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FINAL RESOURCE CONSERVATION AND RECOVERY ACT CORRECTIVE MEASURE STUDY REPORT FOR SOLID WASTE MANAGEMENT UNIT 11 (SWMU 11) OLD STORAGE BUILDING B-225 NSA CRANE IN

04/01/2016

TETRA TECH

Final
Resource Conservation and Recovery Act Corrective Measure Study Report

Solid Waste Management Unit 11 - Old Storage Building, B-225

Naval Support Activity Crane
Crane, Indiana

Naval Facilities Engineering Command
Mid-Atlantic
Contract Number N62470-08-D-1001
Contract Task Order F27R

April 2016

FINAL

RESOURCE CONSERVATION AND RECOVERY ACT CORRECTIVE MEASURE STUDY REPORT FOR SWMU 11 – OLD STORAGE BUILDING, B-225

NAVAL SUPPORT ACTIVITY CRANE
CRANE, INDIANA

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Mid-Atlantic
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Norfolk, Virginia 23511

Submitted by:
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ACRONYMS AND ABBREVIATIONS

µg/kg	Microgram per kilogram
bgs	Below ground surface
BRAC	Base Realignment and Closure
CAAA	Crane Army Ammunition Activity
CAO	Corrective Action Objective
CLEAN	Comprehensive Long-Term Environmental Action Navy
CMIP	Corrective Measure Implementation Plan
CMS	Corrective Measure Study
COC	Chemical of concern
CSM	Conceptual site model
CTO	Contract Task Order
DAF	Dilution attenuation factor
DCE	Dichloroethene
ERA	Ecological risk assessment
ERP	Environmental Restoration Program
HHRA	Human health risk assessment
HI	Hazard index
IDEM	Indiana Department of Environmental Management
ILCR	Incremental lifetime cancer risk
LUC	Land use control
LUCIP	Land Use Control Implementation Plan
LTM	Long-term monitoring
MCL	Maximum Contaminant Level
MCS	Media cleanup standard
mg/L	Milligram per liter
MNA	Monitored natural attenuation
NAD	Naval Ammunition Depot
NAVD88	North American Vertical Datum of 1988
NIRIS	Naval Installation Restoration Information Solution
NPW	Net Present Worth
NSA	Naval Support Activity
NSWC	Naval Surface Warfare Center
O&M	Operation and maintenance
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene

PCP	Pentachlorophenol
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
SAP	Sampling and Analysis Plan
SPLP	Synthetic precipitation leaching procedure
SSL	Soil screening level
SVE	Soil vapor extraction
SVOC	Semivolatile organic compound
SWMU	Solid Waste Management Unit
TCE	Trichloroethene
TOC	Total organic carbon
TCLP	Toxicity Characteristic Leaching Procedure
TSDF	Treatment, storage, or disposal facility
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
UST	Underground storage tank
VC	Vinyl chloride
VOC	Volatile organic compound

1.0 INTRODUCTION

This Resource Conservation and Recovery Act (RCRA) Corrective Measure Study (CMS) Report was prepared for the Old Storage Building, B-225, at Naval Support Activity (NSA) Crane, located in Crane, Indiana. The Old Storage Building, B-225, is also known as Solid Waste Management Unit (SWMU) 11 and is identified in Attachment 0 of the Indiana State RCRA Hazardous Waste Management Permit for the facility (IN5170023498) as SWMU 11/00 (IDEM, 2013). Tetra Tech, Inc., prepared this CMS Report under Contract Task Order (CTO) F27R of Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62470-08-D-1001.

1.1 SCOPE AND OBJECTIVES OF THE CORRECTIVE MEASURE STUDY

Indiana Department of Environmental Management (IDEM) is the lead regulatory agency for RCRA corrective actions at SWMU 11. This CMS Report was prepared to meet the requirements of the Indiana State RCRA Hazardous Waste Management Permit for NSA Crane (IN5170023498), which went into effect on October 18, 2001.

The corrective action requirements for SWMU 11 are being addressed as part of the Navy Environmental Restoration Program (ERP), which is designed to identify contamination from past operations at Navy and Marine Corps lands and facilities and to institute corrective measures as needed.

The purpose of the CMS is to develop and evaluate corrective action alternatives and to recommend the corrective measure(s) to be taken at the site. The RCRA Permit, Attachment 0, Tasks 6 to 8 and 9B address general requirements for a CMS. Tasks include identification and development of the corrective measure alternative(s) (Task 6), evaluation of the corrective measure alternative(s) (Task 7), and justification and recommendation of the corrective measure(s) (Task 8) for the site. The results of the evaluation and recommendation based on the results are provided in a CMS Report (Task 9B) for the site. Specific objectives of the CMS include the following:

- Identify Corrective Action Objectives (CAOs).

- Identify media cleanup standards (MCSs) for the site chemicals of concern (COCs) that are protective of human receptors and the environment based on the CAOs.

- Develop and evaluate corrective measure alternatives that satisfy the CAOs by protecting human receptors and the environment.

- Recommend a corrective measure alternative.

1.2 PURPOSE OF THE CORRECTIVE MEASURE STUDY REPORT FOR SWMU 11

This CMS Report was prepared to provide the results of the CMS for SWMU 11 to identify and recommend corrective measures for subsurface soil and groundwater contamination at SWMU 11.

As discussed further in Section 1.5.2, a 1976 fire at the Old Storage Building, B-225, resulted in a release of chemicals, paints, dyes, and solvents. Based on the results of the RCRA Facility Investigation (RFI) Report (Tetra Tech, September 2015), potential unacceptable human health risks were identified at SWMU 11 associated with the historical release that will be addressed by remedial alternatives in this CMS Report. Chlorinated volatile organic compounds (VOCs), arsenic, and iron in subsurface soil are greater than acceptable levels for potential migration to groundwater and are a potential concern if these chemicals migrate to groundwater and site groundwater is used for drinking. Chlorinated VOCs and benzene concentrations in groundwater exceed acceptable risk levels for drinking water and are a potential concern if site groundwater is used for drinking. Trichloroethene (TCE) concentrations in groundwater exceed acceptable levels for indoor air vapor exposure and are a potential concern if a building were constructed over the contaminated groundwater plume.

Based on these potential unacceptable risks and the following considerations, the evaluation of technologies and alternatives for addressing contamination at SWMU 11 focuses on long-term management (e.g., monitoring and land use controls [LUCs]) rather than active treatment of soil and groundwater:

- NSA Crane is a fenced military installation controlled by the Navy. NSA Crane was not included in the 2005 Base Realignment and Closure (BRAC) process and will remain a military installation for the foreseeable future.

- Current and anticipated future land uses at the site are military (i.e., industrial). Residential land use occurs only in very limited areas of the facility, none of which are located within or adjacent to SWMU 11.

- The source of contamination identified at SWMU 11 was a one-time historical release associated with the 1976 fire. Building 225 and its contents were destroyed by the fire, and operations at SWMU 11 were discontinued at that time. Following the fire, only the Building 225 concrete foundation remains.

- The building foundation isolates contaminated soil remaining under Building 225 from the environment; therefore, potential residual soil contamination under the concrete foundation of this building is not a source for migration to groundwater as long as the concrete foundation is intact. Alternative development considers the potential that soil could be a potential source to groundwater in the future if the building foundation is removed. At that time, the Navy, in consultation with IDEM, would determine whether additional action may be warranted for SWMU 11.

- Unique topography, geology, and hydrogeology prevent contaminated groundwater in bedrock at the site from migrating beyond the NSA Crane boundary. Low concentrations of VOCs detected in groundwater near the site boundary indicate that the extent of contaminated groundwater at the site is stable. Based on ground elevation decreases to the west, groundwater is expected to be expressed as seeps downgradient of SWMU 11. An adverse impact from groundwater to surface water or seeps has not been identified based on the low groundwater concentrations at the site boundary.

1.3 ORGANIZATION OF THE CORRECTIVE MEASURE STUDY REPORT

This CMS Report consists of four sections. Section 1.0 is this introduction. Section 2.0 provides the results of the identification and development of corrective measure alternatives and includes a description of current conditions based on previous investigations and the conceptual site model (CSM); develops CAOs, including specifying the MCSs for SWMU 11; and provides the results of the screening of corrective measure technologies and identification of corrective measure alternatives developed for SWMU 11. Section 3.0 provides an evaluation of each corrective measure alternative, and Section 4.0 provides a comparative analysis of alternatives and justification and recommendation of corrective measures for SWMU 11. Appendix A provides the cost estimates for the corrective measure alternatives and the supporting calculations (e.g., soil area/volume) for the alternatives, as applicable.

1.4 FACILITY BACKGROUND INFORMATION

1.4.1 Facility Location

NSA Crane encompasses 62,463 acres (approximately 98 square miles) in the southern portion of Indiana, approximately 75 miles southwest of Indianapolis, Indiana, and 71 miles northwest of Louisville, Kentucky, immediately east of Crane Village and Burns City (Figure 1-1). Most of the NSA Crane facility is located in the northern portion of Martin County, and smaller portions are located in Greene, Daviess, and Lawrence

Counties. NSA Crane is located in a rural sparsely populated area. Most of NSA Crane is forested, and the surrounding area is wooded or farmed land.

NSA Crane provides support for Navy equipment, shipboard weapons systems, and ordnance. In addition, NSA 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 NSA Crane and its activities.

1.4.2.1 History of Ownership and Operation

In 1940, Congress authorized construction of the Naval Ammunition Depot (NAD) in southern Indiana, and NAD Burns City was commissioned in 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 Naval Surface Warfare Center (NSWC) Crane. Under a new command structure of the Navy Region Midwest (now Mid-Atlantic), NSA Crane was established. CAAA and NSWC Crane are two of the tenant commands located at NSA Crane.

NSA Crane's more than 4,000 civilian and contractor employees provide comprehensive support for complex military systems spanning development, deployment, and sustainment in three mission areas, Electronic Warfare/Information Operations, Special Missions, and Strategic Missions. The Navy currently retains ownership of all real estate and facilities at NSA Crane. Responsibility for overall safety, security, and environmental protection remains with the Commanding Officer, NSA Crane.

1.4.2.2 History of Regulatory Actions

Following promulgation of the United States Environmental Protection Agency's (USEPA's) RCRA hazardous waste regulatory program, NSWC Crane filed notification and application in October 1980 to operate as a RCRA hazardous waste treatment, storage, or disposal facility (TSDF). 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 a RCRA Facility Assessment (RFA) was conducted to characterize the potential for releases of hazardous wastes or constituents from approximately 100 SWMUs identified during the RFA.

In December 1989, USEPA issued the federal portion of the Final RCRA Part B permit for NSWC Crane to the Navy. USEPA and IDEM renewed the RCRA Part B permit in 1995, and modifications have been made as necessary with the approval of IDEM, who is authorized to administer the RCRA Corrective Action Program.

1.5 SWMU 11 BACKGROUND INFORMATION

This section provides a summary of background information for SWMU 11. Additional details are provided in the RFI Report (Tetra Tech, September 2015).

1.5.1 Site Description

SWMU 11 is located in an industrial area near the western boundary of NSA Crane, approximately midway between the northern and southern boundaries of the facility (Figure 1-1). It is located on the northwestern side of Highway 101 (Figure 1-2) approximately 0.5 mile north of the intersection of Highway 101 and Highway 45. SWMU 11 is approximately 1 acre in size and includes the former Building 225 concrete floor (slab) and loading dock and grass and asphalt-paved areas immediately surrounding the slab (Figure 1-2). An active railroad siding spur and drainage ditch are located along the western portion of the SWMU. In addition, active railroad tracks border the western boundary of the SWMU (Figure 1-3).

The drainage ditch captures surface water runoff from the site and flows toward the entrance of a culvert located in the northeastern portion of the SWMU (Figure 1-3). The culvert conveys water approximately 200 feet to the west under the railroad tracks and Building 2720 and then discharges to a drainage channel (Figure 1-3). The drainage channel is a natural stream that eventually flows into the upper reaches of Broom Branch approximately 1,000 feet northwest of the site (Figure 1-1). Broom Branch ultimately discharges to Furst Creek, which flows to the west beyond the NSA Crane boundary (Figure 1-1).

A fuel oil underground storage tank (UST) was located within the SWMU 11 boundary approximately 40 feet southwest of former Building 225 (Figure 1-3). The UST was 24 feet long and 5.5 feet in diameter and was installed by partially excavating the ground and then placing soil over the UST to create a mound approximately 3 to 5 feet above the ground. No records have been located regarding removal of this UST; however, no visible evidence (i.e., mounding) of the UST was observed during RFI activities. It is presumed that the tank was removed during the demolition of Building 225 shortly after the fire.

Other areas outside of the Building 225 location that might have been potentially impacted by the fire were identified in the SWMU 11 RFI Report (Tetra Tech, September, 2015). Four areas ranging in distance of 200 to 1,200 feet southwest and northeast of former Building 225 were identified because of potential contamination from smoke particulates carried from the 1976 fire. These four areas are referred to as downwind areas and are shown on Figure 1-4. An additional area is the Building 2981 concrete tank area located approximately 1 mile southwest of former Building 225 (Figure 1-4). This area consists of a former concrete tank that is believed to have received firefighting water that had accumulated in the drainage ditch adjacent to the Building 225 loading dock. The water was pumped from the drainage ditch and then transported to the Building 2981 concrete tank for later disposal because the water had the potential to be contaminated. As discussed in Section 2.2, these other areas were investigated during the RFI and found not to be of concern.

There are no known historical or cultural concerns, such as Native American burial grounds or historic landmarks, within or in the vicinity of the site.

1.5.2 <u>Site History</u>

SWMU 11 was formerly occupied by Building 225, which was used for storage of approximately 50,000 gallons of paints, approximately 500 pounds of sodium fluorescein dye, approximately 5,000 gallons of solvents [acetone, toluene, methyl ethyl ketone, TCE, and tetrachloroethene (PCE)], over 70,000 pounds of pentachlorophenol (PCP), and various other items including inert materials such as inks, staples, and wax paraffin.

On July 13, 1976, Building 225 and its contents were destroyed by a fire that was attributed to deterioration of storage containers that allowed contents to seep out onto cardboard containers and wooden pallets, causing spontaneous ignition. Following the fire, the remaining debris and residue from the Building 225 site were removed and disposed of off-site.

The NSA Crane Fire Department pumped more than 600,000 gallons of water onto the blaze, which flushed chemicals directly onto surface soil at the site. The water runoff was colored a brilliant fluorescent green because of the fluorescein dye stored in Building 225. Some of the firefighting water that accumulated in the drainage ditch on the western side of the site, adjacent to the Building 225 loading dock, was pumped and transported to the Building 2981 concrete tank, located approximately 1 mile southwest of SWMU 11 (Figure 1-1). However, most of the water from firefighting activities that entered the drainage ditch flowed through the drainage culvert to the drainage channel where it discharged into Broom Branch. Temporary dams were placed in Broom Branch to contain and sample the water before allowing the water to be released into Furst Creek.

1.5.3 Topography and Surface Drainage

The topography of SWMU 11 and immediate surrounding area is relatively flat. The surface elevation of the former Building 225 slab is 685 feet [North American Vertical Datum of 1988 (NAVD88)]. The ground surface at the site slopes gently from northeast to southwest with elevations ranging from 688 (northeast) to 683 (southwest) feet. The elevation of the drainage ditch is approximately 675 feet, and elevations in the drainage channel west of SWMU 11 decrease downstream to 670 and 660 feet. Figure 1-4 shows the topographic contours.

Site surface water runoff flows either to the drainage ditch or onto Highway 101. Drainage from Highway 101 in areas north of SWMU 11 also flows to the drainage ditch and then is conveyed off site via the drainage culvert. Section 1.5.1 describes the flow path of surface water runoff after it exits SWMU 11.

1.5.4 Site Geology and Soil

The soil below SWMU 11 is identified as a member of the Zanesville-Udorthents Complex in the Soil Survey of Martin County, Indiana, published by the United States Department of Agriculture (USDA) Natural Resource Conservation Service (September 1988). Zanesville-Udorthents soil is described as gently sloping, shallow to deep, well drained and moderately well drained soil. Udorthents are soils that have been affected by construction activities such as those at SWMU 11. This silt loam has low organic matter, moderate permeability, and moderate surface runoff. Near the top of bedrock, the soil is a friable silt loam. These soil descriptions are generally consistent with the surface and subsurface soils observed at

SWMU 11 during RFI activities. In general, SWMU 11 soils were described as brown to gray silty clays grading to a thin layer of fine sand with clay, interpreted as weathered sandstone, at the top of bedrock.

Bedrock at SWMU 11 is mapped as the Lower Pennsylvanian-age Mansfield formation of the Raccoon Creek Group, which is overlain by thin Quaternary-age deposits. The Mansfield formation consists of alternating beds of dark shale, sandstone, mudstone, siltstone, and discontinuous coal units. Based on boring logs from monitoring well borings advanced during the RFI at SWMU 11, the top of bedrock was encountered from 6.7 (18CMWT001) to 17 (11MWT05) feet below ground surface (bgs). The bedrock at SWMU 11 is 2 to 3 feet of orange to brown weathered sandstone or gray siltstone (11MWT02) underlain by gray to brown silty sandstone and gray siltstone with an average thickness of about 7 feet. This sandstone unit was often dry with a few minor fractures. Below the gray to brown silty sandstone unit are laminated units of (in order of depth) gray siltstone and/or shale, silty sandstone, siltstone and shale, and brown sandstone. Discontinuous coal layers were encountered at several locations. All of the monitoring wells are screened in these laminated units, which are highly fractured. Two geological cross sections, A-A' and B-B', were developed during the RFI to illustrate the subsurface materials underlying SWMU 11. A cross section location map is presented as Figure 1-5, and cross sections A-A' and B-B' are presented as Figures 1-6 and 1-7, respectively.

1.5.5 Site Hydrogeology

The groundwater at NSA Crane is divided into two distinct regimes, one associated with the overburden/unconsolidated material and one associated with bedrock. The shallow groundwater is probably transient; during periods of prolonged rainfall and during the early spring months, there is probably saturated soil and free water above the soil-rock interface. The shallow groundwater dissipates by percolation into bedrock and into intermittent or perennial streams. The groundwater associated with bedrock is stable, and groundwater levels probably fluctuate only a minor amount (less than 10 feet) per year. Possibly more than one zone of saturation exists in the bedrock due to the successive beds of sandstone, shale, and, limestone. The shale beds should be the least permeable of the series, and where they underlie a permeable sandstone or limestone, they would support a saturated or free-water zone. These shale zones grade laterally to zones of sandstone, so the downward percolating water would be free to move continually downward (NEESA, May 1983).

Groundwater at SWMU 11 was encountered within bedrock and likely travels through an interconnected network of fractures within the laminated shale, siltstone, and sandstone units. Groundwater was not encountered in the overburden at SWMU 11. Wet zones were observed immediately above bedrock in two borings (11MWT03 and 11MWT04); however, these zones were discontinuous and considered localized, thin, perched zones.

Groundwater flow at SWMU 11 is to the west with a hydraulic gradient of approximately 0.13. Groundwater would generally be discharged as seeps before reaching the NSA Crane boundary. Aquifer testing was not conducted at SWMU 11, but estimates of bulk hydraulic conductivity were calculated during the RFI for SWMU 8 - Building 106 Pond (Tetra Tech, June 2008) located approximately 500 feet east of SWMU 11. The median bulk hydraulic conductivity for the upper groundwater zone at SWMU 8 was 6.6 feet per day.

1.5.6 Water Supply

Groundwater beneath SWMU 11 is not currently used for any purpose, and there are no plans to use the groundwater in the future. Greenwood Lake, an 800-acre lake in the northern portion of NSA Crane (Figure 1-1), is the main source of drinking water at NSA Crane and is expected to remain as such in the future. Greenwood Lake is located more than 2.5 miles from SWMU 11.

1.5.7 Surrounding Land Use

SWMU 11 is currently vacant and not used by NSA Crane; but land use at SWMU 11 is designated as military/industrial, and this designation is not expected to change in the future. Current use of the areas surrounding SWMU 11 is military/industrial and is expected to remain the same in the future. Active railroad tracks bound SWMU 11 to the west, and several non-residential buildings are located to the east, south, and west of the site, as shown on Figure 1-2. The nearest residence to SWMU 11 is located off base, just over 1 mile southwest of SWMU 11 in the Town of Burns City.

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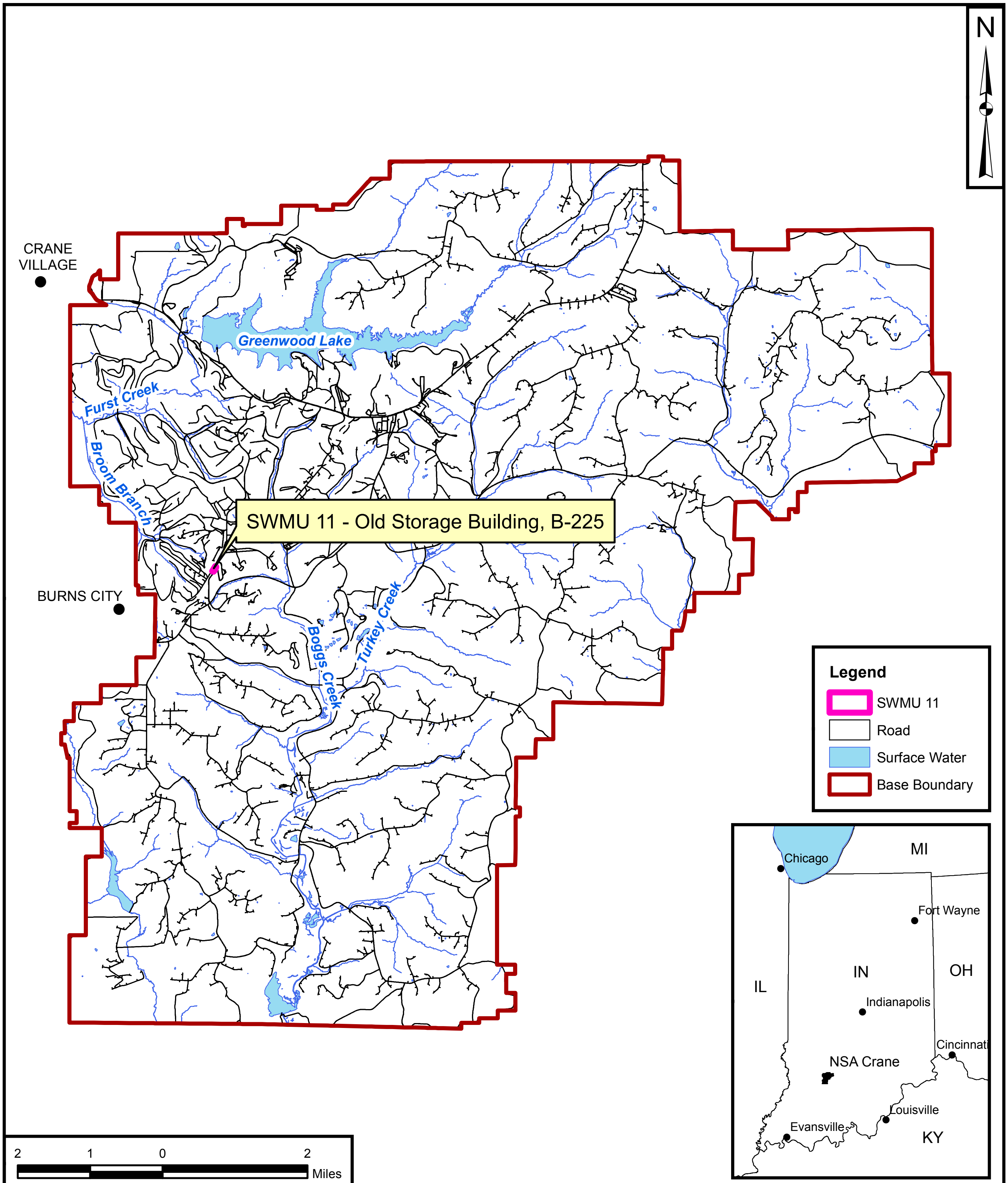

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BASE AND SITE LOCATION MAP
SWMU 11
OLD STORAGE BUILDING, B-225
NSA CRANE
CRANE, INDIANA

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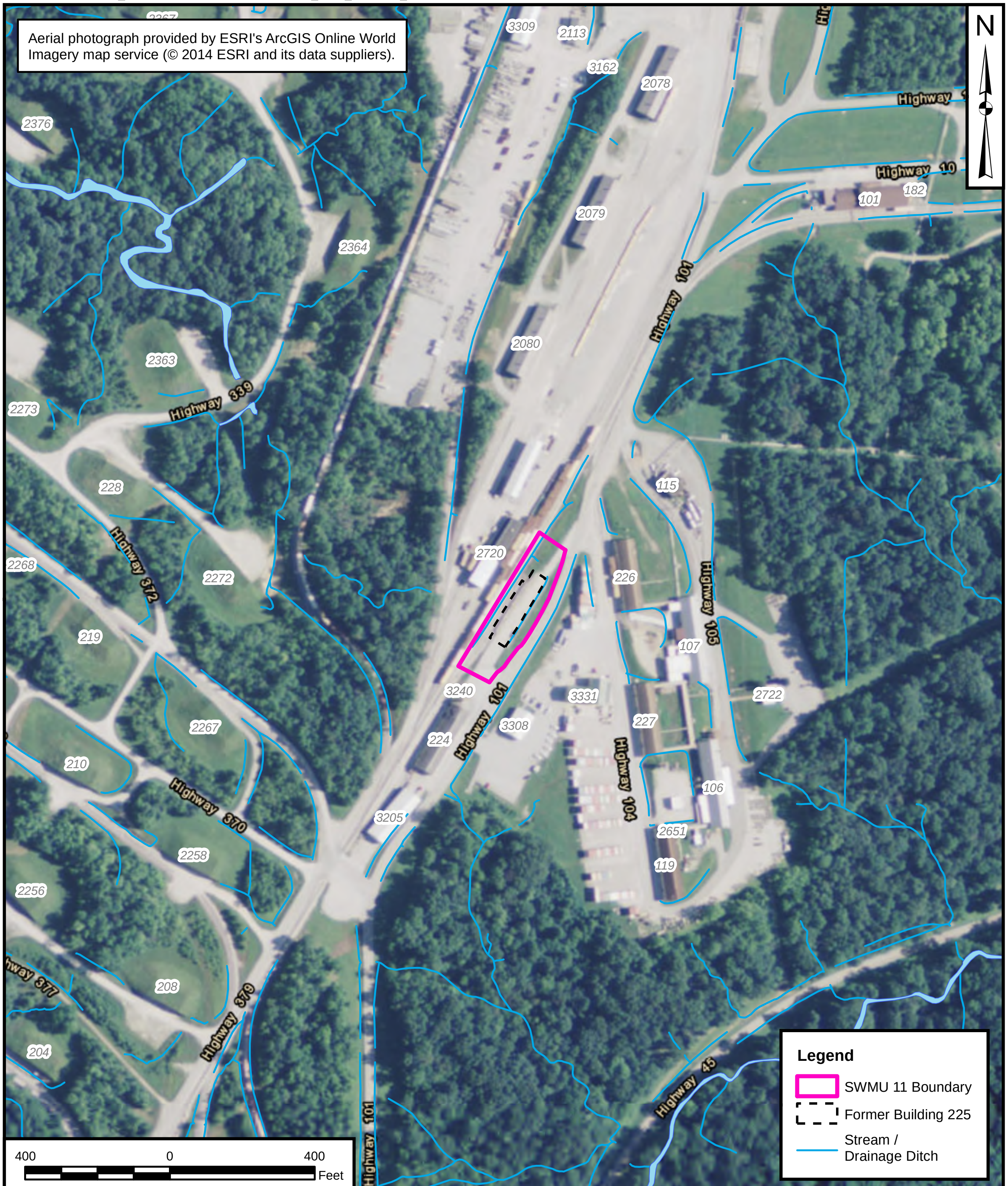

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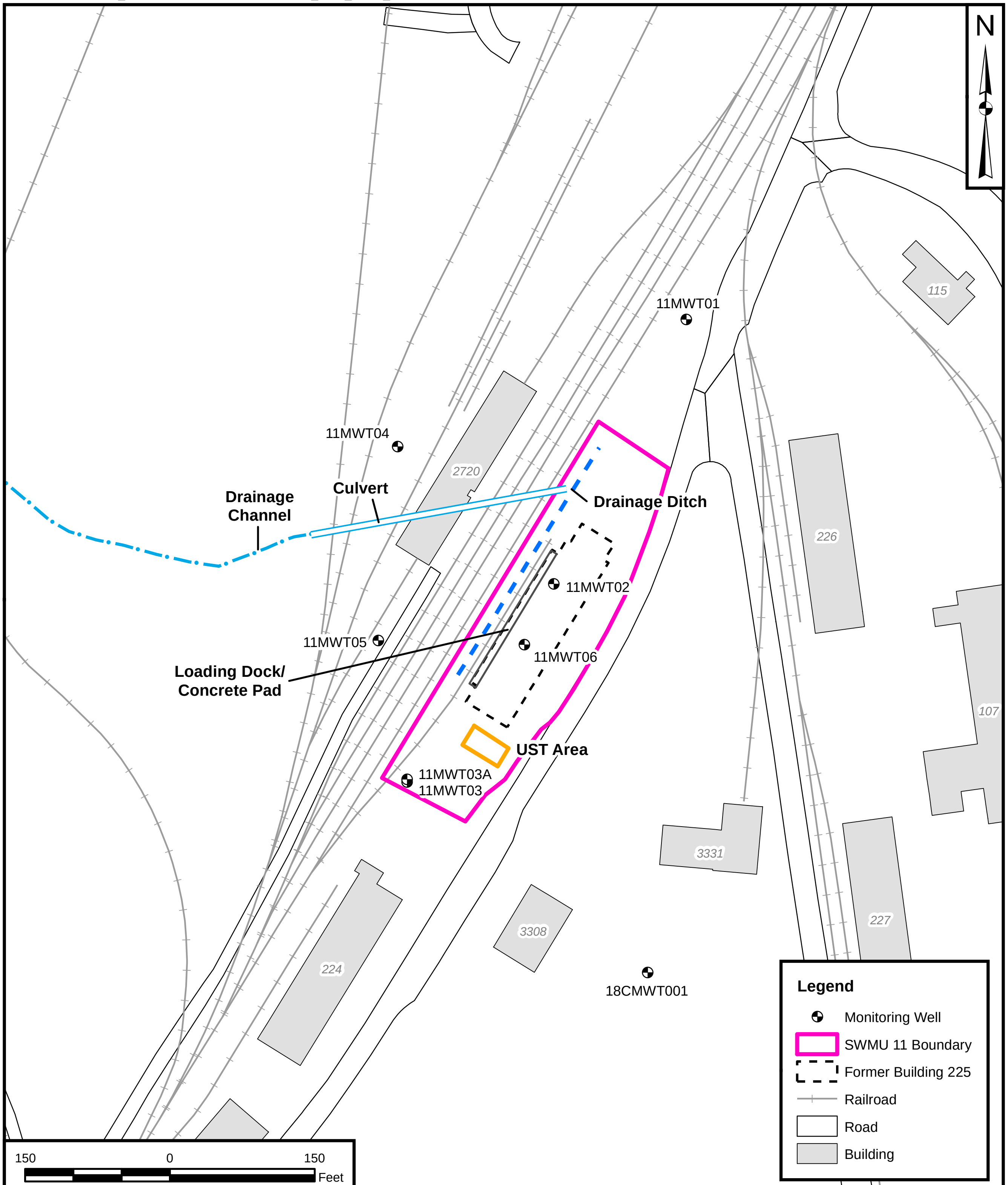

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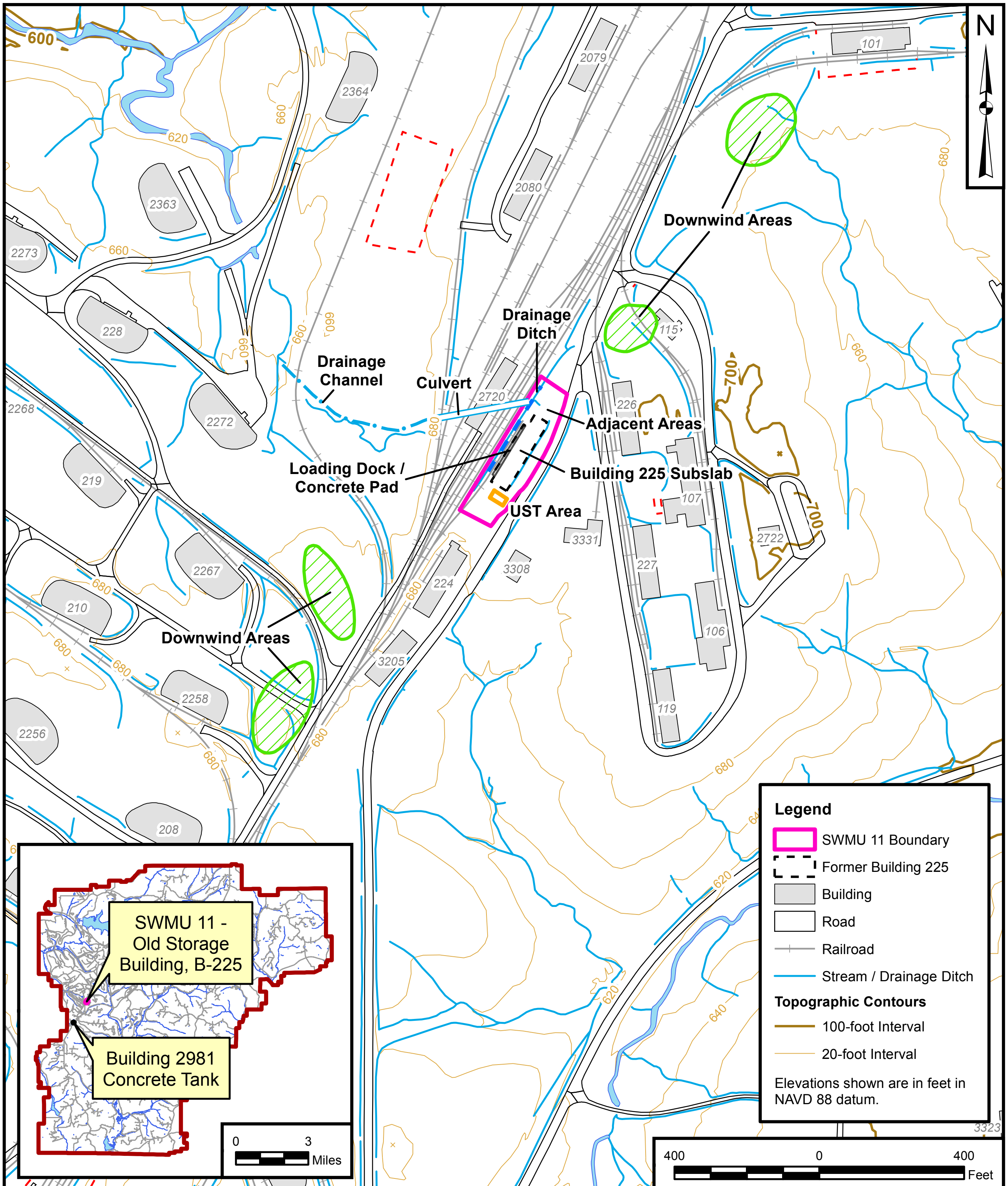

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J. BUEL	03/28/16	NSA CRANE	J. BUEL	03/28/16
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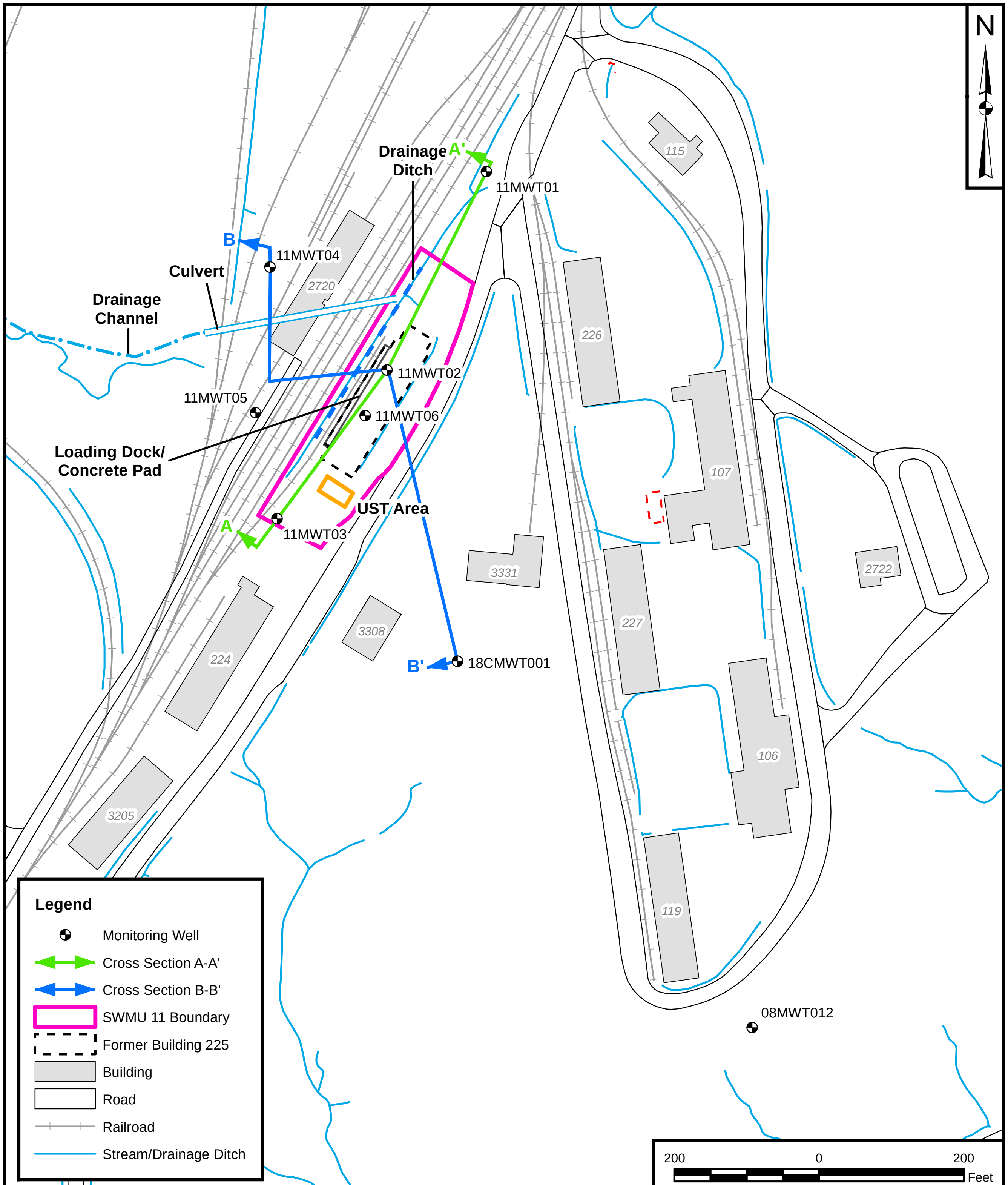

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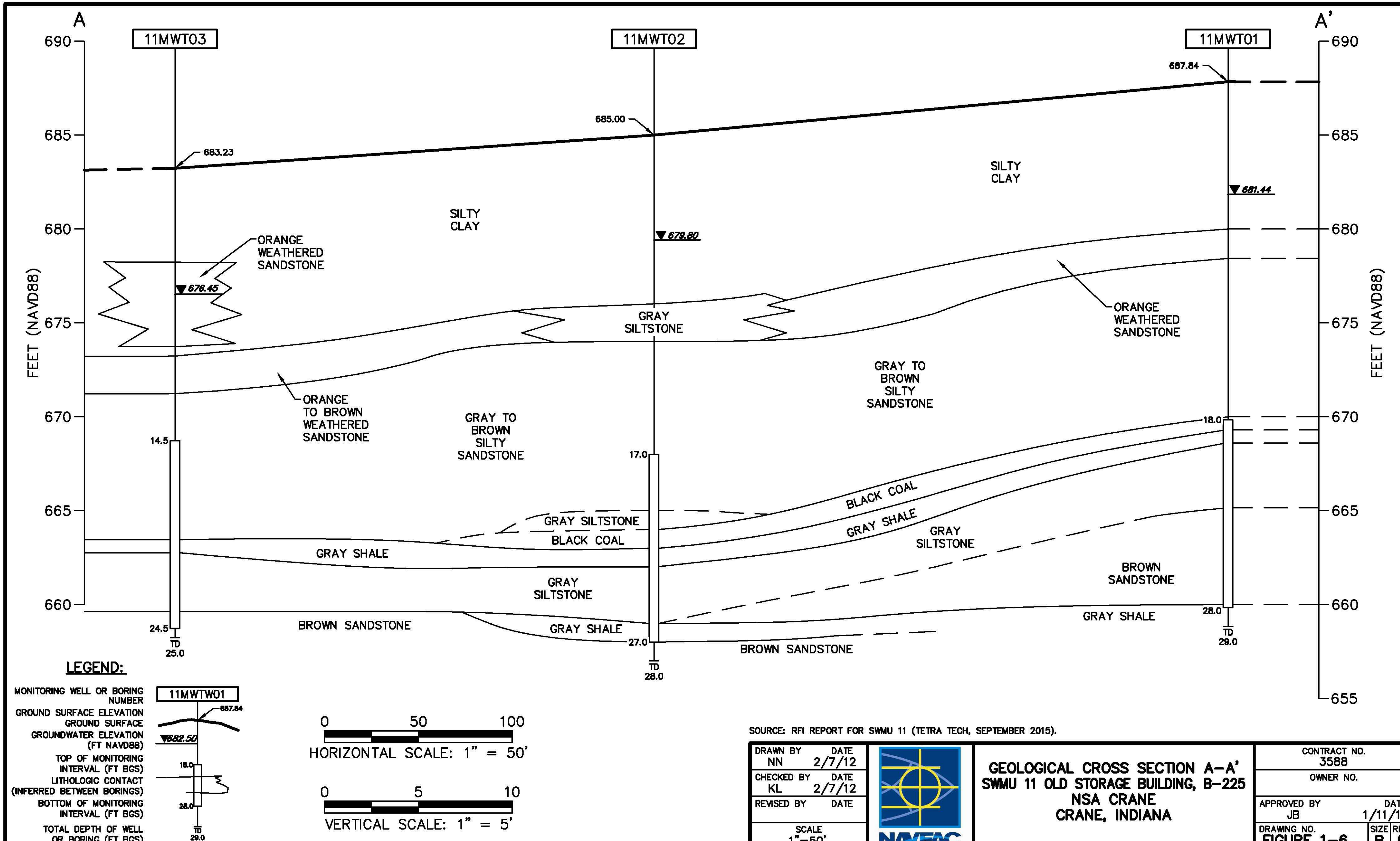
SCALE AS NOTED				FIGURE NO. FIGURE 1-5 — REV 0



SOURCE: RFI REPORT FOR SWMU 11 (TETRA TECH, SEPTEMBER 2015).

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SCALE 1"=50'			DRAWING NO. FIGURE 1–6 — SIZE B — REV. 0

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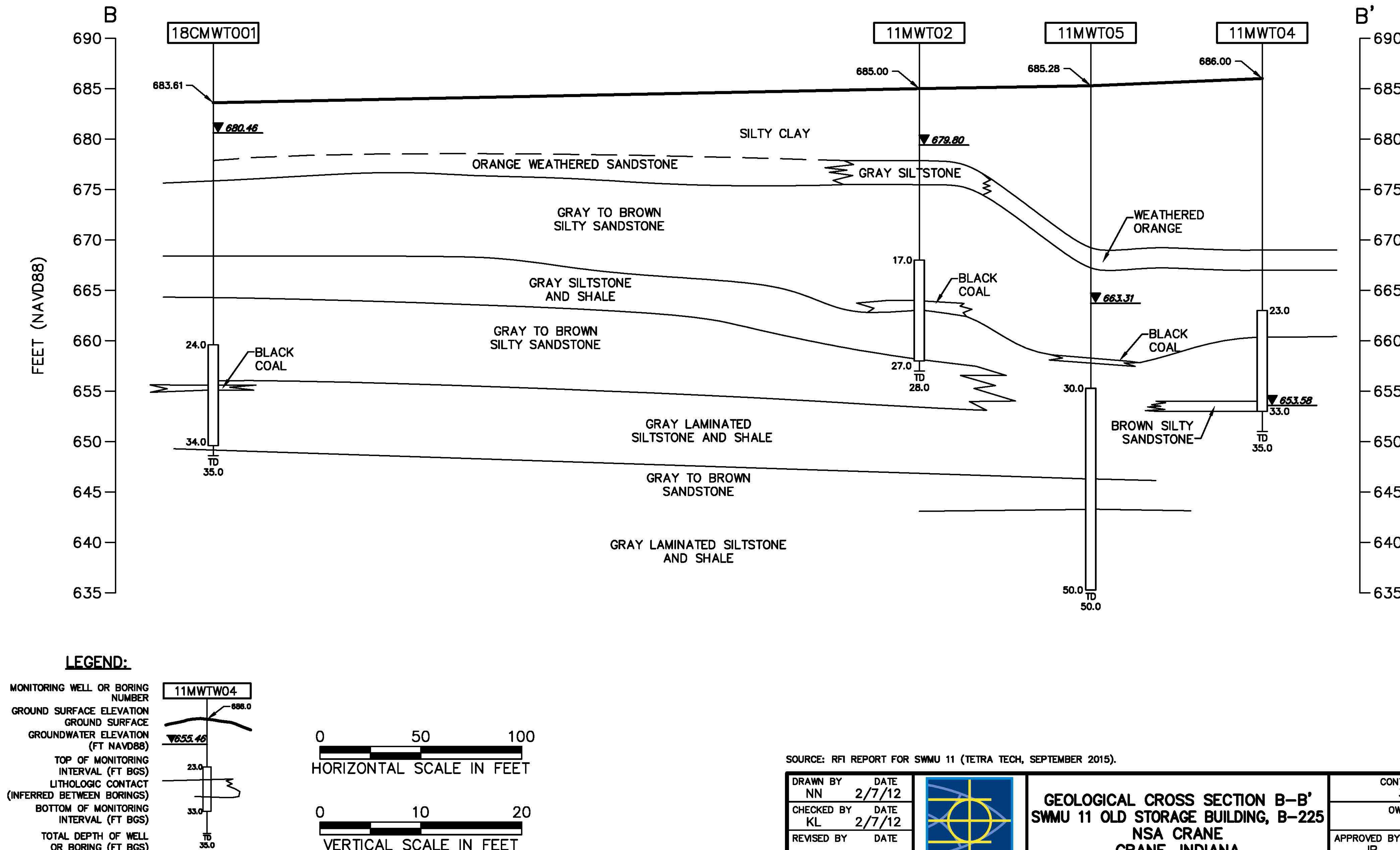

SOURCE: RFI REPORT FOR SWMU 11 (TETRA TECH, SEPTEMBER 2015).

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SCALE 1"=50'			DRAWING NO. FIGURE 1-7 — SIZE B — REV. 0

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2.0 IDENTIFICATION AND DEVELOPMENT OF CORRECTIVE MEASURE ALTERNATIVES

Environmental investigations and the baseline human health risk assessment conducted for SWMU 11 identified the need for corrective action at the site. Section 2.1 describes the current situation, including previous investigations that have resulted in the identification of contaminated media and the COCs for those media along with the CSM components that support the development of CAOs and MCSs. Section 2.2 presents the CAOs and MCSs. Section 2.3 provides the screening of corrective measure technologies, and Section 2.4 provides the results of identification of corrective measure alternatives for SWMU 11. Together, these four sections meet the requirements of the RCRA Permit, Attachment 0, Task 6, Subtasks A through D.

2.1 DESCRIPTION OF CURRENT SITUATION

The following provides a description of the current situation at SWMU 11 by providing information on previous investigations conducted at SWMU 11 and presentation of the current understanding of the CSM. The CSM discussion identifies the potential exposure pathways and associated COCs that need to be addressed by the corrective measures.

2.1.1 Previous Investigations

Previous environmental investigations related to SWMU 11 were in immediate response to the 1976 fire at Building 225 and as part of the RFI for SWMU 11. No interim measure has been conducted at SWMU 11. SWMU 11 environmental investigations are summarized in the following table.

Investigation	Date	Activities
Investigations in response to fire at Building 225	1976	The Navy prepared two reports in response to the fire at Building 225 in 1976. The information provided in these two documents were used as part of the development of the RFI Sampling and Analysis Plan (SAP), and both documents are included in Appendix D of the RFI SAP (Tetra Tech, March 2011). The Green Water Report detailed the events resulting from the runoff of water used to put out the fire that destroyed Building 225 and presented the results of water samples collected from temporary dams placed in Broom Branch. Copper, lead, zinc, sodium fluorescein, and PCP were identified as potential contaminants. The report concluded that the metals were confined and that the dye was “reasonably non-toxic”, leaving PCP as the primary contaminant of concern. PCP concentrations in Broom Branch approximately 1 mile from the site were reported at greater than 30 milligrams per liter (mg/L). PCP was not detected at locations further downstream. Approximately 1 week after the fire, the ponded water behind

Investigation	Date	Activities
		the temporary dams was sampled and released in a controlled manner. PCP concentrations in the water leaving NSA Crane was less than 0.02 mg/L. The Report on the Fire Investigation, Building 225 discussed the details of the fire at Building 225, including the cause of the fire, fire department response, and recommendations on how to prevent future fires at NSA Crane. No samples were collected as part of this report.
RFI	2011 to 2013	RFI field activities at SWMU 11 were performed from April 2011 to January 2013 and included collection of 28 surface soil, 83 subsurface soil, 10 sediment, and 11 groundwater samples. Soil samples were analyzed for VOCs, semivolatile organic compounds (SVOCs), polychlorinated biphenyl (PCBs), pesticides, dioxins/furans, metals, and/or cyanide. Sediment samples were analyzed for SVOCs, PCBs, dioxins/furans, metals, cyanide, and total organic carbon (TOC), and groundwater was analyzed for VOCs. Sampling included locations under the Building 225 concrete floor (slab), in adjacent areas to Building 225, in the UST area, in downwind areas, in the drainage channel, and in the Building 2981 concrete tank area. Although the 1976 reports provided evidence that there was a release of copper, zinc, lead, and PCP at the SWMU, elevated levels of these chemicals were not confirmed during the RFI. Instead, sample results identified chlorinated VOC and benzene contamination in subsurface soil and groundwater and a data gap associated with arsenic and iron contamination in subsurface soil. A human health risk assessment (HHRA) and ecological risk assessment (ERA) were completed as part of the RFI. Based on RFI results, the RFI Report, finalized in 2015, recommended that the site proceed to a CMS and identifies the COCs for SWMU 11 as discussed in Section 2.1.2.

2.1.2 Conceptual Site Model

The fire and firefighting efforts at SWMU 11 are the likely sources of subsurface contamination identified at SWMU 11. The historical information indicates that releases occurred directly onto the surface soil, and RFI data indicate that chlorinated solvents and benzene have migrated to subsurface soil and groundwater at concentrations that warrant a corrective measure. RFI results did not identify site-related chemicals in the UST area, drainage ditch, drainage channel, downwind areas, or Building 2981 concrete tank area at concentrations that warrant a corrective measure. A data gap was identified for arsenic and iron contamination in subsurface soil and groundwater.

There are no longer storage operations at the site, and only the Building 225 concrete floor slab, loading dock, and railroad siding spur remain. The railroad tracks to the west of the site are currently active.

Nature and Extent of Contamination

As stated above, the fire and firefighting efforts at SWMU 11 are the likely sources of subsurface contamination identified at SWMU 11. Surface soil contamination was not identified within the SWMU 11 boundary, at downwind locations potentially impacted by the fire, or at the Building 2981 concrete tank. Subsurface contamination was also not found in the UST area. Subsurface soil contamination was identified in the immediate vicinity of the Building 225 floor slab and appears to have migrated to the west toward the railroad tracks and south of Building 2720. The subsurface soil contamination consists primarily of PCE, TCE and degradation products cis-1,2-dichloroethene (DCE) and vinyl chloride (VC). Low concentrations of cis-1,2-DCE and PCE were detected in surface soil below the slab; however, much greater concentrations are present in subsurface soil, demonstrating the downward migration tendency of this chemical class (i.e., halogenated aliphatics) in the environment. The maximum PCE concentration of 31,200 micrograms per kilogram (µg/kg) detected in subsurface soil (11SB040) coincided with the location where PCE and TCE were stored inside Building 225 prior to the fire. In addition to volatiles, two metals (arsenic and iron) were detected in subsurface soil at concentrations greater than facility background levels and with the potential to leach to groundwater at concentrations of concern. A data gap was identified for these two metals because the maximum concentrations of arsenic and iron (at 11SB02) in subsurface soil were detected near the greatest concentrations of PCE and TCE, and limited subsurface soil data and no groundwater data are available for these metals at the site (the only available data are from upgradient well 18CMWT001). The presence of the Building 225 floor slab currently eliminates the leaching of soil to groundwater pathway for soil located underneath the slab. Table 2-1 provides a summary of SWMU 11 subsurface soil data for the COCs identified in the RFI Report, and Figure 2-1 shows soil sampling locations under and around the Building 225 floor slab.

Groundwater samples collected from SWMU 11 monitoring wells had chlorinated VOC concentrations exceeding MCSs. Table 2-2 provides a summary of SWMU 11 groundwater data for the COCs identified in the RFI Report, and Figure 2-2 shows the monitoring well locations. Groundwater contamination was identified under the northern half of the slab and to the west/southwest beyond the railroad tracks at depths ranging from 17 to 30 feet bgs. Concentrations of PCE and TCE in the monitoring well within the source area (11MWT02) exceeded federal Maximum Contaminant Levels (MCLs). There was one minor exceedance of the MCL for PCE in one downgradient well (11MWT05). Ground surface elevations decrease to the west of the site, and groundwater would generally be discharged as seeps before reaching the NSA Crane boundary and any downgradient human receptors. Based on analytical results from a deeper bedrock well installed beneath the slab (screened from 62 to 72 feet bgs), contamination has not migrated into deeper groundwater. The presence of the degradation products cis-1,2-DCE and VC shows that natural degradation of PCE and TCE in groundwater is occurring.

Risk Assessment Summary

The HHRA performed during the RFI estimated non-carcinogenic and carcinogenic risks [hazard indices (HIs) and incremental lifetime cancer risks (ILCRs), respectively] to potential human receptors exposed to soil, sediment, and groundwater at the site. Potential receptors evaluated included maintenance workers, industrial workers, construction works, adolescent trespassers, child and adult recreational users, and hypothetical child and adult residents. Although future land use is likely to be the same as current land use with trespassers as the most likely receptors, all of the receptors were evaluated in the baseline HHRA for decision-making purposes.

Under Reasonable Maximum Exposure (RME) conditions, a calculated risk was determined to be unacceptable if: (a) the ILCR exceeded the USEPA target risk range of 1×10^{-6} to 1×10^{-4} or (b) the target organ/critical effect-specific HI exceeded 1. The HHRA concluded that human health risk under current land use was acceptable. However, potential unacceptable human health risks for hypothetical future residents were identified associated with direct contact (ingestion) exposure to VOCs in groundwater, specifically benzene, cis,-1,2-DCE, TCE, and VC. Although no COCs were identified for vapor intrusion from groundwater based on estimated indoor air concentrations using the Johnson and Ettinger Model, TCE in groundwater was retained as a COC for the groundwater to indoor air pathway because the site groundwater concentrations under the Building 225 slab were greater than IDEM Vapor Exposure Screening Levels for residential and commercial/industrial scenarios. IDEM does not accept the use of modeling to dismiss concerns regarding vapor intrusion.

A qualitative analysis was completed to identify COCs for the soil-to-groundwater migration pathway in the HHRA. A multiple lines-of-evidence approach was used to identify chemicals that may migrate from soil to groundwater. This approach considered exceedances of risk-based soil screening levels (SSLs) and MCL-based SSLs, frequency of detections and exceedances, magnitude of exceedances, background concentrations, chemical properties, and groundwater concentrations. Benzene, cis-1,2-DCE, PCE, TCE, and VC were retained as COCs for the soil-to-groundwater migration pathway at SWMU 11 because subsurface soil concentrations could represent a source of groundwater contamination and because these chemicals were detected in groundwater. Arsenic and iron were also retained as COCs for the soil-to-groundwater migration pathway at SWMW 11 because concentrations of these metals exceeded their respective soil-to-groundwater migration screening levels and because groundwater data from the site are not available to confirm whether migration from soil to groundwater has occurred and whether groundwater concentrations are greater than established NSA Crane background concentrations.

The ERA for SWMU 11 evaluated surface soil and sediment to determine the potential for adverse ecological impacts due to site-related contamination. No unacceptable risks were identified for the ecological receptors identified in the ERA, which included mammals, birds, terrestrial plants, soil invertebrates, and sediment invertebrates.

The following summarizes the identified potential unacceptable risks and associated COCs for SWMU 11 that are addressed by the CMS Report:

- Potential future migration from soil to groundwater adversely impacting groundwater. Benzene, cis-1,2-DCE, PCE, TCE, VC, arsenic, and iron were identified as COCs for the soil-to-groundwater migration pathway based on potential future ingestion of groundwater. There are no current potential concerns associated with exposure to groundwater at SWMU 11.

- Potential future ingestion of contaminated groundwater at SWMU 11. Benzene, cis-1,2-DCE, TCE, and VC were identified as COCs based on unacceptable risks for a hypothetical future residential receptor. TCE and PCE were identified as COCs based on exceedance of MCLs. Arsenic and iron are included as COCs because of the potential for migration to groundwater and because no groundwater data are currently available to verify groundwater concentrations. Concentrations of arsenic and iron in groundwater will need to be further evaluated to determine whether they should continue to be retained as COCs. There are no current potential concerns associated with exposure to groundwater at SWMU 11.

- Potential future indoor air exposure if a residential or industrial building were constructed over the contaminated groundwater plume at SWMU 11. TCE was identified as a COC because concentrations in groundwater at SWMU 11 exceed the IDEM vapor exposure levels. Benzene, PCE, and VC concentrations in groundwater were less than the IDEM levels, and these chemicals are not considered COCs for this exposure pathway at this time; however, they could be a future concern if concentrations in groundwater increase. There are no current potential exposure concerns for the indoor air pathway because there are no buildings over the contaminated groundwater plume.

2.2 ESTABLISHMENT OF CORRECTIVE ACTION OBJECTIVES

Based on the potential unacceptable human health risks and COCs identified in Section 2.1.2, CAOs and MCSs were developed for SWMU 11, as provided in Sections 2.2.1 and 2.2.2.

2.2.1 Corrective Action Objectives

The following CAOs have been identified for SWMU 11:

- CAO 1: Minimize the potential for subsurface soil COC concentrations to adversely impact the stability of the groundwater contamination plume.

- CAO 2: Prevent hypothetical future residential exposure to site groundwater with COC concentrations greater than MCSs.

- CAO 3: Prevent future unacceptable indoor air exposure resulting from vapor intrusion of volatile COCs in groundwater into an occupied structure.

2.2.2 Media Cleanup Standards

Cleanup goals, or MCSs for subsurface soil were identified for the protection of groundwater. As shown on Table 2-3, potential sources of MCSs considered for soil include the IDEM screening levels for migration to groundwater as presented in Appendix A of the Remediation Closure Guidance as updated in 2015 (IDEM, 2015), USEPA SSLs provided in the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites (June 2015) adjusted to be representative of a dilution attenuation factor (DAF) of 20, and for inorganics NSA Crane background soil concentrations presented in the Basewide Background Soil Investigation Report (Tetra Tech, January 2001) were also considered. The selected subsurface soil MCSs for the site are based on the IDEM screening levels for migration to groundwater and NSA Crane background soil concentrations. The NSA Crane background soil concentration was selected as the MCS if it was greater than the IDEM migration to groundwater value. Table 2-3 presents the subsurface soil MCSs for SWMU 11 and identifies the source of the MCS for each COC.

Cleanup goals, or MCSs, for groundwater have been identified to address potential unacceptable risks at SWMU 11 for drinking water and vapor intrusion. As shown on Table 2-4, potential sources of MCSs considered for groundwater include federal MCLs (40 Code of Federal Regulations 141.6), IDEM vapor exposure groundwater concentrations as presented in Appendix A of the Remediation Closure Guide as updated in 2015 (IDEM, 2015), and for inorganics NSA Crane background groundwater concentrations presented in the Basewide Pennsylvanian Background Groundwater Evaluation Report (Tetra Tech, September 2013) were also considered. The selected groundwater MCSs for the site are based on the federal MCLs and NSA Crane background groundwater concentrations. The federal MCL was selected because it will be protective of the drinking water and vapor intrusion pathway. The NSA Crane background groundwater concentration was selected as the MCS if it was greater than the federal MCL. Table 2-4 presents the groundwater MCSs for SWMU 11 and identifies the source of the MCS for each COC.

2.3 SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES

Categories of general response actions that could be implemented to satisfy or address a component of the CAOs were screened based on the site characteristics, COC characteristics, and technology limitations. As discussed in Section 1.2, active treatment technologies for groundwater were eliminated during the screening process because treatment would not provide additional benefit due to low groundwater concentrations at the site and absence of downgradient receptors. Active treatment technologies for soil were eliminated during the screening process based on the soil types, depth of contamination at SWMU 11, and cost benefit. For example, soil vapor extraction (SVE) works best in permeable soil types, whereas the soil at SWMU 11 tend to be silty and less permeable, and thermal processes are more expensive for a very limited source such is present at SWMU 11.

Therefore, the following general response action categories were retained for further consideration at SWMU 11:

- No Action
- Limited Action (Institutional Controls and Monitoring)
- Removal

Limited action for groundwater was identified because of the presence of degradation products in groundwater indicating that degradation is already occurring naturally at the site. Removal was identified for soil because it is the most likely feasible remedial option for soil based on the soil types and depth of the soil contamination.

2.4 IDENTIFICATION OF CORRECTIVE MEASURE ALTERNATIVES

Based on the screening of technologies in Section 2.3, two alternatives in addition to a no action alternative were developed using LUCs to prevent exposure to contamination until COC concentrations are less than MCSs. LUCs refer to any restriction or administrative action, including engineering controls (e.g., constructed containment barrier) and institutional controls (e.g., administrative and legal controls) that help minimize risk to human health and the environment.

The corrective measure alternatives considered for corrective action of soil and groundwater at SWMU 11 include:

- Alternative 1 – No Action
- Alternative 2 – Monitored Natural Attenuation (MNA) and LUCs
- Alternative 3 – Source Reduction, MNA, and LUCs

Table 2-5 summarizes site risks and identifies potential corrective measures on a medium-specific basis.

2.4.1 Alternative 1 – No Action

Alternative 1 is a no action alternative. No corrective measure would be performed to protect human health or the environment. This alternative is used as a baseline for comparison with other alternatives.

2.4.2 Alternative 2 – MNA and LUCs

Alternative 2 includes a combination of MNA, long-term monitoring (LTM) of groundwater, LUCs, and seven-year reviews. It was developed as an alternative that relies on natural attenuation processes to achieve groundwater MCSs, an LTM program to evaluate the stability of the groundwater contamination plume, and LUCs to meet CAOs 2 and 3 until site contaminants are less than groundwater MCSs. The natural processes include a variety of physical, chemical, and biological processes that act to reduce the mass, toxicity, mobility, volume, and/or concentration of contaminants in groundwater. This alternative was identified for SWMU 11 because existing groundwater data suggest that natural attenuation of VOCs is already occurring at the site. Groundwater data for arsenic and iron are not available; however, based on the slight exceedances of the soil MCS for arsenic and limited number of exceedances of the soil MCS for iron (one location), it is anticipated that groundwater concentrations of arsenic and iron will be less than groundwater MCSs. If exceedances of the groundwater MCSs are detected during the first round of LTM for the two metals, then they would continue to be monitored under the LTM program. For purposes of planning and costing, it was assumed that the groundwater MCSs for VOCs would be attained at SWMU 11 in 30 years and that additional monitoring for metals beyond the initial Round 1 sampling event would not be required.

Under Alternative 2, LTM would include sampling and analysis of groundwater to determine the effectiveness of natural attenuation, to confirm that COCs are not migrating off site at unacceptable levels, and to determine when the groundwater MCSs have been attained. A SAP would be prepared to provide the required sampling program and decisions based on the sampling results, including number of monitoring wells, frequency of monitoring and analytical program, and decisions to reduce frequency and analytes. For CMS costing purposes, it was assumed that three new monitoring wells would be installed (with their location to be determined in the SAP) and that nine monitoring wells would be sampled biennially for the organic COCs as part of the LTM program. Based on LTM at other NSA Crane sites, biennial sampling and analysis should be sufficient to observe groundwater concentration trends and potential changes in the stability of the groundwater plume. In addition, it was assumed that the initial groundwater sampling event would also include analysis for arsenic and iron to show that arsenic and iron groundwater concentration are less than MCSs and that analysis for arsenic and iron could be discontinued. It was also assumed that the initial groundwater samples would be analyzed for typical MNA indicator parameters.

Alternative 2 would address CAO 1 through a LUC instead of meeting the subsurface soil MCSs. A LUC is necessary under this alternative because soil with concentrations greater than MCSs beneath the floor slab of Building 225 could be a continuing source of contamination to groundwater if the floor slab is removed. The LUC would require monitoring and maintaining the integrity of the floor slab indefinitely unless additional evaluations are completed that demonstrate that removal of the floor slab would not adversely impact the stability of the groundwater contamination plume (e.g., synthetic precipitation leaching procedure [SPLP] testing). For soil located outside the footprint of the floor slab with concentrations greater than the subsurface soil MCSs, the LTM program would evaluate whether contaminants are leaching from soil into groundwater by installing monitoring wells in the impacted areas and sampling these wells as part of the LTM program or by SPLP testing. The COC concentrations in the groundwater would be used to determine whether contaminants are leaching from the soil into the groundwater at concentrations that may adversely impact the groundwater contamination plume such that additional measure(s) are necessary. The specific sampling and analysis requirements would be specified in the LTM SAP.

LUCs would also be implemented to ensure that contaminated groundwater is not used as a source of drinking water until the groundwater MCSs are attained and that residential or industrial construction is not conducted until groundwater meets the MCSs to prevent vapor intrusion into habitable structures to meet CAOs 2 and 3. Site inspections would be performed to verify the continued maintenance of LUCs associated with preventing groundwater use until the groundwater MCSs have been achieved. Site inspections associated with monitoring the integrity of the floor slab would be needed in perpetuity to confirm that the floor slab remains intact. A LUC Implementation Plan (LUCIP) would be prepared to provide the specific LUC requirements and formalize the management of site controls. LUCs would be established in Naval Installation Restoration Information Solution (NIRIS) LUC Tracker and appropriate NSA Crane documents, as specified in the LUCIP. For CMS costing purposes, it was assumed that annual LUC inspections would be conducted, which is consistent with inspections for other NSA Crane sites.

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

The details of the LTM and LUCs would be provided in a Corrective Measure Implementation Plan (CMIP)/Quality Assurance Project Plan (QAPP), which would include the LUCIP and LTM SAP.

2.4.3 Alternative 3 – Source Reduction, MNA, and LUCs

Alternative 3 includes the MNA, LTM, LUC, and seven-year review components described in Alternative 2 in addition to soil source reduction. It was developed as an alternative that relies on natural attenuation processes to achieve groundwater MCSs after soil source reduction is complete to expedite the MNA process by eliminating potential source migration to groundwater. Under Alternative 3, subsurface soil with COC concentrations greater than soil MCSs would be excavated and transported to a licensed TSDF for appropriate off-site disposal to address CAO 1. The contaminated subsurface soil would be excavated from within the excavation boundaries shown on Figure 2-3. The excavation boundaries shown on Figure 2-3 are based on the soil samples with concentrations greater than soil MCSs for VOCs only because whether arsenic and iron are adversely contributing to the groundwater contamination is not known at this time. For purposes of planning and costing, it was assumed that the subsurface soil MCSs would be attained within 3 months after the contracting process is complete and that groundwater MCSs would be attained at SWMU 11 in 20 years.

Prior to mobilization for soil excavation activities, additional soil samples would be collected to determine the horizontal and vertical excavation limits. For the purpose of the CMS, it was assumed that a total of 60 samples would be collected to confirm the excavation limits and analyzed for chlorinated VOCs and that four soil samples would be collected and analyzed for the full list of Toxicity Characteristic Leaching Procedure (TCLP) waste characterization parameters to confirm whether the soil is nonhazardous for disposal purposes. It was assumed that sampling and analysis for arsenic, benzene, and iron would not be necessary because exceedances of MCSs were minor and within the chlorinated VOC contaminated area. For purposes of planning and costing and based on RFI soil results, it was estimated that 10 percent of the soil excavated would be sent to a RCRA Subtitle C landfill for disposal as hazardous waste, and the remainder would be sent to a Subtitle D landfill as non-hazardous waste. Details of the additional delineation sampling and waste characterization sampling program would be presented in a CMIP.

The estimated excavation area of SWMU 11 is approximately 21,000 square feet. The majority of the detections in soil that exceed soil MCSs are in the deeper soil samples collected from 2 to 6 feet above bedrock in the unsaturated zone, which equates to depths of 2 to 9 feet bgs in the areas closest to former Building 225 and 9 to 17 feet bgs along the rail-road tracks. It is assumed that the shallower soil and gravel would be removed and stockpiled for backfill. With an average soil thickness of 6 feet above bedrock, it was assumed that approximately 126,000 cubic feet (4,700 cubic yards) of chlorinated VOC-contaminated soil would require off-site disposal under this alternative to meet the soil MCSs. The excavated areas would be backfilled and regraded to the approximate original contours, ensuring appropriate site drainage. Backup information for the soil volume and area calculations are provided in Appendix A.

As shown on Figure 2-3, subsurface soil below active railroad tracks and loading dock would be excavated. This would require approximately 650 feet of railroad track and ballast to be temporarily removed and later reconstructed and approximately 1,800 square feet of loading dock to be removed and replaced. The Building 225 floor slab would also be removed, but would not require replacement.

Under Alternative 3, there would be a difference in the LUC component compared to Alternative 2. Because the soil excavation would remove soil with concentrations greater than the MCSs, the soil-to-groundwater pathway would be eliminated for the COCs and so a LUC to maintain the Building 225 floor slab would not be necessary. LUCs would only be implemented to ensure that contaminated groundwater is not used as a source of drinking water until MCSs are attained and that residential or industrial construction is not conducted until groundwater meets MCSs to satisfy CAOs 2 and 3. The other portions of the LUCs (e.g., site inspections and LUCIP preparation) would be similar to Alternative 2.

The LTM, LUCs, and seven-year review components would be similar to Alternative 2 except that they are assumed to end after 20 years (instead of 30 years as provided in Alternative 2). The details of the LTM and LUCs would be provided in a CMIP/QAPP, which would include the LUCIP and LTM SAP.

TABLE 2-1

SUMMARY OF SUBSURFACE SOIL DATA FOR CHEMICALS OF CONCERN
SWMU 11 - OLD STORAGE BUILDING, B-225
NSA CRANE, CRANE, INDIANA

Chemical of Concern	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample ID of Maximum Detection	Range of Non-Detects	Average of Detections	Soil MCS[1]
Volatile Organics (ug/kg)								
BENZENE	4/83	1.3 J	146 J	11SB36	11SB360405	1.98 - 465	37.8	51
CIS-1,2-DICHLOROETHENE	43/83	4.99	1700 J	11SB40	11SB400506	1.98 - 136	197	410
TETRACHLOROETHENE	36/83	1.57 J	31200	11SB40	11SB400506	1.98 - 136	1128	45
TRICHLOROETHENE	42/83	1.5 J	1290	11SB68	11SB68-1315	1.98 - 136	163	36
VINYL CHLORIDE	23/83	1.58 J	154	11SB02	11SB020406	1.98 - 465	29.4	14
Inorganics (mg/kg)								
ARSENIC	4/4	2.49	20.4	11SB02	11SB020406	-	8.88	12.5
IRON	4/4	11400	75600	11SB02	11SB020406	-	32275	37400

1 - Development of Media Cleanup Standards (MCSs) is provided in Section 2.2.
J - Estimated concentration.
ug/kg - micrograms per kilogram.
mg/kg - milligrams per kilogram.

TABLE 2-2

SUMMARY OF GROUNDWATER DATA FOR CHEMICALS OF CONCERN
SWMU 11 - OLD STORAGE BUILDING, B-225
NSA CRANE, CRANE, INDIANA

Parameter	Frequency of Detection	Minimum Detection	Maximum Detection	Location of Maximum Detection	Sample ID of Maximum Detection	Range of Non-Detects	Average of Detections	Drinking Water MCS(1)	Vapor Intrusion Residential MCS(1)	Vapor Intrusion Industrial MCS(1)
Volatile Organics (ug/L)										
BENZENE	2/11	1.4	3.23	11MWT02	11MWT0201	0.5 - 0.5	2.32	5	28	12
CIS-1,2-DICHLOROETHENE	3/11	3.05	27.6	11MWT02	11MWT0201	0.5 - 0.5	11.9	70	-	-
TETRACHLOROETHENE	3/11	5.54	25.5	11MWT02	11MWT0201	0.5 - 0.5	14.0	5	110	470
TRICHLOROETHENE	4/11	0.255 J	115	11MWT02	11MWT0201	0.5 - 0.5	36.0	5	9.1	38
VINYL CHLORIDE	1/11	0.503 J	0.503 J	11MWT02	11MWT0201	0.5 - 0.5	0.503	2	2.1	35
Inorganics (ug/l)										
ARSENIC(2)	1/1	1.79 J	1.79 J	18CMWT001	18CGWT001	-	1.79	10	-	-
IRON	0/0	-	-	-	-	-	-	34500	-	-
Filtered Inorganics (ug/L)										
ARSENIC(2)	1/1	1.62 J	1.62 J	18CMWT001	18CGWT001	-	1.62	10	-	-
IRON	0/0	-	-	-	-	-	-	34500	-	-

1 - Development of Media Cleanup Standards (MCSs) is provided in Section 2.2.
2 - Only upgradient groundwater data are available for this parameter.
ug/L - micrograms per liter.
J - Estimated concentration.

TABLE 2-3

SUBSURFACE SOIL MEDIA CLEANUP STANDARDS
SWMU 11 - OLD STORAGE BUILDING, B-225
NSA CRANE, CRANE, INDIANA

Chemical of Concern	IDEM Migration to Groundwater(1)	EPA Soil Screening Level(2)	Facility Background(3)	Selected Soil MCS(4)	Basis
Benzene	51	52	N/A	51	IDEM MTG(1)
cis-1,2-Dichloroethene	410	420	N/A	410	IDEM MTG(1)
Tetrachloroethene	45	46	N/A	45	IDEM MTG(1)
Trichloroethene	36	36	N/A	36	IDEM MTG(1)
Vinyl Chloride	14	13.8	N/A	14	IDEM MTG(1)
Arsenic	5.9	5.8	9.6	9.6	Facility Background (2)
Iron	5,600	7,000	34,500	34,500	Facility Background (2)

Units for organic compounds are presented in micrograms per kilogram (ug/kg) and units for metals are presented in millgrams per kilogram (mg/kg).

1 - Indiana Department of Environmental Management (IDEM) screening level for migration to groundwater (MTG) as presented in the Appendix A (Table A-6) of the Remediation Closure Guide as updated in 2015 (IDEM, 2015).

2 - United States Environmental Protection Agency (USEPA) Maximum Contaminant Level (MCL)-based Soil Screening Levels (SSLs) provided in the USEPA Regional Screening Levels for Chemical Contaminants at Superfund Sites (June 2015) with an applied dilution attenuation factor (DAF) of 20. If an MCL-based SSL was not available, then the risk-based SSL based on a DAF of 20 is presented.

3 - Upper tolerance limit (UTL) background concentration for complete background soil sample data set at NSA Crane, as presented in the Basewide Background Soil Investigation Report (Tetra Tech, January 2001).

4 - IDEM screening levels for MTG selected as the Media Cleanup Standard (MCS) unless the facility background concentration was greater than the IDEM screening level; then the facility background concentration was selected as the MCS.

TABLE 2-4

GROUNDWATER MEDIA CLEANUP STANDARDS
SWMU 11 - OLD STORAGE BUILDING, B-225
NSA CRANE, CRANE INDIANA

Chemical of Concern	Drinking Water				Vapor Intrusion				Selected Groundwater MCS [4] (µg/L)	Basis
	MCL (µg/L)	Facility Background (µg/L)	Drinking Water MCS (µg/L)	Basis	IDEM Residential Vapor Exposure (µg/L)	IDEM Industrial Vapor Exposure (µg/L)	Vapor Intrusion MCS (µg/L)	Basis		
Benzene	5	N/A	5	MCL[1]	N/A	N/A	N/A	N/A	5	MCL[1]
cis-1,2-Dichloroethene	70	N/A	70	MCL[1]	N/A	N/A	N/A	N/A	70	MCL[1]
Tetrachloroethene	5	N/A	5	MCL[1]	N/A	N/A	N/A	N/A	5	MCL[1]
Trichloroethene	5	N/A	5	MCL[1]	9.1	38	9.1	IDEM Residential[3]	5	MCL[1]
Vinyl Chloride	2	N/A	2	MCL[1]	N/A	N/A	N/A	N/A	2	MCL[1]
Arsenic	10	9.1	10	MCL[1]	N/A	N/A	N/A	N/A	10	MCL[1]
Iron	N/A	34,500	34,500	Facility Background[2]	N/A	N/A	N/A	N/A	34,500	Facility Background[2]

1 - Maximum Contaminant Level (MCL). 40 Code of Federal Regulations (CFR) 141.61.

2 - The facility background was selected as the media cleanup standard (MCS) if it was greater than the MCL. Facility background concentration is the background upper tolerance limit (UTL) as presented in the Final Basewide Pennsylvanian Bedrock Background Groundwater Evaluation Report (Tetra Tech, September 2013).

3 - Vapor exposure groundwater concentration presented in the Appendix A of IDEM Remediation Closure Guide, as updated in 2015 (IDEM, 2015).

4 - The selected groundwater MCSs for the site will be protective of drinking water and vapor intrusion exposure pathways.

TABLE 2-5

RCRA CORRECTIVE MEASURE EVALUATION PROCESS SUMMARY
SWMU 11 – OLD STORAGE BUILDING, B-225
NSA CRANE, INDIANA

MEDIUM	INVESTIGATION STAGE			REMEDIAL ACTION EVALUATION PHASE		
	Document	Findings/Evaluations	Conclusions	Considerations	Evaluation/Conclusions	Potential Corrective Measures
Surface Soil	RFI Report	• No unacceptable risks to human health, ecological receptors, or the environment.	• No action.	• No further evaluation necessary.	• None required.	• No action.
Subsurface Soil	RFI Report	• No unacceptable risks to human health, ecological receptors, or the environment identified for direct contact pathways. • Benzene, cis-1,2-DCE, PCE, TCE, VC, arsenic, and iron were retained as COCs for the soil-to-groundwater pathway.	• Proceed to CMS.	• Subsurface soil concentrations could represent a continuing source of groundwater contamination. • No groundwater data are currently available to evaluate whether arsenic and/or iron have migrated to groundwater at unacceptable concentrations.	• COCs for the soil-to-groundwater pathway will be addressed by groundwater corrective measures and/or subsurface soil source reduction.	• Conduct monitoring under groundwater corrective measure. • Conduct soil source reduction.
Groundwater	RFI Report	• Potential unacceptable risks for hypothetical future residents were identified associated with direct contact exposure to VOCs in groundwater. • Only PCE and TCE were detected at concentrations greater than federal MCLs for drinking water. • Limited VOC-contaminated groundwater identified in bedrock groundwater beneath the concrete slab (11MWT02) has migrated west toward 11MWT05. Bedrock groundwater contamination was identified at depths of 17 to 30 feet bgs. • Groundwater is expected to be expressed as seeps approximately 1,200 feet from the site and before reaching the NSA Crane boundary. • Groundwater contamination has not migrated into deeper groundwater.	• Proceed to CMS.	• Groundwater beneath the site is not used. • Limited VOC-contaminated groundwater migrated away from 11MWT02 to 11MWT05.	• No unacceptable risks under current land use scenario was identified. • No action and MNA and LUC corrective actions were evaluated.	• LUCs to prevent use of groundwater. • LTM to evaluate effectiveness of natural attenuation of groundwater contaminants, verify contaminant migration, and evaluate whether other corrective measures are required.
Sediment	RFI Report	• No unacceptable risks to human health, ecological receptors, or the environment.	• No action.	• No evaluation necessary.	• None required.	• No further action.

COCs Chemicals of concern.
CMS Corrective Measure Study.
DCE Dichloroethene.
LTM Long-term monitoring.
LUCs Land use controls.
MCLs Maximum Contaminant Levels.
MNA Monitored natural attenuation.
PCE Tetrachloroethene.
RCRA Resource Conservation and Recovery Act.
RFI RCRA Facility Investigation.
TCE Trichloroethene.
VC Vinyl chloride.
VOC Volatile organic compound.

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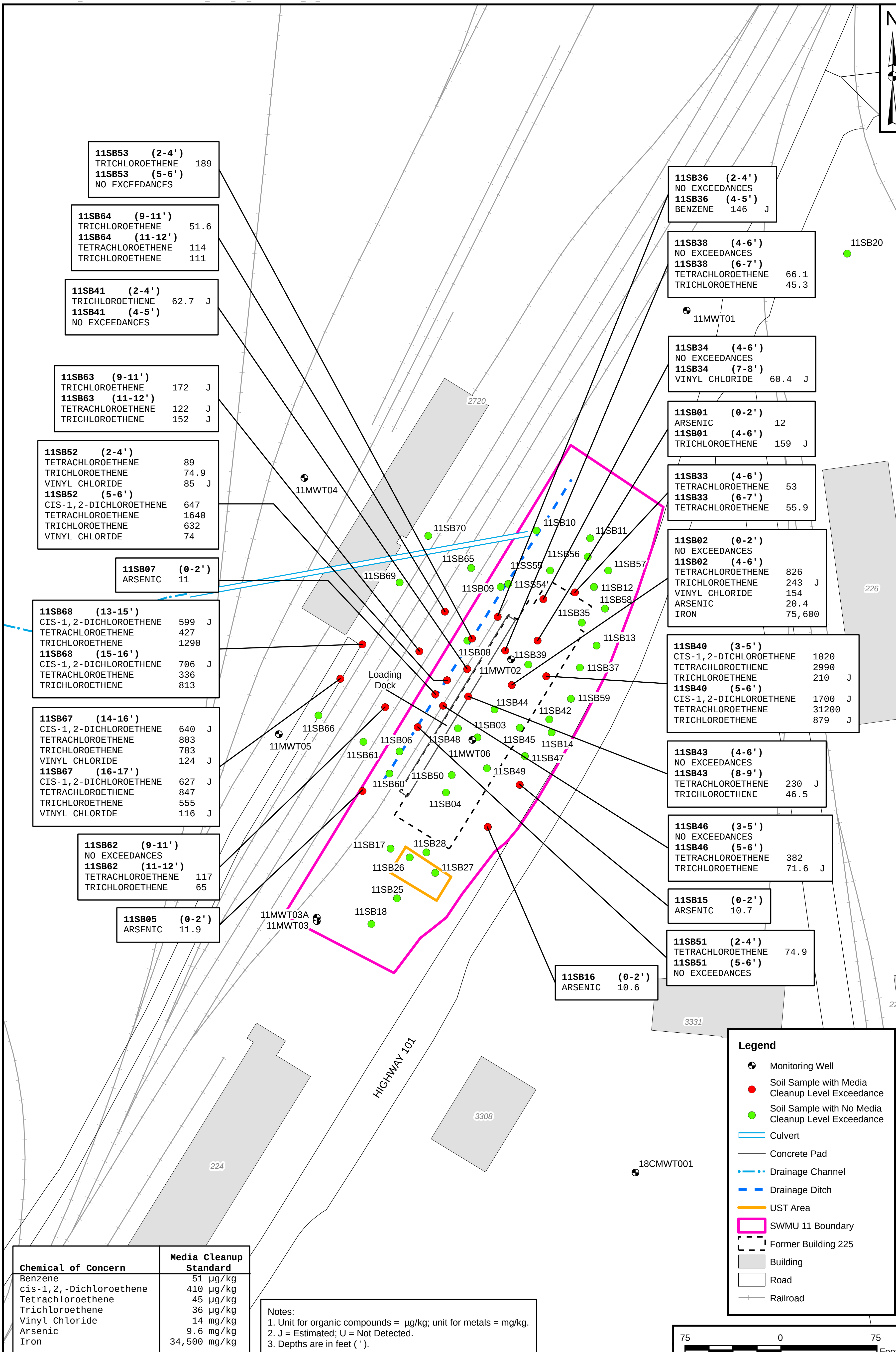

Chemical of Concern	Media Cleanup Standard
Benzene	51 µg/kg
cis-1,2,-Dichloroethene	410 µg/kg
Tetrachloroethene	45 µg/kg
Trichloroethene	36 µg/kg
Vinyl Chloride	14 mg/kg
Arsenic	9.6 mg/kg
Iron	34,500 mg/kg

Notes:
1. Unit for organic compounds = µg/kg; unit for metals = mg/kg.
2. J = Estimated; U = Not Detected.
3. Depths are in feet (').

DRAWN BY	DATE
J. ENGLISH	10/22/15
CHECKED BY	DATE
J. BUEL	01/12/16
REVISED BY	DATE
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SCALE	
AS NOTED	

NAVFAC

EXCEEDANCES OF SOIL MEDIA CLEANUP STANDARDS
SWMU 11 - OLD STORAGE BUILDING, B-225
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER	
F27R	
APPROVED BY	DATE
J. BUEL	01/12/16
APPROVED BY	DATE
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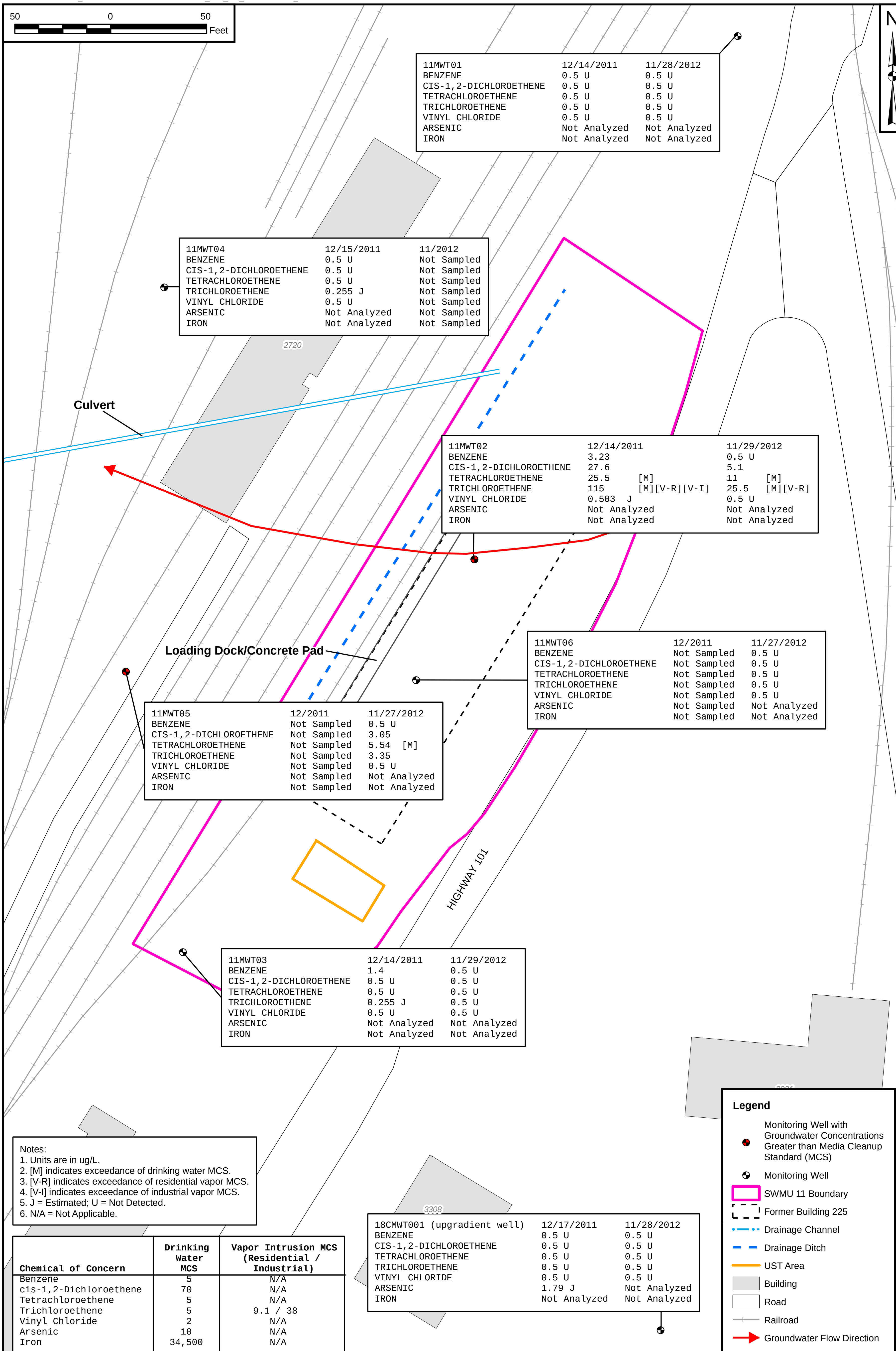
FIGURE NO.	REV
FIGURE 2-1	0



Notes:
1. Units are in ug/L.
2. [M] indicates exceedance of drinking water MCS.
3. [V-R] indicates exceedance of residential vapor MCS.
4. [V-I] indicates exceedance of industrial vapor MCS.
5. J = Estimated; U = Not Detected.
6. N/A = Not Applicable.

Chemical of Concern	Drinking Water MCS	Vapor Intrusion MCS (Residential / Industrial)
Benzene	5	N/A
cis-1,2-Dichloroethene	70	N/A
Tetrachloroethene	5	N/A
Trichloroethene	5	9.1 / 38
Vinyl Chloride	2	N/A
Arsenic	10	N/A
Iron	34,500	N/A

DRAWN BY J. ENGLISH DATE 10/22/15
CHECKED BY J. BUEL DATE 01/12/16
REVISED BY __ DATE __
SCALE AS NOTED

NAVFAC

CHEMICAL OF CONCERN CONCENTRATIONS IN GROUNDWATER
SWMU 11 - OLD STORAGE BUILDING, B-225
NSA CRANE
CRANE, INDIANA

CONTRACT NUMBER F27R
APPROVED BY J. BUEL DATE 01/12/16
APPROVED BY __ DATE __
FIGURE NO. FIGURE 2-2
REV 0

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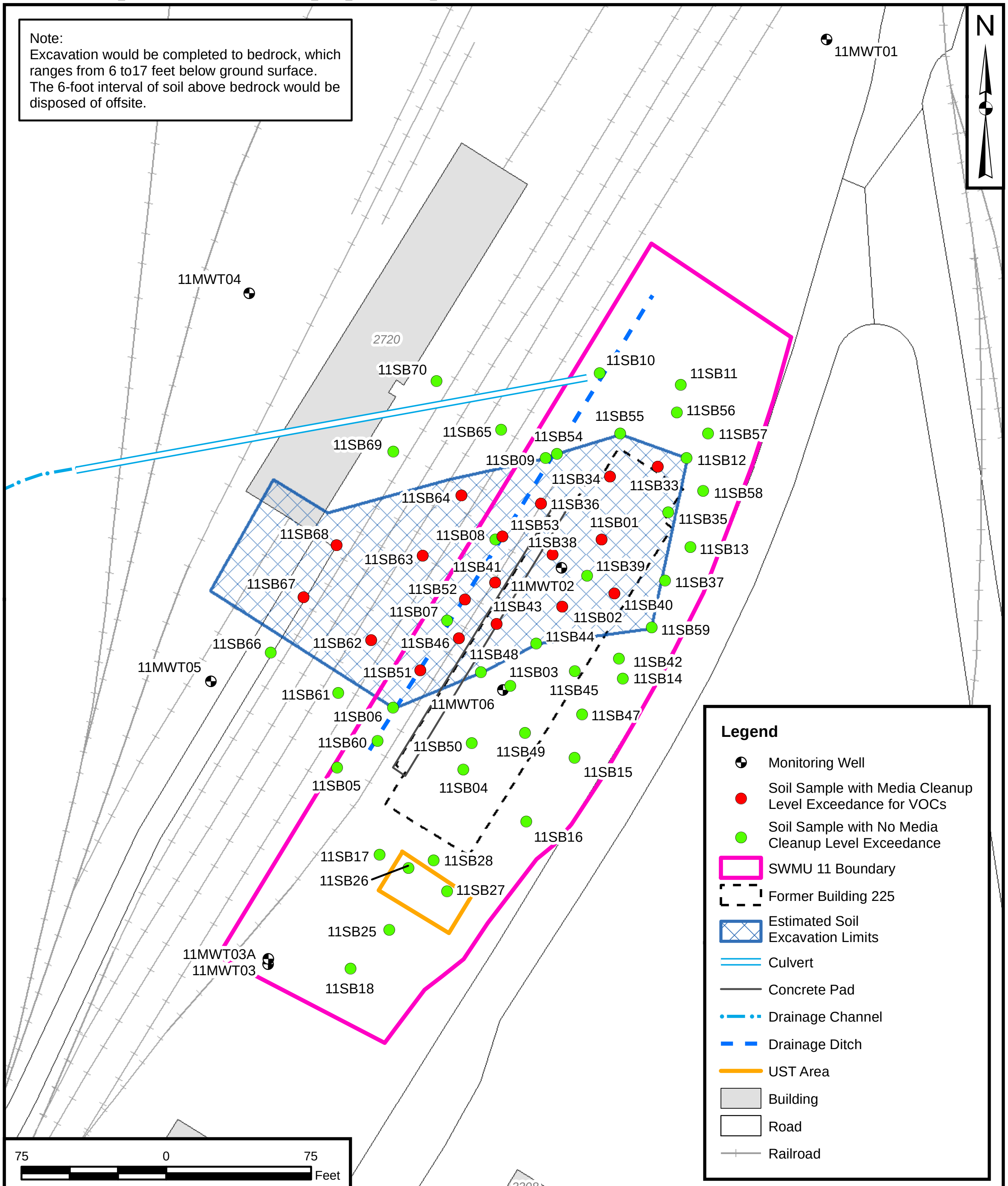

DRAWN BY J. ENGLISH	DATE 10/22/15	NAVFAC	ALTERNATIVE 3	CONTRACT NUMBER F27R
CHECKED BY J. BUEL	DATE 01/12/16		ESTIMATED SOIL EXCAVATION LIMITS SWMU 11	APPROVED BY J. BUEL DATE 01/12/16
REVISED BY	DATE		OLD STORAGE BUILDING, B-225	APPROVED BY ___ DATE ___
SCALE AS NOTED			NSA CRANE CRANE, INDIANA	FIGURE NO. FIGURE 2-3 REV 0

3.0 EVALUATION OF CORRECTIVE MEASURE ALTERNATIVES

The alternatives identified in Section 2.4 are evaluated in this section with respect to criteria presented in the RCRA Permit, Attachment 0, Task 7, Subtasks A and B. The evaluation criteria identified in the RCRA Permit include technical, environmental, human health, and institutional concerns, and cost estimates are also developed under Task 7.

Evaluation of the technical criterion includes evaluation of the performance, reliability, implementability, and safety of the alternative. As part of performance, the effectiveness and useful life of the corrective measures are considered. Information on reliability of the corrective measures includes consideration of operation and maintenance (O&M) requirements and availability of labor and materials to meet these requirements and potential for the alternative to fail and any impacts from failure. Implementability is evaluated in terms of relative ease of installation (constructability) and time required to achieve a given level of response based on time to implement and time to see beneficial results. Safety includes consideration of threats to nearby communities, the environment, and workers during implementation of the corrective measures.

Evaluation of the environmental criterion includes assessing facility conditions and pathways of contamination to be addressed by each alternative and evaluating short- and long-term beneficial and adverse impacts of the corrective measures to the environment, any potential adverse impacts on environmentally sensitive areas, and analysis of measures to mitigate adverse impacts if needed.

Evaluation of the human health criterion includes assessing the extent to which the corrective measures mitigate short- and long-term potential exposure to residual contamination and protect human health during and after implementation.

Evaluation of the institutional criterion includes assessing the effect of regulatory standards, guidance, and other requirements on the corrective measures.

Cost estimates consider both capital and O&M costs for the purposes of cost comparisons.

3.1 ALTERNATIVE 1 – NO ACTION

Under Alternative 1, no action would be taken to prevent use of contaminated groundwater at SWMU 11 as a source of drinking water, to prevent future residential or industrial construction, to confirm the integrity of the Building 225 floor slab (through inspection), or to provide monitoring to evaluate natural degradation and reduction in groundwater contaminant concentrations.

3.1.1 Technical

Although no action is proposed under this alternative, current groundwater data indicate that natural attenuation is occurring at the site. Natural attenuation relies on naturally occurring processes to reduce groundwater concentrations and because there is no technology being implemented, there is no useful life to consider under this alternative. Also, there is no way to evaluate the effectiveness and reliability of natural attenuation because no data would be collected under this alternative. Alternative 1 would be readily implementable because no action would occur. Alternative 1 would involve no action; therefore, it would not pose any safety risks to on-site workers, the surrounding community, or the environment.

3.1.2 Environmental

Under Alternative 1, the groundwater MCSs would be expected to eventually be attained; however, no data would be collected to verify when the MCSs are reached. There would be no adverse effect on the environment because there is no action under this alternative. The CSM indicates the absence of environmentally sensitive areas at SWMU 11.

3.1.3 Human Health

This alternative would be protective of human health in the short term but not in the long term. The alternative would be protective of human health in the short term because there are no current users of site groundwater and no inhabitable structures at the site. However, Alternative 1 would not prevent future use of groundwater from SWMU 11 as a source of drinking water or future construction of residential or industrial structures, which could result in unacceptable risks to human health in the future until MCSs are met. Also, Alternative 1 does not include monitoring to determine whether migration of COCs could adversely impact in the groundwater contamination plume and/or result in unacceptable human health risks in the future. Alternative 1 would not require monitoring the integrity of the Building 225 floor slab, and failures (e.g., major cracking, settling) or removal of the slab could result in unacceptable risk to human health in the future through migration of contaminants from soil to groundwater. Under current conditions, the Building 225 floor slab prevents migration of contamination into groundwater from precipitation infiltrating through underlying soil.

3.1.4 Institutional

No actions would be implemented under Alternative 1; therefore, there are no institutional criteria to consider for this alternative.

3.1.5 Cost Estimate

There are no costs associated with the no action alternative.

3.2 ALTERNATIVE 2 – MNA AND LUCs

Under Alternative 2, a combination of MNA, LTM of groundwater, LUCs and seven-year reviews would be conducted to prevent potential unacceptable human health exposures at SWMU 11. Potential unacceptable exposures identified in Section 2.1.2 include: (1) hypothetical future residential exposure to site groundwater with COC concentrations greater than MCSs and (2) hypothetical future residential and industrial/commercial exposure to indoor air impacted by vapor intrusion of volatile COCs in groundwater at concentrations greater than IDEM vapor exposure levels into an occupied structure.

3.2.1 Technical

Current data indicate that natural attenuation is occurring at the site, and under this alternative, LTM would verify the long-term effectiveness of natural attenuation. NSA Crane is a secured facility with the ability to enforce LUCs, making LUCs a reliable and effective way to prevent potential unacceptable exposures. The useful life of the components under this alternative is indefinite because natural attenuation relies on naturally occurring processes to reduce groundwater concentrations, and LUCs which can be enforced and maintained indefinitely. Also, monitoring wells are typically functional for years, but can be cleaned or replaced, as needed.

MNA has been applied at numerous sites and is considered a reliable technology provided that conditions favoring natural attenuation continue to be present. Naturally occurring processes require no O&M, making natural attenuation a very reliable technology. LUCs have been applied at numerous sites and implemented through LUCIPs or other existing facility-specific site use plans and these plans are reliably enforced at active facilities such as NSA Crane. The reliability of the LUC component is contingent upon LUCs being effective in preventing exposure until MCSs are met. MNA combined with LUCs has been implemented at several NSA Crane sites. Early indications of the occurrence of natural attenuation support the reliability of MNA to reduce groundwater concentrations and LUCs to prevent unacceptable exposures at NSA Crane sites.

Alternative 2 would be easy to implement because resources, materials, and equipment are readily available to implement LUCs and perform LTM over the 30 years it is assumed for natural attenuation to reduce groundwater concentrations to the MCSs. Coordination with the appropriate railroad dispatch would be required for any work occurring in or near the railroad right-of-way.

There would be short-term safety and exposure risks associated with the implementation of Alternative 2. Active railroad lines near the site present the opportunity for potential struck-by hazards to workers performing LTM and LUC inspection activities (e.g., installing or sampling wells). Groundwater sampling activities would also present a potential exposure risk to COCs in groundwater for site workers during sample collection. These potential safety and exposure risks would be minimized by following health and safety procedures, including workers undergoing site-specific health and safety training prior to commencing field work and wearing personal protective equipment during sampling activities. Implementation of this alternative is not expected to result in any short-term safety or exposure risks to the surrounding community.

3.2.2 Environmental

Alternative 2 would be expected to eventually attain groundwater MCSs and LTM would verify when the MCSs are reached. Natural attenuation would not have an adverse effect on the environment because it relies on naturally occurring processes. The CSM indicates the absence of environmentally sensitive areas at SWMU 11.

3.2.3 Human Health

Alternative 2 would be protective of human health in the short term and long term. The alternative would be protective of human health in the short term because there are no current users of site groundwater and no inhabitable structures at the site. This alternative would be protective of human health in the long term because LUCs would prevent future use of groundwater from SWMU 11 as a source of drinking water and restrict future construction of residential or industrial structures until MCSs are met. In addition, Alternative 2 would include a LUC that would require monitoring the integrity of the Building 225 floor slab to eliminate potential unacceptable risk to human health in the future through migration of contaminants from soil under the building slab to groundwater. Under current conditions, the Building 225 floor slab prevents migration of contamination into groundwater from precipitation infiltrating through underlying soil and adversely impacting the groundwater contamination plume. The effects of COC concentrations in subsurface soil located outside of the footprint of the building foundation that are greater than the subsurface soil MCSs would be evaluated by installing additional monitoring wells in the impacted areas and sampling these wells as part of the LTM program or through SPLP testing. The COC concentrations in the groundwater would be used to determine whether contaminants are leaching from soil into the groundwater at concentrations that may adversely impact the groundwater plume stability. The results of recent groundwater sampling downgradient of the building do not suggest a significant source of COCs leaching from the soil outside the building foundation.

3.2.4 Institutional

No special permits would be anticipated for conducting LTM and implementing LUCs. However, because the rail lines next to the site are active, rules and regulations of the railroad must be followed during any activities in the railroad right-of-way. Notification and coordination with the appropriate railroad dispatch would be required for any work in or near the railroad right-of way. In addition, any monitoring wells installed near or along the railroad would be required to be flush mount.

3.2.5 Cost Estimate

The following costs have been estimated for Alternative 2:

- Capital cost: $ 127,000
- O&M Annual Cost: $ 3,000
- O&M Biennial Cost: $ 22,000
- Seven-Year Review: $ 13,000
- 30-Year Net Present Worth (NPW): $ 500,000

The above costs have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. Detailed cost estimates for Alternative 2 are provided in Appendix A.

3.3 ALTERNATIVE 3 – SOURCE REDUCTION, MNA, AND LUCs

Under Alternative 3, a combination of soil removal, MNA, LTM of groundwater, LUCs and seven-year reviews would be conducted to prevent potential unacceptable human health exposures at SWMU 11. Potential unacceptable exposures identified in Section 2.1.2 include: (1) hypothetical future residential exposure to site groundwater with COC concentrations greater than MCSs and (2) hypothetical future residential or industrial/commercial exposures to indoor air impacted by vapor intrusion of volatile COCs in groundwater at concentrations greater than IDEM vapor exposure levels into an occupied structure.

3.3.1 Technical

Current data indicate that natural attenuation is occurring at the site, and excavation of soils with COC concentrations greater than MCSs would expedite the natural attenuation process while LTM would verify the long-term effectiveness of natural attenuation. NSA Crane is a secured facility with the ability to enforce LUCs, making LUCs a reliable and effective way to prevent potential unacceptable exposures. The useful life of the components under this alternative is indefinite because natural attenuation relies on naturally occurring processes to reduce groundwater concentrations, and excavation requires no long-term O&M. Monitoring wells are typically functional for years, but can be cleaned or replaced, as needed. LUCs can be enforced and maintained until MCSs are met. Soil excavation would permanently remove contaminants from the site eliminating the need to monitor the integrity of the Building 225 floor slab.

MNA has been applied at numerous sites and is considered a reliable technology provided that conditions favoring natural attenuation continue to be present. Excavation is a reliable method for removal of contaminated soil, and sampling and visual observations would be used to evaluate its effectiveness. At SWMU 11, the tracks, ballast, loading dock and Building 225 floor slab would have to be removed to access contaminated soil. Soil excavation and naturally occurring processes require no long-term O&M, making them very reliable technologies. LUCs have been applied at numerous sites and implemented through LUCIPs or other existing facility-specific site use plans and these plans are reliably enforced at active facilities such as NSA Crane. The reliability of the LUC component is contingent upon LUCs being effective in preventing exposure until MCSs are met. Excavation combined with MNA to reduce groundwater concentrations and LUCs to prevent unacceptable exposures has been performed at several NSA Crane sites.

Although resources, materials, and equipment are readily available to implement soil excavation and LUCs and to perform LTM over the 20 years it is assumed for natural attenuation to reduce groundwater concentrations to MCSs, soil excavation would involve additional constructability considerations. First, coordination with the appropriate railroad dispatch would be required for any work occurring in or near the railroad right-of-way, and impacts to production operations would be anticipated while the rail line is out of service. Second, soil excavation would be complicated by surface infrastructure. The railroad tracks and ballast and loading dock would need to be temporarily removed to implement the soil excavation and would need to be subsequently reconstructed. The Building 225 floor slab would also need to be removed but would not need to be replaced. Third, the removal of contaminated soil to the top of bedrock, up to 16 to 17 feet bgs, could be accomplished through the use of excavation bracing, soldier piles, and/or long-reach or clam shell excavators; however, special measures would need to be taken to ensure that the excavation does not impact the stability of the rail lines. Multiple general and specialized contractors have the capability to perform the activities specified for this alternative, including the special considerations associated with performing work near active rail lines.

There would be short-term safety and exposure risks associated with implementation of Alternative 3. Active railroad lines near the site present the opportunity for potential struck-by hazards to workers performing soil excavation and LTM and LUC activities (e.g., excavation or sampling wells). There would be additional hazards associated with trenching and excavation work (e.g., cave-ins) that can occur during construction activities if an unstable trench or excavation collapses. Groundwater sampling activities also present a potential exposure risk to COCs in groundwater for site workers during sample collection; no unacceptable risks associated with direct contact exposure to soils at the site were identified in the human health risk assessment presented in the RFI Report (Tetra Tech, September 2015). Potential safety and exposure risks would be prevented or minimized by following health and safety procedures, including workers undergoing site-specific health and safety training prior to commencing field work and wearing personal protective equipment during sampling activities. There would be a slight increase in risk to the surrounding community during transportation of excavated soil and backfill operations compared to soil remaining undisturbed at the site.

3.3.2 Environment

The soil excavation and natural attenuation components of Alternative 3 would be expected to attain groundwater MCSs, and LTM would verify when the MCSs are reached. Soil excavation would benefit the environment by eliminating the soil-to-groundwater migration pathway for COCs and expediting the natural attenuation process. Natural attenuation would not have an adverse effect on the environment because it relies on naturally occurring processes. The CSM indicates the absence of environmentally sensitive areas at SWMU 11.

3.3.3 Human Health

Alternative 3 would be protective of human health in the short term and long term. The alternative would be protective of human health in the short term because there are no current users of the site groundwater and no inhabitable structures at the site. This alternative would be protective of human health in the long term because LUCs would prevent future use of groundwater from SWMU 11 as a source of drinking water and restrict future construction of residential or industrial structures until MCSs are met. In addition, soil excavation would mitigate potential risks and groundwater contamination associated with the soil-to-groundwater pathway.

3.3.4 Institutional

Soil excavation and disposal would need to be conducted in accordance with RCRA requirements. No special permits would be anticipated for conducting soil removal and LTM and for implementing LUCs. However, because the rail lines next to the site are active, rules and regulations of the railroad must be followed during any activities in the railroad right-of-way. Notification and coordination with the appropriate railroad dispatch would be required for any work in or near the railroad right-of way. In addition, any monitoring wells installed near or along the railroad would be required to be flush mount, and extra care would need to be taken during excavation work to ensure that the stability of the rail lines is not impacted.

3.3.5 Cost Estimate

The following costs have been estimated for Alternative 3:

- Capital cost: $ 2,672,000
- Annual Cost: $ 3,000
- Biennial Cost: $ 22,000
- Seven-Year Review: $ 13,000
- 30-Year NPW: $ 2,933,000

The above costs have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. Detailed cost estimates and supporting calculations for Alternative 3 are provided in Appendix A.

4.0 JUSTIFICATION AND RECOMMENDATION OF THE CORRECTIVE MEASURES

This section provides the justification for and recommendation of the corrective measures at SWMU 11. Justification is provided in Section 4.1 through a comparison of the alternatives to the four criteria (technical, environmental, human health, and cost) specified in Task 8 of the RCRA Permit. Table 4-1 provides a summary of the comparison. Section 4.2 identifies the recommended corrective measures and provides the rationale for the recommendation. This section meets the requirements of the RCRA Permit, Attachment 0, Task 8, Subtasks A to D.

4.1 JUSTIFICATION FOR CORRECTIVE MEASURES

Comparisons of the technical, environmental, human health, and cost criteria among the three alternatives are provided in the following subsections.

4.1.1 <u>Technical</u>

Technical evaluations of all three alternatives indicate that natural attenuation is already occurring at the site and that the useful lives of the components of Alternatives 2 and 3 are indefinite, primarily because natural attenuation relies on naturally occurring processes to reduce groundwater concentrations; there is no useful life to consider under Alternative 1 because there is no technology being implemented. The reliability of Alternative 1 cannot be evaluated because no data would be collected to confirm groundwater concentration reductions. Alternatives 2 and 3 have been proven to be reliable methods to reduce groundwater concentrations and prevent unacceptable exposures at other sites at NSA Crane. The reliability of Alternatives 2 and 3 is contingent on LUCs preventing exposure until MCSs are met.

The major differences identified under the technical evaluation of the alternatives are related to implementability and safety. There are no issues with implementation or safety under Alternative 1 because no action would occur. Alternative 2 would be more easily implemented than Alternative 3 due to the soil excavation component associated with Alternative 3. The soil excavation would be complicated by surface infrastructure and depths of the excavation (to the top of bedrock, which is 16 feet in some parts of the site) and production impacts associated with the railroad lines being taken out of service. The soil excavation component would also be associated with the increased safety risk to workers and the surrounding community identified for Alternative 3 compared to Alternative 2. Due to the low groundwater COC concentrations at the site, implementation of the soil excavation under Alternative 3 would only be expected to reduce the amount of time for natural attenuation to achieve MCSs by 10 years.

4.1.2 Environmental

All three alternatives are expected to attain groundwater MCSs, and none would be expected to have an adverse effect of the environment because natural attenuation relies on naturally occurring processes and because no environmentally sensitive areas are present at the site. The soil excavation component of Alternative 3 would offer an added benefit to the environment of preventing migration of COCs from soil to groundwater by preventing potential future groundwater contamination.

4.1.3 Human Health

All three alternatives would be protective of human health in the short term because there are no current receptors and/or exposure pathways. Alternative 1 would not be protective of human health in the long term due to the lack of action to prevent future exposures. Alternatives 2 and 3 would offer similar protection of human health in the long term associated with implementation of LUCs and natural attenuation process reducing groundwater concentrations. The addition of soil excavation under Alternative 3 would offer some additional protection to prevent future groundwater contamination; however, the LUC component under Alternative 2 is equally protective in preventing exposures.

4.1.4 Cost

There is no cost associated with Alternative 1 because no action would occur. Alternative 3 (NPW of $2,933,000) is approximately six times more expensive than Alternative 2 (NPW of 500,000) due to the additional soil excavation component included under Alternative 3.

4.2 RECOMMENDATION OF CORRECTIVE MEASURES

The components of Alternative 2 (MNA, LTM of groundwater, LUCs, and seven-year reviews) are the recommended corrective measures for SWMU 11. Alternative 2 includes MNA and LTM of groundwater to address potential unacceptable risks associated with exposure to site groundwater and vapor intrusion. LUCs would be implemented to prevent exposures to groundwater, restrict construction of inhabitable buildings until the groundwater MCSs are met, and protect the integrity of the existing Building 225 floor slab to prevent contaminants in soil beneath the floor slab from adversely impacting the groundwater plume stability.

Alternative 1 was eliminated for consideration because it would not protect human health in the long term. Alternative 2 poses less of a potential threat to the safety of nearby residents and the environment as well as workers during implementation compared to Alternative 3. Alternatives 2 and 3 were found to both be technically adequate and sufficiently protective of human health and the environment; therefore, per

Attachment 0, Task 8, Subtask D of the RCRA Permit, the corrective measure that costs the least (i.e., Alternative 2) has been selected as the recommended corrective measure for SWMU 11.

SUMMARY OF COMPARATIVE ANALYSIS OF CORRECTIVE MEASURE ALTERNATIVES
SWMU 11 – OLD STORAGE BUILDING, B-225
NSA CRANE, CRANE, INDIANA

Evaluation Criterion	Alternative 1: No Action	Alternative 2: MNA and LUCs	Alternative 3: Source Reduction, MNA, and LUCs
Technical	Performance: Current data indicate natural attenuation is occurring; however, there would be no way to evaluate effectiveness of natural attenuation because no data would be collected. Because there is no technology being implemented, there is no useful life to consider. Reliability: There would be no way to evaluate reliability of natural attenuation because no data would be collected. Implementability: Not applicable because no action would occur. Nothing would be implemented. Safety: No safety or exposure risks to workers or the surrounding community because no action would occur.	Performance: Current data indicate natural attenuation is occurring, and LTM would verify effectiveness of natural attenuation. NSA Crane is a secured facility and LUCs would be reliably enforced. Useful life of the components is indefinite because natural attenuation relies on naturally occurring processes to reduce groundwater concentrations and LUCs, which can be maintained indefinitely. Reliability: Naturally occurring processes require no O&M. MNA combined with LUCs has been demonstrated to be a reliable method at NSA Crane to reduce groundwater concentrations and prevent unacceptable exposures. Reliability would be contingent on LUCs being effective to prevent exposure until MCSs are met. Implementability: Resources, materials, and equipment are readily available to implement LUCs and perform LTM over the 30 years it is assumed to meet MCSs. No special permits are anticipated for conducting LTM and LUCs; however, coordination with railroad dispatch would be required. Safety: Short-term safety and exposure risks to workers installing/sampling wells near active rail lines; risks could be reduced by following H&S procedures.	Performance: Current data indicate natural attenuation is occurring, and LTM would verify effectiveness of natural attenuation. Soil excavation would eliminate future migration of COCs from soil to groundwater and expedite natural attenuation. Useful life of the components is indefinite because the action relies on naturally occurring processes to reduce groundwater concentrations and LUCs, which can be maintained until MCSs are met. Excavation would remove contaminants and would not require O&M of the Building 225 floor slab. Reliability: Soil excavation and naturally occurring processes require no O&M. Excavation combined with MNA and LUCs has been demonstrated to be a reliable method at NSA Crane to reduce groundwater concentrations and prevent unacceptable exposures. Reliability would be contingent on LUCs being effective to prevent exposure until MCSs are met. Implementability: Resources, materials, and equipment are readily available to implement LUCs and soil excavation and perform LTM over the 20 years it is assumed to meet MCSs. Excavation would be complicated by surface infrastructure (e.g., building floor slab, railroad tracks and ballast). Production operations would be impacted while the railroad tracks are out of service. No special permits anticipated for conducting excavation, LTM, or LUCs; however, coordination with railroad dispatch would be required. Safety: Short-term safety and exposure risks to workers excavating soils and installing/sampling wells and conducting site inspections near active rail lines; risks could be reduced by following H&S procedures. Slight risks to surrounding community during soil excavation.

TABLE 4-1

SUMMARY OF COMPARATIVE ANALYSIS OF CORRECTIVE MEASURE ALTERNATIVES
SWMU 11 – OLD STORAGE BUILDING, B-225
NSA CRANE, CRANE, INDIANA

Evaluation Criterion	Alternative 1: No Action	Alternative 2: MNA and LUCs	Alternative 3: Source Reduction, MNA, and LUCs
Environmental	Alternative would eventually attain groundwater MCS; however, no data would be collected to verify when MCSs are reached. NA would not have an adverse effect on the environment because it relies on naturally occurring processes. CSM indicates absence of environmentally sensitive areas.	Alternative would attain groundwater MCS, and LTM would verify when MCSs are reached. Natural attenuation would not have an adverse effect on the environment because it relies on naturally occurring processes. CSM indicates absence of environmentally sensitive areas.	Alternative would attain groundwater MCSs, and LTM would verify when MCSs are reached. Natural attenuation would not have an adverse effect on the environment because it relies on naturally occurring processes. Excavation of soils would benefit the environment by preventing migration of COCs from soil to groundwater. CSM indicates absence of environmentally sensitive areas.
Human Health	No action would be protective of human health in the short term because there are no current users of groundwater and no inhabitable structures at the site. However, there would be no action to prevent future potential unacceptable risks associated with groundwater, indoor air, and the soil-to-groundwater migration pathway.	Alternative would be protective of human health in the short term and long term. Although there are no current receptors at the site, LUCs would prevent future exposure to contaminated groundwater and restrict construction of inhabitable buildings until MCSs are met through MNA. In addition, LUCs would protect the integrity of the existing Building 225 floor slab and prevent contaminants in soil beneath the floor slab of Building 225 with concentrations greater than MCSs from migrating to groundwater. LTM groundwater data would evaluate the soil to groundwater migration pathway for areas outside the footprint of the Building 225 floor slab.	Alternative would be protective of human health in the short term and long term. Although there are no current receptors at the site, LUCs would prevent future exposure to contaminated groundwater and restrict construction of inhabitable buildings until MCSs are met through MNA. Soil excavation would mitigate potential risks associated with the soil-to-groundwater pathway such that groundwater concentrations would no longer be adversely impacted and LUCs to monitor the integrity of Building 225 floor slab would not be necessary.
Cost: Capital Annual Biennial Seven-Year NPW	 $0 $0 $0 $0 $0	 $127,000 $ 3,000 $ 22,000 $ 13,000 $500,000	 $2,672,000 $ 3,000 $ 22,000 $ 13,000 $2,933,000

COC – Chemical of concern.
CSM – Conceptual site model.
H&S – Health and safety.
LTM – Long-term monitoring.
LUC – Land use control.
MCS – Media cleanup standard.
MNA – Monitored natural attenuation.
NPW – Net present worth.
O&M – Operation and Maintenance.

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APPENDIX A

COST ESTIMATE

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION AND LUCS
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Subtotal
1 PROJECT DOCUMENTS/INSTITUTIONAL CONTROLS											
1.1 Prepare Documents, Plans	150	hr			$40.00		$0	$0	$6,000	$0	$6,000
1.2 Prepare Land Use Controls Documents	100	hr			$40.00		$0	$0	$4,000	$0	$4,000
2 MONITORING WELLS INSTALLATION											
2.1 Underground Utility Clearances	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
2.2 Mobilization/Demobilization	1	ls	$3,000.00				$3,000	$0	$0	$0	$3,000
2.3 Monitoring Wells Installation (3- 2" wells @50 ft. each)	150	lf	$60.00				$9,000	$0	$0	$0	$9,000
2.4 Well Heads	3	ea	$250.00				$750	$0	$0	$0	$750
2.5 Well Development @3 hours/well	3	ea	$500.00				$1,500	$0	$0	$0	$1,500
2.6 Well Layout Survey	1	day	$1,950.00				$1,950	$0	$0	$0	$1,950
2.7 Well Installation Oversight	4	day		$140.00	$432.70		$0	$560	$1,731	$0	$2,291
2.8 IDW Disposal	4	drum	$250.00				$1,000	$0	$0	$0	$1,000
3 MNA EVALUATION											
3.1 Groundwater for VOCs Analysis	12	sample	$120.00				$1,440	$0	$0	$0	$1,440
3.2 Groundwater for metals Analysis	10	sample	$120.00				$1,200	$0	$0	$0	$1,200
3.3 Groundwater for TOC, Volatile Fatty Acids, Dissolved Gases	4	sample	$350.00				$1,400	$0	$0	$0	$1,400
3.4 Groundwater for Genes qPCR (11MWT02 and two new well)	3	sample	$475.00				$1,425	$0	$0	$0	$1,425
3.5 Sampling labor 4 days/event/2 people	80	hr			$40.00		$0	$0	$3,200	$0	$3,200
3.6 Natural Attenuation Evaluation and Reporting	180	hr			$40.00		$0	$0	$7,200	$0	$7,200
3.7 Sampling ODCs	1	ls		$2,500.00			$0	$2,500	$0	$0	$2,500
							$30,165	$3,060	$22,131	$0	$55,356
Overhead on Labor Cost @ 30%									$6,639		$6,639
G & A on Labor, Material, Equipment, & Subs Cost @ 10%							$3,017	$306	$2,213	$0	$5,536
Tax on Materials and Equipment Cost @ 7%								$214		$0	$214
Total Direct Cost							$33,182	$3,580	$30,983	$0	$67,745
Indirects on Total Direct Cost @ 30%											$20,323
Profit on Total Direct Cost @ 10%											$6,774
Subtotal											$94,843
Health & Safety Monitoring @ 3%											$2,845
Total Field Cost											$97,688
Contingency on Total Field Costs @ 20%											$19,538
Engineering on Total Field Cost @ 10%											$9,769
TOTAL COST											**$126,994**

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION AND LUCS
Groundwater Monitoring

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 Direct Cost
1 Long-Term Groundwater Monitoring Per Event											
1.1 Groundwater for VOCs,9 samples/event	12	samples	$120.00				$1,440	$0	$0	$0	$1,440
1.2 Sampling labor 3days/event/2 people	60	hours			$40.00		$0	$0	$2,400	$0	$2,400
1.3 Prepare Report	80	hours			$40.00		$0	$0	$3,200	$0	$3,200
1.4 Sampling ODCs	1	ls		$2,000.00			$0	$2,000	$0	$0	$2,000
Subtotal							$1,440	$2,000	$5,600	$0	$9,040
Overhead on Labor Cost @	30%								$1,680		$1,680
G & A on Labor, Material, Equipment, & Subs Cost @	10%						$144	$200	$560	$0	$904
Tax on Materials and Equipment Cost @	7%							$140.00		$0	$140
Total Direct Cost							$1,584	$2,340	$7,840	$0	$11,764
Indirects on Total Direct Cost @	30%										$3,529
Profit on Total Direct Cost @	10%										$1,176
Subtotal											$16,470
Health & Safety Monitoring @	0%										$0
Total Field Cost											$16,470
Contingency on Total Field Costs @	20%										$3,294
Engineering on Total Field Cost @	0%										$0
Total Monitoring Cost											**$19,764**

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION AND LUCS
O&M Cost

Item	Item Cost annual	Item Cost every two years	Item Cost every 7 years	Notes
Groundwater Monitoring		$19,764		Collect groundwater samples from 6 existing monitoring wells and 3 new monitoring wells per sampling event biennially plus travel, living, and shipping costs. 12 samples will be collected for TCL VOCs analysis.
Land Use Controls Inspection and Report	$2,710			LUCs inspection annually
7 -Year Review			$12,000	Review of site conditions by two engineers for every 7 years.
Subtotal	$2,710	$19,764	$12,000	
Contingency @ 10%	$271	$1,976	$1,200	
TOTAL	**$2,981**	**$21,740**	**$13,200**	

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 2 - MONITORED NATURAL ATTENUATION AND LUCS
Present Worth Analysis

Year	Capital Cost	O & M Cost	Total Year Cost	Annual Discount Rate 1.4%	Yearly Present Worth	Total Present Worth
0	$126,994		$126,994	1.000	$126,994	
1		$2,981	$2,981	0.986	$2,940	
2		$24,721	$24,721	0.973	$24,043	
3		$2,981	$2,981	0.959	$2,859	
4		$24,721	$24,721	0.946	$23,384	
5		$2,981	$2,981	0.933	$2,781	
6		$24,721	$24,721	0.920	$22,742	
7		$16,181	$16,181	0.907	$14,680	
8		$24,721	$24,721	0.895	$22,119	
9		$2,981	$2,981	0.882	$2,630	
10		$24,721	$24,721	0.870	$21,512	
11		$2,981	$2,981	0.858	$2,558	
12		$24,721	$24,721	0.846	$20,922	
13		$2,981	$2,981	0.835	$2,488	
14		$37,921	$37,921	0.823	$31,214	
15		$2,981	$2,981	0.812	$2,420	
16		$24,721	$24,721	0.801	$19,790	
17		$2,981	$2,981	0.790	$2,354	
18		$24,721	$24,721	0.779	$19,248	
19		$2,981	$2,981	0.768	$2,289	
20		$24,721	$24,721	0.757	$18,720	
21		$16,181	$16,181	0.747	$12,084	
22		$24,721	$24,721	0.736	$18,207	
23		$2,981	$2,981	0.726	$2,165	
24		$24,721	$24,721	0.716	$17,707	
25		$2,981	$2,981	0.706	$2,106	
26		$24,721	$24,721	0.697	$17,222	
27		$2,981	$2,981	0.687	$2,048	
28		$37,921	$37,921	0.678	$25,693	
29		$2,981	$2,981	0.668	$1,992	
30		$24,721	$24,721	0.659	$16,290	**$504,202**

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 3 - SOURCE REDUCTION, MONITORED NATURAL ATTENUATION AND LUCS
Capital Cost

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT DOCUMENTS/INSTITUTIONAL CONTROLS											
1.1 Prepare Work Plans/Permits	240	hr			$40.00		$0	$0	$9,600	$0	$9,600
1.2 Prepare Land Use Controls Documents	100	hr			$40.00		$0	$0	$4,000	$0	$4,000
2 ADDITIONAL SITE CHARACTERIZATION											
2.1 Mobilization/Demobilization	1	ls	$4,500.00				$4,500	$0	$0	$0	$4,500
2.2 DPT Drilling (30 borings @18 ft)	10	day	$2,500.00				$25,000	$0	$0	$0	$25,000
2.3 Sample Collection	10	day		$140.00	$390.00	$100.00	$0	$1,400	$3,900	$1,000	$6,300
2.4 Soil for VOCs Analysis	60	sample	$110.00	$15.00			$6,600	$900	$0	$0	$7,500
2.5 Soil for metals Analysis	60	sample	$110.00	$15.00			$6,600	$900	$0	$0	$7,500
2.6 Monitoring Wells Installation (3- 2" wells @50 ft. each)	150	ft	$60.00				$9,000	$0	$0	$0	$9,000
2.7 Well Heads	3	ea	$250.00				$750	$0	$0	$0	$750
2.8 Well Development @3 hours/well	3	ea	$500.00				$1,500	$0	$0	$0	$1,500
2.9 Waste Disposal Characterization / Analytical	5	ea	$1,200.00	$50.00	$75.00	$40.00	$6,000	$250	$375	$200	$6,825
2.10 IDW Disposal	4	drum	$250.00				$1,000	$0	$0	$0	$1,000
3 SITE PREPARATION AND FIELD SUPPORT							$0		$0		
3.1 Office Trailer	3	mo				$410.00	$0	$0	$0	$1,230	$1,230
3.2 Field Office Equipment, Utilities, & Support	3	mo		$520.00			$0	$1,560	$0	$0	$1,560
3.3 Storage Trailer	3	mo				$101.00	$0	$0	$0	$303	$303
3.4 Utility Connection/Disconnection (phone/electric)	1	ls	$1,250.00				$1,250	$0	$0	$0	$1,250
3.5 Construction Layout Survey	5	day	$1,950.00				$9,750	$0	$0	$0	$9,750
3.6 Underground Utility Clearances	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
3.7 Support Pads,50' by 50' each	1	ea		$1,650.00	$1,800.00	$1,200.00	$0	$1,650	$1,800	$1,200	$4,650
3.8 Equipment Mobilization/Demobilization	8	ea			$456.00	$470.00	$0	$0	$3,648	$3,760	$7,408
3.9 Site Superintendent	66	day		$140.00	$432.70		$0	$9,240	$28,558	$0	$37,798
3.7 Site Health & Safety and QA/QC	66	day		$140.00	$384.60		$0	$9,240	$25,384	$0	$34,624
4 DECONTAMINATION											
4.1 Decontamination Services	3	mo		$1,225.00	$2,400.00	$1,650.00	$0	$3,675	$7,200	$4,950	$15,825
4.2 Temporary Equipment Decon Pad	1	ls		$2,400.00	$1,370.00	$1,050.00	$0	$2,400	$1,370	$1,050	$4,820
4.3 Decon Water	3,000	gal		$0.20			$0	$600	$0	$0	$600
4.4 Decon Water Storage Tank, 6,000 gallon	3	mo				$790.00	$0	$0	$0	$2,370	$2,370
4.5 Clean Water Storage Tank, 4,000 gallon	3	mo				$705.00	$0	$0	$0	$2,115	$2,115
4.6 Disposal of Decon Waste (liquid & solid)	3	mo	$1,020.00				$3,060	$0	$0	$0	$3,060
5 EXCAVATION AND DISPOSAL											
5.1 Remove & Replace Railroad Tracks	652	lf	$66.50				$43,358	$0	$0	$0	$43,358
5.2 Replace Railroad Ballast	652	lf	$81.45				$53,105	$0	$0	$0	$53,105
5.3 Loading Docks Removal and Replacement	1	ls	$22,000.00				$22,000	$0	$0	$0	$22,000
5.4 Excavator, Crawler Mounted,1-1/2 cy	60	day			$404.80	$629.80	$0	$0	$24,288	$37,788	$62,076
5.5 Front End Loader, 3 cy (145HP)	60	day			$404.80	$519.80	$0	$0	$24,288	$31,188	$55,476
5.6 Dozer, Crawler, 105 H. P.	40	day			$404.80	$620.80	$0	$0	$16,192	$24,832	$41,024
5.7 Compactor, 240 hp	10	day			$404.80	$1,206.00	$0	$0	$4,048	$12,060	$16,108
5.8 Site Labor, (2 laborers)	120	day			$291.36		$0	$0	$34,963	$0	$34,963
5.9 Support System for Excavation	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
5.10 Off Site T & D of Excavated Soil, non-hazardous	6,300	ton	$90.00				$567,000	$0	$0	$0	$567,000
5.11 Off Site T & D of Excavated Soil, Hazardous	700	ton	$320.00				$224,000	$0	$0	$0	$224,000
5.12 Confirmatory Sampling, (VOCs, 72 hr TAT)	30	sample	$230.00	$50.00	$75.00	$40.00	$6,900	$1,500	$2,250	$1,200	$11,850
5.13 Confirmatory Sampling, (Metals, 72 hr TAT)	30	sample	$230.00	$50.00	$75.00	$40.00	$6,900	$1,500	$2,250	$1,200	$11,850
6 SITE RESTORATION											
6.1 Backfill, common fill	4,300	cy		$24.70			$0	$106,210	$0	$0	$106,210
6.2 Backfill, topsoil	30	cy		$36.17			$0	$1,085	$0	$0	$1,085
6.3 Asphalt Pavement	5,245	sf	$3.61				$18,934	$0	$0	$0	$18,934
6.4 Geotextile Fabric	1,379	sy		$1.46			$0	$2,013	$0	$0	$2,013
6.5 Gravel, 6" thick	1,379	sy		$6.70	$0.53	$0.89	$0	$9,238	$731	$1,227	$11,196
6.6 Revegetation, seed	2	msf	$68.00				$136	$0	$0	$0	$136

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 3 - SOURCE REDUCTION, MONITORED NATURAL ATTENUATION AND LUCS
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
7	**POST CONSTRUCTION COST**											
7.1	Contractor Completion Report	100	hr			$40.00		$0	$0	$4,000	$0	$4,000
8	**MNA EVALUATION**											
8.1	Groundwater for VOCs Analysis	12	sample	$120.00				$1,440	$0	$0	$0	$1,440
8.2	Groundwater for metals Analysis	10	sample	$120.00				$1,200	$0	$0	$0	$1,200
8.3	Groundwater for TOC, Volatile Fatty Acids, Dissolved Ga	4	sample	$350.00				$1,400	$0	$0	$0	$1,400
8.4	Groundwater for Genes qPCR (11MWT02 and two new	3	sample	$475.00				$1,425	$0	$0	$0	$1,425
8.5	Sampling labor 4 days/event/2 people	80	hr			$40.00		$0	$0	$3,200	$0	$3,200
8.6	Natural Attenuation Evaluation and Reporting	180	hr			$40.00		$0	$0	$7,200	$0	$7,200
8.7	Sampling ODCs	1	ls		$2,500.00			$0	$2,500	$0	$0	$2,500
	Subtotal							$1,048,309	$155,861	$209,245	$127,673	$1,541,088
	Overhead on Labor Cost @	30%								$62,773		$62,773
	G & A on Labor, Material, Equipment, & Subs Cost @	10%						$104,831	$15,586	$20,924	$12,767	$154,109
	Tax on Materials and Equipment Cost @	7%							$10,910		$8,937	$19,847
	Total Direct Cost							$1,153,140	$182,357	$292,943	$149,378	$1,777,817
	Indirects on Total Direct Cost @	15%	(excluding transportation and disposal cost)									$148,023
	Profit on Total Direct Cost @	10%										$177,782
	Total Field Cost											$2,103,622
	Contingency on Total Field Cost @	20%										$420,724
	Engineering on Total Field Cost @	7%										$147,254
	GRAND TOTAL COST											**$2,671,599**

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 3 - SOURCE REDUCTION, MONITORED NATURAL ATTENUATION AND LUCS
Groundwater Monitoring

Item	Quantity	Unit	Unit Cost Subcontract	Material	Labor	Equipment	Extended Cost Subcontract	Material	Labor	Equipment	Subtotal Direct Cost
1 MONITORING											
Long-Term Groundwater Monitoring Per Event											
1.1 Groundwater for VOCs,9 samples/event	12	samples	$120.00				$1,440	$0	$0	$0	$1,440
1.2 Sampling labor 3days/event/2 people	60	hours			$40.00		$0	$0	$2,400	$0	$2,400
1.3 Prepare Report	80	hours			$40.00		$0	$0	$3,200	$0	$3,200
1.4 Sampling ODCs	1	ls		########			$0	$2,000	$0	$0	$2,000
Subtotal							$1,440	$2,000	$5,600	$0	$9,040
Overhead on Labor Cost @	30%								$1,680		$1,680
G & A on Labor, Material, Equipment, & Subs Cost @	10%						$144	$200	$560	$0	$904
Tax on Materials and Equipment Cost @	7%							$140.00		$0	$140
Total Direct Cost							$1,584	$2,340	$7,840	$0	$11,764
Indirects on Total Direct Cost @	30%										$3,529
Profit on Total Direct Cost @	10%										$1,176
Subtotal											$16,470
Health & Safety Monitoring @	0%										$0
Total Field Cost											$16,470
Contingency on Total Field Costs @	20%										$3,294
Engineering on Total Field Cost @	0%										$0
Total Monitoring Cost											**$19,764**

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 3 - SOURCE REDUCTION, MONITORED NATURAL ATTENUATION AND LUCS
O&M Cost

Item	Item Cost annual	Item Cost every two years	Item Cost every 7 years	Notes
Groundwater Monitoring		$19,764		Collect groundwater samples from 6 existing monitoring wells and 3 new monitoring wells per sampling event biennially plus travel, living, and shipping costs. 12 samples will be collected for TCL VOCs analysis.
Land Use Controls Inspection and Report	$2,710			LUCs inspection annually.
7 -Year Review			$12,000	Review of site conditions by two engineers every 7 years.
Subtotal	$2,710	$19,764	$12,000	
Contingency @ 10%	$271	$1,976	$1,200	
TOTAL	**$2,981**	**$21,740**	**$13,200**	

NSA CRANE
CRANE, INDIANA
SWMU 11 – OLD STORAGE BUILDING, B-225
ALTERNATIVE 3 - SOURCE REDUCTION, MONITORED NATURAL ATTENUATION AND LUCS
Present Worth Analysis

Year	Capital Cost	O & M Cost	Total Year Cost	Annual Discount Rate 1.4%	Yearly Present Worth	Total Present Worth
0	$2,671,599		$2,671,599	1.000	$2,671,599	
1		$2,981	$2,981	0.986	$2,940	
2		$24,721	$24,721	0.973	$24,043	
3		$2,981	$2,981	0.959	$2,859	
4		$24,721	$24,721	0.946	$23,384	
5		$2,981	$2,981	0.933	$2,781	
6		$24,721	$24,721	0.920	$22,742	
7		$16,181	$16,181	0.907	$14,680	
8		$24,721	$24,721	0.895	$22,119	
9		$2,981	$2,981	0.882	$2,630	
10		$24,721	$24,721	0.870	$21,512	
11		$2,981	$2,981	0.858	$2,558	
12		$24,721	$24,721	0.846	$20,922	
13		$2,981	$2,981	0.835	$2,488	
14		$37,921	$37,921	0.823	$31,214	
15		$2,981	$2,981	0.812	$2,420	
16		$24,721	$24,721	0.801	$19,790	
17		$2,981	$2,981	0.790	$2,354	
18		$24,721	$24,721	0.779	$19,248	
19		$2,981	$2,981	0.768	$2,289	
20		$24,721	$24,721	0.757	$18,720	**$2,933,293**

CLIENT: NSA CRANE	JOB NUMBER 112G02362/112G03588 FS.DR
SUBJECT: SWMU 11 – OLD STORAGE BUILDING, B-225	
BASED ON CMS Alternative 3	DRAWING NUMBER:
BY: Xuejun Chen Date: 5-2014 / CHECKED BY:JWL Date: 6/17/14	APPROVED BY: DATE:

Soil Contaminated Area

Assume:

1) Loading docks will be removed and replaced to complete excavation.
2) Assume an average soil layer with a thickness of six feet above the bedrock would be removed for offsite disposal.
3) Assume 10 percent excavated soil is hazardous and will be sent to a RCRA Subtitle C landfill.
4) Areas to be restored with geotextile and gravel, pavement, or soil/grass.
5) Surface soil and gravel would be removed and stockpiled for backfill.
6) 652 lf of railroad would be removed and replaced.
7) Cost based on standard week: 8 hours per day, 5 days per week

Areas		
21,038	sf	
652	ft Removal & Replacement of railroad tracks and ballast	
Excavation Areas		
21,038	total sf comprised of:	
5,245	sf concrete slab of Building 225	average 4inches
1,605	sf soil/grass	
12,409	sf gravel	
786	sf loading dock of Building 225	length 110 ft
1,011	sf loading dock of Building 2720	length 80 ft
Remove/Dispose		
126,228	cf	
4,675	cy or	
7,013	tons	
Backfill (topsoil)		
1,605	sf	
0.5	ft	
803	cf or	
30	cy	
Backfill (gravel)		
12,409	sf	
0.5	ft	
6,205	cf or	
230	cy	
Pavement		
5,245	sf	
0.5	ft	
2,623	cf or	
97	cy	

CLIENT: NSA CRANE		JOB NUMBE 112G02362/112G03588 FS.DR
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BY: Xuejun Chen Date: 5-2014	CHECKED BY:JWL Date: 6/17/14	APPROVED BY: DATE:

Common Fill		
fill required	4,675	cy
gravel volume	230	cy
topsoil volume	30	cy
pavement volume	97	cy
common fill	4,318	cy

Restoration		
gravel	12,409	sf or
	1379	sy
pavement	5,245	sf or
	583	sy

Time to complete:

Mob	5	days
Loading Docks & Concrete pads Remo	3	days
Railroad tracks and ballast Removal	8	days
Excavation & Disposal	22	days
Loading Docks Replacement	5	days
Railroad tracks & ballast Replacement	12	days
Backfill & Seed/Gravel/Pave	8	days
Demob	3	days
	66	days
	3	months