Supplemental Site Inspection (SOC 4)/ Remedial Investigation (SOC 5) Report

UMore Mining Area
Dakota County, Minnesota

Prepared for
University of Minnesota

January 12, 2010

BARR

Supplemental Site Inspection (SOC 4)/ Remedial Investigation (SOC 5) Report

UMore Mining Area
Dakota County, Minnesota

Prepared for
University of Minnesota

January 12, 2010

BARR

4700 West 77th Street
Minneapolis, MN 55435-4803
Phone: (952) 832-2600
Fax: (952) 832-2601

Supplemental Site Inspection (SOC 4)/ Remedial Investigation (SOC 5) Report

UMore Mining Area
Dakota County, Minnesota

January 12, 2010

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Acronyms

AES	Agricultural Experiment Station (University of Minnesota)
ARAR	Applicable or Relevant and Appropriate Requirements
AOC	Area of Concern
ASTM	American Society for Testing and Materials
BaP	Benzo(a)pyrene
BaPe	Benzo(a)pyrene-equivalent concentration
bgs	Below ground surface
COC	Constituent of Concern
DBP	Dibutyl phthalate
DNT	Dinitrotoluene
DPA	Diphenylamine
DEIS	Draft Environmental Impact Statement
FSI	Focused Site Inspection
FUDS	Formerly Used Defense Sites
GOW	Gopher OrdnanceWorks
GPS	Global Positioning System
HRL	Health Risk Value
MDA	Minnesota Department of Agriculture
MDH	Minnesota Department of Health
MPCA	Minnesota Pollution Control Agency
MSL	Mean sea level
PA	Preliminary Assessment
PAHs	Polyaromatic Hydrocarbons
PDC	Prairie Du Chien
PID	Photoionization Detector
PPL	Pollutant Priority List
ppm	Parts per million (mg/l or mg/kg)
QA/QC	Quality Assurance/Quality Control
REC	Recognized Environmental Condition
RPD	Relative Percent Difference
RTK	Real-Time Kinematic
SAP	Sampling and Analysis Plan
SLV	Soil Leaching Value

SOC	Site of Concern
SOP	Standard Operating Procedure
SRV	Soil Reference Value
SVOC	Semi- Volatile Organic Compound
TBC	To-be-considered Criteria
TKN	Total Kjeldahl Nitrogen
UMA	UMore Mining Area
UMore Park	University of Minnesota Outreach, Research and Education Park
Army	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
VOC	Volatile Organic Compound

Executive Summary

The University plans to the develop sand and gravel mining operations at the University of Minnesota Outreach, Research and Education (UMore) Park located in Dakota County, Minnesota. The proposed mining area, referred to as the UMore Mining Area (UMA), is located on the western one-third of UMore Park. The sites of concern (SOCs) investigated in the Supplemental Site Inspection and Remedial Investigation (SSI/RI) are the Former DNT Loading Platform and Drainage Ditch (SOC 4) and the Central Services Station/Former DNT Storage Bunkers (SOC 5).

These areas were used as storage and support areas for the former Gopher Ordnance Works (GOW), a World War II ordinance plant that manufactured smokeless gunpowder. A portion of SOC 4 (referred to as AOC 3 DA-1) and all of SOC 5 (referred to as AOC 5) were previously the subject of limited investigations by the U.S. Army Corps of Engineers (Army). The previous environmental investigations, including a Preliminary Assessment (PA) and a Focused Site Inspection (FSI; Army, 2006a and 2009, respectively), were conducted under the Formerly Used Defense Site (FUDS) Program. Results of the FSI indicated that releases of hazardous substances and petroleum products have occurred in SOC 5. The results of the Army's previous, limited investigation of SOC 4 were inconclusive.

The SSI/RI was designed to evaluate the nature and extent of hazardous substances or petroleum products in SOCs 4 and 5 that were released during or after the operation of the GOW. This report will be used as a resource document for the Draft Environmental Impact Statement (DEIS) that the University is preparing for the proposed mining operations in the UMA.

A total of fifty-four test trenches and thirty-five direct-push soil borings were placed during the SSI/RI. Sixty-one surface locations were sampled. Ninety-two soil samples and seven groundwater samples were collected and analyzed. All work was completed as described in the Supplemental Site Investigation and Remedial Investigation Work Plan, Sites of Concern 4 and 5 (Work Plan) (Barr, 2009a) and approved by the Minnesota Pollution Control Agency (MPCA) on August 12, 2009.

Results of the investigation are as follows:

- An area of buried debris was delineated in an approximately 55-foot by 120-foot area north of the former settling basin in SOC 4, near the southeast corner of SOC 5. The debris extends to a depth of approximately ten feet below the ground surface and consists

of materials characteristic of a farm/demolition debris dump. No evidence of a release of hazardous substances or petroleum products to the soil or groundwater was identified below the buried debris or elsewhere in SOC 4.

- Surface soils in the vicinity of the DNT storage bunkers in SOC 5 (SOC 5, Operable Unit #1) contain visible black waterproofing materials and are impacted above the unrestricted land use (Tier I) Soil Reference Values (SRVs) with semivolatile organic compounds (SVOCs), including carcinogenic polyaromatic hydrocarbons (cPAHs; as expressed by benzo(a)pyrene (BaP) equivalent). The extent of the impacted soils is limited to surface soils located within approximately fifteen feet of the exposed DNT storage bunker walls.

- Near surface soil in the Petroleum Release Area in SOC 5 (SOC 5, Operable Unit #2) was found to contain lead at concentrations at or above the Tier I SRV. The impacted soil exhibits visual and olfactory evidence of petroleum product impacts and is limited to the upper 4.5 feet of soil in the vicinity of a former fuel (leaded gasoline) dispenser.

- Mercury was detected at concentrations above Tier I SRV in near surface soils in the shallow drainage ditch located in the northwestern portion of SOC 5. The extent of the mercury impacted soil is limited to the base of the drainage ditch.

- Chloromethane was detected in groundwater from temporary wells SOC5-GP1 and SOC5-GP4. A HRL has not been established for chloromethane. It is recommended that potential sources of chloromethane in the northern portion of SOC5 are evaluated during preparation of the site for sand and gravel mining operations.

- Beryllium and thallium were detected in shallow groundwater samples collected from one temporary well and the water supply well in SOC 5 at concentrations above their respective Health Risk Limits (HRLs) but below the Maximum Contaminant Levels (MCLs). Both beryllium and thallium are naturally occurring elements and no anthropogenic sources of either are known to exist in SOC 5 or the UMA. The water table aquifer is not considered a potable water supply and, at the temporary well location, is underlain by a thick deposit of low permeability till which restricts downward leakage to the underlying bedrock units. The water supply well in SOC 5 is used for non-potable purposes. Therefore, no additional investigation of the beryllium or thallium detections is recommended.

- A sample collected from the water supply well in the Administration Building north of SOC 5 had a lead concentration above the EPA's action level for lead (15 micrograms per liter). Given the age of the building and the lack of apparent anthropogenic sources of lead to the groundwater, a possible source of the lead is lead pipes or solder used for plumbing in the building. The Administration Building is supplied by bottled water and the well is not used to supply potable water.

1.0 Introduction

This Report presents the results of a Supplemental Site Inspection/Remedial Investigation (SSI/RI) of two sites of concern (SOCs) in the UMore Mining Area (UMA). The UMA comprises approximately the western one-third of the University of Minnesota's Outreach, Research, and Education (UMore) Park in Dakota County, Minnesota (Figure 1). The SOCs addressed by the SSI/RI are the Former DNT Loading Platform and Drainage Ditch (SOC 4) and the Central Services Station/Former DNT Storage Bunkers (SOC 5).

The U.S. Army Corps of Engineers (Army) previously conducted a Preliminary Assessment (PA) and a Focused Site Inspection (FSI) on portions of SOC 4 and SOC 5 (Army, 2006a and 2009, respectively) under the Formerly Used Defense Site (FUDS) Program. The Army investigations were performed because these areas were associated with the former Gopher Ordnance Works (GOW). Specifically, a portion of SOC 4 (referred to as AOC 3 DA-1 by the Army) and all of SOC 5 (referred to as AOC 5 by the Army) were included in previous investigations. The results of the FSI and other investigations indicated that releases of hazardous substances and petroleum products are associated with SOC 5. The Army's investigation in SOC 4 included few sampling locations and a limited parameter list, and did not indicate evidence of a release.

Future sand and gravel mining is being proposed in the UMA and the proposed mining project is the subject of a Draft Environmental Impact Statement (DEIS) which is currently being prepared by the University.

1.1 SSI/RI Purpose and Scope

As described in the Work Plan for the Supplemental Site Inspection (SOC 4)/Remedial Investigation (SOC 5) (Work Plan) (Barr, 2009a), the investigation was designed to build on the findings from previous investigations so that the University can assess the nature and extent of releases of hazardous substances or petroleum products within SOCs 4 and 5.

1.1.1 Purpose

The purpose of the investigation was to collect sufficient information to determine if a release(s) has occurred in SOC 4 and to characterize the nature and extent of the previously identified releases in SOC 5. The findings of this investigation are intended to be used to develop response actions that may be needed to prepare SOCs 4 and 5 for future sand and gravel mining.

Due to future planned land use scenarios including sand and gravel mining and residential/industrial development, it is the University's intent to remediate releases of hazardous substance and petroleum products to levels that are protective relative to unrestricted use health risk-based criteria. Any necessary remedial actions will be conducted in accordance with an MPCA-approved Response Action Plan or Environmental Contingency Plan in conjunction with, or prior to, operations taken to prepare the UMA for future sand and gravel mining.

1.1.2 Scope

The SSI/RI activities included the following:

- Placement of 35 direct-push soil borings.
- Excavation of 54 test trenches.
- Collection of 92 soil samples from direct-push soil borings, test trenches, and surface sampling locations.
- Collection of groundwater samples from seven temporary monitoring wells.
- Collection of groundwater samples from four water supply wells.
- Completion of a well database search in a 4-mile radius area around SOCs 4 and 5.

1.2 Report Organization

This report is organized into the following sections following this introduction:

- Section 2: Site Background and Physical Setting – Provides general information including site location, current land use, physical setting, and historical land use.
- Section 3: Investigation Activities – Describes the sampling approaches and investigation activities
- Section 4: Nature and Extent of Impacts – Describes the types and extent of hazardous substances or petroleum products identified at SOCs 4 and 5 and data quality assurance/quality control results.
- Section 5: Baseline Risk Evaluation – Provides an evaluation of risks to human health and the environment at SOCs 4 and 5.
- Section 6: Summary and Recommendations – Describes the recommendations for future actions to address the needs of the DEIS and the development of sand and gravel mining operations in SOCs 4 and 5.
- Section 7: References – List of cited references.
- Tables – Summary of sample locations and analytical results.
- Figures – Graphical presentation of relevant site features and sampling locations.
- Appendices – Supplemental information pertaining to the SSI/RI.

2.0 Site Background and Physical Setting

2.1 UMA Location and Current Use

The UMA is located approximately 15 miles southeast of the Twin Cities, west of US Highway 52 and south of County Road 42 in Dakota County. The UMA consists of 1,657 acres total, 1,608 of which are developable, within a predominantly rural area located generally between Biscayne and Akron Avenues in UMore Park. The UMA includes most of the University's Agricultural Experiment Station (AES) and is located in parts of Sections 3 and 4, Township 114N, Range 19W and portions of Sections 28, 33, and 34, Township 115 N, Range 19 W (Figure 1). SOCs 4 and 5 are located in the east central portion of the UMA (Figure 2). SOCs 4 and 5 are bounded to the north by Dakota County Road 46 (a.k.a, 160th Street West) and by agricultural fields to the west, south, and east. The southern reach of SOC 4 abuts the drainage ditch on the east side of Station Trail (formerly known as West Patrol Road) (Figure 3).

The majority of the UMA is used for agriculture purposes with a small percentage of the area used for administration and support of the University's research at UMore Park. The principal land use activities at the UMA since 1947 have related to agricultural research on crops and livestock associated with the University's AES. The University also leases a portion of the cropland within the UMA to the U.S. Department of Agriculture (USDA). No other portions of the UMA or its buildings are leased for commercial or industrial purposes.

2.2 Physical Setting

The physical setting of the UMA and SOCs 4 and 5 in terms of climate and hydrology, soils, surface water, geology, and hydrogeology is described in the following subsections.

2.2.1 Climate and Hydrology

Average daily maximum temperatures range from 23 to 83 degrees Fahrenheit and the average annual precipitation is approximately 32.5 inches (NOAA, 2008). Average recharge of precipitation to the shallow groundwater ranges from 6 to 10 inches per year (Metropolitan Council, 2008).

UMore Park is located on a topographic plateau between the Mississippi and Vermillion Rivers. Runoff from areas south of County Road 46 flows towards the south and southeast and contributes to the North Branch of the Vermillion River, Tributary No. 5 to the Vermillion River, and Tributary C to the Vermillion River (the name assigned to that branch in hydrologic model studies of the

Vermillion River). The Vermillion River is located about 2.5 miles south of the UMA. The central and northwestern parts of the UMA are landlocked (i.e. watershed areas are tributary to depressions that will not overflow during the 100-year SCS Type II event) with a limited area draining to the west. The north and northeast parts of the UMA drain to the east and do not contribute to the Vermillion River. Stormwater runoff from areas north of County Road 46 flows towards Rosemount and ultimately to the Mississippi River, located approximately 4.5 miles northeast of the UMA. Due to the flat topography, numerous depressions, and the high permeability of soils in the UMA, surface water runoff is likely to occur only during high intensity storm events.

The ground surface in SOCs 4 and 5 ranges from approximate Elevation 938 to 950 feet relative to mean sea level (feet MSL). Existing conditions and surface topography in SOCs 4 and 5 are shown on Figure 3.

2.2.2 Soils

Waukegan series soils cover much of the UMA including SOCs 4 and 5 (USDA, 2008). The Waukegan series consists of deep, well drained soils that form on outwash plains and stream terraces. These soils are described as moderately to rapidly permeable and have the ability to readily absorb water.

Kennebec silt loam series soils, which consist of moderately well drained soils formed in alluvium, are mapped in small depressions in SOC 4.

2.2.3 Surface Water

No surface water bodies exist in the UMA or SOCs 4 and 5. A ditch which is mapped as an "intermittent stream" is shown running through SOC 5 and the lower reach of SOC 4 (MDNR, 2009). University personnel report that no surface water flow occurs through SOCs 4 and 5 with the exception of runoff during major storm events (1-inch or more precipitation) or spring snow melt.

2.2.4 Geology

2.2.4.1 Unconsolidated Deposits

Surficial soils are relatively thin across the UMA and are developed from glacial sand or loess (wind blown silt) deposits. Localized fill associated with various land use activities is present on small portions of the property. The underlying glacial deposits consist primarily of outwash comprised of sand and gravel and fine-grained diamicton interpreted to be Superior till. The till is described as a

dense, yellowish to reddish brown, massive (unlayered), diamicton with a homogenously mixed texture consisting of gravel and sand within a clay matrix (Barr, 2009b).

Figures 4 and 5 are cross sections that show the subsurface distribution of the outwash and till across SOCs 4 and 5. Cross section A-A' (Figure 4) is oriented north to south and cross section B-B' (Figure 5) is oriented east to west (see inset maps on cross section figures). As shown on both cross sections, till is present approximately 20 feet below the ground surface near the northeastern corner of SOC 5 and northern portion of SOC 4. Northeast of SOC 5, the till deposit is within ten feet of the ground surface (ProSource, 2008) and extends to the bedrock (Barr, 2009b). The upper till surface drops sharply west, south, and east of the localized till high in SOCs 4 and 5.

2.2.4.2 Bedrock

The uppermost bedrock unit beneath SOCs 4 and 5 is the Prairie Du Chien Group (Barr, 2009b). The Prairie Du Chien Group and the underlying Jordan Formation Sandstone together comprise the primary aquifer that is used locally for domestic water supply and crop irrigation. The St. Lawrence Formation, which is considered an aquitard (or confining unit), is present below the Jordan Sandstone. A generalized stratigraphic column is shown in Figure 6.

2.2.4 Hydrogeology

Regional groundwater flow within the outwash and underlying aquifers is to the northeast towards the Mississippi River (Figure 7; Barr, 2009b).

The regional water table is present at approximately Elevation 884 feet MSL (approximately 50 to 65 feet below the ground surface) in the vicinity of SOCs 4 and 5 (Barr, 2009b). The water table is positioned within the outwash in the southern portions of SOCs 4 and 5 and in the till in the northern portions of SOCs 4 and 5 (Figure 4). Of the seven temporary well borings that encountered till, thin (<5 feet thick) intervals of wet soil (outwash or till) near the top of the till were identified and sampled at four temporary well locations. No groundwater was encountered at the other three temporary well locations. These intervals of wet soil likely contain groundwater that has not yet infiltrated to the water table due to the low permeability of the till unit. Similar zones of elevated soil moisture have been reported and referred to as "perched groundwater" by others (Army, 2009).

2.3 Historical Land Use at UMore Park Relevant to UMA

UMore Park was once owned by the U.S. Government and was operated as the Gopher Ordnance Works (GOW). The GOW, which was constructed and operated from approximately 1942 to 1945,

manufactured smokeless gunpowder, oleum (a concentrated form of sulfuric acid used in the manufacture of gun powder), and nitric acid. Ammonia, dinitrotoluene (DNT), aniline, dibutyl phthalate (DBP), diphenylamine (DPA) and many other chemicals were imported for use in the smokeless gunpowder manufacturing process. Other constituents potentially related to the former GOW that may have been released to the environment include metals, pesticides, asbestos, volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). The majority of GOW operations were located east of the UMA; however, GOW operations did occur in SOCs 4 and 5. By 1946, the GOW had been decommissioned and most of the buildings had been decontaminated and demolished by the federal government. The UMore Park property was conveyed to the University in 1947 and 1948.

2.4 SOCs 4 and 5

This section provides an overview of historical and current land use and a discussion of the preliminary operable units (OUs) and conceptual release models for SOCs 4 and 5.

2.4.1 SOC 4 – Former DNT Loading Platform and Drainage Ditch

2.4.1.1 Past Use and Features

According to Dakota County (2006), the DNT loading platform (263-C on Figure 3) received drums of DNT, a dry crystalline product, by rail. The drums containing DNT were reportedly trucked from the loading platform to the DNT storage bunkers in SOC 5. There are no records indicating that releases of DNT occurred at the platform. A drainage ditch extended south of the platform for approximately 750 feet where it joined drainage from the east and turned to the southwest. During extreme precipitation events or snow melt, the drainage ditch could receive surface water runoff from SOC 5 near the depression that was reportedly a settling basin south of SOC 5. The drainage ditch continues to the southwest until it joins the ditch on the east side of Station Trail. Some cobbles and concrete are present in the lower reach of the ditch.

The lower reach of the drainage ditch from the reported settling basin south of SOC 5 to Station Trail is identified by the Army as AOC 3 DA-1(Army, 2009) (Figure 3). The FSI did not include an investigation of the DNT loading platform or the portion of the drainage ditch north/northeast of the former settling basin.

2.4.1.2 Current Use and Features

The upper (northern) reach of SOC 4 consists of a drainage swale that runs from Dakota County Road 46 to Station Trail south of SOC 5. The upper portion of the drainage swale is very shallow

and is used as farm fields for row crop agriculture. The southern 700 feet of SOC 4, referred to as the lower reach, is approximately 50 feet wide and exhibits steep embankments and contains a small cluster of trees and piles of rocks that have been removed from nearby farm fields.

2.4.1.3 Preliminary Operable Units and Conceptual Release Models

Past operations in SOC 4 included the unloading of drums of DNT at the former loading platform. The conceptual release model for SOC 4 consists of spills of crystalline DNT at the former loading platform, subsequent incorporation of spilled DNT into surface soils and the overland transport of DNT via water runoff. Based on a site reconnaissance, additional potential releases at SOC 4 include deposition of SOC 5 constituents of concern via surface water runoff from SOC 5 onto SOC 4 and the dumping of GOW-era demolition debris in the lower reach of the ditch. For the purposes of this investigation, SOC 4 was divided into three OUs as described in the Work Plan and summarized below:

- SOC 4-OU1: Former DNT Loading Platform and Drainage Ditch East of SOC 5 from 160th street to the settling basin (Army AOC 3 DA-1)
- SOC 4-OU2: Settling Basin and Drainage Ditch South of SOC 5 to Station Trail (Army AOC 3 DA-1)
- SOC4-OU3: Area of Suspected Debris Disposal in the lower reach of the drainage ditch

The boundaries of each SOC 4-OU are shown on Figure 8. The limits of the OUs overlap somewhat (such as SOC4-OU2 and OU3). Further discussion of each SOC 4-OU is provided in the Work Plan (Barr, 2009a).

2.4.2 SOC 5 – Former DNT Storage Bunkers/Central Services Station

2.4.2.1 Past Use and Features

Eight DNT storage bunkers were constructed in SOC 5 to store DNT for GOW operations (Army, 2009; Dakota County, 2006). The DNT storage bunkers are identified as GOW Buildings 260-A through 260-H on Figure 3. Prior to the University's acquisition of property containing the UMA in 1947, some or all of the buildings in SOC 5 were leased by the U.S. Government to Raymond Laboratories for storage of explosives including DNT and diphenylamine (DPA) (Army, 2009). Raymond Laboratories was never a tenant of the University. SOC 5 is identified by the Army as AOC 5 (Figure 3) (Army, 2009).

After SOC 5 was deeded to the University in 1947, the DNT storage bunkers were used as Agricultural Experimentation Station (AES) storage facilities and to support agricultural operations at UMore Park. The University's operations within SOC 5 have included equipment fueling areas west of DNT storage bunker 260-F and pesticide mixing and equipment washing west/northwest of DNT storage bunker 260-B.

A leaking underground storage tank (UST) was identified on the west side of DNT storage bunker 260-F (Peer, 2006). The leaky UST had a capacity of 500-gallons and was used to store leaded gasoline for vehicle and equipment fueling. Additional underground fuel tanks included an unleaded gasoline tank and a diesel tank which were located west and southwest of DNT storage bunker 260-F, respectively. All of the USTs have been removed and MPCA leaksite files for releases from the USTs have been administratively closed.

Pesticide mixing and equipment rinsing were conducted west/northwest of DNT storage bunker 260-B. Rinsate containing residual pesticides was collected in a cistern and directed to a lagoon (Figure 8). The lagoon was reportedly lined with organic soil/manure that allowed the infiltration of the rinsate water. The soils in and beneath the lagoon were excavated and land farmed on nearby agricultural fields in 2000. Confirmation soil sampling was conducted to verify soils impacted with pesticides above Minnesota Department of Agriculture clean up goals were removed (Peer, 2001).

2.4.2.2 Current Use and Features

SOC 5 is currently referred to as the Central Services Station and is used for service and maintenance activities to support the University's AES at UMore Park. Operations include equipment repair and maintenance, storage and distribution of supplies, coordination of research and farm operations, feed mixing, and grain drying and storage. The former DNT storage bunkers are used for equipment and materials storage. The north, east, and southern sides of DNT storage bunkers 260-A, B, and C are surrounded by bermed soils. The soil berms around DNT-storage bunkers 260-D, E, F, G, and H have been removed. The roofs of Buildings 603 and 604 have been removed to accommodate storage of miscellaneous farm equipment and supplies.

2.4.2.3 Preliminary Operable Units and Conceptual Release Models

Past operations that potentially resulted in the release of hazardous substances or petroleum products to soil or groundwater at SOC 5 include DNT storage bunker use, pesticide handling, and petroleum fueling. Based on a review of construction plans, past investigations, corrective action reports, and site reconnaissance, the conceptual release model includes spills to the ground surface, releases from

USTs to shallow subsurface soils (generally less than 10 feet below grade) and infiltration of impacted surface runoff. Spills to the ground surface are anticipated to have infiltrated into near surface soils or to have become incorporated into surface soil. As a result of the permeable nature of the surface and subsurface soils, a liquid release to shallow subsurface soils would be expected to migrate downward from the source through approximately 60-feet of unsaturated soil to the water table. Once at the water table, the release would migrate laterally with groundwater flow within the outwash aquifer, assuming sufficient mass was released. The released substances would be subject to attenuation processes in the unsaturated zone and in the groundwater system.

For the purpose of this investigation, SOC 5 was divided into the following three OUs as described in the Work Plan and summarized below:

- SOC 5-OU1– DNT Storage Bunkers 260-A through H
- SOC 5-OU2 – Pesticide Release Area in the north-central portion of SOC 5
- SOC 5-OU3 – Petroleum Release Area in the west-central portion of SOC 5

The boundaries of each of the SOC 5-OUs are shown on Figure 8. A detailed description of each OU is provided in the Work Plan (Barr, 2009a).

3.0 Investigation Activities

SSI/RI field activities were conducted between August 31 and December 23, 2009. Field and laboratory methods followed the Work Plan (Barr, 2009a) and the Sampling and Analysis Plan (SAP) (Barr, 2009c) with the exception of the minor deviations described in Appendix A.

3.1 Field Sampling and Analysis

Field activities are summarized below:

- Direct-push soil borings were advanced at thirty-five locations at SOCs 4 and 5 by Matrix Environmental LLC of Osseo, Minnesota for the purpose of investigating subsurface soils and collecting soil and groundwater samples for laboratory analysis. Soil boring locations and depths are summarized in Table 1. Soil boring logs are in Appendix B. Selected photographs taken during the soil boring investigation are in Appendix C.

- Temporary wells were installed in ten of the direct-push soil borings for the purpose of collecting groundwater samples. Groundwater was not encountered in three of the temporary wells. Each temporary well was removed and all of the soil borings were sealed in accordance with Minnesota Department of Health (MDH) requirements. Well logs and Well and Boring Sealing Records are in Appendix B.

- A total of fifty-four test trenches were excavated in SOCs 4 and 5 for the purpose of investigating near surface soils and collecting soil samples for laboratory analysis. Test trenches were excavated by Stevens Drilling and Environmental of Maple Plain, Minnesota. Test trench locations and depths are summarized in Table 1. Test trench logs are in Appendix B and photographs taken during placement of the test trenches are in Appendix C.

- Sixty-one soil samples were collected from surface soil sampling locations within SOC 5 by Barr field staff. The surface soil sample locations are summarized in Table 1.

- Laboratory analytical services were provided by Legend Technical Services, Inc (Legend), Braun Intertec (Braun), and Test America, Inc (Test America). Legend analyzed the samples for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOC), and priority pollutant list metals (i.e., antimony, arsenic, beryllium, cadmium, chromium (including trivalent and hexavalent species), copper, lead, mercury, nickel, selenium, silver,

thallium and zinc). Test America analyzed the samples for perchlorate and nitrocellulose. Braun Intertec analyzed the samples for Minnesota Department of Agriculture (MDA) List 1 and 2 pesticides, organochlorine pesticides, nitrate plus nitrite as nitrogen, and total Kjeldahl nitrogen (TKN).

3.1.1 Sampling Approach

The sampling approach used during the SSI/RI was consistent with the Work Plan and the SAP (Barr, 2009a, c). The sampling approach focused on evaluating areas for hazardous substance or petroleum product releases through the collection of discrete soil samples from soil borings, test trenches, and surface locations. Soil borings were also used to provide information on geology and hydrogeology including soil type, depth to water (at selected locations), and the presence of subsurface soil impacts. Test trenching was used to evaluate shallow subsurface soils and the extent of the buried debris. Surface soil samples were used to characterize soils at the ground surface. In areas where no field evidence of a release was detected in subsurface soils, the sampling interval defaulted to surface soil (the upper 6-inches of soil below the rooting zone).

Groundwater samples were collected to broaden investigation coverage and to identify potential release area that may have been missed by soil sampling.

Soils encountered in the direct-push soil borings and test trenches were screened in the field and described in accordance with the Work Plan and the SAP (Barr, 2009a, c). Field screening observations included observing soil moisture, odor, discoloration, and the presence of organic vapors. Organic vapor monitoring was conducted with a photoionization detector (PID) equipped with a 10.6 eV lamp. Soils were classified using visual and manual test methods described in ASTM D-2488, Standard Practice for Description and Identification of Soils (Visual/Manual).

Investigation derived waste (IDW) was managed in accordance with the SAP (Barr, 2009c). In general, in areas where no evidence of a release was identified during field work, soil cuttings, decontamination water and well purge water was thin spread at each boring location. Excavated soil was segregated during test trench excavation and was placed back in each test trench in the reverse order it was removed (e.g., topsoil was placed on top).

3.1.2 Sampling Activities

Soil and groundwater samples in SOCs 4 and 5 were collected in accordance with the Work Plan (Barr, 2009a). Sampling activities consisted of organic vapor screening, surface and subsurface soil

sample collection and groundwater sampling. Soil samples were collected from thirty-five direct-push soil borings, sixty-one surface sample locations, and eleven test trenches. Groundwater samples were collected from seven temporary wells installed in direct-push soil borings and four water supply wells located in or near SOCs 4 and 5. Sampling activities are summarized in Table 2. SOC 4 and SOC 5 sampling locations are shown on Figure 8.

3.2 Other Activities

The following activities were completed as a part of the SSI/RI in accordance with the Work Plan (Barr, 2009a).

3.2.1 Surveying

Soil boring, test trench, and surface sampling locations were surveyed in the field using Real-Time Kinematic (RTK) Global Positioning System (GPS) methods. A summary of the survey information for each sampling location is in Table 1 and a copy of the MPCA Spatial Data Reporting Form is in Appendix B.

3.2.2 Well Search

A search of the Minnesota County Well Index (MGS, 2006) database was conducted to identify all wells within a 4-mile radius of the UMA. The Department of Natural Resources (DNR) database of groundwater appropriation information was used to supplement the well survey. Results of these searches are in Appendix D.

4.0 Nature and Extent of Impacts

This section summarizes the investigation results for SOCs 4 and 5 and the results of the data quality control review. Tables 3 and 5 through 8 show the soil sample results compared to risk screening criteria. Groundwater results are shown and compared to risk screening criteria in Tables 4, 9 and 11. Based on a review of potential Applicable or Relevant and Appropriate Requirements (ARARs) (Appendix E), Tier I Soil Reference Values (Tier I SRVs) and Tier I Soil Leaching Values (Tier 1 SLVs) are considered to be appropriate soil risk screening criteria. Applicable groundwater risk screening criteria include Maximum Contaminant Limits (MCLs) and State of Minnesota limits which include Health Risk Limits (HRLs) and Health Based Values (HBVs).

The soil and groundwater data are also summarized on the figures as referenced in the following sections. Electronic copies of the laboratory reports are in Appendix F.

4.1 SOC 4 – Former DNT Loading Area

Sixteen test trenches and seven direct-push soil borings were placed in SOC 4 (Figure 9). The test trench depths ranged from 3 to 19 feet below ground surface (bgs) and soil boring depths ranged from 20 to 62 feet bgs (Table 1). Soil samples were collected from three test trenches and seven soil borings. In accordance with the Work Plan (Barr, 2009a), samples were not collected from locations within SOC 4 where no evidence of a release was identified. Groundwater samples were collected from temporary wells installed in two of the soil borings. Soil and groundwater samples collected in SOC 4 are listed in Table 2.

Each test trench and soil boring extended into the outwash deposit to allow for observation and screening of near surface fine-grained soils. The soils encountered above the outwash in SOC 4 included topsoil and silt. Topsoil thickness varied from one foot in the lower reach of the drainage ditch to approximately eight feet in the middle portion of SOC 4 at test trenches SOC4-TT5, TT6, TT8, TT11, and TT12. The thicker topsoil intervals are likely related to infilling, plowing, and grading of the drainage ditch during post-GOW farming operations. With the exception of test trench SOC4-TT9 (described below), no buried debris or indication of a potential release was observed in SOC 4 test trenches. Minor surface debris consisting of miscellaneous concrete and field stones (likely picked from nearby farm fields) was encountered at the ground surface in test trenches SOC4-TT2 and SOC4-TT14 and near soil boring SOC4-GP6.

Buried debris including concrete, metal, wood, wallboard, plastic, ash, shingles, and glass was encountered in test trench SOC4-TT9. No asbestos containing material (ACM) was observed in the buried debris. A detailed characterization of the buried debris was not performed as part of the investigation. Soil sample SOC4-TT9-6 was collected below the debris to determine if hazardous substances or petroleum products had been released into underlying soils. Eight test pits (SOC4-TT9A through H) were placed in the area to determine the extent and depth of the buried debris. The debris was found to extend up to ten feet below the ground surface. The approximate extent of buried debris is shown on Figure 9.

4.1.1 Soil Analytical Results

Ten soil samples were collected and analyzed for one or more of the following parameter sets: VOCs, SVOCs, metals, nitrocellulose, pesticides, and polychlorinated biphenyls (PCBs). Soil analytical results from SOC 4 are in Table 3 and are summarized on Figure 9. Analytical results from samples collected in SOC 4 during the Army's FSI are also summarized on Figure 9. Pertinent soil results are discussed below.

- SVOCs (including DNT), VOCs, pesticides, or PCBs were not detected in any of the soil samples.

- No metals were detected above Tier I risk-screening criteria. Based on historical use and previous investigations (Barr, 2009d), the chromium in the SOC 4 soil samples is considered to be trivalent chromium.

- Nitrocellulose was not detected in any of the ten soil samples collected during the SSI/RI investigation. Detectable concentrations of nitrocellulose between 1.0 and 8.2 milligrams per kilogram (mg/kg) were reported in soil samples collected at two locations in the lower portion of the SOC 4 drainage ditch during the Army's FSI.

4.1.2 Groundwater Analytical Results

Groundwater samples were collected from temporary wells installed in direct push borings SOC4-GP4 and SOC4-GP5. A temporary well was installed in SOC4-GP1 but no groundwater accumulated in the screened interval due to the fine-grained till. Analytical results for the groundwater samples are in Table 4 and are summarized on Figure 10. Significant groundwater results are discussed below.

- Nitrate plus nitrite (as N) was detected above the MCL of 10 milligrams per liter (mg/l) in groundwater samples collected at both temporary wells (SOC4-GP4 and SOC4-GP5).

- No metals were detected above groundwater risk-screening criteria.

- Nitrocellulose, VOCs, and SVOCs (including DNT) were not detected in the samples.

4.1.3 Discussion

Analytical results and field observation from the SSI/RI indicate that the soil and groundwater in SOC 4 have not been impacted by a release of hazardous materials or petroleum products. The previous detections of nitrocellulose in surface and near surface soils during the FSI were not confirmed by the data collected during the SSI/RI and are not considered to be representative of soil in SOC 4. Elevated nitrate concentrations in shallow groundwater at the water table have been observed upgradient of SOC 4 (Barr, 2009d) and are attributed to agricultural land use.

Buried debris characteristic of building demolition materials was encountered in test trench SOC4-TT9 and in a series of test pits excavated in the surrounding area. Based on the materials observed, screening results, and results from a soil sample collected beneath the debris, the buried debris is not considered a significant threat of a release of hazardous substances or petroleum products. However, additional observations and confirmation sampling are warranted at the time the debris is excavated to verify this assessment. No ACM was observed in the limited amount of materials excavated from the test trench and test pits, but ACM has been reported in other demolition debris disposal areas associated with former GOW operations (Army, 2009).

Based on an approximate footprint of 120 feet by 55 feet and an average thickness of 5 to 10 feet, the estimated volume of debris (and intermixed soil) is on the order of 1,200 to 2,400 (in place) cubic yards. The estimated volume is based on the observations from one test trench and eight test pits excavated in the area and should be considered approximate. Although the soil borings and test trenches were placed in part to determine if buried debris is present in SOC 4, it is possible that additional buried debris not encountered during the SSI/RI work is present and will be encountered during preparation of the area for sand and gravel mining.

4.2 SOC 5 – Former DNT Storage Bunkers/Central Services Station

Thirty-eight test trenches, twenty-eight direct-push soil borings, and sixty-one surface soil sampling locations were included in the investigation of SOC 5 (Figure 8). Test trench depths ranged from 2 to 16 feet bgs and soil boring depths ranged from 4 to 68 feet bgs. Soil samples were collected from

eight test trench, twenty-five soil boring and forty-eight surface soil sampling locations. Groundwater samples were collected from temporary wells installed in five soil borings. Investigation samples collected in SOC 5 are listed in Table 2.

Because there are multiple conceptual release models, the results of the SOC 5 soil investigation are discussed in the following subsections by the OU as described in the Work Plan:

- Operable Unit #1 (SOC5-OU1): DNT Storage Bunkers
- Operable Unit #2 (SOC5-OU2): Pesticide Release Area in the north-central portion of SOC 5
- Operable Unit #3 (SOC5-OU3): Petroleum Release Area in the west-central portion of SOC 5
- Green Space and Other Areas of Investigation

Groundwater sampling was conducted as part of the SOC 5 investigation to broaden the investigative coverage of the area (in case the soil investigation missed a significant source area). The SOC 5 groundwater results are discussed in Section 4.2.5.

4.2.1 DNT Storage Bunkers (SOC5-OU1)

As described in the Work Plan (Barr, 2009a), the conceptual release models for the DNT storage bunkers (SOC5-OU1) include the following:

A. Releases to shallow subsurface soils from the reported floor drains, gutters, and dry wells.
B. Releases of/from exposed waterproofing (tar) material from the exterior bunker walls.

Conceptual release model A was investigated with a series of test trenches excavated around each of the DNT storage bunkers. A total of thirty-two test trenches were excavated around the eight bunkers (Figure 11). The test trenches ranged in depth from two to sixteen feet and were up to ninety feet long. Extensive test trenching was conducted around DNT storage bunkers 260-G and 260-H (which do not have surrounding soil berms) at the beginning of the test trenching program for the purpose of evaluating the construction of the DNT storage bunkers and determining the subsurface configuration of potential drains or dry wells that may have resulted in a subsurface release of DNT or other hazardous substances. As indicated in Appendix G, no drains or dry wells were encountered beneath or around the perimeter of the DNT storage bunkers. Clay drainage tile was found surrounding each of the DNT storage bunkers; however, the clay tile was not plumbed to the bunkers. Because no drains or dry wells were found and no subsurface soil impacts were identified around the DNT storage bunkers were identified, the test trench sampling locations defaulted to locations beneath the drain tile where the drain tile was at the lowest apparent elevation.

Conceptual release model B was investigated with a series of soil samples collected around each bunker. For DNT storage bunkers surrounded by soil berms (see buildings 260-A, B, and C on Figure 11), samples were collected near the exterior walls with direct-push borings to evaluate berm soils. For DNT storage bunkers without soil berms (see buildings 260-D, E, F, G, and H on Figure 11), surface samples were collected to evaluate soil quality.

4.2.1.1 Soil Analytical Results

Seven subsurface and thirty-one surface soil samples were collected around the DNT storage bunkers and analyzed for one or more of the following parameter sets: SVOCs, metals, nitrocellulose and pesticides. Soil analytical results from SOC 5-OU1 are in Table 5 and are summarized on Figure 11. Sampling locations and results from the Army's FSI are shown on Figure 12. Significant soil results are discussed below.

- Sub-surface soil

    - No elevated headspace readings or indication of subsurface soil impacts were observed in the test trenches placed around the bunkers.

    - Nitrocellulose, SVOCs (including DNT) and pesticides were not detected in any of the subsurface soil samples. Metals were detected in the soil samples at concentrations below Tier I SRVs.

- Surface soil

    - Fragments of black waterproofing material used to coat the exterior walls of the DNT storage bunkers, were observed in the upper six-inches of soil at most of the surface sampling locations that were located within five feet of the DNT storage bunkers. No elevated headspace readings were measured at the surface sampling locations.

    - cPAHs, as reported by B(a)P equivalent (B(a)Pe) concentrations, were detected above the Tier I SRV of 2 mg/kg and the Tier II industrial SRV of 3 mg/kg in nine of nineteen surface soil samples collected around the DNT storage bunkers. Additional SVOCs detected above the Tier I SRVs included naphthalene and p-creosol (but only in samples that had B(a)Pe exceedences). The B(a)Pe exceedences were consistent with analytical results from the Army's FSI sampling locations AOC5-GP4, GP8, GP10 and GP11 (Army, 2009). The exceedences of the Tier I SRV for B(a)P

occurred in samples collected within 15 feet of the exterior DNT storage bunker walls that are not surrounded by soil berms. B(a)Pe concentrations in "step-out" surface soil samples SOC5-SS19, SS27, SS23, SS25, and SS27 collected around DNT storage bunkers 260-F and G were below Tier I SRVs.

- No cPAHs or SVOCs were detected at concentrations above Tier I SRVs in the samples of the berm soils around DNT storage bunkers 260-A, B and C.

- 2,4-DNT was reported at a concentration of 0.35 mg/kg in sample AOC5-GP9-0-0.5 which was collected near DNT storage bunker 260-F during the Army's FSI. DNT was not detected in any of the sixty-six soil samples that were collected from SOC 5 and analyzed for SVOCs.

- In a number of samples collected during the Army's FSI, nitrocellulose reported at concentrations less than 10 mg/kg with qualifiers that indicated detections in associated blank samples (Figure 12). Nitrocellulose was not detected in any of the samples collected during the SSI/RI.

4.2.1.2 Discussion

Conceptual release model A (release of materials from the DNT storage bunkers to shallow subsurface soils via transport through a drain or dry wells) is not supported by the field data. No drains or dry wells were observed in test excavations beneath or around the perimeter of the DNT storage bunkers. No indications of soil impacts or release of hazardous substances or petroleum products was identified in the test trenches excavated around the DNT storage bunkers. No nitrocellulose, SVOCs (including DNT), pesticides, or metals were detected above human health risk-screening criteria in the subsurface soil samples collected around the DNT storage bunkers.

Conceptual release model B (surface soil impacts from exposed waterproofing material on the exterior DNT storage bunker walls) is supported by the data generated during the SSI/RI. The detections of cPAHs in soil at concentrations above residential and industrial risk screening criteria correlate to the observed presence of fragments of waterproofing material in surface soil around DNT storage bunker walls that are not surrounded by bermed soil. As described in Appendix G, laboratory analysis of the waterproofing material collected from one of the bunkers walls confirms that the waterproofing contains elevated concentrations of cPAHs and other SVOCs.

The extent of cPAH concentrations above residential and industrial humane health risk-screening criteria correlates with the visual observations of waterproofing material in the soils surrounding the exposed storage bunker walls. Based on results of the step-out samples and visual observation of the surface soils, the horizontal extent of the impacted surface soils around the storage bunker walls is estimated to be less than 15-feet. Based on the analysis of subsurface soils samples collected from the test trenches, the cPAH impacts are limited to the upper 6-inches of the soil. Based on the current land use and nature of the waterproofing material, the cPAHs impacts do not pose an immediate threat to human health or the environment.

The data generated during the investigation of SOC5-OU1 (and in green space areas as discussed later in this report) do not support the Army's FSI data suggesting that low concentrations (<10 mg/kg) of nitrocellulose are present in surface soils in SOC 5. No risk screening criteria have been established for nitrocellulose by the MPCA.

4.2.2 Pesticide Release Area (SOC5-OU2)

Based on data generated as part of the Army's FSI, the conceptual release model for the Pesticide Release Area (SOC5-OU2) involves a pesticide release to the ground surface near the northwest corner of DNT storage bunker 260-A and subsequent overland transport. The Pesticide Release Area was investigated with four clusters of borings advanced for the purpose of collecting composite soil samples for pesticide analysis per Minnesota Department of Agriculture guidelines, one test trench near DNT storage bunker 260-A, and five test trenches and one soil boring in the vicinity of the former rinsate lagoon. Previous investigations of the Pesticide Release Area included soil sampling at FSI locations AOC5-GP1 and AOC5-GP7 (Army, 2009) and the investigation and removal of soils beneath the former rinsate lagoon (Peer, 2001).

4.2.2.1 Soil Analytical Results

Eleven soil samples were collected and analyzed for pesticides. One of the samples collected from the former lagoon area was also analyzed for metals. Soil analytical results are in Table 6 and are summarized on Figure 13. Significant results are discussed below.

- No indications of a release (including vegetative stress) of pesticides, other hazardous substances or petroleum products was identified in the vicinity of DNT storage bunker 260-A or the former rinsate lagoon.

- No pesticides were detected at concentrations above Tier I SRVs in any of the composite samples collected from soil borings SOC5-GP12, GP13, GP14 and GP27 which were placed around DNT storage bunker 260-A.

- Test trenches SOC5-TT28 through TT32 were placed in the former rinsate lagoon area. A gray, clayey organic soil layer was encountered in test trenches SOC5-TT29 and TT31 (see logs in Appendix B). Based on discussions with University staff, the gray clayey organic soil layer is likely material used to line the base of the former rinsate lagoon. Low concentrations (<0.2 mg/kg) of two pesticides, alpha-chlordane and gamma-chlordane, were detected in sample SOC5-TT29-5 from the clayey organic soil layer. Tier I SRVs have not been established for alpha-chlordane or gamma-chlordane. No pesticides were detected in sample SOC5-TT29-6 which was collected from native soils underlying the clayey organic soil layer.

- Direct-push soil boring SOC5-GP28 was advanced in the former rinsate lagoon to evaluate deeper soils. The former rinsate lagoon base liner material was not encountered and no pesticides were detected in sample SOC5-GP28-9-10, collected at a depth of 9 to 10 feet bgs.

4.2.2.2 Discussion

Based on the data collected during the SSI/RI, soils in SOC5-OU2 are not impacted with pesticides at concentrations above Tier I SRVs. The presence of dieldrin at 17 mg/kg (detected during the Army's FSI) was not confirmed in the vicinity of sample location AOC5-GP1.

The gray organic soil layer that was identified within five feet of the ground surface in test trenches SOC5-TT29 and TT31 is interpreted to be remnant material from the rinsate lagoon liner. This material was not encountered in soil boring SOC5-GP28, which was placed near the center of the former lagoon, likely because the material and underlying soils were removed as part of past corrective actions. Based on the observations made during the placement of test trenches and soil boring SOC5-GP28 and the analytical data, previous corrective actions appear to have adequately addressed the soil impacts in the vicinity of the former rinsate lagoon.

4.2.3 Petroleum Release Area (SOC5-OU3)

Based on data generated as part of the Army's FSI, the conceptual release model for the Petroleum Release Area (SOC5-OU3) (Figure 13) included petroleum spills at the ground surface or releases to the shallow subsurface soils from dispenser islands and/or storage tanks. Four direct push soil borings (SOC5-GP5 through GP8) were advanced to a depth of twenty feet below the ground surface

for the purpose of investigating and sampling subsurface soils. Previous activities at this location have involved a soil investigation and the installation, operation, and decommissioning of a soil vapor extraction system (STS, 1991; Peer, 1994).

4.2.3.1 Soil Analytical Results

Eight soil samples were collected and analyzed for metals, SVOCs, VOCs, and nitrocellulose. Soil analytical results from the Petroleum Release Area are in Table 7 and are summarized on Figure 13. Significant results are discussed below.

- With the exception of SOC5-GP8, no indication of a release was observed in soil borings advanced in the Petroleum Release Area. At SOC5-GP8, elevated headspace readings, soil staining, and a petroleum odor were detected in the upper 4.5 feet of the soil column.

- Lead was detected in sample SOC5-GP8-1-1.5 at a concentration of 300 mg/kg which is equal to the Tier I SRV. Lead was reported at a concentration of 330 mg/kg in the Army's FSI soil sample AOC5-GP9-0-0.5 and at a concentration of 1.9 mg/kg at the 2 to 4 foot bgs sampling interval. No analytes were detected at concentrations above Tier I risk-screening criteria in soil sample SOC5-GP8-5-7. No other metals were detected above Tier I risk-screening criteria.

- Pentachlorophenol was detected in sample SOC5-GP8-1-1.5 at an estimated concentration of 0.15 mg/kg, which is below the laboratory reporting limit and Tier I SRV but above the Tier I SLV of 0.034 mg/kg. No SVOCs were detected in sample GP8-5-7.

- Arsenic was detected below the Tier I human health risk-screening criterion in seven of eight samples collected in SOC5-OU3. In sample SOC5-GP5-1.5-2.5, arsenic was detected at a concentration of 9.4 mg/kg, slightly above the Tier I SRV of 9 mg/kg.

- Nitrocellulose and VOCs were not detected in any of the soil samples.

4.2.3.2 Discussion

Based on the data from the Pesticide Release Area, shallow subsurface soil in the vicinity of DNT storage bunker 260-F and neighboring building to the south are impacted with lead above the Tier I SRV but below the industrial Tier II SRV of 700 mg/kg. The source of the elevated lead is likely a past release of petroleum from the former leaded gasoline fueling dispenser or fueling operations. Analytical data and observations from deeper soil borings indicate that the soil impacts are limited to

the upper 2 to 4.5 feet of soil in the area. The horizontal extent of the impacts is not fully documented but evidence of petroleum impacts was not observed at test trench or surface sample locations on the north, east, and south side of DNT storage bunker 260-F.

Pentachlorophenol was detected at an estimated concentration exceeding the Tier I SLV of 0.034 mg/kg but two orders of magnitude lower than the Tier I SRV. Based on groundwater data (discussed later in this report), there is no evidence that pentachlorophenol is leaching to groundwater. Therefore, the pentachlorophenol Tier I SLV exceedence is not of concern.

4.2.4 Green Space and Other Areas

Soil samples were collected to determine if soil in other portions of SOC 5 has been impacted by surface deposition from airborne releases, miscellaneous spills or past land use activities. Green space sampling locations included ditches where surface water runoff would collect and infiltrate, random locations that have been maintained as turf or agricultural plots, and access road base materials to determine if oils with PCBs were used for dust suppression. One sample was collected in the former Carpenter's Shop where a small (55-gallon) dip tank was reportedly used to treat fence posts. These sampling locations are shown on Figure 14.

4.2.4.1 Soil Analytical Results

Forty-one soil samples were collected and analyzed for one or more of the following parameter sets: nitrocellulose, metals, SVOCs, and pesticides. Soil analytical results are in Table 8 and are summarized on Figure 14. Sampling locations and results from the Army's FSI soil borings AOC5-GP3, GP5 and GP12 are also shown on Figure 14. Significant results are discussed below.

- Mercury was detected at concentrations above the Tier I and Tier II SRVs in samples SOC5-SS2-0.5, SOC5-SS2B-0.5, and SOC5-SS2B-1.5-2, which were located in the drainage ditch east of the public garden in the northwestern portion of SOC 5. The highest mercury concentration (3.8 mg/kg) was detected in SOC5-SS2B-0.5. Mercury was not detected in samples collected on the east and west sides of the drainage ditch or north of SOC5-SS2A (up slope in the ditch).

- Mercury was also detected at concentrations slightly above the Tier I SRV in FSI samples AOC5-GP8-0-0.5 and AOC5-GP1-0-0.5 collected near DNT storage bunkers 260-A and 260-E, respectively.

- cPAHs, as expressed by a B(a)P, and p-cresol were detected above the Tier I SRVs in one (SOC5-SS1-0.5) of the twenty SOC5 green space samples analyzed for SVOCs. B(a)Pe and p-cresol were not detected in the three step out samples (SS1A through C) or the sample collected from 1.5 feet bgs at location SS1.

- Nitrocellulose was not detected in the eleven samples analyzed for nitrocellulose as part of the SSI/RI. Low concentrations (<5 mg/kg) of nitrocellulose were reported in numerous Army FSI surface samples (and associated blank samples).

- DNT was not detected in any of the twenty soil samples analyzed for SVOCs.

- No pesticides were detected above Tier I risk-screening criteria.

- PCBs were not detected in the four samples from the access road base materials

- No metals or SVOCs were detected above Tier I risk screening criteria in sample SOC5-SS39-0-0.5 which was collected from the floor of the former Carpenter's Shop.

4.2.4.2 Discussion

Based on the surface soil sampling results, soils in the drainage ditch in the northwestern portion of SOC 5 exhibit mercury concentrations that exceed the Tier I and Tier II (industrial) SRVs. The source of the mercury is unknown. Current site operations do not involve mercury and current operations are not considered a source.

Based on the concentrations and distance from the drainage ditch, the mercury detections in Army FSI soil borings AOC5-GP1 and GP8 do not appear related to the mercury detected in the ditch soil samples. Due to the proximity of theAOC5-GP1 and AOC5-GP8 to the DNT storage bunkers 260-A and E and the land use in the vicinity of the storage bunkers, the mercury impacts detected during the FSI do not pose an immediate threat to human health or the environment.

The B(a)Pe exceedence at location SOC5-SS1 appears to be isolated. Data from step-out surface samples indicate that wide-spread cPAH impacts are not an issue in the vicinity of SOC-SS1. Furthermore, the SVOC data from the green space areas indicate that the cPAH impacts from the release of waterproofing materials from the DNT storage bunkers are not widespread in SOC 5.

4.2.5 Groundwater

Groundwater samples were collected from temporary wells installed in direct push borings SOC5-GP1 through 4 and GP9 through GP11. Due to the low permeability of the fine-grained till that was encountered after 12 or more hours, no groundwater accumulated in temporary wells SOC5-GP2 and SOC5-GP9.

4.2.5.1 Results

Results for the analysis of groundwater samples from the remaining temporary wells are in Table 9 on Figure 10. Significant groundwater results are discussed below.

- At SOC5-GP4, thallium and beryllium were detected at concentrations above the respective HRLs but below the MCLs. No other metals were detected above HRLs or MCLs.
- Nitrate plus nitrite-nitrogen was detected above the MCL of 10 milligrams per liter (mg/l) in groundwater from SOC5-GP11.
- No pesticides were detected above HRLs or MCLs. Atrazine and desethylatrazine were detected at low concentrations (<2.0 ug/l) in groundwater from temporary monitoring wells SOC5-GP3, GP4, and GP10.
- No VOCs were detected above HRLs or MCLs. Chloromethane was detected in groundwater from SOC5-GP1 and SOC5-GP4 at 36 ug/l and 6.9 ug/l, respectively. No risk screening criteria have been established for chloromethane.
- Nitrocellulose, perchlorate and SVOCs (including DNT) were not detected above laboratory reporting limits in any of the groundwater samples.

4.2.5.2 Discussion

Shallow groundwater in the southern portion of SOC 5 contains nitrate at concentrations above the MCL. Elevated nitrate concentrations are present in groundwater upgradient of SOC 5 (Barr, 2009d) and are attributed to agricultural land use.

In the central portion of SOC 5, thallium and beryllium were detected at concentrations above the HRLs but below the MCLs in shallow groundwater. Thallium and beryllium are naturally occurring trace elements that were detected in temp well SOC5-GP4 and water supply well 207607 (discussed later in this report). Literature indicates that thallium is released into the environment primarily from

industrial processes (such as fossil fuel combustion, smelting, cement manufacturing, and iron and steel production) in which thallium is a trace contaminant in the raw materials (California EPA, 1999). Although used for certain industrial applications, there are no major anthropogenic sources of beryllium in the environment (MPCA, 1999). No industrial process, raw material, or product sources of thallium or beryllium have been identified at SOC 5 or at the UMA, thus the detected concentrations of thallium and beryllium are attributed to natural background water quality.

Atrazine and desethylatrazine (a metabolite produced by the degradation of atrazine) were detected at concentrations below risk-screening criteria in groundwater from temporary wells SOC5-GP3 and GP4, which were installed in the Pesticide Release Area, and temporary well SOC5-GP10 which was installed south of the Pesticide Release Area. Potential sources of the pesticides include the application of pesticides upgradient of SOC 5, and in the case of GP3 and GP4, residual pesticides in subsurface soils within the Pesticide Release Area. Based on the analytical data, the previous corrective actions in the Pesticide Release Area have adequately addressed the past pesticide release(s) to the soils and groundwater.

Chloromethane was detected in shallow groundwater at SOC5-GP1. The groundwater sampled from temporary well SOC5-GP1 is likely "perched" at the top of the till unit and is isolated from the regional water table by the underlying till. The source of the chloromethane is not known at this time but chloromethane is a degradation product of carbon tetrachloride which has historically been used in the United States as a fumigant to protect grain stockpiles. None of the groundwater or soil samples collected exhibited carbon tetrachloride above the detection limit of 0.16 ug/l. Based on the elevation of the groundwater and positioning above the till deposit (and the regional water table), the source of chloromethane is likely near the northern portion of SOC 5. Because the groundwater at SOC5-GP1 is separated from the regional water table and does not contribute significantly to the shallow groundwater flow system, and the water table aquifer is not used as a potable aquifer, the presence of the chloromethane in groundwater at SOC5-GP1 does not pose a significant risk to groundwater receptors.

4.2.6 Water Supply Wells

Four water supply wells were sampled to evaluate groundwater quality near SOC 5. Locations of the water supply wells are shown on Figure 15 and construction details are provided in Table 10. Results of the area-wide well search are in Appendix D.

4.2.6.1 Results

Each water supply well was sampled for nitrate plus nitrite (as N), nitrocellulose, perchlorate, total metals (unfiltered samples), SVOCs, VOCs, and pesticides. Analytical results are summarized in Table 11. Significant results are discussed below:

- Lead was detected at a concentration of 18 micrograms per liter (ug/L) in the groundwater sample collected from the UMore Administration Building (WSW-208402). The EPA Action Level for lead is 15 ug/L. No MCL or HRL has been established for lead.

- Beryllium and thallium were detected above the respective HRLs but below the MCLs in the groundwater sample collected from the Central Services well (WSW-207607).

- Nitrate plus nitrite-nitrogen (as N) was detected below the MCL of 10 mg/L in samples from the water supply wells.

- No nitrocellulose, perchlorate, VOCs or pesticides were detected in any of the samples from the water supply wells.

4.2.6.2 Discussion

Each sampled well is constructed in the upper portion of the Prairie-du-Chien Formation. The total depths range from 166 to 235 feet bgs. The well at the leased residence (WSW-208405) is presumably used as a potable water supply; the other three wells are used to supply water for non-potable uses.

The lead detection in the sample from the UMore Administration Building well (WSW-208402) is likely from of the building's plumbing system. The detections of beryllium and thallium in the sample from the Central Services well (WSW-207607) are attributed to natural trace elements in the local soil and/or bedrock. As discussed earlier in this report, no current or historical sources of beryllium or thallium are known to exist in SOC 5 or the UMA.

4.3 Analytical Quality Control Summary

The analytical data demonstrated compliance with the data quality objectives as measured by the quality control samples. All sample data are considered acceptable with the assigned data qualifiers.

The following table summarizes the significant quality assurance issues that affect multiple data values.

Samples	Matrix	Analytes	Description	Action/Assessment
SOC5-GP4	Groundwater	VOCs, SVOCs, dissolved metals	Sample arrived at the lab at a temperature of 9.3 degrees Celsius.	Data were qualified with "h" indicating potential low bias. Sample from SOC5-GP4 was collected downgradient of the Petroleum Release Area. One VOC and two pesticides were detected in the sample. An additional sample was collected down gradient of SOC5-GP4 and no significant impacts were detected. No additional groundwater sampling is needed.
Multiple	Soil	Dinoseb, picloram	Low LCS/LCSD recoveries.	Low recoveries are attributed to inherent quantitation issues. Based on land use and pesticide data from other investigations, dinoseb and picloram are not anticipated to be significant constituents of concern in the project area. No additional sampling is needed.
SOC5-GP12-0.5-1, SOC5-GP13-0.5-1, SOC5-GP14-0.5-1, SOC5-GP27-0.5-1	Soil	Pesticides	Laboratory extracted samples past acceptable extraction date.	Data were qualified with an "h" indicating potential low bias due to holding time exceedences. Data from deeper intervals at sampling locations were non-detect. No release was identified at the sampling locations and no indication of a release was observed. No additional sampling is needed.

The analytical quality control review and subsequent data qualifications are in Appendix H.

5.0 Baseline Risk Evaluation

Baseline risk evaluations are conducted to evaluate of the potential threat that identified releases pose to human health and the environment in the absence of any remedial action. Result of the baseline risk evaluation are used as a basis to determine if remedial action is necessary to reduce the risks that impacts may have on human health and the environment. The components of the baseline risk evaluation include characterizing the levels of hazardous substances or petroleum products present in environmental media, environmental fate and transport mechanisms for each environmental media, potential human and environmental receptors, potential routes and extent of expected exposure, extent of expected impact, and level of uncertainty associated with the assessment. Table 12 provides a summary of the baseline risk evaluation components for SOCs 4 and 5.

Due to the factors below, a detailed baseline risk assessment is not needed for SOCs 4 and 5.

- The use of established human health risk-screening criteria applicable to unrestricted land use scenarios is a conservative approach in that specific future land use scenarios have not been finalized for SOCs 4 and 5.

- The University is committed to implementing remedial actions to ensure that the impacted environmental media at SOCs 4 and 5 are addressed in a manner that satisfactorily mitigates unacceptable risks to human health assuming future residential land use. Although remedial action objectives have not been finalized, future remedial actions will be designed to address soil impacts that exceed established residential risk-based criteria to ensure that site soils may be used in an unrestricted manner during site development (mining included).

- The implementation of future remedial actions will include field observation and confirmation sampling to verify that unacceptable impacts to human health are addressed. Furthermore, during the course of future site development, any discovered unacceptable impacts will be addressed under an MPCA-approved Environmental Contingency Plan.

6.0 Summary and Recommendations

SOCs 4 and 5 were investigated to evaluate the nature and extent of released hazardous substances or petroleum products related to past and current operations in SOCs 4 and 5. Based on the field observations and analytical data from the SSI/RI and on previous investigations, the conceptual release models which require future remedial action are summarized in Table 13. The areas requiring remedial action are shown on Figure 16.

The following recommendations are provided to address the environmental releases detected in SOCs 4 and 5 and prepare the area for future sand and gravel mining operations.

- An estimated 1,200 to 2,400 (in place) cubic yards of buried building demolition debris were identified in the vicinity of SOC4-TT9. No ACM was observed in the debris during the investigation but a thorough characterization of the buried debris was not conducted. It is recommended that the buried debris be removed prior to topsoil removal and sand and gravel mining. At the time of the buried debris is removed, confirmation soil sampling is recommended to verify that the buried debris has not resulted in impacts to underlying soils. No further environmental investigation is recommended in SOC 4.

- No indications of subsurface releases to soil or groundwater were found around the DNT storage bunkers. No drains or dry wells were found during the subsurface investigation around the DNT storage bunkers. Because the soil observation and sampling focused on soils beneath edges and around the perimeter of the DNT storage bunkers (via test trench excavation), the University should confirm that no drains exist beneath the bunker floor slabs during the demolition of the DNT storage bunkers.

- Field observation and analytical results indicate that surface soils near exposed (non-bermed) exterior DNT storage bunker walls are impacted with cPAHs from weathered waterproofing materials. Based on these results, the top six-inches of soils within 15-feet of exposed DNT storage bunker walls be removed and managed in accordance with an MPCA-approved Response Action Plan. Surface and berm soils around DNT storage bunkers 260-A, B, and C can be managed in an unrestricted manner as long as waterproofing material from the bunker walls is appropriately removed during demolition activities.

- Investigation results do not support the Army's FSI data that the low concentrations (<10 mg/kg) of nitrocellulose are present in surface soil in SOCs 4 and 5. No risk screening criteria have been established for nitrocellulose. No additional investigation for the presence of nitrocellulose in SOC 5 is recommended.

- Based on the observations made during the placement of test trenches and soil boring SOC5-GP28 and the analytical data from the Pesticide Release Area, previous corrective actions appear to have adequately addressed the soil impacts in the vicinity of the former rinsate lagoon. No additional investigation or corrective actions are recommended.

- Mercury was detected at concentrations above the Tier I and Tier II (industrial) SRVs in near surface soils in the shallow drainage ditch located in the northwestern portion of SOC 5. The mercury impacted soil is limited to a 40 foot long area in the bottom of the drainage ditch. Prior to addressing the mercury impacted soils, the schedule of field work and details of the corrective actions will be submitted to the MPCA for review.

- With the exception of the samples collected in the drainage ditch in the northwestern corner of SOC 5, mercury was not detected above the Tier I SRV at the SSI/RI sampling locations. The mercury detections above the Tier I SRV at FSI sampling locations near former DNT storage bunkers 260-E and 260-A appear to be isolated to those areas. Additional soil characterization around sampling locations AOC5-GP1 and AOC5-GP8 is recommended as part of RAP implementation work that will be conducted to prepare the site for sand and gravel mining.

- Lead was detected at concentrations at and slightly above the Tier I SRV in two surface soil samples collected near the former leaded gasoline dispenser in the Petroleum Release Area. Elevated headspace readings and staining were also observed in the upper 4.5 feet of soil at this location. Due to the lead and possible other petroleum impacts, soil removal is recommended in this area. Based on the current land use, the lead-impacted soil does not pose a risk to human health or the environment. The excavation of the lead impacted soil can be conducted in accordance with an MPCA-approved Response Action Plan at the time SOC 5 is being prepared for sand and gravel mining.

- Chloromethane was detected in groundwater from temporary wells SOC5-GP1 and SOC5-GP4. A HRL has not been established for chloromethane. It is recommended that potential

sources of chloromethane in the northern portion of SOC5 are evaluated during preparation of the site for sand and gravel mining operations.

- Thallium and beryllium were detected in groundwater above the HRLs but below the MCLs in temporary well SOC5-GP4 and water supply well 207607 in SOC 5. No additional investigation is warranted with respect to these detections because:
  - Beryllium and thallium are naturally occurring earth elements and the relatively low concentrations detected may be the result of natural background conditions
  - There are no anthropogenic sources of beryllium and thallium known to exist or believed to have existed in this area based on past land use.
  - The groundwater in this area is not used as a potable water source and therefore does not present a risk to potential receptors.

7.0 References

Barr Engineering, 2009a. Work Plan for Supplemental Site Inspection (SOC 4) and Remedial Investigation (SOC 5), UMore Mining Area, Dakota County, Minnesota.

Barr Engineering, 2009b. Groundwater Assessment Report, Resource Document for Environmental Impact Statement, UMore Mining Area, Dakota County, Minnesota.

Barr Engineering, 2009c. Sampling and Analysis Plan, Supplemental Site Investigation (SOC 4) and Remedial Investigation (SOC 5), UMore Mining Area, Dakota County, Minnesota.

Barr Engineering, 2009d. Phase II Investigation Report, Sites of Concern 1-3 and 6-8, UMore Mining Area, Dakota County, Minnesota.

California EPA, 1999. Public Health Goal for Thallium in Drinking Water.

Dakota County (MN), 2006. DNT Unloading Platform – Site 5704 and DNT West Drainage Ditch – Site 5706, Former Gopher Ordnance Works, UMore Park, Rosemount.

Metropolitan Council, 2008. Twin Cities Metropolitan Area Regional Groundwater Flow Model Version 2.00: Technical Report in Support of the Metropolitan Area Master Water Supply Plan (Draft)

Minnesota Department of Natural Resources, DNR 24K Streams at http://deli.dnr.state.us/, accessed May 2009.

Minnesota Geological Survey, 2006. County Well Index, update November 3, 2006

Minnesota Pollution Control Agency (MPCA), 1999. Barium, Beryllium, Calcium, Magnesium and Strontium in Minnesota's Ground Water.

MPCA, 2006. Superfund and Emergency Response Guidance for Collection of Spatial Data, Publication C-S4-02, MPCA 2006.

NOAA Satellite and Information Service, 2008. Monthly Station Climate Summary for St. Paul, Minnesota, http://cdo.ncdc.noaa.gov/cgi-bin/climatenormals/climatenormals.pl.

Peer, 2001. Comprehensive Summary Report and Site Investigation and Corrective Actions for AgSpill File# 14388, 14389, and 4783, UMore Park, Rosemount, MN. Prepared for the University of Minnesota by Peer Environmental and Engineering Resources, Inc., April 2001.

Peer, 2006. Phase I Environmental Site Assessment, UMore Park, Rosemount, Minnesota, Prepared for the University of Minnesota by Peer Environmental and Engineering Resources, Inc.

Peer, 1994. Letter to Mr. Don Milles of MPCA from Thomas McMullen of Peer summarizing previous reports and providing soil and groundwater and SVE system data in support of closure for LEAK #2529, August 30, 1994.

ProSource Technologies, Inc., 2008. Geological Assessment, UMore Park, Rosemount and Empire Township, Minnesota.

STS Consultants, Ltd, 1991. Soil Exploration/Remedial Investigation, Rosemount Agricultural Experiment Station Petroleum Release Site.

United States Army Corps of Engineers, Omaha District, 2006. Preliminary Assessment Report, Final 1947 Quitclaim Property, Former Gopher Ordnance Works, Rosemount, Minnesota.

Army, 2009. Final Focused Site Inspection Report, Former Gopher Ordnance Works, Rosemount, Minnesota.

United States Department of Agriculture, 2008. Dakota County Soil Survey, Minnesota, http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx