



Ford Motor Company

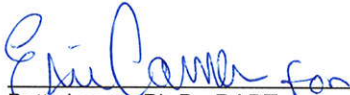
**Additional Soil Investigation and
Surface Soil Risk Assessment
Report – Baseball Fields – Feature
139**

Twin Cities Assembly Plant (TCAP)
St. Paul, Minnesota

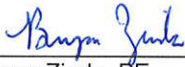
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Andrew Fiskness, PG
Geologist



Betty Locey, Ph.D., DABT
Principal Scientist



Bryan Zinda, PE
Project Manager

**Additional Soil Investigation and
Surface Soil Risk Assessment
Report – Baseball Fields –
Feature 139**

Twin Cities Assembly Plant
(TCAP)
966 South Mississippi Boulevard
St. Paul, Minnesota

Prepared for:
Ford Motor Company

Prepared by:
ARCADIS
430 First Avenue North
Suite 720
Minneapolis
Minnesota 55401
Tel 612.339.9434
Fax 612.336.4538

Our Ref.:
MN000593.0001

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Executive Summary

ARCADIS was retained by Ford Motor Company to conduct additional soil investigation and risk assessment services regarding potential environmental impacts in the baseball field area (Feature 139) of the Twin Cities Assembly Plant (TCAP) property located in St. Paul, Minnesota. These services were conducted to supplement the environmental investigations for Feature 139 described in the following ARCADIS reports: *Phase I Environmental Site Assessment (June 29, 2007)*, *Initial Phase II – Exterior Investigation Report (October 29, 2007)*, and *Soil Investigation Report – Baseball Fields – Feature 139 (September 7, 2007)*.

The findings from these previous investigations indicated that (1) historical battery disposal activities could potentially have taken place in the area of Feature 139 and (2) arsenic, copper, and iron were detected in certain surface and subsurface soil samples at concentrations above applicable Minnesota Pollution Control Agency (MPCA) soil screening levels (Tier 2 Soil Reference Values [SRV] for recreational land use). Based on these previous findings, ARCADIS prepared a *Soil Investigation and Risk Assessment Work Plan – Baseball Fields – Feature 139* report, which was approved by the MPCA on September 11, 2007. The additional soil investigation and risk assessment activities defined in the approved Work Plan were conducted in accordance with the MPCA Voluntary Investigation and Cleanup (VIC) Program to achieve the following objectives:

- Characterization of surface soils to facilitate further evaluation of arsenic, copper, iron (constituents of potential concern [COPCs]), and lead that may be present in the surface soils in the Feature 139 area. Although lead was not detected above the Tier 2 SRV during the initial investigation, it was included for analysis because it is a common component of batteries. For this study, surface soils are defined as soils encountered from 0 to 0.5 feet below ground surface (bgs).
- Completion of a surface soil risk assessment to evaluate risks and hazards, if any, associated with continued recreational use of the baseball fields by the general public. Based on the current recreational land use, this risk assessment focused on potential human exposure to surface soils.
- Characterization of subsurface soils and perched groundwater to facilitate further evaluation of COPCs and to evaluate potential battery disposal activities. Worker exposure to subsurface soils during potential future excavation activities (e.g., construction, landscaping, or grading activities) was evaluated by comparison to

Tier 2 Short-Term Worker SRVs. For this study, subsurface soils are defined as soils encountered within the depth interval of 0.5 foot to 12 feet bgs.

Field Investigation Activities

In September 2007, ARCADIS collected and analyzed 36 surface soil samples and 57 subsurface soil samples and installed and sampled two temporary groundwater monitoring wells. Nine surface soil samples were collected from each of the three baseball fields in the Feature 139 area. The locations of surface soil samples were biased toward base running areas, warning tracks, and other areas with exposed soil to aid in determining the concentrations of constituents in non-vegetated areas (i.e., sample locations were chosen to represent anticipated worst-case exposure conditions based on the current recreational land use). In addition, nine surface soil samples were collected from locations outside the baseball fields and were biased toward areas of high use and where soil was exposed (i.e., in front of the concession stand, the batting cages, the sand box, and the gravel parking area). All of the surface soil samples were analyzed for arsenic, copper, iron, and lead.

The subsurface soil samples were collected from soil borings in September 2007 and were completed in a grid pattern (100 feet by 100 feet), and one soil boring was completed within each of the 29 grid locations. In total, 57 subsurface samples from multiple depths within the soil borings were analyzed for arsenic, copper, iron, and lead. Two temporary wells were installed and sampled along the eastern side of the investigated area in perched groundwater, which was encountered at depths of approximately 8 to 12 feet bgs. Both perched groundwater samples were analyzed for arsenic, copper, iron, and lead, and one of the samples was also analyzed for volatile organic compounds (VOCs).

Field Investigation Results

Arsenic was detected above the MPCA Tier 2 Recreational SRV in five of the 39 surface soil samples collected during both investigations, with the highest concentration reported as 16.4 milligrams per kilograms (mg/kg); copper was detected above the Tier 2 Recreational SRV in 13 of the 39 surface soil samples, with the highest concentration reported as 19.4 mg/kg; and iron was detected above the Tier 2 Recreational SRV in 14 of the 39 surface soil samples, with the highest concentration reported as 18,100 mg/kg. Lead was not detected at concentrations exceeding the Tier 1 Residential or Tier 2 Recreational SRVs.

The results from the subsurface soil samples collected during both investigations indicate that arsenic was detected above the Tier 2 Recreational SRV at 17 of the 30 subsurface boring locations, with the highest concentration reported as 18.9 mg/kg; copper was detected above the Tier 2 Recreational SRV at 17 of the 30 subsurface boring locations, with the highest concentration reported as 79.6 mg/kg; and iron was detected above the Tier 2 Recreational SRV at 28 of the 30 subsurface boring locations, with the highest concentration reported as 28,000 mg/kg. Lead was not detected at concentrations exceeding the Tier 1 Residential or Tier 2 Recreational SRVs.

Results from the two perched groundwater samples indicate that arsenic, copper, and lead were detected above the Minnesota Department of Health (MDH) Health Risk Limits (HRLs). Iron was also detected in both samples; however, there is no established HRL for iron. One perched groundwater sample was also analyzed for VOCs, and no VOCs were detected above the HRLs.

Risk Assessment

Potential risks and hazards associated with COPCs in surface soil were evaluated based on surface soil data collected in the Feature 139 area. The property is currently used for recreational purposes. MPCA SRVs protective of a recreational land-use and protective of short-term worker exposure were deemed appropriate to evaluate the site. Arsenic, copper, and iron were identified as COPCs based on a comparison to the MPCA's generic Tier 2 Recreational SRVs.

A statistical analysis was completed to characterize the data sets for surface soil samples and to provide a basis for comparing to applicable statewide background data that were provided by the MPCA. Surface soil sample results for arsenic, copper, and iron, which are all naturally occurring elements, were shown to be consistent with statewide background data for these constituents. However, one sample result for arsenic (16.4 mg/kg) appeared to be an outlier and was slightly higher than the maximum arsenic background concentration (15 mg/kg).

A risk assessment was conducted consistent with applicable MPCA guidance (MPCA's *Draft Guidelines, Risk-Based Guidance for the Soil – Human Health Pathway, Volume 2. Technical Support Document*, dated January 1999 (Guidance Document) and the latest Tier 2 excel spreadsheets, dated May 2007, associated with the Guidance Document) for COPCs using surface soil sample results collected during both investigations. The surface soil data were initially evaluated against background

data as described above and then by comparison to MPCA Tier 2 SRVs based on both acute and chronic exposure conditions. Arsenic and copper exceeded generic Acute Child Tier 2 SRVs and were further evaluated through a Short-Term Hazard Assessment based on MPCA guidance. Based on the results of the Short-Term Hazard Assessment and the comparisons to the Tier 2 Recreational SRVs, concentrations of constituents detected in surface soils were consistent with background conditions and do not present a concern (unacceptable risk or hazard) to users of the baseball fields.

Because the current recreational land use does not create any exposure to the subsurface soils, a detailed risk assessment was not conducted for the subsurface soils. However, the subsurface data were evaluated relative to the Tier 2 Short-Term Worker SRVs to determine if there would be any unacceptable human health risks during any future construction or grading work that may be conducted at this site in the future. The subsurface soil evaluation demonstrated that the Tier 2 Short-Term Worker SRVs were not exceeded in any of the subsurface soil samples.

Perched groundwater data were not evaluated at this time. The perched groundwater samples were collected from the temporary groundwater wells with limited development and the perched groundwater samples were not filtered, which could potentially result in elevated metal concentrations because of the presence of sediments. More representative data will be collected from a permanent perched groundwater monitoring well installed in the area at a future date and the data will then be evaluated.

Conclusions/Recommendations

Conclusions and recommendations reached from the additional soil investigation and surface soil risk assessment study are provided below.

Surface Soil

- The analytical results indicate there were no lead exceedances above the Tier 1 Residential or Tier 2 Recreational SRVs in surface soils at Feature 139. Levels of lead detected in the soil are acceptable for the current use of the property. There was no evidence within the surface soils of alleged battery disposal activities.
- Based on the data collected and the results of the risk assessment, concentrations of arsenic, copper, and iron detected in surface soils do not present a concern

(unacceptable risk or hazard) to users of the baseball fields. Levels detected in surface soil samples are consistent with, and generally lower than, naturally occurring background concentrations in Minnesota. Although the site data appear to be consistent with applicable background data, one surface soil sample result for arsenic (16.4 mg/kg) appears to be a statistical outlier and was slightly higher than the background screening level (15 mg/kg), which is also equivalent to the maximum arsenic concentration in the background data set.

- While the surface soil evaluation indicates that risks and hazards are acceptable for the current land use, Ford is electing to implement precautionary measures for the surface soils proximal to the one surface soil sample where arsenic was detected at a level slightly above the range of background concentrations. The proposed mitigation measures will involve removal of the surface soils in this one defined area. A work plan will be developed and submitted to the MPCA prior to removal activities. Following completion of the removal activities, the area will be backfilled with clean soil and restored to its previous condition. It is recommended that the baseball fields be reopened following completion of the removal activities.

Subsurface Soil

- The analytical results indicate there were no lead exceedances above the Tier 1 Residential or Tier 2 Recreational SRVs. Levels of lead detected in the soil are acceptable for the current use of the property. The visual observations, combined with the laboratory results for lead, indicate that there is no evidence of the alleged battery disposal activities in the baseball field area.
- Based on current recreational land use, the only potentially complete exposure pathways to subsurface soils are associated with subsurface activities such as construction or grading work in this area (e.g., below-grade utility installation, planting). To evaluate this potential worker exposure, the subsurface data were compared against the Tier 2 Short-Term Worker SRVs. No constituent concentrations in the subsurface soils samples exceeded the Tier 2 Short-Term Worker SRV. As a result, no further action or investigation of the subsurface soils is recommended at this time. If subsurface soils are excavated or brought to the surface at some point in the future, the work will be conducted in accordance with applicable rules and regulations.

Perched Groundwater

- Perched groundwater samples were collected from the temporary groundwater wells with limited development. In addition, the perched groundwater samples were not filtered, which could potentially result in elevated metal concentrations because of the presence of sediments. Therefore to facilitate further evaluation of perched groundwater conditions, the installation of one perched groundwater monitoring well is recommended near the eastern edge of the area followed by two additional groundwater sampling events. Samples will be analyzed for both dissolved and total arsenic, copper, iron, and lead for the first sampling event and dissolved arsenic, copper, iron, and lead thereafter.

1. Introduction

On behalf of Ford Motor Company (Ford), ARCADIS has prepared this *Additional Soil Investigation and Surface Soil Risk Assessment Report* for the Baseball Field Area (Feature 139), which is located within the Twin Cities Assembly Plant (TCAP) property. TCAP is located at 966 South Mississippi Boulevard within the city of St. Paul, in Ramsey County, Minnesota as shown on Figure 1. For the purpose of this report, Feature 139 will refer to the Baseball Fields and adjacent areas, including the concession building, practice pitching area, batting cages, restrooms, and parking surfaces.

The additional soil investigation and surface soil risk assessment services were conducted to supplement the environmental investigations for Feature 139 described in the *Phase I Environmental Site Assessment* (ARCADIS U.S., Inc. 2007a), *Initial Phase II – Exterior Investigation Report* (ARCADIS U.S., Inc. 2007b), and *Soil Investigation Report – Baseball Fields – Feature 139* (ARCADIS U.S., Inc. 2007c).

The findings from these previous investigations indicated that (1) historical battery disposal activities could potentially have taken place in the area of Feature 139 and (2) arsenic, copper, and iron were detected in certain surface and subsurface soil samples at concentrations above applicable Minnesota Pollution Control Agency (MPCA) soil screening levels (Tier 2 Soil Reference Values [SRV] for recreational land use). Based on these previous findings, ARCADIS prepared a *Soil Investigation and Risk Assessment Work Plan – Baseball Fields – Feature 139* (ARCADIS U.S., Inc. 2007d), which was approved by the MPCA on September 11, 2007. The additional soil investigation and surface soil risk assessment activities defined in the approved Work Plan were conducted in accordance with the MPCA Voluntary Investigation and Cleanup (VIC) Program to achieve the following objectives:

- Characterization of surface soils to facilitate further evaluation of arsenic, copper, iron, and lead (COPCs) that may be present in the surface soils in the Feature 139 area. Although lead was not detected above the generic Tier 2 SRV during the initial investigation, it was included for analysis because it is a common component of batteries. For this study, surface soils are defined as soils from 0 to 0.5 feet below ground surface (bgs).
- Completion of a surface soil risk assessment to evaluate risks and hazards, if any, associated with continued recreational use of the baseball fields by the general

public. Based on the current recreational land use, this risk assessment focused on potential human exposure to surface soils.

- Characterization of subsurface soils and perched groundwater to facilitate further evaluation of COPCs and to evaluate potential battery disposal activities. Worker exposure to subsurface soils during potential future excavation activities (e.g., construction, landscaping, or grading activities) was evaluated by comparison to Tier 2 Short-Term Worker SRVs. For this study, subsurface soils are defined as soils encountered within the depth interval of 0.5 foot to 12 feet bgs.

1.1 Background

The area occupied by Feature 139 is approximately 6 acres and presently includes three baseball fields. The area also includes a concession building with a practice pitching area, batting cages, restrooms, graveled surfaces and grassed areas (see Figure 2).

1.2 Location and Setting

Feature 139 is located in a mixed industrial, commercial, and residential area immediately east of the Mississippi River. Adjacent property land use is provided below:

- North of Feature 139: A residential apartment building.
- West of Feature 139: Twin Cities Assembly Plant.
- South of Feature 139: The TCAP truck storage lot and railroad tracks. Beyond the railroad tracks is a residential area.
- East of Feature 139: Residential area.

1.3 Regulatory Framework

The additional soil investigation and surface soil risk assessment activities were completed in general accordance with the requirements of the MPCA VIC Program, under the Minnesota Environmental Response and Liability Act, Minn. Stat. §115B.01 to 115B.24 (MERLA). Risks and hazards associated with constituents in surface soil were evaluated consistent with MPCA's *Draft Guidelines, Risk-Based Guidance for the*

Soil – Human Health Pathway, Volume 2. Technical Support Document, dated January 1999 (Guidance Document) and the latest Tier 2 excel spreadsheets, dated May 2007, associated with the Guidance Document. The specific process followed for evaluating risks and hazards associated with constituents in surface soil is defined in Section 5 of this report.

1.4 Feature 139 Geology/Hydrogeology

The general geology in the area of Feature 139 has been determined based on information obtained during the *Phase I Environmental Site Assessment* (ARCADIS U.S., Inc. 2007a). At the surface is unconsolidated soils (approximately 4.7 to 16 feet thick) overlying bedrock. The bedrock units are, in descending order, Decorah Shale, Platteville Limestone/Dolostone, Glenwood Shale, and St. Peter Sandstone.

Based on the borings completed at Feature 139, the geology generally consists of approximately 1 foot to 4.5 feet of sand and gravel fill material. Underlying the fill material is unconsolidated terrace deposits comprised of clays, silty sands, and gravel units. Beneath the unconsolidated material is the Decorah Shale, which is in general 4.5 to 16 feet bgs. The Decorah Shale is expected to be approximately 25 to 30 feet thick.

The geologic units below the Decorah Shale consist of the Platteville Limestone, which lies atop the Glenwood Shale formation. Beneath the Glenwood Shale is the St. Peter Sandstone. All of these formations outcrop along the bluffs of the Mississippi River, and the St. Peter Sandstone continues below the elevation of the river bed.

Perched groundwater was encountered at two of the soil boring locations at depths ranging from 8 to 12 feet bgs. The remaining soil borings did not encounter the perched groundwater. The Decorah shale is present at depths ranging from 6 to approximately 16 feet bgs. The surface topography of the shale unit provides for a discontinuous perched groundwater unit in the unconsolidated sediments within Feature 139.

1.5 Initial Investigations at the Baseball Fields - Feature 139

1.5.1 Investigation

Based on documentation reviewed during the *Phase I Environmental Site Assessment* (ARCADIS U.S., Inc. 2007a), Feature 139 was potentially used for disposal of battery waste. The MPCA requested a geophysical study in the area.

ARCADIS conducted a geophysical investigation as part of the Initial Phase II – Exterior Investigation. ARCADIS also collected soil samples from six boring locations and three surface soil sample locations. The results from these initial investigation activities were documented in a previous report titled *Soil Investigation Report – Baseball Fields - Feature 139* (ARCADIS U.S., Inc. 2007c).

A geophysical survey was completed at Feature 139 on June 20 and 21, 2007 by 3Dgeophysics of Chaska, Minnesota. The geophysical study was conducted using EM-31 and EM-61 frequency domain electromagnetic methods. The geophysical surveys were used to identify potential metallic anomalies (EM-61) in the subsurface and to determine changes in electrical conductivity from differences in soil types, disturbances, etc. (EM-31).

The most significant and apparently naturally occurring anomaly detected by the EM-31 survey is a northwestern trending area of low conductivity within the center of Feature 139. Typically, sandy and drier sediments exhibit low conductivity, while clayey and moist sediments exhibit higher conductivity.

Following the geophysical investigation, six direct-push soil borings (ASB-049 to ASB-054) were completed. The borings were advanced at select locations based on anomalies identified during the geophysical survey on July 5, 2007. The soil borings were completed using direct-push methods by Matrix Environmental, LLC. (Matrix) of Osseo, Minnesota.

Three surface soil samples were collected at Feature 139 on August 13, 2007. Sample AGM-SS-01 was collected near Boring ASB-049; Sample AGM-SS-02 was collected near Boring ASB-051; and Sample AGM-SS-03 was collected near Boring ASB-053. Surface soil samples were collected from the upper 6 inches of the ground surface.

1.5.2 Initial Soil Sampling Results

The analytical soil data were evaluated by comparison to MPCA's generic SRVs for residential, recreational, and commercial industrial land uses. Results from the initial soil samples indicated that concentrations of arsenic, copper, and iron exceeded the Tier 2 Recreational SRVs at several soil sample locations at Feature 139 but were below the Tier 2 Industrial SRVs. Based on the results from the initial soil sampling and the potential that battery disposal activities may have taken place historically in the area of Feature 139, additional soil investigation and risk assessment activities were deemed necessary. As stated previously, the additional soil investigation and surface soil risk assessment activities were defined in the *Soil Investigation and Risk Assessment Work Plan – Baseball Fields – Feature 139* report (ARCADIS U.S., Inc. 2007d), which was approved by the MPCA on September 11, 2007. The remainder of this report summarizes the methods and results of the additional soil investigation and surface soil risk assessment activities for the Feature 139 area.

2. Field Investigation

To delineate the vertical and horizontal extents of COPCs at Feature 139, ARCADIS collected and analyzed 36 additional surface soil samples, 57 additional subsurface soils samples, and installed and sampled two temporary groundwater monitoring wells. These additional field investigation activities were conducted in September 2007 and are further described below.

2.1 Collection of Surface Soil Samples

On September 17 and 18, 2007, ARCADIS collected 36 surface soil samples to further characterize soils at Feature 139. The surface soil sample locations are presented on Figure 3.

Nine samples were collected from each of three baseball fields (for a total of 27 samples), and an additional nine samples were collected outside the baseball fields but within areas accessible by the public (e.g., below the bleachers). The Northwest, Northeast, and South Baseball Field samples were located in an evenly spaced grid pattern, with an individual grid established for each baseball field. One surface soil sample was collected in each area of the grid.

The locations of surface soil samples were biased toward base running areas, warning tracks, and other areas with exposed soil to aid in determining the concentrations of constituents in non-vegetated areas (i.e., sample locations were chosen to represent anticipated worst-case exposure conditions based on the current recreational land use). In addition, nine surface soil samples were collected from locations outside the baseball fields and were biased toward areas of high use and where soil was exposed (i.e., in front of the concession stand, the batting cages, the sand box, and the gravel parking area).

The locations of the nine surface soil samples that were collected outside the baseball fields are also shown on Figure 3. All samples were collected from approximately 0 to 6 inches bgs. When samples were collected in grass-covered areas, samples were collected below the root zone. Samples were submitted for laboratory analysis for total arsenic, copper, iron, and lead by United States Environmental Protection Agency (USEPA) Method 6010, and sampling was conducted according to the TCAP Field Sampling Plan (ARCADIS U.S., Inc. 2007e). Following collection of the samples, the surface was restored, and the sample location was marked for surveying. A copy of the Surface Soil Sample Log is provided in Appendix A.

2.2 Completion of Soil Borings/Collection of Subsurface Soil Samples

On September 17, 2007, a utility clearance was performed prior to initiating subsurface work at Feature 139. Gopher State One Call was notified, and all known public utility lines servicing the area in and around Feature 139 were marked. In addition to notifying Gopher State One Call, a private utility locator, Hance Utility Service, Inc. of Buffalo, Minnesota, was retained to locate private lines in the areas where subsurface work was conducted.

ARCADIS completed 24 soil borings (ASB-071 to ASB-094) to evaluate subsurface soil conditions. The soil borings were completed using direct-push methods by Matrix from September 19 to 21, 2007. The soil boring locations are presented on Figure 4. The borings were located in a grid pattern (100 feet by 100 feet) (ARCADIS U.S., 2007c), and one soil boring was completed within each grid location. The grid consisted of 29 locations; however, five grid locations had soil borings installed previously during the Initial Phase II - Exterior Investigation and therefore were not duplicated during this effort.

The boreholes were completed using a direct-push drill rig to an approximate depth of 8 feet, or until competent bedrock/refusal was encountered. Following the completion of several borings to a depth greater than 8 feet bgs, sampling depth was discussed with the MPCA during a site visit (September 20, 2007). It was determined at that time that a perched groundwater sample and duplicate would be collected, and the remaining borings would be completed to a maximum depth of 12 feet bgs if bedrock was not encountered. The additional groundwater samples were analyzed for the COPCs along with lead and volatile organic compounds (VOCs) as discussed with the MPCA. Soil samples were collected continuously from each boring to provide a profile of the subsurface materials at each location. Soil boring logs were prepared for each boring in accordance with MPCA and MDH requirements and to present the United Soil Classification System (USCS) classification of the materials encountered. Each soil sample was screened in the field with a photoionization detector (PID). PID headspace readings are presented in Table 1. Soil boring logs are presented in Appendix B.

Up to eight soil samples per boring were collected for potential laboratory analysis. Soil samples were collected from 2-foot intervals from ground surface to termination (e.g., 0-2 foot, 2-4 foot, 4-6 foot). In total, 113 soil samples were collected and sent to the laboratory.

Soil sampling techniques were consistent with procedures outlined in the *TCAP Field Sampling Plan* (FSP) (ARCADIS U.S., Inc. 2007e). Soil samples collected for potential laboratory analysis were placed in a cooler with wet ice and transported to the laboratory by laboratory courier following standard chain-of-custody procedures. Samples were submitted for laboratory chemical analysis as follows:

- Initially, two samples from each boring were submitted for analyses of total arsenic, copper, iron, and lead using USEPA Method 6010 (generally intervals from 2-4 feet bgs and from the depth closest to the termination of the boring). Three samples were analyzed from Boring ASB-079.
- If results from the initial samples at a boring location were below the Tier 2 Recreational SRVs for all constituents, then no further samples were analyzed from that location.
- On October 5, 2007, the laboratory results for eight boring locations indicated that one interval had a constituent concentration above the Tier 2 Recreational criteria, and the other interval had constituent concentrations below the criteria; thus, a third sample from the middle interval was analyzed.
- The remaining samples are being held by the project laboratory until MPCA comments are received.

The soil material logged during the field investigation appears to be consistent with the results of the previous geophysical investigation. During the geophysical investigation, a northwest trending area of low conductivity within the center of Feature 139 was identified. The observed lithology of the unconsolidated material at the soil borings completed in the northeastern corner of Feature 139 is generally clay. The middle portion of Feature 139 trending from the southeast to the northwest generally consists of sand or clayey sand units. And the southeast to southwestern portion of Feature 139 consists of clay above the Decorah Shale, which was encountered at 4.5 to 8 feet bgs. There was no evidence of any battery waste material in any of the soil samples. Soil boring logs are presented in Appendix B.

2.3 Collection of Perched Groundwater Samples

Perched groundwater was encountered at Borings ASB-076 and ASB-087. At each of these two locations, a temporary monitoring well was installed and an unfiltered groundwater grab sample was collected. Both groundwater samples were submitted

for laboratory analysis of total arsenic, copper, iron and lead by the EPA Method 6010. Additionally, the sample collected from Boring ASB-087 was analyzed for VOCs by USEPA Method 8260 at the request of the MPCA. Groundwater sampling was conducted according to the TCAP FSP (ARCADIS U.S., Inc. 2007e). Following sample collection, the temporary wells were abandoned according to MDH well code. The boring locations were marked for survey following the completion of the boring.

2.4 Surveying

Surface soil sample locations, soil borings locations, and temporary well locations and elevations were surveyed to the Ramsey County coordinates and 1929 USGS Vertical Datum on September 24, 2007 by Sunde Land Surveying of Bloomington, Minnesota.

2.5 Characterization and Disposal of Investigative-Derived Waste

Soil and groundwater investigative-derived waste (IDW) were containerized, properly labeled, and disposed at the Waste Management Spruce Ridge Landfill Waste located in Glencoe, Minnesota.

2.6 Analytical Data Validation

All analytical data collected during this investigation has been verified and/or validated. Verification consists of reviewing the laboratory report and electronic data deliverable (including the case narrative), sample analytical data, quality control documentation, and chain-of-custody. Verification is a process completed to ensure that all quality control procedures have been followed and that they meet the minimum requirements of the analytical methodology and contract. Specifically, it includes a review of holding times, blank contaminants, laboratory control samples, and quality control limits. Full (Level IV) validation was completed on approximately 10 percent of all field sample data. Validation is a detailed process that extends the review beyond the verification step to determine the specific quality of a set of data. Full validation consisted of a comprehensive review of the raw data, transcriptions, and calculations. The data review process included interaction with the laboratory to correct data deficiencies and obtain additional information, as appropriate. Data verification and validation was completed by Enovis, Inc. of Detroit, Michigan. The verification and validation reports are included with the laboratory reports in Appendix C.

All unqualified, "B" qualified, and "J" qualified data were included in the data set without further analysis. There were no "R" qualified data (i.e., data that were rejected)

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identified during the validation process. Had "R" qualified data been identified, those data would have been eliminated from the data set used for the risk assessment.

3. Results

3.1 Surface Soil Samples

A total of 39 surface soil samples were collected and analyzed between August 2007 and September 2007 from the sampling locations indicated on Figure 3 and as described in Section 3.1.

Lead was not detected at concentrations above the generic Tier 2 Recreational SRV of 5 milligrams per kilogram (mg/kg) in any of the surface soil samples. Arsenic, copper, and iron were detected at concentrations that exceed applicable Minnesota screening criteria for recreational use. No constituents were detected in any samples above the Tier 2 Industrial SRVs (see Table 2).

Arsenic was detected above the generic Tier 2 Recreational SRV of 5 mg/kg at five of the 39 locations (Figure 5). Arsenic was detected at concentrations that range from 0.71 mg/kg to 16.4 mg/kg. The arithmetic mean arsenic concentration was 3.3 mg/kg, and the median detected arsenic concentration was 2.4 mg/kg.

Copper was detected above the generic Tier 2 Recreational SRV of 13 mg/kg at 13 of the 39 sample locations (Figure 6). Copper was detected at concentrations that range from 3.1 mg/kg to 19.4 mg/kg. The arithmetic mean copper concentration was 9.3 mg/kg, and the median detected copper concentration was 6.8 mg/kg.

Iron was detected above the generic Tier 2 Recreational SRV of 12,000 mg/kg at 14 of the 39 grid locations (Figure 7). Iron was detected at concentrations that range from 3,950 mg/kg to 18,100 mg/kg. The arithmetic mean iron concentration was 10,740 mg/kg, and the median detected iron concentration was 10,600 mg/kg.

3.2 Subsurface Soil Samples

A total of 113 subsurface soil samples were collected from 30 soil borings performed in July and September 2007, and 63 subsurface soil samples were analyzed from the 29 grid locations, as indicated on Figure 4. The soil samples collected from the direct-push borings did not exhibit PID readings above background levels, and visual signs of impacts or odors were not detected (see Table 1).

Lead was not detected at concentrations exceeding the applicable Minnesota screening criteria for recreational use in any of the subsurface soil samples. Arsenic,

copper, and iron were detected at concentrations that exceed applicable Minnesota screening criteria for recreational use (see Figure 8). No constituents were detected in any samples above the Tier 2 Short-Term Worker or the Tier 2 Industrial SRVs (see Table 3).

Arsenic was detected above the generic Tier 2 Recreational SRV of 5 mg/kg at 16 of the 29 grid locations. Arsenic was detected in 62 samples at concentrations that range from 0.86 mg/kg to 18.9 mg/kg. The arithmetic mean arsenic concentration was 4.9 mg/kg, and the median detected arsenic concentration was 4.2 mg/kg. Arsenic was detected at concentrations above the generic Tier 2 Recreational SRV at depths ranging from 2 to 12 feet bgs.

Copper was detected above the generic Tier 2 Recreational SRV of 11 mg/kg at 17 of the 29 grid locations. Copper was detected in 63 samples at concentrations that range from 2.2 mg/kg to 79.6 mg/kg. The arithmetic mean copper concentration was 10.7 mg/kg, and the median detected copper concentration was 8.6 mg/kg. Copper was detected at concentrations above the generic Tier 2 Recreational SRV at depths ranging from 2 to 12 feet bgs.

Iron was detected above the generic Tier 2 Recreational SRV of 12,000 mg/kg at 28 of the 29 grid locations. Iron was detected in 63 samples at concentrations that range from 3,610 mg/kg to 28,000 mg/kg. The arithmetic mean iron concentration was 14,988 mg/kg, and the median detected iron concentration was 14,317 mg/kg. Iron was detected at concentrations above the generic Tier 2 Recreational SRV at depths ranging from 2 to 12 feet bgs. The results from the subsurface samples are presented in Table 3. Also presented in Table 3 are applicable MPCA comparison criteria including the Recreational and Industrial Tier 2 SRVs.

3.3 Perched Groundwater

The perched groundwater within Feature 139 was found to be discontinuous. Two unfiltered groundwater samples were collected and submitted for laboratory analysis from temporary wells installed at Borings ASB-076 and ASB-087. Both samples were visibly cloudy. The two groundwater samples were analyzed for arsenic, copper, iron, and lead. Arsenic was detected above the Minnesota Department of Health (MDH) Health Risk Limit (HRL) of 10 micrograms per liter ($\mu\text{g/L}$) at Borings ASB-076 (290 $\mu\text{g/L}$) and ASB-087 (284 $\mu\text{g/L}$). Copper was detected above the HRL of 1,300 $\mu\text{g/L}$ at Boring ASB-076 (1,850 $\mu\text{g/L}$). Lead was detected above the MDH HRL for groundwater of 15 $\mu\text{g/L}$ at Borings ASB-076 (430 $\mu\text{g/L}$) and ASB-087 (296 $\mu\text{g/L}$). Iron

was also detected in both samples; however, there is no established HRL for iron. Laboratory analysis of unfiltered samples can release metals loosely bound to suspended solids in water, thus metal concentrations can be overestimated.

The groundwater sample collected at Boring ASB-087 was also analyzed for VOCs. No VOCs were detected above their respective MDH HRLs in the sample. The results from the perched groundwater samples are presented in Table 4 and are shown on Figure 9.

4. Risk Assessment

4.1 Surface Soils

One of the main objectives of the study that is summarized in this report was to conduct a surface soil risk assessment to evaluate risk and hazards, if any, associated with continued recreational use of the baseball fields by the general public. Based on the current recreational land use, the risk assessment focused on potential human exposure to surface soils (soils found from 0 to 6 inches bgs).

4.1.1 Approach

The approach used for evaluating risks associated with exposure to surface soils is consistent with the MPCA's Tier 2 SRV Risk Characterization described in the MPCA draft guidance (1999).

Initially, limited surface soil data (three surface and six subsurface soil samples) were collected (August 2007) in the area to address concerns that the property may have been used for battery waste disposal. Samples were analyzed for target analyte list (TAL) "metals" (elements, metals, metalloids), semi-volatile organic compounds (SVOCs), and VOCs.

Arsenic, copper, and iron were identified as COPCs as they were detected at levels greater than the MPCA's generic SRVs (see Table 5). Additional soil samples were collected in September 2007 to characterize surface and subsurface soils, and these samples were evaluated for arsenic, copper, iron, and lead. Lead was added to the list of COPCs to further evaluate potential historical battery disposal activities. In total, 39 surface soil samples were collected and analyzed in this area.

The main steps that were conducted to evaluate all data collected in surface soil are summarized below:

1. Characterize the nature and extent of the COPCs (i.e., arsenic, copper, iron, and lead). The results of this characterization step were summarized in Section 4.
2. Determine applicable land use, receptors, and exposure conditions. Based on this determination, identify applicable SRVs.

3. Compare site data to the applicable MPCA generic SRVs. If there are no exceedances of the SRVs for a particular COPC, then that COPC is eliminated from further evaluation. The final MPCA generic SRV is the lowest of several SRVs that are calculated for a particular receptor and land-use condition.
4. For those COPCs that exceed the SRVs and are elements that are naturally present in the state's soils, the site data are compared to representative background data sets. This is to determine whether the levels of COPCs present at the site are consistent with ubiquitous and naturally occurring conditions or if they are at elevated levels indicating an impacted area. It is important to note that all of COPCs at the site are naturally occurring elements and are present in soils even within the most pristine environments.
5. COPCs present at levels consistent with background concentrations and at levels below the most conservative SRVs (MPCA's final generic SRVs) were eliminated from further evaluation.
6. Because the final MPCA Recreational SRVs are based on the lowest of a set of potentially relevant SRVs, the basis for the final values for each COPC was identified. Additional SRVs were calculated to provide a better understanding of potential risks and hazards. For example, if the final Recreational SRVs were based on the Acute Child SRVs, then SRVs protective of longer term/chronic exposure were calculated, consistent with MPCA guidance (1999). These SRVs were also compared to site data to determine whether longer term/chronic exposures were acceptable or if they warranted additional evaluation.
7. A short-term hazard assessment was conducted for those COPCs that were detected at levels that might be above background concentrations (e.g., outlier) or detected at levels above SRVs protective of acute child exposure (Acute Child SRVs).
8. Based on these steps, conclusions were drawn on whether site conditions were acceptable for continued recreational use of the property.

4.1.2 Land Use and Potential Exposure

The following factors were considered in determining the applicable exposure pathways, exposure point concentrations, and SRVs:

- **Land use:** The property is currently used for recreational purposes. Activities at Feature 139 include baseball playing (i.e., running bases, fielding baseballs) and general recreational activities (i.e., children playing around the baseball fields, people walking or running around the area). There is a concession building and restrooms on the premises. In addition to recreational users of the property, maintenance workers are expected to be on the property.
- **Contact with surface soil:** The risk assessment focuses on potential contact with COPCs in surface soils. The baseball field surface area is generally covered with grass (see Figure 2) except for select areas on the baseball fields (e.g., running paths, bases). Surface soils found beneath the grass root zone generally consist of sand and gravel fill material.
- **Point of exposure concentrations:** Chronic exposures to constituents in surface soil were evaluated using all data and based on conditions across Feature 139. The mean and the 95 percent upper confidence level on the mean (95% UCL) were used to represent the data collected in the area (point of exposure concentrations). The maximum detected concentration and sample-by-sample evaluation were used to evaluate short-term and acute exposure.
- **Exposure unit/area evaluated where exposure might occur:** Feature 139 encompasses approximately 6 acres. The property is used as a park, and activities may occur anywhere on the property. There are three baseball fields, and over time, players are likely to play on all fields. In addition, other users of the property can move freely within the property when games are not being played. The default exposure area used for calculating the Particulate Emission Factor (PEF) for the Residential and Recreational SRVs is 5 acres (Which is comparable to this 6 acre baseball field area), as noted in Appendix A of the Guidance Document (Minnesota Pollution Control Agency 1999).
- **Data set used to evaluate risk:** Because there were no significant data quality issues noted during validation (Section 3.6), all surface soil sample results were included in the data set used to evaluate potential risks.

4.1.3 Initial Screening – Comparison to Tier 2 Recreational Soil Reference Values

The surface soil sample results were compared to the MPCA generic Tier 2 Recreational SRVs (see Table 5 and Table 6). Lead concentrations did not exceed the Tier 2 Recreational SRV in any of the surface soil samples. Based on the data and this

comparison, levels of lead in surface soil are acceptable for recreational use of the property. Thus, lead was eliminated from further evaluation.

Levels of arsenic, copper, and iron were detected at levels that exceed their generic Tier 2 Recreational SRVs at more than one sample location and thus were retained for further evaluation.

4.1.4 Background Data

The remaining COPCs (arsenic, copper, and iron) are all naturally occurring elements in soil. Constituents can be eliminated from a risk assessment if they are present at levels consistent with natural background conditions, and those levels do not pose an unacceptable risk or hazard. The arsenic, copper, and iron data sets were evaluated to determine whether they could be eliminated from the risk assessment based on a comparison to background levels.

Background soil data for Minnesota are available from a number of sources. These are summarized in Table 7. Surface soil data were evaluated against background soil data published by the United States Geological Survey (USGS) (Boerngen and Shacklette 1981). These data sets were chosen because the data had been collected to represent natural background to the extent possible; the data set includes data collected from 1961 through 1975 from 37 counties; and the data was provided by MPCA. This data set is provided in Appendix D. A summary of the comparison between the site data set and the background data set is presented in Table 8.

Consistent with the MPCA guidance (1999), if the median and maximum values for a site data set are less than the median and maximum background values, then it can be concluded that the site data are consistent with background levels, and a statistical test of background to site data is not necessary. As shown in Table 8, the median concentrations of arsenic, copper, and iron in Feature 139 soils were less than the respective median concentrations in background soils. Maximum concentrations of copper and iron were also less than the respective maximum concentration in background soils. For arsenic, the maximum detected concentration in Feature 139 soils (16.4 mg/kg) is only slightly higher than the background screening level maximum concentration in background soils (15 mg/kg), which is equivalent to the maximum arsenic concentration in background soil (15 mg/kg). By inspection, the site data set appears to be consistent with, and generally lower than, applicable background levels. However, a detailed statistical evaluation was conducted because the maximum

arsenic concentration in the site data set was higher than the maximum background concentration.

4.1.5 Statistical Evaluation of Site Data to Background Data

A statistical analysis was completed for surface soil metal concentrations at Feature 139 and in background soils (Boerngen and Shacklette 1981) both to characterize the data sets and provide a basis for comparing Feature 139 data to background.

Statistical methods were selected in accordance with guidance from the MPCA (1999) and the USEPA (1989; 1992; 2000; 2002; 2006) for comparing concentrations in surface soil samples from Feature 139 and background soils. Background data sets were compiled from soil samples collected from 37 counties in Minnesota between 1961 and 1975 from sites that, to the extent possible, represented soil in its natural condition (Boerngen and Shacklette 1981). Summary statistics are provided in Table 7, and a detailed description of the methods and results is provided below.

Summary statistics used to establish background screening levels were calculated using ProUCL 4.0 (United States Environmental Protection Agency 2007a). Summary statistics presented in Table 8 include frequency of detection, minimum, maximum, arithmetic mean, standard deviation, geometric mean, geometric standard deviation, distribution of the data, 95% UCL, 95% upper prediction limit (95% UTL), 95 percent upper tolerance limit (for the 95th percentile) (95/95 UTL), and identification of potential outliers, consistent with requirements defined in Minnesota guidance (Minnesota Pollution Control Agency 1999).

Potential outliers were evaluated using several statistical tests, including Dixon, Rosner, or Walsh's test, quantile-quantile (Q-Q), and Box plots. Statistical outliers include the following:

- Feature 139 data set: One surface soil sample with arsenic at 16.4 mg/kg (AGM-SS-001).
- Background set: Samples included in the background data sets of copper (50 mg/kg, 70 mg/kg, and 700 mg/kg) and iron (50,000 mg/kg and 50,000 mg/kg). The background data set represents a compilation of state-wide background concentrations of metals in soils collected from different locations and different soil types. Statistical outliers identified in the background data sets of copper and iron may be the result of heterogeneity in the data set due to this compilation.

Three methods were explored to compare Feature 139 data to background data: (1) hypothesis testing; (2) comparison of summary statistics (i.e., medians and maximums) recommended by the MPCA (1999); and (3) point-by-point comparisons of Feature 139 data to a background screening level (BSL) (i.e., the 95/95 UTL). The USEPA (2007b) indicates methods that compare the distributions (i.e., Methods 1 and 2) and, in particular hypothesis tests, are preferred to point-by-point comparisons provided sufficient sample sizes (e.g., 8 to 10 detected observations) are available in both the Feature 139 and background data sets. For this analysis, sample sizes were sufficient ($n \geq 36$) for both Feature 139 and background data sets to use hypothesis tests to perform the statistical comparison.

Two-sample hypothesis testing consisted of a t-test (for normal or lognormal data sets) or Wilcoxon-Mann Whitney (WMW) test (for data sets that do not fit normal or lognormal distributions). Hypothesis tests and goodness-of-fit tests (using the Shapiro-Wilk test) were performed at a 95 percent confidence level ($\alpha = 0.05$).

The results suggest that concentrations of arsenic, copper, and iron in Feature 139 soils were not statistically greater than background concentrations. Statistical comparisons for arsenic were conducted both with and without the potential outlier in the Feature 139 data set. The results of the hypothesis testing were unaffected by the presence of this potential outlier sample.

A comparison of the 95 percent one-sided confidence limit for 95 percent coverage upper tolerance levels (95/95 UTLs) to Feature 139 metal concentrations indicates no exceedances for copper or iron. For arsenic, multiple 95/95 UTLs can be calculated because the data are consistent with both a gamma and a lognormal distribution. The Feature 139 data do not exceed the lognormal 95/95 UTL, but the maximum Feature 139 concentration (16.4 mg/kg) does exceed the gamma and nonparametric 95/95 UTL (15 mg/kg).

A more detailed description of the statistical analyses is provided in Appendix E.

4.1.6 Conclusions of Background Analysis

Based on this analysis, concentrations of arsenic, copper, and iron within the surface soil of Feature 139 are consistent with naturally occurring background levels found throughout Minnesota. These results suggest that, while there may be one localized area of elevated concentrations of arsenic in Feature 139 soils (represented by Sample AGM-SS-001), the majority of Feature 139 soils have COPC concentrations that are

consistent with (and generally lower than) ambient levels in Minnesota. Although data sets were deemed comparable, arsenic detected in Sample AGM-SS-001 (16.4 mg/kg) was identified as a potential outlier in the Feature 139 data set. The detailed results of the background metals evaluation are provided in Tables 8 and 9.

4.1.7 Tier 2 Soil Reference Values Risk Characterization

The results of the background evaluation indicate that the levels of arsenic, copper, and iron found in the surface soils at Feature 139 are consistent with background levels. However, one sample was identified as potentially different from background (an "outlier") for arsenic based on some of the statistical tests used to evaluate the data. Although identified as an outlier, the level detected was only slightly higher than the maximum concentration detected in the background data sets (16.4 mg/kg in surface soil compared to 15 mg/kg in the background data set). Generally, the analytical results do not indicate impact within surface soils at Feature 139 above levels that are ubiquitous and naturally present in the environment.

Consistent with MPCA guidance (1999), further risk characterization is not necessarily required if levels detected are within naturally occurring background. However because the naturally occurring levels of arsenic, copper, and iron can be above the generic MPCA recreational criteria (Tier 2 Recreational SRVs) and levels of all three exceed the Tier 2 Recreational SRVs in certain samples, further evaluation was completed to confirm conditions on the property are acceptable for continued recreational use.

The generic Tier 2 Recreational SRVs referenced above represent the lowest concentrations determined from multiple, pathway-specific exposure criteria (e.g., acute child exposure criteria, chronic exposure criteria). SRVs based on acute exposure criteria are generally compared to site data on a point-by-point basis. SRVs based on chronic exposure criteria are generally compared against the 95% UCL for a site data set, if the data set is statistically valid.

- **Iron:** The generic Tier 2 Recreational SRV for iron is based on chronic/long-term recreational exposure criteria (see Table 6). As a result, it is appropriate to compare the generic Tier 2 SRV to the 95% UCL for the site data (95 upper confidence on the mean) to determine if there are any potential risks for chronic/long-term exposure to iron in the surface soils. The 95% UCL for iron is less than the generic Tier 2 SRV. As a result, iron does not represent a concern and is eliminated from further evaluation.

- **Arsenic:** The generic Tier 2 Recreational SRV for arsenic is based on acute child exposure criteria (see Table 6) (Tier 2 Child Acute SRV). Additional SRVs were calculated based on long-term /chronic recreational exposure to provide a better understanding of potential risks and hazards (see Table 6 and Appendix F). The 95% UCL for arsenic is less than the calculated chronic recreation Tier 2 SRVs for arsenic. Based on this, risks and hazards associated with longer term/chronic exposure are acceptable. However because arsenic was detected in several samples at concentrations that exceed the Tier 2 Child Acute SRV, additional evaluation was completed.
- **Copper:** The generic Tier 2 Recreational SRV for copper is based on acute child exposure criteria (see Table 6) (Tier 2 Child Acute SRV). Similar to what was done for arsenic, additional SRVs were calculated based on long-term /chronic recreational exposure criteria to provide a better understanding of potential risks and hazards (see Table 6 and Appendix F). The 95% UCL for copper is less than the calculated chronic recreation Tier 2 SRV for copper. Based on this, risks and hazards associated with longer term/chronic exposure are acceptable. However because copper was detected in several samples at concentrations that exceed the Tier 2 Child Acute SRV, additional evaluation was completed.

Based on the comparison to the generic MPCA Recreational SRVs, only the potential short-term/acute exposure to arsenic and copper in surface soils warranted additional evaluation. A Short-Term Hazard Assessment was completed for both arsenic and copper.

4.1.8 Short-Term Hazard Assessment

A Short-Term Hazard Assessment was completed for arsenic and copper to more fully understand potential acute hazards.

Levels of arsenic and copper detected in several surface soil samples exceed the Tier 2 Child Acute SRV. The Tier 2 Child Acute SRV is based on protection of a 1- to 2-year old child weighing 11 kilograms who ingests a 10,000 milligram bolus of soil (the “pica child”). This soil ingestion rate was based on results reported by Stanek and Calabrese in 1995 where one child out of more than 600 children was observed to have a soil intake of approximately 10,000 milligrams per day (mg/day) of soil for the second week of a two-week study (United States Environmental Protection Agency 1997; Calabrese 1989). The “pica child” behavior is not typical and represents an extreme in the regulated community. It is sometimes used to identify potential exposure issues.

The following provide additional discussion on the potential for exposures, as assumed for the Tier 2 Acute Child SRV (“the pica child”), to occur.

- Most of the ground surface is covered with grass, and soils of interest are generally below the grass root zone. These soils would not be easily accessible to a 1- to 2-year old. If a parent brought a small child to watch an older sibling play ball, it is unlikely that child would be sitting within the baseball field. If the child were in this area, it is not likely they would be able to access the soils beneath the root zone unless the grass had been torn up.
- It is not likely a parent would leave a 1- to 2-year old child unattended at the park, providing an opportunity for the child to ingest significant quantities of soil. This would be more likely to happen in a more controlled environment, such as in a fenced residential backyard.
- As stated above, the Tier 2 Acute Child SRVs are based on protection of a 1- to 2-year old child that consumes 10,000 milligrams of soil per day (the “pica child”). Ingestion of that quantity of soil is not expected, as this is abnormal behavior. It is highly unlikely a parent would leave a very young child who exhibits abnormal behavior alone in a park for an opportunity like this behavior to occur.

Based on this assessment, the levels of arsenic and copper in the surface soils at Feature 139 do not pose an unacceptable short-term or acute hazard to recreational users of the site.

4.2 Subsurface Soils

Under the current land use, workers may be exposed to subsurface soils during excavation activities (e.g., construction activities, utility, or grading work). Therefore, the subsurface data were evaluated by comparison to the Tier 2 Short-Term Worker SRVs. COPCs were not detected at concentrations greater than the SRVs. Based on the data and this evaluation, COPCs in the subsurface do not pose a concern for workers (the risk and hazard are acceptable).

4.3 Perched Groundwater

Perched groundwater data were not evaluated at this time. The perched groundwater samples were collected from the temporary groundwater wells with limited development and the perched groundwater samples were not filtered, which could

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potentially result in elevated metal concentrations because of the presence of sediments. More representative data will be collected from a permanent perched groundwater monitoring well installed in the area at a future date and the data will then be evaluated.

5. Summary and Conclusions

5.1 Surface Soils

Below summarizes the findings of this analysis for surface soils at Feature 139:

- Lead was not detected at concentrations that exceed the health protective Tier 2 Recreational SRVs or Tier 1 Residential SRVs in surface soils at Feature 139. Levels of lead are acceptable for the current use of the property.
- Based on the data collected and the results of the risk assessment, concentrations of arsenic, copper, and iron detected in surface soils are acceptable for continued recreational use of the property and do not present a concern (unacceptable risk or hazard) to users of the baseball fields.
 - Levels detected in surface soil samples are consistent with naturally occurring background concentrations in Minnesota. Only one surface soil sample result for arsenic (16.4 mg/kg) was identified as a statistical outlier. The level detected in this sample was only slightly higher than the maximum arsenic concentration in the background data set (15 mg/kg).
 - Levels of COPCs in surface soil are acceptable based on comparisons to health protective Tier 2 Recreational SRVs and the results of the Short-Term Hazard Assessment.
- There is no evidence within the surface soils of alleged historical battery disposal activities.

5.2 Subsurface Soils

The following summarizes the findings of this analysis for subsurface soils at Feature 139:

- The analytical results indicate there were no lead exceedances above the Tier 1 Residential or Tier 2 Recreational SRVs. Levels of lead detected in the soil are acceptable for the current use of the property. The visual observations, combined

with the laboratory results for lead, indicate that there is no evidence of the alleged battery disposal activities in the baseball field area.

- Based on current recreational land use, the only potentially complete exposure pathways to subsurface soils are associated with subsurface activities such as construction or grading work in this area (e.g., below-grade utility installation, planting). To evaluate this potential worker exposure, the subsurface data were compared against the Tier 2 Short-Term Worker SRVs. No constituent concentrations in the subsurface soils samples exceeded the Tier 2 Short-Term Worker SRV.

5.3 Perched Groundwater

Perched groundwater samples were collected from the temporary groundwater wells with limited development. The groundwater analytical results indicate that arsenic, copper, and lead were present in the groundwater samples at levels above the MDH HRLs. However, the perched groundwater samples were not filtered, which could potentially result in elevated metal concentrations because of the presence of sediments.

6. Recommendations

6.1 Surface Soils

While the surface soil evaluation indicates that risks and hazards are acceptable for the current land use, Ford is electing to implement precautionary measures for the surface soils proximal to the one surface soil sample where arsenic was detected at a level slightly above the range of background concentrations. The proposed mitigation measures will involve removal of the surface soils in this one defined area. A work plan will be developed and submitted to the MPCA prior to removal activities. Following completion of the removal activities, the area will be backfilled with clean soil and restored to its previous condition. It is recommended that the baseball fields be reopened following completion of the removal activities.

6.2 Subsurface Soils

No further action or investigation is recommended at this time regarding the subsurface soils. If subsurface soils are excavated or brought to the surface, applicable rules and regulations need to be followed.

6.3 Perched Groundwater

ARCADIS recommends the installation of one perched groundwater monitoring well near Boring ASB-076 and two additional groundwater sampling events occur. Samples will be analyzed for both dissolved and total COPCs for the first sampling event and dissolved COPCs thereafter.

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