Phase II Investigation Report

Sites of Concern 1-3 and 6-8
UMore Mining Area
Dakota County, Minnesota

Prepared for
University of Minnesota

November 12, 2009

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

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List of Acronyms

AES	Agricultural Experiment Station (University of Minnesota)
AOC	Area of Concern
ASTM	American Society for Testing and Materials
bgs	Below ground surface
COC	Constituent of Concern
DBP	Dibutyl phthalate
DNT	Dinitrotoluene
DPA	Diphenylamine
DEIS	Draft Environmental Impact Statement
ECP	Environmental Contingency Plan
FSI	Focused Site Inspection
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
PDC	Prairie Du Chien
PID	Photoionization Detector
PPL	Pollutant Priority List
ppm	Parts per million
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

TKN	Total Kjeldahl Nitrogen
UMA	UMore Mining Area
UMore Park	University of Minnesota Outreach, Research and Education Park
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
VOC	Volatile Organic Compound

Executive Summary

The University is proposing the development of 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), consists of approximately the western one-third of UMore Park. This Phase II Investigation was conducted to determine whether historical activities at six sites of concern (SOCs) identified in the UMA resulted in releases of hazardous substances or petroleum products to the environment. This report will be incorporated into the Draft Environmental Impact Statement (DEIS) that the University is preparing for the proposed mining operations in the UMA.

A total of sixty-six test trenches, fifteen direct-push soil borings, and fourteen surface sampling locations were evaluated during the Phase II Investigation. No incidental odors, discoloration, or elevated headspace measurements indicative of a past release of hazardous substances or petroleum products were encountered during the field investigation. With the exception of SOC 3, no buried debris was encountered during the investigation. Debris encountered within SOC 3 included a small amount of demolition debris (concrete and rebar) in the northeast corner of the former "K" Street Dump and miscellaneous debris in fill soils in the former manure lagoon.

Forty-six soil samples and ten groundwater samples were collected and analyzed in accordance with the Phase II Investigation Work Plan, Sites of Concern 1-3 and 6-8 (Work Plan) (Barr, 2009a). Sampling results that slightly exceeded health risk-based regulatory screening criteria included semi-volatile organic compounds (SVOCs) detected in one soil sample from the railroad grade in SOC 1, arsenic detected in two soil samples from SOC 3, and nitrate + nitrite in one groundwater sample from SOC 6. Additional investigation is recommended to further evaluate SVOC concentrations in surface soils on the former railroad bed throughout the UMA.

Asbestos containing material (ACM) was encountered at the ground surface at SOC 8 during the Phase II Investigation. The University reported the ACM to the Minnesota Pollution Control Agency (MPCA) and coordinated the ACM remediation in accordance with the University's Emission Control Plan.

1.0 Introduction

This document presents the results of a Phase II Investigation of six sites of concern (SOCs) that were identified 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 UMA is being proposed for future sand and gravel mining and is the subject of a Draft Environmental Impact Statement (DEIS) which is currently in preparation by the University. This report presents the findings of the Phase II Investigation of SOCs 1-3 and 6-8 and will be included as a resource document to the DEIS.

1.1 Phase II Investigation Purpose and Scope

As described in the Phase II Investigation Work Plan, Sites of Concern 1-3 and 6-8 (Work Plan) (Barr, 2009a), eight sites of concern were identified in the UMA and were selected for further investigation because they either met the ASTM definition of a Recognized Environmental Condition (REC) or were potentially associated with past activities that make them a possible source of a release. In a Preliminary Assessment (USACE, 2006) (PA) completed under the Formerly Used Defense Sites (FUDS) Program, USACE designated SOCs 4 and 5 as GOW "Areas of Concern" (AOCs) 3-DA1 (drainage area) and 5 (DNT Storage Area), respectively. In 2007, the USACE completed limited sampling in SOCs 4 and 5, it was determined through discussion with MPCA that these two SOCs would be evaluated under a separate investigation work plan that is consistent with FUDS Program requirements. The MPCA subsequently approved the Supplemental Site Inspection (SOC 4) and Remedial Investigation (SOC 5) (Barr, 2009). The results of that investigation will be presented in a separate report. The SOCs included in this Phase II Investigation are listed below.

- SOC 1 – Former Railroad "Y"
- SOC 2 – Forestry Research/Former GOW Storage
- SOC 3 – Ag Engineering Complex/Former "K" Street Dump Area
- SOC 6 – Southern Complex Storage Buildings and Wash Pads
- SOC 7 – Suspected Dump Area
- SOC 8 – Undetermined Use Area West of Patrol Road and South of CR 46

The location of each SOC is shown on Figure 2. Due to recent UMA boundary revisions, SOC 2 and a portion of SOC 1 are now located outside of the UMA.

1.1.1 Purpose

The Phase II Investigation was conducted to determine whether historical activities at SOCs 1-3 and 6-8 resulted in releases of hazardous substances or petroleum products to the environment. The data generated from this investigation will be used to identify data gaps for future investigation as necessary and will be incorporated into the University's DEIS.

1.1.2 Scope

Phase II investigation activities included the following:

- Advancement of fifteen direct-push soil borings.
- Excavation of sixty-six test trenches.
- Collection of forty-six soil samples from direct push soil borings, test trenches, and surface sample locations.
- Collection of groundwater samples from six temporary wells.
- Collection of a groundwater sample from one water supply well.
- Collection of background groundwater samples from three monitoring wells previously installed in the UMA.
- Inventory of the wells located in the UMA.

The activities below were performed to follow-up on the initial results of the investigation.

- Collection of surface soil samples at five of the seven locations where total chromium concentrations in soil were detected above health-risk based regulatory screening criteria (risk screening criteria) for hexavalent chromium. These data were collected to verify that chromium in soils at the UMA is present in the trivalent state.
- Collection of groundwater samples for dissolved metals from three direct push soil boring locations where lab preparation errors rendered the initial data as unusable.
- The installation of one monitoring well and sampling of three additional existing monitoring wells for the purpose of monitoring groundwater quality downgradient of SOC 6. The monitoring well installation and sampling was completed due to refusal of the planned direct push soil borings above the water table at SOC 6.

1.2 Report Organization

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

- Section 2: Background – Provides general information including site location, historical and current land use, and physical setting information.
- Section 3: Investigation Activities – Describes the sampling approaches and investigation activities.
- Section 4: Investigation Results and Discussion – Provides a summary and discussion of investigation results from SOCs 1-3 and 6-8, background sampling results, and data quality assurance/quality control findings.
- Section 5: Recommendations – Describes the recommendations for additional investigation to address the needs of the DEIS and the development of gravel mining operations at the UMA.
- Section 6: References – Includes a list of cited references.
- Tables – Present a summary of sample locations and results of testing.
- Figures – Graphically present relevant site features and sampling locations.
- Appendices – Contains supplemental and detailed information from the investigation.

2.0 Background

This section describes the location, historical and current use, past SOC uses, climate and hydrology, soils, geology, and hydrogeology at the UMA. Information presented in this section is based on published reports and past investigations conducted at UMore Park.

2.1 UMA Location and Current Use

The UMA is located approximately 15 miles southeast of the Twin Cities, on the west side of US Highway 52 and south of County Road 42 in Dakota County. The UMA consists of a total of 1,657 acres, 1608 of which are proposed for future mining development, 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 in Township 114N, Range 19W and portions of Section 28, 33, and 34 of Township 115 N, and Range 19 W (Figure 1).

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 Historical Land Use at UMore Park Relevant to UMA

UMore Park was once owned by the U.S. Government and includes portions of the former Gopher Ordnance Works (GOW). The GOW, which was constructed and operated from 1942 to 1945, was established to manufacture smokeless gunpowder, oleum (a concentrated form of sulfuric acid used in the manufacture of gun powder), and nitric acid. Dinitrotoluene (DNT), aniline, dibutyl phthalate (DBP), and diphenylamine (DPA) 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. 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.

2.3 Past SOC Uses

This section provides an overview of historical land use at SOCs 1-3 and 6-8. The location of each SOC is shown on Figure 2.

2.3.1 SOC 1 – The Former Railroad "Y"

Construction of the GOW began rapidly in 1942, starting with heavy gauge rail service to supply the construction materials for the many buildings and to bring in the equipment needed for the munitions plant (Peer, 2006). The Railroad "Y" was the main railroad junction for material arriving at the GOW. Although there is no information indicating that derailments or spills occurred at the "Y", there have been no investigations conducted in this area and it is reasoned that railroad junctions are areas where rail car accidents are more likely to occur (as compared to straight track intervals). The "Y"-shaped area exhibits a raised rail grade that is less vegetated and higher in elevation than the topographic lows on either side of the former railroad grade. No railroad tracks or ties are present on the former railroad grade.

2.3.2 SOC 2 – Forestry Research/Former GOW Storage

SOC 2 is located along the former railroad grade south of the "Y" described above. GOW-era records indicate that a railroad dock platform and several "Excess Material" storage buildings were located in this area just south of Patrol Road (Peer, 2006). SOC 2 is also located south of the former lumber yard that was used for the GOW. The 1945 and 1951 air photos (Barr, 2009a) show several areas of disturbed or bare soil located west of the buildings along the rail line. Because the timing of the appearance of the disturbed soil areas on the aerial photos coincided with the commencement of government demolition activities at the GOW, it was concluded that dumping may have occurred in SOC 2.

2.3.3 SOC 3 – Ag Engineering Complex/Former "K" Street Dump Area

The so-called "K" Street Dump was a borrow pit that was reportedly excavated for aggregate used for GOW construction. Evidence of the area being a dump is mainly attributed to the discovery of construction debris on the northeast corner of SOC 3 during the construction of County Road 46. The area is located in the northeast corner of SOC 3 and is heavily wooded and exhibits uneven topography and an abrupt escarpment on the west side that was interpreted as an evidence of filling and possible dumping in the area. The former "K" Street Dump site was originally planned for the construction of the DNT Screening House plant on the site as indicated in the following excerpt from the site write-up prepared by Dakota County (2006):

> "In 1942, the area originally slated to become one of several service areas for smokeless powder lines D-E-F, but the latter's on-again, off-again construction in 1943 and 1944 made any work there moot beyond bulldozing and the mining of sand and gravel. For example, a DNT (dinitrotoluene) Screening House was originally planned for the northeast corner of the area, but its location was moved to GOW 40th Street (now known as Barbara Avenue East), where it was near to the active smokeless powder lines A-B-C."

The Agricultural Engineering complex is located west of the "K" Street Dump at the former Kane farmstead. The Agricultural Engineering complex was used for petroleum and pesticide storage and used a former lagoon to store animal manure west. Based on a review of available records, no releases in SOC 3 have been identified. The area has not been previously investigated.

2.3.4 SOC 6 – Southern Complex Storage Buildings and Wash Pads

The Southern Complex includes the plant pathology research area. A number of buildings in SOC 6 are used to store agricultural chemicals including pesticides and fertilizers. There are two documented agricultural releases (AgSpill numbers 14388 and 14389) associated with two buildings in the Southern Complex (Peer, 2001). Both agricultural chemical spill files were closed in 2002.

2.3.5 SOC 7 – Suspected Dump Area

SOC 7 is a suspected dump area located near a topographic depression in the west central portion of the UMA. Traces of concrete rubble and small pieces of vinyl and fabric were noted in the surface soils during field reconnaissance site visit that was part of Work Plan development. There are no obvious indications of former structures in historic aerial photographs, but it is possible that demolition waste disposal occurred in this area or in the topographic depression north of SOC 7. Currently the area is a cultivated field.

2.3.6 SOC 8 – Undetermined Use Area West of Patrol Road and South of CR 46

SOC 8 is located on the west side of the patrol road. Prior to 1945, the area was used as farmland. On the 1945 air photo, several light colored areas (interpreted to be debris piles) are located throughout much of the area. There are no records indicating storage or disposal of hazardous substances or petroleum products and past land use appears to be agricultural cropland.

2.4 Physical Setting

The following sections provide a summary of the physical setting at the UMA. Geology and hydrogeology at the UMA are described in more detail in the Groundwater Assessment Report (Barr, 2009d) prepared as a resource document for the DEIS.

2.4.1 Climate and Hydrology

The UMA is located in a humid continental climate zone (Kottek, et al., 2006). Average daily maximum temperature ranges from 23 to 83 degrees Fahrenheit and average annual precipitation is approximately 32.5 inches (NOAA, 2008).

UMore Park is generally located on a sandy flat topographic plateau between the Mississippi River and Vermillion River. The ground surface within the UMA generally slopes from west to east, from approximately elevation 950 to 940 feet relative to mean sea level (feet MSL). Runoff from areas south of 160th Street 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 for that branch in hydrologic model studies of the Vermillion River) and eventually the Vermillion River, located about 2.5 miles south of the site. The central and northwestern parts of the UMore Mining Area are landlocked (i.e. watershed areas 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 areas drain to the east and do not contribute to the Vermillion River. Stormwater runoff from areas north of 160th Street flow towards Rosemount and ultimately to the Mississippi River, located approximately 4.5 miles northeast of the site. However, 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.

2.4.2 Soils

Waukegan series soils cover approximately ninety percent of the UMA (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.

2.4.3 Geology

The geology at the UMA consists of 25 to over 150 feet of unconsolidated glacial deposits overlying an erosional bedrock surface (Barr, 2009d).

2.4.3.1 Unconsolidated Deposits

The surficial soils at the UMA are relatively thin (generally less than 5 feet thick) and are derived from loess (windblown silt) or consist of localized fill associated with post-settlement development (Barr, 2009d). In most places, the underlying near-surface deposits consist of sand and gravel. Diamicton (till) sediments consisting of a mixture of gravel and sand within a fine-grained matrix are present beneath the surficial outwash throughout much of the UMA and UMore Park. Other fine grained sediments, including low energy fluvial or lacustrine deposits are present discontinuously within the outwash across the site.

An older outwash deposit has also been identified within the UMA and was differentiated from the younger outwash by its lower gravel content and the presence of iron mottling (ProSource, 2008). This older outwash deposit is directly overlain by either younger outwash or till deposits depending on location.

2.4.3.2 Bedrock Deposits

The uppermost bedrock units within the UMA and surrounding area consist of remnants of the St. Peter Formation Sandstone (St. Peter) and the Prairie Du Chien Group (PDC), which underlies the St. Peter and comprises the uppermost continuous bedrock unit in the area (Barr, 2009d). The PDC and underlying Jordan Formation Sandstone are the uppermost bedrock aquifers in the area and are used locally for crop irrigation and municipal water supply, respectively. The St Lawrence Formation, considered a confining layer, is present below the Jordan Sandstone.

2.4.4 Hydrogeology

Groundwater in the UMA is at approximate elevation 885 ft MSL or about 65 feet below the average ground surface (bgs) elevation of approximately 950 ft MSL. The water table surface is within the Quaternary outwash sediments across much of the UMA, with the exceptions being in the southern portion of the UMA where St. Peter sandstone is present near the ground surface and the east central portion of the UMA where till is present. Groundwater flow within the outwash is to the northeast towards the Mississippi River (Figure 3). Where the water table is located within the outwash or the St. Peter, groundwater flow occurs under unconfined conditions (Barr, 2009d). Confined groundwater flow occurs in the outwash where overlying till deposits are present at or beneath the water table (Barr, 2009d).

3.0 Investigation Activities

The initial Phase II Investigation field activities were conducted between June 3 and June 15, 2009. The follow-up field activities were completed in October 2009. Field and laboratory methods followed the Work Plan (Barr, 2009a) and the Sampling and Analysis Plan (SAP) (Barr, 2009b) with the exception of the minor deviations described in Appendix A.

A total of fifteen direct-push soil borings were advanced with a Geoprobe rig at SOCs 1, 3, and 6 for the purpose of screening subsurface soils and collecting soil and groundwater samples for laboratory analysis. The soil borings were advanced by Matrix Environmental LLC of Osseo, Minnesota. A summary of soil boring locations and depths is provided in Table 1. Temporary wells were installed at six of the direct-push soil boring locations for the purpose of collecting groundwater samples. All temporary wells were removed and all soil borings were sealed in accordance with Minnesota Department of Health (MDH) requirements. Soil boring logs and a Well and Boring Sealing Record are in Appendix B. Selected photographs taken during the direct-push soil boring investigation are in Appendix C.

A total of sixty-six test trenches were excavated in SOCs 2, 3, 7 and 8 for the purpose of screening near surface soils and collecting soil samples for laboratory analysis. Test trenching was conducted by Stevens Drilling and Environmental (SDE) of Maple Plain, Minnesota. A summary of the test trench locations and depths is provided in Table 1. Test trench logs are in Appendix B. Photographs taken during the test trench investigation are in Appendix C.

Nine surface soil samples were collected from SOC 1 and five surface samples were collected from background sampling location outside of the SOCs. The surface samples were collected by Barr field staff. A summary of the surface sampling locations is in Table 1.

Monitoring well MW-E2-012 was installed downgradient of SOC 6 by SDE. The well was installed in accordance with MDH well code and Dakota County Ordnance. A copy of the well log and development and sampling forms are included in Appendix B.

Laboratory analytical services were provided by Legend Technical Services, Inc (Legend), Braun Intertec (Braun), Test America, Inc (Test America), and Davy Laboratories (Davy). In accordance with the SAP, Legend analyzed the samples for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOC), organochlorine and organophosphorus pesticides, and priority pollutant

list metals (i.e., antimony, arsenic, beryllium, cadmium, total 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 and hexavalent chromium. Davy, as a subcontractor to Legend, analyzed the samples for nitrate plus nitrite (as nitrogen) and total kjeldahl nitrogen (TKN).

3.1 Sampling Approach

The sampling approach used during the Phase II Investigation was consistent with the Work Plan and the SAP (Barr, 2009a, b). The sampling approach focused on evaluating areas for hazardous substance or petroleum releases through the collection of discrete soil samples from soil borings, test trenches, and surface sample 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 surface 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 soils. Groundwater samples were collected to broaden investigation coverage and to identify potential release area that may have been missed by soil sampling. Background soil and groundwater samples were collected to evaluate analyte concentrations outside of the SOCs.

Soils encountered in direct-push soil borings and test trenches were screened and described in accordance with the Work Plan and the SAP. Field screening observations included observing soil moisture, odor, discoloration, and the presence of organic vapors. Organic vapor screening 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).

Investigative derived waste (IDW) was managed in accordance with the SAP. Because no evidence of impacts was identified during field work, soil cuttings, decontamination water and well purge water was spread at each boring location. Excavated soil was segregated during test trench excavation and was placed back in test trenches in the reverse order it was removed (i.e., topsoil was placed on top).

3.2 Sampling Activities

Soil and groundwater samples in SOCs 1-3 and 6-8 were collected in accordance with the Work Plan. Sampling activities consisted of organic vapor (headspace) screening, surface and subsurface soil sample collection and groundwater sampling. Soil samples were collected from seven direct-push soil borings, fourteen surface sample locations, and fifteen test trenches. Groundwater samples were collected from six temporary wells installed in direct-push soil borings, one water supply well located in SOC 3, and one new and five existing monitoring wells near SOC 6. Sampling activities are summarized in Table 2. Sampling locations for each SOC are shown on Figures 4 through 16.

Follow-up soil sampling and groundwater sampling from selected direct-push borings was conducted after the analytical results from the initial sampling activities were received. Soil samples SOC2-TT1R-1.5', SOC2-TT3R-0.5-1', SOC2-TT4R-0.5-1', SOC2-TT5R-0.5-1', and SOC3-TT6R-0.5-1' were collected from five locations where the total chromium concentrations exceeded standards for hexavalent chromium. The samples were collected adjacent to original sample location and at the same depth to verify that chromium in the soil is present in the trivalent form. Three groundwater samples, SOC1-GP3R, SOC3-GP2R, and SOC3-GP3R, were collected in borings advanced adjacent to the initial direct push borings due to a dissolved metals sample preparation error by the laboratory. The letter "R" was used in the sample identification numbers to differentiate the results of the re-sampling with the original results.

3.3 Other Activities

The following activities were completed as a part of the Phase II Investigation.

3.3.1 Surveying

Soil boring and test trench locations and elevations were surveyed in the field using Real-Time Kinematic (RTK) Global Positioning System (GPS) methods in accordance with the Work Plan. Surface soil sample locations were collected using a handheld GPS. Ground surface elevations at the background surface sampling locations were estimated using LIDAR data provided by Dakota County (Table 1). 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.

3.3.3 Well Inventory

An inventory of wells located within the UMA was completed. As part of the inventory, each well was surveyed with a hand held GPS, the location of the well was described (e.g., well located inside well house), the diameter of each well was measured, and the Unique Well Identification Number

was verified if a well tag was found. Of the twenty-six wells identified with the UMA (Barr, 2009a), Barr staff identified seventeen active wells and five sealed wells. Five of the wells were not located and are presumed to be sealed or mis-located in the well databases. A description of the well inventory activities and findings is provided in Appendix D.

4.0 Investigation Results and Discussion

This section presents the investigation results for each SOC. Tables 3, 5, 6, 8, 10 and 11 show the soil sample results compared to risk screening criteria, including Tier I Residential Soil Reference Values (Tier I SRVs) and the Tier I Soil Leaching Values (Tier 1 SLVs). Groundwater results from SOCs 1, 3, and 6 are compared to Maximum Contaminant Levels (MCLs) and MDH Health Risk Limits (HRLs) in Tables 4, 7, 9 and 12. The soil and groundwater data are also summarized on the figures as referenced in the following sections. Electronic copies of the laboratory reports are included in Appendix E.

4.1 SOC 1 –Former Railroad "Y"

The investigation of SOC1 included soil and groundwater sampling from three direct-push soil borings and soil samples from nine surface soil sampling locations (Figure 4). The total depth of the soil borings ranged from 20-68 feet bgs. Soil samples were collected from the three soil borings and all nine of the surface soil locations. Groundwater samples were collected from temporary wells placed in borings SOC1-GP1 and SOC1-GP3/3R. Investigation samples collected in SOC 1 are listed in Table 2.

Soils at SOC 1 consist of loamy topsoil underlain by brown silt and sand and gravel. Fill encountered on the surface of the former railroad track bed consisted of fine aggregate. At SOC1-GP3, approximately ten feet of organic silt was encountered near the ground surface. Figure 5 shows a cross section with the subsurface soils and the approximate water table elevation at SOC 1.

4.1.1 Soil Analytical Results

A total of fifteen soil samples were collected and analyzed for one or more of the following parameter sets: VOCs, SVOCs, priority pollutant list (PPL) metals, nitrocellulose, arsenic, and pesticides. Analytical results from the soil samples collected at SOC 1 are in Table 3 and are graphically summarized on Figure 4. Pertinent soil results are discussed below.

- SVOC results were below risk screening criteria in eleven of twelve samples analyzed for SVOCs. In sample SOC1-SS2B collected from the former railroad bed, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), expressed as benzo(a)pyrene (BaP) equivalent were detected at a concentration of 2.8 milligrams per kilogram (mg/kg) which is slightly above the Tier I SRV of 2.0 mg/kg, but below the Tier I SLV of 10.2 mg/kg. Sample SOC1-

SS2B was one of nine surface soil samples collected from the former railroad bed within SOC 1.

- Arsenic was detected at concentrations below Tier I SRV and SLV in all twelve of the samples analyzed for arsenic. No PPL metals were detected above risk screening criteria.
- Nitrocellulose, pesticides, and VOCs were not detected above reporting limits in any of the samples analyzed for those compounds.
- No visually impacted soils, odors, discoloration, or elevated organic vapor headspace results were observed during the course of field work.

4.1.2 Groundwater Analytical Results

Groundwater samples were collected from temporary wells installed in direct push borings SOC1-GP1 and SOC1-GP3 (Figure 4). Temporary well SOC1-GP3 was located downgradient from temporary well SOC1-GP1. Analytical results for the groundwater samples are in Table 4 and are summarized on Figure 5. Pertinent groundwater results are discussed below.

- VOCs, metals, pesticides, and perchlorate were not detected in either of the groundwater samples collected from SOC1.
- One SVOC, diethyl phthalate, was detected at a concentration well below risk screening criteria in sample SOC1-GP1 but not in the duplicate groundwater sample.

4.1.3 Discussion

Analytical results indicate that the soils on the railroad bed in SOC 1 may be impacted by past land use. Surface soil sample SOC1-SS2B, which was collected from the former railroad bed, had a BaP equivalent concentration slightly above the Tier I SRV. SVOCs were not detected above the SRV in the other eight soils samples collected at the surface sampling locations along the railroad grade. The source of the BaP detection is likely associated with railroad ties or railroad activity along the railroad track. Based on the BaP equivalent exceedence, additional sampling and analysis is recommended to evaluate surface soils on the former railroad grade in SOC 1 prior to development.

Based on the groundwater analytical results, groundwater quality in SOC 1 is not significantly affected by past land use activities and no further investigation is needed.

4.2 SOC 2 – Forestry Research / Former GOW Storage

Sixteen test trenches were placed to depths ranging from five to twelve feet bgs in/near SOC 2 (Figure 6). Investigative samples and analytes from SOC 2 are listed in Table 2.

The soils encountered in test trenches excavated at SOC 2 consisted of loamy topsoil, underlain by approximately five feet of silt and light brown sand and gravel. No fill or buried debris was encountered.

4.2.1 Soil Analytical Results

Soil samples were collected from five locations in SOC 2 and analyzed for VOCs, SVOCs, PPL metals, and nitrocellulose. Four soil samples were analyzed for hexavalent chromium. The soil analytical results are in Table 5 and are summarized on Figure 6. Pertinent results are discussed below.

- SVOCs, VOCs and nitrocellulose were not detected above reporting limits in any of the samples.
- Total chromium concentrations were detected at concentrations ranging from 19-46 mg/kg in soil samples SOC2-TT1-1.5', SOC2-TT3-0-0.5', SOC2-TT4-0-0.5', and SOC2-TT5-0-0.5'. Hexavalent chromium was not detected in the surface soil samples that were collected at SOC2-TT1R-1.5', SOC2-TT3R-0-0.5', SOC2-TT4R-0-0.5', and SOC2R-TT5-0-0.5' during follow-up sampling activities.
- No visually impacted soils, odors, discoloration, or elevated organic vapor headspace results were observed during the course of field work.

4.2.2 Discussion

Observations and field screening results give no indication that past land use resulted in a release of hazardous substances or petroleum products in SOC 2.

Based on the hexavalent chromium analytical results, the total chromium concentrations in the soil samples are representative of trivalent chromium. The presence of trivalent chromium is consistent with literature references that indicate that when present, hexavalent chromium does not typically persist in the environment for significant lengths of time (Health Canada, 1986). The total chromium concentrations are three or more orders of magnitude lower than risk screening criteria for trivalent chromium and are not of concern.

4.3 SOC 3 – Ag Engineering Complex / Former "K" Street Dump

Sixteen test trenches and four direct-push soil borings were placed in SOC 3 (Figure 7). Test trench depths ranged from four to fourteen feet bgs and soil boring depths ranged from twenty to sixty feet bgs. Soil samples were collected from eight test trenches and two soil borings. In accordance with the Work Plan, samples were not collected from the other locations within SOC 3 because no evidence of a release was identified. Groundwater samples were collected from temporary wells installed at three soil boring locations and from water supply well WSW-207605. Hexavalent chromium was collected from one surface soil sample location as a follow-up to initial results. Investigation samples collected in SOC 3 are listed in Table 2.

Soils encountered in the central portion of SOC 3 included up to three feet of topsoil, underlain by brown silt, and sand with gravel. A fine-grained diamicton (till) deposit was encountered in soil borings SOC3-GP2, SOC3-GP3, and SOC-GP4 at depths between 30 and 50 feet bgs (Figures 8 and 9). Thin intervals of wet soil were encountered near the till contact in the soil borings (Appendix A). Based on site-wide groundwater elevation data (Figure 3), the groundwater encountered at the till contact appears to be at a higher elevation than the regional water table in the outwash, likely due to the presence of the fine-grained till deposit. Similar findings have been reported at UMore (Bay West, 2008) and referred to as "perched groundwater" by others. It is possible that the till deposit is saturated, however, due to the low hydraulic conductivity of the till, groundwater flow from the till to a well is expected to be insufficient for an effective monitoring well.

In the vicinity of the so-called "K" Street Dump in the northeast corner of SOC 3, a thin (<1') surficial topsoil horizon is underlain by approximately five or more feet of silt, sand and gravel. Unlike elsewhere in the UMA, the silt exhibits a blocky nature and contains intervals of with increased sand content. In test trench SOC3-TT9, concrete, rebar, and other inert debris are present in the silt layer. Based on observations made during test trenching, the debris is limited to a small area in the northeastern corner of the former "K" Street Dump area. The sand underlying the debris exhibited horizontal stratification characteristic of native sand and gravel in the area. Based on the observations made during test trenching, the silt is interpreted to be fill (re-deposited silt) across much of the "K" Street Dump area.

In the footprint of the former manure lagoon, up to four feet of fill with minor debris (wire, PVC, wood, etc.) was encountered above an apparent plastic liner and underlying native sand and gravel.

Cross sections B-B' (Figure 8) and C-C' (Figure 9) show the interpreted spatial relationships between the fill, lagoon area soils, subsurface geologic units, and groundwater at SOC 3.

4.3.1 Soil Analytical Results

The soil samples collected in SOC 3 were analyzed for VOCs, SVOCs, PPL metals, nitrocellulose, arsenic, and pesticides. Soil sample analytical results are in Table 6 and are summarized on Figure 7. Pertinent results are discussed below.

- Arsenic concentrations in samples SOC3-GP1-0-0.5' and SOC3-TT6-0-1' were 9.2 and 9.8 mg/kg, respectively, which is slightly above the Tier I SRV of 9 mg/kg, but below the Tier I SLV of 15.1 mg/kg. The arsenic concentration in a duplicate of sample SOC3-GP1-0-0.5' was 7.1 mg/kg. Arsenic concentrations in the other 13 analyzed soil samples were below risk-screening criteria.

- Total chromium was detected in samples SOC3-GP1-0.5' and SOC3-TT6-0-1'at concentrations below the Tier I SRV for trivalent chromium. Hexavalent chromium was not detected in sample SOC3-TT6R-0-1' that was re-collected adjacent to test trench SOC3-TT6.

- Nitrocellulose, pesticides, VOCs, and SVOCs were not detected in any of the samples.

- One surface soil sample collected at SOC3-TT6 exhibited a headspace reading of 150 parts per million (ppm) with the PID. Additional headspace screening was conducted on surface samples in the immediate vicinity of the sample with the elevated reading and no other elevated headspace readings were encountered. A sample from test trench SOC3-TT6, which was collected to evaluate the near surface soil with the elevated headspace reading was analyzed for VOCs, SVOCs, metals, nitrocellulose, and pesticides. With the exception of metals concentrations described above, no analytes were detected.

- A light organic odor was incidentally noted in the fill encountered in the former manure lagoon area but headspace readings were consistent with background concentrations. No compounds were detected above risk-screening criteria in soil sample SOC3-TT2-4' which was collected from the fill in the former manure lagoon.

4.3.2 Groundwater Analytical Results

Groundwater samples were collected from temporary wells installed in direct-push soil borings SOC3-GP2/2R, SOC3-GP3/3R, and SOC3-GP4. A groundwater sample was collected from water

supply well WSW-207605 which is completed in the Prairie du Chien and supplies water to the buildings in SOC 3. Analytical results are in Table 7. Figures 8 and 9 provide a summary of groundwater results from the temporary wells. Pertinent groundwater results are discussed below.

- No VOCs, SVOCs, pesticides, perchlorate or nitrocellulose were detected in the water sample from WSW-207605. Detected concentrations of metals and nitrate plus nitrite (as nitrogen) were below risk-screening criteria.

- Nitrocellulose, VOCs, pesticides, and perchlorate were not detected in any of the samples collected from the temporary wells.

- No metals were detected above risk-screening criteria in the groundwater samples collected from temporary wells SOC3-GP2R and SOC4-GP3R.

- Nitrate plus nitrite as nitrogen was detected above the MCL in groundwater from the temporary well installed in soil boring SOC3-GP3 located near the southwest corner of SOC 3. Elevated nitrates in groundwater are consistent with background data and are attributed to agricultural land use in the area.

4.3.3 Discussion

Observations from the test trenches excavated in SOC 3 indicate that the former "K" Street Dump does not contain substantial amounts of buried debris. Debris encountered in SOC 3 consisted of inert materials located in the vicinity of test trench SOC3-TT9 which was excavated at the northeast corner of the "K" Street Dump area. Based on field observations, headspace screening, and analytical data, the debris appears to be isolated and not associated with a release of hazardous substances or petroleum products or buried ACM. The prominent topographic mound was found to be composed mainly of clean fill soils and appears to be consistent with a building pad. The observations from the test trenches are consistent with the placement of a building pad as a foundation for the planned but never-constructed DNT screening house reported by Dakota County.

The elevated headspace reading in the single location at test trench SOC3-TT6 is considered to be a *de minimus* condition based on the lack of reproducibility of headspace data and analytical data from the soil sample collected at that location. The area with the elevated headspace reading was in an access road that was cleared (by a tree removal crew) prior to mobilizing the excavator. The source of the elevated headspace readings could be related to fueling of tree removal equipment.

On average, arsenic concentrations were below risk-screening criteria at SOC 3. The arsenic detections slightly above the Tier I SRVs in two of eleven soil samples collected at SOC 3 are minor and not of concern. Based on follow-up sampling at SOC3-TT6, total chromium in soil consists of trivalent chromium and is not of concern.

The groundwater sampled at locations SOC3-GP2 and SOC3-GP3 appears to be from saturated interval that is above the regional water table. This is likely results from mounding above the low permeability till deposit (Barr 2009d) and is not anticipated to significantly contribute to regional groundwater flow. Based on the groundwater analytical results, groundwater quality in SOC 3 is not significantly affected by past land use activities and no further investigation is needed.

4.4 SOC 6 – Southern Complex Storage Buildings and Wash Pads

Eight soil borings were advanced in SOC 6 (Figure 10). The total depths of the soil borings ranged from twenty to approximately fifty feet bgs. Soil samples were collected for laboratory analysis from four borings and a groundwater samples was collected from one temporary well. Soil borings SOC6-GP1 through SOC6-GP4 were terminated at depths ranging from 20 and 52 feet bgs due to refusal in the St. Peter Sandstone. As a result of refusal, groundwater samples were not collected from soil borings SOC6-GP1 through SOC6-GP4. A groundwater sample was collected from a temporary well installed in soil boring SOC6-GP6. Temporary well was located near the septic drain field and was completed to a depth of twenty-five feet to monitor a thin saturated interval above a clayey till deposit. As shown in Cross Section D-D' on Figure 11, the groundwater sampled from SOC6-GP6 is interpreted to be located above the regional water table.

To collect groundwater samples downgradient from SOC 6, monitoring wells MW-E2-009, MW-E2-305, MW-E2-012, and MW-D3-007 were sampled to monitor the water quality at the regional water table surface. Investigation samples collected in SOC 6 are listed in Table 2.

4.4.1 Soil Analytical Results

Soil samples were collected four soil boring locations for pesticide analyses at SOC 6. Soil analytical results are listed in Table 8 and summarized on Figure 10. Pertinent results are discussed below:

- Pesticides were not detected above risk-screening criteria in any of the samples. Alachlor was detected in sample SOC6-GP5-1-2' above the reporting limit. Tier I SRV and SLVs have not been established for this parameter.

- Pesticides were not detected in samples SOC6-GP6-2-4', SOC6-GP7-0-4', and SOC6-GP8-2-4'.

- Headspace monitoring results were consistent with background levels and no odors or discolorations were observed.

4.4.2 Groundwater

Groundwater samples were collected from the temporary well installed in soil boring SOC6-GP6 located near the septic system south of Building 707 (Figure 10) and in monitoring wells downgradient and sidegradient of the site. Groundwater analytical results are listed in Table 9 and summarized on Figures 11 and 12. Pertinent groundwater results are discussed below.

- Pesticides were not detected in the sample from temporary well SOC6-GP6.
- Pesticides were not detected above risk-screening criteria in groundwater samples collected from any of the monitoring wells.

4.4.3 Discussion

Based on field screening and the soil and groundwater analytical results, past clean up of pesticide releases (AgSpill numbers 14388 and 14389) at SOC 6 have successfully reduced concentrations below risk screening criteria. Based on the analytical results, groundwater quality is SOC 6 not significantly affected by past land use activities and no further investigation is needed.

4.5 SOC 7 – Suspected Dump Area

Eleven test trenches were excavated in and near SOC 7 (Figure 13). Test trench depths ranged from four to seventeen feet bgs. Four additional test trenches were installed north of SOC 7 to investigate subsurface soils in a topographic low area. Investigative samples collected in SOC 7 are listed in Table 2.

Soils at SOC 7 consist of up to seven feet of topsoil, underlain by silt, sand and gravel. No evidence of filling or buried debris was observed in any of the test trenches excavated in or north of SOC 7.

4.5.1 Soil

Two soil samples were collected from the test trenches placed in SOC 7 and analyzed for VOCs, SVOCs, and PPL metals (Table 2). Analytical results are listed in Table 10 and are summarized on Figure 13. Pertinent results are discussed below.

- No visually impacted soils, odors, discoloration, elevated headspace results, or buried debris were observed during the course of field work.

- SVOCs and VOCs were not detected in the samples.

- A number of metals were detected in the soil samples below risk screening criteria. Based on a lack of buried debris and hexavalent chromium results from SOCs 2 and 3, it is assumed total chromium results are representative of trivalent chromium concentrations.

4.5.2 Discussion

Evidence of a release was not observed during test trench activities or in the analytical samples collected at SOC 7. No further action is required at this location.

4.6 SOC 8 – Undetermined Use Area West of Patrol Road and South of CR 46

A total of nineteen test trenches were excavated in SOC 8 (Figure 14). Excavation depths ranged from four to ten feet bgs. The soils at SOC 8 consist of topsoil underlain by silt, sand and gravel. Headspace monitoring results were consistent with background levels and no odors or discoloration were observed.

During the excavation of test trench SOC8-TT1, suspected ACM was observed on the ground surface. Test trenching activities were stopped, the University was notified, the ACM was wetted and covered, and the area was secured. University personnel visually confirmed that the suspected ACM consisted of transite shingles and siding. A sample was collected by the University and confirmed the material contained greater than 1% asbestos by area. The results are presented in Appendix F. The University contacted the MPCA Asbestos Program to make the appropriate notifications. Prior to ACM abatement, the location of the concentrated ACM debris on the ground surface was surveyed by Barr using a handheld GPS. The locations of the ACM debris are superimposed on the 1945 air photo on Figure 15. The ACM debris appears to be associated with the light features observed on aerial photographs in the northern and eastern portion of SOC 8. The light features are interpreted to be piles of demolition debris that included ACM (including shingles and siding) and that ACM was left on the ground surface after the demolition debris was removed. The University coordinated the handling and disposal of the ACM under the provisions of the Emission Control Plan for UMore Park which was appended to the Phase II Investigation Work Plan (Barr, 2008a). Documentation of the University's abatement efforts and ACM disposal is presented in Appendix F of this report.

After ACM abatement was complete, additional test trenching was conducted in areas of the ACM on the ground surface to determine if subsurface debris was present. Twelve test trenches were added to the scope after the ACM was observed at the ground surface in SOC 8. These additional test trenches were located in areas targeting the apparent debris piles on the 1945 aerial photograph (Figure 15). Buried debris was not encountered in any of the nineteen test trenches. Due to the lack of subsurface debris encountered in the test trenches, it is assumed that the piles of demolition debris visible on the aerial photograph were disposed of outside of SOC 8.

4.7 Background Sampling

Results from five soil samples and three groundwater samples were used to assess concentrations of SVOCs, metals, and pesticides outside of the SOCs. The groundwater samples were collected from monitoring wells MW-B1-001, MW-E2-009, and MW-E2-209. Background sample locations are shown on Figure 16. The sample identification numbers are listed in Table 2.

Five surface soil samples were collected to determine background concentrations of pesticides, SVOCs, and metals within the UMA. Analytical results for the soil samples are in Table 11 and are summarized on Figure 16. The background soil samples contained detectable metals, pesticides and nitrocellulose. Background metals sample results are below Tier 1 SRVs and SLVs. One pesticide compound, terbufos (sold as Counter), was detected in sample SS2 at a concentration of 2.3 mg/kg which exceeds the Tier I SRV for this compound. The detection of terbufos is attributed to agricultural operations in the UMA.

Nitrocellulose was detected in sample SS5 at a concentration of 12.8 mg/kg.. This concentration is three orders of magnitude lower than some nitrocellulose detections from a previous investigation of GOW-related areas on the east side of UMore Park (Bay West, 2008). No SRV or SLV has been established for nitrocellulose. Because no unusual material or indication of a release was observed at SS5 and the location is approximately two miles from the GOW production area, it is believed that the detection of nitrocellulose is a false positive.

Three groundwater samples were collected from existing monitoring wells to determine the background concentrations of pesticides, SVOCs, VOCs, PPL metals, nitrate and nitrite as nitrogen and TKN within the UMA. Analytical results for the groundwater samples are in Table 12 and are summarized on Figure 16. Groundwater samples collected from the monitoring wells located upgradient of the SOCs had detectable nitrate plus nitrite as nitrogen and TKN concentrations.

Nitrate plus nitrite as nitrogen concentrations were near the MCL in well MW-B1-001. No VOCs, SVOCs, or metals were present in background samples above respective MCLs and/or HRLs.

4.8 Analytical Quality Control Summary

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

The following table summarizes the data qualified as unusable and includes a description of corrective actions/assessment of significance.

Samples	Matrix	Analytes	Description	Action/Assessment
SOC1-GP3, SOC1-GP2, SOC3-GP3	Groundwater	Metals, Dissolved	Laboratory sample preparation error.	Re-collected samples from replacement points SOC1-GP3R, SOC3-GP2R, and SOC3-GP3R. Resulting metals data is representative of groundwater conditions.
MW-B1-001, MW-E2-009, MW-E2-209, WSW-207605, SOC1-GP3, SOC3-GP2, SOC3-GP3	Groundwater	Phorate	Sample extraction issue in laboratory.	Based on non-detections of other pesticide compounds, no re-sampling was conducted for this investigation. WSW-207605 will be sampled for phorate as part of a separate investigation and will be reported under separate cover. The laboratory modified the extraction method to avoid further issues with this analyte.

A summary of the analytical quality control review and subsequent data qualifications is in Appendix G.

5.0 Recommendations

SOCs 1-3 and 6-8 were selected for investigation to determine whether these sites exhibited evidence of a release of hazardous substances and petroleum products resulting from past land use activities. Results from this investigation suggest that past land uses have not resulted in significant releases of hazardous substances or petroleum products in the investigated SOCs.

There is evidence including analytical data and field observations that historical activities within SOCs 1, 3, and 8 have marginally affected soil quality or, in some cases, have resulted in the presence of small amounts of debris mixed in with surface or shallow subsurface soils.

The following recommendations for future investigation or management are intended to address the findings in SOCs 1, 3 and 8.

- In SOC 1, one of nine surface soil samples collected on the former railroad grade slightly exceeded the Tier I SRV for carcinogenic PAHs (as expressed by benzo(a)pyrene (BaP equivalent). The source of the cPAHs is interpreted to be residual materials from former railroad operations. Although the single Tier I SRV exceedences for BaP is unlikely to represent a significant release in SOC 1, it does suggest that the development of a response action plan (RAP) for railroad grade soils may be prudent in portions of the UMA transected by the GOW-era railroad grade. The RAP would be submitted to the MPCA for approval, and include provisions for additional sample collection as mining progresses into the former railroad grade. The plan would also address the stripping, stockpiling, and confirmation sampling of soil located along the railroad grade prior to active mining to ensure that potentially contaminated soils are proactively managed. The RAP would also incorporate an MPCA-approved Environmental Contingency Plan (ECP) (discussed below) in the event that additional issues are discovered during the operations.

- The University may reasonably elect to defer the development of the RAP until additional investigations within the UMA are complete but well before mining operations begin.

- Based on the findings of minor amounts of subsurface debris in SOC 3 and ACM in surface soils in SOC 8, an ECP should be developed for use during future site development activities that include the removal of topsoil and shallow subsurface soil. The ECP should include locations of all former farmsteads, wells that may have been sealed but were not located

during the investigations and investigation areas SOC 3 and SOC 8. In addition, the ECP shall describe the roles of the University and the site contractors and provide the process by which pre-development inspections and communication of findings will be conducted during site development. The ECP should be submitted to the MPCA for review and comment.

6.0 References

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