:05	29.55	570.47	
29 Nov 81	11:40	29.87	570.15	

Groundwater Elevations

Highway 58 Dump Site A

Boring Number: WES-7-4-81

Top of Pipe Elevation: 598.80 ft MSL

Screen Interval: 571.49 to 562.16 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
13 Oct 81	8:54	29.39	569.41	
14 Oct 81	11:15	29.55	569.25	
15 Oct 81	2:26	29.43	569.37	
16 Oct 81	12:45	29.34	569.46	
17 Oct 81	9:32	29.29	569.51	
18 Oct 81	--	--	--	
19 Oct 81	10:31	29.50	569.30	
26 Oct 81	9:20	29.01	569.79	
2 Nov 81	8:51	29.30	569.50	
9 Nov 81	4:45	29.32	569.48	
16 Nov 81	12:53	28.86	569.94	
23 Nov 81	12:10	28.88	569.92	
29 Nov 81	11:41	29.23	569.57	

Groundwater Elevations

Highway 58 Dump Site A

Boring Number: WES-7-5-81

Top of Pipe Elevation: 596.73 ft MSL

Screen Interval: 569.43 to 560.08 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
6 Nov 81	10:36	26.48	570.25	
7 Nov 81	11:09	26.72	570.01	
8 Nov 81	11:50	26.61	570.12	
9 Nov 81	4:42	26.78	569.95	
10 Nov 81	4:01	26.70	570.03	
11 Nov 81	2:10	26.67	570.06	
12 Nov 81	4:08	26.51	570.22	
16 Nov 81	12:51	26.19	570.54	
23 Nov 81	12:08	26.40	570.33	
29 Nov 81	11:41	26.60	570.13	

B.4 SWMU 25 FIELD NOTES

"Rite in the Rain"®
ALL-WEATHER WRITING PAPER

Name

Address

Phone

Project NSA Crane - SWMU 25
Existing Wells Redevelopment
and Sampling.
Project # 112G03116

Clear Vinyl Protective Slipcovers (Item No. 30) are available for this style of notebook.
Helps protect your notebook from wear & tear. Contact your dealer or the J. L. Darling Corporation.

7-11-11 (Date)

CONTENTS

PAGE	REFERENCE	DATE
	7-1-81 (well I.D.) - well Development	
	water level 24.5 ft below casing	
	20 ft of water	
	$V = (.163)(20ft)(1)^2$	
	3.26 gal/10	
	Started pumping at	
	6:10 300mL to 600mL/min	
	3.2 gal at 6:30	
	6:35 resume pumping	
	Horiba not working	

Date: 7-12-11

7-3-81 (Well I.D.) Well Development

29.23 - H_2O

38.88 TOTAL

- used surge block first to clear fines.
- used bailer for development.
- well water clear - purged 9 gallons

Date: 7-12-11

7-5-81 (Well I.D.) - well Development

26.20 H_2O

41.40 TOTAL Silty bottom

obstruction.
Used a surge method for development - Wattera.
Removed 7 gallons of a reddish colored water, before the well went dry and more silt than water was coming through the obstruction.

Date: 7-12-11

7-4-81 (well I.D.) - Well Development

28.10 H_2O

28.30 total Silty bottom

18' to obstruction

Surged out 2 gallons before going dry - muddy - well is compromised

Date: 7-12-11

7-2-81 (well I.D.) - well Development

36.04 H_2O

44.40 total Silty

Bailed 10 gallons with a bailer - water was clear. Water level returned to static level.

Date: 7-13-11 | 200 mL/min 7-13-11

7-1-81 (Well I.D.) - Groundwater sample collection

14:00 Grundfos Submersible pump

18.0°C 5.97 PH 17 PH mV
2.9 DO
82 ORP 1.49 ms/cm 31.0 NTU

14:10

16.0°C 6.03 PH 12 PH mV
2.9 DO
86 ORP 1.46 ms/cm 23.1 NTU

14:15

16.0°C 6.02 PH 14 PH mV
2.1 DO
70 ORP 1.46 ms/cm 23.3 NTU

14:25 14.2°C 6.0 PH 13 PH mV
2.9 DO
58 ORP 1.47 ms/cm 11.1 NTU

14:30 14°C 6.0 PH 12 PH mV
2.5 DO
49 ORP 1.45 ms/cm 6.0 NTU

14:35 14°C 6.0 PH 12.5 PH mV
2.1 DO
48 ORP 1.46 ms/cm 5.0 NTU
2.2 DO

14:40 14°C 6.1 PH 12.5 PH mV
1.9 DO
48 ORP 1.46 5.6 NTU

Sampled 14:40

total 3.5 Gal.

WL 24.5
TD 44.75

Date: 7-13-11

7-3-81 (Well I.D.) Groundwater Sample Collection – Grundfos pump

WL=29.25 200 mL/min

TD=38.75

16:00 14.5°C 6.67 PH -23 PHmV

1.3 DO 181 ORP .573 ms/cm 808 NTU

16:20 14°C 7.0 PH -37 PHmV 2.14 DO

182 ORP .563 ms/cm 800 NTU

16:30 14.1°C 6.8 PH -37 PHmV 2.77 DO

182 ORP .556 ms/cm 800 NTU

16:45 14.3°C 6.9 PH -40 PHmV 1.00 DO

-6.0 ORP .543 ms/cm 293 NTU

17:00 14.4°C 6.8 PH -42 PHmV .98 DO

-6.5 ORP .542 ms/cm 160 NTU

Date: 7-13-11

17:10 14.3°C 6.8 PH -40 PHmV 1.00 DO

-6 ORP .539 ms/cm 158 NTU

17:15 14.4°C 6.9 pH -41 PHmV .98 DO

-7 ORP .540 ms/cm 157 NTU

4 gal total purge

Sampled at 17:15

Date: 7-13-11

7-2-81 (well I.D.) Groundwater Sample collection - Grundfos Submersible pump

WL = 36.0

TD = 44.60

Start pumping at 18:45

18:50 16.50c 7 pH -39 pHmV 8.4 DO

138 ORP .608 ms/cm 100 NTU

19:00 13.44c 6.5 pH -11 pHmV 1.6 DO

44 ORP .673 ms/cm 26 NTU

19:05 13.4 6.42 pH -7 pHmV 1.6 DO

22 ORP .66 ms/cm 25 NTU

19:15 13.4c 6.4 pH -6 pHmV 1.6 DO

21 ORP .64 ms/cm 23 NTU

19:20 sampled

Date: 7-14-11

7-4-81 (well I.D.) Groundwater sample collection

WL = 36.30 0900

TD = 37.90

Attempted to place pump down well, but casing is bent approximately 18 feet bgs. Tried Wattera with surge block, but could not get past bent and cracked pipe. Will attempt to grab a groundwater sample with a smaller diameter Wattera with no surger.

*(well compromised)

Purged and collected enough water for bottleware. Filtered groundwater with a 40 micron filter and peristaltic pump. Did not take readings, as water was so turbid.

* well compromised but will collect sample to get an idea of the groundwater quality in the vicinity of the well for future considerations.

Date: 7-14-11

7-5-81 : (well I.D) 0915 Groundwater sample collection

WL = 26.18

TD = 41.16

* See notes on previous page — same issue.
(well compromised)

Tetra Tech

BORING LOG

PROJECT NAME: SWMU 25 Dump site A
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Chase Environmental
DRILLING RIG:

BORING No.: 25MWT06
DATE: 10/23/12
GEOLOGIST: Kevin Losekamp
DRILLER: John Barton

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1		4/3	1.5/		Soft	BRN	Silty Clay	CL					
		6/6	/2.0										
S-2		3/2	2.0/										
		2/	/2.0										
S-3	5	3/50/5	1.0/1.0		Bl. Stiff	DK BRN	Sandy Clay	CL					
				Bedrock			Some S.S. Seams						
							No recovery.						
							All overburden.						
	10						HSA to 21'						
	15												
	20												
				21'									
					m. Hard	BRN	Sandstone						
				23'					Little moisture less dust				
					m. Soft	Gray	Shale		Gi				
	25												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): NA

Remarks: 6" hole in bedrock. HSA 5'. Competent bedrock at 21'.

Converted to Well: Yes x No _____ Well I.D. #: _____

Tetra Tech

BORING LOG

PROJECT NAME: SWMU 25 Dump site A
PROJECT NUMBER: 112G03116
DRILLING COMPANY: Chase Environmental
DRILLING RIG:

BORING No.: 25MWT06
DATE: 10/23/12
GEOLOGIST: Kevin Losekamp
DRILLER: John Barton

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
	25												
					m. Hard	gray	Sandstone						
					m Hard	gray	Shale / Sandstone						
	30			29	m. Hard	gray	Sandstone		water at 29.0' after sitting for 10 min. at 40'				
	35												
				39									
	40												
				EOB									
	45												

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Remarks: Sand 25-40, Screen 29-39, Bentonite 23-25

Drilling Area Background (ppm): NA

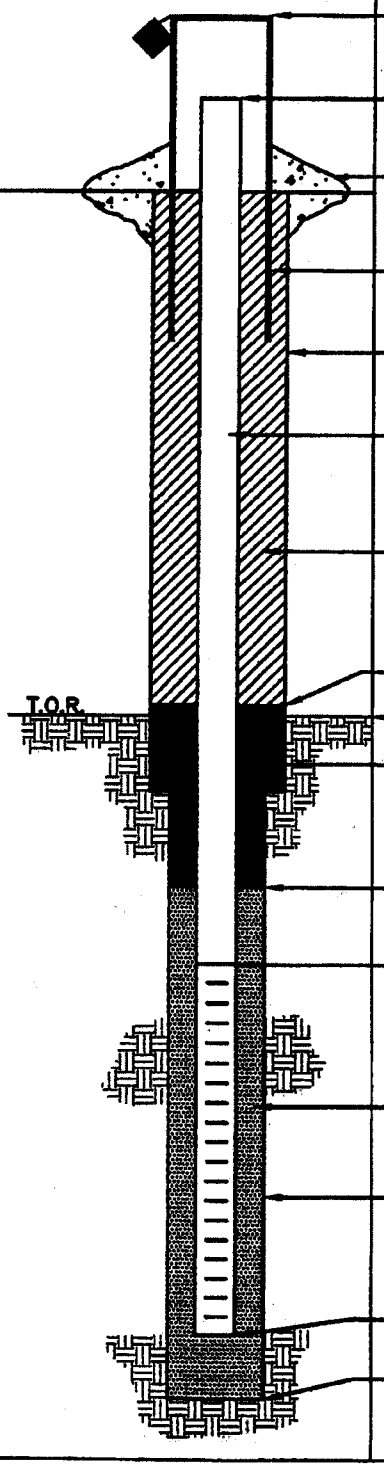
Converted to Well: Yes x No _____ Well I.D. #: _____

WELL NO.: 25MWT06

Tetra Tech

BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT Summer 25	LOCATION NSA Crane	DRILLER John Barton
PROJECT NO. 112G03116	BORING 25MWT06	DRILLING METHOD Air Rotary
DATE BEGUN 10-23-12	DATE COMPLETED 10-24-12	
FIELD GEOLOGIST K. Loseekamp		DEVELOPMENT METHOD 12v sub / surge
GROUND ELEVATION	DATUM	



ELEVATION/HEIGHT OF TOP OF SURFACE CASING: 136"

ELEVATION/HEIGHT TOP OF RISER: 134"

TYPE OF SURFACE SEAL: ~~4'x4'x6"~~ 2x2x6" KC
Concrete pad + 2 bollards

I.D. OF SURFACE CASING: 6" steel

DIAMETER OF HOLE: 4"

RISER PIPE I.D.: 2"
TYPE OF RISER PIPE: 2" PVC

TYPE OF BACKFILL: Grout Slurry

ELEVATION/DEPTH TOP OF SEAL: 125"

ELEVATION/DEPTH TOP OF BEDROCK: 21'

TYPE OF SEAL: Bentonite

ELEVATION/DEPTH TOP OF SAND: 125"

ELEVATION/DEPTH TOP OF SCREEN: 129"
TYPE OF SCREEN: PVC
SLOT SIZE x LENGTH: .020 X 10'
I.D. SCREEN: 2"

TYPE OF SAND PACK: 20/40 Silica

DIAMETER OF HOLE IN BEDROCK: 6"
CORE/REAM: —

ELEVATION/DEPTH BOTTOM SCREEN: 139"
ELEVATION/DEPTH BOTTOM OF SAND: 140"
ELEVATION/DEPTH BOTTOM OF HOLE: 140"
BACKFILL MATERIAL BELOW SAND: NA

ACAD:FORM_MWNBR.dwg 07/26/99 INL

Tetra Tech

DAILY ACTIVITIES RECORD

PROJECT NAME:	SWMU 25	**PROJECT NUMBER:**	112G03116
CLIENT:	NAVFAC-MW	**LOCATION:**	SWMU 25
DATE:	10/23/12	**ARRIVAL TIME:**	0900
Tt PERSONNEL:	K. Losekamp	**DEPARTURE TIME:**	1800
CONTRACTOR:	Chase Env.	**DRILLER:**	John Barton

	ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE
1	Mobilization/Demobilization	1 Lump Sum	1	0	1
2	Overburden Drilling with Continuous Sampling	10 Feet	21	0	21
3	Rock Drilling, NoSampling	29 Feet	19	0	19
4	Well Installation	39 Feet	40	0	40
5	Well Completion				
5a	Protective Stick-Up Well Casing and Concrete Pad	1 Each	–	–	0
5b	Bollards (Set of four per well)	1 Set	–	–	0
5c	Locking Well Cap	1 Each	–	–	0
6	Well Development	2 Hours	–	–	0
7	Well Abandonment	78 Feet	–	–	0
8	Decontamination and	2 Hours	–	–	0
	IDW Management				0
9	Standby	1 Hours	0	–	0

COMMENTS:

APPROVED BY:

TETRA TECH REPRESENTATIVE

DRILLER

DATE: 10/23/12

Tetra Tech

DAILY ACTIVITIES RECORD

PROJECT NAME:	SWMU 25	**PROJECT NUMBER:**	112G03116
CLIENT:	NAVFAC-MW	**LOCATION:**	SWMU 25
DATE:	10-24-12	**ARRIVAL TIME:**	0735
Tt PERSONNEL:	K. Losekamp	**DEPARTURE TIME:**	
CONTRACTOR:	Chase Env.	**DRILLER:**	John Barton

	ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE
1	Mobilization/Demobilization	1 Lump Sum	0	1	1
2	Overburden Drilling with Continuous Sampling	10 Feet	0	21	21
3	Rock Drilling, NoSampling	29 Feet	0	19	19
4	Well Installation	39 Feet	0	40	40
5	Well Completion				
5a	Protective Stick-Up Well Casing and Concrete Pad	1 Each *	1	~~1~~ 0	1
5b	Bollards (Set of four per well)	1 Set *	1	~~1~~ 0	1
5c	Locking Well Cap	1 Each	1	~~1~~ 0	1
6	Well Development	2 Hours			
7	Well Abandonment	78 Feet	78	0	78
8	Decontamination and	2 Hours	1	~~1~~ 0	1
	IDW Management				
9	Standby	1 Hours	0	0	0

COMMENTS: Only two bollards and a 2'x2'x6" Pad were installed per Tom Brent.

APPROVED BY:

TETRA TECH REPRESENTATIVE

DRILLER

DATE: 10/24/12

Tetra Tech

DAILY ACTIVITIES RECORD

PROJECT NAME:	SWMU 25	**PROJECT NUMBER:**	112G03116
CLIENT:	NAVFAC-MW	**LOCATION:**	SWMU 25
DATE:	10-25-12	**ARRIVAL TIME:**	0900
Tt PERSONNEL:	K. Losekamp	**DEPARTURE TIME:**	
CONTRACTOR:	Chase Env.	**DRILLER:**	

	ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE
1	Mobilization/Demobilization	1 Lump Sum	0	1	1
2	Overburden Drilling with Continuous Sampling	10 Feet	0	21	21
3	Rock Drilling, NoSampling	29 Feet	0	19	19
4	Well Installation	39 Feet	0	40	40
5	Well Completion				
5a	Protective Stick-Up Well Casing and Concrete Pad	1 Each	0	1	1
5b	Bollards (Set of four per well)	1 Set	0	1	1
5c	Locking Well Cap	1 Each	0	1	1
6	Well Development	2 Hours	1	0	1
7	Well Abandonment	78 Feet	0	78	78
8	Decontamination and	2 Hours	0	1	1
	IDW Management				
9	Standby	1 Hours	0	0	0

COMMENTS:

APPROVED BY:

TETRA TECH REPRESENTATIVE

DRILLER

DATE: 10-25-12

10/30/12

1135 - Fed-Ex arrives with new pump to collect groundwater (GW) samples at SWMU 25

1220 - Chris Rumer (CR) arrives on site at SWMU 25 to collect GW samples from the newly installed well 25MWT06.

Weather - 40°F; windy; cloudy
vehicle - Chevrolet Suburban

25MWT06 water level
= 28.39 ft.
Total Depth = 44.5 ft.
Horiba calibrated
pH = 4.0
conductivity = 4.5 ms/cm
Turb = 0.0 NTU

1300 - Finished set-up; Powered up generator and turned on pump.

10/30/12

1330 - Home screen of pump appeared. When pump was directed to begin, a fault icon appeared that said, "DC Bus Low".

1400 - CR contacted Field Environmental and two people said that the plug needed to be converted. The converter was not included with the pump. FEI said this part would be available at Lowes.

1430 - CR packed up equipment and locked well and will return once adapter is obtained.

1630 - CR purchased adapter. Tested Grundfos and it worked.

(KL) 10/31/12

0800 - CR and Kevin Lose Kamp arrive at SWMU 25 to begin GW sampling at MWT06.
Power on pump shuts off.
CR calls Master Services Rental in Bloomington about obtaining generator with more power

0930 - CR arrives in Bloomington and obtains 5000W generator.

1030 - CR returns to NSA Crane

1045 - CR/KL return to SWMU 25. Pump now operates and purging has begun.

1405 - CR completed sampling of MWT06, Filtered in the field for dissolved metals

1445 - CR began sampling MW03

10/31/12

1605 - CR/KL had to adjust pump because it stopped pulling water. Turbidity went from 170 NTU to 450 NTU as a result.

11/1/12

0815 CR/KL arrive at SWMU 25 to sample MW01-MW03.

Weather: Clear, 26°F, light breeze

0845 Begin well-sampling at 25MW02. After 30 minutes of purging, well was dry and pumping wet silt. KL tried to contact Ralph Besinski. He talked to Tom Brent who said to take a grab sample as soon as possible from wells 02 and 03.

1015 CR moves to MW01 to begin purging 25MW01.

1050 CR set up at 25MW01 to start purging.

1155 Purging complete and sampling also complete.

11/1/12

1250 - CR ~~sets~~ up to take grab sample at 25MW03 per Tom Brent's instructions.

1320 Sampling complete. Turbidity at 388 NTU. Collected dissolved metals first.

1335 CR leaves SWMU 25 to go to trailer to obtain one filter and one plastic container

1400 CR returns to SWMU 25 to collect grab sample from 25MW02 per Tom Brent's instructions.

1420 CR collects samples from 25MW02. Turbidity very high. Horiba U-52 read 270, but GW was much darker than 25MW03.

11/1/12

1430 ~~&~~ KL arrives at SWMU 25 to assist loading generator into vehicle.

1450 CR/KL return to trailer to package samples for SWMU 25. KL contacted Brian Richard from Empirical Laboratories, LLC to inform him of turbid samples

1600 De-mob from NSA Crane.

1645 CR arrives at Master Rental Services to return generator

B.5 SWMU 25 CALIBRATION LOGS

FIGURE 7-1

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: *SWMU ~~16 & 25~~ 25+29 NSA Crane, Indiana*

PROJECT NO.: 112603116 / 112603137

Date of Calibration	Instrument Name and Model	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		
7/11/11	MultiRae Plus	095-520503	Kevin			oxy 20.9	oxy 20.9		
						CO 48.0	CO 49.0		
						H_2S 22.0	H_2S 24.0		
7/13/11	MultiRae Plus	095-520503	E. Berktite			oxy 20.9	oxy 24		
						CO 48.0	48		
						H_2S 22.0	22		

Tetra Tech NUS, Inc.

WATER QUALITY METER CALIBRATION LOG

PROJECT NAME : NSA ~~Naples, Italy~~ Crane

SITE NAME: ~~Residential / Other Properties~~ SWMU 25

PROJECT No.: ~~112G01735~~ 112603116

INSTRUMENT NAME/MODEL: Horiba / U-22

MANUFACTURER: Horiba

SERIAL NUMBER: FEI12270-1

Date of Calibration	Person Performing Calibration	INITIAL READINGS						FINAL READINGS						Calibration Standard (Lot No.)	Remarks and Comments
		PH (S.U.)	COND (mS/cm)	DO (mg/L)	ORP (mV)	TEMP (°C)	SAL % or ppt	PH (S.U.)	COND (mS/cm)	DO (mg/L)	ORP (mV)	TEMP (°C)	SAL % or ppt		
7-11-11	E. Berkhe	6.98	0.907	0	199	16.28	0.4	4.0	200	0	200	17.00	0	0271-16	
7-13-11	E. Berkhe	4.21	5.11	0	313	20.40	0.0	4.0	4.49	9.56	313	20.37	0	0271-16	
7-14-11	E. Berkhe	3.99	4.50	9.46	300	20.15	0.0	4.0	4.49	9.16	300	20.15	0	0271-16	

Tetra Tech NUS, Inc.

TURBIDITY METER CALIBRATION LOG

PROJECT NAME : ~~NSA Mechanicsburg~~ NSA Crane

INSTRUMENT NAME /MODEL: LaMotte 2020

SITE NAME: ~~Site 3~~ SWMU25

MANUFACTURER: LaMotte

PROJECT No.: ~~112GN5077~~ 112G03116

SERIAL NUMBER: U00847X

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	[] 0 or [] 1 NTUs		10 NTUs		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		
7-11-11	2020	E. Berklite	0.95	0.95				
			9.4	9.4				
7-13-11	2020	E. Berklite	0.85	1.1				
			9.8	9.8				
7-14-11	2020	E. Berklite	1.0	1.0				
			10.0	10.0				

Swmu 25 Groundwater

Tetra Tech NUS, Inc.

DOCUMENTATION OF FIELD CALIBRATION

PROJECT NAME : NSA ~~NSWC CRANE~~

SITE NAME: Swmu 25

PROJECT No.: 112G06222

INSTRUMENT NAME/MODEL: ~~YSI~~ Horiba - U52

MANUFACTURER: ~~YSI~~ Horiba

SERIAL NUMBER:

Date of Calibration	Person Performing Calibration	INITIAL READINGS PH 7	PH 4	COND	DO	~~ORP~~ Turb		FINAL READINGS PH 7	PH 4	COND	~~DO~~	~~ORP~~ Turb	Calibration Standard (Lot No.)	Remarks and Comments
10/30/12	KL/CR	6.8	4.0	4.61	/	0.0		7.0	4.0	4.49		0.0	L148273	
10/31/12	KL/CR	7.0	4.0	4.51	/	0.0		7.0	4.0	4.49		0.0	L148273	

B.6 SWMU 25 CHAIN OF CUSTODY (ROUNDS 1 AND 2)

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER NB 0354 | PAGE 1 OF ____

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G03116	NSA CRANE SWMU 25	JOE LUCAS	(412) 921-7090	RTI LAB / FRED HOITASH
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
ELLEN BERKLITE		JOHN FLOYD	(502) 693-1417	31628 GLENDALE STREET
		CARRIER/WAYBILL NUMBER		CITY, STATE
		FEDEX / 8731 7167 0624		LIVONIA, MI 48150-1827

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

DATE YEAR 2011	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	SVOC/LL-PAHS	TOTAL METALS (NOT PRESERVED WITH HNO3)							COMMENTS
CONTAINER TYPE PLASTIC (P) or GLASS (G)									G	G							
PRESERVATIVE USED									ICE	ICE							
7/11	1515	25SS0010002	SS001	0	2	SO	G	2	X	X							
"	1525	25SB0010206	SB001	2	6	SO	G	2	X	X							
"	1545	25SS0020002	SS002	0	2	SO	G	2	X	X							
"	1600	25SS0030002	SS003	0	2	SO	G	2	X	X							
"	1615	25SB0030206	SB003	2	6	SO	G	2	X	X							
"	1630	25SS0040002	SS004	0	2	SO	G	2	X	X							
"	1650	25SB0040610	SB004	6	10	SO	G	2	X	X							
7/12	~~1040~~ 0900	25SS0050002	SS005	0	2	SO	G	2	X	X							
"	0910	25SB0050206	SB005	2	6	SO	G	2	X	X							
"	0920	25SS0060002	SS006	0	2	SO	G	2	X	X							MS/MSD
"	0930	25SB0060206	SB006	2	6	SO	G	2	X	X							
"	0940	25SB0060610	SB006	6	10	SO	G	2	X	X							
"	0945	25SS0070002	SS007	0	2	SO	G	2	X	X							

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY	7/15/11	12:00	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

NOTE: ALL SAMPLE LABEL ID #'S SHOULD HAVE 2 DIGIT NUMBER [illegible]

TETRA TECH NUS, INC. | CHAIN OF CUSTODY | NUMBER NB 0360 | PAGE 2 OF ____

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G03116	NSA CRANE SWMU25	JOE LUCAS	(412) 921-7090	RTI LAB / FRED HOITASH
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
ELLEN BERKLITE		JOHN FLOYD	(502) 568-6688	31628 GLENDALE
		CARRIER/WAYBILL NUMBER		CITY, STATE
		FEDEX / 8731 7167 0624		LIVONIA, MI 48150-1827

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G G
PRESERVATIVE USED: ICE ICE

DATE YEAR 2011	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	TYPE OF ANALYSIS: SVOCS / LL PAHS	TOTAL METALS (NOT PRESERVED WITH HNO_3)							COMMENTS
7/12	0950	25SB0070206	SB007	2	6	SO	G	2	X	X							
"	0955	25SB0070610	SB007	6	10	SO	G	2	X	X							
~~7/11~~	~~1655~~																
7/12	0910	25SB0050206	SB005	2	6	SO	G	2	X	X							
7/11	—	25FD07111101	—	—	—	—	—	2	X	X							
7/11	—	25FD07111102	—	—	—	—	—	2	X	X							
7/12	1000	25SS008 0002	SS008	0	2	SO	G	2	X	X							
7/12	1005	25SB008 0206	SB008	2	6	SO	G	2	X	X							
7/12	1010	25SB008 0610	SB008	6	10	SO	G	2	X	X							
7/11	1710	25SS009 0002	SS009	0	2	SO	G	2	X	X							
7/11	1655	25SS010 0002	SS010	0	2	SO	G	2	X	X							
7/11	1500	25SS011 0002	SS011	0	2	SO	G	2	X	X							

	DATE	TIME		DATE	TIME
1. RELINQUISHED BY OK	7/15/11	12:00	1. RECEIVED BY		
2. RELINQUISHED BY			2. RECEIVED BY		
3. RELINQUISHED BY			3. RECEIVED BY		

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

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FORM NO. TtNUS-001

TETRA TECH NUS, INC.

CHAIN OF CUSTODY

NUMBER N2 0362

PAGE 3 OF ____

PROJECT NO:	FACILITY:	PROJECT MANAGER	PHONE NUMBER	LABORATORY NAME AND CONTACT:
112G03116	CRANE-SWMU25	JOE LUCAS	(412)921-7090	RTI LAB / FRED HOITASH
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER	PHONE NUMBER	ADDRESS
KEVIN LOSEKAMP		JOHN FLOYD	(502)568-6688	31628 GLENDALE STREET
		CARRIER/WAYBILL NUMBER		CITY, STATE
		FEDEX/ 8731 7167 0624		LIVONIA, MI 48150-1827

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G P P P

PRESERVATIVE USED: ICE

TYPE OF ANALYSIS

DATE YEAR 2011	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	SVOCs/LL PAHs	TOTAL METALS	DISSOLVED METALS	Temperature						COMMENTS
7/13	1440	25GW718101	7-1-81			GW		12	8	4								NTU<10/MS/MSD
7/14	1000	25GW728101	7-2-81					4	2	1	1							
7/13	1115	25GW738101	7-3-81															
7/14	1115	25GW748101	7-4-81															
7/14	1125	25GW758101	7-5-81															
		25FD713N-01	—	—	—	GW	—	3	X	X								
7/15	1100	25RB071511-01	RB01	—	—	QC			X	X	X							
7/15	1100	25RB071511-02	RB02	—	—	QC			X	X	X							
7/15	1100	Temp Blank	—	—	—	QC	—	5			X							

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
	7/15/11	1100			
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TtNUS-001

1211023

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER № 2334 | PAGE 1 OF 1

PROJECT NO: 112G03116	FACILITY: NSA Crane	PROJECT MANAGER Joe Lucas	PHONE NUMBER 412-921-7090	LABORATORY NAME AND CONTACT: Brian Richards / Empirical
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER Kevin Losekamp	PHONE NUMBER 513-333-3680	ADDRESS 621 Mainstream Dr. Suite 270
		CARRIER/WAYBILL NUMBER		CITY, STATE Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G P P

PRESERVATIVE USED: 4°C HNO_3 HNO_3

TYPE OF ANALYSIS: SVOCs / Total Metals / Dissolved Metals

DATE YEAR 2012	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	SVOCs	Total Metals	Dissolved Metals						COMMENTS
11/1	1155	25MW718102	MW 01	—	—	GW	G	4	2	1	1						01/02
11/1		25MW728102	MW 02	—	—	↓	↓	4	2	1	1				JV 11-02-12		~~02~~ 03/04
11/1	1320	25MW738102	MW 03	—	—	↓	↓	4	2	1	1				JV 11-02-12		~~03~~ 05/06
1405 10/31		25MWT1061202	MW 06	—	—	↓	↓	4	2	1	1						07/08
11/1		FD110112-01		—	—	↓	↓	4	2	1	1						09/10

1. RELINQUISHED BY Chris Rumer	DATE 11/1/12	TIME 1730	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY Jack Deutch Jr.	DATE 11-02-12	TIME 815

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TINUS-001

1211023

TETRA TECH NUS, INC.

CHAIN OF CUSTODY | NUMBER № 2334 | PAGE 1 OF 1

PROJECT NO: 112G03116	FACILITY: NSA Crane	PROJECT MANAGER Joe Lucas	PHONE NUMBER 412-921-7090	LABORATORY NAME AND CONTACT: Brian Richards / Empirical
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER Kevin Losekamp	PHONE NUMBER 513-333-3680	ADDRESS 621 Mainstream Dr. Suite 270
		CARRIER/WAYBILL NUMBER		CITY, STATE Nashville, TN 37228

STANDARD TAT ☒
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G): G P P

PRESERVATIVE USED: 4°C HNO_3 HNO_3

TYPE OF ANALYSIS: SVOCs / Total Metals / Dissolved Metals

DATE YEAR 2012	TIME	SAMPLE ID	LOCATION ID	TOP DEPTH (FT)	BOTTOM DEPTH (FT)	MATRIX (GW, SO, SW, SD, QC, ETC.)	COLLECTION METHOD GRAB (G) COMP (C)	No. OF CONTAINERS	SVOCs	Total Metals	Dissolved Metals						COMMENTS
11/1	1155	25MW718102	MW 01	—	—	GW	G	4	2	1	1						01/02
11/1		25MW728102	MW 02	—	—	↓	↓	4	2	1	1				JV 11-02-12		~~02~~ 03/04
11/1	1320	25MW738102	MW 03	—	—	↓	↓	4	2	1	1				JV 11-02-12		~~03~~ 05/06
1405 10/31		25MWT1061202	MW 06	—	—	↓	↓	4	2	1	1						07/08
11/1		FD110112-01		—	—	↓	↓	4	2	1	1						09/10

1. RELINQUISHED BY Chris Rumer	DATE 11/1/12	TIME 1730	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY Jack Deutch Jr.	DATE 11-02-12	TIME 815

COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

4/02R
FORM NO. TINUS-001

APPENDIX C

SWMU 25 ANALTYICAL DATA

C.1 SWMU 25 ANALYTICAL DATA FOR SURFACE SOIL

C.2 SWMU 25 ANALTYICAL DATA FOR SUBSURFACE SOIL

C.3 SWMU 25 ANALTYICAL DATA FOR GROUNDWATER

C.1 SWMU 25 ANALYTICAL DATA FOR SURFACE SOIL

APPENDIX C.1

SURFACE SOIL RESULTS
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA[1]	IDEM[2]	ERA[3]	MIN[4]	25SB001		25SB002		25SB003		25SB004				25SB005		25SB006		25SB007		25SB008	
SAMPLE ID					25SS0010002		25SS0020002		25SS0030002		25SS0040002		25SS0040002-D		25SS0050002		25SS0060002		25SS0070002		25SS0080002	
SAMPLE DATE					20110711		20110711		20110711		20110711		20110711		20110712		20110712		20110712		20110712	
SAMPLE CODE					NORMAL		NORMAL		NORMAL		NORMAL		DUP		NORMAL		NORMAL		NORMAL		NORMAL	
MATRIX					SO		SO		SO		SO		SO		SO		SO		SO		SO	
SAMPLE TYPE					NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
SUBMATRIX					SS		SS		SS		SS		SS		SS		SS		SS		SS	
TOP DEPTH					0		0		0		0		0		0		0		0		0	
BOTTOM DEPTH					2		2		2		2		2		2		2		2		2	
METALS (UG/KG)																						
ALUMINUM	7700000	100000000	NC	7700000	20000000	J	11000000	J	10000000	J	5200000	J	5100000	J	6500000	J	9500000	J	8900000	J	15000000	J
ANTIMONY	6000	5400	270	270	190	U	160	U	71	U	93	U	170	U	260	U	200	U	150	U	550	U
ARSENIC	26	5500	18000	26	9600	J	4700	J	9300	J	4200	J	10000	J	23000	J	8900	J	12000	J	8900	J
BARIUM	1500000	1700000	330000	330000	87000	J	65000	J	52000	J	28000	J	30000	J	67000	J	79000	J	61000	J	86000	
BERYLLIUM	16000	63000	21000	16000	630		580		690		360	U	330		820		800		650		610	J
CADMIUM	7000	7500	360	360	450		430		240	U	230	U	290		760		340		310		660	
CHROMIUM	11.8 [5]	120 [5]	26000	17	21000		15000		21000		7900		9300		29000		14000		15000		26000	
COBALT	2300	4300	13000	2300	6400	J	10000	J	4700	J	1900	J	1200	J	9400	J	18000	J	10000	J	12000	
COPPER	310000	920000	28000	28000	18000		11000		14000		11000		9800		16000		9100		12000		17000	
IRON	5400000	5600000	NC	5500000	29000000	J	17000000	J	27000000	J	8200000	J	9900000	J	38000000	J	19000000	J	27000000	J	29000000	J
LEAD	280000 [6]	270000	11000	11000	18000		24000		13000		6400		7600		53000		24000		16000		20000	
MANGANESE	180000	420000	220000	180000	310000	J	510000	J	200000	J	110000	J	43000	J	590000	J	960000	J	560000	J	770000	J
MERCURY	660	2100	100	100	56		34	J	6	J	16	J	24	J	30	J	9.5	J	29		39	
NICKEL	150000	390000	38000	38000	13000		13000		11000		7100		11000		16000		13000		13000		17000	
SELENIUM	8000	5300	520	520	540	U	540	U	370	U	450	U	340	U	480	U	550	U	640	U	750	U
SILVER	12000	12000	4200	4200	77	J	52	J	33	J	40	J	48	J	120	J	98	J	33	J	42	J
THALLIUM	78	1100	56.9	56.9	300	J	170	J	150	J	110	J	90	J	140	J	190	J	150	J	300	J
VANADIUM	39000	550000	7800	7800	35000		18000		22000		7900		9400		31000		19000		18000		40000	
ZINC	2300000	5900000	46000	46000	58000	J	43000	J	38000	J	24000	J	24000	J	81000	J	41000	J	45000	J	44000	J
MISCELLANEOUS PARAMETERS (%)																						
PERCENT MOISTURE	NC	NC	NC	NC	20		16		13		13		12		16		16		13		16	
SEMIVOLATILES (UG/KG)																						
1,1-BIPHENYL	174	170	NC	380000	200	UJ	190	UJ	370	UJ	180	UJ	180	UJ	20	UR	20	UR	180	UJ	20	UR
1,2,4,5-TETRACHLOROBENZENE	116	110	2020	1000	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2,2'-OXYBIS(1-CHLOROPROPANE)	2.2	23	19900	2.4	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2,3,4,6-TETRACHLOROPHENOL	22000	21000	199	199	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2,4,5-TRICHLOROPHENOL	66000	67000	14100	14100	21	U	20	U	39	U	19	U	19	U	8	U	8	U	19	U	8	U
2,4,6-TRICHLOROPHENOL	260	680	9940	70	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2,4-DICHLOROPHENOL	820	830	87500	1100	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2,4-DIMETHYLPHENOL	6400	6400	10	10	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2,4-DINITROPHENOL	680	670	60.9	60.9	420	UJ	400	UJ	770	UJ	380	UJ	380	UJ	400	UJ	400	UJ	380	UJ	400	UJ
2,4-DINITROTOLUENE	5.6	54	1280	5.8	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2,6-DINITROTOLUENE	400	410	32.8	32.8	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2-CHLORONAPHTHALENE	58000	57000	12.2	12.2	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
2-CHLOROPHENOL	1140	1200	243	243	21	U	20	U	39	U	19	U	19	U	400	U	400	U	19	U	400	U
2-METHYLNAPHTHALENE	2800	2800	29000	3100	8.4	U	8	U	15	U	7.7	U	7.6	U	8	U	8	U	7.7	U	8	U
2-METHYLPHENOL	11600	12000	40400	14000	21	U	20	U	39	U	19	U	19	U	8	U	8	U	19	U	8	U
2-NITROANILINE	1240	1300	74100	670	21	U	20	U	39	U	19	U	19	U	190	U	190	U	19	U	190	U
2-NITROPHENOL	NC	NC	1600	1600	21	U	20	U	39	U	19	U	19	U	8	U	8	U	19	U	8	U
3&4-METHYLPHENOL	NC	NC	3490	1100	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
3,3'-DICHLOROBENZIDINE	14.2	140	646	20	420	UJ	400	UJ	770	UJ	380	UJ	380	UJ	20	UJ	20	UJ	380	UJ	20	UJ
3-NITROANILINE	NC	NC	3160	3160	21	UJ	20	UJ	39	UJ	19	UJ	19	UJ	190	U	190	U	19	UJ	190	U

APPENDIX C.1

SURFACE SOIL RESULTS
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA[1]	IDEM[2]	ERA[3]	MIN[4]	25SB001		25SB002		25SB003		25SB004				25SB005		25SB006		25SB007		25SB008	
SAMPLE ID					25SS0010002		25SS0020002		25SS0030002		25SS0040002		25SS0040002-D		25SS0050002		25SS0060002		25SS0070002		25SS0080002	
SAMPLE DATE					20110711		20110711		20110711		20110711		20110711		20110712		20110712		20110712		20110712	
SAMPLE CODE					NORMAL		NORMAL		NORMAL		NORMAL		DUP		NORMAL		NORMAL		NORMAL		NORMAL	
MATRIX					SO		SO		SO		SO		SO		SO		SO		SO		SO	
SAMPLE TYPE					NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
SUBMATRIX					SS		SS		SS		SS		SS		SS		SS		SS		SS	
TOP DEPTH					0		0		0		0		0		0		0		0		0	
BOTTOM DEPTH					2		2		2		2		2		2		2		2		2	
4,6-DINITRO-2-METHYLPHENOL	40	41	144	100	100	UJ	99	UJ	190	UJ	95	UJ	95	UJ	8	UJ	8	U	96	UJ	8	UJ
4-CHLORO-3-METHYLPHENOL	26000	26000	7950	7950	21	U	20	U	39	U	19	U	19	U	8	U	8	U	19	U	8	U
4-CHLOROANILINE	2.6	27	1100	2.8	21	U	20	U	39	U	19	U	19	U	8	U	8	U	19	U	8	U
4-NITROANILINE	28	280	21900	28	21	UJ	20	UJ	39	UJ	19	UJ	19	UJ	40	U	40	U	19	UJ	40	U
4-NITROPHENOL	NC	NC	5120	5120	420	U	400	U	770	U	380	U	380	U	20	UJ	20	U	380	U	20	UJ
ACENAPHTHENE	82000	82000	29000	29000	8.4	U	8	U	15	U	7.7	U	7.6	U	20	U	20	U	7.7	U	20	U
ACENAPHTHYLENE	82000 [7]	NC	29000	18000	8.4	UJ	8	UJ	30	J	7.7	UJ	7.6	UJ	12	J	20	U	29	J	20	UJ
ACETOPHENONE	9000	9100	300000	22000	200	UR	190	UR	370	UR	180	UR	180	UR	190	UR	190	UR	180	UR	190	UR
ANTHRACENE	840000	860000	29000	29000	8.4	U	8	U	15	U	7.7	U	7.6	U	12		8	U	10		8	U
BENZALDEHYDE	6600	6700	NC	16200	200	UJ	190	UJ	370	UJ	180	UJ	180	UJ	20	UR	20	UR	180	UJ	20	UR
BENZO(A)ANTHRACENE	150	2100	1100	150	13		20	U	42		19	U	19	U	31		20		40		20	U
BENZO(A)PYRENE	15	210	1100	15	**16**		8	U	**55**		7.7	U	7.6	U	**35**		**19**	**J**	**54**		20	U
BENZO(B)FLUORANTHENE	150	2100	1100	150	19		8	U	62		7.7	U	7.6	U	45		30	J	64		20	U
BENZO(G,H,I)PERYLENE	170000 [8]	NC	1100	1100	13		8	U	43		7.7	U	7.6	U	19		8	UJ	53		22	
BENZO(K)FLUORANTHENE	1500	21000	1100	1100	12	U	8	U	32		7.7	U	7.6	U	27		13	J	32		20	U
BIS(2-CHLOROETHOXY)METHANE	220	210	302	302	21	U	20	U	39	U	19	U	19	U	8	U	8	U	19	U	8	U
BIS(2-CHLOROETHYL)ETHER	0.062	0.63	23700	0.062	42	U	40	U	77	U	38	U	38	U	20	U	20	U	38	U	20	U
BIS(2-ETHYLHEXYL)PHTHALATE	22000	29000	925	925	21	UJ	20	UJ	39	UJ	19	UJ	19	UJ	20	J	14	J	35	J	18	J
BUTYL BENZYL PHTHALATE	4000	41000	239	239	21	U	20	U	39	U	19	U	19	U	8	J	8	U	19	U	8	U
CAPROLACTAM	38000	38000	NC	90000	200	U	190	U	370	U	180	U	180	U	20	UR	20	UR	180	U	20	UR
CARBAZOLE	NC	NC	NC	5900	21	UJ	20	UJ	39	UJ	19	UJ	19	UJ	8	J	99	U	19	UJ	99	U
CHRYSENE	15000	210000	1100	1100	13		8	U	44		7.7	U	7.6	U	35		23		43		8	U
DIBENZO(A,H)ANTHRACENE	15	210	1100	15	8.4	U	8	U	15	U	7.7	U	7.6	U	20	U	20	UJ	7.7	U	20	U
DIBENZOFURAN	2200	2100	NC	4900	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
DIETHYL PHTHALATE	94000	90000	24800	24800	21	U	20	U	39	U	19	U	19	U	8	J	20	U	19	U	20	U
DIMETHYL PHTHALATE	NC	NC	734000	240000	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
DI-N-BUTYL PHTHALATE	34000	34000	150	150	21	U	20	U	39	U	19	U	19	U	11	J	20	UJ	19	U	20	U
DI-N-OCTYL PHTHALATE	NC	NC	709000	709000	21	U	20	U	39	U	19	U	19	U	8	U	8	U	19	U	8	U
FLUORANTHENE	230000	1400000	29000	29000	11		8	U	49		7.7	U	7.6	U	42		29		52		20	U
FLUORENE	80000	81000	29000	29000	8.4	U	8	U	15	U	7.7	U	7.6	U	20	U	20	U	7.7	U	20	U
HEXACHLOROBENZENE	10.6	250	199	11	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
HEXACHLOROBUTADIENE	10	100	39.8	34	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
HEXACHLOROCYCLOPENTADIENE	1400	3100	755	755	100	UJ	99	UJ	190	UJ	95	UJ	95	UJ	99	UJ	99	UJ	96	UJ	99	UJ
HEXACHLOROETHANE	9.6	62	596	58	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
INDENO(1,2,3-CD)PYRENE	150	2100	1100	150	8.4	U	8	U	32		7.7	U	7.6	U	18		40	UJ	38		40	U
ISOPHORONE	440	4400	139000	460	21	UJ	20	UJ	39	UJ	19	UJ	19	UJ	20	UJ	20	UJ	19	UJ	20	UJ
NAPHTHALENE	9.4	92	29000	9.4	8.4	U	8	U	15	U	7.7	U	7.6	U	20	U	20	U	7.7	U	20	U
NITROBENZENE	1.58	16	1310	1.6	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
N-NITROSO-DI-N-PROPYLAMINE	0.14	1.4	544	0.14	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
N-NITROSODIPHENYLAMINE	1140	11000	545	545	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
PENTACHLOROPHENOL	7.2	200	2100	28	100	UJ	99	UJ	190	UJ	95	UJ	95	UJ	99	UJ	99	UJ	96	UJ	99	UJ
PHENANTHRENE	170000 [8]	NC	29000	13000	8.4	U	8	U	23		7.7	U	7.6	U	23		15		25		20	U
PHENOL	52000	52000	120000	56000	21	U	20	U	39	U	19	U	19	U	20	U	20	U	19	U	20	U
PYRENE	170000	190000	1100	1100	12		8	U	50		7.7	U	7.6	U	43		38		55		20	U

ERA = Ecological Risk Assessment
HHRA = Human Health Risk Assessment
IDEM = Indiana Department of Environmental Management
MIN = Minimum of the listed HHRA, ERA, and IDEM criteria. The listed criteria are the lesser of the direct contact and the migration to groundwater criteria (see notes 1 and 2).

1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens that were used to determine the lowest applicable screening value correspond to a hazard quotient (HQ) of 0.1. Soil screening levels (SSLs) for groundwater protection, which were also used to determine the lowest applicable screening level, are risk-based SSLs multiplied by 20 to represent a dilution attenuation factor (DAF) of 20.
2 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
3 - Value is the lowest applicable ecological screening value (USEPA, 2005-2007 and USEPA, 2003).
4 - Value is the lowest of the displayed screening criteria.
5 - Value is for hexavalent chromium.
6 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.
7 - Value is for acenaphthene.
8 - Value is for pyrene.

APPENDIX C.1

SURFACE SOIL RESULTS
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA[1]	IDEM[2]	ERA[3]	MIN[4]	25SB009		25SB010		25SB011	
SAMPLE ID					25SS0090002		25SS0100002		25SS0110002	
SAMPLE DATE					20110711		20110711		20110711	
SAMPLE CODE					NORMAL		NORMAL		NORMAL	
MATRIX					SO		SO		SO	
SAMPLE TYPE					NORMAL		NORMAL		NORMAL	
SUBMATRIX					SS		SS		SS	
TOP DEPTH					0		0		0	
BOTTOM DEPTH					2		2		2	
METALS (UG/KG)										
ALUMINUM	7700000	100000000	NC	7700000	7600000		5500000		5800000	
ANTIMONY	6000	5400	270	270	210	U	350	U	250	U
ARSENIC	26	5500	18000	26	12000		24000		15000	
BARIUM	1500000	1700000	330000	330000	40000		40000		77000	
BERYLLIUM	16000	63000	21000	16000	730	J	340	J	570	J
CADMIUM	7000	7500	360	360	420		320		390	
CHROMIUM	11.8 [5]	120 [5]	26000	17	20000		14000		21000	
COBALT	2300	4300	13000	2300	11000		6000		21000	
COPPER	310000	920000	28000	28000	14000		14000		13000	
IRON	5400000	5600000	NC	5500000	63000000		26000000		32000000	
LEAD	280000 [6]	270000	11000	11000	19000		26000		21000	
MANGANESE	180000	420000	220000	180000	460000		220000		1600000	
MERCURY	660	2100	100	100	31	J	35	J	34	J
NICKEL	150000	390000	38000	38000	13000		9500	J	24000	
SELENIUM	8000	5300	520	520	1400	J	770	J	570	J
SILVER	12000	12000	4200	4200	20	J	40	J	51	J
THALLIUM	78	1100	56.9	56.9	150	J	130	J	170	J
VANADIUM	39000	550000	7800	7800	19000		20000		33000	
ZINC	2300000	5900000	46000	46000	60000		24000		41000	J
MISCELLANEOUS PARAMETERS (%)										
PERCENT MOISTURE	NC	NC	NC	NC	16		16		18	
SEMIVOLATILES (UG/KG)										
1,1-BIPHENYL	174	170	NC	380000	190	UR	190	UR	190	UR
1,2,4,5-TETRACHLOROBENZENE	116	110	2020	1000	20	U	20	U	20	U
2,2'-OXYBIS(1-CHLOROPROPANE)	2.2	23	19900	2.4	20	U	20	U	20	U
2,3,4,6-TETRACHLOROPHENOL	22000	21000	199	199	20	U	20	U	20	U
2,4,5-TRICHLOROPHENOL	66000	67000	14100	14100	20	U	20	U	20	U
2,4,6-TRICHLOROPHENOL	260	680	9940	70	20	U	20	U	20	U
2,4-DICHLOROPHENOL	820	830	87500	1100	20	U	20	U	20	U
2,4-DIMETHYLPHENOL	6400	6400	10	10	20	U	20	U	20	U
2,4-DINITROPHENOL	680	670	60.9	60.9	400	UJ	400	UJ	410	UJ
2,4-DINITROTOLUENE	5.6	54	1280	5.8	20	U	20	U	20	U
2,6-DINITROTOLUENE	400	410	32.8	32.8	20	U	20	U	20	U
2-CHLORONAPHTHALENE	58000	57000	12.2	12.2	20	U	20	U	20	U
2-CHLOROPHENOL	1140	1200	243	243	20	U	20	U	20	U
2-METHYLNAPHTHALENE	2800	2800	29000	3100	8	U	8	U	8.2	U
2-METHYLPHENOL	11600	12000	40400	14000	20	U	20	U	20	U
2-NITROANILINE	1240	1300	74100	670	20	U	20	U	20	U
2-NITROPHENOL	NC	NC	1600	1600	20	U	20	U	20	U
3&4-METHYLPHENOL	NC	NC	3490	1100	20	U	20	U	20	U
3,3'-DICHLOROBENZIDINE	14.2	140	646	20	400	UJ	400	UJ	410	UJ
3-NITROANILINE	NC	NC	3160	3160	20	U	20	U	20	U

APPENDIX C.1

SURFACE SOIL RESULTS
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA[1]	IDEM[2]	ERA[3]	MIN[4]	25SB009		25SB010		25SB011	
SAMPLE ID					25SS0090002		25SS0100002		25SS0110002	
SAMPLE DATE					20110711		20110711		20110711	
SAMPLE CODE					NORMAL		NORMAL		NORMAL	
MATRIX					SO		SO		SO	
SAMPLE TYPE					NORMAL		NORMAL		NORMAL	
SUBMATRIX					SS		SS		SS	
TOP DEPTH					0		0		0	
BOTTOM DEPTH					2		2		2	
4,6-DINITRO-2-METHYLPHENOL	40	41	144	100	100	UJ	99	UJ	100	UJ
4-CHLORO-3-METHYLPHENOL	26000	26000	7950	7950	20	U	20	U	20	U
4-CHLOROANILINE	2.6	27	1100	2.8	20	U	20	U	20	U
4-NITROANILINE	28	280	21900	28	20	U	20	U	20	U
4-NITROPHENOL	NC	NC	5120	5120	400	UJ	400	UJ	410	UJ
ACENAPHTHENE	82000	82000	29000	29000	8	U	8	U	8.2	U
ACENAPHTHYLENE	82000 [7]	NC	29000	18000	8	UJ	8	UJ	8.2	UJ
ACETOPHENONE	9000	9100	300000	22000	190	UR	190	UR	190	UR
ANTHRACENE	840000	860000	29000	29000	8	U	8	U	8.2	U
BENZALDEHYDE	6600	6700	NC	16200	190	UR	190	UR	190	UR
BENZO(A)ANTHRACENE	150	2100	1100	150	20	U	20	U	20	U
BENZO(A)PYRENE	15	210	1100	15	8	U	8	U	8.2	U
BENZO(B)FLUORANTHENE	150	2100	1100	150	8	U	8	U	8.2	U
BENZO(G,H,I)PERYLENE	170000 [8]	NC	1100	1100	8	U	8	U	8.2	U
BENZO(K)FLUORANTHENE	1500	21000	1100	1100	8	U	8	U	8.2	U
BIS(2-CHLOROETHOXY)METHANE	220	210	302	302	20	U	20	U	20	U
BIS(2-CHLOROETHYL)ETHER	0.062	0.63	23700	0.062	40	U	40	U	41	U
BIS(2-ETHYLHEXYL)PHTHALATE	22000	29000	925	925	20	U	20	U	20	U
BUTYL BENZYL PHTHALATE	4000	41000	239	239	20	U	20	U	20	U
CAPROLACTAM	38000	38000	NC	90000	190	UR	190	UR	190	UR
CARBAZOLE	NC	NC	NC	5900	20	U	20	U	20	U
CHRYSENE	15000	210000	1100	1100	8	U	8	U	8.2	U
DIBENZO(A,H)ANTHRACENE	15	210	1100	15	8	U	8	U	8.2	U
DIBENZOFURAN	2200	2100	NC	4900	20	U	20	U	20	U
DIETHYL PHTHALATE	94000	90000	24800	24800	20	U	20	U	20	U
DIMETHYL PHTHALATE	NC	NC	734000	240000	20	U	20	U	20	U
DI-N-BUTYL PHTHALATE	34000	34000	150	150	20	U	20	U	20	U
DI-N-OCTYL PHTHALATE	NC	NC	709000	709000	20	U	20	U	20	U
FLUORANTHENE	230000	1400000	29000	29000	8	U	8	U	8.2	U
FLUORENE	80000	81000	29000	29000	8	U	8	U	8.2	U
HEXACHLOROBENZENE	10.6	250	199	11	20	U	20	U	20	U
HEXACHLOROBUTADIENE	10	100	39.8	34	20	U	20	U	20	U
HEXACHLOROCYCLOPENTADIENE	1400	3100	755	755	100	UJ	99	UJ	100	UJ
HEXACHLOROETHANE	9.6	62	596	58	20	U	20	U	20	U
INDENO(1,2,3-CD)PYRENE	150	2100	1100	150	8	U	8	U	8.2	U
ISOPHORONE	440	4400	139000	460	20	UJ	20	UJ	20	UJ
NAPHTHALENE	9.4	92	29000	9.4	8	U	8	U	8.2	U
NITROBENZENE	1.58	16	1310	1.6	20	U	20	U	20	U
N-NITROSO-DI-N-PROPYLAMINE	0.14	1.4	544	0.14	20	U	20	U	20	U
N-NITROSODIPHENYLAMINE	1140	11000	545	545	20	U	20	U	20	U
PENTACHLOROPHENOL	7.2	200	2100	28	100	UJ	99	UJ	100	UJ
PHENANTHRENE	170000 [8]	NC	29000	13000	8	U	8	U	8.2	U
PHENOL	52000	52000	120000	56000	20	U	20	U	20	U
PYRENE	170000	190000	1100	1100	8	U	8	U	8.2	U

ERA = Ecological Risk Assessment
HHRA = Human Health Risk Assessment
IDEM = Indiana Department of Environmental Management
MIN = Minimum of the listed HHRA, ERA, and IDEM criteria. The listed criteria are the lesser of th

1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, Nov
carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for
hazard quotient (HQ) of 0.1. Soil screening levels (SSLs) for groundwater protection, which wer
represent a dilution attenuation factor (DAF) of 20.
2 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure
3 - Value is the lowest applicable ecological screening value (USEPA, 2005-2007 and USEPA, 20(
4 - Value is the lowest of the displayed screening criteria.
5 - Value is for hexavalent chromium.
6 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.
7 - Value is for acenaphthene.
8 - Value is for pyrene.

C.2 SWMU 25 ANALTYICAL DATA FOR SUBSURFACE SOIL

APPENDIX C.2

SUBSURFACE SOIL RESULTS
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA[1]	IDEM[2]	ERA[3]	MIN[4]	25SB001		25SB003		25SB004						25SB005		25SB006				25SB007			
SAMPLE ID					25SB0010206		25SB0030206		25SB0040206		25SB0040206-D		25SB0040610		25SB0050206		25SB0060206		25SB0060610		25SB0070206		25SB0070610	
SAMPLE DATE					20110711		20110711		20110712		20110711		20110711		20110712		20110712		20110712		20110712		20110711	
SAMPLE CODE					NORMAL		NORMAL		NORMAL		DUP		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
MATRIX					SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
SAMPLE TYPE					NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
SUBMATRIX					SB		SB		SB		SB		SB		SB		SB		SB		SB		SB	
TOP DEPTH					2		2		2		2		6		2		2		6		2		6	
BOTTOM DEPTH					6		6		6		6		10		6		6		10		6		10	
METALS (UG/KG)																								
ALUMINUM	7700000	100000000	NC	7700000	11000000	J	4700000	J	12000000	J	13000000	J	5400000	J	7000000	J	7800000	J	4700000	J	7800000	J	4800000	J
ANTIMONY	6000	43000	270	270	63	U	150	U	150	U	150	U	280	U	86	U	86	U	41	U	62	U	120	U
ARSENIC	26	5500	18000	26	5900	J	2600	J	5000	J	8500	J	10000	J	14000	J	5800	J	9500	J	14000	J	3600	J
BARIUM	1500000	1700000	330000	330000	28000	J	49000	J	55000	J	110000	J	31000	J	49000	J	66000	J	19000	J	33000	J	380000	J
BERYLLIUM	16000	63000	21000	16000	440		370	U	400	U	820	J	390		640		480		1200		750		1800	
CADMIUM	7000	7500	360	360	270	U	190	U	230	U	680	J	230		290		210	U	150	U	190	U	230	U
CHROMIUM	11.8 [5]	120	26000	11.8 [5]	18000		7800		18000		22000		10000		13000		15000		4700		20000		26000	
COBALT	2300	4300	13000	2300	2200	J	2100	J	4400	J	12000	J	2800	J	9900	J	9100	J	1000	J	4500	J	23000	J
COPPER	310000	920000	28000	28000	9400		5900		10000		14000		10000		12000		6900		14000		9100		23000	
IRON	5400000	5600000	NC	5400000	22000000	J	8000000	J	32000000	J	23000000	J	18000000	J	29000000	J	17000000	J	6200000	J	55000000	J	130000000	J
LEAD	280000 [6]	270000	11000	11000	14000		6200		15000	J	29000	J	7200		16000		11000		9900		17000		54000	
MANGANESE	180000	420000	220000	180000	94000	J	110000	J	390000	J	1200000	J	140000	J	440000	J	530000	J	82000	J	200000	J	2600000	J
MERCURY	660	2100	100	100	23	J	16	J	39	J	39		16	J	16	J	21	J	9	J	9	J	12	U
NICKEL	150000	390000	38000	38000	6800		4700		8400		14000		8800		13000		8900		7400		17000		52000	
SELENIUM	8000	5300	520	520	480	U	460	U	500	U	610	U	560	U	600	U	370	U	380	U	870	U	570	U
SILVER	12000	12000	4200	4200	42	J	63	J	61	J	55	J	55	J	53	J	38	J	46	J	40	J	120	J
THALLIUM	78	1100	56.9	56.9	140	J	93	U	130	J	220	J	86	J	140	J	120	J	100	J	170	J	270	J
VANADIUM	39000	550000	7800	7800	21000		11000		24000		29000		12000		18000		19000		3400		29000		17000	
ZINC	2300000	5900000	46000	46000	20000	J	15000	J	26000	J	310000	J	39000	J	41000	J	25000	J	12000	J	41000	J	110000	J
MISCELLANEOUS PARAMETERS (%)																								
PERCENT MOISTURE	NC	NC	NC	NC	16		14		15		17		12		14		20		9		21		16	
SEMIVOLATILES (UG/KG)																								
1,1-BIPHENYL	5100	71000	NC	5100	190	UJ	190	UJ	190	UJ	190	UJ	180	UJ	190	UJ	200	UJ	180	UJ	200	UJ	190	UJ
1,2,4,5-TETRACHLOROBENZENE	1800	25000	2020	1800	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2,2'-OXYBIS(1-CHLOROPROPANE)	4600	64000	19900	4600	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2,3,4,6-TETRACHLOROPHENOL	180000	2500000	199	199	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2,4,5-TRICHLOROPHENOL	610000	8500000	14100	14100	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2,4,6-TRICHLOROPHENOL	6100	85000	9940	6100	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2,4-DICHLOROPHENOL	18000	250000	87500	18000	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2,4-DIMETHYLPHENOL	120000	1700000	10	10	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2,4-DINITROPHENOL	12000	170000	60.9	60.9	390	UJ	390	UJ	390	UJ	400	UJ	380	UJ	390	UJ	420	UJ	370	UJ	420	UJ	400	UJ
2,4-DINITROTOLUENE	1600	22000	1280	1280	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2,6-DINITROTOLUENE	6100	85000	32.8	32.8	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2-CHLORONAPHTHALENE	630000	8800000	12.2	12.2	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2-CHLOROPHENOL	39000	550000	243	243	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2-METHYLNAPHTHALENE	23000	320000	29000	23000	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
2-METHYLPHENOL	310000	4300000	40400	40400	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2-NITROANILINE	61000	850000	74100	61000	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
2-NITROPHENOL	NC	NC	1600	1600	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
3&4-METHYLPHENOL	NC	NC	3490	3490	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
3,3'-DICHLOROBENZIDINE	1100	15000	646	646	390	UJ	390	UJ	390	UJ	400	UJ	380	UJ	390	UJ	420	UJ	370	UJ	420	UJ	400	UJ
3-NITROANILINE	NC	NC	3160	3160	20	UJ	19	UJ	20	UJ	20	UJ	19	UJ	19	UJ	21	UJ	18	UJ	21	UJ	20	UJ
4,6-DINITRO-2-METHYLPHENOL	490	6900	144	144	99	UJ	97	UJ	97	UJ	100	UJ	94	UJ	96	UJ	100	UJ	92	UJ	110	UJ	100	UJ
4-CHLORO-3-METHYLPHENOL	610000	8500000	7950	7950	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
4-CHLOROANILINE	2400	34000	1100	1100	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
4-NITROANILINE	24000	340000	21900	21900	20	UJ	19	UJ	20	UJ	20	UJ	19	UJ	19	UJ	21	UJ	18	UJ	21	UJ	20	UJ
4-NITROPHENOL	NC	NC	5120	5120	390	U	390	U	390	U	400	U	380	U	390	U	420	U	370	U	420	U	400	U
ACENAPHTHENE	340000	4800000	29000	29000	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
ACENAPHTHYLENE	340000 [7]	NC	29000	29000	7.9	UJ	7.8	UJ	7.8	UJ	8	UJ	7.6	UJ	7.8	UJ	8.4	UJ	7.4	UJ	8.5	UJ	8	UJ
ACETOPHENONE	780000	2500000	300000	300000	190	UR	190	UR	190	UR	190	UR	180	UR	190	UR	200	UR	180	UR	200	UR	190	UR
ANTHRACENE	1700000	24000000	29000	29000	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
BENZALDEHYDE	780000	1200000	NC	780000	190	UJ	190	UJ	190	UJ	190	UJ	180	UJ	190	UJ	200	UJ	180	UJ	200	UJ	190	UJ
BENZO(A)ANTHRACENE	150	2100	1100	150	20	U	19	U	20	U	20	U	19	U	8		21	U	18	U	21	U	20	U
BENZO(A)PYRENE	15	210	1100	15	7.9	U	7.8	U	7.8	U	8	U	7.6	U	10		8.4	U	7.4	U	8.5	U	8	U
BENZO(B)FLUORANTHENE	150	2100	1100	150	7.9	U	7.8	U	7.8	U	8	U	7.6	U	12		8.4	U	7.4	U	8.5	U	8	U
BENZO(G,H,I)PERYLENE	170000 [8]	NC	1100	1100	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
BENZO(K)FLUORANTHENE	1500	21000	1100	1100	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
BIS(2-CHLOROETHOXY)METHANE	18000	250000	302	302	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
BIS(2-CHLOROETHYL)ETHER	210	2900	23700	210	39	U	39	U	39	U	40	U	38	U	39	U	42	U	37	U	42	U	40	U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	490000	925	925	24	J	19	UJ	19	J	18	J	33	J	300	J	21	UJ	18	UJ	21	UJ	20	UJ

APPENDIX C.2

SUBSURFACE SOIL RESULTS
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA[1]	IDEM[2]	ERA[3]	MIN[4]	25SB001		25SB003		25SB004						25SB005		25SB006				25SB007			
SAMPLE ID					25SB0010206		25SB0030206		25SB0040206		25SB0040206-D		25SB0040610		25SB0050206		25SB0060206		25SB0060610		25SB0070206		25SB0070610	
SAMPLE DATE					20110711		20110711		20110712		20110711		20110711		20110712		20110712		20110712		20110712		20110711	
SAMPLE CODE					NORMAL		NORMAL		NORMAL		DUP		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
MATRIX					SO		SO		SO		SO		SO		SO		SO		SO		SO		SO	
SAMPLE TYPE					NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL		NORMAL	
SUBMATRIX					SB		SB		SB		SB		SB		SB		SB		SB		SB		SB	
TOP DEPTH					2		2		2		2		6		2		2		6		2		6	
BOTTOM DEPTH					6		6		6		6		10		6		6		10		6		10	
BUTYL BENZYL PHTHALATE	260000	3600000	239	239	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
CAPROLACTAM	3100000	43000000	NC	3100000	190	U	190	U	190	U	190	U	180	U	190	U	200	U	180	U	200	U	190	U
CARBAZOLE	NC	NC	NC	NC	20	UJ	19	UJ	20	UJ	20	UJ	19	UJ	19	UJ	21	UJ	18	UJ	21	UJ	20	UJ
CHRYSENE	15000	210000	1100	1100	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
DIBENZO(A,H)ANTHRACENE	15	210	1100	15	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
DIBENZOFURAN	7800	110000	NC	7800	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
DIETHYL PHTHALATE	4900000	69000000	24800	24800	16	J	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
DIMETHYL PHTHALATE	NC	NC	734000	734000	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
DI-N-BUTYL PHTHALATE	610000	8500000	150	150	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
DI-N-OCTYL PHTHALATE	NC	NC	709000	709000	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
FLUORANTHENE	230000	3200000	29000	29000	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
FLUORENE	230000	3200000	29000	29000	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
HEXACHLOROBENZENE	300	4200	199	199	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
HEXACHLOROBUTADIENE	6100	85000	39.8	39.8	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
HEXACHLOROCYCLOPENTADIENE	37000	520000	755	755	99	UJ	97	UJ	97	UJ	100	UJ	94	UJ	96	UJ	100	UJ	92	UJ	110	UJ	100	UJ
HEXACHLOROETHANE	4300	60000	596	596	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
INDENO(1,2,3-CD)PYRENE	150	2100	1100	150	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
ISOPHORONE	510000	7100000	139000	139000	20	UJ	19	UJ	20	UJ	20	UJ	19	UJ	19	UJ	21	UJ	18	UJ	21	UJ	20	UJ
NAPHTHALENE	3600	50000	29000	3600	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
NITROBENZENE	4800	67000	1310	1310	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
N-NITROSO-DI-N-PROPYLAMINE	69	970	544	69	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
N-NITROSODIPHENYLAMINE	99000	1400000	545	545	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
PENTACHLOROPHENOL	890	12000	2100	890	99	UJ	97	UJ	97	UJ	100	UJ	94	UJ	96	UJ	100	UJ	92	UJ	110	UJ	100	UJ
PHENANTHRENE	170000 [8]	NC	29000	29000	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U
PHENOL	1800000	25000000	120000	120000	20	U	19	U	20	U	20	U	19	U	19	U	21	U	18	U	21	U	20	U
PYRENE	170000	2400000	1100	1100	7.9	U	7.8	U	7.8	U	8	U	7.6	U	7.8	U	8.4	U	7.4	U	8.5	U	8	U

ERA = Ecological Risk Assessment
HHRA = Human Health Risk Assessment
IDEM = Indiana Department of Environmental Management
MIN = Minimum of the listed HHRA, ERA, and IDEM criteria. The listed criteria are the lesser of the direct contact and the migration to groundwater criteria (see notes 1 and 2).

1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens that were used to determine the lowest applicable screening value correspond to a hazard quotient (HQ) of 0.1. Soil screening levels (SSLs) for groundwater protection, which were also used to determine the lowest applicable screening level, are risk-based SSLs multiplied by 20 to represent a dilution attenuation factor (DAF) of 20.
2 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
3 - Value is the lowest of the applicable ecological screening values.
4 - Value is the lowest of the displayed screening criteria.
5 - Value is for hexavalent chromium.
6 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.
7 - Value is for acenaphthene.
8 - Value is for pyrene.

APPENDIX C.2

SUBSURFACE SOIL RESULTS
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA[1]	IDEM[2]	ERA[3]	MIN[4]	25SB008			
SAMPLE ID					25SB0080206		25SB0080610	
SAMPLE DATE					20110712		20110712	
SAMPLE CODE					NORMAL		NORMAL	
MATRIX					SO		SO	
SAMPLE TYPE					NORMAL		NORMAL	
SUBMATRIX					SB		SB	
TOP DEPTH					2		6	
BOTTOM DEPTH					6		10	
METALS (UG/KG)								
ALUMINUM	7700000	100000000	NC	7700000	6300000	J	5500000	
ANTIMONY	6000	43000	270	270	330	U	86	U
ARSENIC	26	5500	18000	26	13000	J	1600	
BARIUM	1500000	1700000	330000	330000	36000		23000	
BERYLLIUM	16000	63000	21000	16000	400	J	450	
CADMIUM	7000	7500	360	360	380		240	
CHROMIUM	11.8 [5]	120	26000	11.8 [5]	11000		10000	
COBALT	2300	4300	13000	2300	2800		7200	
COPPER	310000	920000	28000	28000	9700		11000	
IRON	5400000	5600000	NC	5400000	13000000	J	22000000	
LEAD	280000 [6]	270000	11000	11000	11000		9800	
MANGANESE	180000	420000	220000	180000	84000	J	170000	
MERCURY	660	2100	100	100	26	J	25	J
NICKEL	150000	390000	38000	38000	5800		12000	
SELENIUM	8000	5300	520	520	630	U	420	J
SILVER	12000	12000	4200	4200	26	J	73	U
THALLIUM	78	1100	56.9	56.9	170	J	120	J
VANADIUM	39000	550000	7800	7800	11000		9300	
ZINC	2300000	5900000	46000	46000	17000		28000	
MISCELLANEOUS PARAMETERS (%)								
PERCENT MOISTURE	NC	NC	NC	NC	14		15	
SEMIVOLATILES (UG/KG)								
1,1-BIPHENYL	5100	71000	NC	5100	190	UJ	190	UR
1,2,4,5-TETRACHLOROBENZENE	1800	25000	2020	1800	19	U	20	U
2,2'-OXYBIS(1-CHLOROPROPANE)	4600	64000	19900	4600	19	U	20	U
2,3,4,6-TETRACHLOROPHENOL	180000	2500000	199	199	19	U	20	U
2,4,5-TRICHLOROPHENOL	610000	8500000	14100	14100	19	U	20	U
2,4,6-TRICHLOROPHENOL	6100	85000	9940	6100	19	U	20	U
2,4-DICHLOROPHENOL	18000	250000	87500	18000	19	U	20	U
2,4-DIMETHYLPHENOL	120000	1700000	10	10	19	U	20	U
2,4-DINITROPHENOL	12000	170000	60.9	60.9	390	UJ	390	UJ
2,4-DINITROTOLUENE	1600	22000	1280	1280	19	U	20	U
2,6-DINITROTOLUENE	6100	85000	32.8	32.8	19	U	20	U
2-CHLORONAPHTHALENE	630000	8800000	12.2	12.2	19	U	20	U
2-CHLOROPHENOL	39000	550000	243	243	19	U	20	U
2-METHYLNAPHTHALENE	23000	320000	29000	23000	7.8	U	7.9	U
2-METHYLPHENOL	310000	4300000	40400	40400	19	U	20	U
2-NITROANILINE	61000	850000	74100	61000	19	U	20	U
2-NITROPHENOL	NC	NC	1600	1600	19	U	20	U
3&4-METHYLPHENOL	NC	NC	3490	3490	19	U	20	U
3,3'-DICHLOROBENZIDINE	1100	15000	646	646	390	UJ	390	UJ
3-NITROANILINE	NC	NC	3160	3160	19	UJ	20	U
4,6-DINITRO-2-METHYLPHENOL	490	6900	144	144	97	UJ	98	UJ
4-CHLORO-3-METHYLPHENOL	610000	8500000	7950	7950	19	U	20	U
4-CHLOROANILINE	2400	34000	1100	1100	19	U	20	U
4-NITROANILINE	24000	340000	21900	21900	19	UJ	20	U
4-NITROPHENOL	NC	NC	5120	5120	390	U	390	UJ
ACENAPHTHENE	340000	4800000	29000	29000	7.8	U	7.9	U
ACENAPHTHYLENE	340000 [7]	NC	29000	29000	7.8	UJ	7.9	UJ
ACETOPHENONE	780000	2500000	300000	300000	190	UR	190	UR
ANTHRACENE	1700000	24000000	29000	29000	7.8	U	7.9	U
BENZALDEHYDE	780000	1200000	NC	780000	190	UJ	190	UR
BENZO(A)ANTHRACENE	150	2100	1100	150	19	U	20	U
BENZO(A)PYRENE	15	210	1100	15	7.8	U	7.9	U
BENZO(B)FLUORANTHENE	150	2100	1100	150	7.8	U	7.9	U
BENZO(G,H,I)PERYLENE	170000 [8]	NC	1100	1100	7.8	U	7.9	U
BENZO(K)FLUORANTHENE	1500	21000	1100	1100	7.8	U	7.9	U
BIS(2-CHLOROETHOXY)METHANE	18000	250000	302	302	19	U	20	U
BIS(2-CHLOROETHYL)ETHER	210	2900	23700	210	39	U	39	U
BIS(2-ETHYLHEXYL)PHTHALATE	35000	490000	925	925	19	UJ	20	U

APPENDIX C.2

SUBSURFACE SOIL RESULTS
NSA CRANE
CRANE, INDIANA

LOCATION	HHRA[1]	IDEM[2]	ERA[3]	MIN[4]	25SB008			
SAMPLE ID					25SB0080206		25SB0080610	
SAMPLE DATE					20110712		20110712	
SAMPLE CODE					NORMAL		NORMAL	
MATRIX					SO		SO	
SAMPLE TYPE					NORMAL		NORMAL	
SUBMATRIX					SB		SB	
TOP DEPTH					2		6	
BOTTOM DEPTH					6		10	
BUTYL BENZYL PHTHALATE	260000	3600000	239	239	19	U	20	U
CAPROLACTAM	3100000	43000000	NC	3100000	190	U	190	UR
CARBAZOLE	NC	NC	NC	NC	19	UJ	20	U
CHRYSENE	15000	210000	1100	1100	7.8	U	7.9	U
DIBENZO(A,H)ANTHRACENE	15	210	1100	15	7.8	U	7.9	U
DIBENZOFURAN	7800	110000	NC	7800	19	U	20	U
DIETHYL PHTHALATE	4900000	69000000	24800	24800	19	U	20	U
DIMETHYL PHTHALATE	NC	NC	734000	734000	19	U	20	U
DI-N-BUTYL PHTHALATE	610000	8500000	150	150	19	U	20	U
DI-N-OCTYL PHTHALATE	NC	NC	709000	709000	19	U	20	U
FLUORANTHENE	230000	3200000	29000	29000	7.8	U	7.9	U
FLUORENE	230000	3200000	29000	29000	7.8	U	7.9	U
HEXACHLOROBENZENE	300	4200	199	199	19	U	20	U
HEXACHLOROBUTADIENE	6100	85000	39.8	39.8	19	U	20	U
HEXACHLOROCYCLOPENTADIENE	37000	520000	755	755	97	UJ	98	UJ
HEXACHLOROETHANE	4300	60000	596	596	19	U	20	U
INDENO(1,2,3-CD)PYRENE	150	2100	1100	150	7.8	U	7.9	U
ISOPHORONE	510000	7100000	139000	139000	19	UJ	20	UJ
NAPHTHALENE	3600	50000	29000	3600	7.8	U	7.9	U
NITROBENZENE	4800	67000	1310	1310	19	U	20	U
N-NITROSO-DI-N-PROPYLAMINE	69	970	544	69	19	U	20	U
N-NITROSODIPHENYLAMINE	99000	1400000	545	545	19	U	20	U
PENTACHLOROPHENOL	890	12000	2100	890	97	UJ	98	UJ
PHENANTHRENE	170000 [8]	NC	29000	29000	7.8	U	7.9	U
PHENOL	1800000	25000000	120000	120000	19	U	20	U
PYRENE	170000	2400000	1100	1100	7.8	U	7.9	U

ERA = Ecological Risk Assessment
HHRA = Human Health Risk Assessment
IDEM = Indiana Department of Environmental Management
MIN = Minimum of the listed HHRA, ERA, and IDEM criteria. The listed criteria are the lesser of the direct

1 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November
carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncar
hazard quotient (HQ) of 0.1. Soil screening levels (SSLs) for groundwater protection, which were also u
represent a dilution attenuation factor (DAF) of 20.
2 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC)
3 - Value is the lowest of the applicable ecological screening values.
4 - Value is the lowest of the displayed screening criteria.
5 - Value is for hexavalent chromium.
6 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.
7 - Value is for acenaphthene.
8 - Value is for pyrene.

C.3 SWMU 25 ANALTYICAL DATA FOR GROUNDWATER

APPENDIX C.3

GROUNDWATER SAMPLE RESULTS - ROUND 1
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	MIN	25MW01	25MW02	25MW03	
SAMPLE ID				25GW718101	25GW728101	25GW738101	25GW738101-D
SAMPLE DATE				20110713	20110714	20110713	20110714
SAMPLE CODE				NORMAL	NORMAL	NORMAL	DUP
MATRIX				GW	GW	GW	GW
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX				NA	NA	NA	NA
DISSOLVED METALS (UG/L)							
ALUMINUM	1600	16000	1600	NA	1.7 J	4.3 J	NA
ANTIMONY	0.6	6	0.6	NA	0.4 U	0.4 U	NA
ARSENIC	0.045	10	0.045	NA	**0.41 J**	**0.85**	NA
BARIUM	290	2000	290	NA	8 J	90	NA
BERYLLIUM	1.6	4	1.6	NA	0.2 U	0.2 U	NA
CADMIUM	0.69	5	0.69	NA	0.35 U	0.2 U	NA
CHROMIUM	0.031	0.31	0.031	NA	**3.9 J**	**2.6 J**	NA
COBALT	0.47	4.7	0.47	NA	**18**	**2.4**	NA
COPPER	62	1300	62	NA	0.91 J	0.61 J	NA
IRON	1100	11000	1100	NA	**2400**	50 U	NA
LEAD	NC	15	15	NA	0.2 U	0.2 U	NA
MANGANESE	32	320	32	NA	**1200**	**570**	NA
MERCURY	0.063	2	0.063	NA	0.1 U	0.1 U	NA
NICKEL	30	300	30	NA	**42**	6	NA
SELENIUM	7.8	50	7.8	NA	1 U	1 U	NA
SILVER	7.1	71	7.1	NA	0.2 U	0.2 U	NA
THALLIUM	0.016	2	0.016	NA	0.2 U	0.2 U	NA
VANADIUM	7.8	78	7.8	NA	1 J	0.89 J	NA
ZINC	470	4700	470	NA	16 J	2.2 J	NA
TOTAL METALS (UG/L)							
ALUMINUM	1600	16000	1600	61 J	39 J	190 J	76 J
ANTIMONY	0.6	6	0.6	1 U	1 U	1 U	1 U
ARSENIC	0.045	10	0.045	1.2 U	1.5 U	**2**	1 U
BARIUM	290	2000	290	120	9.3 J	110	120
BERYLLIUM	1.6	4	1.6	0.2 U	0.2 U	0.2 U	0.1 J
CADMIUM	0.69	5	0.69	0.44 U	0.46	0.24 U	0.42 U
CHROMIUM	0.031	0.31	0.031	0.57 U	0.5 U	**1.8 J**	0.65 U
COBALT	0.47	4.7	0.47	**7.4**	**20**	**3.9**	**9.2**
COPPER	62	1300	62	1.8 J	1.4 J	2.3	2.2
IRON	1100	11000	1100	**5500**	**3300**	**3900**	**5200**
LEAD	NC	15	15	0.97	0.32 U	2.4	1.2
MANGANESE	32	320	32	**6100 J**	**1400 J**	**810 J**	**5600 J**
MERCURY	0.063	2	0.063	0.1 U	0.1 U	0.1 U	0.1 U
NICKEL	30	300	30	**54 J**	**49 J**	9.2 J	**53 J**
SELENIUM	7.8	50	7.8	1 U	1 U	1 U	1 U
SILVER	7.1	71	7.1	0.5 U	0.5 U	0.5 U	0.5 U
THALLIUM	0.016	2	0.016	0.29 U	0.2 U	0.2 U	0.2 U
VANADIUM	7.8	78	7.8	0.2 UJ	0.27 J	2.9 J	0.2 UJ
ZINC	470	4700	470	72	17 J	7.4 J	81

APPENDIX C.3

GROUNDWATER SAMPLE RESULTS - ROUND 1
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	MIN	25MW01	25MW02	25MW03	
SAMPLE ID				25GW718101	25GW728101	25GW738101	25GW738101-D
SAMPLE DATE				20110713	20110714	20110713	20110714
SAMPLE CODE				NORMAL	NORMAL	NORMAL	DUP
MATRIX				GW	GW	GW	GW
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX				NA	NA	NA	NA
TURBIDITY (NTU)							
TURBIDITY	NA	NA	NA	5.6	23	157	157

APPENDIX C.3

GROUNDWATER SAMPLE RESULTS - ROUND 1
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	MIN	25MW01	25MW02	25MW03	
SAMPLE ID				25GW718101	25GW728101	25GW738101	25GW738101-D
SAMPLE DATE				20110713	20110714	20110713	20110714
SAMPLE CODE				NORMAL	NORMAL	NORMAL	DUP
MATRIX				GW	GW	GW	GW
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX				NA	NA	NA	NA
SEMIVOLATILES (UG/L)							
1,1-BIPHENYL	0.083	0.83	0.083	5 UR	5 UR	5 UR	5 UR
1,2,4,5-TETRACHLOROBENZENE	0.12	1.2	0.12	5 U	5 U	5 U	5 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.31	3.1	0.31	0.5 U	**0.43 J**	0.5 U	0.5 U
2,3,4,6-TETRACHLOROPHENOL	17	170	17	5 UR	5 U	5 U	5 UR
2,4,5-TRICHLOROPHENOL	89	890	89	0.5 UR	0.5 U	0.5 U	0.5 UR
2,4,6-TRICHLOROPHENOL	0.9	9	0.9	0.5 UR	0.5 U	0.5 U	0.5 UR
2,4-DICHLOROPHENOL	3.5	35	3.5	0.5 UR	0.5 U	0.5 U	0.5 UR
2,4-DIMETHYLPHENOL	27	270	27	1 UR	1 U	1 U	1 UR
2,4-DINITROPHENOL	3	30	3	10 UR	10 U	10 U	10 UR
2,4-DINITROTOLUENE	0.02	2	0.02	0.5 U	0.5 U	0.5 U	0.5 U
2,6-DINITROTOLUENE	1.5	15	1.5	0.5 U	0.5 U	0.5 U	0.5 U
2-CHLORONAPHTHALENE	55	550	55	1 UJ	1 U	1 U	1 U
2-CHLOROPHENOL	7.1	71	7.1	0.5 UR	0.5 U	0.5 U	0.5 UR
2-METHYLNAPHTHALENE	2.7	27	2.7	0.2 U	0.2 U	0.2 U	0.2 U
2-METHYLPHENOL	72	720	72	0.5 UR	0.5 U	0.5 U	0.5 UR
2-NITROANILINE	15	150	15	0.5 U	0.5 U	0.5 U	0.5 U
2-NITROPHENOL	NC	NC	NC	0.5 UR	0.5 U	0.5 U	0.5 UR
3&4-METHYLPHENOL	140	NC	140	1 UR	1 U	1 U	1 UR
3,3'-DICHLOROBENZIDINE	0.11	1.1	0.11	10 UJ	10 UJ	10 UJ	10 UJ
4,6-DINITRO-2-METHYLPHENOL	0.12	1.2	0.12	2.5 UR	2.5 U	2.5 U	2.5 UR
4-CHLORO-3-METHYLPHENOL	110	1100	110	0.5 UR	0.5 U	0.5 U	0.5 UR
4-CHLOROANILINE	0.32	3.2	0.32	0.5 U	0.5 U	0.5 U	0.5 U
4-NITROANILINE	3.3	33	3.3	0.5 U	0.5 U	0.5 U	0.5 U
ACENAPHTHENE	40	400	40	0.2 U	0.2 U	0.2 U	0.2 U
ACENAPHTHYLENE	40	NC	40	0.2 U	0.2 U	0.2 U	0.2 U
ACETOPHENONE	150	1500	150	5 UR	5 UR	5 UR	5 UR
ANTHRACENE	130	1300	130	0.2 U	0.2 U	0.2 U	0.2 U
BENZALDEHYDE	150	1500	150	10 UR	10 UR	10 UR	10 UR
BENZO(A)ANTHRACENE	0.029	0.29	0.029	0.2 U	0.2 U	0.2 U	0.2 U
BENZO(A)PYRENE	0.0029	0.2	0.0029	0.2 U	0.2 U	0.2 U	0.2 U
BENZO(B)FLUORANTHENE	0.029	0.29	0.029	0.2 UJ	0.2 UJ	0.2 UJ	0.2 UJ
BENZO(G,H,I)PERYLENE	8.7	NC	8.7	0.2 U	0.2 U	0.2 U	0.2 U
BENZO(K)FLUORANTHENE	0.29	2.9	0.29	0.2 U	0.2 U	0.2 U	0.2 U
BIS(2-CHLOROETHOXY)METHANE	4.6	46	4.6	0.5 U	0.5 U	0.5 U	0.5 U
BIS(2-CHLOROETHYL)ETHER	0.012	0.12	0.012	0.5 U	0.5 U	0.5 U	0.5 U
BIS(2-ETHYLHEXYL)PHTHALATE	4.8	6	4.8	0.5 U	0.5 U	0.5 U	0.76 J
BUTYL BENZYL PHTHALATE	14	140	14	0.5 U	0.5 U	0.5 U	0.5 U
CAPROLACTAM	770	7700	770	5 UR	5 UR	5 UR	5 UR
CARBAZOLE	NC	NC	NC	0.5 U	0.5 U	0.5 U	0.5 U

APPENDIX C.3

GROUNDWATER SAMPLE RESULTS - ROUND 1
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	MIN	25MW01	25MW02	25MW03	
SAMPLE ID				25GW718101	25GW728101	25GW738101	25GW738101-D
SAMPLE DATE				20110713	20110714	20110713	20110714
SAMPLE CODE				NORMAL	NORMAL	NORMAL	DUP
MATRIX				GW	GW	GW	GW
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX				NA	NA	NA	NA
CHRYSENE	2.9	29	2.9	0.2 U	0.2 U	0.2 U	0.2 U
DIBENZO(A,H)ANTHRACENE	0.0029	0.029	0.0029	0.2 U	0.2 U	0.2 U	0.2 U
DIBENZOFURAN	0.58	5.8	0.58	0.5 U	0.5 U	0.5 U	0.5 U
DIETHYL PHTHALATE	1100	11000	1100	0.5 U	0.5 U	0.5 U	0.5 U
DIMETHYL PHTHALATE	NC	NC	NC	0.5 U	0.5 U	0.5 U	0.5 U
DI-N-BUTYL PHTHALATE	67	670	67	0.24 U	0.28 U	0.21 U	0.33 U
DI-N-OCTYL PHTHALATE	NC	NC	NC	0.5 U	0.5 U	0.5 U	0.5 U
FLUORANTHENE	63	630	63	0.2 U	0.2 U	0.2 U	0.2 U
FLUORENE	22	220	22	0.2 U	0.2 U	0.2 U	0.2 U
HEXACHLOROBENZENE	0.042	1	0.042	0.5 U	0.5 U	0.5 U	0.5 U
HEXACHLOROBUTADIENE	0.26	2.6	0.26	0.5 U	0.5 U	0.5 U	0.5 U
HEXACHLOROCYCLOPENTADIENE	2.2	50	2.2	2.5 UJ	2.5 UJ	2.5 UJ	2.5 UJ
HEXACHLOROETHANE	0.51	5.1	0.51	0.5 U	0.5 U	0.5 U	0.5 U
INDENO(1,2,3-CD)PYRENE	0.029	0.29	0.029	0.2 U	0.2 U	0.2 U	0.2 U
ISOPHORONE	67	670	67	1 UJ	1 UJ	1 UJ	1 UJ
NAPHTHALENE	0.14	1.4	0.14	0.2 U	0.2 U	0.2 U	0.2 U
NITROBENZENE	0.12	1.2	0.12	0.5 U	0.5 U	0.5 U	0.5 U
N-NITROSO-DI-N-PROPYLAMINE	0.0093	0.093	0.0093	0.5 U	0.5 U	0.5 U	0.5 U
N-NITROSODIPHENYLAMINE	10	100	10	0.5 U	0.5 U	0.5 U	0.5 U
PENTACHLOROPHENOL	0.035	1	0.035	2.5 UR	2.5 UJ	2.5 UJ	2.5 UR
PHENANTHRENE	8.7	NC	8.7	0.2 U	0.2 U	0.2 U	0.2 U
PHENOL	450	4500	450	0.5 UR	0.5 UJ	0.5 UJ	0.5 UR
PYRENE	8.7	87	8.7	0.2 U	0.2 U	0.2 U	0.2 U

APPENDIX C.4

GROUNDWATER SAMPLE RESULTS - ROUND 2
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	MIN	25MW01		25MW02	25MW03	25MWT06
SAMPLE ID				25MW718102	25MW718102-D	25MW728102	25MW738102	25MWT1061202
SAMPLE DATE				20121101	20121101	20121101	20121101	20121031
SAMPLE CODE				ORIG	DUP	NORMAL	NORMAL	NORMAL
MATRIX				GW	GW	GW	GW	GW
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX				NA	NA	NA	NA	NA
TOP DEPTH				-9999	-9999	-9999	-9999	-9999
BOTTOM DEPTH				-9999	-9999	-9999	-9999	-9999
DISSOLVED METALS (UG/L)								
ALUMINUM	1600	16000	1600	140	154	148	165	119
ANTIMONY	0.6	6	0.6	2 U	2 U	2 U	2 U	2 U
ARSENIC	0.045	10	0.045	1.5 U	1.5 U	1.5 U	1.5 U	**1.5 J**
BARIUM	290	2000	290	125	127	8.66 J	67.9	55.7
BERYLLIUM	1.6	4	1.6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CADMIUM	0.69	5	0.69	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
CALCIUM	NC	NC	NC	92200	87600	94700	76400	46700
CHROMIUM	0.031	0.31	0.031	1 U	1 U	1 U	1 U	1 U
COBALT	0.47	4.7	0.47	**7.84**	**8.28**	**4.51**	2.5 U	**16.8**
COPPER	62	1300	62	2 U	2 U	2 U	2 U	2 U
IRON	1100	11000	1100	**4760**	**4520**	15 U	169	**1410**
LEAD	NC	15	15	0.75 U	0.75 U	0.75 U	0.75 U	0.75 U
MAGNESIUM	NC	NC	NC	69900	69600	26400	10200	15300
MANGANESE	32	320	32	**4630**	**4810**	**318**	**395**	**1500**
MERCURY	0.063	2	0.063	0.16 U	0.0847 U	0.0854 U	0.0881 U	0.0818 U
NICKEL	30	300	30	**45.3**	**47.7**	20.3	7.66	**35.4**
POTASSIUM	NC	NC	NC	5300	5130	1300	1040 J	2170
SELENIUM	7.8	50	7.8	1.25 U	1.25 U	1.25 U	1.25 U	1.25 U
SILVER	7.1	71	7.1	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
SODIUM	NC	NC	NC	65600	61400	11000	18200	23800
THALLIUM	0.016	2	0.016	**2.38**	**1.96 J**	1 U	1 U	1 U
VANADIUM	7.8	78	7.8	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
ZINC	470	4700	470	35.1	35.5	5.53	2.51 J	17.5
TOTAL METALS (UG/L)								
ALUMINUM	1600	16000	1600	262	179	**3490**	**5630**	301
ANTIMONY	0.6	6	0.6	2 U	2 U	4 U	2 U	2 U
ARSENIC	0.045	10	0.045	1.5 U	1.5 U	**127**	**13.6**	**2.11 J**
BARIUM	290	2000	290	138	136	72	107	53.9
BERYLLIUM	1.6	4	1.6	0.5 U	0.5 U	0.873 J	0.329 J	0.5 U
CADMIUM	0.69	5	0.69	0.5 U	0.5 U	**1.09 J**	0.5 U	0.5 U
CHROMIUM	0.031	0.31	0.031	**1.22 J**	1 U	**27**	**85.4**	**4.34**
COBALT	0.47	4.7	0.47	**8.67**	**8.97**	**149**	**9.16**	**17.8**
COPPER	62	1300	62	2 U	2 U	18.8	9.96	2 U
IRON	1100	11000	1100	**5730**	**5130**	**146000**	**27500**	**3330**

APPENDIX C.4

GROUNDWATER SAMPLE RESULTS - ROUND 2
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	MIN	25MW01		25MW02	25MW03	25MWT06
SAMPLE ID				25MW718102	25MW718102-D	25MW728102	25MW738102	25MWT1061202
SAMPLE DATE				20121101	20121101	20121101	20121101	20121031
SAMPLE CODE				ORIG	DUP	NORMAL	NORMAL	NORMAL
MATRIX				GW	GW	GW	GW	GW
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX				NA	NA	NA	NA	NA
TOP DEPTH				-9999	-9999	-9999	-9999	-9999
BOTTOM DEPTH				-9999	-9999	-9999	-9999	-9999
LEAD	NC	15	15	0.75 U	0.75 U	14.5	9.67	0.75 U
MANGANESE	32	320	32	**5130**	**5130**	**7440**	**972**	**1550**
MERCURY	0.063	2	0.063	0.0879 U	0.0843 U	0.103 U	0.0939 U	0.0861 U
NICKEL	30	300	30	**48.4**	**49.8**	**398**	**68.2**	**35.7**
SELENIUM	7.8	50	7.8	1.25 U	1.25 U	2.5 UJ	1.25 U	1.25 U
SILVER	7.1	71	7.1	0.5 U	0.5 U	1 U	0.5 U	0.5 U
THALLIUM	0.016	2	0.016	**2.19**	**2.13**	**3.56 J**	1 U	1 U
VANADIUM	7.8	78	7.8	2.5 U	2.5 U	**25.9**	**31.3**	1.76 J
ZINC	470	4700	470	51	42.5	190	40.3	20.4
TURBIDITY (NTU)								
TUIRBIDITY	NA	NA	NA	2.6	2.6	270	388	23
SEMIVOLATILES (UG/L)								
1,1-BIPHENYL	0.083	0.83	0.083	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
1,2,4,5-TETRACHLOROBENZENE	0.12	1.2	0.12	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
2,2'-OXYBIS(1-CHLOROPROPANE)	0.31	3.1	0.31	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
2,3,4,6-TETRACHLOROPHENOL	17	170	17	4.63 U	5 UJ	5 U	4.9 UR	5 U
2,4,5-TRICHLOROPHENOL	89	890	89	2.31 U	2.5 UJ	2.5 U	2.45 UR	2.5 U
2,4,6-TRICHLOROPHENOL	0.9	9	0.9	2.31 U	2.5 UJ	2.5 U	2.45 UR	2.5 U
2,4-DICHLOROPHENOL	3.5	35	3.5	2.31 U	2.5 UJ	2.5 U	2.45 UR	2.5 U
2,4-DIMETHYLPHENOL	27	270	27	9.26 U	10 UJ	10 U	9.8 UR	10 U
2,4-DINITROPHENOL	3	30	3	23.1 UJ	25 UJ	25 UJ	24.5 UR	25 UJ
2,4-DINITROTOLUENE	0.02	2	0.02	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
2,6-DINITROTOLUENE	1.5	15	1.5	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
2-CHLORONAPHTHALENE	55	550	55	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
2-CHLOROPHENOL	7.1	71	7.1	2.31 U	2.5 UJ	2.5 U	2.45 UR	2.5 U
2-METHYLNAPHTHALENE	2.7	27	2.7	0.0926 U	0.1 U	0.1 U	0.098 U	0.0933 J
2-METHYLPHENOL	72	720	72	2.31 U	2.5 UJ	2.5 U	2.45 UR	2.5 U
2-NITROANILINE	15	150	15	9.26 U	10 U	10 U	9.8 U	10 U
2-NITROPHENOL	NC	NC	NC	2.31 UJ	2.5 UJ	2.5 UJ	2.45 UR	2.5 UJ
3&4-METHYLPHENOL	140	NC	140	2.31 U	2.5 UJ	2.5 U	2.45 UR	2.5 U
3,3'-DICHLOROBENZIDINE	0.11	1.1	0.11	2.31 UJ	2.5 UJ	2.5 UJ	2.45 UJ	2.5 UJ
4,6-DINITRO-2-METHYLPHENOL	0.12	1.2	0.12	9.26 UJ	10 UJ	10 UJ	9.8 UR	10 UJ
4-CHLORO-3-METHYLPHENOL	110	1100	110	2.31 U	2.5 U	2.5 U	2.45 UR	2.5 U
4-CHLOROANILINE	0.32	3.2	0.32	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
4-NITROANILINE	3.3	33	3.3	9.26 U	10 U	10 U	9.8 U	10 U

APPENDIX C.4

GROUNDWATER SAMPLE RESULTS - ROUND 2
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	MIN	25MW01		25MW02	25MW03	25MWT06
SAMPLE ID				25MW718102	25MW718102-D	25MW728102	25MW738102	25MWT1061202
SAMPLE DATE				20121101	20121101	20121101	20121101	20121031
SAMPLE CODE				ORIG	DUP	NORMAL	NORMAL	NORMAL
MATRIX				GW	GW	GW	GW	GW
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX				NA	NA	NA	NA	NA
TOP DEPTH				-9999	-9999	-9999	-9999	-9999
BOTTOM DEPTH				-9999	-9999	-9999	-9999	-9999
ACENAPHTHENE	40	400	40	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
ACENAPHTHYLENE	40	NC	40	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
ACETOPHENONE	150	1500	150	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
ANTHRACENE	130	1300	130	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
ATRAZINE	0.26	0.26	3	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
BENZALDEHYDE	150	1500	150	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
BENZO(A)ANTHRACENE	0.029	0.29	0.029	0.0926 UJ	0.1 UJ	0.1 UJ	0.098 UJ	0.1 UJ
BENZO(A)PYRENE	0.0029	0.2	0.0029	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
BENZO(B)FLUORANTHENE	0.029	0.29	0.029	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
BENZO(G,H,I)PERYLENE	8.7	NC	8.7	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
BENZO(K)FLUORANTHENE	0.29	2.9	0.29	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
BIS(2-CHLOROETHOXY)METHANE	4.6	46	4.6	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
BIS(2-CHLOROETHYL)ETHER	0.012	0.12	0.012	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
BIS(2-ETHYLHEXYL)PHTHALATE	4.8	6	4.8	0.463 U	0.5 U	0.5 U	0.493 J	0.5 U
BUTYL BENZYL PHTHALATE	14	140	14	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
CAPROLACTAM	770	7700	770	2.31 UJ	2.5 UJ	2.5 UJ	2.45 UJ	2.5 UJ
CARBAZOLE	NC	NC	NC	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
CHRYSENE	2.9	29	2.9	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
DIBENZO(A,H)ANTHRACENE	0.0029	0.029	0.0029	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
DIBENZOFURAN	0.58	5.8	0.58	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
DIETHYL PHTHALATE	1100	11000	1100	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
DIMETHYL PHTHALATE	NC	NC	NC	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
DI-N-BUTYL PHTHALATE	67	670	67	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
DI-N-OCTYL PHTHALATE	NC	NC	NC	2.31 UJ	2.5 UJ	2.5 UJ	2.45 UJ	2.5 UJ
FLUORANTHENE	63	630	63	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
FLUORENE	22	220	22	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
HEXACHLOROBENZENE	0.042	1	0.042	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
HEXACHLOROBUTADIENE	0.26	2.6	0.26	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
HEXACHLOROCYCLOPENTADIENE	2.2	50	2.2	4.63 U	5 U	5 U	4.9 U	5 U
HEXACHLOROETHANE	0.51	5.1	0.51	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
INDENO(1,2,3-CD)PYRENE	0.029	0.29	0.029	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
ISOPHORONE	67	670	67	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
NAPHTHALENE	0.14	1.4	0.14	0.0844 J	0.09 J	0.0545 J	**0.169 J**	**0.157 J**
NITROBENZENE	0.12	1.2	0.12	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
N-NITROSO-DI-N-PROPYLAMINE	0.0093	0.093	0.0093	0.463 U	0.5 U	0.5 U	0.49 U	0.5 U

APPENDIX C.4

GROUNDWATER SAMPLE RESULTS - ROUND 2
SWMU 25 HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

LOCATION	RSL	IDEM	MIN	25MW01		25MW02	25MW03	25MWT06
SAMPLE ID				25MW718102	25MW718102-D	25MW728102	25MW738102	25MWT1061202
SAMPLE DATE				20121101	20121101	20121101	20121101	20121031
SAMPLE CODE				ORIG	DUP	NORMAL	NORMAL	NORMAL
MATRIX				GW	GW	GW	GW	GW
SAMPLE TYPE				NORMAL	NORMAL	NORMAL	NORMAL	NORMAL
SUBMATRIX				NA	NA	NA	NA	NA
TOP DEPTH				-9999	-9999	-9999	-9999	-9999
BOTTOM DEPTH				-9999	-9999	-9999	-9999	-9999
N-NITROSODIPHENYLAMINE	10	100	10	2.31 U	2.5 U	2.5 U	2.45 U	2.5 U
PENTACHLOROPHENOL	0.035	1	0.035	0.926 U	1 UJ	1 U	0.98 UR	1 U
PHENANTHRENE	8.7	NC	8.7	0.185 U	0.2 U	0.2 U	0.196 U	0.2 U
PHENOL	450	4500	450	2.31 U	2.5 UJ	2.5 U	2.45 UR	2.5 U
PYRENE	8.7	87	8.7	0.0926 U	0.1 U	0.1 U	0.098 U	0.1 U
FIELD PARAMETERS								
TEMPERATURE (C)	NC	NC	NC	9.9	NA	14.7	15.1	11.2
DISSOLVED OXYGEN (MG/L)	NC	NC	NC	6.2	NA	10.6	2.84	4.63
SPECIFIC CONDUCTANCE (MS/CM)	NC	NC	NC	1.59	NA	0.001	0.604	0.532
OXIDATION REDUCTION POTENTIAL (MV)	NC	NC	NC	-8	NA	108	100	2
TURBIDITY (NTU)	NC	NC	NC	2.6	NA	270	388	23
PH (S.U.)	NC	NC	NC	7.1	NA	7.2	7.4	7.22

APPENDIX D

DATA QUALITY REVIEW

APPENDIX D. DATA VALIDATION PROCESS AND DATA QUALITY REVIEW

This section contains a description of the data review processes used to determine whether analytical laboratory data were of acceptable technical quality for use in decision making. The review began with data validation, which is a comparison of data quality indicators (DQIs) against prescribed acceptance criteria. The DQIs used are measures to assess the bias and precision of the analytical calibrations and sample analyses. The output of this review was a set of alphabetic flags such as ”U,” “J,” “R,” or combinations thereof, that may have been assigned to individual results based on the validation effort. These flags were used to infer the general quality of the data and if data quality meets the data quality objectives (DQOs) of the project. The DQOs are presented in the Sampling and Analysis Plan for SWMU 25 – HIGHWAY 58 DUMP SITE A (April 2011). Also evaluated were the measures of data completeness, sensitivity, comparability and representativeness.

Data Validation Process

In accordance with Navy requirements for this project, Tetra Tech performed a full data validation on 100 percent of analytical laboratory results. Sample data validation generally followed the guidelines presented in EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (1999) and EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Validation (2004).

Data validation specifications require assignment of data qualifiers in response to various data deficiencies. Validation specifications also require data qualifiers be applied to results that are reported as being less than the detection limit. The flags used for data qualification are as follows:

U –The analytical method could not detect the analyte at the sample specific detection limit. This qualifier is also added to a result (reported by the laboratory) if the detected concentration is determined to be attributable to contamination introduced during field sampling or laboratory analysis.

UJ – The analytical method could not detect the analyte at the sample specific detection limit; however, the sample-specific detection limit may be inaccurate or imprecise based on validation review criteria. The associated numerical detection limit may be inaccurate or imprecise.

J –The chemical was present; however, the associated numerical result is not a precise representation of the concentration that is actually present in the sample. The laboratory reported concentration is an estimate of the true concentration.

UR – Indicates that the chemical may or may not be present. The non-detected analytical result reported by the laboratory may be unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies (i.e., holding times missed by a factor of two or more times the specified time limit, severe calibration non-compliances, and extremely low quality control recoveries).

R – The result is unusable. The positive analytical result reported by the laboratory is unreliable and unusable. The application of this qualifier is for cases of gross technical deficiencies.

The preceding data qualifiers categorize data as indicative of major or minor problems. Major problems result in the rejection of data and qualification with UR or R data validation qualifiers. Minor problems result in the estimation of data, and qualification with U, J, and UJ data validation qualifiers. It is noteworthy that a U qualifier does not necessarily indicate that a data deficiency exists because all non-detect values are flagged with the U qualifier regardless of whether a quality deficiency has been detected.

When data are qualified or rejected a data qualifier code is associated with the data by Tetra Tech. The qualifier codes used for validation are as follows:

A = Lab Blank Contamination
B = Field Blank Contamination
C = Calibration Noncompliance (i.e., % RSDs, %Ds, ICVs, CCVs, RRFs, etc.)
C01 = GC/MS Tuning Noncompliance
D = MS/MSD Recovery Noncompliance
E = LCS/LCSD Recovery Noncompliance
F = Lab Duplicate Imprecision
G = Field Duplicate Imprecision
H = Holding Time Exceedance
I = ICP Serial Dilution Noncompliance
J = ICP PDS Recovery Noncompliance; MSA's $r < 0.995$
K = ICP Interference - includes ICS % R Noncompliance
L = Instrument Calibration Range Exceedance
M = Sample Preservation Noncompliance
N = Internal Standard Noncompliance
N01 = Internal Standard Recovery Noncompliance Dioxins
N02 = Recovery Standard Noncompliance Dioxins
N03 = Clean-up Standard Noncompliance Dioxins
O = Poor Instrument Performance (i.e., base-line drifting)
P = Uncertainty near detection limit (<2 x IDL for inorganics and <CRDL for organics)
Q = Other problems (can encompass a number of issues; i.e., chromatography, interferences, etc.)
R = Surrogates Recovery Noncompliance

S = Pesticide/PCB Resolution
T = % Breakdown Noncompliance for DDT and Endrin
U = % Difference between columns/detectors >40% for positive results determined via GC/HPLC
V = Non-linear calibrations; correlation coefficient r < 0.995
W = EMPC result
X = Signal to noise response drop
Y = Percent solids <30%
Z = Uncertainty at 2 sigma deviation is greater than sample activity
Z1 = Tentatively Identified Compound considered presumptively present
Z2 = Tentatively Identified Compound column bleed

Data Validation Outputs

After data were validated, a list was developed of non-conformities requiring data qualifier flags that were used to alert the data user to inaccurate or imprecise data. For situations in which several QC criteria were out of specification, the data validator made professional judgments and or comments on the validity of the overall data package. The reviewer then prepared a technical memorandum presenting qualification of the data, if necessary, and the rationale for making such qualifications. The net result was a data package that had been carefully reviewed for its adherence to prescribed technical requirements. Pertinent quality estimates are summarized in a more quantitative format in the following section.

Data Quality Review

Some of the DQIs are generated from analysis of field samples (e.g., field duplicates) and some are generated from the analysis of laboratory samples (e.g., laboratory duplicates). Individually, field and laboratory DQIs provide measures of the performance of the respective investigative operations (field or laboratory). If individual QC results were acceptable, there was no assignment of validation flags to an analytical result; otherwise, there was assignment of a flag indicating the type of QC deficiency to the result as presented in Table 1. Table 2 summarizes the rejected data points, along with the assigned qualifiers, qualifier codes, and the reasons for the rejections. The rejected data are not acceptable for performing risk assessments. These tabulations do not include results for groundwater samples collected during Round 1 from wells 25MW04 and 25MW04 because the samples were very turbid and not representative of groundwater conditions. The results for the turbid samples are considered not to be useful for site characterization or risk assessment because the samples, themselves, were not valid samples. Installation of well 25MTW06 in 2012 provided data necessary to characterize the portion of the site intended to be represented by wells 25MW04 and 25MW05.

Completeness

Completeness is a measure of the number of valid samples or measurements that are available relative to the number of samples or measurements that were intended to be generated. For this project, completeness was measured on two different bases: samples collected and laboratory measurements.

- Sample completeness was a measure of the usable samples collected as compared to those intended to be collected.

- Laboratory measurement completeness was a measure of the amount of usable, valid laboratory measurements per matrix obtained for each target analyte.

Usable, valid samples (or results) were those judged, after data assessment, to represent the sampling populations and to have not been disqualified for use through data validation or additional data review. Completeness was determined using the following equation:

$$\%C = \frac{V}{T} \text{ x } 100$$

where	%C	=	percent completeness
	V	=	number of samples (or results) determined to be valid
	T	=	total number of planned samples (or results)

The percent completeness for sample collection for the SWMU 25 – HIGHWAY 58 DUMP SITE A project was 100 because all samples that could be collected were collected. The laboratory completeness is presented in Table 3. The nondetected results for semivolatile compounds 1-1-biphenyl, benzaldehyde, and caprolactam in 7 soil samples were rejected because of calibration response factors of less than 0.05. This indicates that the analytical sensitivity was low for these compounds, therefore the ability to detect these compounds was limited. The nondetected results for compounds 1-1-biphenyl, benzaldehyde, and caprolactam were also rejected because of calibration response factors of less than 0.05 and laboratory control sample (LCS) recovery noncompliances in all aqueous samples. LCS recovery is a measure of how well the target analtyes can be recovered from a smaple matrix under ideal conditions. If recovery is low, the potential for detecting and quantifying the affected compounds is compromised. These semivolatile compounds are known calibration poor responders, however, and have no history of being released at the SWMU 25 – HIGHWAY 58 DUMP SITE A; therefore the rejected data not do not have a significant impact on data quality for this project. The nondetected results for the compound acetophenone were rejected in all aqueous and soil samples because of matrix spike (MS) and LCS recoveries less than 10%. Acetophenone has no history of being released at the SWMU 25 –

HIGHWAY 58 DUMP SITE A and the toxicity of this compound is low compared to many other potentially site-related organic compounds; therefore the rejected data do not have a significant impact on data quality. The nondetected phenolic acid compounds for three aqueous samples were rejected because of MS and surrogate recoveries less than 10%. This is in indication that concentrations of the affected compunds in groundwater could be greater than the reported concentrations. Phenolic compounds were not detected in any soil samples and were detected in just one aqueous sample at a concentration of 2.2 ug/L. The soil was a potential source of groundwater contamination at SWMU 25 but all contmianted soil has been removed. There are no known or suspected sources of groundwater contamiantion remaining. If phenolic compunds are not detectable in soil, there is a very low potential for them to be present in groundwater. Therefore, the rejection of the phenolic compounds for groundwater sampels does not have a significant impact on data quality.

Sensitivity

Analytical sensitivity was generally satisfactory to meet DQOs presented in the Sampling and Analysis Plan for SWMU 25 – HIGHWAY 58 DUMP SITE A (April 2011). It was known at the start of the project, however, that the laboratory could not meet the screening level limits for several analytes. The laboratory reported the nondetected results down the limit of detection (LOD) in order to meet the Project Action Limits (PALs) for as many analytes as possible. Tables 4 and 5 present the ranges of nondetected values for analytes that did not meet the screening level limits for aqueous and soil samples, respectively. The range and number of exceedances are not considered excessive and should not have an impact on the quality of the data, although there is some uncertainty associated with estimating risks when analytical sensitivity is not sufficient to measure analyte concentrations as low as the screening levels.

The following are reasons other than the analytical sensitivity that can cause a nondetected result to exceed the screening level limits.

1. Laboratory or field blank contamination can cause the LOD to be raised to exceed screening level limits.
2. Percent moisture in soil samples can cause the adjusted LOD to exceed screening level limits.
3. Sample dilution due to concentrations greater than the calibration range of the instrument or due to matrix interference can raise the LOD to above the screening level limits.

The risk assessments presented in Sections 7 and 8 describe the significance, if any that the nondetected excedances of the screening level limits have upon the data set.

Laboratory Accuracy

Accuracy in the laboratory is measured through the comparison of a laboratory control sample (LCS) result to a known or calculated value and is expressed as a percent recovery (%R). Surrogates and internal standards assess accuracy in organic methods. LCSs assess the accuracy of laboratory operations with minimal sample matrix effects. Surrogate compound analyses measure the combined accuracy effects of the sample matrix, sample preparation, and sample measurement. Internal standards, added after preparation, are for sample quantitation. Laboratory accuracy is determined by comparing calculated percent recoveries to accuracy control limits specified by the laboratory using the appropriate analytical method.

Percent recovery is calculated using the following equation:

$$\%R = \frac{Ss - So}{S} \times 100$$

where	%R	=	percent recovery
	Ss	=	result of spiked sample
	So	=	result of non-spiked sample
	S	=	concentration of spiked amount.

Table 1 shows that some soil and groundwater results were qualified because of blank contamination, matrix spike, LCS, surrogate, internal standard, ICP serial dilution, or calibration noncompliances. The noncompliances in general do not show any directional bias trends within the data sets. Overall, the laboratory accuracy was acceptable and the amount of data qualified is not considered excessive. There were no quality control deficiencies noted for field accuracy.

Laboratory Precision

Precision is a measure of the degree to which two or more measurements are in agreement and describes the reproducibility of measurements of the same parameter for samples analyzed under similar conditions.

Precision for chemical parameters is expressed as a Relative Percent Difference (RPD), which is defined as the ratio of the difference to the mean for the two values being evaluated. RPDs, typically expressed as percentages, are used to evaluate both field and laboratory duplicate precision and are calculated as follows:

$$RPD = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where RPD = relative percent difference

V1, V2 = two results obtained by analyzing duplicate samples

The precision estimates obtained from duplicate field samples encompass the combined uncertainty associated with sample collection, homogenization, splitting, handling, laboratory and field storage (as applicable), preparation for analysis, and analysis. In contrast, precision estimates obtained from analyzing duplicate laboratory samples incorporate only homogenization, subsampling, preparation for analysis, laboratory storage (if applicable), and analysis uncertainties.

Laboratory duplicate imprecision did not result in any qualification of the data. Table 1 shows that aqueous and soil results were qualified as estimated values for some samples because of field duplicate imprecision for aluminum, arsenic, barium, beryillum, cadmium, cobalt, lead, manganese, nickel, vanadium, and zinc. The precision noncompliances in general do not show any trends within the data sets. Overall, the laboratory precision was acceptable and the amount of data qualified is not considered excessive. Nevertheless, the potential for uncertainty greater than anticipated should be considered when using these data.

Comparability

Comparability is defined as the confidence with which one data set can be compared with another (e.g., among sampling points and among sampling events). Comparability was achieved by using standardized sampling and analysis methods, as well as standardized data reporting formats. Comparability of laboratory measurements was achieved primarily through the use and documentation of standard sampling and analytical methods. Results were reported in units that ensured comparability with previous data. Comparability of laboratory measurements was assessed primarily through the use of QC samples and through adherence to the Sampling and Analysis Plan for SWMU 25 – HIGHWAY 58 DUMP SITE A (April 2011).

Representativeness

Representativeness is an expression of the degree to which data accurately and precisely depict the actual characteristics of a population or environmental condition existing at the site.

The Sampling and Analysis Plan for SWMU 25 – HIGHWAY 58 DUMP SITE A (April 2011) and the use of standardized sampling, sample handling, sample analysis, and data reporting procedures were designed

so that the final data would be accurate representations of actual site conditions. It is believed that all reported data are adequately representative of site conditions and intended populations. Data for non-respresentative groundwater samples were excluded from the site characterization and risk assessment data sets.

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25GW718101	ALUMINUM	61	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW718101	ANTIMONY	1	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW718101	ARSENIC	1.2	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW718101	CADMIUM	0.44	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW718101	CHROMIUM	0.57	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW718101	COPPER	1.8	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW718101	MANGANESE	6100	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW718101	NICKEL	54	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW718101	SELENIUM	1	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW718101	SILVER	0.5	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW718101	THALLIUM	0.29	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW718101	VANADIUM	0.2	UG/L	UJ	G	FIELD DUPLICATE IMPRECISION
25GW718101	2-CHLORONAPHTHALENE	1	UG/L	UJ	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25GW718101	3,3'-DICHLOROBENZIDINE	10	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25GW718101	BENZO(B)FLUORANTHENE	0.2	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW718101	DI-N-BUTYL PHTHALATE	0.24	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW718101	HEXACHLOROCYCLOPENTADIENE	2.5	UG/L	UJ	CDE	CALIBRATION, MATRIX SPIKE, AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW718101	ISOPHORONE	1	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW728101	ALUMINUM	39	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW728101	ANTIMONY	1	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	ARSENIC	1.5	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	BARIUM	9.3	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	CHROMIUM	0.5	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	COPPER	1.4	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	LEAD	0.32	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	MANGANESE	1400	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW728101	NICKEL	49	UG/L	J	G	FIELD DUPLICATE IMPRECISION

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25GW728101	SILVER	0.5	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	VANADIUM	0.27	UG/L	J	GP	FIELD DUPLICATE IMPRECISION AND UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	ZINC	17	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	ALUMINUM	1.7	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	ANTIMONY	0.4	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	ARSENIC	0.41	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	BARIUM	8	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	CADMIUM	0.35	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	CHROMIUM	3.9	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	COPPER	0.91	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	LEAD	0.2	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	VANADIUM	1	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	ZINC	16	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW728101	2,2'-OXYBIS(1-CHLOROPROPANE)	0.43	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25GW728101	3,3'-DICHLOROBENZIDINE	10	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW728101	BENZO(B)FLUORANTHENE	0.2	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW728101	DI-N-BUTYL PHTHALATE	0.28	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW728101	HEXACHLOROCYCLOPENTADIENE	2.5	UG/L	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW728101	ISOPHORONE	1	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW728101	PENTACHLOROPHENOL	2.5	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW728101	PHENOL	0.5	UG/L	UJ	E	LABORATORY CONTROL SAMPLE RECOVERY
25GW738101	ALUMINUM	190	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW738101	CADMIUM	0.24	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW738101	CHROMIUM	1.8	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW738101	MANGANESE	810	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW738101	NICKEL	9.2	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW738101	VANADIUM	2.9	UG/L	J	G	FIELD DUPLICATE IMPRECISION
25GW738101	ZINC	7.4	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25GW738101	ALUMINUM	4.3	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW738101	CADMIUM	0.2	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW738101	CHROMIUM	2.6	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW738101	COPPER	0.61	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW738101	LEAD	0.2	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW738101	VANADIUM	0.89	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW738101	ZINC	2.2	UG/L	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25GW738101	3,3'-DICHLOROBENZIDINE	10	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW738101	BENZO(B)FLUORANTHENE	0.2	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW738101	DI-N-BUTYL PHTHALATE	0.21	UG/L	U	A	LABORATORY BLANK CONTAMINATION
25GW738101	HEXACHLOROCYCLOPENTADIENE	2.5	UG/L	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW738101	ISOPHORONE	1	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW738101	PENTACHLOROPHENOL	2.5	UG/L	UJ	C	CALIBRATION NONCOMPLIANCE
25GW738101	PHENOL	0.5	UG/L	UJ	E	LABORATORY CONTROL SAMPLE RECOVERY

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0010206	ALUMINUM	11000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0010206	ANTIMONY	63	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0010206	ARSENIC	5900	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0010206	BARIUM	28000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0010206	CADMIUM	270	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0010206	COBALT	2200	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0010206	IRON	22000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0010206	MANGANESE	94000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0010206	MERCURY	23	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0010206	SILVER	42	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0010206	THALLIUM	140	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0010206	ZINC	20000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0010206	1,1-BIPHENYL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	2,4-DINITROPHENOL	390	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0010206	3,3'-DICHLOROBENZIDINE	390	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	3-NITROANILINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	4,6-DINITRO-2-METHYLPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	4-NITROANILINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	ACENAPHTHYLENE	7.9	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	BENZALDEHYDE	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	BIS(2-ETHYLHEXYL)PHTHALATE	24	UG/KG	J	CP	CALIBRATION NONCOMPLIANCE AND UNCERTAINTY NEAR DETECTION LIMIT
25SB0010206	CARBAZOLE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	DIETHYL PHTHALATE	16	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0010206	HEXACHLOROCYCLOPENTADIENE	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0010206	PENTACHLOROPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	ALUMINUM	4700000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0030206	ANTIMONY	150	UG/KG	U	A	LABORATORY BLANK CONTAMINATION

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0030206	ARSENIC	2600	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0030206	BARIUM	49000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0030206	BERYLLIUM	370	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0030206	CADMIUM	190	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0030206	COBALT	2100	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0030206	IRON	8000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0030206	MANGANESE	110000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0030206	MERCURY	16	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0030206	SILVER	63	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0030206	ZINC	15000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0030206	1,1-BIPHENYL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	2,4-DINITROPHENOL	390	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0030206	3,3'-DICHLOROBENZIDINE	390	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	3-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0030206	4,6-DINITRO-2-METHYLPHENOL	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	4-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	ACENAPHTHYLENE	7.8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	BENZALDEHYDE	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	BIS(2-ETHYLHEXYL)PHTHALATE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	CARBAZOLE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	HEXACHLOROCYCLOPENTADIENE	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	ISOPHORONE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0030206	PENTACHLOROPHENOL	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	ALUMINUM	12000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0040206	ANTIMONY	150	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0040206	ARSENIC	5000	UG/KG	J	GI	FIELD DUPLICATE IMPRECISION AND ICP SERIAL DILUTION NONCOMPLIANCE
25SB0040206	BARIUM	55000	UG/KG	J	DG	MATRIX SPIKE RECOVERY NONCOMPLIANCE AND FIELD DUPLICATE IMPRECISION

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0040206	BERYLLIUM	400	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0040206	CADMIUM	230	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0040206	COBALT	4400	UG/KG	J	DG	MATRIX SPIKE RECOVERY NONCOMPLIANCE AND FIELD DUPLICATE IMPRECISION
25SB0040206	IRON	32000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0040206	LEAD	15000	UG/KG	J	G	FIELD DUPLICATE IMPRECISION
25SB0040206	MANGANESE	390000	UG/KG	J	GI	FIELD DUPLICATE IMPRECISION AND ICP SERIAL DILUTION NONCOMPLIANCE
25SB0040206	MERCURY	39	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0040206	SILVER	61	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0040206	THALLIUM	130	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0040206	ZINC	26000	UG/KG	J	DG	MATRIX SPIKE RECOVERY NONCOMPLIANCE AND FIELD DUPLICATE IMPRECISION
25SB0040206	1,1-BIPHENYL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0040206	2,4-DINITROPHENOL	390	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0040206	3,3'-DICHLOROBENZIDINE	390	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	3-NITROANILINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	4,6-DINITRO-2-METHYLPHENOL	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	4-NITROANILINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	ACENAPHTHYLENE	7.8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	BENZALDEHYDE	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	BIS(2-ETHYLHEXYL)PHTHALATE	19	UG/KG	J	CP	CALIBRATION NONCOMPLIANCE AND UNCERTAINTY NEAR DETECTION LIMIT
25SB0040206	CARBAZOLE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	HEXACHLOROCYCLOPENTADIENE	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040206	PENTACHLOROPHENOL	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	ALUMINUM	5400000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0040610	ANTIMONY	280	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0040610	ARSENIC	10000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0040610	BARIUM	31000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0040610	COBALT	2800	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0040610	IRON	18000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0040610	MANGANESE	140000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0040610	MERCURY	16	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0040610	SELENIUM	560	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0040610	SILVER	55	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0040610	THALLIUM	86	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0040610	ZINC	39000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0040610	1,1-BIPHENYL	180	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	2,4-DINITROPHENOL	380	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0040610	3,3'-DICHLOROBENZIDINE	380	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0040610	3-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	4,6-DINITRO-2-METHYLPHENOL	94	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	4-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	ACENAPHTHYLENE	7.6	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	BENZALDEHYDE	180	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	BIS(2-ETHYLHEXYL)PHTHALATE	33	UG/KG	J	CP	CALIBRATION NONCOMPLIANCE AND UNCERTAINTY NEAR DETECTION LIMIT
25SB0040610	CARBAZOLE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	HEXACHLOROCYCLOPENTADIENE	94	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	ISOPHORONE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0040610	PENTACHLOROPHENOL	94	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	ALUMINUM	7000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0050206	ANTIMONY	86	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0050206	ARSENIC	14000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0050206	BARIUM	49000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0050206	COBALT	9900	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0050206	IRON	29000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0050206	MANGANESE	440000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0050206	MERCURY	16	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0050206	SELENIUM	600	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0050206	SILVER	53	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0050206	THALLIUM	140	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0050206	ZINC	41000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0050206	1,1-BIPHENYL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	2,4-DINITROPHENOL	390	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0050206	3,3'-DICHLOROBENZIDINE	390	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	3-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	4,6-DINITRO-2-METHYLPHENOL	96	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	4-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0050206	ACENAPHTHYLENE	7.8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	BENZALDEHYDE	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	BIS(2-ETHYLHEXYL)PHTHALATE	300	UG/KG	J	C	CALIBRATION NONCOMPLIANCE
25SB0050206	CARBAZOLE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	HEXACHLOROCYCLOPENTADIENE	96	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	ISOPHORONE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0050206	PENTACHLOROPHENOL	96	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	ALUMINUM	7800000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0060206	ANTIMONY	86	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0060206	ARSENIC	5800	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0060206	BARIUM	66000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0060206	CADMIUM	210	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0060206	COBALT	9100	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0060206	IRON	17000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0060206	MANGANESE	530000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0060206	MERCURY	21	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0060206	SELENIUM	370	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0060206	SILVER	38	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0060206	THALLIUM	120	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0060206	ZINC	25000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0060206	1,1-BIPHENYL	200	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	2,4-DINITROPHENOL	420	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0060206	3,3'-DICHLOROBENZIDINE	420	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	3-NITROANILINE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	4,6-DINITRO-2-METHYLPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	4-NITROANILINE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	ACENAPHTHYLENE	8.4	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	BENZALDEHYDE	200	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	BIS(2-ETHYLHEXYL)PHTHALATE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0060206	CARBAZOLE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	HEXACHLOROCYCLOPENTADIENE	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	ISOPHORONE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060206	PENTACHLOROPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	ALUMINUM	4700000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0060610	ARSENIC	9500	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0060610	BARIUM	19000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0060610	CADMIUM	150	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0060610	COBALT	1000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0060610	IRON	6200000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0060610	MANGANESE	82000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0060610	MERCURY	9	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0060610	SELENIUM	380	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0060610	SILVER	46	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0060610	THALLIUM	100	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0060610	ZINC	12000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0060610	1,1-BIPHENYL	180	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	2,4-DINITROPHENOL	370	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0060610	3,3'-DICHLOROBENZIDINE	370	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	3-NITROANILINE	18	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	4,6-DINITRO-2-METHYLPHENOL	92	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	4-NITROANILINE	18	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	ACENAPHTHYLENE	7.4	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	BENZALDEHYDE	180	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	BIS(2-ETHYLHEXYL)PHTHALATE	18	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	CARBAZOLE	18	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	HEXACHLOROCYCLOPENTADIENE	92	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	ISOPHORONE	18	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0060610	PENTACHLOROPHENOL	92	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0070206	ALUMINUM	7800000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0070206	ANTIMONY	62	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0070206	ARSENIC	14000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0070206	BARIUM	33000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0070206	CADMIUM	190	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0070206	COBALT	4500	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0070206	IRON	55000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0070206	MANGANESE	200000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0070206	MERCURY	9	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0070206	SELENIUM	870	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0070206	SILVER	40	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0070206	THALLIUM	170	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0070206	ZINC	41000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0070206	1,1-BIPHENYL	200	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0070206	2,4-DINITROPHENOL	420	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0070206	3,3'-DICHLOROBENZIDINE	420	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	3-NITROANILINE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	4,6-DINITRO-2-METHYLPHENOL	110	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	4-NITROANILINE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	ACENAPHTHYLENE	8.5	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	BENZALDEHYDE	200	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	BIS(2-ETHYLHEXYL)PHTHALATE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	CARBAZOLE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	HEXACHLOROCYCLOPENTADIENE	110	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	ISOPHORONE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070206	PENTACHLOROPHENOL	110	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	ALUMINUM	4800000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0070610	ANTIMONY	120	UG/KG	U	A	LABORATORY BLANK CONTAMINATION

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0070610	ARSENIC	3600	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0070610	BARIUM	380000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0070610	CADMIUM	230	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0070610	COBALT	23000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0070610	IRON	1.3E+08	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0070610	MANGANESE	2600000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0070610	SELENIUM	570	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0070610	SILVER	120	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0070610	THALLIUM	270	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0070610	ZINC	110000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SB0070610	1,1-BIPHENYL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	2,4-DINITROPHENOL	400	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0070610	3,3'-DICHLOROBENZIDINE	400	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	3-NITROANILINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0070610	4,6-DINITRO-2-METHYLPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	4-NITROANILINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	ACENAPHTHYLENE	8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	BENZALDEHYDE	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	BIS(2-ETHYLHEXYL)PHTHALATE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	CARBAZOLE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	HEXACHLOROCYCLOPENTADIENE	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0070610	PENTACHLOROPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	ALUMINUM	6300000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0080206	ANTIMONY	330	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0080206	ARSENIC	13000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0080206	BERYLLIUM	400	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0080206	IRON	13000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SB0080206	MANGANESE	84000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE

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QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0080206	MERCURY	26	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0080206	SELENIUM	630	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0080206	SILVER	26	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0080206	THALLIUM	170	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0080206	1,1-BIPHENYL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	2,4-DINITROPHENOL	390	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0080206	3,3'-DICHLOROBENZIDINE	390	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	3-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	4,6-DINITRO-2-METHYLPHENOL	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	4-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	ACENAPHTHYLENE	7.8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	BENZALDEHYDE	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	BIS(2-ETHYLHEXYL)PHTHALATE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	CARBAZOLE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0080206	HEXACHLOROCYCLOPENTADIENE	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	ISOPHORONE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080206	PENTACHLOROPHENOL	97	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080610	ANTIMONY	86	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SB0080610	MERCURY	25	UG/KG	J	DP	MATRIX SPIKE RECOVERY NONCOMPLIANCE AND UNCERTAINTY NEAR DETECTION LIMIT
25SB0080610	SELENIUM	420	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0080610	THALLIUM	120	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SB0080610	2,4-DINITROPHENOL	390	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080610	3,3'-DICHLOROBENZIDINE	390	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080610	4,6-DINITRO-2-METHYLPHENOL	98	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080610	4-NITROPHENOL	390	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080610	ACENAPHTHYLENE	7.9	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080610	HEXACHLOROCYCLOPENTADIENE	98	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SB0080610	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SB0080610	PENTACHLOROPHENOL	98	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	ALUMINUM	20000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0010002	ANTIMONY	190	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0010002	ARSENIC	9600	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0010002	BARIUM	87000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0010002	COBALT	6400	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0010002	IRON	29000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0010002	MANGANESE	310000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0010002	SELENIUM	540	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0010002	SILVER	77	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0010002	THALLIUM	300	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0010002	ZINC	58000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0010002	1,1-BIPHENYL	200	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	2,4-DINITROPHENOL	420	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0010002	3,3'-DICHLOROBENZIDINE	420	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	3-NITROANILINE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	4,6-DINITRO-2-METHYLPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	4-NITROANILINE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	ACENAPHTHYLENE	8.4	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	BENZALDEHYDE	200	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	BIS(2-ETHYLHEXYL)PHTHALATE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	CARBAZOLE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	HEXACHLOROCYCLOPENTADIENE	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	ISOPHORONE	21	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0010002	PENTACHLOROPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	ALUMINUM	11000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0020002	ANTIMONY	160	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0020002	ARSENIC	4700	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0020002	BARIUM	65000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0020002	COBALT	10000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0020002	IRON	17000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0020002	MANGANESE	510000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0020002	MERCURY	34	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0020002	SELENIUM	540	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0020002	SILVER	52	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0020002	THALLIUM	170	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0020002	ZINC	43000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0020002	1,1-BIPHENYL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	2,4-DINITROPHENOL	400	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0020002	3,3'-DICHLOROBENZIDINE	400	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	3-NITROANILINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	4,6-DINITRO-2-METHYLPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	4-NITROANILINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0020002	ACENAPHTHYLENE	8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	BENZALDEHYDE	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	BIS(2-ETHYLHEXYL)PHTHALATE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	CARBAZOLE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	HEXACHLOROCYCLOPENTADIENE	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0020002	PENTACHLOROPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	ALUMINUM	10000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0030002	ANTIMONY	71	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0030002	ARSENIC	9300	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0030002	BARIUM	52000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0030002	CADMIUM	240	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0030002	COBALT	4700	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0030002	IRON	27000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0030002	MANGANESE	200000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0030002	MERCURY	6	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0030002	SELENIUM	370	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0030002	SILVER	33	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0030002	THALLIUM	150	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0030002	ZINC	38000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0030002	1,1-BIPHENYL	370	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	2,4-DINITROPHENOL	770	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0030002	3,3'-DICHLOROBENZIDINE	770	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	3-NITROANILINE	39	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	4,6-DINITRO-2-METHYLPHENOL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	4-NITROANILINE	39	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	ACENAPHTHYLENE	30	UG/KG	J	C	CALIBRATION NONCOMPLIANCE
25SS0030002	BENZALDEHYDE	370	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	BIS(2-ETHYLHEXYL)PHTHALATE	39	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0030002	CARBAZOLE	39	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	HEXACHLOROCYCLOPENTADIENE	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	ISOPHORONE	39	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0030002	PENTACHLOROPHENOL	190	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	ALUMINUM	5200000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0040002	ANTIMONY	93	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0040002	ARSENIC	4200	UG/KG	J	GI	FIELD DUPLICATE IMPRECISION AND ICP SERIAL DILUTION NONCOMPLIANCE
25SS0040002	BARIUM	28000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0040002	BERYLLIUM	360	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0040002	CADMIUM	230	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0040002	COBALT	1900	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0040002	IRON	8200000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0040002	MANGANESE	110000	UG/KG	J	GI	FIELD DUPLICATE IMPRECISION AND ICP SERIAL DILUTION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0040002	MERCURY	16	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0040002	SILVER	40	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0040002	THALLIUM	110	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0040002	ZINC	24000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0040002	1,1-BIPHENYL	180	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	2,4-DINITROPHENOL	380	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0040002	3,3'-DICHLOROBENZIDINE	380	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	3-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	4,6-DINITRO-2-METHYLPHENOL	95	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	4-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	ACENAPHTHYLENE	7.7	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	BENZALDEHYDE	180	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	BIS(2-ETHYLHEXYL)PHTHALATE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	CARBAZOLE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0040002	HEXACHLOROCYCLOPENTADIENE	95	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	ISOPHORONE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0040002	PENTACHLOROPHENOL	95	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0050002	ALUMINUM	6500000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0050002	ANTIMONY	260	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0050002	ARSENIC	23000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0050002	BARIUM	67000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0050002	COBALT	9400	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0050002	IRON	38000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0050002	MANGANESE	590000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0050002	MERCURY	30	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0050002	SELENIUM	480	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0050002	SILVER	120	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0050002	THALLIUM	140	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0050002	ZINC	81000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0050002	2,4-DINITROPHENOL	400	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0050002	3,3'-DICHLOROBENZIDINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0050002	4,6-DINITRO-2-METHYLPHENOL	8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0050002	4-NITROPHENOL	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0050002	ACENAPHTHYLENE	12	UG/KG	J	C	CALIBRATION NONCOMPLIANCE
25SS0050002	BIS(2-ETHYLHEXYL)PHTHALATE	20	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0050002	BUTYL BENZYL PHTHALATE	8	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0050002	CARBAZOLE	8	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0050002	DI-N-BUTYL PHTHALATE	11	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0050002	DIETHYL PHTHALATE	8	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0050002	HEXACHLOROCYCLOPENTADIENE	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0050002	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0050002	PENTACHLOROPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0060002	ALUMINUM	9500000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0060002	ANTIMONY	200	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0060002	ARSENIC	8900	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0060002	BARIUM	79000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0060002	COBALT	18000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0060002	IRON	19000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0060002	MANGANESE	960000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0060002	MERCURY	9.5	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0060002	SELENIUM	550	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0060002	SILVER	98	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0060002	THALLIUM	190	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0060002	ZINC	41000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0060002	2,4-DINITROPHENOL	400	UG/KG	UJ	E	LABORATORY CONTROL SAMPLE RECOVERY
25SS0060002	3,3'-DICHLOROBENZIDINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0060002	BENZO(A)PYRENE	19	UG/KG	J	N	INTERNAL STANDARD NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0060002	BENZO(B)FLUORANTHENE	30	UG/KG	J	CN	CALIBRATION AND INTERNAL STANDARD RECOVERY NONCOMPLIANCE
25SS0060002	BENZO(G,H,I)PERYLENE	8	UG/KG	UJ	N	INTERNAL STANDARD NONCOMPLIANCE
25SS0060002	BENZO(K)FLUORANTHENE	13	UG/KG	J	N	INTERNAL STANDARD NONCOMPLIANCE
25SS0060002	BIS(2-ETHYLHEXYL)PHTHALATE	14	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0060002	DI-N-BUTYL PHTHALATE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0060002	DIBENZO(A,H)ANTHRACENE	20	UG/KG	UJ	N	INTERNAL STANDARD NONCOMPLIANCE
25SS0060002	HEXACHLOROCYCLOPENTADIENE	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0060002	INDENO(1,2,3-CD)PYRENE	40	UG/KG	UJ	N	INTERNAL STANDARD NONCOMPLIANCE
25SS0060002	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0060002	PENTACHLOROPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	ALUMINUM	8900000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0070002	ANTIMONY	150	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0070002	ARSENIC	12000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0070002	BARIUM	61000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0070002	COBALT	10000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0070002	IRON	27000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0070002	MANGANESE	560000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0070002	SELENIUM	640	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0070002	SILVER	33	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0070002	THALLIUM	150	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0070002	ZINC	45000	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0070002	1,1-BIPHENYL	180	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	2,4-DINITROPHENOL	380	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0070002	3,3'-DICHLOROBENZIDINE	380	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	3-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	4,6-DINITRO-2-METHYLPHENOL	96	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	4-NITROANILINE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	ACENAPHTHYLENE	29	UG/KG	J	C	CALIBRATION NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0070002	BENZALDEHYDE	180	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	BIS(2-ETHYLHEXYL)PHTHALATE	35	UG/KG	J	CP	CALIBRATION NONCOMPLIANCE AND UNCERTAINTY NEAR DETECTION LIMIT
25SS0070002	CARBAZOLE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	HEXACHLOROCYCLOPENTADIENE	96	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	ISOPHORONE	19	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0070002	PENTACHLOROPHENOL	96	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0080002	ALUMINUM	15000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0080002	ANTIMONY	550	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0080002	ARSENIC	8900	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0080002	BERYLLIUM	610	UG/KG	J	N	INTERNAL STANDARD NONCOMPLIANCE
25SS0080002	IRON	29000000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0080002	MANGANESE	770000	UG/KG	J	I	ICP SERIAL DILUTION NONCOMPLIANCE
25SS0080002	SELENIUM	750	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0080002	SILVER	42	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0080002	THALLIUM	300	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0080002	ZINC	44000	UG/KG	J	N	INTERNAL STANDARD NONCOMPLIANCE
25SS0080002	2,4-DINITROPHENOL	400	UG/KG	UJ	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0080002	3,3'-DICHLOROBENZIDINE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0080002	4,6-DINITRO-2-METHYLPHENOL	8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0080002	4-NITROPHENOL	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0080002	ACENAPHTHYLENE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0080002	BIS(2-ETHYLHEXYL)PHTHALATE	18	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0080002	HEXACHLOROCYCLOPENTADIENE	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0080002	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0080002	PENTACHLOROPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0090002	ANTIMONY	210	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0090002	BERYLLIUM	730	UG/KG	J	N	INTERNAL STANDARD NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0090002	MERCURY	31	UG/KG	J	DP	MATRIX SPIKE RECOVERY NONCOMPLIANCE AND UNCERTAINTY NEAR DETECTION LIMIT
25SS0090002	SELENIUM	1400	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0090002	SILVER	20	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0090002	THALLIUM	150	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0090002	2,4-DINITROPHENOL	400	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0090002	3,3'-DICHLOROBENZIDINE	400	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0090002	4,6-DINITRO-2-METHYLPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0090002	4-NITROPHENOL	400	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0090002	ACENAPHTHYLENE	8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0090002	HEXACHLOROCYCLOPENTADIENE	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0090002	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0090002	PENTACHLOROPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0100002	ANTIMONY	350	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0100002	BERYLLIUM	340	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0100002	MERCURY	35	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0100002	NICKEL	9500	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0100002	SELENIUM	770	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0100002	SILVER	40	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0100002	THALLIUM	130	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0100002	2,4-DINITROPHENOL	400	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0100002	3,3'-DICHLOROBENZIDINE	400	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0100002	4,6-DINITRO-2-METHYLPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0100002	4-NITROPHENOL	400	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0100002	ACENAPHTHYLENE	8	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0100002	HEXACHLOROCYCLOPENTADIENE	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0100002	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0100002	PENTACHLOROPHENOL	99	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0110002	ANTIMONY	250	UG/KG	U	A	LABORATORY BLANK CONTAMINATION
25SS0110002	BERYLLIUM	570	UG/KG	J	N	INTERNAL STANDARD NONCOMPLIANCE

TABLE 1

QUALIFIED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	QUALIFICATION CODE	REASON FOR QUALIFICATION
25SS0110002	MERCURY	34	UG/KG	J	D	MATRIX SPIKE RECOVERY NONCOMPLIANCE
25SS0110002	SELENIUM	570	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0110002	SILVER	51	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0110002	THALLIUM	170	UG/KG	J	P	UNCERTAINTY NEAR DETECTION LIMIT
25SS0110002	ZINC	41000	UG/KG	J	N	INTERNAL STANDARD NONCOMPLIANCE
25SS0110002	2,4-DINITROPHENOL	410	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0110002	3,3'-DICHLOROBENZIDINE	410	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0110002	4,6-DINITRO-2-METHYLPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0110002	4-NITROPHENOL	410	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0110002	ACENAPHTHYLENE	8.2	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0110002	HEXACHLOROCYCLOPENTADIENE	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0110002	ISOPHORONE	20	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE
25SS0110002	PENTACHLOROPHENOL	100	UG/KG	UJ	C	CALIBRATION NONCOMPLIANCE

TABLE 2

REJECTED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	REJECTION CODE	REASON FOR QUALIFICATION
25GW718101	1,1-BIPHENYL	5	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW718101	2,3,4,6-TETRACHLOROPHENOL	5	UG/L	UR	R	SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	2,4,5-TRICHLOROPHENOL	0.5	UG/L	UR	DR	MATRIX SPIKE AND SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	2,4,6-TRICHLOROPHENOL	0.5	UG/L	UR	DR	MATRIX SPIKE AND SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	2,4-DICHLOROPHENOL	0.5	UG/L	UR	DR	MATRIX SPIKE AND SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	2,4-DIMETHYLPHENOL	1	UG/L	UR	R	SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	2,4-DINITROPHENOL	10	UG/L	UR	R	SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	2-CHLOROPHENOL	0.5	UG/L	UR	DR	MATRIX SPIKE AND SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	2-METHYLPHENOL	0.5	UG/L	UR	R	SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	2-NITROPHENOL	0.5	UG/L	UR	DR	MATRIX SPIKE AND SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	3&4-METHYLPHENOL	1	UG/L	UR	R	SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	4,6-DINITRO-2-METHYLPHENOL	2.5	UG/L	UR	R	SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	4-CHLORO-3-METHYLPHENOL	0.5	UG/L	UR	R	SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	ACETOPHENONE	5	UG/L	UR	DE	MATRIX SPIKE AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE

TABLE 2

REJECTED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	REJECTION CODE	REASON FOR QUALIFICATION
25GW718101	BENZALDEHYDE	10	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW718101	CAPROLACTAM	5	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW718101	PENTACHLOROPHENOL	2.5	UG/L	UR	R	SURROGATE RECOVERY NONCOMPLIANCE
25GW718101	PHENOL	0.5	UG/L	UR	DR	MATRIX SPIKE AND SURROGATE RECOVERY NONCOMPLIANCE
25GW728101	1,1-BIPHENYL	5	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW728101	ACETOPHENONE	5	UG/L	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW728101	BENZALDEHYDE	10	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW728101	CAPROLACTAM	5	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW738101	1,1-BIPHENYL	5	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW738101	ACETOPHENONE	5	UG/L	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25GW738101	BENZALDEHYDE	10	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE

TABLE 2

REJECTED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	REJECTION CODE	REASON FOR QUALIFICATION
25GW738101	CAPROLACTAM	5	UG/L	UR	CE	CALIBRATION AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0010206	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0030206	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0040206	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0040206-D	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0040610	ACETOPHENONE	180	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0050206	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0060206	ACETOPHENONE	200	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0060610	ACETOPHENONE	180	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0070206	ACETOPHENONE	200	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0070610	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0080206	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0080610	1,1-BIPHENYL	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SB0080610	ACETOPHENONE	190	UG/KG	UR	DE	MATRIX SPIKE AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SB0080610	BENZALDEHYDE	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE

TABLE 2

REJECTED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	REJECTION CODE	REASON FOR QUALIFICATION
25SB0080610	CAPROLACTAM	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0010002	ACETOPHENONE	200	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0020002	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0030002	ACETOPHENONE	370	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0040002	ACETOPHENONE	180	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0040002-D	ACETOPHENONE	180	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0050002	1,1-BIPHENYL	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0050002	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0050002	BENZALDEHYDE	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0050002	CAPROLACTAM	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0060002	1,1-BIPHENYL	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0060002	ACETOPHENONE	190	UG/KG	UR	DE	MATRIX SPIKE AND LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0060002	BENZALDEHYDE	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0060002	CAPROLACTAM	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0070002	ACETOPHENONE	180	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0080002	1,1-BIPHENYL	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0080002	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0080002	BENZALDEHYDE	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0080002	CAPROLACTAM	20	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE

TABLE 2

REJECTED DATA
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

SAMPLE NUMBER	PARAMETER	SAMPLE RESULT	UNITS	VALIDATION QUALIFER	REJECTION CODE	REASON FOR QUALIFICATION
25SS0090002	1,1-BIPHENYL	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0090002	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0090002	BENZALDEHYDE	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0090002	CAPROLACTAM	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0100002	1,1-BIPHENYL	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0100002	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0100002	BENZALDEHYDE	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0100002	CAPROLACTAM	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0110002	1,1-BIPHENYL	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0110002	ACETOPHENONE	190	UG/KG	UR	E	LABORATORY CONTROL SAMPLE RECOVERY NONCOMPLIANCE
25SS0110002	BENZALDEHYDE	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE
25SS0110002	CAPROLACTAM	190	UG/KG	UR	C	CALIBRATION NONCOMPLIANCE

TABLE 3

LABORATORY COMPLETENESS FOR AQUEOUS AND SOIL SAMPLES
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

FRACTION	TOTAL NUMBER OF DATA POINTS	REJECTED DATA POINTS	ANALYTICAL PERCENT COMPLETENESS
AQUEOUS SAMPLES (ROUNDS 1 AND 2)			
METALS	133	0	100
FILTERED METALS	130	0	100
SEMIVOLATILE	438	40	90.9
SOIL SAMPLES (ROUND 1 ONLY)			
METALS	456	0	100
SEMIVOLATILE	1,536	45	97.1

TABLE 4

RANGE OF NON-DETECTED VALUES FOR AQUEOUS SAMPLES
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

PARAMETER	UNITS	PROJECT ACTION LIMIT (PAL)	NUMBER OF NON-DETECTED RESULTS	NUMBER OF NON-DETECTED RESULTS EXCEEDING PAL	% OF NON-DETECTED RESULTS EXCEEDING PAL	RANGE OF NON-DETECTED VALUES
ARSENIC	UG/L	0.045	3	3	100	1.2 - 1.5
CHROMIUM	UG/L	0.043	2	2	100	0.5 - 0.57
1,2,4,5-TETRACHLOROBENZENE	UG/L	1.1	7	7	100	2.31 - 5
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/L	0.32	6	6	100	0.43 - 2.5
2,4-DINITROPHENOL	UG/L	7.3	5	5	100	10 - 25
2,4-DINITROTOLUENE	UG/L	0.22	7	7	100	0.5 - 2.5
3,3'-DICHLOROBENZIDINE	UG/L	0.15	7	7	100	2.31 - 10
4,6-DINITRO-2-METHYLPHENOL	UG/L	0.29	5	5	100	2.5 - 10
4-CHLOROANILINE	UG/L	0.34	7	7	100	0.5 - 2.5
BENZO(A)ANTHRACENE	UG/L	0.029	7	7	100	0.09 - 0.2
BENZO(A)PYRENE	UG/L	0.0029	7	7	100	0.09 - 0.2
BENZO(B)FLUORANTHENE	UG/L	0.029	7	7	100	0.09 - 0.2
BIS(2-CHLOROETHYL)ETHER	UG/L	0.012	7	7	100	0.5 - 2.5
DIBENZO(A,H)ANTHRACENE	UG/L	0.0029	7	7	100	0.09 - 0.2
HEXACHLOROBENZENE	UG/L	0.042	7	7	100	0.5 - 2.5
HEXACHLOROCYCLOPENTADIENE	UG/L	0.019	7	7	100	2.5 - 5
INDENO(1,2,3-CD)PYRENE	UG/L	0.029	7	7	100	0.09 - 0.2
N-NITROSO-DI-N-PROPYLAMINE	UG/L	0.0096	7	7	100	0.46 - 0.5
NAPHTHALENE	UG/L	0.14	3	3	100	0.2 - 0.2
NITROBENZENE	UG/L	0.12	7	7	100	0.5 -2.5
PENTACHLOROPHENOL	UG/L	0.17	5	5	100	0.92 - 2.5

TABLE 5

RANGE OF NON-DETECTED VALUES FOR SOIL SAMPLES
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

PARAMETER	UNITS	PROJECT ACTION LIMIT (PAL)	NUMBER OF NON-DETECTED RESULTS	NUMBER OF NON-DETECTED RESULTS EXCEEDING PAL	% OF NON-DETECTED RESULTS EXCEEDING PAL	RANGE OF NON-DETECTED VALUES
ANTIMONY	UG/KG	270	22	4	18	280 - 550
SELENIUM	UG/KG	520	18	10	56	540 - 870
THALLIUM	UG/KG	56.9	1	1	100	93 - 93
2,2'-OXYBIS(1-CHLOROPROPANE)	UG/KG	2.4	22	22	100	18 - 39
2,4-DIMETHYLPHENOL	UG/KG	10	22	22	100	18 - 39
2,4-DINITROPHENOL	UG/KG	60.9	22	22	100	370 - 770
2,4-DINITROTOLUENE	UG/KG	5.8	22	22	100	18 - 39
2,6-DINITROTOLUENE	UG/KG	32.8	22	1	5	39 - 39
2-CHLORONAPHTHALENE	UG/KG	12.2	22	22	100	18 - 39
2-CHLOROPHENOL	UG/KG	243	22	3	14	400 - 400
3,3'-DICHLOROBENZIDINE	UG/KG	20	22	19	86	370 - 770
4,6-DINITRO-2-METHYLPHENOL	UG/KG	100	22	2	9	110 - 190
4-CHLOROANILINE	UG/KG	2.8	22	22	100	8 - 39
4-NITROANILINE	UG/KG	28	22	4	18	39 - 40
BENZO(A)PYRENE	UG/KG	15	16	1	6	20
BIS(2-CHLOROETHYL)ETHER	UG/KG	0.062	22	22	100	20 - 77
DIBENZO(A,H)ANTHRACENE	UG/KG	15	22	2	9	20 - 20
HEXACHLOROBENZENE	UG/KG	11	22	22	100	18 - 39
HEXACHLOROBUTADIENE	UG/KG	34	22	1	5	39 - 39
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	0.14	22	22	100	18 - 39
NAPHTHALENE	UG/KG	9.4	22	4	18	15 - 20

TABLE 5

RANGE OF NON-DETECTED VALUES FOR SOIL SAMPLES
SWMU 25
NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

PARAMETER	UNITS	PROJECT ACTION LIMIT (PAL)	NUMBER OF NON-DETECTED RESULTS	NUMBER OF NON-DETECTED RESULTS EXCEEDING PAL	% OF NON-DETECTED RESULTS EXCEEDING PAL	RANGE OF NON-DETECTED VALUES
NITROBENZENE	UG/KG	1.6	22	22	100	18 - 39
PENTACHLOROPHENOL	UG/KG	28	22	22	100	92 - 190

APPENDIX E

SUPPORTING INFORMATION FOR HUMAN HEALTH RISK ASSESSMENT

E.1 Samples Used in Risk Assessment
E.2 RAGS Part D Tables
E.3 ProUCL Outputs
E.4 Sample Calculations
E.5 Risks for Chemicals within Background Levels
E.6 Risks for Dissolved Metals in Groundwater

APPENDIX E.1

SAMPLES USED IN RISK ASSESSMENT

TABLE 1
SAMPLES USED IN THE HUMAN HEALTH RISK ASSESSMENT

Surface Soil	Subsurface Soil	Groundwater
25SS0010002	25SB0010206	25GW718101
25SS0020002	25SB0030206	25MW718102
25SS0030002	25SB0040206	25GW728101
25SS0040002	25SB0040610	25MW728102
25SS0050002	25SB0050206	25GW738101
25SS0060002	25SB0060206	25MW738102
25SS0070002	25SB0060610	25MWT1061202
25SS0080002	25SB0070206	
25SS0090002	25SB0070610	
25SS0100002	25SB0080206	
25SS0110002	25SB0080610	

APPENDIX E.2

RAGS PART D TABLES

RAGS Part D Table 1

Selection of Exposure Pathways

LIST OF TABLES
RAGS PART D TABLE 1
SELECTION OF EXPOSURE PATHWAYS

Table No.

1 Selection of Exposure Pathways

TABLE 1

SELECTION OF EXPOSURE PATHWAYS
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Current/Future	Surface Soil	Surface Soil	SWMU 25	Construction Workers	Adult	Ingestion Dermal	Quant Quant	Construction workers may have contact with surface soil during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	Quant Quant	Industrial workers may contact surface soil during normal work activities.
				Trespassers	Adolescents	Ingestion Dermal	Quant Quant	Trespassers may contact surface soil while at the site.
		Air	SWMU 25	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to fugitive dust and volatile emissions from surface soil during excavation activities.
				Industrial Worker	Adult	Inhalation	Quant	Industrial workers may be exposed to fugitive dust and volatile emissions from surface soil during work activities.
				Trespassers	Adolescents	Inhalation	Quant	Adolescent trespassers may be exposed to fugitive dust and volatile emissions from surface soil while at the site.
	Subsurface Soil	Subsurface Soil	SWMU 25	Construction Workers	Adult	Ingestion Dermal	Quant Quant	Construction workers may have contact with subsurface soil during excavation activities.
				Industrial Worker	Adult	Ingestion Dermal	Quant Quant	Although exposure to subsurface soil by industrial workers is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
				Trespassers	Adolescents	Ingestion Dermal	Quant Quant	Adolescent trespassers are not expected to be exposed to subsurface soil; however, this scenario is included to aid in future risk management decisions.
		Air	SWMU 25	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to fugitive dust and volatile emissions from subsurface soil during excavation activities.
				Industrial Worker	Adult	Inhalation	Quant	Although exposure to subsurface soil by industrial workers is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
				Trespassers	Adolescents	Inhalation	Quant	Adolescent trespassers are not expected to be exposed to fugitive dust and volatile emissions from subsurface soil; however, this scenario is included to aid in future risk management decisions.
	Groundwater	Groundwater	SWMU 25	Construction Workers	Adult	Ingestion Dermal	None Quant	Construction workers may have dermal contact with groundwater during excavation activities; incidental ingestion of groundwater is not anticipated for this receptor.
				Industrial Worker	Adult	Ingestion Dermal	None None	Industrial workers are not expected to have contact with groundwater.
				Trespassers	Adolescents	Ingestion Dermal	None None	Adolescent trespassers are not expected to be exposed to groundwater.
		Air	SWMU 25	Construction Workers	Adult	Inhalation	Quant	Construction workers may be exposed to COPCs that volatilized from groundwater during excavation activities.
				Industrial Worker	Adult	Inhalation	None	Industrial workers are not expected to be exposed to chemicals that have volatilized from groundwater.
				Trespassers	Adolescents	Inhalation	None	Adolescent trespassers are not expected to be exposed to chemicals that have volatilized from groundwater.
			Vapor Intrusion	Industrial Worker	Adult	Inhalation	None	No COPCs were identified in groundwater for the vapor intrusion pathway.

TABLE 1

SELECTION OF EXPOSURE PATHWAYS
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Future	Surface Soil	Surface Soil	SWMU 25	Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
		Air	SWMU 25	Residents	Child	Inhalation	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
					Adult	Inhalation	Quant	
	Subsurface Soil	Subsurface Soil	SWMU 25	Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
	Subsurface Soil	Air	SWMU 25	Residents	Child	Inhalation	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
					Adult	Inhalation	Quant	
	Groundwater	Groundwater	SWMU 25	Residents	Child	Ingestion	Quant	Although a future residential scenario is considered unlikely at the site, this scenario is included to aid in future risk management decisions.
						Dermal	Quant	
					Adult	Ingestion	Quant	
						Dermal	Quant	
		Air	SWMU 25	Residents	Child	Inhalation	Quant	
					Adult	Inhalation	Quant	
			Vapor Intrusion	Residents	Child	Inhalation	None	No COPCs were identified in groundwater for the vapor intrusion pathway.
					Adult	Inhalation	None	

Notes:
COPC = Chemical of Potential Concern.
Quant = Quantitative.

RAGS Part D Table 2

Occurrence, Distribution and Selection Of Chemicals of Potential Concern

LIST OF TABLES
RAGS PART D TABLE 2
OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

Table No.

2.1 Surface Soil - Direct Contact
2.2 Surface Soil - Migration From Soil to Groundwater
2.3 Subsurface Soil - Direct Contact
2.4 Subsurface Soil - Migration From Soil to Groundwater
2.5 Groundwater - Direct Contact
2.6 Groundwater - Vapor Intrusion

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	Adjusted USEPA RSL - Residential Soil[4]	IDEM Residential Direct Contact[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
SWMU 25	**Metals**													
	7429-90-5	Aluminum	5,200,000 J	20,000,000 J	ug/kg	25SS0010002	11/11	-	20,000,000	22,800,000	**7,700,000 N**	100,000,000 L	No	BKG
	7440-38-2	**Arsenic**	4,200 J	24,000	ug/kg	25SS0100002	11/11	-	24,000	**10,600**	**390 C**	**5,500 C**	**Yes**	ASL
	7440-39-3	Barium	28,000 J	87,000 J	ug/kg	25SS0010002	11/11	-	87,000	262,000	1,500,000 N	21,000,000 M	No	BSL, BKG
	7440-41-7	Beryllium	340 J	820	ug/kg	25SS0050002	10/11	360 - 360	820	1,030	16,000 N	220,000 N	No	BSL, BKG
	7440-43-9	Cadmium	310	760	ug/kg	25SS0050002	9/11	230 - 240	760	NA	7,000 N	98,000 N	No	BSL
	7440-47-3	**Chromium**	7,900	29,000	ug/kg	25SS0050002	11/11	-	29,000	**22,200**	**290 C[7]**	**4,100 C[7]**	**Yes**	ASL
	7440-48-4	Cobalt	1,900 J	21,000	ug/kg	25SS0110002	11/11	-	21,000	27,400	**2,300 N**	32,000 N	No	BKG
	7440-50-8	Copper	9,100	18,000	ug/kg	25SS0010002	11/11	-	18,000	**17,700**	310,000 N	4,300,000 N	No	BSL
	7439-89-6	**Iron**	8,200,000 J	63,000,000	ug/kg	25SS0090002	11/11	-	63,000,000	**27,100,000**	**5,500,000 N**	77,000,000 N	**Yes**	ASL
	7439-92-1	Lead	6,400	53,000	ug/kg	25SS0050002	11/11	-	53,000	**23,000**	400,000	400,000 N	No	BSL
	7439-96-5	Manganese	110,000 J	1,600,000	ug/kg	25SS0110002	11/11	-	1,600,000	5,450,000	**180,000 N**	2,500,000 N	No	BKG
	7439-97-6	Mercury	6 J	56	ug/kg	25SS0010002	11/11	-	56	108	2,300 N[8]	32,000 N	No	BSL, BKG
	7440-02-0	Nickel	7,100	24,000	ug/kg	25SS0110002	11/11	-	24,000	26,200	150,000 N	2,100,000 N	No	BSL, BKG
	7782-49-2	Selenium	570 J	1,400 J	ug/kg	25SS0090002	3/11	370 - 750	1,400	NA	39,000 N	550,000 N	No	BSL
	7440-22-4	Silver	20 J	120 J	ug/kg	25SS0050002	11/11	-	120	**105**	39,000 N	550,000 N	No	BSL
	7440-28-0	Thallium	110 J	300 J	ug/kg	25SS0010002, 25SS0080002	11/11	-	300	412	**78 N**	1,100 N	No	BKG
	7440-62-2	Vanadium	7,900	40,000	ug/kg	25SS0080002	11/11	-	40,000	49,700	**39,000 N**	550,000 N	No	BKG
	7440-66-6	Zinc	24,000 J	81,000 J	ug/kg	25SS0050002	11/11	-	81,000	135,000	2,300,000 N	32,000,000 N	No	BSL, BKG
	Semivolatile Organic Compounds													
	208-96-8	Acenaphthylene	12 J	30 J	ug/kg	25SS0030002	3/11	7.7 - 20	30	NA	340,000 N[9]	4,800,000 N	No	BSL
	120-12-7	Anthracene	10	12	ug/kg	25SS0050002	2/11	7.7 - 15	12	NA	1,700,000 N	24,000,000 N	No	BSL
	56-55-3	Benzo(a)anthracene	13	42	ug/kg	25SS0030002	5/11	19 - 20	42	NA	150 C	2,100 C	No	BSL
	50-32-8	**Benzo(a)pyrene**	16	55	ug/kg	25SS0030002	5/11	7.7 - 20	55	NA	**15 C**	210 C	**Yes**	ASL
	205-99-2	Benzo(b)fluoranthene	19	64	ug/kg	25SS0070002	5/11	7.7 - 20	64	NA	150 C	2,100 C	No	BSL
	191-24-2	Benzo(g,h,i)perylene	13	53	ug/kg	25SS0070002	5/11	7.7 - 8.2	53	NA	170,000 N[10]	NA	No	BSL
	207-08-9	Benzo(k)fluoranthene	13 J	32	ug/kg	25SS0030002, 25SS0070002	4/11	7.7 - 20	32	NA	1,500 C	21,000 C	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	14 J	35 J	ug/kg	25SS0070002	4/11	19 - 39	35	NA	35,000 C	490,000 C	No	BSL
	85-68-7	Butyl Benzyl Phthalate	8 J	8 J	ug/kg	25SS0050002	1/11	8 - 39	8	NA	260,000 C	3,600,000 N	No	BSL
	86-74-8	Carbazole	8 J	8 J	ug/kg	25SS0050002	1/11	19 - 99	8	NA	NA	NA	No	BSL
	218-01-9	Chrysene	13	44	ug/kg	25SS0030002	5/11	7.7 - 8.2	44	NA	15,000 C	210,000 C	No	BSL
	84-66-2	Diethyl Phthalate	8 J	8 J	ug/kg	25SS0050002	1/11	19 - 39	8	NA	4,900,000 N	69,000,000 N	No	BSL
	84-74-2	di-n-Butyl Phthalate	11 J	11 J	ug/kg	25SS0050002	1/11	19 - 39	11	NA	610,000 N	8,500,000 N	No	BSL
	206-44-0	Fluoranthene	11	52	ug/kg	25SS0070002	5/11	7.7 - 20	52	NA	230,000 N	3,200,000 N	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	18	38	ug/kg	25SS0070002	3/11	7.7 - 40	38	NA	150 C	2,100 C	No	BSL
	85-01-8	Phenanthrene	15	25	ug/kg	25SS0070002	4/11	7.7 - 20	25	NA	170,000 N[10]	NA	No	BSL
	129-00-0	Pyrene	12	55	ug/kg	25SS0070002	5/11	7.7 - 20	55	NA	170,000 N	2,400,000 N	No	BSL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - 95% Upper Tolerance Limit (UTL) for Group 1 Soil. Tetra Tech, 2001: Final Base-Wide Background Soil Investigation Report for NSWC Crane.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is greater than background.
7 - Value is for hexavalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).
9 - Value is for acenaphthene.
10 - Value is for pyrene.
Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000 mg/kg (soil direct contact only).
M = Based on MCL (migration to ground water).
N = Noncarcinogen
NA = Not Applicable/Not Available
ug/kg = Microgram per kilogram

TABLE 2.1

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SURFACE SOIL
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Associated Samples:
25SS0010002
25SS0020002
25SS0030002
25SS0040002
25SS0050002
25SS0060002
25SS0070002
25SS0080002
25SS0090002
25SS0100002
25SS0110002

Rationale Codes:

For selection as a COPC:
ASL = Above Screening Level and background

For elimination as a COPC:
BKG = Less than background concentration
BSL = Below COPC Screening Level

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	USEPA SSL - Groundwater Protection[4]	IDEM Migration to Groundwater[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
SWMU 25	**Metals**													
	7429-90-5	Aluminum	5,200,000 J	20,000,000 J	ug/kg	25SS0010002	11/11	-	20,000,000	22,800,000	460,000,000	480,000,000 N	No	BSL, BKG
	7440-38-2	**Arsenic**	4,200 J	24,000	ug/kg	25SS0100002	11/11	-	24,000	**10,600**	**26**	**5,900 M**	**Yes**	ASL
	7440-39-3	Barium	28,000 J	87,000 J	ug/kg	25SS0010002	11/11	-	87,000	262,000	2,400,000	1,700,000 N	No	BSL, BKG
	7440-41-7	Beryllium	340 J	820	ug/kg	25SS0050002	10/11	360 - 360	820	1,030	260,000	63,000 M	No	BSL, BKG
	7440-43-9	Cadmium	310	760	ug/kg	25SS0050002	9/11	230 - 240	760	NA	10,400	7,500 M	No	BSL
	7440-47-3	**Chromium**	7,900	29,000	ug/kg	25SS0050002	11/11	-	29,000	**22,200**	**11.8 [7]**	**120 C[7]**	**Yes**	ASL
	7440-48-4	Cobalt	1,900 J	21,000	ug/kg	25SS0110002	11/11	-	21,000	27,400	**4,200**	**4,300 N**	No	BKG
	7440-50-8	Copper	9,100	18,000	ug/kg	25SS0010002	11/11	-	18,000	**17,700**	440,000	920,000 M	No	BSL
	7439-89-6	**Iron**	8,200,000 J	63,000,000	ug/kg	25SS0090002	11/11	-	63,000,000	**27,100,000**	**5,400,000**	**5,600,000 N**	**Yes**	ASL
	7439-92-1	Lead	6,400	53,000	ug/kg	25SS0050002	11/11	-	53,000	**23,000**	280,000 [8]	270,000 M	No	BSL
	7439-96-5	Manganese	110,000 J	1,600,000	ug/kg	25SS0110002	11/11	-	1,600,000	5,450,000	**420,000**	**420,000 N**	No	BKG
	7439-97-6	Mercury	6 J	56	ug/kg	25SS0010002	11/11	-	56	108	660	2,100 M	No	BSL, BKG
	7440-02-0	Nickel	7,100	24,000	ug/kg	25SS0110002	11/11	-	24,000	26,200	400,000	390,000 N	No	BSL, BKG
	7782-49-2	Selenium	570 J	1,400 J	ug/kg	25SS0090002	3/11	370 - 750	1,400	NA	8,000	5,300 M	No	BSL
	7440-22-4	Silver	20 J	120 J	ug/kg	25SS0050002	11/11	-	120	**105**	12,000	12,000 N	No	BSL
	7440-28-0	Thallium	110 J	300 J	ug/kg	25SS0010002, 25SS0080002	11/11	-	300	412	**220**	2,900 M	No	BKG
	7440-62-2	Vanadium	7,900	40,000	ug/kg	25SS0080002	11/11	-	40,000	49,700	1,560,000	1,600,000 N	No	BSL, BKG
	7440-66-6	Zinc	24,000 J	81,000 J	ug/kg	25SS0050002	11/11	-	81,000	135,000	5,800,000	5,900,000 N	No	BSL, BKG
	Semivolatile Organic Compounds													
	208-96-8	Acenaphthylene	12 J	30 J	ug/kg	25SS0030002	3/11	7.7 - 20	30	NA	82,000 [9]	82,000 N	No	BSL
	120-12-7	Anthracene	10	12	ug/kg	25SS0050002	2/11	7.7 - 15	12	NA	840,000	860,000 N	No	BSL
	56-55-3	Benzo(a)anthracene	13	42	ug/kg	25SS0030002	5/11	19 - 20	42	NA	200	2,100 C	No	BSL
	50-32-8	Benzo(a)pyrene	16	55	ug/kg	25SS0030002	5/11	7.7 - 20	55	NA	70	4,700 M	No	BSL
	205-99-2	Benzo(b)fluoranthene	19	64	ug/kg	25SS0070002	5/11	7.7 - 20	64	NA	700	7,000 C	No	BSL
	191-24-2	Benzo(g,h,i)perylene	13	53	ug/kg	25SS0070002	5/11	7.7 - 8.2	53	NA	190,000 [10]	NA	No	BSL
	207-08-9	Benzo(k)fluoranthene	13 J	32	ug/kg	25SS0030002, 25SS0070002	4/11	7.7 - 20	32	NA	7,000	68,000 C	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	14 J	35 J	ug/kg	25SS0070002	4/11	19 - 39	35	NA	22,000	29,000 M	No	BSL
	85-68-7	Butyl Benzyl Phthalate	8 J	8 J	ug/kg	25SS0050002	1/11	8 - 39	8	NA	4,000	41,000 C	No	BSL
	86-74-8	Carbazole	8 J	8 J	ug/kg	25SS0050002	1/11	19 - 99	8	NA	NA	NA	No	BSL
	218-01-9	Chrysene	13	44	ug/kg	25SS0030002	5/11	7.7 - 8.2	44	NA	22,000	210,000 C	No	BSL
	84-66-2	Diethyl Phthalate	8 J	8 J	ug/kg	25SS0050002	1/11	19 - 39	8	NA	94,000	90,000 N	No	BSL
	84-74-2	di-n-Butyl Phthalate	11 J	11 J	ug/kg	25SS0050002	1/11	19 - 39	11	NA	34,000	34,000 N	No	BSL
	206-44-0	Fluoranthene	11	52	ug/kg	25SS0070002	5/11	7.7 - 20	52	NA	1,400,000	1,400,000 N	No	BSL
	193-39-5	Indeno(1,2,3-cd)pyrene	18	38	ug/kg	25SS0070002	3/11	7.7 - 40	38	NA	4,000	40,000 C	No	BSL
	85-01-8	Phenanthrene	15	25	ug/kg	25SS0070002	4/11	7.7 - 20	25	NA	190,000 [10]	NA	No	BSL
	129-00-0	Pyrene	12	55	ug/kg	25SS0070002	5/11	7.7 - 20	55	NA	190,000	190,000 N	No	BSL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - 95% Upper Tolerance Limit (UTL) for Group 1 Soil. Tetra Tech, 2001: Final Base-Wide Background Soil Investigation Report for NSWC Crane.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. Soil screening levels (SSLs) for groundwater protection are risk-based SSLs multiplied by 20 to represent a dilution attenuation factor (DAF) of 20.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is greater than background.
7 - Value is for hexavalent chromium.
8 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.
9 - Value is for acenaphthene.
10 - Value is for pyrene.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
M = Based on MCL (migration to ground water).
N = Noncarcinogen
NA = Not Applicable/Not Available
R = Capped at 1,000,000 mg/kg (migration to ground water only).
ug/kg = Microgram per kilogram

TABLE 2.2

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SURFACE SOIL TO GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Associated Samples:
25SS0010002
25SS0020002
25SS0030002
25SS0040002
25SS0050002
25SS0060002
25SS0070002
25SS0080002
25SS0090002
25SS0100002
25SS0110002

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and background

For elimination as a COPC:
BKG = Less than background concentration
BSL = Below COPC Screening Level

TABLE 2.3

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH SUBSURFACE SOIL
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	Adjusted USEPA RSL - Residential Soil[4]	IDEM Residential Direct Contact[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
SWMU 25	**Metals**													
	7429-90-5	Aluminum	4,700,000 J	12,000,000 J	ug/kg	25SB0040206	11/11	-	12,000,000	20,600,000	**7,700,000 N**	100,000,000 L	No	BKG
	7440-38-2	**Arsenic**	1,600	14,000 J	ug/kg	25SB0050206, 25SB0070206	11/11	-	14,000	**12,500**	**390 C**	**5,500 C**	**Yes**	ASL
	7440-39-3	Barium	19,000 J	380,000 J	ug/kg	25SB0070610	11/11	-	380,000	**115,000**	1,500,000 N	21,000,000 M	No	BSL
	7440-41-7	Beryllium	390	1,800	ug/kg	25SB0070610	9/11	370 - 400	1,800	NA	16,000 N	220,000 N	No	BSL
	7440-43-9	Cadmium	230	380	ug/kg	25SB0080206	4/11	150 - 270	380	829	7,000 N	98,000 N	No	BSL, BKG
	7440-47-3	Chromium	4,700	26,000	ug/kg	25SB0070610	11/11	-	26,000	33,000	**290 C[7]**	**4,100 C[7]**	No	BKG
	7440-48-4	**Cobalt**	1,000 J	23,000 J	ug/kg	25SB0070610	11/11	-	23,000	**21,200**	**2,300 N**	32,000 N	**Yes**	ASL
	7440-50-8	Copper	5,900	23,000	ug/kg	25SB0070610	11/11	-	23,000	33,300	310,000 N	4,300,000 N	No	BSL, BKG
	7439-89-6	**Iron**	6,200,000 J	130,000,000 J	ug/kg	25SB0070610	11/11	-	130,000,000	**60,200,000**	**5,500,000 N**	**77,000,000 N**	**Yes**	ASL
	7439-92-1	Lead	6,200	54,000	ug/kg	25SB0070610	11/11	-	54,000	**19,600**	400,000	400,000 N	No	BSL
	7439-96-5	**Manganese**	82,000 J	2,600,000 J	ug/kg	25SB0070610	11/11	-	2,600,000	**704,000**	**180,000 N**	**2,500,000 N**	**Yes**	ASL
	7439-97-6	Mercury	9 J	39 J	ug/kg	25SB0040206	10/11	12 - 12	39	178	2,300 N[8]	32,000 N	No	BSL, BKG
	7440-02-0	Nickel	4,700	52,000	ug/kg	25SB0070610	11/11	-	52,000	**29,600**	150,000 N	2,100,000 N	No	BSL
	7782-49-2	Selenium	420 J	420 J	ug/kg	25SB0080610	1/11	370 - 870	420	1,070	39,000 N	550,000 N	No	BSL, BKG
	7440-22-4	Silver	26 J	120 J	ug/kg	25SB0070610	10/11	73 - 73	120	143	39,000 N	550,000 N	No	BSL, BKG
	7440-28-0	Thallium	86 J	270 J	ug/kg	25SB0070610	10/11	93 - 93	270	332	**78 N**	1,100 N	No	BKG
	7440-62-2	Vanadium	3,400	29,000	ug/kg	25SB0070206	11/11	-	29,000	69,100	39,000 N	550,000 N	No	BSL, BKG
	7440-66-6	Zinc	12,000 J	110,000 J	ug/kg	25SB0070610	11/11	-	110,000	**83,300**	2,300,000 N	32,000,000 N	No	BSL
	Semivolatile Organic Compounds													
	56-55-3	Benzo(a)anthracene	8	8	ug/kg	25SB0050206	1/11	18 - 21	8	NA	150 C	2,100 C	No	BSL
	50-32-8	Benzo(a)pyrene	10	10	ug/kg	25SB0050206	1/11	7.4 - 8.5	10	NA	15 C	210 C	No	BSL
	205-99-2	Benzo(b)fluoranthene	12	12	ug/kg	25SB0050206	1/11	7.4 - 8.5	12	NA	150 C	2,100 C	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	19 J	300 J	ug/kg	25SB0050206	4/11	18 - 21	300	NA	35,000 C	490,000 C	No	BSL
	84-66-2	Diethyl Phthalate	16 J	16 J	ug/kg	25SB0010206	1/11	18 - 21	16	NA	4,900,000 N	69,000,000 N	No	BSL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - 95% Upper Tolerance Limit (UTL) for Group 8 Soil. Tetra Tech, 2001: Final Base-Wide Background Soil Investigation Report for NSWC Crane.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is greater than background.
7 - Value is for hexavalent chromium.
8 - Value is for mercuric chloride (and other mercury salts).

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25SB0010206
25SB0030206
25SB0040206
25SB0040610
25SB0050206
25SB0060206
25SB0060610
25SB0070206
25SB0070610
25SB0080206
25SB0080610

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
L = Capped at 100,000 mg/kg (soil direct contact only).
N = Noncarcinogen
NA = Not Applicable/Not Available
ug/kg = Microgram per kilogram

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and background

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 2.4

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - MIGRATION FROM SUBSURFACE SOIL TO GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

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

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	USEPA SSL - Groundwater Protection[4]	IDEM Migration to Groundwater[5]	COPC Flag	Rationale for Contaminant Deletion or Selection[6]
SWMU 25	**Metals**													
	7429-90-5	Aluminum	4,700,000 J	12,000,000 J	ug/kg	25SB0040206	11/11	-	12,000,000	20,600,000	460,000,000	480,000,000 N	No	BSL, BKG
	7440-38-2	**Arsenic**	1,600	14,000 J	ug/kg	25SB0050206, 25SB0070206	11/11	-	14,000	**12,500**	**26**	**5,900 M**	**Yes**	ASL
	7440-39-3	Barium	19,000 J	380,000 J	ug/kg	25SB0070610	11/11	-	380,000	**115,000**	2,400,000	1,700,000 N	No	BSL
	7440-41-7	Beryllium	390	1,800	ug/kg	25SB0070610	9/11	370 - 400	1,800	NA	260,000	63,000 M	No	BSL
	7440-43-9	Cadmium	230	380	ug/kg	25SB0080206	4/11	150 - 270	380	829	10,400	7,500 M	No	BSL, BKG
	7440-47-3	Chromium	4,700	26,000	ug/kg	25SB0070610	11/11	-	26,000	33,000	**11.8 [7]**	**120 C[7]**	No	BKG
	7440-48-4	**Cobalt**	1,000 J	23,000 J	ug/kg	25SB0070610	11/11	-	23,000	**21,200**	**4,200**	**4,300 N**	**Yes**	ASL
	7440-50-8	Copper	5,900	23,000	ug/kg	25SB0070610	11/11	-	23,000	33,300	440,000	920,000 M	No	BSL, BKG
	7439-89-6	**Iron**	6,200,000 J	130,000,000 J	ug/kg	25SB0070610	11/11	-	130,000,000	**60,200,000**	**5,400,000**	**5,600,000 N**	**Yes**	ASL
	7439-92-1	Lead	6,200	54,000	ug/kg	25SB0070610	11/11	-	54,000	**19,600**	280,000 [8]	270,000 M	No	BSL
	7439-96-5	**Manganese**	82,000 J	2,600,000 J	ug/kg	25SB0070610	11/11	-	2,600,000	**704,000**	**420,000**	**420,000 N**	**Yes**	ASL
	7439-97-6	Mercury	9 J	39 J	ug/kg	25SB0040206	10/11	12 - 12	39	178	660	2,100 M	No	BSL, BKG
	7440-02-0	Nickel	4,700	52,000	ug/kg	25SB0070610	11/11	-	52,000	**29,600**	400,000	390,000 N	No	BSL
	7782-49-2	Selenium	420 J	420 J	ug/kg	25SB0080610	1/11	370 - 870	420	1,070	8,000	5,300 M	No	BSL, BKG
	7440-22-4	Silver	26 J	120 J	ug/kg	25SB0070610	10/11	73 - 73	120	143	12,000	12,000 N	No	BSL, BKG
	7440-28-0	Thallium	86 J	270 J	ug/kg	25SB0070610	10/11	93 - 93	270	332	**220**	2,900 M	No	BKG
	7440-62-2	Vanadium	3,400	29,000	ug/kg	25SB0070206	11/11	-	29,000	69,100	1,560,000	1,600,000 N	No	BSL, BKG
	7440-66-6	Zinc	12,000 J	110,000 J	ug/kg	25SB0070610	11/11	-	110,000	**83,300**	5,800,000	5,900,000 N	No	BSL
	Semivolatile Organic Compounds													
	56-55-3	Benzo(a)anthracene	8	8	ug/kg	25SB0050206	1/11	18 - 21	8	NA	200	19,000 C	No	BSL
	50-32-8	Benzo(a)pyrene	10	10	ug/kg	25SB0050206	1/11	7.4 - 8.5	10	NA	70	8,200 M	No	BSL
	205-99-2	Benzo(b)fluoranthene	12	12	ug/kg	25SB0050206	1/11	7.4 - 8.5	12	NA	700	57,000 C	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	19 J	300 J	ug/kg	25SB0050206	4/11	18 - 21	300	NA	22,000	3,600,000 M	No	BSL
	84-66-2	Diethyl Phthalate	16 J	16 J	ug/kg	25SB0010206	1/11	18 - 21	16	NA	94,000	450,000 N	No	BSL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - 95% Upper Tolerance Limit (UTL) for Group 8 Soil. Tetra Tech, 2001: Final Base-Wide Background Soil Investigation Report for NSWC Crane.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. Soil screening levels (SSLs) for groundwater protection are risk-based SSLs multiplied by 20 to represent a dilution attenuation factor (DAF) of 20.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level and is greater than background.
7 - Value is for hexavalent chromium.
8 - No risk-based SSL is available; therefore, the MCL-based SSL is presented.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25SB0010206
25SB0030206
25SB0040206
25SB0040610
25SB0050206
25SB0060206
25SB0060610
25SB0070206
25SB0070610
25SB0080206
25SB0080610

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
M = Based on MCL (migration to ground water).
N = Noncarcinogen
NA = Not Applicable/Not Available
R = Capped at 1,000,000 mg/kg (migration to ground water only).
ug/kg = Microgram per kilogram

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level and background

For elimination as a COPC:
BKG = Less than Background Concentration
BSL = Below COPC Screening Level

TABLE 2.5

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - DIRECT CONTACT WITH GROUNDWATER
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects[1]	Concentration Used for Screening[2]	Background Value[3]	Adjusted USEPA RSL Tap Water[4]	USEPA MCL[5]	IDEM Groundwater Residential[6]	COPC Flag	Rationale for Contaminant Deletion or Selection[7]
SWMU 25	**Metals**														
	7429-90-5	**Aluminum**	39 J	5,630	ug/L	25MW738102	5/5	-	5,630	**262**	**1,600 N**	NA	16,000 N	**Yes**	ASL
	7440-38-2	**Arsenic**	2	127	ug/L	25MW728102	4/5	1.5	127	**ND**	**0.045 C**	**10**	**10 M**	**Yes**	ASL
	7440-39-3	Barium	9.3 J	110	ug/L	25GW738101	5/5	-	110	138	290 N	2,000	2,000 M	No	BSL, BKG
	7440-41-7	Beryllium	0.329 J	0.873 J	ug/L	25MW728102	2/5	0.2-0.5	0.873	**ND**	1.6 N	4	4 M	No	BSL
	7440-43-9	**Cadmium**	0.46	1.09 J	ug/L	25MW728102	2/5	0.24-0.5	1.09	**ND**	**0.69 N**	5	5 M	**Yes**	ASL
	7440-47-3	**Chromium**	1.8 J	85.4	ug/L	25MW738102	4/5	0.5	85.4	**1.22**	**0.031 C[8]**	100	**0.31 C[8]**	**Yes**	ASL
	7440-48-4	**Cobalt**	3.9	149	ug/L	25MW728102	5/5	-	149	**8.67**	**0.47 N**	NA	**4.7 N**	**Yes**	ASL
	7440-50-8	Copper	1.4 J	18.8	ug/L	25MW728102	4/5	2	18.8	**1.8**	62 N	1,300	1,300 N	No	BSL
	7439-89-6	**Iron**	3,300	146,000	ug/L	25MW728102	5/5	-	146,000	**5,730**	**1,100 N**	NA	**11,000 N**	**Yes**	ASL
	7439-92-1	Lead	2.4	14.5	ug/L	25MW728102	3/5	0.32-0.75	14.5	**0.97**	NA	15	15 M	No	BSL
	7439-96-5	**Manganese**	810 J	7,440	ug/L	25MW728102	5/5	-	7,440	**6,100**	**32 N**	NA	**320 N**	**Yes**	ASL
	7440-02-0	**Nickel**	9.2 J	398	ug/L	25MW728102	5/5	-	398	**54**	**30 N**	NA	**300 N**	**Yes**	ASL
	7440-28-0	**Thallium**	3.56 J	3.56 J	ug/L	25MW728102	1/5	0.2-1	3.56	**2.19**	**0.016 N**	**2**	**2 M**	**Yes**	ASL
	7440-62-2	**Vanadium**	0.27 J	31.3	ug/L	25MW738102	5/5	-	31.3	**ND**	**7.8 N**	NA	78 N	**Yes**	ASL
	7440-66-6	Zinc	7.4 J	190	ug/L	25MW728102	5/5	-	190	**72**	470 N	NA	4,700 N	No	BSL
	Dissolved Metals														
	7429-90-5	Aluminum	1.7 J	165	ug/L	25MW738102	5/5	-	165	**140**	1,600 N	NA	16,000 N	No	BSL
	7440-38-2	**Arsenic**	0.41 J	1.5 J	ug/L	25MWT1061202	3/5	1.5	1.5	**ND**	**0.045 C**	10	10 M	**Yes**	ASL
	7440-39-3	Barium	8 J	90	ug/L	25GW738101	5/5	-	90	125	290 N	2,000	2,000 M	No	BSL, BKG
	7440-70-2	Calcium	46,700	94,700	ug/L	25MW728102	3/3	-	94,700	**92,200**	NA	NA	NA	No	NUT
	7440-47-3	**Chromium**	2.6 J	3.9 J	ug/L	25GW728101	2/5	1	3.9	**ND**	**0.031 C[8]**	100	**0.31 C[8]**	**Yes**	ASL
	7440-48-4	**Cobalt**	2.4	18	ug/L	25GW728101	4/5	2.5	18	**7.84**	**0.47 N**	NA	**4.7 N**	**Yes**	ASL
	7440-50-8	Copper	0.61 J	0.91 J	ug/L	25GW728101	2/5	2	0.91	**ND**	62 N	1,300	1,300 N	No	BSL
	7439-89-6	Iron	169	2,400	ug/L	25GW728101	3/5	15-50	2,400	4,760	**1,100 N**	NA	11,000 N	No	BKG
	7439-95-4	Magnesium	10,200	26,400	ug/L	25MW728102	3/3	-	26,400	69,900	NA	NA	NA	No	NUT, BKG
	7439-96-5	Manganese	318	1,500	ug/L	25MWT1061202	5/5	-	1,500	4,630	**32 N**	NA	**320 N**	No	BKG
	7440-02-0	Nickel	6	42	ug/L	25GW728101	5/5	-	42	45.3	**30 N**	NA	300 N	No	BKG
	7440-09-7	Potassium	1,040 J	2,170	ug/L	25MWT1061202	3/3	-	2,170	5,300	NA	NA	NA	No	NUT, BKG
	7440-23-5	Sodium	11,000	23,800	ug/L	25MWT1061202	3/3	-	23,800	65,600	NA	NA	NA	No	NUT, BKG
	7440-62-2	Vanadium	0.89 J	1 J	ug/L	25GW728101	2/5	2.5	1	**ND**	7.8 N	NA	78 N	No	BSL
	7440-66-6	Zinc	2.2 J	17.5	ug/L	25MWT1061202	5/5	-	17.5	35.1	470 N	NA	4,700 N	No	BSL, BKG
	Semivolatile Organic Compounds														
	91-57-6	2-Methylnaphthalene	0.0933 J	0.0933 J	ug/L	25MWT1061202	1/5	0.098-0.2	0.0933	**ND**	2.7 N	NA	27 N	No	BSL
	117-81-7	Bis(2-ethylhexyl)phthalate	0.493 J	0.493 J	ug/L	25MW738102	1/5	0.5	0.493	**ND**	4.8 C	6	6 M	No	BSL
	91-20-3	**Naphthalene**	0.0545 J	0.169 J	ug/L	25MW738102	3/5	0.2	0.169	**0.084**	**0.14 C**	NA	1.4 C	**Yes**	ASL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - The maximum detected concentration from the upgradient well (MW2501) is presented.
4 - USEPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites, November 2012. RSLs for carcinogens correspond to an integrated lifetime cancer risk (ILCR) of 1E-06; adjusted RSLs for noncarcinogens correspond to a hazard quotient (HQ) of 0.1.
5 - 2012 Edition of the Drinking Water Standards and Health Advisories (USEPA, April 2012).
6 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, March 2013).
7 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.
8 - Value is for hexavalent chromium.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25GW728101
25MW728102
25GW738101
25MW738102
25MWT1061202

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
M = Set to maximum contaminant limit (MCL).
N = Noncarcinogen
NA = Not Applicable/Not Available
ND = Not detected
ug/L = Microgram per liter

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level

For elimination as a COPC:
BKG = Less than background concentration
BSL = Below COPC Screening Level
NUT = Essential Nutrient

TABLE 2.6

OCCURRENCE, DISTRIBUTION, AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN - GROUNDWATER VAPOR INTRUSION
SWMU 25 - HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	CAS Number	Chemical	Minimum Concentration	Maximum Concentration	Units	Sample of Maximum Concentration	Frequency of Detection	Range of Nondetects(1)	Concentration Used for Screening(2)	Background Value(3)	USEPA Groundwater Volatilization Criterion(4)	IDEM Vapor Exposure Residential(5)	COPC Flag	Rationale for Contaminant Deletion or Selection(6)
SWMU 25	**Metals**													
	7429-90-5	Aluminum	39 J	5,630	ug/L	25MW738102	5/5	-	5,630	**262**	NA	NA	No	NTX
	7440-38-2	Arsenic	2	127	ug/L	25MW728102	4/5	1.5	127	**ND**	NA	NA	No	NTX
	7440-39-3	Barium	9.3 J	110	ug/L	25GW738101	5/5	-	110	138	NA	NA	No	NTX, BKG
	7440-41-7	Beryllium	0.329 J	0.873 J	ug/L	25MW728102	2/5	0.2-0.5	0.873	**ND**	NA	NA	No	NTX
	7440-43-9	Cadmium	0.46	1.09 J	ug/L	25MW728102	2/5	0.24-0.5	1.09	**ND**	NA	NA	No	NTX
	7440-47-3	Chromium	1.8 J	85.4	ug/L	25MW738102	4/5	0.5	85.4	**1.22**	NA	NA	No	NTX
	7440-48-4	Cobalt	3.9	149	ug/L	25MW728102	5/5	-	149	**8.67**	NA	NA	No	NTX
	7440-50-8	Copper	1.4 J	18.8	ug/L	25MW728102	4/5	2	18.8	**1.8**	NA	NA	No	NTX
	7439-89-6	Iron	3,300	146,000	ug/L	25MW728102	5/5	-	146,000	**5,730**	NA	NA	No	NTX
	7439-92-1	Lead	2.4	14.5	ug/L	25MW728102	3/5	0.32-0.75	14.5	**0.97**	NA	NA	No	NTX
	7439-96-5	Manganese	810 J	7,440	ug/L	25MW728102	5/5	-	7,440	**6,100**	NA	NA	No	NTX
	7440-02-0	Nickel	9.2 J	398	ug/L	25MW728102	5/5	-	398	**54**	NA	NA	No	NTX
	7440-28-0	Thallium	3.56 J	3.56 J	ug/L	25MW728102	1/5	0.2-1	3.56	**2.19**	NA	NA	No	NTX
	7440-62-2	Vanadium	0.27 J	31.3	ug/L	25MW738102	5/5	-	31.3	**ND**	NA	NA	No	NTX
	7440-66-6	Zinc	7.4 J	190	ug/L	25MW728102	5/5	-	190	**72**	NA	NA	No	NTX
	Dissolved Metals													
	7429-90-5	Aluminum	1.7 J	165	ug/L	25MW738102	5/5	-	165	**140**	NA	NA	No	NTX
	7440-38-2	Arsenic	0.41 J	1.5 J	ug/L	25MWT1061202	3/5	1.5	1.5	**ND**	NA	NA	No	NTX
	7440-39-3	Barium	8 J	90	ug/L	25GW738101	5/5	-	90	125	NA	NA	No	NTX, BKG
	7440-70-2	Calcium	46,700	94,700	ug/L	25MW728102	3/3	-	94,700	**92,200**	NA	NA	No	NTX
	7440-47-3	Chromium	2.6 J	3.9 J	ug/L	25GW728101	2/5	1	3.9	**ND**	NA	NA	No	NTX
	7440-48-4	Cobalt	2.4	18	ug/L	25GW728101	4/5	2.5	18	**7.84**	NA	NA	No	NTX
	7440-50-8	Copper	0.61 J	0.91 J	ug/L	25GW728101	2/5	2	0.91	**ND**	NA	NA	No	NTX
	7439-89-6	Iron	169	2,400	ug/L	25GW728101	3/5	15-50	2,400	4,760	NA	NA	No	NTX, BKG
	7439-95-4	Magnesium	10,200	26,400	ug/L	25MW728102	3/3	-	26,400	69,900	NA	NA	No	NTX, BKG
	7439-96-5	Manganese	318	1,500	ug/L	25MWT1061202	5/5	-	1,500	4,630	NA	NA	No	NTX, BKG
	7440-02-0	Nickel	6	42	ug/L	25GW728101	5/5	-	42	45.3	NA	NA	No	NTX, BKG
	7440-09-7	Potassium	1,040 J	2,170	ug/L	25MWT1061202	3/3	-	2,170	5,300	NA	NA	No	NTX, BKG
	7440-23-5	Sodium	11,000	23,800	ug/L	25MWT1061202	3/3	-	23,800	65,600	NA	NA	No	NTX, BKG
	7440-62-2	Vanadium	0.89 J	1 J	ug/L	25GW728101	2/5	2.5	1	**ND**	NA	NA	No	NTX
	7440-66-6	Zinc	2.2 J	17.5	ug/L	25MWT1061202	5/5	-	17.5	35.1	NA	NA	No	NTX, BKG
	Semivolatile Organic Compounds													
	91-57-6	2-Methylnaphthalene	0.0933 J	0.0933 J	ug/L	25MWT1061202	1/5	0.098-0.2	0.0933	**ND**	NA	NA	No	NTX
	117-81-7	Bis(2-ethylhexyl)phthalate	0.493 J	0.493 J	ug/L	25MW738102	1/5	0.5	0.493	**ND**	NA	NA	No	NTX
	91-20-3	Naphthalene	0.0545 J	0.169 J	ug/L	25MW738102	3/5	0.2	0.169	**0.084**	4.0 C	91 C	No	BSL

Footnotes:
1 - Values presented are sample-specific quantitation limits.
2 - The maximum detected concentration is used for screening purposes.
3 - The maximum detected concentration from the upgradient well (MW2501) is presented.
4 - Calculated using USEPA's Vapor Intrusion Screening Level (VISL) calculator Version 3.0 (USEPA, March 2013) and toxicity criteria from USEPA's November 2012 Regional Screening Level table. Values correspond to a target cancer risk level of 1E-06 or HQ = 0.1 and an attenuation factor of 0.001.
5 - Indiana Department of Environmental Management (IDEM), Risk Integrated System of Closure (RISC) (IDEM, July 2012).
6 - The chemical is selected as a COPC if the maximum detected concentration exceeds the risk-based COPC screening level.

Shaded criterion indicates that the maximum detected concentration exceeds one or more screening criteria. Shaded chemical name indicates that the chemical was retained as a COPC.

Associated Samples:
25GW728101 25MW738102
25MW728102 25MWT1061202
25GW738101

Definitions:
C = Carcinogen
CAS = Chemical Abstract Service
COPC = Chemical Of Potential Concern
J = Estimated value
NA = Not Applicable/Not Available
ug/L = Microgram per liter

Rationale Codes:
For selection as a COPC:
ASL = Above Screening Level

For elimination as a COPC:
BKG = Less than background concentration
BSL = Below COPC Screening Level
NTX = No toxicity criteria

RAGS Part D Table 3

Medium-Specific Exposure Point Concentration Summary

LIST OF TABLES
RAGS PART D TABLE 3
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY

Table No.	Reasonable Maximum Exposures
3.1.RME	Surface Soil
3.2.RME	Subsurface Soil
3.3.RME	Groundwater

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE, INDIANA

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 25	Arsenic	mg/kg	12.0	15.5 (N)	24	15.5	mg/kg	95% Student's-t UCL	ProUCL 4.1.01
	Chromium	mg/kg	18.5	21.8 (N)	29	21.8	mg/kg	95% Student's-t UCL	ProUCL 4.1.01
	Iron	mg/kg	28700	36300 (N)	63000	36300	mg/kg	95% Student's-t UCL	ProUCL 4.1.01
	Benzo(a)pyrene	mg/kg	0.019	0.034 (N)	0.055	0.034	mg/kg	95% KM (t) UCL	ProUCL 4.1.01

G = Gamma
N = Normal

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.2.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE, INDIANA

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 25	Arsenic	mg/kg	7.7	10.2 (N)	14 J	10.2	mg/kg	95% Student's-t UCL	ProUCL 4.1.01
	Cobalt	mg/kg	6.3	10.7 (G)	23 J	10.7	mg/kg	95% Approximate Gamma UCL	ProUCL 4.1.01
	Iron	mg/kg	32000	54500 (G)	130000 J	54500	mg/kg	95% Approximate Gamma UCL	ProUCL 4.1.01
	Manganese	mg/kg	400	897 (G)	2600 J	897	mg/kg	95% Approximate Gamma UCL	ProUCL 4.1.01

G = Gamma
N = Normal

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.3.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 25	Aluminum	ug/L	1430	10225 (G)	5630	5630	ug/L	Maximum Detected Concentration	(1)
	Arsenic	ug/L	21.0	62.2 (G)	127	62.2	ug/L	95% KM (BCA) UCL	ProUCL 4.1.01
	Cadmium	ug/L	NA(2)	NA(3)	1.09 J	1.09	ug/L	Maximum Detected Concentration	(3)
	Chromium	ug/L	17.2	71 (G)	85.4	71	ug/L	95% KM (Chebyshev) UCL	ProUCL 4.1.01
	Cobalt	ug/L	30.9	117 (L)	149	117	ug/L	95% Chebyshev (Mean, Sd) UCL	ProUCL 4.1.01
	Iron	ug/L	27900	639000 (NP)	146000	146000	ug/L	Maximum Detected Concentration	(1)
	Manganese	ug/L	3340	5390 (N)	7440	5390	ug/L	95% Student's-t UCL	ProUCL 4.1.01
	Nickel	ug/L	94.6	317 (L)	398	317	ug/L	95% Chebyshev (Mean, Sd) UCL	ProUCL 4.1.01
	Thallium	ug/L	NA(2)	NA(3)	3.56 J	3.56	ug/L	Maximum Detected Concentration	(3)
	Vanadium	ug/L	9.1	19.3 (N)	31.3	19.3	ug/L	95% KM (t) UCL	ProUCL 4.1.01
	Naphthalene	ug/L	0.11	0.17 (N)	0.169 J	0.169	ug/L	Maximum Detected Concentration	(1)

EPC = Exposure point concentration.
G - Gamma distribution.
L - Lognormal distribution.
N - Normal distribution.
NP = Nonparametric distribution.
UCL = Upper Confidence Limit.

1 - The 95% UCL is greater than the maximum concentration; therefore, the maximum concentration was used as the EPC.
2 - There are less than three detected concentrations; therefore, the arithmetic mean concentration was not calculated.
3 - There are less than four detected concentrations. Reliable statistics cannot be computed. The maximum concentration was used as the EPC.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

RAGS Part D Table 4

Values Used For Daily Intake Calculations

LIST OF TABLES
RAGS PART D TABLE 4
VALUES USED FOR DAILY INTAKE CALCULATIONS

Table No.

Reasonable Maximum Exposures

4.1.RME Construction Workers Exposed to Surface Soil/Subsurface Soil
4.2.RME Construction Workers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.3.RME Construction Workers Exposed to Groundwater
4.4.RME Construction Workers Exposed to Volatile Emissions from Groundwater
4.5.RME Industrial Workers Exposed to Surface Soil/Subsurface Soil
4.6.RME Industrial Workers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.7.RME Adolescent Trespassers Exposed to Surface Soil/Subsurface Soil
4.8.RME Adolescent Trespassers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.9.RME Child Residents Exposed to Surface Soil/Subsurface Soil
4.10.RME Child Residents Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.11.RME Child Residents Exposed to Groundwater
4.12.RME Child Residents Exposed to Volatiles While Showering
4.13.RME Adult Residents Exposed to Surface Soil/Subsurface Soil
4.14.RME Adult Residents Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.15.RME Adult Residents Exposed to Groundwater
4.16.RME Adult Residents Exposed to Volatiles While Showering

Central Tendency Exposures

4.1.CTE Construction Workers Exposed to Surface Soil/Subsurface Soil
4.2.CTE Construction Workers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.3.CTE Construction Workers Exposed to Groundwater
4.4.CTE Construction Workers Exposed to Volatile Emissions from Groundwater
4.5.CTE Industrial Workers Exposed to Surface Soil/Subsurface Soil
4.6.CTE Industrial Workers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.7.CTE Adolescent Trespassers Exposed to Surface Soil/Subsurface Soil
4.8.CTE Adolescent Trespassers Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.9.CTE Child Residents Exposed to Surface Soil/Subsurface Soil
4.10.CTE Child Residents Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.11.CTE Child Residents Exposed to Groundwater
4.12.CTE Child Residents Exposed to Volatiles While Showering
4.13.CTE Adult Residents Exposed to Surface Soil/Subsurface Soil
4.14.CTE Adult Residents Exposed to Air Emissions from Surface Soil/Subsurface Soil
4.15.CTE Adult Residents Exposed to Groundwater
4.16.CTE Adult Residents Exposed to Volatiles While Showering

4.17 Dermal Worksheet

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS- SOILS

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	330	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	150	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Workers	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.3	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	150	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes:

1 - Professional judgment.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 2002a:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.77E-08 Cancer Dermal Intake = 8.30E-08

Noncancer Ingestion Intake = 1.94E-06 Noncancer Dermal Intake = 5.81E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - SOILS

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Construction Workers	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	165	mg/day	(1)	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	75	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
Dermal	Construction Workers	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2002b	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.1	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	75	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes:

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 2002a:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 6.92E-09 Cancer Dermal Intake = 1.38E-08

Noncancer Ingestion Intake = 4.84E-07 Noncancer Dermal Intake = 9.69E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.2.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - SOILS TO AIR

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	150	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration	1	years	(1)	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.34E+06	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	14.31	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Professional judgment.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.96E-03 Noncancer Inhalation Intake = 1.37E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.2.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - SOILS TO AIR

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	75	days/year	(1)	AT x 24 hours/day
				ED	Exposure Duration	1	years	(1)	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.34E+06	m3/kg	USEPA, 2002a	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	14.31	g/m2-s per kg/m3	USEPA, 2002a	

Notes:

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 9.78E-04 Noncancer Inhalation Intake = 6.85E-02

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.3.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - GROUNDWATER

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Workers	Adult	SWMU 25	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	30	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	1	years	(1)	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	70	kg	USEPA, 1989	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes

1 - Professional judgment.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Dermal Intake = 5.54E-02 Noncancer Dermal Intake = 3.87E+00

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.3.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - GROUNDWATER

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Workers	Adult	SWMU 25	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	4	hr/event	(1)	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	(1)	
				EF	Exposure Frequency	15	days/year	(1)	For organics if tevent > t*
				ED	Exposure Duration	1	years	(1)	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				BW	Body Weight	70	kg	USEPA, 1989	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	

Notes

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Cancer Dermal Intake = 2.77E-02 Noncancer Dermal Intake = 1.94E+00

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.4.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CONSTRUCTION WORKERS - GROUNDWATER TO AIR

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	VDEQ, 2004	Exposure Concentration (mg/m^3) =
				CW	Chemical concentration in water.	Max or 95% UCL	ug/L	--	
				CF	Conversion Factor	0.001	mg/ug	--	CA x ET x EF x ED
				ET	Exposure Time	4	hours/day	(1)	AT x 24 hours/day
				EF	Exposure Frequency	30	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	CA = CW x CF x VF
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				VF	Volatilization Factor	Calculated	(mg/m3)/(mg/L)	VDEQ, 2004	

Notes:

1 - Professional judgment.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

VDEQ, February 2012: Virginia Department of Environmental Quality (VDEQ, online- http://www.deq.state.va.us/vrprisk/homepage.html).

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.96E-07 Noncancer Inhalation Intake = 1.37E-05

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.4.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CONSTRUCTION WORKERS - GROUNDWATER TO AIR

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Construction Workers	Adult	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	VDEQ, 2004	Exposure Concentration (mg/m^3) =
				CW	Chemical concentration in water.	Max or 95% UCL	ug/L	--	
				CF	Conversion Factor	0.001	mg/ug	--	CA x ET x EF x ED
				ET	Exposure Time	4	hours/day	(1)	AT x 24 hours/day
				EF	Exposure Frequency	15	days/year	(1)	
				ED	Exposure Duration	1	years	(1)	CA = CW x CF x VF
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	365	days	USEPA, 1989	
				VF	Volatilization Factor	Calculated	(mg/m3)/(mg/L)	VDEQ, 2004	

Notes:

1 - Professional judgment. For some factors, CTE is assumed to be 50 percent of RME.

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

VDEQ, 2004: Virginia Department of Environmental Quality (VDEQ, online- http://www.deq.state.va.us/vrprisk/homepage.html).

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 9.78E-08 Noncancer Inhalation Intake = 6.85E-06

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.5.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - INDUSTRIAL WORKERS - SOIL
NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Workers	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 2002b	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 2002b	BW x AT
				EF	Exposure Frequency	250	days/year	USEPA, 2002b	
				ED	Exposure Duration	25	years	USEPA, 2002b	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	
Dermal	Industrial Workers	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	250	days/year	USEPA, 2002b	
				ED	Exposure Duration	25	years	USEPA, 1989	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	

Sources:
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.
USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)
Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 3.49E-07 Cancer Dermal Intake = 2.31E-06
Noncancer Ingestion Intake = 9.78E-07 Noncancer Dermal Intake = 6.46E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor
Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.5.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES - INDUSTRIAL WORKERS - SOIL
NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Industrial Workers	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	219	days/year	USEPA, 1993	
				ED	Exposure Duration	9	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 1989	
Dermal	Industrial Workers	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3300	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.02	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	219	days/year	USEPA, 1993	
				ED	Exposure Duration	9	years	USEPA, 1993	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 1989	

Sources:
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.
USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)
Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 5.51E-08 Cancer Dermal Intake = 7.27E-08
Noncancer Ingestion Intake = 4.29E-07 Noncancer Dermal Intake = 5.66E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor
Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.6.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - INDUSTRIAL WORKERS - SOIL TO AIR

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Industrial Workers	Adult	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	250	days/year	USEPA, 2002a	AT x 24 hours/day
				ED	Exposure Duration	25	years	USEPA, 2002a	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	9125	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.316E+09	m3/kg	IDEM, 2009	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.81	g/m2-s per kg/m3	IDEM, 2009	

Notes:

1 - Length of typical work day.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1997: Exposure Factors Handbook. USEPA/600/8-95/002FA.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

IDEM, 2009: RISC Technical Guide – January 31, 2006 Appendix 1, Revised May 1, 2009.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 8.15E-02 Noncancer Inhalation Intake = 2.28E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.6.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - INDUSTRIAL WORKERS - SOIL TO AIR

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Industrial Workers	Adult	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	8	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	219	days/year	USEPA, 2002a	AT x 24 hours/day
				ED	Exposure Duration	9	years	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3285	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.316E+09	m3/kg	IDEM, 2009	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.81	g/m2-s per kg/m3	IDEM, 2009	

Notes:

1 - Length of typical work day.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b:Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

IDEM, 2009: RISC Technical Guide – January 31, 2006 Appendix 1, Revised May 1, 2009.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 2.57E-02 Noncancer Inhalation Intake = 2.00E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.7.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SOILS

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	43	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3280	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	26	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	43	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

1 - Assume one day a week in warm weather months for RME and one day every other week for CTE.

2 - Older child from age 6 to 17.

3 - Assume 25 percent of total body surface area is exposed, USEPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors. OSWER Directive 9285.6-03.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 2.37E-08 Cancer Dermal Intake = 1.55E-07

Noncancer Ingestion Intake = 1.66E-07 Noncancer Dermal Intake = 1.09E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.7.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SOILS

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Trespassers	Adolescent	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	0.000001	kg/mg	--	CSs x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	43	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	
Dermal	Trespassers	Adolescent	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	0.000001	kg/mg	--	
				SA	Skin Surface Available for Contact	3280	cm2	(3)	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	13	days/year	(1)	
				ED	Exposure Duration	10	years	(2)	
				BW	Body Weight	43	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3650	days	USEPA, 1989	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA guidance (USEPA, 2005).

1 - Assume one day a week in warm weather months for RME and one day every other week for CTE.

2 - Older child from age 6 to 17.

3 - Assume 25 percent of total body surface area is exposed, U.S. EPA, 1997: Exposure Factors Handbook. EPA/600/8-95/002FA.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Cancer Ingestion Intake = 5.92E-09 Cancer Dermal Intake = 1.55E-08

Noncancer Ingestion Intake = 4.14E-08 Noncancer Dermal Intake = 1.09E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.8.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADOLESCENT TRESPASSERS - SOILS TO AIR

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespassers	Adolescent	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	4	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	26	days/year	(2)	AT x 24 hours/day
				ED	Exposure Duration	10	years	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.316E+09	m3/kg	IDEM, 2009	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.81	g/m2-s per kg/m3	IDEM, 2009	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

1 - Professional judgment.

2 - Assume one day a week in warm weather months for RME and one day every other week for CTE.

3 - Older child from age 6 to 17.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

IDEM, 2009: RISC Technical Guide – January 31, 2006 Appendix 1, Revised May 1, 2009.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 1.70E-03 Noncancer Inhalation Intake = 1.19E-02

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.8.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADOLESCENT TRESPASSERS - SOILS TO AIR

NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Trespassers	Adolescent	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	2	hours/day	(1)	CA x ET x EF x ED
				EF	Exposure Frequency	13	days/year	(2)	AT x 24 hours/day
				ED	Exposure Duration	10	years	(3)	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	3,650	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.316E+09	m3/kg	IDEM, 2009	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.81	g/m2-s per kg/m3	IDEM, 2009	

Notes:

For chemicals that act via the mutagenic mode of action the intake will be multiplied by the appropriate age-dependent adjustment factor in accordance with USEPA guidance (USEPA, 2005).

1 - Professional judgment.

2 - Assume one day a week in warm weather months for RME and one day every other week for CTE.

3 - Older child from age 6 to 17.

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

IDEM, 2009: RISC Technical Guide – January 31, 2006 Appendix 1, Revised May 1, 2009.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Cancer Inhalation Intake = 4.24E-04 Noncancer Inhalation Intake = 2.97E-03

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.9.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - SOILS
NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	200	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Resident	Child	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.2	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.
USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.
USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)
Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 1.10E-06 Cancer Dermal Intake (Age 0 - 6) = 3.07E-06

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 3.65E-07 Cancer Dermal Intake (Age 0 - 2) = 1.02E-06
Cancer Ingestion Intake (Age 2 - 6) = 7.31E-07 Cancer Dermal Intake (Age 2 - 6) = 2.05E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.28E-05 Noncancer Dermal Intake = 3.58E-05

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor
Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.9.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SOILS
NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Child	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
Dermal	Resident	Child	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	2,800	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.04	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	

Notes:
1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)
Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 1.22E-07 Cancer Dermal Intake = 1.37E-07

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 6.11E-08 Cancer Dermal Intake (Age 0 - 2) = 6.84E-08
Cancer Ingestion Intake (Age 2 - 6) = 6.11E-08 Cancer Dermal Intake (Age 2 - 6) = 6.84E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 4.27E-06 Noncancer Dermal Intake = 4.79E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor
Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.10.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS SOILS TO AIR

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 1991	CA x ET x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	CA = (1/PEF + 1/VF) x Cs
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2190	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.316E+09	m3/kg	IDEM, 2009	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.81	g/m2-s per kg/m3	IDEM, 2009	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

IDEM, 2009: RISC Technical Guide – January 31, 2006 Appendix 1, Revised May 1, 2009.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 6) = 8.22E-02

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 1.92E+00

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 2.74E-02

Cancer Inhalation Intake (Age 2 - 6) = 5.48E-02

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.10.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - SOILS TO AIR

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Child	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 1993	CA x ET x EF x ED
				EF	Exposure Frequency	234	days/year	USEPA, 1993	AT x 24 hours/day
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	1	years	(1), USEPA, 1989, 2005	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	730	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.316E+09	m3/kg	IDEM, 2009	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.81	g/m2-s per kg/m3	IDEM, 2009	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

IDEM, 2009: RISC Technical Guide – January 31, 2006 Appendix 1, Revised May 1, 2009.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake = 1.83E-02

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 6.41E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 9.16E-03

Cancer Inhalation Intake (Age 2 - 6) = 9.16E-03

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.11.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - GROUNDWATER
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	SWMU 25	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1.5	L/day	(1)	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1991	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Residents	Child	SWMU 25	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	1	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,600	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1991	
				ED1	Exposure Duration (Age 0 - 2)	2	years	(2), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(2), USEPA, 1989, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	15	kg	USEPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:
1 - Professional judgment.
1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.
USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)
Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 6) = 8.22E-06 Cancer Dermal Intake Time (Age 0 - 6) = 3.62E+01

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 2.74E-06 Cancer Dermal Intake (Age 0 - 2) = 1.21E+01
Cancer Ingestion Intake (Age 2 - 6) = 5.48E-06 Cancer Dermal Intake (Age 2 - 6) = 2.41E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 9.59E-05 Noncancer Dermal Intake = 4.22E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor
Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.11.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES - CHILD RESIDENTS - GROUNDWATER
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Child	SWMU 25	CGW	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	1.5	L/day	USEPA, 1997	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	234	days/year	USEPA, 1993	BW x AT
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1993	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	
Dermal	Residents	Child	SWMU 25	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	0.33	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	6,600	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	For organics if tevent > t*
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 2 - 6)	4	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	15	kg	USEPA, 1993	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)

Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 5.50E-06 Cancer Dermal Intake = 2.42E+01

Mutagenic Chemicals

Cancer Ingestion Intake (Age 0 - 2) = 1.83E-06 Cancer Dermal Intake (Age 0 - 2) = 8.06E+00

Cancer Ingestion Intake (Age 2 - 6) = 3.66E-06 Cancer Dermal Intake (Age 2 - 6) = 1.61E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 6.41E-05 Noncancer Dermal Intake = 2.82E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor

Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.12.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - CHILD RESIDENTS - INHALATION OF VOLATILES FROM GROUNDWATER

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residents	Child	SWMU 25	S	Volatile Chemical Generation Rate	Derived	mg/m3-min-shower	Foster&Chrostowski 1987	Exposure Concentration (mg/m^3)=
				K	Masss Transfer Coefficient	Derived	min	Foster&Chrostowski 1987	
				EF	Exposure Frequency	350	showers/year	USEPA, 1991	$\frac{S \times K \times EF \times ED}{AT \times Ra \times CF}$
				ED1	Exposure Duration (Age 0 - 2)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 4 - 6)	4	years	(1), USEPA, 1989, 2005	
				Ra	Air Exchange Rate	0.017	min^{-1}	Foster&Chrostowski 1987	
				CF	Conversion Factor	1440	min/day	--	
				Ds	Shower Duration	30	min	USEPA, 2004	
				Dt	Total Time in Bathroom	60	min	Professional judgement	
				Fr	Shower Water Flow Rate	10	L/min	Foster&Chrostowski 1987	
				Sv	Shower Room Air Volume	12	m^3	Foster&Chrostowski 1987	
				ts	Shower Dropler Drop Time	0.5	sec	Foster&Chrostowski 1987	
				d	Shower Droplet Diameter	1	mm	Foster&Chrostowski 1987	
				T1	Calibration Water Temperature	293	K	Foster&Chrostowski 1987	
				Ts	Shower Water Temperature	318	K	Foster&Chrostowski 1987	
				m1	Water Viscosity at T1	1.002	cp	Foster&Chrostowski 1987	
				ms	Water Viscosity at Ts	0.596	cp	Foster&Chrostowski 1987	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Noncancer)	2190	days	USEPA ,1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance

TABLE 4.12.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURE - CHILD RESIDENTS - INHALATION OF VOLATILES FROM GROUNDWATER

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residents	Child	SWMU 25	S	Volatile Chemical Generation Rate	Derived	mg/m3-min-shower	Foster & Chrostowski 1987	Exposure Concentration (mg/m^3)=
				K	Masss Transfer Coefficient	Derived	min	Foster&Chrostowski 1987	
				EF	Exposure Frequency	234	showers/year	USEPA, 1993	S x K x EF x ED
				ED1	Exposure Duration (Age 0 - 2)	1	years	(1), USEPA, 1989, 2005	AT x Ra x CF
				ED2	Exposure Duration (Age 4 - 6)	1	years	(1), USEPA, 1989, 2005	
				Ra	Air Exchange Rate	0.017	min^{-1}	Foster&Chrostowski 1987	
				CF	Conversion Factor	1440	min/day	--	
				Ds	Shower Duration	15	min	USEPA, 2004	
				Dt	Total Time in Bathroom	20	min	Professional Judgement	
				Fr	Shower Water Flow Rate	10	L/min	Foster&Chrostowski 1987	
				Sv	Shower Room Air Volume	12	m^3	Foster&Chrostowski 1987	
				ts	Shower Dropler Drop Time	0.5	sec	Foster&Chrostowski 1987	
				d	Shower Droplet Diameter	1	mm	Foster&Chrostowski 1987	
				T1	Calibration Water Temperature	293	K	Foster&Chrostowski 1987	
				Ts	Shower Water Temperature	318	K	Foster&Chrostowski 1987	
				m1	Water Viscosity at T1	1.002	cp	Foster&Chrostowski 1987	
				ms	Water Viscosity at Ts	0.596	cp	Foster&Chrostowski 1987	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Noncancer)	730	days	USEPA, 1989	

Notes:

1 - Children will be evaluated as one age group (0 - 6 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential children will be evaluated as two age groups, 0 - 2 years and 2 - 6 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.

Unit Intake Calculations

Inhalation Intake = (EF x ED)/(AT x Ra x CF)

Non-Mutagenic Chemicals

Cancer Inhalation Intake = 7.63E-04

Mutagenic Chemicals

Cancer Inhalation Intake (Age 0 - 2) = 3.82E-04

Cancer Inhalation Intake n (Age 4 - 6) = 3.82E-04

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 2.67E-02

TABLE 4.13.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SOILS
NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	100	mg/day	USEPA, 1991	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1991	BW x AT
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Resident	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002a	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.07	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 2002b	
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10, December.

USEPA, 2002b: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 4.70E-07 Cancer Dermal Intake (Age 6 - 30) = 1.87E-06

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.96E-07 Cancer Dermal Intake (Age 6 - 16) = 7.81E-07

Cancer Ingestion Intake (Age 16 - 30) = 2.74E-07 Cancer Dermal Intake (Age 16 - 30) = 1.09E-06

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.37E-06 Noncancer Dermal Intake = 5.47E-06

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.13.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SOILS
NSA CRANE, CRANE, INDIANA

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

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Intake (mg/kg/day) =
				IR-S	Ingestion Rate	50	mg/day	USEPA, 1993	
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	CS x IRS x CF3 x FI x EF x ED
				FI	Fraction Ingested	1	unitless	USEPA, 1993	BW x AT
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Resident	Adult	SWMU 25	CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002	Dermally Absorbed Dose (mg/kg/day) =
				CF3	Conversion Factor 3	1.0E-06	kg/mg	--	
				SA	Skin Surface Available for Contact	5,700	cm2	USEPA, 2004	CS x CF3 x SA x SSAF x DABS x EV x EF x ED
				SSAF	Soil to Skin Adherence Factor	0.01	mg/cm2/event	USEPA, 2004	BW x AT
				DABS	Absorption Factor	Chemical Specific	unitless	USEPA, 2004	
				EV	Events Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1993	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Incidental Ingestion Intake = (IR-S x CF3 x FI x EF x ED)/(BW x AT)

Dermal Intake = (CF3 x SA x SSAF x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 4.58E-08 Cancer Dermal Intake = 5.22E-08

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 1.31E-08 Cancer Dermal Intake (Age 6 - 16) = 1.49E-08

Cancer Ingestion Intake (Age 16 - 30) = 3.27E-08 Cancer Dermal Intake (Age 16 - 30) = 3.73E-08

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 4.58E-07 Noncancer Dermal Intake = 5.22E-07

Cancer risk from ingestion = Soil concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor

Cancer risk from dermal contact = Soil concentration x Cancer Dermal Intake x Absorption Factor x Dermal Cancer Slope Factor

Hazard Index from ingestion = Soil concentration x Noncancer Ingestion Intake / Oral Reference Dose

Hazard Index from dermal contact = Soil concentration x Noncancer Dermal Intake x Absorption Factor / Dermal Reference Dose

TABLE 4.14.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - SOILS TO AIR

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 1991	CA x ET x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 2002a	AT x 24 hours/day
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	CA = (1/PEF + 1/VF) x Cs
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8760	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.316E+09	m3/kg	IDEM, 2009	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.81	g/m2-s per kg/m3	IDEM, 2009	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

IDEM, 2009: RISC Technical Guide – January 31, 2006 Appendix 1, Revised May 1, 2009.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 30) = 3.29E-01

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 9.59E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 1.37E-01

Cancer Inhalation Intake (Age 16 - 30) = 1.92E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.14.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - SOILS TO AIR

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Surface/Subsurface Soil
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Resident	Adult	SWMU 25	CA	Chemical concentration in air	Calculated	mg/m3	USEPA, 2002a	Exposure Concentration (mg/m^3) =
				CS	Chemical concentration in soil	Max or 95% UCL	mg/kg	USEPA, 2002b	
				ET	Exposure Time	24	hours/day	USEPA, 1993	CA x ET x EF x ED
				EF	Exposure Frequency	234	days/year	USEPA, 1993	AT x 24 hours/day
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	CA = (1/PEF + 1/VF) x Cs
				AT-N	Averaging Time (Non-Cancer)	2555	days	USEPA, 1989	
				PEF	Particulate Emission Factor	1.316E+09	m3/kg	IDEM, 2009	
				VF	Volatilization Factor	Chemical-specific	m3/kg	USEPA, 2002a	
				Q/C	Inverse of mean concentration at center of source	68.81	g/m2-s per kg/m3	IDEM, 2009	

Notes:

1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. USEPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2002a: Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites. OSWER 9355.4-24.

USEPA, 2002b: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.

IDEM, 2009: RISC Technical Guide – January 31, 2006 Appendix 1, Revised May 1, 2009.

Unit Intake Calculations

Unit Exposure Concentration = (ET x EF x ED)/(AT x 24 hours/day)

Non-Mutagenic Chemicals

Cancer Inhalation Intake = 6.41E-02

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 6.41E-01

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 1.83E-02

Cancer Inhalation Intake (Age 16 - 30) = 4.58E-02

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Inhalation Cancer Slope Factor

Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Inhalation Reference Dose

TABLE 4.15.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - GROUNDWATER
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	SWMU 25	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	2	L/day	USEPA, 1989	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	350	days/year	USEPA, 1989	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	
Dermal	Residents	Adult	SWMU 25	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002a	DAevent x EV x EF x ED x SA
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	BW x AT
				CF	Conversion factor	0.001	L/cm^3	- -	
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	For inorganics
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	
				tevent	Duration of event	0.58	hr/event	USEPA, 2004	For organics if tevent <= t*
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				SA	Skin Surface Available for Contact	18,000	cm2	USEPA, 2004	
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	350	days/year	USEPA, 1989	For organics if tevent > t*
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	2 x τ +(1 + 3B + $3B^2$)/(1+B^2)
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	USEPA, 1989	

Notes:
1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.
USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)
Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 30) = 9.39E-06 Cancer Dermal Intake (Age 6 - 30) = 8.45E+01

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 3.91E-06 Cancer Dermal Intake (Age 6 - 16) = 3.52E+01
Cancer Ingestion Intake (Age 16 - 30) = 5.48E-06 Cancer Dermal Intake (Age 16 - 30) = 4.93E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 2.74E-05 Noncancer Dermal Intake = 2.47E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor
Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.15.CTE
VALUES USED FOR DAILY INTAKE CALCULATIONS
CENTRAL TENDENCY EXPOSURES - ADULT RESIDENTS - GROUNDWATER
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Residents	Adult	SWMU 25	CGW	Chemical Concentration in Groundwater	95% UCL or Max	ug/L	USEPA, 2002	Chronic Daily Intake (CDI) (mg/kg/day) =
				CF	Conversion Factor	0.001	mg/ug	--	
				IR-GW	Ingestion Rate of Groundwater	2	L/day	USEPA, 1989	CGW x CF x IR-GW x EF x ED
				EF	Exposure Frequency	234	days/year	USEPA, 1989	BW x AT
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	
Dermal	Residents	Adult	SWMU 25	Daevent	Dermally Absorbed Dose per Event	Calculated	mg/cm2-event	USEPA, 2004	Dermally Absorbed Dose (mg/kg/day) =
				Cw	Chemical Concentration in Groundwater	Max or 95% UCL	mg/kg	USEPA, 2002	
				FA	Fraction Absorbed	Chemical Specific	unitless	USEPA, 2004	DAevent x EV x EF x ED x SA
				CF	Conversion factor	0.001	L/cm^3	- -	BW x AT
				Kp	Permeability coefficient	Chemical Specific	cm/hr	USEPA, 2004	
				τ	Lag time	Chemical Specific	hr/event	USEPA, 2004	For inorganics
				t*	Time it takes to reach steady state	Chemical Specific	hr/event	USEPA, 2004	DAevent = Kp x CW x CF x tevent
				tevent	Duration of event	0.25	hr/event	USEPA, 2004	
				B	Bunge model constant	Chemical Specific	unitless	USEPA, 2004	For organics if tevent <= t*
				SA	Skin Surface Available for Contact	18,000	cm2	USEPA, 2004	DAevent= 2 x FA x Kp x Cw x CF x sqrt[(6 x τ x tevent)/pi]
				EV	Event Frequency	1	events/day	USEPA, 2004	
				EF	Exposure Frequency	234	days/year	USEPA, 1989	
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	DAevent =FA x Kp x Cw x CF x [tevent/(1+B) +
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				BW	Body Weight	70	kg	USEPA, 1989	$2 \times \tau + (1 + 3B + 3B^2)/(1+B^2)$
				AT-C	Averaging Time (Cancer)	25,550	days	USEPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,555	days	USEPA, 1989	

Notes:
1 - Adults will be evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults will be evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:
USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.
USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.
USEPA, 2002: Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites. OSWER 9285.6-10.
USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Unit Intake Calculations

Ingestion Intake = (IR-GW x EF x ED)/(BW x AT)
Dermal Intake = (SA x EV x EF x ED)/(BW x AT)

Non-Mutagenic Chemicals

Cancer Ingestion Intake = 1.83E-06 Cancer Dermal Intake = 1.65E+01

Mutagenic Chemicals

Cancer Ingestion Intake (Age 6 - 16) = 5.23E-07 Cancer Dermal Intake (Age 6 - 16) = 4.71E+00
Cancer Ingestion Intake (Age 16 - 30) = 1.31E-06 Cancer Dermal Intake (Age 16 - 30) = 1.18E+01

Noncarcinogenic Chemicals

Noncancer Ingestion Intake = 1.83E-05 Noncancer Dermal Intake = 1.65E+02

Cancer risk from ingestion = Groundwater concentration x Cancer Ingestion Intake x Oral Cancer Slope Factor
Cancer risk from dermal contact = Groundwater concentration x Cancer Dermal Intake x DAevent x Dermal Cancer Slope Factor
Hazard Index from ingestion = Groundwater concentration x Noncancer Ingestion Intake / Oral Reference Dose
Hazard Index from dermal contact = Groundwater concentration x Noncancer Dermal Intake x DAevent / Dermal Reference Dose

TABLE 4.16.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - INHALATION OF VOLATILES FROM GROUNDWATER

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residents	Adult	SWMU 25	S	Volatile Chemical Generation Rate	Derived	mg/m3-min-shower	Foster&Chrostowski 1987	Exposure Concentration (mg/m^3)=
				K	Masss Transfer Coefficient	Derived	min	Foster&Chrostowski 1987	
				EF	Exposure Frequency	350	showers/year	USEPA, 1991	S x K x EF x ED / AT x Ra x CF
				ED1	Exposure Duration (Age 6 - 16)	10	years	(1), USEPA, 1989, 2005	
				ED2	Exposure Duration (Age 16 - 30)	14	years	(1), USEPA, 1989, 2005	
				Ra	Air Exchange Rate	0.017	min^{-1}	Foster&Chrostowski 1987	
				CF	Conversion Factor	1440	min/day	--	
				Ds	Shower Duration	20	min	USEPA, 2004	
				Dt	Total Time in Bathroom	35	min	Professional judgement	
				Fr	Shower Water Flow Rate	10	L/min	Foster&Chrostowski 1987	
				Sv	Shower Room Air Volume	12	m^3	Foster&Chrostowski 1987	
				ts	Shower Dropler Drop Time	0.5	sec	Foster&Chrostowski 1987	
				d	Shower Droplet Diameter	1	mm	Foster&Chrostowski 1987	
				T1	Calibration Water Temperature	293	K	Foster&Chrostowski 1987	
				Ts	Shower Water Temperature	318	K	Foster&Chrostowski 1987	
				m1	Water Viscosity at T1	1.002	cp	Foster&Chrostowski 1987	
				ms	Water Viscosity at Ts	0.596	cp	Foster&Chrostowski 1987	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Noncancer)	8760	days	USEPA ,1989	

Notes:

1 - Adults were evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults were evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.

Unit Intake Calculations

Inhalation Intake = (EF x ED)/(AT x Ra x CF)

Non-Mutagenic Chemicals		Noncarcinogenic Chemicals	
Cancer Inhalation Intake (Age 6 - 30) =	1.37E-02	Noncancer Inhalation Intake =	4.00E-02

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) =	5.71E-03
Cancer Inhalation Intake (Age 16 - 30) =	7.99E-03

TABLE 4.16.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE - ADULT RESIDENTS - INHALATION OF VOLATILES FROM GROUNDWATER

NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Air

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Inhalation	Residents	Adult	SWMU 25	S	Volatile Chemical Generation Rate	Derived	mg/m3-min-shower	Foster & Chrostowski 1987	Exposure Concentration (mg/m^3)=
				K	Masss Transfer Coefficient	Derived	min	Foster&Chrostowski 1987	
				EF	Exposure Frequency	234	showers/year	USEPA, 1993	S x K x EF x ED
				ED1	Exposure Duration (Age 6 - 16)	2	years	(1), USEPA, 1989, 2005	AT x Ra x CF
				ED2	Exposure Duration (Age 16 - 30)	5	years	(1), USEPA, 1989, 2005	
				Ra	Air Exchange Rate	0.017	min^{-1}	Foster&Chrostowski 1987	
				CF	Conversion Factor	1440	min/day	--	
				Ds	Shower Duration	10	min	USEPA, 2004	
				Dt	Total Time in Bathroom	15	min	Professional Judgement	
				Fr	Shower Water Flow Rate	10	L/min	Foster&Chrostowski 1987	
				Sv	Shower Room Air Volume	12	m^3	Foster&Chrostowski 1987	
				ts	Shower Dropler Drop Time	0.5	sec	Foster&Chrostowski 1987	
				d	Shower Droplet Diameter	1	mm	Foster&Chrostowski 1987	
				T1	Calibration Water Temperature	293	K	Foster&Chrostowski 1987	
				Ts	Shower Water Temperature	318	K	Foster&Chrostowski 1987	
				m1	Water Viscosity at T1	1.002	cp	Foster&Chrostowski 1987	
				ms	Water Viscosity at Ts	0.596	cp	Foster&Chrostowski 1987	
				AT-C	Averaging Time (Cancer)	25550	days	USEPA, 1989	
				AT-N	Averaging Time (Noncancer)	2555	days	USEPA, 1989	

Notes:

1 - Adults were evaluated as one age group (7 - 30 years) for non-mutagenic chemicals. For chemicals that act via the mutagenic mode of action, residential adults were evaluated as two age groups, 7 - 16 years and 16 - 30 years in accordance with USEPA's Supplemental Guidance of Assessing Susceptibility from Early-Life Exposure to Carcinogens (USEPA, 2005).

Sources:

USEPA, 1989: Risk Assessment Guidance for Superfund. Vol 1: Human Health Evaluation Manual, Part A. EPA/540/1-86/060.

USEPA, 1991: Risk Assessment Guidance for Superfund - Supplemental Guidance- Standard Default Exposure Factors Interim Final.

USEPA, 1993: Superfund Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

Foster, S.A. and P.C. Chrostowski, 1987. Inhalation Exposure to Volatile Organic Contaminants in the Shower.

Unit Intake Calculations

Inhalation Intake = (EF x ED)/(AT x Ra x CF)

Non-Mutagenic Chemicals

Cancer Inhalation Intake = 2.67E-03

Noncarcinogenic Chemicals

Noncancer Inhalation Intake = 2.67E-02

Mutagenic Chemicals

Cancer Inhalation Intake (Age 6 - 16) = 7.63E-04

Cancer Inhalation Intake (Age 16 - 30) = 1.91E-03

TABLE 4-17

INTERMEDIATE VARIABLES FOR CALCULATING DA(EVENT)
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Medium	Dermal Absorption Fraction (soil)	FA	Kp		T(event)		Tau		T*		B
			Value	Value	Units	Value	Units	Value	Units	Value	Units	Value
Inorganics												
Aluminum	Groundwater	NA	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Arsenic	Soil, Groundwater	0.03	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Cadmium	Groundwater	NA	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Chromium	Soil, Groundwater	0	1	2.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Cobalt	Soil, Groundwater	0	1	4.00E-04	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Iron	Soil, Groundwater	0	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Manganese	Soil, Groundwater	0	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Nickel	Groundwater	NA	1	2.00E-04	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Thallium	Groundwater	NA	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Vanadium	Groundwater	NA	1	1.00E-03	cm/hr	(1)	hr	NA	NA	NA	NA	NA
Semivolatile Organic Compounds												
Benzo(a)pyrene	Soil	0.13	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Groundwater	NA	1	4.7E-02	cm/hr	(1)	hr	5.6E-01	hr	1.3E+00	hr	2.0E-01

Notes:
All values are from USEPA's Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final, July 2004.

1 - T(event) for the construction worker is 4 hours for RME and CTE. T(event) for the child resident is 1 hour for RME and 0.33 hour for CTE. T(event) for the adult resident is 0.58 hour for RME and 0.25 hour for CTE.
FA = Fraction absorbed water
Kp = Dermal permeability coefficient of a compound in water
T(event) = Event duration
Tau = Lag time
T* = Time to reach steady-state
B = Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis
cm/hr = centimeters per hour
hr = hour
NA = Not applicable for this medium.

RAGS Part D Table 5

Non-Cancer Toxicity Data

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NON-CANCER TOXICITY DATA

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5.1 Non-Cancer Toxicity Data - Oral/Dermal
5.2 Non-Cancer Toxicity Data - Inhalation

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal[1]	Absorbed RfD for Dermal[2]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Inorganics										
Aluminum	Chronic	1.0E+00	mg/kg/day	1	1.0E+00	mg/kg/day	CNS	100	PPRTV	10/23/2006
Arsenic	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Skin, CVS	3/1	IRIS	5/20/2013
Cadmium[3]	Chronic	5.0E-04	mg/kg/day	0.05	2.5E-05	mg/kg/day	Kidney	10/1	Cal EPA	9/2009
Chromium[4]	Subchronic	2.0E-02	mg/kg/day	0.025	5.0E-04	mg/kg/day	None Reported	100/3	HEAST	9/1997
	Chronic	3.0E-03	mg/kg/day	0.025	7.5E-05	mg/kg/day	None Reported	300/3	IRIS	5/20/2013
Cobalt	Subchronic	3.0E-03	mg/kg/day	1	3.0E-03	mg/kg/day	Thyroid	NA	PPRTV	8/25/2008
	Chronic	3.0E-04	mg/kg/day	1	3.0E-04	mg/kg/day	Thyroid	NA	PPRTV	8/25/2008
Iron	Subchronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	PPRTV	9/11/2006
	Chronic	7.0E-01	mg/kg/day	1	7.0E-01	mg/kg/day	GS	1.5	PPRTV	9/11/2006
Manganese[5]	Chronic	2.4E-02	mg/kg/day	0.04	9.6E-04	mg/kg/day	CNS	1	IRIS	5/20/2013
Nickel	Chronic	2.0E-02	mg/kg/day	0.04	8.0E-04	mg/kg/day	Body Weight	300/1	IRIS	5/20/2013
Thallium	Subchronic	4.0E-05	mg/kg/day	1	4.0E-05	mg/kg/day	Skin	1/1000	PPRTV	10/2010
	Chronic	1.0E-05	mg/kg/day	1	1.0E-05	mg/kg/day	Skin	NA	PPRTV	10/8/2010
Vanadium	Chronic	5.0E-03	mg/kg/day	1	5.0E-03	mg/kg/day	Kidney	300	RSL	11/2012
Semivolatile Organic Compounds										
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Subchronic	6.0E-01	mg/kg/day	1	6.0E-01	mg/kg/day	Central Nervous System	90/1	ATSDR	9/2005
	Chronic	2.0E-02	mg/kg/day	1	2.0E-02	mg/kg/day	Body Weight	3000/1	IRIS	5/20/2013

Notes:
1 - U.S. EPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted dermal RfD = Oral RfD x Oral Absorption Efficiency for Dermal.
3 - Value is for cadmium - water.
4 - Value is for hexavalent chromium.
5 - Adjusted IRIS value in accordance with recommendations on IRIS.

Definitions:
ATSDR = Agency for Toxic Substances and Disease Registry
Cal EPA = California Environmental Protection Agency
CNS = Central nervous system
CVS = Cardiovascular system
GS = Gastrointestinal system
HEAST = Health Effects Assessment Summary Tables
IRIS = Integrated Risk Information System
NA = Not available
PPRTV = Provisional Peer Reviewed Toxicity Value
RfD = Reference dose
RSL = USEPA Regional Screening Level Table, November 2012

TABLE 5.2

NON-CANCER TOXICITY DATA -- INHALATION
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC		Extrapolated RfD[1]		Primary Target Organ(s)	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s) (MM/DD/YYYY)
Inorganics									
Aluminum	Chronic	5.0E-03	mg/m^3	1.4E-03	(mg/kg/day)	CNS	300	PPRTV	10/23/2006
Arsenic	Chronic	1.5E-05	mg/m^3	4.3E-06	(mg/kg/day)	NA	NA	Cal EPA	9/2009
Cadmium	Chronic	2.0E-05	mg/m^3	5.7E-06	(mg/kg/day)	Respiratory	NA	ATSDR	9/2008
Chromium[2]	Chronic	1.0E-04	mg/m^3	2.9E-05	(mg/kg/day)	Respiratory	300/1	IRIS	5/20/2013
	Subchronic	2.0E-05	mg/m^3	5.7E-06	(mg/kg/day)	Respiratory	NA	PPRTV	8/25/2008
Cobalt	Chronic	6.0E-06	mg/m^3	1.7E-06	(mg/kg/day)	Respiratory	NA	PPRTV	8/25/2008
Iron	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	Chronic	5.0E-05	mg/m^3	1.4E-05	(mg/kg/day)	CNS	1000/1	IRIS	5/20/2013
	Subchronic	2.0E-04	mg/m^3	5.7E-05	(mg/kg/day)	Respiratory	30/1	ATSDR	9/2005
Nickel	Chronic	9.0E-05	mg/m^3	2.6E-05	(mg/kg/day)	Respiratory	30/1	ATSDR	9/2005
Thallium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds									
Benzo(a)pyrene	NA	NA	NA	NA	NA	NA	NA	NA	NA
Naphthalene	Chronic	3.0E-03	mg/m3	8.6E-04	(mg/kg/day)	Respiratory System	3000/1	IRIS	5/20/2013

Notes:
1 - Extrapolated RfD = RfC*$20m^3$/day / 70 kg.
2 - Value is for hexavalent chromium.

Definitions:
ATSDR = Agency for Toxic Substances and Disease Registry
Cal EPA = California Environmental Protection Agency
CNS = Central Nervous System
IRIS = Integrated Risk Information System
NA = Not Applicable
PPRTV = Provisional Peer Reviewed Toxicity Value
RfC = Reference concentration
RfD = Reference dose

RAGS Part D Table 6

Cancer Toxicity Data

LIST OF TABLES
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CANCER TOXICITY DATA

Table No.

6.1 Cancer Toxicity Data - Oral/Dermal
6.2 Cancer Toxicity Data - Inhalation

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal[1]	Absorbed Cancer Slope Factor for Dermal[2]		Weight of Evidence/ Cancer Guideline Description	Oral CSF	
	Value	Units		Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Inorganics								
Aluminum	NA	NA	NA	NA	NA	NA	NA	NA
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	1	1.5E+00	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	5/20/2013
Cadmium	NA	NA	NA	NA	NA	B1 / Probable human carcinogen	IRIS	5/20/2013
Chromium[3][4]	5.0E-01	$(mg/kg/day)^{-1}$	0.025	2.0E+01	$(mg/kg/day)^{-1}$	A / Known human carcinogen	NJDEP	4/8/2009
Cobalt	NA	NA	NA	NA	NA	NA	NA	NA
Iron	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	NA	D (Not classifiable as to human carcinogenicity)	IRIS	5/20/2013
Nickel	NA	NA	NA	NA	NA	NA	NA	NA
Thallium	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds								
Benzo(a)pyrene[4]	7.3E+00	$(mg/kg/day)^{-1}$	1	7.3E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	IRIS	5/20/2013
Naphthalene	NA	NA	NA	NA	NA	Carcinogenic potential cannot be determined	IRIS	5/20/2013

Notes:
1 - USEPA, 2004: Risk Assessment Guidance for Superfund (Part E, Supplemental Guidance for Dermal Risk Assessment) Interim. EPA/540/R/99/005.
2 - Adjusted cancer slope factor for dermal = Oral cancer slope factor / Oral Absorption Efficiency for Dermal.
3 - Value is for hexavalent chromium.
4 - Hexavalent chromium and benzo(a)pyrene are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Definitions:
CSF = Cancer Slope Factor
IRIS = Integrated Risk Information System.
NA = Not Available.
NJDEP = New Jersey Department of Environmental Protection, Derivation of Ingestion-Based Soil Remediation Criterion for Cr+6 Based on the NTP Chronic Bioassay Data for Sodium Dichromate Dihydrate, April 8, 2009.

TABLE 6.2

CANCER TOXICITY DATA -- INHALATION
SWMU 25 – HIGHWAY DUMP SITE A
NSA CRANE
CRANE, INDIANA

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor[1]		Weight of Evidence/ Cancer Guideline Description	Unit Risk : Inhalation CSF	
	Value	Units	Value	Units		Source(s)	Date(s) (MM/DD/YYYY)
Inorganics							
Aluminum	NA	NA	NA	NA	NA	NA	NA
Arsenic	4.3E-03	$(ug/m^3)^{-1}$	1.5E+01	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	5/20/2013
Cadmium	1.8E-03	$(ug/m^3)^{-1}$	6.3E+00	$(mg/kg/day)^{-1}$	B1 / Probable human carcinogen	IRIS	5/20/2013
Chromium[2][3]	8.4E-02	$(ug/m^3)^{-1}$	2.9E+02	$(mg/kg/day)^{-1}$	A / Known human carcinogen	IRIS	5/20/2013
Cobalt	9.0E-03	$(ug/m^3)^{-1}$	3.2E+01	$(mg/kg/day)^{-1}$	NA	PPRTV	8/25/2008
Iron	NA	NA	NA	NA	NA	NA	NA
Manganese	NA	NA	NA	NA	D / Not classifiable as to human carcinogenicity	IRIS	5/20/2013
Nickel	2.6E-04	$(ug/m^3)^{-1}$	9.1E-01	$(mg/kg/day)^{-1}$	NA	Cal EPA	9/2009
Thallium	NA	NA	NA	NA	NA	NA	NA
Vanadium	NA	NA	NA	NA	NA	NA	NA
Semivolatile Organic Compounds							
Benzo(a)pyrene[3]	1.1E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	B2 / Probable human carcinogen	Cal EPA	9/2009
Naphthalene	3.4E-05	$(ug/m^3)^{-1}$	1.2E-01	$(mg/kg/day)^{-1}$	Carcinogenic potential cannot be determined	Cal EPA(2)	8/2004

Notes:

1 - Inhalation CSF = Unit Risk * 70 kg / $20m^3$/day.

2 - Value is for hexavalent chromium.

3 - Hexavalent chromium and benzo(a)pyrene are considered to act via the mutagenic mode of action. These chemicals are evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Definitions:

Cal EPA = California Environmental Protection Agency, Technical Support Document for Describing Available Cancer Slope Factors, September 2009.

Cal EPA(2) = Air Toxic Hot Spots: Adoption of a Unit Risk Value for Naphthalene, August 2004.

CSF = Cancer Slope Factor.

IRIS = Integrated Risk Information System.

NA = Not Available.

PPRTV = Provisional Peer Reviewed Toxicity Value.

RAGS Part D Table 7

Calculation of Cancer Risks and Non-Cancer Hazards

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CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

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	REASONABLE MAXIMUM EXPOSURES
7.1.RME	Construction Workers
7.2.RME	Occupational Workers
7.3.RME	Adolescent Trespassers
7.4.RME	Child Residents
7.5.RME	Adult Residents
	CENTRAL TENDENCY EXPOSURES
7.1.CTE	Construction Workers
7.2.CTE	Occupational Workers
7.3.CTE	Adolescent Trespassers
7.4.CTE	Child Residents
7.5.CTE	Adult Residents

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	4.3E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6.4E-07	3.0E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.1
				Chromium	21.8	mg/kg	6.0E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	3.0E-07	4.2E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.002
				Iron	36,300	mg/kg	1.0E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.0E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.1
				Benzo(a)pyrene	0.034	mg/kg	9.4E-10	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	6.9E-09	6.6E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								9.5E-07					0.2
			Dermal	Arsenic	15.5	mg/kg	3.9E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.8E-08	2.7E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.009
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	3.7E-10	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.7E-09	2.6E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								6.1E-08					0.009
		Exposure Point Total									1.0E-06					0.2
	Exposure Medium Total										1.0E-06					0.2
	Air	SWMU 25	Inhalation	Arsenic	1.2E-5	mg/m^3	2.3E-08	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	9.7E-08	1.6E-06	(mg/m^3)	1.5E-05	(mg/m^3)	0.1
				Chromium	1.6E-5	mg/m^3	3.2E-08	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	2.7E-06	2.2E-06	(mg/m^3)	2.0E-05	(mg/m^3)	0.1
				Iron	0.027	mg/m^3	5.3E-05	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	3.7E-03	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.5E-8	mg/m^3	5.0E-11	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	5.5E-11	3.5E-09	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								2.8E-06					0.2
		Exposure Point Total									2.8E-06					0.2
	Exposure Medium Total										2.8E-06					0.2
Medium Total											3.8E-06					0.4
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	2.8E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.2E-07	2.0E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.07
				Cobalt	10.7	mg/kg	3.0E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.1E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.007
				Iron	54,500	mg/kg	1.5E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-01	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.2
				Manganese	897	mg/kg	2.5E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.7E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.07
			Exp. Route Total								4.2E-07					0.3
			Dermal	Arsenic	10.2	mg/kg	2.5E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.8E-08	1.8E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.006
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								3.8E-08					0.006
		Exposure Point Total									4.6E-07					0.3
	Exposure Medium Total										4.6E-07					0.3
	Air	SWMU 25	Inhalation	Arsenic	7.6E-6	mg/m^3	1.5E-08	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	6.4E-08	1.0E-06	(mg/m^3)	1.5E-05	(mg/m^3)	0.07
				Cobalt	8.0E-6	mg/m^3	1.6E-08	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	1.4E-07	1.1E-06	(mg/m^3)	2.0E-05	(mg/m^3)	0.05
				Iron	0.041	mg/m^3	8.0E-05	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	5.6E-03	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.7E-4	mg/m^3	1.3E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	9.2E-05	(mg/m^3)	5.0E-05	(mg/m^3)	1.8
			Exp. Route Total								2.0E-07					2.0
		Exposure Point Total									2.0E-07					2.0
	Exposure Medium Total										2.0E-07					2.0
Medium Total											6.7E-07					2.3

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Dermal	Aluminum	163	ug/L	3.6E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.5E-06	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.0005
				Arsenic	1.5	ug/L	3.3E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.0E-10	2.3E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00008
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	2.5E-05	(mg/kg/day)	--
				Chromium	3.9	ug/L	1.7E-09	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	3.5E-08	1.2E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0002
				Cobalt	16.60	ug/L	1.5E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00003
				Iron	2400	ug/L	5.3E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.7E-05	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.00005
				Manganese	1,300	ug/L	2.9E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.0E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.02
				Nickel	37.70	ug/L	1.7E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-07	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.0001
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	2.2E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.5E-08	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.000003
				Naphthalene	0.2	ug/L	2.0E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.4E-07	(mg/kg/day)	6.0E-01	(mg/kg/day)	2.4E-7
			Exp. Route Total								3.5E-08					0.02
		Exposure Point Total									3.5E-08					0.02
	Exposure Medium Total										3.5E-08					0.02
	Air	SWMU 25	Inhalation	Aluminum	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Cadmium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	1.8E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Iron	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-05	(mg/m^3)	--
				Nickel	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	2.6E-04	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-04	(mg/m^3)	--
				Thallium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Naphthalene	4.9E-6	mg/m^3	9.6E-10	(mg/m^3)	3.4E-05	$(ug/m^3)^{-1}$	3.3E-11	6.7E-08	(mg/m^3)	3.0E-03	(mg/m^3)	0.00002
			Exp. Route Total								3.3E-11					0.00002
		Exposure Point Total									3.3E-11					0.00002
	Exposure Medium Total										3.3E-11					0.00002
Medium Total											3.5E-08					0.02
										Total of Receptor Risks Across All Media	4.5E-06				Total of Receptor Hazards Across All Media	2.7

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	5.4E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	8.1E-06	1.5E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.05
				Chromium	21.8	mg/kg	7.6E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	3.8E-06	2.1E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.007
				Iron	36,300	mg/kg	1.3E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.6E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.05
				Benzo(a)pyrene	0.034	mg/kg	1.2E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	8.7E-08	3.3E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.2E-05					0.1
			Dermal	Arsenic	15.5	mg/kg	1.1E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.6E-06	3.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	1.0E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	7.4E-08	2.9E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.7E-06					0.01
		Exposure Point Total									1.4E-05					0.1
	Exposure Medium Total										1.4E-05					0.1
	Air	SWMU 25	Inhalation	Arsenic	1.2E-8	mg/m^3	9.6E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	4.1E-09	2.7E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0002
				Chromium	1.7E-8	mg/m^3	1.4E-09	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1.1E-07	3.8E-09	(mg/m^3)	2.0E-05	(mg/m^3)	0.0002
				Iron	2.8E-5	mg/m^3	2.2E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	6.3E-06	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.6E-11	mg/m^3	2.1E-12	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	2.3E-12	5.9E-12	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.2E-07					0.0004
		Exposure Point Total									1.2E-07					0.0004
	Exposure Medium Total										1.2E-07					0.0004
Medium Total											1.4E-05					0.1
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	3.6E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.3E-06	1.0E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.03
				Cobalt	10.7	mg/kg	3.7E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.03
				Iron	54,500	mg/kg	1.9E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.3E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.08
				Manganese	897	mg/kg	3.1E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.8E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.04
			Exp. Route Total								5.3E-06					0.2
			Dermal	Arsenic	10.2	mg/kg	7.1E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-06	2.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.007
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								1.1E-06					0.007
		Exposure Point Total									6.4E-06					0.2
	Exposure Medium Total										6.4E-06					0.2
	Air	SWMU 25	Inhalation	Arsenic	7.8E-9	mg/m^3	6.3E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	2.7E-09	1.8E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0001
				Cobalt	8.1E-9	mg/m^3	6.6E-10	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	6.0E-09	1.9E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.0003
				Iron	4.1E-5	mg/m^3	3.4E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	9.5E-06	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.8E-7	mg/m^3	5.6E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.6E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.003
			Exp. Route Total								8.7E-09					0.004
		Exposure Point Total									8.7E-09					0.004
	Exposure Medium Total										8.7E-09					0.004
Medium Total											6.4E-06					0.2
										Total of Receptor Risks Across All Media	2.0E-05				Total of Receptor Hazards Across All Media	0.3

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	3.7E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.5E-07	2.6E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.009
				Chromium	21.8	mg/kg	1.5E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	7.7E-07	3.6E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.001
				Iron	36,300	mg/kg	8.6E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.0E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.009
				Benzo(a)pyrene	0.034	mg/kg	2.4E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.8E-08	5.6E-09	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.3E-06					0.02
			Dermal	Arsenic	15.5	mg/kg	7.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-07	5.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	2.1E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.5E-08	4.8E-09	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.2E-07					0.002
		Exposure Point Total									1.5E-06					0.02
	Exposure Medium Total										1.5E-06					0.02
	Air	SWMU 25	Inhalation	Arsenic	1.2E-8	mg/m^3	2.0E-11	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	8.6E-11	1.4E-10	(mg/m^3)	1.5E-05	(mg/m^3)	0.000009
				Chromium	1.7E-8	mg/m^3	8.4E-11	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	7.1E-09	2.0E-10	(mg/m^3)	2.0E-05	(mg/m^3)	0.000010
				Iron	2.8E-5	mg/m^3	4.7E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	3.3E-07	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.6E-11	mg/m^3	1.3E-13	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	1.4E-13	3.1E-13	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								7.2E-09					0.00002
		Exposure Point Total									7.2E-09					0.00002
	Exposure Medium Total										7.2E-09					0.00002
Medium Total											1.5E-06					0.02
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	2.4E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.6E-07	1.7E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.006
				Cobalt	10.7	mg/kg	2.5E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.8E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.006
				Iron	54,500	mg/kg	1.3E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	9.0E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.01
				Manganese	897	mg/kg	2.1E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.5E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.006
			Exp. Route Total								3.6E-07					0.03
			Dermal	Arsenic	10.2	mg/kg	4.8E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.1E-08	3.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.001
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								7.1E-08					0.001
		Exposure Point Total									4.3E-07					0.03
	Exposure Medium Total										4.3E-07					0.03
	Air	SWMU 25	Inhalation	Arsenic	7.8E-9	mg/m^3	1.3E-11	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	5.7E-11	9.2E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000006
				Cobalt	8.1E-9	mg/m^3	1.4E-11	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	1.2E-10	9.7E-11	(mg/m^3)	6.0E-06	(mg/m^3)	0.00002
				Iron	4.1E-5	mg/m^3	7.0E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.9E-07	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.8E-7	mg/m^3	1.2E-09	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	8.1E-09	(mg/m^3)	5.0E-05	(mg/m^3)	0.0002
			Exp. Route Total								1.8E-10					0.0002
		Exposure Point Total									1.8E-10					0.0002
	Exposure Medium Total										1.8E-10					0.0002
Medium Total											4.3E-07					0.03
										Total of Receptor Risks Across All Media	1.9E-06				Total of Receptor Hazards Across All Media	0.05

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	1.7E-05	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.5E-05	2.0E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.7
				Chromium	21.8	mg/kg	1.3E-04	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	6.4E-05	2.8E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.09
				Iron	36,300	mg/kg	4.0E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.6E-01	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.7
				Benzo(a)pyrene	0.034	mg/kg	2.0E-07	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.5E-06	4.3E-07	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								9.1E-05					1.4
			Dermal	Arsenic	15.5	mg/kg	1.4E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.1E-06	1.7E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.06
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	7.2E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	5.3E-07	1.6E-07	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								2.7E-06					0.06
		Exposure Point Total									9.3E-05					1.5
	Exposure Medium Total										9.3E-05					1.5
	Air	SWMU 25	Inhalation	Arsenic	1.2E-8	mg/m^3	9.7E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	4.2E-09	1.1E-08	(mg/m^3)	1.5E-05	(mg/m^3)	0.0008
				Chromium	1.7E-8	mg/m^3	7.3E-09	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	6.1E-07	1.6E-08	(mg/m^3)	2.0E-05	(mg/m^3)	0.0008
				Iron	2.8E-5	mg/m^3	2.3E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.6E-05	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.6E-11	mg/m^3	1.1E-11	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	1.2E-11	2.5E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								6.1E-07					0.002
		Exposure Point Total									6.1E-07					0.002
	Exposure Medium Total										6.1E-07					0.002
Medium Total											9.4E-05					1.5
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	1.1E-05	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.7E-05	1.3E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.4
				Cobalt	10.7	mg/kg	1.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.4E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.5
				Iron	54,500	mg/kg	6.0E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.0E-01	(mg/kg/day)	7.0E-01	(mg/kg/day)	1.0
				Manganese	897	mg/kg	9.8E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-02	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.5
			Exp. Route Total								1.7E-05					2.4
			Dermal	Arsenic	10.2	mg/kg	9.4E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.4E-06	1.1E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.04
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								1.4E-06					0.04
		Exposure Point Total									1.8E-05					2.4
	Exposure Medium Total										1.8E-05					2.4
	Air	SWMU 25	Inhalation	Arsenic	7.8E-9	mg/m^3	6.4E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	2.7E-09	7.4E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0005
				Cobalt	8.1E-9	mg/m^3	6.7E-10	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	6.0E-09	7.8E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.001
				Iron	4.1E-5	mg/m^3	3.4E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.0E-05	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.8E-7	mg/m^3	5.6E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	6.5E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.01
			Exp. Route Total								8.8E-09					0.01
		Exposure Point Total									8.8E-09					0.01
	Exposure Medium Total										8.8E-09					0.01
Medium Total											1.8E-05					2.4

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Ingestion	Aluminum	163	ug/L	1.3E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.6E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.02
				Arsenic	1.5	ug/L	1.2E-05	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.8E-05	1.4E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.5
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
				Chromium	3.9	ug/L	1.7E-04	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	8.5E-05	3.7E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.1
				Cobalt	16.60	ug/L	1.4E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.6E-03	(mg/kg/day)	3.0E-04	(mg/kg/day)	5.3
				Iron	2400	ug/L	2.0E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.3E-01	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.3
				Manganese	1,300	ug/L	1.1E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.2E-01	(mg/kg/day)	2.4E-02	(mg/kg/day)	5.2
				Nickel	37.70	ug/L	3.1E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.6E-03	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.2
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	8.2E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.6E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.02
				Naphthalene	0.2	ug/L	1.4E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.6E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0008
			Exp. Route Total								1.0E-04					12
			Dermal	Aluminum	163	ug/L	5.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.9E-05	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.00007
				Arsenic	1.5	ug/L	5.4E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	8.1E-08	6.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.5E-05	(mg/kg/day)	--
				Chromium	3.9	ug/L	1.5E-06	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	3.0E-05	3.3E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.04
				Cobalt	16.60	ug/L	2.4E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.8E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.009
				Iron	2400	ug/L	8.7E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.0E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.001
				Manganese	1,300	ug/L	4.7E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.5E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.6
				Nickel	37.70	ug/L	2.7E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.2E-06	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.004
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	3.6E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.2E-07	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.00008
				Naphthalene	0.2	ug/L	5.9E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.9E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0003
			Exp. Route Total								3.0E-05					0.6
		Exposure Point Total									1.3E-04					12
	Exposure Medium Total										1.3E-04					12
	Air	SWMU 25	Inhalation	Aluminum	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-03	(mg/m^3)	--
				Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Cadmium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	1.8E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	6.0E-06	(mg/m^3)	--
				Iron	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-05	(mg/m^3)	--
				Nickel	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	2.6E-04	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	9.0E-05	(mg/m^3)	--
				Thallium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Naphthalene	1.8E-4	mg/m^3	6.1E-07	(mg/m^3)	3.4E-05	(ug/m^3)$^{-1}$	2.1E-08	7.1E-06	(mg/m^3)	3.0E-03	(mg/m^3)	0.002
			Exp. Route Total								2.1E-08					0.002
		Exposure Point Total									2.1E-08					0.002
	Exposure Medium Total										2.1E-08					0.002
Medium Total											1.3E-04					12
										Total of Receptor Risks Across All Media	2.5E-04				Total of Receptor Hazards Across All Media	16

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	7.3E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-05	2.1E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.07
				Chromium	21.8	mg/kg	1.9E-05	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	9.4E-06	3.0E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.010
				Iron	36,300	mg/kg	1.7E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.0E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.07
				Benzo(a)pyrene	0.034	mg/kg	2.9E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.1E-07	4.7E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								2.1E-05					0.2
			Dermal	Arsenic	15.5	mg/kg	8.7E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.3E-06	2.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.008
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	1.5E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.1E-07	2.4E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.4E-06					0.008
		Exposure Point Total									2.2E-05					0.2
	Exposure Medium Total										2.2E-05					0.2
	Air	SWMU 25	Inhalation	Arsenic	1.2E-8	mg/m^3	3.9E-09	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1.7E-08	1.1E-08	(mg/m^3)	1.5E-05	(mg/m^3)	0.0008
				Chromium	1.7E-8	mg/m^3	1.0E-08	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	8.4E-07	1.6E-08	(mg/m^3)	2.0E-05	(mg/m^3)	0.0008
				Iron	2.8E-5	mg/m^3	9.1E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.6E-05	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.6E-11	mg/m^3	1.6E-11	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	1.7E-11	2.5E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								8.6E-07					0.002
		Exposure Point Total									8.6E-07					0.002
	Exposure Medium Total										8.6E-07					0.002
Medium Total											2.3E-05					0.2
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	4.8E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.2E-06	1.4E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.05
				Cobalt	10.7	mg/kg	5.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.5E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.05
				Iron	54,500	mg/kg	2.6E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.5E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.1
				Manganese	897	mg/kg	4.2E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.05
			Exp. Route Total								7.2E-06					0.3
			Dermal	Arsenic	10.2	mg/kg	5.7E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	8.6E-07	1.7E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.006
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								8.6E-07					0.006
		Exposure Point Total									8.0E-06					0.3
	Exposure Medium Total										8.0E-06					0.3
	Air	SWMU 25	Inhalation	Arsenic	7.8E-9	mg/m^3	2.5E-09	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1.1E-08	7.4E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0005
				Cobalt	8.1E-9	mg/m^3	2.7E-09	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	2.4E-08	7.8E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.001
				Iron	4.1E-5	mg/m^3	1.4E-05	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.0E-05	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.8E-7	mg/m^3	2.2E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	6.5E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.01
			Exp. Route Total								3.5E-08					0.01
		Exposure Point Total									3.5E-08					0.01
	Exposure Medium Total										3.5E-08					0.01
Medium Total											8.1E-06					0.3

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Ingestion	Aluminum	163	ug/L	1.5E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.5E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.004
				Arsenic	1.5	ug/L	1.4E-05	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	2.1E-05	4.1E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.1
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
				Chromium	3.9	ug/L	6.7E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	3.4E-05	1.1E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.04
				Cobalt	16.60	ug/L	1.6E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.5E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	1.5
				Iron	2400	ug/L	2.3E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.6E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.09
				Manganese	1,300	ug/L	1.2E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.6E-02	(mg/kg/day)	2.4E-02	(mg/kg/day)	1.5
				Nickel	37.70	ug/L	3.5E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.0E-03	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.05
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	9.4E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.7E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.005
				Naphthalene	0.2	ug/L	1.6E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.6E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0002
			Exp. Route Total								5.5E-05					3.3
			Dermal	Aluminum	163	ug/L	8.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.3E-05	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.00002
				Arsenic	1.5	ug/L	7.4E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.1E-07	2.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0007
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.5E-05	(mg/kg/day)	--
				Chromium	3.9	ug/L	7.0E-07	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	1.4E-05	1.1E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.01
				Cobalt	16.60	ug/L	3.3E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Iron	2400	ug/L	1.2E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.4E-04	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.0005
				Manganese	1,300	ug/L	6.4E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.9E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.2
				Nickel	37.70	ug/L	3.7E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.1E-06	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.001
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	4.9E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.4E-07	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.00003
				Naphthalene	0.2	ug/L	1.0E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.1E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0002
			Exp. Route Total								1.4E-05					0.2
		Exposure Point Total									6.9E-05					3.5
	Exposure Medium Total										6.9E-05					3.5
	Air	SWMU 25	Inhalation	Aluminum	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-03	(mg/m^3)	--
				Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Cadmium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	1.8E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	6.0E-06	(mg/m^3)	--
				Iron	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-05	(mg/m^3)	--
				Nickel	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	2.6E-04	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	9.0E-05	(mg/m^3)	--
				Thallium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Naphthalene	7.7E-5	mg/m^3	1.1E-06	(mg/m^3)	3.4E-05	(ug/m^3)$^{-1}$	3.6E-08	3.1E-06	(mg/m^3)	3.0E-03	(mg/m^3)	0.001
			Exp. Route Total								3.6E-08					0.001
		Exposure Point Total									3.6E-08					0.001
	Exposure Medium Total										3.6E-08					0.001
Medium Total											6.9E-05					3.5
										Total of Receptor Risks Across All Media	1.0E-04				Total of Receptor Hazards Across All Media	4.0

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.1.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	1.1E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.6E-07	7.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.03
				Chromium	21.8	mg/kg	1.5E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	7.5E-08	1.1E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0005
				Iron	36,300	mg/kg	2.5E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.8E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.03
				Benzo(a)pyrene	0.034	mg/kg	2.4E-10	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.7E-09	1.6E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								2.4E-07					0.05
			Dermal	Arsenic	15.5	mg/kg	6.4E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	9.7E-09	4.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	6.1E-11	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	4.5E-10	4.3E-09	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.0E-08					0.002
		Exposure Point Total									2.5E-07					0.05
	Exposure Medium Total										2.5E-07					0.05
	Air	SWMU 25	Inhalation	Arsenic	1.2E-5	mg/m^3	1.1E-08	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	4.9E-08	7.9E-07	(mg/m^3)	1.5E-05	(mg/m^3)	0.05
				Chromium	1.6E-5	mg/m^3	1.6E-08	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1.3E-06	1.1E-06	(mg/m^3)	2.0E-05	(mg/m^3)	0.06
				Iron	0.027	mg/m^3	2.7E-05	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.9E-03	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.5E-8	mg/m^3	2.5E-11	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	2.7E-11	1.7E-09	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.4E-06					0.1
		Exposure Point Total									1.4E-06					0.1
	Exposure Medium Total										1.4E-06					0.1
Medium Total											1.6E-06					0.2
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	7.1E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-07	4.9E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Cobalt	10.7	mg/kg	7.4E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.2E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.002
				Iron	54,500	mg/kg	3.8E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.6E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.04
				Manganese	897	mg/kg	6.2E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.3E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.02
			Exp. Route Total								1.1E-07					0.07
			Dermal	Arsenic	10.2	mg/kg	4.2E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6.4E-09	3.0E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0010
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								6.4E-09					0.0010
		Exposure Point Total									1.1E-07					0.07
	Exposure Medium Total										1.1E-07					0.07
	Air	SWMU 25	Inhalation	Arsenic	7.6E-6	mg/m^3	7.4E-09	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	3.2E-08	5.2E-07	(mg/m^3)	1.5E-05	(mg/m^3)	0.03
				Cobalt	8.0E-6	mg/m^3	7.8E-09	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	7.0E-08	5.5E-07	(mg/m^3)	2.0E-05	(mg/m^3)	0.03
				Iron	0.041	mg/m^3	4.0E-05	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.8E-03	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.7E-4	mg/m^3	6.5E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.6E-05	(mg/m^3)	5.0E-05	(mg/m^3)	0.9
			Exp. Route Total								1.0E-07					1.0
		Exposure Point Total									1.0E-07					1.0
	Exposure Medium Total										1.0E-07					1.0
Medium Total											2.1E-07					1.1

TABLE 7.1.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Dermal	Aluminum	163	ug/L	1.8E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-06	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.0003
				Arsenic	1.5	ug/L	1.7E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.5E-10	1.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00004
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	2.5E-05	(mg/kg/day)	--
				Chromium	3.9	ug/L	8.6E-10	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	1.7E-08	6.0E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0001
				Cobalt	16.60	ug/L	7.4E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.1E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00002
				Iron	2400	ug/L	2.7E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.9E-05	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.00003
				Manganese	1,300	ug/L	1.4E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.01
				Nickel	37.70	ug/L	8.3E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.8E-08	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.00007
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	1.1E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.7E-09	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.000002
				Naphthalene	0.2	ug/L	1.0E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.1E-08	(mg/kg/day)	6.0E-01	(mg/kg/day)	1.2E-7
			Exp. Route Total								1.8E-08					0.01
		Exposure Point Total									1.8E-08					0.01
	Exposure Medium Total										1.8E-08					0.01
	Air	SWMU 25	Inhalation	Aluminum	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Cadmium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	1.8E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Iron	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-05	(mg/m^3)	--
				Nickel	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	2.6E-04	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-04	(mg/m^3)	--
				Thallium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Naphthalene	4.9E-6	mg/m^3	4.8E-10	(mg/m^3)	3.4E-05	$(ug/m^3)^{-1}$	1.6E-11	3.4E-08	(mg/m^3)	3.0E-03	(mg/m^3)	0.00001
			Exp. Route Total								1.6E-11					0.00001
		Exposure Point Total									1.6E-11					0.00001
	Exposure Medium Total										1.6E-11					0.00001
Medium Total											1.8E-08					0.01
										Total of Receptor Risks Across All Media	1.9E-06				Total of Receptor Hazards Across All Media	1.2

TABLE 7.2.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	8.5E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.3E-06	6.6E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Chromium	21.8	mg/kg	1.2E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	6.0E-07	9.3E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.003
				Iron	36,300	mg/kg	2.0E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.02
				Benzo(a)pyrene	0.034	mg/kg	1.9E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.4E-08	1.5E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.9E-06					0.05
			Dermal	Arsenic	15.5	mg/kg	3.4E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.1E-08	2.6E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0009
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	3.2E-10	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.3E-09	2.5E-09	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								5.3E-08					0.0009
		Exposure Point Total									1.9E-06					0.05
	Exposure Medium Total										1.9E-06					0.05
	Air	SWMU 25	Inhalation	Arsenic	1.2E-8	mg/m^3	3.0E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1.3E-09	2.4E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0002
				Chromium	1.7E-8	mg/m^3	4.3E-10	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	3.6E-08	3.3E-09	(mg/m^3)	2.0E-05	(mg/m^3)	0.0002
				Iron	2.8E-5	mg/m^3	7.1E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	5.5E-06	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.6E-11	mg/m^3	6.6E-13	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	7.3E-13	5.2E-12	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								3.7E-08					0.0003
		Exposure Point Total									3.7E-08					0.0003
	Exposure Medium Total										3.7E-08					0.0003
Medium Total											2.0E-06					0.05
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	5.6E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	8.4E-07	4.4E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.01
				Cobalt	10.7	mg/kg	5.9E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.6E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Iron	54,500	mg/kg	3.0E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.3E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.03
				Manganese	897	mg/kg	4.9E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.8E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.02
			Exp. Route Total								8.4E-07					0.08
			Dermal	Arsenic	10.2	mg/kg	2.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.3E-08	1.7E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0006
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								3.3E-08					0.0006
		Exposure Point Total									8.8E-07					0.08
	Exposure Medium Total										8.8E-07					0.08
	Air	SWMU 25	Inhalation	Arsenic	7.8E-9	mg/m^3	2.0E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	8.6E-10	1.6E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0001
				Cobalt	8.1E-9	mg/m^3	2.1E-10	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	1.9E-09	1.6E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.0003
				Iron	4.1E-5	mg/m^3	1.1E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	8.3E-06	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.8E-7	mg/m^3	1.8E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.4E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.003
			Exp. Route Total								2.7E-09					0.003
		Exposure Point Total									2.7E-09					0.003
	Exposure Medium Total										2.7E-09					0.003
Medium Total											8.8E-07					0.08
										Total of Receptor Risks Across All Media	2.9E-06				Total of Receptor Hazards Across All Media	0.1

TABLE 7.3.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	9.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.4E-07	6.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Chromium	21.8	mg/kg	3.9E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	1.9E-07	9.0E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0003
				Iron	36,300	mg/kg	2.1E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.5E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.002
				Benzo(a)pyrene	0.034	mg/kg	6.0E-10	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	4.4E-09	1.4E-09	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								3.4E-07					0.005
			Dermal	Arsenic	15.5	mg/kg	7.2E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-08	5.1E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	2.1E-10	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.5E-09	4.8E-10	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.2E-08					0.0002
		Exposure Point Total									3.5E-07					0.005
	Exposure Medium Total										3.5E-07					0.005
	Air	SWMU 25	Inhalation	Arsenic	1.2E-8	mg/m^3	5.0E-12	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	2.1E-11	3.5E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000002
				Chromium	1.7E-8	mg/m^3	2.1E-11	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1.8E-09	4.9E-11	(mg/m^3)	2.0E-05	(mg/m^3)	0.000002
				Iron	2.8E-5	mg/m^3	1.2E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	8.2E-08	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.6E-11	mg/m^3	3.3E-14	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	3.6E-14	7.7E-14	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.8E-09					0.000005
		Exposure Point Total									1.8E-09					0.000005
	Exposure Medium Total										1.8E-09					0.000005
Medium Total											3.5E-07					0.005
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	6.0E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	9.1E-08	4.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.001
				Cobalt	10.7	mg/kg	6.3E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.001
				Iron	54,500	mg/kg	3.2E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.3E-03	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.003
				Manganese	897	mg/kg	5.3E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.7E-05	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.002
			Exp. Route Total								9.1E-08					0.008
			Dermal	Arsenic	10.2	mg/kg	4.8E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.1E-09	3.3E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0001
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								7.1E-09					0.0001
		Exposure Point Total									9.8E-08					0.008
	Exposure Medium Total										9.8E-08					0.008
	Air	SWMU 25	Inhalation	Arsenic	7.8E-9	mg/m^3	3.3E-12	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	1.4E-11	2.3E-11	(mg/m^3)	1.5E-05	(mg/m^3)	0.000002
				Cobalt	8.1E-9	mg/m^3	3.4E-12	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	3.1E-11	2.4E-11	(mg/m^3)	6.0E-06	(mg/m^3)	0.000004
				Iron	4.1E-5	mg/m^3	1.8E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.2E-07	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.8E-7	mg/m^3	2.9E-10	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.0E-09	(mg/m^3)	5.0E-05	(mg/m^3)	0.00004
			Exp. Route Total								4.5E-11					0.00005
		Exposure Point Total									4.5E-11					0.00005
	Exposure Medium Total										4.5E-11					0.00005
Medium Total											9.8E-08					0.008
										Total of Receptor Risks Across All Media	4.5E-07				Total of Receptor Hazards Across All Media	0.01

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.4.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	1.9E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.8E-06	6.6E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
				Chromium	21.8	mg/kg	1.7E-05	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	8.7E-06	9.3E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.03
				Iron	36,300	mg/kg	4.4E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-01	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.2
				Benzo(a)pyrene	0.034	mg/kg	2.7E-08	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.0E-07	1.5E-07	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.2E-05					0.5
			Dermal	Arsenic	15.5	mg/kg	6.4E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	9.5E-08	2.2E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.007
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	3.9E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.9E-08	2.1E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.2E-07					0.007
		Exposure Point Total									1.2E-05					0.5
	Exposure Medium Total										1.2E-05					0.5
	Air	SWMU 25	Inhalation	Arsenic	1.2E-8	mg/m^3	2.2E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	9.3E-10	7.6E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0005
				Chromium	1.7E-8	mg/m^3	2.0E-09	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1.7E-07	1.1E-08	(mg/m^3)	2.0E-05	(mg/m^3)	0.0005
				Iron	2.8E-5	mg/m^3	5.1E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.8E-05	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.6E-11	mg/m^3	3.1E-12	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	3.4E-12	1.7E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.7E-07					0.001
		Exposure Point Total									1.7E-07					0.001
	Exposure Medium Total										1.7E-07					0.001
Medium Total											1.2E-05					0.5
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	1.2E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.9E-06	4.4E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.1
				Cobalt	10.7	mg/kg	1.3E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.6E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
				Iron	54,500	mg/kg	6.7E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.3E-01	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.3
				Manganese	897	mg/kg	1.1E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.8E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.2
			Exp. Route Total								1.9E-06					0.8
			Dermal	Arsenic	10.2	mg/kg	4.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	6.3E-08	1.5E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.005
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								6.3E-08					0.005
		Exposure Point Total									1.9E-06					0.8
	Exposure Medium Total										1.9E-06					0.8
	Air	SWMU 25	Inhalation	Arsenic	7.8E-9	mg/m^3	1.4E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	6.1E-10	5.0E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0003
				Cobalt	8.1E-9	mg/m^3	1.5E-10	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	1.3E-09	5.2E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.0009
				Iron	4.1E-5	mg/m^3	7.6E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.7E-05	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.8E-7	mg/m^3	1.2E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.4E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.009
			Exp. Route Total								2.0E-09					0.010
		Exposure Point Total									2.0E-09					0.010
	Exposure Medium Total										2.0E-09					0.010
Medium Total											1.9E-06					0.8

TABLE 7.4.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Ingestion	Aluminum	163	ug/L	9.0E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.0E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.01
				Arsenic	1.5	ug/L	8.2E-06	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.2E-05	9.6E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.3
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
				Chromium	3.9	ug/L	1.1E-04	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	5.7E-05	2.5E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.08
				Cobalt	16.60	ug/L	9.1E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.1E-03	(mg/kg/day)	3.0E-04	(mg/kg/day)	3.5
				Iron	2400	ug/L	1.3E-02	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.5E-01	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.2
				Manganese	1,300	ug/L	7.1E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	8.3E-02	(mg/kg/day)	2.4E-02	(mg/kg/day)	3.5
				Nickel	37.70	ug/L	2.1E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.4E-03	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.1
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	5.5E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.4E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.01
				Naphthalene	0.2	ug/L	9.3E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.1E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0005
			Exp. Route Total								7.0E-05					7.8
			Dermal	Aluminum	163	ug/L	1.3E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.5E-05	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.00002
				Arsenic	1.5	ug/L	1.2E-08	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	1.8E-08	1.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.5E-05	(mg/kg/day)	--
				Chromium	3.9	ug/L	3.3E-07	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	6.6E-06	7.3E-07	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.010
				Cobalt	16.60	ug/L	5.3E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Iron	2400	ug/L	1.9E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.2E-04	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.0003
				Manganese	1,300	ug/L	1.0E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.2E-04	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.1
				Nickel	37.70	ug/L	6.0E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	7.0E-07	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.0009
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	8.0E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.3E-08	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.00002
				Naphthalene	0.2	ug/L	2.3E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.6E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0001
			Exp. Route Total								6.7E-06					0.1
		Exposure Point Total									7.6E-05					7.9
	Exposure Medium Total										7.6E-05					7.9
	Air	SWMU 25	Inhalation	Aluminum	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-03	(mg/m^3)	--
				Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Cadmium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	1.8E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	6.0E-06	(mg/m^3)	--
				Iron	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-05	(mg/m^3)	--
				Nickel	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	2.6E-04	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	9.0E-05	(mg/m^3)	--
				Thallium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Naphthalene	3.2E-5	mg/m^3	2.4E-08	(mg/m^3)	3.4E-05	(ug/m^3)$^{-1}$	8.2E-10	8.5E-07	(mg/m^3)	3.0E-03	(mg/m^3)	0.0003
			Exp. Route Total								8.2E-10					0.0003
		Exposure Point Total									8.2E-10					0.0003
	Exposure Medium Total										8.2E-10					0.0003
Medium Total											7.6E-05					7.9
										Total of Receptor Risks Across All Media	9.0E-05				Total of Receptor Hazards Across All Media	9.2

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.5.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Arsenic	15.5	mg/kg	7.1E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-06	7.1E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Chromium	21.8	mg/kg	1.6E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	7.8E-07	1.0E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.003
				Iron	36,300	mg/kg	1.7E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.7E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.02
				Benzo(a)pyrene	0.034	mg/kg	2.4E-09	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	1.8E-08	1.6E-08	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								1.9E-06					0.05
			Dermal	Arsenic	15.5	mg/kg	2.4E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	3.6E-08	2.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0008
				Chromium	21.8	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Iron	36,300	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Benzo(a)pyrene	0.034	mg/kg	3.6E-10	(mg/kg/day)	7.3E+00	$(mg/kg/day)^{-1}$	2.6E-09	2.3E-09	(mg/kg/day)	NA	(mg/kg/day)	--
			Exp. Route Total								3.9E-08					0.0008
		Exposure Point Total									1.9E-06					0.05
	Exposure Medium Total										1.9E-06					0.05
	Air	SWMU 25	Inhalation	Arsenic	1.2E-8	mg/m^3	7.6E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	3.2E-09	7.6E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0005
				Chromium	1.7E-8	mg/m^3	1.7E-09	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1.4E-07	1.1E-08	(mg/m^3)	2.0E-05	(mg/m^3)	0.0005
				Iron	2.8E-5	mg/m^3	1.8E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.8E-05	(mg/m^3)	NA	(mg/m^3)	--
				Benzo(a)pyrene	2.6E-11	mg/m^3	2.6E-12	(mg/m^3)	1.1E-03	$(ug/m^3)^{-1}$	2.9E-12	1.7E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.4E-07					0.001
		Exposure Point Total									1.4E-07					0.001
	Exposure Medium Total										1.4E-07					0.001
Medium Total											2.0E-06					0.05
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Arsenic	10.2	mg/kg	4.7E-07	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	7.0E-07	4.7E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Cobalt	10.7	mg/kg	4.9E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.9E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Iron	54,500	mg/kg	2.5E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.5E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.04
				Manganese	897	mg/kg	4.1E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.1E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.02
			Exp. Route Total								7.0E-07					0.08
			Dermal	Arsenic	10.2	mg/kg	1.6E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.4E-08	1.6E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
				Cobalt	10.7	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Iron	54,500	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.0E-01	(mg/kg/day)	--
				Manganese	897	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
			Exp. Route Total								2.4E-08					0.0005
		Exposure Point Total									7.2E-07					0.09
	Exposure Medium Total										7.2E-07					0.09
	Air	SWMU 25	Inhalation	Arsenic	7.8E-9	mg/m^3	5.0E-10	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	2.1E-09	5.0E-09	(mg/m^3)	1.5E-05	(mg/m^3)	0.0003
				Cobalt	8.1E-9	mg/m^3	5.2E-10	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	4.7E-09	5.2E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.0009
				Iron	4.1E-5	mg/m^3	2.7E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.7E-05	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	6.8E-7	mg/m^3	4.4E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.4E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.009
			Exp. Route Total								6.8E-09					0.010
		Exposure Point Total									6.8E-09					0.010
	Exposure Medium Total										6.8E-09					0.010
Medium Total											7.3E-07					0.10

TABLE 7.5.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Ingestion	Aluminum	163	ug/L	3.0E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.0E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.003
				Arsenic	1.5	ug/L	2.7E-06	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	4.1E-06	2.7E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.09
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
				Chromium	3.9	ug/L	1.1E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	5.6E-06	7.1E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.02
				Cobalt	16.60	ug/L	3.0E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.0E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	1.0
				Iron	2400	ug/L	4.4E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.4E-02	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.06
				Manganese	1,300	ug/L	2.4E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.4E-02	(mg/kg/day)	2.4E-02	(mg/kg/day)	1.0
				Nickel	37.70	ug/L	6.9E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.9E-04	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.03
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	1.8E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.8E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.004
				Naphthalene	0.2	ug/L	3.1E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.1E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0002
			Exp. Route Total								9.7E-06					2.2
			Dermal	Aluminum	163	ug/L	6.7E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	6.7E-06	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.000007
				Arsenic	1.5	ug/L	6.2E-09	(mg/kg/day)	1.5E+00	(mg/kg/day)$^{-1}$	9.3E-09	6.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Cadmium	0.0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	2.5E-05	(mg/kg/day)	--
				Chromium	3.9	ug/L	5.1E-08	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	1.0E-06	3.2E-07	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.004
				Cobalt	16.60	ug/L	2.7E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.7E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0009
				Iron	2400	ug/L	9.9E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.9E-05	(mg/kg/day)	7.0E-01	(mg/kg/day)	0.0001
				Manganese	1,300	ug/L	5.4E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.4E-05	(mg/kg/day)	9.6E-04	(mg/kg/day)	0.06
				Nickel	37.70	ug/L	3.1E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.1E-07	(mg/kg/day)	8.0E-04	(mg/kg/day)	0.0004
				Thallium	0	ug/L	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	1	ug/L	4.1E-09	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.1E-08	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.000008
				Naphthalene	0.2	ug/L	1.3E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.3E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.00007
			Exp. Route Total								1.0E-06					0.06
		Exposure Point Total									1.1E-05					2.3
	Exposure Medium Total										1.1E-05					2.3
	Air	SWMU 25	Inhalation	Aluminum	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-03	(mg/m^3)	--
				Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Cadmium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	1.8E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	6.0E-06	(mg/m^3)	--
				Iron	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Manganese	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	5.0E-05	(mg/m^3)	--
				Nickel	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	2.6E-04	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	9.0E-05	(mg/m^3)	--
				Thallium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	0.0E+00	(mg/m^3)	NA	(mg/m^3)	--
				Naphthalene	1.7E-5	mg/m^3	4.6E-08	(mg/m^3)	3.4E-05	(ug/m^3)$^{-1}$	1.6E-09	4.6E-07	(mg/m^3)	3.0E-03	(mg/m^3)	0.0002
			Exp. Route Total								1.6E-09					0.0002
		Exposure Point Total									1.6E-09					0.0002
	Exposure Medium Total										1.6E-09					0.0002
Medium Total											1.1E-05					2.3
										Total of Receptor Risks Across All Media	1.4E-05				Total of Receptor Hazards Across All Media	2.4

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

RAGS Part D Table 9

Summary of Receptor Risks and Hazards for COPCs

LIST OF TABLES
RAGS PART D TABLE 9
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPC

Table No.	
	REASONABLE MAXIMUM EXPOSURES
9.1.RME	Construction Workers
9.2.RME	Occupational Workers
9.3.RME	Adolescent Trespassers
9.4.RME	Child Residents
9.5.RME	Adult Residents
9.6.RME	Lifelong Residents
	CENTRAL TENDENCY EXPOSURES
9.1.CTE	Construction Workers
9.2.CTE	Occupational Workers
9.3.CTE	Adolescent Trespassers
9.4.CTE	Child Residents
9.5.CTE	Adult Residents
9.6.CTE	Lifelong Residents

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	6E-07	--	6E-08	--	7E-07	Skin, CVS	0.1	--	0.009	0.1
			Chromium	3E-07	--	- -	--	3E-07	None Reported	0.002	--	--	0.002
			Iron	- -	--	- -	--	- -	GS	0.1	--	--	0.1
			Benzo(a)pyrene	7E-09	--	3E-09	--	1E-08	NA	--	--	--	--
			Chemical Total	1E-06	--	6E-08	--	1E-06		0.2	--	0.009	0.2
		Exposure Point Total						1E-06					0.2
	Exposure Medium Total							1E-06					0.2
	Air	SWMU 25	Arsenic	--	1E-07	--	--	1E-07	NA	--	0.1	--	0.1
			Chromium	--	3E-06	--	--	3E-06	Respiratory	--	0.1	--	0.1
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	5E-11	--	--	5E-11	NA	--	--	--	--
			Chemical Total	--	3E-06	--	--	3E-06		- -	0.2	- -	0.2
		Exposure Point Total						3E-06					0.2
	Exposure Medium Total							3E-06					0.2
Medium Total								4E-06					0.4
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	4E-07	--	4E-08	--	5E-07	Skin, CVS	0.07	--	0.006	0.07
			Cobalt	- -	--	- -	--	- -	Thyroid	0.007	--	--	0.007
			Iron	- -	--	- -	--	- -	GS	0.2	--	--	0.2
			Manganese	- -	--	- -	--	- -	CNS	0.07	--	--	0.07
			Chemical Total	4E-07	--	4E-08	--	5E-07		0.3	--	0.006	0.3
		Exposure Point Total						5E-07					0.3
	Exposure Medium Total							5E-07					0.3
	Air	SWMU 25	Arsenic	--	6E-08	--	--	6E-08	NA	--	0.07	--	0.07
			Cobalt	--	1E-07	--	--	1E-07	Respiratory	--	0.05	--	0.05
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	2	--	2
			Chemical Total	--	2E-07	--	--	2E-07		- -	2	- -	2
		Exposure Point Total						2E-07					2
	Exposure Medium Total							2E-07					2
Medium Total								7E-07					2

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	--	--	0.0005	0.0005
			Arsenic	- -	--	5E-10	--	5E-10	Skin, CVS	--	--	0.00008	0.00008
			Cadmium	- -	--	- -	--	- -	Kidney	--	--	--	--
			Chromium	- -	--	3E-08	--	3E-08	None Reported	--	--	0.0002	0.0002
			Cobalt	- -	--	- -	--	- -	Thyroid	--	--	0.00003	0.00003
			Iron	- -	--	- -	--	- -	GS	--	--	0.00005	0.00005
			Manganese	- -	--	- -	--	- -	CNS	--	--	0.02	0.02
			Nickel	- -	--	- -	--	- -	Body Weight	--	--	0.0001	0.0001
			Thallium	- -	--	- -	--	- -	Skin	--	--	--	--
			Vanadium	- -	--	- -	--	- -	Kidney	--	--	0.000003	0.000003
			Naphthalene	- -	--	- -	--	- -	Central Nervous System	--	--	0.0000002	0.0000002
			Chemical Total	- -	--	4E-08	--	4E-08		--	--	0.02	0.02
		Exposure Point Total						4E-08					0.02
	Exposure Medium Total							4E-08					0.02
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Cadmium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	--	--	--
			Nickel	--	- -	--	--	- -	Respiratory	--	--	--	--
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Naphthalene	--	3E-11	--	--	3E-11	Respiratory	--	0.00002	--	0.00002
			Chemical Total	--	3E-11	--	--	3E-11		- -	0.00002	- -	0.00002
		Exposure Point Total						3E-11					0.00002
	Exposure Medium Total							3E-11					0.00002
Medium Total								4E-08					0.02
Receptor Total							Receptor Risk Total	4E-06				Receptor HI Total	3

Total Body Weight HI	0.0001
Total CNS HI	2
Total CVS HI	0.2
Total GS HI	0.3
Total Kidney HI	0.000003
Total Respiratory HI	0.2
Total None Reported HI	0.002
Total Skin HI	0.2
Total Thyroid HI	0.007
Total NA HI	0.2

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	8E-06	--	2E-06	--	1E-05	Skin, CVS	0.05	--	0.01	0.06
			Chromium	4E-06	--	- -	--	4E-06	None Reported	0.007	--	--	0.007
			Iron	- -	--	- -	--	- -	GS	0.05	--	--	0.05
			Benzo(a)pyrene	9E-08	--	7E-08	--	2E-07	NA	--	--	--	--
			Chemical Total	1E-05	--	2E-06	--	1E-05		0.1	--	0.01	0.1
		Exposure Point Total						1E-05					0.1
	Exposure Medium Total							1E-05					0.1
	Air	SWMU 25	Arsenic	--	4E-09	--	--	4E-09	NA	--	0.0002	--	0.0002
			Chromium	--	1E-07	--	--	1E-07	Respiratory	--	0.0002	--	0.0002
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	2E-12	--	--	2E-12	NA	--	--	--	--
			Chemical Total	--	1E-07	--	--	1E-07		- -	0.0004	- -	0.0004
		Exposure Point Total						1E-07					0.0004
	Exposure Medium Total							1E-07					0.0004
Medium Total								1E-05					0.1
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	5E-06	--	1E-06	--	6E-06	Skin, CVS	0.03	--	0.007	0.04
			Cobalt	- -	--	- -	--	- -	Thyroid	0.03	--	--	0.03
			Iron	- -	--	- -	--	- -	GS	0.08	--	--	0.08
			Manganese	- -	--	- -	--	- -	CNS	0.04	--	--	0.04
			Chemical Total	5E-06	--	1E-06	--	6E-06		0.2	--	0.007	0.2
		Exposure Point Total						6E-06					0.2
	Exposure Medium Total							6E-06					0.2
	Air	SWMU 25	Arsenic	--	3E-09	--	--	3E-09	NA	--	0.0001	--	0.0001
			Cobalt	--	6E-09	--	--	6E-09	Respiratory	--	0.0003	--	0.0003
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.003	--	0.003
			Chemical Total	--	9E-09	--	--	9E-09		- -	0.004	- -	0.004
		Exposure Point Total						9E-09					0.004
	Exposure Medium Total							9E-09					0.004
Medium Total								6E-06					0.2
Receptor Total							Receptor Risk Total	2E-05				Receptor HI Total	0.3

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	6E-07	--	1E-07	--	7E-07	Skin, CVS	0.009	--	0.002	0.01
			Chromium	8E-07	--	- -	--	8E-07	None Reported	0.001	--	--	0.001
			Iron	- -	--	- -	--	- -	GS	0.009	--	--	0.009
			Benzo(a)pyrene	2E-08	--	2E-08	--	3E-08	NA	--	--	--	--
			Chemical Total	1E-06	--	1E-07	--	1E-06		0.02	--	0.002	0.02
		Exposure Point Total						1E-06					0.02
	Exposure Medium Total							1E-06					0.02
	Air	SWMU 25	Arsenic	--	9E-11	--	--	9E-11	NA	--	0.000009	--	0.000009
			Chromium	--	7E-09	--	--	7E-09	Respiratory	--	0.000010	--	0.000010
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	1E-13	--	--	1E-13	NA	--	--	--	--
			Chemical Total	--	7E-09	--	--	7E-09		- -	0.00002	- -	0.00002
		Exposure Point Total						7E-09					0.00002
	Exposure Medium Total							7E-09					0.00002
Medium Total								1E-06					0.02
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	4E-07	--	7E-08	--	4E-07	Skin, CVS	0.006	--	0.001	0.007
			Cobalt	- -	--	- -	--	- -	Thyroid	0.006	--	--	0.006
			Iron	- -	--	- -	--	- -	GS	0.01	--	--	0.01
			Manganese	- -	--	- -	--	- -	CNS	0.006	--	--	0.006
			Chemical Total	4E-07	--	7E-08	--	4E-07		0.03	--	0.001	0.03
		Exposure Point Total						4E-07					0.03
	Exposure Medium Total							4E-07					0.03
	Air	SWMU 25	Arsenic	--	6E-11	--	--	6E-11	NA	--	0.000006	--	0.000006
			Cobalt	--	1E-10	--	--	1E-10	Respiratory	--	0.00002	--	0.00002
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.0002	--	0.0002
			Chemical Total	--	2E-10	--	--	2E-10		- -	0.0002	- -	0.0002
		Exposure Point Total						2E-10					0.0002
	Exposure Medium Total							2E-10					0.0002
Medium Total								4E-07					0.03
Receptor Total							Receptor Risk Total	2E-06				Receptor HI Total	0.05

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	3E-05	--	2E-06	--	3E-05	Skin, CVS	0.7	--	0.06	0.7
			Chromium	6E-05	--	- -	--	6E-05	None Reported	0.09	--	--	0.09
			Iron	- -	--	- -	--	- -	GS	0.7	--	--	0.7
			Benzo(a)pyrene	1E-06	--	5E-07	--	2E-06	NA	--	--	--	--
			Chemical Total	9E-05	--	3E-06	--	9E-05		1	--	0.06	1
		Exposure Point Total						9E-05					1
	Exposure Medium Total							9E-05					1
	Air	SWMU 25	Arsenic	--	4E-09	--	--	4E-09	NA	--	0.0008	--	0.0008
			Chromium	--	6E-07	--	--	6E-07	Respiratory	--	0.0008	--	0.0008
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	1E-11	--	--	1E-11	NA	--	--	--	--
			Chemical Total	--	6E-07	--	--	6E-07		- -	0.002	- -	0.002
		Exposure Point Total						6E-07					0.002
	Exposure Medium Total							6E-07					0.002
Medium Total								9E-05					1
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	2E-05	--	1E-06	--	2E-05	Skin, CVS	0.4	--	0.04	0.5
			Cobalt	- -	--	- -	--	- -	Thyroid	0.5	--	--	0.5
			Iron	- -	--	- -	--	- -	GS	1.0	--	--	1.0
			Manganese	- -	--	- -	--	- -	CNS	0.5	--	--	0.5
			Chemical Total	2E-05	--	1E-06	--	2E-05		2	--	0.04	2
		Exposure Point Total						2E-05					2
	Exposure Medium Total							2E-05					2
	Air	SWMU 25	Arsenic	--	3E-09	--	--	3E-09	NA	--	0.0005	--	0.0005
			Cobalt	--	6E-09	--	--	6E-09	Respiratory	--	0.001	--	0.001
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.01	--	0.01
			Chemical Total	--	9E-09	--	--	9E-09		- -	0.01	- -	0.01
		Exposure Point Total						9E-09					0.01
	Exposure Medium Total							9E-09					0.01
Medium Total								2E-05					2

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.02	--	0.00007	0.02
			Arsenic	2E-05	--	8E-08	--	2E-05	Skin, CVS	0.5	--	0.002	0.5
			Cadmium	- -	--	- -	--	- -	Kidney	--	--	--	--
			Chromium	9E-05	--	3E-05	--	1E-04	None Reported	0.1	--	0.04	0.2
			Cobalt	- -	--	- -	--	- -	Thyroid	5	--	0.009	5
			Iron	- -	--	- -	--	- -	GS	0.3	--	0.001	0.3
			Manganese	- -	--	- -	--	- -	CNS	5	--	0.6	6
			Nickel	- -	--	- -	--	- -	Body Weight	0.2	--	0.004	0.2
			Thallium	- -	--	- -	--	- -	Skin	--	--	--	--
			Vanadium	- -	--	- -	--	- -	Kidney	0.02	--	0.00008	0.02
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.0008	--	0.0003	0.001
			Chemical Total	1E-04	--	3E-05	--	1E-04		12	--	0.6	12
		Exposure Point Total						1E-04					12
	Exposure Medium Total							1E-04					12
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Cadmium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	--	--	--
			Nickel	--	- -	--	--	- -	Respiratory	--	--	--	--
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Naphthalene	--	2E-08	--	--	2E-08	Respiratory	--	0.002	--	0.002
			Chemical Total	--	2E-08	--	--	2E-08		- -	0.002	- -	0.002
		Exposure Point Total						2E-08					0.002
	Exposure Medium Total							2E-08					0.002
Medium Total								1E-04					12
Receptor Total							Receptor Risk Total	2E-04				Receptor HI Total	16

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total Body Weight HI	0.2
Total CNS HI	6
Total CVS HI	2
Total GS HI	2
Total Kidney HI	0.02
Total Respiratory HI	0.004
Total None Reported HI	0.3
Total Skin HI	2
Total Thyroid HI	6
Total NA HI	0.001

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	1E-05	--	1E-06	--	1E-05	Skin, CVS	0.07	--	0.008	0.08
			Chromium	9E-06	--	- -	--	9E-06	None Reported	0.010	--	--	0.010
			Iron	- -	--	- -	--	- -	GS	0.07	--	--	0.07
			Benzo(a)pyrene	2E-07	--	1E-07	--	3E-07	NA	--	--	--	--
			Chemical Total	2E-05	--	1E-06	--	2E-05		0.2	--	0.008	0.2
		Exposure Point Total						2E-05					0.2
	Exposure Medium Total							2E-05					0.2
	Air	SWMU 25	Arsenic	--	2E-08	--	--	2E-08	NA	--	0.0008	--	0.0008
			Chromium	--	8E-07	--	--	8E-07	Respiratory	--	0.0008	--	0.0008
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	2E-11	--	--	2E-11	NA	--	--	--	--
			Chemical Total	--	9E-07	--	--	9E-07		- -	0.002	- -	0.002
		Exposure Point Total						9E-07					0.002
	Exposure Medium Total							9E-07					0.002
Medium Total								2E-05					0.2
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	7E-06	--	9E-07	--	8E-06	Skin, CVS	0.05	--	0.006	0.05
			Cobalt	- -	--	- -	--	- -	Thyroid	0.05	--	--	0.05
			Iron	- -	--	- -	--	- -	GS	0.1	--	--	0.1
			Manganese	- -	--	- -	--	- -	CNS	0.05	--	--	0.05
			Chemical Total	7E-06	--	9E-07	--	8E-06		0.3	--	0.006	0.3
		Exposure Point Total						8E-06					0.3
	Exposure Medium Total							8E-06					0.3
	Air	SWMU 25	Arsenic	--	1E-08	--	--	1E-08	NA	--	0.0005	--	0.0005
			Cobalt	--	2E-08	--	--	2E-08	Respiratory	--	0.001	--	0.001
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.01	--	0.01
			Chemical Total	--	4E-08	--	--	4E-08		- -	0.01	- -	0.01
		Exposure Point Total						4E-08					0.01
	Exposure Medium Total							4E-08					0.01
Medium Total								8E-06					0.3

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.004	--	0.00002	0.004
			Arsenic	2E-05	--	1E-07	--	2E-05	Skin, CVS	0.1	--	0.0007	0.1
			Cadmium	- -	--	- -	--	- -	Kidney	--	--	--	--
			Chromium	3E-05	--	1E-05	--	5E-05	None Reported	0.04	--	0.01	0.05
			Cobalt	- -	--	- -	--	- -	Thyroid	2	--	0.003	2
			Iron	- -	--	- -	--	- -	GS	0.09	--	0.0005	0.09
			Manganese	- -	--	- -	--	- -	CNS	1	--	0.2	2
			Nickel	- -	--	- -	--	- -	Body Weight	0.05	--	0.001	0.05
			Thallium	- -	--	- -	--	- -	Skin	--	--	--	--
			Vanadium	- -	--	- -	--	- -	Kidney	0.005	--	0.00003	0.006
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.0002	--	0.0002	0.0004
			Chemical Total	5E-05	--	1E-05	--	7E-05		3	--	0.2	4
		Exposure Point Total						7E-05					4
	Exposure Medium Total							7E-05					4
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Cadmium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	--	--	--
			Nickel	--	- -	--	--	- -	Respiratory	--	--	--	--
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Naphthalene	--	4E-08	--	--	4E-08	Respiratory	--	0.001	--	0.001
			Chemical Total	--	4E-08	--	--	4E-08		- -	0.001	- -	0.001
		Exposure Point Total						4E-08					0.001
	Exposure Medium Total							4E-08					0.001
Medium Total								7E-05					4
Receptor Total							Receptor Risk Total	1E-04				Receptor HI Total	4

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total Body Weight HI	0.05
Total CNS HI	2
Total CVS HI	0.3
Total GS HI	0.3
Total Kidney HI	0.006
Total Respiratory HI	0.003
Total None Reported HI	0.06
Total Skin HI	0.3
Total Thyroid HI	2
Total NA HI	0.001

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	4E-05	--	3E-06	--	4E-05					
			Chromium	7E-05	--	- -	--	7E-05					
			Iron	- -	--	- -	--	- -					
			Benzo(a)pyrene	2E-06	--	6E-07	--	2E-06					
			Chemical Total	1E-04	--	4E-06	--	1E-04					
		Exposure Point Total						1E-04					
	Exposure Medium Total							1E-04					
	Air	SWMU 25	Arsenic	--	2E-08	--	--	2E-08					
			Chromium	--	1E-06	--	--	1E-06					
			Iron	--	- -	--	--	- -					
			Benzo(a)pyrene	--	3E-11	--	--	3E-11					
			Chemical Total	--	1E-06	--	--	1E-06					
		Exposure Point Total						1E-06					
	Exposure Medium Total							1E-06					
Medium Total								1E-04					
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	2E-05	--	2E-06	--	3E-05					
			Cobalt	- -	--	- -	--	- -					
			Iron	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Chemical Total	2E-05	--	2E-06	--	3E-05					
		Exposure Point Total						3E-05					
	Exposure Medium Total							3E-05					
	Air	SWMU 25	Arsenic	--	1E-08	--	--	1E-08					
			Cobalt	--	3E-08	--	--	3E-08					
			Iron	--	- -	--	--	- -					
			Manganese	--	- -	--	--	- -					
			Chemical Total	--	4E-08	--	--	4E-08					
		Exposure Point Total						4E-08					
	Exposure Medium Total							4E-08					
Medium Total								3E-05					

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Aluminum	- -	--	- -	--	- -					
			Arsenic	4E-05	--	2E-07	--	4E-05					
			Cadmium	- -	--	- -	--	- -					
			Chromium	1E-04	--	4E-05	--	2E-04					
			Cobalt	- -	--	- -	--	- -					
			Iron	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Nickel	- -	--	- -	--	- -					
			Thallium	- -	--	- -	--	- -					
			Vanadium	- -	--	- -	--	- -					
			Naphthalene	- -	--	- -	--	- -					
			Chemical Total	2E-04	--	4E-05	--	2E-04					
		Exposure Point Total						2E-04					
	Exposure Medium Total							2E-04					
	Air	SWMU 25	Aluminum	--	- -	--	--	- -					
			Arsenic	--	- -	--	--	- -					
			Cadmium	--	- -	--	--	- -					
			Chromium	--	- -	--	--	- -					
			Cobalt	--	- -	--	--	- -					
			Iron	--	- -	--	--	- -					
			Manganese	--	- -	--	--	- -					
			Nickel	--	- -	--	--	- -					
			Thallium	--	- -	--	--	- -					
			Vanadium	--	- -	--	--	- -					
			Naphthalene	--	6E-08	--	--	6E-08					
			Chemical Total	--	6E-08	--	--	6E-08					
		Exposure Point Total						6E-08					
	Exposure Medium Total							6E-08					
Medium Total								2E-04					
Receptor Total							Receptor Risk Total	3E-04					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	2E-07	--	1E-08	--	2E-07	Skin, CVS	0.03	--	0.002	0.03
			Chromium	8E-08	--	- -	--	8E-08	None Reported	0.0005	--	--	0.0005
			Iron	- -	--	- -	--	- -	GS	0.03	--	--	0.03
			Benzo(a)pyrene	2E-09	--	4E-10	--	2E-09	NA	--	--	--	--
			Chemical Total	2E-07	--	1E-08	--	2E-07		0.05	--	0.002	0.05
		Exposure Point Total						2E-07					0.05
	Exposure Medium Total							2E-07					0.05
	Air	SWMU 25	Arsenic	--	5E-08	--	--	5E-08	NA	--	0.05	--	0.05
			Chromium	--	1E-06	--	--	1E-06	Respiratory	--	0.06	--	0.06
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	3E-11	--	--	3E-11	NA	--	--	--	--
			Chemical Total	--	1E-06	--	--	1E-06		- -	0.1	- -	0.1
		Exposure Point Total						1E-06					0.1
	Exposure Medium Total							1E-06					0.1
Medium Total								2E-06					0.2
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	1E-07	--	6E-09	--	1E-07	Skin, CVS	0.02	--	0.0010	0.02
			Cobalt	- -	--	- -	--	- -	Thyroid	0.002	--	--	0.002
			Iron	- -	--	- -	--	- -	GS	0.04	--	--	0.04
			Manganese	- -	--	- -	--	- -	CNS	0.02	--	--	0.02
			Chemical Total	1E-07	--	6E-09	--	1E-07		0.07	--	0.0010	0.07
		Exposure Point Total						1E-07					0.07
	Exposure Medium Total							1E-07					0.07
	Air	SWMU 25	Arsenic	--	3E-08	--	--	3E-08	NA	--	0.03	--	0.03
			Cobalt	--	7E-08	--	--	7E-08	Respiratory	--	0.03	--	0.03
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.9	--	0.9
			Chemical Total	--	1E-07	--	--	1E-07		- -	1.0	- -	1.0
		Exposure Point Total						1E-07					1.0
	Exposure Medium Total							1E-07					1.0
Medium Total								2E-07					1

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	--	--	0.0003	0.0003
			Arsenic	- -	--	2E-10	--	2E-10	Skin, CVS	--	--	0.00004	0.00004
			Cadmium	- -	--	- -	--	- -	Kidney	--	--	--	--
			Chromium	- -	--	2E-08	--	2E-08	None Reported	--	--	0.0001	0.0001
			Cobalt	- -	--	- -	--	- -	Thyroid	--	--	0.00002	0.00002
			Iron	- -	--	- -	--	- -	GS	--	--	0.00003	0.00003
			Manganese	- -	--	- -	--	- -	CNS	--	--	0.01	0.01
			Nickel	- -	--	- -	--	- -	Body Weight	--	--	0.00007	0.00007
			Thallium	- -	--	- -	--	- -	Skin	--	--	--	--
			Vanadium	- -	--	- -	--	- -	Kidney	--	--	0.000002	0.000002
			Naphthalene	- -	--	- -	--	- -	Central Nervous System	--	--	0.0000001	0.0000001
			Chemical Total	- -	--	2E-08	--	2E-08		--	--	0.01	0.01
		Exposure Point Total						2E-08					0.01
	Exposure Medium Total							2E-08					0.01
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Cadmium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	--	--	--
			Nickel	--	- -	--	--	- -	Respiratory	--	--	--	--
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Naphthalene	--	2E-11	--	--	2E-11	Respiratory	--	0.00001	--	0.00001
			Chemical Total	--	2E-11	--	--	2E-11		- -	0.00001	- -	0.00001
		Exposure Point Total						2E-11					0.00001
	Exposure Medium Total							2E-11					0.00001
Medium Total								2E-08					0.01
Receptor Total							Receptor Risk Total	2E-06				Receptor HI Total	1

Total Body Weight HI	0.00007
Total CNS HI	0.9
Total CVS HI	0.04
Total GS HI	0.06
Total Kidney HI	0.000002
Total Respiratory HI	0.08
Total None Reported HI	0.0006
Total Skin HI	0.04
Total Thyroid HI	0.002
Total NA HI	0.09

TABLE 9.2.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	1E-06	--	5E-08	--	1E-06	Skin, CVS	0.02	--	0.0009	0.02
			Chromium	6E-07	--	- -	--	6E-07	None Reported	0.003	--	--	0.003
			Iron	- -	--	- -	--	- -	GS	0.02	--	--	0.02
			Benzo(a)pyrene	1E-08	--	2E-09	--	2E-08	NA	--	--	--	--
			Chemical Total	2E-06	--	5E-08	--	2E-06		0.05	--	0.0009	0.05
		Exposure Point Total						2E-06					0.05
	Exposure Medium Total							2E-06					0.05
	Air	SWMU 25	Arsenic	--	1E-09	--	--	1E-09	NA	--	0.0002	--	0.0002
			Chromium	--	4E-08	--	--	4E-08	Respiratory	--	0.0002	--	0.0002
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	7E-13	--	--	7E-13	NA	--	--	--	--
			Chemical Total	--	4E-08	--	--	4E-08		- -	0.0003	- -	0.0003
		Exposure Point Total						4E-08					0.0003
	Exposure Medium Total							4E-08					0.0003
Medium Total								2E-06					0.05
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	8E-07	--	3E-08	--	9E-07	Skin, CVS	0.01	--	0.0006	0.02
			Cobalt	- -	--	- -	--	- -	Thyroid	0.02	--	--	0.02
			Iron	- -	--	- -	--	- -	GS	0.03	--	--	0.03
			Manganese	- -	--	- -	--	- -	CNS	0.02	--	--	0.02
			Chemical Total	8E-07	--	3E-08	--	9E-07		0.08	--	0.0006	0.08
		Exposure Point Total						9E-07					0.08
	Exposure Medium Total							9E-07					0.08
	Air	SWMU 25	Arsenic	--	9E-10	--	--	9E-10	NA	--	0.0001	--	0.0001
			Cobalt	--	2E-09	--	--	2E-09	Respiratory	--	0.0003	--	0.0003
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.003	--	0.003
			Chemical Total	--	3E-09	--	--	3E-09		- -	0.003	- -	0.003
		Exposure Point Total						3E-09					0.003
	Exposure Medium Total							3E-09					0.003
Medium Total								9E-07					0.08
Receptor Total							Receptor Risk Total	3E-06				Receptor HI Total	0.1

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	1E-07	--	1E-08	--	1E-07	Skin, CVS	0.002	--	0.0002	0.002
			Chromium	2E-07	--	- -	--	2E-07	None Reported	0.0003	--	--	0.0003
			Iron	- -	--	- -	--	- -	GS	0.002	--	--	0.002
			Benzo(a)pyrene	4E-09	--	2E-09	--	6E-09	NA	--	--	--	--
			Chemical Total	3E-07	--	1E-08	--	3E-07		0.005	--	0.0002	0.005
		Exposure Point Total						3E-07					0.005
	Exposure Medium Total							3E-07					0.005
	Air	SWMU 25	Arsenic	--	2E-11	--	--	2E-11	NA	--	0.000002	--	0.000002
			Chromium	--	2E-09	--	--	2E-09	Respiratory	--	0.000002	--	0.000002
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	4E-14	--	--	4E-14	NA	--	--	--	--
			Chemical Total	--	2E-09	--	--	2E-09		- -	0.000005	- -	0.000005
		Exposure Point Total						2E-09					0.000005
	Exposure Medium Total							2E-09					0.000005
Medium Total								3E-07					0.005
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	9E-08	--	7E-09	--	1E-07	Skin, CVS	0.001	--	0.0001	0.002
			Cobalt	- -	--	- -	--	- -	Thyroid	0.001	--	--	0.001
			Iron	- -	--	- -	--	- -	GS	0.003	--	--	0.003
			Manganese	- -	--	- -	--	- -	CNS	0.002	--	--	0.002
			Chemical Total	9E-08	--	7E-09	--	1E-07		0.008	--	0.0001	0.008
		Exposure Point Total						1E-07					0.008
	Exposure Medium Total							1E-07					0.008
	Air	SWMU 25	Arsenic	--	1E-11	--	--	1E-11	NA	--	0.000002	--	0.000002
			Cobalt	--	3E-11	--	--	3E-11	Respiratory	--	0.000004	--	0.000004
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.00004	--	0.00004
			Chemical Total	--	5E-11	--	--	5E-11		- -	0.00005	- -	0.00005
		Exposure Point Total						5E-11					0.00005
	Exposure Medium Total							5E-11					0.00005
Medium Total								1E-07					0.008
Receptor Total							Receptor Risk Total	4E-07				Receptor HI Total	0.01

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.4.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	3E-06	--	1E-07	--	3E-06	Skin, CVS	0.2	--	0.007	0.2
			Chromium	9E-06	--	- -	--	9E-06	None Reported	0.03	--	--	0.03
			Iron	- -	--	- -	--	- -	GS	0.2	--	--	0.2
			Benzo(a)pyrene	2E-07	--	3E-08	--	2E-07	NA	--	--	--	--
			Chemical Total	1E-05	--	1E-07	--	1E-05		0.5	--	0.007	0.5
		Exposure Point Total						1E-05					0.5
	Exposure Medium Total							1E-05					0.5
	Air	SWMU 25	Arsenic	--	9E-10	--	--	9E-10	NA	--	0.0005	--	0.0005
			Chromium	--	2E-07	--	--	2E-07	Respiratory	--	0.0005	--	0.0005
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	3E-12	--	--	3E-12	NA	--	--	--	--
			Chemical Total	--	2E-07	--	--	2E-07		- -	0.001	- -	0.001
		Exposure Point Total						2E-07					0.001
	Exposure Medium Total							2E-07					0.001
Medium Total								1E-05					0.5
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	2E-06	--	6E-08	--	2E-06	Skin, CVS	0.1	--	0.005	0.2
			Cobalt	- -	--	- -	--	- -	Thyroid	0.2	--	--	0.2
			Iron	- -	--	- -	--	- -	GS	0.3	--	--	0.3
			Manganese	- -	--	- -	--	- -	CNS	0.2	--	--	0.2
			Chemical Total	2E-06	--	6E-08	--	2E-06		0.8	--	0.005	0.8
		Exposure Point Total						2E-06					0.8
	Exposure Medium Total							2E-06					0.8
	Air	SWMU 25	Arsenic	--	6E-10	--	--	6E-10	NA	--	0.0003	--	0.0003
			Cobalt	--	1E-09	--	--	1E-09	Respiratory	--	0.0009	--	0.0009
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.009	--	0.009
			Chemical Total	--	2E-09	--	--	2E-09		- -	0.010	- -	0.010
		Exposure Point Total						2E-09					0.010
	Exposure Medium Total							2E-09					0.010
Medium Total								2E-06					0.8

TABLE 9.4.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.01	--	0.00002	0.01
			Arsenic	1E-05	--	2E-08	--	1E-05	Skin, CVS	0.3	--	0.0005	0.3
			Cadmium	- -	--	- -	--	- -	Kidney	--	--	--	--
			Chromium	6E-05	--	7E-06	--	6E-05	None Reported	0.08	--	0.010	0.09
			Cobalt	- -	--	- -	--	- -	Thyroid	4	--	0.002	4
			Iron	- -	--	- -	--	- -	GS	0.2	--	0.0003	0.2
			Manganese	- -	--	- -	--	- -	CNS	3	--	0.1	4
			Nickel	- -	--	- -	--	- -	Body Weight	0.1	--	0.0009	0.1
			Thallium	- -	--	- -	--	- -	Skin	--	--	--	--
			Vanadium	- -	--	- -	--	- -	Kidney	0.01	--	0.00002	0.01
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.0005	--	0.0001	0.0007
			Chemical Total	7E-05	--	7E-06	--	8E-05		8	--	0.1	8
		Exposure Point Total						8E-05					8
	Exposure Medium Total							8E-05					8
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Cadmium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	--	--	--
			Nickel	--	- -	--	--	- -	Respiratory	--	--	--	--
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Naphthalene	--	8E-10	--	--	8E-10	Respiratory	--	0.0003	--	0.0003
			Chemical Total	--	8E-10	--	--	8E-10		- -	0.0003	- -	0.0003
		Exposure Point Total						8E-10					0.0003
	Exposure Medium Total							8E-10					0.0003
Medium Total								8E-05					8
Receptor Total							Receptor Risk Total	9E-05				Receptor HI Total	9

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total Body Weight HI	0.1
Total CNS HI	4
Total CVS HI	0.7
Total GS HI	0.8
Total Kidney HI	0.01
Total Respiratory HI	0.002
Total None Reported HI	0.1
Total Skin HI	0.7
Total Thyroid HI	4
Total NA HI	0.0008

TABLE 9.5.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	1E-06	--	4E-08	--	1E-06	Skin, CVS	0.02	--	0.0008	0.02
			Chromium	8E-07	--	- -	--	8E-07	None Reported	0.003	--	--	0.003
			Iron	- -	--	- -	--	- -	GS	0.02	--	--	0.02
			Benzo(a)pyrene	2E-08	--	3E-09	--	2E-08	NA	--	--	--	--
			Chemical Total	2E-06	--	4E-08	--	2E-06		0.05	--	0.0008	0.05
		Exposure Point Total						2E-06					0.05
	Exposure Medium Total							2E-06					0.05
	Air	SWMU 25	Arsenic	--	3E-09	--	--	3E-09	NA	--	0.0005	--	0.0005
			Chromium	--	1E-07	--	--	1E-07	Respiratory	--	0.0005	--	0.0005
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Benzo(a)pyrene	--	3E-12	--	--	3E-12	NA	--	--	--	--
			Chemical Total	--	1E-07	--	--	1E-07		- -	0.001	- -	0.001
		Exposure Point Total						1E-07					0.001
	Exposure Medium Total							1E-07					0.001
Medium Total								2E-06					0.05
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	7E-07	--	2E-08	--	7E-07	Skin, CVS	0.02	--	0.0005	0.02
			Cobalt	- -	--	- -	--	- -	Thyroid	0.02	--	--	0.02
			Iron	- -	--	- -	--	- -	GS	0.04	--	--	0.04
			Manganese	- -	--	- -	--	- -	CNS	0.02	--	--	0.02
			Chemical Total	7E-07	--	2E-08	--	7E-07		0.08	--	0.0005	0.09
		Exposure Point Total						7E-07					0.09
	Exposure Medium Total							7E-07					0.09
	Air	SWMU 25	Arsenic	--	2E-09	--	--	2E-09	NA	--	0.0003	--	0.0003
			Cobalt	--	5E-09	--	--	5E-09	Respiratory	--	0.0009	--	0.0009
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	0.009	--	0.009
			Chemical Total	--	7E-09	--	--	7E-09		- -	0.010	- -	0.010
		Exposure Point Total						7E-09					0.010
	Exposure Medium Total							7E-09					0.010
Medium Total								7E-07					0.10

TABLE 9.5.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.003	--	0.000007	0.003
			Arsenic	4E-06	--	9E-09	--	4E-06	Skin, CVS	0.09	--	0.0002	0.09
			Cadmium	- -	--	- -	--	- -	Kidney	--	--	--	--
			Chromium	6E-06	--	1E-06	--	7E-06	None Reported	0.02	--	0.004	0.03
			Cobalt	- -	--	- -	--	- -	Thyroid	1	--	0.0009	1
			Iron	- -	--	- -	--	- -	GS	0.06	--	0.0001	0.06
			Manganese	- -	--	- -	--	- -	CNS	1.0	--	0.06	1
			Nickel	- -	--	- -	--	- -	Body Weight	0.03	--	0.0004	0.03
			Thallium	- -	--	- -	--	- -	Skin	--	--	--	--
			Vanadium	- -	--	- -	--	- -	Kidney	0.004	--	0.000008	0.004
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.0002	--	0.00007	0.0002
			Chemical Total	1E-05	--	1E-06	--	1E-05		2	--	0.06	2
		Exposure Point Total						1E-05					2
	Exposure Medium Total							1E-05					2
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Cadmium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Iron	--	- -	--	--	- -	NA	--	--	--	--
			Manganese	--	- -	--	--	- -	CNS	--	--	--	--
			Nickel	--	- -	--	--	- -	Respiratory	--	--	--	--
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Naphthalene	--	2E-09	--	--	2E-09	Respiratory	--	0.0002	--	0.0002
			Chemical Total	--	2E-09	--	--	2E-09		- -	0.0002	- -	0.0002
		Exposure Point Total						2E-09					0.0002
	Exposure Medium Total							2E-09					0.0002
Medium Total								1E-05					2
Receptor Total							Receptor Risk Total	1E-05				Receptor HI Total	2

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total Body Weight HI	0.04
Total CNS HI	1
Total CVS HI	0.1
Total GS HI	0.1
Total Kidney HI	0.004
Total Respiratory HI	0.002
Total None Reported HI	0.03
Total Skin HI	0.1
Total Thyroid HI	1
Total NA HI	0.0008

TABLE 9.6.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Arsenic	4E-06	--	1E-07	--	4E-06					
			Chromium	9E-06	--	- -	--	9E-06					
			Iron	- -	--	- -	--	- -					
			Benzo(a)pyrene	2E-07	--	3E-08	--	2E-07					
			Chemical Total	1E-05	--	2E-07	--	1E-05					
		Exposure Point Total						1E-05					
	Exposure Medium Total							1E-05					
	Air	SWMU 25	Arsenic	--	4E-09	--	--	4E-09					
			Chromium	--	3E-07	--	--	3E-07					
			Iron	--	- -	--	--	- -					
			Benzo(a)pyrene	--	6E-12	--	--	6E-12					
			Chemical Total	--	3E-07	--	--	3E-07					
		Exposure Point Total						3E-07					
	Exposure Medium Total							3E-07					
Medium Total								1E-05					
Subsurface Soil	Subsurface Soil	SWMU 25	Arsenic	3E-06	--	9E-08	--	3E-06					
			Cobalt	- -	--	- -	--	- -					
			Iron	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Chemical Total	3E-06	--	9E-08	--	3E-06					
		Exposure Point Total						3E-06					
	Exposure Medium Total							3E-06					
	Air	SWMU 25	Arsenic	--	3E-09	--	--	3E-09					
			Cobalt	--	6E-09	--	--	6E-09					
			Iron	--	- -	--	--	- -					
			Manganese	--	- -	--	--	- -					
			Chemical Total	--	9E-09	--	--	9E-09					
		Exposure Point Total						9E-09					
	Exposure Medium Total							9E-09					
Medium Total								3E-06					

TABLE 9.6.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Aluminum	- -	--	- -	--	- -					
			Arsenic	2E-05	--	3E-08	--	2E-05					
			Cadmium	- -	--	- -	--	- -					
			Chromium	6E-05	--	8E-06	--	7E-05					
			Cobalt	- -	--	- -	--	- -					
			Iron	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Nickel	- -	--	- -	--	- -					
			Thallium	- -	--	- -	--	- -					
			Vanadium	- -	--	- -	--	- -					
			Naphthalene	- -	--	- -	--	- -					
			Chemical Total	8E-05	--	8E-06	--	9E-05					
		Exposure Point Total						9E-05					
	Exposure Medium Total							9E-05					
	Air	SWMU 25	Aluminum	--	- -	--	--	- -					
			Arsenic	--	- -	--	--	- -					
			Cadmium	--	- -	--	--	- -					
			Chromium	--	- -	--	--	- -					
			Cobalt	--	- -	--	--	- -					
			Iron	--	- -	--	--	- -					
			Manganese	--	- -	--	--	- -					
			Nickel	--	- -	--	--	- -					
			Thallium	--	- -	--	--	- -					
			Vanadium	--	- -	--	--	- -					
			Naphthalene	--	2E-09	--	--	2E-09					
			Chemical Total	--	2E-09	--	--	2E-09					
		Exposure Point Total						2E-09					
	Exposure Medium Total							2E-09					
Medium Total								9E-05					
Receptor Total							Receptor Risk Total	1E-04					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

APPENDIX E.3

PROUCL OUTPUTS

Surface Soil

PROUCL OUTPUT - SURFACE SOIL

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	9
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	4200	Minimum of Log Data	8.343
Maximum	24000	Maximum of Log Data	10.09
Mean	11964	Mean of log Data	9.257
Median	9600	SD of log Data	0.55
SD	6484		
Std. Error of Mean	1955		
Coefficient of Variation	0.542		
Skewness	0.975		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.874	Shapiro Wilk Test Statistic	0.934
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	15507	95% H-UCL	17996
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	20886
95% Adjusted-CLT UCL (Chen-1995)	15793	97.5% Chebyshev (MVUE) UCL	24732
95% Modified-t UCL (Johnson-1978)	15603	99% Chebyshev (MVUE) UCL	32286

Arsenic (continued)			
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.911	**Data appear Normal at 5% Significance Level**	
Theta Star	4110		
MLE of Mean	11964		
MLE of Standard Deviation	7012		
nu star	64.04		
Approximate Chi Square Value (.05)	46.63	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	15179
Adjusted Chi Square Value	44.22	95% Jackknife UCL	15507
		95% Standard Bootstrap UCL	15086
Anderson-Darling Test Statistic	0.391	95% Bootstrap-t UCL	17348
Anderson-Darling 5% Critical Value	0.733	95% Hall's Bootstrap UCL	21549
Kolmogorov-Smirnov Test Statistic	0.168	95% Percentile Bootstrap UCL	14936
Kolmogorov-Smirnov 5% Critical Value	0.257	95% BCA Bootstrap UCL	15700
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	20485
		97.5% Chebyshev(Mean, Sd) UCL	24172
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	31415
95% Approximate Gamma UCL	16431		
95% Adjusted Gamma UCL	17328		
Potential UCL to Use		Use 95% Student's-t UCL	15507

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - SURFACE SOIL

Chromium			
General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	7
Number of Missing Values	1		
Raw Statistics		Log-transformed Statistics	
Minimum	7900	Minimum of Log Data	8.975
Maximum	29000	Maximum of Log Data	10.28
Mean	18536	Mean of log Data	9.773
Median	20000	SD of log Data	0.362
SD	6040		
Std. Error of Mean	1821		
Coefficient of Variation	0.326		
Skewness	0.0726		
Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.954	Shapiro Wilk Test Statistic	0.919
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	21837	95% H-UCL	23587
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	27578
95% Adjusted-CLT UCL (Chen-1995)	21575	97.5% Chebyshev (MVUE) UCL	31454
95% Modified-t UCL (Johnson-1978)	21844	99% Chebyshev (MVUE) UCL	39067
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	6.832	Data appear Normal at 5% Significance Level	
Theta Star	2713		
MLE of Mean	18536		
MLE of Standard Deviation	7092		
nu star	150.3		
Approximate Chi Square Value (.05)	123	Nonparametric Statistics	
Adjusted Level of Significance	0.0278	95% CLT UCL	21532
Adjusted Chi Square Value	118.9	95% Jackknife UCL	21837
		95% Standard Bootstrap UCL	21362
Anderson-Darling Test Statistic	0.389	95% Bootstrap-t UCL	22013
Anderson-Darling 5% Critical Value	0.73	95% Hall's Bootstrap UCL	21718
Kolmogorov-Smirnov Test Statistic	0.18	95% Percentile Bootstrap UCL	21455
Kolmogorov-Smirnov 5% Critical Value	0.255	95% BCA Bootstrap UCL	21091
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	26475
		97.5% Chebyshev(Mean, Sd) UCL	29910
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	36657
95% Approximate Gamma UCL	22657		
95% Adjusted Gamma UCL	23425		

Chromium (continued)											
Potential UCL to Use						Use 95% Student's-t UCL					21837
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											

PROUCL OUTPUT - SURFACE SOIL

Iron

General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	9
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	8200000	Minimum of Log Data	15.92
Maximum	63000000	Maximum of Log Data	17.96
Mean	28654545	Mean of log Data	17.06
Median	27000000	SD of log Data	0.511
SD	13922382		
Std. Error of Mean	4197756		
Coefficient of Variation	0.486		
Skewness	1.372		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.874	Shapiro Wilk Test Statistic	0.918
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	36262815	95% H-UCL	41696524
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	48716614
95% Adjusted-CLT UCL (Chen-1995)	37415095	97.5% Chebyshev (MVUE) UCL	57290295
95% Modified-t UCL (Johnson-1978)	36552291	99% Chebyshev (MVUE) UCL	74131632
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.522	**Data appear Normal at 5% Significance Level**	
Theta Star	8135431		
MLE of Mean	28654545		
MLE of Standard Deviation	15268172		
nu star	77.49		
Approximate Chi Square Value (.05)	58.21	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	35559240
Adjusted Chi Square Value	55.49	95% Jackknife UCL	36262815
		95% Standard Bootstrap UCL	35303817
Anderson-Darling Test Statistic	0.461	95% Bootstrap-t UCL	38857967
Anderson-Darling 5% Critical Value	0.732	95% Hall's Bootstrap UCL	77391453
Kolmogorov-Smirnov Test Statistic	0.206	95% Percentile Bootstrap UCL	35818182
Kolmogorov-Smirnov 5% Critical Value	0.256	95% BCA Bootstrap UCL	37454545
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	46952140
		97.5% Chebyshev(Mean, Sd) UCL	54869524
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	70421692
95% Approximate Gamma UCL	38144546		
95% Adjusted Gamma UCL	40011938		

Iron (continued)											
Potential UCL to Use						Use 95% Student's-t UCL					36262815
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											

PROUCL OUTPUT - SURFACE SOIL

	General UCL Statistics for Data Sets with Non-Detects
User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzo(a)pyrene

General Statistics

Number of Valid Data	11	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	6
Number of Missing Values	1	Percent Non-Detects	54.55%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	16	Minimum Detected	2.773
Maximum Detected	55	Maximum Detected	4.007
Mean of Detected	35.8	Mean of Detected	3.454
SD of Detected	18.54	SD of Detected	0.576
Minimum Non-Detect	7.7	Minimum Non-Detect	2.041
Maximum Non-Detect	20	Maximum Non-Detect	2.996
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	8
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	72.73%

Warning: There are only 5 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.859	Shapiro Wilk Test Statistic	0.867
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Benzo(a)pyrene (continued)			
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	19	Mean	2.408
SD	19.98	SD	1.098
95% DL/2 (t) UCL	29.92	95% H-Stat (DL/2) UCL	61.44
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	2.614
		SD in Log Scale	0.912
		Mean in Original Scale	20.12
		SD in Original Scale	19.1
		95% t UCL	30.56
		95% Percentile Bootstrap UCL	29.34
		95% BCA Bootstrap UCL	31.46
		95% H-UCL	46.82
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.807	**Data appear Normal at 5% Significance Level**	
Theta Star	19.81		
nu star	18.07		
A-D Test Statistic	0.433	**Nonparametric Statistics**	
5% A-D Critical Value	0.681	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.681	Mean	25.04
5% K-S Critical Value	0.358	SD	14.89
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	5.019
		95% KM (t) UCL	34.14
Assuming Gamma Distribution		95% KM (z) UCL	33.3
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	32.97
Minimum	0.000001	95% KM (bootstrap t) UCL	35.6
Maximum	55	95% KM (BCA) UCL	54.09
Mean	16.27	95% KM (Percentile Bootstrap) UCL	40.36
Median	0.000001	95% KM (Chebyshev) UCL	46.92
SD	22.07	97.5% KM (Chebyshev) UCL	56.39
k star	0.129	99% KM (Chebyshev) UCL	74.98
Theta star	126.5		
Nu star	2.83	**Potential UCLs to Use**	
AppChi2	0.324	95% KM (t) UCL	34.14
95% Gamma Approximate UCL	142.2	95% KM (Percentile Bootstrap) UCL	40.36
95% Adjusted Gamma UCL	203.1		
Note: DL/2 is not a recommended method.			

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

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

For additional insight, the user may want to consult a statistician.

Subsurface Soil

PROUCL OUTPUT - SUBSURFACE SOIL

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	WorkSheet_a.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Arsenic			
General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	10
Number of Missing Values	1		
Raw Statistics		**Log-transformed Statistics**	
Minimum	1600	Minimum of Log Data	7.378
Maximum	14000	Maximum of Log Data	9.547
Mean	7727	Mean of log Data	8.748
Median	5900	SD of log Data	0.723
SD	4584		
Std. Error of Mean	1382		
Coefficient of Variation	0.593		
Skewness	0.24		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.909	Shapiro Wilk Test Statistic	0.924
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	10233	95% H-UCL	14489
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	15795
95% Adjusted-CLT UCL (Chen-1995)	10108	97.5% Chebyshev (MVUE) UCL	19189
95% Modified-t UCL (Johnson-1978)	10249	99% Chebyshev (MVUE) UCL	25855

Arsenic (continued)			
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.953	**Data appear Normal at 5% Significance Level**	
Theta Star	3956		
MLE of Mean	7727		
MLE of Standard Deviation	5529		
nu star	42.98		
Approximate Chi Square Value (.05)	28.94	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	10001
Adjusted Chi Square Value	27.08	95% Jackknife UCL	10233
		95% Standard Bootstrap UCL	9907
Anderson-Darling Test Statistic	0.322	95% Bootstrap-t UCL	10338
Anderson-Darling 5% Critical Value	0.736	95% Hall's Bootstrap UCL	9819
Kolmogorov-Smirnov Test Statistic	0.163	95% Percentile Bootstrap UCL	9964
Kolmogorov-Smirnov 5% Critical Value	0.258	95% BCA Bootstrap UCL	9864
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	13752
		97.5% Chebyshev(Mean, Sd) UCL	16359
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	21480
95% Approximate Gamma UCL	11473		
95% Adjusted Gamma UCL	12264		
Potential UCL to Use		Use 95% Student's-t UCL	10233

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - SUBSURFACE SOIL

Cobalt			
General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	10
Number of Missing Values	1		
Raw Statistics		**Log-transformed Statistics**	
Minimum	1000	Minimum of Log Data	6.908
Maximum	23000	Maximum of Log Data	10.04
Mean	6273	Mean of log Data	8.379
Median	4400	SD of log Data	0.883
SD	6280		
Std. Error of Mean	1893		
Coefficient of Variation	1.001		
Skewness	2.156		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.751	Shapiro Wilk Test Statistic	0.977
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	9705	95% H-UCL	13969
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	13645
95% Adjusted-CLT UCL (Chen-1995)	10702	97.5% Chebyshev (MVUE) UCL	16889
95% Modified-t UCL (Johnson-1978)	9910	99% Chebyshev (MVUE) UCL	23262
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.163	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	5394		
MLE of Mean	6273		
MLE of Standard Deviation	5817		
nu star	25.59		
Approximate Chi Square Value (.05)	15.06	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	9387
Adjusted Chi Square Value	13.76	95% Jackknife UCL	9705
		95% Standard Bootstrap UCL	9253
Anderson-Darling Test Statistic	0.364	95% Bootstrap-t UCL	13110
Anderson-Darling 5% Critical Value	0.742	95% Hall's Bootstrap UCL	21270
Kolmogorov-Smirnov Test Statistic	0.179	95% Percentile Bootstrap UCL	9509
Kolmogorov-Smirnov 5% Critical Value	0.26	95% BCA Bootstrap UCL	10818
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	14526
		97.5% Chebyshev(Mean, Sd) UCL	18098
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	25113
95% Approximate Gamma UCL	10656		
95% Adjusted Gamma UCL	11664		

Cobalt (continued)											
Potential UCL to Use						Use 95% Approximate Gamma UCL					10656
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											

PROUCL OUTPUT - SUBSURFACE SOIL

Iron			
General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	10
Number of Missing Values	1		
Raw Statistics		**Log-transformed Statistics**	
Minimum	6200000	Minimum of Log Data	15.64
Maximum	130000000	Maximum of Log Data	18.68
Mean	32018182	Mean of log Data	16.91
Median	22000000	SD of log Data	0.85
SD	35164807		
Std. Error of Mean	10602588		
Coefficient of Variation	1.098		
Skewness	2.548		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.673	Shapiro Wilk Test Statistic	0.963
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	51234961	95% H-UCL	66043960
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	66263349
95% Adjusted-CLT UCL (Chen-1995)	58163041	97.5% Chebyshev (MVUE) UCL	81731351
95% Modified-t UCL (Johnson-1978)	52592789	99% Chebyshev (MVUE) UCL	112100000
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.154	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	27734429		
MLE of Mean	32018182		
MLE of Standard Deviation	29799429		
nu star	25.4		
Approximate Chi Square Value (.05)	14.92	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	49457887
Adjusted Chi Square Value	13.62	95% Jackknife UCL	51234961
		95% Standard Bootstrap UCL	48642083
Anderson-Darling Test Statistic	0.517	95% Bootstrap-t UCL	92004495
Anderson-Darling 5% Critical Value	0.742	95% Hall's Bootstrap UCL	133100000
Kolmogorov-Smirnov Test Statistic	0.21	95% Percentile Bootstrap UCL	50581818
Kolmogorov-Smirnov 5% Critical Value	0.26	95% BCA Bootstrap UCL	60272727
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	78233792
		97.5% Chebyshev(Mean, Sd) UCL	98231324
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	137500000
95% Approximate Gamma UCL	54516220		
95% Adjusted Gamma UCL	59696399		

Iron (continued)											
Potential UCL to Use						Use 95% Approximate Gamma UCL					54516220
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											

PROUCL OUTPUT - SUBSURFACE SOIL

Manganese			
General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	11
Number of Missing Values	1		
Raw Statistics		**Log-transformed Statistics**	
Minimum	82000	Minimum of Log Data	11.31
Maximum	2600000	Maximum of Log Data	14.77
Mean	440000	Mean of log Data	12.33
Median	170000	SD of log Data	1.051
SD	733500		
Std. Error of Mean	221158		
Coefficient of Variation	1.667		
Skewness	3.05		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.525	Shapiro Wilk Test Statistic	0.87
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	840841	95% H-UCL	1102257
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	906318
95% Adjusted-CLT UCL (Chen-1995)	1021118	97.5% Chebyshev (MVUE) UCL	1139634
95% Modified-t UCL (Johnson-1978)	874742	99% Chebyshev (MVUE) UCL	1597938
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.702	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
Theta Star	626651		
MLE of Mean	440000		
MLE of Standard Deviation	525097		
nu star	15.45		
Approximate Chi Square Value (.05)	7.574	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	803773
Adjusted Chi Square Value	6.694	95% Jackknife UCL	840841
		95% Standard Bootstrap UCL	791647
Anderson-Darling Test Statistic	1.03	95% Bootstrap-t UCL	2006549
Anderson-Darling 5% Critical Value	0.757	95% Hall's Bootstrap UCL	2095690
Kolmogorov-Smirnov Test Statistic	0.246	95% Percentile Bootstrap UCL	860182
Kolmogorov-Smirnov 5% Critical Value	0.264	95% BCA Bootstrap UCL	1067636
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1404007
		97.5% Chebyshev(Mean, Sd) UCL	1821134
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	2640499
95% Approximate Gamma UCL	897423		
95% Adjusted Gamma UCL	1015341		

Manganese (continued)											
Potential UCL to Use						Use 95% Approximate Gamma UCL					897423
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											

Groundwater

PROUCL OUTPUT - GROUNDWATER

	General UCL Statistics for Full Data Sets
User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Aluminum

General Statistics

Number of Valid Observations	7	Number of Distinct Observations	7
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	39	Minimum of Log Data	3.664
Maximum	5630	Maximum of Log Data	8.636
Mean	1425	Mean of log Data	5.87
Geometric Mean	354.3	SD of log Data	1.886
Median	262		
SD	2231		
Std. Error of Mean	843.3		
Coefficient of Variation	1.566		
Skewness	1.536		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.69	Shapiro Wilk Test Statistic	0.903
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	3063	95% H-UCL	287542
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	5151
95% Adjusted-CLT UCL (Chen-1995)	3335	97.5% Chebyshev (MVUE) UCL	6810
95% Modified-t UCL (Johnson-1978)	3145	99% Chebyshev (MVUE) UCL	10068

Aluminum (continued)			
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.359	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
Theta Star	3965		
MLE of Mean	1425		
MLE of Standard Deviation	2377		
nu star	5.03		
Approximate Chi Square Value (.05)	1.166	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0158	95% CLT UCL	2812
Adjusted Chi Square Value	0.701	95% Jackknife UCL	3063
		95% Standard Bootstrap UCL	2708
Anderson-Darling Test Statistic	0.644	95% Bootstrap-t UCL	27483
Anderson-Darling 5% Critical Value	0.758	95% Hall's Bootstrap UCL	24871
Kolmogorov-Smirnov Test Statistic	0.34	95% Percentile Bootstrap UCL	2679
Kolmogorov-Smirnov 5% Critical Value	0.329	95% BCA Bootstrap UCL	3013
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	5101
		97.5% Chebyshev(Mean, Sd) UCL	6691
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	9816
95% Approximate Gamma UCL (Use when n >= 40)	6146		
95% Adjusted Gamma UCL (Use when n < 40)	10225		
Potential UCL to Use		Use 95% Adjusted Gamma UCL	10225
Recommended UCL exceeds the maximum observation			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Cobalt

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	3.9	Minimum of Log Data	1.361
Maximum	149	Maximum of Log Data	5.004
Mean	30.85	Mean of log Data	2.659
Geometric Mean	14.29	SD of log Data	1.171
Median	9.16		
SD	52.42		
Std. Error of Mean	19.81		
Coefficient of Variation	1.699		
Skewness	2.58		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.554	Shapiro Wilk Test Statistic	0.869
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	69.35	95% H-UCL	210.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	72.43
95% Adjusted-CLT UCL (Chen-1995)	84.08	97.5% Chebyshev (MVUE) UCL	93.06
95% Modified-t UCL (Johnson-1978)	72.57	99% Chebyshev (MVUE) UCL	133.6

Cobalt (continued)			
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.538	**Data appear Lognormal at 5% Significance Level**	
Theta Star	57.36		
MLE of Mean	30.85		
MLE of Standard Deviation	42.06		
nu star	7.529		
Approximate Chi Square Value (.05)	2.466	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0158	95% CLT UCL	63.44
Adjusted Chi Square Value	1.683	95% Jackknife UCL	69.35
		95% Standard Bootstrap UCL	60.57
Anderson-Darling Test Statistic	0.908	95% Bootstrap-t UCL	275.2
Anderson-Darling 5% Critical Value	0.735	95% Hall's Bootstrap UCL	229.7
Kolmogorov-Smirnov Test Statistic	0.342	95% Percentile Bootstrap UCL	69.57
Kolmogorov-Smirnov 5% Critical Value	0.322	95% BCA Bootstrap UCL	73.42
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	117.2
		97.5% Chebyshev(Mean, Sd) UCL	154.6
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	228
95% Approximate Gamma UCL (Use when n >= 40)	94.2		
95% Adjusted Gamma UCL (Use when n < 40)	138		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	117.2

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Iron

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	3300	Minimum of Log Data	8.102
Maximum	146000	Maximum of Log Data	11.89
Mean	27894	Mean of log Data	9.123
Geometric Mean	9163	SD of log Data	1.423
Median	5500		
SD	52798		
Std. Error of Mean	19956		
Coefficient of Variation	1.893		
Skewness	2.508		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.557	Shapiro Wilk Test Statistic	0.769
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	66672	95% H-UCL	446701
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	66744
95% Adjusted-CLT UCL (Chen-1995)	80929	97.5% Chebyshev (MVUE) UCL	86882
95% Modified-t UCL (Johnson-1978)	69825	99% Chebyshev (MVUE) UCL	126438

Iron (continued)

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	0.416	Data do not follow a Discernable Distribution (0.05)	
Theta Star	67116		
MLE of Mean	27894		
MLE of Standard Deviation	43268		
nu star	5.819		
Approximate Chi Square Value (.05)	1.548	Nonparametric Statistics	
Adjusted Level of Significance	0.0158	95% CLT UCL	60719
Adjusted Chi Square Value	0.978	95% Jackknife UCL	66672
		95% Standard Bootstrap UCL	58220
Anderson-Darling Test Statistic	1.083	95% Bootstrap-t UCL	1129528
Anderson-Darling 5% Critical Value	0.748	95% Hall's Bootstrap UCL	639442
Kolmogorov-Smirnov Test Statistic	0.393	95% Percentile Bootstrap UCL	65171
Kolmogorov-Smirnov 5% Critical Value	0.326	95% BCA Bootstrap UCL	75143
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	114880
		97.5% Chebyshev(Mean, Sd) UCL	152518
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	226452
95% Approximate Gamma UCL (Use when n >= 40)	104857		
95% Adjusted Gamma UCL (Use when n < 40)	165974		
Potential UCL to Use		Use 95% Hall's Bootstrap UCL	639442

Recommended UCL exceeds the maximum observation

In Case Bootstrap t and/or Hall's Bootstrap yields an unreasonably large UCL value, use 97.5% or 99% Chebyshev (Mean, Sd) UCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Manganese

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	810	Minimum of Log Data	6.697
Maximum	7440	Maximum of Log Data	8.915
Mean	3343	Mean of log Data	7.763
Geometric Mean	2352	SD of log Data	0.931
Median	1550		
SD	2787		
Std. Error of Mean	1053		
Coefficient of Variation	0.834		
Skewness	0.568		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.827	Shapiro Wilk Test Statistic	0.865
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	5390	95% H-UCL	13754
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	8534
95% Adjusted-CLT UCL (Chen-1995)	5318	97.5% Chebyshev (MVUE) UCL	10775
95% Modified-t UCL (Johnson-1978)	5428	99% Chebyshev (MVUE) UCL	15175

Manganese (continued)			
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.991	**Data appear Normal at 5% Significance Level**	
Theta Star	3374		
MLE of Mean	3343		
MLE of Standard Deviation	3359		
nu star	13.87		
Approximate Chi Square Value (.05)	6.483	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0158	95% CLT UCL	5076
Adjusted Chi Square Value	5.039	95% Jackknife UCL	5390
		95% Standard Bootstrap UCL	4968
Anderson-Darling Test Statistic	0.589	95% Bootstrap-t UCL	6232
Anderson-Darling 5% Critical Value	0.72	95% Hall's Bootstrap UCL	4481
Kolmogorov-Smirnov Test Statistic	0.288	95% Percentile Bootstrap UCL	4909
Kolmogorov-Smirnov 5% Critical Value	0.317	95% BCA Bootstrap UCL	5056
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	7935
		97.5% Chebyshev(Mean, Sd) UCL	9922
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	13825
95% Approximate Gamma UCL (Use when n >= 40)	7153		
95% Adjusted Gamma UCL (Use when n < 40)	9202		
Potential UCL to Use		Use 95% Student's-t UCL	5390

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Nickel

General Statistics			
Number of Valid Observations	7	Number of Distinct Observations	7
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	9.2	Minimum of Log Data	2.219
Maximum	398	Maximum of Log Data	5.986
Mean	94.64	Mean of log Data	3.966
Geometric Mean	52.78	SD of log Data	1.108
Median	49		
SD	135		
Std. Error of Mean	51.03		
Coefficient of Variation	1.427		
Skewness	2.542		

Warning: A sample size of 'n' = 7 may not adequate enough to compute meaningful and reliable test statistics and estimates!

It is suggested to collect at least 8 to 10 observations using these statistical methods!

If possible compute and collect Data Quality Objectives (DQO) based sample size and analytical results.

Warning: There are only 7 Values in this data

Note: It should be noted that even though bootstrap methods may be performed on this data set,

the resulting calculations may not be reliable enough to draw conclusions

The literature suggests to use bootstrap methods on data sets having more than 10-15 observations.

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.585	Shapiro Wilk Test Statistic	0.89
Shapiro Wilk Critical Value	0.803	Shapiro Wilk Critical Value	0.803
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	193.8	95% H-UCL	597.2
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	244.9
95% Adjusted-CLT UCL (Chen-1995)	231	97.5% Chebyshev (MVUE) UCL	313.4
95% Modified-t UCL (Johnson-1978)	202	99% Chebyshev (MVUE) UCL	447.9

Nickel (continued)			
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	0.661	**Data appear Lognormal at 5% Significance Level**	
Theta Star	143.2		
MLE of Mean	94.64		
MLE of Standard Deviation	116.4		
nu star	9.251		
Approximate Chi Square Value (.05)	3.48	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0158	95% CLT UCL	178.6
Adjusted Chi Square Value	2.5	95% Jackknife UCL	193.8
		95% Standard Bootstrap UCL	172.5
Anderson-Darling Test Statistic	0.802	95% Bootstrap-t UCL	653.4
Anderson-Darling 5% Critical Value	0.728	95% Hall's Bootstrap UCL	754.6
Kolmogorov-Smirnov Test Statistic	0.342	95% Percentile Bootstrap UCL	192.9
Kolmogorov-Smirnov 5% Critical Value	0.32	95% BCA Bootstrap UCL	202.2
Data not Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	317.1
		97.5% Chebyshev(Mean, Sd) UCL	413.3
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	602.4
95% Approximate Gamma UCL (Use when n >= 40)	251.6		
95% Adjusted Gamma UCL (Use when n < 40)	350.3		
Potential UCL to Use		Use 95% Chebyshev (Mean, Sd) UCL	317.1

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

	General UCL Statistics for Data Sets with Non-Detects
User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Number of Valid Data	7	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	3
Number of Missing Values	1	Percent Non-Detects	42.86%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	2	Minimum Detected	0.693
Maximum Detected	127	Maximum Detected	4.844
Mean of Detected	36.18	Mean of Detected	2.224
SD of Detected	60.79	SD of Detected	1.961
Minimum Non-Detect	1.2	Minimum Non-Detect	0.182
Maximum Non-Detect	1.5	Maximum Non-Detect	0.405

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	3
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	4
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	42.86%

Warning: There are only 4 Distinct Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.696	Shapiro Wilk Test Statistic	0.868
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Arsenic (continued)

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	20.97	Mean	1.115
SD	46.98	SD	1.959
95% DL/2 (t) UCL	55.48	95% H-Stat (DL/2) UCL	4142
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.235
		SD in Log Scale	3.415
		Mean in Original Scale	20.69
		SD in Original Scale	47.13
		95% t UCL	55.3
		95% Percentile Bootstrap UCL	55.04
		95% BCA Bootstrap UCL	72.6
		95% H-UCL	1.843E+09
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	0.284	Data appear Gamma Distributed at 5% Significance Level	
Theta Star	127.3		
nu star	2.273		
A-D Test Statistic	0.486	Nonparametric Statistics	
5% A-D Critical Value	0.684	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.684	Mean	21.53
5% K-S Critical Value	0.411	SD	43.24
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	18.87
		95% KM (t) UCL	58.2
Assuming Gamma Distribution		95% KM (z) UCL	52.57
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	55.8
Minimum	0.000001	95% KM (bootstrap t) UCL	222.6
Maximum	127	95% KM (BCA) UCL	62.2
Mean	20.67	95% KM (Percentile Bootstrap) UCL	57.23
Median	2	95% KM (Chebyshev) UCL	103.8
SD	47.14	97.5% KM (Chebyshev) UCL	139.4
k star	0.155	99% KM (Chebyshev) UCL	209.3
Theta star	133.1		
Nu star	2.174	Potential UCLs to Use	
AppChi2	0.177	95% KM (BCA) UCL	62.2
95% Gamma Approximate UCL (Use when n >= 40)	254.3		
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Cadmium

General Statistics			
Number of Valid Data	7	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	5
Number of Missing Values	1	Percent Non-Detects	71.43%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.46	Minimum Detected	-0.777
Maximum Detected	1.09	Maximum Detected	0.0862
Mean of Detected	0.775	Mean of Detected	-0.345
SD of Detected	0.445	SD of Detected	0.61
Minimum Non-Detect	0.24	Minimum Non-Detect	-1.427
Maximum Non-Detect	0.5	Maximum Non-Detect	-0.693

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	6
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	1
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	85.71%

Warning: Data set has only 2 Distinct Detected Values.

This may not be adequate enough to compute meaningful and reliable test statistics and estimates.

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		Data not Lognormal at 5% Significance Level	

Cadmium (continued)

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.377	Mean	-1.212
SD	0.33	SD	0.693
95% DL/2 (t) UCL	0.62	95% H-Stat (DL/2) UCL	0.857
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
		95% H-UCL	N/A
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.55
5% K-S Critical Value	N/A	SD	0.22
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.118
		95% KM (t) UCL	0.779
Assuming Gamma Distribution		95% KM (z) UCL	0.744
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.02
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	1.09
Mean	N/A	95% KM (Percentile Bootstrap) UCL	1.09
Median	N/A	95% KM (Chebyshev) UCL	1.064
SD	N/A	97.5% KM (Chebyshev) UCL	1.286
k star	N/A	99% KM (Chebyshev) UCL	1.722
Theta star	N/A		
Nu star	N/A	Potential UCLs to Use	
AppChi2	N/A	95% KM (t) UCL	0.779
95% Gamma Approximate UCL (Use when n >= 40)	N/A	95% KM (% Bootstrap) UCL	1.09
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Chromium

General Statistics			
Number of Valid Data	7	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	2
Number of Missing Values	1	Percent Non-Detects	28.57%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	1.22	Minimum Detected	0.199
Maximum Detected	85.4	Maximum Detected	4.447
Mean of Detected	23.95	Mean of Detected	2
SD of Detected	35.98	SD of Detected	1.816
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	0.57	Maximum Non-Detect	-0.562
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	2
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	5
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	28.57%

Warning: There are only 5 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.743	Shapiro Wilk Test Statistic	0.917
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data not Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	17.19	Mean	1.051
SD	31.57	SD	2.197
95% DL/2 (t) UCL	40.37	95% H-Stat (DL/2) UCL	23670
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	9.722	Mean in Log Scale	0.636
SD	36.99	SD in Log Scale	2.761
95% MLE (t) UCL	36.89	Mean in Original Scale	17.13
95% MLE (Tiku) UCL	37.8	SD in Original Scale	31.6
		95% t UCL	40.34
		95% Percentile Bootstrap UCL	37.86
		95% BCA Bootstrap UCL	44.5
		95% H UCL	2648241

Chromium (continued)			
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.347	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	69.01		
nu star	3.471		
A-D Test Statistic	0.401	**Nonparametric Statistics**	
5% A-D Critical Value	0.709	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.709	Mean	17.46
5% K-S Critical Value	0.371	SD	29.07
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	12.28
		95% KM (t) UCL	41.33
Assuming Gamma Distribution		95% KM (z) UCL	37.66
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	40.43
Minimum	0.000001	95% KM (bootstrap t) UCL	352.8
Maximum	85.4	95% KM (BCA) UCL	37.83
Mean	17.11	95% KM (Percentile Bootstrap) UCL	37.74
Median	1.8	95% KM (Chebyshev) UCL	71
SD	31.61	97.5% KM (Chebyshev) UCL	94.17
k star	0.178	99% KM (Chebyshev) UCL	139.7
Theta star	96.3		
Nu star	2.487	**Potential UCLs to Use**	
AppChi2	0.238	95% KM (Chebyshev) UCL	71
95% Gamma Approximate UCL (Use when n >= 40)	178.6		
95% Adjusted Gamma UCL (Use when n < 40)	335.2		
Note: DL/2 is not a recommended method.			

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

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

For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Thallium

General Statistics			
Number of Valid Data	7	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	5
Number of Missing Values	1	Percent Non-Detects	71.43%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	2.19	Minimum Detected	0.784
Maximum Detected	3.56	Maximum Detected	1.27
Mean of Detected	2.875	Mean of Detected	1.027
SD of Detected	0.969	SD of Detected	0.344
Minimum Non-Detect	0.2	Minimum Non-Detect	-1.609
Maximum Non-Detect	1	Maximum Non-Detect	0
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	5
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	2
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	71.43%

Warning: Data set has only 2 Distinct Detected Values.

This may not be adequate enough to compute meaningful and reliable test statistics and estimates.

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	

Thallium (continued)

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.014	Mean	-0.838
SD	1.343	SD	1.449
95% DL/2 (t) UCL	2	95% H-Stat (DL/2) UCL	24.19
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
		95% H-UCL	N/A
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	N/A	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	**Nonparametric Statistics**	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	2.386
5% K-S Critical Value	N/A	SD	0.479
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.256
		95% KM (t) UCL	2.884
Assuming Gamma Distribution		95% KM (z) UCL	2.807
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	3.408
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	3.503
SD	N/A	97.5% KM (Chebyshev) UCL	3.986
k star	N/A	99% KM (Chebyshev) UCL	4.935
Theta star	N/A		
Nu star	N/A	**Potential UCLs to Use**	
AppChi2	N/A	95% KM (t) UCL	2.884
95% Gamma Approximate UCL (Use when n >= 40)	N/A	95% KM (% Bootstrap) UCL	N/A
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Note: DL/2 is not a recommended method.

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

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

For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Vanadium

General Statistics			
Number of Valid Data	7	Number of Detected Data	5
Number of Distinct Detected Data	5	Number of Non-Detect Data	2
Number of Missing Values	1	Percent Non-Detects	28.57%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.27	Minimum Detected	-1.309
Maximum Detected	31.3	Maximum Detected	3.444
Mean of Detected	12.43	Mean of Detected	1.404
SD of Detected	14.92	SD of Detected	1.985
Minimum Non-Detect	0.2	Minimum Non-Detect	-1.609
Maximum Non-Detect	2.5	Maximum Non-Detect	0.916
Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	4
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	3
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	57.14%

Warning: There are only 5 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.786	Shapiro Wilk Test Statistic	0.92
5% Shapiro Wilk Critical Value	0.762	5% Shapiro Wilk Critical Value	0.762
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	9.069	Mean	0.706
SD	13.47	SD	2.14
95% DL/2 (t) UCL	18.96	95% H-Stat (DL/2) UCL	10709
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	0.378
		SD in Log Scale	2.458
		Mean in Original Scale	8.926
		SD in Original Scale	13.57
		95% t UCL	18.89
		95% Percentile Bootstrap UCL	17.05
		95% BCA Bootstrap UCL	17.99
		95% H-UCL	112412

Vanadium (continued)			
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.357	**Data appear Normal at 5% Significance Level**	
Theta Star	34.8		
nu star	3.571		
A-D Test Statistic	0.393	**Nonparametric Statistics**	
5% A-D Critical Value	0.708	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.708	Mean	9.024
5% K-S Critical Value	0.37	SD	12.5
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	5.283
		95% KM (t) UCL	19.29
Assuming Gamma Distribution		95% KM (z) UCL	17.71
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	18.82
Minimum	0.000001	95% KM (bootstrap t) UCL	90.55
Maximum	31.3	95% KM (BCA) UCL	18.36
Mean	8.876	95% KM (Percentile Bootstrap) UCL	18.59
Median	1.76	95% KM (Chebyshev) UCL	32.05
SD	13.61	97.5% KM (Chebyshev) UCL	42.01
k star	0.181	99% KM (Chebyshev) UCL	61.58
Theta star	49.07		
Nu star	2.532	**Potential UCLs to Use**	
AppChi2	0.249	95% KM (t) UCL	19.29
95% Gamma Approximate UCL (Use when n >= 40)	90.43	95% KM (Percentile Bootstrap) UCL	18.59
95% Adjusted Gamma UCL (Use when n < 40)	171.1		

Note: DL/2 is not a recommended method.

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

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

For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Naphthalene

General Statistics			
Number of Valid Data	7	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	3
Number of Missing Values	1	Percent Non-Detects	42.86%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0545	Minimum Detected	-2.91
Maximum Detected	0.169	Maximum Detected	-1.778
Mean of Detected	0.116	Mean of Detected	-2.253
SD of Detected	0.0556	SD of Detected	0.537
Minimum Non-Detect	0.2	Minimum Non-Detect	-1.609
Maximum Non-Detect	0.2	Maximum Non-Detect	-1.609

Warning: There are only 4 Distinct Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.89	Shapiro Wilk Test Statistic	0.898
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.109	Mean	-2.274
SD	0.0403	SD	0.381
95% DL/2 (t) UCL	0.139	95% H-Stat (DL/2) UCL	0.158
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.253
		SD in Log Scale	0.472
		Mean in Original Scale	0.115
		SD in Original Scale	0.05
		95% t UCL	0.152
		95% Percentile Bootstrap UCL	0.144
		95% BCA Bootstrap UCL	0.142
		95% H-UCL	0.187

Naphthalene (continued)			
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	1.45	**Data appear Normal at 5% Significance Level**	
Theta Star	0.0802		
nu star	11.6		
A-D Test Statistic	0.379	**Nonparametric Statistics**	
5% A-D Critical Value	0.659	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.659	Mean	0.116
5% K-S Critical Value	0.396	SD	0.0481
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0278
		95% KM (t) UCL	0.17
Assuming Gamma Distribution		95% KM (z) UCL	0.162
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.174
Minimum	0.0545	95% KM (bootstrap t) UCL	0.176
Maximum	0.169	95% KM (BCA) UCL	0.161
Mean	0.116	95% KM (Percentile Bootstrap) UCL	0.163
Median	0.118	95% KM (Chebyshev) UCL	0.237
SD	0.0494	97.5% KM (Chebyshev) UCL	0.29
k star	3.386	99% KM (Chebyshev) UCL	0.393
Theta star	0.0344		
Nu star	47.41	**Potential UCLs to Use**	
AppChi2	32.61	95% KM (t) UCL	0.17
95% Gamma Approximate UCL (Use when n >= 40)	0.169	95% KM (Percentile Bootstrap) UCL	0.163
95% Adjusted Gamma UCL (Use when n < 40)	N/A		
Warning: Recommended UCL exceeds the maximum observation			
Note: DL/2 is not a recommended method.			
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.			
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).			
For additional insight, the user may want to consult a statistician.			

APPENDIX E.4

SAMPLE CALCULATIONS

CALCULATION WORKSHEET

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL INDUSTRIAL WORKERS		
BASED ON: USEPA, DECEMBER 1989		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from incidental ingestion of surface soil.

EQUATION:

$$IEX = \frac{CS \times IR \times EF \times ED \times FI \times CF}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
IR	=	incidental ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
CF	=	conversion factor (1E-06 kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Cs	=	15.5	mg/kg	Chemical: Arsenic
IR	=	100	mg/day	
EF	=	250	days/year	
ED	=	25	years	
FI	=	1		
CF	=	1E-06	kg/mg	
BW	=	70	kg	
ATc	=	25,550	days	
ATnc	=	9125	days	
CSFo	=	1.5E+00	$(mg/kg/day)^{-1}$	
RfDo	=	3.0E-04	(mg/kg/day)	

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL INDUSTRIAL WORKERS		
BASED ON: USEPA, DECEMBER 1989		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{15.5 \text{ mg/kg} \times 100 \text{ mg/day} \times 250 \text{ days/year} \times 25 \text{ years} \times 1 \times 1E\text{-}06 \text{ kg/mg}}{70 \text{ kg} \times 25550 \text{ days}}$$

IEXc = 5.42E-06 mg/kg/day

ILCR = 5.42E-06 mg/kg/day x 1.50E+00 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 8.1E-06

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{15.5 \text{ mg/kg} \times 100 \text{ mg/day} \times 250 \text{ days/year} \times 25 \text{ years} \times 1 \times 1E\text{-}06 \text{ kg/mg}}{70 \text{ kg} \times 9125 \text{ days}}$$

IEXnc = 1.52E-05 mg/kg/day

HQ = 1.52E-05 mg/kg/day / 3.00E-04 (mg/kg/day) = Hazard Quotient

HQ = 5.1E-02

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL INDUSTRIAL WORKERS		
BASED ON: USEPA, JULY 2004		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with surface soil.

EQUATION:

$$DEX = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

Where:

DEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
CF	=	conversion factor (1E-06 kg/mg)
SA	=	skin surface available for contact (cm2/day)
ABS	=	absorption factor (unitless)
AF	=	adherence factor (mg/cm2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDd	=	dermal noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFd (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDd (mg/kg/day)

ASSUMPTIONS:

Cs	=	15.5	mg/kg	Chemical: Arsenic
CF	=	1E-06	kg/mg	
SA	=	3,300	cm^2/day	
AF	=	0.2	mg/cm^2	
ABS	=	0.03		
EF	=	250	days/year	
ED	=	25	years	
BW	=	70	kg	
ATc	=	25,550	days	
ATnc	=	9125	days	
CSFd	=	1.5E+00	$(mg/kg/day)^{-1}$	
RfDd	=	3.0E-04	(mg/kg/day)	

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL INDUSTRIAL WORKERS		
BASED ON: USEPA, JULY 2004		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$DEXc = \frac{15.5 \text{ mg/kg} \times 1E\text{-}06 \text{ kg/mg} \times 3300 \text{ cm2/day} \times 0.2 \text{ mg/cm2} \times 0.03 \times 250 \text{ days/year} \times 25 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}}$$

DEXc = 1.07E-06 mg/kg/day

ILCR = 1.07E-06 mg/kg/day x 1.50E+00 (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = 1.6E-06

EXAMPLE NONCARCINOGENIC CALCULATION

$$DEXnc = \frac{15.5 \text{ mg/kg} \times 1E\text{-}06 \text{ kg/mg} \times 3300 \text{ cm2/day} \times 0.2 \text{ mg/cm2} \times 0.03 \times 250 \text{ days/year} \times 25 \text{ years}}{70 \text{ kg} \times 9125 \text{ days}}$$

DEXnc = 3.00E-06 mg/kg/day

HQ = 3.00E-06 mg/kg/day / 3.00E-04 (mg/kg/day) = Hazard Quotient

HQ = 1.0E-02

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF FUGATIVE DUST EMISSIONS INDUSTRIAL WORKERS		
BASED ON: USEPA, JANUARY 2009		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from inhalation of surface soil.

EQUATION:

$$EC = \frac{Ca \times ET \times EF \times ED}{AT \times 24 \text{ hours/day}}$$

Where:

EC	=	exposure concentration (mg/m3)
Ca	=	exposure point concentration in air (mg/m3)
	=	Cs x 1/PEF
Cs	=	exposure point concentration in soil (mg/kg)
PEF	=	particulate emission factor (m3/kg)
ET	=	exposure time (hrs/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (hours)
IUR	=	inhalation unit risk ($(ug/m3)^{-1}$)
RfC	=	inhalation reference concentration (mg/m3)

RISKS:

ILCR (Carcinogens) = Exposure Concentration (mg/m3) x IURi (ug/m3)-1 x 1000 ug/mg
HQ (Noncarcinogens) = Exposure Concentration (mg/m3) / RFCi (mg/m3)

ASSUMPTIONS:

Cs	=	15.5	mg/kg	Chemical: Arsenic
PEF	=	1.316E+09	m3/kg	
Ca	=	1.18E-08	mg/m3	
ET	=	8	hours/day	
EF	=	250	days/year	
ED	=	25	years	
ATc	=	25,550	days	
ATnc	=	9,125	days	
IUR	=	4.3E-03	$(ug/m3)^{-1}$	
RfC	=	1.5E-05	(mg/m3)	

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF FUGATIVE DUST EMISSIONS INDUSTRIAL WORKERS		
BASED ON: USEPA, JANUARY 2009		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{1.18E\text{-}08\ mg/m3 \times 8\ hours/day \times 250\ days/year \times 25\ years}{25550\ days \times 24\ hours/day}$$

IEXc = 9.60E-10 mg/m3

ILCR = 9.60E-10 mg/m3 x 4.30E-03 (ug/m3)-1 x 1000 ug/mg = Incremental Lifetime Cancer Risk

ILCR = 4.1E-09

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{1.18E\text{-}08\ mg/m3 \times 8\ hours/day \times 250\ days/year \times 25\ years}{9125\ days \times 24\ hours/day}$$

IEXnc = 2.69E-09 mg/m3

HQ = 2.69E-09 mg/m3 / 1.50E-05 (mg/m3) = Hazard Quotient

HQ **1.8E-04**

CLIENT:	JOB NUMBER:
NSA CRANE, CRANE, INDIANA	112G03116

SUBJECT:
CALCULATION OF PARTICUALATE EMISSION FACTOR FOR CONSTRUCTION WORKERS

BASED ON:
Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites (USEPA, December 2002)

BY:	CHECKED BY:	DATE:
L. CIOFANI		2/5/2013

Equation 5-5
Derivation of the Particulate Emission Factor
Construction Scenario - Construction Worker

$$PEF_{sc} = Q/C_{sr} \times \frac{1}{F_D} \times \left[\frac{T \times A_R}{556 \times (W/3)^{0.4} \times \frac{(365d/yr - p)}{365d/yr} \times \Sigma VKT} \right]$$

Parameter/Definition (units)	Default
PEF_{sc}/subchronic road particulate emission factor (m^3/kg)	site-specific
Q/C_{sr}/ inverse of the ratio of the 1-h geometric mean air concentration to the emission flux along a straight road segment bisecting a square site (g/m^2-s per kg/m^2)	23.02[a] (Equation 5-6)
F_D/dispersion correction factor (unitless)	0.185 (Appendix E)
T/total time over which construction occurs (s)	site-specific
A_R/surface area of contaminated road segment (m^2) L_R/length of road segment (ft) W_R/width of road segment (ft)	274.213 ($A_R = L_R \times W_R \times 0.092903 m^2/ft^2$)
W/mean vehicle weight (tons)	site-specific
p/number of days with at least 0.01 inches of precipitation (days/year)	site-specific (Exhibit 5-2)
ΣVKT/sum of fleet vehicle kilometers traveled during the exposure duration (km)	site-specific

[a] Assumes a 0.5 acre site

T	4.32E+06	sec	3600 sec/hr x 8hr/day x 150 days/yr
A_R	274.213	m^2	
W	8	tons	
p	125	day/year	
VKT	202.5	km	30 vehicles x 0.045 km/day x 150 days

PEF = 1.34E+06 m^3/kg

CALCULATION WORKSHEET

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from ingestion of groundwater.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IR \times EF \times ED}{BW \times AT}$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cgw	=	exposure point concentration in groundwater (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
IR	=	ingestion rate (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)
RfDo	=	oral noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1
HQ (Noncarcinogens) = Intake (mg/kg/day) / RFDo (mg/kg/day)

ASSUMPTIONS:

Cgw	=	0.169	ug/L	Chemical: Naphthalene
IR	=	2	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED	=	24	years	
BW	=	70	kg	
ATc	=	25,550	days	
ATnc	=	8,760	days	
CSFo	=	NA	$(mg/kg/day)^{-1}$	
RfDo	=	2.0E-02	(mg/kg/day)	

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{0.169\ ug/L \times 0.001\ mg/ug \times 2\ L/day \times 350\ days/year \times 24\ years}{70\ kg \times 25550\ days}$$

IEXc = 1.59E-06 mg/kg/day

ILCR = 1.59E-06 mg/kg/day x NA (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = Not applicable (no CSFo is available for Naphthalene)

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{0.169\ ug/L \times 0.001\ mg/ug \times 2\ L/day \times 350\ days/year \times 24\ years}{70\ kg \times 8760\ days}$$

IEXnc = 4.63E-06 mg/kg/day

$$HQ = \frac{4.63E\text{-}06\ mg/kg/day}{2.00E\text{-}02\ (mg/kg/day)} = \text{Hazard Quotient}$$

HQ = 2.3E-04

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with groundwater.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT}$$

Where:

DAD	=	dermally absorbed dose (mg/kg/day)
DAevent	=	absorbed does per event (mg/cm^2/event)
EV	=	event frequency (events/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
A	=	skin surface available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ((mg/kg/day)$^{-1}$)
RfDd	=	dermal noncarcinogenic reference dose (mg/kg/day)

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd (mg/kg/day)-1
HQ (Noncarcinogens) = DAD (mg/kg/day) / RFDd (mg/kg/day)

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If } tevent \le t^*, \text{ then: } DAevent = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then: } DAevent = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

Where:

Kp	=	permeability coefficient from water (cm/hr)
FA	=	fraction absorbed water (dimensionless)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Cgw	=	0.000169	mg/L	Chemical: Naphthalene
Kp	=	4.66E-02	cm/hr	
FA	=	1	unitless	
tevent	=	0.58	hr/event	
CF	=	0.001	L/cm^3	
t*	=	1.34	hr/event	
τ	=	0.56	hr/event	
B	=	0.038		

tevent < t*, therefore,

$$DAevent = (2 \times 0.0466\ cm/hr)\ (1)\ (0.000169\ mg/L)\ (0.001\ L/cm3) \times \sqrt{\frac{6 \times 0.56\ hr/event \times 0.58\ hr/event}{\pi}}$$

DAevent = 1.24E-08 mg/cm^2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	18,000	cm^2
EV	=	1	event/day
ED	=	24	years
EF	=	350	days/year
BW	=	70	kg
ATc	=	25,550	days
ATnc	=	8,760	days
CSFd	=	NA	$(mg/kg/day)^{-1}$
RfDd	=	2.0E-02	(mg/kg/day)

CLIENT: NSA CRANE, CRANE, INDIANA		JOB NUMBER: 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, JULY 2004		
BY: L. CIOFANI	CHECKED BY:	DATE: 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$DADc = \frac{1.24E\text{-}08 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 24 \text{ years} \times 350 \text{ days/year} \times 18000 \text{ cm2}}{70 \text{ kg} \times 25550 \text{ days}}$$

DADc = 1.05E-06 mg/kg/day

DADc = 1.05E-06 mg/kg/day x NA (mg/kg/day)-1 = Incremental Lifetime Cancer Risk

ILCR = Not applicable (no CSFd is available for Naphthalene)

EXAMPLE NONCARCINOGENIC CALCULATION

$$DADnc = \frac{1.24E\text{-}08 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 24 \text{ years} \times 350 \text{ days/year} \times 18000 \text{ cm2}}{70 \text{ kg} \times 8760 \text{ days}}$$

DADnc = 3.06E-06 mg/kg/day

HQ = 3.06E-06 mg/kg/day / 2.00E-02 (mg/kg/day) = Hazard Quotient

HQ = 1.5E-04

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: ESTIMATION OF AMBIENT AIR CONCENTRATIONS IN A TRENCH RESULTING FROM VOLATILE EMISSIONS FROM GROUNDWATER		
BASED ON: VDEQ, 2012		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To calculate ambient air concentrations resulting from volatilization of Naphthalene from groundwater.

Ctrench = CGW x VF

Where:

Ctrench = concentration of contaminant in the trench $\mu g/m^3$
CGW = concentration of contaminant in groundwater µg/L
VF = volatilization factor L/m^3

1. Calculate kiG (gas-phase mass transfer coefficient of component i)

$kiG = (MWH2O/MWi)^{0.335} \times (T/298)^{1.005} \times kG, H2O$

Where:

kiG = gas-phase mass transfer coefficient of component i cm/s
MW_{H2O} = molecular weight of water = 18 g/mol
$MW_{Naphthalene}$ = molecular weight of Naphthalene = 128 g/mol

kG,H_2O = gas-phase mass transfer coefficient of water vapor at 25°C cm/s = 0.833 cm/s
T = average system absolute temperature = 298
The value of kG, H_2O is 0.833 cm/s (Superfund Exposure Assessment Manual, USEPA, April 1988)

$kiG = (18/128)^{0.335} \times (298/298)^{1.005} \times 0.833$ cm/s = 4.32E-01 cm/s

2. Calculate kiL (liquid-phase mass transfer coefficient of component i)

$kiL = (MWO_2/MWi)^{0.5} \times (T/298) \times kL, O_2$

Where:
kiL = liquid-phase mass transfer coefficient of component i cm/s
MW_{O2} = molecular weight of O_2 = 32 g/mol
$MW_{Naphthalene}$ = molecular weight of Naphthalene = 128 g/mol

T = average system absolute temperature = 298
kL, O_2 = liquid-phase mass transfer coefficient of oxygen at 25°C cm/s = 0.002 cm/s

$kiL = (32/128)^{0.5} \times (298/298) \times 0.002$ cm/s = 1.00E-03 cm/s

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: ESTIMATION OF AMBIENT AIR CONCENTRATIONS IN A TRENCH RESULTING FROM VOLATILE EMISSIONS FROM GROUNDWATER		
BASED ON: VDEQ, 2012		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

3. Calculate Ki (overall mass transfer coefficient of contaminant)

Ki = 1 / {(1/kiL) + [(RT) / (Hi x kiG)]}

Where:

kiL = liquid-phase mass transfer coefficient of i cm/s =	1.00E-03
R = ideal gas constant atm-m^3/mole-°K =	8.20E-05
T = average system absolute temperature =	298
Hi = Henry's Law constant of Naphthalene (atm-m3/mol) =	4.40E-04
KiG = gas-phase mass transfer coefficient of i cm/s	4.32E-01

Ki = 1 / {(1/1.00E-3) + [(298 x 8.2E-5) / (4.40E-4 x 0.432]} = 8.86E-04 cm/s

4. Calculation of VF (Volatilization Factor)

VF = (Ki x A x F x 10^{-3} x 10^4 x 3,600) / (ACH x V)

Where:

VF = volatilization factor (L/m^3)		
Ki = overall mass transfer coefficient of contaminant =		8.86E-04 cm/s
A = area of the trench =		8.18 m^2
F = fraction of floor through which contaminant can enter (unitless) =		1
ACH = air changes per hour =		360 h^{-1}
V = volume of trench =		24.92 m^3
10^{-3} = conversion factor L/cm^3	0.001	
10^4 = conversion factor cm^2/m^2	10000	
3,600 = conversion factor seconds/hr	3600	

VF = (8.86E-4 x 8.18 x 1 x 10^{-3} x 10^4 x 3,600) / (360 x 24.92) = 2.91E-02 L/m^3

5. Calculation of C_{trench} (concentration of contaminant in the trench)

C_{trench} = C_{GW} x VF

Where:

C_{trench} = concentration of contaminant in the trench (µg/m^3)	
C_{GW} = concentration of Naphthalene in groundwater =	0.169 µg/L
VF = volatilization factor =	2.91E-02 L/m^3

C_{trench} = 0.169 µg/L x 2.91E-02 L/m3 = **4.91E-03 µg/m^3**
4.91E-06 mg/m^3

CALCULATION WORKSHEET

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF VOLATILES FROM GROUNDWATER - CONSTRUCTION WORKERS		
BASED ON: USEPA, DECEMBER 1989		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from inhalation of volatiles from groundwater.

EQUATION:

$$EC = \frac{Ca \times ET \times EF \times ED}{AT \times 24 \text{ hours/day}}$$

Where:

EC	=	exposure concentration (mg/m3)
Ca	=	exposure point concentration in air (mg/m3)
ET	=	exposure time (hrs/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
AT	=	averaging time (days)
IURi	=	inhalation unit risk ($(ug/m3)^{-1}$)
RfCi	=	inhalation reference concentration (mg/m3)

RISKS:

ILCR (Carcinogens) = Exposure Concentration (mg/m3) x IURi (ug/m3)-1 x 1000 ug/mg
HQ (Noncarcinogens) = Exposure Concentration (mg/m3) / RFCi (mg/m3)

ASSUMPTIONS:

Ca	=	4.91E-06	mg/m3	Chemical: Naphthalene
ET	=	4	hr/day	
EF	=	30	days/year	
ED	=	1	years	
ATc	=	25,550	days	
ATnc	=	365	days	
IURi	=	3.4E-05	$(ug/m^3)^{-1}$	
RfCi	=	3.0E-03	mg/m^3	

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF VOLATILES FROM GROUNDWATER - CONSTRUCTION WORKERS		
BASED ON: USEPA, DECEMBER 1989		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{4.91E\text{-}06 \text{ mg/m3} \times 4 \text{ hr/day} \times 30 \text{ days/year} \times 1 \text{ years}}{25550 \text{ days} \times 24 \text{ hours/day}}$$

IEXc = 9.61E-10 mg/m3

ILCR = 9.61E-10 mg/m3 x 3.40E-05 (ug/m3)-1 x 1000 ug/mg = Incremental Lifetime Cancer Risk

ILCR = 3.3E-11

EXAMPLE NONCARCINOGENIC CALCULATION

$$IEXnc = \frac{4.91E\text{-}06 \text{ mg/m3} \times 4 \text{ hr/day} \times 30 \text{ days/year} \times 1 \text{ years}}{365 \text{ days} \times 24 \text{ hours/day}}$$

IEXnc = 6.73E-08 mg/m3

HQ = 6.73E-08 mg/m3 / 3.00E-03 mg/m3 ug/mg = Hazard Quotient

HQ = 2.2E-05

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF VOLATILES WHILE SHOWERING BY AN ADULT RESIDENT		
BASED ON: USEPA, 1989 AND FOSTER AND CHROSTOWSKI, 1987		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from inhalation of volatiles while showering by an adult resident.

EQUATIONS:

$$EC = \frac{S \times K \times EF \times ED}{AT \times Ra \times CF}$$

Where:

$$K = Ds + \frac{\exp(-Ra \times Dt) - \exp[Ra \times (Ds - Dt)]}{Ra}$$

$S = Cwd \times FR/SV$ $\quad$ $Cwd = Cw \times [1-\exp(-Kal \times ts/60d)]$

$Kal = Kl \times [(T1 \times Us)/(Ts \times U1)^{-0.5}$ $\quad$ $Kl = 1/[1/k1 + RT/(H \times kg)]$

$k1 = 20\ cm/hr \times (44/MW)^{0.5}$ $\quad$ $kg = 3000\ cm/hr \times (18/MW)^{0.5}$

RISKS:

ILCR (Carcinogens) = Exposure Concentration (mg/m3) x IUR (ug/m3)-1 x 1000 ug/mg
HQ (Noncarcinogens) = Exposure Concentration (mg/m3) / RFC (mg/m3)

Where:

EC	=	exposure concentration (mg/m3)
S	=	volatile chemical generation rate (mg/m3-min - shower)
EF	=	exposure frequency (showers/year)
ED	=	exposure duration (years)
AT	=	averaging time (days)
Ra	=	air exchange rate (1/min)
Ds	=	shower duration (min)
Dt	=	total time in bathroom (min)
FR	=	shower water flow rate (L/min)
SV	=	shower room air volume (m3)
CW	=	chemical concentration in groundwater (mg/L)
ts	=	shower droplet drop time (sec)
d	=	shower droplet diameter (mm)
MW	=	molecular weight of compound (g/mole)
H	=	Henry's Law constant (atm-m3/mole)
RT	=	Ideal gas constant x absolute temperature (2.4E-02 atm-m3/mole)
T1	=	calibration water temperature (K)
Ts	=	shower water temperature (K)
U1	=	water viscosity at T1 (cp)
Us	=	water viscosity at Ts (cp)
IUR	=	inhalation unit risk ($(ug/m3)^{-1}$)
RfC	=	inhalation reference concentration (mg/m3)

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF VOLATILES WHILE SHOWERING BY AN ADULT RESIDENT		
BASED ON: USEPA, 1989 AND FOSTER AND CHROSTOWSKI, 1987		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

ASSUMPTIONS: Chemical: Naphthalene

EF	=	350	showers/year
ED	=	24	years
ATc	=	25550	days
ATn	=	8760	days
Ra	=	0.0167	1/min
CF	=	1440	min/day
Ds	=	20	min
Dt	=	35	min
FR	=	10	L/min
SV	=	12	m3
Cw	=	0.000169	mg/L
ts	=	0.5	sec
d	=	1	mm
MW	=	128	g/mole
H	=	4.40E-04	atm-m3/mole
RT	=	2.40E-02	atm-m3/mole
T1	=	293	K
Ts	=	320	K
U1	=	1.002	centipoise
Us	=	0.596	centipoise
IUR	=	3.4E-05	(ug/m3)-1
RfC	=	3.0E-03	(mg/m3)

EXAMPLE CALCULATION:

k1 = 20 cm/hr x (44 g/mole / 128 g/mole)^0.5

k1 = **11.73 cm/hr**

kg = 3000 cm/hr x (18 g/mole / 128 g/mole)^0.5

kg = **1125.00 cm/hr**

Kl = 1/[1/11.7 cm/hr + 2.40E-02 atm-m3/mole/(4.40E-04 atm-m3/mole x 1125.0 cm/hr)]

Kl = **7.48E+00 cm/hr**

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF VOLATILES WHILE SHOWERING BY AN ADULT RESIDENT		
BASED ON: USEPA, 1989 AND FOSTER AND CHROSTOWSKI, 1987		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

Kal = 7.48E+00 cm/hr x [(293 K x 0.596 centipoise)/(320 K x 1.002 centipoise)]^-0.5

Kal = **10.1 cm/hr**

Cwd = 0.000169 mg/L x [1 - exp((-10.1 cm/hr x 0.5 sec)/(60 x 1 mm))]

Cwd = **1.37E-05 mg/L**

S = 1.37E-05 mg/L x 10 L/min / 12 m3

S = **1.14E-05 mg/m3-min-shower**

$$K = 20 \text{ min} + \frac{\exp(-0.0167 \text{ 1/min} \times 35 \text{ min}) - \exp[0.0167 \text{ 1/min} \times (20 \text{ min} - 35 \text{ min})]}{0.0167 \text{ 1/min}}$$

K = **6.76 min**

CARCINOGENIC INTAKE:

$$EC = \frac{1.14E\text{-}05 \text{ mg/m3-min-shower} \times 6.76 \text{ min} \times 350 \text{ showers/year} \times 24 \text{ years}}{25550 \text{ days} \times 0.0167 \text{ 1/min} \times 1440 \text{ min/day}}$$

EC = **1.05E-06 mg/m3**

Risk = 1.05E-06 mg/m3 x 3.40E-05 (ug/m3)-1 x 1000 ug/mg

Risk = **3.58E-08**

NONCARCINOGENIC INTAKE:

$$EC = \frac{1.14E\text{-}05 \text{ mg/m3-min-shower} \times 6.76 \text{ min} \times 350 \text{ showers/year} \times 24 \text{ years}}{8760 \text{ days} \times 0.0167 \text{ 1/min} \times 1440 \text{ min/day}}$$

EC = **3.08E-06 mg/m3**

HQ = 3.08E-06 mg/m3 / 3.00E-03 (mg/m3)

HQ = 1.03E-03

CALCULATION WORKSHEET

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake and cancer risks for mutagenic chemicals from incidental ingestion of surface soil.

EQUATION:

$$IEX = \frac{CS \times IR \times EF \times ED \times FI \times CF}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
IR	=	incidental ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
CF	=	conversion factor (1.0E-6 kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cs	=	0.034	mg/kg	Chemical: Benzo(a)pyrene
IR	=	200	mg/day	
EF	=	350	days/year	
ED_1	=	2	years	
ED_2	=	4	years	
FI	=	1		
CF	=	1.0E-06	kg/mg	
BW	=	15	kg	
AT	=	25,550	days	
CSFo	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	10		
$ADAF_2$	=	3		

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEX_1 = \frac{0.034 \text{ mg/kg} \times 200 \text{ mg/day} \times 350 \text{ days/year} \times 2 \text{ years} \times 1 \times 1.0\text{E-06 kg/mg}}{15 \text{ kg} \times 25550 \text{ days}} \times 10$$

IEX_1 = 1.24E-07 mg/kg/day

$$IEX_2 = \frac{0.034 \text{ mg/kg} \times 200 \text{ mg/day} \times 350 \text{ days/year} \times 4 \text{ years} \times 1 \times 1.0\text{E-06 kg/mg}}{15 \text{ kg} \times 25550 \text{ days}} \times 3$$

IEX_2 = 7.45E-08 mg/kg/day

ILCR = (1.24E-07 mg/kg/day + 7.45E-08 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 1.5E-06

CLIENT: NSA CRANE, CRANE, INDIANA		JOB NUMBER: 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FOR MUTAGENIC CHEMICALS HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	CHECKED BY:	DATE: 2/5/2013

PURPOSE: To estimate intake and cancer risks for mutagenic chemicals from dermal contact with surface soil.

EQUATION:

$$DEX = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

DEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
CF	=	conversion factor (1.0E-6 kg/mg)
SA	=	skin surface available for contact (cm^2/day)
ABS	=	absorption factor (unitless)
AF	=	adherence factor (mg/cm^2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFd (mg/kg/day)-1

ASSUMPTIONS:

Cs	=	0.034	mg/kg	Chemical: Benzo(a)pyrene
CF	=	1.0E-06	kg/mg	
SA	=	2,800	cm^2/day	
AF	=	0.2	mg/cm^2	
ABS	=	0.13		
EF	=	350	days/year	
ED_1	=	2	years	
ED_2	=	4	years	
BW	=	15	kg	
AT	=	25,550	days	
CSFd	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	10		
$ADAF_2$	=	3		

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FOR MUTAGENIC CHEMICALS HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$DEXc = \frac{0.034 \text{ mg/kg} \times 1.0E\text{-}06 \text{ kg/mg} \times 2800 \text{ cm2/day} \times 0.2 \text{ mg/cm2} \times 0.13 \times 350 \text{ days/year} \times 2 \text{ years}}{15 \text{ kg} \times 25550 \text{ days}} \times 10$$

DEXc = 4.52E-08 mg/kg/day

$$DEXc = \frac{0.034 \text{ mg/kg} \times 1.0E\text{-}06 \text{ kg/mg} \times 2800 \text{ cm2/day} \times 0.2 \text{ mg/cm2} \times 0.13 \times 350 \text{ days/year} \times 4 \text{ years}}{15 \text{ kg} \times 25550 \text{ days}} \times 3$$

DEXc = 2.71E-08 mg/kg/day

ILCR = (4.52E-08 mg/kg/day + 2.71E-08 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 5.3E-07

CALCULATION WORKSHEET

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF FUGATIVE DUST EMISSIONS FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from inhalation of surface soil.

EQUATION:

$$EC = \frac{Ca \times ET \times EF \times ED}{AT \times 24 \text{ hours/day}} \times ADAF$$

Where:

EC	=	estimated exposure concentration (mg/m3)
Ca	=	exposure point concentration in air (mg/m3)
	=	Cs x 1/PEF
Cs	=	exposure point concentration in soil (mg/kg)
PEF	=	particulate emission factor (m3/kg)
ET	=	exposure time (hrs/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
AT	=	averaging time (hours)
ADAF	=	age-dependent adjustment factor
IUR	=	inhalation unit risk($(ug/mg)^{-1}$)

RISKS:

ILCR = Exposure concentration (mg/m3) x IURi (ug/m3)-1 x 1000 ug/mg

ASSUMPTIONS:

Cs	=	0.034	mg/kg	Chemical: Benzo(a)pyrene
PEF	=	1.32E+09	m3/kg	
Ca	=	2.58E-11	mg/m3	
ET	=	24	hr/day	
EF	=	350	days/year	
ED_1	=	2	years	
ED_2	=	4	years	
ATc	=	25,550	days	
IUR	=	1.1E-03	$(ug/m3)^{-1}$	
$ADAF_1$	=	10		
$ADAF_2$	=	3		

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF FUGATIVE DUST EMISSIONS FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$EC = \frac{2.58E\text{-}11\ mg/m3 \times 24\ hr/day \times 350\ days/year \times 2\ years}{25550\ days \times 24\ hours/day} \times 10$$

EC = 7.08E-12 mg/m3

$$EC = \frac{2.58E\text{-}11\ mg/m3 \times 24\ hr/day \times 350\ days/year \times 4\ years}{25550\ days \times 24\ hours/day} \times 3$$

EC = 4.25E-12 mg/m3

ILCR = (7.08E-12 mg/m3 + 4.25E-12 mg/m3) x 1.10E-03 (ug/m3)-1 x 1000 ug/mg

ILCR = 1.2E-11

CALCULATION WORKSHEET

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake and cancer risks for mutagenic chemicals from incidental ingestion of surface soil.

EQUATION:

$$IEX = \frac{CS \times IR \times EF \times ED \times FI \times CF}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
IR	=	incidental ingestion rate (mg/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
FI	=	fraction ingested from contaminated source (unitless)
CF	=	conversion factor (1.0E-6 kg/mg)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cs	=	0.034	mg/kg	Chemical: Benzo(a)pyrene
IR	=	100	mg/day	
EF	=	350	days/year	
ED_1	=	10	years	
ED_2	=	14	years	
FI	=	1		
CF	=	1.0E-06	kg/mg	
BW	=	70	kg	
AT	=	25,550	days	
CSFo	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	3		
$ADAF_2$	=	1		

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INCIDENTAL INGESTION OF SOIL FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEX_1 = \frac{0.034 \text{ mg/kg} \times 100 \text{ mg/day} \times 350 \text{ days/year} \times 10 \text{ years} \times 1 \times 1.0\text{E-06 kg/mg}}{70 \text{ kg} \times 25550 \text{ days}} \times 3$$

IEX_1 = 2.00E-08 mg/kg/day

$$IEX_2 = \frac{0.034 \text{ mg/kg} \times 100 \text{ mg/day} \times 350 \text{ days/year} \times 14 \text{ years} \times 1 \times 1.0\text{E-06 kg/mg}}{70 \text{ kg} \times 25550 \text{ days}} \times 1$$

IEX_2 = 9.32E-09 mg/kg/day

ILCR = (2.00E-08 mg/kg/day + 9.32E-09 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 2.1E-07

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FOR MUTAGENIC CHEMICALS HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake and cancer risks for mutagenic chemicals from dermal contact with surface soil.

EQUATION:

$$DEX = \frac{Cs \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

DEX	=	estimated exposure intake (mg/kg/day)
Cs	=	exposure point concentration in soil (mg/kg)
CF	=	conversion factor (1.0E-6 kg/mg)
SA	=	skin surface available for contact (cm^2/day)
ABS	=	absorption factor (unitless)
AF	=	adherence factor (mg/cm^2)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFd	=	dermal carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFd (mg/kg/day)-1

ASSUMPTIONS:

Cs	=	0.034	mg/kg	Chemical: Benzo(a)pyrene
CF	=	1.0E-06	kg/mg	
SA	=	5,700	cm^2/day	
AF	=	0.07	mg/cm^2	
ABS	=	0.13		
EF	=	350	days/year	
ED_1	=	10	years	
ED_2	=	14	years	
BW	=	70	kg	
AT	=	25,550	days	
CSFd	=	7.3E+00	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	3		
$ADAF_2$	=	1		

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH SOIL FOR MUTAGENIC CHEMICALS HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$\text{DEXc} = \frac{0.034 \text{ mg/kg} \times 1.0\text{E-06 kg/mg} \times 5700 \text{ cm2/day} \times 0.07 \text{ mg/cm2} \times 0.13 \times 350 \text{ days/year} \times 10 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}} \times 3$$

DEXc = 1.04E-08 mg/kg/day

$$\text{DEXc} = \frac{0.034 \text{ mg/kg} \times 1.0\text{E-06 kg/mg} \times 5700 \text{ cm2/day} \times 0.07 \text{ mg/cm2} \times 0.13 \times 350 \text{ days/year} \times 14 \text{ years}}{70 \text{ kg} \times 25550 \text{ days}} \times 1$$

DEXc = 4.83E-09 mg/kg/day

ILCR = (1.04E-08 mg/kg/day + 4.83E-09 mg/kg/day) x 7.30E+00 (mg/kg/day)-1

ILCR = 1.1E-07

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF FUGATIVE DUST EMISSIONS FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from inhalation of surface soil.

EQUATION:

$$EC = \frac{Ca \times ET \times EF \times ED}{AT \times 24\ hours/day} \times ADAF$$

Where:

EC	=	estimated exposure intake (mg/kg/day)
Ca	=	exposure point concentration in air (mg/m3)
	=	Cs x 1/PEF
Cs	=	exposure point concentration in soil (mg/kg)
PEF	=	particulate emission factor (m3/kg)
ET	=	exposure time (hrs/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (hours)
ADAF	=	age-dependent adjustment factor
IURi	=	inhalation unit risk($(ug/mg)^{-1}$)

RISKS:

ILCR = Exposure concentration (mg/m3) x IUR (ug/m3)-1 x 1000 ug/mg

ASSUMPTIONS:

Cs	=	0.034	mg/kg	Chemical: Benzo(a)pyrene
PEF	=	1.32E+09	m3/kg	
Ca	=	2.58E-11	mg/m3	
ET	=	24	hr/day	
EF	=	350	days/year	
ED_1	=	10	years	
ED_2	=	14	years	
ATc	=	25,550	days	
IUR	=	1.1E-03	$(ug/m3)^{-1}$	
$ADAF_1$	=	3		
$ADAF_2$	=	1		

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INHALATION OF FUGATIVE DUST EMISSIONS FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$EC = \frac{2.58E\text{-}11\ mg/m3 \times 24\ hr/day \times 350\ days/year \times 10\ years}{25550\ days \times 24\ hours/day} \times 3$$

EC = 1.06E-11 mg/m3

$$EC = \frac{2.58E\text{-}11\ mg/m3 \times 24\ hr/day \times 350\ days/year \times 14\ years}{25550\ days \times 24\ hours/day} \times 1$$

EC = 4.95E-12 mg/m3

ILCR = (1.06E-11 mg/m3 + 4.95E-12 mg/m3) x 1.10E-03 (ug/m3)-1 x 1000 ug/mg

ILCR = 1.7E-11

CALCULATION WORKSHEET

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from ingestion of groundwater.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IF \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cgw	=	exposure point concentration in groundwater (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
IR	=	ingestion rate (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cgw	=	71	ug/L	Chemical: Chromium
IR	=	1.5	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED_1	=	2	years	
ED_2	=	4	years	
BW	=	15	kg	
ATc	=	25550	days	
CSFo	=	5.0E-01	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	10		
$ADAF_2$	=	3		

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENTS		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{71\ ug/L \times 0.001\ mg/ug \times 1.5\ L/day \times 350\ days/year \times 2\ years}{15\ kg \times 25550\ days} \times 10$$

IEXc = 1.95E-03 mg/kg/day

$$IEXc = \frac{71\ ug/L \times 0.001\ mg/ug \times 1.5\ L/day \times 350\ days/year \times 4\ years}{15\ kg \times 25550\ days} \times 3$$

IEXc = 1.17E-03 mg/kg/day

ILCR = (1.95E-03 mg/kg/day + 1.17E-03 mg/kg/day) x 5.00E-01 (mg/kg/day)-1

ILCR = 1.6E-03

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic risks for mutagenic chemicals from ingestion of groundwater.

EQUATION:

$$IEX = \frac{Cgw \times CF \times IF \times EF \times ED}{BW \times AT} \times ADAF$$

Where:

IEX	=	estimated exposure intake (mg/kg/day)
Cgw	=	exposure point concentration in groundwater (ug/L)
CF	=	conversion factor (1.0E-3 mg/ug)
IR	=	ingestion rate (L/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
BW	=	body weight (kg)
AT	=	averaging time (days)
ADAF	=	age-dependent adjustment factor
CSFo	=	oral carcinogenic slope factor ($(mg/kg/day)^{-1}$)

RISKS:

ILCR (Carcinogens) = Intake (mg/kg/day) x CSFo (mg/kg/day)-1

ASSUMPTIONS:

Cgw	=	71	ug/L	Chemical: Chromium
IR	=	2	L/day	
CF	=	1.0E-03	mg/ug	
EF	=	350	days/year	
ED_1	=	10	years	
ED_2	=	14	years	
BW	=	70	kg	
ATc	=	25550	days	
CSFo	=	5.0E-01	$(mg/kg/day)^{-1}$	
$ADAF_1$	=	3		
$ADAF_2$	=	1		

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM INGESTION OF GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, DECEMBER 1989, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$IEXc = \frac{71\ ug/L \times 0.001\ mg/ug \times 2\ L/day \times 350\ days/year \times 10\ years}{70\ kg \times 25550\ days} \times 3$$

IEXc = 8.34E-04 mg/kg/day

$$IEXc = \frac{71\ ug/L \times 0.001\ mg/ug \times 2\ L/day \times 350\ days/year \times 14\ years}{70\ kg \times 25550\ days} \times 1$$

IEXc = 3.89E-04 mg/kg/day

ILCR = (8.34E-04 mg/kg/day + 3.89E-04 mg/kg/day) x 5.00E-01 (mg/kg/day)-1

ILCR = 6.1E-04

CLIENT: NSA CRANE, CRANE, INDIANA		JOB NUMBER: 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENT		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	CHECKED BY:	DATE: 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with groundwater.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT} \times ADAF$$

Where:

DAD	=	dermally absorbed dose (mg/kg/day)
DAevent	=	absorbed dose per event (mg/cm^2/event)
EV	=	event frequency (events/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
A	=	skin surface available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ((mg/kg/day)$^{-1}$)
ADAF	=	age-dependent adjustment factor

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd (mg/kg/day)-1
HQ (Noncarcinogens) = DAD (mg/kg/day) / RFDd (mg/kg/day)

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If } tevent \le t^*, \text{ then: } DAevent = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then: } DAevent = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENT		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

Where:

Kp	=	permeability coefficient from water (cm/hr)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Cgw	=	0.071	mg/L	Chemical: Chromium
Kp	=	2.00E-03	cm/hr	
FA	=	1	unitless	
tevent	=	1	hr/event	
CF	=	0.001	L/cm^3	
t*	=	NA	hr/event	
τ	=	NA	hr/event	
B	=	NA		

DAevent = 0.002 cm/hr x 0.071 mg/L x 0.001 L/cm3 x 1 hr/event

DAevent = 1.42E-07 mg/cm^2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	6600	cm^2/day
EV	=	1	event/day
ED_1	=	2	years
ED_2	=	4	years
EF	=	350	days/year
BW	=	15	kg
ATc	=	25550	days
CSFd	=	2.0E+01	$(mg/kg/day)^{-1}$
$ADAF_1$	=	10	
$ADAF_2$	=	3	

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL CHILD RESIDENT		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$DADc = \frac{1.42E\text{-}07 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 2 \text{ years} \times 350 \text{ days/year} \times 6600 \text{ cm2/day}}{15 \text{ kg} \times 25550 \text{ days}} \times 10$$

DADc = 1.71E-05 mg/kg/day

$$DADc = \frac{1.42E\text{-}07 \text{ mg/cm2-event} \times 1 \text{ event/day} \times 4 \text{ years} \times 350 \text{ days/year} \times 6600 \text{ cm2/day}}{15 \text{ kg} \times 25550 \text{ days}} \times 3$$

DADc = 1.03E-05 mg/kg/day

DADc = (1.71E-05 mg/kg/day + 1.03E-05 mg/kg/day) x 2.00E+01 (mg/kg/day)-1

ILCR = 5.5E-04

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

PURPOSE: To estimate intake, carcinogenic and noncarcinogenic risks from dermal contact with groundwater.

EQUATION:

$$DAD = \frac{DAevent \times EV \times ED \times EF \times A}{BW \times AT} \times ADAF$$

Where:

DAD	=	dermally absorbed dose (mg/kg/day)
DAevent	=	absorbed dose per event (mg/cm^2/event)
EV	=	event frequency (events/day)
EF	=	exposure frequency (days/year)
ED	=	exposure duration (years)
A	=	skin surface available for contact (cm^2)
BW	=	body weight (kg)
AT	=	averaging time (days)
CSFd	=	dermal carcinogenic slope factor ((mg/kg/day)$^{-1}$)
ADAF	=	age-dependent adjustment factor

RISKS:

ILCR (Carcinogens) = DAD (mg/kg/day) x CSFd (mg/kg/day)-1
HQ (Noncarcinogens) = DAD (mg/kg/day) / RFDd (mg/kg/day)

EQUATIONS for DAevent:

For Inorganics:

DAevent = Kp x Cw x CF x tevent

For Organics:

$$\text{If } tevent \le t^*, \text{ then: } DAevent = 2 \times FA \times Kp \times Cw \times CF \times \sqrt{\frac{6 \times tau \times tevent}{\pi}}$$

$$\text{If } tevent > t^*, \text{ then: } DAevent = FA \times Kp \times Cw \times CF \times \left[\frac{tevent}{1+B} + 2 \times tau \times \left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

CLIENT: NSA CRANE, CRANE, INDIANA		JOB NUMBER: 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	CHECKED BY:	DATE: 2/5/2013

Where:

Kp	=	permeability coefficient from water (cm/hr)
Cgw	=	concentration of chemical in groundwater (mg/L)
tevent	=	duration of event (hr/event)
CF	=	conversion factor (0.001 L/cm^3)
t*	=	time it takes to reach steady-state (hr/event)
τ	=	lag time (hr/event)
B	=	Bunge Model Constant (dimensionless)

EXAMPLE CALCULATION OF DAevent

ASSUMPTIONS:

Cgw	=	0.071	mg/L	Chemical: Chromium
Kp	=	2.00E-03	cm/hr	
FA	=	1	unitless	
tevent	=	0.58	hr/event	
CF	=	0.001	L/cm^3	
t*	=	NA	hr/event	
τ	=	NA	hr/event	
B	=	NA		

DAevent = 0.002 cm/hr x 0.071 mg/L x 0.001 L/cm3 x 0.58 hr/event

DAevent = 8.24E-08 mg/cm^2-event

RISK CALCULATIONS

ASSUMPTIONS:

A	=	18000	cm^2/day
EV	=	1	event/day
ED	=	10	years
ED	=	14	years
EF	=	350	days/year
BW	=	70	kg
ATc	=	25550	days
CSFd	=	2.0E+01	(mg/kg/day)$^{-1}$
$ADAF_1$	=	3	
ADAF	=	1	

CLIENT: NSA CRANE, CRANE, INDIANA		**JOB NUMBER:** 112G03116
SUBJECT: CALCULATION OF INTAKE/RISK FROM DERMAL CONTACT WITH GROUNDWATER FOR MUTAGENIC CHEMICALS - HYPOTHETICAL ADULT RESIDENT		
BASED ON: USEPA, JULY 2004, MARCH 2005		
BY: L. CIOFANI	**CHECKED BY:**	**DATE:** 2/5/2013

EXAMPLE CARCINOGENIC CALCULATION

$$\text{DADc} = \frac{\text{8.24E-08 mg/cm2-event x 1 event/day x 10 years x 350 days/year x 18000 cm2/day}}{\text{70 kg x 25550 days}} \text{ x 3}$$

DADc = 8.70E-06 mg/kg/day

$$\text{DADc} = \frac{\text{8.24E-08 mg/cm2-event x 1 event/day x 14 years x 350 days/year x 18000 cm2/day}}{\text{70 kg x 25550 days}} \text{ x 1}$$

DADc = 4.06E-06 mg/kg/day

DADc = 4.06E-06 mg/kg/day x 2.00E+01 (mg/kg/day)-1

ILCR = 2.6E-04

APPENDIX E.5

RISKS FOR CHEMICALS WITHIN BACKGROUND LEVELS

RAGS Part D Table 3

Medium-Specific Exposure Point Concentration Summary

TABLE 3.1.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE, INDIANA

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 25	Aluminum	mg/kg	9550	12000 (N)	20000 J	12000	mg/kg	95% Student's-t UCL	ProUCL 4.1.00
	Cobalt	mg/kg	10.0	13.1 (N)	21	13.1	mg/kg	95% Student's-t UCL	ProUCL 4.1.00
	Manganese	mg/kg	572000	804 (N)	1600	804	mg/kg	95% Student's-t UCL	ProUCL 4.1.00
	Thallium	mg/kg	0.18	0.22 (G)	0.30	0.22	mg/kg	95% Approximate Gamma UCL	ProUCL 4.1.00
	Vanadium	mg/kg	23.9	29.1 (N)	40	29.1	mg/kg	95% Student's-t UCL	ProUCL 4.1.00

G = Gamma
N = Normal

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

TABLE 3.2.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE, INDIANA

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

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale
SWMU 25	Aluminum	mg/kg	7000	8510 (G)	12000 J	8510	mg/kg	95% Approximate Gamma UCL	ProUCL 4.1.00
	Chromium	mg/kg	14.0	17.3 (N)	26	17.3	mg/kg	95% Student's-t UCL	ProUCL 4.1.00
	Thallium	mg/kg	0.14	0.17 (N)	0.27 J	0.17	mg/kg	95% KM (t) UCL	ProUCL 4.1.00

G = Gamma
N = Normal

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

RAGS Part D Table 7

Calculation of Cancer Risks and Non-Cancer Hazards

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	3.3E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.3E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.02
				Cobalt	13.1	mg/kg	3.6E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.5E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.008
				Manganese	804	mg/kg	2.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.06
				Thallium	0.220	mg/kg	6.1E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.3E-07	(mg/kg/day)	4.0E-05	(mg/kg/day)	0.01
				Vanadium	29.1	mg/kg	8.1E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.6E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.01
			Exp. Route Total								- -					0.1
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.1
	Exposure Medium Total										- -					0.1
	Air	SWMU 25	Inhalation	Aluminum	0.009	mg/m^3	1.8E-05	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.2E-03	(mg/m^3)	NA	(mg/m^3)	--
				Cobalt	9.8E-6	mg/m^3	1.9E-08	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	1.7E-07	1.3E-06	(mg/m^3)	2.0E-05	(mg/m^3)	0.07
				Manganese	6.0E-4	mg/m^3	1.2E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	8.2E-05	(mg/m^3)	5.0E-05	(mg/m^3)	1.6
				Thallium	1.6E-7	mg/m^3	3.2E-10	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.2E-08	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-5	mg/m^3	4.2E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	3.0E-06	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.7E-07					1.7
		Exposure Point Total									1.7E-07					1.7
	Exposure Medium Total										1.7E-07					1.7
Medium Total											1.7E-07					1.8
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	2.4E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.02
				Chromium	17.3	mg/kg	4.8E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	2.4E-07	3.4E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.002
				Thallium	0.170	mg/kg	4.7E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.3E-07	(mg/kg/day)	4.0E-05	(mg/kg/day)	0.008
			Exp. Route Total								2.4E-07					0.03
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									2.4E-07					0.03
	Exposure Medium Total										2.4E-07					0.03
	Air	SWMU 25	Inhalation	Aluminum	0.006	mg/m^3	1.2E-05	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	8.7E-04	(mg/m^3)	NA	(mg/m^3)	--
				Chromium	1.3E-5	mg/m^3	2.5E-08	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	2.1E-06	1.8E-06	(mg/m^3)	2.0E-05	(mg/m^3)	0.09
				Thallium	1.3E-7	mg/m^3	2.5E-10	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.7E-08	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								2.1E-06					0.09
		Exposure Point Total									2.1E-06					0.09
	Exposure Medium Total										2.1E-06					0.09
Medium Total											2.4E-06					0.1
										Total of Receptor Risks Across All Media	2.5E-06				Total of Receptor Hazards Across All Media	1.9

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	4.2E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.2E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.01
				Cobalt	13.1	mg/kg	4.6E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.3E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.04
				Manganese	804	mg/kg	2.8E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	7.9E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.03
				Thallium	0.220	mg/kg	7.7E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.2E-07	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.02
				Vanadium	29.1	mg/kg	1.0E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.8E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.006
			Exp. Route Total								- -					0.1
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.1
	Exposure Medium Total										- -					0.1
	Air	SWMU 25	Inhalation	Aluminum	9.1E-6	mg/m^3	7.4E-07	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	2.1E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.0004
				Cobalt	1.0E-8	mg/m^3	8.1E-10	(mg/m^3)	9.0E-03	(ug/m^3)$^{-1}$	7.3E-09	2.3E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.0004
				Manganese	6.1E-7	mg/m^3	5.0E-08	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	1.4E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.003
				Thallium	1.7E-10	mg/m^3	1.4E-11	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	3.8E-11	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-8	mg/m^3	1.8E-09	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	5.0E-09	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								7.3E-09					0.004
		Exposure Point Total									7.3E-09					0.004
	Exposure Medium Total										7.3E-09					0.004
Medium Total											7.3E-09					0.1
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	3.0E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	8.3E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.008
				Chromium	17.3	mg/kg	6.0E-06	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	3.0E-06	1.7E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.006
				Thallium	0.170	mg/kg	5.9E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.7E-07	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.02
			Exp. Route Total								3.0E-06					0.03
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									3.0E-06					0.03
	Exposure Medium Total										3.0E-06					0.03
	Air	SWMU 25	Inhalation	Aluminum	6.5E-6	mg/m^3	5.3E-07	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	1.5E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.0003
				Chromium	1.3E-8	mg/m^3	1.1E-09	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	9.0E-08	3.0E-09	(mg/m^3)	2.0E-05	(mg/m^3)	0.0002
				Thallium	1.3E-10	mg/m^3	1.1E-11	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	2.9E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								9.0E-08					0.0004
		Exposure Point Total									9.0E-08					0.0004
	Exposure Medium Total										9.0E-08					0.0004
Medium Total											3.1E-06					0.03
										Total of Receptor Risks Across All Media	3.1E-06				Total of Receptor Hazards Across All Media	0.1

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	2.8E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.0E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.002
				Cobalt	13.1	mg/kg	3.1E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.2E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.007
				Manganese	804	mg/kg	1.9E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.006
				Thallium	0.220	mg/kg	5.2E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.6E-08	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.004
				Vanadium	29.1	mg/kg	6.9E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.8E-06	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.0010
			Exp. Route Total								- -					0.02
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.02
	Exposure Medium Total										- -					0.02
	Air	SWMU 25	Inhalation	Aluminum	9.1E-6	mg/m^3	1.5E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.1E-07	(mg/m^3)	5.0E-03	(mg/m^3)	0.00002
				Cobalt	1.0E-8	mg/m^3	1.7E-11	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	1.5E-10	1.2E-10	(mg/m^3)	6.0E-06	(mg/m^3)	0.00002
				Manganese	6.1E-7	mg/m^3	1.0E-09	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	7.3E-09	(mg/m^3)	5.0E-05	(mg/m^3)	0.0001
				Thallium	1.7E-10	mg/m^3	2.8E-13	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.0E-12	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-8	mg/m^3	3.8E-11	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.6E-10	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.5E-10					0.0002
		Exposure Point Total									1.5E-10					0.0002
	Exposure Medium Total										1.5E-10					0.0002
Medium Total											1.5E-10					0.02
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	2.0E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.4E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.001
				Chromium	17.3	mg/kg	1.2E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	6.1E-07	2.9E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0010
				Thallium	0.170	mg/kg	4.0E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.8E-08	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.003
			Exp. Route Total								6.1E-07					0.005
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									6.1E-07					0.005
	Exposure Medium Total										6.1E-07					0.005
	Air	SWMU 25	Inhalation	Aluminum	6.5E-6	mg/m^3	1.1E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	7.7E-08	(mg/m^3)	5.0E-03	(mg/m^3)	0.00002
				Chromium	1.3E-8	mg/m^3	6.7E-11	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	5.6E-09	1.6E-10	(mg/m^3)	2.0E-05	(mg/m^3)	0.000008
				Thallium	1.3E-10	mg/m^3	2.2E-13	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.5E-12	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								5.6E-09					0.00002
		Exposure Point Total									5.6E-09					0.00002
	Exposure Medium Total										5.6E-09					0.00002
Medium Total											6.2E-07					0.005
										Total of Receptor Risks Across All Media	6.2E-07				Total of Receptor Hazards Across All Media	0.02

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.4.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	1.3E-02	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.5E-01	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.2
				Cobalt	13.1	mg/kg	1.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.7E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.6
				Manganese	804	mg/kg	8.8E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-02	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.4
				Thallium	0.220	mg/kg	2.4E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.8E-06	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.3
				Vanadium	29.1	mg/kg	3.2E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.7E-04	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.07
			Exp. Route Total								- -					1.5
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					1.5
	Exposure Medium Total										- -					1.5
	Air	SWMU 25	Inhalation	Aluminum	9.1E-6	mg/m^3	7.5E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	8.7E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.002
				Cobalt	1.0E-8	mg/m^3	8.2E-10	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	7.4E-09	9.5E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.002
				Manganese	6.1E-7	mg/m^3	5.0E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	5.9E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.01
				Thallium	1.7E-10	mg/m^3	1.4E-11	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.6E-10	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-8	mg/m^3	1.8E-09	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.1E-08	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								7.4E-09					0.02
		Exposure Point Total									7.4E-09					0.02
	Exposure Medium Total										7.4E-09					0.02
Medium Total											7.4E-09					1.5
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	9.3E-03	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-01	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.1
				Chromium	17.3	mg/kg	1.0E-04	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	5.1E-05	2.2E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.07
				Thallium	0.170	mg/kg	1.9E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.2E-06	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.2
			Exp. Route Total								5.1E-05					0.4
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									5.1E-05					0.4
	Exposure Medium Total										5.1E-05					0.4
	Air	SWMU 25	Inhalation	Aluminum	6.5E-6	mg/m^3	5.3E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	6.2E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.001
				Chromium	1.3E-8	mg/m^3	5.8E-09	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	4.8E-07	1.3E-08	(mg/m^3)	2.0E-05	(mg/m^3)	0.0006
				Thallium	1.3E-10	mg/m^3	1.1E-11	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.2E-10	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								4.8E-07					0.002
		Exposure Point Total									4.8E-07					0.002
	Exposure Medium Total										4.8E-07					0.002
Medium Total											5.1E-05					0.4
										Total of Receptor Risks Across All Media	5.1E-05				Total of Receptor Hazards Across All Media	1.9

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.5.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	5.6E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.6E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.02
				Cobalt	13.1	mg/kg	6.2E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.8E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.06
				Manganese	804	mg/kg	3.8E-04	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.1E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.05
				Thallium	0.220	mg/kg	1.0E-07	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.0E-07	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.03
				Vanadium	29.1	mg/kg	1.4E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	4.0E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.008
			Exp. Route Total								- -					0.2
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.2
	Exposure Medium Total										- -					0.2
	Air	SWMU 25	Inhalation	Aluminum	9.1E-6	mg/m^3	3.0E-06	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	8.7E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.002
				Cobalt	1.0E-8	mg/m^3	3.3E-09	(mg/m^3)	9.0E-03	(ug/m^3)$^{-1}$	2.9E-08	9.5E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.002
				Manganese	6.1E-7	mg/m^3	2.0E-07	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	5.9E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.01
				Thallium	1.7E-10	mg/m^3	5.5E-11	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	1.6E-10	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-8	mg/m^3	7.3E-09	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	2.1E-08	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								2.9E-08					0.02
		Exposure Point Total									2.9E-08					0.02
	Exposure Medium Total										2.9E-08					0.02
Medium Total											2.9E-08					0.2
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	4.0E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.2E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.01
				Chromium	17.3	mg/kg	1.5E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	7.4E-06	2.4E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.008
				Thallium	0.170	mg/kg	8.0E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	2.3E-07	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.02
			Exp. Route Total								7.4E-06					0.04
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									7.4E-06					0.04
	Exposure Medium Total										7.4E-06					0.04
	Air	SWMU 25	Inhalation	Aluminum	6.5E-6	mg/m^3	2.1E-06	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	6.2E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.001
				Chromium	1.3E-8	mg/m^3	7.9E-09	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	6.7E-07	1.3E-08	(mg/m^3)	2.0E-05	(mg/m^3)	0.0006
				Thallium	1.3E-10	mg/m^3	4.2E-11	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	1.2E-10	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								6.7E-07					0.002
		Exposure Point Total									6.7E-07					0.002
	Exposure Medium Total										6.7E-07					0.002
Medium Total											8.1E-06					0.04
										Total of Receptor Risks Across All Media	8.1E-06				Total of Receptor Hazards Across All Media	0.2

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.1.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	8.3E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.8E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.006
				Cobalt	13.1	mg/kg	9.1E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.3E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.002
				Manganese	804	mg/kg	5.6E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.9E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.02
				Thallium	0.220	mg/kg	1.5E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-07	(mg/kg/day)	4.0E-05	(mg/kg/day)	0.003
				Vanadium	29.1	mg/kg	2.0E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.4E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.003
			Exp. Route Total								- -					0.03
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-03	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.03
	Exposure Medium Total										- -					0.03
	Air	SWMU 25	Inhalation	Aluminum	0.009	mg/m^3	8.8E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	6.1E-04	(mg/m^3)	NA	(mg/m^3)	--
				Cobalt	9.8E-6	mg/m^3	9.6E-09	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	8.6E-08	6.7E-07	(mg/m^3)	2.0E-05	(mg/m^3)	0.03
				Manganese	6.0E-4	mg/m^3	5.9E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.1E-05	(mg/m^3)	5.0E-05	(mg/m^3)	0.8
				Thallium	1.6E-7	mg/m^3	1.6E-10	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.1E-08	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-5	mg/m^3	2.1E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.5E-06	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								8.6E-08					0.9
		Exposure Point Total									8.6E-08					0.9
	Exposure Medium Total										8.6E-08					0.9
Medium Total											8.6E-08					0.9
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	5.9E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.1E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.004
				Chromium	17.3	mg/kg	1.2E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	6.0E-08	8.4E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0004
				Thallium	0.170	mg/kg	1.2E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	8.2E-08	(mg/kg/day)	4.0E-05	(mg/kg/day)	0.002
			Exp. Route Total								6.0E-08					0.007
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-04	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	4.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									6.0E-08					0.007
	Exposure Medium Total										6.0E-08					0.007
	Air	SWMU 25	Inhalation	Aluminum	0.006	mg/m^3	6.2E-06	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.3E-04	(mg/m^3)	NA	(mg/m^3)	--
				Chromium	1.3E-5	mg/m^3	1.3E-08	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1.1E-06	8.8E-07	(mg/m^3)	2.0E-05	(mg/m^3)	0.04
				Thallium	1.3E-7	mg/m^3	1.2E-10	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	8.7E-09	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.1E-06					0.04
		Exposure Point Total									1.1E-06					0.04
	Exposure Medium Total										1.1E-06					0.04
Medium Total											1.1E-06					0.05
										Total of Receptor Risks Across All Media	1.2E-06				Total of Receptor Hazards Across All Media	0.9

TABLE 7.2.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	6.6E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.1E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.005
				Cobalt	13.1	mg/kg	7.2E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.6E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Manganese	804	mg/kg	4.4E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.4E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.01
				Thallium	0.220	mg/kg	1.2E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	9.4E-08	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.009
				Vanadium	29.1	mg/kg	1.6E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.002
			Exp. Route Total								- -					0.05
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.05
	Exposure Medium Total										- -					0.05
	Air	SWMU 25	Inhalation	Aluminum	9.1E-6	mg/m^3	2.3E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.8E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.0004
				Cobalt	1.0E-8	mg/m^3	2.6E-10	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	2.3E-09	2.0E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.0003
				Manganese	6.1E-7	mg/m^3	1.6E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.2E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.002
				Thallium	1.7E-10	mg/m^3	4.3E-12	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	3.3E-11	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-8	mg/m^3	5.7E-10	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.4E-09	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								2.3E-09					0.003
		Exposure Point Total									2.3E-09					0.003
	Exposure Medium Total										2.3E-09					0.003
Medium Total											2.3E-09					0.05
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	4.7E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.6E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.004
				Chromium	17.3	mg/kg	9.5E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	4.8E-07	7.4E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.002
				Thallium	0.170	mg/kg	9.4E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.3E-08	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.007
			Exp. Route Total								4.8E-07					0.01
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									4.8E-07					0.01
	Exposure Medium Total										4.8E-07					0.01
	Air	SWMU 25	Inhalation	Aluminum	6.5E-6	mg/m^3	1.7E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.3E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.0003
				Chromium	1.3E-8	mg/m^3	3.4E-10	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	2.8E-08	2.6E-09	(mg/m^3)	2.0E-05	(mg/m^3)	0.0001
				Thallium	1.3E-10	mg/m^3	3.3E-12	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.6E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								2.8E-08					0.0004
		Exposure Point Total									2.8E-08					0.0004
	Exposure Medium Total										2.8E-08					0.0004
Medium Total											5.1E-07					0.01
										Total of Receptor Risks Across All Media	5.1E-07				Total of Receptor Hazards Across All Media	0.07

TABLE 7.3.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	7.1E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.0E-04	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.0005
				Cobalt	13.1	mg/kg	7.8E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Manganese	804	mg/kg	4.8E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.3E-05	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.001
				Thallium	0.220	mg/kg	1.3E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	9.1E-09	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.0009
				Vanadium	29.1	mg/kg	1.7E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.2E-06	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.0002
			Exp. Route Total								- -					0.005
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.005
	Exposure Medium Total										- -					0.005
	Air	SWMU 25	Inhalation	Aluminum	9.1E-6	mg/m^3	3.9E-09	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	2.7E-08	(mg/m^3)	5.0E-03	(mg/m^3)	0.000005
				Cobalt	1.0E-8	mg/m^3	4.2E-12	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	3.8E-11	3.0E-11	(mg/m^3)	6.0E-06	(mg/m^3)	0.000005
				Manganese	6.1E-7	mg/m^3	2.6E-10	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.8E-09	(mg/m^3)	5.0E-05	(mg/m^3)	0.00004
				Thallium	1.7E-10	mg/m^3	7.1E-14	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	5.0E-13	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-8	mg/m^3	9.4E-12	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	6.6E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								3.8E-11					0.00005
		Exposure Point Total									3.8E-11					0.00005
	Exposure Medium Total										3.8E-11					0.00005
Medium Total											3.8E-11					0.005
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	5.0E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.5E-04	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.0004
				Chromium	17.3	mg/kg	3.1E-07	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	1.5E-07	7.2E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.0002
				Thallium	0.170	mg/kg	1.0E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.0E-09	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.0007
			Exp. Route Total								1.5E-07					0.001
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									1.5E-07					0.001
	Exposure Medium Total										1.5E-07					0.001
	Air	SWMU 25	Inhalation	Aluminum	6.5E-6	mg/m^3	2.7E-09	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.9E-08	(mg/m^3)	5.0E-03	(mg/m^3)	0.000004
				Chromium	1.3E-8	mg/m^3	1.7E-11	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1.4E-09	3.9E-11	(mg/m^3)	2.0E-05	(mg/m^3)	0.000002
				Thallium	1.3E-10	mg/m^3	5.5E-14	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	3.8E-13	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.4E-09					0.000006
		Exposure Point Total									1.4E-09					0.000006
	Exposure Medium Total										1.4E-09					0.000006
Medium Total											1.5E-07					0.001
										Total of Receptor Risks Across All Media	1.5E-07				Total of Receptor Hazards Across All Media	0.006

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.4.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	1.5E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.1E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.05
				Cobalt	13.1	mg/kg	1.6E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	5.6E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.2
				Manganese	804	mg/kg	9.8E-05	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.4E-03	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.1
				Thallium	0.220	mg/kg	2.7E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	9.4E-07	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.09
				Vanadium	29.1	mg/kg	3.6E-06	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	1.2E-04	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.02
			Exp. Route Total								- -					0.5
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.5
	Exposure Medium Total										- -					0.5
	Air	SWMU 25	Inhalation	Aluminum	9.1E-6	mg/m^3	1.7E-07	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	5.8E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.001
				Cobalt	1.0E-8	mg/m^3	1.8E-10	(mg/m^3)	9.0E-03	(ug/m^3)$^{-1}$	1.6E-09	6.4E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.001
				Manganese	6.1E-7	mg/m^3	1.1E-08	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	3.9E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.008
				Thallium	1.7E-10	mg/m^3	3.1E-12	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	1.1E-10	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-8	mg/m^3	4.1E-10	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	1.4E-08	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.6E-09					0.01
		Exposure Point Total									1.6E-09					0.01
	Exposure Medium Total										1.6E-09					0.01
Medium Total											1.6E-09					0.5
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	1.0E-03	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	3.6E-02	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.04
				Chromium	17.3	mg/kg	1.4E-05	(mg/kg/day)	5.0E-01	(mg/kg/day)$^{-1}$	6.9E-06	7.4E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.02
				Thallium	0.170	mg/kg	2.1E-08	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	7.3E-07	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.07
			Exp. Route Total								6.9E-06					0.1
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	(mg/kg/day)$^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									6.9E-06					0.1
	Exposure Medium Total										6.9E-06					0.1
	Air	SWMU 25	Inhalation	Aluminum	6.5E-6	mg/m^3	1.2E-07	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	4.1E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.0008
				Chromium	1.3E-8	mg/m^3	1.6E-09	(mg/m^3)	8.4E-02	(ug/m^3)$^{-1}$	1.3E-07	8.4E-09	(mg/m^3)	2.0E-05	(mg/m^3)	0.0004
				Thallium	1.3E-10	mg/m^3	2.4E-12	(mg/m^3)	NA	(ug/m^3)$^{-1}$	- -	8.3E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.3E-07					0.001
		Exposure Point Total									1.3E-07					0.001
	Exposure Medium Total										1.3E-07					0.001
Medium Total											7.0E-06					0.1
										Total of Receptor Risks Across All Media	7.0E-06				Total of Receptor Hazards Across All Media	0.6

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.5.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Surface Soil	Surface Soil	SWMU 25	Ingestion	Aluminum	12,000	mg/kg	5.5E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.5E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.005
				Cobalt	13.1	mg/kg	6.0E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.0E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.02
				Manganese	804	mg/kg	3.7E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.7E-04	(mg/kg/day)	2.4E-02	(mg/kg/day)	0.02
				Thallium	0.220	mg/kg	1.0E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-07	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.01
				Vanadium	29.1	mg/kg	1.3E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-05	(mg/kg/day)	5.0E-03	(mg/kg/day)	0.003
			Exp. Route Total								- -					0.05
			Dermal	Aluminum	12,000	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Cobalt	13.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	3.0E-04	(mg/kg/day)	--
				Manganese	804	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	9.6E-04	(mg/kg/day)	--
				Thallium	0.220	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
				Vanadium	29.1	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	5.0E-03	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									- -					0.05
	Exposure Medium Total										- -					0.05
	Air	SWMU 25	Inhalation	Aluminum	9.1E-6	mg/m^3	5.8E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	5.8E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.001
				Cobalt	1.0E-8	mg/m^3	6.4E-10	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	5.7E-09	6.4E-09	(mg/m^3)	6.0E-06	(mg/m^3)	0.001
				Manganese	6.1E-7	mg/m^3	3.9E-08	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	3.9E-07	(mg/m^3)	5.0E-05	(mg/m^3)	0.008
				Thallium	1.7E-10	mg/m^3	1.1E-11	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.1E-10	(mg/m^3)	NA	(mg/m^3)	--
				Vanadium	2.2E-8	mg/m^3	1.4E-09	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	1.4E-08	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								5.7E-09					0.01
		Exposure Point Total									5.7E-09					0.01
	Exposure Medium Total										5.7E-09					0.01
Medium Total											5.7E-09					0.06
Subsurface Soil	Subsurface Soil	SWMU 25	Ingestion	Aluminum	8,510	mg/kg	3.9E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.9E-03	(mg/kg/day)	1.0E+00	(mg/kg/day)	0.004
				Chromium	17.3	mg/kg	1.2E-06	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	6.2E-07	7.9E-06	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.003
				Thallium	0.170	mg/kg	7.8E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.8E-08	(mg/kg/day)	1.0E-05	(mg/kg/day)	0.008
			Exp. Route Total								6.2E-07					0.01
			Dermal	Aluminum	8,510	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E+00	(mg/kg/day)	--
				Chromium	17.3	mg/kg	0.0E+00	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	7.5E-05	(mg/kg/day)	--
				Thallium	0.170	mg/kg	0.0E+00	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	0.0E+00	(mg/kg/day)	1.0E-05	(mg/kg/day)	--
			Exp. Route Total								- -					--
		Exposure Point Total									6.2E-07					0.01
	Exposure Medium Total										6.2E-07					0.01
	Air	SWMU 25	Inhalation	Aluminum	6.5E-6	mg/m^3	4.1E-07	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	4.1E-06	(mg/m^3)	5.0E-03	(mg/m^3)	0.0008
				Chromium	1.3E-8	mg/m^3	1.3E-09	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	1.1E-07	8.4E-09	(mg/m^3)	2.0E-05	(mg/m^3)	0.0004
				Thallium	1.3E-10	mg/m^3	8.3E-12	(mg/m^3)	NA	$(ug/m^3)^{-1}$	- -	8.3E-11	(mg/m^3)	NA	(mg/m^3)	--
			Exp. Route Total								1.1E-07					0.001
		Exposure Point Total									1.1E-07					0.001
	Exposure Medium Total										1.1E-07					0.001
Medium Total											7.3E-07					0.02
										Total of Receptor Risks Across All Media	7.4E-07				Total of Receptor Hazards Across All Media	0.08

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

RAGS Part D Table 9

Summary of Receptor Risks and Hazards for COPCs

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.02	--	--	0.02
			Cobalt	- -	--	- -	--	- -	Thyroid	0.008	--	--	0.008
			Manganese	- -	--	- -	--	- -	CNS	0.06	--	--	0.06
			Thallium	- -	--	- -	--	- -	Skin	0.01	--	--	0.01
			Vanadium	- -	--	- -	--	- -	Kidney	0.01	--	--	0.01
			Chemical Total	- -	--	- -	--	- -		0.1	--	--	0.1
		Exposure Point Total						- -					0.1
	Exposure Medium Total							- -					0.1
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Cobalt	--	2E-07	--	--	2E-07	Respiratory	--	0.07	--	0.07
			Manganese	--	- -	--	--	- -	CNS	--	2	--	2
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	2E-07	--	--	2E-07		- -	2	- -	2
		Exposure Point Total						2E-07					2
	Exposure Medium Total							2E-07					2
Medium Total								2E-07					2
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.02	--	--	0.02
			Chromium	2E-07	--	- -	--	2E-07	None Reported	0.002	--	--	0.002
			Thallium	- -	--	- -	--	- -	Skin	0.008	--	--	0.008
			Chemical Total	2E-07	--	- -	--	2E-07		0.03	--	--	0.03
		Exposure Point Total						2E-07					0.03
	Exposure Medium Total							2E-07					0.03
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Chromium	--	2E-06	--	--	2E-06	Respiratory	--	0.09	--	0.09
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	2E-06	--	--	2E-06		- -	0.09	- -	0.09
		Exposure Point Total						2E-06					0.09
	Exposure Medium Total							2E-06					0.09
Medium Total								2E-06					0.1
Receptor Total							Receptor Risk Total	3E-06				Receptor HI Total	2

Total CNS HI	2
Total Kidney HI	0.01
Total Respiratory HI	0.2
Total None Reported HI	0.002
Total Skin HI	0.02
Total Thyroid HI	0.008

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.01	--	--	0.01
			Cobalt	- -	--	- -	--	- -	Thyroid	0.04	--	--	0.04
			Manganese	- -	--	- -	--	- -	CNS	0.03	--	--	0.03
			Thallium	- -	--	- -	--	- -	Skin	0.02	--	--	0.02
			Vanadium	- -	--	- -	--	- -	Kidney	0.006	--	--	0.006
			Chemical Total	- -	--	- -	--	- -		0.1	--	--	0.1
		Exposure Point Total						- -					0.1
	Exposure Medium Total							- -					0.1
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.0004	--	0.0004
			Cobalt	--	7E-09	--	--	7E-09	Respiratory	--	0.0004	--	0.0004
			Manganese	--	- -	--	--	- -	CNS	--	0.003	--	0.003
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	7E-09	--	--	7E-09		- -	0.004	- -	0.004
		Exposure Point Total						7E-09					0.004
	Exposure Medium Total							7E-09					0.004
Medium Total								7E-09					0.1
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.008	--	--	0.008
			Chromium	3E-06	--	- -	--	3E-06	None Reported	0.006	--	--	0.006
			Thallium	- -	--	- -	--	- -	Skin	0.02	--	--	0.02
			Chemical Total	3E-06	--	- -	--	3E-06		0.03	--	--	0.03
		Exposure Point Total						3E-06					0.03
	Exposure Medium Total							3E-06					0.03
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.0003	--	0.0003
			Chromium	--	9E-08	--	--	9E-08	Respiratory	--	0.0002	--	0.0002
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	9E-08	--	--	9E-08		- -	0.0004	- -	0.0004
		Exposure Point Total						9E-08					0.0004
	Exposure Medium Total							9E-08					0.0004
Medium Total								3E-06					0.03
Receptor Total							Receptor Risk Total	3E-06				Receptor HI Total	0.1

Total CNS HI	0.06
Total Kidney HI	0.006
Total Respiratory HI	0.0005
Total None Reported HI	0.006
Total Skin HI	0.04
Total Thyroid HI	0.04

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.002	--	--	0.002
			Cobalt	- -	--	- -	--	- -	Thyroid	0.007	--	--	0.007
			Manganese	- -	--	- -	--	- -	CNS	0.006	--	--	0.006
			Thallium	- -	--	- -	--	- -	Skin	0.004	--	--	0.004
			Vanadium	- -	--	- -	--	- -	Kidney	0.0010	--	--	0.0010
			Chemical Total	- -	--	- -	--	- -		0.02	--	--	0.02
		Exposure Point Total						- -					0.02
	Exposure Medium Total							- -					0.02
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.00002	--	0.00002
			Cobalt	--	2E-10	--	--	2E-10	Respiratory	--	0.00002	--	0.00002
			Manganese	--	- -	--	--	- -	CNS	--	0.0001	--	0.0001
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	2E-10	--	--	2E-10		- -	0.0002	- -	0.0002
		Exposure Point Total						2E-10					0.0002
	Exposure Medium Total							2E-10					0.0002
Medium Total								2E-10					0.02
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.001	--	--	0.001
			Chromium	6E-07	--	- -	--	6E-07	None Reported	0.0010	--	--	0.0010
			Thallium	- -	--	- -	--	- -	Skin	0.003	--	--	0.003
			Chemical Total	6E-07	--	- -	--	6E-07		0.005	--	--	0.005
		Exposure Point Total						6E-07					0.005
	Exposure Medium Total							6E-07					0.005
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.00002	--	0.00002
			Chromium	--	6E-09	--	--	6E-09	Respiratory	--	0.000008	--	0.000008
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	6E-09	--	--	6E-09		- -	0.00002	- -	0.00002
		Exposure Point Total						6E-09					0.00002
	Exposure Medium Total							6E-09					0.00002
Medium Total								6E-07					0.005
Receptor Total							Receptor Risk Total	6E-07				Receptor HI Total	0.02

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total CNS HI	0.009
Total Kidney HI	0.0010
Total Respiratory HI	0.00003
Total None Reported HI	0.0010
Total Skin HI	0.006
Total Thyroid HI	0.007

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.2	--	--	0.2
			Cobalt	- -	--	- -	--	- -	Thyroid	0.6	--	--	0.6
			Manganese	- -	--	- -	--	- -	CNS	0.4	--	--	0.4
			Thallium	- -	--	- -	--	- -	Skin	0.3	--	--	0.3
			Vanadium	- -	--	- -	--	- -	Kidney	0.07	--	--	0.07
			Chemical Total	- -	--	- -	--	- -		1	--	--	1
		Exposure Point Total						- -					1
	Exposure Medium Total							- -					1
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.002	--	0.002
			Cobalt	--	7E-09	--	--	7E-09	Respiratory	--	0.002	--	0.002
			Manganese	--	- -	--	--	- -	CNS	--	0.01	--	0.01
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	7E-09	--	--	7E-09		- -	0.02	- -	0.02
		Exposure Point Total						7E-09					0.02
	Exposure Medium Total							7E-09					0.02
Medium Total								7E-09					2
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.1	--	--	0.1
			Chromium	5E-05	--	- -	--	5E-05	None Reported	0.07	--	--	0.07
			Thallium	- -	--	- -	--	- -	Skin	0.2	--	--	0.2
			Chemical Total	5E-05	--	- -	--	5E-05		0.4	--	--	0.4
		Exposure Point Total						5E-05					0.4
	Exposure Medium Total							5E-05					0.4
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.001	--	0.001
			Chromium	--	5E-07	--	--	5E-07	Respiratory	--	0.0006	--	0.0006
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	5E-07	--	--	5E-07		- -	0.002	- -	0.002
		Exposure Point Total						5E-07					0.002
	Exposure Medium Total							5E-07					0.002
Medium Total								5E-05					0.4
Receptor Total							Receptor Risk Total	5E-05				Receptor HI Total	2

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total CNS HI	0.7
Total Kidney HI	0.07
Total Respiratory HI	0.002
Total None Reported HI	0.07
Total Skin HI	0.5
Total Thyroid HI	0.6

TABLE 9.5.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.02	--	--	0.02
			Cobalt	- -	--	- -	--	- -	Thyroid	0.06	--	--	0.06
			Manganese	- -	--	- -	--	- -	CNS	0.05	--	--	0.05
			Thallium	- -	--	- -	--	- -	Skin	0.03	--	--	0.03
			Vanadium	- -	--	- -	--	- -	Kidney	0.008	--	--	0.008
			Chemical Total	- -	--	- -	--	- -		0.2	--	--	0.2
		Exposure Point Total						- -					0.2
	Exposure Medium Total							- -					0.2
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.002	--	0.002
			Cobalt	--	3E-08	--	--	3E-08	Respiratory	--	0.002	--	0.002
			Manganese	--	- -	--	--	- -	CNS	--	0.01	--	0.01
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	3E-08	--	--	3E-08		- -	0.02	- -	0.02
		Exposure Point Total						3E-08					0.02
	Exposure Medium Total							3E-08					0.02
Medium Total								3E-08					0.2
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.01	--	--	0.01
			Chromium	7E-06	--	- -	--	7E-06	None Reported	0.008	--	--	0.008
			Thallium	- -	--	- -	--	- -	Skin	0.02	--	--	0.02
			Chemical Total	7E-06	--	- -	--	7E-06		0.04	--	--	0.04
		Exposure Point Total						7E-06					0.04
	Exposure Medium Total							7E-06					0.04
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.001	--	0.001
			Chromium	--	7E-07	--	--	7E-07	Respiratory	--	0.0006	--	0.0006
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	7E-07	--	--	7E-07		- -	0.002	- -	0.002
		Exposure Point Total						7E-07					0.002
	Exposure Medium Total							7E-07					0.002
Medium Total								8E-06					0.04
Receptor Total							Receptor Risk Total	8E-06				Receptor HI Total	0.2

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total CNS HI	0.09
Total Kidney HI	0.008
Total Respiratory HI	0.002
Total None Reported HI	0.008
Total Skin HI	0.05
Total Thyroid HI	0.06

TABLE 9.6.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -					
			Cobalt	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Thallium	- -	--	- -	--	- -					
			Vanadium	- -	--	- -	--	- -					
			Chemical Total	- -	--	- -	--	- -					
		Exposure Point Total						- -					
	Exposure Medium Total							- -					
	Air	SWMU 25	Aluminum	--	- -	--	--	- -					
			Cobalt	--	4E-08	--	--	4E-08					
			Manganese	--	- -	--	--	- -					
			Thallium	--	- -	--	--	- -					
			Vanadium	--	- -	--	--	- -					
			Chemical Total	--	4E-08	--	--	4E-08					
		Exposure Point Total						4E-08					
	Exposure Medium Total							4E-08					
Medium Total								4E-08					
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -					
			Chromium	6E-05	--	- -	--	6E-05					
			Thallium	- -	--	- -	--	- -					
			Chemical Total	6E-05	--	- -	--	6E-05					
		Exposure Point Total						6E-05					
	Exposure Medium Total							6E-05					
	Air	SWMU 25	Aluminum	--	- -	--	--	- -					
			Chromium	--	1E-06	--	--	1E-06					
			Thallium	--	- -	--	--	- -					
			Chemical Total	--	1E-06	--	--	1E-06					
		Exposure Point Total						1E-06					
	Exposure Medium Total							1E-06					
Medium Total								6E-05					
Receptor Total							Receptor Risk Total	6E-05					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.006	--	--	0.006
			Cobalt	- -	--	- -	--	- -	Thyroid	0.002	--	--	0.002
			Manganese	- -	--	- -	--	- -	CNS	0.02	--	--	0.02
			Thallium	- -	--	- -	--	- -	Skin	0.003	--	--	0.003
			Vanadium	- -	--	- -	--	- -	Kidney	0.003	--	--	0.003
			Chemical Total	- -	--	- -	--	- -		0.03	--	--	0.03
		Exposure Point Total						- -					0.03
	Exposure Medium Total							- -					0.03
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Cobalt	--	9E-08	--	--	9E-08	Respiratory	--	0.03	--	0.03
			Manganese	--	- -	--	--	- -	CNS	--	0.8	--	0.8
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	9E-08	--	--	9E-08		- -	0.9	- -	0.9
		Exposure Point Total						9E-08					0.9
	Exposure Medium Total							9E-08					0.9
Medium Total								9E-08					0.9
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.004	--	--	0.004
			Chromium	6E-08	--	- -	--	6E-08	None Reported	0.0004	--	--	0.0004
			Thallium	- -	--	- -	--	- -	Skin	0.002	--	--	0.002
			Chemical Total	6E-08	--	- -	--	6E-08		0.007	--	--	0.007
		Exposure Point Total						6E-08					0.007
	Exposure Medium Total							6E-08					0.007
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	--	--	--
			Chromium	--	1E-06	--	--	1E-06	Respiratory	--	0.04	--	0.04
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	1E-06	--	--	1E-06		- -	0.04	- -	0.04
		Exposure Point Total						1E-06					0.04
	Exposure Medium Total							1E-06					0.04
Medium Total								1E-06					0.05
Receptor Total							Receptor Risk Total	1E-06				Receptor HI Total	0.9

Total CNS HI	0.8
Total Kidney HI	0.003
Total Respiratory HI	0.08
Total None Reported HI	0.0004
Total Skin HI	0.005
Total Thyroid HI	0.002

TABLE 9.2.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Industrial Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.005	--	--	0.005
			Cobalt	- -	--	- -	--	- -	Thyroid	0.02	--	--	0.02
			Manganese	- -	--	- -	--	- -	CNS	0.01	--	--	0.01
			Thallium	- -	--	- -	--	- -	Skin	0.009	--	--	0.009
			Vanadium	- -	--	- -	--	- -	Kidney	0.002	--	--	0.002
			Chemical Total	- -	--	- -	--	- -		0.05	--	--	0.05
		Exposure Point Total						- -					0.05
	Exposure Medium Total							- -					0.05
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.0004	--	0.0004
			Cobalt	--	2E-09	--	--	2E-09	Respiratory	--	0.0003	--	0.0003
			Manganese	--	- -	--	--	- -	CNS	--	0.002	--	0.002
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	2E-09	--	--	2E-09		- -	0.003	- -	0.003
		Exposure Point Total						2E-09					0.003
	Exposure Medium Total							2E-09					0.003
Medium Total								2E-09					0.05
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.004	--	--	0.004
			Chromium	5E-07	--	- -	--	5E-07	None Reported	0.002	--	--	0.002
			Thallium	- -	--	- -	--	- -	Skin	0.007	--	--	0.007
			Chemical Total	5E-07	--	- -	--	5E-07		0.01	--	--	0.01
		Exposure Point Total						5E-07					0.01
	Exposure Medium Total							5E-07					0.01
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.0003	--	0.0003
			Chromium	--	3E-08	--	--	3E-08	Respiratory	--	0.0001	--	0.0001
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	3E-08	--	--	3E-08		- -	0.0004	- -	0.0004
		Exposure Point Total						3E-08					0.0004
	Exposure Medium Total							3E-08					0.0004
Medium Total								5E-07					0.01
Receptor Total							Receptor Risk Total	5E-07				Receptor HI Total	0.07

Total CNS HI	0.03
Total Kidney HI	0.002
Total Respiratory HI	0.0005
Total None Reported HI	0.002
Total Skin HI	0.02
Total Thyroid HI	0.02

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Trespassers
Receptor Age: Adolescent

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.0005	--	--	0.0005
			Cobalt	- -	--	- -	--	- -	Thyroid	0.002	--	--	0.002
			Manganese	- -	--	- -	--	- -	CNS	0.001	--	--	0.001
			Thallium	- -	--	- -	--	- -	Skin	0.0009	--	--	0.0009
			Vanadium	- -	--	- -	--	- -	Kidney	0.0002	--	--	0.0002
			Chemical Total	- -	--	- -	--	- -		0.005	--	--	0.005
		Exposure Point Total						- -					0.005
	Exposure Medium Total							- -					0.005
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.000005	--	0.000005
			Cobalt	--	4E-11	--	--	4E-11	Respiratory	--	0.000005	--	0.000005
			Manganese	--	- -	--	--	- -	CNS	--	0.00004	--	0.00004
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	4E-11	--	--	4E-11		- -	0.00005	- -	0.00005
		Exposure Point Total						4E-11					0.00005
	Exposure Medium Total							4E-11					0.00005
Medium Total								4E-11					0.005
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.0004	--	--	0.0004
			Chromium	2E-07	--	- -	--	2E-07	None Reported	0.0002	--	--	0.0002
			Thallium	- -	--	- -	--	- -	Skin	0.0007	--	--	0.0007
			Chemical Total	2E-07	--	- -	--	2E-07		0.001	--	--	0.001
		Exposure Point Total						2E-07					0.001
	Exposure Medium Total							2E-07					0.001
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.000004	--	0.000004
			Chromium	--	1E-09	--	--	1E-09	Respiratory	--	0.000002	--	0.000002
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	1E-09	--	--	1E-09		- -	0.000006	- -	0.000006
		Exposure Point Total						1E-09					0.000006
	Exposure Medium Total							1E-09					0.000006
Medium Total								2E-07					0.001
Receptor Total							Receptor Risk Total	2E-07				Receptor HI Total	0.006

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total CNS HI	0.002
Total Kidney HI	0.0002
Total Respiratory HI	0.000007
Total None Reported HI	0.0002
Total Skin HI	0.002
Total Thyroid HI	0.002

TABLE 9.4.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.05	--	--	0.05
			Cobalt	- -	--	- -	--	- -	Thyroid	0.2	--	--	0.2
			Manganese	- -	--	- -	--	- -	CNS	0.1	--	--	0.1
			Thallium	- -	--	- -	--	- -	Skin	0.09	--	--	0.09
			Vanadium	- -	--	- -	--	- -	Kidney	0.02	--	--	0.02
			Chemical Total	- -	--	- -	--	- -		0.5	--	--	0.5
		Exposure Point Total						- -					0.5
	Exposure Medium Total							- -					0.5
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.001	--	0.001
			Cobalt	--	2E-09	--	--	2E-09	Respiratory	--	0.001	--	0.001
			Manganese	--	- -	--	--	- -	CNS	--	0.008	--	0.008
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	2E-09	--	--	2E-09		- -	0.01	- -	0.01
		Exposure Point Total						2E-09					0.01
	Exposure Medium Total							2E-09					0.01
Medium Total								2E-09					0.5
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.04	--	--	0.04
			Chromium	7E-06	--	- -	--	7E-06	None Reported	0.02	--	--	0.02
			Thallium	- -	--	- -	--	- -	Skin	0.07	--	--	0.07
			Chemical Total	7E-06	--	- -	--	7E-06		0.1	--	--	0.1
		Exposure Point Total						7E-06					0.1
	Exposure Medium Total							7E-06					0.1
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.0008	--	0.0008
			Chromium	--	1E-07	--	--	1E-07	Respiratory	--	0.0004	--	0.0004
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	1E-07	--	--	1E-07		- -	0.001	- -	0.001
		Exposure Point Total						1E-07					0.001
	Exposure Medium Total							1E-07					0.001
Medium Total								7E-06					0.1
Receptor Total							Receptor Risk Total	7E-06				Receptor HI Total	0.6

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total CNS HI	0.2
Total Kidney HI	0.02
Total Respiratory HI	0.001
Total None Reported HI	0.02
Total Skin HI	0.2
Total Thyroid HI	0.2

TABLE 9.5.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.005	--	--	0.005
			Cobalt	- -	--	- -	--	- -	Thyroid	0.02	--	--	0.02
			Manganese	- -	--	- -	--	- -	CNS	0.02	--	--	0.02
			Thallium	- -	--	- -	--	- -	Skin	0.01	--	--	0.01
			Vanadium	- -	--	- -	--	- -	Kidney	0.003	--	--	0.003
			Chemical Total	- -	--	- -	--	- -		0.05	--	--	0.05
		Exposure Point Total						- -					0.05
	Exposure Medium Total							- -					0.05
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.001	--	0.001
			Cobalt	--	6E-09	--	--	6E-09	Respiratory	--	0.001	--	0.001
			Manganese	--	- -	--	--	- -	CNS	--	0.008	--	0.008
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Vanadium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	6E-09	--	--	6E-09		- -	0.01	- -	0.01
		Exposure Point Total						6E-09					0.01
	Exposure Medium Total							6E-09					0.01
Medium Total								6E-09					0.06
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -	CNS	0.004	--	--	0.004
			Chromium	6E-07	--	- -	--	6E-07	None Reported	0.003	--	--	0.003
			Thallium	- -	--	- -	--	- -	Skin	0.008	--	--	0.008
			Chemical Total	6E-07	--	- -	--	6E-07		0.01	--	--	0.01
		Exposure Point Total						6E-07					0.01
	Exposure Medium Total							6E-07					0.01
	Air	SWMU 25	Aluminum	--	- -	--	--	- -	CNS	--	0.0008	--	0.0008
			Chromium	--	1E-07	--	--	1E-07	Respiratory	--	0.0004	--	0.0004
			Thallium	--	- -	--	--	- -	NA	--	--	--	--
			Chemical Total	--	1E-07	--	--	1E-07		- -	0.001	- -	0.001
		Exposure Point Total						1E-07					0.001
	Exposure Medium Total							1E-07					0.001
Medium Total								7E-07					0.02
Receptor Total							Receptor Risk Total	7E-07				Receptor HI Total	0.08

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total CNS HI	0.03
Total Kidney HI	0.003
Total Respiratory HI	0.001
Total None Reported HI	0.003
Total Skin HI	0.02
Total Thyroid HI	0.02

TABLE 9.6.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Surface Soil	Surface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -					
			Cobalt	- -	--	- -	--	- -					
			Manganese	- -	--	- -	--	- -					
			Thallium	- -	--	- -	--	- -					
			Vanadium	- -	--	- -	--	- -					
			Chemical Total	- -	--	- -	--	- -					
		Exposure Point Total						- -					
	Exposure Medium Total							- -					
	Air	SWMU 25	Aluminum	--	- -	--	--	- -					
			Cobalt	--	7E-09	--	--	7E-09					
			Manganese	--	- -	--	--	- -					
			Thallium	--	- -	--	--	- -					
			Vanadium	--	- -	--	--	- -					
			Chemical Total	--	7E-09	--	--	7E-09					
		Exposure Point Total						7E-09					
	Exposure Medium Total							7E-09					
Medium Total								7E-09					
Subsurface Soil	Subsurface Soil	SWMU 25	Aluminum	- -	--	- -	--	- -					
			Chromium	7E-06	--	- -	--	7E-06					
			Thallium	- -	--	- -	--	- -					
			Chemical Total	7E-06	--	- -	--	7E-06					
		Exposure Point Total						7E-06					
	Exposure Medium Total							7E-06					
	Air	SWMU 25	Aluminum	--	- -	--	--	- -					
			Chromium	--	2E-07	--	--	2E-07					
			Thallium	--	- -	--	--	- -					
			Chemical Total	--	2E-07	--	--	2E-07					
		Exposure Point Total						2E-07					
	Exposure Medium Total							2E-07					
Medium Total								8E-06					
Receptor Total							Receptor Risk Total	8E-06					

Notes:

1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

PROUCL OUTPUTS

Surface Soil

PROUCL OUTPUT - SURFACE SOIL

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	WorkSheet.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

Aluminum

General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	11
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	5200000	Minimum of Log Data	15.46
Maximum	20000000	Maximum of Log Data	16.81
Mean	9545455	Mean of log Data	15.98
Median	8900000	SD of log Data	0.426
SD	4518045		
Std. Error of Mean	1362242		
Coefficient of Variation	0.473		
Skewness	1.42		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.86	Shapiro Wilk Test Statistic	0.944
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	12014465	95% H-UCL	12678940
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	14889038
95% Adjusted-CLT UCL (Chen-1995)	12409303	97.5% Chebyshev (MVUE) UCL	17224654
95% Modified-t UCL (Johnson-1978)	12111665	99% Chebyshev (MVUE) UCL	21812520

Aluminum (continued)			
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	4.328	**Data appear Normal at 5% Significance Level**	
Theta Star	2205526		
MLE of Mean	9545455		
MLE of Standard Deviation	4588327		
nu star	95.22		
Approximate Chi Square Value (.05)	73.71	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	11786143
Adjusted Chi Square Value	70.63	95% Jackknife UCL	12014465
		95% Standard Bootstrap UCL	11666451
Anderson-Darling Test Statistic	0.346	95% Bootstrap-t UCL	13746206
Anderson-Darling 5% Critical Value	0.731	95% Hall's Bootstrap UCL	24218968
Kolmogorov-Smirnov Test Statistic	0.132	95% Percentile Bootstrap UCL	11936364
Kolmogorov-Smirnov 5% Critical Value	0.256	95% BCA Bootstrap UCL	12372727
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	15483329
		97.5% Chebyshev(Mean, Sd) UCL	18052651
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	23099588
95% Approximate Gamma UCL	12330491		
95% Adjusted Gamma UCL	12867997		
Potential UCL to Use		Use 95% Student's-t UCL	12014465

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - SURFACE SOIL

Cobalt			
General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	10
Number of Missing Values	1		
Raw Statistics		**Log-transformed Statistics**	
Minimum	1900	Minimum of Log Data	7.55
Maximum	21000	Maximum of Log Data	9.952
Mean	10036	Mean of log Data	9.044
Median	10000	SD of log Data	0.665
SD	5595		
Std. Error of Mean	1687		
Coefficient of Variation	0.557		
Skewness	0.717		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.941	Shapiro Wilk Test Statistic	0.93
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	13094	95% H-UCL	17553
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	19658
95% Adjusted-CLT UCL (Chen-1995)	13200	97.5% Chebyshev (MVUE) UCL	23696
95% Modified-t UCL (Johnson-1978)	13154	99% Chebyshev (MVUE) UCL	31630
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	2.317	**Data appear Normal at 5% Significance Level**	
Theta Star	4332		
MLE of Mean	10036		
MLE of Standard Deviation	6594		
nu star	50.97		
Approximate Chi Square Value (.05)	35.57	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	12811
Adjusted Chi Square Value	33.49	95% Jackknife UCL	13094
		95% Standard Bootstrap UCL	12674
Anderson-Darling Test Statistic	0.255	95% Bootstrap-t UCL	13840
Anderson-Darling 5% Critical Value	0.733	95% Hall's Bootstrap UCL	15235
Kolmogorov-Smirnov Test Statistic	0.167	95% Percentile Bootstrap UCL	12782
Kolmogorov-Smirnov 5% Critical Value	0.257	95% BCA Bootstrap UCL	13018
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	17389
		97.5% Chebyshev(Mean, Sd) UCL	20571
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	26820
95% Approximate Gamma UCL	14380		
95% Adjusted Gamma UCL	15276		

Cobalt (continued)											
Potential UCL to Use						Use 95% Student's-t UCL					13094
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											

PROUCL OUTPUT - SURFACE SOIL

Manganese

General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	11
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	110000	Minimum of Log Data	11.61
Maximum	1600000	Maximum of Log Data	14.29
Mean	571818	Mean of log Data	13.01
Median	510000	SD of log Data	0.768
SD	425178		
Std. Error of Mean	128196		
Coefficient of Variation	0.744		
Skewness	1.495		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Test Statistic	0.983
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	804168	95% H-UCL	1119549
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	1189111
95% Adjusted-CLT UCL (Chen-1995)	844429	97.5% Chebyshev (MVUE) UCL	1452941
95% Modified-t UCL (Johnson-1978)	813800	99% Chebyshev (MVUE) UCL	1971183
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	1.629	**Data appear Normal at 5% Significance Level**	
Theta Star	350983		
MLE of Mean	571818		
MLE of Standard Deviation	447994		
nu star	35.84		
Approximate Chi Square Value (.05)	23.14	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	782682
Adjusted Chi Square Value	21.49	95% Jackknife UCL	804168
		95% Standard Bootstrap UCL	774077
Anderson-Darling Test Statistic	0.168	95% Bootstrap-t UCL	919679
Anderson-Darling 5% Critical Value	0.738	95% Hall's Bootstrap UCL	1851839
Kolmogorov-Smirnov Test Statistic	0.119	95% Percentile Bootstrap UCL	794545
Kolmogorov-Smirnov 5% Critical Value	0.258	95% BCA Bootstrap UCL	846364
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	1130612
		97.5% Chebyshev(Mean, Sd) UCL	1372402
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	1847352
95% Approximate Gamma UCL	885640		
95% Adjusted Gamma UCL	953684		
Potential UCL to Use		Use 95% Student's-t UCL	804168

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - SURFACE SOIL

Thallium

General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	7
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	110	Minimum of Log Data	4.7
Maximum	300	Maximum of Log Data	5.704
Mean	178.2	Mean of log Data	5.133
Median	150	SD of log Data	0.317
SD	63.85		
Std. Error of Mean	19.25		
Coefficient of Variation	0.358		
Skewness	1.439		

Relevant UCL Statistics

Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.78	Shapiro Wilk Test Statistic	0.871
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	213.1	95% H-UCL	217.1
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	252.1
95% Adjusted-CLT UCL (Chen-1995)	218.8	97.5% Chebyshev (MVUE) UCL	284.3
95% Modified-t UCL (Johnson-1978)	214.5	99% Chebyshev (MVUE) UCL	347.7

Gamma Distribution Test		Data Distribution	
k star (bias corrected)	7.545	**Data Follow Appr. Gamma Distribution at 5% Significance Level**	
Theta Star	23.62		
MLE of Mean	178.2		
MLE of Standard Deviation	64.87		
nu star	166		
Approximate Chi Square Value (.05)	137.2	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	209.8
Adjusted Chi Square Value	132.9	95% Jackknife UCL	213.1
		95% Standard Bootstrap UCL	208.1
Anderson-Darling Test Statistic	0.841	95% Bootstrap-t UCL	253.7
Anderson-Darling 5% Critical Value	0.729	95% Hall's Bootstrap UCL	427.5
Kolmogorov-Smirnov Test Statistic	0.245	95% Percentile Bootstrap UCL	209.1
Kolmogorov-Smirnov 5% Critical Value	0.255	95% BCA Bootstrap UCL	217.3
Data follow Appr. Gamma Distribution at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	262.1
		97.5% Chebyshev(Mean, Sd) UCL	298.4
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	369.7
95% Approximate Gamma UCL	215.6		
95% Adjusted Gamma UCL	222.5		
Potential UCL to Use		Use 95% Approximate Gamma UCL	215.6

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - SURFACE SOIL

Vanadium

General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	9
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	7900	Minimum of Log Data	8.975
Maximum	40000	Maximum of Log Data	10.6
Mean	23900	Mean of log Data	9.998
Median	20000	SD of log Data	0.451
SD	9529		
Std. Error of Mean	2873		
Coefficient of Variation	0.399		
Skewness	0.26		

Relevant UCL Statistics			
Normal Distribution Test		Lognormal Distribution Test	
Shapiro Wilk Test Statistic	0.922	Shapiro Wilk Test Statistic	0.89
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
95% Student's-t UCL	29108	95% H-UCL	32927
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	38659
95% Adjusted-CLT UCL (Chen-1995)	28867	97.5% Chebyshev (MVUE) UCL	44954
95% Modified-t UCL (Johnson-1978)	29145	99% Chebyshev (MVUE) UCL	57320
Gamma Distribution Test		Data Distribution	
k star (bias corrected)	4.551	Data appear Normal at 5% Significance Level	
Theta Star	5251		
MLE of Mean	23900		
MLE of Standard Deviation	11203		
nu star	100.1		
Approximate Chi Square Value (.05)	78.05	Nonparametric Statistics	
Adjusted Level of Significance	0.0278	95% CLT UCL	28626
Adjusted Chi Square Value	74.87	95% Jackknife UCL	29108
		95% Standard Bootstrap UCL	28399
Anderson-Darling Test Statistic	0.51	95% Bootstrap-t UCL	29533
Anderson-Darling 5% Critical Value	0.731	95% Hall's Bootstrap UCL	28991
Kolmogorov-Smirnov Test Statistic	0.205	95% Percentile Bootstrap UCL	28527
Kolmogorov-Smirnov 5% Critical Value	0.256	95% BCA Bootstrap UCL	28545
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	36424
		97.5% Chebyshev(Mean, Sd) UCL	41843
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	52488
95% Approximate Gamma UCL	30663		
95% Adjusted Gamma UCL	31963		
Potential UCL to Use		Use 95% Student's-t UCL	29108

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

Subsurface Soil

PROUCL OUTPUT - SUBSURFACE SOIL

	General UCL Statistics for Full Data Sets		
User Selected Options			
From File	WorkSheet.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		

Aluminum

General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	9
Number of Missing Values	1		

Raw Statistics		Log-transformed Statistics	
Minimum	4700000	Minimum of Log Data	15.36
Maximum	12000000	Maximum of Log Data	16.3
Mean	7000000	Mean of log Data	15.71
Median	6300000	SD of log Data	0.329
SD	2509980		
Std. Error of Mean	756787		
Coefficient of Variation	0.359		
Skewness	1.138		

Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.846	Shapiro Wilk Test Statistic	0.896
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	8371648	95% H-UCL	8620287
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	10029896
95% Adjusted-CLT UCL (Chen-1995)	8522257	97.5% Chebyshev (MVUE) UCL	11349857
95% Modified-t UCL (Johnson-1978)	8414925	99% Chebyshev (MVUE) UCL	13942666

Aluminum (continued)			
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	7.165	**Data appear Gamma Distributed at 5% Significance Level**	
Theta Star	976949		
MLE of Mean	7000000		
MLE of Standard Deviation	2615080		
nu star	157.6		
Approximate Chi Square Value (.05)	129.6	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	8244805
Adjusted Chi Square Value	125.5	95% Jackknife UCL	8371648
		95% Standard Bootstrap UCL	8186428
Anderson-Darling Test Statistic	0.526	95% Bootstrap-t UCL	9059007
Anderson-Darling 5% Critical Value	0.729	95% Hall's Bootstrap UCL	9652444
Kolmogorov-Smirnov Test Statistic	0.186	95% Percentile Bootstrap UCL	8281818
Kolmogorov-Smirnov 5% Critical Value	0.255	95% BCA Bootstrap UCL	8527273
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	10298760
		97.5% Chebyshev(Mean, Sd) UCL	11726136
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	14529940
95% Approximate Gamma UCL	8513610		
95% Adjusted Gamma UCL	8794574		
Potential UCL to Use		Use 95% Approximate Gamma UCL	8513610

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - SUBSURFACE SOIL

Chromium			
General Statistics			
Number of Valid Observations	11	Number of Distinct Observations	9
Number of Missing Values	1		
Raw Statistics		**Log-transformed Statistics**	
Minimum	4700	Minimum of Log Data	8.455
Maximum	26000	Maximum of Log Data	10.17
Mean	13955	Mean of log Data	9.445
Median	13000	SD of log Data	0.485
SD	6164		
Std. Error of Mean	1858		
Coefficient of Variation	0.442		
Skewness	0.483		
Relevant UCL Statistics			
Normal Distribution Test		**Lognormal Distribution Test**	
Shapiro Wilk Test Statistic	0.971	Shapiro Wilk Test Statistic	0.968
Shapiro Wilk Critical Value	0.85	Shapiro Wilk Critical Value	0.85
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
95% Student's-t UCL	17323	95% H-UCL	19802
95% UCLs (Adjusted for Skewness)		95% Chebyshev (MVUE) UCL	23202
95% Adjusted-CLT UCL (Chen-1995)	17301	97.5% Chebyshev (MVUE) UCL	27157
95% Modified-t UCL (Johnson-1978)	17368	99% Chebyshev (MVUE) UCL	34925
Gamma Distribution Test		**Data Distribution**	
k star (bias corrected)	3.876	**Data appear Normal at 5% Significance Level**	
Theta Star	3600		
MLE of Mean	13955		
MLE of Standard Deviation	7088		
nu star	85.27		
Approximate Chi Square Value (.05)	64.99	**Nonparametric Statistics**	
Adjusted Level of Significance	0.0278	95% CLT UCL	17011
Adjusted Chi Square Value	62.11	95% Jackknife UCL	17323
		95% Standard Bootstrap UCL	16913
Anderson-Darling Test Statistic	0.172	95% Bootstrap-t UCL	17817
Anderson-Darling 5% Critical Value	0.731	95% Hall's Bootstrap UCL	17656
Kolmogorov-Smirnov Test Statistic	0.138	95% Percentile Bootstrap UCL	16982
Kolmogorov-Smirnov 5% Critical Value	0.256	95% BCA Bootstrap UCL	17273
Data appear Gamma Distributed at 5% Significance Level		95% Chebyshev(Mean, Sd) UCL	22055
		97.5% Chebyshev(Mean, Sd) UCL	25560
Assuming Gamma Distribution		99% Chebyshev(Mean, Sd) UCL	32446
95% Approximate Gamma UCL	18310		
95% Adjusted Gamma UCL	19159		

Chromium (continued)											
Potential UCL to Use						Use 95% Student's-t UCL					17323
Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.											
These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002)											
and Singh and Singh (2003). For additional insight, the user may want to consult a statistician.											

PROUCL OUTPUT - SUBSURFACE SOIL

	General UCL Statistics for Data Sets with Non-Detects		
User Selected Options			
From File	WorkSheet.wst		
Full Precision	OFF		
Confidence Coefficient	95%		
Number of Bootstrap Operations	2000		
Thallium			
General Statistics			
Number of Valid Data	11	Number of Detected Data	10
Number of Distinct Detected Data	7	Number of Non-Detect Data	1
Number of Missing Values	1	Percent Non-Detects	9.09%
Raw Statistics		Log-transformed Statistics	
Minimum Detected	86	Minimum Detected	4.454
Maximum Detected	270	Maximum Detected	5.598
Mean of Detected	144.6	Mean of Detected	4.926
SD of Detected	51.54	SD of Detected	0.318
Minimum Non-Detect	93	Minimum Non-Detect	4.533
Maximum Non-Detect	93	Maximum Non-Detect	4.533
UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.846	Shapiro Wilk Test Statistic	0.948
5% Shapiro Wilk Critical Value	0.842	5% Shapiro Wilk Critical Value	0.842
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	135.7	Mean	4.827
SD	57.14	SD	0.445
95% DL/2 (t) UCL	166.9	95% H-Stat (DL/2) UCL	185.4
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	134.6	Mean in Log Scale	4.876
SD	56.51	SD in Log Scale	0.344
95% MLE (t) UCL	165.4	Mean in Original Scale	138.7
95% MLE (Tiku) UCL	165.7	SD in Original Scale	52.68
		95% t UCL	167.5
		95% Percentile Bootstrap UCL	165.6
		95% BCA Bootstrap UCL	172.3
		95% H UCL	172.7
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	7.407	Data appear Normal at 5% Significance Level	
Theta Star	19.52		
nu star	148.1		

Thallium (continued)			
A-D Test Statistic	0.383	**Nonparametric Statistics**	
5% A-D Critical Value	0.725	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.725	Mean	139.3
5% K-S Critical Value	0.267	SD	49.57
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	15.75
		95% KM (t) UCL	167.8
Assuming Gamma Distribution		95% KM (z) UCL	165.2
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	167.3
Minimum	57.04	95% KM (bootstrap t) UCL	183.1
Maximum	270	95% KM (BCA) UCL	169.3
Mean	136.6	95% KM (Percentile Bootstrap) UCL	166.9
Median	130	95% KM (Chebyshev) UCL	207.9
SD	55.56	97.5% KM (Chebyshev) UCL	237.7
k star	5.231	99% KM (Chebyshev) UCL	296
Theta star	26.12		
Nu star	115.1	**Potential UCLs to Use**	
AppChi2	91.32	95% KM (t) UCL	167.8
95% Gamma Approximate UCL	172.2	95% KM (Percentile Bootstrap) UCL	166.9
95% Adjusted Gamma UCL	179		

Note: DL/2 is not a recommended method.

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

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

For additional insight, the user may want to consult a statistician.

APPENDIX E.6

RISKS FOR DISSOLVED METALS IN GROUNDWATER

RAGS Part D Table 3

Medium-Specific Exposure Point Concentration Summary

TABLE 3.3.RME
EXPOSURE POINT CONCENTRATION SUMMARY
REASONABLE MAXIMUM EXPOSURE
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Medium: Groundwater
Exposure Medium: Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean[1]	95% UCL (Distribution)[1]	Maximum Concentration (Qualifier)[1]	Exposure Point Concentration			
						Value[1]	Units	Statistic	Rationale
SWMU 25	Arsenic	ug/L	0.85	NA[2]	1.5 J	1.5	ug/L	Maximum Detected Concentration	(2)
	Chromium	ug/L	NA[3]	NA[2]	3.9 J	3.9	ug/L	Maximum Detected Concentration	(2)
	Cobalt	ug/L	8.6	16.6 (N)	18	16.6	ug/L	95% KM (t) UCL	ProUCL 4.1.01
	Naphthalene	ug/L	0.12	NA[2]	0.169 J	0.169	ug/L	Maximum Detected Concentration	(2)

EPC = Exposure point concentration.
N - Normal distribution.
NA = Not applicable.
ND = Not detected in dissolved metals fraction.
UCL = Upper Confidence Limit.

1 - Metals values presented are for dissolved metals results.
2 - There are less than four detected concentrations. Reliable statistics cannot be computed. The maximum concentration was used as the EPC.
3 - There are less than three detected concentrations; therefore, the arithmetic mean concentration was not calculated.

Exposure point concentrations for the RME scenarios are also the exposure point concentrations for the CTE scenarios.

RAGS Part D Table 7

Calculation of Cancer Risks and Non-Cancer Hazards

LIST OF TABLES
RAGS PART D TABLE 7
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

Table No.

REASONABLE MAXIMUM EXPOSURES

7.1.RME Construction Workers
7.2.RME Child Residents
7.3.RME Adult Residents

CENTRAL TENDENCY EXPOSURES

7.1.CTE Construction Workers
7.2.CTE Child Residents
7.3.CTE Adult Residents

TABLE 7.1.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Dermal	Arsenic	1.50	ug/L	3.3E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	5.0E-10	2.3E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00008
				Chromium	3.90	ug/L	1.7E-09	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	3.5E-08	1.2E-07	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0002
				Cobalt	16.6	ug/L	1.5E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.0E-07	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00003
				Naphthalene	0.169	ug/L	2.0E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.4E-07	(mg/kg/day)	6.0E-01	(mg/kg/day)	2.4E-7
			Exp. Route Total								3.5E-08					0.0004
		Exposure Point Total									3.5E-08					0.0004
	Exposure Medium Total										3.5E-08					0.0004
	Air	SWMU 25	Inhalation	Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Naphthalene	4.9E-6	mg/m^3	9.6E-10	(mg/m^3)	3.4E-05	$(ug/m^3)^{-1}$	3.3E-11	6.7E-08	(mg/m^3)	3.0E-03	(mg/m^3)	0.00002
			Exp. Route Total								3.3E-11					0.00002
		Exposure Point Total									3.3E-11					0.00002
	Exposure Medium Total										3.3E-11					0.00002
Medium Total											3.5E-08					0.0004
Total of Receptor Risks Across All Media											3.5E-08	Total of Receptor Hazards Across All Media				0.0004

TABLE 7.2.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Ingestion	Arsenic	1.50	ug/L	1.2E-05	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.8E-05	1.4E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.5
				Chromium	3.90	ug/L	1.7E-04	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	8.5E-05	3.7E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.1
				Cobalt	16.6	ug/L	1.4E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-03	(mg/kg/day)	3.0E-04	(mg/kg/day)	5.3
				Naphthalene	0.169	ug/L	1.4E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.6E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0008
			Exp. Route Total								1.0E-04					5.9
			Dermal	Arsenic	1.50	ug/L	5.4E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	8.1E-08	6.3E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Chromium	3.90	ug/L	1.5E-06	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	3.0E-05	3.3E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.04
				Cobalt	16.6	ug/L	2.4E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.8E-06	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.009
				Naphthalene	0.169	ug/L	5.9E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.9E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0003
			Exp. Route Total								3.0E-05					0.06
		Exposure Point Total									1.3E-04					6.0
	Exposure Medium Total										1.3E-04					6.0
	Air	SWMU 25	Inhalation	Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	6.0E-06	(mg/m^3)	--
				Naphthalene	1.8E-4	mg/m^3	6.1E-07	(mg/m^3)	3.4E-05	$(ug/m^3)^{-1}$	2.1E-08	7.1E-06	(mg/m^3)	3.0E-03	(mg/m^3)	0.002
			Exp. Route Total								2.1E-08					0.002
		Exposure Point Total									2.1E-08					0.002
	Exposure Medium Total										2.1E-08					0.002
Medium Total											1.3E-04					6.0
										Total of Receptor Risks Across All Media	1.3E-04				Total of Receptor Hazards Across All Media	6.0

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Ingestion	Arsenic	1.50	ug/L	1.4E-05	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.1E-05	4.1E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.1
				Chromium	3.90	ug/L	6.7E-05	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	3.4E-05	1.1E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.04
				Cobalt	16.6	ug/L	1.6E-04	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.5E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	1.5
				Naphthalene	0.169	ug/L	1.6E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	4.6E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0002
			Exp. Route Total								5.5E-05					1.7
			Dermal	Arsenic	1.50	ug/L	7.4E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.1E-07	2.1E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0007
				Chromium	3.90	ug/L	7.0E-07	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	1.4E-05	1.1E-06	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.01
				Cobalt	16.6	ug/L	3.3E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	9.5E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.003
				Naphthalene	0.169	ug/L	1.0E-06	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.1E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0002
			Exp. Route Total								1.4E-05					0.02
		Exposure Point Total									6.9E-05					1.7
	Exposure Medium Total										6.9E-05					1.7
	Air	SWMU 25	Inhalation	Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	6.0E-06	(mg/m^3)	--
				Naphthalene	7.7E-5	mg/m^3	1.1E-06	(mg/m^3)	3.4E-05	$(ug/m^3)^{-1}$	3.6E-08	3.1E-06	(mg/m^3)	3.0E-03	(mg/m^3)	0.001
			Exp. Route Total								3.6E-08					0.001
		Exposure Point Total									3.6E-08					0.001
	Exposure Medium Total										3.6E-08					0.001
Medium Total											6.9E-05					1.7
										Total of Receptor Risks Across All Media	6.9E-05			Total of Receptor Hazards Across All Media		1.7

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.1.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Dermal	Arsenic	1.50	ug/L	1.7E-10	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	2.5E-10	1.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.00004
				Chromium	3.90	ug/L	8.6E-10	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	1.7E-08	6.0E-08	(mg/kg/day)	5.0E-04	(mg/kg/day)	0.0001
				Cobalt	16.6	ug/L	7.4E-10	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	5.1E-08	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.00002
				Naphthalene	0.169	ug/L	1.0E-09	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	7.1E-08	(mg/kg/day)	6.0E-01	(mg/kg/day)	1.2E-7
			Exp. Route Total								1.8E-08					0.0002
		Exposure Point Total									1.8E-08					0.0002
	Exposure Medium Total										1.8E-08					0.0002
	Air	SWMU 25	Inhalation	Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Naphthalene	4.9E-6	mg/m^3	4.8E-10	(mg/m^3)	3.4E-05	$(ug/m^3)^{-1}$	1.6E-11	3.4E-08	(mg/m^3)	3.0E-03	(mg/m^3)	0.00001
			Exp. Route Total								1.6E-11					0.00001
		Exposure Point Total									1.6E-11					0.00001
	Exposure Medium Total										1.6E-11					0.00001
Medium Total											1.8E-08					0.0002
										Total of Receptor Risks Across All Media	1.8E-08				Total of Receptor Hazards Across All Media	0.0002

TABLE 7.2.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Ingestion	Arsenic	1.50	ug/L	8.2E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.2E-05	9.6E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.3
				Chromium	3.90	ug/L	1.1E-04	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	5.7E-05	2.5E-04	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.08
				Cobalt	16.6	ug/L	9.1E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-03	(mg/kg/day)	3.0E-04	(mg/kg/day)	3.5
				Naphthalene	0.169	ug/L	9.3E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.1E-05	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0005
			Exp. Route Total								7.0E-05					4.0
			Dermal	Arsenic	1.50	ug/L	1.2E-08	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	1.8E-08	1.4E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0005
				Chromium	3.90	ug/L	3.3E-07	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	6.6E-06	7.3E-07	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.010
				Cobalt	16.6	ug/L	5.3E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	6.2E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.002
				Naphthalene	0.169	ug/L	2.3E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.6E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0001
			Exp. Route Total								6.7E-06					0.01
		Exposure Point Total									7.6E-05					4.0
	Exposure Medium Total										7.6E-05					4.0
	Air	SWMU 25	Inhalation	Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	6.0E-06	(mg/m^3)	--
				Naphthalene	3.2E-5	mg/m^3	2.4E-08	(mg/m^3)	3.4E-05	$(ug/m^3)^{-1}$	8.2E-10	8.5E-07	(mg/m^3)	3.0E-03	(mg/m^3)	0.0003
			Exp. Route Total								8.2E-10					0.0003
		Exposure Point Total									8.2E-10					0.0003
	Exposure Medium Total										8.2E-10					0.0003
Medium Total											7.6E-05					4.0
										Total of Receptor Risks Across All Media	7.6E-05			Total of Receptor Hazards Across All Media		4.0

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 7.3.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Groundwater	SWMU 25	Ingestion	Arsenic	1.50	ug/L	2.7E-06	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	4.1E-06	2.7E-05	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.09
				Chromium	3.90	ug/L	1.1E-05	(mg/kg/day)	5.0E-01	$(mg/kg/day)^{-1}$	5.6E-06	7.1E-05	(mg/kg/day)	3.0E-03	(mg/kg/day)	0.02
				Cobalt	16.6	ug/L	3.0E-05	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.0E-04	(mg/kg/day)	3.0E-04	(mg/kg/day)	1.0
				Naphthalene	0.169	ug/L	3.1E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	3.1E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.0002
			Exp. Route Total								9.7E-06					1.1
			Dermal	Arsenic	1.50	ug/L	6.2E-09	(mg/kg/day)	1.5E+00	$(mg/kg/day)^{-1}$	9.3E-09	6.2E-08	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0002
				Chromium	3.90	ug/L	5.1E-08	(mg/kg/day)	2.0E+01	$(mg/kg/day)^{-1}$	1.0E-06	3.2E-07	(mg/kg/day)	7.5E-05	(mg/kg/day)	0.004
				Cobalt	16.6	ug/L	2.7E-08	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	2.7E-07	(mg/kg/day)	3.0E-04	(mg/kg/day)	0.0009
				Naphthalene	0.169	ug/L	1.3E-07	(mg/kg/day)	NA	$(mg/kg/day)^{-1}$	- -	1.3E-06	(mg/kg/day)	2.0E-02	(mg/kg/day)	0.00007
			Exp. Route Total								1.0E-06					0.005
		Exposure Point Total									1.1E-05					1.1
	Exposure Medium Total										1.1E-05					1.1
	Air	SWMU 25	Inhalation	Arsenic	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	4.3E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	1.5E-05	(mg/m^3)	--
				Chromium	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	8.4E-02	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	2.0E-05	(mg/m^3)	--
				Cobalt	0.0E+0	mg/m^3	0.0E+00	(mg/m^3)	9.0E-03	$(ug/m^3)^{-1}$	- -	0.0E+00	(mg/m^3)	6.0E-06	(mg/m^3)	--
				Naphthalene	1.7E-5	mg/m^3	4.6E-08	(mg/m^3)	3.4E-05	$(ug/m^3)^{-1}$	1.6E-09	4.6E-07	(mg/m^3)	3.0E-03	(mg/m^3)	0.0002
			Exp. Route Total								1.6E-09					0.0002
		Exposure Point Total									1.6E-09					0.0002
	Exposure Medium Total										1.6E-09					0.0002
Medium Total											1.1E-05					1.1
										Total of Receptor Risks Across All Media	1.1E-05				Total of Receptor Hazards Across All Media	1.1

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

RAGS Part D Table 9

Summary of Receptor Risks and Hazards for COPCs

LIST OF TABLES
RAGS PART D TABLE 9
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

Table No.

REASONABLE MAXIMUM EXPOSURES

9.1.RME Construction Workers
9.2.RME Child Residents
9.3.RME Adult Residents
9.4.RME Lifelong Residents

CENTRAL TENDENCY EXPOSURES

9.1.CTE Construction Workers
9.2.CTE Child Residents
9.3.CTE Adult Residents
9.4.CTE Lifelong Residents

TABLE 9.1.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Arsenic	- -	--	5E-10	--	5E-10	Skin, CVS	--	--	0.00008	0.00008
			Chromium	- -	--	3E-08	--	3E-08	None Reported	--	--	0.0002	0.0002
			Cobalt	- -	--	- -	--	- -	Thyroid	--	--	0.00003	0.00003
			Naphthalene	- -	--	- -	--	- -	entral Nervous Syster	--	--	0.0000002	0.0000002
			Chemical Total	- -	--	4E-08	--	4E-08		--	--	0.0004	0.0004
		Exposure Point Total						4E-08					0.0004
	Exposure Medium Total							4E-08					0.0004
	Air	SWMU 25	Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Naphthalene	--	3E-11	--	--	3E-11	Respiratory	--	0.00002	--	0.00002
			Chemical Total	--	3E-11	--	--	3E-11		- -	0.00002	- -	0.00002
		Exposure Point Total						3E-11					0.00002
	Exposure Medium Total							3E-11					0.00002
Medium Total								4E-08					0.0004
Receptor Total							Receptor Risk Total	4E-08				Receptor HI Total	0.0004

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Arsenic	2E-05	--	8E-08	--	2E-05	Skin, CVS	0.5	--	0.002	0.5
			Chromium	9E-05	--	3E-05	--	1E-04	None Reported	0.1	--	0.04	0.2
			Cobalt	- -	--	- -	--	- -	Thyroid	5	--	0.009	5
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.0008	--	0.0003	0.001
			Chemical Total	1E-04	--	3E-05	--	1E-04		6	--	0.06	6
		Exposure Point Total						1E-04					6
	Exposure Medium Total							1E-04					6
	Air	SWMU 25	Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Naphthalene	--	2E-08	--	--	2E-08	Respiratory	--	0.002	--	0.002
			Chemical Total	--	2E-08	--	--	2E-08		- -	0.002	- -	0.002
		Exposure Point Total						2E-08					0.002
	Exposure Medium Total							2E-08					0.002
Medium Total								1E-04					6
Receptor Total							Receptor Risk Total	1E-04				Receptor HI Total	6

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total Body Weight HI	0.001
Total CVS HI	0.5
Total Respiratory HI	0.002
Total Skin HI	0.5
Total Thyroid HI	5

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Arsenic	2E-05	--	1E-07	--	2E-05	Skin, CVS	0.1	--	0.0007	0.1
			Chromium	3E-05	--	1E-05	--	5E-05	None Reported	0.04	--	0.01	0.05
			Cobalt	- -	--	- -	--	- -	Thyroid	2	--	0.003	2
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.0002	--	0.0002	0.0004
			Chemical Total	5E-05	--	1E-05	--	7E-05		2	--	0.02	2
		Exposure Point Total						7E-05					2
	Exposure Medium Total							7E-05					2
	Air	SWMU 25	Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Naphthalene	--	4E-08	--	--	4E-08	Respiratory	--	0.001	--	0.001
			Chemical Total	--	4E-08	--	--	4E-08		- -	0.001	- -	0.001
		Exposure Point Total						4E-08					0.001
	Exposure Medium Total							4E-08					0.001
Medium Total								7E-05					2
Receptor Total							Receptor Risk Total	7E-05				Receptor HI Total	2

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total Body Weight HI	0.0004
Total CVS HI	0.1
Total Respiratory HI	0.001
Total Skin HI	0.1
Total Thyroid HI	2

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Arsenic	4E-05	--	2E-07	--	4E-05					
			Chromium	1E-04	--	4E-05	--	2E-04					
			Cobalt	- -	--	- -	--	- -					
			Naphthalene	- -	--	- -	--	- -					
			Chemical Total	2E-04	--	4E-05	--	2E-04					
		Exposure Point Total						2E-04					
	Exposure Medium Total							2E-04					
	Air	SWMU 25	Arsenic	--	- -	--	--	- -					
			Chromium	--	- -	--	--	- -					
			Cobalt	--	- -	--	--	- -					
			Naphthalene	--	6E-08	--	--	6E-08					
			Chemical Total	--	6E-08	--	--	6E-08					
		Exposure Point Total						6E-08					
	Exposure Medium Total							6E-08					
Medium Total								2E-04					
Receptor Total							Receptor Risk Total	2E-04					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.1.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Construction Workers
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Arsenic	- -	--	2E-10	--	2E-10	Skin, CVS	--	--	0.00004	0.00004
			Chromium	- -	--	2E-08	--	2E-08	None Reported	--	--	0.0001	0.0001
			Cobalt	- -	--	- -	--	- -	Thyroid	--	--	0.00002	0.00002
			Naphthalene	- -	--	- -	--	- -	entral Nervous Syster	--	--	0.0000001	0.0000001
			Chemical Total	- -	--	2E-08	--	2E-08		--	--	0.0002	0.0002
		Exposure Point Total						2E-08					0.0002
	Exposure Medium Total							2E-08					0.0002
	Air	SWMU 25	Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Naphthalene	--	2E-11	--	--	2E-11	Respiratory	--	0.00001	--	0.00001
			Chemical Total	--	2E-11	--	--	2E-11		- -	0.00001	- -	0.00001
		Exposure Point Total						2E-11					0.00001
	Exposure Medium Total							2E-11					0.00001
Medium Total								2E-08					0.0002
Receptor Total							Receptor Risk Total	2E-08				Receptor HI Total	0.0002

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.2.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Current/Future
Receptor Population: Residents
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Arsenic	1E-05	--	2E-08	--	1E-05	Skin, CVS	0.3	--	0.0005	0.3
			Chromium	6E-05	--	7E-06	--	6E-05	None Reported	0.08	--	0.010	0.09
			Cobalt	- -	--	- -	--	- -	Thyroid	4	--	0.002	4
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.0005	--	0.0001	0.0007
			Chemical Total	7E-05	--	7E-06	--	8E-05		4	--	0.01	4
		Exposure Point Total						8E-05					4
	Exposure Medium Total							8E-05					4
	Air	SWMU 25	Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Naphthalene	--	8E-10	--	--	8E-10	Respiratory	--	0.0003	--	0.0003
			Chemical Total	--	8E-10	--	--	8E-10		- -	0.0003	- -	0.0003
		Exposure Point Total						8E-10					0.0003
	Exposure Medium Total							8E-10					0.0003
Medium Total								8E-05					4
Receptor Total							Receptor Risk Total	8E-05				Receptor HI Total	4

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

Total Body Weight HI	0.0007
Total CVS HI	0.3
Total Respiratory HI	0.0003
Total Skin HI	0.3
Total Thyroid HI	4

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Arsenic	4E-06	--	9E-09	--	4E-06	Skin, CVS	0.09	--	0.0002	0.09
			Chromium	6E-06	--	1E-06	--	7E-06	None Reported	0.02	--	0.004	0.03
			Cobalt	- -	--	- -	--	- -	Thyroid	1	--	0.0009	1
			Naphthalene	- -	--	- -	--	- -	Body Weight	0.0002	--	0.00007	0.0002
			Chemical Total	1E-05	--	1E-06	--	1E-05		1	--	0.005	1
		Exposure Point Total						1E-05					1
	Exposure Medium Total							1E-05					1
	Air	SWMU 25	Arsenic	--	- -	--	--	- -	NA	--	--	--	--
			Chromium	--	- -	--	--	- -	Respiratory	--	--	--	--
			Cobalt	--	- -	--	--	- -	Respiratory	--	--	--	--
			Naphthalene	--	2E-09	--	--	2E-09	Respiratory	--	0.0002	--	0.0002
			Chemical Total	--	2E-09	--	--	2E-09		- -	0.0002	- -	0.0002
		Exposure Point Total						2E-09					0.0002
	Exposure Medium Total							2E-09					0.0002
Medium Total								1E-05					1
Receptor Total							Receptor Risk Total	1E-05				Receptor HI Total	1

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

TABLE 9.4.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURES
NSA CRANE, CRANE, INDIANA

Scenario Timeframe: Hypothetical
Receptor Population: Residents
Receptor Age: Lifelong (Child and Adult)

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk					Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	External (Radiation)	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	SWMU 25	Arsenic	2E-05	--	3E-08	--	2E-05					
			Chromium	6E-05	--	8E-06	--	7E-05					
			Cobalt	- -	--	- -	--	- -					
			Naphthalene	- -	--	- -	--	- -					
			Chemical Total	8E-05	--	8E-06	--	9E-05					
		Exposure Point Total						9E-05					
	Exposure Medium Total							9E-05					
	Air	SWMU 25	Arsenic	--	- -	--	--	- -					
			Chromium	--	- -	--	--	- -					
			Cobalt	--	- -	--	--	- -					
			Naphthalene	--	2E-09	--	--	2E-09					
			Chemical Total	--	2E-09	--	--	2E-09					
		Exposure Point Total						2E-09					
	Exposure Medium Total							2E-09					
Medium Total								9E-05					
Receptor Total							Receptor Risk Total	9E-05					

Notes:
1 - Mutagenic chemicals were evaluated in accordance with USEPA's Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens (2005).

PROUCL OUTPUTS

PROUCL OUTPUT - GROUNDWATER

	General UCL Statistics for Data Sets with Non-Detects
User Selected Options	
From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Arsenic

General Statistics

Number of Valid Data	5	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	2
Number of Missing Values	1	Percent Non-Detects	40.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.41	Minimum Detected	-0.892
Maximum Detected	1.5	Maximum Detected	0.405
Mean of Detected	0.92	Mean of Detected	-0.216
SD of Detected	0.548	SD of Detected	0.65
Minimum Non-Detect	1.5	Minimum Non-Detect	0.405
Maximum Non-Detect	1.5	Maximum Non-Detect	0.405

Warning: There are only 3 Distinct Detected Values in this data set

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.988	Shapiro Wilk Test Statistic	0.995
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	

Arsenic (Continued)

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.852	Mean	-0.245
SD	0.399	SD	0.461
95% DL/2 (t) UCL	1.232	95% H-Stat (DL/2) UCL	1.672
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-0.353
		SD in Log Scale	0.523
		Mean in Original Scale	0.787
		SD in Original Scale	0.439
		95% t UCL	1.206
		95% Percentile Bootstrap UCL	1.082
		95% BCA Bootstrap UCL	1.152
		95% H-UCL	1.775
Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data appear Normal at 5% Significance Level	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.804
5% K-S Critical Value	N/A	SD	0.4
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.244
		95% KM (t) UCL	1.324
Assuming Gamma Distribution		95% KM (z) UCL	1.205
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	1.868
SD	N/A	97.5% KM (Chebyshev) UCL	2.328
k star	N/A	99% KM (Chebyshev) UCL	3.232
Theta star	N/A		
Nu star	N/A	Potential UCLs to Use	
AppChi2	N/A	95% KM (t) UCL	1.324
95% Gamma Approximate UCL (Use when n >= 40)	N/A	95% KM (Percentile Bootstrap) UCL	N/A
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Note: DL/2 is not a recommended method.

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

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

For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Chromium

General Statistics			
Number of Valid Data	5	Number of Detected Data	2
Number of Distinct Detected Data	2	Number of Non-Detect Data	3
Number of Missing Values	1	Percent Non-Detects	60.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	2.6	Minimum Detected	0.956
Maximum Detected	3.9	Maximum Detected	1.361
Mean of Detected	3.25	Mean of Detected	1.158
SD of Detected	0.919	SD of Detected	0.287
Minimum Non-Detect	1	Minimum Non-Detect	0
Maximum Non-Detect	1	Maximum Non-Detect	0

Warning: Data set has only 2 Distinct Detected Values.

This may not be adequate enough to compute meaningful and reliable test statistics and estimates.

The Project Team may decide to use alternative site specific values to estimate environmental parameters (e.g., EPC, BTV).

Unless Data Quality Objectives (DQOs) have been met, it is suggested to collect additional observations.

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	N/A	Shapiro Wilk Test Statistic	N/A
5% Shapiro Wilk Critical Value	N/A	5% Shapiro Wilk Critical Value	N/A
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.6	Mean	0.0474
SD	1.575	SD	1.024
95% DL/2 (t) UCL	3.101	95% H-Stat (DL/2) UCL	23.03
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	N/A
		SD in Log Scale	N/A
		Mean in Original Scale	N/A
		SD in Original Scale	N/A
		95% t UCL	N/A
		95% Percentile Bootstrap UCL	N/A
		95% BCA Bootstrap UCL	N/A
		95% H-UCL	N/A

Chromium (Continued)

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data do not follow a Discernable Distribution (0.05)	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	2.86
5% K-S Critical Value	N/A	SD	0.52
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.329
		95% KM (t) UCL	3.561
Assuming Gamma Distribution		95% KM (z) UCL	3.401
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	N/A
Minimum	N/A	95% KM (bootstrap t) UCL	N/A
Maximum	N/A	95% KM (BCA) UCL	N/A
Mean	N/A	95% KM (Percentile Bootstrap) UCL	N/A
Median	N/A	95% KM (Chebyshev) UCL	4.294
SD	N/A	97.5% KM (Chebyshev) UCL	4.914
k star	N/A	99% KM (Chebyshev) UCL	6.132
Theta star	N/A		
Nu star	N/A	Potential UCLs to Use	
AppChi2	N/A	95% KM (t) UCL	3.561
95% Gamma Approximate UCL (Use when n >= 40)	N/A	95% KM (% Bootstrap) UCL	N/A
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Note: DL/2 is not a recommended method.

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

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

For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Cobalt

General Statistics			
Number of Valid Data	5	Number of Detected Data	4
Number of Distinct Detected Data	4	Number of Non-Detect Data	1
Number of Missing Values	1	Percent Non-Detects	20.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	2.4	Minimum Detected	0.875
Maximum Detected	18	Maximum Detected	2.89
Mean of Detected	10.43	Mean of Detected	2.023
SD of Detected	8.112	SD of Detected	0.996
Minimum Non-Detect	2.5	Minimum Non-Detect	0.916
Maximum Non-Detect	2.5	Maximum Non-Detect	0.916

Warning: There are only 4 Distinct Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set

the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics			
Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.828	Shapiro Wilk Test Statistic	0.867
5% Shapiro Wilk Critical Value	0.748	5% Shapiro Wilk Critical Value	0.748
Data appear Normal at 5% Significance Level		Data appear Lognormal at 5% Significance Level	
Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	8.592	Mean	1.663
SD	8.136	SD	1.18
95% DL/2 (t) UCL	16.35	95% H-Stat (DL/2) UCL	303.2
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	5.915	Mean in Log Scale	1.777
SD	10.65	SD in Log Scale	1.023
95% MLE (t) UCL	16.07	Mean in Original Scale	8.783
95% MLE (Tiku) UCL	17.41	SD in Original Scale	7.929
		95% t UCL	16.34
		95% Percentile Bootstrap UCL	14.58
		95% BCA Bootstrap UCL	14.6
		95% H UCL	129.2

Cobalt (Continued)

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.593	**Data appear Normal at 5% Significance Level**	
Theta Star	17.59		
nu star	4.743		
A-D Test Statistic	0.464	**Nonparametric Statistics**	
5% A-D Critical Value	0.662	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.662	Mean	8.822
5% K-S Critical Value	0.399	SD	7.056
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	3.644
		95% KM (t) UCL	16.59
Assuming Gamma Distribution		95% KM (z) UCL	14.82
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	16.37
Minimum	1.15	95% KM (bootstrap t) UCL	13.16
Maximum	18	95% KM (BCA) UCL	17.28
Mean	8.572	95% KM (Percentile Bootstrap) UCL	17.04
Median	4.51	95% KM (Chebyshev) UCL	24.71
SD	8.159	97.5% KM (Chebyshev) UCL	31.58
k star	0.587	99% KM (Chebyshev) UCL	45.08
Theta star	14.6		
Nu star	5.869	**Potential UCLs to Use**	
AppChi2	1.573	95% KM (t) UCL	16.59
95% Gamma Approximate UCL (Use when n >= 40)	31.98	95% KM (Percentile Bootstrap) UCL	17.04
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Note: DL/2 is not a recommended method.

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

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

For additional insight, the user may want to consult a statistician.

PROUCL OUTPUT - GROUNDWATER

Naphthalene

General Statistics			
Number of Valid Data	5	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	2
Number of Missing Values	1	Percent Non-Detects	40.00%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.0545	Minimum Detected	-2.91
Maximum Detected	0.169	Maximum Detected	-1.778
Mean of Detected	0.127	Mean of Detected	-2.18
SD of Detected	0.0629	SD of Detected	0.633
Minimum Non-Detect	0.2	Minimum Non-Detect	-1.609
Maximum Non-Detect	0.2	Maximum Non-Detect	-1.609

Warning: There are only 3 Distinct Detected Values in this data set

The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.

Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.

However, results obtained using 4 to 9 distinct values may not be reliable.

It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics			
Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.828	Shapiro Wilk Test Statistic	0.799
5% Shapiro Wilk Critical Value	0.767	5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.116	Mean	-2.229
SD	0.0469	SD	0.453
95% DL/2 (t) UCL	0.161	95% H-Stat (DL/2) UCL	0.225
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-2.18
		SD in Log Scale	0.516
		Mean in Original Scale	0.124
		SD in Original Scale	0.0535
		95% t UCL	0.175
		95% Percentile Bootstrap UCL	0.162
		95% BCA Bootstrap UCL	0.149
		95% H-UCL	0.28

Naphthalene (Continued)

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	N/A	Data appear Normal at 5% Significance Level	
Theta Star	N/A		
nu star	N/A		
A-D Test Statistic	N/A	Nonparametric Statistics	
5% A-D Critical Value	N/A	Kaplan-Meier (KM) Method	
K-S Test Statistic	N/A	Mean	0.127
5% K-S Critical Value	N/A	SD	0.0514
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.0363
		95% KM (t) UCL	0.204
Assuming Gamma Distribution		95% KM (z) UCL	0.187
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	0.212
Minimum	N/A	95% KM (bootstrap t) UCL	0.193
Maximum	N/A	95% KM (BCA) UCL	0.165
Mean	N/A	95% KM (Percentile Bootstrap) UCL	0.169
Median	N/A	95% KM (Chebyshev) UCL	0.285
SD	N/A	97.5% KM (Chebyshev) UCL	0.354
k star	N/A	99% KM (Chebyshev) UCL	0.488
Theta star	N/A		
Nu star	N/A	Potential UCLs to Use	
AppChi2	N/A	95% KM (t) UCL	0.204
95% Gamma Approximate UCL (Use when n >= 40)	N/A	95% KM (Percentile Bootstrap) UCL	0.169
95% Adjusted Gamma UCL (Use when n < 40)	N/A		

Warning: Recommended UCL exceeds the maximum observation

Note: DL/2 is not a recommended method.

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

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

For additional insight, the user may want to consult a statistician.

APPENDIX F

IDEM APPROVAL OF SWMU 25 RFI REPORT

-----Original Message-----
From: GRIFFIN, DOUG [mailto:DGRIFFIN@idem.IN.gov]
Sent: Thursday, September 25, 2014 8:48 AM
To: Brent, Thomas CIV NAVFAC MW, PWD Crane EV
Subject: RE: SWMU 25 RFI

OK, I've reviewed the report, which didn't take that long because I had already seen the original data back in 2012. This one just adds a well and samples four. The results verify what we suspected, that the higher metals concentrations are Penn coal seam hits. Add this one to the NFA list on the next permit mod.

And if I was a beancounter concerned about getting credit for things I would be asking why this data was collected in November of 2012 and the report came out in June of 2014.

-----Original Message-----
From: Brent, Thomas CIV NAVFAC MW, PWD Crane EV [mailto:thomas.brent@navy.mil]
Sent: Tuesday, September 23, 2014 8:57 AM
To: GRIFFIN, DOUG
Subject: SWMU 25 RFI

I know that you, like most of us, are swamped. However, if you can squeeze it in, I would really appreciate it if you could take a look at the SWMU 25 (H58 Dumpsite A) RFI report and give me some feedback before the end of the FY.