DEPARTMENT OF THE NAVY
CRANE DIVISION
NAVAL SURFACE WARFARE CENTER
300 HIGHWAY 361
CRANE, INDIANA 47522-5001

4-1-2009

IN REPLY REFER TO:
5090/54.7.5
Ser 0592/9105
20 MAY 2009

U.S. Environmental Protection Agency, Region V
Waste, Pesticides, & Toxics Division
Waste Management Branch
Corrective Action Section LU-9J
77 West Jackson Blvd.
Chicago, IL 60604

Dear Mr. Ramanauskas:

Crane Division, Naval Surface Warfare Center submits the Draft Corrective Measures Proposal (CMP) for McComish Gorge (McG), Solid Waste Management Unit 4. One copy is presented as enclosure 1 for your review and comment. The permit required Certification Statement is provided as enclosure 2.

If you require any further information, my point of contact is Mr. Thomas J. Brent, PRCR43, at 812-854-6160, email thomas.brent@navy.mil.

Sincerely,

J. M. Hunsicker
J. M. HUNSICKER
Environmental Protection Mgr
By direction of the Commander

Enclosures: 1. Draft McG CMP
2. Certification Statement

Copy to:
ADMINISTRATIVE RECORD
NAVFAC MW (Howard Hickey) (w/o encl)
IDEM (Doug Griffin)
TTNUS (Kim Turnbull) (w/o encl)

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

SIGNATURE

Environmental Protection Mgr
TITLE

05/12/09
DATE

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62472-03-D-0057

Rev. 0
4/09

Resource Conservation and Recovery Act Corrective Measures Proposal Report for SWMU 4 – McComish Gorge

Naval Surface Warfare Center Crane Division Crane, Indiana

Contract Task Order C065

April 2009

NAVFAC
Naval Facilities Engineering Command
Midwest
201 Decatur Avenue
Building 1A, Code EV
Great Lakes, Illinois 60088

TETRA TECH NUS, Inc.

RESOURCE CONSERVATION AND RECOVERY ACT
CORRECTIVE MEASURES PROPOSAL REPORT
FOR
SWMU 4 – McCOMISH GORGE

NAVAL SURFACE WARFARE CENTER
CRANE DIVISION
CRANE, INDIANA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Midwest
201 Decatur Avenue
Building IA, Code EV
Great Lakes, Illinois 60088

Submitted by:
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234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

CONTRACT NUMBER N62472-03-D-0057
CONTRACT TASK ORDER C065

APRIL 2009

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ACRONYMS

µg/L	Microgram per liter
bgs	Below ground surface
BRAC	Base Realignment and Closure
CAAA	Crane Army Ammunition Activity
CLEAN	Comprehensive Long-Term Environmental Action Navy
CMP	Corrective Measures Proposal
CMS	Corrective Measures Study
COC	Chemical of concern
COPC	Chemical of potential concern
CTO	Contract Task Order
HHRA	Human health risk assessment
HI	Hazard index
IAS	Initial Assessment Study
IDEM	Indiana Department of Environmental Management
IR	Installation Restoration
LUC	Land use control
MCL	Maximum Contaminant Level
MCS	Media Cleanup Standard
NAD	Naval Ammunition Depot
NAVFAC	Naval Facilities Engineering Command
NEESA	Naval Energy and Environmental Support Activity
NPW	Net present worth
NSWC	Naval Surface Warfare Center
PA	Preliminary Assessment
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SMCL	Secondary Maximum Contaminant Level
SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit

USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
WES	Waterways Experiment Station

1.0 INTRODUCTION

1.1 SCOPE AND OBJECTIVES

This Resource Conservation and Recovery Act (RCRA) Corrective Measures Proposal (CMP) Report was prepared for McComish Gorge at the Naval Surface Warfare Center (NSWC) Crane facility located in Crane, Indiana, for Naval Facilities Engineering Command (NAVFAC) Midwest under Contract Task Order (CTO) C065 of the Comprehensive Long-Term Environmental Action Navy (CLEAN) IV Contract Number N62472-03-D-0057. McComish Gorge is also known as Solid Waste Management Unit (SWMU) 4.

This CMP Report is part of the Navy Installation Restoration (IR) Program, which is designed to identify contamination from past operations at Navy and Marine Corps lands and facilities and to institute corrective measures, as needed. There are typically four distinct phases of work conducted for IR sites. Phase 1 is the Preliminary Assessment (PA) [formerly known as the Initial Assessment Study (IAS)]. Phase 2 is the RCRA Facility Assessment (RFA), which augments the information collected in the PA. Phase 3 is the RCRA Facility Investigation (RFI)/Corrective Measures Study (CMS), which characterizes the contamination at a facility and develops options for corrective action at the site. Phase 4 is the corrective measures implementation, which results in the control or cleanup of contamination at the site. This CMP Report was prepared under Phase 3 after completion of RFI activities.

The United States Environmental Protection Agency (USEPA) is the lead oversight agency for SWMU 4. This CMP Report was prepared in accordance with the requirements of the Indiana State RCRA Hazardous Waste Permit for NSWC Crane (IN5170023498), which went into effect on October 18, 2001.

The objectives of the CMP for SWMU 4 are as follows:

- Identify risk-based action levels for chemicals of concern (COCs) that are protective of human receptors and the environment.
- Develop corrective measures to protect human receptors and the environment.

1.2 PURPOSE OF THE CORRECTIVE MEASURES PROPOSAL

A CMP is a streamlined or focused approach to the CMS. The purpose of the CMP is to provide supporting documentation for the corrective measures proposed to remediate releases at a site, such as

SWMU 4, determined to have limited or simple environmental problems. Supporting documentation includes data and information that have been gathered during the IAS, RFA, and RFI.

A CMP instead of a CMS is appropriate for SWMU 4 based on the following:

- NSWC Crane is a fenced military installation controlled by the Navy.
- NSWC Crane was not included in the 2005 Base Realignment and Closure (BRAC) process and will remain a military installation for the indefinite future.
- Anticipated land uses are military (i.e., industrial).
- The only potential risks to human health are associated with the hypothetical future residential exposure scenario.
- There are no current or future unacceptable risks to ecological receptors.
- Residential land use occurs only in very limited areas of the facility, none of which are located within or adjacent to SWMU 4.

1.3 ORGANIZATION OF THE CORRECTIVE MEASURES PROPOSAL

This CMP Report consists of four sections. Section 1.0 is this introduction. Section 2.0 provides a description of previous investigations and presents the media cleanup standards (MCSs) for SWMU 4. Section 3.0 describes the corrective measures alternatives for SWMU 4. Section 4.0 provides a comparative analysis of the corrective measures alternatives.

1.4 FACILITY BACKGROUND INFORMATION

1.4.1 Facility Location

NSWC Crane is located in the southern portion of Indiana, approximately 75 miles southwest of Indianapolis and 71 miles northwest of Louisville, Kentucky, immediately east of Crane Village and Burns City (Figure 1-1).

NSWC Crane encompasses 62,463 acres (approximately 98 square miles). Most of the Crane facility is located in the northern portion of Martin County. Smaller portions are located in Greene, Daviess, and Lawrence Counties. NSWC Crane is located in a rural, sparsely populated area. Most of NSWC Crane is forested, and the surrounding area is wooded or farmed land.

NSWC Crane provides support for Navy equipment, shipboard weapons systems, and ordnance. In addition, NSWC Crane supports the Crane Army Ammunition Activity (CAAA) with production, renovation, storage, shipment, demilitarization, and disposal of conventional ammunition.

1.4.2 Facility History

This section provides general information on the history of NSWC Crane and its activities.

1.4.2.1 History of Ownership and Operation

In 1940, Congress authorized construction of a Naval Ammunition Depot (NAD) in southern Indiana. NAD Burns City was commissioned in late 1941. In 1943, NAD Burns City was renamed NAD Crane, and the Town of Crane was built to house the rapidly growing number of civil service employees. The overall mission of NAD Crane was to load, prepare, renovate, receive, store, and issue ammunition to the fleet.

During World War II, the mission of NAD Crane was expanded to include pyrotechnics production, mine filling, rocket assembly, field storage, torpedo storage, and ordnance spare parts and mobile equipment storage. During the 1950s, several new departments were created. The Ammunition Loading and Production Engineering Center was transferred to NAD Crane, and the Central Ammunition Supply Control Office was established. NAD Crane supplied ammunition to the fleet during the Korean and Vietnam Conflicts. During the Vietnam Conflict, the number of full-time employees at NAD Crane increased to 6,800.

In 1975, NAD Crane was redesignated Naval Weapons Support Center Crane. Its new mission was to provide support for ships, aircraft, equipment, shipboard weapons systems, and assigned ordnance items and to perform additional functions as directed.

In 1977, the Single Manager Concept was implemented, the CAAA was created, and the Army assumed ordnance production, storage, and related responsibilities as a tenant organization at Naval Weapons Support Center Crane. Other functions remained under Navy control. In 1992, the facility was redesignated as NSWC Crane. The Navy currently retains ownership of all real estate and facilities at

NSWC Crane. Responsibility for overall station safety, security, and environmental protection remains with the Commanding Officer, NSWC Crane. Approximately 3,600 people are currently employed at NSWC Crane.

1.4.2.2 History of Regulatory Actions

Following promulgation of the USEPA RCRA hazardous waste regulatory program, NSWC Crane filed notification and application to operate as a RCRA hazardous waste treatment, storage, or disposal facility in October 1980. Interim status was granted subject to the operating requirements and applicable technical standards in Title 40 of the Code of Federal Regulations, Part 265.

Corrective action programs established as part of the 1984 RCRA Hazardous and Solid Waste Amendments required NSWC Crane to address past releases of hazardous waste or hazardous constituents at SWMUs. Accordingly, NSWC Crane submitted a Hazardous Waste Management Report, and an RFA was conducted to characterize the potential for releases of hazardous waste or constituents from approximately 100 SWMUs identified during the RFA.

On December 23, 1989, USEPA issued the federal portion of the Final RCRA Part B permit for NSWC Crane to the Navy. USEPA renewed the permit in 1995. The Indiana Department of Environmental Management (IDEM) now has responsibility for the federal Corrective Action Program, and IDEM renewed the Corrective Action Permit on October 18, 2001.

1.5 SWMU 4 BACKGROUND INFORMATION

This section provides a summary of background information for SWMU 4. Additional details are provided in the RFI Report (TtNUS, 2005).

1.5.1 Site Description

SWMU 4 is a former waste disposal area that covers approximately 10 acres in the northwestern corner of NSWC Crane (Figure 1-1). The site is bounded on the north by Culpepper Branch and on the east by Highway 140 and Railroad 140. Jeep Trail 1 is located in the southern portion of the site. Almost 60 percent of the site is forested. The forested area occurs around the perimeter of the former disposal area. Transitional old field vegetation comprises most of the former disposal area and is dominated by grasses and forbs with scattered woody plant species. Areas along Jeep Trail 1 and Highway 140 are vegetated with maintained grass. Site features are shown on Figure 1-2.

1.5.2 Site History

SWMU 4 was used as a dump site for an unknown period between 1942 and 1972. Unknown amounts and types of garbage and trash, such as construction debris, office trash, plaster-filled warheads, and metal shavings, were buried in a gorge at the site. Reportedly, small arms ammunition may also have been buried at the site but was not encountered during the RFI.

1.5.3 Topography and Surface Drainage

The topography of the SWMU 4 area consists of undulating terrain dissected by many small drainageways (Figure 1-2). There is a steep wooded ridge located between Culpepper Branch and the former disposal area. Highway 140 and Railroad 140, the eastern site boundary, are at a higher elevation than the disposal area. The majority of the disposal area is an oval-shaped bowl with elevated sides, thus preventing any off-site surface water drainage from the portion of the site north of Jeep Trail 1.

An intermittent stream (drainage ditch) located south of the disposal area and Jeep Trail 1 flows eastward under Highway 140. It then flows north toward a small, bowl-shaped, marshy area where drainage is confined by elevated Highway 140 and the raised southern bank of Culpepper Branch.

Culpepper Branch flows from west to east past the site and discharges into Furst Creek. Wetland areas are located north of Culpepper Branch, northwest of the disposal area, and east of Highway 140. None of the wetlands are located within the disposal area.

1.5.4 Site Geology and Soil

Most of SWMU 4 is located in the dissected alluvial valley of Culpepper Branch. Unconsolidated deposits include alluvium in the floodplain along Culpepper Branch, glacial outwash along the southern border of the site, and residual soil derived from bedrock in the immediate SWMU area and farther south. Two geologic cross sections (A-A' and B-B') were developed during the RFI to illustrate the subsurface materials underlying SWMU 4 and the surrounding area. Figure 1-3 shows the locations of the generalized cross sections, and the cross sections are presented on Figures 1-4 and 1-5.

Subsurface materials include fill, natural unconsolidated materials, and bedrock. Fill that included glass, wood, metal, and plastic was encountered in the central portion of the site and extended to a maximum depth of 10 feet below ground surface (bgs). Natural unconsolidated materials representative of the alluvium, glacial outwash, and eroded bedrock underlie the fill and exist at the ground surface where fill is not present. The unconsolidated materials include varying amounts of clay, silt, and sand with lesser

amounts of gravel. Unconsolidated materials extend to at least 128 feet bgs, where bedrock was encountered in an exploratory boring (04C01). There is limited information on bedrock geology because only one well was installed in the bedrock, and well construction details are not known.

1.5.5 Site Hydrogeology

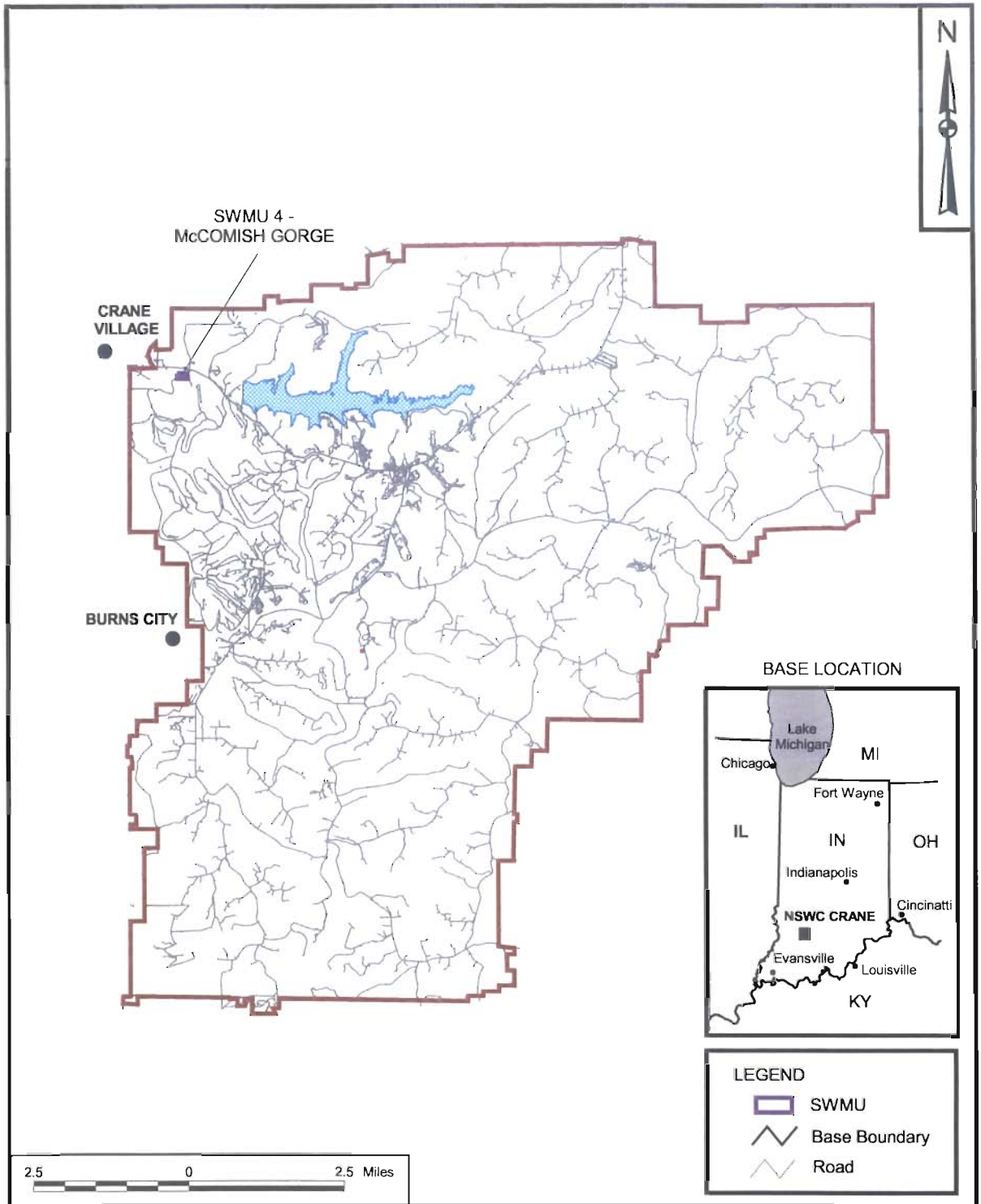
Depths to groundwater in the SWMU 4 area range from less than 5 feet bgs near Culpepper Branch and the marshy area east of Highway 140 to greater than 30 feet bgs in wells located at higher elevations to the south. Groundwater was encountered in the natural unconsolidated materials and bedrock but not in the fill. Shallow groundwater in the unconsolidated materials flows to the northeast and east toward Culpepper Branch and to the marshy area east of Highway 140, as shown on Figure 1-6.

1.5.6 Water Supply

Groundwater at SWMU 4 is not currently used and is not likely to be used in the future. Lake Greenwood, an 800-acre, man-made, spring-fed lake in the northwestern portion of the installation (Figure 1-1) is the main source of drinking water at NSWC Crane and is expected to remain as such in the future. Lake Greenwood is located approximately 1 mile east of SWMU 4.

1.5.7 Surrounding Land Use

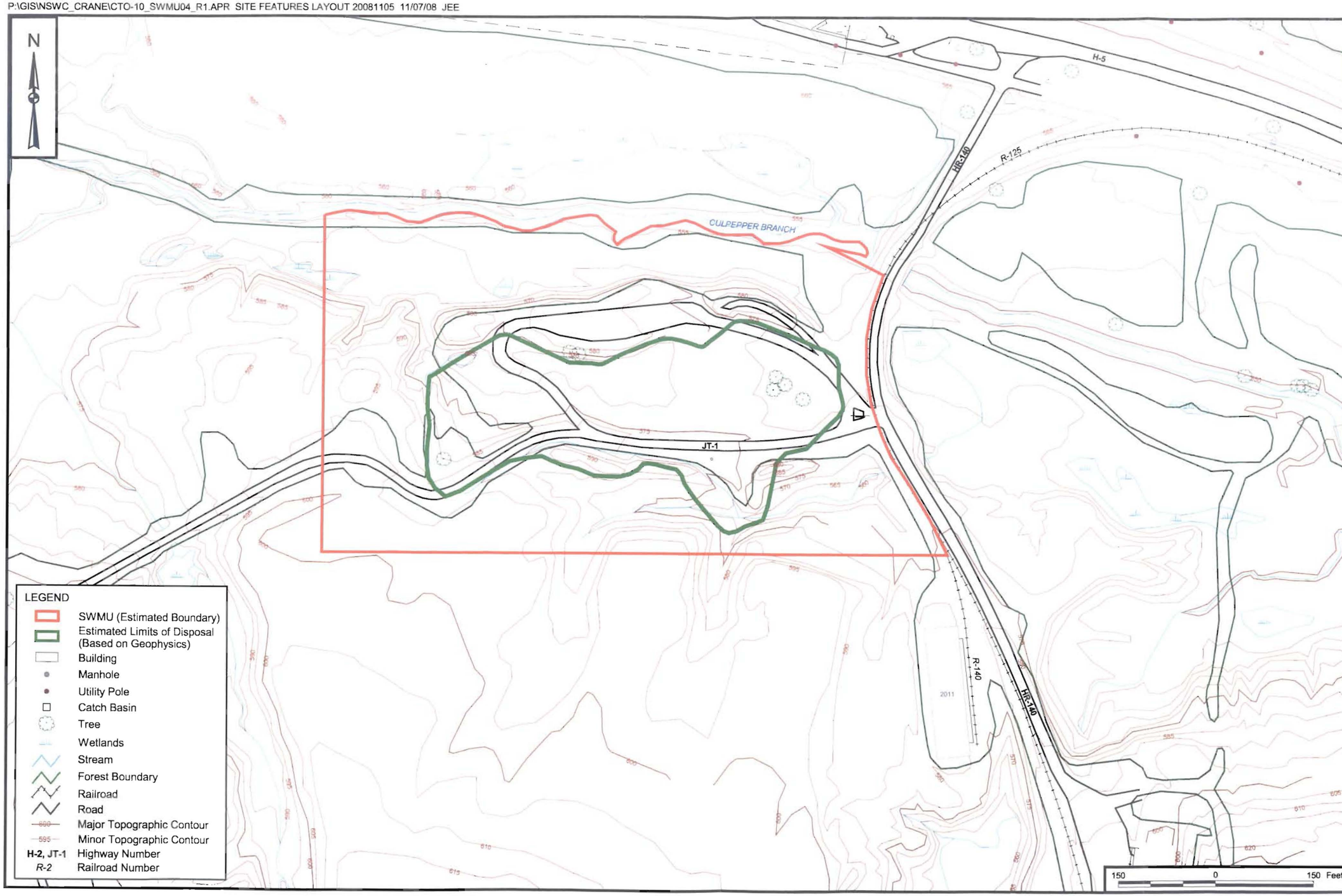
SWMU 4 is approximately 0.5 mile east of the nearest NSWC Crane property boundary. There are no known or likely future land use changes under consideration or proposed at this time for SWMU 4. SWMU 4 is contained completely within NSWC Crane, and likely future surrounding land use is expected to be limited to military/industrial uses.



DRAWN BY J. ENGLISH	DATE 11/05/08	SITE LOCATION MAP SWMU 4 - McCOMISH GORGE NSWC CRANE CRANE, INDIANA	CONTRACT NUMBER CTO C065
CHECKED BY K. TURNBULL	DATE 11/07/08		APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 1-1 / REV 0

P:\GIS\CRANE_NWSC\CRANE_REPORTFIGURES.APR SWMU 04 SITE LOCATION LAYOUT 11/07/08 JEE

P:\GIS\NSWC_CRANE\CTO-10_SWMU04_R1.APR SITE FEATURES LAYOUT 20081105 11/07/08 JEE



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CTO C065

APPROVED BY — DATE

APPROVED BY — DATE

DRAWING NO. FIGURE 1 - 2

REV –

SITE FEATURES
SWMU 4 - MCCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY J. ENGLISH — DATE 11/05/08

CHECKED BY K. TURNBULL — DATE 11/07/08

COST/SCHED-AREA

SCALE AS NOTED

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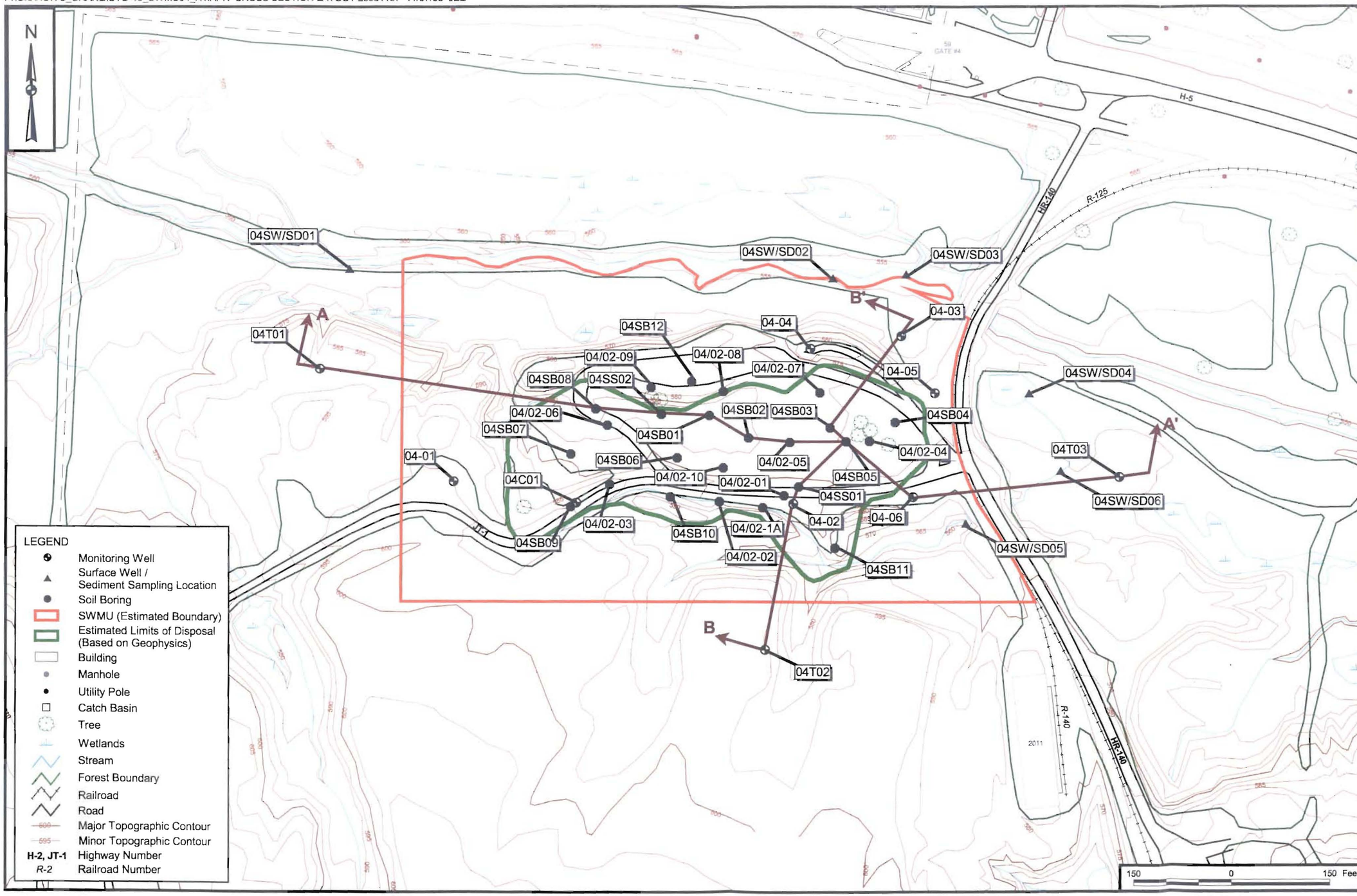


CONTRACT NO.
CTO C065

APPROVED BY ___ DATE ___

APPROVED BY ___ DATE ___

DRAWING NO. FIGURE 1 - 3

REV -

CROSS SECTION LOCATION MAP
SWMU 4 - MCCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

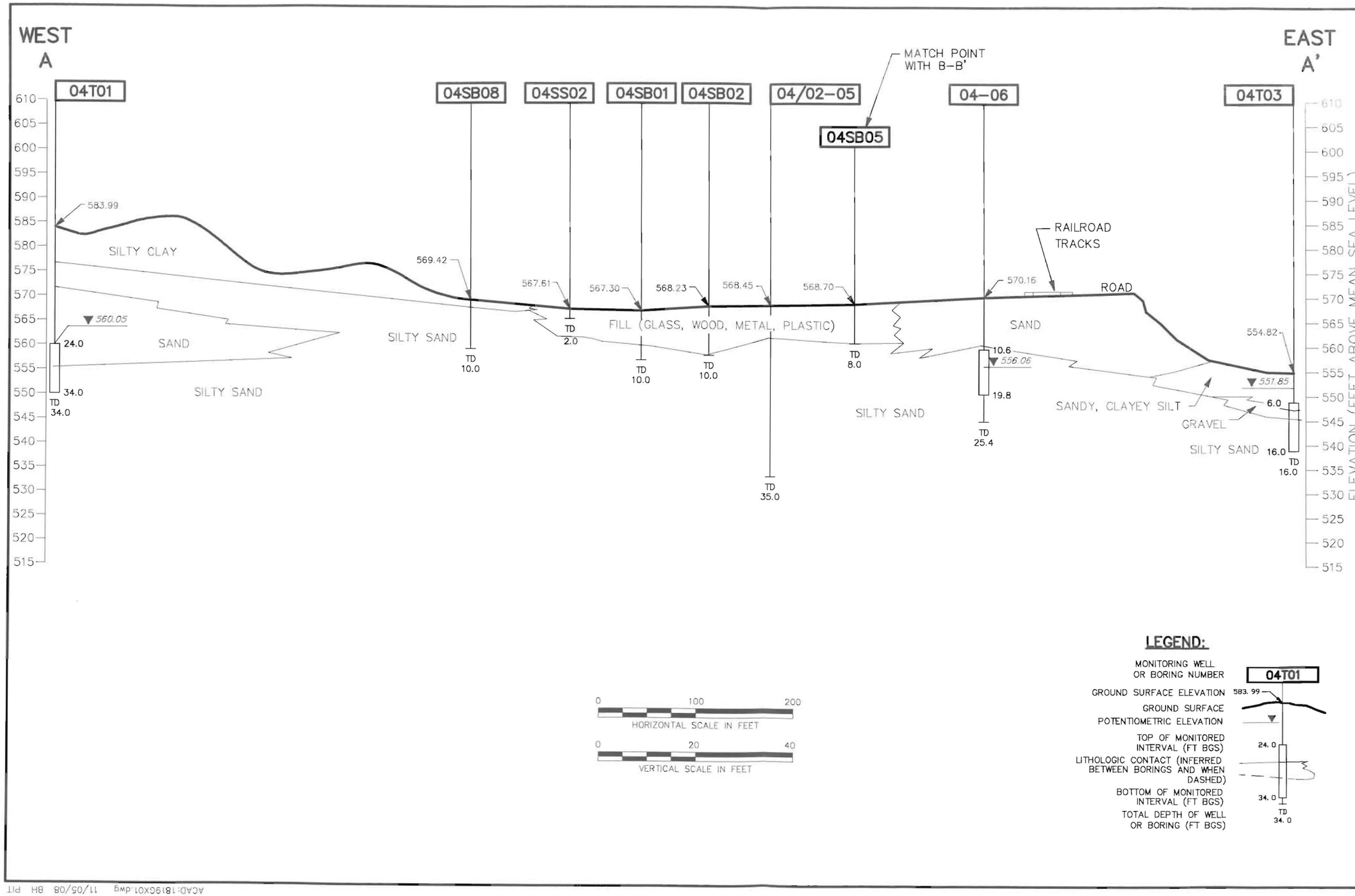
NAVFAC

DRAWN BY J. ENGLISH DATE 11/07/08

CHECKED BY K. TURNBULL DATE 11/07/08

COST/SCHED-AREA

SCALE AS NOTED



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APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 1-4

REV. 0

GEOLOGIC CROSS SECTION A-A'
SWMU 4 - MCCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

NAVFAC

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COST/SCHED-AREA

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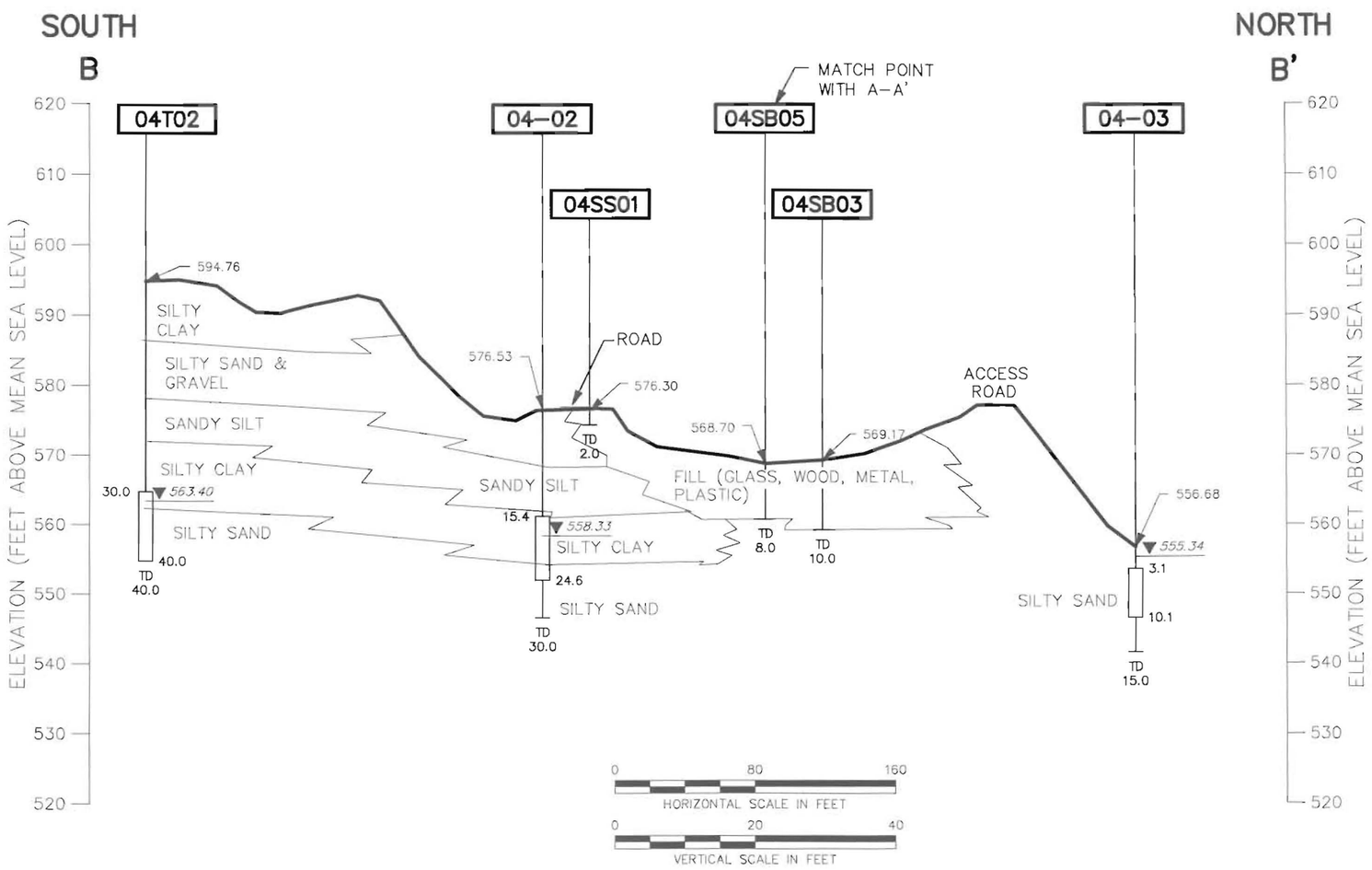

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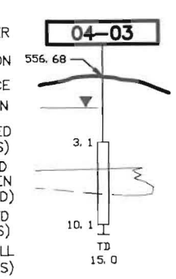

CONTRACT NO. CTO C065

APPROVED BY DATE

APPROVED BY DATE

DRAWING NO. FIGURE 1-5

REV. 0

GEOLOGIC CROSS SECTION B-B'
SWMU 4 - MCCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY BH DATE 11/5/08

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COST/SCHED-AREA

SCALE AS NOTED

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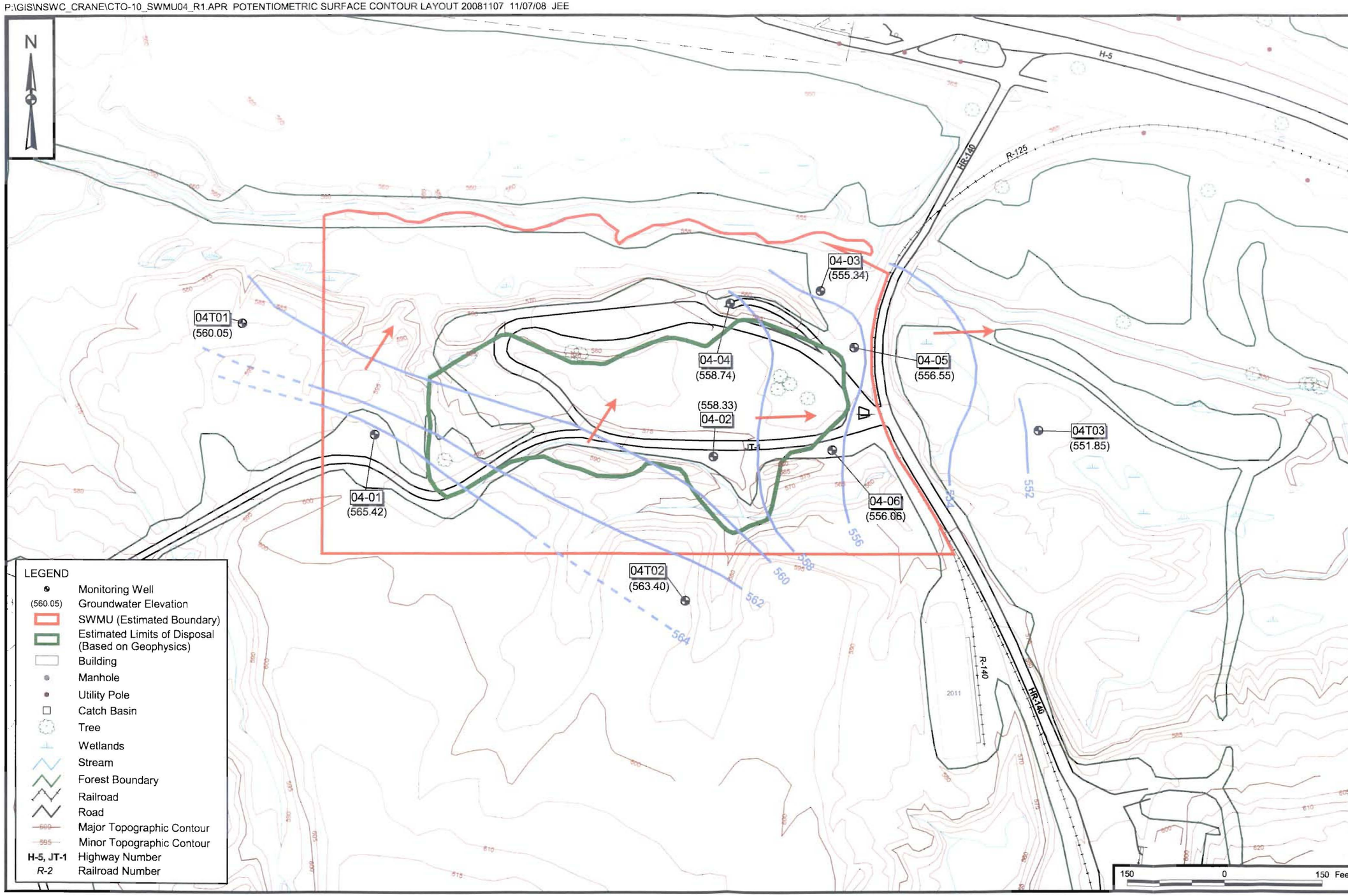

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CTO C065

APPROVED BY ____ DATE ____

APPROVED BY ____ DATE ____

DRAWING NO. FIGURE 1 - 6

REV ____

POTENTIOMETRIC SURFACE MAP (JANUARY 16, 2001)
SWMU 4 - MCCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY J. ENGLISH DATE 11/07/08

CHECKED BY K. TURNBULL DATE 11/07/08

COST/SCHED-AREA

SCALE AS NOTED

2.0 DESCRIPTION OF CURRENT CONDITIONS AND MEDIA CLEANUP STANDARDS

Various investigations and risk assessments have been conducted at SWMU 4. Section 2.1 describes the historical investigations that have resulted in identification of chemicals of potential concern (COPCs) and includes a summary of the nature and extent of contamination. Section 2.2 describes the conceptual site model for SWMU 4, Section 2.3 summarizes the results of the human health risk assessment (HHRA) conducted during the RFI, and Section 2.4 presents the MCSs. Based on investigations conducted to date, there are no unacceptable risks to ecological receptors; therefore, details of the ecological risk assessment are not discussed in this CMP Report.

2.1 PREVIOUS INVESTIGATIONS

Investigations were completed from 1981 to 1987 as part of several multi-site investigations. As part of the IAS (NEESA, 1983), six monitoring wells (04-01 through 04-06) were installed around the perimeter of SWMU 4 in 1981. Quarterly and semi-annual sampling of the wells was conducted from 1982 to 1986. Chemicals of interest included pesticides and several inorganics.

An RFI Phase II Soils Release Characterization was performed by the United States Army Corps of Engineers (USACE) Waterways Experiment Station (WES) in 1990 (USACE WES, 1998). Eleven soil borings were installed, and surface and subsurface soil samples were collected. Chemicals of interest detected in surface soil included a pesticide and several metals. Chemicals of interest detected in subsurface soil included a few explosives and several metals.

In 1991, USACE WES prepared a draft work plan for an RFI Phase III Groundwater Release Characterization. The proposed study included installation of new monitoring wells and sampling of new and existing wells. A geophysical investigation was also proposed but was not conducted. Because of funding constraints, only a portion of the planned work was conducted, and a Release Characterization Report was not prepared. Chemicals of interest detected in groundwater included volatile organic compounds (VOCs), pesticides, polychlorinated biphenyls (PCBs), and several inorganics.

The following sections present a summary of the contamination conditions based on RFI sampling conducted in 2001. Additional details can be found in the RFI Report (TtNUS, 2005). Because of uncertainties associated with data quality, historical data collected during the previous (pre-2001) investigations were not used to quantitatively assess potential risks at SWMU 4. The quality of the

historical data had not been adequately documented, and the data did not seem to have been validated. The 2001 field investigation was developed to be comprehensive and was partially based on the results of the previous investigations; therefore, the uncertainty associated with the elimination of historical data from the quantitative risk assessment was deemed to not be significant, as documented in the risk assessment work plan (TtNUS, 2000).

2.1.1 Soil

Geophysical surveys were conducted to estimate the horizontal extent of the disposal area. Twelve boreholes were drilled based on the results of geophysical surveys and to determine the site boundaries. From these boreholes, 12 surface soil samples were collected from 0 to 2 feet bgs, and 12 subsurface soil samples were collected from depths ranging from 2 to 10 feet bgs. Two additional surface soil samples were collected near surface debris. All soil samples were analyzed for VOCs, semivolatile organic compounds (SVOCs) (including polynuclear aromatic hydrocarbons [PAHs]), pesticides, PCBs, herbicides, metals, and cyanide. Samples were not analyzed for explosives because they were infrequently detected during the USACE Phase II Soils Release Characterization, and the detected concentrations were less than human health screening values.

COPCs for soil based on comparisons of detected concentrations to human health risk-based screening criteria included several SVOCs (all PAHs), one PCB, and several metals, as follows:

- SVOCs – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene
- PCB – Aroclor-1254
- Metals – antimony, arsenic, barium, cadmium, iron, and manganese

Based on the conclusions and recommendations from the RFI, no further action is required to address the detections of these chemicals in soil.

COPCs for soil based on comparisons of detected concentrations to screening levels based on migration to groundwater included one VOC, one pesticide, one herbicide, and several inorganics, as follows:

- VOC – methylene chloride
- Pesticide – delta-BHC
- Herbicide – pentachlorophenol
- Inorganics – antimony, arsenic, barium, cadmium, mercury, nickel, selenium, and cyanide

Arsenic was the only one of these COPCs detected in groundwater, and the detections of the other chemicals were determined not to be problematic. Based on the conclusions and recommendations from the RFI, no further action is required to address the detections of these chemicals in soil. Screening levels based on migration to groundwater are not available for iron and manganese, which were identified as COPCs for groundwater.

2.1.2 Groundwater

Nine groundwater samples were collected from six existing monitoring wells (04-01 through 04-06) and three new monitoring wells (04T01 through 04T03). All groundwater samples were analyzed for VOCs, SVOCs, pesticides, PCBs, herbicides, total metals, and cyanide. The sample from well 04T02 was also analyzed for dissolved metals because of elevated turbidity, which could bias the total metals results.

COPCs for groundwater based on comparisons of detected concentrations to human health risk-based screening criteria included only metals (aluminum, arsenic, iron, and manganese). The RFI recommended that a CMS be prepared to address the detection of these metals in groundwater.

2.1.3 Surface Water

Five surface water samples (04SW01 through 04SW05) were collected. Three samples were collected from Culpepper Branch, one sample was collected from a drainage ditch on the southern portion of the site west of Highway 140, and one sample was collected from a wetland area east of Highway 140. All surface water samples were analyzed for VOCs, SVOCs, pesticides, PCBs, herbicides, total and dissolved metals, and cyanide.

COPCs for surface water based on comparisons of detected concentrations to human health risk-based screening criteria included only metals (aluminum, arsenic, barium, and manganese). Based on the conclusions and recommendations from the RFI, no further action is required to address the detection of these metals in surface water.

2.1.4 Sediment

Six sediment samples (04SD01 through 04SD06) were collected. Three samples were collected from Culpepper Branch, one sample was collected from a drainage ditch on the southern portion of the site west of Highway 140, one sample was collected from a wetland area east of Highway 140, and one sample was collected from a drainage ditch discharging to the wetland. All sediment samples were analyzed for VOCs, SVOCs, pesticides, PCBs, herbicides, metals, and cyanide.

COPCs for sediment based on comparisons of detected concentrations to human health risk-based screening criteria included only metals (arsenic, iron, and manganese). Based on the conclusions and recommendations from the RFI, no further action is required to address the detection of these metals in sediment.

2.1.5 Summary of the Nature and Extent of Contamination

This section summarizes the extent of groundwater contamination. The RFI Report (TtNUS, 2005) concluded that no further action was required for soil, surface water, and sediment. Based on the results and conclusions presented in the RFI Report, the degree and extent of groundwater contamination is rather limited but somewhat unbounded. The primary contaminants are aluminum, arsenic, iron, and manganese. Figure 2-1 presents the concentrations of chemicals detected in groundwater during the 2001 RFI.

Aluminum was detected in one groundwater sample (well 04T02) at a concentration of 513 micrograms per liter (µg/L). This concentration was less than the human health risk screening level (3,600 µg/L) but greater than the USEPA Secondary Maximum Contaminant Level (SMCL) (50 to 200 µg/L). The SMCL is a non-enforceable guideline based on aesthetic qualities (e.g., color, taste, odor), not toxicity. Based on the groundwater flow direction (see Figure 1-6), well 04T02 is upgradient of the former disposal area, and the detection of aluminum is not expected to be site related.

Arsenic was detected in most groundwater samples at concentrations ranging from 0.15 to 3.6 µg/L. All detected concentrations were greater than the human health risk screening level (0.045 µg/L) but less than the USEPA Maximum Contaminant Level (MCL) of 10 µg/L.

Iron was detected in most groundwater samples at concentrations ranging from 198 to 33,300 µg/L. The greatest concentration was detected at the farthest downgradient location (well 04T03); however, the concentrations in wells 04-05 and 04-06, located between the disposal area and well 04T03, were much lower (379 and 198 µg/L, respectively). As a point of comparison, the concentrations at locations 04-01 and 04T02, which are upgradient of the disposal area, were 324 and 1,140 µg/L, respectively. These upgradient concentrations are similar to and greater than the concentrations detected at downgradient wells 04-05 (379 µg/L) and 04-06 (198 µg/L). The concentration in a sample collected from well 04-05 in 1982 was 32,300 µg/L (TtNUS, 2000), which is significantly greater than the concentration detected at this location in 2001 (379 µg/L). Based on the topography and groundwater flow direction (see Figure 1-6), groundwater at the farthest downgradient location would be expected to discharge to the

marshy area east of Highway 140. This would limit further downgradient contaminant migration beyond the marsh area.

Manganese was detected at five locations at concentrations ranging from 23.4 to 2,000 µg/L. The greatest concentration was detected at the farthest downgradient location (well 04T03); however, the concentrations in wells 04-05 and 04-06, located between the disposal area and well 04T03, were much less (40.6 and 29.2 µg/L, respectively). As a point of comparison, the concentration at location 04T02, which is upgradient of the disposal area, was 23.4 µg/L. The concentration in a sample collected from well 04-04 in 1992 was 12,800 µg/L (TtNUS, 2000), which is significantly greater than the concentration detected at this location in 2001 (1,920 µg/L). Based on the topography and groundwater flow direction (see Figure 1-6), groundwater at the farthest downgradient location would be expected to discharge to the marshy area east of Highway 140. This would limit further downgradient contaminant migration beyond the marsh area.

2.2 CONCEPTUAL SITE MODEL

Past disposal operations at SWMU 4 resulted in the release of VOCs, PAHs, one pesticide, one PCB, one herbicide, and metals to soil at concentrations of potential concern. Surface and subsurface soil contaminants can migrate to groundwater via infiltration, and groundwater can discharge to downgradient surface water bodies. Based on the results of surface water sampling, groundwater discharge has not adversely affected Culpepper Branch or other water bodies.

Surface soil contaminants can migrate to surface water and sediment via surface runoff. Site topography would prevent runoff from flowing into Culpepper Branch, but runoff could flow into the drainage ditch along Jeep Trail 1 and discharge to the wetland east of Highway 140.

There is no source of organic chemicals at SWMU 4 that is an ongoing source of groundwater, surface water, or sediment contamination. Metals are the only chemicals that have been detected at concentrations of potential concern in groundwater, surface water, and sediment. Arsenic and manganese were COPCs for soil, groundwater, surface water, and sediment. Barium was a COPC for soil and surface water, and iron was a COPC for soil, groundwater, and sediment.

2.3 HUMAN HEALTH RISK ASSESSMENT SUMMARY

An HHRA was performed using the data collected during the 2001 RFI to characterize the potential risks to likely human receptors under current and potential future land use. Potential receptors under current

land use are adolescent trespassers. Additional potential receptors under future land use are construction workers, maintenance workers, recreational users, and 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 primarily for decision-making purposes and to determine whether land use restrictions would be needed at SWMU 4.

The HHRA concluded that there were no unacceptable carcinogenic or non-carcinogenic risks associated with exposure to soil, surface water, and sediment for any current or future receptors. There were no unacceptable carcinogenic risks associated with exposure to groundwater for any of the receptors. The only unacceptable non-carcinogenic risks were for future child and adult residents that use groundwater as a source of drinking water. The noncancer hazard index (HI) was greater than 1 for arsenic (child – 1.2), iron (child – 5.3; adult – 1.5), and manganese (child – 8.9; adult – 2.6). The HHRA stated that the calculated risks may be biased high because maximum concentrations were used as exposure point concentrations (fewer than 10 groundwater samples were collected). This may result in an overestimation of risks because it assumes that future residents would be exposed to the maximum concentrations almost every day for 30 years. The HHRA also stated that the calculated risks may be biased high because the data suggest that the metals concentrations may be elevated because of suspended particulate matter in the samples. In addition, the concentrations of arsenic in most groundwater samples were less than or slightly exceeded the concentration in some of the upgradient wells, and it is possible that the concentrations of arsenic in groundwater are within naturally occurring levels. Although arsenic in groundwater poses a potential unacceptable risk, all detected concentrations were less than the USEPA MCL and IDEM Risk Integrated System of Closure default residential closure level of 10 µg/L.

The concentrations of the COCs (risk drivers) detected in groundwater are provided in Table 2-1.

2.4 MEDIA CLEANUP STANDARDS

Groundwater is the only medium of concern at SWMU 4. There are no unacceptable risks to human health, ecological receptors, or the environment associated with soil, surface water, and sediment. Groundwater COCs were identified in the RFI Report based on unacceptable risk. MCSs for groundwater, which are based on potential risks to the most sensitive receptor (i.e., child resident), are as follows:

- Iron – 6,280 µg/L
- Manganese – 225 µg/L

Calculations for risk-based MCSs are provided in Appendix A. The most recent data (2001) from wells with groundwater concentrations greater than MCSs are summarized in Table 2-2. Concentrations of COCs were greater than MCSs for monitoring wells 04-04 (manganese) and 04T03 (iron and manganese).

TABLE 2-1

ANALYTICAL RESULTS FOR GROUNDWATER CHEMICALS OF CONCERN - 2001
SWMU 4 - McCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

Chemical of Concern	04-01	04-02	04-03	04-04	04-05	04-06	04T01	04T02	04T03
Total Metals (µg/L)									
Iron	324	451 J	1370 J	4130	379 J	198 J	100 U	1140 J	33300 J
Manganese	15.0 U	15.0 U	114 J	1820 J	40.6 J	29.2 J	15.0 U	23.4 J	2000 J
Dissolved Metals (µg/L)									
Iron								121 J	

Blank cell indicates sample was not analyzed for this parameter.
µg/L - Micrograms per liter.
J - Estimated.
U - Not detected.

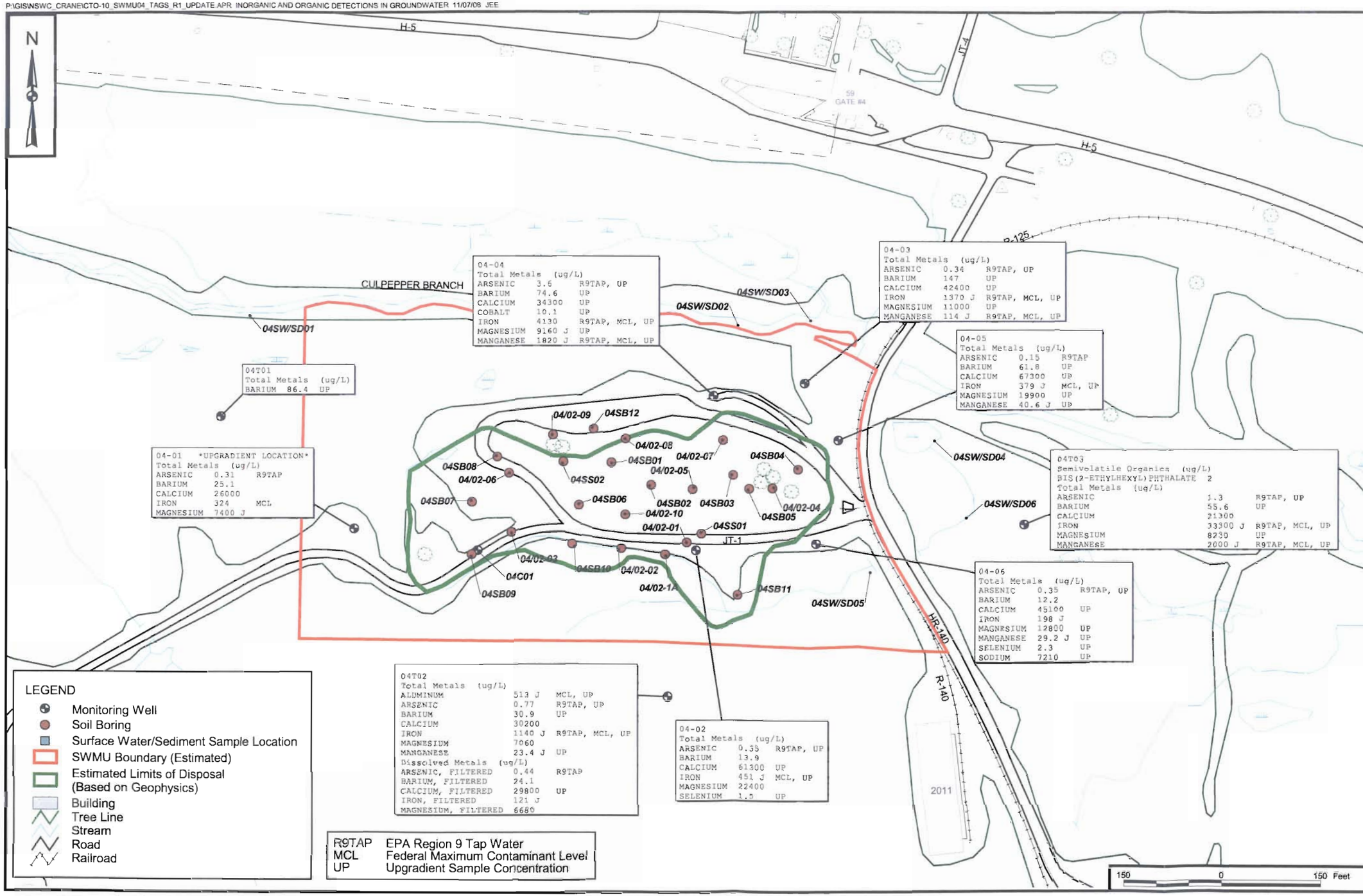
TABLE 2-2

SUMMARY OF EXCEEDANCES OF MEDIA CLEANUP STANDARDS - 2001
SWMU 4 – McCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

Location	Chemical of Concern	Concentration (µg/L)	Media Cleanup Standard (µg/L)
04-04	Manganese	1,820	225
04T03	Iron	33,300	6,280
	Manganese	2,000	225

µg/L Micrograms per liter.

P:\GIS\NSWC_CRANE\CTO-10_SWMU04_TAGS_R1_UPDATE.APR INORGANIC AND ORGANIC DETECTIONS IN GROUNDWATER 11/07/08 JEE



CONTRACT NO.
CTO C065

APPROVED BY ___ DATE ___

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DRAWING NO. FIGURE 2 - 1

REV 0

ORGANIC AND INORGANIC DETECTIONS
IN GROUNDWATER
SWMU 4 - McCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

NAVFAC

DRAWN BY K. PEILA DATE 05/08/02

CHECKED BY K. TURNBULL DATE 11/07/08

COST/SCHED-AREA

SCALE AS NOTED

3.0 CORRECTIVE MEASURES ALTERNATIVES

This section summarizes the corrective measures alternatives considered for SWMU 4. The following corrective measures were considered based on the information provided in Section 2.0:

- Alternative 1 – No Action
- Alternative 2 – Limited Action
- Alternative 3 – Complete Removal

3.1 ALTERNATIVE 1 – NO ACTION

No action would be conducted under Alternative 1. This alternative is used as a baseline for comparison with other alternatives.

3.2 ALTERNATIVE 2 – LIMITED ACTION

Alternative 2 would include natural attenuation, land use controls (LUCs), and 5-year reviews. A comparison of data collected during investigations in 1982 and 1992 to data collected for the 2001 RFI indicates that iron and manganese concentrations at some monitoring well locations are decreasing over time through natural attenuation (e.g., advection, hydrodynamic dispersion, dilution from recharge). LUCs would be implemented to ensure that contaminated groundwater is not used as a source of drinking water. There may be inherent risks from exposure to waste. LUCs would also be implemented to ensure that the former disposal area is not developed for residential purposes in the future.

Five-year site reviews would be conducted to verify the long-term reliability and effectiveness of this alternative and to provide direction for further corrective action, if deemed necessary.

3.3 ALTERNATIVE 3 – COMPLETE REMOVAL

Alternative 3 would include removal of waste, natural attenuation, LUCs, and 5-year reviews. Discrete samples of waste were not collected during the RFI. There may be inherent risks from exposure to waste, and the waste may be a source of ongoing groundwater contamination. However, this was not confirmed during the RFI. In accordance with Navy policy, this alternative was developed to compare the long-term costs of maintaining LUCs (Alternative 2) with the short-term costs of complete removal (Alternative 3).

All material in the former disposal area would be removed and transported off site for disposal, and the excavated area would be backfilled and revegetated. It may be possible to reduce the volume of material for off-site disposal by separating the waste from the soil. Based on current information, contaminated soil does not pose potential risks to human health or the environment. The separated waste would be transported for off-site disposal. The separated soil would need to be sampled to determine whether it would be acceptable for use as backfill. There are insufficient data to determine the relative volumes of waste and soil.

A comparison of data collected during investigations in 1982 and 1992 to data collected for the 2001 RFI indicates that iron and manganese concentrations at some monitoring well locations are decreasing over time through natural attenuation (e.g., advection, hydrodynamic dispersion, dilution from recharge). LUCs would be implemented to ensure that contaminated groundwater is not used as a source of drinking water.

Five-year site reviews would be conducted to verify the long-term reliability and effectiveness of this alternative and to provide direction for further corrective action, if deemed necessary.

4.0 CORRECTIVE MEASURES EVALUATION

This section evaluates the corrective measures alternatives presented in Section 3.0 and summarized in Table 4-1. The alternatives were evaluated using the following standards/criteria set forth in USEPA guidance on RCRA Corrective Action Plans (1994):

- Protection of human health and the environment.
- Attainment of MCSs.
- Control of the sources of releases.
- Compliance with any applicable standards for management of wastes.
- Other factors (long-term reliability and effectiveness, reduction in the toxicity, mobility, or volume of wastes, short-term effectiveness, implementability, and cost). Cost includes capital cost, annual costs, and net present worth (NPW).

Two additional criteria will also be evaluated when the required information is available prior to the selection and implementation of a corrective action. These are regulatory and community acceptance of the proposed alternative, as follows:

- Regulatory acceptance: The Navy will respond to comments and resolve issues with IDEM throughout the finalization of this CMP Report and other reports pertaining to the corrective measures selection and implementation process.

- Community acceptance: The Navy has established a Restoration Advisory Board (RAB) to provide updates to the community on the environmental activities at NSWC Crane. RAB members are notified prior to RAB meetings, which are scheduled on an as-needed basis. A website has been established to provide information on the current status of projects and corrective action decisions (http://www.crane.navy.mil/newscommunity/Envir_RAB_default.asp). Reports on environmental activities are also maintained as part of the NSWC Crane Administrative Record, and access to the reports is available on request to the NSWC Crane Environmental Department. The website and Administrative Record provide access to reports and will be used to obtain input from the local community on this CMP Report and other reports pertaining to the corrective measures selection and implementation process. The Statement of Basis, which will be generated following regulatory agency approval of this CMP Report, will be the official document of record in which the proposed corrective action is first made available to the public. The public will have the opportunity to comment

on the Statement of Basis, and the comments will be considered when selecting the final corrective measures for SWMU 4.

4.1 EVALUATION OF CORRECTIVE MEASURES ALTERNATIVES

4.1.1 Alternative 1 – No Action

4.1.1.1 Protection of Human Health and the Environment

Alternative 1 would not be protective of human health or the environment. There are no current users of groundwater; therefore, there are no unacceptable risks to current receptors. However, Alternative 1 would not prevent future use of groundwater as a source of drinking water, which could result in unacceptable risks to human health in the future. Alternative 1 would not limit development of the former disposal area, which could cause human exposure to buried waste materials in the future.

There is no evidence that migration of groundwater contaminants to surrounding surface water has resulted in unacceptable risks to human health or ecological receptors.

4.1.1.2 Attainment of Media Cleanup Standards

Alternative 1 would eventually attain MCSs.

4.1.1.3 Source Control

Alternative 1 would not include any source control.

4.1.1.4 Compliance with Waste Management Standards

No actions would be implemented under Alternative 1; therefore, no waste would be generated.

4.1.1.5 Other Factors

Long-Term Reliability and Effectiveness

Alternative 1 would not be reliable and effective in the long term because no action would occur. Groundwater contaminant concentrations would be expected to decrease as a result of natural attenuation processes. The potential threats to human health and the environment would remain because there would be no controls to prevent future groundwater use or exposure to waste.

Reduction in Toxicity, Mobility, or Volume of Wastes

Alternative 1 would not reduce the toxicity, mobility, or volume of wastes in the former disposal area. The toxicity and volume of contaminated groundwater would be expected to be reduced by natural attenuation. There would be no reduction in groundwater contaminant mobility.

Short-Term Effectiveness

Alternative 1 would involve no action and therefore would not pose any risks to on-site workers, the surrounding community, or the environment during remedy implementation.

Implementability

Because no action would occur, Alternative 1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable.

Cost

There are no costs associated with the no-action alternative.

4.1.2 Alternative 2 – Limited Action

4.1.2.1 Protection of Human Health and the Environment

Alternative 2 would be protective of human health and the environment. LUCs would protect human health by preventing exposure to contaminated groundwater. LUCs would also protect human health by preventing residential development of the former disposal area to prevent exposure to waste.

4.1.2.2 Attainment of Media Cleanup Standards

Alternative 2 would eventually attain MCSs for metals in groundwater through natural attenuation. Current site information does not allow an accurate prediction of the time required for natural attenuation to attain MCSs.

4.1.2.3 Source Control

Alternative 2 would not include any source control. A significant source of the iron and manganese detected in groundwater was not discovered during the RFI. Metal debris is present in the former disposal area; however, there are only a few subsurface soil sampling locations where the concentrations of iron and manganese exceeded NSWC Crane background concentrations. The soil boring and sampling locations were biased toward areas most likely to be contaminated.

4.1.2.4 Compliance with Waste Management Standards

Alternative 2 would not involve any removal or ex-situ treatment of contaminated groundwater. Periodic sampling activities would generate some waste (e.g., purge water) that would have to be properly disposed. The volume of waste would be very small, and waste management regulations would be easily met.

4.1.2.5 Other Factors

Long-Term Reliability and Effectiveness

Alternative 2 would be reliable and effective in the long term. Natural attenuation would be expected to reduce the concentrations of COCs detected in groundwater. LUCs would be reliable and effective in preventing potential exposure to contaminated groundwater and residential development of the former waste disposal area.

Reduction in Toxicity, Mobility, or Volume of Waste

Alternative 2 would not reduce the toxicity, mobility, or volume of wastes in the former disposal area. The toxicity and volume of contaminated groundwater would be expected to be reduced through natural attenuation. There would be no reduction in groundwater contaminant mobility.

Short-Term Effectiveness

Implementation of this alternative would not result in any short-term threats to on-site workers, the surrounding community, or the environment.

Implementability

Alternative 2 would be readily implementable. LUCs would be readily implementable because SWMU 4 is completed contained within NSWC Crane and would be similar to current LUCs at other environmental sites within NSWC Crane.

Alternative 2 could be implemented in less than 12 months. Current site information does not allow the accurate prediction of the time required for natural attenuation to attain MCSs.

Cost

The following costs are estimated for Alternative 2:

- Capital cost: $3,000
- Annual costs: $2,000 per year plus $15,000 every 5 years
- 30-Year NPW: $61,000

The above costs have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. Detailed cost estimates are provided in Appendix B.

4.1.3 Alternative 3 – Complete Removal

4.1.3.1 Protection of Human Health and the Environment

Alternative 3 would be protective of human health and the environment. Removal of all waste would eliminate a potential source of groundwater contamination. LUCs would protect human health by preventing exposure to contaminated groundwater as long as contaminant concentrations are greater than MCSs. LUCs to prevent future development of the waste disposal area would not be required.

4.1.3.2 Attainment of Media Cleanup Standards

Alternative 3 would eventually attain MCSs for metals in groundwater through natural attenuation. Current site information does not allow an accurate prediction of the time required for natural attenuation to attain MCSs. The time to attain MCSs under Alternative 3 would be expected to be shorter than for Alternative 2.

4.1.3.3 Source Control

Alternative 3 would remove all waste from the site.

4.1.3.4 Compliance with Waste Management Standards

All waste would be transported to an off-site, permitted, solid waste landfill.

4.1.3.5 Other Factors

Long-Term Effectiveness and Permanence

Alternative 3 would be reliable and effective in the long term. Waste would be permanently removed from the site. Natural attenuation would be expected to reduce the concentrations of COCs detected in groundwater. LUCs would be reliable and effectively prevent potential exposure to contaminated groundwater.

Reduction in Toxicity, Mobility, or Volume of Waste

Alternative 3 would remove the entire volume of waste from the site. The toxicity and volume of contaminated groundwater would be expected to be reduced through natural attenuation. There would be no reduction in groundwater contaminant mobility.

Short-Term Effectiveness

Excavation and off-site transport of wastes would have short-term impacts to the community, on-site workers, and the environment. Hauling wastes off site would generate additional traffic. Although there would be a potential for spills during transport, all materials would be solids that could easily be placed back into the transport container. Any dust that would be generated could be adequately controlled.

Short-term risks to on-site workers would be adequately controlled. Workers involved in excavation would undergo site-specific health and safety training and wear personal protective equipment to minimize potential risks.

Erosion and sediment controls would need to be installed before excavation begins to minimize potential risks to local streams associated with surface water runoff.

Implementability

Alternative 3 would be readily implementable. Waste excavation and off-site disposal are common remediation methods. There would be no excavation below the water table, so no dewatering and subsequent wastewater handling would be required. Excavation and off-site disposal could be implemented with common construction equipment and transportation methods. Personnel trained to excavate waste are readily available. Disposal capacity for the anticipated quantity of waste is available.

LUCs would be readily implementable because SWMU 4 is completed contained within NSWC Crane and would be similar to current LUCs at other environmental sites within NSWC Crane.

Alternative 3 could be implemented in less than 12 months. Current site information does not allow the accurate prediction of the time for natural attenuation to attain MCSs. The time to attain MCSs would be expected to be shorter than for Alternative 2 because Alternative 3 would remove a potential source of groundwater contamination.

Cost

The following costs are estimated for Alternative 3 and assume that all waste and soil will be removed from the disposal area:

- Capital cost: $6,759,000
- Annual costs: $2,000 per year plus $15,000 every 5 years
- 30-Year NPW: $6,817,000

The above costs have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. Detailed cost estimates are provided in Appendix B. It may be possible to reduce the waste volume and associated capital costs by separating the waste from the soil. Based on current information, contaminated soil does not pose potential risks to human health or the environment. The separated waste would be transported off site for disposal. The separated soil would need to be sampled to determine whether it would be acceptable for use as backfill. There are insufficient data to determine the relative volumes of waste and soil and the potential capital cost reduction.

4.2 CONCLUSIONS AND RECOMMENDATIONS

The following are the conclusions and recommendations of the CMP for the former disposal area and groundwater based on the conceptual site model and HHRA presented in Sections 2.2 and 2.3, respectively:

- Screening and detailed evaluations of alternatives to address unacceptable risks from ingestion of groundwater are not necessary because there are no current groundwater receptors and because all future exposure to groundwater can be prevented by LUCs. Residential development of the former disposal area can be prevented by LUCs.

- There are no unacceptable risks to human health associated with chemicals detected in soil in the waste disposal area. In accordance with Navy policy, waste removal was included as an alternative to compare the long-term costs of maintaining LUCs with the additional short-term costs of cleanup to unrestricted use.

- Alternative 2 is the recommended alternative. LUCs should be designed to prevent use of groundwater and residential development of the former disposal area.

TABLE 4-1

CORRECTIVE MEASURES EVALUATION PROCESS SUMMARY
SWMU 4 – McCOMISH GORGE
NSWC CRANE
CRANE, INDIANA

MEDIUM	INVESTIGATION STAGE			CORRECTIVE MEASURES EVALUATION PHASE		
	Document	Findings/Evaluation	Conclusions	Considerations	Evaluation/Conclusions	Remedy
Soil	RFI Report (TtNUS, 2005)	• No unacceptable risks to human health, ecological receptors, or the environment.	• No further action.	• No evaluation necessary.	• None required.	• No further action.
Waste	RFI Report (TtNUS, 2005)	• Discrete samples of waste not collected; soil samples biased toward probable waste locations.	• None.	• Possible inherent risks from exposure to buried waste; however, risk not confirmed during RFI. • Waste may be potential source of groundwater contamination; however, this was not confirmed during RFI.	• No unacceptable risks to current receptors were identified. • No action, limited action (land use controls), and complete removal were the only corrective measures evaluated. • Complete removal evaluated to compare long-term cost of maintaining land use controls to additional short-term cost of waste removal, in accordance with Navy policy. • Cost for complete removal much greater than cost for maintaining land use controls.	• Land use controls to prevent residential development of former disposal area.
Groundwater	RFI Report (TtNUS, 2005)	• Potential unacceptable risks for hypothetical residents from exposure to arsenic, iron, and manganese.	• Proceed to CMS	• Groundwater not used. • Groundwater contaminants not migrating to surface water at unacceptable concentrations. • Greatest iron and manganese concentrations detected in farthest downgradient well (04T03); however, well not sampled since 2001 when installed. • Greatest arsenic concentration less than MCL. • Topography and groundwater flow direction would likely inhibit groundwater contaminant migration beyond marshy area near farthest downgradient well (04T03). • Wells 04-05 and 04-06 located between former disposal area and farthest downgradient well (04T03) had lesser iron and manganese concentrations than well 04T03 in 2001. • Significant reductions in 2001 iron and manganese concentrations at wells where historical maximum concentrations were detected. For well 04-05, iron concentration decreased from 32,300 µg/L (1982) to 379 µg/L (2001). For well 04-04, manganese concentration decreased from 12,800 µg/L (1992) to 1,920 µg/L (2001)	• No unacceptable risks to current receptors were identified. • No action and limited action (land use controls and monitoring) were the only corrective measures evaluated.	• Land use controls to prevent use of groundwater.
Surface Water	RFI Report (TtNUS, 2005)	• No unacceptable risks to human health, ecological receptors, or the environment.	• No further action.	• No evaluation necessary.	• None required.	• No further action.
Sediment	RFI Report (TtNUS, 2005)	• No unacceptable risks to human health, ecological receptors, or the environment.	• No further action.	• No evaluation necessary.	• None required.	• No further action.

CMS Corrective Measures Study.
MCL Maximum Contaminant Level.
RCRA Resource Conservation and Recovery Act.
RFI RCRA Facility Investigation.
SWMU Solid Waste Management Unit.

REFERENCES

NEESA (Naval Energy and Environmental Support Activity), 1983. Initial Assessment Study of Naval Weapons Support Center, Crane, Indiana. NEESA 13-003. Port Hueneme, California.

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TtNUS, 2005. Resource Conservation and Recovery Act Facility Investigation Report for SWMUs 4 (McCornish Gorge), 5 (Old Burn Pit), 9 (Pesticide Control/R-150 Tank Area), and 10 (Rockeye), Naval Surface Warfare Center, Crane Division, Crane, Indiana. Prepared for Southern Division, Naval Facilities Engineering Command, North Charleston, South Carolina. Pittsburgh, Pennsylvania.

USACE WES (United States Army Corps of Engineers Waterways Experiment Station), 1991. Draft RCRA Facility Investigation Phase III Groundwater Work Plan for Naval Weapons Support Center, Crane, Indiana, Old Burn Pit and McCornish Gorge. Vicksburg, Mississippi.

USACE WES, 1998. RCRA Facility Investigation, Phase II Soils Release Characterization, SWMU 04/02, McCornish Gorge, NSWC Crane. Technical Report GL98-21, Vicksburg, Mississippi.

USEPA (United States Environmental Protection Agency), 1994. RCRA Corrective Action Plan (Final). Office of Waste Programs Enforcement, Office of Solid Waste, OSWER Directive 9902.3-2A, Washington, D.C.

APPENDIX A

DEVELOPMENT OF MEDIA CLEANUP STANDARDS

DEVELOPMENT OF MEDIA CLEANUP STANDARDS

The media cleanup standards (MCSs) for iron and manganese were based on the risk to a future child resident, the most sensitive receptor, using the following equation:

$$MCS = \frac{EPC \times MCS\ HI}{EPC\ HI}$$

Where:

MCS = Media cleanup standard

EPC = Exposure point concentrations (from RFI Report)

MCS HI = Hazard index for MCS (target is 1.0)

EPC HI = Hazard Index for EPC (from RFI Report)

The MCSs for COCs in groundwater are as follows:

COC	EPC (µg/L)	MCS HI	EPC HI	MCS (µg/L)
Iron	33,300	1.0	5.3	6,280
Manganese	2,000	1.0	8.9	225

The MCS is rounded to three significant figures (the same as the EPC).

APPENDIX B

COST ESTIMATES

CLIENT: NSWC CRANE - SWMU 4 CMP		JOB NUMBER: 112G01819.0000.1210	
SUBJECT: ALTERNATIVE 3 - COMPLETE REMOVAL			
BASED ON:		DRAWING NUMBER:	
BY: KCT Date: 4/16/09	CHECKED BY: TJR Date: 4/17/09	APPROVED BY:	DATE:

Captial Costs

Capital costs include planning documents, waste excavation, off-site transport and disposal, and site restoration.

Planning documents:

Health and Safety Plan (HASP)
Work Plan for excavation (incl. Erosion and Sediment Control Plan and Waste Mgmt. Plan)
Land Use Control Remedial Design (LUC RD)

Waste area and volume:

Area by planimeter (Fig. 2-1) = $(5.82\ in^2)(150\ ft/in)^2 = 130{,}950\ ft^2 = 3$ acres

Depth of fill ranges from 0 to 10 ft; assume 5 ft. average depth

Volume = $(130{,}950\ ft^2)(5\ ft)(yd^3/27\ ft^3) = 24{,}250\ yd^3$

Extent of excavation determined by visual inspection for waste; no verification samples required.

Area to be excavated is mostly grasses and shrubs with some trees.

Haul road not required. Road that can bear truck traffic adjacent to site.

Annual Costs

Annual costs would be the same as for Alternative 2 and include LUC inspections for 30 years.

Assume 1 person could conduct LUC inspection in 1 day.

Assume annual report needed to document results LUC inspection.

Five-year reviews would be required.

CLIENT: NSWC CRANE - SWMU 4 CMP		JOB NUMBER: 112G01819.0000.1210	
SUBJECT: ALTERNATIVE 2 - LIMITED ACTION (LAND USE CONTROLS)			
BASED ON:		DRAWING NUMBER:	
BY: KCT Date: 4/16/09	CHECKED BY: TJR Date: 4/17/09	APPROVED BY:	DATE:

Capital Costs

Capital costs associated include the following planning document:

Land Use Control Remedial Design (LUC RD)

Annual costs

Annual costs would include LUC inspections for 30 years.

Assume 1 person could conduct LUC inspection in 1 day.

Assume annual report needed to document results of LUC inspection.

Five-year reviews would be required.

CLIENT: NSWC CRANE		JOB NUMBER: 112G01819.0000.1210	
SUBJECT: SWMU 4 - McComish Gorge			
BASED ON:		DRAWING NUMBER:	
BY: TJR Date: 4-16-09	CHECKED BY: KCT Date: 4/17/09	APPROVED BY:	DATE:

Alternative 2: Limited Action (Land Use Controls)

Annual Cost

Site Inspection
Labor & Materials, per round
Assume 1 day for LUC inspection with 1 person

1 person @ $60.00 per hour for 10 hours per day for 1 day =	$600
car for 1 day =	$100
Per Diem @ $109 per day =	$109
Misc supplies, etc. =	$250
	$1,059

CLIENT: NSWC CRANE			JOB NUMBER: 112G01819.0000.1210
SUBJECT: SWMU 4 - McComish Gorge			
BASED ON:			DRAWING NUMBER:
BY: TJR Date: 4-16-09	CHECKED BY: KCT Date: 4/17/09		APPROVED BY: DATE:

Alternative 3: Complete Removal

Site Work

Excavation Time: assume based on transportation limits of 25 trucks per day

excavation/disposal volume	24,250	cy
	36,375	tons @ 1.5 ton/cy
	22	tons per truck
	1,653	trucks
	25	trucks per day
	66	days

assume backfill in one-half the time to excavate/dispose

33 days

Backfill Required:

backfill area	130,950	sf
	0.5	feet of topsoil
	65,475	cf of topsoil or
	2,425	cy of topsoil
fill needed	24,250	cy
	2,425	cy of topsoil
	21,825	cy of fill

Road Replacement:

600 feet long by 10 feet wide

60	ft
10	ft
600	sf or
67	sy

Time to complete:

Mob	5	days
Site Clearing	6	days
Excavation & Disposal	66	days
Backfill	33	days
Topsoil & Seed	10	days
Demob	5	days
	125	days
	25	weeks
	6	months

Annual Cost

Site Inspection

Same as Alternative 2

NAVAL SURFACE WARFARE CENTER CRANE
Crane, Indiane
SWMU 4 - McComish Gorge
Alternative 2: Limited Action (Land Use Controls)
Capitel Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Meteriel	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents, LUC RD	40	hr			$37.00		$0	$0	$1,480	$0	$1,480
Subtotal							$0	$0	$1,480	$0	$1,480
Local Area Adjustments							100.0%	102.8%	89.7%	89.7%	
							$0	$0	$1,328	$0	$1,328
Overhead on Labor Cost @ 30%									$398		$398
G & A on Labor Cost @ 10%									$133		$133
G & A on Material Cost @ 10%								$0			$0
G & A on Subcontract Cost @ 10%							$0				$0
Tax on Materials and Equipment 8%								$0		$0	$0
Total Direct Cost							$0	$0	$1,859	$0	$1,859
Indirects on Total Direct Cost @ 30%											$558
Profit on Total Direct Cost @ 10%											$186
Subtotal											$2,602
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$2,602
Contingency on Total Field Costs @ 10%											$260
Engineering on Total Field Cost @ 20%											$520
TOTAL COST											**$3,383**

NAVAL SURFACE WARFARE CENTER CRANE
Crane, Indiana
SWMU 4 - McComish Gorge
Alternative 2: Limited Action (Land Use Controls)
Annual Cost

Item	Item Cost Year 1 - 30	Item Cost every 5 years	Notes
Site Inspection	$1,059		Labor, field supplies, and per diem for 1 person/1 day
Report	$1,000		Document LUC site inspection
Site Review		$15,000	Five Year Site Reviews
TOTALS	$2,059	$15,000	

Site inspections would occur annually for years 1 through 30.

NAVAL SURFACE WARFARE CENTER CRANE
Crane, Indiana
SWMU 4 - McComish Gorge
Alternative 2: Limited Action (Land Use Controls)
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$3,383		$3,383	1.000	$3,383
1		$2,059	$2,059	0.935	$1,925
2		$2,059	$2,059	0.873	$1,798
3		$2,059	$2,059	0.816	$1,680
4		$2,059	$2,059	0.763	$1,571
5		$17,059	$17,059	0.713	$12,163
6		$2,059	$2,059	0.666	$1,371
7		$2,059	$2,059	0.623	$1,283
8		$2,059	$2,059	0.582	$1,198
9		$2,059	$2,059	0.544	$1,120
10		$17,059	$17,059	0.508	$8,666
11		$2,059	$2,059	0.475	$978
12		$2,059	$2,059	0.444	$914
13		$2,059	$2,059	0.415	$854
14		$2,059	$2,059	0.388	$799
15		$17,059	$17,059	0.362	$6,175
16		$2,059	$2,059	0.339	$698
17		$2,059	$2,059	0.317	$653
18		$2,059	$2,059	0.296	$609
19		$2,059	$2,059	0.277	$570
20		$17,059	$17,059	0.258	$4,401
21		$2,059	$2,059	0.242	$498
22		$2,059	$2,059	0.226	$465
23		$2,059	$2,059	0.211	$434
24		$2,059	$2,059	0.197	$406
25		$17,059	$17,059	0.184	$3,139
26		$2,059	$2,059	0.172	$354
27		$2,059	$2,059	0.161	$331
28		$2,059	$2,059	0.150	$309
29		$2,059	$2,059	0.141	$290
30		$17,059	$17,059	0.131	$2,235
				TOTAL PRESENT WORTH	**$61,273**

NAVAL SURFACE WARFARE CENTER CRANE
Crane, Indiana
SWMU 4 - McComish Gorge
Alternative 3: Complete Removal
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents, HASP	40	hr			$37.00		$0	$0	$1,480	$0	$1,480
1.2 Prepare Documents, LUC RD	40	hr			$37.00		$0	$0	$1,480	$0	$1,480
1.3 Prepare Documents, Work Plans	180	hr			$37.00		$0	$0	$6,660	$0	$6,660
2 SITE SUPPORT											
2.1 Site Superintendent	125	day			$450.00		$0	$0	$56,250	$0	$56,250
2.2 H & S; QA/QC Site Support	125	day			$400.00		$0	$0	$50,000	$0	$50,000
2.3 Labor, Common (3 laborers for 125 days)	375	day				$241.76	$0	$0	$0	$90,660	$90,660
2.4 Pick-up Truck (2 trucks for 125 days)	250	day				$110.00	$0	$0	$0	$27,500	$27,500
2.5 Sanitary Facilities	6	mo				$185.00	$0	$0	$0	$1,110	$1,110
2.6 Utilities (phones, water, etc.)	125	day				$31.00	$0	$0	$0	$3,875	$3,875
2.7 Decon Facilities - Materials	2	ea		$400.00			$0	$800	$0	$0	$800
2.8 Decon Facilities - Equipment (duration x # of pads)	250	day				$80.00	$0	$0	$0	$20,000	$20,000
2.9 Survey Support	5	day	$1,250.00				$6,250	$0	$0	$0	$6,250
3 SITE PREPARATION											
3.1 Stone Construction Entrance	2	ea		$1,100.00			$0	$2,200	$0	$0	$2,200
3.2 Clear Site, cut & chip trees	5	day				$296.20	$0	$0	$0	$1,491	$1,491
3.3 Mob/demob Equipment	4	ea			$122.00	$220.00	$0	$0	$468	$880	$1,368
4 SITE WORK											
4.1 Excavation (2 cubic yard bucket)	77	day			$304.80	$1,060.00	$0	$0	$23,470	$81,620	$105,090
4.2 Dozer, 140 hp	48	day			$304.80	$664.40	$0	$0	$14,630	$31,891	$46,522
4.3 Compactor, 200 hp	48	day			$304.80	$1,006.00	$0	$0	$14,630	$48,288	$62,918
4.4 Common Fill	21,825	cy		$21.00			$0	$458,325	$0	$0	$458,325
4.5 Top Dress Top Soil	2,425	cy		$25.00			$0	$60,625	$0	$0	$60,625
4.6 Grade & Seed Cover	14,550	sy		$0.42	$1.53	$0.29	$0	$6,111	$22,262	$4,220	$32,592
4.7 Road Replacement, geotextile	67	sy		$1.12		$0.03	$0	$75	$0	$2	$77
4.8 Road Replacement, 8" gravel	67	sy		$9.45		$0.46	$0	$633	$0	$31	$664
5 TRANSPORTATION & DISPOSAL											
5.1 T & D of Contaminated Soils	36,375	ton	$83.00				$3,019,125	$0	$0	$0	$3,019,125
Subtotal							$3,025,375	$528,769	$191,350	$311,568	$4,057,062
Local Area Adjustments							100.0%	102.8%	89.7%	89.7%	
							$3,025,375	$543,575	$171,641	$279,476	$4,020,067
Overhead on Labor Cost @ 30%									$51,492		$51,492
G & A on Labor Cost @ 10%									$17,164		$17,164
G & A on Material Cost @ 10%								$54,357			$54,357
G & A on Subcontract Cost @ 10%							$302,538				$302,538
Tax on Materials and Equipment 6%								$32,614		$16,769	$49,383
Total Direct Cost							$3,327,913	$630,547	$240,297	$296,245	$4,495,001
Indirects on Total Direct Cost @ 30%			(excluding transportation and disposal cost)								$442,763
Profit on Total Direct Cost @ 10%											$449,500

NAVAL SURFACE WARFARE CENTER CRANE
Crane, Indiana
SWMU 4 - McComish Gorge
Alternative 3: Complete Removal
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Subtotal											$5,387,264
Health & Safety Monitoring @ 2%											$107,745
Total Field Cost											$5,495,009
Contingency on Total Field Costs @ 20%											$1,099,002
Engineering on Total Field Cost @ 3%											$164,850
TOTAL COST											**$6,758,861**

NAVAL SURFACE WARFARE CENTER CRANE
Crane, Indiana
SWMU 4 - McComish Gorge
Alternative 3: Complete Removal
Annual Cost

Item	Item Cost Year 1 - 30	Item Cost every 5 years	Notes
Site Inspection	$1,059		Labor, field supplies, and per diem for 1 person/1 day
Report	$1,000		Document LUC site inspection
Site Review		$15,000	Five Year Site Reviews
TOTALS	$2,059	$15,000	

Site inspections would occur annually for years 1 through 30.

NAVAL SURFACE WARFARE CENTER CRANE
Crane, Indiana
SWMU 4 - McComish Gorge
Alternative 3: Complete Removal
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$6,758,861		$6,758,861	1.000	$6,758,861
1		$2,059	$2,059	0.935	$1,925
2		$2,059	$2,059	0.873	$1,798
3		$2,059	$2,059	0.816	$1,680
4		$2,059	$2,059	0.763	$1,571
5		$17,059	$17,059	0.713	$12,163
6		$2,059	$2,059	0.666	$1,371
7		$2,059	$2,059	0.623	$1,283
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9		$2,059	$2,059	0.544	$1,120
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11		$2,059	$2,059	0.475	$978
12		$2,059	$2,059	0.444	$914
13		$2,059	$2,059	0.415	$854
14		$2,059	$2,059	0.388	$799
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17		$2,059	$2,059	0.317	$653
18		$2,059	$2,059	0.296	$609
19		$2,059	$2,059	0.277	$570
20		$17,059	$17,059	0.258	$4,401
21		$2,059	$2,059	0.242	$498
22		$2,059	$2,059	0.226	$465
23		$2,059	$2,059	0.211	$434
24		$2,059	$2,059	0.197	$406
25		$17,059	$17,059	0.184	$3,139
26		$2,059	$2,059	0.172	$354
27		$2,059	$2,059	0.161	$331
28		$2,059	$2,059	0.150	$309
29		$2,059	$2,059	0.141	$290
30		$17,059	$17,059	0.131	$2,235
				TOTAL PRESENT WORTH	**$6,816,751**