

RACER Trust

RECREATIONAL USE RISK EVALUATION

Saginaw Malleable Industrial Land, Green Point
Landfill, and Peninsula Properties

September 18, 2017

A large, solid orange geometric shape, resembling a stylized triangle or a section of a larger triangle, is positioned in the bottom right corner of the page. It is composed of two overlapping triangles, creating a complex, angular form that extends from the bottom edge towards the top right corner.

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Green Point Landfill, And Peninsula
Properties



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CONTENTS

Acronyms and Abbreviations	iv
1 Introduction	1
1.1 Organization of the Report.....	1
1.2 Approach.....	2
2 Background	2
3 Identification of Constituents of Potential Concern	6
3.1 Soil	7
3.1.1 Soil Direct Contact.....	7
3.1.2 Ambient Air Inhalation - Volatile Constituents	10
3.1.3 Ambient Air Inhalation – Particulates	11
3.2 Sediment.....	11
3.3 Surface Water	11
4 Exposure Assessment	12
4.1 Exposure Pathway Conceptual Site Model	12
4.2 Exposure Pathways	13
5 Development of Recreational Criteria	14
5.1 Special Considerations	15
5.1.1 Developmental and Reproductive Toxicants.....	15
5.1.2 Carcinogenic Polycyclic Aromatic Hydrocarbons	16
5.1.3 Dioxins and Furans.....	16
5.1.4 Soil Maximum Ceiling Concentration Versus Risk-Based Criteria	16
5.2 Lead	17
5.2.1 Soil.....	17
5.2.2 Surface Water Exposure	18
6 Comparison of Data To Recreational Criteria and Discussion of Results	19
6.1 Discussion of Soil at SMI	20
6.1.1 Polychlorinated Biphenyls	20
6.1.2 Copper.....	20
6.1.3 Lead.....	21

6.1.4	Vanadium	21
6.2	Discussion of Soil at GPL	22
6.3	Discussion of Soil at Peninsula.....	24
6.3.1	Cobalt	24
6.3.2	Manganese.....	24
6.3.3	Vanadium	24
6.3.4	Lead.....	24
6.3.5	Iron	25
6.4	Discussion of Sediment Data.....	25
7	Summary and Conclusions	26
7.1	Summary.....	26
7.2	Conclusions	27
8	References.....	27

TABLES

1	Recreational Criteria Equations and Exposure Parameters for Soil and Sediment Direct Contact
2	Recreational Screening Level Equations for Particulate Soil Inhalation and Volatile Soil Inhalation
3	Recreational Criteria Equations and Exposure Parameters for Exposure to Surface Water
4	Dermal and Oral Absorption Parameters
5	Toxicity Values
6	Soil Volatilization Factors
7	Recreational Criteria for Soil - Direct Contact - Recreational User
8	Recreational Criteria for Soil - Direct Contact - Adolescent Trespasser
9	Recreational Criteria for Soil - Direct Contact - Adult Dog Walker
10	Recreational Criteria for Soil - Particulate Soil Inhalation - Recreational User
11	Recreational Criteria for Soil - Particulate Soil Inhalation - Adolescent Trespasser
12	Recreational Criteria for Soil - Particulate Soil Inhalation - Adult Dog Walker
13	Recreational Criteria for Soil - Volatile Soil Inhalation - Recreational User
14	Recreational Criteria for Soil - Volatile Soil Inhalation - Adolescent Trespasser
15	Recreational Criteria for Soil - Volatile Soil Inhalation - Adult Dog Walker
16	Recreational Criteria for Sediment - Direct Contact - Recreational User
17	Recreational Criteria for Sediment - Direct Contact - Trespasser
18	Recreational Criteria for Surface Water - Recreational User Wading
19	Recreational Criteria for Surface Water - Adolescent Trespasser Swimming
20	Summary of Calculated Recreational Criteria
21	Summary of Maximum Detected Concentrations Compared to Calculated Recreational Criteria
22	Summary of Soil Exceedances of the Calculated Recreational Criteria

23 Summary of Sediment Exceedances of the Calculated Recreational Criteria

FIGURES

- 1 Site Location Map
- 2 Summary of Planned Restriction Areas on SMI and GPL
- 3 Summary of Planned Restriction Areas on the Peninsula Property
- 4 Exposure Pathway Conceptual Site Model
- 5 Iron Concentrations in Soil at Peninsula
- 6 Copper Exceedances of Recreational Criteria in Soil at SMI
- 7 Lead Exceedances of Recreational Criteria in Soil at SMI
- 8 Vanadium Exceedances of Recreational Criteria in Soil at SMI
- 9 Vanadium Exceedances of Recreational Criteria in Soil at Green Point Landfill
- 10 Cobalt Exceedances of Recreational Criteria in Soil at Peninsula
- 11 Manganese Exceedances of Recreational Criteria in Soil at Peninsula
- 12 Vanadium Exceedances of Recreational Criteria in Soil at Peninsula
- 13 Lead Exceedances of Recreational Criteria in Soil at Peninsula
- 14 Vanadium Exceedances of Recreational Criteria in Sediment

APPENDICES

- A Exposure Parameter Rationale Information
- B Planned Restrictions
- C Conversion of Carcinogenic PAH and Dioxin and Furan Data to Toxic Equivalents
- D Dioxin Summary Letter and Additional Dioxin Information
- E Fine Fraction Lead Evaluation
- F Saturated Soil Samples Evaluation Regarding Use in Comparison to Ambient Air Criteria at the RACER Saginaw Malleable Industrial Land
- G Default Michigan Department of Environmental Quality Lead Parameters
- H Coplanar Polychlorinated Biphenyl Evaluation
- I Data Used for Constituent-Specific Evaluations and ProUCL Output

ACRONYMS AND ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
BBL	Blasland, Bouck & Lee, Inc.
COPC	constituent of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CRA	Conestoga-Rovers & Associates
EPCSM	exposure pathway conceptual site model
FS	Feasibility Study
ft bgs	feet below ground surface
GM	General Motors
GPL	Green Point Landfill
IEUBK	Integrated Exposure Uptake Biokinetic
LNAPL	light non-aqueous phase liquid
MDEQ	Michigan Department of Environmental Quality
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PSIC	Particulate Soil Inhalation Criterion
RAP	Remedial Action Plan
REALM	Remediation and Liability Management Company, Inc.
RI	Remedial Investigation
SMI	Saginaw Malleable Industrial Land
SVOC	semi-volatile organic compound
TCDD	tetrachlorodibenzo-p-dioxin
TEF	toxic equivalency factor
TEQ	toxic equivalents
USEPA	United States Environmental Protection Agency
VOC	volatile organic compound

1 INTRODUCTION

Arcadis, on behalf of the Revitalizing Auto Communities Environmental Response (RACER) Trust, has prepared this Recreational Use Risk Evaluation for the Saginaw Malleable Industrial Land (SMI) Plant property, the former Green Point Landfill, and the Peninsula Property, located in Saginaw, Michigan (collectively the Site) (Figure 1).

Historical activities have impacted the Site with various hazardous substances and contaminants, including metals, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs). Previous risk evaluations prepared for the Site have recommended institutional and engineering controls and have focused on future industrial use of the properties. However, the properties are being considered for redevelopment and use as a passive recreational area. Therefore, Arcadis has completed a recreational use evaluation for the Site.

1.1 Organization of the Report

This recreational use evaluation is organized into the following sections:

- Section 2, Background. The background section provides a very brief history of the Site, the investigations and remediation completed to date, and the planned engineering and institutional controls for the Site.
- Section 3, Identification of Constituents of Potential Concern. This section identifies the Part 201 generic criteria selected to identify constituents of potential concern (COPCs) for the recreational use evaluation and identified COPCs by providing a summary of the comparison of the available data to the selected criteria. Constituents are hazardous substances or other contaminants identified or potentially present in environmental media at the Site.
- Section 4, Exposure Assessment. This section discusses the exposure pathway conceptual site model (EPCSM) and identifies potential receptors and potentially complete exposure routes.
- Section 5, Development of Recreational Criteria. This section provides the equations and exposure parameters used to develop the Site-specific cleanup criteria for recreational use of the Site (recreational criteria), and presents the calculated recreational criteria. In addition, special considerations, including developmental/reproductive toxicants, carcinogenic PAHs, dioxins and furans, and lead are discussed in more detail.
- Section 6, Comparison to Recreational Criteria and Discussion of Results. This section presents a comparison of the Site data to the recreational criteria, provides figures showing locations of exceedances, and discusses the results of the recreational use evaluation.
- Section 7, Conclusions. This section discusses the conclusions that can be reached based on the recreational use evaluation presented in this document.
- Section 8, References. This section lists the references used in the recreational use evaluation.

1.2 Approach

The Michigan Department of Environmental Quality (MDEQ) has not developed generic cleanup criteria for either a recreational use or a trespasser scenario. As a result, the RACER Trust and MDEQ project teams participated in several conference calls to develop the approach used in the recreational use evaluation included in this report. The EPCSM, potential receptors, and equations and exposure parameters used to calculate the recreational criteria for this evaluation have been agreed to by the parties. As part of the discussions with MDEQ, Arcadis prepared a memo providing additional rationale or justification for various proposed exposure parameters, as requested by MDEQ to demonstrate that the Site-specific criteria, in comparison to generic criteria, better reflect best available information concerning the toxicity or exposure risk posed by the hazardous substance or other factors (MCL 324.20120b¹). This memo is included as Appendix A. MDEQ approved all of the parameters that were presented in this memo, with the exception of the sediment ingestion rates. The sediment ingestion rates used in this recreational use evaluation were agreed upon at a later date and documentation of those rates is also provided in Appendix A.

The approach used to evaluate exposures to lead was also agreed upon with MDEQ, and includes consideration of the new acceptable blood lead level (BLL) of 5 micrograms per deciliter, the use of United States Environmental Protection Agency's (USEPA's) Integrated Exposure Uptake Biokinetic (IEUBK) Model (USEPA 1994, 2007), and recommendations from USEPA's *Assessing Intermittent or Variable Exposures at Lead Sites* (USEPA 2003) to evaluate lead in soil. Lead exposures to sediment and surface water were semi-quantitatively evaluated by comparison of potential doses from the Site to potential doses from a residential exposure to lead in soil and drinking water.

2 BACKGROUND

The SMI property encompasses approximately 150 acres, Green Point Landfill (GPL) approximately 170 acres, and Peninsula approximately 3.69 acres. Plant operations ceased in 2007 at SMI, and decommissioning/demolition was completed between 2009 and 2010. The remaining structures on SMI include the former plant slab and parking lot, two closed Type III Landfills, a stormwater pond, and the Secondary Settling Pond (part of a former Water Recycle System). GPL consists of the former landfill, a former cultivated field, wetlands, previously proposed Type III landfill area, and two mitigation wetland areas. The landfill was operated by various enterprises between the 1950s and 1978, and used for the disposal of municipal waste, foundry sand, and industrial waste. Peninsula is vacant and, reportedly, process waste materials from the Delphi Plant was used as fill on the property. Peninsula was formerly part of the adjoining Delphi Automotive Systems property. It was transferred to Remediation and Liability Management Company, Inc. (REALM), a subsidiary of General Motors (GM) in 1999.

¹ "324.20120b Numeric or nonnumeric site-specific criteria., Sec. 20120b. (1) The department shall approve numeric or nonnumeric site-specific criteria in a response activity under section 20120a if such criteria, in comparison to generic criteria, better reflect best available information concerning the toxicity or exposure risk posed by the hazardous substance or other factors."

Manufacturing activities occurred from approximately 1907 until 2007. Manufacturing activities consisted of casting and heat treating iron. Metal was melted and transferred through a series of furnaces before it was placed, as molten metal, into molds to form the castings.

The following reports have been prepared for the Site, and substantively fulfilled the purpose of the Corrective Measures Study for the Site:

- *Remedial Investigation (RI) Report, July 5, 2001 (Blasland, Bouck & Lee, Inc. [BBL]):* Provides a summary of the environmental setting, investigation activities, investigation results, RI activities completed, and the nature and extent of chemical constituents.
- *Feasibility Study (FS) Report, July 29, 2003 (BBL):* Provides the Human Health Evaluation (HHE) and the Ecological Risk Assessment (ERA), as well as proposed remedial actions.
- *Remedial Action Plan (RAP) Report, July 30, 2008 (Modified on December 31, 2008) (Arcadis):* Provides proposed remedial actions including an addendum to the HHE that evaluates additional data collected since the RI and FS.
- *Risk-Based Disposal Work Plan for PCB-Impacted Material, May 8, 2015 (Conestoga-Rovers & Associates [CRA]):* Provides a summary of the delineation of PCBs in the concrete floor slab and in soil in the I27.7 Manhole Area and proposed remedial plan. Risks associated with PCBs in concrete and soil will be significantly reduced after implementation of the proposed Work Plan.
- *PCB Cleanup Completion Summary Report, March 21, 2017 (GHD Services, Inc. [GHD]; formerly CRA):* Provides a summary of the cleanup activities completed to address PCB impacts present in the concrete floor slab and in soil in the I27.7 Manhole Area. Site figures and laboratory analytical data are presented in the report.
- *Supplemental Technical Memorandum, July 21, 2017 (GHD):* Provides a summary of the installation of the cover, which provides a barrier from contact with the remaining PCBs in the concrete slab and underlying soil prevents precipitation from directly falling on the slab. The technical memorandum provides figures showing the final extents of the cover material.

Below is a list of reports that describe the corrective measures completed at the Site to achieve targeted cleanup standards, as outlined in the reports summarized above, and based on the approved remediation strategy from the RAP dated June 30, 2008, which was updated in December 2008, and approved by the MDEQ in February 2009.

- *Melting Department Area Investigation and Remediation Report, April 1997 (CRA):* The Melting Department Area was cleaned, capacitors in this area were replaced, and rooms containing PCBs above action levels were remediated by removing flooring material and soils containing PCBs at concentrations greater than the generic Industrial Direct Contact Criteria to the extent practicable given the access limitations within the plant. PCBs were left in place at depth (approximately 20 feet below ground surface [ft bgs]) and covered with flowable fill.
- *Green Point Landfill Cover System Certification Report, January 2000 (BBL):* Construction of the landfill cap was completed consistent with Part 115 of Michigan Act 451. GPL was closed as part of an interim response action under Part 201 and in accordance with a Consent Judgment between

General Motors, Waste Management Inc., and the State of Michigan. Annual monitoring is ongoing at GPL.

- *RI Report, July 5, 2001 (BBL)*: A soil excavation was completed in 1998 to remove PCB-impacted soils in the Former Railyard Area. Confirmation samples indicated the soils containing PCBs at concentrations greater than MDEQ generic industrial criteria were removed.
- *RI Report, July 5, 2001 (BBL)*: Two Type III Landfills existed at the Facility: the eastern landfill and the central landfill. The eastern landfill started receiving waste in 1979 and was closed in 1984. The central landfill received wastes from 1984 until approximately 1990. Closure certifications for these two landfills have been filed with MDEQ. The MDEQ received a closure plan for the eastern landfill on November 6, 1985, and the central landfill received a closure approval dated November 8, 1991 according to the online MDEQ Waste Data System.
- *Feasibility Study Report, July 2003 (BBL)*: GM completed weekly PCB sampling and analysis of the sewer discharge to the publicly-owned treatment works (POTW). GM conducted extensive testing, cleanup, and remediation of sewers including replacement, lining, abandonment, and cleaning in coordination with the City of Saginaw. Additionally, more recently in 2010, all inputs to the City sewer that transects the Facility were bulkheaded; and in 2015, the City sewer that transected the Facility was bulkheaded and all flow was diverted to another City sewer not on the Facility.
- *Feasibility Study Report, July 2003 (BBL)*: Drum Remediation Area/Former Hillock Area: In 1987, GM excavated, overpacked, and staged 339 drums/drum fragments from the western portion of the area. In 1998, GM collected and disposed of surface metal debris, collected additional surface drums and overpacked them as needed, restaged the previous 339 drums, and excavated 23 test pits (removing drums and drum fragments). In February 1990, 408 tons of staged material was disposed. In June 1990, 1,538 tons of non-hazardous waste and eight drums were disposed off-site. In 1994 and 1995, an additional three drums were removed from the Facility. Soil and fill that constituted the remaining unexcavated part of the area were excavated to the water table and placed with the fill materials of the GPL prior to capping. Clean fill was used to bring the Hillock Area back to grade.
- *Summary of Interim Response Activities Associated with the East/West Ditch Filling and Removal of Manganese Impacted Soil in Saginaw River Berm, GMPT SMI, September 2005 (CRA)*: Manganese-impacted soils from an on-site berm along the Saginaw River as well as soils from the Crotty Street mitigation wetland project were used to fill in the bottom of the remaining channel of the SMI former water recirculation system. These soils were capped by two feet of clean fill and topsoil and re-seeded. Although the standard (MDEQ generic residential Particulate Soil Inhalation Criterion [PSIC] standard) was not achieved in the floors of the excavations, 2 to 3 feet of fill was placed over the floors thereby eliminating the pathway of particulate air inhalation for those areas.
- *Remedial Action Plan (RAP) Report July 30, 2008, (Modified on December 31, 2008) (Arcadis)*: Operations at the SMI plant ceased in 2007. Decommissioning and demolition of the plant was completed from 2009 to 2010, and the potential for additional impacts from operations has been eliminated. Additionally, a corrective measure was completed in 2001 by adding a soil cover consisting of 8 inches of clean fill and seeding with grass at the former CTC Parking Lot East of the Plant.
- *Light Non-Aqueous Phase Liquid (LNAPL) Status Presentation November 7, 2014 (CRA)*:

- o Southwest Plant LNAPL Area – An automated LNAPL and Groundwater Recovery System was installed in 1997. Prior to 2003, sewer cleaning, replacement, and lining was conducted. Current activities include: quarterly monitoring of LNAPL
- o Quench Pit Area – Active LNAPL recovery system was installed in February 2002. Sewer bulkheading, cleaning, replacement, and lining were also conducted. As part of the demolition, 55,000 gallons of LNAPL were removed from the quench pits and immediately adjacent area. Current activities include: active LNAPL recovery and quarterly monitoring.

Additional investigation or remediation activities completed at the Site and not listed above include:

- Storm sewers have been tested, cleaned, and lined or abandoned. All inputs to the City sewer that transects the Site were bulkheaded in 2010 and in 2015 the City sewer flow was diverted to another City sewer and the outflow from the Site was bulkheaded at two locations, effectively isolating the sewer at the Site from any connection to a publicly owned sewer.
- Concrete and soil excavation have been completed at SMI, and although some PCBs remain, the concentrations are below applicable risk-based criteria or exposure barriers will be placed to prevent exposure to the impacts.
- Landfill inspection and groundwater monitoring has been on-going since 2000.
- Investigation activities occurred 1994 to 1999 at Peninsula and the RI Report was submitted in 2000.
- A Site investigation was performed at Peninsula in December 2013 and October 2014 in relation to potential human health risks at the Site and the groundwater surface water interface (GSI) for metal impacts to the nearby wetland. MDEQ approved no further action for the GSI exposure pathway in 2014.
- An excavation of shallow impacted soils and placement of a soil cover over areas with lead in exceedance of 2013 nonresidential direct contact criteria occurred in 2015 at Peninsula. Further evaluation of lead impacted soil is in progress in anticipation of MDEQ adopting a revised, lower nonresidential direct contact criteria for lead.
- A Site investigation was completed in October 2016 to confirm the results of select previous soil, surface water, and sediment samples, and included analysis of select samples for hexavalent chromium.
- A Site investigation was completed at GPL in June 2017 to verify vanadium results reported in the 2007 Due Care Plan for the Eastern Property Extension, which is now part of the GPL property. After receipt of the full Baseline Environmental Assessment Report from GHD it was determined that previously reported vanadium results were actually zinc results. The June 2017 Site investigation on the GPL property yielded vanadium results that were consistent with data collected on other portions of the GPL property. The analytical results of the investigation have been incorporated into this report.
- Delineation activities were completed in July 2017 at the Peninsula property for lead, manganese, and vanadium around the property boundary of the Peninsula property. Total lead, fine fraction lead, and coarse fraction lead analyses were completed in order to refine the fine to total lead ratio for the Peninsula property. A technical memorandum summarizing the results of the delineation activities was submitted to MDEQ on August 18, 2017 (Arcadis 2017b) and the data have been incorporated into this report.

- Delineation of lead impacts in the former Railyard area was completed in July and August 2017. Total lead, fine fraction lead, and coarse fraction lead analyses were completed in order to obtain a fine to total lead ratio for the former Railyard area. A technical memorandum summarizing the results of these investigations were submitted to MDEQ on September 7, 2017 (Arcadis 2017c) and the data have been incorporated into this report.
- A Site investigation was completed in August and September 2017 in the former underground storage tank (UST) #7 area to delineate elevated concentrations of VOCs in soil that exceeded adjusted Volatile Soil Inhalation Criteria (VSIC) for a 5-meter source thickness (VSIC-5m) for a 400-acre source area. A technical memorandum summarizing the results of these investigations were submitted to MDEQ on September 18, 2017 (Arcadis 2017d) and the data have been incorporated into this report.

To establish land and groundwater use restrictions, to prevent damage to or disturbance of any component of the constructed remedy/corrective measures, to prohibit or restrict activities that could result in unacceptable exposure to environmental contamination, to require future activities at the Site to be completed in accordance with applicable requirements, and to provide notification of polychlorinated biphenyls (PCB) remediation waste at the Site, Declaration of Restrictive Covenants (DRC) will be recorded for SMI, GPL, and Peninsula. Planned restrictions are outlined in **Appendix B**, and are summarized on the proposed figures (**Figure 2** [SMI and GPL] and **Figure 3** [Peninsula]). Corrective measures are being evaluated and discussed with MDEQ to ensure that areas of exceedances have the appropriate restrictions in place.

3 IDENTIFICATION OF CONSTITUENTS OF POTENTIAL CONCERN

COPCs for potential recreational users at the Site were identified by a comparison of maximum detected concentrations in soil, sediment, and surface water to available unrestricted use (i.e., residential) criteria, as requested by MDEQ. The following criteria sources were considered: the draft residential Part 201 criteria, presented in the September 2016 draft *Cleanup Criteria Requirements for Response Activity* document² (MDEQ 2016c) (draft Part 201 criteria); the MDEQ Rule 57 Criteria (MDEQ 2016d) (Rule 57 criteria); and the USEPA's National Recommended Water Quality Criteria (USEPA 2013) (NRWQC). Specifically, the following criteria were used to identify COPCs by media:

- Soil:
 - o Draft Part 201 Statewide Default Background Levels (Background Levels);
 - o Draft Part 201 residential Direct Contact Criteria (DCC);

² Use of the draft Part 201 criteria has been recommended by MDEQ as representing the best available science at the time this evaluation was started.

- o Draft Part 201 residential Volatile Soil Inhalation Criteria for a 5-Meter Source Thickness (VSIC-5m), adjusted to a 400-acre source area³; and
 - o Draft Part 201 residential PSIC, adjusted to a 400-acre source area.
- Sediment:
 - o Draft Part 201 Background Levels
 - o Draft Part 201 residential DCC
- Surface water:
 - o Draft Part 201 GSI Criteria (GSIC)
 - o Rule 57 criteria (MDEQ 2016d)
 - o NRWQC for consumption of organisms only (USEPA 2013)

Data used in the recreational use evaluation include soil, sediment, and surface water samples that remain onsite after any remedial activities were completed. As a conservative first pass, this included samples that were collected beneath exposure barriers. This evaluation includes supplemental data that were collected in October 2016 and July, August, and September 2017. The following sections summarize the selection of COPCs for soil, sediment, and surface water.

3.1 Soil

3.1.1 Soil Direct Contact

The maximum concentrations of 16 constituents exceeded the draft Part 201 residential DCC and were identified as COPCs for direct contact in soil. These COPCs included: benzo(a)pyrene toxic equivalents (TEQ); four PCB-containing Aroclors (Aroclors 1242, 1248, 1254, and 1260)⁴; dioxins and furans (as 2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD] TEQ)⁵; arsenic; hexavalent chromium; cobalt; copper; iron; lead; manganese; nickel; thallium; and vanadium.

³ The combined acreage of the three areas evaluated is between 300 and 400 acres. Therefore, the more conservative adjustment factor of 0.33 for 400 acres was applied to the generic VISC and PSIC to determine the overall source area sizes.

⁴ Although not all PCB results from soil and concrete samples collected by GHD were included in this evaluation, PCB results from soil, sediment, and surface water sample collected from outside of the former building footprints were included in the evaluation. In accordance with the MDEQ- and USEPA-approved TSCA work plan (MDEQ 2016a, USEPA 2016), portions of the former plant slab with concentrations greater than 10 milligrams per kilogram (mg/kg) were removed and 1 foot of clean soil was placed on top of the slab. The soil cover will be maintained per the plan; therefore, PCBs in this area will not be accessible to potential receptors. Concentrations of total PCBs in the remaining concrete are below the calculated recreational criterion.

⁵ It should be noted that dioxins and furans are present at the Site as a result of periodic flooding of the Saginaw River. RACER is not responsible for cleanup of dioxins and furans. However, this evaluation includes dioxins and furans for informational purposes. Additional details are provided in the updated Dioxin Letter prepared for the Site and included in **Appendix D**.

As required in the draft Part 201 criteria, the seven carcinogenic PAHs (cPAHs)⁶ were adjusted using the benzo(a)pyrene toxic equivalency factors (TEFs) and summed together into one benzo(a)pyrene TEQ, which was then compared to the draft Part 201 residential DCC. Following recommendations in the MDEQ's draft *Cleanup Criteria and Screening Levels Development and Application* document (MDEQ 2016b), non-detect cPAHs were set at one-half the laboratory reporting limit. If all seven cPAHs were not detected in a sample, the benzo(a)pyrene TEQ was also set to non-detect. The data conversion to the benzo(a)pyrene TEQs for each of the three plants are provided in **Appendix C**. Additional information on cPAHs is provided in **Section 5.1.2**.

Similar to cPAHs, the individual dioxins and furans were adjusted using the 2,3,7,8-TCDD TEFs and summed together into one 2,3,7,8-TCDD TEQ value, which was then compared to the 2,3,7,8-TCDD draft Part 201 residential DCC. Coplanar PCBs were not analyzed in the available data for the Site; however, coplanar PCBs are not expected to significantly contribute to the 2,3,7,8-TCDD TEQ, as discussed in **Section 6**. The data conversion to the 2,3,7,8-TCDD TEQs for SMI and GPL are provided in **Appendix C**.

Total chromium data were compared to the trivalent chromium criteria, as hexavalent chromium data were available for soil at the Site and were relatively low. Concentrations of total chromium did not exceed the trivalent chromium draft Part 201 residential DCC; therefore, total chromium was not retained as a COPC in soil. As stated above, hexavalent chromium was retained as a COPC in soil for the Site.

3.1.1.1 Lead

According to MDEQ guidance, fine fraction (instead of total) lead concentrations should be compared to the soil DCC. The MDEQ guidance states that samples exhibiting lead concentrations greater than 75,000 µg/kg should be analyzed for total lead, fine fraction lead, and coarse fraction lead. The MDEQ determined this value based on calculated fine fraction to total lead ratios of paired total and fine fraction data collected at sites across the State of Michigan. This is a conservative threshold where the fine fraction concentration is not expected to be greater than 400,000 µg/kg, which was the residential DCC at that time.

Some fine fraction and total lead data have been collected from the Site; however, not all historical samples that had a total lead concentration greater than 75,000 µg/kg were analyzed for fine fraction and coarse fraction lead. Therefore, consistent with the MDEQ approach used from a State-wide perspective in preparation of the guidance, area-specific fine fraction to total lead ratios were calculated using the available paired data, as described below.

A total of 38 remaining soil samples at the Site (26 in the Former Railyard Area at SMI and 12 at Peninsula) have been analyzed for both fine fraction lead and total lead (see **Table E-1** of **Appendix E**). Fine fraction to total lead ratios were derived for these two areas separately. **Table E-1** provides the calculated fine fraction to total lead ratio for each individual sample. As shown in **Table E-1**, the fine fraction to total lead ratios for the Former Railyard Area ranged from 0.0027 to 11.000, and for the Peninsula property ranged from 0.443 to 2.933. It is noted that if there is additional sampling and analysis

⁶ The seven cPAHs are: benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

in either of these areas the fine fraction to total lead ratio may be recalculated to allow for evaluation of any necessary further action.

Outlier Analysis

Prior to calculating an overall fine fraction to total lead ratio for each area, USEPA's ProUCL version 5.1.002 (USEPA 2016) statistical software was used to determine if statistical outliers were present in the datasets (see **Table E-2**).

Because more than 25 samples were collected at the Former Railyard Area, Rosner's Outlier Test was used to determine if the five highest ratios were statistical outliers. ProUCL indicated that the two highest results, 11.000 and 7.368, were statistical outliers at a 5 percent (%) significance level. Therefore, those two samples were removed from the ratio calculation dataset for the Former Railyard Area. In addition, although the low value (0.227) was not identified as an outlier, it was removed from the dataset prior to calculating an overall fine to total lead ratio for the Former Railyard Area, thereby resulting in a higher, more conservative ratio. Based on the outlier evaluation for the Former Railyard Area, three ratios (11.000, 7.368, and 0.227) were removed from the dataset prior to calculating an overall ratio for this area. After these three ratios were removed, Dixon's Outlier Test was used (due to the reduced number of samples) to re-test the data for outliers. As shown in **Table E-2**, no additional outliers were identified for the Former Railyard Area. Box plots were also prepared for the two Former Railyard Area ratio datasets, and are shown in **Figure E-1 of Appendix E**. These box plots show the distribution of the datasets and potential outliers.

For the Peninsula property, 12 fine fraction to total lead ratios were available; therefore Dixon's Outlier Test was used to determine if either the high value (2.933) or the low value (0.443) was a statistical outlier. ProUCL indicated that these two values were not outliers, as shown in **Table E-2**. Therefore, no ratios were removed from the dataset for the overall fine fraction to total lead ratio for the Peninsula property. If future additional sampling at the Peninsula property indicates that these low ratios are outliers, they may be removed from future ratio calculation datasets. A box plot was also prepared for the Peninsula ratio dataset and is shown in **Figure E-1**. The box plot for the Peninsula ratio dataset shows the distribution of the data and the high value (which was not identified as an outlier).

Calculation of Overall Fine Fraction to Total Lead Ratios

Fine fraction to total lead ratios for the Former Railyard Area and the Peninsula properties were calculated as the 95 percent (%) upper confidence limit (95% UCL) of the ratios. The 95% UCL is a statistical number calculated to represent the mean value with a high level (i.e., 95%) of confidence. The true arithmetic mean value for the Site is lower than the 95% UCL. The high level of confidence is used to compensate for the uncertainty in representing area conditions with a finite number of samples.

For the Former Railyard Area, the ratios followed a gamma distribution and the 95% Adjusted Gamma UCL of 2.374 was recommended by ProUCL, as shown in the ProUCL output sheets provided in **Appendix E, Table E-3**. Therefore, a fine fraction to total lead ratio of 2.4 was used to estimate fine fraction lead concentrations for samples in the Former Railyard Area that did not have fractionated results.

For the Peninsula property, the ratios followed a normal distribution and the 95% Student's-t UCL of 1.795 was recommended by ProUCL, as shown in **Table E-3**. Therefore, a fine fraction to total lead ratio

of 1.8 was used to estimate fine fraction lead concentrations for samples at the Peninsula property that did not have fractionated results.

Comparison of Fine Fraction Lead Data to Applicable Screening Levels

For samples that did not have fractionated results, the analyzed total lead concentrations were multiplied by the overall fine fraction to total lead ratios to estimate fine fraction lead concentrations. The Former Railyard Area ratio of 2.4, which is higher and more conservative than the ratio for the Peninsula property, was used for all the areas at SMI and GPL. The area-specific ratio of 1.8 was used for the Peninsula property. The maximum detected or estimated fine fraction lead concentrations in all three properties exceeded the draft Part 201 residential DCC of 190,000 micrograms per kilogram ($\mu\text{g/kg}$). Therefore, lead was retained as a COPC for further evaluation in soil.

3.1.2 Ambient Air Inhalation - Volatile Constituents

Ambient air inhalation of constituents volatilizing from soil can occur from vadose zone soils. Groundwater beneath the Site is generally observed at depths less than 4 feet below ground surface (ft bgs). As discussed in **Appendix F**, volatile constituents in water-saturated soils are not likely to act as a direct source to either ambient (i.e., outdoor) or indoor air. Therefore, analytical data from soil samples collected below the water table (i.e., water saturated soil) should not be compared to the draft Part 201 residential VSIC-5m adjusted for a 400-acre source area. Following is a summary of the comparison of vadose zone soil samples to the draft Part 201 residential VSIC-5m adjusted for a 400-acre source area.

The maximum detected concentrations of Aroclors 1242 and 1254, ethylbenzene, naphthalene, phenanthrene, and mercury in vadose zone soil exceeded the draft Part 201 residential VSIC-5m, adjusted for a 400-acre source area. These constituents were retained as COPCs for further evaluation for the ambient air inhalation pathway. Concentrations of benzene and ethylbenzene in soil samples collected below the water table (i.e., water-saturated soil) also exceeded the draft Part 201 residential VSIC-5m, adjusted for a 400-acre source area. However, as discussed in **Appendix F**, volatile constituents in water-saturated soils do not act as a direct source to ambient or indoor air (Arcadis 2017a). At the request of the MDEQ, Arcadis conservatively retained benzene as an additional COPC for soil for the ambient air inhalation pathway. In addition, an investigation was completed to delineate exceedances and determine vadose zone concentrations of volatile constituents in soil in the vicinity of former UST #7. A summary of this investigation (Arcadis 2017d) is included in **Appendix F**.

PCBs are present in soil at concentrations above the draft Part 201 residential VSIC-5m adjusted for a 400-acre source area in a relatively small area under the former SMI plant slab. Exposure to soils in this area will be prohibited through the use of engineering and institutional controls that include the requirement for the concrete slab to remain in-place over the entire area except for the I27.7 excavation area where there will be a minimum of 2 feet of soil cover and a prohibition of intrusive activities. In addition, a 12-inch layer of soil will be placed on top of the concrete slab. The presence of the concrete slab will also inhibit the movement of volatilized PCBs to the ambient air. As a conservative approach, Aroclors 1242 and 1254 were retained as COPCs for further evaluation for this pathway.

3.1.3 Ambient Air Inhalation – Particulates

The maximum detected concentrations of cobalt, manganese, and nickel exceeded the draft Part 201 residential PSIC adjusted for a 400-acre source area. These three COPCs were carried through into the recreational use evaluation.

In addition, the maximum detected or estimated fine fraction lead concentration at SMI (4,272,000 µg/kg; **Table E-4**) and Peninsula (18,180,000 µg/kg; **Table E-5**) exceeded the adjusted PSIC for a 400-acre source area (2,541,000 µg/kg). However, the average estimated fine fraction lead concentrations at SMI (approximately 185,000 µg/kg) and Peninsula (approximately 738,000 µg/kg) are well below the adjusted PSIC. The maximum estimated fine fraction lead concentration at GPL (489,300 µg/kg) was below the adjusted PSIC. Therefore, lead in soil is not a concern for the ambient air inhalation pathway.

It should be noted that the maximum detected concentrations of the cPAHs did not exceed the draft residential PSIC adjusted for a 400-acre source area.

3.2 Sediment

In general, sediment concentrations should be compared to sediment criteria; however, MDEQ does not have generic sediment criteria. Other state agencies (e.g., Virginia Department of Environmental Quality [VDEQ]) use adjusted soil criteria (VDEQ uses 10 times the soil criteria) to identify COPCs for sediment due to a much lower potential for exposure to sediments (compared to soil). Therefore, the sediment data collected at SMI and GPL were compared to the unadjusted MDEQ draft Part 201 residential soil DCC to identify COPCs. The maximum detected concentrations of cPAHs (as benzo(a)pyrene TEQ), four Aroclors (1242, 1248, 1254, and 1260), dioxins and furans (as 2,3,7,8-TCDD TEQ), arsenic, hexavalent chromium, copper, manganese, thallium, and vanadium exceeded the draft Part 201 DCC. The data conversions for the cPAHs to benzo(a)pyrene TEQ and the individual dioxins and furans to 2,3,7,8-TCDD TEQ are presented in **Appendix C**.

The maximum detected concentration of total lead in sediment samples was 245,000 µg/kg, which exceeds the draft Part 201 residential soil DCC of 190,000 µg/kg. The average concentration of total lead in sediment samples was 36,300 µg/kg, which is well below the draft Part 201 residential soil DCC. Therefore, lead was not retained as a COPC for sediments at the Site.

3.3 Surface Water

Surface water analytical data were compared to the draft Part 201 GSIC, the MDEQ's Rule 57 Water Quality Criteria, and the USEPA NRWQC. Together, these criteria account for both recreational use of surface water (included ingestion of fish from surface water) and for effects to wildlife and aquatic organisms. The maximum detected concentrations of phenanthrene, copper, cyanide, lead, mercury, thallium, and zinc exceeded one or more of the applicable criteria and were identified as COPCs for further evaluation. Concentrations of bis(2-ethylhexyl)phthalate exceeded the NRWQC for consumption of organisms in two samples collected in 1995 from the Secondary Settling Pond; however, supplemental sampling of these locations in October 2016 did not indicate the presence of bis(2-ethylhexyl)phthalate. Therefore, bis(2-ethylhexyl)phthalate was not evaluated further in the recreational use evaluation.

4 EXPOSURE ASSESSMENT

The EPCSM was developed by completing an exposure assessment. The purpose of the exposure assessment is to evaluate the ways receptors might be exposed to COPCs at the Site. Exposure can only occur when the potential exists for a receptor to contact COPCs or when there is a mechanism for COPCs to be transported to a receptor. Without exposure, there is no risk; therefore, the exposure assessment is a critical component of the risk evaluation. The assessment of exposure includes characterization of the physical environment, identification of exposure pathways (including migration pathways, exposure points, and exposure routes), and identification of potentially exposed individuals and populations.

An exposure pathway is defined by the following four elements:

1. A source and mechanism of constituent release to the environment
2. An environmental transport medium for the released constituent
3. A point of potential contact by the receptor with the medium containing the constituent (the exposure point)
4. A route of exposure to the receptor at the exposure point (i.e., ingestion, inhalation, or dermal contact)

The exposure assessment is a critical component of the risk evaluation process, as it qualitatively and quantitatively describes potential contact between COPCs and the potential receptors. In accordance with USEPA exposure assessment and risk characterization guidance (USEPA 1992, 1995), a reasonable maximum exposure (RME) scenario was evaluated. The RME scenario aims to protect for majority of the population by using a combination of upper end and average estimates.

The following sections present the EPCSM detailing the potential receptors and exposure pathways.

4.1 Exposure Pathway Conceptual Site Model

The EPCSM provides the framework of a risk evaluation. It characterizes the primary and secondary potential sources and release mechanisms and identifies the media of concern (exposure points), potential receptors, and their potential exposure routes. Exposure points are places or “points” where exposure could potentially occur, and exposure routes are the means by which constituents of interest may be taken up by the receptor (ingestion, inhalation, and dermal contact). The EPCSM for the Site, which was developed with input from and was approved by the MDEQ, is provided on **Figure 4** and discussed below.

As discussed in Section 2, the SMI property encompasses approximately 150 acres, GPL approximately 170 acres, and Peninsula approximately 3.69 acres. Plant operations ceased in 2007 at SMI, and decommissioning was completed between 2009 and 2010. The remaining structures on SMI include the former plant slab and parking lot, two closed Type III Landfills, two stormwater ponds, and the Secondary Settling Pond (part of a former Water Recycle System). GPL consists of the former landfill and protected wetlands area. The landfill was operated by various enterprises between the 1950s and 1978, and used for the disposal of municipal waste, foundry sand, and industrial waste. Peninsula is vacant and reportedly process waste materials from the adjacent former Delphi Plant was used as fill at the property.

Peninsula was formerly part of the Delphi Automotive Systems property. It was transferred to REALM, a subsidiary of GM in 1999.

Soil, groundwater, sediment, and surface water have been impacted by historical activities at the Site. There are no current exposures to groundwater at the Site, and future exposure to groundwater will be prohibited through the placement of restrictive covenants on the properties. Potential exposure to soil, sediment, and surface water may occur. However, exposure to soil in certain portions of the properties will be limited through the use of engineering (e.g., exposure barriers) and institutional controls (i.e., deed restrictions).

The future anticipated use of the property is as a passive recreational area (e.g., a natural area for observing wildlife with walking and/or biking trails). As such, potential receptors identified for the Site include child and adult recreational users, adolescent trespassers, and adult dog walkers. Consistent with the MDEQ draft Part 201 Rules, this risk evaluation considers potential pregnant receptors at the Site. Future residential development of the properties will be prohibited through the placement of deed restrictions on the properties; therefore, residential receptors were not evaluated.

It should be noted that the ponds that are present at the Site will not be stocked with fish. In addition, only one constituent, bis(2-ethylhexyl)phthalate, was detected in historical surface water data at a maximum concentration that exceeded the USEPA's screening level for consumption of organisms. Arcadis completed surface water sampling of the Secondary Settling Pond in October 2016, and bis(2-ethylhexyl)phthalate was not detected. Therefore, the fish ingestion pathway was not evaluated further in this risk evaluation.

4.2 Exposure Pathways

The exposure pathways and the associated exposure medium identified for the receptors at the Site are described below by receptor. **Figure 4** summarizes the EPCSM for the recreational use evaluation:

- Child and adult recreational users:
 - o Exposure to soil through incidental ingestion and dermal contact;
 - o Exposure to soil through inhalation of particulates in ambient air; and
 - o Exposure to sediment and surface water through incidental ingestion and direct contact while wading in ponds and wetland features.
- Adolescent trespassers:
 - o Exposure to soil through incidental ingestion and dermal contact;
 - o Exposure to soil through inhalation of particulates in ambient air; and
 - o Exposure to sediment and surface water through incidental ingestion and direct contact while swimming in ponds.
- Adult dog walkers:
 - o Exposure to soil through incidental ingestion and dermal contact while walking their dog; and
 - o Exposure to soil through inhalation of particulates in ambient air while walking their dog.

5 DEVELOPMENT OF RECREATIONAL CRITERIA

Recreational criteria were calculated for soil (direct contact and particulate soil inhalation), sediment (direct contact), and surface water (direct contact) based on the Site-specific exposure scenarios identified above. The approach and exposure parameters were approved by an MDEQ toxicologist.

The MDEQ soil equations presented in the draft Part 201 Rules were used to calculate Site-specific recreational criteria for soil and sediment direct contact (incidental ingestion and dermal contact) and soil particulate inhalation. The USEPA Regional Screening Level equations (USEPA 2017b) were used to calculate Site-specific recreational surface water criteria for direct contact (incidental ingestion and dermal contact). The equations and input parameters used to calculate the Site-specific soil and sediment DCC, soil PSIC, and surface water criteria (SWC) are shown in **Table 1**, **Table 2**, and **Table 3**, respectively.

Because MDEQ does not have generic criteria for a recreational scenario, a combination of Site-specific and MDEQ's default exposure parameters was used to develop Site-specific recreational criteria based on an RME scenario. Default MDEQ exposure parameters (MDEQ 2016c) such as target risk and hazard levels, residential exposure durations and averaging times, age-averaged body weights, and skin surface areas were used, where appropriate, as these parameters are considered best available information. Site-specific exposure parameters such as exposure frequency, exposure time, ingestion rates, and adherence factors were obtained from the USEPA's Regional Screening Levels User's Guide (USEPA 2017b), USEPA's Exposure Factors Handbook (USEPA 2011), the Virginia Department of Environmental Quality (VDEQ) Risk Assessment Guidance (VDEQ 2016), and other sources, as cited in **Table 1** through **Table 3**. These parameters were evaluated for appropriateness to Site conditions. The rationale for select exposure parameters, as requested by the MDEQ, is provided in the memo in **Appendix A**.

Table 4 provides chemical-specific, MDEQ default (MDEQ 2016c) relative source contribution (RSC) factors for soil, water, and air; MDEQ default (MDEQ 2016c) oral and dermal absorption efficiencies (AE_i and AE_d , respectively); and the USEPA default dermal absorption parameters for water, obtained from the Chemical Specific Parameters Table in the RSL tables (USEPA 2017a).

Table 5 provides the chemical-specific toxicity values that were used in the recreational criteria development. These values were obtained from the draft Part 201 Rules (MDEQ 2016c)⁷. **Table 5** also indicates if each COPC is a developmental or reproductive toxicant, or carcinogenic by a mutagenic mode of action. Additional information is provided for the developmental and reproductive toxicants in **Section 5.1.1** below.

Table 6 provides the soil volatilization factors (VFs) for volatile COPCs. The finite-source VFs for a 5-meter source thickness were calculated with modeled flux values provided by MDEQ using the EMSOFT model.

Recreational risk-based values were calculated for each receptor and medium/pathway based on cancer endpoints (including through a mutagenic mode of action, if applicable), non-cancer endpoints, and developmental or reproductive endpoints (if applicable). The recreational criterion for each receptor and medium/pathway is the minimum of the carcinogenic, non-cancer, and developmental/reproductive

⁷ The benzo(a)pyrene toxicity values used are the final toxicity values from the USEPA's Integrated Risk Information System (IRIS; USEPA 2017c).

health-based values (HBVs). The calculated recreational criteria are presented in **Tables 7 through 19** as follows:

- **Table 7:** Soil DCC for recreational users
- **Table 8:** Soil DCC for adolescent trespassers
- **Table 9:** Soil DCC for adult dog walkers
- **Table 10:** PSIC for recreational users
- **Table 11:** PSIC for adolescent trespassers
- **Table 12:** PSIC for adult dog walkers
- **Table 13:** VSIC for recreational users
- **Table 14:** VSIC for adolescent trespassers
- **Table 15:** VSIC for adult dog walkers
- **Table 16:** Sediment DCC for recreational users
- **Table 17:** Sediment DCC for adolescent trespassers
- **Table 18:** SWC for recreational users
- **Table 19:** SWC for adolescent trespassers.

The recreational criterion for each receptor and medium/pathway are summarized in **Table 20**. The calculated recreational user criteria is the basis for the final recreational criteria for all Site receptors as the calculated values were the minimum criteria between recreational users, trespassers, and adult dog walkers. The recreational DCC for vanadium, 26,500 µg/kg, is below the draft Part 201 Statewide Default Background Level for vanadium of 27,000 µg/kg. Therefore, the recreational DCC for vanadium was set at the draft Part 201 Statewide Default Background Level.

5.1 Special Considerations

5.1.1 Developmental and Reproductive Toxicants

The MDEQ, in the draft Part 201 Rules (MDEQ 2016c), has identified constituents which are developmental and/or reproductive toxicants and are evaluated differently to be protective of sensitive receptors, including children and pregnant women. Developmental and reproductive toxicants have been categorized as either full term (FT) or single exposure (SE). The most sensitive receptor for direct contact exposures is a child, whereas the most sensitive receptor for inhalation exposures is a pregnant woman. MDEQ (2016c) has developed separate criteria equations and exposure parameters for developmental and reproductive toxicants. This evaluation uses the equations provided in the draft Part 201 Rules (MDEQ 2016c) to calculate soil and sediment recreational criteria, and has adapted the USEPA equations for surface water accordingly. Developmental and reproductive toxicants identified as COPCs at the Site include:

- Seven cPAHs (soil and sediment direct contact),
- Four Aroclors (soil and sediment direct contact),
- Dioxins and furans (soil and sediment direct contact), and
- Cyanide (surface water).

5.1.2 Carcinogenic Polycyclic Aromatic Hydrocarbons

The draft Part 201 Rules (MDEQ 2016bc) indicate that for the direct contact pathway, the cPAHs should be evaluated based on the benzo(a)pyrene TEQ, meaning that the seven cPAHs are adjusted by the benzo(a)pyrene TEFs, provided in footnote Q of the draft Part 201 Rules, and summed together for a total benzo(a)pyrene TEQ. Following this guidance, soil and sediment recreational DCC were calculated for benzo(a)pyrene TEQs only. The maximum detected concentrations of the individual cPAHs did not exceed the draft Part 201 generic residential PSIC for a 400-acre source size; therefore, recreational PSIC were not calculated for the cPAHs. The soil and sediment data for the seven cPAHs were adjusted by the benzo(a)pyrene TEFs and summed for comparison of the benzo(a)pyrene TEQ to the soil and sediment recreational DCC. Non-detected results were treated as detections at ½ the reporting limits; however, if all seven cPAHs were not detected in a sample, the benzo(a)pyrene TEQ for that sample was also treated as a non-detect. The comparison of the benzo(a)pyrene TEQ for soil and sediment is discussed in **Section 6**.

5.1.3 Dioxins and Furans

The draft Part 201 Rules (MDEQ 2016c) indicate that dioxin-like constituents (e.g., dioxins, furans, and 12 coplanar PCB congeners) shall be adjusted by their TEFs (provided in footnote O of the draft Part 201 Rules), summed together, and compared to the criteria for 2,3,7,8-TCDD. Following this guidance, Site-specific recreational soil and sediment DCC were only calculated for 2,3,7,8-TCDD. Data for dioxins and furans were adjusted by their TEF, summed, and compared to these criteria. However, soil and sediment samples have not been analyzed for coplanar PCB congeners. This potential data gap is discussed in **Section 6**.

5.1.4 Soil Maximum Ceiling Concentration Versus Risk-Based Criteria

The proposed draft Part 201 Rules (MDEQ 2016c) include a maximum ceiling concentration of 100,000,000 µg/kg (10%) for any constituent in soil⁸. However, MDEQ does not provide a basis for establishing the ceiling concentration. Iron was the only constituent analyzed at the Site that was detected at concentrations exceeding this maximum ceiling concentration. The maximum detected concentrations of iron at SMI and GPL were equal to the maximum ceiling concentration (100,000,000 µg/kg), while the detected concentrations of iron in 14 samples collected on Peninsula (**Figure 5**) exceeded the maximum ceiling concentration. It should be noted that soil boring logs from various locations advanced on the Peninsula property indicated that brick fragments, cinders, and concrete fragments were present. In addition, an iron fragment and a steel bolt were present in soil boring SB98-120 within the top 2 feet.

The calculated risk-based criteria for iron⁹ (minimum of 3,890,000,000 µg/kg) are higher than the maximum ceiling concentration due to the much lower potential for exposure under the Site-specific scenarios evaluated. The maximum detected concentration of iron in soil at Peninsula was 270,000,000

⁸ The currently promulgated Part 201 Rules do not include this maximum ceiling concentration.

⁹ The calculated Site-specific recreational criteria for other COPCs also exceeded the maximum ceiling concentration of 100,000,000 µg/kg; however, the maximum detected concentrations of the other COPCs were below the maximum ceiling concentration.

µg/kg, which is over an order of magnitude below the minimum risk-based criterion. The 95% UCL of the mean is 66,900,000 µg/kg for surface soil and 87,000,000 µg/kg for the soil column.

5.2 Lead

Lead was identified as a COPC in soil and surface water. The following sections describe the process used to develop Site-specific recreational soil criteria for lead and provide a semi-quantitative evaluation for exposure to lead in surface water. According to the Agency for Toxic Substances and Disease Registry (2017), dermal exposure to lead is “not considered to be a significant pathway for the general population.” Therefore, this evaluation focuses on potential exposure to lead in soil through incidental ingestion and inhalation of particulates in ambient air, and lead in surface water through incidental ingestion.

5.2.1 Soil

A Site-specific soil DCC for lead was developed for child recreational users¹⁰ following USEPA guidance for lead, including the USEPA’s IEUBK Model for Lead in Children (USEPA 1994, 2007) and the USEPA’s *Assessing Intermittent or Variable Exposures at Lead Sites* (USEPA 2003). The IEUBK Model accounts for exposure to lead in soil and other media, including indoor dust, particulates in ambient air, drinking water, and food. The intermittent lead guidance recommends a time-weighted average approach to evaluate lead at sites such as day cares or recreational areas, where exposure may be intermittent. The time-weighted average, calculated using Equation 5-1 below, accounts for exposures both at the Site and at other offsite locations such as a residence.

Equation 5-1:
$$PbS_w = (PbS_{site} \times f_{site}) + (PbS_{other} \times f_{other})$$

Where:

PbS_w = Target time-weighted average lead concentration in soil (µg/kg)

PbS_{site} = Target lead concentration for the Site (µg/kg)

f_{site} = Fraction of time spent at the Site (unitless)

PbS_{other} = Average lead concentration in soil at other (offsite) locations (µg/kg)

f_{other} = Fraction of time spent in other (offsite) locations (unitless)

As part of the draft Part 201 criteria, MDEQ (2016b) has developed a draft residential soil DCC for lead of 190,000 micrograms per kilogram (µg/kg) using the USEPA’s IEUBK Model and an updated target blood lead (PbB) concentration of 5 micrograms per deciliter (µg/dL). In addition to the updated target PbB, the MDEQ has adopted changes to other exposure parameters used in the IEUBK¹¹. This draft residential

¹⁰ Child receptors are the most sensitive population for exposure to lead, and the Site-specific soil DCC for child recreational users will be protective of other potential receptors at the Site. Therefore, recreational lead DCC were not calculated for adult recreational users, adolescent trespassers, or adult dog walkers.

¹¹ The MDEQ’s proposed exposure parameters were provided to Arcadis by Dr. Divinia Ries of the MDEQ, and are included in Appendix E. The state-wide air concentration for lead of 0.01 micrograms per

DCC accounts for exposure to impacted soil and other media, including ambient air, food and drinking water, on a daily basis between the ages of 6 and 84 months (7 years). Therefore, this default residential DCC was chosen as the target time-weighted average lead concentration in soil (PbS_W).

As approved by MDEQ, the average lead concentration in soil at other (offsite) locations was set at the proposed MDEQ Statewide Default Background Level of 11,000 µg/kg.

The fraction of time spent at the Site (f_{site}) and the resulting fraction of time spent in other locations (i.e., offsite) were calculated based on the Site-specific exposure parameters for the recreational scenario, specifically the exposure frequency of 75 days per year and more conservative exposure time of 8 hours per day for lead. Equation 5-2, below, was used to calculate the f_{site} values. The f_{other} values were calculated as 1 minus f_{site} ($1-f_{site}$).

$$\text{Equation 5-2: } f_{site} = \frac{\text{Waking hours at Site}}{\text{Total waking hours}} = \frac{75 \text{ days/year} \times 8 \text{ hours/day}}{365 \text{ days/year} \times 16 \text{ hours/day}} = 0.10$$

Based on the above calculations of f_{site} , the f_{other} is calculated to be 0.90.

The recreational soil DCC for lead is then calculated by solving Equation 5-1 above for the target average lead concentration at the Site (PbS_{site}) using Equation 5-3 below.

$$\text{Equation 5-3: } PbS_{site} = \frac{(PbS_W - [PbS_{other} \times f_{other}])}{f_{site}}$$

The recreational soil DCC for lead based on the conservative scenario is 1,750,000 (1.75E+6) µg/kg. Soil data collected at the Site were compared to this recreational soil DCC. Consistent with USEPA guidance (USEPA 2007) and with approval by MDEQ, average fine fraction lead concentrations were used to evaluate recreational exposures to lead, as discussed in **Section 6.1.3**.

5.2.2 Surface Water Exposure

Due to the low exposure frequency assumption for surface water exposure, Site-specific criteria for lead were not developed. However, a comparison of the estimated annual intake of lead from surface water for recreational users and trespasser during recreational exposure to an estimated annual intake of lead from drinking water under a residential scenario was used to evaluate the relative magnitude of exposure from ingestion of surface water at the Site.

An estimated annual intake of lead from water (surface water or drinking water) can be calculated by multiplying the ingestion rate of water (IR_W) by the exposure frequency (EF) and the concentration of lead in the water (Pb_W), as shown in Equation 5-5.

$$\text{Equation 5-5: } \text{Intake} = IR_W \times EF \times Pb_W$$

cubic meter (µg/m³) is consistent with area-specific 3-month average lead concentrations for monitoring stations in Grand Rapids, Allen Park, and Dearborn, Michigan, which range from 0.00 to 0.02 µg/m³ (MDEQ 2017). Therefore, the default air concentration of 0.01 µg/m³ can also be considered an area-specific value.

The following table summarizes estimated annual lead intakes for a child recreational user, an adolescent trespasser, and a child resident, and compares the estimated annual lead intakes for child recreational users and adolescent trespassers to that of a child resident.

Receptor	Ingestion Rate	Exposure Frequency	Lead Concentration in Water	Annual Lead Intake	Percent of Child Resident
	(L/day)	(days/year)	(µg/L)	(µg/year)	(%)
Child Recreational User	0.0037	32	5.78	0.68	0.25
Adolescent Trespasser	0.05	21	5.78	6.1	2.2
Child Resident	0.78	350	1.0	273	--

As shown in the table above, the estimated annual intake of lead from exposure to surface water at the Site for recreational users is approximately 0.25 percent of the residential annual intake from drinking water, while the estimated annual intake of lead from exposure to surface water at the Site for trespassers is approximately 2 percent of the residential annual intake from drinking water. Based on this evaluation, exposure to lead in surface water is not expected to be a concern for recreational users or trespassers, as incidental ingestion of lead in surface water from the Site does not contribute significantly to an expected annual intake for children.

6 COMPARISON OF DATA TO RECREATIONAL CRITERIA AND DISCUSSION OF RESULTS

Detected concentrations of the COPCs were compared to the minimum calculated recreational criterion for each receptor in each medium. **Table 21** shows the maximum detected concentration for each COPC in each of the three properties evaluated (SMI, GPL and Peninsula) compared to the minimum calculated recreational criterion for each receptor. As shown in **Table 21**, the maximum concentrations of Aroclors 1242 and 1254, copper, lead, and vanadium in soil at SMI; dioxins and furans and vanadium in soil at GPL; cobalt, lead, manganese, and vanadium in soil at Peninsula; and copper and vanadium in sediment exceeded the minimum recreational criterion for one or more receptors. The maximum detected concentrations in soil did not exceed the calculated recreational PSIC. Concentrations of ethylbenzene, mercury, naphthalene, and phenanthrene in vadose zone soil did not exceed the recreational VSIC-5m for a 400-acre source area.

Table 22 provides a summary of soil exceedances at SMI, GPL, and Peninsula and provides additional information such as present or planned engineering controls and deed restrictions. It should be noted that while concentrations of iron exceeded the maximum ceiling concentration of 100,000,000 µg/kg, the risk-based recreational criteria for iron were greater than 1,000,000,000 µg/kg. Based on the considerations discussed in 5.1.4, exposure to concentrations of iron observed at the Site is not a concern for recreational use of the Site.

Table 23 provides a summary of the COPC concentrations in sediment compared to the sediment recreational criteria.

It should be noted that the maximum calculated benzo(a)pyrene TEQs for soil and sediment did not exceed the soil or sediment recreational DCC for benzo(a)pyrene TEQ. The calculations of the benzo(a)pyrene TEQ in soil for each of the three properties and sediment samples are provided in **Appendix C**.

The following sections provide a detailed evaluation of the constituents whose concentrations exceed the recreational criteria. Where applicable and appropriate, 95 percent upper confidence limits on the mean (95% UCLs) using USEPA's ProUCL version 5.1.00 (USEPA 2015) or average concentrations (lead only) were used for comparison to the Site-specific criteria.

6.1 Discussion of Soil at SMI

Concentrations of PCBs, copper, lead, and vanadium in soil at SMI exceeded the recreational DCC. Locations of exceedances are shown on **Figure 6** through **Figure 8**. Following is a discussion of the exceedances.

6.1.1 Polychlorinated Biphenyls

Extensive Site characterization activities and soil and concrete excavation activities have been completed by GHD on SMI in the I27.7 Manhole Area and the Former Melting Department Area, which are located in the former plant footprint (see **Figure 2**). Concrete and soil excavation have been completed at SMI, and although some PCBs remain, the concentrations are below applicable risk-based criteria or exposure barriers will be placed to prevent exposure to the impacts. The integrity of this exposure barrier will be ensured through an inspection and maintenance process and the DRC that will be recorded for SMI. Therefore, the PCB exceedances of the recreational DCC are not a concern for future use of the Site for recreational purposes.

Aroclor 1254 in soil at SMI exceeded the recreational VSIC-5m for a 400-acre source area of 712,000 µg/kg; however, according to the approved PCB work plan (CRA 2015), soil with total PCB concentrations greater than 100,000 µg/kg at depths of up to 5 ft bgs were excavated and disposed of offsite. Floor confirmation samples showed two locations where the total PCB concentrations were greater than 400,000 µg/kg; but less than the recreational VSIC of 712,000 µg/kg. Based on depth to water during the excavation activities, groundwater in this area is very shallow (less than 1 foot below the concrete). Therefore, remaining concentrations of PCBs in the vadose zone soil are less than the recreational VSIC of 712,000 µg/kg for Aroclors and are not a concern for future recreational use of the Site.

6.1.2 Copper

The concentration of copper in one sample (SB-363 at 4-6 ft bgs, [approximate sample elevation of 586 to 588 ft above mean sea level [amsl]]) exceeded the recreational DCC of 5,560,000 µg/kg (**Figure 6**). This sample is located in the Southwest Plant LNAPL Area and is below the water table. Therefore, there is little to no practical likelihood of exposure to this soil. In addition, as part of the remedial strategy for LNAPL present in this area, an exposure barrier will be constructed and the integrity of this exposure barrier will be ensured through an inspection and maintenance process and the DRC that will be recorded

for SMI. Therefore, the exceedance of the recreational DCC for copper in soil at SMI is not a concern for future recreational use of the Site.

6.1.3 Lead

Measured or estimated fine fraction lead was present at concentrations exceeding the recreational DCC (1,750,000 [1.75E+6] µg/kg) in six samples at SMI (**Table E-4** in **Appendix E** and **Figure 7**). The exceedances were located at:

- Soil borings SB-362 (0-2 ft bgs, surface elevation of approximately 592 ft amsl) and SB-363 (0-2 and 4-6 ft bgs, sample elevations of approximately 590 to 592 and 586 to 588 ft amsl) in the Southwest Plant LNAPL Area, which, as discussed above, has an exposure barrier. These samples were not fractionated; therefore, the fine fraction results were estimated.
- Historical soil borings RS-2-5 (0-1 ft bgs, surface elevation of approximately 597 ft amsl) and RS-2-6 (0-1 ft bgs, surface elevation of approximately 598 ft amsl) in the Former Railyard Area. These samples were not fractionated; therefore, the fine fraction results were estimated.
- New soil boring SB-17-25 (0-0.5 ft bgs, surface elevation of approximately 597 ft amsl) in the Former Railyard Area. The fine fraction lead results for this sample was measured by the laboratory.

Based on the historical data available in the Former Railyard Area, additional lead delineation and fractionated analysis was completed in July and August 2017. Two surface soil samples each were collected from 0-0.5 ft bgs in the immediate vicinity of both RS-2-5 (soil borings SB-17-23 and SB-17-29) and RS-2-6 (soil borings SB-17-22 and SB-17-28). These four 2017 surface soil samples were analyzed for total lead, fine fraction lead, and coarse fraction lead. The analyzed fine fraction lead results in these four samples, which ranged from 37,000 µg/kg to 460,000 µg/kg, did not exceed the recreational DCC of 1,750,000 (1.75E+6) µg/kg. Based on the analyzed fine fraction lead results, the historical exceedances of estimated fine fraction lead may be considered a hot spot area, and further evaluation will be completed to analyze surface soil samples for fine fraction lead and determine if this area is a hot spot area. The average lead concentration for the Former Railyard Area, approximately 412,000 µg/kg, was compared to the recreational DCC of 1,750,000 (1.75E+6) µg/kg. Based on this evaluation, lead in soil is not a concern for future recreational use of the Former Railyard Area.

In addition, the average fine fraction lead concentration for SMI (calculated to be approximately 185,000 µg/kg) is well below the recreational DCC of 1,750,000 (1.75E+6) µg/kg. Based on this evaluation, lead in soil is not a concern for future recreational use of SMI. The data used to calculate the average fine fraction lead concentrations for the Former Railyard Area and SMI are provided in **Appendix E, Table E-4**.

6.1.4 Vanadium

Vanadium was detected at concentrations exceeding the recreational DCC of 27,000 µg/kg in 18 soil sample locations spread across SMI, ranging from the surface to 14 feet bgs (or from approximately 578 to 592 ft amsl) (**Figure 8**). The maximum detected concentration of vanadium at SMI was 45,000 µg/kg, less than two times the recreational soil DCC. Because the exceedances were distributed across SMI and the maximum concentration of vanadium was relatively low, indicating the absence of “hot spots”, the 95% UCL of approximately 17,000 µg/kg was compared to the recreational criteria. The calculated 95%

UCL does not exceed the recreational DCC; therefore, vanadium in soil at SMI is not a concern for future recreational users exposed to soil. The data used to calculate the 95% UCL and the ProUCL output sheets are provided in **Appendix I**.

6.2 Discussion of Soil at GPL

6.2.1 Dioxins and Furans

Extensive sampling programs conducted show the presence of dioxin and furan compounds throughout the flood plains and river sediments of the Tittabawassee and Saginaw Rivers that trace from the Dow plant located in Midland Michigan; this documentation was identified on the MDEQ website located at the MDEQ Dioxin Information - Midland Area Soils Corrective Action document archive website: (http://www.michigan.gov/deq/0,4561,7-135-3307_29693_21234-271213--,00.html). Dow has also completed significant remediation of dioxin impacted soil and sediment along the Tittabawassee River and there are plans for further remediation including at and in the vicinity of the Site. Various soil and sediment samples collected at the Site have been analyzed for dioxins and furans, with a focus on areas in the 100-year flood plain. The maximum 2,3,7,8-TCDD TEQ concentration at GPL was 7.3 µg/kg from samples collected by MDEQ in vicinity of the wetland mitigation area on the Eastern Property Extension portion of GPL. This exceeds the recreational DCC of 2.25 µg/kg¹². Five samples were collected in December 2000 by MDEQ in this area, with concentrations ranging from 0.34 µg/kg to 7.3 µg/kg. Available information for these samples does not provide exact sample locations with sample identification labels or the laboratory analytical reports to confirm correct conversion to 2,3,7,8-TCDD TEQs. The information available is provided in **Appendix D**.

In addition, various samples have been analyzed for several of the Aroclors, but have not been analyzed for the 12 coplanar PCB congeners, which may act like dioxins and furans. The lack of dioxin-like coplanar PCB congener data produces some uncertainty in the results of this evaluation and it may represent a potential data gap. However, the MDEQ *Phase II Tittabawassee/Saginaw River Dioxin Flood Plain Sampling Study* stated that there is an insignificant contribution of the total dioxin-like toxicity from coplanar PCB compounds found in connection with dioxin flood plain impacts originating from Dow. (MDEQ 2003).

In order to evaluate the potential contribution of the 12 dioxin-like coplanar PCB congeners to the overall 2,3,7,8-TCDD TEQ, the average percent contribution (by weight) of each of the 12 congeners reported for the four Aroclor mixtures detected at the Site (Aroclors 1242, 1248, 1254, and 1260) was obtained from the ATSDR's *Toxicological Profile for Polychlorinated Biphenyls (PCBs)* (ATSDR 2000). The average percent composition was multiplied by the maximum detected concentration of each Aroclor to estimate the potential maximum concentration of each of the 12 dioxin-like coplanar PCB congeners. The maximum estimated concentrations of the dioxin-like coplanar PCB congeners were then adjusted by their TEFs, and summed to obtain an estimated contribution to the 2,3,7,8-TCDD TEQ. **Table H-1** in **Appendix H** provides the TEF for the 12 coplanar PCB congeners; the average estimated weight percent

¹² The MDEQ and USEPA have identified a Site-specific floodplain soil response action criterion of 2,000 parts per trillion (or 2 µg/kg) for non-residential land uses.

contribution of the 12 coplanar PCB congeners in the four Aroclors detected at GPL¹³; and the calculated 2,3,7,8-TCDD TEQ based on the maximum detected concentrations in soil and sediment for each of the four PCB Aroclors at GPL. As shown in **Table H-1**, the maximum contribution of 2,3,7,8-TCDD TEQ from the PCB Aroclors detected in soil at GPL was 0.0334 µg/kg, and in sediment was 0.0362 µg/kg. As shown in **Table 21**, the maximum 2,3,7,8-TCDD TEQ based on detected dioxins and furans was 7.3 µg/kg in soil at GPL. The addition of the estimated 2,3,7,8-TCDD TEQ contribution from the dioxin-like coplanar PCBs present in the Aroclors increases the estimated 2,3,7,8-TCDD TEQ to 7.33 µg/kg, which is above the recreational DCC for soil of 2.25 µg/kg, indicating that dioxins and furans are a potential concern for future recreational users exposed to soil in this area of the Site.

The maximum 2,3,7,8-TCDD TEQ for sediment was 0.65 µg/kg. The addition of the estimated 2,3,7,8-TCDD TEQ due to the contribution of the coplanar dioxin-like PCBs from sediment increases the estimated 2,3,7,8-TCDD TEQ to 0.686 µg/kg, which is below the sediment recreational DCC of 0.748 µg/kg, indicating that dioxins and furans are not a concern for sediments based on a future recreational use of the Site.

As previously discussed, dioxins and furans are present in the Saginaw River floodplain as a result of periodic flooding of the river due to upstream contamination from Dow. From discussions with MDEQ it is understood that in accordance with Dow's commitment to MDEQ and USEPA, Dow will address this area within the next few years. RACER is not responsible for cleanup of dioxins and furans in the floodplain. The exceedances of the recreational DCC indicate that appropriate Due Care be taken in this area.

6.2.2 Vanadium

Vanadium was detected at concentrations exceeding the recreational DCC of 27,000 µg/kg in four soil sample locations spread across GPL, ranging from the surface to 16 feet bgs (or from approximately 574 to 590 ft amsl) (**Figure 9**). The maximum detected concentration of vanadium at GPL was 34,100 µg/kg, less than two times the recreational soil DCC. Because the exceedances were distributed across GPL and the maximum concentration of vanadium was relatively low, indicating the absence of "hot spots", the 95% UCL of approximately 15,800 µg/kg was compared to the recreational DCC. The calculated 95% UCL does not exceed the recreational DCC; therefore, vanadium in soil at GPL is not a concern for future recreational users exposed to soil. The data used to calculate the 95% UCL and the ProUCL output sheets are provided in **Appendix I**.

¹³ Although Aroclors 1242, 1248, 1254, and 1260 have been detected in soil at SMI, the majority of the PCB samples have been collected in the footprint of the former plant, where PCBs were known to have been used and elevated concentrations have been detected. This area has been well-characterized and extensive remediation has been completed, including excavation of impacted concrete and underlying soils, placement of clean fill, and replacement of concrete that was removed. As part of the final remedy for this area, 1 foot of clean soil was placed on top of the concrete slab and the soil cover will be maintained to eliminate the potential for exposure to PCBs. Therefore, dioxin-like PCBs in soil were not evaluated at SMI.

6.3 Discussion of Soil at Peninsula

Concentrations of cobalt, manganese, vanadium, and lead in surface soil at Peninsula exceeded the recreational soil DCC. Locations of exceedances are shown on **Figure 10** through **Figure 13**. Following is a discussion of the exceedances. Based on the presence of these COPCs in surface soil, the potential for direct contact exposure exists and exceedances require further evaluation.

6.3.1 Cobalt

The concentration of cobalt in one surface soil sample (3,940,000 [3.94E+6] µg/kg at SB10-125 0-2 ft bgs) on Peninsula exceeded the recreational soil DCC of 1,670,000 (1.67E+6) µg/kg (**Figure 10**). Because there was only one exceedance of the recreational DCC and no hot spots were identified, the 95% UCL of approximately 336,000 µg/kg was compared to the recreational soil DCC. The calculated 95% UCL does not exceed the recreational soil DCC; therefore, cobalt in soil at Peninsula is not a concern for future recreational users exposed to soil. The data used to calculate the 95% UCL and the ProUCL output sheets are provided in **Appendix I**.

6.3.2 Manganese

The concentration of manganese in one surface soil sample (27,700,000 [2.77E+7] µg/kg at SB10-154 0-2 ft bgs) on Peninsula exceeded the recreational soil DCC of 26,700,000 (2.67E+7) µg/kg (**Figure 11**). Because there was only one exceedance of the recreational DCC and no hot spots were identified, the 95% UCL of approximately 10,100,000 (1.01E+7) µg/kg was compared to the recreational DCC. The calculated 95% UCL does not exceed the recreational soil DCC; therefore, manganese in soil at Peninsula is not a concern for future recreational users exposed to soil. The data used to calculate the 95% UCL and the ProUCL output sheets are provided in **Appendix I**.

6.3.3 Vanadium

The concentration of vanadium in seven surface soil samples at Peninsula exceeded the recreational soil DCC, as shown on **Figure 12**. The maximum detected concentration was 72,300 µg/kg, which is less than three times the recreational soil DCC of 27,000 µg/kg. The distribution of exceedances across Peninsula and the relatively low magnitude of the exceedances suggest that hot spots are not present for vanadium at Peninsula. Therefore, the 95% UCL of approximately 20,500 µg/kg was compared to the recreational DCC. The 95% UCL does not exceed the recreational DCC for vanadium; therefore, vanadium in soil at Peninsula is not a concern for future recreational uses of the property. The data used to calculate the 95% UCL and the ProUCL output sheets are provided in **Appendix I**.

6.3.4 Lead

The measured or estimated fine fraction lead concentration in eight samples collected at the Peninsula exceeded the recreational soil DCC of 1,750,000 (1.75E+6) µg/kg (**Table E-5 of Appendix E**). As shown on **Figure 13**, four samples (SB10-104, SB10-113, SB10-114, and SB10-119) are located under soil exposure barriers, where the top 6 inches of soil were excavated, a geotextile barrier was placed, and 6 inches of clean fill was placed on top of the geotextile barrier. Three additional samples (SB15-01, SB15-12 and SB15-13) are located adjacent to the larger southwest excavated area with the soil barrier. The

remaining sample (SB10-153, an estimated result) is located on the southern portion of the Peninsula property near the eastern property boundary, and appears to be an isolated occurrence based on an evaluation of adjacent samples that were analyzed for fine fraction lead. Based on the close proximity of six of the samples exceeding the recreational DCC (SB10-113, SB10-114, SB10-119, SB15-01, SB15-12, and SB15-13), this area has been identified as a hot spot, and these locations were not included in the average lead concentration for the Peninsula property. Additional discussion of the hot spot area is presented below.

The average fine fraction lead concentration at the Peninsula property excluding the samples located under an exposure barrier or in the hot spot area is approximately 369,000 µg/kg, which is well below the recreational soil DCC of 1,750,000 (1.75E+6) µg/kg¹⁴. Therefore, lead concentrations in soil at Peninsula at locations not currently under an exposure barrier or within the hot spot area are not a concern for future recreational use at the Peninsula property.

Due to their close proximity and detected concentrations above the recreational soil DCC for lead, sample locations SB10-113, SB10-114, SB10-119, SB15-01, SB15-12, and SB15-13 were identified as a hot spot. Samples SB10-113, SB10-114, and SB10-119 are already located beneath an exposure barrier. Based on the results of this evaluation, and the identification of the hot spot, RACER will evaluate remedial alternatives to reduce potential exposure to lead at SB15-01, SB15-12, and SB15-13.

6.3.5 Iron

Concentrations of iron in 14 samples collected on the Peninsula property (**Figure 5**) exceeded the maximum ceiling concentration (100,000,000 [1.00E+8] µg/kg), but did not exceed the recreational DCC of 3,890,000,000 (3.89E+9) µg/kg. Three of the samples that exceed the maximum ceiling concentration were collected at depths greater than 0.5 ft bgs, while 10 of the samples were collected from the surface (sample depth starting at 0 ft bgs). One sample was collected from a location that is now under an exposure barrier. Because the anticipated future use of the Site is expected to be similar throughout the Peninsula property (e.g., passive recreational activities), 95% UCLs were calculated for the whole Peninsula property, accounting for surface soil (samples with a starting depth of 0 ft bgs), and the soil column. The calculated 95% UCL for surface soil was approximately 66,900,000 (6.69E+7) µg/kg, and the 95% UCL for the soil column was 87,100,000 (8.71E+7) µg/kg. Both the surface soil and soil column 95% UCLs are below the maximum ceiling concentration and well below the recreational DCC. Because the recreational DCC are based on conservative assumptions that represent a reasonable maximum exposure scenario, the detected concentrations at the Peninsula property, which are well below the recreational DCC, do not represent a risk for potential future recreational users at the Site. The data used to calculate the 95% UCL and the ProUCL output are provided in **Appendix I**.

6.4 Discussion of Sediment Data

Concentrations of copper and vanadium in sediment exceeded the recreational sediment DCC at one and three locations, respectively, as shown on **Figure 14** and summarized in **Table 23**. The detected

¹⁴ The average estimated fine fraction lead concentration including the uncovered hot spot areas is approximately 482,000 µg/kg, while the average estimated fine fraction lead concentration including all remaining samples at the Peninsula property is approximately 738,000 µg/kg.

concentrations of copper in the parent and duplicate samples collected at SD-62 at 0-0.5' (1,140,000 [1.14E+6] µg/kg and 1,170,000 [1.17E+6] µg/kg, respectively) were slightly above the recreational sediment DCC of 1,110,000 (1.10E+6) µg/kg. Concentrations of vanadium in three samples (SD-32 0-1.4' at 36,300 µg/kg, SD-33 0-1.3' at 38,200 µg/kg, and SD-64 at 36,100 µg/kg) were slightly above the recreational sediment DCC of 35,800 µg/kg. Due to the limited number of samples exceeding the recreational sediment DCC and the relatively low magnitude of exceedances, the 95% UCLs for copper and vanadium were calculated and compared to the recreational sediment DCC. The 95% UCLs for copper (approximately 38,500 µg/kg) and vanadium (approximately 16,100 µg/kg) were below the recreational sediment DCC. Therefore, exposure to copper and vanadium in sediment at the Site is not a concern for future recreational users of the Site. The data used to calculate the 95% UCL and the ProUCL output are provided in **Appendix I**.

7 SUMMARY AND CONCLUSIONS

The following sections provide a summary of the recreational use evaluation and conclusions that can be drawn based on this evaluation.

7.1 Summary

Arcadis, on behalf of the RACER Trust, has prepared this Recreational Use Risk Evaluation for the Saginaw Malleable Industrial Land (SMI) Plant property, the former Green Point Landfill (GPL), and the Peninsula Property, located in Saginaw, Michigan (the Site). Historical activities have impacted the Site with various constituents, including metals, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs). The Site is being considered for redevelopment and use as a passive recreational area. Therefore, Arcadis has completed a recreational use evaluation for the Site. The Michigan Department of Environmental Quality's (MDEQ's) project team collaborated in the development of and approved the approach used to complete this risk evaluation.

Exposure to soil, sediment, and surface water was evaluated for potential receptors including child and adult recreational users, adolescent trespassers, and adult dog walkers. Constituents of potential concern (COPCs) were identified for each media through a conservative screen against draft MDEQ Part 201 residential criteria (MDEQ 2016c) and other applicable screening levels. Site-specific recreational criteria were calculated for COPCs using MDEQ and United States Environmental Protection Agency (USEPA) standard equations, along with Site-specific and default exposure parameters. Site-specific recreational lead criteria were calculated using the USEPA's Integrated Exposure Uptake Biokinetic (IEUBK) Model (USEPA 1994, 2007).

Available Site data were compared to the final recreational criteria, and exceedances were further evaluated based on locations of exceedances, current or planned restrictions, and Site- or area-wide exposure point concentrations (i.e., 95 percent upper confidence limits on the mean, or average concentrations [lead only]). Following is a summary of the conclusions that can be made based on the Site-specific recreational use risk evaluation.

7.2 Conclusions

The following conclusions can be drawn based on the recreational use risk evaluation completed for the Site:

- Concentrations of COPCs in sediment and surface water at the Site are not a concern for potential future recreational users wading or adolescent trespassers swimming in surface water bodies at the Site.
- Based on the available surface water data, potential ingestion of fish from the Secondary Settling Pond is not likely a concern for recreational users.
- Concentrations of COPCs in soil are not a concern for potential exposure of potential future recreational users, adolescent trespassers, and adult dog walkers at SMI, GPL, and the Peninsula property (with the exception of dioxins and furans in the floodplain area and lead as discussed below).
- Dioxins and furans are present in the Saginaw River floodplain as a result of periodic flooding of the river due to upstream contamination from Dow. From discussions with MDEQ it is understood that in accordance with Dow's commitment to MDEQ and USEPA, Dow will address this area within the next few years. RACER is not responsible for cleanup of dioxins and furans in the floodplain. The exceedances of the recreational DCC indicate that appropriate Due Care be taken in this area.
- Concentrations of measured or estimated fine fraction lead in the Former Railyard Area indicated the presence of fine fraction lead at concentrations exceeding the recreational direct contact criterion (DCC) of 1,750,000 (1.75E+6) µg/kg; however, the average fine fraction lead concentration of 412,000 µg/kg for the Former Railyard Area does not exceed the recreational DCC. Additional data collection may be conducted in this area to further refine the fine fraction to total lead ratio for the Former Railyard Area.
- Concentrations of measured or estimated fine fraction lead at the Peninsula property indicated the presence of a hot spot in the area of the southwest soil cover area (shown on **Figure 3**). Three of the six samples with elevated fine fraction lead concentrations are located beneath the existing exposure barrier which eliminates the potential for contact; however, three locations with elevated fine fraction lead concentrations (SB15-10, SB15-12 and SB15-13) are located adjacent to this area with the exposure barrier. The detected concentrations of fine fraction lead in these three samples exceeded the recreational DCC of 1,750,000 (1.75E+6) µg/kg. The average estimated fine fraction lead concentration for the Peninsula property, including samples beneath the current soil cover is approximately 738,000 µg/kg, which does not exceed the recreational DCC. As a conservative measure, RACER is evaluating potential corrective measures to determine the most appropriate remedy to eliminate potential exposures above the recreational DCC.

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TABLES



Table 1
Recreational Criteria Equations and Exposure Parameters for Soil and Sediment Direct Contact
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

ENDPOINT-SPECIFIC RECREATIONAL SCREENING LEVELS:

Carcinogenic [source: MDEQ 2016]:

$$(DCVrec)_C = \frac{TR \times AT_C \times CF1}{(CSF_o \times EF_{rec} \times IFs \times ET \times CF2 \times AE_i) + (CSF_d \times EF_{rec} \times DFs \times AE_d)}$$

Mutagenic [source: MDEQ 2016]:

$$(DCVrec)_{C,mut} = \frac{TR \times AT_C \times CF1}{(CSF_o \times EF_{rec} \times IFs_{mut} \times ET \times CF2 \times AE_i) + (CSF_d \times EF_{rec} \times DFs_{mut} \times AE_d)}$$

Non-carcinogenic / Developmental [source: MDEQ 2016]:

$$(DCVrec)_{NC} = \frac{THQ \times AT_{NC} \times BW \times RSC_s \times CF1}{ED \times [(1/RfD_o \times EF_{rec} \times IRs \times ET \times CF2 \times AE_i) + (1/RfD_d \times EF_{rec} \times SAs \times EV \times AFs \times AE_d)]}$$

Ingestion Factor:

$$IFs = \frac{IRs_{child} \times ED_{child}}{BW_{child}} + \frac{IRs_{adult} \times ED_{adult}}{BW_{adult}}$$

$$IFs_{mut} = \frac{IRs_{-2} \times ED_{-2} \times ADAF_{-2}}{BW_{-2}} + \frac{IRs_{2-6} \times ED_{2-6} \times ADAF_{2-6}}{BW_{2-6}} + \frac{IRs_{6-16} \times ED_{6-16} \times ADAF_{6-16}}{BW_{6-16}} + \frac{IRs_{16-32} \times ED_{16-32} \times ADAF_{16-32}}{BW_{16-32}}$$

Dermal Factor:

$$DFs = \frac{SAs_{child} \times EV \times AFs_{child} \times ED_{child}}{BW_{child}} + \frac{SAs_{adult} \times EV \times AFs_{adult} \times ED_{adult}}{BW_{adult}}$$

$$DFs_{mut} = \frac{SAs_{-2} \times EV \times AFs_{-2} \times ED_{-2} \times ADAF_{-2}}{BW_{-2}} + \frac{iAs_{2-6} \times EV \times AFs_{2-6} \times ED_{2-6} \times ADAF_{2-6}}{BW_{2-6}} + \frac{SAs_{6-16} \times EV \times AFs_{6-16} \times ED_{6-16} \times ADAF_{6-16}}{BW_{6-16}} + \frac{SAs_{16-32} \times EV \times AFs_{16-32} \times ED_{16-32} \times ADAF_{16-32}}{BW_{16-32}}$$

Final DCVrec = Minimum DCVrec for all endpoints.

Note: The MDEQ (2016) residential soil direct contact equations were used to calculate recreational criteria. For soil and sediment, the most conservative receptor for developmental endpoints is the child, ages 0 to 6 years old; therefore, equations and exposure parameters are not provided for a pregnant receptor.

Symbol	Parameter	Units	Recreational User																Carcinogenic / Non-cancer / Developmental								Trespasser				Dog Walker			
			Mutagenic																								All endpoints				All Endpoints			
			Infant				Toddler				Adolescent				Adult				Child				Adult				Adolescent				Adult			
			0 to 2 years				2 to 6 years				6 to 16 years				16 to 32 years				0 to 6 years				6 to 32 years				6 to 16 years				26 years			
			value	note		ref	value	note		ref	value	note		ref	value	note		ref	value	note		ref	value	note		ref	value	note		ref				
ADAF	Age-dependent adjustment factor for mutagenic constituents	unitless	10	[a]	--	USEPA 2005	3	[a]	--	USEPA 2005	3	[a]	--	USEPA 2005	1	[a]	--	USEPA 2005	NA				NA				NA				NA			
AE _d	Dermal absorption efficiency	unitless	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016
AE _i	Ingestion absorption efficiency	unitless	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016
AFs (soil)	Soil-to-skin adherence factor	mg/cm²/event	0.2	[c]	U	USEPA 2016	0.2	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016	0.2	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016
AFs (sed)	Sediment-to-skin adherence factor	mg/cm²/event	0.2	[d]	U	RAIS 2016	0.2	[d]	U	RAIS 2016	0.07	[d]	U	RAIS 2016	0.07	[d]	U	RAIS 2016	0.2	[d]	U	RAIS 2016	0.07	[d]	U	RAIS 2016	0.07	[d]	U	RAIS 2016	NA			
AT _C	Averaging time for cancer effects	days	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016
AT _{NC}	Averaging time for non-cancer effects	days	730	[f]	U	MDEQ 2016	1,460	[f]	U	MDEQ 2016	3,650	[f]	U	MDEQ 2016	5,840	[f]	U	MDEQ 2016	2,190	[f]	U	MDEQ 2016	9,490	[f]	U	MDEQ 2016	3,650	[f]	U	MDEQ 2016	9,490	[f]	U	MDEQ 2016
BW	Body weight	kg	9.6	[g]	C	MDEQ 2016	17	[g]	C	MDEQ 2016	44	[g]	C	MDEQ 2016	77	[g]	C	MDEQ 2016	15	[g]	C	MDEQ 2016	80	[g]	C	MDEQ 2016	44	[g]	C	MDEQ 2016	80	[g]	C	MDEQ 2016
CF1	Conversion factor for kilograms to micrograms	µg/kg	1.00E+09		NA		1.00E+09		NA		1.00E+09		NA		1.00E+09		NA		1.00E+09		NA		1.00E+09		NA		1.00E+09		NA		1.00E+09		NA	
CF2	Conversion factor for hours to days	day/hour	0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA	
CSF _d	Cancer slope factor for dermal exposure	(mg/kg-day) ⁻¹	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016
CSF _o	Cancer slope factor for oral exposure	(mg/kg-day) ⁻¹	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016
DCV _{rec}	Direct contact value for soil or sediment, recreational scenario	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U	
(DCV _{rec}) _C	Direct contact value for soil or sediment, cancer	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U	
(DCV _{rec}) _{C,mut}	Direct contact value for soil or sediment, cancer-mutagenic	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U	
(DCV _{rec}) _{NC}	Direct contact value for soil or sediment, non-cancer	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U	
ED	Exposure duration	years	2	[h]	U	MDEQ 2016	4	[h]	U	MDEQ 2016	10	[h]	U	MDEQ 2016	16	[h]	U	MDEQ 2016	6	[h]	U	MDEQ 2016	26	[h]	U	MDEQ 2016	10	[j]	U	PJ	26	[h]	U	MDEQ 2016
EF _d (soil)	Exposure frequency soil, dermal contact	days/year	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	50	[k]	--	PJ	75	[j]	--	PJ
EF _d (sed)	Exposure frequency for sediment, dermal contact	days/year	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	21	[n]	--	PJ	NA			
E _{Fo} (soil)	Exposure frequency soil, ingestion	days/year	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	50	[k]	--	PJ	75	[j]	--	PJ
E _{Fo} (sed)	Exposure frequency for sediment, ingestion	days/year	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	21	[n]	--	PJ	NA			
ET (soil)	Exposure time for soil exposure	hours/day	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[p]	C	VDEQ 2014	0.33	[q]	C	Pedigree.com
ET (sed)	Exposure time for sediment exposure	hours/day	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[s]	C	PJ, RAIS 2016	NA			
EV	Event frequency	events/day	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016
IRs (soil)	Ingestion rate of soil	mg/day	200	[u]	U	USEPA 2016	200	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016	200	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016
IRs (sed)	Ingestion rate of sediment	mg/hour	300	[v]	U	Wilson 2014	300	[v]	U	Wilson 2014	178	[w]	U	Wilson 2014	80	[x]	U	Wilson 2014	300	[v]	U	Wilson 2014	116	[y]	U	Wilson 2014	178	[w]	U	Wilson 2014	NA			
RfD _d	Reference dose for dermal exposure	mg/kg-day	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016
RfD _o	Reference dose for oral exposure	mg/kg-day	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016
RSC _s	Relative source contribution factor	unitless	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016
SAs (soil)	Exposed skin surface area for soil contact	cm²	2,000	[z]	C	MDEQ 2016	2,600	[z]	C	MDEQ 2016	3,700	[z]	C	MDEQ 2016	5,700	[z]	C	MDEQ 2016	2,400	[z]	C	MDEQ 2016	6,000	[z]	C	MDEQ 2016	3,700	[z]	C	MDEQ 2016	6,000	[z]	C	MDEQ 2016
SAs (sed)	Exposed skin surface area for sediment contact	cm²	2,000	[aa]	C	MDEQ 2016	2,600	[aa]	C	MDEQ 2016	4,600	[ab]	C	MDEQ 2016	6,900	[ab]	C	MDEQ 2016	2,400	[aa]	C	MDEQ 2016	6,100	[ab]	C	MDEQ 2016	4,600	[ab]	C	MDEQ 2016	NA			
THQ	Target hazard quotient for non-cancer effects	unitless	1	[ac]	U	MDEQ 2016	1	[ac]	U	MDEQ 2016	1	[ac]	U	MDEQ 2016	1	[ac]	U	MDEQ 2016	1	[ac]	U	MDEQ 2016	1	[ac]	U	MDEQ 2016	1	[ac]	U	MDEQ 2016	1	[ac]	U	MDEQ 2016
TR	Target cancer risk	unitless	1.00E-05	[ac]	U	MDEQ 2016	1.00E-05	[ac]	U	MDEQ 2016	1.00E-05	[ac]	U	MDEQ 2016	1.00E-05	[ac]	U	MDEQ 2016	1.00E-05	[ac]	U	MDEQ 2016	1.00E-05	[ac]	U	MDEQ 2016	1.00E-05	[ac]	U	MDEQ 2016	1.00E-05	[ac]	U	MDEQ 2016

Definitions:

--	unknown	kg	kilogram	mg/kg-day	milligram per kilogram per day	sed	sediment
cm²	square centimeter	mg/cm²/event	milligram per square centimeter per event	(mg/kg-day) ⁻¹	per milligram per kilogram per day	µg/kg	microgram per kilogram
C	central tendency value	mg/day	milligram per day	NA	not applicable	U	upper-end value
CS	constituent-specific	mg/kg	milligram per kilogram	PJ	professional judgement		

Table 1
Recreational Criteria Equations and Exposure Parameters for Soil and Sediment Direct Contact
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

References:	
MDEQ 2016	Michigan Department of Environmental Quality (MDEQ). 2016. Draft Cleanup Criteria Requirements for Response Activity. May 24. Available online at: http://w3.lara.state.mi.us/orr/Files/ORR/1604_2015-094EQ_orr-draft.pdf .
Pedigree.com	Pedigree.com. 2016. "Your Dog's Primal Need to Be Walked." Available online at: http://www.pedigree.com/All-Things-Dog/Article-Library/Your-Dog-s-Primal-Need-to-Be-Walked.aspx . Accessed August 27.
RAIS 2016	The University of Tennessee. 2016. RAIS [The Risk Assessment Information System] Preliminary Remediation Goals (PRGs) for Chemicals User's Guide. Available online at: https://rais.ornl.gov/tools/rais_chemical_pr_g_guide.html .
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USEPA 2016	USEPA. 2016. Regional Screening Levels (RSLs) - User's Guide (May 2016). Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-may-2016 .
VDEQ 2014	Virginia Department of Environmental Quality (VDEQ). 2014. Risk Assessment Guidance.
Wilson 2014	Wilson, R., H. Jones-Otazo, S. Petrovic, M. Roushorne, L. Smith-Munoz, D. Williams, and I. Mitchell. 2014. Estimation of Sediment Ingestion Rates Based on Hand-to-Mouth Contact and Incidental Surface Water Ingestion. <i>Human and Ecological Risk Assessment: An International Journal</i> , 00: 1-14. October 14.

- Notes:
- [a] USEPA default value for specified age group.
 - [b] Value will be obtained from the draft MDEQ Part 201 Rules (MDEQ 2016), if available.
 - [c] Value is the USEPA soil adherence factor for recreational users (USEPA 2016, Table 1. Standard Default Factors).
 - [d] Table 9. Recreator Soil/Sediment Land Use Equation Variables. Adherence factors for soil/sediment exposures.
 - [e] MDEQ (2016) default value. Based on a lifetime of 78 years, expressed in days.
 - [f] Value is the exposure duration, expressed in days.
 - [g] Value is the MDEQ (2016) default body weight for the corresponding age group.
 - [h] Value is the MDEQ (2016) default exposure durations for residential scenarios, as receptors would likely be nearby residents using the park.
 - [i] Trespassers are assumed to be adolescents, ages 6 to 16, for a total of 10 years. It is unlikely that young children would be trespassing at this site.
 - [j] RAIS default value for soil / sediment exposure for the recreational scenario (RAIS 2016, Table 9). Assumed to be spread throughout the year.
 - [k] Trespassers are assumed to be present at the site one day a week for 50 weeks. This is more conservative than other agencies, such as the VDEQ, which assume trespassers are at a site 24 days per year (6 days per month for 4 months).
 - [l] Assumes that nearby residents walk their dog in the park 100 days per year, or 2 days a week. Value accounts for snow cover approximately 3 months of the year.
 - [m] Value is the RAIS (2016) default exposure frequency for soil multiplied by 5/12 to account for warmer months only (May through September). Value is rounded up to the next full day.
 - [n] Value is the trespasser soil exposure frequency for soil multiplied by 5/12 to account for warmer months only (May through September). Value is rounded up to the next full day.
 - [o] Average of mean time spent outdoors at parks from Tables 16-10, 16-82, and 16-84 (USEPA 2011). Value rounded to the nearest hour.
 - [p] Assumes time spent trespassing at the park would be similar to time spent in recreational activities.
 - [q] According to Pedigree.com, "Twenty minutes is a good amount of time to aim for most dogs - even seniors, if they're in good health."
 - [r] Reasonable estimate provided in Table 9 for soil/sediment exposure for recreational scenarios (RAIS 2016). Consistent with one-half of the time spent at the park being spent playing in the sediments.
 - [s] Reasonable estimate provided in Table 9 for soil/sediment exposure for recreational scenarios (RAIS 2016). Consistent with one-half of the time spent at the park being spent playing in the sediments.
 - [t] MDEQ (2016) default value for residential and non-residential scenarios.
 - [u] USEPA (2016) default value for soil ingestion for recreational scenarios.
 - [v] Recommended hourly sediment ingestion rate for 7 months to 4 years.
 - [w] Age-averaged recommended hourly sediment ingestion rate for 6 to 16 year olds.
 - [x] Recommended hourly sediment ingestion rate for adults.
 - [y] Age-averaged recommended hourly sediment ingestion rate for 6 to 32 year olds.
 - [z] MDEQ (2016) residential default skin surface area for soil dermal contact for specified age group. For children (ages 0 to 6 years), value includes face, hands, forearms, lower legs and feet. For adults (ages 6 to 32), value does not include feet.
 - [aa] The MDEQ (2016) residential default skin surface area for soil dermal contact was used for sediment, as it includes exposure to feet.
 - [ab] The average skin surface area of the feet was added to the MDEQ (2016) residential default skin surface area for soil dermal contact for the specified age group.
 - [ac] Value is the MDEQ (2016) default target cancer risk or non-cancer hazard quotient.

Table 2
Recreational Screening Level Equations for Particulate Soil Inhalation and Volatile Soil Inhalation
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

ENDPOINT-SPECIFIC RECREATIONAL SCREENING LEVELS [a]:

Inhalation (carcinogenic) [source MDEQ 2016]:

(PSICrec or
VSICrec)_C

=

TR × AT_C

IUR × EF_{rec} × ED × ET × CF3 × (1 / [PEF or VF])

VF

=

Q/C ×

1

Js,ave-5m

Inhalation (non-cancer) [source MDEQ 2016]:

(PSICrec or
VSICrec)_{NC}

=

THQ × AT_{NC} × RfC × RSC_a

EF_{rec} × ED × ET × CF3 × (1 / [PEF or VF])

Final PSICrec = Minimum PSICrec for all endpoints

Note: The MDEQ (2016) residential particulate soil inhalation criteria (PSIC) and volatile soil inhalation criteria (VSIC) equations were used to calculate recreational criteria. No mutagenic constituents of potential concern (COPCs) were identified for this pathway. Therefore, the mutagenic equations and exposure parameters are not provided.

Symbol	Parameter	Units	Recreational User														Trespasser				Dog Walker			
			Non-cancer (includes Developmental / Reproductive Endpoints) [a]														Carcinogenic / Non-cancer [a]				Carcinogenic / Non-cancer [a]			
			Child			Adult			Pregnant Receptor							Adolescent				Adult				
			0 to 6 years			Single Exposure			Single Exposure			Full Term				6 to 16 years				26 years				
			value	note	ref	value	note	ref	value	note	ref	value	note	ref	value	note	ref	value	note	ref	value	note	ref	
AT _C	Averaging time for carcinogenic effects	days	28,470	[b]	U	MDEQ 2016	NA		NA		NA	NA		NA	28,470	[b]	U	MDEQ 2016		28,470	[b]	U	MDEQ 2016	
AT _{NC}	Averaging time for non-cancer effects	days	2,190	[c]	U	MDEQ 2016	1	[c]	U	MDEQ 2016	1	[c]	U	MDEQ 2016	280	[c]	U	MDEQ 2016		3,650	[c]	U	MDEQ 2016	
CF3	Conversion factor for hours to days	day/hour	0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		NA	
ED	Exposure duration	years or 1 day	6	[d]	U	MDEQ 2016	1 day	[d]	U	MDEQ 2016	1 day	[d]	U	MDEQ 2016	0.767	[d]	U	MDEQ 2016		10	[e]	U	PJ	
EF	Exposure frequency	days/year or days/day	75	[f]	--	RAIS 2016	1 day/day	[g]	U	MDEQ 2016	1 day/day	[g]	U	MDEQ 2016	75	[h]	--	RAIS 2016		50	[i]	--	PJ	
ET	Exposure time	hours/day	2	[k]	C	USEPA 2011	2	[k]	C	USEPA 2011	2	[k]	C	USEPA 2011	2	[k]	C	USEPA 2011		2	[l]	C	USEPA 2011	
IUR	Inhalation unit risk	(µg/m³) ⁻¹	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016		CS	[n]	U	MDEQ 2016	
Js,ave-5m	Normalized average flux for a 5-meter finite source	g/m²-sec	CS	[o]	C	MDEQ 2017	CS	[o]	C	MDEQ 2017	CS	[o]	C	MDEQ 2017	CS	[o]	C	MDEQ 2017		CS	[o]	C	MDEQ 2017	
PEF	Particulate emission factor	m³/kg	4.91E+07	[p]	U	MDEQ 2016	4.91E+07	[p]	U	MDEQ 2016	4.91E+07	[p]	U	MDEQ 2016	4.91E+07	[p]	U	MDEQ 2016		4.91E+07	[p]	U	MDEQ 2016	
PSICrec	Particulate Soil Inhalation Criteria for recreational scenario	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated	
Q/C	Dispersion factor for 1/2 acre	g/m²-sec per kg/m³	42.45	[q]	C	MDEQ 2016	42.45	[q]	C	MDEQ 2016	42.45	[q]	C	MDEQ 2016	42.45	[q]	C	MDEQ 2016		42.45	[q]	C	MDEQ 2016	
RfC	Reference concentration	µg/m³	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016		CS	[n]	U	MDEQ 2016	
RSC _a	Relative source contribution factor for air	unitless	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016		CS	[n]	--	MDEQ 2016	
THQ	Target hazard quotient for non-cancer effects	unitless	1	[r]	--	MDEQ 2016	1	[r]	--	MDEQ 2016	1	[r]	--	MDEQ 2016	1	[r]	--	MDEQ 2016		1	[r]	--	MDEQ 2016	
TR	Target risk for carcinogenic effects	unitless	1.00E-05	[r]	--	MDEQ 2016	1.00E-05	[r]	--	MDEQ 2016	1.00E-05	[r]	--	MDEQ 2016	1.00E-05	[r]	--	MDEQ 2016		1.00E-05	[r]	--	MDEQ 2016	
VF	Volatilization factor	m³/kg	CS	[s]	U	MDEQ 2016	CS	[s]	U	MDEQ 2016	CS	[s]	U	MDEQ 2016	CS	[s]	U	MDEQ 2016		CS	[s]	U	MDEQ 2016	
VSICrec	Volatile Soil Inhalation Criteria for recreational scenario	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated	

Definitions:					
--	unknown		g/m²-sec per kg/m³		gram per square meter per second per kilogram per cubic meter
CS	constituent-specific		m³/kg		cubic meter per kilogram
g/m²-sec	gram per square meter per second		NA		not applicable
					PJ
					U
					µg/m³
					profes professional judgement
					upper upper-bound estimate
					microgram per cubic meter

References:

MDEQ 2016 Michigan Department of Environmental Quality (MDEQ). 2016. Draft Cleanup Criteria Requirements for Response Activity. May 24. Available online at: http://w3.lara.state.mi.us/orr/Files/ORR/1604_2015-094EQ_orr-draft.pdf.

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USEPA 2011 USEPA. 2011. Exposure Factors Handbook 2011 Edition (Final). EPA/600/R-09/052F. Available online at: <https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252>.

USEPA 2016 USEPA. 2016. Regional Screening Levels (RSLs) - User's Guide (May 2016). Available online at: <https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-may-2016>.

Notes:

[a] Mutagenic constituents of potential concern were not identified for the ambient air inhalation pathway. Therefore, mutagenic exposure parameters are not provided.

[b] MDEQ (2016) default value. Based on a lifetime of 78 years, expressed in days.

[c] Value is the exposure duration, expressed in days.

[d] Value is the MDEQ (2016) default exposure durations for residential scenarios, as receptors would likely be nearby residents using the park.

[e] Trespassers are assumed to be adolescents, ages 6 to 16, for a total of 10 years.

[f] RAIS default value for soil / sediment exposure for the recreational scenario (RAIS 2016, Table 9). Assumed to be spread throughout the year.

[g] Single exposure (e.g., 1 day).

[h] RAIS default value for soil / sediment exposure for the recreational scenario (RAIS 2016, Table 9). Conservatively assumed to occur during pregnancy.

[i] Trespassers are assumed to be present at the site one day a week for 50 weeks. This is more conservative than other agencies, such as the VDEQ, which assume trespassers are at a site 24 days per year (6 days per month for 4 months).

[j] Assumes that nearby residents walk their dog in the park 100 days per year, or 2 days a week. Value accounts for snow cover approximately 3 months of the year.

[k] Average of mean time spent outdoors at parks from Tables 16-10, 16-82, and 16-84 (USEPA 2011). Value rounded to the nearest hour.

[l] Assumes time spent trespassing at the park would be consistent with time spent in recreational activities.

[m] According to Pedigree.com, "Twenty minutes is a good amount of time to aim for most dogs - even seniors, if they're in good health."

[n] Value will be obtained from the draft MDEQ Part 201 Rules (MDEQ 2016), if available.

[o] Values were provided by Dr. Divinia Ries of the MDEQ and were calculated using EMSOFT.

[p] The MDEQ default value, which accounts for vehicle traffic was conservatively used. A review of the available data indicated the presence of very limited impacts above the generic PSIC, adjusted for a 400-acre source area. Therefore, the conservative MDEQ default value was deemed appropriate for use at this site.

[q] MDEQ (2016) default value for a 1/2 acre source area.

[r] Value is the MDEQ (2016) default target cancer risk or non-cancer hazard quotient.

[s] The VF for a 5-meter source thickness was calculated using the equations provided in the draft MDEQ Part 201 Rules (MDEQ 2016). Normalized flux values were provided by Dr. Divinia Ries of the MDEQ.

9/15/2017

1 / 1

Table 3
Recreational Criteria Equations and Exposure Parameters for Exposure to Surface Water
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

ROUTE-SPECIFIC RECREATIONAL SCREENING LEVELS [source: USEPA 2016b] [a]:

Noncarcinogenic:

Oral:

$$(SWrec_o)_{NC} = \frac{THQ \times AT_{NC} \times RfD_o \times BW \times RSC_w \times CF3}{IR_{sw} \times EF \times ED}$$

Dermal:

$$(SWrec_d)_{NC} = \frac{THQ \times AT_{NC} \times RfD_d \times BW \times CF3}{SA_{sw} \times DA \times EV \times EF \times ED}$$

Dermal Absorption Factors:

Inorganics:

DA [0]

=

$$\frac{K_p \times ET_{sw}}{1000 \text{ cm}^3/\text{L}}$$

Organics:

DA [1]

=

$$\frac{2 \text{ FA} \times K_p}{1000 \text{ cm}^3/\text{L}} \times [(6 \tau \times ET_{sw}) / \pi]^{\frac{1}{2}}$$

or

DA [2]

=

$$\frac{\text{FA} \times K_p}{1000 \text{ cm}^3/\text{L}} \times \left(\frac{ET_{sw}}{1 + B} + \frac{2 \tau (1 + 3 B + 3 B^2)}{(1 + B)^2} \right)$$

if $ET_{sw} \leq t^*$

if $ET_{sw} > t^*$

Recreational Screening Level (combining all exposure routes):

SWrec

=

$$\frac{1}{[1 / (SWrec_o)_{NC}] + [1 / (SWrec_d)_{NC}]}$$

Final SWrec = Minimum of SWrec for all endpoints

Note: The USEPA Regional Screening Level equations for recreational users exposed to surface water were used to calculate recreational criteria. No carcinogenic or mutagenic constituents of potential concern (COPCs) were identified for surface water. Therefore, the carcinogenic and mutagenic equations and exposure parameters are not provided.

Symbol	Parameter	Units	Recreational User												Trespasser			
			Non-cancer (includes Developmental / Reproductive Endpoints) [a]												Non-cancer [a]			
			Child				Pregnant Receptor								Adolescent			
			0 to 6 years				Single Exposure				Full Term				6 to 16 years			
			value	note		ref	value	note		ref	value	note		ref	value	note		ref
T	Lag time for dermal absorption through the skin	hour	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
AT _{NC}	Averaging time for noncancer effects	days	2,190	[c]	U	MDEQ 2016	1	[c]	U	MDEQ 2016	280	[c]	U	MDEQ 2016	3,650	[c]	U	MDEQ 2016
B	Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
BW	Body weight	kg	15	[d]	C	MDEQ 2016	75	[d]	C	MDEQ 2016	75	[d]	C	MDEQ 2016	44	[d]	C	MDEQ 2016
CF3	Conversion factor for milligrams to micrograms	µg/mg	1,000		NA		1,000		NA		1,000		NA		1,000		NA	
DA	Dermal absorption factor, calculated using Equation [0], [1], or [2], as appropriate	L/cm²/event	CS	[b]	--	USEPA 2016b	CS	[b]	--	USEPA 2016b	CS	[b]	--	USEPA 2016b	CS	[b]	--	USEPA 2016b
ED	Exposure duration	years or days	6	[e]	U	MDEQ 2016	1 day	[e]	U	MDEQ 2016	0.767	[e]	U	MDEQ 2016	10	[e]	U	MDEQ 2016
EF	Exposure frequency	days/year or day/day	32	[f]	--	PJ, RAIS 2016	1	[g]	--	MDEQ 2016	32	[h]	--	PJ, RAIS 2016	21	[i]	--	PJ
ET _{sw}	Exposure time for wading or swimming water contact	hours/event	1	[j]	C	RAIS 2016	1	[j]	C	RAIS 2016	1	[j]	C	RAIS 2016	1	[j]	C	PJ, RAIS 2016
EV	Event frequency	events/day	1	[k]	--	USEPA 2016b	1	[k]	--	USEPA 2016b	1	[k]	--	USEPA 2016b	1	[k]	--	USEPA 2016b
FA	Fraction of absorbed water	unitless	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
IR _{sw}	Incidental ingestion rate of surface water, assumes a 1-hour exposure	L/day	0.0037	[l]	C	USEPA 2011	0.0037	[l]	C	USEPA 2011	0.0037	[l]	C	USEPA 2011	0.05	[m]	C	USEPA 2016b
K _p	Permeability coefficient	cm/hour	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
RfD _d	Reference dose for dermal exposure	mg/kg-day	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016
RfD _o	Reference dose for oral exposure	mg/kg-day	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016
RSC _w	Relative source contribution factor	unitless	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016
SA _{sw}	Exposed skin surface area for surface water contact	cm²	2,400	[o]	C	MDEQ 2016	7,000	[p]	C	MDEQ 2016	7,000	[p]	C	MDEQ 2016	13,400	[q]	C	USEPA 2011
SWrec	Recreational screening level for surface water	µg/L	calculated		U		calculated		U		calculated		U		calculated		U	
t*	Time required to reach steady state	hour	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
THQ	Target hazard quotient for non-cancer effects	unitless	1	[r]	U	MDEQ 2016	1	[r]	U	MDEQ 2016	1	[r]	U	MDEQ 2016	1	[r]	U	MDEQ 2016

Definitions:								
--	unknown	CS	constituent-specific	mg/kg-day	milligram per kilogram per day	U	upper-bound estimate	
C	central tendency estimate	kg	kilogram	NA	not applicable	µg/L	microgram per liter	
cm²	square centimeter	L/cm²/event	liter per square centimeter per event	PJ	professional judgement	µg/mg	microgram per milligram	
cm/hour	centimeter per hour	L/day	liter per day	SS	site-specific			

Table 3
Recreational Criteria Equations and Exposure Parameters for Exposure to Surface Water
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

References:

MDEQ 2016	Michigan Department of Environmental Quality (MDEQ). 2016. Draft Cleanup Criteria Requirements for Response Activity. May 24. Available online at: http://w3.lara.state.mi.us/orr/Files/ORR/1604_2015-094EQ_orr-draft.pdf .
RAIS 2016	The University of Tennessee. 2016. RAIS [The Risk Assessment Information System] Preliminary Remediation Goals (PRGs) for Chemicals User's Guide. Available online at: https://rais.ornl.gov/tools/rais_chemical_prg_guide.html .
USEPA 2011	USEPA. 2011. Exposure Factors Handbook 2011 Edition (Final). EPA/600/R-09/052F. Available online at: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252 .
USEPA 2016a	USEPA. 2016a. Regional Screening Levels (RSLs) - Generic Tables (May 2016). Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016 .
USEPA 2016b	USEPA. 2016b. Regional Screening Levels (RSLs) - User's Guide (May 2016). Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-may-2016 .

Notes:

[a]	Carcinogenic and mutagenic constituents of potential concern were not identified for surface water. Therefore, only non-cancer exposure parameters are provided.
[b]	Value obtained from the USEPA RSL Tables.
[c]	Value is the exposure duration, expressed in days.
[d]	Value is the MDEQ (2016) default body weight for the corresponding age group.
[e]	Value is the MDEQ (2016) default exposure durations for residential scenarios, as receptors would likely be nearby residents using the park.
[f]	Value is the RAIS (2016) default exposure frequency multiplied by 5/12 to account for warmer months only (May through September). Value is rounded up to the next full day.
[g]	Single exposure (e.g., 1 day).
[h]	RAIS default value for sediment exposure for the recreational scenario (RAIS 2016, Table 9), multiplied by 5/12 to account for warmer months only (May through September). Conservatively assumed to occur during pregnancy.
[i]	Value is the trespasser soil exposure frequency multiplied by 5 /12 to account for warmer months only (May through September). Value is rounded up to the next full day.
[j]	Surface water exposure time is equal to sediment exposure time. Reasonable estimate provided in Table 9 for soil/sediment exposure for recreational scenarios (RAIS 2016).
[k]	USEPA (2016b) default for event frequency.
[l]	USEPA (2011) surface water ingestion rate for wading / splashing, assuming 1 hour of exposure (Table 3-93).
[m]	USEPA (2016b) surface water ingestion rate for swimming, assuming 1 hour exposure.
[n]	Value will be obtained from the draft MDEQ Part 201 Rules (MDEQ 2016), if available.
[o]	Value is consistent with sediment exposure.
[p]	The average skin surface area of the feet was added to the MDEQ (2016) residential default skin surface area for soil dermal contact for the specified age group.
[q]	The trespasser is assumed to swim in the Secondary Settling Pond. Value is the average skin surface area for the whole body for 6 to <16 year olds from Table 7-1 (USEPA 2011).
[r]	Value is the MDEQ (2016) default target non-cancer hazard quotient.

Table 4
Dermal and Oral Absorption Parameters
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Relative Source Contribution (RSC) Factors and Absorption Efficiencies (AE) [a]					Within EPD [b]	Permeability Constant		Non-Steady State Dermal Absorption Parameters [d]					DA_1hr
	RSCw (unitless)	RSCs (unitless)	RSCa (unitless)	AEi (unitless)	AEd (unitless)		Kp (cm/hour) [c]		FA (unitless)	τ (hour)	t* (hour)	B (unitless)	Source	[e] (L/cm²/event)
							Value	Source						
Volatile Organic Compounds														
Benzene	0.2	1	1	1	0.1	Yes	1.49E-02	RSL	1.0	2.88E-01	6.91E-01	5.07E-02	RSL	2.32E-05 [2]
Ethylbenzene	0.2	1	1	1	0.1	Yes	4.93E-02	RSL	1.0	4.13E-01	9.92E-01	1.95E-01	RSL	8.98E-05 [2]
Semi Volatile Organic Compounds														
Benzo(a)pyrene TEQ	0.2	1	1	0.5	0.13	No	7.13E-01	RSL	1.0	2.72E+00	1.18E+01	4.36E+00	RSL	–
Naphthalene	0.2	1	1	1	0.1	Yes	4.66E-02	RSL	1.0	5.49E-01	1.32E+00	2.03E-01	RSL	9.54E-05 [1]
Phenanthrene	0.2	1	1	1	0.1	Yes	1.40E-01	calc	1.0	1.05E+00	4.07E+00	7.18E-01	calc	3.96E-04 [1]
Polychlorinated Biphenyls														
Aroclor 1242	0.2	1	1	0.5	0.14	No	5.45E-01	RSL	0.7	4.54E+00	1.94E+01	3.58E+00	RSL	–
Aroclor 1248	0.2	1	1	0.5	0.14	No	4.75E-01	RSL	0.0	4.54E+00	1.94E+01	3.58E+00	RSL	–
Aroclor 1254	0.2	1	1	0.5	0.14	No	7.51E-01	RSL	0.5	4.54E+00	1.94E+01	3.58E+00	RSL	–
Aroclor 1260	0.2	1	1	0.5	0.14	No	9.86E-01	RSL	0.0	4.54E+00	1.94E+01	3.58E+00	RSL	–
Dioxins and Furans														
2,3,7,8-Tetrachlorodibenzo-p-dioxin	0.2	1	1	0.5	0.03	No	8.08E-01	RSL	0.5	1.72E+01	7.71E+01	7.54E+00	RSL	–
Inorganics														
Arsenic	0.2	1	1	0.5	0.03	Yes	1.00E-03	RSL	1.0	2.39E-01	5.73E-01	3.07E-03	RSL	1.00E-06 [0]
Chromium (as CrIII)	0.7	1	1	0.5	0.01	Yes	1.00E-03	RSL	1.0	2.39E-01	5.73E-01	3.07E-03	RSL	1.00E-06 [0]
Hexavalent Chromium	0.7	1	1	0.5	0.01	Yes	2.00E-03	RSL	1.0	2.39E-01	5.73E-01	3.07E-03	RSL	2.00E-06 [0]
Cobalt	0.2	1	1	0.5	0.01	Yes	4.00E-04	RSL	1.0	2.06E-01	4.93E-01	2.77E-03	RSL	4.00E-07 [0]
Copper	1	1	1	0.5	0.01	Yes	1.00E-03	RSL	1.0	2.06E-01	4.93E-01	5.55E-03	RSL	1.00E-06 [0]
Cyanide, Total	0.2	1	1	1	0.01	Yes	1.00E-03	RSL	1.0	1.47E-01	3.53E-01	1.96E-03	RSL	1.00E-06 [0]
Iron	0.2	1	1	0.5	0.01	Yes	1.00E-03	RSL	1.0	2.16E-01	5.19E-01	2.87E-03	RSL	1.00E-06 [0]
Manganese	0.5	1	1	0.5	0.01	Yes	1.00E-03	RSL	1.0	2.14E-01	5.13E-01	2.85E-03	RSL	1.00E-06 [0]
Mercury	0.2	1	1	0.5	0.01	Yes	1.00E-03	RSL	1.0	1.40E+00	3.35E+00	5.45E-03	RSL	1.00E-06 [0]
Nickel	0.2	1	1	0.5	0.01	Yes	2.00E-04	RSL	1.0	1.40E+00	3.35E+00	5.45E-03	RSL	2.00E-07 [0]
Thallium	0.2	1	1	0.5	0.01	Yes	1.00E-03	RSL	1.0	1.40E+00	3.35E+00	5.45E-03	RSL	1.00E-06 [0]
Vanadium	0.2	1	1	0.5	0.01	Yes	1.00E-03	RSL	1.0	2.03E-01	4.87E-01	2.75E-03	RSL	1.00E-06 [0]
Zinc	0.2	1	1	0.5	0.01	Yes	6.00E-04	RSL	1.0	2.44E-01	5.86E-01	1.87E-03	RSL	6.00E-07 [0]

References [ref]:

calc Calculated value (USEPA 2004b).
RSL United States Environmental Protection Agency Regional Screening Level Tables (May 2016) (USEPA 2016a).

– Not applicable.

AE Absorption efficiencies for ingestion (i) and dermal (d).

DA Dermal absorption factor for water.

EPD Effective predictive domain.

L/cm²/event Liter per centimeter squared per event.

RSC Relative Source Contribution Factors for air (a), soil (s), and water (w). Soil value is used for sediment.

[a] RSC factors and AE values were obtained from the draft 2016 Part 201 Cleanup Criteria Requirements for Response Activity (MDEQ 2016).

[b] As defined by USEPA 2004b, constituents with a molecular weight and Kow outside the EPD are not evaluated for dermal exposure in the water pathway.

[c] Permeability coefficient for dermal contact with constituents in water (centimeters per hour), from USEPA 2016a.

[d] Absorption parameters for use in the non-steady state model for dermal contact with constituents in water; from USEPA 2016a.

τ = Lag time for dermal absorption through the skin.

t* = Time required to reach steady state.

B = Ratio of the permeability coefficient through the stratus corneum relative to the permeability coefficient across the viable epidermis.

FA = Fraction of absorbed water.

[e] DA calculated according to equations presented in USEPA 2016b (using Equation [0], [1], or [2] as shown on Table 3), based on exposure time (ET) = 1 hours.

DA is not applicable for constituents that are outside of the EPD.

Table 5
Toxicity Values
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	ABS _{GI} [a]	Oral RfD (mg/kg/day) [b]		Dermal RfD (mg/kg/day) [c]	Developmental or Reproductive Toxicant?	Single Exposure or Full-Term	Inhalation RfC (µg/m ³) [b]		Developmental or Reproductive Toxicant?	Single Exposure or Full-Term	Oral CSF (mg/kg/day) ¹ [b]		Dermal CSF (mg/kg/day) ⁻¹ [c]	Mutagenic Carcinogen?	Inhalation Unit Risk (µg/m ³) ⁻¹ [b]		Mutagenic Carcinogen?
Volatile Organic Compounds																	
Benzene	1	5.00E-04	ATSDR	5.0E-04	No		1.00E+01	ATSDR	No		5.50E-02	IRIS	5.5E-02	No	7.80E-06	IRIS	No
Ethylbenzene	1	4.00E-02	ATSDR	4.0E-02	No		2.60E+02	ATSDR	No		1.10E-02	CAEPA	1.1E-02	No	2.50E-06	CAEPA	No
Semi Volatile Organic Compounds																	
Benzo(a)pyrene TEQ	1	3.00E-04	IRIS	3.0E-04	Yes	SE	2.00E-03	IRIS	Yes	SE	1.00E+00	IRIS	1.0E+00	Yes	6.00E-04	IRIS	Yes
Naphthalene	1	1.00E-01	OPP	1.0E-01	No		3.00E+00	IRIS	No		NA	MDEQ	NA	No	3.40E-05	CAEPA	No
Phenanthrene	1	3.00E-02	IRIS	3.0E-02	No		1.00E-01	MDEQ	No		NA	MDEQ	NA	No	NA	MDEQ	No
Polychlorinated Biphenyls																	
Aroclor 1242	1	2.00E-05	IRIS	2.0E-05	Yes	FT	NA	MDEQ	No		2.00E+00	IRIS	2.0E+00	No	1.00E-04	IRIS	No
Aroclor 1248	1	2.00E-05	IRIS	2.0E-05	Yes	FT	NA	MDEQ	No		2.00E+00	IRIS	2.0E+00	No	1.00E-04	IRIS	No
Aroclor 1254	1	2.00E-05	IRIS	2.0E-05	Yes	FT	NA	MDEQ	No		2.00E+00	IRIS	2.0E+00	No	1.00E-04	IRIS	No
Aroclor 1260	1	2.00E-05	IRIS	2.0E-05	Yes	FT	NA	MDEQ	No		2.00E+00	IRIS	2.0E+00	No	1.00E-04	IRIS	No
Dioxins and Furans																	
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	7.00E-10	IRIS	7.0E-10	Yes	FT	2.00E-06	MDEQ	Yes	FT	7.50E+04	MDEQ	7.5E+04	No	4.40E+01	MDEQ	No
Inorganics																	
Arsenic	1	3.00E-04	ATSDR	3.0E-04	No		NA	MDEQ	No		1.50E+00	IRIS	1.5E+00	No	4.30E-03	IRIS	No
Chromium (as CrIII)	0.013	1.50E+00	IRIS	2.0E-02	No		1.00E-01	ATSDR	No		NA	MDEQ	NA	No	NA	MDEQ	No
Hexavalent Chromium	0.025	9.00E-04	ATSDR	2.3E-05	No		5.00E-03	ATSDR	No		5.00E-01	CAEPA	2.0E+01	Yes	1.20E-02	IRIS	Yes
Cobalt	1	3.00E-04	PPRTV	3.0E-04	No		6.00E-03	PPRTV	No		NA	MDEQ	NA	No	9.00E-03	PPRTV	No
Copper	1	1.00E-03	ATSDR	1.0E-03	No		2.00E+00	MDEQ	No		NA	MDEQ	NA	No	NA	MDEQ	No
Cyanide, Total	1	6.30E-04	IRIS	6.3E-04	Yes	FT	8.00E-01	IRIS	No		NA	MDEQ	NA	No	NA	MDEQ	No
Iron	1	7.00E-01	PPRTV	7.0E-01	No		NA	MDEQ	No		NA	MDEQ	NA	No	NA	MDEQ	No
Manganese	0.04	4.70E-02	I/MDEQ	1.9E-03	No		3.00E-01	ATSDR	No		NA	MDEQ	NA	No	NA	MDEQ	No
Mercury	1	6.00E-05	MDEQ	6.0E-05	No		3.00E-01	IRIS	No		NA	MDEQ	NA	No	NA	MDEQ	No
Nickel	0.04	6.00E-03	MDEQ	2.4E-04	No		9.00E-02	ATSDR	No		NA	MDEQ	NA	No	2.40E-04	IRIS	No
Thallium	1	1.00E-05	PPRTV	1.0E-05	No		2.00E-01	MDEQ	No		NA	MDEQ	NA	No	NA	MDEQ	No
Vanadium	0.026	7.00E-05	PPRTV	1.8E-06	No		1.00E-01	ATSDR	No		NA	MDEQ	NA	No	NA	MDEQ	No
Zinc	1	3.00E-01	IRIS	3.0E-01	No		NA	MDEQ	No		NA	MDEQ	NA	No	NA	MDEQ	No

References, as provided in the draft MDEQ (2016) [ref]:
ATSDR Agency for Toxic Substances and Disease Registry
CAEPA California Environmental Protection Agency
IRIS USEPA's Integrated Risk Information System
I/MDEQ IRIS value has been modified by MDEQ
MDEQ Michigan Department of Environmental Quality (2016)
PPRTV USEPA's Provisional Peer Reviewed Toxicity Values

mg/kg/day Milligram per kilogram per day.
(mg/kg/day)⁻¹ Inverse milligram per kilogram per day (risk per unit dose).
µg/m³ Microgram per cubic meter.
(µg/m³)⁻¹ Inverse microgram per cubic meter.

[a] ABSGI = Gastrointestinal track absorption factor; from MDEQ (2016) or set at a default of 1.
[b] Toxicity values were obtained from the draft MDEQ Part 201 Rules (MDEQ 2016).
[c] RfD (dermal) = RfD (oral) × ABSGI.
 CSF (dermal) = CSF (oral) / ABSGI.

Table 6
Soil Volatilization Factors
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	J_{s,fin_5m} [a] g/m ² /sec	VF_{fin-5m} [b] m ³ /kg
Volatile Organic Compounds		
Benzene	7.54E-03	5.63E+03
Ethylbenzene	7.14E-03	5.95E+03
Semi Volatile Organic Compounds		
Benzo(a)pyrene TEQ	NCOPC	NCOPC
Naphthalene	2.42E-03	1.76E+04
Phenanthrene	1.80E-04	2.36E+05
Polychlorinated Biphenyls		
Aroclor 1242	2.80E-04	1.52E+05
Aroclor 1248	NCOPC	NCOPC
Aroclor 1254	2.80E-04	1.52E+05
Aroclor 1260	NCOPC	NCOPC
Dioxins and Furans		
2,3,7,8-Tetrachlorodibenzo-p-dioxin	NCOPC	NCOPC
Inorganics		
Arsenic	NCOPC	NCOPC
Chromium (as CrIII)	NCOPC	NCOPC
Hexavalent Chromium	NCOPC	NCOPC
Cobalt	NCOPC	NCOPC
Copper	NCOPC	NCOPC
Cyanide, Total	NCOPC	NCOPC
Iron	NCOPC	NCOPC
Manganese	NCOPC	NCOPC
Mercury	7.96E-03	5.33E+03
Nickel	NCOPC	NCOPC
Thallium	NCOPC	NCOPC
Vanadium	NCOPC	NCOPC
Zinc	NCOPC	NCOPC

[a] The normalized average flux for a 5-meter source thickness (J_{s,fin_5m}) was provided to Arcadis by Dr. Divinia Ries of the MDEQ. The J_{s,fin_5m} was calculated using EMSOFT.

[b] The soil volatilization factor was calculated using equations and default parameters provided in the September 2016 version of the draft MDEQ Part 201 Rules.

g/m²/sec grams per square meter per second
m³/kg cubic meters per kilogram

Table 7
Recreational Criteria for Soil - Direct Contact - Recreational User
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	CANCER EFFECTS		NON-CANCER EFFECTS		Recreational Criterion [a] (µg/kg)
			Non-Mutagenic (child to adult)	Mutagenic (child to adult)	Non-Cancer (child)	Developmental (child)	
			(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	
Semi Volatile Organic Compounds							
Benzo(a)pyrene TEQ	Yes	Yes	NA	1.75E+04	3.10E+05	3.10E+05	1.75E+04
Polychlorinated Biphenyls							
Aroclor 1242	No	Yes	3.75E+04	NA	1.93E+04	1.93E+04	1.93E+04
Aroclor 1248	No	Yes	3.75E+04	NA	1.93E+04	1.93E+04	1.93E+04
Aroclor 1254	No	Yes	3.75E+04	NA	1.93E+04	1.93E+04	1.93E+04
Aroclor 1260	No	Yes	3.75E+04	NA	1.93E+04	1.93E+04	1.93E+04
Dioxins and Furans							
2,3,7,8-Tetrachlorodibenzo-p-dioxin	No	Yes	3.48E+00	NA	2.25E+00	2.25E+00	2.25E+00
Inorganics							
Arsenic	No	No	1.74E+05	NA	9.63E+05	NA	1.74E+05
Chromium (as CrIII)	No	No	NA	NA	2.90E+08	NA	2.90E+08
Hexavalent Chromium	Yes	No	NA	1.24E+04	3.28E+05	NA	1.24E+04
Cobalt	No	No	NA	NA	1.67E+06	NA	1.67E+06
Copper	No	No	NA	NA	5.56E+06	NA	5.56E+06
Iron	No	No	NA	NA	3.89E+09	NA	3.89E+09
Manganese	No	No	NA	NA	2.67E+07	NA	2.67E+07
Nickel	No	No	NA	NA	3.41E+06	NA	3.41E+06
Thallium	No	No	NA	NA	5.56E+04	NA	5.56E+04
Vanadium	No	No	NA	NA	2.65E+04	NA	2.65E+04

[a] The recreational criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects.

CrIII	trivalent chromium	TEQ	toxic equivalents
NA	not applicable	µg/kg	microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 1. Constituent-specific absorption parameters are presented in Table 4. Constituent-specific toxicity values are presented in Table 5.

Table 8
Recreational Criteria for Soil - Direct Contact - Adolescent Trespasser
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	CANCER EFFECTS		NON-CANCER EFFECTS	Trespasser Criterion [a] (µg/kg)
			Non-Mutagenic (adolescent)	Mutagenic (adolescent)	Non-Cancer (adolescent)	
			(µg/kg)	(µg/kg)	(µg/kg)	
Semi Volatile Organic Compounds						
Benzo(a)pyrene TEQ	Yes	Yes	NA	2.21E+05	2.55E+06	2.21E+05
Polychlorinated Biphenyls						
Aroclor 1242	No	Yes	3.10E+05	NA	1.59E+05	1.59E+05
Aroclor 1248	No	Yes	3.10E+05	NA	1.59E+05	1.59E+05
Aroclor 1254	No	Yes	3.10E+05	NA	1.59E+05	1.59E+05
Aroclor 1260	No	Yes	3.10E+05	NA	1.59E+05	1.59E+05
Dioxins and Furans						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	No	Yes	2.80E+01	NA	1.88E+01	1.88E+01
Inorganics						
Arsenic	No	No	1.40E+06	NA	8.07E+06	1.40E+06
Chromium (as CrIII)	No	No	NA	NA	2.37E+09	2.37E+09
Hexavalent Chromium	Yes	No	NA	1.55E+05	2.68E+06	1.55E+05
Cobalt	No	No	NA	NA	1.43E+07	1.43E+07
Copper	No	No	NA	NA	4.75E+07	4.75E+07
Iron	No	No	NA	NA	3.33E+10	3.33E+10
Manganese	No	No	NA	NA	2.19E+08	2.19E+08
Nickel	No	No	NA	NA	2.80E+07	2.80E+07
Thallium	No	No	NA	NA	4.75E+05	4.75E+05
Vanadium	No	No	NA	NA	2.17E+05	2.17E+05

[a] The trespasser criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects.

CrIII trivalent chromium

NA not applicable

TEQ toxic equivalents

µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 1.

Constituent-specific absorption parameters are presented in Table 4.

Constituent-specific toxicity values are presented in Table 5.

Table 9
Recreational Criteria for Soil - Direct Contact - Adult Dog Walker
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	CANCER EFFECTS		NON-CANCER EFFECTS	Dog Walker Criterion [a] (µg/kg)
			Non-Mutagenic (adolescent)	Mutagenic (adolescent)	Non-Cancer (adolescent)	
			(µg/kg)	(µg/kg)	(µg/kg)	
Semi Volatile Organic Compounds						
Benzo(a)pyrene TEQ	Yes	Yes	NA	2.11E+05	2.11E+06	2.11E+05
Polychlorinated Biphenyls						
Aroclor 1242	No	Yes	9.82E+04	NA	1.31E+05	9.82E+04
Aroclor 1248	No	Yes	9.82E+04	NA	1.31E+05	9.82E+04
Aroclor 1254	No	Yes	9.82E+04	NA	1.31E+05	9.82E+04
Aroclor 1260	No	Yes	9.82E+04	NA	1.31E+05	9.82E+04
Dioxins and Furans						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	No	Yes	1.17E+01	NA	2.05E+01	1.17E+01
Inorganics						
Arsenic	No	No	5.86E+05	NA	8.79E+06	5.86E+05
Chromium (as CrIII)	No	No	NA	NA	1.80E+09	1.80E+09
Hexavalent Chromium	Yes	No	NA	1.38E+05	2.08E+06	1.38E+05
Cobalt	No	No	NA	NA	2.39E+07	2.39E+07
Copper	No	No	NA	NA	7.97E+07	7.97E+07
Iron	No	No	NA	NA	5.58E+10	5.58E+10
Manganese	No	No	NA	NA	1.73E+08	1.73E+08
Nickel	No	No	NA	NA	2.21E+07	2.21E+07
Thallium	No	No	NA	NA	7.97E+05	7.97E+05
Vanadium	No	No	NA	NA	1.68E+05	1.68E+05

[a] The dog walker criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects.

CrIII trivalent chromium TEQ toxic equivalents
 NA not applicable µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 1.
 Constituent-specific absorption parameters are presented in Table 4.
 Constituent-specific toxicity values are presented in Table 5.

Table 10
Recreational Criteria for Soil - Particulate Soil Inhalation - Recreational User
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	PEF m ³ /kg	CANCER EFFECTS	NON-CANCER EFFECTS	Recreational Criterion [a] (µg/kg)
				Non-Mutagenic (child to adult)	Non-Cancer (child)	
				(µg/kg)	(µg/kg)	
Inorganics						
Cobalt	No	No	4.91E+07	7.77E+06	1.72E+07	7.77E+06
Manganese	No	No	4.91E+07	NA	8.60E+08	8.60E+08
Nickel	No	No	4.91E+07	2.91E+08	2.58E+08	2.58E+08

[a] The recreational criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects.

m³/kg cubic meter per kilogram PEF particulate emission factor
 NA not applicable µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 2.
 Constituent-specific toxicity values are presented in Table 5.

Table 11
Recreational Criteria for Soil - Particulate Soil Inhalation - Adolescent Trespasser
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	PEF m ³ /kg	CANCER EFFECTS	NON-CANCER EFFECTS	Trespasser Criterion [a] (µg/kg)
				Non-Mutagenic (adolescent)	Non-Cancer (adolescent)	
				(µg/kg)	(µg/kg)	
Inorganics						
Cobalt	No	No	4.91E+07	3.73E+07	2.58E+07	2.58E+07
Manganese	No	No	4.91E+07	NA	1.29E+09	1.29E+09
Nickel	No	No	4.91E+07	1.40E+09	3.87E+08	3.87E+08

[a] The trespasser criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects.

m³/kg cubic meter per kilogram PEF particulate emission factor
 NA not applicable µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 2.
 Constituent-specific toxicity values are presented in Table 5.

Table 12
Recreational Criteria for Soil - Particulate Soil Inhalation - Adult Dog Walker
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	PEF m ³ /kg	CANCER EFFECTS	NON-CANCER EFFECTS	Dog Walker Criterion [a] (µg/kg)
				Non-Mutagenic (adult)	Non-Cancer (adult)	
				(µg/kg)	(µg/kg)	
Inorganics						
Cobalt	No	No	4.91E+07	5.79E+07	1.04E+08	5.79E+07
Manganese	No	No	4.91E+07	NA	5.21E+09	5.21E+09
Nickel	No	No	4.91E+07	2.17E+09	1.56E+09	1.56E+09

[a] The dog walker criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects.

m³/kg cubic meter per kilogram
 NA not applicable

PEF particulate emission factor
 µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 2.
 Constituent-specific toxicity values are presented in Table 5.

Table 13
Recreational Criteria for Soil - Volatile Soil Inhalation - Recreational User
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	VF m ³ /kg	CANCER EFFECTS	NON-CANCER EFFECTS	Recreational Criterion [a] (µg/kg)
				Non-Mutagenic (child to adult)	Non-Cancer (child)	
				(µg/kg)	(µg/kg)	
Volatile Organic Compounds						
Benzene	No	No	5.63E+03	3.39E+05	1.08E+06	3.39E+05
Ethylbenzene	No	No	5.95E+03	1.12E+06	2.98E+07	1.12E+06
Semi Volatile Organic Compounds						
Naphthalene	No	No	1.76E+04	2.43E+05	1.01E+06	2.43E+05
Phenanthrene	No	No	2.36E+05	NA	4.55E+05	4.55E+05
Polychlorinated Biphenyls						
Aroclor 1242	No	No	1.52E+05	7.12E+05	NA	7.12E+05
Aroclor 1254	No	No	1.52E+05	7.12E+05	NA	7.12E+05
Inorganics						
Mercury	No	No	5.33E+03	NA	3.08E+04	3.08E+04

[a] The recreational criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects. The volatile soil inhalation criteria have been adjusted by a source area size factor of 0.33 for a 400-acre source area.

m³/kg cubic meter per kilogram VF volatilization factor
 NA not applicable µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 2.
 Constituent-specific toxicity values are presented in Table 5.
 Volatilization factors are presented in Table 6.

Table 14
Recreational Criteria for Soil - Volatile Soil Inhalation - Adolescent Trespasser
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	VF m ³ /kg	CANCER EFFECTS	NON-CANCER EFFECTS	Trespasser Criterion [a] (µg/kg)
				Non-Mutagenic (adolescent)	Non-Cancer (adolescent)	
				(µg/kg)	(µg/kg)	
Volatile Organic Compounds						
Benzene	No	No	5.63E+03	1.63E+06	1.63E+06	1.63E+06
Ethylbenzene	No	No	5.95E+03	5.36E+06	4.47E+07	5.36E+06
Semi Volatile Organic Compounds						
Naphthalene	No	No	1.76E+04	1.16E+06	1.52E+06	1.16E+06
Phenanthrene	No	No	2.36E+05	NA	6.83E+05	6.83E+05
Polychlorinated Biphenyls						
Aroclor 1242	No	No	1.52E+05	3.42E+06	NA	3.42E+06
Aroclor 1254	No	No	1.52E+05	3.42E+06	NA	3.42E+06
Inorganics						
Mercury	No	No	5.33E+03	NA	4.63E+04	4.63E+04

[a] The recreational criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects. The volatile soil inhalation criteria have been adjusted by a source area size factor of 0.33 for a 400-acre source area.

m³/kg cubic meter per kilogram
 NA not applicable

VF volatilization factor
 µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 2.
 Constituent-specific toxicity values are presented in Table 5.
 Volatilization factors are presented in Table 6.

Table 15
Recreational Criteria for Soil - Volatile Soil Inhalation - Adult Dog Walker
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	VF m ³ /kg	CANCER EFFECTS	NON-CANCER EFFECTS	Dog Walker Criterion [a] (µg/kg)
				Non-Mutagenic (adult)	Non-Cancer (adult)	
				(µg/kg)	(µg/kg)	
Volatile Organic Compounds						
Benzene	No	No	5.63E+03	2.53E+06	6.57E+06	2.53E+06
Ethylbenzene	No	No	5.95E+03	8.33E+06	1.81E+08	8.33E+06
Semi Volatile Organic Compounds						
Naphthalene	No	No	1.76E+04	1.81E+06	6.15E+06	1.81E+06
Phenanthrene	No	No	2.36E+05	NA	2.76E+06	2.76E+06
Polychlorinated Biphenyls						
Aroclor 1242	No	No	1.52E+05	5.31E+06	NA	5.31E+06
Aroclor 1254	No	No	1.52E+05	5.31E+06	NA	5.31E+06
Inorganics						
Mercury	No	No	5.33E+03	NA	1.87E+05	1.87E+05

[a] The recreational criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects. The volatile soil inhalation criteria have been adjusted by a source area size factor of 0.33 for a 400-acre source area.

m³/kg cubic meter per kilogram
 NA not applicable

VF volatilization factor
 µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 2.
 Constituent-specific toxicity values are presented in Table 5.
 Volatilization factors are presented in Table 6.

Table 16
Recreational Criteria for Sediment - Direct Contact - Recreational User
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	CANCER EFFECTS		NON-CANCER EFFECTS		Recreational Criterion [a] (µg/kg)
			Non-Mutagenic (child to adult)	Mutagenic (child to adult)	Non-Cancer (child)	Developmental (child)	
			(µg/kg)	(µg/kg)	(µg/kg)	(µg/kg)	
Semi Volatile Organic Compounds							
Benzo(a)pyrene TEQ	Yes	Yes	NA	1.37E+04	2.42E+05	2.42E+05	1.37E+04
Polychlorinated Biphenyls							
Aroclor 1242	No	Yes	3.55E+04	NA	1.58E+04	1.58E+04	1.58E+04
Aroclor 1248	No	Yes	3.55E+04	NA	1.58E+04	1.58E+04	1.58E+04
Aroclor 1254	No	Yes	3.55E+04	NA	1.58E+04	1.58E+04	1.58E+04
Aroclor 1260	No	Yes	3.55E+04	NA	1.58E+04	1.58E+04	1.58E+04
Dioxins and Furans							
2,3,7,8-Tetrachlorodibenzo-p-dioxin	No	Yes	1.34E+00	NA	7.29E-01	7.29E-01	7.29E-01
Inorganics							
Arsenic	No	No	6.68E+04	NA	3.12E+05	NA	6.68E+04
Chromium (as CrIII)	No	No	NA	NA	4.94E+08	NA	4.94E+08
Hexavalent Chromium	Yes	No	NA	1.68E+04	4.50E+05	NA	1.68E+04
Copper	No	No	NA	NA	1.11E+06	NA	1.11E+06
Manganese	No	No	NA	NA	2.98E+07	NA	2.98E+07
Thallium	No	No	NA	NA	1.11E+04	NA	1.11E+04
Vanadium	No	No	NA	NA	3.58E+04	NA	3.58E+04

[a] The recreational criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects.

CrIII trivalent chromium TEQ toxic equivalents
 NA not applicable µg/kg microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 1.

Constituent-specific absorption parameters are presented in Table 4.

Constituent-specific toxicity values are presented in Table 5.

Table 17
Recreational Criteria for Sediment - Direct Contact - Trespasser
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Mutagen? Yes/No	Developmental / Reproductive? Yes/No	CANCER EFFECTS		NON-CANCER EFFECTS	Trespasser Criterion [a] (µg/kg)
			Non-Mutagenic (adolescent)	Mutagenic (adolescent)	Non-Cancer (adolescent)	
			(µg/kg)	(µg/kg)	(µg/kg)	
Semi Volatile Organic Compounds						
Benzo(a)pyrene TEQ	Yes	Yes	NA	1.52E+05	1.75E+06	1.52E+05
Polychlorinated Biphenyls						
Aroclor 1242	No	Yes	2.22E+05	NA	1.14E+05	1.14E+05
Aroclor 1248	No	Yes	2.22E+05	NA	1.14E+05	1.14E+05
Aroclor 1254	No	Yes	2.22E+05	NA	1.14E+05	1.14E+05
Aroclor 1260	No	Yes	2.22E+05	NA	1.14E+05	1.14E+05
Dioxins and Furans						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	No	Yes	8.06E+00	NA	5.43E+00	5.43E+00
Inorganics						
Arsenic	No	No	4.03E+05	NA	2.33E+06	4.03E+05
Chromium (as CrIII)	No	No	NA	NA	3.41E+09	3.41E+09
Hexavalent Chromium	Yes	No	NA	1.83E+05	3.16E+06	1.83E+05
Copper	No	No	NA	NA	8.29E+06	8.29E+06
Manganese	No	No	NA	NA	2.12E+08	2.12E+08
Thallium	No	No	NA	NA	8.29E+04	8.29E+04
Vanadium	No	No	NA	NA	2.52E+05	2.52E+05

[a] The trespasser criterion was identified as the minimum of the criteria calculated based on cancer or non-cancer effects.

CrIII trivalent chromium

NA not applicable

TEQ

µg/kg

toxic equivalents

microgram per kilogram

Equations and receptor-specific exposure parameters are presented in Table 1.

Constituent-specific absorption parameters are presented in Table 4.

Constituent-specific toxicity values are presented in Table 5.

Table 18
Recreational Criteria for Surface Water - Recreational User Wading
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Developmental / Reproductive?		DA [a]	NON-CANCER EFFECTS												Recreational Criterion SWrec [b]
	Yes/No	SE/FT		Non-Cancer			Developmental (Child)			Developmental (Pregnant, SE)			Developmental (Pregnant, FT)			
			Oral	Dermal	SWrec _{NC}	Oral	Dermal	SWrec _{NC,dev (c)}	Oral	Dermal	SWrec _{NC,dev (preg,SE)}	Oral	Dermal	SWrec _{NC,dev (preg,FT)}		
			(SWrec _o) _{NC}	(SWrec _d) _{NC}	(µg/L)	(SWrec _o) _{NC,dev (c)}	(SWrec _d) _{NC,dev (c)}	(µg/L)	(SWrec _o) _{NC,dev (preg,SE)}	(SWrec _d) _{NC,dev (preg,SE)}	(µg/L)	(SWrec _o) _{NC,dev (preg,FT)}	(SWrec _d) _{NC,dev (preg,FT)}	(µg/L)		
Semi Volatile Organic Compounds																
Phenanthrene	No		3.96E-04 [1]	2.77E+05	5.4E+03	5.3E+03	NA	NA	NA	NA	NA	NA	NA	NA	5.3E+03	
Inorganics																
Copper	No		1.00E-06 [0]	4.62E+04	7.1E+04	2.8E+04	NA	NA	NA	NA	NA	NA	NA	NA	2.8E+04 NC	
Cyanide (CN-)	Yes	FT	1.00E-06 [0]	5.83E+03	4.5E+04	5.2E+03	5.83E+03	4.49E+04	5.2E+03	NA	NA	NA	2.91E+04	7.70E+04	2.1E+04 5.2E+03	
Mercury	No		1.00E-06 [0]	5.55E+02	4.3E+03	4.9E+02	NA	NA	NA	NA	NA	NA	NA	NA	4.9E+02	
Thallium	No		1.00E-06 [0]	9.25E+01	7.1E+02	8.2E+01	NA	NA	NA	NA	NA	NA	NA	NA	8.2E+01	
Zinc	No		6.00E-07 [0]	2.77E+06	3.6E+07	2.6E+06	NA	NA	NA	NA	NA	NA	NA	NA	2.6E+06 NC	

(c)

child

DA

dermal absorption factor

dev

developmental

FT

full term

L/cm²/event

liter per cubic centimer per event

NA

not applicable

NC

non-cancer

preg

pregnant receptor

SE

single exposure

SWrec

recreational screening level for surface water

µg/L

microgram per liter

[a] The dermal absorption factor was calculated using the equations, as indicated, on Table 3 and input parameters presented in Table 4.
[b] The recreational criterion for surface water was identified as the minimum of the criteria calculated based on non-cancer effects, as no carcinogenic constituents were identified as constituents of potential concern.

Equations and receptor-specific exposure parameters are presented in Table 3.
Constituent-specific absorption parameters are presented in Table 4.
Toxicity values are presented in Table 5.

Table 19
Recreational Criteria for Surface Water - Adolescent Trespasser Swimming
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	DA [a]	NON-CANCER EFFECTS			Trespasser Criterion SWrec [b]
		Non-Cancer			
		Oral	Dermal	SWrec _{NC}	
	(L/cm²/event)	(SWrec _o) _{NC}	(SWrec _d) _{NC}	(µg/L)	
Semi Volatile Organic Compounds					
Phenanthrene	3.96E-04 [1]	9.18E+04	4.3E+03	4.1E+03	4.1E+03
Inorganics					
Copper	1.00E-06 [0]	1.53E+04	5.7E+04	1.2E+04	1.2E+04
Cyanide (CN⁻)	1.00E-06 [0]	1.93E+03	3.6E+04	1.8E+03	1.8E+03
Mercury	1.00E-06 [0]	1.84E+02	3.4E+03	1.7E+02	1.7E+02
Thallium	1.00E-06 [0]	3.06E+01	5.7E+02	2.9E+01	2.9E+01
Zinc	6.00E-07 [0]	9.18E+05	2.9E+07	8.9E+05	8.9E+05

DA dermal absorption factor

L/cm²/event liter per cubic centimeter per event

NA not applicable

NC non-cancer

SWrec recreational screening level for surface water

µg/L microgram per liter

[a] The dermal absorption factor was calculated using the equations, as indicated, on Table 3 and input parameters presented in Table 4.

[b] The recreational criterion for surface water was identified as the minimum of the criteria calculated based on non-cancer effects, as no carcinogenic constituents were identified as constituents of potential concern.

Equations and receptor-specific exposure parameters are presented in Table 3.

Constituent-specific absorption parameters are presented in Table 4.

Toxicity values are presented in Table 5.

Table 20
Summary of Calculated Recreational Criteria
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Soil - Direct Contact			Soil - Particulate Soil Inhalation			Soil - Volatile Soil Inhalation			Sediment		Surface Water	
	µg/kg			µg/kg			µg/kg			µg/kg		µg/L	
	Recreational User	Trespasser	Dog Walker	Recreational User	Trespasser	Dog Walker	Recreational User	Trespasser	Dog Walker	Recreational User	Trespasser	Recreational User	Trespasser
Volatile Organic Compounds													
Benzene	NA	NA	NA	NA	NA	NA	3.39E+05	1.63E+06	2.53E+06	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	1.12E+06	5.36E+06	8.33E+06	NA	NA	NA	NA
Semi Volatile Organic Compounds													
Benzo(a)pyrene TEQ	1.75E+04	2.21E+05	2.11E+05	NA	NA	NA	NA	NA	NA	1.37E+04	1.52E+05	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	2.43E+05	1.16E+06	1.81E+06	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	4.55E+05	6.83E+05	2.76E+06	NA	NA	5.30E+03	4.13E+03
Polychlorinated Biphenyls													
Aroclor 1242	1.93E+04	1.59E+05	9.82E+04	NA	NA	NA	7.12E+05	3.42E+06	5.31E+06	1.58E+04	1.14E+05	NA	NA
Aroclor 1248	1.93E+04	1.59E+05	9.82E+04	NA	NA	NA	NA	NA	NA	1.58E+04	1.14E+05	NA	NA
Aroclor 1254	1.93E+04	1.59E+05	9.82E+04	NA	NA	NA	7.12E+05	3.42E+06	5.31E+06	1.58E+04	1.14E+05	NA	NA
Aroclor 1260	1.93E+04	1.59E+05	9.82E+04	NA	NA	NA	NA	NA	NA	1.58E+04	1.14E+05	NA	NA
Dioxins and Furans													
2,3,7,8-Tetrachlorodibenzo-p-dioxin	2.25E+00	1.88E+01	1.17E+01	NA	NA	NA	NA	NA	NA	7.29E-01	5.43E+00	NA	NA
Inorganics													
Arsenic	1.74E+05	1.40E+06	5.86E+05	NA	NA	NA	NA	NA	NA	6.68E+04	4.03E+05	NA	NA
Chromium (as CrIII)	1.00E+08 [a]	1.00E+08 [a]	1.00E+08 [a]	NA	NA	NA	NA	NA	NA	1.00E+08 [a]	1.00E+08 [a]	NA	NA
Hexavalent Chromium	1.24E+04	1.55E+05	1.38E+05	NA	NA	NA	NA	NA	NA	1.68E+04	1.83E+05	NA	NA
Cobalt	1.67E+06	1.43E+07	2.39E+07	7.77E+06	2.58E+07	5.79E+07	NA	NA	NA	NA	NA	NA	NA
Copper	5.56E+06	4.75E+07	7.97E+07	NA	NA	NA	NA	NA	NA	1.11E+06	8.29E+06	2.80E+04	1.21E+04
Cyanide, Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.16E+03	1.83E+03
Iron	1.00E+08 [a]	1.00E+08 [a]	1.00E+08 [a]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead [b]	1.75E+06	See Rec	See Rec	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese	2.67E+07	1.00E+08 [a]	1.00E+08 [a]	1.00E+08 [a]	1.00E+08 [a]	1.00E+08 [a]	NA	NA	NA	2.98E+07	1.00E+08 [a]	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	3.08E+04	4.63E+04	1.87E+05	NA	NA	4.91E+02	1.74E+02
Nickel	3.41E+06	2.80E+07	2.21E+07	1.00E+08 [a]	1.00E+08 [a]	1.00E+08 [a]	NA	NA	NA	NA	NA	NA	NA
Thallium	5.56E+04	4.75E+05	7.97E+05	NA	NA	NA	NA	NA	NA	1.11E+04	8.29E+04	8.19E+01	2.90E+01
Vanadium	2.70E+04 [c]	2.17E+05	1.68E+05	NA	NA	NA	NA	NA	NA	3.58E+04	2.52E+05	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.57E+06	8.89E+05

CrIII

trivalent chromium

TEQ

toxic equivalents

toxic equivalents

NA

not applicable

µg/kg

microgram per kilogram

microgram per kilogram

Rec

recreational user

µg/L

microgram liter

microgram liter

[a] The calculated risk-based criterion is greater than the maximum allowable concentration of 1.00E+08 µg/kg. Therefore, the site-specific criterion was set at the maximum allowable concentration. The calculated risk-based criteria are presented in Tables 7 through 19.

[b] The more conservative scenario site-specific DCC for lead is shown. The likely scenario site-specific DCC for lead was calculated to be 6,980,000 µg/kg.

[c] The calculated recreational criterion for recreational users is 26,500 µg/kg, which is less than the draft 2016 Statewide Default Background Level of 27,000 µg/kg. Therefore, the recreational criterion defaults to the Sitewide Default Background Level.

Table 21
Summary of Maximum Detected Concentrations Compared to Calculated Recreational Criteria
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Soil - Direct Contact			Soil - Particulate Soil Inhalation			Soil - Volatile Soil Inhalation			Maximum Soil Concentration			Sediment		Maximum Sediment Concentration µg/kg	Surface Water		Maximum Surface Water Concentration µg/L
	µg/kg			µg/kg			µg/kg			µg/kg			µg/L					
	Recreational User	Trespasser	Dog Walker	Recreational User	Trespasser	Dog Walker	Recreational User	Trespasser	Dog Walker	GPL	SMI	Peninsula	Recreational User	Trespasser		Recreational User	Trespasser	
Volatile Organic Compounds																		
Benzene	NA	NA	NA	NA	NA	NA	3.39E+05	1.63E+06	2.53E+06	2.00E+00	7.30E+04	1.50E+02	NA	NA	NA	NA	NA	NA
Ethylbenzene	NA	NA	NA	NA	NA	NA	1.12E+06	5.36E+06	8.33E+06	ND	9.90E+04	3.40E+02	NA	NA	NA	NA	NA	NA
Semi Volatile Organic Compounds																		NA
Benzo(a)pyrene TEQ	1.75E+04	2.21E+05	2.11E+05	NA	NA	NA	NA	NA	NA	1.01E+03	8.46E+03	8.81E+03	1.37E+04	1.52E+05	9.43E+03	NA	NA	NA
Naphthalene	NA	NA	NA	NA	NA	NA	2.43E+05	1.16E+06	1.81E+06	5.50E+03	1.80E+03	4.70E+02	NA	NA	NA	NA	NA	NA
Phenanthrene	NA	NA	NA	NA	NA	NA	4.55E+05	6.83E+05	2.76E+06	4.70E+03	2.30E+04	7.80E+03	NA	NA	NA	5.30E+03	4.13E+03	NA
Polychlorinated Biphenyls																		
Aroclor 1242	1.93E+04	1.59E+05	9.82E+04	NA	NA	NA	7.12E+05	3.42E+06	5.31E+06	ND	4.10E+04	ND	1.58E+04	1.14E+05	9.80E+02	NA	NA	NA
Aroclor 1248	1.93E+04	1.59E+05	9.82E+04	NA	NA	NA	NA	NA	NA	8.40E+03	1.10E+04	1.30E+03	1.58E+04	1.14E+05	8.60E+02	NA	NA	NA
Aroclor 1254	1.93E+04	1.59E+05	9.82E+04	NA	NA	NA	7.12E+05	3.42E+06	5.31E+06	1.20E+03	1.50E+06 [b]	3.00E+03	1.58E+04	1.14E+05	1.30E+03	NA	NA	NA
Aroclor 1260	1.93E+04	1.59E+05	9.82E+04	NA	NA	NA	NA	NA	NA	1.50E+03	1.10E+04	8.80E+03	1.58E+04	1.14E+05	6.50E+02	NA	NA	NA
Dioxins and Furans																		
2,3,7,8-Tetrachlorodibenzo-p-dioxin	2.25E+00	1.88E+01	1.17E+01	NA	NA	NA	NA	NA	NA	7.30E+00	7.48E-01	NA	7.29E-01	5.43E+00	6.50E-01	NA	NA	NA
Inorganics																		
Arsenic	1.74E+05	1.40E+06	5.86E+05	NA	NA	NA	NA	NA	NA	1.40E+04	2.36E+04	3.80E+04	6.68E+04	4.03E+05	1.77E+04	NA	NA	NA
Chromium (as CrIII)	1.00E+08	1.00E+08	1.00E+08	NA	NA	NA	NA	NA	NA	2.20E+05	1.11E+06	7.30E+05	1.00E+08	1.00E+08	1.95E+05	NA	NA	NA
Hexavalent Chromium	1.24E+04	1.55E+05	1.38E+05	NA	NA	NA	NA	NA	NA	ND	6.40E+02	6.70E+03	1.68E+04	1.83E+05	ND	NA	NA	NA
Cobalt	1.67E+06	1.43E+07	2.39E+07	7.77E+06	2.58E+07	5.79E+07	NA	NA	NA	9.37E+03	1.43E+05	3.94E+06	NA	NA	1.11E+04	NA	NA	NA
Copper	5.56E+06	4.75E+07	7.97E+07	NA	NA	NA	NA	NA	NA	5.01E+05	4.47E+07	3.50E+06	1.11E+06	8.29E+06	1.17E+06	2.80E+04	1.21E+04	4.87E+01
Cyanide, Total	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	5.16E+03	1.83E+03	1.50E+01
Iron	1.00E+08	1.00E+08	1.00E+08	NA	NA	NA	NA	NA	NA	1.00E+08	1.00E+08	2.70E+08	NA	NA	NA	NA	NA	NA
Lead [a]	1.75E+06	See Rec	See Rec	NA	NA	NA	NA	NA	NA	5.59E+05	4.27E+06	1.82E+07	NA	NA	NA	NA	NA	NA
Manganese	2.67E+07	1.00E+08	1.00E+08	1.00E+08	1.00E+08	1.00E+08	NA	NA	NA	1.00E+07	2.66E+07	2.77E+07	2.98E+07	1.00E+08	1.67E+07	NA	NA	NA
Mercury	NA	NA	NA	NA	NA	NA	3.08E+04	4.63E+04	1.87E+05	7.70E+01	6.91E+02	2.00E+02	NA	NA	NA	4.91E+02	1.74E+02	3.90E-01
Nickel	3.41E+06	2.80E+07	2.21E+07	1.00E+08	1.00E+08	1.00E+08	NA	NA	NA	4.50E+04	3.40E+06	4.00E+05	NA	NA	NA	NA	NA	NA
Thallium	5.56E+04	4.75E+05	7.97E+05	NA	NA	NA	NA	NA	NA	5.90E+03	3.60E+03	7.00E+02	1.11E+04	8.29E+04	6.50E+03	8.19E+01	2.90E+01	8.60E+00
Vanadium	2.70E+04	2.17E+05	1.68E+05	NA	NA	NA	NA	NA	NA	3.41E+04	4.50E+04	7.23E+04	3.58E+04	2.52E+05	3.82E+04	NA	NA	NA
Zinc	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.57E+06	8.89E+05	3.68E+03

Note:

Blue values indicate that the maximum detected concentration exceeds a site-specific criterion.

[a] Measured or estimated fine fraction concentrations are presented. For samples that were not fractionated at GPL and SMI, a ratio of 2.4 was used. For samples that were not fractionated at Peninsula, a ratio of 1.8 was used.

[b] The maximum detected concentration of Aroclor 1254 was collected from 13 to 15 feet below ground surface (bgs), which is below the water table. According to the approved PCB work plan, soil exhibiting total polychlorinated biphenyl (PCB) concentrations greater than 100,000 µg/kg in the top 5 feet of soil were excavated and backfilled with clean fill. This area also has a concrete slab and 1 to 2 feet of clean fill material on top of the concrete slab. The water table in the vicinity of elevated PCB concentrations is at approximately 4 feet bgs. Therefore, any remaining PCB impacts in the vadose zone are less than the recreational volatile soil inhalation criteria of 712,000 µg/kg.

CrIII

trivalent chromium

TEQ

toxic equivalents

NA

not applicable

µg/kg

microgram per kilogram

ND

not detected

µg/L

microgram liter

Rec

recreational user

Table 22
Summary of Soil Exceedances of the Calculated Recreational Criteria
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Sample ID	Sample Depth (ft bgs)	Sample Date	Concentration (µg/kg)	Minimum Soil Criterion (µg/kg)	Notes
Saginaw Malleable Industrial Land (SMI)						
Aroclor 1242	S1188	3 - 5	6/15/1996	41,000	19,300	No additional action needed beyond the planned restrictions. Exceedances are all located in an area with a planned restriction on intrusive activities and requiring the installation and maintenance of an exposure barrier.
Aroclor 1254 (Direct Contact)	BH01-98	5 - 7	1/16/1998	35,000	19,300	
	BH03-98	5 - 6.5	1/16/1998	29,000	19,300	
	BH04-98	1 - 3	1/16/1998	42,000	19,300	
	BH06-98	1 - 3	4/15/1998	93,000	19,300	
	BH07-98	13 - 15	4/15/1998	1,500,000	19,300	
Aroclor 1254 (Ambient Air)	BH07-98	13 - 15	4/15/1998	1,500,000	712,000	This sample is located beneath the water table; therefore, volatilization to ambient air is not likely to occur. In addition, according to the approved PCB work plan, soil exhibiting total polychlorinated biphenyl (PCB) concentrations greater than 100,000 µg/kg in the top 5 feet of soil were excavated and backfilled with clean fill. This area also has a concrete slab and 1 to 2 feet of clean fill material on top of the concrete slab. The water table in the vicinity of elevated PCB concentrations is at approximately 4 feet bgs. Therefore, any remaining PCB impacts in the vadose zone are less than the recreational volatile soil inhalation criteria of 712,000 µg/kg.
Copper	SB-363	4 - 6	9/28/1995	44,700,000	5,560,000	No additional action needed beyond the planned restrictions. Exceedance is not a concern, as it is located in a planned restriction area where intrusive activities will be prohibited and an exposure barrier will be installed and maintained.
Lead (Fine Fraction)	SB-362	0 - 2	9/28/1995	2,448,000	1,750,000	No additional action needed beyond the planned restrictions. Exceedances are not a concern, as they are located in a planned restriction area where intrusive activities will be prohibited and an exposure barrier will be installed and maintained. In addition, the average fine fraction lead concentration for SMI is approximately 185,000 µg/kg, which is well below the recreational direct contact criterion (DCC) of 1,750,000 µg/kg.
	SB-363	0 - 2	9/28/1995	3,168,000	1,750,000	
	SB-363	4 - 6	9/28/1995	4,272,000	1,750,000	
	RS-2-5	0 - 1	6/10/1996	1,845,600	1,750,000	No additional action needed beyond the planned restrictions. These samples were collected in the Former Railyard Area. RS-2-5 and RS-2-6 are estimated concentrations based on historical data. Measured fine fraction lead concentrations in surface soil in 2017 did not indicate the presence of fine fraction lead at these two locations at concentrations that exceeded th recreational DCC. In addition, the average fine fraction lead concentration for the Former Railyard Area is approximately 412,000 µg/kg, which is well below the recreational DCC of 1,750,000 µg/kg.
	RS-2-6	0 - 1	6/10/1996	1,900,800	1,750,000	
	SB-17-25	0 - 0.5		2,400,000 **	1,750,000	
Vanadium	NS-1	0 - 14	6/23/1995	32,300	27,000	No additional action needed. The 95 percent upper confidence level on the mean (95% UCL) for SMI is approximately 17,000 µg/kg, which is less than the recreational DCC of 27,000 µg/kg.
	PL-1	0.75 - 1.21	8/10/2001	45,000	27,000	
	PL-2	0.75 - 1.67	8/10/2001	28,000 [31,000]	27,000	
	PL-3	0.67 - 1.67	8/10/2001	38,000	27,000	
	BH10	1 - 2	3/6/2007	30,400	27,000	
	BH10	2 - 4	3/6/2007	41,000	27,000	
	BH12	0 - 2	3/6/2007	33,900	27,000	
	SB-377	0 - 0.5	7/25/2000	29,000	27,000	
	RS-2	0 - 1	6/13/1995	32,100	27,000	
	BH02	2 - 4	11/26/1997	31,000	27,000	
	BH03	2 - 4	11/26/1997	34,000	27,000	
	AR-2	3 - 4	6/3/2015	39,000 B	27,000	
	AR-6	9.5 - 10	6/4/2015	29,000 B	27,000	
	NS-SD-20	1.9 - 2.5	6/20/1995	31,400	27,000	
	NS-SD-15	2.3 - 3.4	6/20/1995	28,400	27,000	
	NS-SD-17	2.4 - 3	6/20/1995	35,100	27,000	
	NS-SD-13	3.4 - 4.1	6/20/1995	30,100	27,000	
	NS-SD-11	2.3 - 2.9	6/20/1995	33,400	27,000	
Green Point Landfill (GPL)						
Vanadium	MW-126WT	14 - 16	2/8/1995	34,100	27,000	No additional action needed. The 95% UCL for GPL is approximately 15,800 µg/kg, which is less than the recreational DCC of 27,000 µg/kg.
	SB-412	0 - 0.5	8/11/2000	28,300	27,000	
	BH02	2 - 4	11/26/1997	31,000	27,000	
	BH03	2 - 4	11/26/1997	34,000	27,000	
Dioxins and Furans	DX#2	0 - 1.25	12/1/2000	7.3	2.25	These samples were collected in the Eastern Property Extension in the vicinity of the wetland mitigation pond. Dioxins and furans are present in the Saginaw River floodplain as a result of periodic flooding of the river due to upstream contamination from Dow. RACER is not responsible for cleanup of dioxins and furans in the floodplain; however, the exceedances of the recreational DCC suggest that steps should be taken to notify potential receptors of the presence of dioxin and furans in this area.
	DX#3	0 - 1.25	12/1/2000	6.3	2.25	
	DX#4	0 - 1.25	12/1/2000	3.6	2.25	

Table 22
Summary of Soil Exceedances of the Calculated Recreational Criteria
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Sample ID	Sample Depth (ft bgs)	Sample Date	Concentration (µg/kg)	Minimum Soil Criterion (µg/kg)	Notes
Peninsula Property (Peninsula)						
Cobalt	SB10-125	0 - 2	1/20/2010	3,940,000	1,670,000	No additional action needed. The 95% UCL for Peninsula, excluding samples under an exposure barrier, is approximately 336,000 µg/kg, which is less than the recreational DCC of 1,670,000 µg/kg.
Lead (Fine Fraction)	SB10-104	0 - 2	1/19/2010	4,824,000	1,750,000	No additional action needed beyond the planned restrictions and completed excavations for these locations. The top 6 inches were excavated, an exposure barrier was installed, and clean fill was placed.
	SB10-113	0 - 2	1/20/2010	4,752,000	1,750,000	
	SB10-114	0 - 2	1/20/2010	18,180,000	1,750,000	
	SB10-119	0 - 2	1/20/2010	3,816,000	1,750,000	
	SB15-01	0 - 0.5	11/23/2015	2,000,000 **	1,750,000	These three locations are not currently under an exposure barrier; however, corrective measures are being evaluated to determine the most appropriate remedy to eliminate potential exposures above the recreational DCC.
	SB15-12	0 - 0.5	11/23/2015	2,300,000 **	1,750,000	
	SB15-13	0 - 0.5	11/23/2015	8,800,000 **	1,750,000	
	SB10-153	0 - 2	1/21/2010	7,524,000	1,750,000	No additional actions are needed for this location. Resampling in 2013 indicated significantly lower measured fine fraction lead concentrations (64,200 µg/kg). In addition, the average fine fraction lead concentration <u>including</u> samples currently located under an exposure barrier and in the hot spot area is approximately 738,000 µg/kg, which is below the recreational criterion of 1,750,000 µg/kg.
Iron	MW98-110S1	4 - 6	9/22/1998	270,000,000 D	100,000,000	No additional action needed for these locations. The 95% UCL for the soil column at Peninsula, excluding samples under an exposure barrier, is approximately 87,100,000 µg/kg, which is less than the maximum allowable concentration of 100,000,000 µg/kg and the recreational DCC of 3,890,000,000 µg/kg.
	MW98-109S1	0.5 - 1	9/23/1998	110,000,000 D	100,000,000	
	SB98-120	0.5 - 1	9/23/1998	250,000,000 D	100,000,000	
	SB10-109	0 - 2	1/21/2010	141,000,000	100,000,000	No additional action needed for these locations. The 95% UCL for surface soil at Peninsula, excluding samples under an exposure barrier, is approximately 66,900,000 µg/kg, which is less than the maximum allowable concentration of 100,000,000 µg/kg and the recreational DCC of 3,890,000,000 µg/kg. SB10-144 is located in an area with a soil exposure barrier.
	SB10-117	0 - 2	1/22/2010	126,000,000	100,000,000	
	SB10-125	0 - 2	1/20/2010	236,000,000 J	100,000,000	
	SB10-135	0 - 2	1/22/2010	133,000,000	100,000,000	
	SB10-143	0 - 2	1/19/2010	238,000,000 J	100,000,000	
	SB10-144	0 - 2	1/20/2010	154,000,000 J [42,800,000 J]	100,000,000	
	SB10-146	0 - 2	1/21/2010	265,000,000	100,000,000	
	SB10-148	0 - 2	1/19/2010	161,000,000 J	100,000,000	
	SB10-149	0 - 2	1/19/2010	132,000,000 J [167,000,000 J]	100,000,000	
	SB10-152	0 - 2	1/21/2010	137,000,000	100,000,000	
Manganese	SB10-154	0 - 2	1/19/2010	27,700,000	27,600,000	No additional action needed. 95% UCL for Peninsula, excluding samples under an exposure barrier, is approximately 10,100,000 µg/kg, which is less than the recreational DCC of 26,700,000 µg/kg.
Vanadium	SB10-109	0 - 2	1/21/2010	27,200 J	27,000	No additional actions needed. 95% UCL for Peninsula is approximately 20,500 µg/kg, which is less than the recreational DCC of 27,000 µg/kg.
	SB10-115	0 - 2	1/21/2010	19,400 J [28,200]	27,000	
	SB10-125	0 - 2	1/20/2010	34,600	27,000	
	SB10-135	0 - 2	1/22/2010	29,100	27,000	
	SB10-146	0 - 2	1/21/2010	72,300	27,000	
	SB10-148	0 - 2	1/19/2010	47,400	27,000	
	SB10-149	0 - 2	1/19/2010	35,900 [32,500]	27,000	

Notes:
 All concentrations are in micrograms per kilogram (µg/kg).
 Field duplicate results are presented in square brackets.
 Fine fraction lead concentrations were estimated using a ratio of 2.4 for SMI and 1.8 for Peninsula, unless noted with a "****", indicating a measured fine fraction lead concentration.
 See text for additional details and evaluation.

Table 23
Summary of Sediment Exceedances of the Calculated Recreational Criteria
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Constituent	Sample ID	Sample Depth (ft bgs)	Sample Date	Concentration (µg/kg)	Minimum Sediment Criterion (µg/kg)	Notes
Copper	SD-62	0 - 0.5	8/10/2000	1,140,000 [1,170,000]	1,110,000	No additional actions needed. The 95 percent upper confidence level on the mean (95% UCL) for sediment is approximately 38,500 ug/kg, which is less than the recreational criterion of 1,110,000 µg/kg.
Vanadium	SD-32	0 - 1.4	6/19/1995	36,300 [27,800]	35,800	No additional actions needed. 95% UCL for sediment is 16,100 µg/kg, which is less than the recreational criterion of 35,800 µg/kg.
	SD-33	0 - 1.3	6/19/1995	38,200	35,800	
	SD-64	0 - 0.5	8/10/2000	36,100	35,800	

Notes:

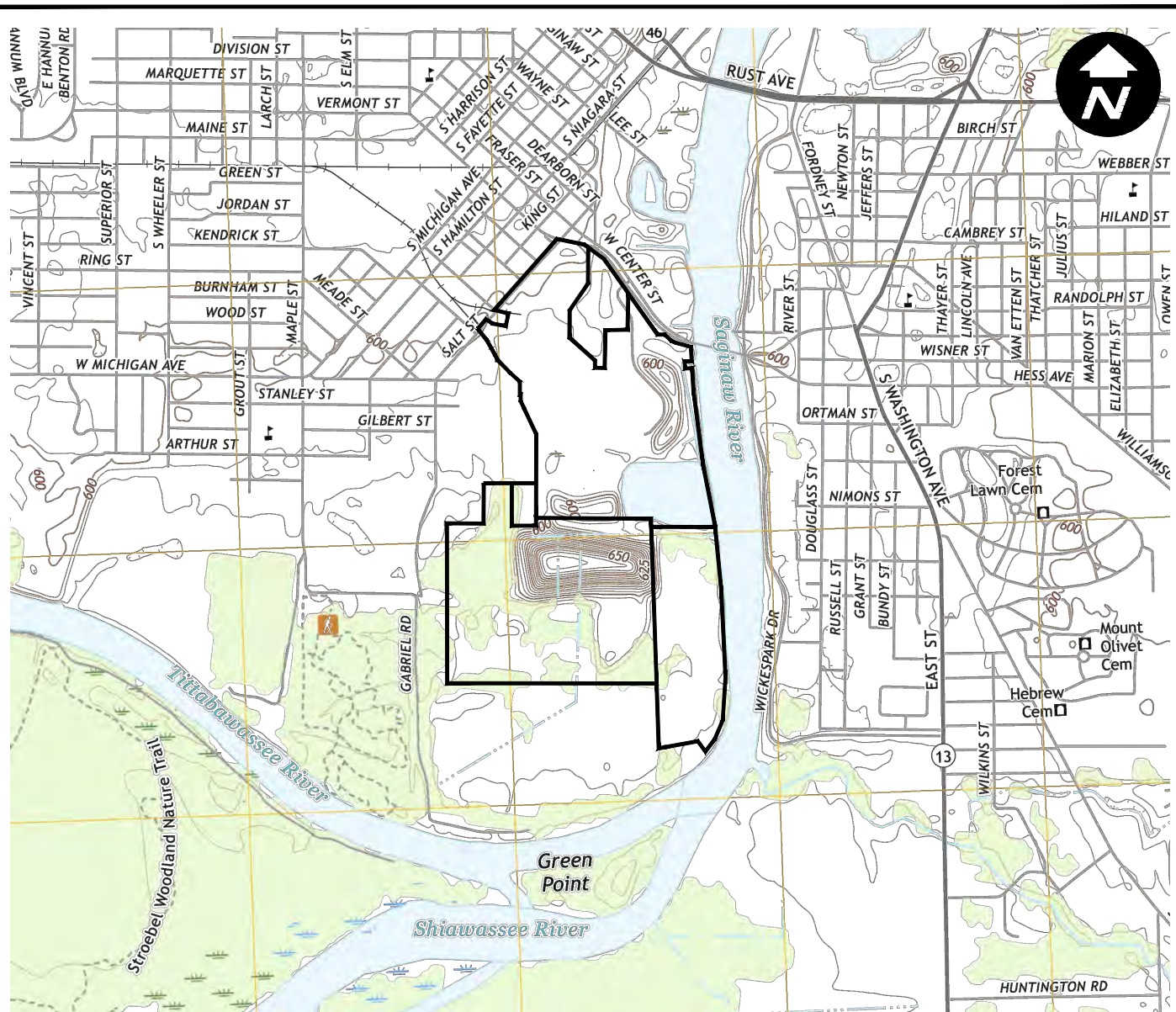
All concentrations are in micrograms per kilogram (µg/kg).

Field duplicate results are presented in square brackets.

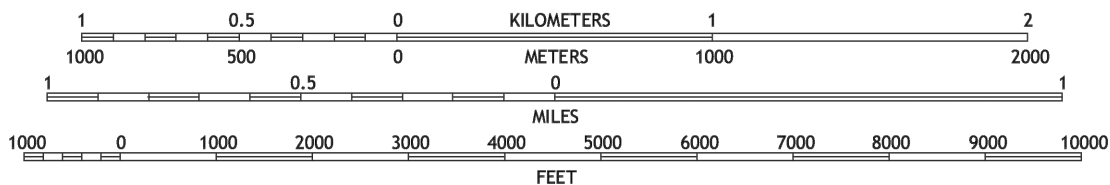
See text for additional details and evaluation.

FIGURES





SCALE 1:24 000



CONTOUR INTERVAL 5 FEET
 NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the
 National Geospatial Program US Topo Product Standard, 2011.
 A metadata file associated with this product is draft version 0.6.19



SAGINAW MALLEABLE INDUSTRIAL LAND,
 GREEN POINT LANDFILL, AND PENINSULA PROPERTY
 SAGINAW, MICHIGAN

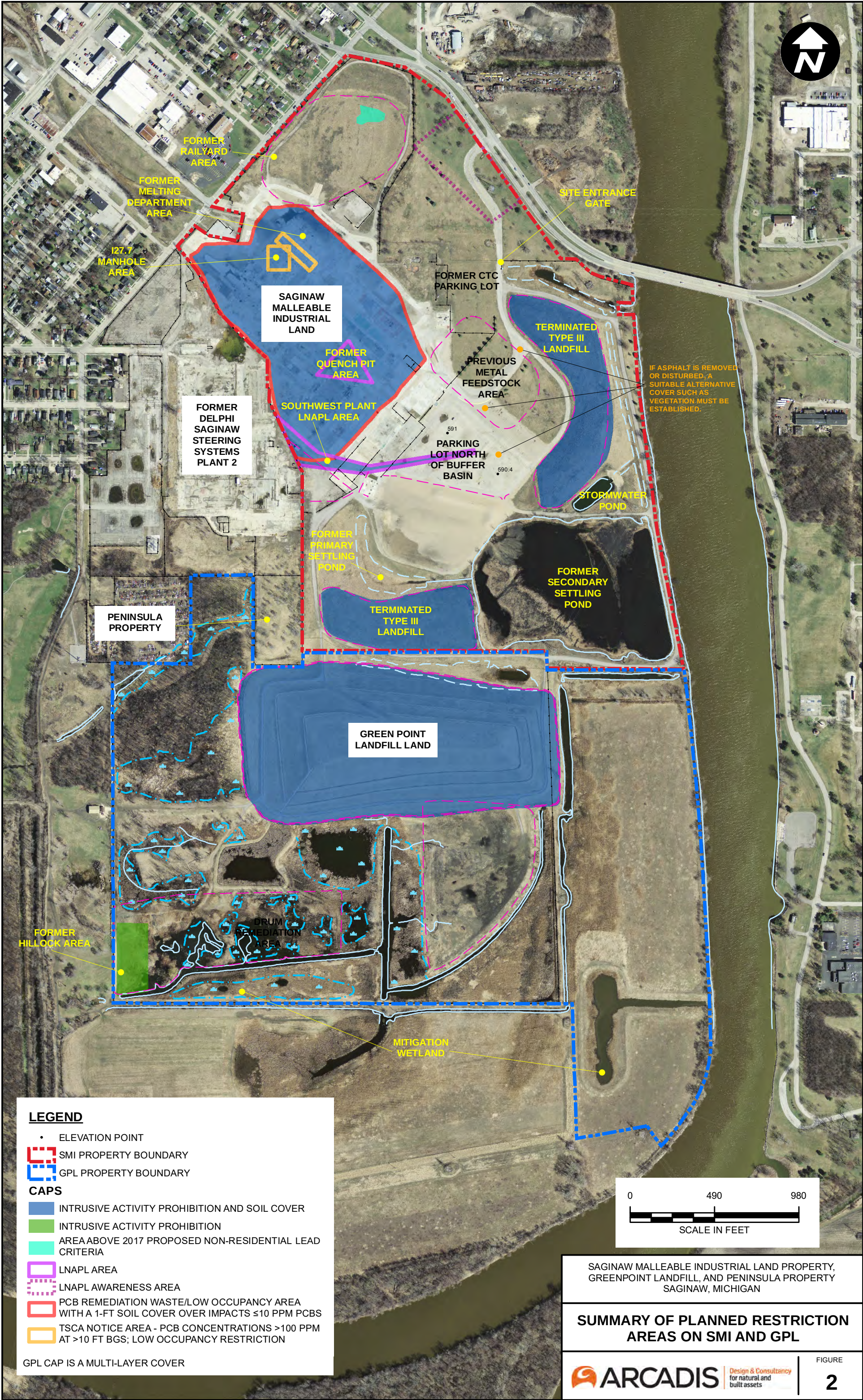
SITE LOCATION MAP



FIGURE

1

CITY: Novi, DIV: ENV, DB: TRY, PIC: PM, TM: TR, PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South, FIPS 2113 Feet Intl, G:\COMMON\RACER\Saginaw\64434 - SMI (10030) Main Location\GIS\Docs\RACER\Saginaw Site Features_No Excavations.mxd PLOTTED: 7/25/2017 1:50:05 PM BY: dolexa



LEGEND

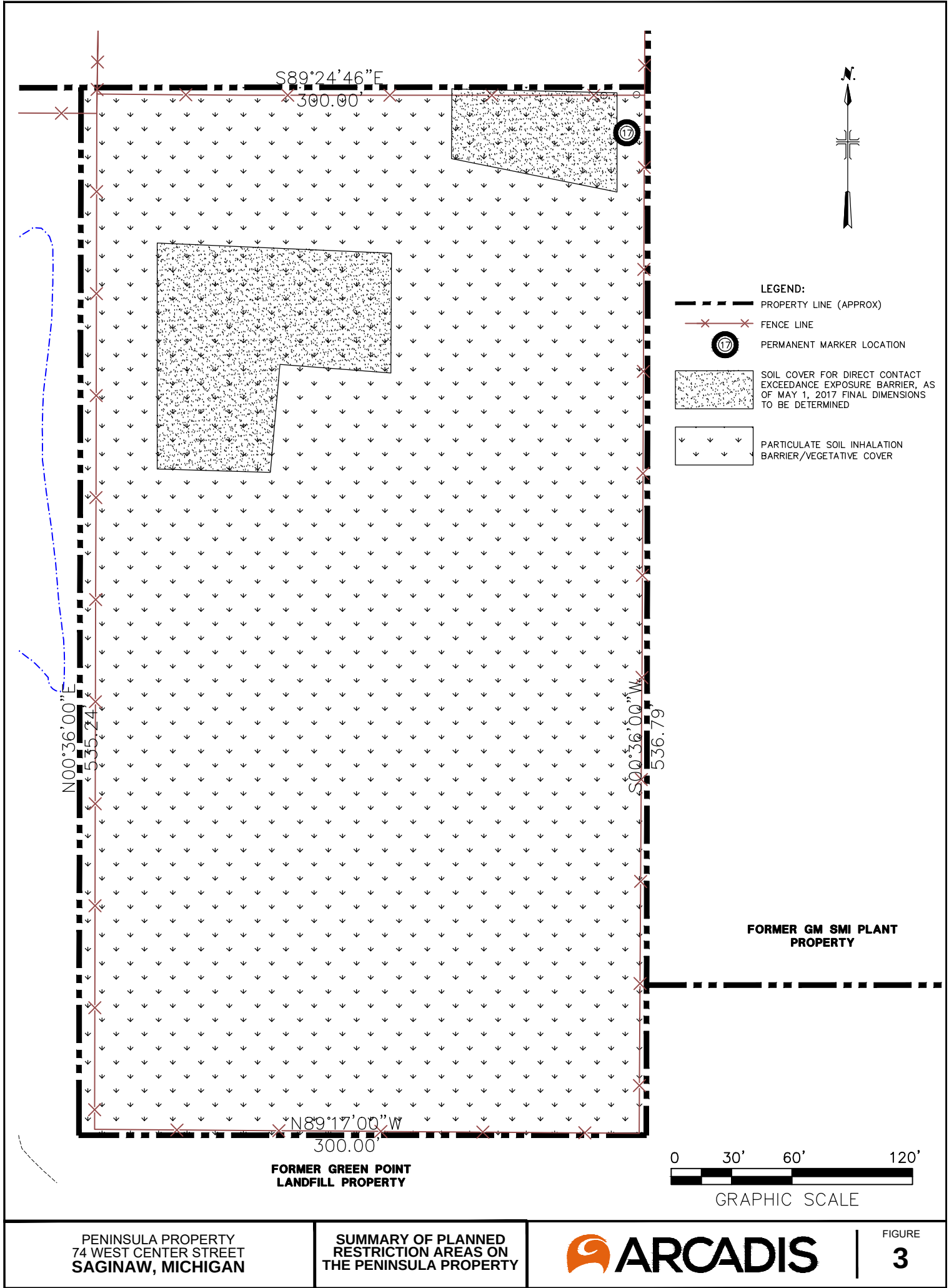
- ELEVATION POINT
- SMI PROPERTY BOUNDARY
- GPL PROPERTY BOUNDARY
- CAPS**
 - INTRUSIVE ACTIVITY PROHIBITION AND SOIL COVER
 - INTRUSIVE ACTIVITY PROHIBITION
 - AREA ABOVE 2017 PROPOSED NON-RESIDENTIAL LEAD CRITERIA
 - LNAPL AREA
 - LNAPL AWARENESS AREA
 - PCB REMEDIATION WASTE/LOW OCCUPANCY AREA WITH A 1-FT SOIL COVER OVER IMPACTS ≤ 10 PPM PCBs
 - TSCA NOTICE AREA - PCB CONCENTRATIONS >100 PPM AT >10 FT BGS; LOW OCCUPANCY RESTRICTION

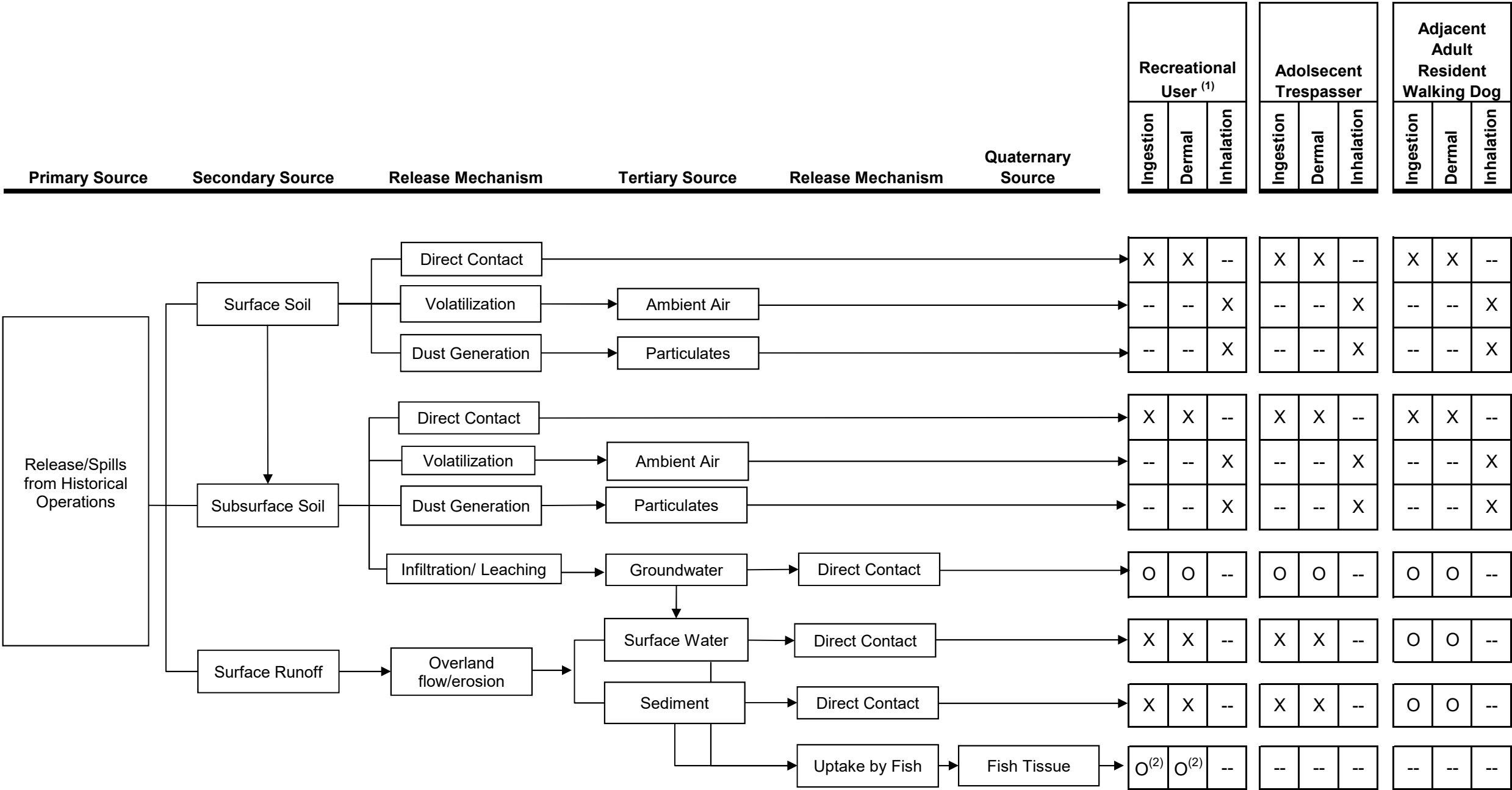
GPL CAP IS A MULTI-LAYER COVER



SAGINAW MALLEABLE INDUSTRIAL LAND PROPERTY,
GREENPOINT LANDFILL, AND PENINSULA PROPERTY
SAGINAW, MICHIGAN

**SUMMARY OF PLANNED RESTRICTION
AREAS ON SMI AND GPL**



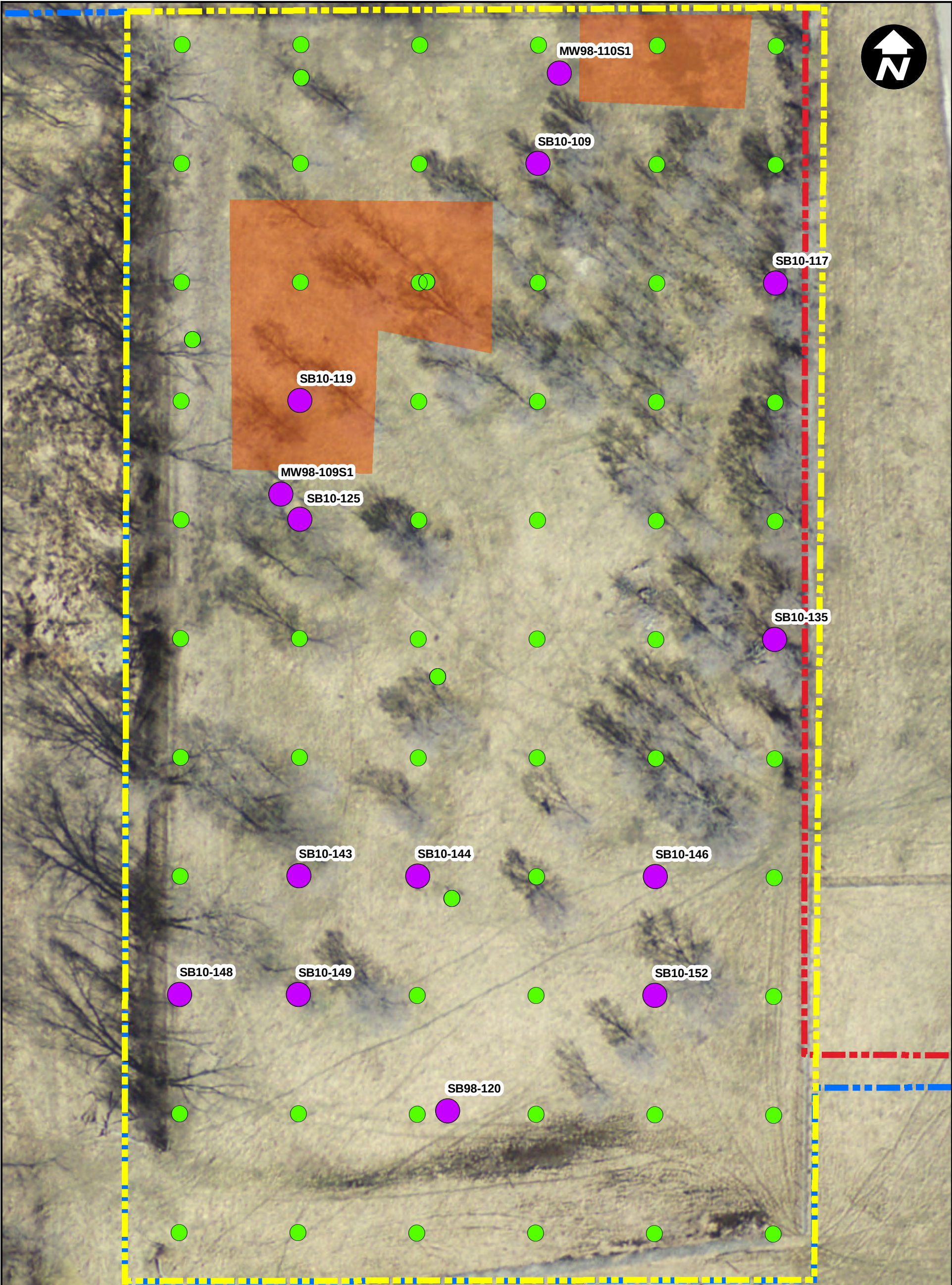


X = Potentially Complete Exposure Pathway
O = Incomplete Exposure Pathway
-- = Not Applicable

⁽¹⁾ = Child only recreational users will be evaluated for non-cancer effects. Age-averaged (child through adult) recreational users will be evaluated for cancer effects (including constituents with a mutagenic mode of action) and child only or adult only recreational users will be evaluated for developmental effects, as appropriate.

⁽²⁾ = The ponds present at the site will not be stocked with fish. Therefore, this pathway is not complete.

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LEGEND

- IRON < 100,000,000 µg/kg
- IRON > 100,000,000 µg/kg
- SOIL COVER
- GPL PROPERTY BOUNDARY
- SMI PROPERTY BOUNDARY
- PENINSULA PROPERTY BOUNDARY

NOTES:

SAMPLES LOCATED IN EXCAVATED AREAS ARE NOT INCLUDED IN THE 95 PERCENT UPPER CONFIDENCE LIMIT (95% UCL) CALCULATIONS. THE TOP 6 INCHES OF SOIL WAS EXCAVATED AND A GEOTEXTILE BARRIER WAS PLACED BEFORE THE EXCAVATION WAS BACKFILLED WITH 6 INCHES OF CLEAN FILL.

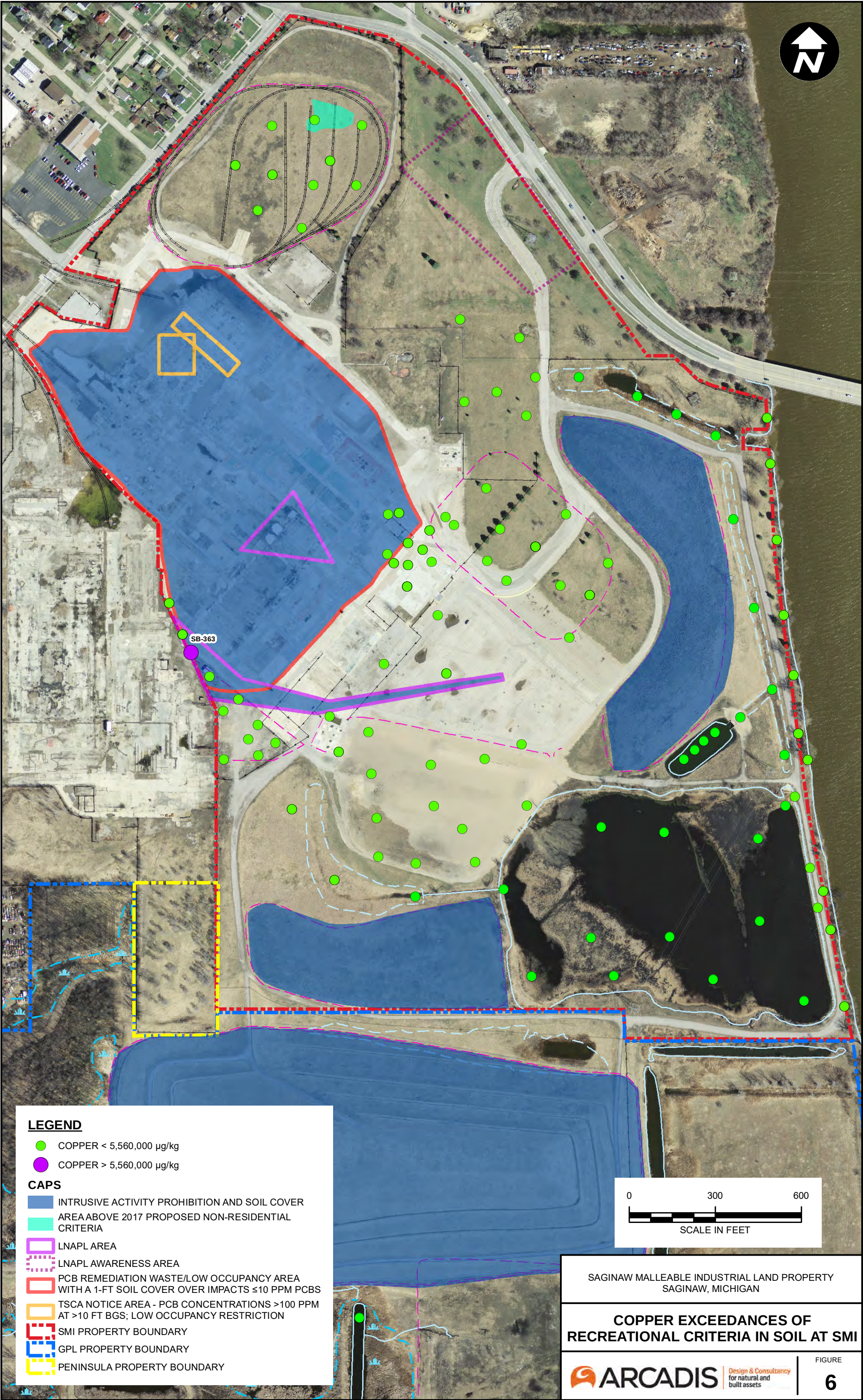


RACER PENINSULA PROPERTY
SAGINAW, MICHIGAN

IRON CONCENTRATIONS IN SOIL
AT PENINSULA



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LEGEND

- COPPER < 5,560,000 µg/kg
- COPPER > 5,560,000 µg/kg

CAPS

- INTRUSIVE ACTIVITY PROHIBITION AND SOIL COVER
- AREA ABOVE 2017 PROPOSED NON-RESIDENTIAL CRITERIA
- LNAPL AREA
- LNAPL AWARENESS AREA
- PCB REMEDIATION WASTE/LOW OCCUPANCY AREA WITH A 1-FT SOIL COVER OVER IMPACTS ≤10 PPM PCBs
- TSCA NOTICE AREA - PCB CONCENTRATIONS >100 PPM AT >10 FT BGS; LOW OCCUPANCY RESTRICTION
- SMI PROPERTY BOUNDARY
- GPL PROPERTY BOUNDARY
- PENINSULA PROPERTY BOUNDARY

SAGINAW MALLEABLE INDUSTRIAL LAND PROPERTY
SAGINAW, MICHIGAN

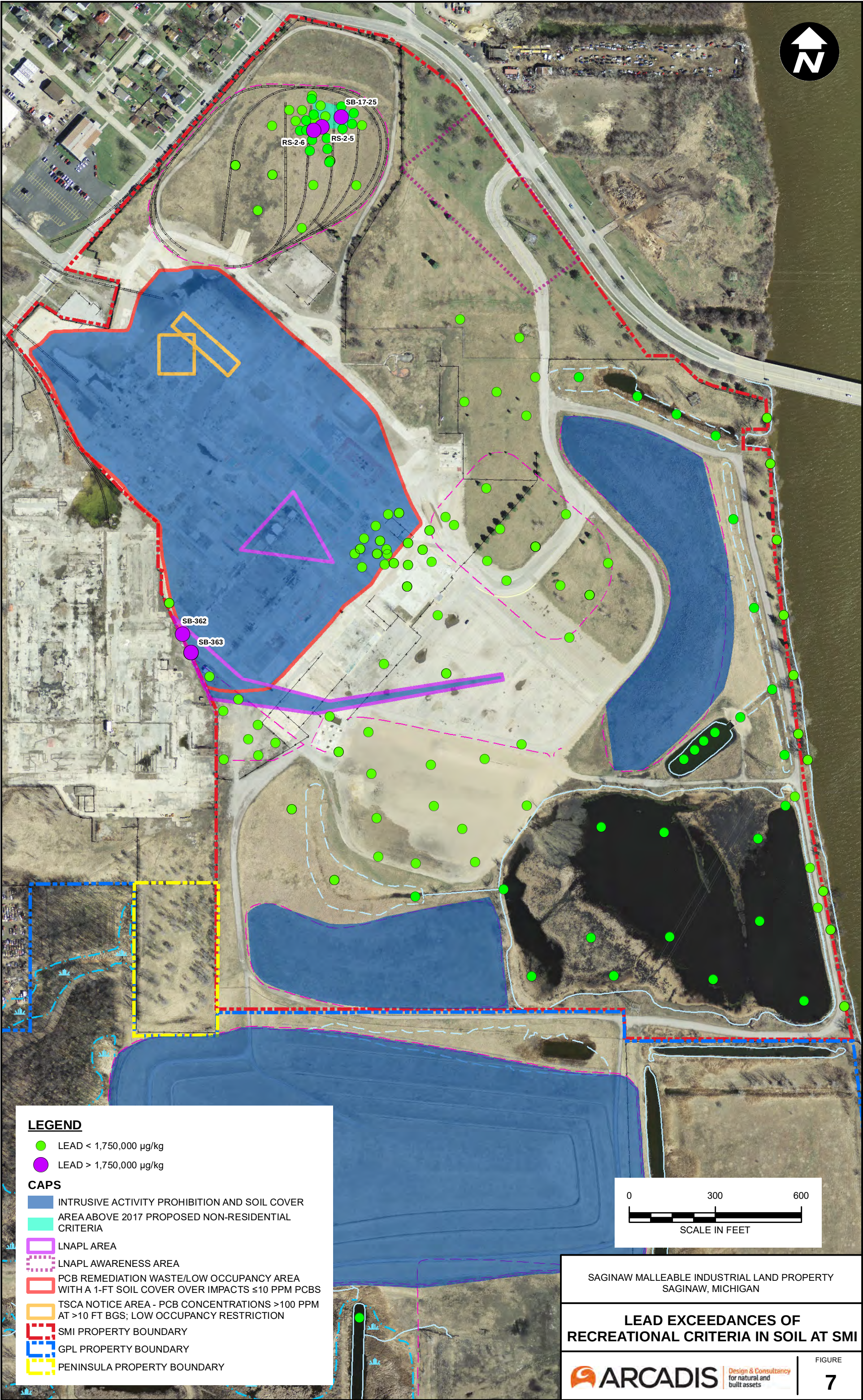
**COPPER EXCEEDANCES OF
RECREATIONAL CRITERIA IN SOIL AT SMI**



FIGURE

6

CITY: Novi, DIV: ENV, DB: TRY, PIC: PM, TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
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LEGEND

- LEAD < 1,750,000 µg/kg
- LEAD > 1,750,000 µg/kg

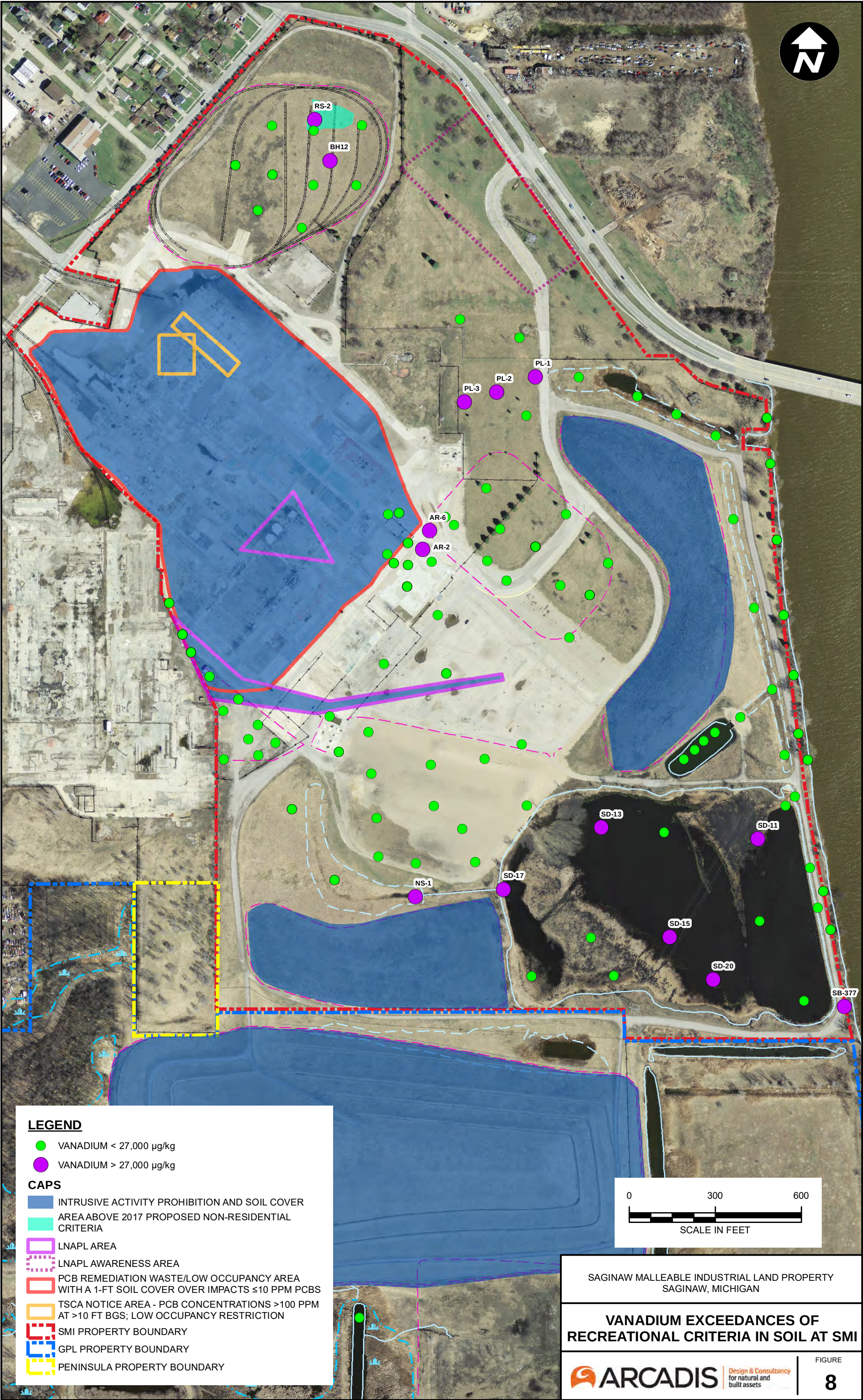
CAPS

- INTRUSIVE ACTIVITY PROHIBITION AND SOIL COVER
- AREA ABOVE 2017 PROPOSED NON-RESIDENTIAL CRITERIA
- LNAPL AREA
- LNAPL AWARENESS AREA
- PCB REMEDIATION WASTE/LOW OCCUPANCY AREA WITH A 1-FT SOIL COVER OVER IMPACTS ≤10 PPM PCBs
- TSCA NOTICE AREA - PCB CONCENTRATIONS >100 PPM AT >10 FT BGS; LOW OCCUPANCY RESTRICTION
- SMI PROPERTY BOUNDARY
- GPL PROPERTY BOUNDARY
- PENINSULA PROPERTY BOUNDARY

SAGINAW MALLEABLE INDUSTRIAL LAND PROPERTY
SAGINAW, MICHIGAN

**LEAD EXCEEDANCES OF
RECREATIONAL CRITERIA IN SOIL AT SMI**

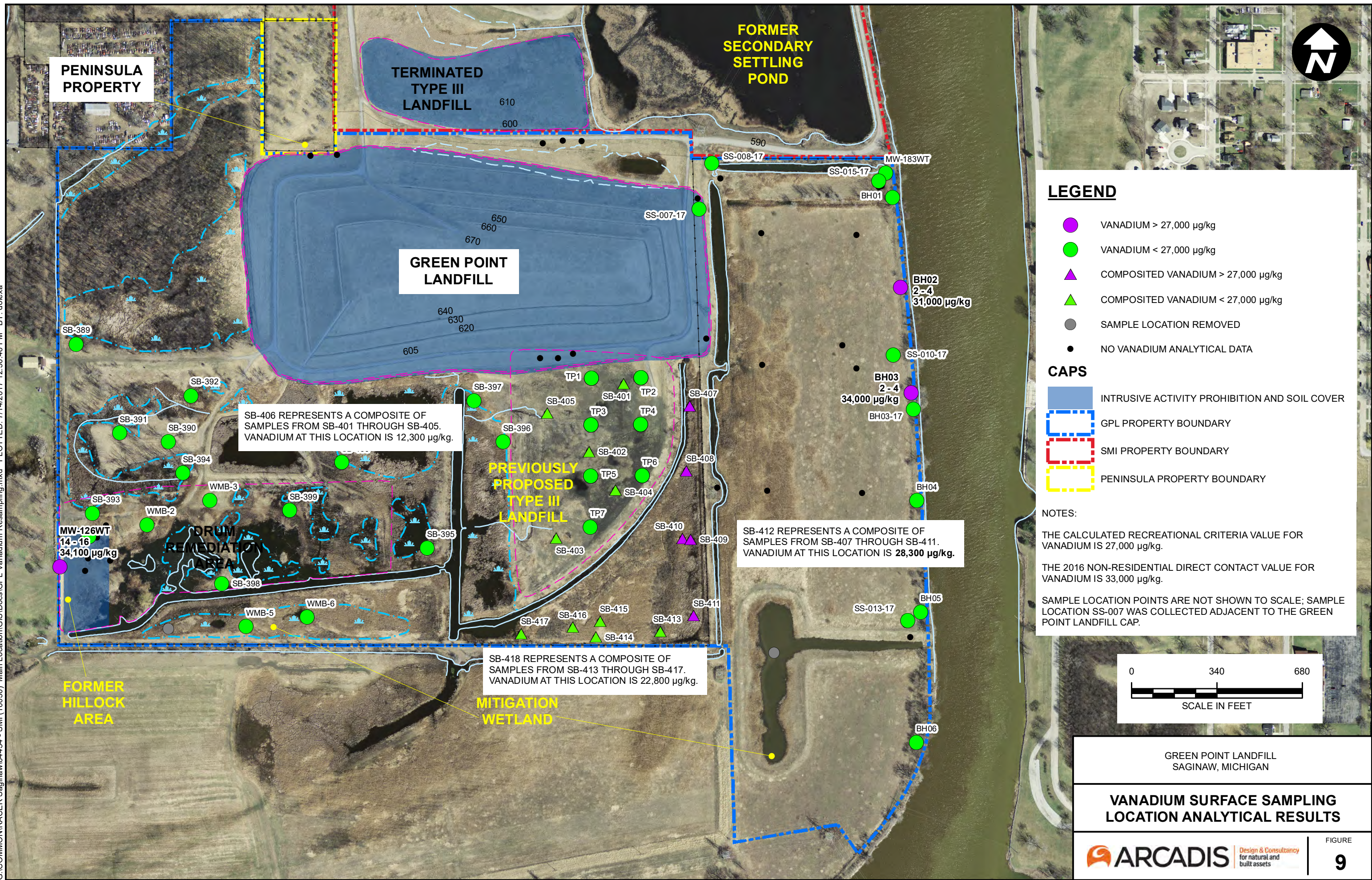
CITY: Novi, DIV: ENV, DB: TRY, PIC: PM, TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\COMMON\RACER\Saginaw\64434 - SMI (10030) Main Location\GIS\Docs\SMI Metals Map.mxd PLOTTED: 9/14/2017 5:28:46 PM BY: dotexa



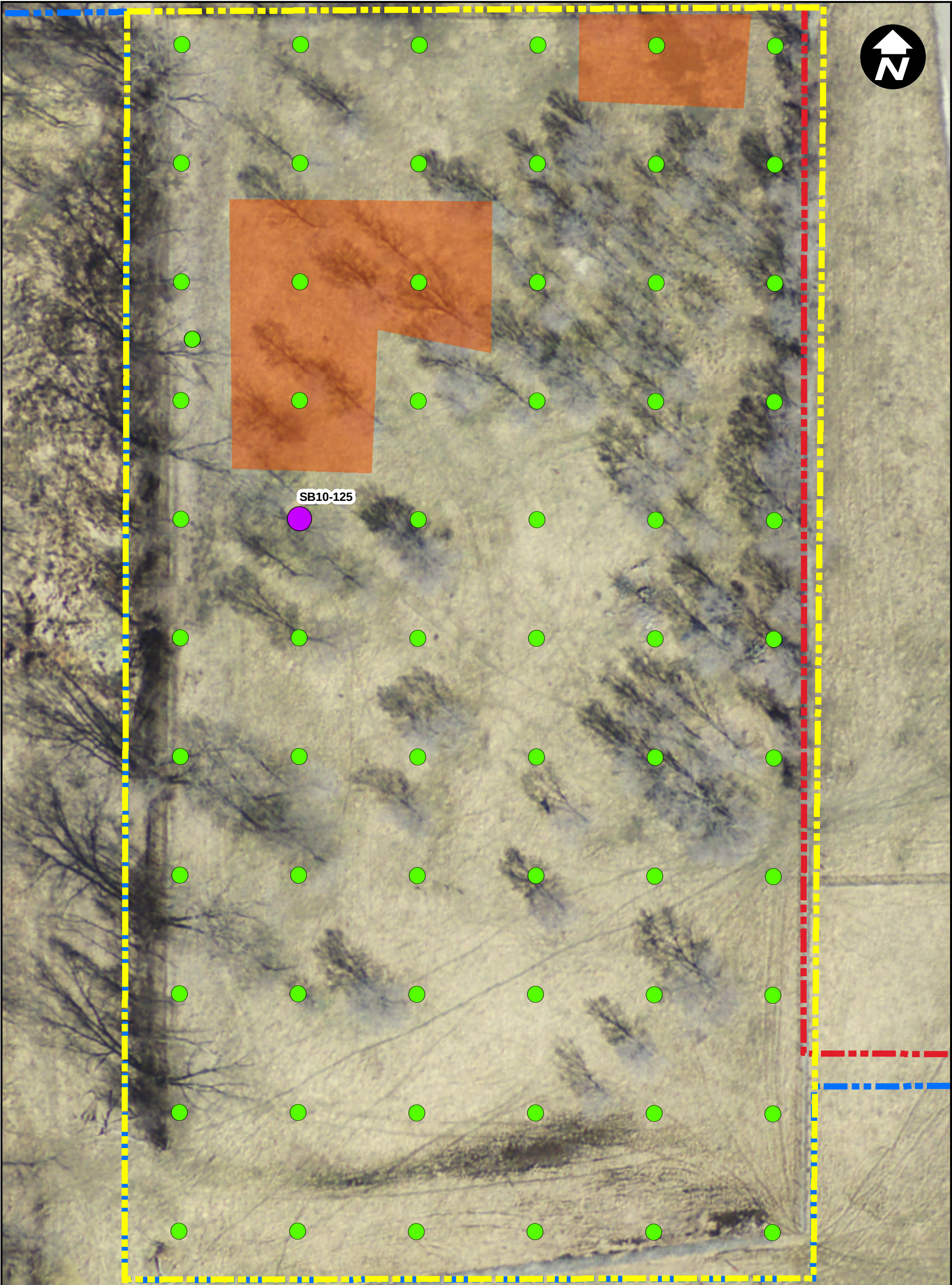
SAGINAW MALLEABLE INDUSTRIAL LAND PROPERTY
SAGINAW, MICHIGAN

**VANADIUM EXCEEDANCES OF
RECREATIONAL CRITERIA IN SOIL AT SMI**

CITY: Novi DIV: ENV DB: TRY PIC: PM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl G:\COMMON\NACER\Saginaw\64434 - SMI (10030) Main Location\GIS\Docs\GPL Vanadium Resampling.mxd PLOTTED: 7/14/2017 12:50:46 PM BY: dolexa



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LEGEND

- COBALT < 1,670,000 µg/kg
- COBALT > 1,670,000 µg/kg
- SOIL COVER
- ▭ GPL PROPERTY BOUNDARY
- ▭ SMI PROPERTY BOUNDARY
- ▭ PENINSULA PROPERTY BOUNDARY

NOTES:

SAMPLES LOCATED IN EXCAVATED AREAS ARE NOT INCLUDED IN THE 95 PERCENT UPPER CONFIDENCE LIMIT (95% UCL) CALCULATIONS. THE TOP 6 INCHES OF SOIL WAS EXCAVATED AND A GEOTEXTILE BARRIER WAS PLACED BEFORE THE EXCAVATION WAS BACKFILLED WITH 6 INCHES OF CLEAN FILL.



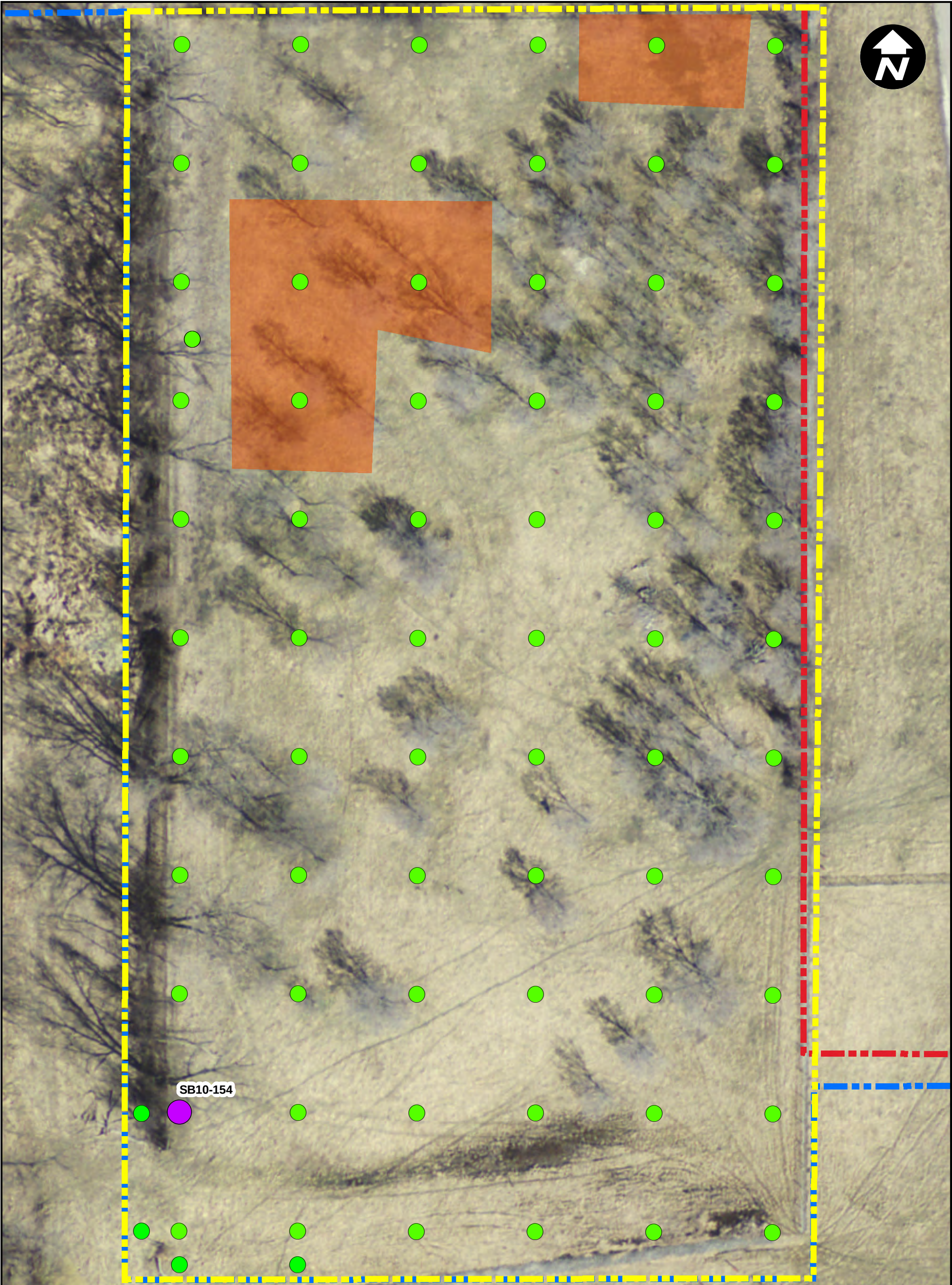
RACER PENINSULA PROPERTY
SAGINAW, MICHIGAN

COBALT EXCEEDANCES OF
RECREATIONAL CRITERIA IN SOIL
AT PENINSULA



FIGURE

10



LEGEND

- MANGANESE < 27,600,000 µg/kg
- MANGANESE > 27,600,000 µg/kg
- SOIL COVER
- GPL PROPERTY BOUNDARY
- SMI PROPERTY BOUNDARY
- PENINSULA PROPERTY BOUNDARY

NOTES:

SAMPLES LOCATED IN EXCAVATED AREAS ARE NOT INCLUDED IN THE 95 PERCENT UPPER CONFIDENCE LIMIT (95% UCL) CALCULATIONS. THE TOP 6 INCHES OF SOIL WAS EXCAVATED AND A GEOTEXTILE BARRIER WAS PLACED BEFORE THE EXCAVATION WAS BACKFILLED WITH 6 INCHES OF CLEAN FILL.



RACER PENINSULA PROPERTY
SAGINAW, MICHIGAN

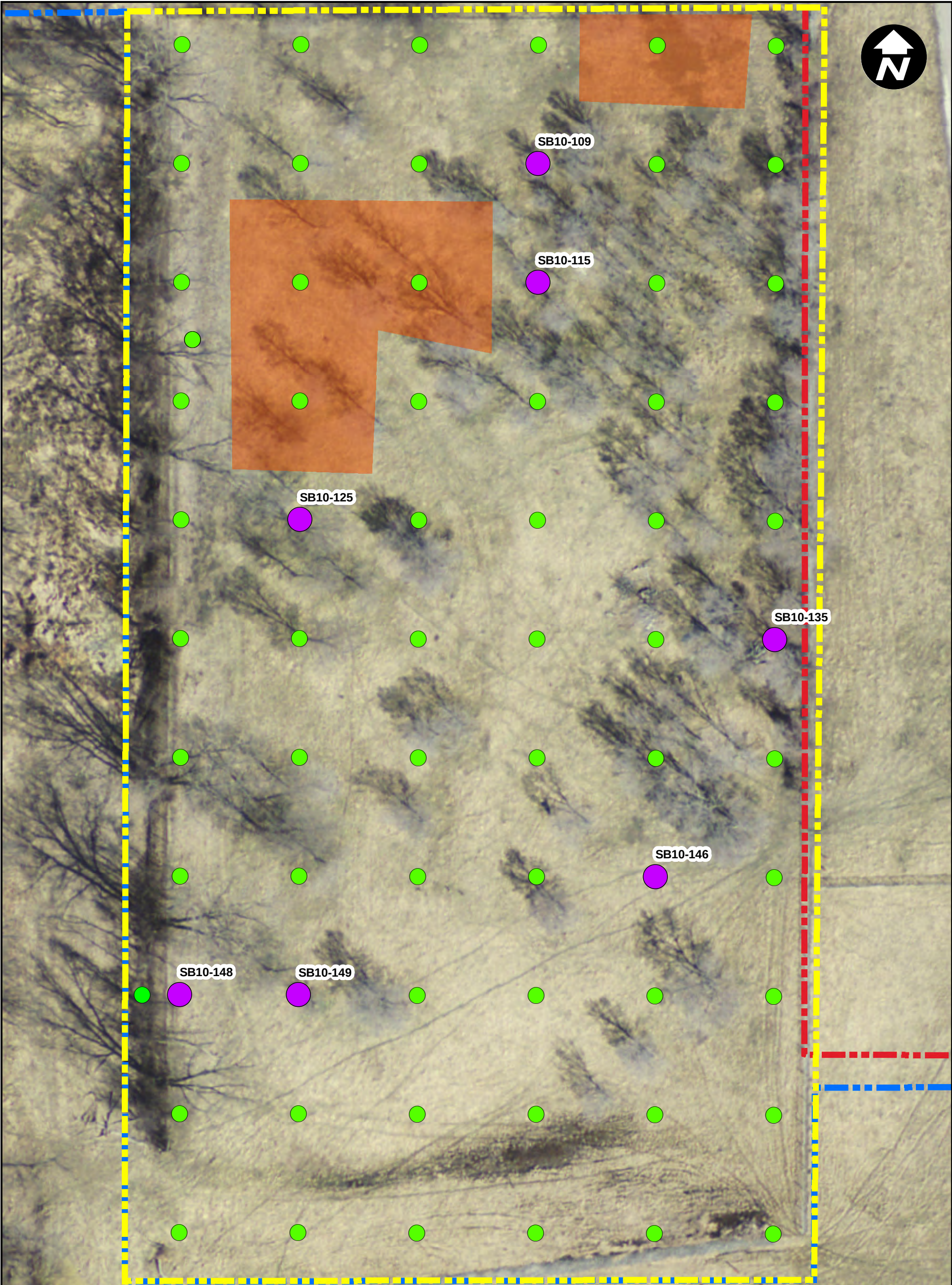
MANGANESE EXCEEDANCES OF
RECREATIONAL CRITERIA IN SOIL
AT PENINSULA



FIGURE

11

CITY: Novi, DIV: ENV, DB: TRY, PIC: PM, TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
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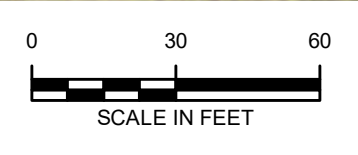


LEGEND

- VANADIUM < 27,000 µg/kg
- VANADIUM > 27,000 µg/kg
- SOIL COVER
- GPL PROPERTY BOUNDARY
- SMI PROPERTY BOUNDARY
- PENINSULA PROPERTY BOUNDARY

NOTES:

SAMPLES LOCATED IN EXCAVATED AREAS ARE NOT INCLUDED IN THE 95 PERCENT UPPER CONFIDENCE LIMIT (95% UCL) CALCULATIONS. THE TOP 6 INCHES OF SOIL WAS EXCAVATED AND A GEOTEXTILE BARRIER WAS PLACED BEFORE THE EXCAVATION WAS BACKFILLED WITH 6 INCHES OF CLEAN FILL.



RACER PENINSULA PROPERTY
SAGINAW, MICHIGAN

**VANADIUM EXCEEDANCES OF
RECREATIONAL CRITERIA IN SOIL
AT PENINSULA**



Design & Consultancy
for natural and
built assets

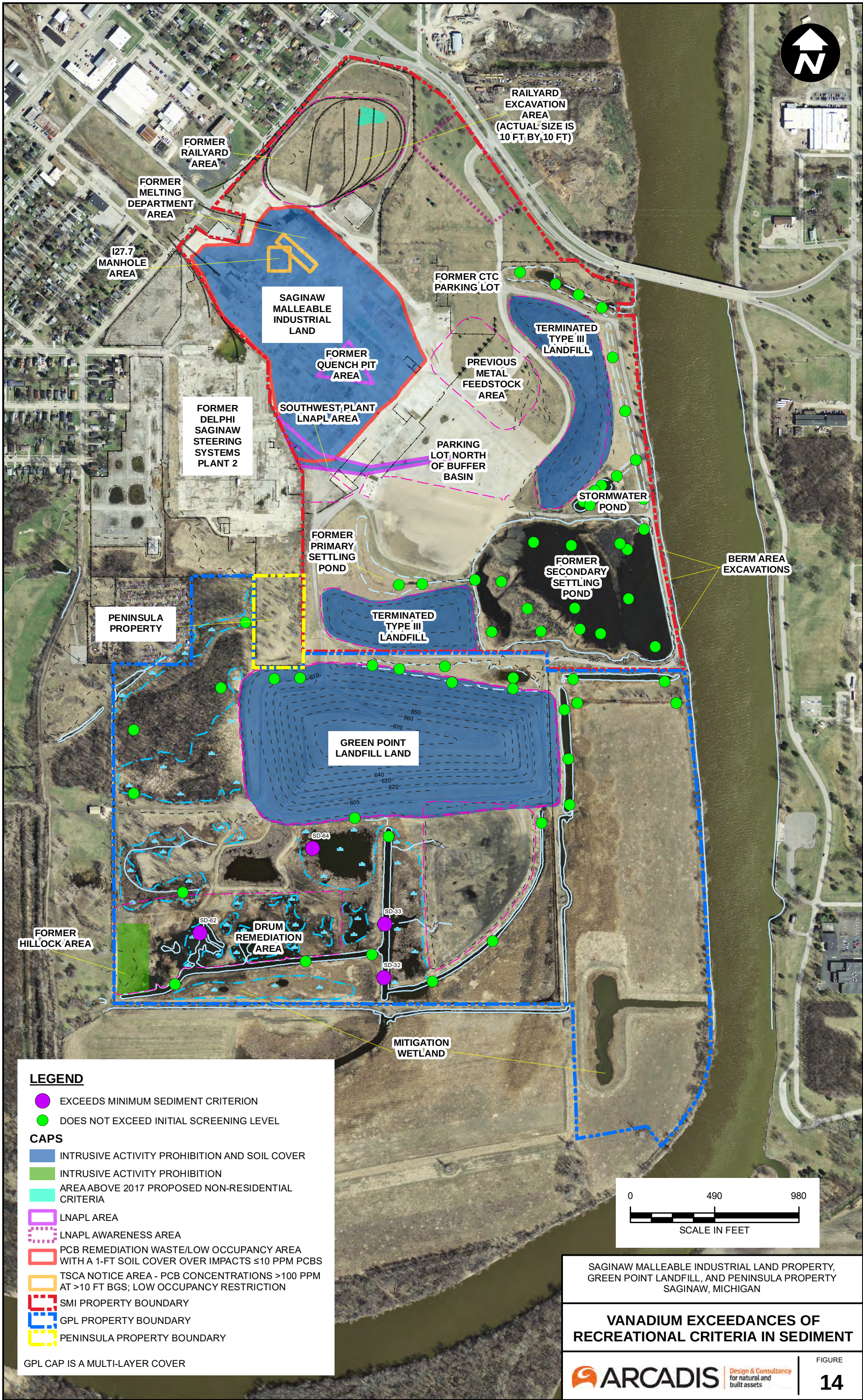
FIGURE

12

CITY: Novi DIV: ENV DB: TRY PIC: PM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
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APPENDIX A

Exposure Parameter Rationale Information



MEMO

To:

Divinia Ries, MDEQ

Copies:

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Rhonda Klann, MDEQ
Ann Person, MDEQ
Scott Clearwater, Arcadis
Dave Favero, RACER Trust

Arcadis U.S., Inc.

114 Lovell Road

Suite 202

Knoxville

Tennessee 37934

Tel 865 675 6700

Fax 865 675 6712

From:

Jeanine Smith, Shawn Sager

Date:

November 1, 2016

Arcadis Project No.:

B0064434.AD16

Subject:

Response to MDEQ Request for Additional Information for the Recreational
Evaluation at the RACER Saginaw Malleable Industrial Property

Arcadis, U.S., Inc. (Arcadis), on behalf of the RACER Trust, has prepared this memo to respond to a request from Ms. Divinia Ries of the Michigan Department of Environmental Quality (MDEQ) for additional information on various proposed exposure parameters for a recreational evaluation of the RACER Saginaw Malleable Industrial (SMI) Property located in Saginaw, Michigan (the Site). The proposed recreational evaluation is intended to evaluate if conditions at the Site are protective of the possible future passive recreational use of the Site. As RACER and Arcadis understand, the park will mainly be used for passive recreational purposes such as bird watching and will have walking and biking paths and will not have playground areas. The Site is located along the Saginaw River and currently has various wetland and surface water areas.

In an email dated October 18, 2016, Ms. Ries requested:

1. Additional rationale for 12 of the proposed exposure parameters,
2. That a child-only recreational user be evaluated for the Site, and

3. An indication of whether each exposure parameter is an upper-bound or a central tendency estimate, if known, and a discussion of how a reasonable maximum exposure (RME) scenario is achieved using the combined exposure estimates.

After further correspondence, Arcadis and MDEQ agreed that various age groups would be used to evaluate the recreational receptor based on the toxicological endpoints evaluated (e.g., for non-cancer endpoints that are not based on developmental effects, a child-only recreational receptor would be evaluated; however, for carcinogenic and mutagenic effects, an age-averaged (child through adult) recreational receptor would be evaluated). Arcadis has updated the conceptual site model (CSM) to reflect these changes. Arcadis has also indicated whether each exposure parameter represents an upper-bound (“U”) or central tendency (“C”) estimate, if known, to the proposed exposure parameter tables. The updated CSM (showing changes in red text) and updated proposed exposure parameter tables are provided in Attachment 1 of this memo.

The following sections provide the requested rationale for the 12 proposed exposure parameters and a discussion of how the RME scenario is achieved using the proposed exposure parameters. The United States Environmental Protection Agency (USEPA) uses a mix of central tendency and RME parameters to develop an RME scenario (USEPA 2007).

Soil-to-Skin Adherence Factor

The USEPA default soil adherence factors for recreational users, as presented in Table 1 of the USEPA Regional Screening Levels (RSLs) User’s Guide (USEPA 2016) were used. The USEPA’s recreational default soil adherence factors are the same as the residential default values, which account for dermal exposure to soil of the face, hands, forearms, and lower legs for receptors in all age groups, and adds in exposure to the feet for children. The adherence factors for each included body part are weighted by skin surface area for each body part. For children, the recommended activity was “playing in wet soil” with an adherence factor of 0.2 milligrams per square centimeter (mg/cm²), and for adults, the recommended activity was “gardening” with an adherence factor of 0.07 mg/cm² (USEPA 2007). The USEPA’s source of the default residential/recreational parameters (USEPA 2014) is the Risk Assessment Guidance for Superfund (RAGS) Part E (USEPA 2007), which indicates these are considered RME assumptions.

Sediment-to-Skin Adherence Factor

The sediment-to-skin adherence factors were obtained from the Risk Assessment Information System (RAIS) Preliminary Remediation Goals (PRGs) for Chemicals Users’ Guide and calculator (University of Tennessee 2016). The PRG calculator provides constituent-specific concentrations in specific media which can be used to determine if further investigation or remedial actions are warranted. The PRG User’s guide provides a soil/sediment scenario for recreational users, with a default soil/sediment adherence factor of 0.2 mg/cm² for children and 0.07 mg/cm² for adults (University of Tennessee 2016). These values are consistent with the USEPA’s default soil adherence factors for recreational scenarios; however, default USEPA values were not available for sediment in the RSLs User’s Guide (USEPA 2016). These sediment-to-skin adherence factors are assumed to represent RME assumptions.

Exposure Duration

The MDEQ default residential exposure duration of 32 years (broken out by age group, as applicable) was used for recreational users. The Site is located near a residential area. Based on this, the most likely users of the future park would be residents that live nearby. Similarly, the USEPA default recreational exposure

durations presented in the USEPA RSLs User's Guide are also consistent with the USEPA default exposure durations for residential scenarios. This exposure duration is considered to represent RME assumptions.

Exposure Frequency for Soil (Dermal Contact, Ingestion, and Inhalation)

The exposure frequency of 75 days per year for soil is based on the default soil exposure frequency for recreational scenarios presented in the RAIS PRGs for Chemicals User's Guide (University of Tennessee 2016). An exposure duration of 75 days per year represents approximately 1 to 2 days of exposure per week.

Exposure Frequency for Sediment and Surface Water (Dermal Contact and Ingestion)

The exposure frequencies for sediment and surface water are based on the proposed soil exposure frequencies and were adjusted to account for exposure only during warmer months. Based on professional judgment, the warmer months were identified as May through September, which have average monthly high temperatures greater than 70 degrees Fahrenheit (Weather Channel 2016). The sediment and surface water exposure frequency is calculated as 75 days per year $\times$ (5 months / 12 months), which is equal to approximately 32 days per year. It was assumed that adult dog walkers would not contact sediment or surface water.

Exposure Time (Soil)

The exposure time for exposure to soil by recreational users is based on the data available in Chapter 16 of the USEPA's Exposure Factors Handbook (USEPA 2011). Age group-specific values were derived from the mean duration spent in "Other Locations" (park, playground listed for highest average time) for all respondents under 12 years of age from Table 16-10, and the mean time spent "Outdoors at Park" from Table 16-84. In Table 16-10, the mean duration for all respondents was 79 minutes per day (1.3 hours per day). In Table 16-84, the mean time ranged between 1.3 hours per day (birth to < 1 month and 3 months to <6 months) to 2.6 hours per day (11 to <16 years). An average time spent in parks for all age groups was rounded to 2 hours per day.

The exposure time for adolescent trespassers was conservatively assumed to be the same as for recreational users.

The exposure time for adult dog walkers is based on information obtained online (pedigree.com 2016) about recommended time for walking a dog.

These exposure times represent central tendency estimates.

Exposure Time (Sediment and Surface Water)

The sediment exposure time was based on professional judgement and the soil exposure time. It was assumed that recreational users and trespassers would spend approximately half of their time at the park playing in surface water bodies, including the wetland and various surface water areas located at the Site. The selection of the exposure time was based on conservative, health-protective, assumptions.

Soil Ingestion Rate

The USEPA default soil ingestion rates for recreational users of 200 milligrams per day (mg/day) for children and 100 mg/day for adults, as presented in the USEPA's RSLs User's Guide (USEPA 2016),

were used. These values are consistent with USEPA default residential soil ingestion parameters and represent upper-bound estimates of combined soil and indoor dust ingestion. Inclusion of the indoor dust ingestion portion of the soil ingestion rate is considered conservative, as exposure at the Site will only occur outdoors. The soil ingestion rate represents an RME approach.

Sediment Ingestion Rate

The recommended soil (including outdoor dust) ingestion rate for the “General Population Central Tendency” from the USEPA’s Exposure Factor Handbook (USEPA 2011) was used as the sediment ingestion rate. For children, an age-averaged value of 40 mg/day was used. For older receptors, the central tendency value for ages 6 to < 21 years was used.

Exposed Skin Surface Area for Sediment Contact

The exposed skin surface area for sediment contact assumes that the receptor is wading in surface water areas present at the Site. The skin surface areas include the head, hands, forearms, lower legs, and feet. Values were obtained from the MDEQ’s “Cleanup Criteria and Screening Levels Development and Application” document (MDEQ 2016a) and were based on recommended values from USEPA’s Exposure Factors Handbook (USEPA 2011). For children, ages 0 to 6 years old, the skin surface area values proposed for sediment contact are consistent with the MDEQ default residential exposed skin surface area values for soil contact, as those default values include the feet. For older receptor age groups (i.e., greater than 6 years old), the surface area of the feet for each age group was added to the default residential surface area for soil contact, as they do not include the feet.

Discussion of How a Reasonable Maximum Exposure Scenario is Achieved

The USEPA describes an RME scenario as individuals or exposures at the upper end of the population distribution (greater than 90th percentile, but not above the distribution). Using a mix of central tendency exposure parameters with RME exposure parameters and constituent-specific toxicity values, as is proposed by Arcadis, will result in an overall RME and health-protective scenario.

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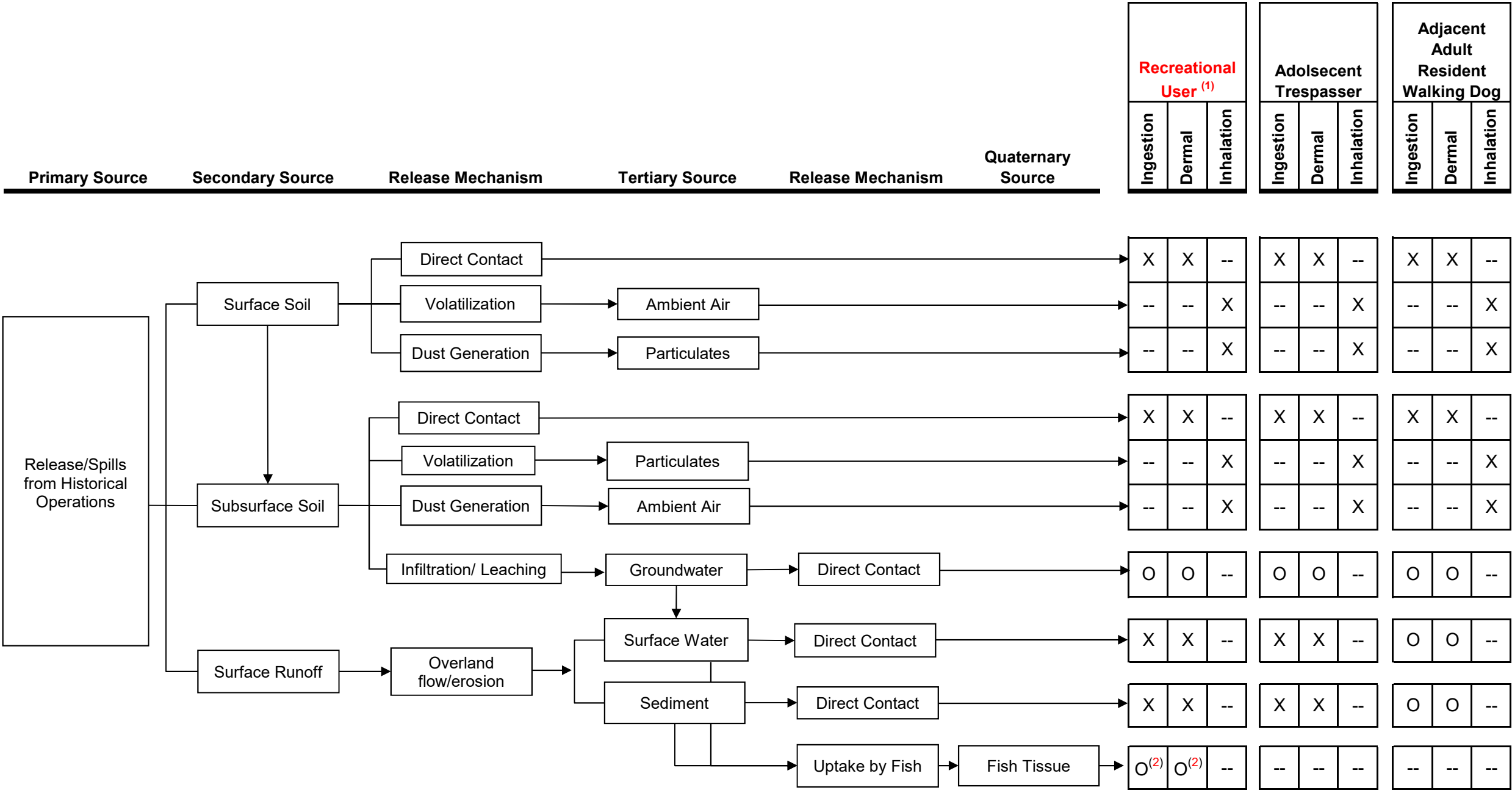
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X = Potentially Complete Exposure Pathway
 O = Incomplete Exposure Pathway
 -- = Not Applicable

⁽¹⁾ = Child only recreational users will be evaluated for non-cancer effects. Age-averaged (child through adult) recreational users will be evaluated for cancer effects (including constituents with a mutagenic mode of action) and child only or adult only recreational users will be evaluated for developmental effects, as appropriate.

⁽²⁾ = The ponds present at the site will not be stocked with fish. Therefore, this pathway is not complete.

Table 1
Recreational Criteria Equations and Exposure Parameters for Soil and Sediment Direct Contact
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

ENDPOINT-SPECIFIC RECREATIONAL SCREENING LEVELS:

Carcinogenic [source: MDEQ 2016]:

$$(DCVrec)_C = \frac{TR \times AT_C \times CF1}{(CSF_o \times EF_{rec} \times IFs \times ET \times CF2 \times AE_i) + (CSF_d \times EF_{rec} \times DFs \times AE_d)}$$

Mutagenic [source: MDEQ 2016]:

$$(DCVrec)_{C,mut} = \frac{TR \times AT_C \times CF1}{(CSF_o \times EF_{rec} \times IFs_{mut} \times ET \times CF2 \times AE_i) + (CSF_d \times EF_{rec} \times DFs_{mut} \times AE_d)}$$

Non-carcinogenic / Developmental [source: MDEQ 2016]:

$$(DCVrec)_{NC} = \frac{THQ \times AT_{NC} \times BW \times RSC_s \times CF1}{ED \times [(1/RfD_o \times EF_{rec} \times IRs \times ET \times CF2 \times AE_i) + (1/RfD_d \times EF_{rec} \times SAs \times EV \times AFs \times AE_d)]}$$

Ingestion Factor:

$$IFs = \frac{IRs_{child} \times ED_{child}}{BW_{child}} + \frac{IRs_{adult} \times ED_{adult}}{BW_{adult}}$$

$$IFs_{mut} = \frac{IRs_{<2} \times ED_{<2} \times ADAF_{<2}}{BW_{<2}} + \frac{IRs_{2-6} \times ED_{2-6} \times ADAF_{2-6}}{BW_{2-6}} + \frac{IRs_{6-16} \times ED_{6-16} \times ADAF_{6-16}}{BW_{6-16}} + \frac{IRs_{16-32} \times ED_{16-32} \times ADAF_{16-32}}{BW_{16-32}}$$

Dermal Factor:

$$DFs = \frac{SAs_{child} \times EV \times AFs_{child} \times ED_{child}}{BW_{child}} + \frac{SAs_{adult} \times EV \times AFs_{adult} \times ED_{adult}}{BW_{adult}}$$

$$DFs_{mut} = \frac{SAs_{<2} \times EV \times AFs_{<2} \times ED_{<2} \times ADAF_{<2}}{BW_{<2}} + \frac{iAs_{2-6} \times EV \times AFs_{2-6} \times ED_{2-6} \times ADAF_{2-6}}{BW_{2-6}} + \frac{SAs_{6-16} \times EV \times AFs_{6-16} \times ED_{6-16} \times ADAF_{6-16}}{BW_{6-16}} + \frac{SAs_{16-32} \times EV \times AFs_{16-32} \times ED_{16-32} \times ADAF_{16-32}}{BW_{16-32}}$$

Final DCVrec = Minimum DCVrec for all endpoints.

Note: The MDEQ (2016) residential soil direct contact equations will be used to calculate recreational criteria. For soil and sediment, the most conservative receptor for developmental endpoints is the child, ages 0 to 6 years old; therefore, equations and exposure parameters are not provided for a pregnant receptor.

Symbol	Parameter	Units	Recreational User																		Trespasser				Dog Walker									
			Mutagenic												Carcinogenic / Non-cancer / Developmental						All endpoints				All Endpoints									
			Infant				Toddler				Adolescent				Adult				Child			Adult			Adolescent				Adult					
			0 to 2 years				2 to 6 years				6 to 16 years				16 to 32 years				0 to 6 years			6 to 32 years			6 to 16 years				26 years					
			value	note		ref	value	note		ref	value	note		ref	value	note		ref	value	note		ref	value	note		ref	value	note		ref				
ADAF	Age-dependent adjustment factor for mutagenic constituents	unitless	10	[a]	--	USEPA 2005	3	[a]	--	USEPA 2005	3	[a]	--	USEPA 2005	1	[a]	--	USEPA 2005	NA				NA				3	[a]	--	USEPA 2005	NA			
AE _d	Dermal absorption efficiency	unitless	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016
AE _i	Ingestion absorption efficiency	unitless	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016
AFs (soil)	Soil-to-skin adherence factor	mg/cm²/event	0.2	[c]	U	USEPA 2016	0.2	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016	0.2	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016	0.07	[c]	U	USEPA 2016
AFs (sed)	Sediment-to-skin adherence factor	mg/cm²/event	0.2	[d]	U	RAIS 2016	0.2	[d]	U	RAIS 2016	0.07	[d]	U	RAIS 2016	0.07	[d]	U	RAIS 2016	0.2	[d]	U	RAIS 2016	0.07	[d]	U	RAIS 2016	0.07	[d]	U	RAIS 2016	NA			
AT _C	Averaging time for cancer effects	days	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016	28,470	[e]	C	MDEQ 2016
AT _{NC}	Averaging time for non-cancer effects	days	730	[f]	U	MDEQ 2016	1,460	[f]	U	MDEQ 2016	3,650	[f]	U	MDEQ 2016	5,840	[f]	U	MDEQ 2016	2,190	[f]	U	MDEQ 2016	9,490	[f]	U	MDEQ 2016	3,650	[f]	U	MDEQ 2016	9,490	[f]	U	MDEQ 2016
BW	Body weight	kg	9.6	[g]	C	MDEQ 2016	17	[g]	C	MDEQ 2016	44	[g]	C	MDEQ 2016	77	[g]	C	MDEQ 2016	15	[g]	C	MDEQ 2016	80	[g]	C	MDEQ 2016	44	[g]	C	MDEQ 2016	80	[g]	C	MDEQ 2016
CF1	Conversion factor for kilograms to micrograms	µg/kg	1.00E-09		NA		1.00E-09		NA		1.00E-09		NA		1.00E-09		NA		1.00E-09		NA		1.00E-09		NA		1.00E-09		NA		1.00E-09		NA	
CF2	Conversion factor for hours to days	day/hour	0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA	
CSF _d	Cancer slope factor for dermal exposure	(mg/kg-day) ⁻¹	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016
CSF _o	Cancer slope factor for oral exposure	(mg/kg-day) ⁻¹	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016
DCV _{rec}	Direct contact value for soil or sediment, recreational scenario	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U	
(DCV _{rec}) _C	Direct contact value for soil or sediment, cancer	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U	
(DCV _{rec}) _{C,mut}	Direct contact value for soil or sediment, cancer-mutagenic	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U	
(DCV _{rec}) _{NC}	Direct contact value for soil or sediment, non-cancer	µg/kg	calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U		calculated		U	
ED	Exposure duration	years	2	[h]	U	MDEQ 2016	4	[h]	U	MDEQ 2016	10	[h]	U	MDEQ 2016	16	[h]	U	MDEQ 2016	6	[h]	U	MDEQ 2016	26	[h]	U	MDEQ 2016	10	[j]	U	PJ	26	[h]	U	MDEQ 2016
EF _d (soil)	Exposure frequency soil, dermal contact	days/year	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	50	[k]	--	PJ	75	[j]	--	PJ
EF _d (sed)	Exposure frequency for sediment, dermal contact	days/year	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	21	[n]	--	PJ	NA			
E _{Fo} (soil)	Exposure frequency soil, ingestion	days/year	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	75	[j]	--	RAIS 2016	50	[k]	--	PJ	75	[j]	--	PJ
E _{Fo} (sed)	Exposure frequency for sediment, ingestion	days/year	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	32	[m]	--	PJ, RAIS 2016	21	[n]	--	PJ	NA			
ET (soil)	Exposure time for soil exposure	hours/day	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[o]	C	USEPA 2011	2	[p]	C	VDEQ 2014	0.33	[q]	C	Pedigree.com
ET (sed)	Exposure time for sediment exposure	hours/day	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[r]	C	RAIS 2016	1	[s]	C	PJ, RAIS 2016	NA			
EV	Event frequency	events/day	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016	1	[t]	C	MDEQ 2016
IRs (soil)	Ingestion rate of soil	mg/day	200	[u]	U	USEPA 2016	200	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016	200	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016	100	[u]	U	USEPA 2016
IRs (sed)	Ingestion rate of sediment	mg/day	40	[v]	C	USEPA 2011	50	[w]	C	USEPA 2011	50	[x]	C	USEPA 2011	50	[x]	C	USEPA 2011	50	[w]	C	USEPA 2011	50	[x]	C	USEPA 2011	50	[w]	C	USEPA 2011	NA			
RfD _d	Reference dose for dermal exposure	mg/kg-day	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016
RfD _o	Reference dose for oral exposure	mg/kg-day	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016	CS	[b]	U	MDEQ 2016
RSC _s	Relative source contribution factor	unitless	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016	CS	[b]	--	MDEQ 2016
SAs (soil)	Exposed skin surface area for soil contact	cm²	2,000	[y]	C	MDEQ 2016	2,600	[y]	C	MDEQ 2016	3,700	[y]	C	MDEQ 2016	5,700	[y]	C	MDEQ 2016	2,400	[y]	C	MDEQ 2016	6,000	[y]	C	MDEQ 2016	3,700	[y]	C	MDEQ 2016	6,000	[y]	C	MDEQ 2016
SAs (sed)	Exposed skin surface area for sediment contact	cm²	2,000	[z]	C	MDEQ 2016	2,600	[z]	C	MDEQ 2016	4,600	[aa]	C	MDEQ 2016	6,900	[aa]	C	MDEQ 2016	2,400	[z]	C	MDEQ 2016	6,100	[aa]	C	MDEQ 2016	4,600	[aa]	C	MDEQ 2016	NA			
THQ	Target hazard quotient for non-cancer effects	unitless	1	[ab]	U	MDEQ 2016	1	[ab]	U	MDEQ 2016	1	[ab]	U	MDEQ 2016	1	[ab]	U	MDEQ 2016	1	[ab]	U	MDEQ 2016	1	[ab]	U	MDEQ 2016	1	[ab]	U	MDEQ 2016	1	[ab]	U	MDEQ 2016
TR	Target cancer risk	unitless	1.00E-05	[ab]	U	MDEQ 2016	1.00E-05	[ab]	U	MDEQ 2016	1.00E-05	[ab]	U	MDEQ 2016	1.00E-05	[ab]	U	MDEQ 2016	1.00E-05	[ab]	U	MDEQ 2016	1.00E-05	[ab]	U	MDEQ 2016	1.00E-05	[ab]	U	MDEQ 2016	1.00E-05	[ab]	U	MDEQ 2016

Definitions:

-- unknown
cm² square centimeter
C central tendency value
CS constituent-specific

kg
mg/cm²/event
mg/day
mg/kg

kilogram
milligram per square centimeter per event
milligram per day
milligram per kilogram

mg/kg-day
(mg/kg-day)⁻¹
NA
PJ

milligram per kilogram per day
per milligram per kilogram per day
not applicable
professional judgement

sed
µg/kg
U

sediment
microgram per kilogram
upper-end value

Table 1
Recreational Criteria Equations and Exposure Parameters for Soil and Sediment Direct Contact
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

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- Notes:**
[a] USEPA default value for specified age group.
[b] Value will be obtained from the draft MDEQ Part 201 Rules (MDEQ 2016), if available.
[c] Value is the USEPA soil adherence factor for recreational users (USEPA 2016, Table 1. Standard Default Factors).
[d] Table 9. Recreator Soil/Sediment Land Use Equation Variables. Adherence factors for soil/sediment exposures.
[e] MDEQ (2016) default value. Based on a lifetime of 78 years, expressed in days.
[f] Value is the exposure duration, expressed in days.
[g] Value is the MDEQ (2016) default body weight for the corresponding age group.
[h] Value is the MDEQ (2016) default exposure durations for residential scenarios, as receptors would likely be nearby residents using the park.
[i] Trespassers are assumed to be adolescents, ages 6 to 16, for a total of 10 years. It is unlikely that young children would be trespassing at this site.
[j] RAIS default value for soil / sediment exposure for the recreational scenario (RAIS 2016, Table 9). Assumed to be spread throughout the year.
[k] Trespassers are assumed to be present at the site one day a week for 50 weeks. This is more conservative than other agencies, such as the VDEQ, which assume trespassers are at a site 24 days per year (6 days per month for 4 months).
[l] Assumes that nearby residents walk their dog in the park 100 days per year, or 2 days a week. Value accounts for snow cover approximately 3 months of the year.
[m] Value is the RAIS (2016) default exposure frequency for soil multiplied by 5/12 to account for warmer months only (May through September). Value is rounded up to the next full day.
[n] Value is the trespasser soil exposure frequency for soil multiplied by 5 /12 to account for warmer months only (May through September). Value is rounded up to the next full day.
[o] Average of mean time spent outdoors at parks from Tables 16-10, 16-82, and 16-84 (USEPA 2011). Value rounded to the nearest hour.
[p] Assumes time spent trespassing at the park would be similar to time spent in recreational activities.
[q] According to Pedigree.com, "Twenty minutes is a good amount of time to aim for most dogs - even seniors, if they're in good health."
[r] Reasonable estimate provided in Table 9 for soil/sediment exposure for recreational scenarios (RAIS 2016). Consistent with one-half of the time spent at the park being spent playing in the sediments.
[s] Reasonable estimate provided in Table 9 for soil/sediment exposure for recreational scenarios (RAIS 2016). Consistent with one-half of the time spent at the park being spent playing in the sediments.
[t] MDEQ (2016) default value for residential and non-residential scenarios.
[u] USEPA (2016) default value for soil ingestion for recreational scenarios.
[v] Average recommended central tendency value for soil ingestion for 6 weeks to < 1 year and 1 year to < 6 years (USEPA 2011, Table 5-1).
[w] Recommended central tendency value for soil ingestion for 1 year to < 6 years (USEPA 2011, Table 5-1).
[x] Recommended central tendency value for soil ingestion for 6 year to < 21 years (USEPA 2011, Table 5-1).
[y] MDEQ (2016) residential default skin surface area for soil dermal contact for specified age group. For children (ages 0 to 6 years), value includes face, hands, forearms, lower legs and feet. For adults (ages 6 to 32), value does not include feet.
[z] The MDEQ (2016) residential default skin surface area for soil dermal contact was used for sediment, as it includes exposure to feet.
[aa] The average skin surface area of the feet was added to the MDEQ (2016) residential default skin surface area for soil dermal contact for the specified age group.
[ab] Value is the MDEQ (2016) default target cancer risk or non-cancer hazard quotient.

Table 2
Recreational Screening Level Equations for Particulate Soil Inhalation
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

ENDPOINT-SPECIFIC RECREATIONAL SCREENING LEVELS [a]:

Inhalation (non-cancer) [source MDEQ 2016]:

(PSICrec)_{NC} =
$$\frac{\text{THQ} \times \text{AT}_{\text{NC}} \times \text{RfC} \times \text{RSC}_a}{\text{EF}_{\text{rec}} \times \text{ED} \times \text{ET} \times \text{CF3} \times (1/\text{PEF})}$$

Final PSICrec = Minimum PSICrec for all endpoints

Note: The MDEQ (2016) residential particulate soil inhalation criteria equations will be used to calculate recreational criteria. No Carcinogenic and mutagenic constituents of potential concern (COPCs) were identified for this pathway. Therefore, the carcinogenic and mutagenic equations and exposure parameters are not provided.

Symbol	Parameter	Units	Recreational User												Trespasser				Dog Walker			
			Non-cancer (includes Developmental / Reproductive Endpoints) [a]												Non-cancer [a]				Non-cancer [a]			
			Child				Pregnant Receptor								Adolescent				Adult			
			0 to 6 years				Single Exposure				Full Term				6 to 16 years				26 years			
			value	note		ref	value	note		ref	value	note		ref	value	note		ref	value	note		ref
AT _{NC}	Averaging time for non-cancer effects	days	2,190	[b]	U	MDEQ 2016	1	[b]	U	MDEQ 2016	280	[b]	U	MDEQ 2016	3,650	[b]	U	MDEQ 2016	9,490	[b]	U	MDEQ 2016
CF2	Conversion factor for hours to days	day/hour	0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA		0.0417		NA	
ED	Exposure duration	years or 1 day	6	[c]	U	MDEQ 2016	1 day	[c]	U	MDEQ 2016	0.767	[c]	U	MDEQ 2016	10	[d]	U	PJ	26	[c]	U	MDEQ 2016
EF	Exposure frequency	days/year or days/day	75	[e]	--	RAIS 2016	1 day/day	[f]	U	MDEQ 2016	75	[g]	--	RAIS 2016	50	[h]	--	PJ	75	[i]	--	PJ
ET	Exposure time	hours/day	2	[j]	C	USEPA 2011	2	[j]	C	USEPA 2011	2	[j]	C	USEPA 2011	2	[k]	C	USEPA 2011	0.33	[l]	C	Pedigree.com
PEF	Particulate emission factor	m³/kg	SS, CS	[m]	C	MDEQ 2016	SS, CS	[m]	C	MDEQ 2016	SS, CS	[m]	C	MDEQ 2016	SS, CS	[m]	C	MDEQ 2016	SS, CS	[m]	C	MDEQ 2016
PSICrec	Particulate Soil Inhalation Criteria for recreation scenario	µg/kg	calculated		U		calculated	U			calculated	U			calculated	U			calculated	U		
RfC	Reference concentration	mg/m³	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016
RSC _a	Relative source contribution factor for air	unitless	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016
THQ	Target hazard quotient for non-cancer effects	unitless	1	[o]	--	MDEQ 2016	1	[o]	--	MDEQ 2016	1	[o]	--	MDEQ 2016	1	[o]	--	MDEQ 2016	1	[o]	--	MDEQ 2016

Definitions:

--	unknown	mg/m³	milligram per cubic meter	SS	site-specific
CS	constituent-specific	NA	not applicable	U	upper-bound estimate
m³/kg	cubic meter per kilogram	PJ	professional judgement		

References:

MDEQ 2016	Michigan Department of Environmental Quality (MDEQ). 2016. Draft Cleanup Criteria Requirements for Response Activity. May 24. Available online at: http://w3.lara.state.mi.us/orr/Files/ORR/1604_2015-094EQ_orr-draft.pdf .
Pedigree.com	Pedigree.com. 2016. "Your Dog's Primal Need to Be Walked." Available online at: http://www.pedigree.com/All-Things-Dog/Article-Library/Your-Dog-s-Primal-Need-to-Be-Walked.aspx . Accessed August 27.
RAIS 2016	The University of Tennessee. 2016. RAIS [The Risk Assessment Information System] Preliminary Remediation Goals (PRGs) for Chemicals User's Guide. Available online at: https://rais.ornl.gov/tools/rais_chemical_prg_guide.html .
USEPA 2011	USEPA. 2011. Exposure Factors Handbook 2011 Edition (Final). EPA/600/R-09/052F. Available online at: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252 .
USEPA 2016	USEPA. 2016. Regional Screening Levels (RSLs) - User's Guide (May 2016). Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-may-2016 .

Notes:

- [a] Carcinogenic and mutagenic constituents of potential concern were not identified for the ambient air inhalation pathway. Therefore, only non-cancer exposure parameters are provided.
- [b] Value is the exposure duration, expressed in days.
- [c] Value is the MDEQ (2016) default exposure durations for residential scenarios, as receptors would likely be nearby residents using the park.
- [d] Trespassers are assumed to be adolescents, ages 6 to 16, for a total of 10 years.
- [e] RAIS default value for soil / sediment exposure for the recreational scenario (RAIS 2016, Table 9). Assumed to be spread throughout the year.
- [f] Single exposure (e.g., 1 day).
- [g] RAIS default value for soil / sediment exposure for the recreational scenario (RAIS 2016, Table 9). Conservatively assumed to occur during pregnancy.
- [h] Trespassers are assumed to be present at the site one day a week for 50 weeks. This is more conservative than other agencies, such as the VDEQ, which assume trespassers are at a site 24 days per year (6 days per month for 4 months).
- [i] Assumes that nearby residents walk their dog in the park 100 days per year, or 2 days a week. Value accounts for snow cover approximately 3 months of the year.
- [j] Average of mean time spent outdoors at parks from Tables 16-10, 16-82, and 16-84 (USEPA 2011). Value rounded to the nearest hour.
- [k] Assumes time spent trespassing at the park would be consistent with time spent in recreational activities.
- [l] According to Pedigree.com, "Twenty minutes is a good amount of time to aim for most dogs - even seniors, if they're in good health."
- [m] A site-specific, and potentially constituent-specific, PEF(s) will be calculated using the MDEQ (2016) equations with region-specific meteorological data and chemical-specific source size estimates.
- [n] Value will be obtained from the draft MDEQ Part 201 Rules (MDEQ 2016), if available.
- [o] Value is the MDEQ (2016) default target non-cancer hazard quotient.

Table 3
Recreational Criteria Equations and Exposure Parameters for Exposure to Surface Water
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

ROUTE-SPECIFIC RECREATIONAL SCREENING LEVELS [source: USEPA 2016b] [a]:

Noncarcinogenic:

Oral:

$$(SWrec_o)_{NC} = \frac{THQ \times AT_{NC} \times RfD_o \times BW \times RSC_w \times CF3}{IR_{sw} \times EF \times ED}$$

Dermal:

$$(SWrec_d)_{NC} = \frac{THQ \times AT_{NC} \times RfD_d \times BW \times CF3}{SA_{sw} \times DA \times EV \times EF \times ED}$$

Dermal Absorption Factors:

Inorganics:

DA [0]

=

$$\frac{K_p \times ET_{sw}}{1000 \text{ cm}^3/L}$$

Organics:

DA [1]

=

$$\frac{2 \text{ FA} \times K_p}{1000 \text{ cm}^3/L} \times [(6 \text{ } \tau \times ET_{sw}) / \pi]^{1/2}$$

or

DA [2]

=

$$\frac{\text{FA} \times K_p}{1000 \text{ cm}^3/L} \times \left(\frac{ET_{sw}}{1 + B} + \frac{2 \text{ } \tau (1 + 3 \text{ B} + 3 \text{ B}^2)}{(1 + B)^2} \right)$$

if $ET_{sw} \leq t^*$

if $ET_{sw} > t^*$

Recreational Screening Level (combining all exposure routes):

SWrec

=

$$\frac{1}{[1 / (SWrec_o)_{NC}] + [1 / (SWrec_d)_{NC}]}$$

Final SWrec = Minimum of SWrec for all endpoints

Note: The USEPA Regional Screening Level equations for recreational users exposed to surface water will be used to calculate recreational criteria. No carcinogenic or mutagenic constituents of potential concern (COPCs) were identified for surface water. Therefore, the carcinogenic and mutagenic equations and exposure parameters are not provided.

Symbol	Parameter	Units	Recreational User												Trespasser			
			Non-cancer (includes Developmental / Reproductive Endpoints) [a]												Non-cancer [a]			
			Child				Pregnant Receptor								Adolescent			
			0 to 6 years				Single Exposure				Full Term				6 to 16 years			
			value	note		ref	value	note		ref	value	note		ref	value	note		ref
τ	Lag time for dermal absorption through the skin	hour	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
AT_{NC}	Averaging time for noncancer effects	days	2,190	[c]	U	MDEQ 2016	1	[c]	U	MDEQ 2016	280	[c]	U	MDEQ 2016	3,650	[c]	U	MDEQ 2016
B	Dimensionless ratio of the permeability coefficient of a compound through the stratum corneum relative to its permeability coefficient across the viable epidermis	unitless	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
BW	Body weight	kg	15	[d]	C	MDEQ 2016	75	[d]	C	MDEQ 2016	75	[d]	C	MDEQ 2016	44	[d]	C	MDEQ 2016
CF3	Conversion factor for milligrams to micrograms	µg/mg	1,000		NA		1,000		NA		1,000		NA		1,000		NA	
DA	Dermal absorption factor, calculated using Equation [0], [1], or [2], as appropriate	L/cm²/event	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
ED	Exposure duration	years or days	6	[e]	U	MDEQ 2016	1 day	[e]	U	MDEQ 2016	0.767	[e]	U	MDEQ 2016	10	[e]	U	MDEQ 2016
EF	Exposure frequency	days/year or day/day	32	[f]	--	PJ, RAIS 2016	1	[g]	--	MDEQ 2016	32	[h]	--	PJ, RAIS 2016	21	[i]	--	PJ
ET_{sw}	Exposure time for wading or swimming water contact	hours/event	1	[j]	C	RAIS 2016	1	[j]	C	RAIS 2016	1	[j]	C	RAIS 2016	1	[j]	C	PJ, RAIS 2016
EV	Event frequency	events/day	1	[k]	--	USEPA 2016b	1	[k]	--	USEPA 2016b	1	[k]	--	USEPA 2016b	1	[k]	--	USEPA 2016b
FA	Fraction of absorbed water	unitless	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
IR_{sw}	Incidental ingestion rate of surface water, assumes a 1-hour exposure	L/day	0.0037	[l]	C	USEPA 2011	0.0037	[l]	C	USEPA 2011	0.0037	[l]	C	USEPA 2011	0.05	[m]	C	USEPA 2016b
K_p	Permeability coefficient	cm/hour	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
RfD_d	Reference dose for dermal exposure	mg/kg-day	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016
RfD_o	Reference dose for oral exposure	mg/kg-day	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016	CS	[n]	U	MDEQ 2016
RSC_w	Relative source contribution factor	unitless	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016	CS	[n]	--	MDEQ 2016
SA_{sw}	Exposed skin surface area for surface water contact	cm²	2,400	[o]	C	MDEQ 2016	7,000	[p]	C	MDEQ 2016	7,000	[p]	C	MDEQ 2016	13,400	[q]	C	USEPA 2011
SWrec	Recreational screening level for surface water	µg/L	calculated		U		calculated		U		calculated		U		calculated		U	
t^*	Time required to reach steady state	hour	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a	CS	[b]	--	USEPA 2016a
THQ	Target hazard quotient for non-cancer effects	unitless	1	[r]	U	MDEQ 2016	1	[r]	U	MDEQ 2016	1	[r]	U	MDEQ 2016	1	[r]	U	MDEQ 2016

Definitions:																		
--	unknown	CS	constituent-specific		mg/kg-day	milligram per kilogram per day		U	upper-bound estimate									
C	central tendency estimate	kg	kilogram		NA	not applicable		µg/L	microgram per liter									
cm²	square centimeter	L/cm²/event	liter per square centimeter per event		PJ	professional judgement		µg/mg	microgram per milligram									
cm/hour	centimeter per hour	L/day	liter per day		SS	site-specific												

Table 3
Recreational Criteria Equations and Exposure Parameters for Exposure to Surface Water
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

References:

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RAIS 2016	The University of Tennessee. 2016. RAIS [The Risk Assessment Information System] Preliminary Remediation Goals (PRGs) for Chemicals User's Guide. Available online at: https://rais.ornl.gov/tools/rais_chemical_prg_guide.html .
USEPA 2011	USEPA. 2011. Exposure Factors Handbook 2011 Edition (Final). EPA/600/R-09/052F. Available online at: https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=236252 .
USEPA 2016a	USEPA. 2016a. Regional Screening Levels (RSLs) - Generic Tables (May 2016). Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables-may-2016 .
USEPA 2016b	USEPA. 2016b. Regional Screening Levels (RSLs) - User's Guide (May 2016). Available online at: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-may-2016 .

Notes:

[a]	Carcinogenic and mutagenic constituents of potential concern were not identified for surface water. Therefore, only non-cancer exposure parameters are provided.
[b]	Value obtained from the USEPA RSL Tables.
[c]	Value is the exposure duration, expressed in days.
[d]	Value is the MDEQ (2016) default body weight for the corresponding age group.
[e]	Value is the MDEQ (2016) default exposure durations for residential scenarios, as receptors would likely be nearby residents using the park.
[f]	Value is the RAIS (2016) default exposure frequency multiplied by 5/12 to account for warmer months only (May through September). Value is rounded up to the next full day.
[g]	Single exposure (e.g., 1 day).
[h]	RAIS default value for sediment exposure for the recreational scenario (RAIS 2016, Table 9), multiplied by 5/12 to account for warmer months only (May through September). Conservatively assumed to occur during pregnancy.
[i]	Value is the trespasser soil exposure frequency multiplied by 5 /12 to account for warmer months only (May through September). Value is rounded up to the next full day.
[j]	Surface water exposure time is equal to sediment exposure time. Reasonable estimate provided in Table 9 for soil/sediment exposure for recreational scenarios (RAIS 2016).
[k]	USEPA (2016b) default for event frequency.
[l]	USEPA (2011) surface water ingestion rate for wading / splashing, assuming 1 hour of exposure (Table 3-93).
[m]	USEPA (2016b) surface water ingestion rate for swimming, assuming 1 hour exposure.
[n]	Value will be obtained from the draft MDEQ Part 201 Rules (MDEQ 2016), if available.
[o]	Value is consistent with sediment exposure.
[p]	The average skin surface area of the feet was added to the MDEQ (2016) residential default skin surface area for soil dermal contact for the specified age group.
[q]	The trespasser is assumed to swim in the Secondary Settling Pond. Value is the average skin surface area for the whole body for 6 to <16 year olds from Table 7-1 (USEPA 2011).
[r]	Value is the MDEQ (2016) default target non-cancer hazard quotient.

Smith, Jeanine

From: Ries, Divinia (DEQ) <RIESD@michigan.gov>
Sent: Thursday, January 12, 2017 10:46 AM
To: Clearwater, Scott; Armbruster, Amanda (DEQ)
Cc: Klann, Rhonda (DEQ); Person, Ann (DEQ); Dave Favero <dfavero@racertrust.org>; Smith, Jeanine; Flaga, Christine (DEQ)
Subject: RE: RACER Saginaw Malleable - Memo for Additional Exposure Parameter Rationale
Attachments: Wilson et al 2014 sediment ingestion rates.pdf; RE: RACER Saginaw sediment ingestion rates

Good morning all,

FYI...
Jeanine and I discussed the proposed sediment ingestion rates based on the Wilson et al. 2014 study. I concur with the sediment ingestion rate proposed for each age group (see attached). The sediment ingestion rate was the only parameter that required further consideration in the development of site-specific recreational screening levels for the site. Therefore, Jeanine could proceed with incorporating these values in her calculation of sediment recreational screening levels and finalize the HHRA.

Thank you,
Divinia

Divinia Nolasco Ries, MPH, MS, Ph.D.

Toxicology Specialist
Remediation and Redevelopment Division
Department of Environmental Quality
P.O. Box 30426
Lansing MI 48909-7926
Phone#: 517-284-5142
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From: Ries, Divinia (DEQ)
Sent: Tuesday, December 13, 2016 9:45 AM
To: 'Clearwater, Scott'
Cc: Armbruster, Amanda (DEQ); Klann, Rhonda (DEQ); Person, Ann (DEQ); Dave Favero <dfavero@racertrust.org>; Smith, Jeanine
Subject: RE: RACER Saginaw Malleable - Memo for Additional Exposure Parameter Rationale

Hi Scott,
Let me review the table again. Based on my recollection, it seems to be as you say except I have a clarification on the use of "exposure time (ET)". This parameter is only applicable to the ingestion pathway, not dermal. I'm sharing it with your group (see attached) as a possible reference for establishing a sediment ingestion rate. This study established sediment ingestion rates for different age groups using probabilistic analysis; this was used at another site that is also doing risk assessment on recreational contact with sediment.

I'll confirm the proposed exposure parameters later today. Thanks.

-Divinia

From: Clearwater, Scott [<mailto:Scott.Clearwater@arcadis.com>]
Sent: Monday, December 12, 2016 3:08 PM
To: Ries, Divinia (DEQ)
Cc: Armbruster, Amanda (DEQ); Klann, Rhonda (DEQ); Person, Ann (DEQ); Dave Favero <dfavero@racertrust.org>; Smith, Jeanine
Subject: RE: RACER Saginaw Malleable - Memo for Additional Exposure Parameter Rationale

Divinia,

I am following up with your phone call from the end of November where you indicated that we need to use a high end estimate for the sediment ingestion rate for children. I noted that this was needed in order to cover any scenario since it is a sensitive parameter in the calculator if we still plan to exclude the fishing/wading/swimming restriction. We are working on making these adjustments and we wanted to confirm is the exposure parameter table approved pending use of a high end sediment ingestion rate for children?

Thanks,
Scott

From: Ries, Divinia (DEQ) [<mailto:RIESD@michigan.gov>]
Sent: Monday, November 14, 2016 1:31 PM
To: Clearwater, Scott <Scott.Clearwater@arcadis.com>
Cc: Armbruster, Amanda (DEQ) <ARMBRUSTERA@michigan.gov>; Klann, Rhonda (DEQ) <KLANNR@michigan.gov>; Person, Ann (DEQ) <PERSONA@michigan.gov>; Dave Favero <dfavero@racertrust.org> <dfavero@racertrust.org>; Smith, Jeanine <Jeanine.Smith@arcadis.com>
Subject: RE: RACER Saginaw Malleable - Memo for Additional Exposure Parameter Rationale

Hi all,

Just got back to the office today, thank you. I will review the revised memo this week and should have a response by early next week.

Thanks,
Divinia

Divinia Nolasco Ries, MPH, MS, Ph.D.

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From: Clearwater, Scott [<mailto:Scott.Clearwater@arcadis.com>]
Sent: Tuesday, November 01, 2016 11:17 AM
To: Ries, Divinia (DEQ)
Cc: Armbruster, Amanda (DEQ); Klann, Rhonda (DEQ); Person, Ann (DEQ); Dave Favero <dfavero@racertrust.org>; Smith, Jeanine
Subject: RACER Saginaw Malleable - Memo for Additional Exposure Parameter Rationale

Divinia,

Attached is a memo providing the additional rationale supporting exposure parameter selection for a recreational evaluation of the RACER Saginaw Malleable Site for your review per your request at our recent recreational exposure parameter review meeting on October 7, 2016. Please let us know if you have any questions or if you would like to discuss the exposure parameter table further.

Thanks,

Scott

Scott Clearwater | Certified Project Manager | scott.clearwater@arcadis.com

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Smith, Jeanine

From: Smith, Jeanine <Jeanine.Smith@arcadis.com>
Sent: Thursday, January 12, 2017 10:03 AM
To: Ries, Divinia (DEQ)
Subject: RE: RACER Saginaw sediment ingestion rates

Recommended from Paper

Age Group		Duration (years)	Rate (mg/hour)	
			Mean	95th percentile
Toddlers	7 months-4 years	5	72	300
Children	5-11 years	7	57	250
Teens	12-19 years	8	18	70
Adults	20-59 years	40	20	80
Seniors	60+ years	19	20	80

Calculated for Specific Age Groups

Age Group		Duration (years)	Rate (mg/hour)		Recommended
			Mean	95th percentile	
0 to 6		6	69.5	291.7	300
6 to 32		26	27.9	116.2	116
0 to 2		2	72	300	300
2 to 6		4	68.25	287.5	300
6 to 16		10	41.4	178	178
16 to 32		16	19.7	78.5	80

Jeanine Smith | Project Life Scientist | jeanine.smith@arcadis.com

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-----Original Appointment-----

From: Ries, Divinia (DEQ) [mailto:RIESD@michigan.gov]

Sent: Tuesday, January 10, 2017 2:53 PM

To: Smith, Jeanine

Subject: Accepted: RACER Saginaw sediment ingestion rates

When: Thursday, January 12, 2017 10:00 AM-10:30 AM (UTC-05:00) Eastern Time (US & Canada).

Where: Jeanine will call Divinia

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Estimation of Sediment Ingestion Rates Based on Hand-to-Mouth Contact and Incidental Surface Water Ingestion

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Estimation of Sediment Ingestion Rates Based on Hand-to-Mouth Contact and Incidental Surface Water Ingestion

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ABSTRACT

There is a lack of scientifically justified approaches for assessing sediment ingestion rates of people exposed to contaminated sediments. Consequently, a method was developed to estimate sediment ingestion rates from: (1) hand-to-mouth contact with sediments and (2) incidental ingestion of surface water containing suspended sediments. In the case of hand-to-mouth contact, a mechanistic approach was used based on established principles and assumptions previously used for estimation of soil and dust ingestion rates. A key modification of the approach was to account for greater adherence of sediments to hands as compared to soil and dusts. For estimation of sediment ingestion from surface water contact, a method was developed that considered the unique aspects of suspended sediments. The analysis indicated that hand-to-mouth contact is the dominant pathway for ingestion of sediment. When people use aquatic areas for recreational purposes, the analysis has indicated that mean sediment ingestion rates may range from 18 to 72 mg/h for various receptor age groups. For sites where people spend more than 1 h per day on a consistent basis in direct contact with sediments, the results indicate that sediment ingestion rates may be greater than those typically assumed in Canadian human health risk assessment guidance for soils.

Key Words: sediment ingestion, HHRA, hand-to-mouth, risk, contaminated sediment.

INTRODUCTION

Similar to sites with chemical impacts to soils, it is not uncommon to find sediments in aquatic environments which have been impacted by historical activities and

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have elevated levels of chemical contaminants. When such impacts are identified, it can be difficult to interpret the significance to human health from use of these areas since most sediment standards or guidelines in Canada and other parts of the world have been developed for protection of ecological health and have not considered impacts to human health. One approach for identifying chemicals of concern in sediment is to compare the values to soil criteria developed for protection of human health (*e.g.*, soil quality guidelines from the Canadian Council of Ministers of the Environment [CCME]). Numerous soil criteria exist for protection of human health; however, soil guidelines should only be used as *de facto* sediment criteria for protection of human health if the parameters used to develop the soil criteria are reasonable for estimating exposure to sediment. Since the ingestion rate is a large part of soil and sediment contact rates, it is important to establish the validity of soil ingestion rates for sediment exposures.

Multiple soil tracer studies have been conducted over the past 25 years to quantify the soil ingestion rate via biomarker studies of elemental tracers in fecal matter (Binder *et al.* 1986; Clausen *et al.* 1987; van Wijnen *et al.* 1990; Calabrese *et al.* 1989, 1997; Davis *et al.* 1990; Davis and Mirick 2006). In the case of sediment ingestion rates, no empirical study using tracer elements has been identified which addressed this specific exposure pathway. Aside from Texas Commission on Environmental Quality (TCEQ), recommended sediment ingestion rates were not identified from any major health agency. TCEQ (2007) recommended that sediment ingestion rates can be assumed to be similar to soil ingestion rates; TCEQ guidance provides 191 mg/d for a 15 kg child (age 0–6 years) for use in the assessment of non-carcinogens; and an age-adjusted by body weight value of 120 mg-yr/kg bw-day to represent childhood through adulthood when carcinogens are assessed; however, the rationale for these assumptions is not clearly provided.

For soils, Health Canada (2010, 2012) and CCME (2006) currently assume toddlers (age 7 months to 4 years) ingest soil at a rate of 80 mg/d based on several fecal tracer studies (Binder *et al.* 1986; Clausen *et al.* 1987; van Wijnen *et al.* 1990; Calabrese *et al.* 1989, 1997; Davis *et al.* 1990; Davis and Mirick 2006). A meta-analysis and re-evaluation of these fecal tracer studies estimated a mean soil ingestion rate of 26 mg/d for children (age 1–8 years) (Stanek *et al.* 2012). Using probabilistic, mechanistic methods rather than tracer studies, Özkaynak *et al.* (2011) estimated mean soil ingestion rates of 41 mg/d for children 3 to <6 years of age while Wilson *et al.* (2013) estimated mean soil ingestion rates of 20 mg/d for toddlers 7 months to 4 years old.

Certain exposure factors suggest that incidental sediment ingestion rates may be higher than soil ingestion rates while other factors indicate the potential for lower rates. When sediment contact occurs, the higher moisture content, and lack of vegetative cover may result in higher loads on skin compared to soil. On the other hand, in terms of daily contact by people, sediment is often less ubiquitous than soil and can be submerged (at least partially or seasonally) by water, meaning that the pattern of human contact with sediment (in terms of timing, frequency and intensity) is thought to be different from soil.

Sediment ingestion may also occur via incidental ingestion of surface water containing suspended sediments. Surface water may contain varying amounts of suspended sediments and incidental ingestion of surface water during recreational

activities, such as swimming, can result in ingestion of suspended sediments. Similar to sediment ingestion from hand-to-mouth contact, no literature providing direct estimates for this pathway was identified.

The goal of this work is to present a mechanistic approach for the estimation of sediment ingestion rates using both deterministic and probabilistic methods. Since the sediment ingestion rate is often an important driver in human health risk assessment (HHRA) of contaminated sediments, it is important to have reliable estimates of this parameter. The developed approach is a mechanistic approach that is a mathematical representation of sediment ingestion arising from hand-to-mouth contact and incidental ingestion of surface water containing suspended sediments during recreational activities. To adapt the approach to the Canadian context, age groups and receptor characteristics defined by Health Canada (2010, 2012) for use in contaminated site risk assessment were adopted; however, different age groups could be considered as it is understood that not all international agencies use the same assumptions.

METHODS USED TO ESTIMATE SEDIMENT INGESTION RATES

Sediment Ingestion Due to Hand-to-Mouth Contact

Various authors have used the concept of frequency of hand-to-mouth events to estimate particulate ingestion rates (Lepow *et al.* 1974, 1975; Hawley 1985; WTCTG 2003; Greene *et al.* 2004; Kuusisto *et al.* 2007; Özkaynak *et al.* 2011; Wilson *et al.*, 2013). This method has been extended to the current analysis for sediments that are not submerged under water (*i.e.*, sediments in intertidal zones or between the low and high water mark).

Using the general principles described in Wilson *et al.* (2013) for soil and dusts, an equation for estimating sediment ingestion rate based on hand-to-mouth activity was developed and can be expressed as:

$$\text{SIR}_{\text{HM}} = \text{SL}_{\text{hands}} \times \text{SA}_{\text{hand}} \times \text{FSA}_{\text{fingers}} \times \text{FQ} \times \text{SE} \quad (1)$$

Where:

SIR_{HM} = sediment ingestion rate arising from hand-to-mouth activity (mg/h)

SL_{hands} = the mass of sediment that adheres to a specified surface area of the hands during outdoor activities (mg/cm²) (Table 1)

SA_{hand} = the surface area of one hand (cm²); (assumes that hand-to-mouth activity is for 1 hand at a time) (Table 2)

$\text{FSA}_{\text{fingers}}$ = Fractional surface area of the hands; relates to the proportion of total hand surface represented by the front (palmar) surface of all 4 fingers and the thumb, that will be mouthed or that would contact food (which ultimately leads to sediment ingestion) (fraction/event) (Table 2)

FQ = frequency of hand-to-mouth events (events/h) (Table 2)

SE = saliva extraction factor (unitless) (Table 1)

The mechanistic model assumes that children are exposed to sediment through direct mouthing behavior that is observed in this age group. Teens and adults are assumed to have direct hand-to-mouth behaviors such as nail-biting, smoking, and eating hand-held foods, all of which can result in subsequent transfer to the mouth.

Table 1. Age-independent probability density functions used to estimate sediment ingestion rates.

Parameter	Value	Reference
Saliva Extraction Factor (SE) (unitless)	0; 0.5 ; 1.0; TRI	Primarily WTCTG (2003)
Sediment Adherence Factor (SL _{hands}) (mg/cm ²)	GM 0.88 (95% CI = 0.35 to 2.2); LN	Shoaf <i>et al.</i> (2005b)
Suspended Sediment Concentration (SS) (mg/L)	39; 847 ; 5,146; TRI	Environment Canada (2012)
Surface Water Ingestion Rate (SWIR) (L/h)	AM 0.0037 (95%ile 0.0112); LN	Dorevitch <i>et al.</i> (2011)

TRI = Triangular distribution; LN = lognormal distribution; GM = geometric mean; AM = arithmetic mean.

Bold entries represent the values assumed for the deterministic assessment.

Ingestion of sediment deposited on objects that are subsequently mouthed was not quantified due to the associated uncertainties (see Discussion). Sediment ingestion rates were not estimated for infants (6 months or younger). Infants of this age range are not expected to contact sediments very often since they are typically placed on soft surfaces to protect them at this developmental stage.

Input Parameters

The deterministic values and the probability distribution functions (PDFs) assigned for each input parameter in Eq. (1) are summarized in Tables 2 (for

Table 2. Age-dependent probability density functions used to estimate sediment ingestion rates.

Age group	Surface area of a hand (SA _{hand}) ¹ cm ²	Fractional surface area (FSA _{fingers}) unitless	Frequency of hand to mouth events (FQ) events/h
Toddlers (7 mo–4 yr)	AM 215 ± 25; LN	0.04; 0.07 ; 0.10; TRI	AM 16 ± 9.9; LN
Children (5–11 yr)	AM 295 ± 40; LN	0.04; 0.07 ; 0.10; TRI	AM 9.1 ± 6.8; LN
Teens (12–19 yr)	AM 400 ± 50; LN	0.04; 0.05 ; 0.06; TRI	AM 3.0 ± 1.5; LN
Adults (20–59 yr)	AM 445 ± 55; LN	0.04; 0.05 ; 0.06; TRI	AM 3.0 ± 1.5; LN
Seniors (60+ yr)	AM 450 ± 55; LN	0.04; 0.05 ; 0.06; TRI	AM 3.0 ± 1.5; LN
Reference	Richardson (1997)	AuYeung <i>et al.</i> (2008)	Xue <i>et al.</i> (2007) for toddlers and children; professional judgment for other age groups

¹SA_{hand} value is for 1 hand; surface area of 2 hands was divided by 2 since fingers of only 1 hand involved in a single hand-to-mouth event.

TRI = Triangular distribution; LN = lognormal distribution; AM = arithmetic mean (values in parentheses indicate standard deviation).

Bold entries represent the values assumed for the deterministic assessment.

Sediment Ingestion Rates

age-dependent variables) and 1 (for input values that were similar across age groups). As described in Wilson *et al.* (2013), the approach taken in selecting input parameters was to estimate mean values for receptor characteristics influencing ingestion. Selection of mean values for input parameters was done to maintain consistency with Health Canada guidance and to avoid compounding conservatism.

Sediment loading onto hands (SL_{hands})

Although the focus of the available literature has been on soil loading rather than sediment loading, certain studies have been identified that measured loading of either wet soils or sediments. In a series of studies, Kissel *et al.* (1996a,b; 1998) reported the amount of soil loading onto skin will depend on properties including moisture content and particle size. In these studies, it has been reported that soil adherence was directly related to moisture content, particularly for larger particle sizes. Kissel *et al.* (1998) found that soil loading to hands is approximately seven times greater for wet soils than dry soils.

Two key field studies were identified that measured sediment adherence to hands. Shoaf *et al.* (2005a) measured sediment adherence to skin with nine children playing at a tidal flat. The geometric mean sediment loading onto the hands was 0.49 mg/cm^2 (with 95% confidence interval of 0.14 to 1.4 mg/cm^2). Shoaf *et al.* (2005b) measured sediment adherence to the hands of 18 adults before and after digging for clams at a tidal flat. Although not specifically measured, it is considered likely that these sediments and those studied in Shoaf *et al.* (2005a) were probably moist and possibly quite wet since tidal flats seldom dry out. Shoaf *et al.* (2005b) reported a sediment adherence factor of 0.88 mg/cm^2 for the hands (as a geometric mean with a 95% confidence range of 0.35 to 2.2 mg/cm^2).

Bergstrom *et al.* (2011) evaluated soil and sediment adherence to the hands under laboratory conditions. The geometric mean adherence factor ranged from 0.0605 to 1.14 mg/cm^2 for dry sediment, and from 1.8 to 20.5 mg/cm^2 for wet sediment, with the difference between dry and wet sediment for each sample being statistically significant. The authors reported that particle sizes $>2 \text{ mm}$ did not appear to readily adhere to hands.

Overall, the most applicable sediment adherence factors for hands were considered to be the field measurements of Shoaf *et al.* (2005a,b). Although the values provided in Shoaf *et al.* (2005b) were developed using adults (as compared to Shoaf *et al.* [2005a] developed for children playing in a tidal flat), there is no obvious reason as to why the Shoaf *et al.* (2005b) adherence factors measured in adults could not also occur with children. In addition, the sediments were finer in the adult study which could also contribute to the higher adherence factors. Consequently, Shoaf *et al.* (2005b) was considered to be the most appropriate and conservative sediment adherence factor for all age groups.

Surface area of the hand (SA_{hand}), fractional surface area (FSA_{fingers}), and saliva extraction factor (SE)

For surface area of the hand (SA_{hand}), fractional surface area entering the mouth during a hand-to-mouth event (FSA_{fingers}), and saliva extraction factor (SE), the

values provided in Wilson *et al.* (2013) for soil and dust ingestion were adopted for estimation of sediment ingestion rates (see Tables 1 and 2 for selected values).

Frequency of hand-to-mouth events (FQ)

The frequency of hand-to-mouth events (FQ) for toddlers (age 7 months to 4 years) and children (age 5 to 11 years) was taken from Wilson *et al.* (2013).

For older age groups (*i.e.*, teens, adults, and seniors), professional judgment was used to estimate FQ. WTCTG (2003) and Wilson *et al.* (2013) assumed that older age groups have lower hand-to-mouth frequencies and have used an FQ of 1 event per hour for soil. Beach exposure scenarios were assumed to involve greater FQ with sediments based on the potential for recreational activities such as picnicking. Based on professional judgement, a typical beach exposure of 4 to 5 hours was assumed to include a single consumption event whereby 10 to 20 hand to mouth events occur. This was accounted for by averaging 12 events over a 4-h period, resulting in a FQ of 3 events per hour. A lognormal distribution with an arithmetic mean of 3 events per hour and standard deviation of 1.5 events per hour was assumed. This estimate is comparable with Stapleton *et al.* (2008), where 2 events per hour were estimated to allow for smoking and consumption of finger foods.

Sediment Ingestion Due to Incidental Water Consumption During Recreational Activities

Incidental consumption of water containing suspended sediments is possible when recreational activities are undertaken in aquatic environments with contaminated sediment. A simple equation to estimate sediment ingestion via this route was developed as follows:

$$\text{SIR}_{\text{WC}}(\text{mg/h}) = \text{SS} \times \text{SWIR} \quad (2)$$

Where:

SIR_{WC} = Sediment ingestion rate due to incidental water consumption (mg/h)

SS = Suspended sediment concentration in surface water (mg/L)

SWIR = Surface water ingestion rate (L/h)

Input Parameters

The deterministic values and the probability distribution functions (PDFs) assigned for each parameter in Eq. (2) are summarized in Table 1. The rationale for developing these values is described below.

Suspended sediment concentration (SS)

Data on suspended sediment concentrations in rivers across Canada were obtained from the Water Survey of Canada (Environment Canada 2012). Due to lower flows and energy, suspended sediment concentrations in lakes are expected to be lower than rivers. The data from rivers were assumed to be approximations for aquatic environments where children are playing; however, it is noted that disturbance of the bottom sediments during recreation in the shallow water may further

increase suspended load. A triangular distribution was constructed using the 5th percentile (39 mg/L) as a low value, the median (847 mg/L) as the most likely value and the 95th percentile (5146 mg/L) as the high value. A triangular distribution has some resemblance to a bell curve in that it has a peak with higher probabilities, and lower probabilities further from this peak; however, it is generally a more conservative distribution and used when there are insufficient data to define the shape of a distribution.

Marine or beach environments with breaking waves have higher suspended sediment concentrations than rivers and lakes (Aagard and Hughes, 2006; Cáceres and Alsina, 2012). Nevertheless, it was considered unlikely that chemical impacts would occur in such high energy environments (*i.e.*, high energy environments would be expected to disperse contamination) and instead most of the sites of interest would be low energy environments.

Surface water ingestion rate (SWIR)

For the purposes of the current exercise, surface water ingestion rates were focused on the intakes that will occur from activities such as wading and playing in shallow water where pockets of contaminated sediments can more readily contribute to total suspended sediment loads as opposed to deeper waters. Although appreciably higher estimates were available for surface water ingestion during swimming in pools with head submersions (Dufour *et al.* 2006; TCEQ 2007; Schets *et al.* 2011; USEPA 2011), these were not considered to be as applicable since much of such activity will occur in deeper water less influenced by contaminated sediment. Instead, it was considered more important to estimate incidental water ingestion while playing in shallow water with higher suspended sediment load. For such exposure to suspended sediments, the greatest exposure is likely to be from incidental splashing and water disturbance in shallow water.

For recreational activities that consist of walking, wading and splashing in shallow waters, Dorevitch *et al.* (2011) reported surface water ingestion rates of 3.7 mL/h (arithmetic mean) and 11.2 mL/h (95th percentile), which were adopted in the deterministic and probabilistic assessments.

Calculation of Probabilistic Sediment Ingestion Rates

Probabilistic sediment ingestion rates were calculated using Eqs. (1) and (2) described above, in a Microsoft® Excel spreadsheet. A Monte Carlo simulation with a random seed was performed using Oracle® Crystal Ball version 11.1.1.3.00 and all the PDFs described above; the number of trials was increased until variation between simulations was negligible at two significant figures (200,000 trials).

RESULTS

Arithmetic mean and 95th percentile sediment ingestion rates (deterministic and probabilistic) resulting from hand-to-mouth contact are presented in Table 3. For the time spent in direct contact with sediments, the deterministic arithmetic mean sediment ingestion rates from hand-to-mouth contact range from 15 mg/h for teenagers (age 12 to 19 years) to 59 mg/h for toddlers (age 7 months to 4 years;

Table 3. Estimated sediment ingestion rates due to hand-to-mouth contact.

Age group	Sediment ingestion rate due to hand-to-mouth contact (SIR _{HM}) (mg/h)	
	Deterministic estimate (arithmetic mean)	Probabilistic estimate arithmetic mean ± standard deviation (95th percentile)
Toddlers (7 mo–4 yr)	59	72 ± 89 (300)
Children (5–11 yr)	46	57 ± 78 (250)
Teens (12–19 yr)	15	18 ± 20 (70)
Adults (20–59 yr)	16	20 ± 23 (80)
Seniors (60+ yr)	17	20 ± 23 (80)

Table 3). Using the probabilistic approach, arithmetic mean sediment ingestion rates range from 18 mg/h (for teens) to 72 mg/h (for toddlers).

In the case of the sediment ingestion rate from incidental ingestion of surface water containing suspended sediments, Table 4 provides the estimated rate for the various receptor age groups. The arithmetic mean rates of sediment ingestion for sediment suspended in surface water were 3.1 and 7.7 mg/h for all age groups using the deterministic and probabilistic approaches, respectively. When suspended sediment ingestion rates are normalized to body weight, this work supports the assumption of the toddler as the receptor most exposed to sediment via surface water ingestion.

Summation of the separate sediment ingestion rates appears unwarranted as the sediment ingestion rate from hand-to-mouth contact represents a greater source of intake than intake of suspended sediment in surface water. It is considered unlikely that receptors would be in contact with sediments and surface water at the same time. Instead, for receptors who spend time in contact with impacted sediment from either uplands or in the water, it was considered adequately conservative to use the sediment ingestion rate from hand-to-mouth contact (*i.e.*, it is not necessary to sum the estimated rates of ingestion). Summation of the two rates could be completed on a site-specific basis, where information is considered adequate.

Notwithstanding the above, it is noted that sediment ingestion from surface water intake may be appreciably greater at sites where contaminated sediments cover large areas. Under such circumstances, it is anticipated that the suspended sediments in deeper water where people are more likely to swim will be more directly reflected by the sediment contamination. For such water bodies, it is possible that the greater

Table 4. Estimated sediment ingestion rates due to surface water intake.

Age group	Sediment ingestion rate due to surface water intake (SIR _{HM}) (mg/h)	
	Deterministic estimate (arithmetic mean)	Probabilistic estimate arithmetic mean ± standard deviation (95th percentile)
All age groups (toddlers to seniors)	3.1	7.7 ± 89 (44)

Sediment Ingestion Rates

Table 5. Correlation coefficients for sediment ingestion rate from hand-to-mouth contact.

Parameter	Toddler	Child	Teen	Adult	Senior
Surface loading to hand (mg/cm ²)	0.61	0.58	0.66	0.65	0.66
Surface area of hand (cm ²)	0.11	0.11	0.12	0.12	0.12
Fractional surface area of fingers	0.17	0.17	0.08	0.08	0.09
Frequency of hand to mouth events/h	0.54	0.60	0.47	0.48	0.48
Saliva extraction factor	0.46	0.44	0.49	0.49	0.49

surface water ingestion rates recommended by Dufour *et al.* (2006) obtained from lap swimming may be more appropriate than the values of Dorevitch *et al.* (2011) for wading and splashing. If the values of Dufour *et al.* (2006) were substituted into the equations, the sediment intake rate from surface water ingestion could exceed those estimated from direct hand-to-mouth contact (*e.g.*, using a surface water ingestion rate of 50 mL/h, sediment ingestion from surface water intake would increase to about 42 mg/h using the deterministic approach). At the same time, the suspended sediment concentration may be appreciably lower in the deeper water where people swim and, thus, the sediment ingestion rate may still be lower than the hand-to-mouth rate even if the water intake rate is higher. Nevertheless, where water bodies with contaminated sediments represent a large amount of the water body, it may be prudent to consider the surface water ingestion rate associated with swimming as opposed to that associated with wading/playing/walking in water. In such circumstances, measurement of the total chemical concentrations in water may be useful since it would eliminate the need for assumptions regarding the suspended sediment concentration that arise from the local impacts.

In order to determine which input parameters had the greatest influence on the probabilistic results, a sensitivity analysis was completed. Correlation coefficients computed during the sensitivity analyses are presented in Tables 5 and 6 for sediment ingestion from hand-to-mouth contact and surface water ingestion, respectively. These tables indicate the parameters that were having the largest influence on the variability in the predicted sediment ingestion rates. Positive coefficients indicate correlation (where a value of 1 indicates perfect correlation) while negative values indicate inverse associations (a value of -1 indicates perfect inverse correlation). For sediment ingestion from hand-to-mouth contact, the surface loading and frequency of hand-to-mouth events were the most influential variables for toddlers and older children while surface loading and exposure time were the highest correlated variables for the older age groups. For sediment ingestion that results from incidental intake of surface water, the rate of surface water intake was the most sensitive parameter.

Table 6. Correlation coefficients for sediment ingestion rate from surface water intake.

Parameter	Toddler	Child	Teen	Adult	Senior
Suspended sediment concentration (mg/L)	0.15	0.15	0.15	0.15	0.15
Surface water ingestion rate (L/h)	0.99	0.99	0.99	0.99	0.99

DISCUSSION

The approach focuses on the most likely exposed individual (*i.e.*, mean ingestion rates) since this has been the focus of Canadian agencies for estimation of soil ingestion rates. Nevertheless, the probabilistic rates as upper 95th percentile are provided for consideration in jurisdictions that focus on these higher parameters. In addition, since the rates are provided in units of “mg per hour of time spent in contact with sediments,” it is important to estimate the amount of time people spend in contact with sediments and in that manner a decision will need to be made regarding the most likely or the most highly exposed individual.

Due to an expected greater variability in how frequently people contact sediments, our approach provides sediment ingestion rates in units of mg per hour in contact with sediments rather than the more typical units of milligrams per day that are typically used to describe soil ingestion rates. Many factors are expected to influence the amount of time people will contact sediments, including the proximity of the site to where people live, the proportion of time that sediments are exposed versus inundated by water, the climate and the presence of attributes that attract people to recreate in the sediments. Consequently, there is expected to be great variability from site to site with respect to time spent in contact with sediments and we have provided estimates of sediment ingestion rates as milligrams per hour of time spent in direct contact with sediments.

To effectively apply the sediment ingestion rates provided herein, an understanding of the typical time spent in contact with sediments at a particular site will be necessary. Of particular importance, the ingestion rates will be dependent on the duration of time when people are expected to partake in activities that involve playing or digging in sediments. A variety of information from studies in Canada and the United States has indicated that it is not uncommon for children to play in soil, grass, or other unpaved outdoor surfaces at a rate of 10 to 20 h per week (Richardson 1997; Wong *et al.*, 2000; Leech *et al.* 2002; USEPA 2008); however, most information has not been specific to sediments.

In addition to the above, various sources have presented a variety of estimates based on professional judgment and survey data. TCEQ (2007) assumed that children spend 39 days per year in contact with sediments in Texas. These estimates were based on professional judgment and were considered by TCEQ (2007) to be upper end estimates based on high frequency use. In the small study of sediment adherence factors for children playing at tidal flats immediately adjacent to a Rhode Island town, Shoaf *et al.* (2005a) informally surveyed parents on their children’s time spent at the area and provided a median estimate of 12 h per week playing in sediments during the warmer months of the year. In the case of teens and adults, Richardson and Stantec (2013) reported that on a typical day less than 2% of Canadians engage in “other outdoor activities” based on a Statistics Canada dataset collected in 2010 as part of the General Social Survey, Cycle 24 (Statistics Canada 2011). The mean plus standard deviation age-specific duration of such activity was reported as follows: 150 ± 133 min per day for teens; 137 ± 120 min per day for adults; and, 101 ± 91 min per day for seniors (lognormally distributed); however, the Statistics Canada (2011) dataset was not specific to time in contact with sediments. In a large survey in the Netherlands by Schets *et al.* (2011), the average time spent swimming in freshwater

Sediment Ingestion Rates

or seawater was each reported to be 20 min per week for children (*i.e.*, about 15 days per year accounting for about 18 h per year of total time in such water) and 12 min per week for adults (*i.e.*, about 13 days per year accounting for about 11 h per year of total time in such water). Since the exposure time may vary appreciably, a site-specific decision on this parameter is likely required. In some cases, time spent in contact with sediments and surface water will be quite low (*e.g.*, locations that are hard to access or have attributes that do not indicate frequent use). In other cases, there could be persons such as cabin/cottage owners, frequent campers, and other recreational users of water bodies who are likely to spend more time at nearby lakes and rivers than the general population and, thus, daily contact during the warmer months may be realistic.

For sites where sediment contact occurs at a rate of approximately 1 hour per day, the hourly hand-to-mouth sediment ingestion rates of 72 mg/h for toddlers and 20 mg/h for adults are similar to the Health Canada (2012) default daily soil ingestion rates of 80 and 20 mg/d for toddlers and adults, respectively. For sites that are used by people for more than one hour per day, the estimated sediment ingestion rates indicate higher rates than typically assumed for soil ingestion. Under a hypothetical scenario of contact with sediments of 2 h per day, the analysis would suggest mean sediment ingestion rates of 144 mg/d for toddlers and 40 mg/d for adults, which are higher than Health Canada (2012) default soil ingestion rates. These rates are also higher than the probabilistic mean soil ingestion rates of 20 and 1.6 mg/d estimated by Wilson *et al.* (2013) using a similar mechanistic approach. The key reason for the finding that sediment ingestion rates are substantially higher than soil ingestion rates is that sediment adherence to skin has been assumed to be approximately nine times greater than soil adherence (based on Shoaf *et al.*, 2005b).

Sediment ingestion rates have not included quantification of intake via object-to-mouth behavior because this pathway was regarded as too uncertain. Recent work by Özkaynak *et al.* (2011) did attempt to quantify this pathway for soil and dust ingestion, but given the inherent uncertainties in addition to the even more tenuous assumptions that would be required to extrapolate this to sediment ingestion, this pathway was not included in the current work. Nevertheless, it is noted that the dust and soil ingestion rate arising from object-to-mouth behavior estimated by Özkaynak *et al.* (2011) is somewhat suggestive that this may be a relatively minor pathway compared to hand-to-mouth behavior.

It is stressed there are limitations and cautions with the approach. The mechanistic approach described herein has been validated to some degree by the similarity between the recent mechanistic approach used for soils by Özkaynak *et al.* (2011) and Wilson *et al.* (2013) and the tracer element meta-analysis completed by Stanek *et al.* (2012). Since this mechanistic approach appears to provide realistic estimation of soil ingestion rates, the results presented are expected to be reasonable estimates of sediment ingestion. Nevertheless, it is noted that no tracer element studies involving sediment ingestion rates have been completed and, thus, there is no direct study for comparison. In addition, it is noted that to meaningfully use these results, it will be important to estimate the duration that persons may spend directly in contact with sediments (we have not provided estimates as it is not a parameter which had been well studied in the literature and would seem to vary greatly from site to site). At sites where impacted sediments cover a large amount of the water body or are present at high energy environments where swimming occurs (*i.e.*, where suspended

sediment concentrations in deeper water will largely be reflected by the concentrations in the sediment), it may important to consider greater surface water ingestion rates. Finally, as is the case with soil ingestion, the approach does not attempt to estimate sediment ingestion from pica episodes and instead this should be evaluated as a separate analysis on a case-by-case basis.

There may be future opportunities to improve and possibly validate these sediment ingestion rates. Since sediment ingestion rates are provided on an hourly basis, patterns of use of sediment sites by the Canadian population would be particularly useful. In addition, the frequency of hand-to-mouth activities (including the proportion of the hand that enters the mouth) while in contact with sediments could be addressed through further study. Information about transfer of sediment particles from cigarettes or finger foods would also be relevant. Finally, it is noted that if more specific grain size and adherence factors are available on a site-specific basis, it may be possible to adjust the estimated ingestion rates using the approach.

CONCLUSIONS

People who spend time at sites with sediments may ingest sediments from two key routes of exposure: (1) hand-to-mouth contact and (2) incidental ingestion of surface water containing suspended sediments. The analysis presented herein represents one of the first attempts to quantify sediment ingestion rates from these routes. For sites where people spend more than 1 hour per day on a consistent basis in direct contact with sediments, the results indicate that sediment ingestion rates will be greater than rates typically recommended by Health Canada (2010, 2012) for evaluation of exposure from soil ingestion (*i.e.*, 20 and 80 mg/d for adults and toddlers).

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Sediment Ingestion Rates

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APPENDIX B

Planned Restrictions



APPENDIX C

Conversion of Carcinogenic PAH and Dioxin and Furan Data to Toxic
Equivalents



Table C-1
Benzo(a)pyrene Toxic Equivalents Calculations - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Indeno(1,2,3-cd)pyrene		Benzo(a)pyrene TEQ
				µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg
				Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 0.01)	Raw Data	TEQ (TEF = 0.001)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	TEQ
SB-304	0 - 1	02/08/95	Remaining	40 J	4	32 J	32	56 J	5.6	20 J	0.2	64 J	0.064	<180	90	21 J	2.1	133.964
SB-304	2 - 4	02/08/95	Remaining	53 J	5.3	55 J	55	88 J	8.8	<180	0.9	77 J	0.077	<180	90	28 J	2.8	162.877
SB-304	6 - 8	02/08/95	Remaining	<210	10.5	<210	105	<210	10.5	<210	1.05	<210	0.105	<210	105	<210	10.5	242.655 U
SB-305	0 - 1	02/08/95	Remaining	<190	9.5	<190	95	<190	9.5	<190	0.95	<190	0.095	<190	95	<190	9.5	219.545 U
SB-305	2 - 4	02/08/95	Remaining	<180	9	<180	90	<180	9	<180	0.9	26 J	0.026	<180	90	<180	9	207.926
SB-305	6 - 8	02/08/95	Remaining	38 J	3.8	<180	90	42 J	4.2	<180	0.9	68 J	0.068	<180	90	<180	9	197.968
SB-305	10 - 12	02/08/95	Remaining	NA	NA	<230	115	<230	11.5	<230	1.15	<230	0.115	<230	115	<230	11.5	254.265 U
MW-145WT	7 - 17	06/08/95	Remaining	600	60	410	410	590	59	<220	1.1	720	0.72	49 J	49	130 J	13	592.82
NS-SD-18	1 - 14	06/20/95	Remaining	<220	11	<220	110	<220	11	<220	1.1	<220	0.11	<220	110	<220	11	254.21 U
NS-SD-19	4 - 5.1	06/20/95	Remaining	<220	11	<220	110	<220	11	<220	1.1	<220	0.11	<220	110	<220	11	254.21 U
NS-SD-20	1.9 - 2.5	06/20/95	Remaining	<250	12.5	<250	125	<250	12.5	<250	1.25	<250	0.125	<250	125	<250	12.5	288.875 U
NS-SD-21	1.8 - 2.4	06/20/95	Remaining	<220	11	<220	110	<220	11	<220	1.1	<220	0.11	<220	110	<220	11	254.21 U
NS-SD-14	2.3 - 3.1	06/20/95	Remaining	<420	21	<420	210	<420	21	<420	2.1	<420	0.21	<420	210	<420	21	485.31 U
NS-SD-15	2.3 - 3.4	06/20/95	Remaining	<230	11.5	<230	115	<230	11.5	<230	1.15	<230	0.115	<230	115	<230	11.5	265.765 U
NS-SD-16	2.7 - 3.7	06/20/95	Remaining	<250	12.5	<250	125	<250	12.5	<250	1.25	<250	0.125	<250	125	<250	12.5	288.875 U
NS-SD-17	2.4 - 3	06/20/95	Remaining	<230	11.5	<230	115	<230	11.5	<230	1.15	<230	0.115	<230	115	<230	11.5	265.765 U
NS-SD-13	3.4 - 4.1	06/20/95	Remaining	<250	12.5	<250	125	<250	12.5	<250	1.25	<250	0.125	<250	125	<250	12.5	288.875 U
NS-SD-12	2.6 - 3.4	06/20/95	Remaining	<240	12	<240	120	<240	12	<240	1.2	<240	0.12	<240	120	<240	12	277.32 U
NS-SD-11	2.3 - 2.9	06/20/95	Remaining	<220	11	<220	110	<220	11	<220	1.1	<220	0.11	<220	110	<220	11	254.21 U
NS-SD-10	2 - 3.4	06/20/95	Remaining	<220	11	<220	110	<220	11	<220	1.1	<220	0.11	<220	110	<220	11	254.21 U
NS-7	0 - 4.5	06/21/95	Remaining	<210	10.5	<210	105	<210	10.5	<210	1.05	<210	0.105	<210	105	<210	10.5	242.655 U
NS-8	0 - 10	06/21/95	Remaining	<240	12	50 J	50	<240	12	<240	1.2	<240	0.12	<240	120	<240	12	207.32
NS-9	0 - 4.5	06/21/95	Remaining	<210	10.5	50 J	50	<210	10.5	<210	1.05	<210	0.105	<210	105	<210	10.5	187.655
NS-10	0 - 10	06/21/95	Remaining	<220	11	<220	110	<220	11	<220	1.1	<220	0.11	<220	110	<220	11	254.21 U
NS-1	0 - 14	06/23/95	Remaining	<240	12	<240	120	<240	12	<240	1.2	<240	0.12	<240	120	<240	12	277.32 U
PL-1	0.75 - 1.21	08/10/01	Remaining	<420	21	<420	210	<420	21	<420	2.1	<420	0.21	<420	210	<420	21	485.31 U
PL-2	0.75 - 1.67	08/10/01	Remaining	<360	18	<360	180	<360	18	42 J [44 J]	0.43	58 J [93 J]	0.0755	<360	180	<360	18	414.5055
PL-3	0.67 - 1.67	08/10/01	Remaining	<370	18.5	<370	185	<370	18.5	<370	1.85	<370	0.185	<370	185	<370	18.5	427.535 U
PL-4	0.75 - 1.5	08/10/01	Remaining	44 J	4.4	<360	180	46 J	4.6	<360	1.8	110 J	0.11	<360	180	<360	18	388.91
BH7	0 - 2	03/06/07	Remaining	51 J	5.1	68 J	68	65 J	6.5	37 J	0.37	82 J	0.082	<290	145	25 J	2.5	227.552
BH7	2 - 4	03/06/07	Remaining	90 J	9	64 J	64	52 J	5.2	41 J	0.41	110 J	0.11	<350	175	<350	17.5	271.22
BH8	0 - 2	03/06/07	Remaining	22 J	2.2	<290	145	19 J	1.9	10 J	0.1	36 J	0.036	<290	145	<290	14.5	308.736
BH8	2 - 4	03/06/07	Remaining	47 J	4.7	<310	155	26 J	2.6	22 J	0.22	68 J	0.068	<310	155	<310	15.5	333.088
BH9	1 - 2	03/06/07	Remaining	8,100	810	6,600	6600	6,700	670	2,800 J	28	7,600	7.6	55 J	55	2,900 J	290	8460.6
BH9	2 - 4	03/06/07	Remaining	60 J	6	100 J	100	57 J	5.7	28 J	0.28	140 J	0.14	<310	155	<310	15.5	282.62
BH10	1 - 2	03/06/07	Remaining	17 J	1.7	<300	150	22 J	2.2	11 J	0.11	38 J	0.038	<300	150	<300	15	319.048
BH10	2 - 4	03/06/07	Remaining	21 J	2.1	<280	140	12 J	1.2	<280	1.4	31 J	0.031	<280	140	<280	14	298.731
BH11	0 - 2	03/06/07	Remaining	310 J	31	360 J	360	430 J	43	190 J	1.9	420 J	0.42	<1,200	600	200 J	20	1056.32
BH11	2 - 4	03/06/07	Remaining	7.9 J	0.79	<310	155	<310	15.5	<310	1.55	9.1 J	0.0091	<310	155	<310	15.5	343.3491
BH12	0 - 2	03/06/07	Remaining	36 J [28 J]	3.2	35 J [21 J]	28	46 J [37 J]	4.15	21 J [9.9 J]	0.1545	47 J [34 J]	0.0405	<300	150	<21	1.05	186.595
BH12	2 - 4	03/06/07	Remaining	60 J	6	61 J	61	66 J	6.6	43 J	0.43	72 J	0.072	<290	145	30 J	3	222.102
SOIL FILL1		10/06/04	Remaining	<350	17.5	<350	175	<350	17.5	<350	1.75	<350	0.175	<350	175	<350	17.5	404.425 U
SOIL FILL2		10/06/04	Remaining	<360	18	<360	180	<360	18	<360	1.8	<360	0.18	<360	180	<360	18	415.98 U
SB-01A	1 - 3	08/23/01	Remaining	<350	17.5	<350	175	<350	17.5	<350	1.75	<350	0.175	<350	175	<350	17.5	404.425 U
SB-01A	5 - 7	08/23/01	Remaining	<350	17.5	<350	175	<350	17.5	<350	1.75	<350	0.175	<350	175	<350	17.5	404.425 U
SB-02-SMI	1.2 - 3.2	08/23/01	Remaining	<380	19	<380	190	<380	19	<380	1.9	<380	0.19	<380	190	<380	19	439.09 U
SB-02-SMI	9 - 11	08/23/01	Remaining	<390	19.5	<390	195	<390	19.5	<390	1.95	<390	0.195	<390	195	<390	19.5	450.645 U
SB-03-SMI	4.7 - 6.7	08/23/01	Remaining	86 J	8.6	72 J	72	86 J	8.6	<380	1.9	160 J	0.16	<380	190	<380	19	300.26
SB-03-SMI	0.7 - 2.7	08/23/01	Remaining	<360	18	<360	180	<360	18	<360	1.8	62 J [72 J]	0.067	<360	180	<360	18	415.867
SB-04-SMI	8.3 - 10	08/23/01	Remaining	<440	22	<440	220	<440	22	<440	2.2	<440	0.22	<440	220	<440	22	508.42 U
SB-312	8 - 10	06/06/95	Remaining	60 J	6	49 J	49	80 J	8	37 J	0.37	85 J	0.085	<200	100	23 J	2.3	165.755
SB-319	14 - 16	06/13/95	Remaining	<26,000	1300	<26,000	13000	<26,000	1300	<26,000	130	<26,000	13	<26,000	13000	<26,000	1300	30043 U
SB-325	8 - 10	06/14/95	Remaining	<16,000	800	<16,000	8000	<16,000	800	<16,000	80	<16,000	8	<16,000	8000	<16,000	800	18488 U

Table C-1
Benzo(a)pyrene Toxic Equivalents Calculations - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Indeno(1,2,3-cd)pyrene		Benzo(a)pyrene TEQ
				µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg
				Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 0.01)	Raw Data	TEQ (TEF = 0.001)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	TEQ
SB-351	0 - 2	06/27/95	Remaining	<370	18.5	<370	185	<370	18.5	<370	1.85	<370	0.185	<370	185	<370	18.5	427.535 U
SB-352	0 - 2	06/28/95	Remaining	120 J	12	130 J	130	350	35	64 J	0.64	250	0.25	<190	95	130 J	13	285.89
SB-354	0 - 2	06/28/95	Remaining	<180	9	<180	90	<180	9	<180	0.9	46 J	0.046	<180	90	<180	9	207.946
SB-362	0 - 2	09/28/95	Remaining	<770	38.5	<770	385	<770	38.5	<770	3.85	R	R	<770	385	<770	38.5	889.35 U
SB-362	4 - 6	09/28/95	Remaining	180 J	18	170 J	170	220 J	22	110 J	1.1	270 J	0.27	<720	360	98 J	9.8	581.17
SB-362	8 - 10	09/28/95	Remaining	<210	10.5	<210	105	<210	10.5	<210	1.05	<210	0.105	<210	105	<210	10.5	242.655 U
SB-363	0 - 2	09/28/95	Remaining	<1,800	90	<1,800	900	<1,800	90	<1,800	9	<1,800	0.9	<1,800	900	<1,800	90	2079.9 U
SB-363	4 - 6	09/28/95	Remaining	<1,800	90	<1,800	900	<1,800	90	<1,800	9	<1,800	0.9	<1,800	900	<1,800	90	2079.9 U
SB-363	8 - 10	09/28/95	Remaining	<2,000	100	<2,000	1000	<2,000	100	<2,000	10	<2,000	1	<2,000	1000	<2,000	100	2311 U
FS-1	0 - 1	06/12/95	Remaining	<710	35.5	<710 J	170	470 J	47	<710	3.55	260 J	0.26	<710	355	<710	35.5	646.81
FS-2	0 - 1	06/12/95	Remaining	<180	9	<180	90	<180	9	<180	0.9	<180	0.09	<180	90	<180	9	207.99 U
FS-3	0 - 1	06/12/95	Remaining	33 J	3.3	<180	90	<180	9	<180	0.9	61 J	0.061	<180	90	<180	9	202.261
FS-4	0 - 1	06/12/95	Remaining	28 J	2.8	<180	90	<180	9	<180	0.9	39 J	0.039	<180	90	<180	9	201.739
FS-5	0 - 1	06/12/95	Remaining	<180	9	<180	90	<180	9	<180	0.9	<180	0.09	<180	90	<180	9	207.99 U
FS-6	0 - 1	06/12/95	Remaining	<170	8.5	<170	85	<170	8.5	<170	0.85	<170	0.085	<170	85	<170	8.5	196.435 U
FS-7	0 - 1	06/12/95	Remaining	<180	9	<180	90	<180	9	<180	0.9	<180	0.09	<180	90	<180	9	207.99 U
FS-8	0 - 1	06/12/95	Remaining	<170	8.5	<170	85	<170	8.5	<170	0.85	<170	0.085	<170	85	<170	8.5	196.435 U
US-1	0 - 1	06/12/95	Remaining	400 J	40	<830	415	560 J	56	<830	4.15	440 J	0.44	<830	415	<830	41.5	972.09
US-2	0 - 1	06/12/95	Remaining	220 J	22	<440	220	<440	22	<440	2.2	270 J	0.27	<440	220	<440	22	508.47
US-3	0 - 1	06/12/95	Remaining	240	24	170 J	170	330	33	<170	0.85	230	0.23	<170	85	74 J	7.4	320.48
US-4	0 - 1	06/12/95	Remaining	<170	8.5	<170	85	<170	8.5	<170	0.85	<170	0.085	<170	85	<170	8.5	196.435 U
US-5	0 - 1	06/12/95	Excavated	<170	8.5	<170	85	62 J	6.2	<170	0.85	<170	0.085	<170	85	<170	8.5	194.135
US-6	0 - 1	06/12/95	Remaining	130 J	13	<340	170	<340	17	<340	1.7	160 J	0.16	<340	170	<340	17	388.86
US-7	0 - 1	06/12/95	Remaining	<170	8.5	<170	85	<170	8.5	<170	0.85	<170	0.085	<170	85	<170	8.5	196.435 U
US-8	0 - 1	06/12/95	Remaining	100 J	10	60 J	60	160 J	16	47 J	0.47	160 J	0.16	<170	85	28 J	2.8	174.43
RS-1	0 - 1	06/13/95	Remaining	150 J	15	110 J	110	160 J	16	46 J	0.46	180	0.18	<170	85	46 J	4.6	231.24
RS-2	0 - 1	06/13/95	Remaining	220 J	22	220 J	220	460 J	46	<900	4.5	350 J	0.35	<900	450	<900	45	787.85
RS-3	0 - 1	06/13/95	Remaining	140 J	14	120 J	120	300	30	<180	0.9	190	0.19	<180	90	68 J	6.8	261.89
RS-4	0 - 1	06/13/95	Remaining	130 J [85 J]	10.75	110 J [65 J]	87.5	140 J [95 J]	11.75	81 J [38 J]	0.595	200 [130 J]	0.165	<170	85	<36	1.8	197.56
RS-6	0 - 1	06/13/95	Remaining	69 J	6.9	64 J	64	98 J	9.8	52 J	0.52	89 J	0.089	<170	85	32 J	3.2	169.509
RS-7	0 - 1	06/13/95	Remaining	99 J	9.9	53 J	53	94 J	9.4	<180	0.9	140 J	0.14	<180	90	<180	9	172.34
RS-8	0 - 1	06/13/95	Remaining	140 J	14	110 J	110	180	18	86 J	0.86	180	0.18	<170	85	47 J	4.7	232.74
NS-RS-4	2.5 - 3	06/13/95	Remaining	<210	10.5	<210	105	<210	10.5	<210	1.05	<210	0.105	<210	105	<210	10.5	242.655 U
VE-1	0.75 - 1.58	08/10/01	Remaining	<400	20	<400	200	<400	20	<400	2	<400	0.2	<400	200	<400	20	462.2 U
VE-2	0.92 - 1.67	08/10/01	Remaining	130 J	13	150 J	150	160 J	16	130 J	1.3	170 J	0.17	<370	185	110 J	11	376.47
AR-1	2 - 3	6/3/2015	Remaining	250 J	25	220 J	220	370	37	160 J	1.6	320	0.32	23 J	23	61 J	6.1	313.02
AR-2	3 - 4	6/3/2015	Remaining	130 J	13	100 J	100	170 J	17	65 J	0.65	170 J	0.17	14 J	14	24 J	2.4	147.22
AR-2	14 - 14.5	6/3/2015	Remaining	55 J	5.5	36 J	36	64 J	6.4	24 J	0.24	60 J	0.06	<320	160	13 J	1.3	209.5
AR-3	2 - 3	6/3/2015	Remaining	42 J [90 J]	6.6	36 J [73 J]	54.5	68 J [130 J]	9.9	26 J [55 J]	0.405	71 J [110 J]	0.0905	<330 [<330]	165	15 J [25 J]	2	238.4955
AR-4	3 - 4	6/4/2015	Remaining	17 J [5.6 J]	1.13	11 J [<310]	83	18 J [6.0 J]	1.2	<320 [<310]	1.575	36 J [10 J]	0.023	<320 [<310]	157.5	<320 [<310]	15.75	260.178
AR-4	13 - 13.5	6/4/2015	Remaining	28 J	2.8	15 J	15	18 J	1.8	7.0 J	0.07	49 J	0.049	<320	160	<320	16	195.719
AR-5	3 - 4	6/4/2015	Remaining	490	49	530	530	570	57	190 J	1.9	600	0.6	140 J	140	230 J	23	801.5
AR-5	12 - 13	6/4/2015	Remaining	50 J	5	22 J	22	24 J	2.4	10 J	0.1	61 J	0.061	<310	155	<310	15.5	200.061
AR-6	3 - 4	6/4/2015	Remaining	25 J	2.5	16 J	16	33 J	3.3	10 J	0.1	41 J	0.041	<310	155	9.0 J	0.9	177.841
AR-6	9.5 - 10	6/4/2015	Remaining	26 J	2.6	11 J	11	21 J	2.1	9.7 J	0.097	33 J	0.033	<320	160	<320	16	191.83
AR-7	3 - 4	6/4/2015	Remaining	1800	180	2200	2200	2900	290	920	9.2	1900	1.9	390 J	390	1100	110	3181.1
AR-7	12 - 13	6/4/2015	Remaining	84 J	8.4	<1,600	800	<1,600	80	<1,600	8	150 J	0.15	<1,600	800	<1,600	80	1776.55
AR-8	2 - 3	6/4/2015	Remaining	43 J	4.3	39 J	39	65 J	6.5	26 J	0.26	59 J	0.059	<290	145	32 J	3.2	198.319
HA-13/14-4	6 - 7	07/22/94	Remaining	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
T02-B001	6 - 8	08/28/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T02-B002	6 - 8	08/28/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T02-B004	6 - 8	08/28/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T02-B047	2 - 4	09/07/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U

Table C-1
Benzo(a)pyrene Toxic Equivalents Calculations - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected		Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Indeno(1,2,3-cd)pyrene		Benzo(a)pyrene TEQ
				µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg
				Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 0.01)	Raw Data	TEQ (TEF = 0.001)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	TEQ
T02-B047	8 - 10	09/07/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T02-B048	2 - 4	09/07/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T02-B048	8 - 10	09/07/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B010	11 - 13	08/29/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B010	13 - 15	08/29/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B011	3 - 5	08/29/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B011	9 - 11	08/29/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B011	14 - 16	08/29/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B012	11 - 13	08/30/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B012	13 - 15	08/30/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B058	0 - 2	10/03/90	Remaining	< 300	15	< 300	150	< 300	15	800	8	900	0.9	< 300	150	< 300	15	353.9
T06-B058	6 - 8	10/03/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B058	12 - 14	10/03/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B059	0 - 2	10/03/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B059	8 - 10	10/03/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T06-B059	14 - 16	10/03/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
UST8-MW1	0 - 2	05/25/94	Remaining	< 330	16.5	< 330	165	< 330	16.5	< 330	1.65	< 330	0.165	< 330	165	< 330	16.5	381.315 U
UST8-MW1	2 - 4	05/25/94	Remaining	< 330	16.5	< 330	165	< 330	16.5	< 330	1.65	< 330	0.165	< 330	165	< 330	16.5	381.315 U
UST8-MW2	0 - 2	05/25/94	Remaining	< 330	16.5	< 330	165	< 330	16.5	< 330	1.65	< 330	0.165	< 330	165	< 330	16.5	381.315 U
UST8-MW3	1 - 3	05/31/94	Remaining	< 330	16.5	< 330	165	< 330	16.5	< 330	1.65	< 330	0.165	< 330	165	< 330	16.5	381.315 U
UST8-SB1	2 - 3	04/01/94	Remaining	< 33000	1650	< 33000	16500	< 33000	1650	< 33000	165	< 33000	16.5	< 33000	16500	< 33000	1650	38131.5 U
UST8-SB2	0 - 1.2	04/01/94	Remaining	< 6600	330	< 6600	3300	< 6600	330	< 6600	33	< 6600	3.3	< 6600	3300	< 6600	330	7626.3 U
UST8-SB3	0.7 - 1.1	04/01/94	Remaining	< 66000	3300	< 66000	33000	< 66000	3300	< 66000	330	< 66000	33	< 66000	33000	< 66000	3300	76263 U
UST8-SB4	1.8 - 2.3	04/01/94	Remaining	< 330	16.5	< 330	165	< 330	16.5	< 330	1.65	< 330	0.165	< 330	165	< 330	16.5	381.315 U
UST8-SB5	4 - 6	05/31/94	Remaining	< 330	16.5	< 330	165	< 330	16.5	< 330	1.65	< 330	0.165	< 330	165	< 330	16.5	381.315 U
T09-B017	8 - 10	08/30/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T09-B018	6 - 8	08/30/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T09-B019	4 - 6	08/30/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T10-B034	6 - 8	09/05/90	Remaining	< 1500	75	< 1500	750	< 1500	75	< 1500	7.5	< 1500	0.75	< 1500	750	< 1500	75	1733.25 U
T10-B034	8 - 10	09/05/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T10-B035	8 - 10	09/05/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
T10-B035	10 - 12	09/05/90	Remaining	< 300	15	< 300	150	< 300	15	< 300	1.5	< 300	0.15	< 300	150	< 300	15	346.65 U
Maximum Detection																		8460.6
Maximum Including Non-detects																		76263

Notes:
Values are presneted in micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
Toxic equivalent factors (TEFs) were obtained from the draft Part 201 Rules (MDEQ 2016b).
Benzo(a)pyrene TEQ is the sum of the concentration of each carcinogenic polycycly aromatic hydrocarbon (cPAH) multiplied by the TEF. Non-detect values are treated as detections at 1/2 the reporting limit for the calculation of benzo(a)pyrene toxic equivalents (TEQ).

< = not detected at the laboratory reporting limit
J = estimated value between the method detection limit and the reporting limit

NA = not available
U = The seven cPAHs were not detected

Table C-2
Benzo(a)pyrene Toxic Equivalents Calculations - GPL
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Indeno(1,2,3-cd)pyrene		Benzo(a)pyrene TEQ
			µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg
			Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 0.01)	Raw Data	TEQ (TEF = 0.001)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	TEQ
MW-126WT	14 - 16	02/08/95	NA	NA	<190	95	<190	9.5	<190	0.95	<190	0.095	<190	95	<190	9.5	210.045 U
WMB-1	3 - 3.5	01/22/97	140 J	14	210	210	240	24	90 J	0.9	180 J	0.18	<190	95	320	32	376.08
WMB-2	3 - 3.5	01/22/97	250	25	270	270	340	34	150 J	1.5	210 J	0.21	<230	115	350	35	480.71
WMB-3	5 - 5.5	01/22/97	<200	10	<200	100	<200	10	<200	1	<200	0.1	<200	100	<200	10	231.1 U
WMB-6	4 - 4.5	01/22/97	<220	11	<220	110	<220	11	<220	1.1	<220	0.11	<220	110	<220	11	254.21 U
SB-313	4 - 6	06/07/95	190 J	19	<740	370	<740	37	<740	3.7	290 J	0.29	<740	370	<740	37	836.99
SB-389	0 - 0.5	08/11/00	61 J	6.1	43 J	43	82 J	8.2	<390	1.95	130 J	0.13	<390	195	<390	19.5	273.88
SB-390	0 - 0.5	08/11/00	<580	29	<580	290	<580	29	<580	2.9	<580	0.29	<580	290	<580	29	670.19 U
SB-391	0 - 0.5	08/11/00	<470	23.5	<470	235	<470	23.5	<470	2.35	<470	0.235	<470	235	<470	23.5	543.085 U
SB-392	0 - 0.5	08/11/00	<450	22.5	<450	225	<450	22.5	<450	2.25	<450	0.225	<450	225	<450	22.5	519.975 U
SB-393	0 - 0.5	08/11/00	550	55	690	690	1,100	110	370 J	3.7	760	0.76	110 J	110	420 J	42	1011.46
SB-394	0 - 0.5	08/11/00	<440	22	<440	220	53 J	5.3	<440	2.2	<440	0.22	<440	220	<440	22	491.72
SB-395	0 - 0.5	08/11/00	<440	22	<440	220	<440	22	<440	2.2	<440	0.22	<440	220	<440	22	508.42 U
SB-396	0 - 0.5	08/11/00	79 J	7.9	<600	300	99 J	9.9	<600	3	120 J	0.12	<600	300	<600	30	650.92
SB-397	0 - 0.5	08/11/00	<460	23	<460	230	<460	23	<460	2.3	<460	0.23	<460	230	<460	23	531.53 U
SB-398	0 - 0.5	08/11/00	96 J	9.6	130 J	130	170 J	17	64 J	0.64	110 J	0.11	<400	200	81 J	8.1	365.45
SB-399	0 - 0.5	08/11/00	<410	20.5	49 J	49	66 J	6.6	<410	2.05	<410	0.205	<410	205	<410	20.5	303.855
SB-400	0 - 0.5	08/11/00	<530	26.5	<530	265	<530	26.5	<530	2.65	<530	0.265	<530	265	<530	26.5	612.415 U
SB-406	0 - 0.5	08/11/00	40 J	4	<360	180	47 J	4.7	<360	1.8	63 J	0.063	<360	180	<360	18	388.563
SB-412	0 - 0.5	08/11/00	<580	29	<580	290	<580	29	<580	2.9	<580	0.29	<580	290	<580	29	670.19 U
SB-418	0 - 0.5	08/11/00	<430	21.5	<430	215	<430	21.5	<430	2.15	<430	0.215	<430	215	<430	21.5	496.865 U
TP1	0 - 4	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP1	4 - 8	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP2	0 - 4	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP2	4 - 8	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP3	0 - 4	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP3	4 - 8	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP4	0 - 4	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP4	4 - 8	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP5	0 - 4	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP5	4 - 8	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP6	0 - 4	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP6	4 - 8	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
TP7	0 - 4	05/22/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
SS-007-CR	0 - 0.5	12/01/97	<1,300	65	<1,300	650	<1,300	65	<1,300	6.5	<1,300	0.65	<1,300	650	<1,300	65	1502.15 U
SS-008-CR	0 - 0.5	12/01/97	<1,200	60	<1,200	600	<1,200	60	<1,200	6	<1,200	0.6	<1,200	600	<1,200	60	1386.6 U
SS-009-CR	0 - 0.5	12/01/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
SS-010-CR	0 - 0.5	12/01/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
SS-015-CR	0 - 0.5	12/01/97	<330	16.5	<330	165	<330	16.5	<330	1.65	390	0.39	<330	165	<330	16.5	381.54
SS-016-CR	0 - 0.5	12/01/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
BH01	0 - 2	11/26/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
BH02	2 - 4	11/26/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
BH03	2 - 4	11/26/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
BH04	2 - 4	11/26/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
BH05	2 - 4	11/26/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
BH06	2 - 4	11/26/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U

Maximum Detection
Maximum Including Non-detects

1011.46
1502.15

Notes:
Values are presneted in micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
Toxic equivalent factors (TEFs) were obtained from the draft Part 201 Rules (MDEQ 2016b).
Benzo(a)pyrene TEQ is the sum of the concentration of each carcinogenic polycycly aromatic hydrocarbon (cPAH) multipliyed by the TEF. Non-detect values are treated as detections at 1/2 the reporting limit for the calculation of benzo(a)pyrene toxic equivalents (TEQ).

< = not detected at the laboratory reporting limit
J = estimated value between the method detection limit and the reporting limit

NA = not available
U = The seven cPAHs were not detected

Table C-3
Benzo(a)pyrene Toxic Equivalents Calculations - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Indeno(1,2,3-cd)pyrene		Benzo(a)pyrene TEQ
			µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg
			Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 0.01)	Raw Data	TEQ (TEF = 0.001)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	TEQ
SB97-110	18 - 20	11/17/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
SB97-110	22 - 24	11/17/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
SB97-111	2 - 4	11/17/97	<330	16.5	<330	165	380	38	<330	1.65	380	0.38	<330	165	<330	16.5	403.03
SB97-111	24 - 26	11/18/97	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
MW98-108S1	4 - 6	09/21/98	500	50	500	500	580	58	500 J	5	610	0.61	<330	165	<330	16.5	795.11
MW98-110S1	0.5 - 1	09/22/98	<880	44	<880	440	<880	44	<880	4.4	<880	0.44	<880	440	<880	44	1016.84 U
MW98-110S1	4 - 6	09/22/98	<2,100	105	<2,100	1050	<2,100	105	<2,100	10.5	<2,100	1.05	<2,100	1050	<2,100	105	2426.55 U
MW98-111S1	0.5 - 1	09/22/98	<4,500	225	<4,500	2250	<4,500	225	<4,500	22.5	<4,500	2.25	<4,500	2250	<4,500	225	5199.75 U
MW98-111S1	2 - 4	09/22/98	<4,100	205	<4,100	2050	<4,100	205	<4,100	20.5	<4,100	2.05	<4,100	2050	<4,100	205	4737.55 U
MW98-109S1	0.5 - 1	09/23/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
MW98-109S1	6 - 8	09/23/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
SB98-120	0.5 - 1	09/23/98	<930	46.5	<930	465	<930	46.5	<930	4.65	<930	0.465	<930	465	<930	46.5	1074.615 U
SB98-120	4 - 6	09/23/98	2,700 DM	270	3,000 DM	3000	2,700 DM	270	2,700 DMJ	27	2,900 DM	2.9	<980	490	1,100 DM	110	4169.9
SB98-119	0.5 - 1	09/23/98	<330	16.5	<330	165	<330	16.5	<330	1.65	<330	0.165	<330	165	<330	16.5	381.315 U
SB98-119	2 - 4	09/23/98	<880	44	<880	440	<880	44	<880	4.4	1,200 DM	1.2	<880	440	<880	44	1017.6
MW98-108S1	0.5 - 1	09/24/98	6,200 DM	620	5,600 DM	5600	7,200 DM	720	4,400 DMJ	44	8,200 DM	8.2	1,500 DM	1500	3,200 DM	320	8812.2
MW01-118WT	0 - 2	11/05/01	<350	17.5	<350	175	<350	17.5	<350	1.75	<350	0.175	<350	175	<350	17.5	404.425 U
MW01-118WT	4 - 6	11/05/01	<400	20	<400	200	<400	20	<400	2	<400	0.2	<400	200	<400	20	462.2 U
SB00-121	0 - 0.5	08/17/00	100 J	10	100 J	100	140 J	14	<420	2.1	140 J	0.14	<420	210	67 J	6.7	342.94
SB00-122	0 - 0.5	08/17/00	120 J	12	110 J	110	160 J	16	56 J	0.56	150 J	0.15	<410	205	77 J	7.7	351.41
SB00-123	0 - 0.5	08/17/00	8,300 [2,300]	530	7,500 [2,000]	4750	9,600 [2,500]	605	4,000 [1,100]	25.5	9,300 [2,600]	5.95	1,100 J [280 J]	690	4,700 [1,200]	295	6901.45
SB00-124	0 - 0.5	08/17/00	360 J	36	340 J	340	490	49	180 J	1.8	430	0.43	50 J	50	240 J	24	501.23
Maximum Detection																	8812.2
Maximum Including Non-detects																	8812.2

Notes:
Values are presneted in micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
Toxic equivalent factors (TEFs) were obtained from the draft Part 201 Rules (MDEQ 2016b).
Benzo(a)pyrene TEQ is the sum of the concentration of each carcinogenic polycycly aromatic hydrocarbon (cPAH) multipliied by the TEF. Non-detect values are treated as detections at 1/2 the reporting limit for the calculation of benzo(a)pyrene toxic equivalents (TEQ).

< = not detected at the laboratory reporting limit
J = estimated value between the method detection limit and the reporting limit

NA = not available
U = The seven cPAHs were not detected

Table C-4
2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Calculations - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location		SB-305	NS-RS-4
Sample Depth (ft bgs)		10 - 12	2.5 - 3
Date Collected	Units	02/08/95	06/13/95
Dioxins/Furans			
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	µg/kg	0.0011 U	0.25 U
Total tetrachlorodibenzo-p-dioxins	µg/kg	0.0011 U	0.0046
Total pentachlorodibenzo-p-dioxins	µg/kg	0.0024 U	0.0027 U
Total hexachlorodibenzo-p-dioxin (HxCDD)	µg/kg	0.0015 U	0.0022 U
Total tetrachlorodibenzofuran (TCDF)	µg/kg	5.6 J	0.00086 U
Total pentachlorodibenzofuran (PeCDF)	µg/kg	3.5	0.001 U
Total hexachlorodibenzofuran (HxCDF)	µg/kg	0.94	0.00036 U
Total 2,3,7,8-TCDD TEQ	µg/kg	0.748	0.00007

Notes:

Values are presneted in micrograms per kilogram (µg/kg).

Duplicate sample results are shown in square brackets.

2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) TEQ is the sum of the concentration of each dioxin or furan congener multiplied by toxic equivalents factor.

-- = not applicable

ft bgs = feet below ground surface

J = estimated concentration

NA = not analyzed

ND = not detected

U = not detected at the laboratory reporting limit

Table C-5
2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Calculations - GPL
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Location ID	TEF	Units	MW-126WT		BH1		BH1		BH2		BH2		BH3	
Sample Depth(ft bgs):			14 - 16		0 - 1		1 - 2		0 - 1		1 - 2		0 - 1	
Date Collected:			02/08/95		03/06/07		03/06/07		03/06/07		03/06/07		03/06/07	
Dioxins/Furans			Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	mg/kg	< 0.00000068	ND	0.0000008 J	0.0000008	< 0.00000028	ND	0.00000097 J	0.00000097	0.00000087 J	0.00000087	0.0000013 J	0.0000013
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	< 0.0000011	ND	< 0.00000028	ND	< 0.0000022	ND	< 0.0000017	ND	0.0000034 J	0.00000034
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	mg/kg	NA	NA	0.000015	0.00000015	< 0.0000006	ND	0.00003	0.0000003	0.000019	0.00000019	0.000049	0.00000049
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	0.0003	mg/kg	NA	NA	0.00014	0.000000042	0.0000088 J	0.0000000026	0.00026	0.000000078	0.00025	0.000000075	0.00046	0.000000138
2,3,7,8-Tetrachlorodibenzofuran	0.1	mg/kg	NA	NA	0.000069	0.0000069	< 0.00000045	ND	0.00026	0.000026	0.0002	0.00002	0.00038	0.000038
1,2,3,7,8-Pentachlorodibenzofuran	0.03	mg/kg	NA	NA	0.000036	0.00000108	< 0.00000041	ND	0.00014	0.0000042	0.0001	0.000003	0.00019	0.00000057
2,3,4,7,8-Pentachlorodibenzofuran	0.3	mg/kg	NA	NA	0.000026	0.0000078	< 0.00000037	ND	0.000092	0.0000276	0.000068	0.0000204	0.00014	0.000042
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	0.00002	0.000002	< 0.00000036	ND	0.000075	0.0000075	0.000056	0.0000056	0.00012	0.000012
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	0.0000048 J	0.00000048	< 0.00000019	ND	0.000017	0.0000017	0.000012	0.0000012	0.000025	0.00000025
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	< 0.000002	ND	< 0.0000002	ND	0.0000066 J	0.00000066	0.0000047 J	0.00000047	0.000011	0.0000011
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	mg/kg	NA	NA	0.000033	0.00000033	< 0.00000054	ND	0.000069	0.00000069	0.000046	0.00000046	0.00015	0.0000015
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	mg/kg	NA	NA	< 0.0000019	ND	< 0.00000029	ND	0.0000065 J	0.000000065	0.0000048 J	0.000000048	0.0000098	0.000000098
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	0.0003	mg/kg	NA	NA	0.000044	0.0000000132	< 0.00000085	ND	0.000078	0.0000000234	0.000058	0.0000000174	0.00015	0.000000045
Total 2,3,78,-TCDD TEQ	--	mg/kg	NA	ND	0.000025644	0.0000196	0.00000000880	0.0000000026	0.000091223	0.0000698	0.000068146	0.0000523	0.000137	0.000105
Total 2,3,78,-TCDD TEQ	--	µg/kg	ND		0.0196		0.00000264		0.0698		0.0523		0.105	

Table C-5
2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Calculations - GPL
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Location ID	TEF	Units	BH3		BH4		BH4		BH5		BH5	
Sample Depth(ft bgs):			1 - 2		0 - 1		1 - 2		0 - 1		1 - 2	
Date Collected:			03/06/07		03/06/07		03/06/07		03/06/07		03/06/07	
Dioxins/Furans			Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	mg/kg	< 0.00000021 [< 0.00000023]	ND	< 0.00000025	ND	< 0.00000024	ND	0.0000012 J	0.0000012	< 0.00000024	ND
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	< 0.00000034 [< 0.00000031]	ND	< 0.00000032	ND	< 0.00000034	ND	0.0000043 J	0.00000043	< 0.00000032	ND
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	mg/kg	< 0.00000074 [< 0.00000088]	ND	0.0000035 J	0.000000035	< 0.00000051	ND	0.000058	0.00000058	< 0.00000043	ND
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	0.0003	mg/kg	0.0000074 J [0.0000083 J]	0.00000000236	0.000033	0.00000000990	< 0.0000036	ND	0.00057	0.000000171	< 0.0000046	ND
2,3,7,8-Tetrachlorodibenzofuran	0.1	mg/kg	0.0000018 [0.0000044]	0.00000031	0.0000041	0.00000041	< 0.00000024	ND	0.00028	0.000028	< 0.00000035	ND
1,2,3,7,8-Pentachlorodibenzofuran	0.03	mg/kg	< 0.0000011 [0.0000037 J]	0.000000111	< 0.000003	ND	< 0.00000024	ND	0.00015	0.0000045	< 0.00000035	ND
2,3,4,7,8-Pentachlorodibenzofuran	0.3	mg/kg	< 0.00000079 [< 0.0000024]	ND	< 0.0000019	ND	< 0.00000024	ND	0.0001	0.00003	< 0.00000027	ND
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	mg/kg	< 0.00000079 [< 0.0000026]	ND	< 0.000002	ND	< 0.0000002	ND	0.000092	0.0000092	< 0.00000029	ND
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	< 0.00000033 [< 0.00000059]	ND	< 0.00000062	ND	< 0.00000018	ND	0.00002	0.000002	< 0.00000019	ND
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	< 0.00000019 [< 0.00000023]	ND	< 0.00000022	ND	< 0.00000022	ND	0.000009	0.0000009	< 0.00000023	ND
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	mg/kg	< 0.0000011 [< 0.0000017]	ND	0.0000072	0.000000072	< 0.00000033	ND	0.00033	0.0000033	< 0.0000018	ND
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	mg/kg	< 0.00000026 [< 0.00000028]	ND	< 0.00000027	ND	< 0.00000025	ND	0.0000089	0.000000089	< 0.00000032	ND
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	0.0003	mg/kg	< 0.0000012 [< 0.0000018]	ND	0.0000074 J	0.00000000222	< 0.00000048	ND	0.00026	0.000000078	< 0.00000094	ND
Total 2,3,78,-TCDD TEQ	--	mg/kg	0.0000001874 [0.0000006283]	0.000000423	0.000000557	0.000000529	ND	ND	0.000104029	8.04E-05	ND	ND
Total 2,3,78,-TCDD TEQ	--	µg/kg	0.000423		0.000529		ND		0.0804		ND	

Table C-5
2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Calculations - GPL
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Location ID	TEF	Units	BH6		BH6		SS-009-CR		SS-010-CR		C1A		E3A	
Sample Depth(ft bgs):			0 - 1		1 - 2		0 - 0.5		0 - 0.5		0-1		0-1	
Date Collected:			03/06/07		03/06/07		12/01/97		12/01/97		4/18/2000		4/19/2000	
Dioxins/Furans			Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	mg/kg	0.00000075 J	0.00000075	< 0.0000003	ND	0.00077 SJ	0.00077	0.000092 J	0.000092	0.0000054	0.0000054	0.00000454	0.00000454
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	0.00000756	NA	0.00000686	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	0.00000591	NA	0.00000496	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	0.0000119	NA	0.0000116	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	< 0.0000017	ND	< 0.00000045	ND	NA	ND	NA	ND	0.000019	0.0000019	0.0000194	0.00000194
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	mg/kg	0.000031	0.00000031	< 0.00000087	ND	NA	ND	NA	ND	0.00028	0.0000028	0.000317	0.00000317
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	0.0003	mg/kg	0.00027 J	0.000000081	0.0000095 J	0.00000000285	NA	ND	NA	ND	0.00225	0.000000675	0.00231	0.000000693
2,3,7,8-Tetrachlorodibenzofuran	0.1	mg/kg	0.00019	0.000019	0.0000019	0.000000190	NA	ND	NA	ND	0.00584	0.000584	0.0042	0.00042
1,2,3,7,8-Pentachlorodibenzofuran	0.03	mg/kg	0.00011	0.0000033	< 0.0000013	ND	NA	ND	NA	ND	0.00291	0.0000873	0.00189	0.0000567
2,3,4,7,8-Pentachlorodibenzofuran	0.3	mg/kg	0.000078	0.0000234	< 0.00000071	ND	NA	ND	NA	ND	0.00229	0.000687	0.00147	0.000441
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	mg/kg	0.000074	0.0000074	< 0.00000099	ND	NA	ND	NA	ND	0.00212	0.000212	0.00142	0.000142
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	0.000017	0.0000017	< 0.00000042	ND	NA	ND	NA	ND	0.000495	0.0000495	0.000324	0.0000324
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	0.0000568	NA	0.0000352	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	0.0000069	0.00000069	< 0.00000033	ND	NA	ND	NA	ND	0.000235	0.0000235	0.000152	0.0000152
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	mg/kg	0.000091	0.00000091	< 0.00000078	ND	NA	ND	NA	ND	0.00137	0.0000137	0.00118	0.0000118
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	mg/kg	0.0000058 J	0.000000058	< 0.00000048	ND	NA	ND	NA	ND	0.000135	0.00000135	0.00011	0.0000011
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	0.0003	mg/kg	0.000087	0.000000026	< 0.0000011	ND	NA	ND	NA	ND	0.0013	0.00000039	0.00137	0.000000411
Total 2,3,78,-TCDD TEQ	--	mg/kg	0.0000757	0.0000576	0.000000200	0.000000193	NA	0.000770	NA	0.0000920	NA	0.00167	NA	0.00113
Total 2,3,78,-TCDD TEQ	--	µg/kg	0.0576		0.000193		0.770		0.0920		1.67		1.13	

Notes:
Values are presneted in milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
Toxic equivalent factors (TEFs) were obtained from the draft Part 201 Rules (MDEQ 2016b).
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) TEQ is the sum of the concentration of each dioxin or furan congener multiplied by the TEF.
-- = not applicable
< = not detected at the laboratory reporting limit
ft bgs = feet below ground surface
J = estimated concentration
NA = not analyzed
ND = not detected

Table C-6
Benzo(a)pyrene Toxic Equivalents Calculations - Sediment
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Indeno(1,2,3-cd)pyrene		Benzo(a)pyrene TEQ
			µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg
			Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 0.01)	Raw Data	TEQ (TEF = 0.001)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	TEQ
SD-1	(0 - 1.5')	6/15/95	1,100 U	55	130 J	130	150 J	15	1,100 U	5.5	1,100 U	0.55	1,100 U	550	1,100 U	55	811.05
SD-1	(1.5 - 3')	6/15/95	1,300 U	65	1,300 U	650	1,300 U	65	1,300 U	6.5	260 J	0.26	1,300 U	650	1,300 U	65	1501.76
SD-1	(3 - 4.5')	6/15/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-2	(0 - 1.7')	6/15/95	2,700 U	135	2,700 U	1350	2,700 U	135	2,700 U	13.5	2,700 U	1.35	2,700 U	1350	2,700 U	135	3119.85 U
SD-2	(1.7 - 3.4')	6/15/95	200 J	20	220 J	220	280 J	28	640 U	3.2	270 J	0.27	640 U	320	70 J	7	598.47
SD-2	(3.4 - 5')	6/15/95	75 J	7.5	420 U	210	95 J	9.5	420 U	2.1	100 J	0.1	420 U	210	420 U	21	460.2
SD-3	(0 - 1.3')	6/15/95	7,200 U [7,000 U]	355	7,200 U [7,000 U]	3550	7,200 U [7,000 U]	355	7,200 U [7,000 U]	35.5	7,200 U [7,000 U]	3.55	7,200 U [7,000 U]	3550	7,200 U [7,000 U]	355	8204.05 U
SD-3	(1.3 - 2.6')	6/15/95	160 J	16	100 J	100	130 J	13	240 U	1.2	210 J	0.21	240 U	120	35 J	3.5	253.91
SD-3	(2.6 - 3.9')	6/15/95	99 J	9.9	78 J	78	120 J	12	410 U	2.05	130 J	0.13	410 U	205	410 U	20.5	327.58
SD-4	(0 - 1.5')	6/19/95	2,200 U	110	2,200 U	1100	2,200 U	110	2,200 U	11	2,200 U	1.1	2,200 U	1100	2,200 U	110	2542.1 U
SD-4	(1.5 - 3')	6/19/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-5	(0 - 1.8')	6/21/95	44 J	4.4	28 J	28	40 J	4	220 U	1.1	65 J	0.065	220 U	110	220 U	11	158.565
SD-5	(1.8 - 3.6')	6/21/95	520 U	26	520 U	260	520 U	26	520 U	2.6	520 U	0.26	520 U	260	520 U	26	600.86 U
SD-5	(3.6 - 5.4')	6/21/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-6	(0 - 1.6')	6/21/95	77 J	7.7	260 U	130	120 J	12	260 U	1.3	120 J	0.12	260 U	130	260 U	13	294.12
SD-6	(1.6 - 3.2')	6/21/95	85 J	8.5	670 U	335	670 U	33.5	670 U	3.35	150 J	0.15	670 U	335	670 U	33.5	749
SD-6	(3.2 - 4.8')	6/21/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-7	(0 - 1.3')	6/21/95	1,000 U	50	1,000 U	500	1,000 U	50	1,000 U	5	1,000 U	0.5	1,000 U	500	1,000 U	50	1155.5 U
SD-7	(1.3 - 2.6')	6/21/95	620 U	31	620 U	310	620 U	31	620 U	3.1	620 U	0.31	620 U	310	620 U	31	716.41 U
SD-7	(2.6 - 3.9')	6/21/95	69 J	6.9	500 U	250	500 U	25	500 U	2.5	86 J	0.086	500 U	250	500 U	25	559.486
SD-8	(0 - 1.5')	6/21/95	280 U	14	280 U	140	280 U	14	280 U	1.4	280 U	0.14	280 U	140	280 U	14	323.54 U
SD-8	(1.5 - 3')	6/21/95	1,400 U	70	1,400 U	700	1,400 U	70	1,400 U	7	1,400 U	0.7	1,400 U	700	1,400 U	70	1617.7 U
SD-8	(3 - 4.5')	6/21/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-9	(0 - 1.5')	6/21/95	800 U [550 J]	47.5	330 J [640 J]	485	580 J [1100]	84	800 U [390 J]	3.95	490 J [770 J]	0.63	800 U [830 U]	407.5	140 J [240 J]	19	1047.58
SD-9	(1.5 - 3')	6/21/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-10	(0 - 0.5')	6/20/95	6,400 U	320	6,400 U	3200	6,400 U	320	6,400 U	32	6,400 U	3.2	6,400 U	3200	6,400 U	320	7395.2 U
SD-10	(0.75 - 1.25')	6/20/95	6,800 U	340	6,800 U	3400	6,800 U	340	6,800 U	34	6,800 U	3.4	6,800 U	3400	6,800 U	340	7857.4 U
SD-10	(1.5 - 2')	6/20/95	1,100 U	55	1,100 U	550	1,100 U	55	1,100 U	5.5	1,100 U	0.55	1,100 U	550	1,100 U	55	1271.05 U
SD-11	(0 - 0.5')	6/20/95	160 J	16	73 J	73	140 J	14	290 U	1.45	200 J	0.2	290 U	145	290 U	14.5	264.15
SD-11	(0.9 - 1.4')	6/20/95	6,600 U	330	6,600 U	3300	6,600 U	330	6,600 U	33	6,600 U	3.3	6,600 U	3300	6,600 U	330	7626.3 U
SD-11	(1.8 - 2.3')	6/20/95	1,400 U	70	1,400 U	700	1,400 U	70	1,400 U	7	1,400 U	0.7	1,400 U	700	1,400 U	70	1617.7 U
SD-12	(0 - 0.5')	6/20/95	1,700 U	85	250 J	250	460 J	46	1,700 U	8.5	630 J	0.63	1,700 U	850	1,700 U	85	1325.13
SD-12	(1.05 - 1.55')	6/20/95	940 J [2,100 U]	99.5	470 J [350 J]	410	980 J [690 J]	83.5	2,300 U [2,100 U]	11	1,400 J [910 J]	1.155	2,300 U [2,100 U]	1100	2,300 U [2,100 U]	110	1815.155
SD-12	(2.1 - 2.6')	6/20/95	1,300 U	65	1,300 U	650	150 J	15	1,300 U	6.5	220 J	0.22	1,300 U	650	1,300 U	65	1451.72
SD-13	(0 - 0.5')	6/20/95	2,600 U	130	2,600 U	1300	2,600 U	130	2,600 U	13	2,600 U	1.3	2,600 U	1300	2,600 U	130	3004.3 U
SD-13	(1.45 - 1.95')	6/20/95	3,000 U	150	3,000 U	1500	3,000 U	150	3,000 U	15	650 J	0.65	3,000 U	1500	3,000 U	150	3465.65
SD-13	(2.9 - 3.4')	6/20/95	80 J	8	740 UJ	370	740 UJ	37	740 UJ	3.7	120 J	0.12	740 UJ	370	740 UJ	37	825.82
SD-14	(0 - 0.5')	6/20/95	1,700 U	85	1,700 U	850	1,700 U	85	1,700 U	8.5	350 J	0.35	1,700 U	850	1,700 U	85	1963.85
SD-14	(0.9 - 1.4')	6/20/95	2,300 U	115	2,300 U	1150	380 J	38	2,300 U	11.5	660 J	0.66	2,300 U	1150	2,300 U	115	2580.16
SD-14	(1.8 - 2.3')	6/20/95	1,400 U	70	1,400 U	700	1,400 U	70	1,400 U	7	1,400 U	0.7	1,400 U	700	1,400 U	70	1617.7 U
SD-15	(0 - 0.5')	6/20/95	2,400 U	120	2,400 U	1200	2,400 U	120	2,400 U	12	270 J	0.27	2,400 U	1200	2,400 U	120	2772.27
SD-15	(0.9 - 1.4')	6/20/95	270 J	27	1,900 U	950	1,900 U	95	1,900 U	9.5	430 J	0.43	1,900 U	950	1,900 U	95	2126.93
SD-15	(1.8 - 2.3')	6/20/95	75 J	7.5	300 U	150	53 J	5.3	300 U	1.5	130 J	0.13	300 U	150	300 U	15	329.43
SD-16	(0 - 0.5')	6/20/95	1,300 U	65	1,300 U	650	1,300 U	65	1,300 U	6.5	1,300 U	0.65	1,300 U	650	1,300 U	65	1502.15 U
SD-16	(1.1 - 1.6')	6/20/95	310 J	31	250 J	250	390 J	39	1,000 UJ	5	510 J	0.51	1,000 UJ	500	1,000 UJ	50	875.51
SD-16	(2.2 - 2.7')	6/20/95	540 U	27	540 U	270	540 U	27	540 U	2.7	100 J	0.1	540 U	270	540 U	27	623.8
SD-17	(0 - 0.5')	6/20/95	330 J [260 J]	29.5	180 J [120 J]	150	350 J [250 J]	30	650 U [530 U]	2.95	550 J [400]	0.475	650 U [530 U]	295	650 U [530 U]	29.5	537.425
SD-17	(0.95 - 1.45')	6/20/95	180 J	18	100 J	100	160 J	16	720 U	3.6	260 J	0.26	720 U	360	720 U	36	533.86
SD-17	(1.9 - 2.4')	6/20/95	170 J	17	1,300 U	650	1,300 U	65	1,300 U	6.5	260 J	0.26	1,300 U	650	1,300 U	65	1453.76
SD-18	(0 - 0.5')	6/20/95	870 U	43.5	870 U	435	870 U	43.5	870 U	4.35	870 U	0.435	870 U	435	870 U	43.5	1005.285 U
SD-18	(2.25 - 2.75')	6/20/95	3,600 U	180	3,600 U	1800	410 J	41	3,600 U	18	3,600 U	1.8	3,600 U	1800	3,600 U	180	4020.8
SD-18	(4.5 - 5')	6/20/95	51 J	5.1	490 U	245	490 U	24.5	490 U	2.45	82 J	0.082	490 U	245	490 U	24.5	546.632
SD-19	(0 - 0.5')	6/20/95	5,100 U	255	5,100 U	2550	5,100 U	255	5,100 U	25.5	5,100 U	2.55	5,100 U	2550	5,100 U	255	5893.05 U
SD-19	(1.75 - 2.25')	6/20/95	3,500 U	175	3,500 U	1750	3,500 U	175	3,500 U	17.5	3,500 U	1.75	3,500 U	1750	3,500 U	175	4044.25 U
SD-19	(3.5 - 4')	6/20/95	970 U	48.5	970 U	485	970 U	48.5	970 U	4.85	180 J	0.18	970 U	485	970 U	48.5	1120.53

Table C-6
Benzo(a)pyrene Toxic Equivalents Calculations - Sediment
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Indeno(1,2,3-cd)pyrene		Benzo(a)pyrene TEQ
			µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg
			Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 0.01)	Raw Data	TEQ (TEF = 0.001)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	TEQ
SD-20	(0 - 0.5')	6/20/95	4,500 U	225	4,500 U	2250	4,500 U	225	4,500 U	22.5	4,500 U	2.25	4,500 U	2250	4,500 U	225	5199.75 U
SD-20	(0.7 - 1.2')	6/20/95	2,000 U	100	2,000 U	1000	2,000 U	100	2,000 U	10	2,000 U	1	2,000 U	1000	2,000 U	100	2311 U
SD-20	(1.4 - 1.9')	6/20/95	1,500 U	75	1,500 U	750	1,500 U	75	1,500 U	7.5	1,500 U	0.75	1,500 U	750	1,500 U	75	1733.25 U
SD-21	(0 - 0.5')	6/20/95	9,800 U	490	9,800 U	4900	9,800 U	490	9,800 U	49	9,800 U	4.9	9,800 U	4900	9,800 U	490	11323.9 U
SD-21	(0.65 - 1.15')	6/20/95	2,600 U	130	2,600 U	1300	2,600 U	130	2,600 U	13	520 J	0.52	2,600 U	1300	2,600 U	130	3003.52
SD-21	(1.3 - 1.8')	6/20/95	110 J	11	720 U	360	720 U	36	720 U	3.6	160 J	0.16	720 U	360	720 U	36	806.76
SD-22	(0 - 1.2')	6/19/95	64 J	6.4	55 J	55	70 J	7	200 U	1	74 J	0.074	200 U	100	200 U	10	179.474
SD-22	(1.2 - 2.4')	6/19/95	280	28	250	250	280	28	220 U	1.1	340	0.34	220 U	110	90 J	9	426.44
SD-22	(2.4 - 3.6')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-23	(0 - 1.2')	6/19/95	47 J	4.7	64 J	64	90 J	9	53 J	0.53	68 J	0.068	200 U	100	200 U	10	188.298
SD-23	(1.2 - 2.4')	6/19/95	53 J	5.3	70 J	70	82 J	8.2	240 U	1.2	62 J	0.062	240 U	120	240 U	12	216.762
SD-23	(2.4 - 3.6')	6/19/95	230 U	11.5	48 J	48	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	198.765
SD-24	(0 - 1.5')	6/19/95	260 U	13	260 U	130	260 U	13	260 U	1.3	260 U	0.13	260 U	130	260 U	13	300.43 U
SD-24	(1.5 - 3')	6/19/95	260 U	13	260 U	130	260 U	13	260 U	1.3	260 U	0.13	260 U	130	260 U	13	300.43 U
SD-25	(0 - 1.1')	6/19/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-25	(1.1 - 2.2')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-25	(2.2 - 3.3')	6/19/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-26	(0 - 1.2')	6/19/95	260 U	13	260 U	130	260 U	13	260 U	1.3	260 U	0.13	260 U	130	260 U	13	300.43 U
SD-26	(1.2 - 2.4')	6/19/95	240 U	12	240 U	120	240 U	12	240 U	1.2	240 U	0.12	240 U	120	240 U	12	277.32 U
SD-26	(2.4 - 3.6')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-27	(0 - 1.3')	6/19/95	260 U	13	260 U	130	260 U	13	260 U	1.3	260 U	0.13	260 U	130	260 U	13	300.43 U
SD-27	(1.3 - 2.6')	6/19/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-27	(2.6 - 3.9')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-28	(0 - 1.2')	6/19/95	300 U	15	300 U	150	300 U	15	300 U	1.5	300 U	0.15	300 U	150	300 U	15	346.65 U
SD-28	(1.2 - 2.4')	6/19/95	240 U	12	240 U	120	240 U	12	240 U	1.2	240 U	0.12	240 U	120	240 U	12	277.32 U
SD-28	(2.4 - 3.6')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-29	(0 - 1.2')	6/19/95	270 U	13.5	270 U	135	270 U	13.5	270 U	1.35	43 J	0.043	270 U	135	270 U	13.5	311.893
SD-29	(1.2 - 2.4')	6/19/95	240 U	12	240 U	120	240 U	12	240 U	1.2	240 U	0.12	240 U	120	240 U	12	277.32 U
SD-29	(2.4 - 3.6')	6/19/95	240 U	12	240 U	120	240 U	12	240 U	1.2	240 U	0.12	240 U	120	240 U	12	277.32 U
SD-30	(0 - 1.1')	6/19/95	280 U	14	280 U	140	280 U	14	280 U	1.4	280 U	0.14	280 U	140	280 U	14	323.54 U
SD-30	(1.1 - 2.2')	6/19/95	210 U	10.5	210 U	105	210 U	10.5	210 U	1.05	210 U	0.105	210 U	105	210 U	10.5	242.655 U
SD-30	(2.2 - 3.3')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-31	(0 - 1.1')	6/19/95	290 U	14.5	290 U	145	290 U	14.5	290 U	1.45	290 U	0.145	290 U	145	290 U	14.5	335.095 U
SD-31	(1.1 - 2.2')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-31	(2.2 - 3.3')	6/19/95	200 U	10	200 U	100	200 U	10	200 U	1	200 U	0.1	200 U	100	200 U	10	231.1 U
SD-32	(0 - 1.4')	6/19/95	340 U [350 U]	17.25	340 U [350 U]	172.5	340 U [350 U]	17.25	340 U [350 U]	1.725	340 U [47 J]	0.1085	340 U [350 U]	172.5	340 U [350 U]	17.25	398.5835
SD-32	(1.4 - 2.8')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-32	(2.8 - 4.2')	6/19/95	210 U	10.5	210 U	105	210 U	10.5	210 U	1.05	210 U	0.105	210 U	105	210 U	10.5	242.655 U
SD-33	(0 - 1.3')	6/19/95	36 J	3.6	350 U	175	57 J	5.7	350 U	1.75	49 J	0.049	350 U	175	350 U	17.5	378.599
SD-33	(1.3 - 2.6')	6/19/95	32 J	3.2	31 J	31	47 J	4.7	270 U	1.35	42 J	0.042	270 U	135	270 U	13.5	188.792
SD-33	(2.6 - 3.9')	6/19/95	190 U	9.5	190 U	95	190 U	9.5	190 U	0.95	190 U	0.095	190 U	95	190 U	9.5	219.545 U
SD-34	(0 - 1.3')	6/21/95	51 J	5.1	45 J	45	61 J	6.1	240 U	1.2	65 J	0.065	240 U	120	240 U	12	189.465
SD-34	(1.3 - 2.6')	6/21/95	250 U	12.5	33 J	33	42 J	4.2	250 U	1.25	44 J	0.044	250 U	125	250 U	12.5	188.494
SD-34	(2.6 - 3.9')	6/21/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-35	(0 - 1.5')	6/21/95	330 U	16.5	330 U	165	330 U	16.5	330 U	1.65	330 U	0.165	330 U	165	330 U	16.5	381.315 U
SD-35	(1.5 - 3')	6/21/95	62 J	6.2	66 J	66	110 J	11	230 U	1.15	91 J	0.091	230 U	115	230 U	11.5	210.941
SD-35	(3 - 4.5')	6/21/95	240 U	12	240 U	120	240 U	12	240 U	1.2	240 U	0.12	240 U	120	240 U	12	277.32 U
SD-36	(0 - 1.2')	6/19/95	120 J	12	150 J	150	200 J	20	96 J	0.96	140 J	0.14	240 U	120	57 J	5.7	308.8
SD-36	(1.2 - 2.4')	6/19/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-36	(2.4 - 3.6')	6/19/95	250 U	12.5	250 U	125	250 U	12.5	250 U	1.25	250 U	0.125	250 U	125	250 U	12.5	288.875 U
SD-37	(0 - 1.3')	6/19/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-37	(1.3 - 2.6')	6/19/95	240 U [250 U]	12.25	240 U [250 U]	122.5	240 U [250 U]	12.25	240 U [250 U]	1.225	240 U [250 U]	0.1225	240 U [250 U]	122.5	240 U [250 U]	12.25	283.0975 U
SD-37	(2.6 - 3.9')	6/19/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-38	(0 - 1.2')	6/19/95	170 J	17	260 J	260	320 J	32	160 J	1.6	190 J	0.19	330 U	165	100 J	10	485.79
SD-38	(1.2 - 2.4')	6/19/95	38 J	3.8	57 J	57	68 J	6.8	32 J	0.32	45 J	0.045	220 U	110	23 J	2.3	180.265

Table C-6
Benzo(a)pyrene Toxic Equivalents Calculations - Sediment
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzo(a)anthracene		Benzo(a)pyrene		Benzo(b)fluoranthene		Benzo(k)fluoranthene		Chrysene		Dibenz(a,h)anthracene		Indeno(1,2,3-cd)pyrene		Benzo(a)pyrene TEQ
			µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg		µg/kg
			Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	Raw Data	TEQ (TEF = 0.01)	Raw Data	TEQ (TEF = 0.001)	Raw Data	TEQ (TEF = 1)	Raw Data	TEQ (TEF = 0.1)	TEQ
SD-39	(0 - 1')	6/22/95	200 U	10	200 U	100	200 U	10	200 U	1	200 U	0.1	200 U	100	200 U	10	231.1 U
SD-39	(1 - 2')	6/22/95	180 U [200 U]	9.5	180 U [200 U]	95	180 U [200 U]	9.5	180 U [200 U]	0.95	180 U [200 U]	0.095	180 U [200 U]	95	180 U [200 U]	9.5	219.545 U
SD-40	(0 - 1.1')	6/22/95	46 J	4.6	58 J	58	85 J	8.5	290 U	1.45	62 J	0.062	290 U	145	290 U	14.5	232.112
SD-40	(1.1 - 2.2')	6/22/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-41	(0 - 1')	6/22/95	120 J	12	90 J	90	190 J	19	50 J	0.5	240 J	0.24	450 U	225	450 U	22.5	369.24
SD-41	(1 - 2')	6/22/95	27 J	2.7	25 J	25	36 J	3.6	200 U	1	36 J	0.036	200 U	100	200 U	10	142.336
SD-42	(0 - 1')	6/22/95	41 J	4.1	26 J	26	41 J	4.1	170 U	0.85	57 J	0.057	170 U	85	170 U	8.5	128.607
SD-42	(1 - 2')	6/22/95	110 J	11	89 J	89	130 J	13	210 U	1.05	150 J	0.15	210 U	105	25 J	2.5	221.7
SD-43	(0 - 0.8')	6/15/95	120 J	12	120 J	120	210 J	21	230 U	1.15	150 J	0.15	230 U	115	26 J	2.6	271.9
SD-43	(0.8 - 1.6')	6/15/95	90 J	9	130 J	130	140 J	14	200 U	1	110 J	0.11	200 U	100	49 J	4.9	259.01
SD-44	(0 - 0.9')	6/15/95	140 J	14	88 J	88	120 J	12	660 U	3.3	240 J	0.24	660 U	330	660 U	33	480.54
SD-44	(0.9 - 1.8')	6/15/95	120 J	12	110 J	110	140 J	14	55 J	0.55	140 J	0.14	260 U	130	46 J	4.6	271.29
SD-45	(0 - 0.7')	6/15/95	230 U	11.5	230 U	115	230 U	11.5	230 U	1.15	230 U	0.115	230 U	115	230 U	11.5	265.765 U
SD-45	(0.7 - 1.4')	6/15/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-46	(0 - 1.5')	6/15/95	100 J	10	61 J	61	95 J	9.5	320 U	1.6	140 J	0.14	320 U	160	320 U	16	258.24
SD-46	(1.5 - 3')	6/15/95	250 U	12.5	250 U	125	250 U	12.5	250 U	1.25	250 U	0.125	250 U	125	250 U	12.5	288.875 U
SD-46	(3 - 4.5')	6/15/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-47	(0 - 1.5')	6/15/95	210 U	10.5	210 U	105	210 U	10.5	210 U	1.05	210 U	0.105	210 U	105	210 U	10.5	242.655 U
SD-47	(1.5 - 3')	6/15/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-48	(0 - 1.3')	6/15/95	34 J	3.4	32 J	32	43 J	4.3	210 U	1.05	46 J	0.046	210 U	105	210 U	10.5	156.296
SD-48	(1.3 - 2.6')	6/15/95	220 U	11	220 U	110	220 U	11	220 U	1.1	220 U	0.11	220 U	110	220 U	11	254.21 U
SD-59	(0 - 0.5')	8/10/00	550 U	27.5	550 U	275	550 U	27.5	550 U	2.75	550 U	0.275	550 U	275	550 U	27.5	635.525 U
SD-60	(0 - 0.5')	8/10/00	550 U	27.5	550 U	275	550 U	27.5	550 U	2.75	550 U	0.275	550 U	275	550 U	27.5	635.525 U
SD-61	(0 - 0.5')	8/10/00	530 U	26.5	530 U	265	530 U	26.5	530 U	2.65	530 U	0.265	530 U	265	530 U	26.5	612.415 U
SD-62	(0 - 0.5')	8/10/00	4800 [3400]	410	6700 [4900]	5800	8400 [5800]	710	2900 [2500]	27	5500 [4000]	4.75	990 J [710 J]	850	3900 [2700]	330	8131.75
SD-64	(0 - 0.5')	8/10/00	690 U	34.5	690 U	345	690 U	34.5	690 U	3.45	690 U	0.345	690 U	345	690 U	34.5	797.295 U
SD-65	(0 - 0.5')	8/10/00	250 J	25	350 J	350	480 J	48	150 J	1.5	300 J	0.3	540 U	270	230 J	23	717.8

Maximum Detection 8131.75
Maximum Including Non-detects 11323.9

Notes:
Values are presneted in micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
Toxic equivalent factors (TEFs) were obtained from the draft Part 201 Rules (MDEQ 2016b).
Benzo(a)pyrene TEQ is the sum of the concentration of each carcinogenic polycycly aromatic hydrocarbon (cPAH) multiplied by the TEF. Non-detect values are treated as detections at 1/2 the reporting limit for the calculation of benzo(a)pyrene toxic equivalents (TEQ).

J = estimated value between the method detection limit and the reporting limit
U = The seven cPAHs were not detected

Table C-7
2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic Equivalents Calculations - Sediment
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Units	SD-5	SD-5	SD-5	SD-6	SD-6	SD-6	SD-7	SD-7	SD-7	SD-8	SD-8	SD-8	SD-17	SD-17	SD-17	SD-26	SD-26	SD-26	SD-27	SD-27	SD-27
Sample Depth (ft bgs)		(0 - 1.8')	(1.8 - 3.6')	(3.6 - 5.4')	(0 - 1.6')	(1.6 - 3.2')	(3.2 - 4.8')	(0 - 1.3')	(1.3 - 2.6')	(2.6 - 3.9')	(0 - 1.5')	(1.5 - 3')	(3 - 4.5')	(0 - 0.5')	(0.95 - 1.45')	(1.9 - 2.4')	(0 - 1.2')	(1.2 - 2.4')	(2.4 - 3.6')	(0 - 1.3')	(1.3 - 2.6')	(2.6 - 3.9')
Sample Date		6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/21/1995	6/20/1995	6/20/1995	6/20/1995	6/19/1995	6/19/1995	6/19/1995	6/19/1995	6/19/1995	6/19/1995
Dioxins/Furans																						
2,3,7,8-Tetrachlorodibenzo-p-dioxin	µg/kg	0.0058 J	0.0087	0.0013 U	0.0040 J	0.008	0.0014 U	0.013	0.0064 J	0.011	0.0028 J	0.0026 J	0.0018 J	0.0018 U [0.0019 J]	0.0065 J	0.014	0.0011 U	0.00032 U	0.00043 U	0.00094 U	0.00029 U	0.00029 U
Total Tetrachlorodibenzo-p-dioxins	µg/kg	0.050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.0050 U	0.016 [0.019]	0.069	0.13	0.018	0.0037	0.00074 U	0.017	0.00074 U	0.00052 U
Total Pentachlorodibenzo-p-dioxins	µg/kg	0.0099	0.032	0.0024 U	0.0067 U	0.020 J	0.0028 U	0.0065 U	0.011 U	0.05	0.0059 U	0.0054 U	0.0065 U	0.0052 U [0.0047 U]	0.011	0.095	0.0036 U	0.0018 U	0.0017 U	0.0046 U	0.0018 U	0.0017 U
Total Hexachlorodibenzo-p-dioxins	µg/kg	0.14	0.24	0.013	0.052	0.14	0.016	0.079	0.095	0.2	0.037	0.049	0.064	0.045 [0.036]	0.23	0.53	0.01	0.0025 U	0.00055 U	0.0098	0.00076 U	0.00041 U
Total Tetrachlorodibenzofurans	µg/kg	0.26	0.47	0.04	0.62	1.2	0.2	0.39	6.6	2.4	0.73	0.72	0.28	0.57 [0.44]	0.68	1	0.71	0.16	0.00047 U	0.69	0.018	0.00029 U
Total Pentachlorodibenzofurans	µg/kg	0.094	0.21	0.0066 U	0.29	0.57	0.056	0.16	2.5	1.3	0.35 J	0.33 J	0.12	0.14 [0.068]	0.22	0.47	0.45	0.089	0.00048 U	0.5	0.0052 U	0.00025 U
Total Hexachlorodibenzofurans	µg/kg	0.13	0.13	0.0030 U	0.063	0.20 J	0.019	0.082	0.37	0.48	0.075	0.057	0.044	0.038 [0.02]	0.069	0.43	0.14	0.024	0.00020 U	0.18	0.0038 U	0.000095 U
Total 2,3,78,-TCDD TEQ	µg/kg	0.027	0.058	0.0014	0.052	0.12	0.016	0.047	0.65	0.29	0.056	0.039	0.021	0.02 [0.017]	0.04	0.094	0.09	0.02	ND	0.098	0.000032	ND

Notes:
Values are presneted in micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) TEQ is the sum of the concentration of each dioxin or furan congener multiplied by toxic equivalents factor.
-- = not applicable
ft bgs = feet below ground surface
J = estimated concentration
NA = not analyzed
ND = not detected
U = not detected at the laboratory reporting limit

APPENDIX D

Dioxin Summary Letter and Additional Dioxin Information



Ms. Amanda Armbruster
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Michigan Department of Environmental Quality
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Subject:

Updated 2017 Dioxin Summary Letter
MID005356696 - RACER Saginaw Malleable Industrial Land / Green Point
Landfill, and Peninsula Property
Saginaw, Michigan

ENVIRONMENT

Date:

April 21, 2017

Dear Ms. Armbruster:

Contact:

Scott Clearwater

This letter has been prepared on behalf of the Revitalizing Auto Communities Environmental Response (RACER) Trust as an update to the October 26, 2016 letter to incorporate additional sample locations, data comparison to toxic equivalency factors (TEFs), and to identify and summarize historical samples collected at the Saginaw Malleable Industrial Land / Green Point Landfill / Peninsula Property (the Site, **Figure 1**) and analyzed for dioxins and furans, and to put those results in context to the regional dioxin contamination situation.

Phone:

810.225.1921

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scott.clearwater@arcadis.com

Our ref:

B0050096.2016

Arcadis reviewed historical data for the Site and identified a limited number of samples that have been collected and analyzed for dioxins and furans. One sample (MW-126WT) collected in 1995 from a depth between 14 and 16 feet below ground surface, and was analyzed for dioxins and furans as shown on Figure 1. The sample location is within the 100-year flood plain on the west side of Green Point Landfill, approximately 2,000 feet from the river, neither dioxins nor furans were detected, see **Table 1**. Additional soil samples were collected as part of a wetland mitigation project completed on behalf of GM. Two of the samples (C1A and E3A) were analyzed for dioxins and furans due to known dioxin impacts deposited across the river flood plain area as a result of releases by the Dow Chemical Company (Dow) upstream from the Site (**Figure 1**). Twenty-one samples were collected for polychlorinated biphenyl (PCBs) Aroclors (non-coplanar) at a depth of 0-1 foot below ground surface, however, only two of those samples were analyzed for dioxin and furans. These two sample locations were within the 100-year flood plain, within 500 feet of the river. Fourteen soil samples were collected from eight sample locations at Green Point Landfill during investigation activities in 1997 and 2007 (**Figure 1**) within the 8-year flood

plain (**Figure 2**). These soil samples were collected adjacent to the Saginaw River and approximately 500 feet west of the river.

Extensive sampling programs show the presence of dioxin and furan compounds throughout the flood plains and river sediments of the Tittabawassee and Saginaw Rivers that trace from the Dow plant located in Midland, Michigan; this documentation was identified on the Michigan Department of Environmental Quality (MDEQ) website located at the MDEQ Dioxin Information - Midland Area Soils Corrective Action document archive website: (http://www.michigan.gov/deq/0,4561,7-135-3307_29693_21234-271213--,00.html). According to a MDEQ Affidavit found at this MDEQ website, a sediment removal action was completed in the Saginaw River adjacent to the Site (**Attachment 1**). Further, the MDEQ *Phase II Tittabawassee/Saginaw River Dioxin Flood Plain Sampling Study* stated that there is an insignificant contribution of the total dioxin-like toxicity from coplanar PCB compounds found in connection with dioxin flood plain impacts originating from Dow. The presence of dioxins and furans has not been extensively investigated at the Site as they were determined to not be Site-related compounds; however, per the attached Affidavit, the presence of the Site within the flood plain of the Tittabawassee and Saginaw Rivers, these compounds may be present.

The draft Part 201 Rules (MDEQ 2016) indicate that dioxin-like constituents (e.g., dioxins, furans, and 12 coplanar PCB congeners) shall be adjusted by their TEFs (provided in footnote O of the draft Part 201 Rules), summed together, and compared to the criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD]. Coplanar PCBs have not been analyzed in soil samples collected at the Site. However, as stated above, there is an insignificant contribution from coplanar PCBs to the total dioxin-like toxicity. The conversion of analyzed dioxins and furans to 2,3,7,8-TCDD TEQ is provided in **Table 1**. The calculated 2,3,7,8-TCDD TEQs range from non-detect to 1.67 µg/kg. The 2,3,7,8-TCDD TEQ were compared to the MDEQ Part 201 Residential Direct Contact Criteria (DCC) of 90 picograms per gram (pg/g) or 0.090 micrograms per kilogram (µg/kg) or 0.000090 milligrams per kilogram (mg/kg) and the site-specific action level of 250 pg/g (0.250 µg/kg or 0.000250 mg/kg) identified in the Dow Chemical Company Interim Response Activity Plan Designed to Meet Criteria (March 2012). Five of the 16 samples collected within 500 feet of the Saginaw River have 2,3,7,8-TCDD TEQs that exceed the MDEQ Part 201 Residential DCC, and three samples exceed Dow's site-specific action level.

Arcadis completed a recreational risk evaluation for the Site, submitted to MDEQ under separate cover, which considers future potential recreational use. Based on the approved approach for the recreational evaluation, a site-specific recreational criterion of 2.25 µg/kg (2,250 pg/g) was calculated. The maximum calculated 2,3,7,8-TCDD TEQ did not exceed the site-specific recreational criterion.

Conclusions and Recommendations:

The individual dioxins and furans were adjusted using the 2,3,7,8-TCDD TEFs, and summed together into one 2,3,7,8-TCDD TEQ value, which was then compared to the 2,3,7,8-TCDD draft Part 201 residential DCC and calculated site-specific recreational criteria. Coplanar PCBs were not analyzed in the available data for the Site; however, coplanar PCBs are not expected to significantly contribute to the 2,3,7,8-TCDD TEQ. Based on the results of the samples collected at the Site and analyzed for dioxins and furans, dioxins and furans do not pose a significant risk for future recreational use of the Site. Based on the above information the presence of dioxins and furans at the Site may be a Due Care consideration.

Ms. Amanda Armbruster
April 21, 2017

Please contact me with any questions.

Sincerely,

Arcadis of Michigan, LLC



Scott Clearwater
Certified Project Manager

Copies:

Rhonda Klann, MDEQ
Ann Person, MDEQ
Divinia Ries, MDEQ
Dave Favero, RACER

Enclosures:

Tables

- 1 Soil Analytical Data

Figures

- 1 Site Layout and Sample Location Map
- 2 Approximate 8-year Flood Plain Map

Attachments

- 1 Affidavit to Support Unremediated Release(s) in a Remedial Action Plan

References:

Phase II Tittabawassee/Saginaw River Dioxin Flood Plain Sampling Study, MDEQ, June 2003

The Dow Chemical Company Interim Response Activity Plan Designed to Meet Criteria, URS Corporation, March 2012 (revised May 2012)

MDEQ. 2016a. Cleanup Criteria and Screening Levels Development and Application. Remediation and Redevelopment Division Resource Materials. Draft. June.

http://www.michigan.gov/documents/deq/deq-rrd-chem-CleanupCriteriaTSD_527410_7.pdf.

MDEQ. 2016b. Cleanup Criteria Requirements for Response Activity. Remediation and Redevelopment Division. Draft. September 29. http://www.michigan.gov/documents/deq/deq-rrd-Sept2016-RevisedProposedCriteriaRules_536510_7.pdf.

TABLES



Table 1
2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic
Equivalents Calculations
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point
Landfill, and Peninsula Properties
Saginaw, Michigan

Location ID	TEF	Units	MW-126WT		BH1		BH1		BH2		BH2		BH3	
Sample Depth(ft bgs):			14 - 16		0 - 1		1 - 2		0 - 1		1 - 2		0 - 1	
Date Collected:			02/08/95		03/06/07		03/06/07		03/06/07		03/06/07		03/06/07	
Dioxins/Furans			Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	mg/kg	< 0.00000068	ND	0.0000008 J	0.0000008	< 0.00000028	ND	0.00000097 J	0.00000097	0.00000087 J	0.00000087	0.0000013 J	0.0000013
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	< 0.0000011	ND	< 0.00000028	ND	< 0.0000022	ND	< 0.0000017	ND	0.0000034 J	0.00000034
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	mg/kg	NA	NA	0.000015	0.00000015	< 0.0000006	ND	0.00003	0.0000003	0.000019	0.00000019	0.000049	0.00000049
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	0.0003	mg/kg	NA	NA	0.00014	0.000000042	0.0000088 J	0.00000000264	0.00026	0.000000078	0.00025	0.000000075	0.00046	0.000000138
2,3,7,8-Tetrachlorodibenzofuran	0.1	mg/kg	NA	NA	0.000069	0.0000069	< 0.00000045	ND	0.00026	0.000026	0.0002	0.00002	0.00038	0.000038
1,2,3,7,8-Pentachlorodibenzofuran	0.03	mg/kg	NA	NA	0.000036	0.00000108	< 0.00000041	ND	0.00014	0.0000042	0.0001	0.000003	0.00019	0.0000057
2,3,4,7,8-Pentachlorodibenzofuran	0.3	mg/kg	NA	NA	0.000026	0.0000078	< 0.00000037	ND	0.000092	0.0000276	0.000068	0.0000204	0.00014	0.000042
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	0.00002	0.000002	< 0.00000036	ND	0.000075	0.0000075	0.000056	0.0000056	0.00012	0.000012
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	0.0000048 J	0.00000048	< 0.00000019	ND	0.000017	0.0000017	0.000012	0.0000012	0.000025	0.0000025
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	< 0.000002	ND	< 0.0000002	ND	0.0000066 J	0.00000066	0.0000047 J	0.00000047	0.000011	0.0000011
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	mg/kg	NA	NA	0.000033	0.00000033	< 0.00000054	ND	0.000069	0.00000069	0.000046	0.00000046	0.00015	0.0000015
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	mg/kg	NA	NA	< 0.0000019	ND	< 0.00000029	ND	0.0000065 J	0.000000065	0.0000048 J	0.000000048	0.0000098	0.000000098
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	0.0003	mg/kg	NA	NA	0.000044	0.0000000132	< 0.00000085	ND	0.000078	0.00000002340	0.000058	0.00000001740	0.00015	0.000000045
Total 2,3,78,-TCDD TEQ	--	mg/kg	NA	ND	0.000025644	0.0000196	0.00000000880	0.00000000264	0.000091223	0.0000698	0.000068146	0.0000523	0.000137438	0.000105
Total 2,3,78,-TCDD TEQ	--	µg/kg	ND		0.0196		0.00000264		0.0698		0.0523		0.10521	

Notes:
Values are presneted in milligrams per kilogram (mg/kg)
or micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
Toxic equivalent factors (TEFs) were obtained from the
draft Part 201 Rules (MDEQ 2016b).
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) TEQ
is the sum of the concentration of each dioxin or furan
congener multiplied by the TEF.
-- = not applicable
< = not detected at the laboratory reporting limit
ft bgs = feet below ground surface
J = estimated concentration
NA = not analyzed
ND = not detected

Table 1
2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic
Equivalents Calculations
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point
Landfill, and Peninsula Properties
Saginaw, Michigan

Location ID	TEF	Units	BH3		BH4		BH4		BH5		BH5	
Sample Depth(ft bgs):			1 - 2		0 - 1		1 - 2		0 - 1		1 - 2	
Date Collected:			03/06/07		03/06/07		03/06/07		03/06/07		03/06/07	
Dioxins/Furans			Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	mg/kg	< 0.00000021 [< 0.00000023]	ND	< 0.00000025	ND	< 0.00000024	ND	0.0000012 J	0.0000012	< 0.00000024	ND
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	< 0.00000034 [< 0.00000031]	ND	< 0.00000032	ND	< 0.00000034	ND	0.0000043 J	0.00000043	< 0.00000032	ND
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	mg/kg	< 0.00000074 [< 0.00000088]	ND	0.0000035 J	0.000000035	< 0.00000051	ND	0.000058	0.00000058	< 0.00000043	ND
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	0.0003	mg/kg	0.0000074 J [0.0000083 J]	0.00000000236	0.000033	0.00000000990	< 0.0000036	ND	0.00057	0.000000171	< 0.0000046	ND
2,3,7,8-Tetrachlorodibenzofuran	0.1	mg/kg	0.0000018 [0.0000044]	0.00000031	0.0000041	0.00000041	< 0.00000024	ND	0.00028	0.000028	< 0.00000035	ND
1,2,3,7,8-Pentachlorodibenzofuran	0.03	mg/kg	< 0.0000011 [0.0000037 J]	0.000000111	< 0.000003	ND	< 0.00000024	ND	0.00015	0.0000045	< 0.00000035	ND
2,3,4,7,8-Pentachlorodibenzofuran	0.3	mg/kg	< 0.00000079 [< 0.0000024]	ND	< 0.0000019	ND	< 0.00000024	ND	0.0001	0.00003	< 0.00000027	ND
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	mg/kg	< 0.00000079 [< 0.0000026]	ND	< 0.000002	ND	< 0.0000002	ND	0.000092	0.0000092	< 0.00000029	ND
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	< 0.00000033 [< 0.00000059]	ND	< 0.00000062	ND	< 0.00000018	ND	0.00002	0.000002	< 0.00000019	ND
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	< 0.00000019 [< 0.00000023]	ND	< 0.00000022	ND	< 0.00000022	ND	0.000009	0.0000009	< 0.00000023	ND
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	mg/kg	< 0.0000011 [< 0.0000017]	ND	0.0000072	0.000000072	< 0.00000033	ND	0.00033	0.0000033	< 0.0000018	ND
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	mg/kg	< 0.00000026 [< 0.00000028]	ND	< 0.00000027	ND	< 0.00000025	ND	0.0000089	0.000000089	< 0.00000032	ND
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	0.0003	mg/kg	< 0.0000012 [< 0.0000018]	ND	0.0000074 J	0.00000000222	< 0.00000048	ND	0.00026	0.000000078	< 0.00000094	ND
Total 2,3,78,-TCDD TEQ	--	mg/kg	0.0000001874 [0.0000006283]	0.000000423	0.000000557	0.0000000529	ND	ND	0.000104029	0.0000804	ND	ND
Total 2,3,78,-TCDD TEQ	--	µg/kg	0.000423		0.000529		ND		0.08045		ND	

Notes:
Values are presneted in milligrams per kilogram (mg/kg)
or micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
Toxic equivalent factors (TEFs) were obtained from the
draft Part 201 Rules (MDEQ 2016b).
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) TEQ
is the sum of the concentration of each dioxin or furan
congener multiplied by the TEF.
-- = not applicable
< = not detected at the laboratory reporting limit
ft bgs = feet below ground surface
J = estimated concentration
NA = not analyzed
ND = not detected

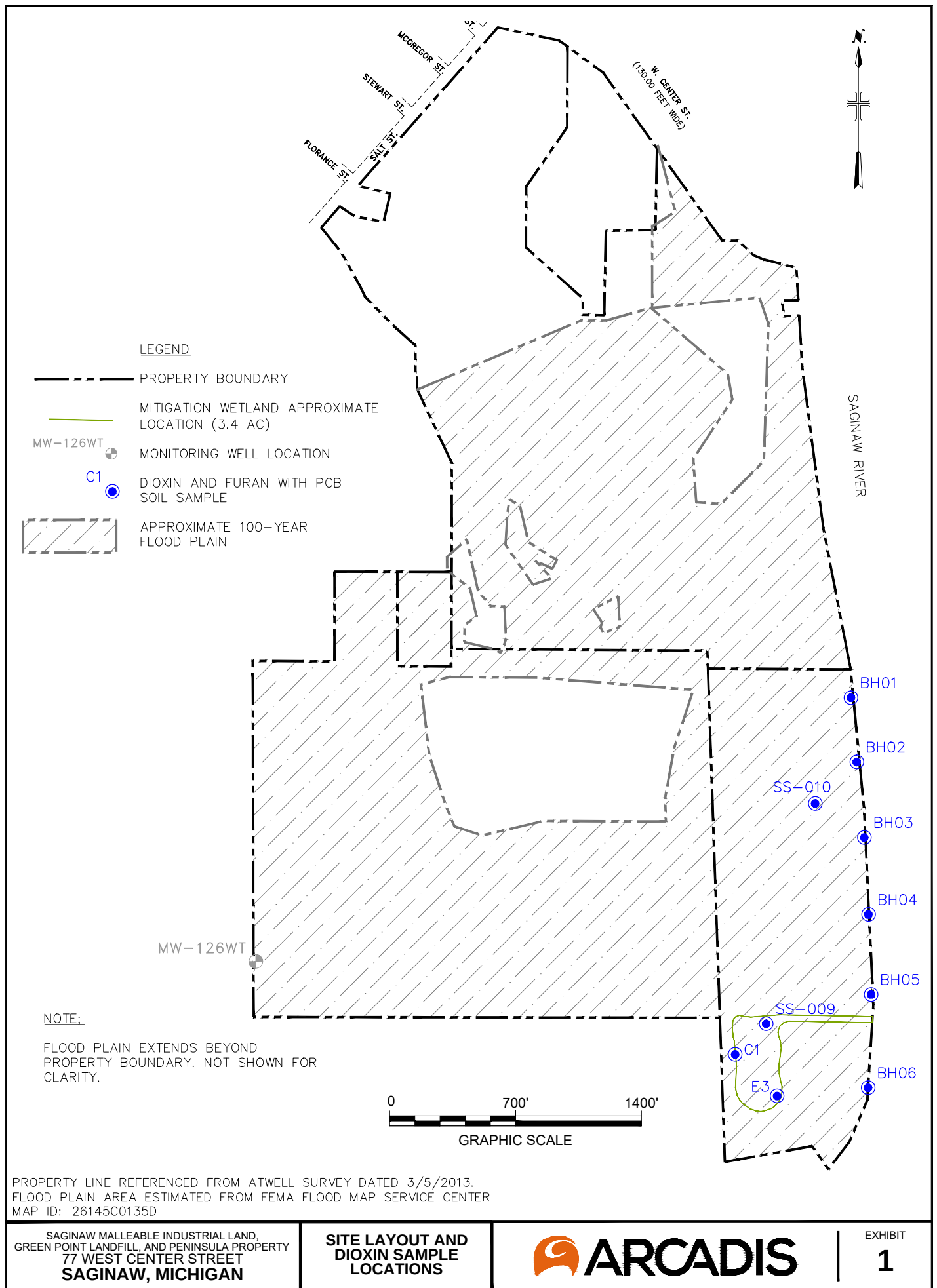
Table 1
2,3,7,8-Tetrachlorodibenzo-p-dioxin Toxic
Equivalents Calculations
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point
Landfill, and Peninsula Properties
Saginaw, Michigan

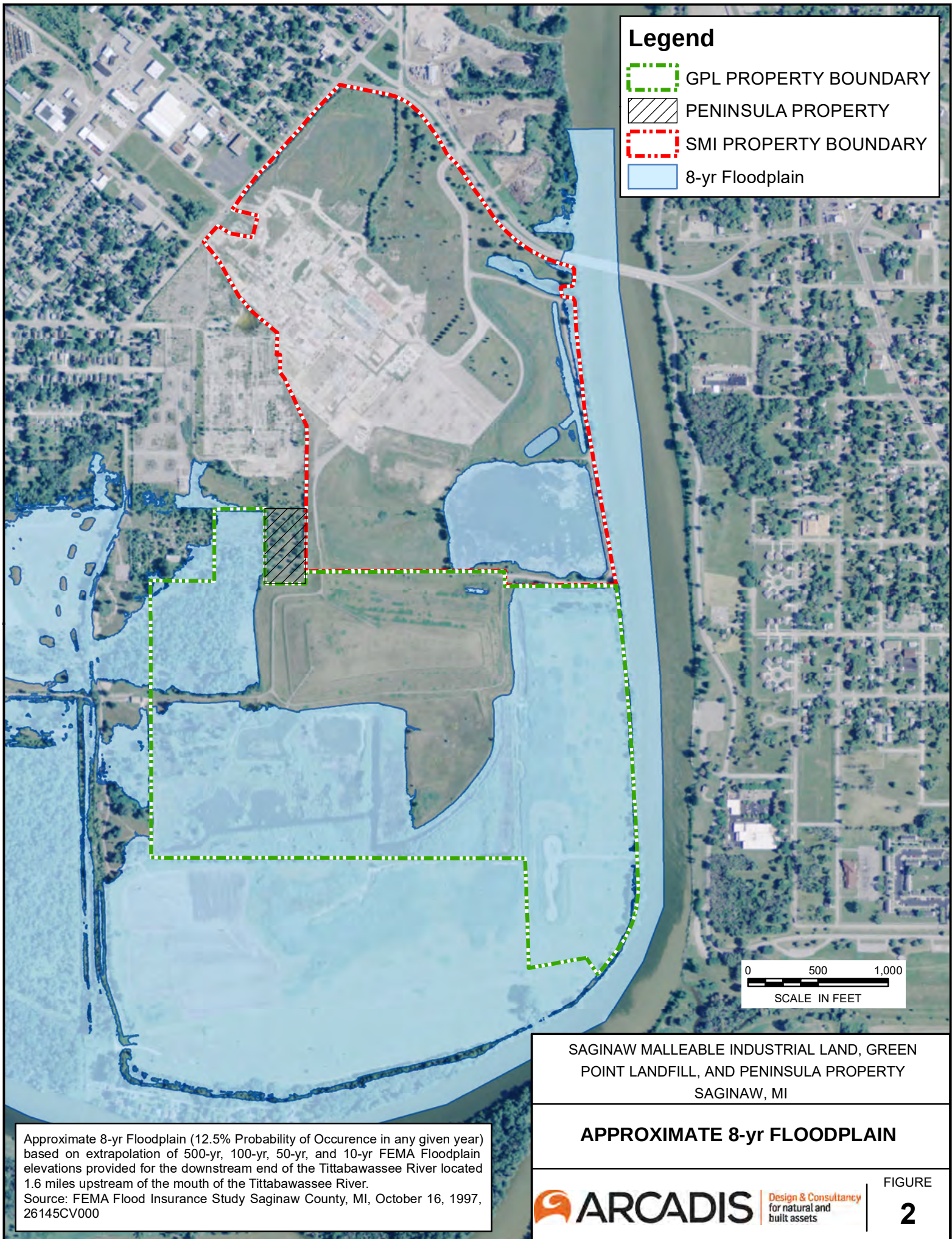
Location ID	TEF	Units	BH6		BH6		SS-009-CR		SS-010-CR		C1A		E3A	
Sample Depth(ft bgs):			0 - 1		1 - 2		0 - 0.5		0 - 0.5		0-1		0-1	
Date Collected:			03/06/07		03/06/07		12/01/97		12/01/97		4/18/2000		4/19/2000	
Dioxins/Furans			Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ	Raw Data	2,3,7,8-TCDD TEQ
2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	mg/kg	0.00000075 J	0.00000075	< 0.0000003	ND	0.00077 SJ	0.00077	0.000092 J	0.000092	0.0000054	0.0000054	0.00000454	0.00000454
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	0.00000756	NA	0.00000686	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	0.00000591	NA	0.00000496	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	0.0000119	NA	0.0000116	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	mg/kg	< 0.0000017	ND	< 0.00000045	ND	NA	ND	NA	ND	0.000019	0.000019	0.0000194	0.0000194
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	mg/kg	0.000031	0.00000031	< 0.00000087	ND	NA	ND	NA	ND	0.00028	0.0000028	0.000317	0.00000317
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	0.0003	mg/kg	0.00027 J	0.000000081	0.00000095 J	0.00000000285	NA	ND	NA	ND	0.00225	0.000000675	0.00231	0.000000693
2,3,7,8-Tetrachlorodibenzofuran	0.1	mg/kg	0.00019	0.000019	0.0000019	0.00000019	NA	ND	NA	ND	0.00584	0.000584	0.0042	0.00042
1,2,3,7,8-Pentachlorodibenzofuran	0.03	mg/kg	0.00011	0.0000033	< 0.0000013	ND	NA	ND	NA	ND	0.00291	0.0000873	0.00189	0.0000567
2,3,4,7,8-Pentachlorodibenzofuran	0.3	mg/kg	0.000078	0.0000234	< 0.00000071	ND	NA	ND	NA	ND	0.00229	0.000687	0.00147	0.000441
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	mg/kg	0.000074	0.0000074	< 0.00000099	ND	NA	ND	NA	ND	0.00212	0.000212	0.00142	0.000142
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	0.000017	0.0000017	< 0.00000042	ND	NA	ND	NA	ND	0.000495	0.0000495	0.000324	0.0000324
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	mg/kg	NA	NA	NA	NA	NA	NA	NA	NA	0.0000568	NA	0.0000352	NA
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	mg/kg	0.0000069	0.00000069	< 0.00000033	ND	NA	ND	NA	ND	0.000235	0.0000235	0.000152	0.0000152
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	mg/kg	0.000091	0.00000091	< 0.00000078	ND	NA	ND	NA	ND	0.00137	0.0000137	0.00118	0.0000118
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	mg/kg	0.0000058 J	0.000000058	< 0.00000048	ND	NA	ND	NA	ND	0.000135	0.00000135	0.00011	0.0000011
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	0.0003	mg/kg	0.000087	0.000000026	< 0.0000011	ND	NA	ND	NA	ND	0.0013	0.00000039	0.00137	0.000000411
Total 2,3,78,-TCDD TEQ	--	mg/kg	0.000075675	0.0000576	0.000000200	0.000000193	NA	0.000770	NA	0.000092	NA	0.00167	NA	0.001131
Total 2,3,78,-TCDD TEQ	--	µg/kg	0.05763		0.000193		0.7700		0.09200		1.7		1.1	

Notes:
Values are presneted in milligrams per kilogram (mg/kg)
or micrograms per kilogram (µg/kg).
Duplicate sample results are shown in square brackets.
Toxic equivalent factors (TEFs) were obtained from the
draft Part 201 Rules (MDEQ 2016b).
2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) TEQ
is the sum of the concentration of each dioxin or furan
congener multiplied by the TEF.
-- = not applicable
< = not detected at the laboratory reporting limit
ft bgs = feet below ground surface
J = estimated concentration
NA = not analyzed
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FIGURES







ATTACHMENT 1

Affidavit to Support Unremediated Release(s) in a Remedial Action Plan



MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

**AFFIDAVIT TO SUPPORT UNREMIEDIATED RELEASE(S)
IN A REMEDIAL ACTION PLAN**

(Under the authority of Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 Act 451, as amended), and the Part 201 Administrative Rules promulgated thereunder)

STATE OF Michigan

COUNTY OF Saginaw

The purpose of this Affidavit is to set forth certain information and documentation to enable the Michigan Department of Environmental Quality (hereinafter, the "MDEQ") to make the determinations pursuant to R 299.5534 (hereinafter, "Rule 534") of the Part 201 Administrative Rules (hereinafter, the "Part 201 Rules") promulgated under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (hereinafter, the "NREPA"). All terms found in this document which are defined in Part 3, Definitions, and Part 201 of the NREPA; and the Part 201 Rules, shall have the same meaning as in the statute and the Part 201 Rules.

The undersigned Affiant, being first duly sworn, deposes and says as follows:

1. THIS AFFIDAVIT is executed by the undersigned, William McFarland, whose title is, Director of Remediation, on behalf of the General Motors Corporation, and President, on behalf of the Remediation and Liability Management Company (hereinafter, "the Affiant") located at Engineering Center - West, Mail Code 480-111-W60, 30200 Mound Rd, Warren, MI 48090.
2. This Affidavit accompanies a Remedial Action Plan ("the RAP") prepared on behalf of the Affiant for the following properties: Saginaw Malleable Iron Property, and REALM, Inc. Green Point Landfill and Drum Remediation Area. The legal description is provided in Attachment 1.
3. The properties referred to in Item Number 2 are associated with a "Facility" as defined in Section 20101(1)(o) of the NREPA.
4. The RAP precisely describes the unremediated release at the Facility. "Unremediated release" means a release for which response activity has not been implemented that satisfies the remedial action requirements of Part 201 of the NREPA and the Part 201 Rules.
5. The Affiant is not liable for the unremediated releases associated with the Dow Chemical manufacturing facility located in Midland, Michigan, as identified in Attachment 2.
6. Attached to this Affidavit is information that explains and supports the basis for the conclusion that the Affiant is not liable for the environmental contamination proposed to be omitted from remediation in the RAP.

-
7. Attached to this Affidavit is documentation that demonstrates divisibility of harm and apportionment of liability as required by Section 20129 of the NREPA.
8. The Affiant acknowledges and agrees to all of the following:
- a. If the MDEQ approves the RAP referenced in Item Number 4 relying on representations about liability that are set forth in this Affidavit, the ability of the MDEQ to subsequently review the liability of the Affiant is not limited or affected by reliance on the Affidavit or approval of the RAP. Upon review of the Affidavit, supporting materials and other information available to the MDEQ at any time, the MDEQ may determine that Affiant is liable for any or all of the contamination omitted from remediation under the RAP, or that the Affiant has not met the burden of demonstrating divisibility of harm and apportionment of liability under Section 20129 of the NREPA.
 - b. If the MDEQ later finds the Affiant to be liable for the Facility or to have failed to establish divisibility of harm and apportionment of liability as required by Section 20129 of the NREPA, the Affiant shall promptly undertake remedial action to address that portion of the Facility not covered by the RAP.
 - c. A person who is liable who undertakes a remedial action that he or she knows will not, when complete, comprehensively address all contamination at a facility at the time the remedial action is undertaken, except as provided for in R. 299.5534 for unremediated releases, is subject to fines and penalties as provided for under Part 201 of the NREPA for failure to diligently pursue response activity under Section 20114(1)(g) of the NREPA, as well as other applicable state or federal laws.
 - d. Response activity undertaken by a person who is liable that does not comprehensively address all contamination at a facility, except unremediated releases addressed through the procedure set forth in R.299.5534, is considered an interim response and not a remedial action.

I affirm that the above representations are true and are based upon my personal knowledge and belief after all reasonable inquiry.

I certify that I am legally authorized to execute this Affidavit and to bind the Affiant to the terms and conditions of this Affidavit.

I understand that intentionally submitting false information to the MDEQ is a felony and may result in fines of up to \$25,000 for each violation.

I acknowledge that this Affidavit has been provided pursuant to Rule 534 of the Part 201 Rules.

William McFarland, Affiant

Signature of Person Legally Authorized to Bind Affiant

Date

Print or Type Legal Name

SUBSCRIBED AND SWORN to before me this ____ day of _____, 200__, a Notary Public
in and for _____ County, Michigan.

Notary Public's Signature

My Commission Expires: _____

ATTACHMENT 1

LEGAL DESCRIPTION OF SITE

The Site encompasses approximately 273 acres, and consists of the Saginaw Malleable Iron (SMI) Plant Property and the REALM Green Point Landfill and Drum Remediation Area (DRA) Property, as shown on Figures 1-1 and 1-2 in the Remedial Action Plan. The SMI Plant Property makes up the northern portion of the Site and includes the inactive SMI Plant and support facilities, including two closed Type III Landfills, two stormwater ponds, and an inoperative Water Recycle System. Foundry operations previously conducted at the SMI Plant consisted of activities related to the casting and heat treating of iron. The southern portion of the Site (now owned by REALM, Inc.) includes the closed Green Point Landfill and the DRA, where drums were previously discovered, excavated, and removed.

The Site is located approximately 1,500 feet north of the confluence of the Tittabawassee and Shiawassee Rivers and is located on the western half of Section 35, T12N, R4E, in the city of Saginaw, Saginaw County, Michigan. A legal description of the SMI Plant Property and the REALM Green Point Landfill and Drum Remediation Area Property is provided below.

SMI Plant Property Legal Description (Tax ID: 19 2231 00000)

DESCRIPTION OF A 150.97 ACRE PARCEL OF LAND (KNOWN AS SAGINAW MALLEABLE IRON PLANT PROPERTY)

Commencing at a found monument at the center-line intersections of Salt Road (66.00 feet wide) and Sylvan Road (60.00 feet wide) being part of Sections 34 & 35, T12N, R4E, City of Saginaw, Saginaw County, Michigan; thence N41°13'20"E 53.66 feet along the center-line of said Salt Road; thence S48°46'40"E 33.00 feet perpendicular to said center-line of said Salt Road for a **PLACE OF BEGINNING**; thence N41°13'20"E 155.86 feet along the Southeasterly Right-of-Way line of said Salt Road; thence S56°24'15"E 100.97 feet; thence S79°30'05"E 162.10 feet; thence N13°24'11"E 160.56 feet; thence along the Southwesterly Right-of-Way line of vacated relocated Florence Street (66.00 feet wide) as recorded thereof in Liber 1269, Page 348 of Saginaw County Records, N76°42'45"W 186.19 feet to the said Southeasterly Right-of-Way line of said Salt Road, said point being S44°49'19"E 33.08 feet from a found monument at the center-line of said Salt Road; thence N41°13'20"E 2.12 feet along the Southeasterly Line of said Salt Road; thence N41°30'33"E 1174.43 feet continuing along said Southeasterly Right-of-Way line of said Salt Road to the Southwesterly Right-of-Way Line of West Center Street (130.00 feet wide) for the following seven (7) courses: [1]S77°59'54"E 348.21 feet; [2]S53°41'09"E 303.68 feet; [3]S35°19'18"E 1142.28 feet; [4]S89°15'47"E 87.93 feet; [5]S46°59'44"E 117.45 feet; [6]S66°53'15"E 55.70 feet; [7]S75°13'36"E 193.96 feet to an intermediate traverse point "A"; said point "A" being N75°13'36"W 81.73 feet from the United States Harbor Line as recorded thereof in Liber 2194 Page 1169 of Saginaw County Records; thence S75°13'36"E 25 feet, plus or minus, to the Westerly Edge of Water of the Saginaw River; thence the following three (3) courses along an intermediate traverse line from aforementioned Intermediate Traverse point "A": [1] S03°21'51"E 548.91 feet, [2]S07°27'01"E 907.34 feet, [3] S10°55'18"E 798.66 feet to an Intermediate Traverse Point "B"; said point "B" being

N89°42'41"W 121.04 feet from said United States Harbor Line; thence N89°40'46"W 720.87 feet to the East line of Consumers Power Company Right-of-Way (72.00 feet wide) as recorded thereof in Liber 1106 Pages, 426 & 427; thence N89°34'47"W 72.06 feet along the North line of said Right-of-Way; thence N01°57'47"W 100.28; thence N89°36'59"W 1421.88 feet; thence

N00°07'58"E 1033.08 feet; thence N25°14'05"W 365.55 feet; thence N24°37'18"W 89.80 feet; thence N00°17'27"W 80.90 feet; thence N89°46'34"W 8.85 feet; thence N00°13'22"E 159.80 feet; thence N48°10'04"W 158.71 feet; thence N44°27'28"W 229.01 feet; thence N26°08'40"W 69.66 feet; thence N28°53'40"W 207.15 feet; thence N38°36'14"W 183.21 feet to the PLACE OF BEGINNING. Containing 150.97 acres of land, more or less, subject to easements, conditions, restrictions and exceptions of record, if any.

REALM Green Point Landfill and Drum Remediation Area Property Legal Description (Tax ID: 19 2249 00000)

**DESCRIPTION OF A 122.23 ACRE PARCEL OF LAND
(REALM, INC. PROPERTY)**

Commencing at the Northwest Corner of Section 2, being part of Sections 34 & 35, T12N, R4E, and part of Sections 2 & 3, T11N, R4E, City of Saginaw, Saginaw County, Michigan; thence N89°38'51"W 799.20 feet along the North line of said Section 2 for a **PLACE OF BEGINNING**; thence N00°07'03"W 812.05 feet; thence S89°39'56"E 453.71 feet; thence N00°08'29"E 499.70 feet; thence S89°40'47"E 349.80 feet; thence S00°10'11"W 524.17 feet; thence S89°35'00"E 300.33 feet; thence N00°07'58"E 98.85 feet; thence S89°36'59"E 1421.88 feet; thence S01°57'47"E 100.28 feet to the West line of Consumers Power Company Right-of-Way (72.00 feet wide) as recorded thereof in Liber 1106 Pages, 426 & 427; thence S01°57'47"E 1942.95 feet along said Consumers Power Company Right-of-Way; thence N89°53'29"W 1754.30 feet to a point being S01°59'22"E 1164.37 feet from the Northeast corner of said Section 3; thence N89°53'15"W 836.68 feet; thence N00°08'37"W 1166.95 feet to the Place of Beginning. Containing 122.23 acres of land, more or less, subject to easements, conditions, restrictions and exceptions of record, if any.

ATTACHMENT 2

In April 2000, elevated concentrations of dioxin and furan compounds were identified in soil samples collected in a farm field located east of the REALM Green Point Landfill property. Through extensive sampling programs conducted by the MDEQ and the DOW Chemical Corporation (DOW), the presence of dioxin and furan compounds was traced from the DOW plant located in Midland Michigan, throughout the flood plains and river sediments of the Tittabawassee and Saginaw Rivers. A sediment removal action was completed in the Saginaw River adjacent to the GM SMI and REALM Green Point Landfill properties. Additional information regarding the distribution of dioxin and furan compounds is provided in the attached report, *Phase II Tittabawassee/Saginaw River Dioxin Flood Plain Sampling Study*. The presence of these compounds has not been extensively studied at the Site; however, based on the presence of the Site within the flood plain of the Tittabawassee and Saginaw Rivers, these compounds are likely present.

Final Report

Phase II Tittabawassee/Saginaw River Dioxin Flood Plain Sampling Study

I. Executive Summary

Soil samples collected during the development of a wetland mitigation project identified elevated levels of dioxin and furan compounds (hereinafter collectively referred to as dioxin) in a farm field located near the confluence of the Tittabawassee and Saginaw Rivers. The samples, collected during April 2000, identified concentrations of dioxin as high as 2,200 parts per trillion (ppt) toxic equivalents (TEQ). The dioxin concentration was nearly 25 times the residential direct contact criterion (RDCC) of 90 ppt TEQ established under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 201). The Part 201 RDCC of 90 ppt is the concentration of dioxin in soil determined to be safe for direct contact from residential exposure. Concern over the public and environmental health implications of these sample results prompted the Department of Environmental Quality (DEQ), Remediation and Redevelopment Division (RRD), to develop and implement a phased soil sampling and assessment program in the Tittabawassee River flood plain to determine the source and extent of the contamination.

Summary - Phase I

The Phase I portion of the soil sampling program was implemented during the period December 2000 through July 2001. The RRD collected 34 soil samples from five locations within a two-mile stretch of the Tittabawassee River flood plain between Center Road in Saginaw Township, Saginaw County, and the Saginaw River confluence. The Phase I sample locations are identified in Map 1. Soil samples were collected at depths ranging from the ground surface to 15 inches below ground level (bgl). Analytical results identified concentrations ranging from 35 to 7,300 ppt TEQ. Only 7 of the 34 samples contained dioxin TEQ concentrations less than the Part 201 RDCC (90 ppt TEQ). A summary of Phase I TEQ sample results is presented in Table 1. The Phase I individual dioxin congener results are presented in Appendix G.

Map 1: Phase I Sampling - - Tittabawassee/Saginaw River Flood Plain

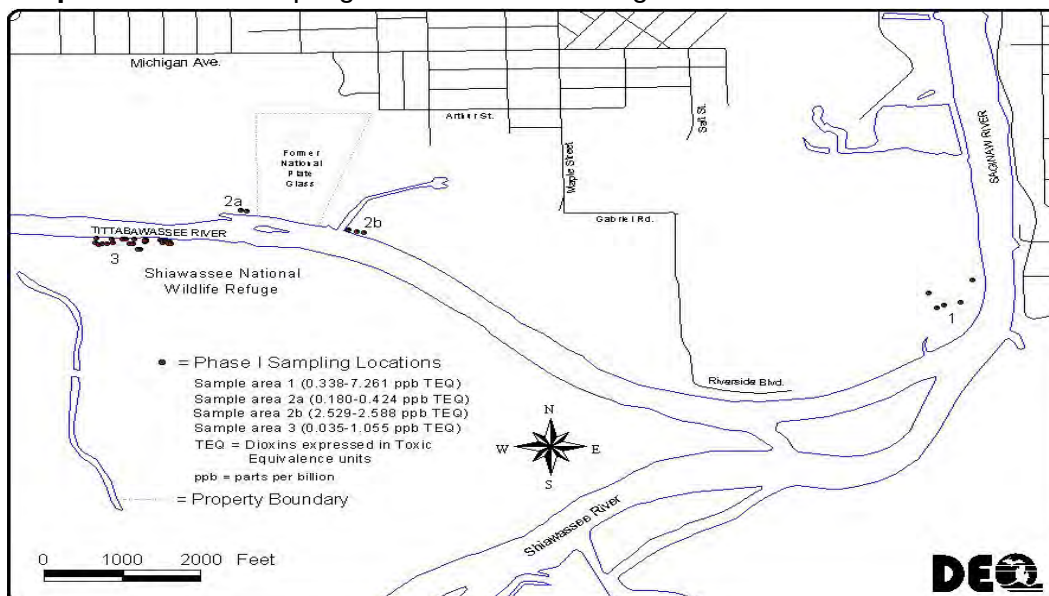


Table 1
Greenpoint-Tittabawassee River Dioxin/Furan Study Area
Phase I Sampling Study

Samples were analyzed by Triangle Laboratory, Durham, NC using US Environmental Protection Agency/USEPA Method 8290. All sample results are reported in pg/g (ppt) TEQ using USEPA Toxic Equivalency Factors (TEF) 1989

General Motors (GM) farm field (GM collected composite surface soil samples from the farm field) April 2000	
E3A	1,500
C1A	2,200

GM farm field (RRD collected discrete surface soil samples from farm field to verify April 2000 results) December 2000	
DX#1	390
DX#2	7,300
DX#3	6,300
DX#4	3,600
DX#5	340

LA Davidson (RRD collected discrete surface soil samples) May 2001	
From the farm field west of the LA Davidson site	
DX1 west	410
DX2 west	180
*From the golf course east of the LA Davidson site	
DX3 east	2,600
DX4 east	2,500

US Fish and Wildlife Service (USFWS) Shiawassee Wildlife Refuge (RRD collected discrete soil samples from wooded area) May 2001			
approximately < 6" bgl (below ground level)		approximately < 12" bgl	
GP1-6	39	GP1-12	58
GP2-6	130	GP2-12	360
GP3-6	59	GP3-12	57
GP4-6	35	GP4-12	160
GP5-6	130	GP5-12	1,100

USFWS Shiawassee Wildlife Refuge (RRD collected discrete soil samples from upland, open area) June 2001					
0 - 3" bgl		3 - 6" bgl		12 - 15" bgl	
SS1-3	390	SS1-6	590	SS1-12	58
SS2-3	770	SS2-6	420	SS2-12	280
SS5-3	390	SS5-6	540	SS5-12	250
SS6-3	590	SS6-6	550	SS6-12	110
SS7-3	490	SS7-6	660	SS7-12	68

DEQ residential direct contact criterion = 90 ppt (expressed as an equivalent concentration of 2,3,7,8-TCDD (TEQ))

The Phase I final report was completed during October 2001. The following determinations were presented in the final report:

- Elevated concentrations of dioxin were confirmed within the lower Tittabawassee River flood plain near the river's confluence with the Saginaw River.
- Dioxin concentrations were consistently found above the Part 201 RDCC (90 ppt TEQ), and were identified as high as 80 times the Part 201 RDCC.
- Human use of the flood plain increases upstream of the Phase I sample area. Residential properties are located within the flood plain, the majority located within the Shields area of Thomas Township and Saginaw Township. Public park lands and agricultural operations are also located within the flood plain.
- A Phase II sampling program was recommended to further evaluate the extent of contamination above the Part 201 RDCC occurring within the flood plain upstream of the Phase I sample area.

Summary – Sediment Study

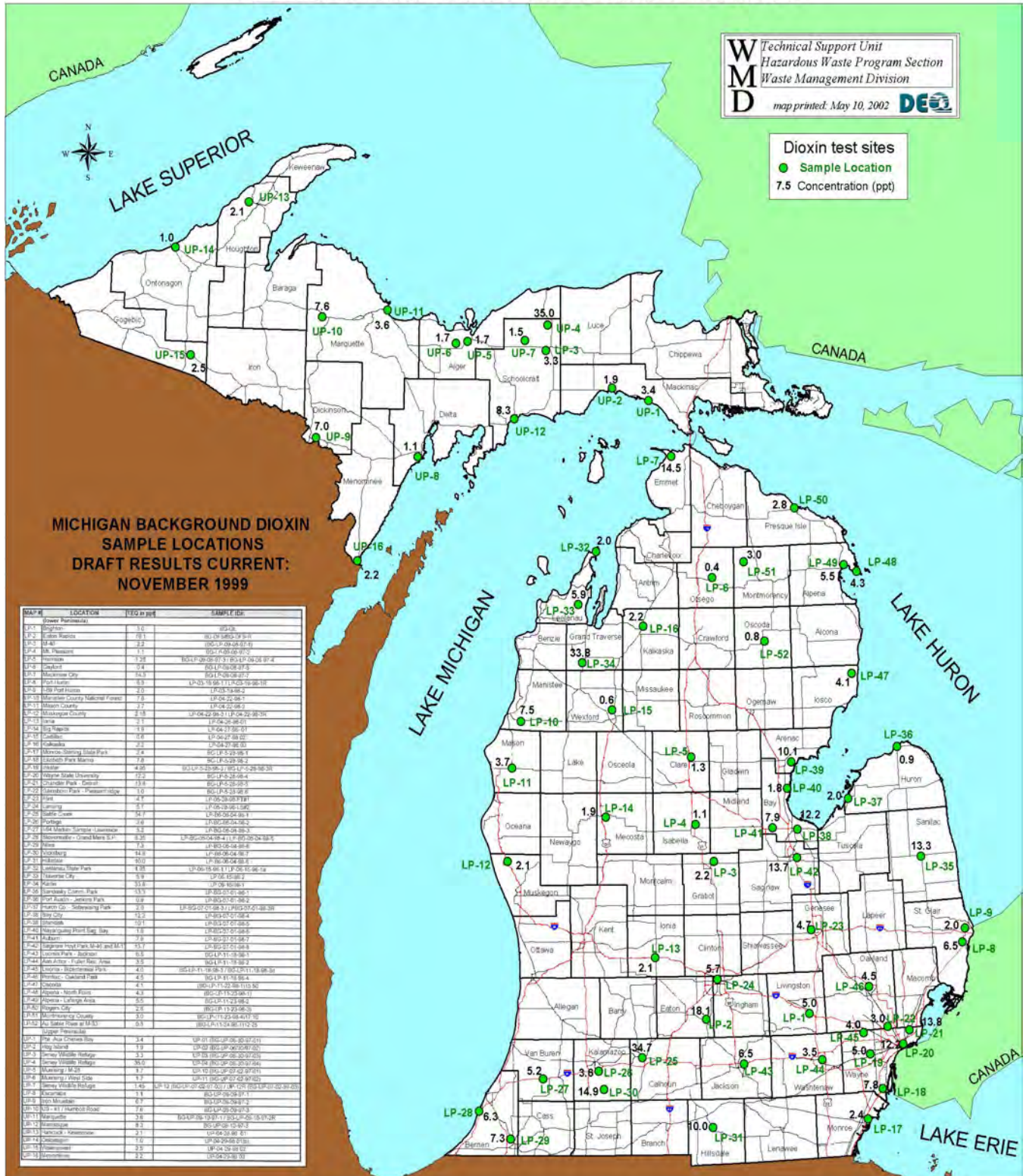
The DEQ collected and analyzed Tittabawassee River sediment samples during spring/summer 2001, as part of the Baseline Characterization of Saginaw Bay Watershed Sediment Study (DEQ Sediment Study). The objective of the DEQ Sediment Study was to provide baseline concentrations of contaminants in Tittabawassee River sediments both upstream and downstream of the city of Midland (Midland). Dioxins and furans were analyzed as part of this study. Surface sediment samples were collected from the Chippewa River, Pine River, and Tittabawassee River beginning immediately upstream of Midland and continuing downstream to the beginning of the Saginaw River. Sediment cores were collected and analyzed in select areas. Some flood plain soil samples were also collected for analysis. Sample locations and results are presented in Appendix H.

The DEQ Sediment Study final report was completed and distributed during the summer of 2002. The study results presented in the final report indicate the following:

- Dioxin concentrations from sediment and flood plain soil sample locations upstream of Midland are consistent with the average dioxin concentration in soil samples collected statewide from areas where there are no known dioxin release source(s) (hereinafter referred to as statewide background, see Figure 1).
- Dioxin is present at elevated concentrations in sediment and flood plain soil samples collected downstream of Midland. The extent of contamination is pervasive throughout the study area downstream of Midland. Sediment contamination ranged up to 2100 ppt TEQ and was present to the downstream limit of the study area, approximately 20 miles downstream of Midland. All flood plain soil samples collected downstream of Midland exceeded the Part 201 RDCC with concentrations ranging between 300 and 1500 ppt TEQ.
- The variability of dioxin concentrations in river sediment samples is believed to be a result of the variability of river water flow and site-specific sediment deposition characteristics.

Figure 1: Michigan Soil Background Dioxin Data

MICHIGAN SOIL BACKGROUND DIOXIN DATA

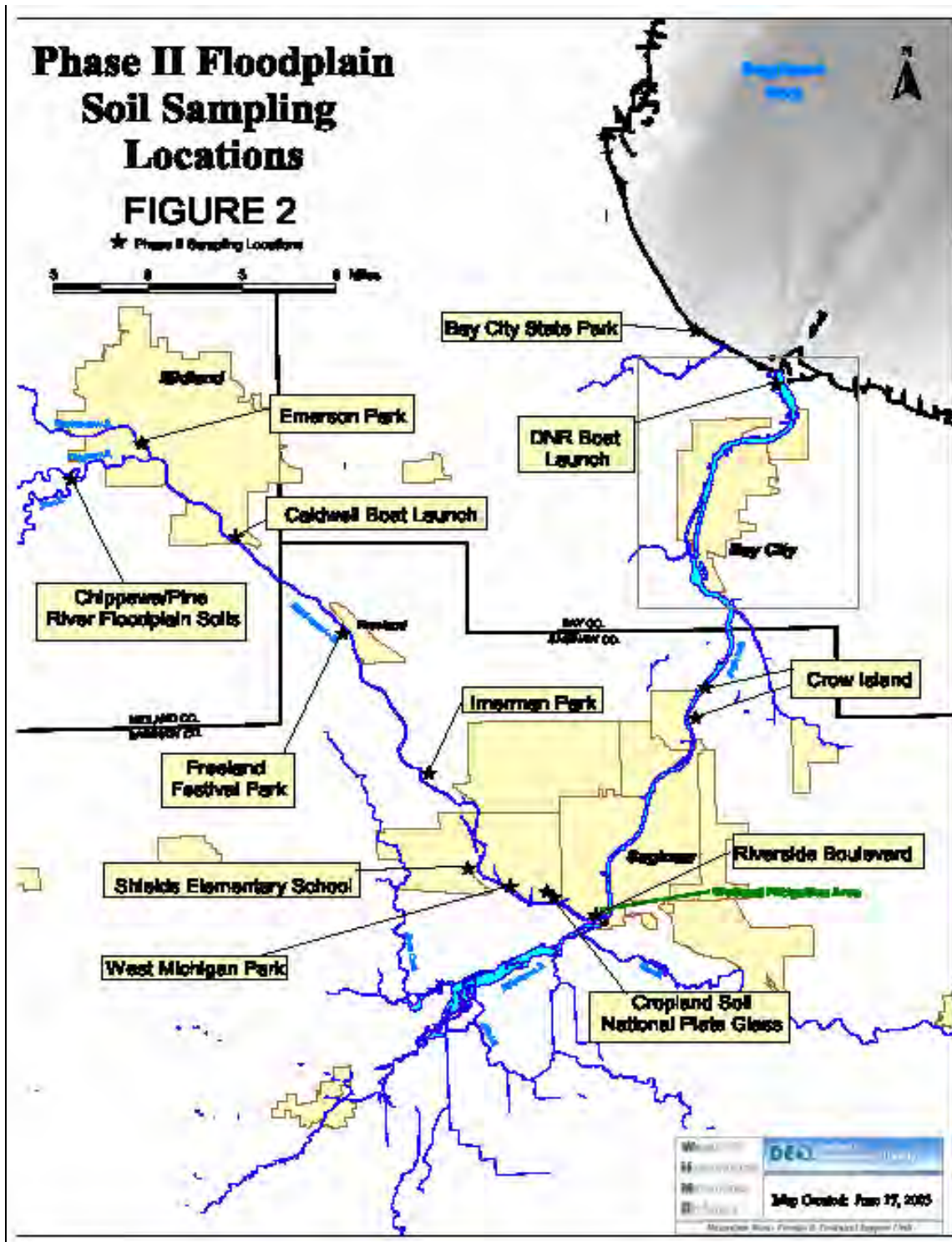


Summary – Phase II

A Phase II flood plain soil sampling program (Phase II) was developed based on the results of the Phase I Report and the DEQ Sediment Study. Flood plain soil samples were collected from the Chippewa, Pine, and Tittabawassee Rivers upstream of Midland, and at specific locations along the Tittabawassee River downstream of Midland to the beginning of the Saginaw River. Phase II soil samples were collected and analyzed during the period from May through December 2002 from the locations shown (see Figure 2). Initial observations of the Phase II sample results identified the following:

- The majority of flood plain soil sample dioxin concentrations downstream of Midland exceed the Part 201 RDCC, indicating that dioxin contamination of flood plain soil downstream of Midland is pervasive.
- Flood plain soil samples collected upstream of Midland contain dioxin concentrations consistent with statewide background concentrations.
- Dioxin concentrations from sample locations located downstream of Midland, but outside the estimated 100-year flood plain, are consistent with statewide background concentrations.
- The deepest initial Phase II soil sample (12-15 ") did not define the vertical extent of dioxin contamination. Soil samples were analyzed from three deep soil borings collected from Freeland Festival Park to improve understanding regarding the vertical extent of dioxin contamination. These additional samples indicate that dioxin contamination above statewide background concentrations exist at the park to a depth of four feet bgl. Additional deep soil sampling is necessary to determine if this vertical distribution of dioxin is consistent throughout the flood plain.
- The concentration of co-planar polychlorinated biphenyl (PCB) compounds represents an insignificant contribution to the total dioxin-like toxicity at all Phase II sample locations.
- Eggs from chickens that free range on flood plain soil exhibit elevated concentrations of dioxin. It is possible that food products from other animals raised on the flood plain could be affected.
- Dioxin concentrations in flood plain drinking water well samples were not determined to exceed applicable regulatory criteria.
- Saginaw River and Saginaw Bay navigation channel sediment samples collected in 1999 by the U.S. Army Corps of Engineers (USACE) indicate that dioxin contaminated sediment from the Tittabawassee River has migrated into the Saginaw River and the inner portions of the Saginaw Bay. Initial soil samples collected by the RRD from the Saginaw River and Saginaw Bay shoreline areas appear to confirm these results, though additional sampling of these areas is needed.

Figure 2: Phase II Soil Sampling Locations



The remainder of this report provides a detailed presentation of Phase II sampling objectives, methodology, sample results, congener profile characterization, conclusions, and recommendations.

APPENDIX E

Fine Fraction Lead Evaluation



Table E-1
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Sample Date	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Ratio (fine / total)
			µg/kg	µg/kg	µg/kg	µg/kg	
Former Railyard Area Samples							
BH11	0 - 2	03/06/07	93,200	143,000	364,000	217,000	3.906
BH12	0 - 2	03/06/07	189,000	229,000	731,000	400,000	3.868
SB-17-22	0 - 0.5	07/13/17	120,000	150,000	280,000	210,000	2.333
SB-17-23	0 - 0.5	07/13/17	250,000	360,000	460,000	390,000	1.840
SB-17-24	0 - 0.5	07/27/17	250,000	270,000	590,000	380,000	2.360
SB-17-25	0 - 0.5	07/27/17	1,500,000	1,300,000	2,400,000	1,600,000	1.600
SB-17-25	2 - 3	07/27/17	150,000	26,000	34,000	29,000	0.227
SB-17-26	0 - 0.5	07/27/17	29,000	47,000	38,000	44,000	1.310
SB-17-26	2 - 3	07/27/17	7,500	8,900	16,000	11,000	2.133
SB-17-27	0 - 0.5	07/27/17	39,000	36,000	110,000	64,000	2.821
SB-17-28	0 - 0.5	07/27/17	57,000	83,000	87,000	85,000	1.526
SB-17-28	2 - 3	07/27/17	13,000	14,000	29,000	17,000	2.231
SB-17-29	0 - 0.5	07/27/17	22,000	19,000	37,000	22,000	1.682
SB-17-29	2 - 3	07/27/17	5,100	5,300	9,600	6,600	1.882
SB-17-29	4 - 5	07/27/17	7,600	28,000	56,000	34,000	7.368
SB-17-30	0 - 0.5	07/27/17	170,000	140,000	350,000	210,000	2.059
SB-17-31	0 - 0.5	07/27/17	110,000	300,000	140,000	240,000	1.273
SB-17-32	0 - 0.5	07/27/17	59,000	110,000	210,000	130,000	3.559
SB-17-33	0 - 0.5	07/27/17	10,000	31,000	110,000	55,000	11.000
SB-17-41	0 - 0.5	08/16/17	340,000 [350,000]	390,000 [350,000]	620,000 [580,000]	450,000 [410,000]	1.739
SB-17-42	0 - 0.5	08/16/17	580,000	540,000	700,000	580,000	1.207
SB-17-43	0 - 0.5	08/16/17	280,000	260,000	410,000	300,000	1.464
SB-17-44	0 - 0.5	08/16/17	94,000	110,000	180,000	120,000	1.915
SB-17-45	0 - 0.5	08/16/17	120,000	110,000	220,000	140,000	1.833
SB-17-46	0 - 0.5	08/16/17	220,000	490,000	340,000	460,000	1.545
SB-17-47	0 - 0.5	08/16/17	140,000	140,000	210,000	160,000	1.500
Average Ratio (all samples)							2.5
Maximum Ratio (all samples)							11.0
Average Ratio (excluding 3 samples) [a]							2.1
Maximum Ratio (excluding 3 samples) [a]							3.9
95% UCL Ratio (excluding 3 samples) [a]							2.4
Peninsula Samples							
SB15-01	0 - 0.5	11/23/15	770,000	3,400,000	2,000,000	3,300,000	2.597
SB15-03	0 - 0.5	11/23/15	780,000	570,000	850,000	610,000	1.090
SB15-04	0 - 0.5	11/23/15	720,000	1,000,000	1,200,000	1,000,000	1.667
SB15-07	0 - 0.5	11/23/15	460,000	420,000	450,000	420,000	0.978
SB15-18	0 - 0.5	11/23/15	640,000	730,000	910,000	750,000	1.422
SB15-19	0 - 0.5	11/23/15	490,000	5,200,000	440,000	5,200,000	0.898
SB15-12	0 - 0.5	11/23/15	1,400,000	1,900,000	2,300,000	1,900,000	1.643
SB15-13	0 - 0.5	11/23/15	3,000,000	8,500,000	8,800,000	8,500,000	2.933
SB-17-06	0 - 0.5	07/13/17	13,000	13,000	19,000	14,000	1.462
SB-17-08	0 - 0.5	07/13/17	34,000	25,000	41,000	35,000	1.206
SB-17-09	0 - 0.5	07/13/17	140,000	48,000	62,000	56,000	0.443
SB-17-10	0 - 0.5	07/13/17	36,000	22,000	21,000	21,000	0.583
Average Ratio							1.4
Maximum Ratio							2.9
95% UCL Ratio							1.8

Notes:

All concentrations are in micrograms per kilogram (µg/kg).

[a] Excludes samples SB-17-25 (2-3) (low), SB-17-29 (4-5) (high), and SB-17-33 (0-0.5) (high).

Table E-2. ProUCL Output - Outlier Tests
RACER Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Outlier Tests for Selected Uncensored Variables

User Selected Options

Date/Time of Computation ProUCL 5.19/6/2017 4:00:05 PM

From File Ratios for ProUCL.xls

Full Precision OFF

Rosner's Outlier Test for Ratio (railyard)

Mean 2.545

Standard Deviation 2.18

Number of data 26

Number of suspected outliers 5

#	Mean	sd	Potential outlier	Obs. Number	Test value	Critical value (5%)	Critical value (1%)
1	2.545	2.137	11	19	3.956	2.84	3.16
2	2.207	1.361	7.368	15	3.793	2.82	3.14
3	1.992	0.852	3.906	1	2.246	2.8	3.11
4	1.909	0.765	3.868	2	2.561	2.78	3.09
5	1.82	0.649	3.559	18	2.678	2.76	3.06

For 5% significance level, there are 2 Potential Outliers

Potential outliers are:

11, 7.368

For 1% Significance Level, there are 2 Potential Outliers

Potential outliers are:

11, 7.368

Dixon's Outlier Test for Ratio (railyard_exclude 3 samples)

Number of Observations = 23

10% critical value: 0.374

5% critical value: 0.421

1% critical value: 0.505

1. Observation Value 3.90557939914163 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.133

For 10% significance level, 3.90557939914163 is not an outlier.

For 5% significance level, 3.90557939914163 is not an outlier.

For 1% significance level, 3.90557939914163 is not an outlier.

2. Observation Value 1.20689655172414 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.044

For 10% significance level, 1.20689655172414 is not an outlier.

For 5% significance level, 1.20689655172414 is not an outlier.

For 1% significance level, 1.20689655172414 is not an outlier.

Table E-2. ProUCL Output - Outlier Tests**RACER Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan****Dixon's Outlier Test for Ratio (peninsula)**

Number of Observations = 12

10% critical value: 0.49

5% critical value: 0.546

1% critical value: 0.642

1. Observation Value 2.93333333333333 is a Potential Outlier (Upper Tail)?

Test Statistic: 0.539

For 10% significance level, 2.93333333333333 is an outlier.

For 5% significance level, 2.93333333333333 is not an outlier.

For 1% significance level, 2.93333333333333 is not an outlier.

2. Observation Value 0.442857142857143 is a Potential Outlier (Lower Tail)?

Test Statistic: 0.211

For 10% significance level, 0.442857142857143 is not an outlier.

For 5% significance level, 0.442857142857143 is not an outlier.

For 1% significance level, 0.442857142857143 is not an outlier.

Table E-3
ProUCL Output, 95% UCLs for Fine Fraction to Total Lead Ratios
RACER Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

UCL Statistics for Uncensored Full Data Sets

User Selected Options
Date/Time of Computation ProUCL 5.19/6/2017 9:17:59 AM
From File Ratios for ProUCL.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Ratio (Peninsula)

General Statistics			
Total Number of Observations	12	Number of Distinct Observations	12
		Number of Missing Observations	0
Minimum	0.443	Mean	1.41
Maximum	2.933	Median	1.314
SD	0.743	Std. Error of Mean	0.214
Coefficient of Variation	0.527	Skewness	0.935

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.918	Data appear Normal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.859	Lilliefors GOF Test	
Lilliefors Test Statistic	0.198	Data appear Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.243		

Data appear Normal at 5% Significance Level

Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.795	95% Adjusted-CLT UCL (Chen-1995)	1.825
		95% Modified-t UCL (Johnson-1978)	1.805

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.203	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.736	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.139	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.246		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	3.993	k star (bias corrected MLE)	3.05
Theta hat (MLE)	0.353	Theta star (bias corrected MLE)	0.462
nu hat (MLE)	95.84	nu star (bias corrected)	73.21
MLE Mean (bias corrected)	1.41	MLE Sd (bias corrected)	0.807
		Approximate Chi Square Value (0.05)	54.51
Adjusted Level of Significance	0.029	Adjusted Chi Square Value	52.05

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	1.894	95% Adjusted Gamma UCL (use when n<50)	1.983

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.97	Data appear Lognormal at 5% Significance Level	
5% Shapiro Wilk Critical Value	0.859	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.127	Data appear Lognormal at 5% Significance Level	
5% Lilliefors Critical Value	0.243		

Data appear Lognormal at 5% Significance Level

Table E-3
ProUCL Output, 95% UCLs for Fine Fraction to Total Lead Ratios
**RACER Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan**

Lognormal Statistics			
Minimum of Logged Data	-0.815	Mean of logged Data	0.213
Maximum of Logged Data	1.076	SD of logged Data	0.548
Assuming Lognormal Distribution			
95% H-UCL	2.07	90% Chebyshev (MVUE) UCL	2.111
95% Chebyshev (MVUE) UCL	2.425	97.5% Chebyshev (MVUE) UCL	2.86
99% Chebyshev (MVUE) UCL	3.715		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	1.763	95% Jackknife UCL	1.795
95% Standard Bootstrap UCL	1.747	95% Bootstrap-t UCL	1.926
95% Hall's Bootstrap UCL	2.17	95% Percentile Bootstrap UCL	1.762
95% BCA Bootstrap UCL	1.793		
90% Chebyshev(Mean, Sd) UCL	2.053	95% Chebyshev(Mean, Sd) UCL	2.344
97.5% Chebyshev(Mean, Sd) UCL	2.749	99% Chebyshev(Mean, Sd) UCL	3.543
Suggested UCL to Use			
95% Student's-t UCL	1.795		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Ratio (Railyard_exclude 3 samples)

General Statistics			
Total Number of Observations	23	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	1.207	Mean	2.069
Maximum	3.906	Median	1.84
SD	0.781	Std. Error of Mean	0.163
Coefficient of Variation	0.378	Skewness	1.385
Normal GOF Test			
Shapiro Wilk Test Statistic	0.833	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.914	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.187	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.18	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	2.349	95% Adjusted-CLT UCL (Chen-1995)	2.387
		95% Modified-t UCL (Johnson-1978)	2.357
Gamma GOF Test			
A-D Test Statistic	0.802	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.154	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.182	Detected data appear Gamma Distributed at 5% Significance Level	
Detected data follow Appr. Gamma Distribution at 5% Significance Level			

Table E-3
ProUCL Output, 95% UCLs for Fine Fraction to Total Lead Ratios
RACER Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Gamma Statistics			
k hat (MLE)	8.83	k star (bias corrected MLE)	7.707
Theta hat (MLE)	0.234	Theta star (bias corrected MLE)	0.268
nu hat (MLE)	406.2	nu star (bias corrected)	354.5
MLE Mean (bias corrected)	2.069	MLE Sd (bias corrected)	0.745
		Approximate Chi Square Value (0.05)	311.9
Adjusted Level of Significance	0.0389	Adjusted Chi Square Value	309
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50)	2.352	95% Adjusted Gamma UCL (use when n<50)	2.374
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.926	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.914	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.132	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.18	Data appear Lognormal at 5% Significance Level	
Data appear Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	0.188	Mean of logged Data	0.669
Maximum of Logged Data	1.362	SD of logged Data	0.335
Assuming Lognormal Distribution			
95% H-UCL	2.356	90% Chebyshev (MVUE) UCL	2.5
95% Chebyshev (MVUE) UCL	2.699	97.5% Chebyshev (MVUE) UCL	2.975
99% Chebyshev (MVUE) UCL	3.518		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	2.337	95% Jackknife UCL	2.349
95% Standard Bootstrap UCL	2.331	95% Bootstrap-t UCL	2.434
95% Hall's Bootstrap UCL	2.388	95% Percentile Bootstrap UCL	2.328
95% BCA Bootstrap UCL	2.385		
90% Chebyshev(Mean, Sd) UCL	2.558	95% Chebyshev(Mean, Sd) UCL	2.779
97.5% Chebyshev(Mean, Sd) UCL	3.087	99% Chebyshev(Mean, Sd) UCL	3.69
Suggested UCL to Use			
95% Adjusted Gamma UCL	2.374		

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Table E-4
Lead Data - SMI
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 2.4 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs							6
Former Railyard Area Samples							
RS-1	0 - 1	06/13/95	97,900 J	NA	NA	NA	234,960
RS-2	0 - 1	06/13/95	530,000 J	NA	NA	NA	1,272,000
RS-3	0 - 1	06/13/95	161,000 J	NA	NA	NA	386,400
RS-4	0 - 1	06/13/95	30,100 J [29,800 J]	NA	NA	NA	71,880
RS-6	0 - 1	06/13/95	98,100 J	NA	NA	NA	235,440
RS-7	0 - 1	06/13/95	6,910 J	NA	NA	NA	16,584
RS-8	0 - 1	06/13/95	72,200 J	NA	NA	NA	173,280
RS-2-1	0 - 1	06/10/96	279,000 J	NA	NA	NA	669,600
RS-2-2	0 - 1	06/10/96	237,000 J	NA	NA	NA	568,800
RS-2-3	0 - 1	06/10/96	335,000 J	NA	NA	NA	804,000
RS-2-4	0 - 1	06/10/96	456,000 J	NA	NA	NA	1,094,400
RS-2-5	0 - 1	06/10/96	769,000 J	NA	NA	NA	1,845,600
RS-2-6	0 - 1	06/10/96	214,000 J [1,370,000 J]	NA	NA	NA	1,900,800
RS-2-7	0 - 1	06/10/96	159,000 J	NA	NA	NA	381,600
RS-2-8	0 - 1	06/10/96	209,000 J	NA	NA	NA	501,600
BH11	0 - 2	03/06/07	93,200	143,000	364,000	217,000	364,000 **
BH11	2 - 4	03/06/07	11,000	NA	NA	NA	26,400
BH12	0 - 2	03/06/07	189,000	229,000 J	731,000 J	400,000 J	731,000 **
BH12	2 - 4	03/06/07	8,800	NA	NA	NA	21,120
SB-17-22	0 - 0.5	07/13/17	120,000	150,000	280,000	210,000	280,000 **
SB-17-23	0 - 0.5	07/13/17	250,000	360,000	460,000	390,000	460,000 **
SB-17-24	0 - 0.5	07/27/17	250,000	270,000	590,000	380,000	590,000 **
SB-17-25	0 - 0.5	07/27/17	1,500,000	1,300,000	2,400,000	1,600,000	2,400,000 **
SB-17-25	2 - 3	07/27/17	150,000	26,000	34,000	29,000	34,000 **
SB-17-25	4 - 5	07/27/17	4,500	NA	NA	NA	10,800
SB-17-26	0 - 0.5	07/27/17	29,000	47,000	38,000	44,000	38,000 **
SB-17-26	2 - 3	07/27/17	7,500	8,900	16,000	11,000	16,000 **
SB-17-26	4 - 5	07/27/17	8,100	NA	NA	NA	19,440
SB-17-27	0 - 0.5	07/27/17	39,000	36,000	110,000	64,000	110,000 **
SB-17-28	0 - 0.5	07/27/17	57,000	83,000	87,000	85,000	87,000 **
SB-17-28	2 - 3	07/27/17	13,000	14,000	29,000	17,000	29,000 **
SB-17-28	4 - 5	07/27/17	6,000	NA	NA	NA	14,400
SB-17-29	0 - 0.5	07/27/17	22,000	19,000	37,000	22,000	37,000 **
SB-17-29	2 - 3	07/27/17	5,100	5,300	9,600	6,600	9,600 **
SB-17-29	4 - 5	07/27/17	7,600	28,000	56,000	34,000	56,000 **

Table E-4
Lead Data - SMI
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 2.4 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	
Number of Exceedances of Recreational Criteria - 8 hrs							6
SB-17-30	0 - 0.5	07/27/17	170,000	140,000	350,000	210,000	350,000 **
SB-17-31	0 - 0.5	07/27/17	110,000	300,000	140,000	240,000	140,000 **
SB-17-32	0 - 0.5	07/27/17	59,000	110,000	210,000	130,000	210,000 **
SB-17-33	0 - 0.5	07/27/17	10,000	31,000	110,000	55,000	110,000 **
SB-17-41	0 - 0.5	08/16/17	340,000 [350,000]	390,000 [350,000]	620,000 [580,000]	450,000 [410,000]	600,000 **
SB-17-42	0 - 0.5	08/16/17	580,000	540,000	700,000	580,000	700,000 **
SB-17-43	0 - 0.5	08/16/17	280,000	260,000	410,000	300,000	410,000 **
SB-17-44	0 - 0.5	08/16/17	94,000	110,000	180,000	120,000	180,000 **
SB-17-45	0 - 0.5	08/16/17	120,000	110,000	220,000	140,000	220,000 **
SB-17-46	0 - 0.5	08/16/17	220,000	490,000	340,000	460,000	340,000 **
SB-17-47	0 - 0.5	08/16/17	140,000	140,000	210,000	160,000	210,000 **
Other Areas of SMI							
SB-304	0 - 1	02/08/95	39,000	NA	NA	NA	93,600
SB-304	2 - 4	02/08/95	279,000	NA	NA	NA	669,600
SB-304	6 - 8	02/08/95	37,100	NA	NA	NA	89,040
SB-305	0 - 1	02/08/95	3,590	NA	NA	NA	8,616
SB-305	2 - 4	02/08/95	18,300	NA	NA	NA	43,920
SB-305	6 - 8	02/08/95	23,500	NA	NA	NA	56,400
SB-305	10 - 12	02/08/95	9,830 J	NA	NA	NA	23,592
BBL-MW1	4 - 6	05/02/96	38,000	NA	NA	NA	91,200
BBL-MW2	4 - 6	05/02/96	12,000	NA	NA	NA	28,800
BBL-MW3	6 - 8	05/02/96	13,200	NA	NA	NA	31,680
BBL-MW4	4 - 6	05/03/96	4,480	NA	NA	NA	10,752
BBL-MW5	4 - 6	05/03/96	2,550	NA	NA	NA	6,120
BBL-SB1	4 - 6	05/06/96	4,390	NA	NA	NA	10,536
BBL-SB1	8 - 10	05/06/96	17,800	NA	NA	NA	42,720
BBL-SB2	0 - 2	05/07/96	28,300	NA	NA	NA	67,920
BBL-SB3	6 - 8	05/07/96	38,200	NA	NA	NA	91,680
BBL-SB3	8 - 10	05/07/96	25,500	NA	NA	NA	61,200
BBL-SB4	0 - 2	05/07/96	14,800	NA	NA	NA	35,520
BBL-SB4	8 - 10	05/07/96	14,900	NA	NA	NA	35,760
BBL-SB5	0 - 2	05/06/96	138,000	NA	NA	NA	331,200
BBL-SB5	20 - 22	05/06/96	5,170	NA	NA	NA	12,408
NS-7	0 - 4.5	06/21/95	2,130	NA	NA	NA	5,112
NS-8	0 - 10	06/21/95	2,520	NA	NA	NA	6,048
NS-9	0 - 4.5	06/21/95	1,480	NA	NA	NA	3,552

Table E-4
Lead Data - SMI
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 2.4 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs							6
NS-10	0 - 10	06/21/95	7,480	NA	NA	NA	17,952
NS-1	0 - 14	06/23/95	13,700	NA	NA	NA	32,880
PL-1	0.75 - 1.21	08/10/01	6,600	NA	NA	NA	15,840
PL-2	0.75 - 1.67	08/10/01	11,000 [12,000]	NA	NA	NA	27,600
PL-3	0.67 - 1.67	08/10/01	7,700	NA	NA	NA	18,480
PL-4	0.75 - 1.5	08/10/01	74,000	NA	NA	NA	177,600
BH7	0 - 2	03/06/07	8,000	NA	NA	NA	19,200
BH7	2 - 4	03/06/07	21,400	NA	NA	NA	51,360
BH8	0 - 2	03/06/07	5,900	NA	NA	NA	14,160
BH8	2 - 4	03/06/07	4,500	NA	NA	NA	10,800
BH9	1 - 2	03/06/07	31,000	NA	NA	NA	74,400
BH9	2 - 4	03/06/07	10,400	NA	NA	NA	24,960
BH10	1 - 2	03/06/07	7,400	NA	NA	NA	17,760
BH10	2 - 4	03/06/07	7,100	NA	NA	NA	17,040
SOIL FILL1	not available	10/06/04	9,800	NA	NA	NA	23,520
SOIL FILL2	not available	10/06/04	6,700	NA	NA	NA	16,080
SB-01A	1 - 3	08/23/01	4,000	NA	NA	NA	9,600
SB-01A	5 - 7	08/23/01	3,100	NA	NA	NA	7,440
SB-02-SMI	1.2 - 3.2	08/23/01	5,500	NA	NA	NA	13,200
SB-02-SMI	9 - 11	08/23/01	5,700	NA	NA	NA	13,680
SB-03-SMI	4.7 - 6.7	08/23/01	14,700	NA	NA	NA	35,280
SB-03-SMI	0.7 - 2.7	08/23/01	29,000 [33,500]	NA	NA	NA	75,000
SB-04-SMI	0.3 - 2.3	08/23/01	4,500	NA	NA	NA	10,800
SB-04-SMI	8.3 - 10	08/23/01	8,900	NA	NA	NA	21,360
SB-351	0 - 2	06/27/95	41,300 E	NA	NA	NA	99,120
SB-352	0 - 2	06/28/95	74,600 E	NA	NA	NA	179,040
SB-354	0 - 2	06/28/95	7,400 E	NA	NA	NA	17,760
SB-362	0 - 2	09/28/95	1,020,000	NA	NA	NA	2,448,000
SB-362	4 - 6	09/28/95	93,200	NA	NA	NA	223,680
SB-362	8 - 10	09/28/95	13,200	NA	NA	NA	31,680
SB-363	0 - 2	09/28/95	1,320,000	NA	NA	NA	3,168,000
SB-363	4 - 6	09/28/95	1,780,000	NA	NA	NA	4,272,000
SB-363	8 - 10	09/28/95	26,500	NA	NA	NA	63,600
SB-374	9.5 - 10.5	07/24/00	5,600	NA	NA	NA	13,440
SB-375	6.5 - 7.5	07/24/00	3,900 U [3,400]	NA	NA	NA	8,160
SB-376	7 - 8	07/25/00	4,300	NA	NA	NA	10,320

Table E-4
Lead Data - SMI
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 2.4 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs							6
SB-377	0 - 0.5	07/25/00	11,700	NA	NA	NA	28,080
SB-377	0.5 - 1	07/25/00	2,600 [11,800]	NA	NA	NA	17,280
SB-379	0 - 0.5	07/25/00	9,600	NA	NA	NA	23,040
SB-379	0.5 - 1	07/25/00	3,500	NA	NA	NA	8,400
SB-382	0 - 0.5	07/25/00	37,700	NA	NA	NA	90,480
SB-382	0.5 - 1	07/25/00	46,900	NA	NA	NA	112,560
SB-383	0 - 0.5	07/25/00	15,200	NA	NA	NA	36,480
SB-383	0.5 - 1	07/25/00	2,600	NA	NA	NA	6,240
SB-384	0 - 0.5	07/25/00	15,500	NA	NA	NA	37,200
SB-384	0.5 - 1	07/25/00	14,500	NA	NA	NA	34,800
SB-385	0 - 0.5	07/25/00	26,300	NA	NA	NA	63,120
SB-385	0.5 - 1	07/25/00	120,000	NA	NA	NA	288,000
SB-386	0 - 0.5	07/25/00	45,100	NA	NA	NA	108,240
SB-386	0.5 - 1	07/25/00	8,500	NA	NA	NA	20,400
SB-387	0 - 0.5	07/25/00	61,500	NA	NA	NA	147,600
SB-387	0.5 - 1	07/25/00	9,000	NA	NA	NA	21,600
SB-388	0 - 0.5	07/25/00	27,400	NA	NA	NA	65,760
SB-388	0.5 - 1	07/25/00	11,300	NA	NA	NA	27,120
FS-1	0 - 1	06/12/95	35,500 J	NA	NA	NA	85,200
FS-2	0 - 1	06/12/95	9,580 J	NA	NA	NA	22,992
FS-3	0 - 1	06/12/95	21,500 J	NA	NA	NA	51,600
FS-4	0 - 1	06/12/95	7,940 J	NA	NA	NA	19,056
FS-5	0 - 1	06/12/95	6,630 J	NA	NA	NA	15,912
FS-6	0 - 1	06/12/95	2,910 J [2,780 J]	NA	NA	NA	6,828
FS-7	0 - 1	06/12/95	2,560 J	NA	NA	NA	6,144
FS-8	0 - 1	06/12/95	10,500 J	NA	NA	NA	25,200
US-1	0 - 1	06/12/95	16,400 J	NA	NA	NA	39,360
US-2	0 - 1	06/12/95	14,700 J	NA	NA	NA	35,280
US-3	0 - 1	06/12/95	13,000 J	NA	NA	NA	31,200
US-4	0 - 1	06/12/95	33,500 J	NA	NA	NA	80,400
US-6	0 - 1	06/12/95	49,200 J	NA	NA	NA	118,080
US-7	0 - 1	06/12/95	12,600 J	NA	NA	NA	30,240
US-8	0 - 1	06/12/95	40,800 J	NA	NA	NA	97,920
NS-RS-4	2.5 - 3	06/13/95	6,290 J	NA	NA	NA	15,096
VE-1	0.75 - 1.58	08/10/01	10,000	NA	NA	NA	24,000
VE-2	0.92 - 1.67	08/10/01	120,000	NA	NA	NA	288,000

Table E-4
Lead Data - SMI
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 2.4 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs							6
AR-1	2 - 3	6/3/2015	53,000	NA	NA	NA	127,200
AR-2	3 - 4	6/3/2015	12,000	NA	NA	NA	28,800
AR-2	14 - 14.5	6/3/2015	3,100	NA	NA	NA	7,440
AR-3	2 - 3	6/3/2015	54,000	NA	NA	NA	129,600
AR-3	2 - 3	6/3/2015	24,000	NA	NA	NA	57,600
AR-4	3 - 4	6/4/2015	14,000	NA	NA	NA	33,600
AR-4	3 - 4	6/4/2015	14,000	NA	NA	NA	33,600
AR-4	13 - 13.5	6/4/2015	31,000	NA	NA	NA	74,400
AR-5	3 - 4	6/4/2015	27,000	NA	NA	NA	64,800
AR-5	12 - 13	6/4/2015	3,800	NA	NA	NA	9,120
AR-6	3 - 4	6/4/2015	26,000	NA	NA	NA	62,400
AR-6	9.5 - 10	6/4/2015	12,000	NA	NA	NA	28,800
AR-7	3 - 4	6/4/2015	20,000 F1	NA	NA	NA	48,000
AR-7	12 - 13	6/4/2015	2,200	NA	NA	NA	5,280
AR-8	2 - 3	6/4/2015	58,000	NA	NA	NA	139,200
NS-SD-18	1 - 14	06/20/95	4,770 [5,040]	NA	NA	NA	11,772
NS-SD-19	4 - 5.1	06/20/95	6,540	NA	NA	NA	15,696
NS-SD-20	1.9 - 2.5	06/20/95	12,900	NA	NA	NA	30,960
NS-SD-21	1.8 - 2.4	06/20/95	4,520	NA	NA	NA	10,848
NS-SD-14	2.3 - 3.1	06/20/95	5,150	NA	NA	NA	12,360
NS-SD-15	2.3 - 3.4	06/20/95	8,210	NA	NA	NA	19,704
NS-SD-16	2.7 - 3.7	06/20/95	6,580	NA	NA	NA	15,792
NS-SD-17	2.4 - 3	06/20/95	8,650	NA	NA	NA	20,760
NS-SD-13	3.4 - 4.1	06/20/95	10,200	NA	NA	NA	24,480
NS-SD-12	2.6 - 3.4	06/20/95	8,290	NA	NA	NA	19,896
NS-SD-11	2.3 - 2.9	06/20/95	9,550	NA	NA	NA	22,920
NS-SD-10	2 - 3.4	06/20/95	3,890	NA	NA	NA	9,336
UST4-MW1	10 - 12	06/01/94	17,000	NA	NA	NA	40,800
UST4-MW2	8 - 10	06/01/94	8,300	NA	NA	NA	19,920
UST4-MW3	10 - 12	06/01/94	6,700 [6,800]	NA	NA	NA	16,200
UST4-MW4	10 - 12	06/02/94	20,000	NA	NA	NA	48,000
T07-B108	1 - 3	07/13/92	5,200	NA	NA	NA	12,480
T07-B109	9 - 11	07/13/92	11,000	NA	NA	NA	26,400
T07-B109	13 - 15	07/13/92	36,000	NA	NA	NA	86,400
T07-B110	5 - 7	07/13/92	6,400	NA	NA	NA	15,360
T07-B110	13 - 15	07/13/92	5,900	NA	NA	NA	14,160

Table E-4
Lead Data - SMI
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 2.4 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs							6
T07-B111	9 - 11	07/13/92	17,000	NA	NA	NA	40,800
T07-B111	13 - 15	07/13/92	3,400	NA	NA	NA	8,160
T07-B112	9 - 11	07/13/92	2,100	NA	NA	NA	5,040
T07-B112	13 - 15	07/13/92	2,500	NA	NA	NA	6,000
UST7-MW1	4 - 6	06/03/94	2,500	NA	NA	NA	6,000
UST7-MW2	5 - 7	06/03/94	16,000	NA	NA	NA	38,400
UST7-MW3	6 - 8	07/07/94	18,000	NA	NA	NA	43,200
UST7-MW4	2 - 4	07/07/94	29,000	NA	NA	NA	69,600
UST7-MW5	4 - 6	07/07/94	37,000	NA	NA	NA	88,800
UST8-MW1	0 - 2	05/25/94	4,900	NA	NA	NA	11,760
UST8-MW1	2 - 4	05/25/94	4,000	NA	NA	NA	9,600
UST8-MW2	0 - 2	05/25/94	14,000	NA	NA	NA	33,600
UST8-MW3	1 - 3	05/31/94	6,700	NA	NA	NA	16,080
UST8-SB1	2 - 3	04/01/94	9,700	NA	NA	NA	23,280
UST8-SB2	0 - 1.2	04/01/94	68,000	NA	NA	NA	163,200
UST8-SB3	0.7 - 1.1	04/01/94	62,000	NA	NA	NA	148,800
UST8-SB4	1.8 - 2.3	04/01/94	9,600	NA	NA	NA	23,040
UST8-SB5	4 - 6	05/31/94	9,100	NA	NA	NA	21,840
			Average Concentration (Former Railyard Area only)				412,189
			Average Concentration (All of SMI)				185,350

Notes:

Concentrations are in micrograms per kilogram (µg/kg).

Duplicate sample results are shown in square brackets. Duplicate results were averaged for estimating the fine fraction.

Blue-shaded results exceed both the proposed Part 201 non-residential direct contact criterion and the site-specific recreational direct contact criterion based on an 8-hour exposure time.

B = analyte was detected in an associated blank sample

E = estimated value

F1 = Matrix spike and/or matrix spike duplicate recovery is outside acceptable limits

J = estimated value above the method detection limit and below the reporting limit

NA = not analyzed

** = Analyzed fine fraction lead data presented and used in average concentration calculations.

Table E-5
Lead Data - Peninsula Property
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 1.8 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs			6	4	3	4	8
SB97-111	2 - 4	11/17/97	310,000	NA	NA	NA	558,000
SB97-111	24 - 26	11/18/97	5,900	NA	NA	NA	10,620
MW98-108S1	4 - 6	09/21/98	59,000	NA	NA	NA	106,200
MW98-110S1	0.5 - 1	09/22/98	340,000	NA	NA	NA	612,000
MW98-110S1	4 - 6	09/22/98	280,000	NA	NA	NA	504,000
MW98-111S1	0.5 - 1	09/22/98	15,000	NA	NA	NA	27,000
MW98-111S1	2 - 4	09/22/98	88,000	NA	NA	NA	158,400
MW98-109S1	0.5 - 1	09/23/98	120,000	NA	NA	NA	216,000
MW98-109S1	6 - 8	09/23/98	22,000	NA	NA	NA	39,600
SB98-120	0.5 - 1	09/23/98	200,000	NA	NA	NA	360,000
SB98-120	4 - 6	09/23/98	640,000	NA	NA	NA	1,152,000
SB98-119	0.5 - 1	09/23/98	50,000	NA	NA	NA	90,000
SB98-119	2 - 4	09/23/98	390,000	NA	NA	NA	702,000
MW98-108S1	0.5 - 1	09/24/98	140,000	NA	NA	NA	252,000
MW01-118WT	0 - 2	11/05/01	22,400 [26,300]	NA	NA	NA	43,830
MW01-118WT	4 - 6	11/05/01	8,800	NA	NA	NA	15,840
SB00-121	0 - 0.5	08/17/00	731,000	NA	NA	NA	1,315,800
SB00-122	0 - 0.5	08/17/00	17,700	NA	NA	NA	31,860
SB00-123	0 - 0.5	08/17/00	200,000 [272,000]	NA	NA	NA	424,800
SB00-124	0 - 0.5	08/17/00	88,100	NA	NA	NA	158,580
SB10-100	0 - 2	01/19/10	30,900	NA	NA	NA	55,620
SB10-101	0 - 2	01/19/10	279,000	NA	NA	NA	502,200
SB10-102	0 - 2	01/19/10	24,700	NA	NA	NA	44,460
SB10-103	0 - 2	01/19/10	109,000	NA	NA	NA	196,200
SB10-105	0 - 2	01/19/10	363,000 J	NA	NA	NA	653,400
SB10-106	0 - 2	01/19/10	29,700	NA	NA	NA	53,460
SB10-107	0 - 2	01/20/10	42,100	NA	NA	NA	75,780
SB10-108	0 - 2	01/20/10	23,200	NA	NA	NA	41,760
SB10-109	0 - 2	01/21/10	214,000 J	NA	NA	NA	385,200
SB10-110	0 - 2	01/21/10	595,000 J	NA	NA	NA	1,071,000
SB10-111	0 - 2	01/22/10	27,400	NA	NA	NA	49,320
SB10-112	0 - 2	01/19/10	17,100	NA	NA	NA	30,780
SB10-115	0 - 2	01/21/10	23,600 J	NA	NA	NA	42,480

Table E-5
Lead Data - Peninsula Property
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 1.8 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs			6	4	3	4	8
SB10-116	0 - 2	01/21/10	32,300 J	NA	NA	NA	58,140
SB10-117	0 - 2	01/22/10	424,000	NA	NA	NA	763,200
SB10-118	0 - 2	01/19/10	41,800	NA	NA	NA	75,240
SB10-120	0 - 2	01/20/10	485,000	NA	NA	NA	873,000
SB10-121	0 - 2	01/21/10	257,000 J	NA	NA	NA	462,600
SB10-122	0 - 2	01/21/10	60,200	NA	NA	NA	108,360
SB10-123	0 - 2	01/22/10	149,000	NA	NA	NA	268,200
SB10-124	0 - 2	01/19/10	57,100	NA	NA	NA	102,780
SB10-125	0 - 2	01/20/10	715,000	NA	NA	NA	1,287,000
SB10-126	0 - 2	01/20/10	213,000 [174,000]	NA [NA]	NA [NA]	NA [NA]	348,300
SB10-127	0 - 2	01/21/10	191,000 J	NA	NA	NA	343,800
SB10-128	0 - 2	01/21/10	251,000	NA	NA	NA	451,800
SB10-129	0 - 2	01/22/10	23,800	NA	NA	NA	42,840
SB10-130	0 - 2	01/19/10	9,300	NA	NA	NA	16,740
SB10-131	0 - 2	01/20/10	8,500	NA	NA	NA	15,300
SB10-132	0 - 2	01/20/10	113,000	NA	NA	NA	203,400
SB10-133	0 - 2	01/21/10	83,900 J	NA	NA	NA	151,020
SB10-134	0 - 2	01/21/10	75,500	NA	NA	NA	135,900
SB10-135	0 - 2	01/22/10	209,000	NA	NA	NA	376,200
SB10-136	0 - 2	01/19/10	33,400	NA	NA	NA	60,120
SB10-137	0 - 2	01/20/10	899,000	NA	NA	NA	1,618,200
SB10-138	0 - 2	01/20/10	34,300	NA	NA	NA	61,740
SB10-139	0 - 2	01/21/10	233,000 J	NA	NA	NA	419,400
SB10-140	0 - 2	01/21/10	72,900	NA	NA	NA	131,220
SB10-141	0 - 2	01/22/10	42,800 [48,300]	NA	NA	NA	81,990
SB10-142	0 - 2	01/19/10	22,700	NA	NA	NA	40,860
SB10-143	0 - 2	01/19/10	470,000	NA	NA	NA	846,000
SB10-144	0 - 2	01/20/10	721,000 [48,300]	NA [NA]	NA [NA]	NA [NA]	692,370
SB10-145	0 - 2	01/20/10	547,000	NA	NA	NA	984,600
SB10-146	0 - 2	01/21/10	567,000	NA	NA	NA	1,020,600
SB10-147	0 - 2	01/21/10	11,100	NA	NA	NA	19,980
SB10-148	0 - 2	01/19/10	11,400	NA	NA	NA	20,520
SB10-149	0 - 2	01/19/10	116,000 [130,000]	NA [NA]	NA [NA]	NA [NA]	221,400

Table E-5
Lead Data - Peninsula Property
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 1.8 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs			6	4	3	4	8
SB10-150	0 - 2	01/20/10	5,400	NA	NA	NA	9,720
SB10-151	0 - 2	01/20/10	20,300	NA	NA	NA	36,540
SB10-152	0 - 2	01/21/10	125,000	NA	NA	NA	225,000
SB10-153	0 - 2	01/21/10	4,180,000	NA	NA	NA	7,524,000
SB10-153-2013	0 - 0.5	08/15/13	NA	22,000	64,200	32,600	64,200 **
SB10-154	0 - 2	01/19/10	15,700	NA	NA	NA	28,260
SB10-155	0 - 2	01/19/10	63,900	NA	NA	NA	115,020
SB10-156	0 - 2	01/20/10	10,100	NA	NA	NA	18,180
SB10-157	0 - 2	01/20/10	36,500	NA	NA	NA	65,700
SB10-158	0 - 2	01/21/10	114,000	NA	NA	NA	205,200
SB10-159	0 - 2	01/21/10	22,800	NA	NA	NA	41,040
SB10-160	0 - 2	01/21/10	19,000	NA	NA	NA	34,200
SB10-161	0 - 2	01/19/10	17,600	NA	NA	NA	31,680
SB10-162	0 - 2	01/20/10	19,300	NA	NA	NA	34,740
SB10-163	0 - 2	01/20/10	9,800	NA	NA	NA	17,640
SB10-164	0 - 2	01/21/10	11,800	NA	NA	NA	21,240
SB10-165	0 - 2	01/21/10	33,000	NA	NA	NA	59,400
SB15-01 [a]	0 - 0.5	11/23/15	770,000	3,400,000 B*	2,000,000 B	3,300,000	2,000,000 **
SB15-02	0 - 0.5	11/23/15	37,000 F1	NA	NA	NA	66,600
SB15-03	0 - 0.5	11/23/15	780,000	570,000 B	850,000 B	610,000	850,000 **
SB15-04	0 - 0.5	11/23/15	720,000	1,000,000 B	1,200,000 B	1,000,000	1,200,000 **
SB15-05	0 - 0.5	11/23/15	82,000	NA	NA	NA	147,600
SB15-06	0 - 0.5	11/23/15	320,000	NA	NA	NA	576,000
SB15-07	0 - 0.5	11/23/15	460,000	420,000 B	450,000 B	420,000	450,000 **
SB15-08	0 - 0.5	11/23/15	210,000	NA	NA	NA	378,000
SB15-09	0 - 0.5	11/23/15	260,000	NA	NA	NA	468,000
SB15-10	0 - 0.5	11/23/15	43,000	NA	NA	NA	77,400
SB15-11	0 - 0.5	11/23/15	380,000	NA	NA	NA	684,000
SB15-12 [a]	0 - 0.5	11/23/15	1,400,000	1,900,000 B	2,300,000 B	1,900,000	2,300,000 **
SB15-13 [a]	0 - 0.5	11/23/15	3,000,000	8,500,000 B	8,800,000 B	8,500,000	8,800,000 **
SB15-14	0 - 0.5	11/23/15	230,000	NA	NA	NA	414,000
SB15-15	0 - 0.5	11/23/15	130,000	NA	NA	NA	234,000
SB15-16	0 - 0.5	11/23/15	56,000	NA	NA	NA	100,800

Table E-5
Lead Data - Peninsula Property
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Lead (Total)	Lead - Coarse Fraction	Lead - Fine Fraction	Lead - Calculated Total [a]	Final Fine Fraction Concentration (Analyzed or Estimated Using a 1.8 Ratio)
			µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
Site-Specific Recreational Direct Contact Criteria (8 hrs)			1,750,000	1,750,000	1,750,000	1,750,000	1,750,000
Number of Exceedances of Recreational Criteria - 8 hrs			6	4	3	4	8
SB15-17	0 - 0.5	11/23/15	6,000	NA	NA	NA	10,800
SB15-18	0 - 0.5	11/23/15	640,000	730,000 B	910,000 B	750,000	910,000 **
SB15-19	0 - 0.5	11/23/15	490,000	5,200,000 B	440,000 B	5,200,000	440,000 **
SB-17-06	0 - 0.5	07/13/17	13,000	13,000	19,000	14,000	19,000 **
SB-17-08	0 - 0.5	07/13/17	34,000	25,000	41,000	35,000	41,000 **
SB-17-09	0 - 0.5	07/13/17	140,000	48,000	62,000	56,000	62,000 **
SB-17-10	0 - 0.5	07/13/17	36,000	22,000	21,000	21,000	21,000 **
SB97-110	18 - 20	11/17/97	11,000 [2,200]	NA	NA	NA	11,880
SB97-110	22 - 24	11/17/97	5,600	NA	NA	NA	10,080
SB10-104	0 - 2	01/19/10	2,680,000	NA	NA	NA	4,824,000
SB10-113	0 - 2	01/20/10	2,640,000	NA	NA	NA	4,752,000
SB10-114	0 - 2	01/20/10	10,100,000	NA	NA	NA	18,180,000
SB10-119	0 - 2	01/20/10	2,120,000	NA	NA	NA	3,816,000
Average-excluding hot spots and covered samples [a]							368,592
Average-excluding covered samples [b]							481,745
Average with all data [c]							738,026

Notes:

Values are in micrograms per kilogram (µg/kg).

Duplicate sample results are shown in square brackets. Duplicate results were averaged for estimating the fine fraction.

Blue-shaded results exceed the site-specific soil direct contact criterion based on an 8-hour exposure time.

Sample location was excavated to a depth of 0.5 feet below ground surface and an exposure barrier was placed prior to backfilling with clean fill.

[a] Average Peninsula concentration excludes samples that are currently under soil cover or were in the identified hot spot area.

[b] Average Peninsula concentration excludes samples that are currently under soil cover.

[c] Average Peninsula concentration includes all remaining samples, including those in the identified hot spot area and those under a soil cover.

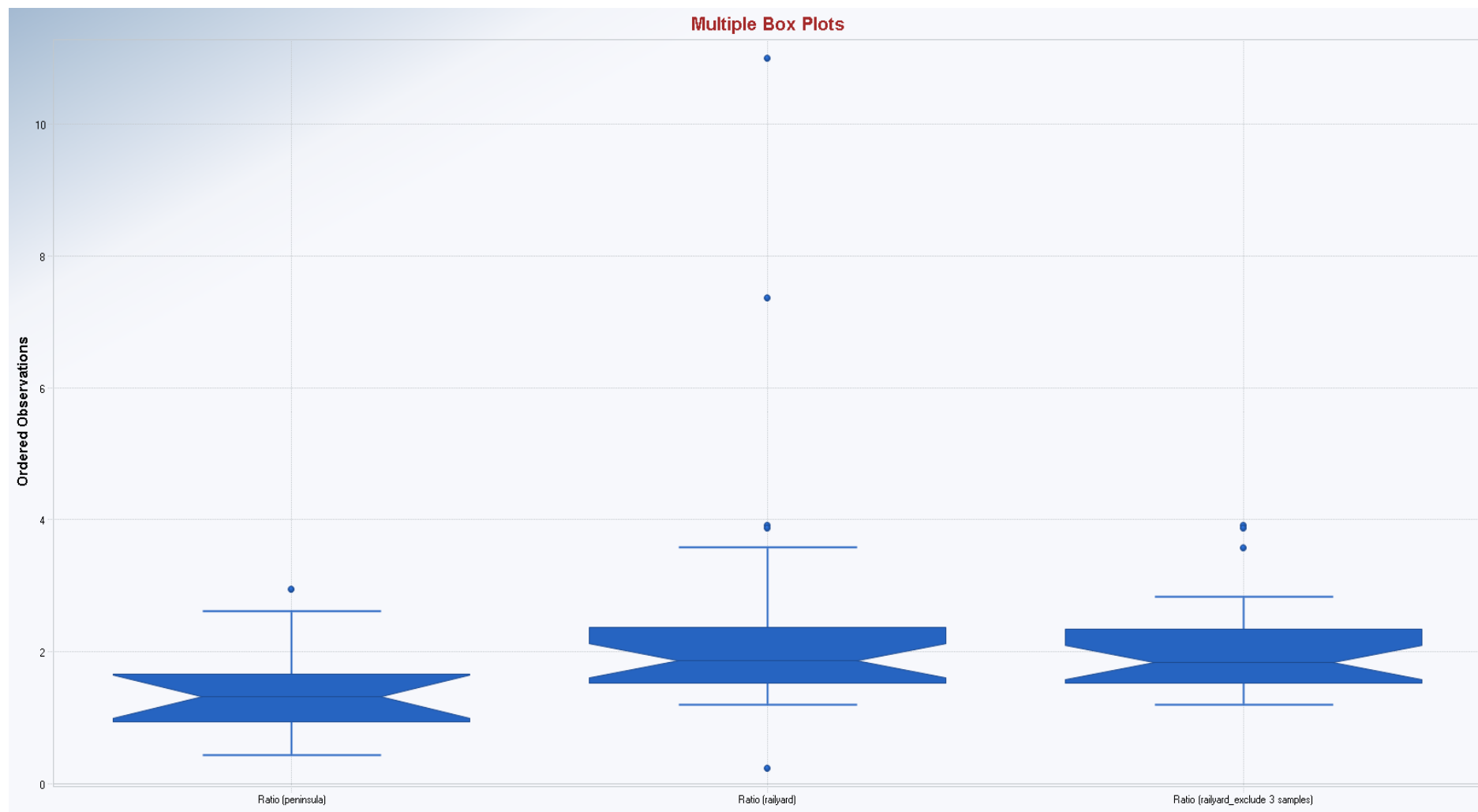
B = analyte was detected in an associated blank sample

J = estimated value above the method detection limit and below the reporting limit

NA = not analyzed

** = Analyzed fine fraction lead data presented and used in average concentration calculations.

Figure E-1. Box Plots for Fine Fraction to Total Lead Ratios



APPENDIX F

Saturated Soil Samples Evaluation Regarding Use in Comparison to Ambient Air Criteria at the RACER Saginaw Malleable Industrial Land and VSIC Investigation Summary Memo



MEMO

To:

Amanda Armbruster, MDEQ
Divinia Ries, MDEQ

Copies:

Dave Favero, RACER Trust

From:

Scott Clearwater, Arcadis
Jeanine Smith, Arcadis

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Date:

June 21, 2017

Arcadis Project No.:

B0064434

Subject:

Saturated Soil Samples Evaluation Regarding Use in Comparison to Ambient Air Criteria
at the RACER Saginaw Malleable Industrial Land

Summary

Various soil samples at the RACER Saginaw Malleable Industrial Land (SMI) Site were collected from depths below the water table, and are, therefore, water-saturated soil samples. A number of these samples contain concentrations of hazardous substances which exceed the 2016 draft residential Volatile Soil Inhalation Criteria (VSIC) for a 5-meter source thickness (VSIC-5M) that have been adjusted for a 400-acre source area.

A majority of the samples that exceeded VSIC were collected in proximity to the former UST #7 Area at SMI. UST #7 was removed in 1990, and the other 10 USTs in nearby areas of the Site and their associated piping were removed between 1982 and 1991. Therefore, the source is no longer present, and given the constituents of concern are petroleum volatile organic compounds (VOCS; benzene and ethylbenzene), natural attenuation has and is occurring. In 1997 MDEQ approved an interim response action consisting of monitored natural attenuation. In 2008 MDEQ approved stopping groundwater monitoring related to UST #7 Area.

Groundwater depth gauging and sampling continued for wells in the UST #7 area until 2008, showing stable to decreasing groundwater concentration trends and average depth to water at 5 to 8 feet below ground surface. These wells were abandoned December 2012 following approval of the RAP and determination that they were not required for long term performance monitoring. Groundwater levels at the Site are known to have generally increased since manufacturing operations ceased and demolition has been completed. Nearby wells without mobile non-aqueous phase liquid (NAPL) in the former

Quench Pit area had a range of depth to water of 1.66 to 3.72 feet bgs in 2016 confirming that most of the soil samples that exceeded VSIC are below the water table.

A summary of the VSIC exceedances at SMI and the Greenpoint Landfill property, with the exception of exceedances of polychlorinated biphenyls (which are all below at least 1 foot of soil and most are also below concrete), is provided in Table 1 with locations shown on Figure 1. As shown in Table 1, all of the benzene and all but one of the ethylbenzene exceedances are located below the water table. The phenanthrene, naphthalene, and mercury exceedances were collected from unsaturated (vadose zone) soils.

The following guidance documents were identified as detailing what role and level of consideration water-saturated soil samples may have towards risk evaluations particularly related to potential vapors and ambient air pathway analysis. Overall, it is determined that volatile constituents in soils that are found beneath the water table are greatly inhibited from volatilizing, thus posing little to no risk to ambient air. Therefore, it is not appropriate or best science to compare water-saturated soils to the VSIC.

Guidance Documents

Michigan Department of Environmental Quality (MDEQ) May 2013 Vapor Intrusion Guidance Document (MDEQ 2013):

Table 1-2: Environmental Factors that May Affect Soil Vapor Intrusion:

Soil Conditions: "Generally, dry, coarse-grained soils facilitate the migration of subsurface vapors and wet, fine-grained or highly organic soils retard migration."

Section 2.3.3 Screening Values for Soil:

"The MDEQ has developed a screening value for soil (S_{vi}) that may be considered conservative for various site conditions. Establishing the actual conditions when the values are conservative can be a lengthy and intensive process that typically requires the collection of soil gas samples and an evaluation of various lines of evidence. Though soil data are generally not recommended as a stand-alone screening tool for eliminating or identifying the potential for VI, the S_{vi} are established and provided as an initial screening tool to establish a potential source of soil gas within the unsaturated soil column to aid in defining potential sources of vapors that can potentially impact a structure."

Section 3.2.1 Identifying Potential Soil Sources of Vapors: "Though not a stand-alone tool, soil data are effective in assisting the delineation of potential vapor sources within the unsaturated soil column (if the release did not include vapors) or to establish sites for further VI assessment."

Interstate Technology & Regulatory Council (ITRC) – Petroleum Vapor Intrusion Guidance, October 2014 (ITRC 2014):

I.1.3 Subsurface Environment – Vadose Zone:

"Vapor and gas diffusion rates through a porous soil matrix are significantly higher when the air space in the soil matrix is connected. This connection occurs when the air-filled fraction of soil θ_a ($\text{cm}^3\text{-air}/\text{cm}^3\text{-soil}$) is greater than approximately 0.2, depending on soil structure. Vapor diffusion is significantly less when the air-filled fraction of soil porosity is disconnected. Disconnection occurs in wetter soils and near the water table capillary fringe. Soil moisture, θ_w ($\text{cm}^3\text{-water}/\text{cm}^3\text{-soil}$), which occupies the remaining soil void can therefore significantly affect diffusion in the soil matrix."

I.1.5 Comparison of Mass Transfer Rates and Relative Attenuation:

"Migration rates of vapors through buildings, foundations, and soils may be qualitatively compared using mass transfer parameters. Choosing nominal parameter ranges, the mass transfer rates and relative attenuation are calculated as shown in Table I-1. The relative attenuation is calculated by simultaneously solving an equation for mass transfer rate for each compartment considered."

Table I-1 Comparison of relative attenuation across compartments. The apportionment in column (1) includes the resistance of wet soils in a capillary fringe; column (2) neglects the contribution of capillary fringe resistance.

Compartment	Nominal parameters	Coefficient	Mass transfer rate	Relative contribution to attenuation (1)	Relative contribution to attenuation (2)
Indoors	ER = 12/day, $L_{mix} = 2.44$ m	$L_{mix} \cdot ER$	29 m/day	1.6E-5	0.001
Foundation	$Q_f = 5$ L/min, $A_f = 100$ m ²	Q_f/A_f	0.072 m/day	0.007	0.35
Soils – Air connected	$D_{eff} = 0.12$ m ² /day, $L_T = 3$ m	D_{eff} / L_T	0.04 m/day	0.012	0.64

Table I-1 Comparison of relative attenuation across compartments. The apportionment in column (1) includes the resistance of wet soils in a capillary fringe; column (2) neglects the contribution of capillary fringe resistance. (continued)

Compartment	Nominal parameters	Coefficient	Mass transfer rate	Relative contribution to attenuation (1)	Relative contribution to attenuation (2)
Soils- wet	$D_{eff} = 0.15E-4$ m ² /day, $L_T = 3$ cm	D_{eff} / L_T	0.0005 m/day	0.98	–
			Sum:	1.0	1.0
Note: Capillary fringe contribution included (1) and neglected (2). ER = exchange rate L_{mix} = mixing zone height Q_f = soil gas flux into building A_f = foundation area D_{eff} = effective diffusion coefficient L_T = layer thickness					

Appendix J, J.2.6 High-Water Conditions:

"Saturated soils may prevent effective depressurization of the subslab region by filling soil pores and making them unavailable for vapor transport."

Appendix M, M.2 Diffusion:

"Diffusion is the movement of a chemical from an area of higher concentration to lower concentration. Diffusion is typically the dominant transport mechanism for vapors in the vadose zone."

The diffusive mass flux of a vapor in the soil is described by Fick's law. Diffusion occurs in both the aqueous and gas phases. The diffusive mass flux is directly proportional to the soil vapor concentration gradient; therefore, higher soil vapor concentrations result in higher flux. Additionally, an effective diffusion coefficient is used to integrate tortuosity of porous media and the diffusivity of the gas phase and soil moisture.

In addition to the concentration gradient, the degree of water saturation also affects the rate of the diffusive mass flux through the vadose zone. Diffusion coefficients in water are typically about four orders of magnitude lower than the diffusion coefficients in air, so as the soil becomes increasingly saturated, vapor flux decreases. Therefore, the capillary fringe (a thin layer of highly saturated soil in the vadose zone) can often reduce the overall vapor diffusive flux from groundwater to ground surface. Conversely, dry soils provide numerous air-filled pore spaces that allow for appreciable rates of diffusive transport.

The site-specific stratigraphy can also significantly affect the upward diffusion of contaminant vapors from the source and the downward diffusion of O₂ from the atmosphere due to changes in soil permeability and soil moisture content. Under dry conditions, diffusive transport can be similar for soils with a broad range of textures and grain sizes. Additionally, work presented by Carr (Carr, Levy, and Horneman 2010) illustrates how layers of saturated fine-grained soils are associated with significant reductions in the concentration of chlorinated vapors."

Conclusions

Based on the above analysis and information in the referenced guidance documents, water-saturated soils do not act as a direct source to vapors in unsaturated vadose zone soils, and do not contribute significantly to volatiles in ambient (or indoor) air. Therefore, analytical results from water saturated soils will not be evaluated against the VSIC in the Recreational Risk Evaluation report.

References

- ITRC. 2014. Guidance Document, Petroleum Vapor Intrusion, Fundamentals of Screening, Investigation, and Management. October. Available online at: <http://www.itrcweb.org/PetroleumVI-Guidance/Content/Resources/PVIPDF.pdf>.
- MDEQ. 2013. Guidance Document for the Vapor Intrusion Pathway, May 2013, Remediation and Redevelopment Division. Available online at: http://www.michigan.gov/documents/deq/deq-rrd-VIGuidanceDoc-May2013_422550_7.pdf.

Table 1
Soil Data for Constituents Exceeding Adjusted VSIC-5M on SMI and GPL
RACER Saginaw
Saginaw Malleable Industrial Land
Saginaw, Michigan

Constituent	Sample ID	Sample Depth	Sample Date	Concentration (ug/kg)
Saginaw Malleable Industrial Land				
Benzene	<i>Draft Residential 5M Source VSIC</i>			18,000
	<i>Draft Residential 5M Source VSIC - 400-acre</i>			5,940
	BBL-MW3	6 - 8	5/2/1996	7,300 J
	BBL-SB3	8 - 10	5/7/1996	21,000 J
	T07-B036	7 - 9	9/5/1990	73,000
	T07-B037	7 - 9	9/5/1990	11,000
	T07-B040	9 - 11	9/5/1990	21,000
	T07-B041	7 - 9	9/5/1990	9,200
	T07-B111	9 - 11	7/13/1992	16,000
Ethylbenzene	<i>Draft Residential 5M Source VSIC</i>			60,000
	<i>Draft Residential 5M Source VSIC - 400-acre</i>			19,800
	BBL-SB3	8 - 10	5/7/1996	29,000 J
	BBL-SB4	0 - 2	5/7/1996	28,000
	BBL-SB4	8 - 10	5/7/1996	23,000
	T07-B036	7 - 9	9/5/1990	99,000
	T07-B037	7 - 9	9/5/1990	20,000
	T07-B040	9 - 11	9/5/1990	20,000
	UST7-MW2	5 - 7	6/3/1994	71,000
Phenanthrene	<i>Draft Residential 5M Source VSIC</i>			25,000
	<i>Draft Residential 5M Source VSIC - 400-acre</i>			8,250
	BH9 [a]	1 - 2	3/6/2007	23,000
Mercury	<i>Draft Residential 5M Source VSIC</i>			1,700
	<i>Draft Residential 5M Source VSIC - 400-acre</i>			561
	SB-304	2 - 4	2/8/1995	691
	BH12	0 - 2	3/6/2007	970 J [220 J]
Greenpoint Landfill				
Naphthalene	<i>Draft Residential 5M Source VSIC</i>			13,000
	<i>Draft Residential 5M Source VSIC - 400-acre</i>			4,290
	SS-008-CR	0 - 0.5	12/1/1997	5,500

Notes:

Soil values are in micrograms per kilogram (µg/kg)

Duplicate sample results are shown in square brackets.

Blue text samples were collected below the water table (i.e., water-saturated samples), which is at approximately 4 feet below ground surface.

Gray-shaded results exceed the volatile soil inhalation criteria (VSIC) for a 5-meter (5M) source thickness, adjusted for a 400-acre source area.

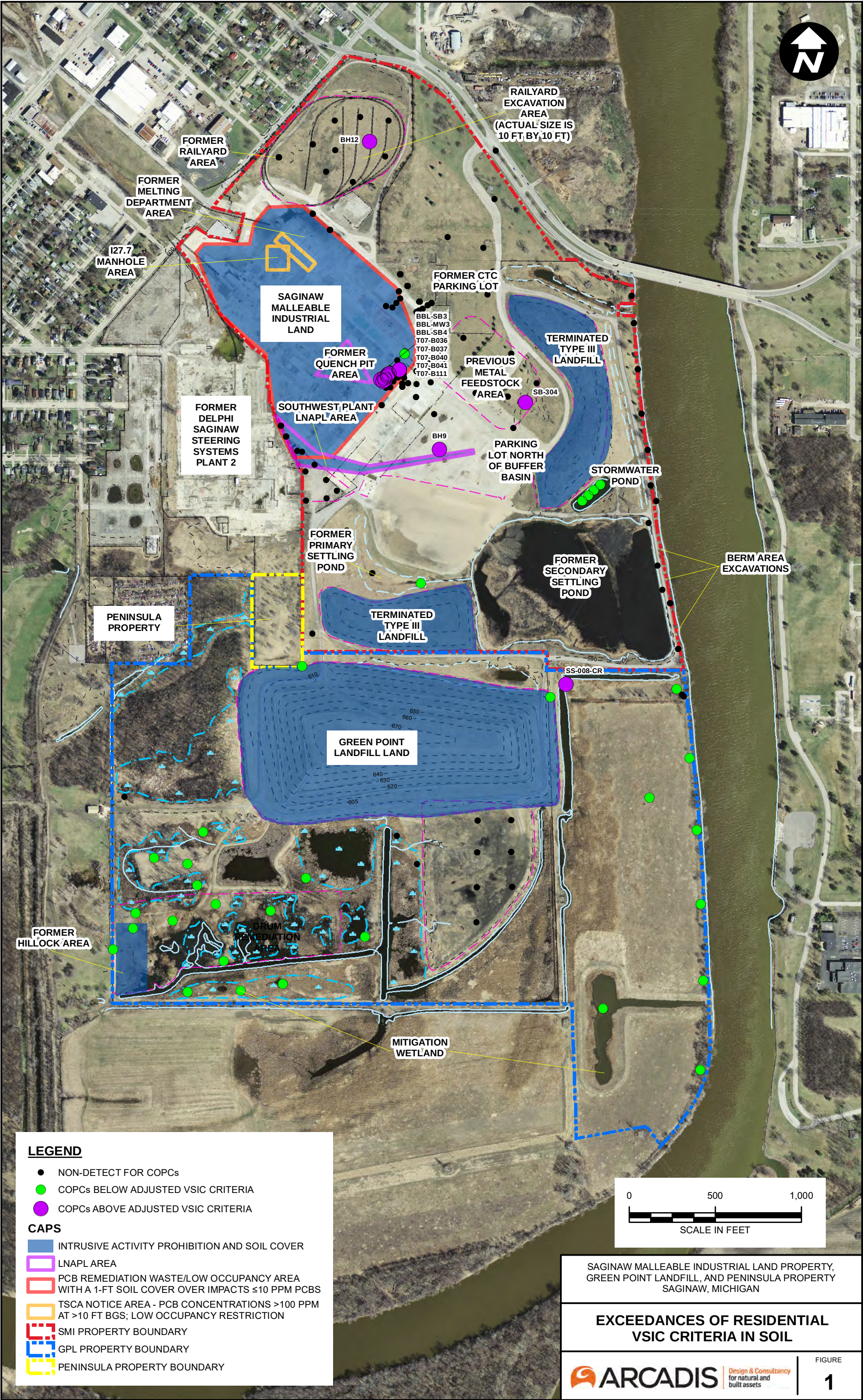
Blue-shaded results exceed the generic 5M Source VSIC, based on a 1/2-acre source area.

Yellow-shaded results exceed the recreational 5M Source VSIC for a 400-acre source area (no exceedances).

J = estimated value above the method detection limit and below the reporting limit

[a] = sample located under asphalt parking lot

CITY: Novi, DIV: ENV, DB: TRY, PIC: PM, TM: TR, PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\COMMON\RACER\Saginaw\64434 - SMI (10030) Main Location\GIS\Docs\RACER Saginaw VSIC Exceedances.mxd PLOTTED: 6/16/2017 1:42:39 PM BY: dalex



Ms. Amanda Armbruster
Saginaw Bay District Office
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Subject:

RACER Saginaw Malleable Industrial Land - VSIC Investigation Summary Memo
Saginaw, Michigan

ENVIRONMENT

Date:
September 18, 2017

Dear Ms. Armbruster:

Contact:
Scott Clearwater

Arcadis of Michigan, LLC (Arcadis) is pleased to provide this summary memo from the supplemental soil sample investigation completed at the RACER Trust, Saginaw Malleable Industrial Land (SMI) in Saginaw, Michigan (Site, **Figure 1**). Soil samples were collected on August 4, 2017, at locations near the former underground storage tank (UST) #7 Area under the former SMI plant slab, in accordance with the RACER Saginaw Malleable Industrial Land – VSIC Shallow Soil Sampling Work Plan, submitted to the Michigan Department of Environmental Quality (MDEQ) on August 2, 2017, and approved in an email received on August 3, 2017, with an additional sampling location requested.

Phone:
810 225 1921

Email:
scott.clearwater@arcadis.com

Our ref:
B0064434.2017

This supplemental investigation work occurred in order to evaluate potential ambient air inhalation risks related to historic soil samples collected from unsaturated (i.e., vadose zone) and saturated soil intervals that had detected concentrations of benzene and ethylbenzene exceeding the 2016 draft MDEQ Residential Volatile Soil Inhalation Criteria (VSIC) for a 5-meter Source thickness (VSIC-5M), adjusted for a 400-acre source area (adjusted VSIC-5M). In order to evaluate the potential for ambient air risks, seven shallow soil borings were completed targeting unsaturated soils on August 4, 2017. Three of the borings (SB-17-34, SB-17-35, and SB-17-38) were completed at locations of previous exceedances and four of the borings were completed to delineate to the south, west, and north where there were fewer shallow soil samples available. Analytical results were compared to the 2016 draft MDEQ Part 201 Non-Residential and Residential adjusted VSIC-5M, and a calculated Site-Specific

Recreational Criterion (SSRC), if the residential criterion was exceeded, consistent with the planned non-residential land use restriction for the Site. Based on the initial results, it was determined additional sampling should be completed to delineate concentrations at SB17-35. Two additional shallow soil borings were completed on September 7, 2017. Those results were also compared to the 2016 draft MDEQ Part 201 Non-Residential and Residential adjusted VSIC-5M, and a calculated SSRC if the residential criterion was exceeded. Analytical results are summarized in **Table 1** and shown in **Figure 2**.

DATA SUMMARY

Soil Sampling Activities

Eighteen soil samples were collected from beneath the former SMI plant slab, near the former UST #7 area. A hand auger was used to collect the top 6 inches of soil beneath the slab, and at a deeper interval just above the water table. All soil samples were submitted to TestAmerica and analyzed for volatile organic compounds (VOCs) via United States Environmental Protection Agency (USEPA) Method 8260.

Soil Analytical Results

Sample results were compared to the 2016 draft MDEQ Part 201 Non-Residential and Residential adjusted VSIC-5M. Additionally, a SSRC was calculated if the residential adjusted VSIC-5M was exceeded. One sample, SB17-35 (2-2.5 feet below ground surface [ft bgs]), exhibited a concentration of benzene at 10,000 micrograms per kilogram ($\mu\text{g/kg}$), exceeding the Non-Residential and Residential adjusted VSIC-5M of 9,240 $\mu\text{g/kg}$ and 5,940 $\mu\text{g/kg}$, respectively. The benzene concentration in SB17-35 (2-2.5 ft bgs) did not exceed the calculated SSRC of 339,000 $\mu\text{g/kg}$ for benzene. Nearby monitoring wells in the quench pit area were gauged with an interface probe to determine the groundwater elevation. Groundwater was identified at 4.78 feet below new soil covered ground surface at MW-QPTW-10 and product was measured at 4.76 feet below ground surface at MW-QPTW-05. These saturation zone depths are approximately 2.7 feet below the new 1 foot soil cover and 1 foot thick concrete slab.

Soil samples collected to delineate the benzene exceedance at SB17-35 (SB17-48 and SB17-49) were below their respective 2016 draft MDEQ Part 201 Non-Residential and Residential adjusted VSIC-5M. The concentrations of the remaining analytes did not exceed their respective Non-Residential or Residential adjusted VSIC-5M. Soil sample results are summarized in **Table 1** and shown in **Figure 2**.

ADDITIONAL DATA EVALUATION

Because the benzene concentration in one sample exceeded the 2016 draft MDEQ Part 201 Non-Residential adjusted VSIC-5M, additional data evaluation was completed to determine if benzene concentrations at SMI were a potential concern for ambient air inhalation under a future nonresidential land use scenario. The 95 percent (%) upper confidence limit on the mean (95% UCL) for benzene in unsaturated (i.e., vadose zone) soil for the entire SMI property was calculated using USEPA's ProUCL (version 5.1.002) statistical software. The 95% UCL is a statistical number calculated to represent the mean value with a high level (i.e., 95%) of confidence. The true arithmetic mean concentration for SMI is

lower than the 95% UCL. The high level of confidence is used to compensate for the uncertainty in representing area conditions with a finite number of samples. The calculated 95% UCL of 31.79 µg/kg for benzene for unsaturated soil at SMI does not exceed the 2016 draft MDEQ Part 201 Non-Residential or Residential adjusted VSIC-5M, or the SSRC. Therefore, benzene in unsaturated soil at SMI is not a concern for ambient air inhalation for future non-residential use of the Site (**Figure 3**). The dataset used to evaluate benzene in unsaturated soil at SMI and the ProUCL output sheets are provided in **Attachment 1**.

CONCLUSION

Analytical results indicated concentrations of benzene above the 2016 draft MDEQ Part 201 Non-Residential and Residential adjusted VSIC-5M. However, the SSRC was not exceeded, and the benzene concentrations have been delineated; therefore, no additional investigation is necessary.

These analytical results will be included and discussed in the recreational use risk evaluation completed for the Site. However, because the concentrations do not exceed the calculated SSRC and the 95% UCL for unsaturated soil at SMI does not exceed the 2016 draft MDEQ Part 201 Non-Residential adjusted VSIC-5M, no additional actions will be required to address the ambient air inhalation pathway for future recreational or non-residential use of the Site.

Please contact me at 810-225-1921 if you have any questions regarding the enclosed report or its attachments.

Sincerely,

Arcadis of Michigan, LLC



Scott Clearwater

Certified Project Manager

Ms. Amanda Armbruster
September 18, 2017

Enclosures:

Figures

- 1 Site Layout Map
- 2 VSIC Soil Sample Location Map
- 3 VSIC Soil Sample Data Summary

Tables

- 1 Soil Data for VSIC Sampling

Lab Reports

- 1 Soil Data Laboratory Analytical Report August 14, 2017
- 2 Soil Data Laboratory Analytical Report September 11, 2017

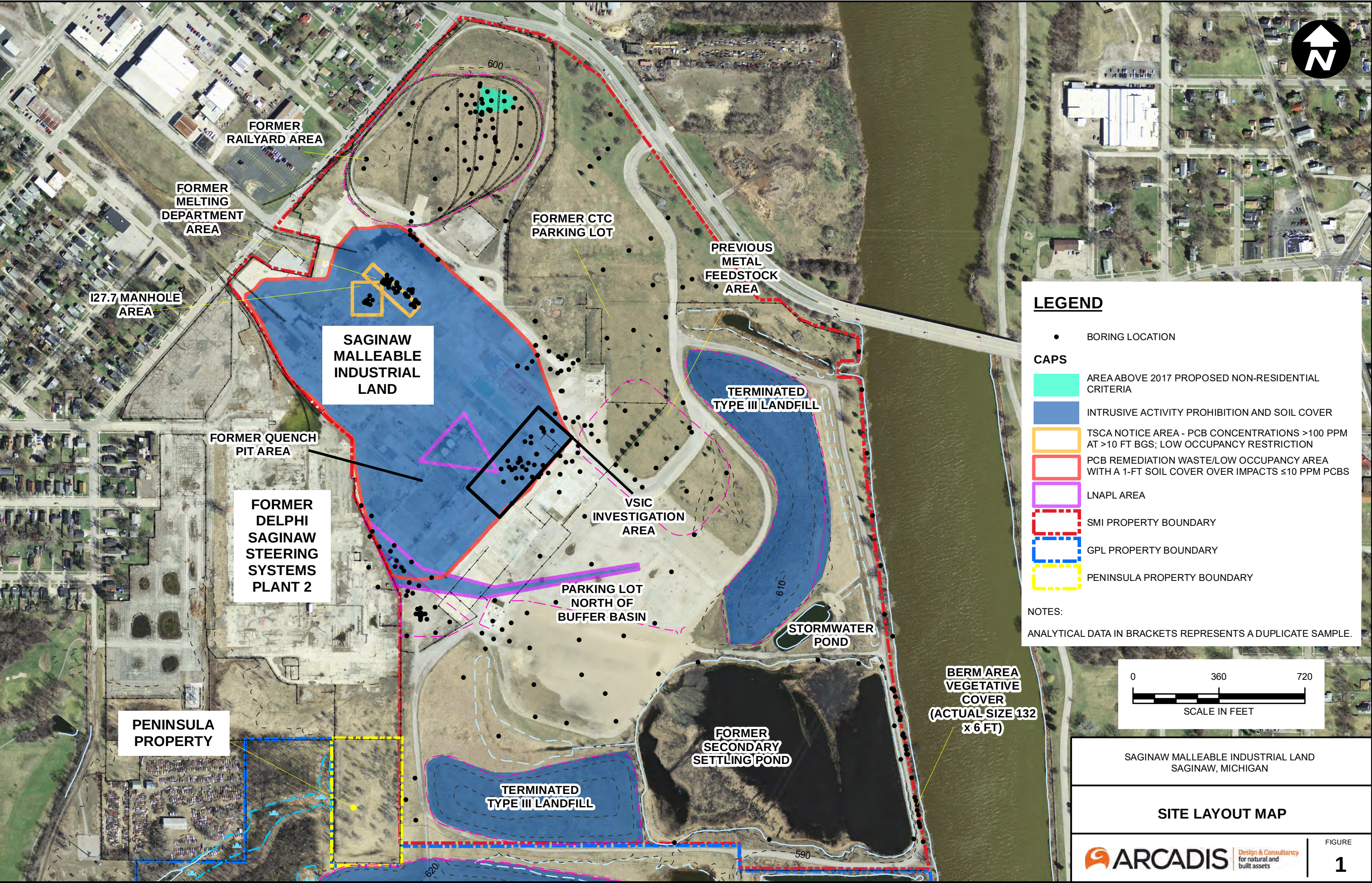
Attachment

- 1 ProUCL Evaluation

FIGURES



CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl G:\COMMON\RACER\Saginaw\64434 - SMI (10030) Main Location\GIS\Docs\SMI Site Layout Map.mxd PLOTTED: 9/15/2017 2:43:14 PM BY: dolexa



FORMER QUENCH PIT AREA

Sample ID	Depth (ft bgs)	Benzene (µg/kg)	Ethylbenzene (µg/kg)
BBL-MW3	6-8	7,300	14,000
BBL-SB3	8-10	21,000	29,000
BBL-SB4	0-2	2,700	28,000
BBL-SB4	8-10	3,000	23,000
T07-B036	7-9	73,000	99,000
T07-B037	7-9	11,000	20,000
T07-B040	9-11	21,000	20,000
T07-B041	7-9	9,200	16,000
T07-B111	9-11	16,000	12,000
UST7-MW2	5-7	4,300	71,000
SB-17-34	0-0.5	860	1,200
SB-17-34	1.5-2	840	1,300
SB-17-35	0-0.5	2,300	660
SB-17-35	2-2.5	10,000	1,700
SB-17-36	0-0.5	65	65
SB-17-36	2-2.5	170	130
SB-17-37	0-0.5	<49	<49
SB-17-37	2.5-3	51	<52
SB-17-38	0-0.5	<68	130
SB-17-38	1.5-2	<54	63
SB-17-39	0-0.5	<50	<50
SB-17-39	1.5-2	<51	<51
SB-17-40	0-0.5	<49	<49
SB-17-40	1.5-2	<55	<55

LEGEND

- 2017 VSIC INVESTIGATION BORING LOCATION
- HISTORIC SOIL BORING LOCATION

CAPS

- INTRUSIVE ACTIVITY PROHIBITION AND SOIL COVER
- LNAPL AREA
- PCB REMEDIATION WASTE/LOW OCCUPANCY AREA WITH A 1-FT SOIL COVER OVER IMPACTS ≤10 PPM PCBs

NOTE:

DRAFT RECREATIONAL USE CRITERIA IS NOT EXCEEDED.

BOLD ENTRIES IN THE TABLE REPRESENT EXCEEDANCES OF ADJUSTED RESIDENTIAL VSIC CRITERIA.

0 50 100
SCALE IN FEET

SAGINAW MALLEABLE INDUSTRIAL LAND PROPERTY
SAGINAW, MICHIGAN

VSIC SOIL SAMPLE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2

FORMER QUENCH PIT AREA

Sample ID	Depth (ft bgs)	Benzene (µg/kg)	Ethylbenzene (µg/kg)
BBL-MW3	6-8	7,300	14,000
BBL-SB3	8-10	21,000	29,000
BBL-SB4	0-2	2,700	28,000
BBL-SB4	8-10	3,000	23,000
T07-B036	7-9	73,000	99,000
T07-B037	7-9	11,000	20,000
T07-B040	9-11	21,000	20,000
T07-B041	7-9	9,200	16,000
T07-B111	9-11	16,000	12,000
UST7-MW2	5-7	4,300	71,000
SB-17-34	0-0.5	860	1,200
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SB-17-35	0-0.5	2,300	660
SB-17-35	2-2.5	10,000	1,700
SB-17-36	0-0.5	65	65
SB-17-36	2-2.5	170	130
SB-17-37	0-0.5	<49	<49
SB-17-37	2.5-3	51	<52
SB-17-38	0-0.5	<68	130
SB-17-38	1.5-2	<54	63
SB-17-39	0-0.5	<50	<50
SB-17-39	1.5-2	<51	<51
SB-17-40	0-0.5	<49	<49
SB-17-40	1.5-2	<55	<55

LEGEND

- 2017 VSIC INVESTIGATION BORING LOCATION
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- INTRUSIVE ACTIVITY PROHIBITION AND SOIL COVER
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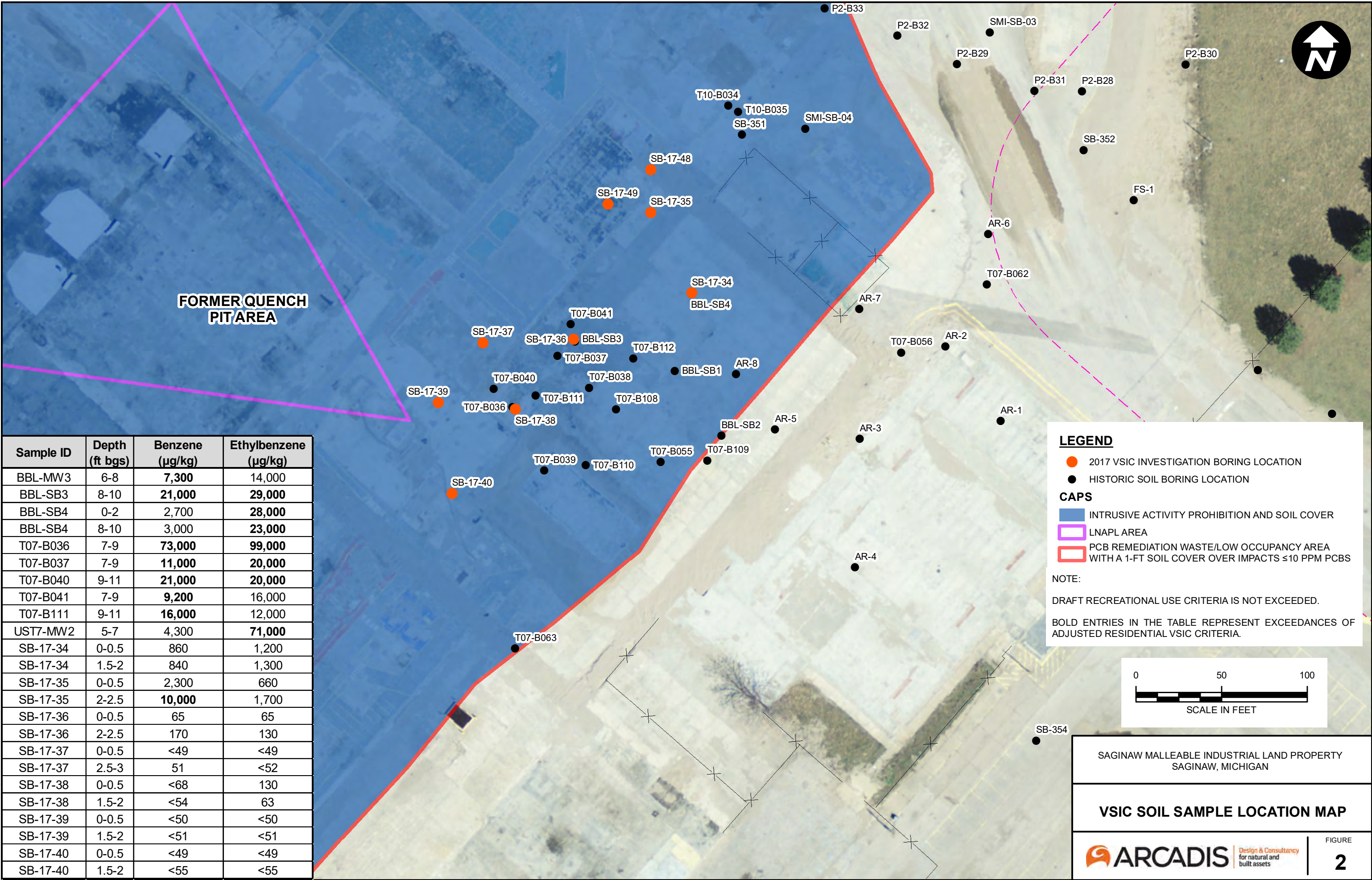
0 50 100
SCALE IN FEET

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SAGINAW, MICHIGAN

VSIC SOIL SAMPLE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

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SB-17-36	2-2.5	170	130
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SB-17-37	2.5-3	51	<52
SB-17-38	0-0.5	<68	130
SB-17-38	1.5-2	<54	63
SB-17-39	0-0.5	<50	<50
SB-17-39	1.5-2	<51	<51
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LEGEND

- 2017 VSIC INVESTIGATION BORING LOCATION
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0 50 100
SCALE IN FEET

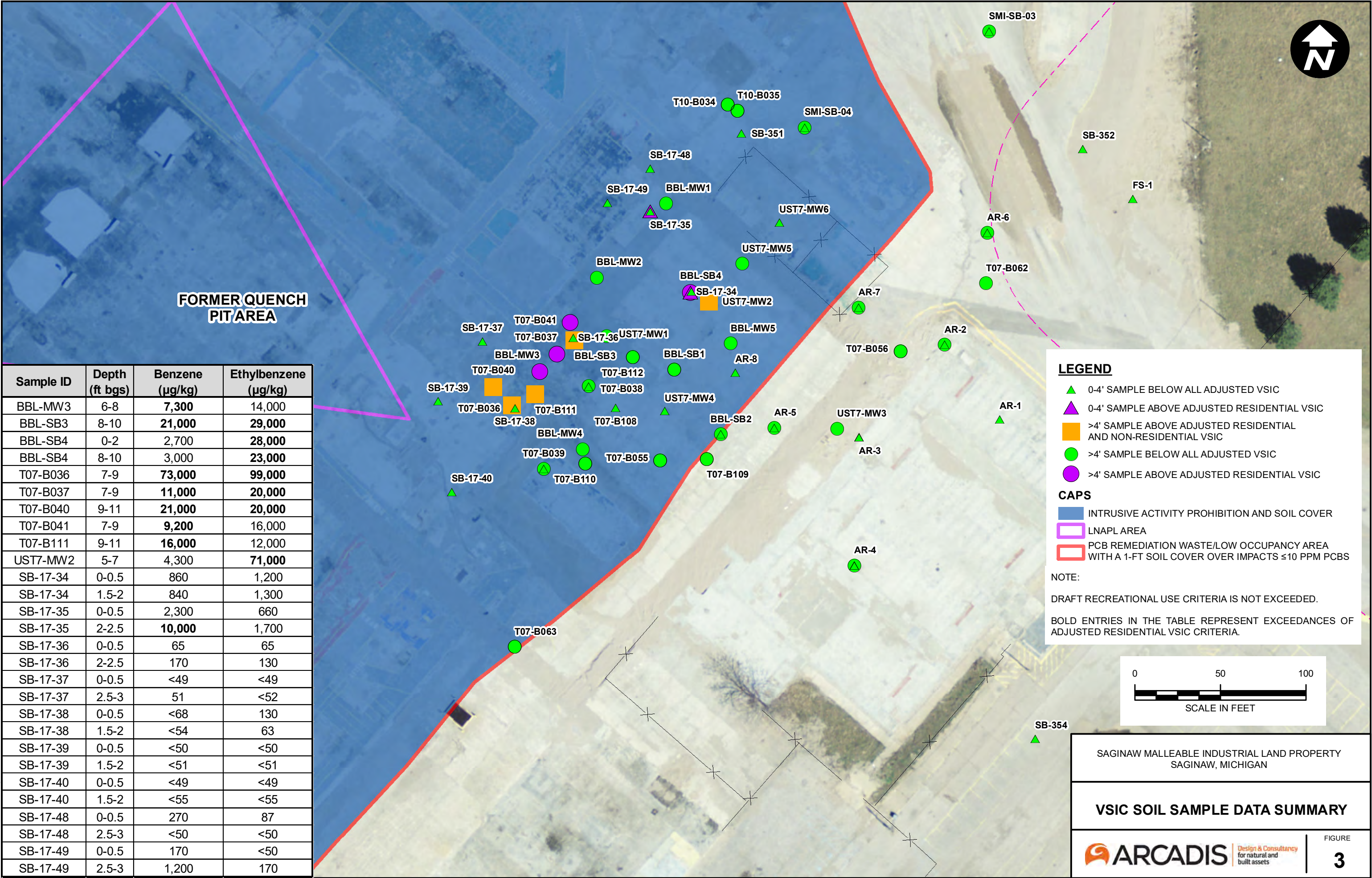
SAGINAW MALLEABLE INDUSTRIAL LAND PROPERTY
SAGINAW, MICHIGAN

VSIC SOIL SAMPLE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2

CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl G:\COMMON\IRACER\Saginaw\64434 - SMI (10030) Main Location\GIS\Docs\VSIC Exceedance Zoom.mxd PLOTTED: 9/11/2017 4:10:39 PM BY: dolexa



TABLES



Table 1. Summary of Analytical Results Compared to Volatile Soil Inhalation Criteria
RACER Saginaw Malleable Industrial Land
Saginaw, Michigan

Constituent	Draft 2016 Non-Residential VSIC Criteria - 400-acre	Draft Residential 5M Source VSIC - 400-acre	Draft Recreational Use VSIC Criteria - 400-acre	Sample Location	SB17-34	SB17-34	SB17-35	SB17-35	SB17-36	SB17-36	SB17-37	SB17-37	SB17-38	SB17-38	SB17-39	SB17-39	SB17-40	SB17-40	SB17-48	SB17-48	SB17-49	SB17-49
				Sample Depth (feet)	0-0.5	1.5-2	0-0.5	2-2.5	0-0.5	2-2.5	0-0.5	2.5-3	0-0.5	1.5-2	0-0.5	1.5-2	0-0.5	1.5-2	0-0.5	2.5-3	0-0.5	2.5-3
				Date Collected	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	8/4/2017	9/7/2017	9/7/2017	9/7/2017	9/7/2017
Acetone	79,200,000	79,200,000	NC	µg/kg	1,200	<1,100	<720	<6,200	<710	<790	<740	<790	<1,000	<800	<740	<760	<740	<820	<710	<750	150 J	360 J
Benzene	9,240	5,940	339,000	µg/kg	860	840	2,300	10,000	65	170	<49	51 J	<68	<54	<50	<51	<49	<55	270	<50	170	1,200
Bromodichloromethane	3,630	2,706	NC	µg/kg	<160	<150	<96	<830	<95	<100	<99	<100	<140	<110	<99	<100	<99	<110	<95	<100	<100	<100
Bromoform	79,200	49,500	NC	µg/kg	<160	<150	<96	<830	<95	<100	<99	<100	<140	<110	<99	<100	<99	<110	<95	<100	<100	<100
Bromomethane	17,160	18,480	NC	µg/kg	<400	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
2-Butanone (MEK)	7,920,000	11,550,000	NC	µg/kg	<1,200	<1,100	<720	<6,200	<710	<790	<740	<790	<1,000	<800	<740	<760	<740	<820	<710	<750	<750	<770
Carbon disulfide	1,188,000	1,287,000	NC	µg/kg	<400	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
Carbon tetrachloride	11,880	7,920	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	71	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
Chlorobenzene	99,000	105,600	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
Chloroethane	6,930,000	7,260,000	NC	µg/kg	<400	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
Chloroform	3,003	2,013	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
Chloromethane	151,800	165,000	NC	µg/kg	<400	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
cis-1,2-Dichloroethene	14,190	15,180	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
cis-1,3-Dichloropropene	17,820	11,880	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
Cyclohexane	10,230,000	10,890,000	NC	µg/kg	78 J	71 J	1,200	2,200 J	50 J	110 J	42 J	52 J	200 J	62 J	110 J	66 J	<1200	<1300	340 J	82 J	750 J	1,600
Dibromochloromethane	3,300	891	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
1,2-Dibromo-3-Chloropropane	33	8	NC	µg/kg	<400	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
1,2-Dibromoethane	7,920	8,250	NC	µg/kg	<400	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
1,2-Dichlorobenzene	726,000	726,000	NC	µg/kg	<160	<150	<96	<830	<95	<100	<99	<100	<140	<110	<99	<100	<99	<110	<95	<100	<100	<100
1,3-Dichlorobenzene	6,930	6,930	NC	µg/kg	<160	<150	<96	<830	<95	<100	<99	<100	<140	<110	<99	<100	<99	<110	<95	<100	<100	<100
1,4-Dichlorobenzene	188	119	NC	µg/kg	<160	<150	<96	<830	<95	<100	<99	<100	<140	<110	<99	<100	<99	<110	<95	<100	<100	<100
Dichlorodifluoromethane	561,000	594,000	NC	µg/kg	<160	<150	<96	<830	<95	<100	<99	<100	<140	<110	<99	<100	<99	<110	<95	<100	<100	<100
1,1-Dichloroethane	858,000	924,000	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
1,2-Dichloroethane	2,838	1,848	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
1,1-Dichloroethene	330,000	363,000	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
1,2-Dichloropropane	7,260	7,920	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
Ethylbenzene	30,360	19,800	NC	µg/kg	1,200	1,300	660	1,700	65	130	<49	<52	130	63	<50	<51	<49	<55	87	<50	<50	170
2-Hexanone	75,900	75,900	NC	µg/kg	<4,000	<3,700	<2,400	<21,000	<2,400	<2,600	<2,500	<2,600	<3,400	<2,700	<2,500	<2,500	<2,500	<2,700	<2,400	<2,500	<2,500	<2,600
Isopropylbenzene	7,260	4,950	NC	µg/kg	100 J	110 J	48 J	400 J	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
Methyl acetate	8,250,000	7,260,000	NC	µg/kg	<1,900*	1,700* J	<1,100*	<9,900*	<1,100*	<1,300*	1,200*	100* J	630* J	3,400*	460* J	<1,200*	<1,200*	<1,300*	1,400	<1,200	<1,200	97 J
Methylcyclohexane	--	--	NC	µg/kg	220 J	220 J	2,200	9,200 J	160 J	200 J	200 J	190 J	840 J	270 J	320 J	200 J	<1200	<1300	450 J	150 J	750 J	1,500
Methylene Chloride	1,056,000	1,122,000	NC	µg/kg	<400	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
4-Methyl-2-pentanone (MIBK)	4,620,000	6,600,000	NC	µg/kg	<4,000	<3,700	<2,400	<21,000	<2,400	<2,600	<2,500	<2,600	<3,400	<2,700	<2,500	<2,500	<2,500	<2,700	<2,400	<2,500	<2,500	<2,600
Methyl tert-butyl ether	5,610,000	5,940,000	NC	µg/kg	<400	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
Styrene	151,800	95,700	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	19 J
1,1,2,2-Tetrachloroethane	1,848	1,122	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
Tetrachloroethene	69,300	75,900	NC	µg/kg	<80	<73	<48	<410	50	80	780	2,500	71	<54	130	100	<49	<55	<48	<50	120	97
Toluene	9,240,000	9,900,000	NC	µg/kg	800	650	210	320 J	160	280	36 J	<100	91 J	<110	72 J	51 J	<99	<110	380	36 j	150	1,300
trans-1,2-Dichloroethene	138,600	148,500	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
trans-1,3-Dichloropropene	17,820	11,880	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
1,2,4-Trichlorobenzene	9,240	8,250	NC	µg/kg	60 J	<370	<240	<2,100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	42 J	<250	<250	<260
1,1,1-Trichloroethane	8,580,000	9,240,000	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	350	390
1,1,2-Trichloroethane	0.40	0.43	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
Trichloroethene	6,900	3,630	NC	µg/kg	<80	<73	<48	<410	<47	<52	<49	<52	<68	<54	<50	<51	<49	<55	<48	<50	<50	<52
Trichlorofluoromethane	693,000	726,000	NC	µg/kg	<160	<150	<96	<830	<95	<100	<99	<100	<140	<110	<99	<100	<99	<110	<95	<100	<100	<100
1,1,2-Trichloro-1,2,2-trifluoroethane	32,670,000	36,300,000	NC	µg/kg	<400	<370	<240	<2100	<240	<260	<250	<260	<340	<270	<250	<250	<250	<270	<240	<250	<250	<260
Vinyl chloride	7,590	4,290	NC	µg/kg	<64	<59	<38	<330	<38	<42	<40	<42	<54	<43	<40	<41	<39	<44	<38	<40	<40	<41
Xylenes, Total	429,000	462,000	NC	µg/kg	3,600	3,700	440	3,500	420	660	97 J	<160	800	390	220	120 J	<150	<160	470	110 J	80 J	2,300

notes:
-- : no criteria
ug/kg - microgram per kilogram
VSIC - Volatile Soil Inhalation Criteria
J - result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximately value
* - Laboratory control sample is outside acceptance limits
NC: Criteria not calucated if results did not exceed the residential criteria
BOLD shows detections
BOLD and highlighted indicates an exceed

LAB REPORTS



TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.

TestAmerica Canton

4101 Shuffel Street NW

North Canton, OH 44720

Tel: (330)497-9396

TestAmerica Job ID: 240-83367-1

Client Project/Site: Racer Saginaw SMI

For:

ARCADIS U.S., Inc.

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Suite 500

Novi, Michigan 48377

Attn: Scott Clearwater

Denise Pohl

Authorized for release by:

8/14/2017 3:52:09 PM

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Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Cover Page	1
Table of Contents	2
Definitions/Glossary	3
Case Narrative	4
Method Summary	6
Sample Summary	7
Detection Summary	8
Client Sample Results	11
Surrogate Summary	41
QC Sample Results	42
QC Association Summary	47
Lab Chronicle	49
Certification Summary	54
Chain of Custody	55



Definitions/Glossary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
U	Indicates the analyte was analyzed for but not detected.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
*	LCS or LCSD is outside acceptance limits.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
α	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Case Narrative

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Job ID: 240-83367-1

Laboratory: TestAmerica Canton

Narrative

CASE NARRATIVE

Client: ARCADIS U.S., Inc.

Project: Racer Saginaw SMI

Report Number: 240-83367-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica Canton attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header.

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT

The samples were received on 8/8/2017 9:00 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 1.2° C.

VOLATILE ORGANIC COMPOUNDS (GCMS)

Samples SB17-34_0"-6"_080417 (240-83367-1), SB17-34_18"-24"_080417 (240-83367-2), SB17-35_0"-6"_080417 (240-83367-3), SB17-35_24"-30"_080417 (240-83367-4), SB17-36_0"-6"_080417 (240-83367-5), SB17-36_24"-30"_080417 (240-83367-6), SB17-37_0"-6"_080417 (240-83367-7), SB17-37_30"-36"_080417 (240-83367-8), SB17-38_0"-6"_080417 (240-83367-9), SB17-38_18"-24"_080417 (240-83367-10), SB17-39_0"-6"_080417 (240-83367-11), SB17-39_18"-24"_080417 (240-83367-12), SB17-40_0"-6"_080417 (240-83367-13) and SB17-40_18"-24"_080417 (240-83367-14) were analyzed for volatile organic compounds (GCMS) in accordance with EPA SW-846 Method 8260B. The samples were prepared on 08/09/2017 and analyzed on 08/10/2017 and 08/11/2017.

Methyl acetate failed the recovery criteria low for LCS 240-290504/2-A. Refer to the QC report for details.

Sample SB17-35_24"-30"_080417 (240-83367-4)[8X] required dilution prior to analysis. The reporting limits have been adjusted accordingly.

Case Narrative

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Job ID: 240-83367-1 (Continued)

Laboratory: TestAmerica Canton (Continued)

Method(s) 5035: The following samples were received in pre-weighed containers with a label that was added in the field, which would cause a slight low bias in the final results. SB17-34_0"-6"_080417 (240-83367-1), SB17-34_18"-24"_080417 (240-83367-2), SB17-35_0"-6"_080417 (240-83367-3), SB17-35_24"-30"_080417 (240-83367-4), SB17-36_0"-6"_080417 (240-83367-5), SB17-36_24"-30"_080417 (240-83367-6), SB17-37_0"-6"_080417 (240-83367-7), SB17-37_30"-36"_080417 (240-83367-8), SB17-38_0"-6"_080417 (240-83367-9), SB17-38_18"-24"_080417 (240-83367-10), SB17-39_0"-6"_080417 (240-83367-11), SB17-39_18"-24"_080417 (240-83367-12), SB17-40_0"-6"_080417 (240-83367-13) and SB17-40_18"-24"_080417 (240-83367-14).

Method(s) 8260B: The laboratory control sample (LCS) for preparation batch 240-290504 and analytical batch 240-290719 recovered outside control limits for methyl acetate. This analyte has been identified as a poor performing analyte when analyzed using this method; therefore, re-extraction/re-analysis was not performed. The results have been reported and qualified.

Method(s) 8260B: Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate/sample duplicate (MS/MSD/DUP) associated with preparation batch 240-290504 and analytical batch 240-290719.

Method(s) 8260B: Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with preparation batch 240-290504 and analytical batch 240-290886.

Method(s) 8260B: The laboratory control sample (LCS) for preparation batch 240-290504 and analytical batch 240-290886 recovered outside control limits for methyl acetate. This analyte has been identified as a poor performing analyte when analyzed using this method; therefore, re-extraction/re-analysis was not performed. The results have been reported and qualified.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

VOLATILE ORGANIC COMPOUNDS (GCMS)

Sample TRIP BLANK_080417 (240-83367-15) was analyzed for volatile organic compounds (GCMS) in accordance with EPA SW-846 Method 8260B. The sample was analyzed on 08/14/2017.

1,1,2-Trichloroethane and Dichlorodifluoromethane failed the recovery criteria high for LCS 240-291046/4. Refer to the QC report for details.

Method(s) 8260B: The laboratory control sample (LCS) for analytical batch 240-291046 recovered outside control limits for multiple analytes: These analytes were biased high in the LCS and were not detected in the associated samples; therefore, the data have been reported.

TRIP BLANK_080417 (240-83367-15) and (LCS 240-291046/4)

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

PERCENT SOLIDS

Samples SB17-34_0"-6"_080417 (240-83367-1), SB17-34_18"-24"_080417 (240-83367-2), SB17-35_0"-6"_080417 (240-83367-3), SB17-35_24"-30"_080417 (240-83367-4), SB17-36_0"-6"_080417 (240-83367-5), SB17-36_24"-30"_080417 (240-83367-6), SB17-37_0"-6"_080417 (240-83367-7), SB17-37_30"-36"_080417 (240-83367-8), SB17-38_0"-6"_080417 (240-83367-9), SB17-38_18"-24"_080417 (240-83367-10), SB17-39_0"-6"_080417 (240-83367-11), SB17-39_18"-24"_080417 (240-83367-12), SB17-40_0"-6"_080417 (240-83367-13) and SB17-40_18"-24"_080417 (240-83367-14) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 08/08/2017.

No analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Method Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Method	Method Description	Protocol	Laboratory
8260B	Volatile Organic Compounds (GC/MS)	SW846	TAL CAN
Moisture	Percent Moisture	EPA	TAL CAN

Protocol References:

EPA = US Environmental Protection Agency

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CAN = TestAmerica Canton, 4101 Shuffel Street NW, North Canton, OH 44720, TEL (330)497-9396

Sample Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
240-83367-1	SB17-34_0"-6"_080417	Solid	08/04/17 12:00	08/08/17 09:00
240-83367-2	SB17-34_18"-24"_080417	Solid	08/04/17 12:15	08/08/17 09:00
240-83367-3	SB17-35_0"-6"_080417	Solid	08/04/17 12:45	08/08/17 09:00
240-83367-4	SB17-35_24"-30"_080417	Solid	08/04/17 13:00	08/08/17 09:00
240-83367-5	SB17-36_0"-6"_080417	Solid	08/04/17 13:45	08/08/17 09:00
240-83367-6	SB17-36_24"-30"_080417	Solid	08/04/17 14:00	08/08/17 09:00
240-83367-7	SB17-37_0"-6"_080417	Solid	08/04/17 14:30	08/08/17 09:00
240-83367-8	SB17-37_30"-36"_080417	Solid	08/04/17 14:45	08/08/17 09:00
240-83367-9	SB17-38_0"-6"_080417	Solid	08/04/17 15:00	08/08/17 09:00
240-83367-10	SB17-38_18"-24"_080417	Solid	08/04/17 15:15	08/08/17 09:00
240-83367-11	SB17-39_0"-6"_080417	Solid	08/04/17 15:30	08/08/17 09:00
240-83367-12	SB17-39_18"-24"_080417	Solid	08/04/17 15:45	08/08/17 09:00
240-83367-13	SB17-40_0"-6"_080417	Solid	08/04/17 16:00	08/08/17 09:00
240-83367-14	SB17-40_18"-24"_080417	Solid	08/04/17 16:15	08/08/17 09:00
240-83367-15	TRIP BLANK_080417	Water	08/04/17 00:00	08/08/17 09:00

Detection Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-34_0"-6"_080417

Lab Sample ID: 240-83367-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	860		80	48	ug/Kg	1	☼	8260B	Total/NA
Cyclohexane	78	J	1900	60	ug/Kg	1	☼	8260B	Total/NA
Ethylbenzene	1200		80	70	ug/Kg	1	☼	8260B	Total/NA
Isopropylbenzene	100	J	400	68	ug/Kg	1	☼	8260B	Total/NA
Methylcyclohexane	220	J	1900	74	ug/Kg	1	☼	8260B	Total/NA
Toluene	800		160	48	ug/Kg	1	☼	8260B	Total/NA
1,2,4-Trichlorobenzene	60	J	400	52	ug/Kg	1	☼	8260B	Total/NA
Xylenes, Total	3600		240	56	ug/Kg	1	☼	8260B	Total/NA

Client Sample ID: SB17-34_18"-24"_080417

Lab Sample ID: 240-83367-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	840		73	44	ug/Kg	1	☼	8260B	Total/NA
Cyclohexane	71	J	1800	55	ug/Kg	1	☼	8260B	Total/NA
Ethylbenzene	1300		73	64	ug/Kg	1	☼	8260B	Total/NA
Isopropylbenzene	110	J	370	62	ug/Kg	1	☼	8260B	Total/NA
Methyl acetate	1700	J *	1800	140	ug/Kg	1	☼	8260B	Total/NA
Methylcyclohexane	220	J	1800	68	ug/Kg	1	☼	8260B	Total/NA
Toluene	650		150	44	ug/Kg	1	☼	8260B	Total/NA
Xylenes, Total	3700		220	51	ug/Kg	1	☼	8260B	Total/NA

Client Sample ID: SB17-35_0"-6"_080417

Lab Sample ID: 240-83367-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	2300		48	29	ug/Kg	1	☼	8260B	Total/NA
Cyclohexane	1200		1100	36	ug/Kg	1	☼	8260B	Total/NA
Ethylbenzene	660		48	42	ug/Kg	1	☼	8260B	Total/NA
Isopropylbenzene	48	J	240	41	ug/Kg	1	☼	8260B	Total/NA
Methylcyclohexane	2200		1100	44	ug/Kg	1	☼	8260B	Total/NA
Toluene	210		96	29	ug/Kg	1	☼	8260B	Total/NA
Xylenes, Total	440		140	33	ug/Kg	1	☼	8260B	Total/NA

Client Sample ID: SB17-35_24"-30"_080417

Lab Sample ID: 240-83367-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	10000		410	250	ug/Kg	8	☼	8260B	Total/NA
Cyclohexane	2200	J	9900	310	ug/Kg	8	☼	8260B	Total/NA
Ethylbenzene	1700		410	360	ug/Kg	8	☼	8260B	Total/NA
Isopropylbenzene	400	J	2100	350	ug/Kg	8	☼	8260B	Total/NA
Methylcyclohexane	9200	J	9900	380	ug/Kg	8	☼	8260B	Total/NA
Toluene	320	J	830	250	ug/Kg	8	☼	8260B	Total/NA
Xylenes, Total	3500		1200	290	ug/Kg	8	☼	8260B	Total/NA

Client Sample ID: SB17-36_0"-6"_080417

Lab Sample ID: 240-83367-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	65		47	28	ug/Kg	1	☼	8260B	Total/NA
Cyclohexane	50	J	1100	36	ug/Kg	1	☼	8260B	Total/NA
Ethylbenzene	65		47	41	ug/Kg	1	☼	8260B	Total/NA
Methylcyclohexane	160	J	1100	44	ug/Kg	1	☼	8260B	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Canton

Detection Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-36_0"-6"_080417 (Continued)

Lab Sample ID: 240-83367-5

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Tetrachloroethene	50		47	25	ug/Kg	1	☼	8260B	Total/NA
Toluene	160		95	28	ug/Kg	1	☼	8260B	Total/NA
Xylenes, Total	420		140	33	ug/Kg	1	☼	8260B	Total/NA

Client Sample ID: SB17-36_24"-30"_080417

Lab Sample ID: 240-83367-6

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	170		52	31	ug/Kg	1	☼	8260B	Total/NA
Cyclohexane	110	J	1300	39	ug/Kg	1	☼	8260B	Total/NA
Ethylbenzene	130		52	46	ug/Kg	1	☼	8260B	Total/NA
Methylcyclohexane	200	J	1300	48	ug/Kg	1	☼	8260B	Total/NA
Tetrachloroethene	80		52	27	ug/Kg	1	☼	8260B	Total/NA
Toluene	280		100	31	ug/Kg	1	☼	8260B	Total/NA
Xylenes, Total	660		160	37	ug/Kg	1	☼	8260B	Total/NA

Client Sample ID: SB17-37_0"-6"_080417

Lab Sample ID: 240-83367-7

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Cyclohexane	42	J	1200	37	ug/Kg	1	☼	8260B	Total/NA
Methyl acetate	1200	*	1200	93	ug/Kg	1	☼	8260B	Total/NA
Methylcyclohexane	200	J	1200	46	ug/Kg	1	☼	8260B	Total/NA
Tetrachloroethene	780		49	26	ug/Kg	1	☼	8260B	Total/NA
Toluene	36	J	99	30	ug/Kg	1	☼	8260B	Total/NA
Xylenes, Total	97	J	150	35	ug/Kg	1	☼	8260B	Total/NA

Client Sample ID: SB17-37_30"-36"_080417

Lab Sample ID: 240-83367-8

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Benzene	51	J	52	31	ug/Kg	1	☼	8260B	Total/NA
Carbon tetrachloride	71		52	35	ug/Kg	1	☼	8260B	Total/NA
Cyclohexane	52	J	1300	39	ug/Kg	1	☼	8260B	Total/NA
Methyl acetate	100	J *	1300	98	ug/Kg	1	☼	8260B	Total/NA
Methylcyclohexane	190	J	1300	48	ug/Kg	1	☼	8260B	Total/NA
Tetrachloroethene	2500		52	27	ug/Kg	1	☼	8260B	Total/NA

Client Sample ID: SB17-38_0"-6"_080417

Lab Sample ID: 240-83367-9

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Cyclohexane	200	J	1600	51	ug/Kg	1	☼	8260B	Total/NA
Ethylbenzene	130		68	59	ug/Kg	1	☼	8260B	Total/NA
Methyl acetate	630	J *	1600	130	ug/Kg	1	☼	8260B	Total/NA
Methylcyclohexane	840	J	1600	63	ug/Kg	1	☼	8260B	Total/NA
Tetrachloroethene	71		68	35	ug/Kg	1	☼	8260B	Total/NA
Toluene	91	J	140	41	ug/Kg	1	☼	8260B	Total/NA
Xylenes, Total	800		200	47	ug/Kg	1	☼	8260B	Total/NA

Client Sample ID: SB17-38_18"-24"_080417

Lab Sample ID: 240-83367-10

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Cyclohexane	62	J	1300	40	ug/Kg	1	☼	8260B	Total/NA

This Detection Summary does not include radiochemical test results.

TestAmerica Canton

Detection Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-38_18"-24"_080417 (Continued)

Lab Sample ID: 240-83367-10

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Ethylbenzene	63		54	47	ug/Kg	1		☼	8260B	Total/NA
Methyl acetate	3400	*	1300	100	ug/Kg	1		☼	8260B	Total/NA
Methylcyclohexane	270	J	1300	50	ug/Kg	1		☼	8260B	Total/NA
Xylenes, Total	390		160	37	ug/Kg	1		☼	8260B	Total/NA

Client Sample ID: SB17-39_0"-6"_080417

Lab Sample ID: 240-83367-11

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Cyclohexane	110	J	1200	37	ug/Kg	1		☼	8260B	Total/NA
Methyl acetate	460	J *	1200	93	ug/Kg	1		☼	8260B	Total/NA
Methylcyclohexane	320	J	1200	46	ug/Kg	1		☼	8260B	Total/NA
Tetrachloroethene	130		50	26	ug/Kg	1		☼	8260B	Total/NA
Toluene	72	J	99	30	ug/Kg	1		☼	8260B	Total/NA
Xylenes, Total	220		150	35	ug/Kg	1		☼	8260B	Total/NA

Client Sample ID: SB17-39_18"-24"_080417

Lab Sample ID: 240-83367-12

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Cyclohexane	66	J	1200	38	ug/Kg	1		☼	8260B	Total/NA
Methylcyclohexane	200	J	1200	47	ug/Kg	1		☼	8260B	Total/NA
Tetrachloroethene	100		51	27	ug/Kg	1		☼	8260B	Total/NA
Toluene	51	J	100	31	ug/Kg	1		☼	8260B	Total/NA
Xylenes, Total	120	J	150	36	ug/Kg	1		☼	8260B	Total/NA

Client Sample ID: SB17-40_0"-6"_080417

Lab Sample ID: 240-83367-13

No Detections.

Client Sample ID: SB17-40_18"-24"_080417

Lab Sample ID: 240-83367-14

No Detections.

Client Sample ID: TRIP BLANK_080417

Lab Sample ID: 240-83367-15

No Detections.

This Detection Summary does not include radiochemical test results.

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-34_0"-6"_080417

Lab Sample ID: 240-83367-1

Date Collected: 08/04/17 12:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 80.7

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	1200	U	1200	190	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Benzene	860		80	48	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Bromodichloromethane	160	U	160	36	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Bromoform	160	U	160	46	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Bromomethane	400	U	400	56	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
2-Butanone (MEK)	1200	U	1200	100	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Carbon disulfide	400	U	400	36	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Carbon tetrachloride	80	U	80	54	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Chlorobenzene	80	U	80	60	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Chloroethane	400	U	400	56	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Chloroform	80	U	80	48	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Chloromethane	400	U	400	36	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
cis-1,2-Dichloroethene	80	U	80	70	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
cis-1,3-Dichloropropene	80	U	80	46	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Cyclohexane	78 J		1900	60	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Dibromochloromethane	80	U	80	68	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,2-Dibromo-3-Chloropropane	400	U	400	96	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,2-Dibromoethane	400	U	400	46	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,2-Dichlorobenzene	160	U	160	36	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,3-Dichlorobenzene	160	U	160	76	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,4-Dichlorobenzene	160	U	160	54	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Dichlorodifluoromethane	160	U	160	44	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,1-Dichloroethane	80	U	80	62	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,2-Dichloroethane	80	U	80	60	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,1-Dichloroethene	80	U	80	72	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,2-Dichloropropane	80	U	80	60	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Ethylbenzene	1200		80	70	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
2-Hexanone	4000	U	4000	170	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Isopropylbenzene	100 J		400	68	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Methyl acetate	1900	U *	1900	150	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Methylcyclohexane	220 J		1900	74	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Methylene Chloride	400	U	400	130	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
4-Methyl-2-pentanone (MIBK)	4000	U	4000	80	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Methyl tert-butyl ether	400	U	400	52	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Styrene	80	U	80	20	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,1,2,2-Tetrachloroethane	80	U	80	48	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Tetrachloroethene	80	U	80	42	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Toluene	800		160	48	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
trans-1,2-Dichloroethene	80	U	80	70	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
trans-1,3-Dichloropropene	80	U	80	30	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,2,4-Trichlorobenzene	60 J		400	52	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,1,1-Trichloroethane	80	U	80	56	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,1,2-Trichloroethane	80	U	80	46	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Trichloroethene	80	U	80	74	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Trichlorofluoromethane	160	U	160	68	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
1,1,2-Trichloro-1,2,2-trifluoroethane	400	U	400	46	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Vinyl chloride	64	U	64	34	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1
Xylenes, Total	3600		240	56	ug/Kg	☼	08/09/17 11:32	08/10/17 18:14	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-34_0"-6"_080417

Lab Sample ID: 240-83367-1

Date Collected: 08/04/17 12:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 80.7

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	106		58 - 142	08/09/17 11:32	08/10/17 18:14	1
Dibromofluoromethane (Surr)	95		31 - 155	08/09/17 11:32	08/10/17 18:14	1
1,2-Dichloroethane-d4 (Surr)	118		64 - 144	08/09/17 11:32	08/10/17 18:14	1
Toluene-d8 (Surr)	113		61 - 137	08/09/17 11:32	08/10/17 18:14	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	80.7		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	19.3		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-34_18"-24"_080417

Lab Sample ID: 240-83367-2

Date Collected: 08/04/17 12:15

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 79.1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	1100	U	1100	180	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Benzene	840		73	44	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Bromodichloromethane	150	U	150	33	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Bromoform	150	U	150	42	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Bromomethane	370	U	370	51	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
2-Butanone (MEK)	1100	U	1100	92	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Carbon disulfide	370	U	370	33	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Carbon tetrachloride	73	U	73	50	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Chlorobenzene	73	U	73	55	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Chloroethane	370	U	370	51	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Chloroform	73	U	73	44	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Chloromethane	370	U	370	33	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
cis-1,2-Dichloroethene	73	U	73	64	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
cis-1,3-Dichloropropene	73	U	73	42	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Cyclohexane	71 J		1800	55	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Dibromochloromethane	73	U	73	62	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,2-Dibromo-3-Chloropropane	370	U	370	88	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,2-Dibromoethane	370	U	370	42	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,2-Dichlorobenzene	150	U	150	33	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,3-Dichlorobenzene	150	U	150	70	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,4-Dichlorobenzene	150	U	150	50	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Dichlorodifluoromethane	150	U	150	40	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,1-Dichloroethane	73	U	73	57	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,2-Dichloroethane	73	U	73	55	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,1-Dichloroethene	73	U	73	66	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,2-Dichloropropane	73	U	73	55	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Ethylbenzene	1300		73	64	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
2-Hexanone	3700	U	3700	160	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Isopropylbenzene	110 J		370	62	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Methyl acetate	1700 J *		1800	140	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Methylcyclohexane	220 J		1800	68	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Methylene Chloride	370	U	370	120	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
4-Methyl-2-pentanone (MIBK)	3700	U	3700	73	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Methyl tert-butyl ether	370	U	370	48	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Styrene	73	U	73	18	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,1,2,2-Tetrachloroethane	73	U	73	44	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Tetrachloroethene	73	U	73	39	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Toluene	650		150	44	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
trans-1,2-Dichloroethene	73	U	73	64	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
trans-1,3-Dichloropropene	73	U	73	28	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,2,4-Trichlorobenzene	370	U	370	48	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,1,1-Trichloroethane	73	U	73	51	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,1,2-Trichloroethane	73	U	73	42	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Trichloroethene	73	U	73	68	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Trichlorofluoromethane	150	U	150	62	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
1,1,2-Trichloro-1,2,2-trifluoroethane	370	U	370	42	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Vinyl chloride	59	U	59	31	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1
Xylenes, Total	3700		220	51	ug/Kg	☼	08/09/17 11:32	08/10/17 18:38	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-34_18"-24"_080417

Lab Sample ID: 240-83367-2

Date Collected: 08/04/17 12:15

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 79.1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	114		58 - 142	08/09/17 11:32	08/10/17 18:38	1
Dibromofluoromethane (Surr)	105		31 - 155	08/09/17 11:32	08/10/17 18:38	1
1,2-Dichloroethane-d4 (Surr)	128		64 - 144	08/09/17 11:32	08/10/17 18:38	1
Toluene-d8 (Surr)	126		61 - 137	08/09/17 11:32	08/10/17 18:38	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	79.1		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	20.9		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-35_0"-6"_080417

Lab Sample ID: 240-83367-3

Date Collected: 08/04/17 12:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 91.3

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	720	U	720	120	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Benzene	2300		48	29	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Bromodichloromethane	96	U	96	21	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Bromoform	96	U	96	27	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Bromomethane	240	U	240	33	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
2-Butanone (MEK)	720	U	720	60	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Carbon disulfide	240	U	240	21	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Carbon tetrachloride	48	U	48	32	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Chlorobenzene	48	U	48	36	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Chloroethane	240	U	240	33	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Chloroform	48	U	48	29	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Chloromethane	240	U	240	21	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
cis-1,2-Dichloroethene	48	U	48	42	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
cis-1,3-Dichloropropene	48	U	48	27	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Cyclohexane	1200		1100	36	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Dibromochloromethane	48	U	48	41	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,2-Dibromo-3-Chloropropane	240	U	240	57	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,2-Dibromoethane	240	U	240	27	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,2-Dichlorobenzene	96	U	96	21	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,3-Dichlorobenzene	96	U	96	45	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,4-Dichlorobenzene	96	U	96	32	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Dichlorodifluoromethane	96	U	96	26	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,1-Dichloroethane	48	U	48	37	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,2-Dichloroethane	48	U	48	36	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,1-Dichloroethene	48	U	48	43	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,2-Dichloropropane	48	U	48	36	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Ethylbenzene	660		48	42	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
2-Hexanone	2400	U	2400	100	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Isopropylbenzene	48 J		240	41	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Methyl acetate	1100	U *	1100	90	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Methylcyclohexane	2200		1100	44	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Methylene Chloride	240	U	240	78	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
4-Methyl-2-pentanone (MIBK)	2400	U	2400	48	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Methyl tert-butyl ether	240	U	240	31	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Styrene	48	U	48	12	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,1,2,2-Tetrachloroethane	48	U	48	29	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Tetrachloroethene	48	U	48	25	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Toluene	210		96	29	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
trans-1,2-Dichloroethene	48	U	48	42	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
trans-1,3-Dichloropropene	48	U	48	18	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,2,4-Trichlorobenzene	240	U	240	31	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,1,1-Trichloroethane	48	U	48	33	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,1,2-Trichloroethane	48	U	48	27	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Trichloroethene	48	U	48	44	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Trichlorofluoromethane	96	U	96	41	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
1,1,2-Trichloro-1,2,2-trifluoroethane	240	U	240	27	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Vinyl chloride	38	U	38	20	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1
Xylenes, Total	440		140	33	ug/Kg	☼	08/09/17 11:32	08/10/17 19:02	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-35_0"-6"_080417

Lab Sample ID: 240-83367-3

Date Collected: 08/04/17 12:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 91.3

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	112		58 - 142	08/09/17 11:32	08/10/17 19:02	1
Dibromofluoromethane (Surr)	96		31 - 155	08/09/17 11:32	08/10/17 19:02	1
1,2-Dichloroethane-d4 (Surr)	123		64 - 144	08/09/17 11:32	08/10/17 19:02	1
Toluene-d8 (Surr)	123		61 - 137	08/09/17 11:32	08/10/17 19:02	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	91.3		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	8.7		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-35_24"-30"_080417

Lab Sample ID: 240-83367-4

Date Collected: 08/04/17 13:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 84.9

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	6200	U	6200	1000	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Benzene	10000		410	250	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Bromodichloromethane	830	U	830	190	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Bromoform	830	U	830	240	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Bromomethane	2100	U	2100	290	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
2-Butanone (MEK)	6200	U	6200	520	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Carbon disulfide	2100	U	2100	190	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Carbon tetrachloride	410	U	410	280	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Chlorobenzene	410	U	410	310	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Chloroethane	2100	U	2100	290	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Chloroform	410	U	410	250	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Chloromethane	2100	U	2100	190	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
cis-1,2-Dichloroethene	410	U	410	360	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
cis-1,3-Dichloropropene	410	U	410	240	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Cyclohexane	2200	J	9900	310	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Dibromochloromethane	410	U	410	350	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,2-Dibromo-3-Chloropropane	2100	U	2100	500	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,2-Dibromoethane	2100	U	2100	240	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,2-Dichlorobenzene	830	U	830	190	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,3-Dichlorobenzene	830	U	830	390	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,4-Dichlorobenzene	830	U	830	280	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Dichlorodifluoromethane	830	U	830	230	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,1-Dichloroethane	410	U	410	320	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,2-Dichloroethane	410	U	410	310	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,1-Dichloroethene	410	U	410	370	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,2-Dichloropropane	410	U	410	310	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Ethylbenzene	1700		410	360	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
2-Hexanone	21000	U	21000	890	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Isopropylbenzene	400	J	2100	350	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Methyl acetate	9900	U *	9900	780	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Methylcyclohexane	9200	J	9900	380	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Methylene Chloride	2100	U	2100	670	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
4-Methyl-2-pentanone (MIBK)	21000	U	21000	410	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Methyl tert-butyl ether	2100	U	2100	270	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Styrene	410	U	410	100	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,1,2,2-Tetrachloroethane	410	U	410	250	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Tetrachloroethene	410	U	410	220	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Toluene	320	J	830	250	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
trans-1,2-Dichloroethene	410	U	410	360	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
trans-1,3-Dichloropropene	410	U	410	160	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,2,4-Trichlorobenzene	2100	U	2100	270	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,1,1-Trichloroethane	410	U	410	290	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,1,2-Trichloroethane	410	U	410	240	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Trichloroethene	410	U	410	380	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Trichlorofluoromethane	830	U	830	350	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
1,1,2-Trichloro-1,2,2-trifluoroethane	2100	U	2100	240	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Vinyl chloride	330	U	330	180	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8
Xylenes, Total	3500		1200	290	ug/Kg	☼	08/09/17 11:32	08/11/17 17:06	8

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-35_24"-30"_080417

Lab Sample ID: 240-83367-4

Date Collected: 08/04/17 13:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 84.9

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	126		58 - 142	08/09/17 11:32	08/11/17 17:06	8
Dibromofluoromethane (Surr)	91		31 - 155	08/09/17 11:32	08/11/17 17:06	8
1,2-Dichloroethane-d4 (Surr)	112		64 - 144	08/09/17 11:32	08/11/17 17:06	8
Toluene-d8 (Surr)	135		61 - 137	08/09/17 11:32	08/11/17 17:06	8

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	84.9		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	15.1		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-36_0"-6"_080417

Lab Sample ID: 240-83367-5

Date Collected: 08/04/17 13:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 92.1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	710	U	710	110	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Benzene	65		47	28	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Bromodichloromethane	95	U	95	21	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Bromoform	95	U	95	27	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Bromomethane	240	U	240	33	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
2-Butanone (MEK)	710	U	710	59	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Carbon disulfide	240	U	240	21	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Carbon tetrachloride	47	U	47	32	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Chlorobenzene	47	U	47	36	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Chloroethane	240	U	240	33	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Chloroform	47	U	47	28	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Chloromethane	240	U	240	21	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
cis-1,2-Dichloroethene	47	U	47	41	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
cis-1,3-Dichloropropene	47	U	47	27	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Cyclohexane	50 J		1100	36	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Dibromochloromethane	47	U	47	40	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,2-Dibromo-3-Chloropropane	240	U	240	57	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,2-Dibromoethane	240	U	240	27	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,2-Dichlorobenzene	95	U	95	21	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,3-Dichlorobenzene	95	U	95	45	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,4-Dichlorobenzene	95	U	95	32	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Dichlorodifluoromethane	95	U	95	26	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,1-Dichloroethane	47	U	47	37	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,2-Dichloroethane	47	U	47	36	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,1-Dichloroethene	47	U	47	43	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,2-Dichloropropane	47	U	47	36	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Ethylbenzene	65		47	41	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
2-Hexanone	2400	U	2400	100	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Isopropylbenzene	240	U	240	40	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Methyl acetate	1100	U *	1100	89	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Methylcyclohexane	160 J		1100	44	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Methylene Chloride	240	U	240	77	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
4-Methyl-2-pentanone (MIBK)	2400	U	2400	47	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Methyl tert-butyl ether	240	U	240	31	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Styrene	47	U	47	12	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,1,2,2-Tetrachloroethane	47	U	47	28	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Tetrachloroethene	50		47	25	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Toluene	160		95	28	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
trans-1,2-Dichloroethene	47	U	47	41	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
trans-1,3-Dichloropropene	47	U	47	18	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,2,4-Trichlorobenzene	240	U	240	31	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,1,1-Trichloroethane	47	U	47	33	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,1,2-Trichloroethane	47	U	47	27	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Trichloroethene	47	U	47	44	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Trichlorofluoromethane	95	U	95	40	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
1,1,2-Trichloro-1,2,2-trifluoroethane	240	U	240	27	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Vinyl chloride	38	U	38	20	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1
Xylenes, Total	420		140	33	ug/Kg	☼	08/09/17 11:32	08/11/17 17:30	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-36_0"-6"_080417

Lab Sample ID: 240-83367-5

Date Collected: 08/04/17 13:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 92.1

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	95		58 - 142	08/09/17 11:32	08/11/17 17:30	1
Dibromofluoromethane (Surr)	75		31 - 155	08/09/17 11:32	08/11/17 17:30	1
1,2-Dichloroethane-d4 (Surr)	89		64 - 144	08/09/17 11:32	08/11/17 17:30	1
Toluene-d8 (Surr)	106		61 - 137	08/09/17 11:32	08/11/17 17:30	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	92.1		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	7.9		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-36_24"-30"_080417

Lab Sample ID: 240-83367-6

Date Collected: 08/04/17 14:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.5

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	790	U	790	130	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Benzene	170		52	31	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Bromodichloromethane	100	U	100	24	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Bromoform	100	U	100	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Bromomethane	260	U	260	37	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
2-Butanone (MEK)	790	U	790	65	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Carbon disulfide	260	U	260	24	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Carbon tetrachloride	52	U	52	35	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Chlorobenzene	52	U	52	39	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Chloroethane	260	U	260	37	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Chloroform	52	U	52	31	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Chloromethane	260	U	260	24	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
cis-1,2-Dichloroethene	52	U	52	46	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
cis-1,3-Dichloropropene	52	U	52	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Cyclohexane	110	J	1300	39	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Dibromochloromethane	52	U	52	45	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,2-Dibromo-3-Chloropropane	260	U	260	63	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,2-Dibromoethane	260	U	260	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,2-Dichlorobenzene	100	U	100	24	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,3-Dichlorobenzene	100	U	100	50	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,4-Dichlorobenzene	100	U	100	35	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Dichlorodifluoromethane	100	U	100	29	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,1-Dichloroethane	52	U	52	41	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,2-Dichloroethane	52	U	52	39	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,1-Dichloroethene	52	U	52	47	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,2-Dichloropropane	52	U	52	39	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Ethylbenzene	130		52	46	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
2-Hexanone	2600	U	2600	110	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Isopropylbenzene	260	U	260	45	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Methyl acetate	1300	U *	1300	98	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Methylcyclohexane	200	J	1300	48	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Methylene Chloride	260	U	260	85	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
4-Methyl-2-pentanone (MIBK)	2600	U	2600	52	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Methyl tert-butyl ether	260	U	260	34	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Styrene	52	U	52	13	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,1,2,2-Tetrachloroethane	52	U	52	31	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Tetrachloroethene	80		52	27	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Toluene	280		100	31	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
trans-1,2-Dichloroethene	52	U	52	46	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
trans-1,3-Dichloropropene	52	U	52	20	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,2,4-Trichlorobenzene	260	U	260	34	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,1,1-Trichloroethane	52	U	52	37	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,1,2-Trichloroethane	52	U	52	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Trichloroethene	52	U	52	48	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Trichlorofluoromethane	100	U	100	45	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
1,1,2-Trichloro-1,2,2-trifluoroethane	260	U	260	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Vinyl chloride	42	U	42	22	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1
Xylenes, Total	660		160	37	ug/Kg	☼	08/09/17 11:32	08/10/17 20:18	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-36_24"-30"_080417

Lab Sample ID: 240-83367-6

Date Collected: 08/04/17 14:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.5

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	98		58 - 142	08/09/17 11:32	08/10/17 20:18	1
Dibromofluoromethane (Surr)	91		31 - 155	08/09/17 11:32	08/10/17 20:18	1
1,2-Dichloroethane-d4 (Surr)	115		64 - 144	08/09/17 11:32	08/10/17 20:18	1
Toluene-d8 (Surr)	112		61 - 137	08/09/17 11:32	08/10/17 20:18	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	86.5		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	13.5		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-37_0"-6"_080417

Lab Sample ID: 240-83367-7

Date Collected: 08/04/17 14:30

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 90.8

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	740	U	740	120	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Benzene	49	U	49	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Bromodichloromethane	99	U	99	22	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Bromoform	99	U	99	28	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Bromomethane	250	U	250	35	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
2-Butanone (MEK)	740	U	740	62	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Carbon disulfide	250	U	250	22	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Carbon tetrachloride	49	U	49	33	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Chlorobenzene	49	U	49	37	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Chloroethane	250	U	250	35	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Chloroform	49	U	49	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Chloromethane	250	U	250	22	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
cis-1,2-Dichloroethene	49	U	49	43	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
cis-1,3-Dichloropropene	49	U	49	28	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Cyclohexane	42	J	1200	37	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Dibromochloromethane	49	U	49	42	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,2-Dibromo-3-Chloropropane	250	U	250	59	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,2-Dibromoethane	250	U	250	28	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,2-Dichlorobenzene	99	U	99	22	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,3-Dichlorobenzene	99	U	99	47	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,4-Dichlorobenzene	99	U	99	33	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Dichlorodifluoromethane	99	U	99	27	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,1-Dichloroethane	49	U	49	38	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,2-Dichloroethane	49	U	49	37	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,1-Dichloroethene	49	U	49	45	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,2-Dichloropropane	49	U	49	37	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Ethylbenzene	49	U	49	43	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
2-Hexanone	2500	U	2500	110	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Isopropylbenzene	250	U	250	42	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Methyl acetate	1200	*	1200	93	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Methylcyclohexane	200	J	1200	46	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Methylene Chloride	250	U	250	80	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
4-Methyl-2-pentanone (MIBK)	2500	U	2500	49	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Methyl tert-butyl ether	250	U	250	32	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Styrene	49	U	49	12	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,1,2,2-Tetrachloroethane	49	U	49	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Tetrachloroethene	780		49	26	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Toluene	36	J	99	30	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
trans-1,2-Dichloroethene	49	U	49	43	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
trans-1,3-Dichloropropene	49	U	49	19	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,2,4-Trichlorobenzene	250	U	250	32	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,1,1-Trichloroethane	49	U	49	35	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,1,2-Trichloroethane	49	U	49	28	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Trichloroethene	49	U	49	46	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Trichlorofluoromethane	99	U	99	42	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
1,1,2-Trichloro-1,2,2-trifluoroethane	250	U	250	28	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Vinyl chloride	40	U	40	21	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1
Xylenes, Total	97	J	150	35	ug/Kg	☼	08/09/17 11:32	08/10/17 20:42	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-37_0"-6"_080417

Lab Sample ID: 240-83367-7

Date Collected: 08/04/17 14:30

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 90.8

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	107		58 - 142	08/09/17 11:32	08/10/17 20:42	1
Dibromofluoromethane (Surr)	94		31 - 155	08/09/17 11:32	08/10/17 20:42	1
1,2-Dichloroethane-d4 (Surr)	122		64 - 144	08/09/17 11:32	08/10/17 20:42	1
Toluene-d8 (Surr)	119		61 - 137	08/09/17 11:32	08/10/17 20:42	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	90.8		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	9.2		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-37_30"-36"_080417

Lab Sample ID: 240-83367-8

Date Collected: 08/04/17 14:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.7

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	790	U	790	130	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Benzene	51	J	52	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Bromodichloromethane	100	U	100	24	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Bromoform	100	U	100	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Bromomethane	260	U	260	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
2-Butanone (MEK)	790	U	790	65	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Carbon disulfide	260	U	260	24	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Carbon tetrachloride	71		52	35	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Chlorobenzene	52	U	52	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Chloroethane	260	U	260	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Chloroform	52	U	52	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Chloromethane	260	U	260	24	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
cis-1,2-Dichloroethene	52	U	52	46	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
cis-1,3-Dichloropropene	52	U	52	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Cyclohexane	52	J	1300	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Dibromochloromethane	52	U	52	45	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,2-Dibromo-3-Chloropropane	260	U	260	63	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,2-Dibromoethane	260	U	260	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,2-Dichlorobenzene	100	U	100	24	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,3-Dichlorobenzene	100	U	100	50	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,4-Dichlorobenzene	100	U	100	35	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Dichlorodifluoromethane	100	U	100	29	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,1-Dichloroethane	52	U	52	41	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,2-Dichloroethane	52	U	52	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,1-Dichloroethene	52	U	52	47	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,2-Dichloropropane	52	U	52	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Ethylbenzene	52	U	52	46	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
2-Hexanone	2600	U	2600	110	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Isopropylbenzene	260	U	260	45	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Methyl acetate	100	J *	1300	98	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Methylcyclohexane	190	J	1300	48	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Methylene Chloride	260	U	260	85	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
4-Methyl-2-pentanone (MIBK)	2600	U	2600	52	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Methyl tert-butyl ether	260	U	260	34	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Styrene	52	U	52	13	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,1,2,2-Tetrachloroethane	52	U	52	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Tetrachloroethene	2500		52	27	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Toluene	100	U	100	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
trans-1,2-Dichloroethene	52	U	52	46	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
trans-1,3-Dichloropropene	52	U	52	20	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,2,4-Trichlorobenzene	260	U	260	34	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,1,1-Trichloroethane	52	U	52	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,1,2-Trichloroethane	52	U	52	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Trichloroethene	52	U	52	48	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Trichlorofluoromethane	100	U	100	45	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
1,1,2-Trichloro-1,2,2-trifluoroethane	260	U	260	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Vinyl chloride	42	U	42	22	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1
Xylenes, Total	160	U	160	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:06	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-37_30"-36"_080417

Lab Sample ID: 240-83367-8

Date Collected: 08/04/17 14:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.7

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	105		58 - 142	08/09/17 11:32	08/10/17 21:06	1
Dibromofluoromethane (Surr)	92		31 - 155	08/09/17 11:32	08/10/17 21:06	1
1,2-Dichloroethane-d4 (Surr)	122		64 - 144	08/09/17 11:32	08/10/17 21:06	1
Toluene-d8 (Surr)	114		61 - 137	08/09/17 11:32	08/10/17 21:06	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	86.7		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	13.3		0.1	0.1	%			08/08/17 14:40	1

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-38_0"-6"_080417

Lab Sample ID: 240-83367-9

Date Collected: 08/04/17 15:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 73.7

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	1000	U	1000	160	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Benzene	68	U	68	41	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Bromodichloromethane	140	U	140	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Bromoform	140	U	140	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Bromomethane	340	U	340	47	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
2-Butanone (MEK)	1000	U	1000	84	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Carbon disulfide	340	U	340	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Carbon tetrachloride	68	U	68	46	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Chlorobenzene	68	U	68	51	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Chloroethane	340	U	340	47	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Chloroform	68	U	68	41	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Chloromethane	340	U	340	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
cis-1,2-Dichloroethene	68	U	68	59	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
cis-1,3-Dichloropropene	68	U	68	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Cyclohexane	200	J	1600	51	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Dibromochloromethane	68	U	68	57	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,2-Dibromo-3-Chloropropane	340	U	340	81	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,2-Dibromoethane	340	U	340	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,2-Dichlorobenzene	140	U	140	30	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,3-Dichlorobenzene	140	U	140	64	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,4-Dichlorobenzene	140	U	140	46	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Dichlorodifluoromethane	140	U	140	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,1-Dichloroethane	68	U	68	52	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,2-Dichloroethane	68	U	68	51	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,1-Dichloroethene	68	U	68	61	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,2-Dichloropropane	68	U	68	51	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Ethylbenzene	130		68	59	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
2-Hexanone	3400	U	3400	150	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Isopropylbenzene	340	U	340	57	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Methyl acetate	630	J *	1600	130	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Methylcyclohexane	840	J	1600	63	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Methylene Chloride	340	U	340	110	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
4-Methyl-2-pentanone (MIBK)	3400	U	3400	68	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Methyl tert-butyl ether	340	U	340	44	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Styrene	68	U	68	17	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,1,2,2-Tetrachloroethane	68	U	68	41	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Tetrachloroethene	71		68	35	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Toluene	91	J	140	41	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
trans-1,2-Dichloroethene	68	U	68	59	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
trans-1,3-Dichloropropene	68	U	68	25	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,2,4-Trichlorobenzene	340	U	340	44	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,1,1-Trichloroethane	68	U	68	47	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,1,2-Trichloroethane	68	U	68	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Trichloroethene	68	U	68	63	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Trichlorofluoromethane	140	U	140	57	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
1,1,2-Trichloro-1,2,2-trifluoroethane	340	U	340	39	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Vinyl chloride	54	U	54	29	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1
Xylenes, Total	800		200	47	ug/Kg	☼	08/09/17 11:32	08/10/17 21:30	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-38_0"-6"_080417

Lab Sample ID: 240-83367-9

Date Collected: 08/04/17 15:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 73.7

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	106		58 - 142	08/09/17 11:32	08/10/17 21:30	1
Dibromofluoromethane (Surr)	98		31 - 155	08/09/17 11:32	08/10/17 21:30	1
1,2-Dichloroethane-d4 (Surr)	127		64 - 144	08/09/17 11:32	08/10/17 21:30	1
Toluene-d8 (Surr)	122		61 - 137	08/09/17 11:32	08/10/17 21:30	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	73.7		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	26.3		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-38_18"-24"_080417

Lab Sample ID: 240-83367-10

Date Collected: 08/04/17 15:15

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 85.4

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	800	U	800	130	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Benzene	54	U	54	32	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Bromodichloromethane	110	U	110	24	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Bromoform	110	U	110	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Bromomethane	270	U	270	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
2-Butanone (MEK)	800	U	800	67	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Carbon disulfide	270	U	270	24	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Carbon tetrachloride	54	U	54	36	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Chlorobenzene	54	U	54	40	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Chloroethane	270	U	270	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Chloroform	54	U	54	32	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Chloromethane	270	U	270	24	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
cis-1,2-Dichloroethene	54	U	54	47	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
cis-1,3-Dichloropropene	54	U	54	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Cyclohexane	62	J	1300	40	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Dibromochloromethane	54	U	54	46	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,2-Dibromo-3-Chloropropane	270	U	270	64	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,2-Dibromoethane	270	U	270	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,2-Dichlorobenzene	110	U	110	24	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,3-Dichlorobenzene	110	U	110	51	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,4-Dichlorobenzene	110	U	110	36	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Dichlorodifluoromethane	110	U	110	29	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,1-Dichloroethane	54	U	54	42	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,2-Dichloroethane	54	U	54	40	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,1-Dichloroethene	54	U	54	48	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,2-Dichloropropane	54	U	54	40	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Ethylbenzene	63		54	47	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
2-Hexanone	2700	U	2700	120	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Isopropylbenzene	270	U	270	46	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Methyl acetate	3400	*	1300	100	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Methylcyclohexane	270	J	1300	50	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Methylene Chloride	270	U	270	87	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
4-Methyl-2-pentanone (MIBK)	2700	U	2700	54	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Methyl tert-butyl ether	270	U	270	35	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Styrene	54	U	54	13	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,1,2,2-Tetrachloroethane	54	U	54	32	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Tetrachloroethene	54	U	54	28	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Toluene	110	U	110	32	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
trans-1,2-Dichloroethene	54	U	54	47	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
trans-1,3-Dichloropropene	54	U	54	20	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,2,4-Trichlorobenzene	270	U	270	35	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,1,1-Trichloroethane	54	U	54	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,1,2-Trichloroethane	54	U	54	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Trichloroethene	54	U	54	50	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Trichlorofluoromethane	110	U	110	46	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
1,1,2-Trichloro-1,2,2-trifluoroethane	270	U	270	31	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Vinyl chloride	43	U	43	23	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1
Xylenes, Total	390		160	37	ug/Kg	☼	08/09/17 11:32	08/10/17 21:53	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-38_18"-24"_080417

Lab Sample ID: 240-83367-10

Date Collected: 08/04/17 15:15

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 85.4

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	94		58 - 142	08/09/17 11:32	08/10/17 21:53	1
Dibromofluoromethane (Surr)	86		31 - 155	08/09/17 11:32	08/10/17 21:53	1
1,2-Dichloroethane-d4 (Surr)	114		64 - 144	08/09/17 11:32	08/10/17 21:53	1
Toluene-d8 (Surr)	106		61 - 137	08/09/17 11:32	08/10/17 21:53	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	85.4		0.1	0.1	%			08/08/17 14:40	1
Percent Moisture	14.6		0.1	0.1	%			08/08/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-39_0"-6"_080417

Lab Sample ID: 240-83367-11

Date Collected: 08/04/17 15:30

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 90.0

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	740	U	740	120	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Benzene	50	U	50	30	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Bromodichloromethane	99	U	99	22	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Bromoform	99	U	99	28	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Bromomethane	250	U	250	35	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
2-Butanone (MEK)	740	U	740	62	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Carbon disulfide	250	U	250	22	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Carbon tetrachloride	50	U	50	33	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Chlorobenzene	50	U	50	37	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Chloroethane	250	U	250	35	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Chloroform	50	U	50	30	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Chloromethane	250	U	250	22	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
cis-1,2-Dichloroethene	50	U	50	43	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
cis-1,3-Dichloropropene	50	U	50	28	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Cyclohexane	110	J	1200	37	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Dibromochloromethane	50	U	50	42	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,2-Dibromo-3-Chloropropane	250	U	250	59	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,2-Dibromoethane	250	U	250	28	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,2-Dichlorobenzene	99	U	99	22	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,3-Dichlorobenzene	99	U	99	47	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,4-Dichlorobenzene	99	U	99	33	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Dichlorodifluoromethane	99	U	99	27	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,1-Dichloroethane	50	U	50	38	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,2-Dichloroethane	50	U	50	37	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,1-Dichloroethene	50	U	50	45	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,2-Dichloropropane	50	U	50	37	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Ethylbenzene	50	U	50	43	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
2-Hexanone	2500	U	2500	110	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Isopropylbenzene	250	U	250	42	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Methyl acetate	460	J *	1200	93	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Methylcyclohexane	320	J	1200	46	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Methylene Chloride	250	U	250	81	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
4-Methyl-2-pentanone (MIBK)	2500	U	2500	50	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Methyl tert-butyl ether	250	U	250	32	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Styrene	50	U	50	12	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,1,2,2-Tetrachloroethane	50	U	50	30	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Tetrachloroethene	130		50	26	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Toluene	72	J	99	30	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
trans-1,2-Dichloroethene	50	U	50	43	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
trans-1,3-Dichloropropene	50	U	50	19	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,2,4-Trichlorobenzene	250	U	250	32	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,1,1-Trichloroethane	50	U	50	35	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,1,2-Trichloroethane	50	U	50	28	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Trichloroethene	50	U	50	46	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Trichlorofluoromethane	99	U	99	42	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
1,1,2-Trichloro-1,2,2-trifluoroethane	250	U	250	28	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Vinyl chloride	40	U	40	21	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1
Xylenes, Total	220		150	35	ug/Kg	☼	08/09/17 11:32	08/10/17 22:15	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-39_0"-6"_080417

Lab Sample ID: 240-83367-11

Date Collected: 08/04/17 15:30

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 90.0

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	93		58 - 142	08/09/17 11:32	08/10/17 22:15	1
Dibromofluoromethane (Surr)	88		31 - 155	08/09/17 11:32	08/10/17 22:15	1
1,2-Dichloroethane-d4 (Surr)	113		64 - 144	08/09/17 11:32	08/10/17 22:15	1
Toluene-d8 (Surr)	108		61 - 137	08/09/17 11:32	08/10/17 22:15	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	90.0		0.1	0.1	%			08/08/17 14:48	1
Percent Moisture	10.0		0.1	0.1	%			08/08/17 14:48	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-39_18"-24"_080417

Lab Sample ID: 240-83367-12

Date Collected: 08/04/17 15:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.2

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	760	U	760	120	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Benzene	51	U	51	31	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Bromodichloromethane	100	U	100	23	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Bromoform	100	U	100	29	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Bromomethane	250	U	250	36	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
2-Butanone (MEK)	760	U	760	64	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Carbon disulfide	250	U	250	23	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Carbon tetrachloride	51	U	51	34	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Chlorobenzene	51	U	51	38	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Chloroethane	250	U	250	36	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Chloroform	51	U	51	31	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Chloromethane	250	U	250	23	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
cis-1,2-Dichloroethene	51	U	51	45	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
cis-1,3-Dichloropropene	51	U	51	29	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Cyclohexane	66	J	1200	38	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Dibromochloromethane	51	U	51	43	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,2-Dibromo-3-Chloropropane	250	U	250	61	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,2-Dibromoethane	250	U	250	29	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,2-Dichlorobenzene	100	U	100	23	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,3-Dichlorobenzene	100	U	100	48	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,4-Dichlorobenzene	100	U	100	34	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Dichlorodifluoromethane	100	U	100	28	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,1-Dichloroethane	51	U	51	39	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,2-Dichloroethane	51	U	51	38	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,1-Dichloroethene	51	U	51	46	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,2-Dichloropropane	51	U	51	38	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Ethylbenzene	51	U	51	45	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
2-Hexanone	2500	U	2500	110	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Isopropylbenzene	250	U	250	43	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Methyl acetate	1200	U *	1200	95	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Methylcyclohexane	200	J	1200	47	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Methylene Chloride	250	U	250	83	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
4-Methyl-2-pentanone (MIBK)	2500	U	2500	51	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Methyl tert-butyl ether	250	U	250	33	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Styrene	51	U	51	13	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,1,2,2-Tetrachloroethane	51	U	51	31	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Tetrachloroethene	100		51	27	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Toluene	51	J	100	31	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
trans-1,2-Dichloroethene	51	U	51	45	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
trans-1,3-Dichloropropene	51	U	51	19	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,2,4-Trichlorobenzene	250	U	250	33	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,1,1-Trichloroethane	51	U	51	36	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,1,2-Trichloroethane	51	U	51	29	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Trichloroethene	51	U	51	47	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Trichlorofluoromethane	100	U	100	43	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
1,1,2-Trichloro-1,2,2-trifluoroethane	250	U	250	29	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Vinyl chloride	41	U	41	22	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1
Xylenes, Total	120	J	150	36	ug/Kg	☼	08/09/17 11:32	08/10/17 22:39	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-39_18"-24"_080417

Lab Sample ID: 240-83367-12

Date Collected: 08/04/17 15:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.2

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	92		58 - 142	08/09/17 11:32	08/10/17 22:39	1
Dibromofluoromethane (Surr)	85		31 - 155	08/09/17 11:32	08/10/17 22:39	1
1,2-Dichloroethane-d4 (Surr)	112		64 - 144	08/09/17 11:32	08/10/17 22:39	1
Toluene-d8 (Surr)	103		61 - 137	08/09/17 11:32	08/10/17 22:39	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	86.2		0.1	0.1	%			08/08/17 14:48	1
Percent Moisture	13.8		0.1	0.1	%			08/08/17 14:48	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-40_0"-6"_080417

Lab Sample ID: 240-83367-13

Date Collected: 08/04/17 16:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 89.5

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	740	U	740	120	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Benzene	49	U	49	30	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Bromodichloromethane	99	U	99	22	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Bromoform	99	U	99	28	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Bromomethane	250	U	250	35	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
2-Butanone (MEK)	740	U	740	62	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Carbon disulfide	250	U	250	22	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Carbon tetrachloride	49	U	49	33	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Chlorobenzene	49	U	49	37	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Chloroethane	250	U	250	35	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Chloroform	49	U	49	30	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Chloromethane	250	U	250	22	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
cis-1,2-Dichloroethene	49	U	49	43	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
cis-1,3-Dichloropropene	49	U	49	28	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Cyclohexane	1200	U	1200	37	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Dibromochloromethane	49	U	49	42	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,2-Dibromo-3-Chloropropane	250	U	250	59	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,2-Dibromoethane	250	U	250	28	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,2-Dichlorobenzene	99	U	99	22	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,3-Dichlorobenzene	99	U	99	47	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,4-Dichlorobenzene	99	U	99	33	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Dichlorodifluoromethane	99	U	99	27	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,1-Dichloroethane	49	U	49	38	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,2-Dichloroethane	49	U	49	37	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,1-Dichloroethene	49	U	49	44	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,2-Dichloropropane	49	U	49	37	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Ethylbenzene	49	U	49	43	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
2-Hexanone	2500	U	2500	110	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Isopropylbenzene	250	U	250	42	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Methyl acetate	1200	U *	1200	93	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Methylcyclohexane	1200	U	1200	46	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Methylene Chloride	250	U	250	80	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
4-Methyl-2-pentanone (MIBK)	2500	U	2500	49	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Methyl tert-butyl ether	250	U	250	32	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Styrene	49	U	49	12	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,1,2,2-Tetrachloroethane	49	U	49	30	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Tetrachloroethene	49	U	49	26	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Toluene	99	U	99	30	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
trans-1,2-Dichloroethene	49	U	49	43	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
trans-1,3-Dichloropropene	49	U	49	19	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,2,4-Trichlorobenzene	250	U	250	32	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,1,1-Trichloroethane	49	U	49	35	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,1,2-Trichloroethane	49	U	49	28	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Trichloroethene	49	U	49	46	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Trichlorofluoromethane	99	U	99	42	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
1,1,2-Trichloro-1,2,2-trifluoroethane	250	U	250	28	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Vinyl chloride	39	U	39	21	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1
Xylenes, Total	150	U	150	35	ug/Kg	☼	08/09/17 11:32	08/10/17 23:03	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-40_0"-6"_080417

Lab Sample ID: 240-83367-13

Date Collected: 08/04/17 16:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 89.5

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	101		58 - 142	08/09/17 11:32	08/10/17 23:03	1
Dibromofluoromethane (Surr)	86		31 - 155	08/09/17 11:32	08/10/17 23:03	1
1,2-Dichloroethane-d4 (Surr)	115		64 - 144	08/09/17 11:32	08/10/17 23:03	1
Toluene-d8 (Surr)	108		61 - 137	08/09/17 11:32	08/10/17 23:03	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	89.5		0.1	0.1	%			08/08/17 14:48	1
Percent Moisture	10.5		0.1	0.1	%			08/08/17 14:48	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-40_18"-24"_080417

Lab Sample ID: 240-83367-14

Date Collected: 08/04/17 16:15

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 84.4

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	820	U	820	130	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Benzene	55	U	55	33	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Bromodichloromethane	110	U	110	25	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Bromoform	110	U	110	31	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Bromomethane	270	U	270	38	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
2-Butanone (MEK)	820	U	820	68	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Carbon disulfide	270	U	270	25	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Carbon tetrachloride	55	U	55	37	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Chlorobenzene	55	U	55	41	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Chloroethane	270	U	270	38	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Chloroform	55	U	55	33	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Chloromethane	270	U	270	25	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
cis-1,2-Dichloroethene	55	U	55	48	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
cis-1,3-Dichloropropene	55	U	55	31	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Cyclohexane	1300	U	1300	41	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Dibromochloromethane	55	U	55	46	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,2-Dibromo-3-Chloropropane	270	U	270	66	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,2-Dibromoethane	270	U	270	31	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,2-Dichlorobenzene	110	U	110	25	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,3-Dichlorobenzene	110	U	110	52	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,4-Dichlorobenzene	110	U	110	37	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Dichlorodifluoromethane	110	U	110	30	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,1-Dichloroethane	55	U	55	42	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,2-Dichloroethane	55	U	55	41	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,1-Dichloroethene	55	U	55	49	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,2-Dichloropropane	55	U	55	41	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Ethylbenzene	55	U	55	48	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
2-Hexanone	2700	U	2700	120	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Isopropylbenzene	270	U	270	46	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Methyl acetate	1300	U *	1300	100	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Methylcyclohexane	1300	U	1300	51	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Methylene Chloride	270	U	270	89	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
4-Methyl-2-pentanone (MIBK)	2700	U	2700	55	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Methyl tert-butyl ether	270	U	270	36	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Styrene	55	U	55	14	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,1,2,2-Tetrachloroethane	55	U	55	33	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Tetrachloroethene	55	U	55	29	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Toluene	110	U	110	33	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
trans-1,2-Dichloroethene	55	U	55	48	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
trans-1,3-Dichloropropene	55	U	55	20	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,2,4-Trichlorobenzene	270	U	270	36	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,1,1-Trichloroethane	55	U	55	38	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,1,2-Trichloroethane	55	U	55	31	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Trichloroethene	55	U	55	51	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Trichlorofluoromethane	110	U	110	46	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
1,1,2-Trichloro-1,2,2-trifluoroethane	270	U	270	31	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Vinyl chloride	44	U	44	23	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1
Xylenes, Total	160	U	160	38	ug/Kg	☼	08/09/17 11:32	08/10/17 23:27	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-40_18"-24"_080417

Lab Sample ID: 240-83367-14

Date Collected: 08/04/17 16:15

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 84.4

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	95		58 - 142	08/09/17 11:32	08/10/17 23:27	1
Dibromofluoromethane (Surr)	81		31 - 155	08/09/17 11:32	08/10/17 23:27	1
1,2-Dichloroethane-d4 (Surr)	108		64 - 144	08/09/17 11:32	08/10/17 23:27	1
Toluene-d8 (Surr)	104		61 - 137	08/09/17 11:32	08/10/17 23:27	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	84.4		0.1	0.1	%			08/08/17 14:48	1
Percent Moisture	15.6		0.1	0.1	%			08/08/17 14:48	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: TRIP BLANK_080417

Lab Sample ID: 240-83367-15

Date Collected: 08/04/17 00:00

Matrix: Water

Date Received: 08/08/17 09:00

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	10	U	10	1.8	ug/L			08/14/17 14:40	1
Benzene	1.0	U	1.0	0.28	ug/L			08/14/17 14:40	1
Dichlorobromomethane	1.0	U	1.0	0.30	ug/L			08/14/17 14:40	1
Bromoform	1.0	U	1.0	0.43	ug/L			08/14/17 14:40	1
Bromomethane	1.0	U	1.0	0.42	ug/L			08/14/17 14:40	1
2-Butanone (MEK)	10	U	10	1.0	ug/L			08/14/17 14:40	1
Carbon disulfide	1.0	U	1.0	0.34	ug/L			08/14/17 14:40	1
Carbon tetrachloride	1.0	U	1.0	0.35	ug/L			08/14/17 14:40	1
Chlorobenzene	1.0	U	1.0	0.32	ug/L			08/14/17 14:40	1
Chloroethane	1.0	U	1.0	0.41	ug/L			08/14/17 14:40	1
Chloroform	1.0	U	1.0	0.31	ug/L			08/14/17 14:40	1
Chloromethane	1.0	U	1.0	0.43	ug/L			08/14/17 14:40	1
1,1-Dichloroethane	1.0	U	1.0	0.25	ug/L			08/14/17 14:40	1
1,2-Dichloroethane	1.0	U	1.0	0.30	ug/L			08/14/17 14:40	1
1,1-Dichloroethene	1.0	U	1.0	0.27	ug/L			08/14/17 14:40	1
1,2-Dichloropropane	1.0	U	1.0	0.30	ug/L			08/14/17 14:40	1
cis-1,3-Dichloropropene	1.0	U	1.0	0.26	ug/L			08/14/17 14:40	1
trans-1,3-Dichloropropene	1.0	U	1.0	0.31	ug/L			08/14/17 14:40	1
Ethylbenzene	1.0	U	1.0	0.26	ug/L			08/14/17 14:40	1
2-Hexanone	10	U	10	1.2	ug/L			08/14/17 14:40	1
Methylene Chloride	1.0	U	1.0	0.53	ug/L			08/14/17 14:40	1
4-Methyl-2-pentanone (MIBK)	10	U	10	0.71	ug/L			08/14/17 14:40	1
Styrene	1.0	U	1.0	0.23	ug/L			08/14/17 14:40	1
1,1,2,2-Tetrachloroethane	1.0	U	1.0	0.32	ug/L			08/14/17 14:40	1
Tetrachloroethene	1.0	U	1.0	0.30	ug/L			08/14/17 14:40	1
Toluene	1.0	U	1.0	0.23	ug/L			08/14/17 14:40	1
Trichloroethene	1.0	U	1.0	0.33	ug/L			08/14/17 14:40	1
Vinyl chloride	1.0	U	1.0	0.45	ug/L			08/14/17 14:40	1
Xylenes, Total	2.0	U	2.0	0.24	ug/L			08/14/17 14:40	1
1,1,1-Trichloroethane	1.0	U	1.0	0.23	ug/L			08/14/17 14:40	1
1,1,2-Trichloroethane	1.0	U *	1.0	0.34	ug/L			08/14/17 14:40	1
Cyclohexane	1.0	U	1.0	0.44	ug/L			08/14/17 14:40	1
1,2-Dibromo-3-Chloropropane	2.0	U	2.0	0.47	ug/L			08/14/17 14:40	1
Ethylene Dibromide	1.0	U	1.0	0.23	ug/L			08/14/17 14:40	1
Dichlorodifluoromethane	1.0	U *	1.0	0.50	ug/L			08/14/17 14:40	1
cis-1,2-Dichloroethene	1.0	U	1.0	0.30	ug/L			08/14/17 14:40	1
trans-1,2-Dichloroethene	1.0	U	1.0	0.29	ug/L			08/14/17 14:40	1
Isopropylbenzene	1.0	U	1.0	0.21	ug/L			08/14/17 14:40	1
Methyl acetate	10	U	10	1.4	ug/L			08/14/17 14:40	1
Methyl tert-butyl ether	1.0	U	1.0	0.27	ug/L			08/14/17 14:40	1
1,1,2-Trichloro-1,2,2-trifluoroethane	1.0	U	1.0	0.41	ug/L			08/14/17 14:40	1
1,2,4-Trichlorobenzene	1.0	U	1.0	0.27	ug/L			08/14/17 14:40	1
1,2-Dichlorobenzene	1.0	U	1.0	0.26	ug/L			08/14/17 14:40	1
1,3-Dichlorobenzene	1.0	U	1.0	0.32	ug/L			08/14/17 14:40	1
1,4-Dichlorobenzene	1.0	U	1.0	0.23	ug/L			08/14/17 14:40	1
Trichlorofluoromethane	1.0	U	1.0	0.50	ug/L			08/14/17 14:40	1
Chlorodibromomethane	1.0	U	1.0	0.25	ug/L			08/14/17 14:40	1
Methylcyclohexane	1.0	U	1.0	0.45	ug/L			08/14/17 14:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: TRIP BLANK_080417

Lab Sample ID: 240-83367-15

Date Collected: 08/04/17 00:00

Matrix: Water

Date Received: 08/08/17 09:00

<i>Surrogate</i>	<i>%Recovery</i>	<i>Qualifier</i>	<i>Limits</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
1,2-Dichloroethane-d4 (Surr)	89		61 - 138		08/14/17 14:40	1
4-Bromofluorobenzene (Surr)	82		69 - 120		08/14/17 14:40	1
Toluene-d8 (Surr)	89		73 - 120		08/14/17 14:40	1
Dibromofluoromethane (Surr)	97		69 - 124		08/14/17 14:40	1

Surrogate Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Matrix: Solid

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)			
		BFB (58-142)	DBFM (31-155)	12DCE (64-144)	TOL (61-137)
240-83367-1	SB17-34_0"-6"_080417	106	95	118	113
240-83367-2	SB17-34_18"-24"_080417	114	105	128	126
240-83367-3	SB17-35_0"-6"_080417	112	96	123	123
240-83367-4	SB17-35_24"-30"_080417	126	91	112	135
240-83367-5	SB17-36_0"-6"_080417	95	75	89	106
240-83367-6	SB17-36_24"-30"_080417	98	91	115	112
240-83367-7	SB17-37_0"-6"_080417	107	94	122	119
240-83367-8	SB17-37_30"-36"_080417	105	92	122	114
240-83367-9	SB17-38_0"-6"_080417	106	98	127	122
240-83367-10	SB17-38_18"-24"_080417	94	86	114	106
240-83367-11	SB17-39_0"-6"_080417	93	88	113	108
240-83367-12	SB17-39_18"-24"_080417	92	85	112	103
240-83367-13	SB17-40_0"-6"_080417	101	86	115	108
240-83367-14	SB17-40_18"-24"_080417	95	81	108	104
LCS 240-290504/2-A	Lab Control Sample	96	87	98	100
MB 240-290504/1-A	Method Blank	93	89	104	102

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)
DBFM = Dibromofluoromethane (Surr)
12DCE = 1,2-Dichloroethane-d4 (Surr)
TOL = Toluene-d8 (Surr)

Method: 8260B - Volatile Organic Compounds (GC/MS)

Matrix: Water

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)			
		12DCE (61-138)	BFB (69-120)	TOL (73-120)	DBFM (69-124)
240-83367-15	TRIP BLANK_080417	89	82	89	97
LCS 240-291046/4	Lab Control Sample	81	97	95	88
MB 240-291046/6	Method Blank	89	83	88	94

Surrogate Legend

12DCE = 1,2-Dichloroethane-d4 (Surr)
BFB = 4-Bromofluorobenzene (Surr)
TOL = Toluene-d8 (Surr)
DBFM = Dibromofluoromethane (Surr)

TestAmerica Canton

QC Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 240-290504/1-A

Matrix: Solid

Analysis Batch: 290719

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 290504

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	600	U	600	97	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Benzene	40	U	40	24	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Bromodichloromethane	80	U	80	18	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Bromoform	80	U	80	23	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Bromomethane	200	U	200	28	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
2-Butanone (MEK)	600	U	600	50	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Carbon disulfide	200	U	200	18	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Carbon tetrachloride	40	U	40	27	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Chlorobenzene	40	U	40	30	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Chloroethane	200	U	200	28	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Chloroform	40	U	40	24	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Chloromethane	200	U	200	18	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
cis-1,3-Dichloropropene	40	U	40	23	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,1-Dichloroethane	40	U	40	31	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,2-Dichloroethane	40	U	40	30	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,1-Dichloroethene	40	U	40	36	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,2-Dichloropropane	40	U	40	30	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Ethylbenzene	40	U	40	35	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
2-Hexanone	2000	U	2000	86	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Cyclohexane	960	U	960	30	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,2-Dibromo-3-Chloropropane	200	U	200	48	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,2-Dibromoethane	200	U	200	23	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Dichlorodifluoromethane	80	U	80	22	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Methylene Chloride	200	U	200	65	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
4-Methyl-2-pentanone (MIBK)	2000	U	2000	40	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
cis-1,2-Dichloroethene	40	U	40	35	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Isopropylbenzene	200	U	200	34	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Methyl acetate	960	U	960	75	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Methyl tert-butyl ether	200	U	200	26	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Styrene	40	U	40	10	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,1,2,2-Tetrachloroethane	40	U	40	24	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Tetrachloroethene	40	U	40	21	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,2-Dichlorobenzene	80	U	80	18	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Toluene	80	U	80	24	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,3-Dichlorobenzene	80	U	80	38	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,4-Dichlorobenzene	80	U	80	27	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
trans-1,2-Dichloroethene	40	U	40	35	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
trans-1,3-Dichloropropene	40	U	40	15	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,2,4-Trichlorobenzene	200	U	200	26	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Dibromochloromethane	40	U	40	34	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,1,1-Trichloroethane	40	U	40	28	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Methylcyclohexane	960	U	960	37	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,1,2-Trichloroethane	40	U	40	23	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Trichloroethene	40	U	40	37	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Trichlorofluoromethane	80	U	80	34	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
1,1,2-Trichloro-1,2,2-trifluoroethane	200	U	200	23	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Vinyl chloride	32	U		17	ug/Kg		08/09/17 11:32	08/10/17 17:30	1
Xylenes, Total	120	U	120	28	ug/Kg		08/09/17 11:32	08/10/17 17:30	1

TestAmerica Canton

QC Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
1,2-Dichloroethane-d4 (Surr)	104		64 - 144	08/09/17 11:32	08/10/17 17:30	1
4-Bromofluorobenzene (Surr)	93		58 - 142	08/09/17 11:32	08/10/17 17:30	1
Toluene-d8 (Surr)	102		61 - 137	08/09/17 11:32	08/10/17 17:30	1
Dibromofluoromethane (Surr)	89		31 - 155	08/09/17 11:32	08/10/17 17:30	1

Lab Sample ID: LCS 240-290504/2-A

Matrix: Solid

Analysis Batch: 290719

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 290504

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	2000	759		ug/Kg		38	24 - 125
Benzene	1000	941		ug/Kg		94	77 - 120
Bromodichloromethane	1000	779		ug/Kg		78	61 - 132
Bromoform	1000	644		ug/Kg		64	40 - 140
Bromomethane	1000	1090		ug/Kg		109	10 - 153
2-Butanone (MEK)	2000	1790		ug/Kg		90	51 - 120
Carbon disulfide	1000	472		ug/Kg		47	17 - 163
Carbon tetrachloride	1000	960		ug/Kg		96	43 - 144
Chlorobenzene	1000	1020		ug/Kg		102	76 - 120
Chloroethane	1000	1050		ug/Kg		105	10 - 166
Chloroform	1000	990		ug/Kg		99	74 - 120
Chloromethane	1000	702		ug/Kg		70	41 - 124
cis-1,3-Dichloropropene	1000	807		ug/Kg		81	66 - 126
1,1-Dichloroethane	1000	965		ug/Kg		96	72 - 120
1,2-Dichloroethane	1000	957		ug/Kg		96	71 - 120
1,1-Dichloroethene	1000	775		ug/Kg		77	58 - 130
1,2-Dichloropropane	1000	886		ug/Kg		89	78 - 122
Ethylbenzene	1000	1050		ug/Kg		105	76 - 120
2-Hexanone	2000	1760	J	ug/Kg		88	52 - 129
Cyclohexane	1000	971		ug/Kg		97	66 - 129
1,2-Dibromo-3-Chloropropane	1000	616		ug/Kg		62	40 - 133
1,2-Dibromoethane	1000	928		ug/Kg		93	80 - 120
Dichlorodifluoromethane	1000	753		ug/Kg		75	15 - 127
Methylene Chloride	1000	1260		ug/Kg		126	64 - 126
4-Methyl-2-pentanone (MIBK)	2000	1740	J	ug/Kg		87	65 - 131
cis-1,2-Dichloroethene	1000	982		ug/Kg		98	78 - 120
Isopropylbenzene	1000	1010		ug/Kg		101	76 - 124
Methyl acetate	2000	1180	*	ug/Kg		59	63 - 126
Methyl tert-butyl ether	1000	1070		ug/Kg		107	68 - 129
Styrene	1000	991		ug/Kg		99	80 - 120
1,1,2,2-Tetrachloroethane	1000	935		ug/Kg		93	78 - 120
Tetrachloroethene	1000	1050		ug/Kg		105	68 - 122
1,2-Dichlorobenzene	1000	985		ug/Kg		98	75 - 120
Toluene	1000	1050		ug/Kg		105	74 - 120
1,3-Dichlorobenzene	1000	964		ug/Kg		96	72 - 120
1,4-Dichlorobenzene	1000	947		ug/Kg		95	71 - 120
trans-1,2-Dichloroethene	1000	1100		ug/Kg		110	74 - 124
trans-1,3-Dichloropropene	1000	819		ug/Kg		82	55 - 121
1,2,4-Trichlorobenzene	1000	1020		ug/Kg		102	60 - 124
Dibromochloromethane	1000	782		ug/Kg		78	46 - 125
1,1,1-Trichloroethane	1000	956		ug/Kg		96	60 - 136
Methylcyclohexane	1000	944	J	ug/Kg		94	71 - 126
1,1,2-Trichloroethane	1000	922		ug/Kg		92	80 - 120
Trichloroethene	1000	917		ug/Kg		92	73 - 123

TestAmerica Canton

QC Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 240-290504/2-A

Matrix: Solid

Analysis Batch: 290719

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 290504

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Trichlorofluoromethane	1000	1030		ug/Kg		103	28 - 152
1,1,2-Trichloro-1,2,2-trifluoroethane	1000	754		ug/Kg		75	64 - 125
Vinyl chloride	1000	688		ug/Kg		69	49 - 131
Xylenes, Total	2000	2030		ug/Kg		102	78 - 120

Surrogate	LCS %Recovery	LCS Qualifier	Limits
1,2-Dichloroethane-d4 (Surr)	98		64 - 144
4-Bromofluorobenzene (Surr)	96		58 - 142
Toluene-d8 (Surr)	100		61 - 137
Dibromofluoromethane (Surr)	87		31 - 155

Lab Sample ID: MB 240-291046/6

Matrix: Water

Analysis Batch: 291046

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	10	U	10	1.8	ug/L			08/14/17 14:16	1
Benzene	1.0	U	1.0	0.28	ug/L			08/14/17 14:16	1
Dichlorobromomethane	1.0	U	1.0	0.30	ug/L			08/14/17 14:16	1
Bromoform	1.0	U	1.0	0.43	ug/L			08/14/17 14:16	1
Bromomethane	1.0	U	1.0	0.42	ug/L			08/14/17 14:16	1
2-Butanone (MEK)	10	U	10	1.0	ug/L			08/14/17 14:16	1
Carbon disulfide	1.0	U	1.0	0.34	ug/L			08/14/17 14:16	1
Carbon tetrachloride	1.0	U	1.0	0.35	ug/L			08/14/17 14:16	1
Chlorobenzene	1.0	U	1.0	0.32	ug/L			08/14/17 14:16	1
Chloroethane	1.0	U	1.0	0.41	ug/L			08/14/17 14:16	1
Chloroform	1.0	U	1.0	0.31	ug/L			08/14/17 14:16	1
Chloromethane	1.0	U	1.0	0.43	ug/L			08/14/17 14:16	1
cis-1,3-Dichloropropene	1.0	U	1.0	0.26	ug/L			08/14/17 14:16	1
1,1-Dichloroethane	1.0	U	1.0	0.25	ug/L			08/14/17 14:16	1
1,2-Dichloroethane	1.0	U	1.0	0.30	ug/L			08/14/17 14:16	1
1,1-Dichloroethene	1.0	U	1.0	0.27	ug/L			08/14/17 14:16	1
1,2-Dichloropropane	1.0	U	1.0	0.30	ug/L			08/14/17 14:16	1
Ethylbenzene	1.0	U	1.0	0.26	ug/L			08/14/17 14:16	1
2-Hexanone	10	U	10	1.2	ug/L			08/14/17 14:16	1
Cyclohexane	1.0	U	1.0	0.44	ug/L			08/14/17 14:16	1
1,2-Dibromo-3-Chloropropane	2.0	U	2.0	0.47	ug/L			08/14/17 14:16	1
Ethylene Dibromide	1.0	U	1.0	0.23	ug/L			08/14/17 14:16	1
Dichlorodifluoromethane	1.0	U	1.0	0.50	ug/L			08/14/17 14:16	1
Methylene Chloride	1.0	U	1.0	0.53	ug/L			08/14/17 14:16	1
4-Methyl-2-pentanone (MIBK)	10	U	10	0.71	ug/L			08/14/17 14:16	1
cis-1,2-Dichloroethene	1.0	U	1.0	0.30	ug/L			08/14/17 14:16	1
Isopropylbenzene	1.0	U	1.0	0.21	ug/L			08/14/17 14:16	1
Methyl acetate	10	U	10	1.4	ug/L			08/14/17 14:16	1
Methyl tert-butyl ether	1.0	U	1.0	0.27	ug/L			08/14/17 14:16	1
Styrene	1.0	U	1.0	0.23	ug/L			08/14/17 14:16	1
1,1,2,2-Tetrachloroethane	1.0	U	1.0	0.32	ug/L			08/14/17 14:16	1

TestAmerica Canton

QC Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: MB 240-291046/6

Matrix: Water

Analysis Batch: 291046

Client Sample ID: Method Blank

Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Tetrachloroethene	1.0	U	1.0	0.30	ug/L			08/14/17 14:16	1
1,2-Dichlorobenzene	1.0	U	1.0	0.26	ug/L			08/14/17 14:16	1
Toluene	1.0	U	1.0	0.23	ug/L			08/14/17 14:16	1
1,3-Dichlorobenzene	1.0	U	1.0	0.32	ug/L			08/14/17 14:16	1
1,4-Dichlorobenzene	1.0	U	1.0	0.23	ug/L			08/14/17 14:16	1
trans-1,2-Dichloroethene	1.0	U	1.0	0.29	ug/L			08/14/17 14:16	1
trans-1,3-Dichloropropene	1.0	U	1.0	0.31	ug/L			08/14/17 14:16	1
1,2,4-Trichlorobenzene	1.0	U	1.0	0.27	ug/L			08/14/17 14:16	1
Chlorodibromomethane	1.0	U	1.0	0.25	ug/L			08/14/17 14:16	1
1,1,1-Trichloroethane	1.0	U	1.0	0.23	ug/L			08/14/17 14:16	1
Methylcyclohexane	1.0	U	1.0	0.45	ug/L			08/14/17 14:16	1
1,1,2-Trichloroethane	1.0	U	1.0	0.34	ug/L			08/14/17 14:16	1
Trichloroethene	1.0	U	1.0	0.33	ug/L			08/14/17 14:16	1
Trichlorofluoromethane	1.0	U	1.0	0.50	ug/L			08/14/17 14:16	1
1,1,2-Trichloro-1,2,2-trifluoroethane	1.0	U	1.0	0.41	ug/L			08/14/17 14:16	1
Vinyl chloride	1.0	U	1.0	0.45	ug/L			08/14/17 14:16	1
Xylenes, Total	2.0	U	2.0	0.24	ug/L			08/14/17 14:16	1

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
1,2-Dichloroethane-d4 (Surr)	89		61 - 138		08/14/17 14:16	1
4-Bromofluorobenzene (Surr)	83		69 - 120		08/14/17 14:16	1
Toluene-d8 (Surr)	88		73 - 120		08/14/17 14:16	1
Dibromofluoromethane (Surr)	94		69 - 124		08/14/17 14:16	1

Lab Sample ID: LCS 240-291046/4

Matrix: Water

Analysis Batch: 291046

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	20.0	17.7		ug/L		89	35 - 131
Benzene	10.0	11.2		ug/L		112	79 - 120
Dichlorobromomethane	10.0	11.2		ug/L		112	79 - 125
Bromoform	10.0	10.5		ug/L		105	55 - 145
Bromomethane	10.0	10.6		ug/L		106	17 - 158
2-Butanone (MEK)	20.0	22.8		ug/L		114	43 - 149
Carbon disulfide	10.0	12.6		ug/L		126	49 - 141
Carbon tetrachloride	10.0	11.6		ug/L		116	55 - 171
Chlorobenzene	10.0	11.3		ug/L		113	80 - 120
Chloroethane	10.0	6.49		ug/L		65	10 - 149
Chloroform	10.0	10.7		ug/L		107	80 - 120
Chloromethane	10.0	8.60		ug/L		86	59 - 124
cis-1,3-Dichloropropene	10.0	9.89		ug/L		99	75 - 120
1,1-Dichloroethane	10.0	9.96		ug/L		100	74 - 120
1,2-Dichloroethane	10.0	9.84		ug/L		98	68 - 133
1,1-Dichloroethene	10.0	11.1		ug/L		111	65 - 127
1,2-Dichloropropane	10.0	10.4		ug/L		104	78 - 127
Ethylbenzene	10.0	11.2		ug/L		112	80 - 120
2-Hexanone	20.0	21.0		ug/L		105	28 - 169

TestAmerica Canton

QC Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 240-291046/4

Matrix: Water

Analysis Batch: 291046

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Cyclohexane	10.0	11.2		ug/L		112	66 - 135
1,2-Dibromo-3-Chloropropane	10.0	10.3		ug/L		103	50 - 130
Ethylene Dibromide	10.0	11.1		ug/L		111	80 - 120
Dichlorodifluoromethane	10.0	14.6	*	ug/L		146	42 - 141
Methylene Chloride	10.0	11.5		ug/L		115	64 - 140
4-Methyl-2-pentanone (MIBK)	20.0	17.0		ug/L		85	53 - 144
cis-1,2-Dichloroethene	10.0	10.6		ug/L		106	77 - 120
Isopropylbenzene	10.0	10.7		ug/L		107	80 - 128
Methyl acetate	20.0	19.8		ug/L		99	63 - 137
Methyl tert-butyl ether	10.0	7.95		ug/L		80	73 - 120
Styrene	10.0	11.6		ug/L		116	80 - 121
1,1,2,2-Tetrachloroethane	10.0	12.1		ug/L		121	58 - 122
Tetrachloroethene	10.0	10.2		ug/L		102	80 - 122
1,2-Dichlorobenzene	10.0	10.6		ug/L		106	80 - 120
Toluene	10.0	11.7		ug/L		117	78 - 120
1,3-Dichlorobenzene	10.0	10.4		ug/L		104	80 - 120
1,4-Dichlorobenzene	10.0	10.5		ug/L		105	80 - 120
trans-1,2-Dichloroethene	10.0	11.4		ug/L		114	74 - 124
trans-1,3-Dichloropropene	10.0	9.86		ug/L		99	67 - 120
1,2,4-Trichlorobenzene	10.0	9.14		ug/L		91	34 - 141
Chlorodibromomethane	10.0	11.8		ug/L		118	64 - 129
1,1,1-Trichloroethane	10.0	10.1		ug/L		101	64 - 147
Methylcyclohexane	10.0	11.6		ug/L		116	63 - 141
1,1,2-Trichloroethane	10.0	12.3	*	ug/L		123	76 - 121
Trichloroethene	10.0	10.2		ug/L		102	76 - 124
Trichlorofluoromethane	10.0	12.2		ug/L		122	27 - 176
1,1,2-Trichloro-1,2,2-trifluoroethane	10.0	12.7		ug/L		127	65 - 144
m-Xylene & p-Xylene	10.0	11.4		ug/L		114	80 - 120
Vinyl chloride	10.0	9.78		ug/L		98	65 - 124
o-Xylene	10.0	10.8		ug/L		108	80 - 120
Xylenes, Total	20.0	22.2		ug/L		111	80 - 120

Surrogate	LCS %Recovery	LCS Qualifier	Limits
1,2-Dichloroethane-d4 (Surr)	81		61 - 138
4-Bromofluorobenzene (Surr)	97		69 - 120
Toluene-d8 (Surr)	95		73 - 120
Dibromofluoromethane (Surr)	88		69 - 124

Method: Moisture - Percent Moisture

Lab Sample ID: 240-83367-8 DU

Matrix: Solid

Analysis Batch: 290309

Client Sample ID: SB17-37_30"-36"_080417

Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier	DU Result	DU Qualifier	Unit	D	RPD	RPD Limit
Percent Solids	86.7		84.3		%		3	20
Percent Moisture	13.3		15.7		%		17	20

TestAmerica Canton

QC Association Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

GC/MS VOA

Prep Batch: 290504

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-83367-1	SB17-34_0"-6"_080417	Total/NA	Solid	5035	
240-83367-2	SB17-34_18"-24"_080417	Total/NA	Solid	5035	
240-83367-3	SB17-35_0"-6"_080417	Total/NA	Solid	5035	
240-83367-4	SB17-35_24"-30"_080417	Total/NA	Solid	5035	
240-83367-5	SB17-36_0"-6"_080417	Total/NA	Solid	5035	
240-83367-6	SB17-36_24"-30"_080417	Total/NA	Solid	5035	
240-83367-7	SB17-37_0"-6"_080417	Total/NA	Solid	5035	
240-83367-8	SB17-37_30"-36"_080417	Total/NA	Solid	5035	
240-83367-9	SB17-38_0"-6"_080417	Total/NA	Solid	5035	
240-83367-10	SB17-38_18"-24"_080417	Total/NA	Solid	5035	
240-83367-11	SB17-39_0"-6"_080417	Total/NA	Solid	5035	
240-83367-12	SB17-39_18"-24"_080417	Total/NA	Solid	5035	
240-83367-13	SB17-40_0"-6"_080417	Total/NA	Solid	5035	
240-83367-14	SB17-40_18"-24"_080417	Total/NA	Solid	5035	
MB 240-290504/1-A	Method Blank	Total/NA	Solid	5035	
LCS 240-290504/2-A	Lab Control Sample	Total/NA	Solid	5035	

Analysis Batch: 290719

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-83367-1	SB17-34_0"-6"_080417	Total/NA	Solid	8260B	290504
240-83367-2	SB17-34_18"-24"_080417	Total/NA	Solid	8260B	290504
240-83367-3	SB17-35_0"-6"_080417	Total/NA	Solid	8260B	290504
240-83367-6	SB17-36_24"-30"_080417	Total/NA	Solid	8260B	290504
240-83367-7	SB17-37_0"-6"_080417	Total/NA	Solid	8260B	290504
240-83367-8	SB17-37_30"-36"_080417	Total/NA	Solid	8260B	290504
240-83367-9	SB17-38_0"-6"_080417	Total/NA	Solid	8260B	290504
240-83367-10	SB17-38_18"-24"_080417	Total/NA	Solid	8260B	290504
240-83367-11	SB17-39_0"-6"_080417	Total/NA	Solid	8260B	290504
240-83367-12	SB17-39_18"-24"_080417	Total/NA	Solid	8260B	290504
240-83367-13	SB17-40_0"-6"_080417	Total/NA	Solid	8260B	290504
240-83367-14	SB17-40_18"-24"_080417	Total/NA	Solid	8260B	290504
MB 240-290504/1-A	Method Blank	Total/NA	Solid	8260B	290504
LCS 240-290504/2-A	Lab Control Sample	Total/NA	Solid	8260B	290504

Analysis Batch: 290886

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-83367-4	SB17-35_24"-30"_080417	Total/NA	Solid	8260B	290504
240-83367-5	SB17-36_0"-6"_080417	Total/NA	Solid	8260B	290504

Analysis Batch: 291046

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-83367-15	TRIP BLANK_080417	Total/NA	Water	8260B	
MB 240-291046/6	Method Blank	Total/NA	Water	8260B	
LCS 240-291046/4	Lab Control Sample	Total/NA	Water	8260B	

General Chemistry

Analysis Batch: 290309

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-83367-1	SB17-34_0"-6"_080417	Total/NA	Solid	Moisture	

TestAmerica Canton

QC Association Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

General Chemistry (Continued)

Analysis Batch: 290309 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-83367-2	SB17-34_18"-24"_080417	Total/NA	Solid	Moisture	
240-83367-3	SB17-35_0"-6"_080417	Total/NA	Solid	Moisture	
240-83367-4	SB17-35_24"-30"_080417	Total/NA	Solid	Moisture	
240-83367-5	SB17-36_0"-6"_080417	Total/NA	Solid	Moisture	
240-83367-6	SB17-36_24"-30"_080417	Total/NA	Solid	Moisture	
240-83367-7	SB17-37_0"-6"_080417	Total/NA	Solid	Moisture	
240-83367-8	SB17-37_30"-36"_080417	Total/NA	Solid	Moisture	
240-83367-9	SB17-38_0"-6"_080417	Total/NA	Solid	Moisture	
240-83367-10	SB17-38_18"-24"_080417	Total/NA	Solid	Moisture	
240-83367-11	SB17-39_0"-6"_080417	Total/NA	Solid	Moisture	
240-83367-12	SB17-39_18"-24"_080417	Total/NA	Solid	Moisture	
240-83367-13	SB17-40_0"-6"_080417	Total/NA	Solid	Moisture	
240-83367-14	SB17-40_18"-24"_080417	Total/NA	Solid	Moisture	
240-83367-8 DU	SB17-37_30"-36"_080417	Total/NA	Solid	Moisture	

Lab Chronicle

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-34_0"-6"_080417

Date Collected: 08/04/17 12:00

Date Received: 08/08/17 09:00

Lab Sample ID: 240-83367-1

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-34_0"-6"_080417

Date Collected: 08/04/17 12:00

Date Received: 08/08/17 09:00

Lab Sample ID: 240-83367-1

Matrix: Solid

Percent Solids: 80.7

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 18:14	TJL1	TAL CAN

Client Sample ID: SB17-34_18"-24"_080417

Date Collected: 08/04/17 12:15

Date Received: 08/08/17 09:00

Lab Sample ID: 240-83367-2

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-34_18"-24"_080417

Date Collected: 08/04/17 12:15

Date Received: 08/08/17 09:00

Lab Sample ID: 240-83367-2

Matrix: Solid

Percent Solids: 79.1

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 18:38	TJL1	TAL CAN

Client Sample ID: SB17-35_0"-6"_080417

Date Collected: 08/04/17 12:45

Date Received: 08/08/17 09:00

Lab Sample ID: 240-83367-3

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-35_0"-6"_080417

Date Collected: 08/04/17 12:45

Date Received: 08/08/17 09:00

Lab Sample ID: 240-83367-3

Matrix: Solid

Percent Solids: 91.3

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 19:02	TJL1	TAL CAN

TestAmerica Canton

Lab Chronicle

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-35_24"-30"_080417

Lab Sample ID: 240-83367-4

Date Collected: 08/04/17 13:00

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-35_24"-30"_080417

Lab Sample ID: 240-83367-4

Date Collected: 08/04/17 13:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 84.9

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		8	290886	08/11/17 17:06	TJL1	TAL CAN

Client Sample ID: SB17-36_0"-6"_080417

Lab Sample ID: 240-83367-5

Date Collected: 08/04/17 13:45

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-36_0"-6"_080417

Lab Sample ID: 240-83367-5

Date Collected: 08/04/17 13:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 92.1

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290886	08/11/17 17:30	TJL1	TAL CAN

Client Sample ID: SB17-36_24"-30"_080417

Lab Sample ID: 240-83367-6

Date Collected: 08/04/17 14:00

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-36_24"-30"_080417

Lab Sample ID: 240-83367-6

Date Collected: 08/04/17 14:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.5

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 20:18	TJL1	TAL CAN

TestAmerica Canton

Lab Chronicle

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-37_0"-6"_080417

Lab Sample ID: 240-83367-7

Date Collected: 08/04/17 14:30

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-37_0"-6"_080417

Lab Sample ID: 240-83367-7

Date Collected: 08/04/17 14:30

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 90.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 20:42	TJL1	TAL CAN

Client Sample ID: SB17-37_30"-36"_080417

Lab Sample ID: 240-83367-8

Date Collected: 08/04/17 14:45

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-37_30"-36"_080417

Lab Sample ID: 240-83367-8

Date Collected: 08/04/17 14:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.7

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 21:06	TJL1	TAL CAN

Client Sample ID: SB17-38_0"-6"_080417

Lab Sample ID: 240-83367-9

Date Collected: 08/04/17 15:00

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-38_0"-6"_080417

Lab Sample ID: 240-83367-9

Date Collected: 08/04/17 15:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 73.7

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 21:30	TJL1	TAL CAN

TestAmerica Canton

Lab Chronicle

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-38_18"-24"_080417

Lab Sample ID: 240-83367-10

Date Collected: 08/04/17 15:15

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:40	PW	TAL CAN

Client Sample ID: SB17-38_18"-24"_080417

Lab Sample ID: 240-83367-10

Date Collected: 08/04/17 15:15

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 85.4

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 21:53	TJL1	TAL CAN

Client Sample ID: SB17-39_0"-6"_080417

Lab Sample ID: 240-83367-11

Date Collected: 08/04/17 15:30

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:48	PW	TAL CAN

Client Sample ID: SB17-39_0"-6"_080417

Lab Sample ID: 240-83367-11

Date Collected: 08/04/17 15:30

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 90.0

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 22:15	TJL1	TAL CAN

Client Sample ID: SB17-39_18"-24"_080417

Lab Sample ID: 240-83367-12

Date Collected: 08/04/17 15:45

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:48	PW	TAL CAN

Client Sample ID: SB17-39_18"-24"_080417

Lab Sample ID: 240-83367-12

Date Collected: 08/04/17 15:45

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 86.2

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 22:39	TJL1	TAL CAN

TestAmerica Canton

Lab Chronicle

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Client Sample ID: SB17-40_0"-6"_080417

Lab Sample ID: 240-83367-13

Date Collected: 08/04/17 16:00

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:48	PW	TAL CAN

Client Sample ID: SB17-40_0"-6"_080417

Lab Sample ID: 240-83367-13

Date Collected: 08/04/17 16:00

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 89.5

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 23:03	TJL1	TAL CAN

Client Sample ID: SB17-40_18"-24"_080417

Lab Sample ID: 240-83367-14

Date Collected: 08/04/17 16:15

Matrix: Solid

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	290309	08/08/17 14:48	PW	TAL CAN

Client Sample ID: SB17-40_18"-24"_080417

Lab Sample ID: 240-83367-14

Date Collected: 08/04/17 16:15

Matrix: Solid

Date Received: 08/08/17 09:00

Percent Solids: 84.4

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			290504	08/09/17 11:32	LAM	TAL CAN
Total/NA	Analysis	8260B		1	290719	08/10/17 23:27	TJL1	TAL CAN

Client Sample ID: TRIP BLANK_080417

Lab Sample ID: 240-83367-15

Date Collected: 08/04/17 00:00

Matrix: Water

Date Received: 08/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	8260B		1	291046	08/14/17 14:40	LRW	TAL CAN

Laboratory References:

TAL CAN = TestAmerica Canton, 4101 Shuffel Street NW, North Canton, OH 44720, TEL (330)497-9396

TestAmerica Canton

Accreditation/Certification Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw SMI

TestAmerica Job ID: 240-83367-1

Laboratory: TestAmerica Canton

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
California	State Program	9	2927	02-23-18
Connecticut	State Program	1	PH-0590	12-31-17 *
Florida	NELAP	4	E87225	06-30-18
Illinois	NELAP	5	200004	07-31-18
Kansas	NELAP	7	E-10336	01-31-18 *
Kentucky (UST)	State Program	4	58	02-23-18
Kentucky (WW)	State Program	4	98016	12-31-17 *
Minnesota	NELAP	5	039-999-348	12-31-17 *
Minnesota (Petrofund)	State Program	1	3506	07-31-17 *
Nevada	State Program	9	OH-000482008A	07-31-18
New Jersey	NELAP	2	OH001	06-30-18
New York	NELAP	2	10975	03-31-18
Ohio VAP	State Program	5	CL0024	09-14-17 *
Oregon	NELAP	10	4062	02-23-18
Pennsylvania	NELAP	3	68-00340	08-31-17 *
Texas	NELAP	6	T104704517-15-5	08-31-17 *
USDA	Federal		P330-16-00404	12-28-19
Virginia	NELAP	3	460175	09-14-17 *
Washington	State Program	10	C971	01-12-18 *
West Virginia DEP	State Program	3	210	12-31-17 *
Wisconsin	State Program	5	999518190	08-31-17 *

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

TestAmerica Canton

SERIAL NUMBER:

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

MICHIGAN
190

BP TRANCHE

TestAmerica

4101 Shuffel Street NW
North Canton, OH 44720

Phone: 330-497-9396

Fax: 330-497-0772

Website: www.testamericainc.com

QUOTE NO.

BOTTLE ORDER NO.

ORDER - LOG-IN NO.

CONSULTANT: Arcadis		ARCADIS OFFICE ADDRESS 28550 Cabot Drive, Suite 500, Novi, MI 48377		ARCADIS PM Scott Clearwater		REQUESTED ANALYSIS		PAGE 2 OF 2	
FACILITY ID# & ADDRESS (CITY & STATE) Racer Saginaw Plant 2 Landfill		ARCADIS WORK AUTHORIZATION # B00064434.2017.00010				POSSIBLE HAZARD IDENTIFICATION			
SAMPLED BY Bill Coburn		810-588-3642		CLIENT E-MAIL OR FAX kristen.patron@arcadis.com		MATRIX			
CLIENT PHONE 810-225-1928						PRESERVATIVE			
TAT REQUESTED: RUSH NEEDS LAB PREAPPROVAL ☐ NORMAL - 14 CALENDAR DAYS						HCL - Hydrochloric Acid			
☐ 1 DAY ☐ 2 DAYS ☐ 5 DAYS ☐ 10 DAYS ☐ OTHER:						HNO3 - Nitric Acid			
SAMPLE DISPOSAL: ☐ RETURN TO CLIENT ☐ DISPOSAL BY LAB						H2SO4 - Sulfuric Acid or H3PO4			
PACKAGE (DELIVERABLE): ☐ TX TRRP ☐ NJ ☐ OTHER:						NAOH - Sodium Hydroxide			
						MEOH - Methanol			
						NAHSO4 - Sodium Bisulfate			
						NA2S2O3 - Sodium Thiosulfate			
						Other:			
						Drinking Water			
						Aqueous GW, SW, WW			
						Solid, Semisolid, Sediment			
						Air			
						NonAqueous (Oil, Solvent, etc.)			

SAMPLE		SAMPLE IDENTIFICATION		RELINQUISHED BY: (SIGNATURE)		RECEIVED BY: (SIGNATURE)		TIME		DATE		RELINQUISHED BY: (SIGNATURE)		RECEIVED BY: (SIGNATURE)		TIME		DATE	
DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME	DATE	TIME
8/4/2017	16:15	SB17-40_18*24*_080417		8/7/17	10:00	8/7/17	10:00	8/7/17	10:00	8/7/17	10:00	8/7/17	10:00	8/7/17	10:00	8/7/17	10:00	8/7/17	10:00
		Trip Blank_080417																	

RECEIVED FOR LABORATORY BY:		DATE		TIME		CUSTODY INTACT? ☐ YES ☐ NO		CUSTODY SEAL NO.		LABORATORY USE ONLY		COOLER TEMPERATURE(S) °C & OTHER REMARKS:	



TestAmerica Canton Sample Receipt Form/Narrative
Canton Facility

Login # : 83307

Client Arcadis Site Name _____ Cooler unpacked by: _____

Cooler Received on 8-8-17 Opened on 8-8-17

FedEx: 1st Grd Exp UPS FAS Clipper Client Drop Off TestAmerica Courier Other _____

Receipt After-hours: Drop-off Date/Time _____ Storage Location _____

TestAmerica Cooler # _____ Foam Box _____ Client Cooler _____ Box _____ Other _____

Packing material used: Bubble Wrap _____ Foam _____ Plastic Bag _____ None _____ Other _____

COOLANT: Wet Ice Blue Ice _____ Dry Ice _____ Water _____ None _____

1. Cooler temperature upon receipt ☐ See Multiple Cooler Form

IR GUN# IR-8 (CF -0.4 °C) Observed Cooler Temp. _____ °C Corrected Cooler Temp. _____ °C

IR GUN #36 (CF +0 °C) Observed Cooler Temp. 1-2 °C Corrected Cooler Temp. 1-2 °C

2. Were custody seals on the outside of the cooler(s)? If Yes Quantity 1 Yes No

-Were custody seals on the outside of the cooler(s) signed & dated? Yes No NA

-Were custody seals on the bottle(s) or bottle kits (LLHg/MeHg)? Yes No

3. Shippers' packing slip attached to the cooler(s)? Yes No

4. Did custody papers accompany the sample(s)? Yes No

5. Were the custody papers relinquished & signed in the appropriate place? Yes No

6. Was/were the person(s) who collected the samples clearly identified on the COC? Yes No

7. Did all bottles arrive in good condition (Unbroken)? Yes No

8. Could all bottle labels be reconciled with the COC? Yes No

9. Were correct bottle(s) used for the test(s) indicated? Yes No

10. Sufficient quantity received to perform indicated analyses? Yes No

11. Are these work share samples? Yes No

If yes, Questions 11-15 have been checked at the originating laboratory.

11. Were sample(s) at the correct pH upon receipt? Yes No NA pH Strip Lot# HC697954

12. Were VOAs on the COC? Yes No

13. Were air bubbles >6 mm in any VOA vials?  Larger than this. Yes No NA

14. Was a VOA trip blank present in the cooler(s)? Trip Blank Lot # _____ Yes No

15. Was a LL Hg or Me Hg trip blank present? Yes No

Contacted PM _____ Date _____ by _____ via Verbal Voice Mail Other _____

Concerning _____

16. CHAIN OF CUSTODY & SAMPLE DISCREPANCIES

Samples processed by: _____

17. SAMPLE CONDITION

Sample(s) _____ were received after the recommended holding time had expired.

Sample(s) _____ were received in a broken container.

Sample(s) _____ were received with bubble >6 mm in diameter. (Notify PM)

18. SAMPLE PRESERVATION

Sample(s) _____ were further preserved in the laboratory.

Time preserved: _____ Preservative(s) added/Lot number(s): _____

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.

TestAmerica Canton

4101 Shuffel Street NW

North Canton, OH 44720

Tel: (330)497-9396

TestAmerica Job ID: 240-84655-1

Client Project/Site: Racer Saginaw Malleable Industrial Land

For:

ARCADIS U.S., Inc.

28550 Cabot Drive

Suite 500

Novi, Michigan 48377

Attn: Scott Clearwater

Denise Pohl

Authorized for release by:

9/11/2017 2:27:15 PM

Denise Pohl, Project Manager II

(330)966-9789

denise.pohl@testamericainc.com

LINKS

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results through

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Have a Question?



Visit us at:

www.testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

Table of Contents

Cover Page	1
Table of Contents	2
Definitions/Glossary	3
Case Narrative	4
Method Summary	6
Sample Summary	7
Detection Summary	8
Client Sample Results	9
Surrogate Summary	19
QC Sample Results	20
QC Association Summary	23
Lab Chronicle	24
Certification Summary	26
Chain of Custody	27



Definitions/Glossary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Qualifiers

GC/MS VOA

Qualifier	Qualifier Description
U	Indicates the analyte was analyzed for but not detected.
J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
α	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Case Narrative

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Job ID: 240-84655-1

Laboratory: TestAmerica Canton

Narrative

CASE NARRATIVE

Client: ARCADIS U.S., Inc.

Project: Racer Saginaw Malleable Industrial Land

Report Number: 240-84655-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica Canton attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header.

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

RECEIPT

The samples were received on 9/8/2017 9:00 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 3.4° C.

VOLATILE ORGANIC COMPOUNDS (GCMS)

Samples SB17-48_0-6"_09072017 (240-84655-1), SB17-48_30-36"_09072017 (240-84655-2), SB17-49_0-6"_09072017 (240-84655-3), SB17-49_30-36"_09072017 (240-84655-4) and TRIP BLANK (240-84655-5) were analyzed for volatile organic compounds (GCMS) in accordance with EPA SW-846 Method 8260B. The samples were prepared and analyzed on 09/08/2017.

Method(s) 5035: The following samples were received in pre-weighed containers with a label that was added in the field, which would cause a slight low bias in the final results. SB17-48_0-6"_09072017 (240-84655-1), SB17-48_30-36"_09072017 (240-84655-2), SB17-49_0-6"_09072017 (240-84655-3), SB17-49_30-36"_09072017 (240-84655-4) and TRIP BLANK (240-84655-5).

Method(s) 8260B: Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with preparation batch 240-294157 and analytical batch 240-294104.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Case Narrative

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Job ID: 240-84655-1 (Continued)

Laboratory: TestAmerica Canton (Continued)

PERCENT SOLIDS

Samples SB17-48_0-6"_09072017 (240-84655-1), SB17-48_30-36"_09072017 (240-84655-2), SB17-49_0-6"_09072017 (240-84655-3) and SB17-49_30-36"_09072017 (240-84655-4) were analyzed for percent solids in accordance with EPA Method 160.3 MOD. The samples were analyzed on 09/08/2017.

Percent Moisture exceeded the RPD limit for the duplicate of sample 240-84618-8. Refer to the QC report for details.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Method Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Method	Method Description	Protocol	Laboratory
8260B	Volatile Organic Compounds (GC/MS)	SW846	TAL CAN
Moisture	Percent Moisture	EPA	TAL CAN

Protocol References:

EPA = US Environmental Protection Agency

SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

TAL CAN = TestAmerica Canton, 4101 Shuffel Street NW, North Canton, OH 44720, TEL (330)497-9396

Sample Summary

Client: ARCADIS U.S., Inc.

Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
240-84655-1	SB17-48_0-6"_09072017	Solid	09/07/17 10:25	09/08/17 09:00
240-84655-2	SB17-48_30-36"_09072017	Solid	09/07/17 10:30	09/08/17 09:00
240-84655-3	SB17-49_0-6"_09072017	Solid	09/07/17 10:55	09/08/17 09:00
240-84655-4	SB17-49_30-36"_09072017	Solid	09/07/17 11:00	09/08/17 09:00
240-84655-5	TRIP BLANK	Solid	09/07/17 00:00	09/08/17 09:00

Detection Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-48_0-6"_09072017

Lab Sample ID: 240-84655-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Benzene	270		48	29	ug/Kg	1		✖	8260B	Total/NA
Cyclohexane	340	J	1100	36	ug/Kg	1		✖	8260B	Total/NA
Ethylbenzene	87		48	42	ug/Kg	1		✖	8260B	Total/NA
Methyl acetate	1400		1100	89	ug/Kg	1		✖	8260B	Total/NA
Methylcyclohexane	450	J	1100	44	ug/Kg	1		✖	8260B	Total/NA
Toluene	380		95	29	ug/Kg	1		✖	8260B	Total/NA
1,2,4-Trichlorobenzene	42	J	240	31	ug/Kg	1		✖	8260B	Total/NA
Xylenes, Total	470		140	33	ug/Kg	1		✖	8260B	Total/NA

Client Sample ID: SB17-48_30-36"_09072017

Lab Sample ID: 240-84655-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Cyclohexane	82	J	1200	38	ug/Kg	1		✖	8260B	Total/NA
Methylcyclohexane	150	J	1200	46	ug/Kg	1		✖	8260B	Total/NA
Toluene	36	J	100	30	ug/Kg	1		✖	8260B	Total/NA
Xylenes, Total	110	J	150	35	ug/Kg	1		✖	8260B	Total/NA

Client Sample ID: SB17-49_0-6"_09072017

Lab Sample ID: 240-84655-3

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Acetone	150	J	750	120	ug/Kg	1		✖	8260B	Total/NA
Benzene	170		50	30	ug/Kg	1		✖	8260B	Total/NA
Cyclohexane	750	J	1200	38	ug/Kg	1		✖	8260B	Total/NA
Methylcyclohexane	750	J	1200	47	ug/Kg	1		✖	8260B	Total/NA
Tetrachloroethene	120		50	26	ug/Kg	1		✖	8260B	Total/NA
Toluene	150		100	30	ug/Kg	1		✖	8260B	Total/NA
1,1,1-Trichloroethane	350		50	35	ug/Kg	1		✖	8260B	Total/NA
Xylenes, Total	80	J	150	35	ug/Kg	1		✖	8260B	Total/NA

Client Sample ID: SB17-49_30-36"_09072017

Lab Sample ID: 240-84655-4

Analyte	Result	Qualifier	RL	MDL	Unit	Dil	Fac	D	Method	Prep Type
Acetone	360	J	770	120	ug/Kg	1		✖	8260B	Total/NA
Benzene	1200		52	31	ug/Kg	1		✖	8260B	Total/NA
Cyclohexane	1600		1200	39	ug/Kg	1		✖	8260B	Total/NA
Ethylbenzene	170		52	45	ug/Kg	1		✖	8260B	Total/NA
Methyl acetate	97	J	1200	97	ug/Kg	1		✖	8260B	Total/NA
Methylcyclohexane	1500		1200	48	ug/Kg	1		✖	8260B	Total/NA
Styrene	19	J	52	13	ug/Kg	1		✖	8260B	Total/NA
Tetrachloroethene	97		52	27	ug/Kg	1		✖	8260B	Total/NA
Toluene	1300		100	31	ug/Kg	1		✖	8260B	Total/NA
1,1,1-Trichloroethane	390		52	36	ug/Kg	1		✖	8260B	Total/NA
Xylenes, Total	2300		150	36	ug/Kg	1		✖	8260B	Total/NA

Client Sample ID: TRIP BLANK

Lab Sample ID: 240-84655-5

No Detections.

This Detection Summary does not include radiochemical test results.

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-48_0-6"_09072017

Lab Sample ID: 240-84655-1

Date Collected: 09/07/17 10:25

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 89.9

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	710	U	710	120	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Benzene	270		48	29	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Bromodichloromethane	95	U	95	21	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Bromoform	95	U	95	27	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Bromomethane	240	U	240	33	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
2-Butanone (MEK)	710	U	710	60	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Carbon disulfide	240	U	240	21	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Carbon tetrachloride	48	U	48	32	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Chlorobenzene	48	U	48	36	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Chloroethane	240	U	240	33	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Chloroform	48	U	48	29	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Chloromethane	240	U	240	21	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
cis-1,2-Dichloroethene	48	U	48	42	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
cis-1,3-Dichloropropene	48	U	48	27	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Cyclohexane	340	J	1100	36	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Dibromochloromethane	48	U	48	41	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,2-Dibromo-3-Chloropropane	240	U	240	57	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,2-Dibromoethane	240	U	240	27	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,2-Dichlorobenzene	95	U	95	21	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,3-Dichlorobenzene	95	U	95	45	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,4-Dichlorobenzene	95	U	95	32	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Dichlorodifluoromethane	95	U	95	26	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,1-Dichloroethane	48	U	48	37	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,2-Dichloroethane	48	U	48	36	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,1-Dichloroethene	48	U	48	43	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,2-Dichloropropane	48	U	48	36	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Ethylbenzene	87		48	42	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
2-Hexanone	2400	U	2400	100	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Isopropylbenzene	240	U	240	41	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Methyl acetate	1400		1100	89	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Methylcyclohexane	450	J	1100	44	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Methylene Chloride	240	U	240	77	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
4-Methyl-2-pentanone (MIBK)	2400	U	2400	48	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Methyl tert-butyl ether	240	U	240	31	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Styrene	48	U	48	12	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,1,2,2-Tetrachloroethane	48	U	48	29	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Tetrachloroethene	48	U	48	25	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Toluene	380		95	29	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
trans-1,2-Dichloroethene	48	U	48	42	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
trans-1,3-Dichloropropene	48	U	48	18	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,2,4-Trichlorobenzene	42	J	240	31	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,1,1-Trichloroethane	48	U	48	33	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,1,2-Trichloroethane	48	U	48	27	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Trichloroethene	48	U	48	44	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Trichlorofluoromethane	95	U	95	41	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
1,1,2-Trichloro-1,2,2-trifluoroethane	240	U	240	27	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Vinyl chloride	38	U	38	20	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1
Xylenes, Total	470		140	33	ug/Kg	☼	09/08/17 11:08	09/08/17 17:40	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-48_0-6"_09072017

Lab Sample ID: 240-84655-1

Date Collected: 09/07/17 10:25

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 89.9

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	88		58 - 142	09/08/17 11:08	09/08/17 17:40	1
Dibromofluoromethane (Surr)	90		31 - 155	09/08/17 11:08	09/08/17 17:40	1
1,2-Dichloroethane-d4 (Surr)	90		64 - 144	09/08/17 11:08	09/08/17 17:40	1
Toluene-d8 (Surr)	100		61 - 137	09/08/17 11:08	09/08/17 17:40	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	89.9		0.1	0.1	%			09/08/17 08:53	1
Percent Moisture	10.1		0.1	0.1	%			09/08/17 08:53	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-48_30-36"_09072017

Lab Sample ID: 240-84655-2

Date Collected: 09/07/17 10:30

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 88.9

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	750	U	750	120	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Benzene	50	U	50	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Bromodichloromethane	100	U	100	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Bromoform	100	U	100	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Bromomethane	250	U	250	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
2-Butanone (MEK)	750	U	750	63	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Carbon disulfide	250	U	250	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Carbon tetrachloride	50	U	50	34	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Chlorobenzene	50	U	50	38	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Chloroethane	250	U	250	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Chloroform	50	U	50	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Chloromethane	250	U	250	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
cis-1,2-Dichloroethene	50	U	50	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
cis-1,3-Dichloropropene	50	U	50	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Cyclohexane	82	J	1200	38	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Dibromochloromethane	50	U	50	43	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,2-Dibromo-3-Chloropropane	250	U	250	60	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,2-Dibromoethane	250	U	250	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,2-Dichlorobenzene	100	U	100	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,3-Dichlorobenzene	100	U	100	48	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,4-Dichlorobenzene	100	U	100	34	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Dichlorodifluoromethane	100	U	100	28	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,1-Dichloroethane	50	U	50	39	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,2-Dichloroethane	50	U	50	38	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,1-Dichloroethene	50	U	50	45	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,2-Dichloropropane	50	U	50	38	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Ethylbenzene	50	U	50	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
2-Hexanone	2500	U	2500	110	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Isopropylbenzene	250	U	250	43	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Methyl acetate	1200	U	1200	94	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Methylcyclohexane	150	J	1200	46	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Methylene Chloride	250	U	250	82	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
4-Methyl-2-pentanone (MIBK)	2500	U	2500	50	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Methyl tert-butyl ether	250	U	250	33	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Styrene	50	U	50	13	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,1,2,2-Tetrachloroethane	50	U	50	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Tetrachloroethene	50	U	50	26	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Toluene	36	J	100	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
trans-1,2-Dichloroethene	50	U	50	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
trans-1,3-Dichloropropene	50	U	50	19	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,2,4-Trichlorobenzene	250	U	250	33	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,1,1-Trichloroethane	50	U	50	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,1,2-Trichloroethane	50	U	50	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Trichloroethene	50	U	50	46	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Trichlorofluoromethane	100	U	100	43	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
1,1,2-Trichloro-1,2,2-trifluoroethane	250	U	250	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Vinyl chloride	40	U	40	21	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1
Xylenes, Total	110	J	150	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:03	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-48_30-36"_09072017

Lab Sample ID: 240-84655-2

Date Collected: 09/07/17 10:30

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 88.9

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	87		58 - 142	09/08/17 11:08	09/08/17 18:03	1
Dibromofluoromethane (Surr)	94		31 - 155	09/08/17 11:08	09/08/17 18:03	1
1,2-Dichloroethane-d4 (Surr)	88		64 - 144	09/08/17 11:08	09/08/17 18:03	1
Toluene-d8 (Surr)	98		61 - 137	09/08/17 11:08	09/08/17 18:03	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	88.9		0.1	0.1	%			09/08/17 08:53	1
Percent Moisture	11.1		0.1	0.1	%			09/08/17 08:53	1

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-49_0-6"_09072017

Lab Sample ID: 240-84655-3

Date Collected: 09/07/17 10:55

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 86.6

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	150	J	750	120	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Benzene	170		50	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Bromodichloromethane	100	U	100	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Bromoform	100	U	100	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Bromomethane	250	U	250	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
2-Butanone (MEK)	750	U	750	63	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Carbon disulfide	250	U	250	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Carbon tetrachloride	50	U	50	34	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Chlorobenzene	50	U	50	38	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Chloroethane	250	U	250	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Chloroform	50	U	50	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Chloromethane	250	U	250	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
cis-1,2-Dichloroethene	50	U	50	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
cis-1,3-Dichloropropene	50	U	50	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Cyclohexane	750	J	1200	38	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Dibromochloromethane	50	U	50	43	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,2-Dibromo-3-Chloropropane	250	U	250	60	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,2-Dibromoethane	250	U	250	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,2-Dichlorobenzene	100	U	100	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,3-Dichlorobenzene	100	U	100	48	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,4-Dichlorobenzene	100	U	100	34	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Dichlorodifluoromethane	100	U	100	28	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,1-Dichloroethane	50	U	50	39	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,2-Dichloroethane	50	U	50	38	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,1-Dichloroethene	50	U	50	45	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,2-Dichloropropane	50	U	50	38	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Ethylbenzene	50	U	50	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
2-Hexanone	2500	U	2500	110	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Isopropylbenzene	250	U	250	43	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Methyl acetate	1200	U	1200	94	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Methylcyclohexane	750	J	1200	47	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Methylene Chloride	250	U	250	82	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
4-Methyl-2-pentanone (MIBK)	2500	U	2500	50	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Methyl tert-butyl ether	250	U	250	33	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Styrene	50	U	50	13	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,1,2,2-Tetrachloroethane	50	U	50	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Tetrachloroethene	120		50	26	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Toluene	150		100	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
trans-1,2-Dichloroethene	50	U	50	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
trans-1,3-Dichloropropene	50	U	50	19	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,2,4-Trichlorobenzene	250	U	250	33	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,1,1-Trichloroethane	350		50	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,1,2-Trichloroethane	50	U	50	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Trichloroethene	50	U	50	47	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Trichlorofluoromethane	100	U	100	43	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
1,1,2-Trichloro-1,2,2-trifluoroethane	250	U	250	29	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Vinyl chloride	40	U	40	21	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1
Xylenes, Total	80	J	150	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:27	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-49_0-6"_09072017

Lab Sample ID: 240-84655-3

Date Collected: 09/07/17 10:55

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 86.6

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	85		58 - 142	09/08/17 11:08	09/08/17 18:27	1
Dibromofluoromethane (Surr)	101		31 - 155	09/08/17 11:08	09/08/17 18:27	1
1,2-Dichloroethane-d4 (Surr)	96		64 - 144	09/08/17 11:08	09/08/17 18:27	1
Toluene-d8 (Surr)	100		61 - 137	09/08/17 11:08	09/08/17 18:27	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	86.6		0.1	0.1	%			09/08/17 08:53	1
Percent Moisture	13.4		0.1	0.1	%			09/08/17 08:53	1

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-49_30-36"_09072017

Lab Sample ID: 240-84655-4

Date Collected: 09/07/17 11:00

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 90.8

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	360	J	770	120	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Benzene	1200		52	31	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Bromodichloromethane	100	U	100	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Bromoform	100	U	100	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Bromomethane	260	U	260	36	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
2-Butanone (MEK)	770	U	770	64	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Carbon disulfide	260	U	260	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Carbon tetrachloride	52	U	52	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Chlorobenzene	52	U	52	39	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Chloroethane	260	U	260	36	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Chloroform	52	U	52	31	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Chloromethane	260	U	260	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
cis-1,2-Dichloroethene	52	U	52	45	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
cis-1,3-Dichloropropene	52	U	52	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Cyclohexane	1600		1200	39	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Dibromochloromethane	52	U	52	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,2-Dibromo-3-Chloropropane	260	U	260	62	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,2-Dibromoethane	260	U	260	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,2-Dichlorobenzene	100	U	100	23	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,3-Dichlorobenzene	100	U	100	49	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,4-Dichlorobenzene	100	U	100	35	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Dichlorodifluoromethane	100	U	100	28	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,1-Dichloroethane	52	U	52	40	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,2-Dichloroethane	52	U	52	39	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,1-Dichloroethene	52	U	52	46	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,2-Dichloropropane	52	U	52	39	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Ethylbenzene	170		52	45	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
2-Hexanone	2600	U	2600	110	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Isopropylbenzene	260	U	260	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Methyl acetate	97	J	1200	97	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Methylcyclohexane	1500		1200	48	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Methylene Chloride	260	U	260	84	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
4-Methyl-2-pentanone (MIBK)	2600	U	2600	52	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Methyl tert-butyl ether	260	U	260	33	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Styrene	19	J	52	13	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,1,2,2-Tetrachloroethane	52	U	52	31	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Tetrachloroethene	97		52	27	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Toluene	1300		100	31	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
trans-1,2-Dichloroethene	52	U	52	45	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
trans-1,3-Dichloropropene	52	U	52	19	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,2,4-Trichlorobenzene	260	U	260	33	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,1,1-Trichloroethane	390		52	36	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,1,2-Trichloroethane	52	U	52	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Trichloroethene	52	U	52	48	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Trichlorofluoromethane	100	U	100	44	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
1,1,2-Trichloro-1,2,2-trifluoroethane	260	U	260	30	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Vinyl chloride	41	U	41	22	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1
Xylenes, Total	2300		150	36	ug/Kg	☼	09/08/17 11:08	09/08/17 18:50	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-49_30-36"_09072017

Lab Sample ID: 240-84655-4

Date Collected: 09/07/17 11:00

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 90.8

Surrogate	%Recovery	Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	81		58 - 142	09/08/17 11:08	09/08/17 18:50	1
Dibromofluoromethane (Surr)	92		31 - 155	09/08/17 11:08	09/08/17 18:50	1
1,2-Dichloroethane-d4 (Surr)	85		64 - 144	09/08/17 11:08	09/08/17 18:50	1
Toluene-d8 (Surr)	94		61 - 137	09/08/17 11:08	09/08/17 18:50	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	90.8		0.1	0.1	%			09/08/17 08:53	1
Percent Moisture	9.2		0.1	0.1	%			09/08/17 08:53	1

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: TRIP BLANK

Date Collected: 09/07/17 00:00

Date Received: 09/08/17 09:00

Lab Sample ID: 240-84655-5

Matrix: Solid

Method: 8260B - Volatile Organic Compounds (GC/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	600	U	600	97	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Benzene	40	U	40	24	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Bromodichloromethane	80	U	80	18	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Bromoform	80	U	80	23	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Bromomethane	200	U	200	28	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
2-Butanone (MEK)	600	U	600	50	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Carbon disulfide	200	U	200	18	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Carbon tetrachloride	40	U	40	27	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Chlorobenzene	40	U	40	30	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Chloroethane	200	U	200	28	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Chloroform	40	U	40	24	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Chloromethane	200	U	200	18	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
cis-1,2-Dichloroethene	40	U	40	35	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
cis-1,3-Dichloropropene	40	U	40	23	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Cyclohexane	960	U	960	30	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Dibromochloromethane	40	U	40	34	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,2-Dibromo-3-Chloropropane	200	U	200	48	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,2-Dibromoethane	200	U	200	23	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,2-Dichlorobenzene	80	U	80	18	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,3-Dichlorobenzene	80	U	80	38	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,4-Dichlorobenzene	80	U	80	27	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Dichlorodifluoromethane	80	U	80	22	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,1-Dichloroethane	40	U	40	31	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,2-Dichloroethane	40	U	40	30	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,1-Dichloroethene	40	U	40	36	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,2-Dichloropropane	40	U	40	30	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Ethylbenzene	40	U	40	35	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
2-Hexanone	2000	U	2000	86	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Isopropylbenzene	200	U	200	34	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Methyl acetate	960	U	960	75	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Methylcyclohexane	960	U	960	37	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Methylene Chloride	200	U	200	65	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
4-Methyl-2-pentanone (MIBK)	2000	U	2000	40	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Methyl tert-butyl ether	200	U	200	26	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Styrene	40	U	40	10	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,1,2,2-Tetrachloroethane	40	U	40	24	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Tetrachloroethene	40	U	40	21	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Toluene	80	U	80	24	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
trans-1,2-Dichloroethene	40	U	40	35	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
trans-1,3-Dichloropropene	40	U	40	15	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,2,4-Trichlorobenzene	200	U	200	26	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,1,1-Trichloroethane	40	U	40	28	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,1,2-Trichloroethane	40	U	40	23	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Trichloroethene	40	U	40	37	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Trichlorofluoromethane	80	U	80	34	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
1,1,2-Trichloro-1,2,2-trifluoroethane	200	U	200	23	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Vinyl chloride	32	U	32	17	ug/Kg		09/08/17 11:08	09/08/17 19:13	1
Xylenes, Total	120	U	120	28	ug/Kg		09/08/17 11:08	09/08/17 19:13	1

TestAmerica Canton

Client Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: TRIP BLANK

Date Collected: 09/07/17 00:00

Date Received: 09/08/17 09:00

Lab Sample ID: 240-84655-5

Matrix: Solid

<i>Surrogate</i>	<i>%Recovery</i>	<i>Qualifier</i>	<i>Limits</i>	<i>Prepared</i>	<i>Analyzed</i>	<i>Dil Fac</i>
4-Bromofluorobenzene (Surr)	77		58 - 142	09/08/17 11:08	09/08/17 19:13	1
Dibromofluoromethane (Surr)	83		31 - 155	09/08/17 11:08	09/08/17 19:13	1
1,2-Dichloroethane-d4 (Surr)	79		64 - 144	09/08/17 11:08	09/08/17 19:13	1
Toluene-d8 (Surr)	84		61 - 137	09/08/17 11:08	09/08/17 19:13	1

Surrogate Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Matrix: Solid

Prep Type: Total/NA

Lab Sample ID	Client Sample ID	Percent Surrogate Recovery (Acceptance Limits)			
		BFB (58-142)	DBFM (31-155)	12DCE (64-144)	TOL (61-137)
240-84655-1	SB17-48_0-6"_09072017	88	90	90	100
240-84655-2	SB17-48_30-36"_09072017	87	94	88	98
240-84655-3	SB17-49_0-6"_09072017	85	101	96	100
240-84655-4	SB17-49_30-36"_09072017	81	92	85	94
240-84655-5	TRIP BLANK	77	83	79	84
LCS 240-294157/2-A	Lab Control Sample	77	87	79	85
MB 240-294157/1-A	Method Blank	85	91	85	94

Surrogate Legend

BFB = 4-Bromofluorobenzene (Surr)

DBFM = Dibromofluoromethane (Surr)

12DCE = 1,2-Dichloroethane-d4 (Surr)

TOL = Toluene-d8 (Surr)

QC Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Method: 8260B - Volatile Organic Compounds (GC/MS)

Lab Sample ID: MB 240-294157/1-A

Matrix: Solid

Analysis Batch: 294104

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 294157

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Acetone	600	U	600	97	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Benzene	40	U	40	24	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Bromodichloromethane	80	U	80	18	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Bromoform	80	U	80	23	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Bromomethane	200	U	200	28	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
2-Butanone (MEK)	600	U	600	50	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Carbon disulfide	200	U	200	18	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Carbon tetrachloride	40	U	40	27	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Chlorobenzene	40	U	40	30	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Chloroethane	200	U	200	28	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Chloroform	40	U	40	24	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Chloromethane	200	U	200	18	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
cis-1,2-Dichloroethene	40	U	40	35	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
cis-1,3-Dichloropropene	40	U	40	23	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Cyclohexane	960	U	960	30	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Dibromochloromethane	40	U	40	34	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,2-Dibromo-3-Chloropropane	200	U	200	48	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,2-Dibromoethane	200	U	200	23	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,2-Dichlorobenzene	80	U	80	18	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,3-Dichlorobenzene	80	U	80	38	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,4-Dichlorobenzene	80	U	80	27	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Dichlorodifluoromethane	80	U	80	22	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,1-Dichloroethane	40	U	40	31	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,2-Dichloroethane	40	U	40	30	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,1-Dichloroethene	40	U	40	36	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,2-Dichloropropane	40	U	40	30	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Ethylbenzene	40	U	40	35	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
2-Hexanone	2000	U	2000	86	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Isopropylbenzene	200	U	200	34	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Methyl acetate	960	U	960	75	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Methylcyclohexane	960	U	960	37	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Methylene Chloride	200	U	200	65	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
4-Methyl-2-pentanone (MIBK)	2000	U	2000	40	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Methyl tert-butyl ether	200	U	200	26	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Styrene	40	U	40	10	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,1,2,2-Tetrachloroethane	40	U	40	24	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Tetrachloroethene	40	U	40	21	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Toluene	80	U	80	24	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
trans-1,2-Dichloroethene	40	U	40	35	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
trans-1,3-Dichloropropene	40	U	40	15	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,2,4-Trichlorobenzene	200	U	200	26	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,1,1-Trichloroethane	40	U	40	28	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,1,2-Trichloroethane	40	U	40	23	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Trichloroethene	40	U	40	37	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Trichlorofluoromethane	80	U	80	34	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
1,1,2-Trichloro-1,2,2-trifluoroethane	200	U	200	23	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Vinyl chloride	32	U	32	17	ug/Kg		09/08/17 11:08	09/08/17 16:54	1
Xylenes, Total	120	U	120	28	ug/Kg		09/08/17 11:08	09/08/17 16:54	1

TestAmerica Canton

QC Sample Results

Client: ARCADIS U.S., Inc.

TestAmerica Job ID: 240-84655-1

Project/Site: Racer Saginaw Malleable Industrial Land

Surrogate	MB %Recovery	MB Qualifier	Limits	Prepared	Analyzed	Dil Fac
4-Bromofluorobenzene (Surr)	85		58 - 142	09/08/17 11:08	09/08/17 16:54	1
Dibromofluoromethane (Surr)	91		31 - 155	09/08/17 11:08	09/08/17 16:54	1
1,2-Dichloroethane-d4 (Surr)	85		64 - 144	09/08/17 11:08	09/08/17 16:54	1
Toluene-d8 (Surr)	94		61 - 137	09/08/17 11:08	09/08/17 16:54	1

Lab Sample ID: LCS 240-294157/2-A

Matrix: Solid

Analysis Batch: 294104

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 294157

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Acetone	2000	1520		ug/Kg		76	24 - 125
Benzene	1000	865		ug/Kg		87	77 - 120
Bromodichloromethane	1000	789		ug/Kg		79	61 - 132
Bromoform	1000	734		ug/Kg		73	40 - 140
Bromomethane	1000	1410		ug/Kg		141	10 - 153
2-Butanone (MEK)	2000	1470		ug/Kg		73	51 - 120
Carbon disulfide	1000	835		ug/Kg		84	17 - 163
Carbon tetrachloride	1000	827		ug/Kg		83	43 - 144
Chlorobenzene	1000	924		ug/Kg		92	76 - 120
Chloroethane	1000	1390		ug/Kg		139	10 - 166
Chloroform	1000	893		ug/Kg		89	74 - 120
Chloromethane	1000	809		ug/Kg		81	41 - 124
cis-1,2-Dichloroethene	1000	925		ug/Kg		92	78 - 120
cis-1,3-Dichloropropene	1000	797		ug/Kg		80	66 - 126
Cyclohexane	1000	788	J	ug/Kg		79	66 - 129
Dibromochloromethane	1000	819		ug/Kg		82	46 - 125
1,2-Dibromo-3-Chloropropane	1000	738		ug/Kg		74	40 - 133
1,2-Dibromoethane	1000	882		ug/Kg		88	80 - 120
1,2-Dichlorobenzene	1000	926		ug/Kg		93	75 - 120
1,3-Dichlorobenzene	1000	917		ug/Kg		92	72 - 120
1,4-Dichlorobenzene	1000	898		ug/Kg		90	71 - 120
Dichlorodifluoromethane	1000	891		ug/Kg		89	15 - 127
1,1-Dichloroethane	1000	849		ug/Kg		85	72 - 120
1,2-Dichloroethane	1000	868		ug/Kg		87	71 - 120
1,1-Dichloroethene	1000	1060		ug/Kg		106	58 - 130
1,2-Dichloropropane	1000	868		ug/Kg		87	78 - 122
Ethylbenzene	1000	916		ug/Kg		92	76 - 120
2-Hexanone	2000	1520	J	ug/Kg		76	52 - 129
Isopropylbenzene	1000	888		ug/Kg		89	76 - 124
Methyl acetate	2000	1530		ug/Kg		76	63 - 126
Methylcyclohexane	1000	768	J	ug/Kg		77	71 - 126
Methylene Chloride	1000	927		ug/Kg		93	64 - 126
4-Methyl-2-pentanone (MIBK)	2000	1570	J	ug/Kg		78	65 - 131
Methyl tert-butyl ether	1000	816		ug/Kg		82	68 - 129
Styrene	1000	935		ug/Kg		93	80 - 120
1,1,2,2-Tetrachloroethane	1000	781		ug/Kg		78	78 - 120
Tetrachloroethene	1000	1010		ug/Kg		101	68 - 122
Toluene	1000	906		ug/Kg		91	74 - 120
trans-1,2-Dichloroethene	1000	949		ug/Kg		95	74 - 124
trans-1,3-Dichloropropene	1000	713		ug/Kg		71	55 - 121
1,2,4-Trichlorobenzene	1000	924		ug/Kg		92	60 - 124
1,1,1-Trichloroethane	1000	867		ug/Kg		87	60 - 136
1,1,2-Trichloroethane	1000	899		ug/Kg		90	80 - 120
Trichloroethene	1000	996		ug/Kg		100	73 - 123

TestAmerica Canton

QC Sample Results

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Method: 8260B - Volatile Organic Compounds (GC/MS) (Continued)

Lab Sample ID: LCS 240-294157/2-A

Matrix: Solid

Analysis Batch: 294104

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 294157

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec. Limits
Trichlorofluoromethane	1000	1070		ug/Kg		107	28 - 152
1,1,2-Trichloro-1,2,2-trifluoroethane	1000	1160		ug/Kg		116	64 - 125
Vinyl chloride	1000	845		ug/Kg		84	49 - 131
Xylenes, Total	2000	1790		ug/Kg		89	78 - 120

Surrogate	LCS %Recovery	LCS Qualifier	Limits
4-Bromofluorobenzene (Surr)	77		58 - 142
Dibromofluoromethane (Surr)	87		31 - 155
1,2-Dichloroethane-d4 (Surr)	79		64 - 144
Toluene-d8 (Surr)	85		61 - 137

QC Association Summary

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

GC/MS VOA

Analysis Batch: 294104

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-84655-1	SB17-48_0-6"_09072017	Total/NA	Solid	8260B	294157
240-84655-2	SB17-48_30-36"_09072017	Total/NA	Solid	8260B	294157
240-84655-3	SB17-49_0-6"_09072017	Total/NA	Solid	8260B	294157
240-84655-4	SB17-49_30-36"_09072017	Total/NA	Solid	8260B	294157
240-84655-5	TRIP BLANK	Total/NA	Solid	8260B	294157
MB 240-294157/1-A	Method Blank	Total/NA	Solid	8260B	294157
LCS 240-294157/2-A	Lab Control Sample	Total/NA	Solid	8260B	294157

Prep Batch: 294157

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-84655-1	SB17-48_0-6"_09072017	Total/NA	Solid	5035	
240-84655-2	SB17-48_30-36"_09072017	Total/NA	Solid	5035	
240-84655-3	SB17-49_0-6"_09072017	Total/NA	Solid	5035	
240-84655-4	SB17-49_30-36"_09072017	Total/NA	Solid	5035	
240-84655-5	TRIP BLANK	Total/NA	Solid	5035	
MB 240-294157/1-A	Method Blank	Total/NA	Solid	5035	
LCS 240-294157/2-A	Lab Control Sample	Total/NA	Solid	5035	

General Chemistry

Analysis Batch: 294118

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
240-84655-1	SB17-48_0-6"_09072017	Total/NA	Solid	Moisture	
240-84655-2	SB17-48_30-36"_09072017	Total/NA	Solid	Moisture	
240-84655-3	SB17-49_0-6"_09072017	Total/NA	Solid	Moisture	
240-84655-4	SB17-49_30-36"_09072017	Total/NA	Solid	Moisture	

Lab Chronicle

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-48_0-6"_09072017

Date Collected: 09/07/17 10:25

Date Received: 09/08/17 09:00

Lab Sample ID: 240-84655-1

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	294118	09/08/17 08:53	AMT	TAL CAN

Client Sample ID: SB17-48_0-6"_09072017

Date Collected: 09/07/17 10:25

Date Received: 09/08/17 09:00

Lab Sample ID: 240-84655-1

Matrix: Solid

Percent Solids: 89.9

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			294157	09/08/17 11:08	LAM	TAL CAN
Total/NA	Analysis	8260B		1	294104	09/08/17 17:40	HMB	TAL CAN

Client Sample ID: SB17-48_30-36"_09072017

Date Collected: 09/07/17 10:30

Date Received: 09/08/17 09:00

Lab Sample ID: 240-84655-2

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	294118	09/08/17 08:53	AMT	TAL CAN

Client Sample ID: SB17-48_30-36"_09072017

Date Collected: 09/07/17 10:30

Date Received: 09/08/17 09:00

Lab Sample ID: 240-84655-2

Matrix: Solid

Percent Solids: 88.9

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			294157	09/08/17 11:08	LAM	TAL CAN
Total/NA	Analysis	8260B		1	294104	09/08/17 18:03	HMB	TAL CAN

Client Sample ID: SB17-49_0-6"_09072017

Date Collected: 09/07/17 10:55

Date Received: 09/08/17 09:00

Lab Sample ID: 240-84655-3

Matrix: Solid

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	294118	09/08/17 08:53	AMT	TAL CAN

Client Sample ID: SB17-49_0-6"_09072017

Date Collected: 09/07/17 10:55

Date Received: 09/08/17 09:00

Lab Sample ID: 240-84655-3

Matrix: Solid

Percent Solids: 86.6

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			294157	09/08/17 11:08	LAM	TAL CAN
Total/NA	Analysis	8260B		1	294104	09/08/17 18:27	HMB	TAL CAN

TestAmerica Canton

Lab Chronicle

Client: ARCADIS U.S., Inc.
Project/Site: Racer Saginaw Malleable Industrial Land

TestAmerica Job ID: 240-84655-1

Client Sample ID: SB17-49_30-36"_09072017

Lab Sample ID: 240-84655-4

Date Collected: 09/07/17 11:00

Matrix: Solid

Date Received: 09/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Analysis	Moisture		1	294118	09/08/17 08:53	AMT	TAL CAN

Client Sample ID: SB17-49_30-36"_09072017

Lab Sample ID: 240-84655-4

Date Collected: 09/07/17 11:00

Matrix: Solid

Date Received: 09/08/17 09:00

Percent Solids: 90.8

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			294157	09/08/17 11:08	LAM	TAL CAN
Total/NA	Analysis	8260B		1	294104	09/08/17 18:50	HMB	TAL CAN

Client Sample ID: TRIP BLANK

Lab Sample ID: 240-84655-5

Date Collected: 09/07/17 00:00

Matrix: Solid

Date Received: 09/08/17 09:00

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	5035			294157	09/08/17 11:08	LAM	TAL CAN
Total/NA	Analysis	8260B		1	294104	09/08/17 19:13	HMB	TAL CAN

Laboratory References:

TAL CAN = TestAmerica Canton, 4101 Shuffel Street NW, North Canton, OH 44720, TEL (330)497-9396

Accreditation/Certification Summary

Client: ARCADIS U.S., Inc.

TestAmerica Job ID: 240-84655-1

Project/Site: Racer Saginaw Malleable Industrial Land

Laboratory: TestAmerica Canton

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	EPA Region	Identification Number	Expiration Date
California	State Program	9	2927	02-23-18
Connecticut	State Program	1	PH-0590	12-31-17 *
Florida	NELAP	4	E87225	06-30-18
Illinois	NELAP	5	200004	07-31-18
Kansas	NELAP	7	E-10336	01-31-18 *
Kentucky (UST)	State Program	4	58	02-23-18
Kentucky (WW)	State Program	4	98016	12-31-17 *
Minnesota	NELAP	5	039-999-348	12-31-17 *
Minnesota (Petrofund)	State Program	1	3506	07-31-17 *
Nevada	State Program	9	OH-000482008A	07-31-18
New Jersey	NELAP	2	OH001	06-30-18
New York	NELAP	2	10975	03-31-18
Ohio VAP	State Program	5	CL0024	09-14-17 *
Oregon	NELAP	10	4062	02-23-18
Pennsylvania	NELAP	3	68-00340	08-31-18
Texas	NELAP	6	T104704517-17-9	08-31-18
USDA	Federal		P330-16-00404	12-28-19
Virginia	NELAP	3	460175	09-14-17 *
Washington	State Program	10	C971	01-12-18 *
West Virginia DEP	State Program	3	210	12-31-17 *

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

TestAmerica Canton

TestAmerica Canton Sample Receipt Form/Narrative
Canton Facility

Login # : 84655

Client Acadix

Site Name _____

Cooler unpacked by:

Cooler Received on 9-8-17

Opened on 9-8-17

POP

FedEx: 1st Grd Exp UPS FAS Clipper Client Drop Off TestAmerica Courier Other

Receipt After-hours: Drop-off Date/Time

Storage Location

TestAmerica Cooler # _____ Foam Box Client Cooler Box Other _____

Packing material used: Bubble Wrap Foam Plastic Bag None Other _____

COOLANT: Wet Ice Blue Ice Dry Ice Water None

☐ See Multiple Cooler Form

1. Cooler temperature upon receipt
IR GUN# IR-8 (CF +0 °C) Observed Cooler Temp. 3.4 °C Corrected Cooler Temp. 3.4 °C
IR GUN #36 (CF +0.3 °C) Observed Cooler Temp. _____ °C Corrected Cooler Temp. _____ °C
 2. Were custody seals on the outside of the cooler(s)? If Yes Quantity 1 Yes No
-Were custody seals on the outside of the cooler(s) signed & dated? Yes No NA
-Were custody seals on the bottle(s) or bottle kits (LLHg/MeHg)? Yes No
 3. Shippers' packing slip attached to the cooler(s)? Yes No
 4. Did custody papers accompany the sample(s)? Yes No
 5. Were the custody papers relinquished & signed in the appropriate place? Yes No
 6. Was/were the person(s) who collected the samples clearly identified on the COC? Yes No
 7. Did all bottles arrive in good condition (Unbroken)? Yes No
 8. Could all bottle labels be reconciled with the COC? Yes No
 9. Were correct bottle(s) used for the test(s) indicated? Yes No
 10. Sufficient quantity received to perform indicated analyses? Yes No
 11. Are these work share samples? Yes No
 12. Were all preserved sample(s) at the correct pH upon receipt? Yes No NA pH Strip Lot# HC697954
 13. Were VOAs on the COC? Yes No
 14. Were air bubbles >6 mm in any VOA vials?  Larger than this. Yes No NA
 15. Was a VOA trip blank present in the cooler(s)? Trip Blank Lot # _____ Yes No
 16. Was a LL Hg or Me Hg trip blank present? Yes No
- Contacted PM _____ Date _____ by _____ via Verbal Voice Mail Other

Tests that are not
checked for pH by
Receiving:

VOAs
Oil and Grease
TOC

Concerning _____

16. CHAIN OF CUSTODY & SAMPLE DISCREPANCIES

Samples processed by:

17. SAMPLE CONDITION

Sample(s) _____ were received after the recommended holding time had expired.
Sample(s) _____ were received in a broken container.
Sample(s) _____ were received with bubble >6 mm in diameter. (Notify PM)

18. SAMPLE PRESERVATION

Sample(s) _____ were further preserved in the laboratory.
Time preserved: _____ Preservative(s) added/Lot number(s): _____

ATTACHMENT 1



Attachment 1
Unsaturated Soil Dataset for Benzene at SMI
RACER Saginaw Malleable Industrial Land
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzene µg/kg
Draft Residential Adjusted VSIC-5M			5,940
Draft Non-Residential Adjusted VSIC-5M			9,240
Site-Specific Recreational Criteria			339,000
SB-304	0 - 1	2/8/1995	5.4 U
SB-304	2 - 4	2/8/1995	5.3 U
SB-305	0 - 1	2/8/1995	5.6 U
SB-305	2 - 4	2/8/1995	5.4 U
AST-B1	1 - 12	11/8/1988	0.4 U
AST-B2	1 - 12	11/8/1988	0.4 U
AST-B3	1 - 12	11/8/1988	0.4 U
AST-B4	1 - 12	11/8/1988	0.4 U
AST-B5	1 - 15	11/8/1988	0.4 U
AST-B6	1 - 13.5	11/8/1988	0.4 U
AST-B7	1 - 12	11/8/1988	0.4 U
BBL-SB2	0 - 2	5/7/1996	2.5 J
BBL-SB4	0 - 2	5/7/1996	2,700 J
BBL-SB5	0 - 2	5/6/1996	6 U
NS-SD-18	1 - 14	6/20/1995	6.7 U [6.6 U]
NS-SD-20	1.9 - 2.5	6/20/1995	7.7 UJ
NS-SD-21	1.8 - 2.4	6/20/1995	6.6 U
NS-SD-14	2.3 - 3.1	6/20/1995	6.4 U
NS-SD-15	2.3 - 3.4	6/20/1995	7 U
NS-SD-16	2.7 - 3.7	6/20/1995	7.6 U
NS-SD-17	2.4 - 3	6/20/1995	7.1 U
NS-SD-13	3.4 - 4.1	6/20/1995	7.5 U
NS-SD-12	2.6 - 3.4	6/20/1995	7.1 U
NS-SD-11	2.3 - 2.9	6/20/1995	6.7 U
NS-SD-10	2 - 3.4	6/20/1995	NA
NS-7	0 - 4.5	6/21/1995	6.3 U
NS-8	0 - 10	6/21/1995	7.2 U
NS-9	0 - 4.5	6/21/1995	6.5 U
NS-10	0 - 10	6/21/1995	6.7 U
NS-1	0 - 14	6/23/1995	7.4 U
PL-1	0.75 - 1.21	8/10/2001	6 U
PL-2	0.75 - 1.67	8/10/2001	5 U [6 U]
PL-3	0.67 - 1.67	8/10/2001	6 U
PL-4	0.75 - 1.5	8/10/2001	6 U
BH7	0 - 2	3/6/2007	45 U
BH7	2 - 4	3/6/2007	51 U
BH8	0 - 2	3/6/2007	46 U
BH8	2 - 4	3/6/2007	29 J
BH9	1 - 2	3/6/2007	46 U
BH9	2 - 4	3/6/2007	49 U
BH10	1 - 2	3/6/2007	41 U
BH10	2 - 4	3/6/2007	12 J
BH11	0 - 2	3/6/2007	88
BH11	2 - 4	3/6/2007	16 J
BH12	0 - 2	3/6/2007	45 U [46 U]
BH12	2 - 4	3/6/2007	7.6 J
SOIL FILL1		10/6/2004	54 U
SOIL FILL2		10/6/2004	53 U
SB-01A	1 - 3	8/23/2001	5.3 U

Attachment 1
Unsaturated Soil Dataset for Benzene at SMI
RACER Saginaw Malleable Industrial Land
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzene µg/kg
Draft Residential Adjusted VSIC-5M			5,940
Draft Non-Residential Adjusted VSIC-5M			9,240
Site-Specific Recreational Criteria			339,000
SB-02-SMI	1.2 - 3.2	8/23/2001	5.7 U
SB-03-SMI	0.7 - 2.7	8/23/2001	5.4 U [5.4 U]
SB-04-SMI	0.3 - 2.3	8/23/2001	5.2 U
SB-351	0 - 2	6/27/1995	5.6 U
SB-352	0 - 2	6/28/1995	1.7 J
SB-354	0 - 2	6/28/1995	6.4
SB-362	0 - 2	9/28/1995	5.9 U
SB-363	0 - 2	9/28/1995	2.6 J
SB-377	0 - 0.5	07/25/00	NA
SB-377	0.5 - 1	07/25/00	NA
SB-379	0 - 0.5	07/25/00	NA
SB-379	0.5 - 1	07/25/00	NA
SB-382	0 - 0.5	07/25/00	NA
SB-382	0.5 - 1	07/25/00	NA
SB-383	0 - 0.5	07/25/00	NA
SB-383	0.5 - 1	07/25/00	NA
SB-384	0 - 0.5	07/25/00	NA
SB-384	0.5 - 1	07/25/00	NA
SB-385	0 - 0.5	07/25/00	NA
SB-385	0.5 - 1	07/25/00	NA
SB-386	0 - 0.5	07/25/00	NA
SB-386	0.5 - 1	07/25/00	NA
SB-387	0 - 0.5	07/25/00	NA
SB-387	0.5 - 1	07/25/00	NA
SB-388	0 - 0.5	07/25/00	NA
SB-388	0.5 - 1	07/25/00	NA
FS-1	0 - 1	6/12/1995	5.4 U
FS-2	0 - 1	6/12/1995	5.4 U
FS-3	0 - 1	6/12/1995	5.6 U
FS-4	0 - 1	6/12/1995	5.6 U
FS-5	0 - 1	6/12/1995	5.4 U
FS-6	0 - 1	6/12/1995	5.1 U [5.1 U]
FS-7	0 - 1	6/12/1995	5.4 U
FS-8	0 - 1	6/12/1995	5.2 U
US-1	0 - 1	6/12/1995	6.3 U
US-2	0 - 1	6/12/1995	5.4 U
US-3	0 - 1	6/12/1995	5.3 U
US-4	0 - 1	6/12/1995	5.3 U
US-6	0 - 1	6/12/1995	5.2 U
US-7	0 - 1	6/12/1995	5.1 U
US-8	0 - 1	6/12/1995	5.1 U
RS-1	0 - 1	6/13/1995	5.3 U
RS-2	0 - 1	6/13/1995	5.4 U
RS-3	0 - 1	6/13/1995	5.4 U
RS-4	0 - 1	6/13/1995	5.3 U [5.3 UJ]
RS-6	0 - 1	6/13/1995	5.2 U
RS-7	0 - 1	6/13/1995	5.4 UJ
RS-8	0 - 1	6/13/1995	5.2 U
NS-RS-4	2.5 - 3	6/13/1995	6.3 U

Attachment 1
Unsaturated Soil Dataset for Benzene at SMI
RACER Saginaw Malleable Industrial Land
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzene µg/kg
Draft Residential Adjusted VSIC-5M			5,940
Draft Non-Residential Adjusted VSIC-5M			9,240
Site-Specific Recreational Criteria			339,000
TW1	1 - 2.5	9/7/1989	10 U
TW1	3.5 - 5	9/7/1989	10 U
TW2	3.5 - 5	9/7/1989	10 U
TW3	1 - 2.5	9/7/1989	10 U
TW4	1 - 2.5	9/7/1989	10 U
TW4	3.5 - 5	9/7/1989	10 U
VE-1	0.75 - 1.58	8/10/2001	6 U
VE-2	0.92 - 1.67	8/10/2001	6 U
AR-1	2 - 3	6/3/2015	<41
AR-2	3 - 4	6/3/2015	20 J
AR-3	2 - 3	6/3/2015	<47
AR-3_dup	2 - 3	6/3/2015	<48
AR-4	3 - 4	6/4/2015	<45
AR-4_dup	3 - 4	6/4/2015	<46
AR-5	3 - 4	6/4/2015	<47
AR-6	3 - 4	6/4/2015	<46
AR-7	3 - 4	6/4/2015	<44
AR-8	2 - 3	6/4/2015	<42
T02-B004	2 - 4	8/28/1990	10 U
T02-B047	2 - 4	9/7/1990	10 U
T02-B048	2 - 4	9/7/1990	10 U
T04-B105	1 - 3	7/10/1992	10 U
T04-B106	1 - 3	7/10/1992	10 U
T06-B011	3 - 5	8/29/1990	NA
T06-B058	0 - 2	10/3/1990	10 U
T06-B059	0 - 2	10/3/1990	10 U
T07-B038	3 - 5	9/5/1990	50
T07-B039	3 - 5	9/5/1990	15
T07-B108	1 - 3	7/13/1992	10 U
UST7-MW4	2 - 4	7/7/1994	10 U
UST7-MW6	2 - 4	7/7/1994	10 U
T08-B016	2 - 4	8/30/1990	17
UST8-MW1	0 - 2	5/25/1994	10 U
UST8-MW1	2 - 4	5/25/1994	10 U
UST8-MW2	0 - 2	5/25/1994	10 U
UST8-MW3	1 - 3	5/31/1994	10 U
UST8-SB1	2 - 3	4/1/1994	10 U
UST8-SB2	0 - 1.2	4/1/1994	10 U
UST8-SB3	0.7 - 1.1	4/1/1994	10 U
UST8-SB4	1.8 - 2.3	4/1/1994	10 U
SB17-34	0-0.5	8/4/2017	860
SB17-34	1.5-2	8/4/2017	840
SB17-35	0-0.5	8/4/2017	2,300
SB17-35	2-2.5	8/4/2017	10,000
SB17-36	0-0.5	8/4/2017	65
SB17-36	2-2.5	8/4/2017	170
SB17-37	0-0.5	8/4/2017	<49
SB17-37	2.5-3	8/4/2017	51 J
SB17-38	0-0.5	8/4/2017	<68

Attachment 1
Unsaturated Soil Dataset for Benzene at SMI
RACER Saginaw Malleable Industrial Land
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Benzene $\mu\text{g/kg}$
Draft Residential Adjusted VSIC-5M			5,940
Draft Non-Residential Adjusted VSIC-5M			9,240
Site-Specific Recreational Criteria			339,000
SB17-38	1.5-2	8/4/2017	<54
SB17-39	0-0.5	8/4/2017	<50
SB17-39	1.5-2	8/4/2017	<51
SB17-40	0-0.5	8/4/2017	<49
SB17-40	1.5-2	8/4/2017	<55
SB17-48	0-0.5	9/7/2017	270
SB17-48	2.5-3	9/7/2017	<50
SB17-49	0-0.5	9/7/2017	170
SB17-49	2.5-3	9/7/2017	1,200

Notes:

Values are in micrograms per kilogram ($\mu\text{g/kg}$).

Duplicate sample results are shown in square brackets.

Gray-shaded results exceed the draft Residential Volatile Soil Inhalation Criteria (VSIC) for a 5-meter (5M) source thickness, adjusted for a 400-acre source area (adjusted VSIC).

Blue-shaded results exceed the draft Non-Residential adjusted VSIC

Yellow-shaded results exceed the Site-Specific Recreational Criteria

B = analyte was detected in an associated blank sample

J = estimated value above the method detection limit and below the reporting limit

NA = not analyzed

U or < = non-detect

Attachment 1
ProUCL Output Sheets for Unsaturated Soil at SMI
RACER Saginaw Malleable Industrial Land
Saginaw, Michigan

UCL Statistics for Data Sets with Non-Detects

User Selected Options

Date/Time of Computation ProUCL 5.19/13/2017 1:45:01 PM
From File VSIC SMI for ProUCL.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Result (benzene)

General Statistics

Total Number of Observations	136	Number of Distinct Observations	56
Number of Detects	24	Number of Non-Detects	112
Number of Distinct Detects	23	Number of Distinct Non-Detects	37
Minimum Detect	1.7	Minimum Non-Detect	0.4
Maximum Detect	10000	Maximum Non-Detect	68
Variance Detects	4380054	Percent Non-Detects	82.35%
Mean Detects	787.2	SD Detects	2093
Median Detects	50.5	CV Detects	2.658
Skewness Detects	4.063	Kurtosis Detects	17.84
Mean of Logged Detects	4.219	SD of Logged Detects	2.403

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.421
5% Shapiro Wilk Critical Value	0.916
Lilliefors Test Statistic	0.354
5% Lilliefors Critical Value	0.177

Shapiro Wilk GOF Test

Detected Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	140	KM Standard Error of Mean	79.83
KM SD	911.3	95% KM (BCA) UCL	300
95% KM (t) UCL	272.2	95% KM (Percentile Bootstrap) UCL	286.7
95% KM (z) UCL	271.3	95% KM Bootstrap t UCL	564.2
90% KM Chebyshev UCL	379.5	95% KM Chebyshev UCL	488
97.5% KM Chebyshev UCL	638.5	99% KM Chebyshev UCL	934.3

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic	1.453
5% A-D Critical Value	0.859
K-S Test Statistic	0.212
5% K-S Critical Value	0.194

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE)	0.284
Theta hat (MLE)	2772
nu hat (MLE)	13.63
Mean (detects)	787.2

k star (bias corrected MLE)	0.276
Theta star (bias corrected MLE)	2850
nu star (bias corrected)	13.26

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Attachment 1
ProUCL Output Sheets for Unsaturated Soil at SMI
RACER Saginaw Malleable Industrial Land
Saginaw, Michigan

Minimum	0.01	Mean	138.9
Maximum	10000	Median	0.01
SD	914.9	CV	6.585
k hat (MLE)	0.102	k star (bias corrected MLE)	0.104
Theta hat (MLE)	1368	Theta star (bias corrected MLE)	1333
nu hat (MLE)	27.62	nu star (bias corrected)	28.34
Adjusted Level of Significance (β)	0.0482		
Approximate Chi Square Value (28.34, α)	17.2	Adjusted Chi Square Value (28.34, β)	17.1
95% Gamma Approximate UCL (use when $n \geq 50$)	229	95% Gamma Adjusted UCL (use when $n < 50$)	230.2

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	140	SD (KM)	911.3
Variance (KM)	830517	SE of Mean (KM)	79.83
k hat (KM)	0.0236	k star (KM)	0.028
nu hat (KM)	6.42	nu star (KM)	7.612
theta hat (KM)	5932	theta star (KM)	5003
80% gamma percentile (KM)	0.99	90% gamma percentile (KM)	67.46
95% gamma percentile (KM)	506	99% gamma percentile (KM)	3680

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (7.61, α)	2.512	Adjusted Chi Square Value (7.61, β)	2.481
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	424.2	95% Gamma Adjusted KM-UCL (use when $n < 50$)	429.5

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Test Statistic	0.961
5% Shapiro Wilk Critical Value	0.916
Lilliefors Test Statistic	0.111
5% Lilliefors Critical Value	0.177

Shapiro Wilk GOF Test

Detected Data appear Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data appear Lognormal at 5% Significance Level

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	139.2	Mean in Log Scale	-1.933
SD in Original Scale	914.8	SD in Log Scale	3.778
95% t UCL (assumes normality of ROS data)	269.1	95% Percentile Bootstrap UCL	279.2
95% BCA Bootstrap UCL	425.8	95% Bootstrap t UCL	584.4
95% H-UCL (Log ROS)	1109		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	0.462	KM Geo Mean	1.587
KM SD (logged)	2.167	95% Critical H Value (KM-Log)	3.476
KM Standard Error of Mean (logged)	0.28	95% H-UCL (KM -Log)	31.79
KM SD (logged)	2.167	95% Critical H Value (KM-Log)	3.476
KM Standard Error of Mean (logged)	0.28		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	145.7
SD in Original Scale	913.9
95% t UCL (Assumes normality)	275.4

DL/2 Log-Transformed

Mean in Log Scale	1.989
SD in Log Scale	1.786
95% H-Stat UCL	57.2

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 31.79

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

APPENDIX G

Default Michigan Department of Environmental Quality Lead
Parameters



ALM model inputs used to derive the revised proposed DEQ nonresidential soil direct contact value for lead:

ALM Input Parameter	Parameter Description	Parameter Value	Reference Source
PbB _{fetal}	Blood Lead Level (PbB) in the fetus (µg/dL)	5	CDC
R _{fetal/maternal}	Fetal/maternal PbB ratio	0.9	ALM
BKSF	Biokinetic slope factor (µg/dL per µg/day)	0.4	ALM
PbB ₀	Baseline PbB (µg/dL)	0.7	EPA 2016
IR _s	Soil and dust ingestion rate (g/day)	0.089	MDEQ
GSD _i	Geometric standard deviation PbB	1.7	EPA 2016
AF _{s,d}	Absorption fraction (same for soil and dust)	0.12	ALM
EF _{s,d}	Exposure frequency (same for soil and dust; days/year)	183	MDEQ
AT _{s,d}	Averaging time (same for soil and dust; days/year)	365	ALM
DCC _{nr}	Nonresidential soil direct contact criterion (mg/kg)	760	MDEQ

Integrated Exposure Uptake Biokinetic (IEUBK) Model

The DEQ generic DCC for lead in soil of 190 ppm (equivalent to 1.9E+5 ppb) was developed using a combination of the USEPA and DEQ default values as the exposure assumptions in the Model. The soil criterion represents a 5% or lower risk that a child will have a blood lead level above the CDC reference level of 5 micrograms of lead per deciliter of blood (µg/dL).

The parameters presented in Table 1 identify the exceptions to the USEPA's default Model assumptions.

Table 1. MDEQ-modified parameters and the values used in the Model to derive the generic residential DCC and DWC water criteria for lead.

Model Input Parameters	Parameter Values
Blood lead concentration reference level (µg/dL)	5 ¹
Maternal blood lead concentration at childbirth (µg/dL)	0.8 ²
Outdoor air lead concentration (µg/m ³)	0.01 ³
Drinking water concentration (µg/L)	1.0
Drinking water ingestion rates (L/day) ⁴	
0-1 year	0.320
1-2 year	0.271
2-3 year	0.317
3-4 year	0.327
4-5 year	0.327
5-6 year	0.327
6-7 year	0.414

¹ CDC, 2012

³ MDEQ, 2011-2014

² CDC, 2015

⁴ USEPA, 2011

Blood Lead Concentration Reference Level:

In 2012, the CDC revised its blood lead level of concern, reducing the level from 10 µg/dL to 5 µg/dL, based on recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention (CDC, 2012). The reference level is used to identify children with blood lead levels that require follow-up actions due to the fact that their blood lead levels are higher than those of most children. It has been shown that blood lead levels at concentrations lower than previously thought, affect IQ, academic achievement, and a child's ability to pay attention. The new CDC reference level (5 µg/dL) is based on the U.S. population of children, ages one to five years old, whose blood lead levels tested in the highest 2.5%. The basis for the reference level is the 97.5th percentile of the National Health and Nutrition Examination Survey's blood lead level distribution in children (CDC, 2012).

Maternal Blood Lead Concentration at Childbirth:

The maternal blood lead level of 0.8 µg/dL is based on the geometric mean blood concentration for U.S. females from the 2011-2012 National Health and Nutrition Examination Survey (CDC, 2015).

APPENDIX H

Coplanar Polychlorinated Biphenyl Evaluation



Table H-1
Calculation of Potential 2,3,7,8-TCDD TEQ Contribution from Aroclors Detected in Soil at Green Point Landfill and Sediment
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

PCB Congener	2,3,7,8-TCDD TEF	Composition of Coplanar PCBs in Aroclors (weight %) [a]						Maximum Contribution - 2,3,7,8-TCDD TEQ (GPL) in Soil (µg/kg)						Maximum Contribution - 2,3,7,8-TCDD TEQ in Sediment (µg/kg)					
		A1242 [b]	A1248 [c]	A1248 [d]	A1254 (late) [e]	A1254 [f]	A1260 [g]	A1242 [b]	A1248 [c]	A1248 [d]	A1254 (late) [e]	A1254 [f]	A1260 [g]	A1242 [b]	A1248 [c]	A1248 [d]	A1254 (late) [e]	A1254 [f]	A1260 [g]
Maximum Detected Concentration (µg/kg)		--	--	--	--	--	--	ND	8400	8400	1200	1200	1500	980	860	860	1300	1300	650
3,3,4,4'-TCB (77)	0.0001	0.31	0.41	0.52	0.20	0.03	--	ND	3.44E-03	4.37E-03	2.40E-04	3.60E-05	--	3.04E-04	3.53E-04	4.47E-04	2.60E-04	3.90E-05	--
3,4,4',5-TCB (81)	0.0003	0.31	0.41	0.52	0.20	0.03	--	ND	1.03E-02	1.31E-02	7.20E-04	1.08E-04	--	9.11E-04	1.06E-03	1.34E-03	7.80E-04	1.17E-04	--
3,3',4,4',5-PeCB (126)	0.1	--	0.00	0.00	0.02	0.00	--	--	0.00E+00	0.00E+00	2.40E-02	0.00E+00	--	--	0.00E+00	0.00E+00	2.60E-02	0.00E+00	--
3,3',4,4',5,5',-HxCB (169)	0.03	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3,3',4,4'-PeCB (105)	0.00003	0.47	1.60	1.45	7.37	2.99	0.22	ND	4.03E-03	3.65E-03	2.65E-03	1.08E-03	9.90E-05	1.38E-04	4.13E-04	3.74E-04	2.87E-03	1.17E-03	4.29E-05
2,3,4,4',5-PeCB (114)	0.00003	0.04	0.12	0.12	0.50	0.18	--	ND	3.02E-04	3.02E-04	1.80E-04	6.48E-05	--	1.18E-05	3.10E-05	3.10E-05	1.95E-04	7.02E-05	--
2,3,4,4',5-PeCB (118)	0.00003	0.66	2.29	2.35	13.59	7.35	0.48	ND	5.77E-03	5.92E-03	4.89E-03	2.65E-03	2.16E-04	1.94E-04	5.91E-04	6.06E-04	5.30E-03	2.87E-03	9.36E-05
2',3,4,4'5-PeCB (123)	0.00003	0.03	0.07	0.08	0.32	0.15	--	ND	1.76E-04	2.02E-04	1.15E-04	5.40E-05	--	8.82E-06	1.81E-05	2.06E-05	1.25E-04	5.85E-05	--
2,3,3',4,4',5-HxCB (156)	0.00003	0.01	0.06	0.04	1.13	0.82	0.52	ND	1.51E-04	1.01E-04	4.07E-04	2.95E-04	2.34E-04	2.94E-06	1.55E-05	1.03E-05	4.41E-04	3.20E-04	1.01E-04
2,3,3',4,4',5-HxCB (157)	0.00003	--	0.01	0.00	0.30	0.19	0.02	--	2.52E-05	0.00E+00	1.08E-04	6.84E-05	9.00E-06	--	2.58E-06	0.00E+00	1.17E-04	7.41E-05	3.90E-06
2,3,4,4',5,5'-HxCB (167)	0.00003	--	0.01	0.01	0.35	0.27	0.19	--	2.52E-05	2.52E-05	1.26E-04	9.72E-05	8.55E-05	--	2.58E-06	2.58E-06	1.37E-04	1.05E-04	3.71E-05
2,3,3',4,4',5,5',-HxCB (189)	0.00003	--	--	--	0.01	0.01	0.10	--	--	--	3.60E-06	3.60E-06	4.50E-05	--	--	--	3.90E-06	3.90E-06	1.95E-05
Sum (2,3,7,8-TCDD TEQ [µg/kg])	--	--	--	--	--	--	--	ND	2.43E-02	2.77E-02	3.34E-02	4.45E-03	6.89E-04	1.57E-03	2.48E-03	2.83E-03	3.62E-02	4.82E-03	2.98E-04

Notes:
[a] Composition by weight percentage was obtained from the Agency for Toxix Substances and Disease Registry's (ATSDR's) Toxicological Profile for Polychlorinated Biphenyls (PCBs) (ATSDR 2000), Table 4-5.
[b] Mean of three Lots of Aroclor 1242.
[c] Lot A3.5 Aroclor 1248.
[d] Lot G3.5 Aroclor 1248.
[e] Lot A4 Aroclor 1254 (Monsanto Lot KI-02-6024) from abnormal late production (1974–1977).
[f] Lot G4 Aroclor 1254 (GE/118-peak analytical standard).
[g] Mean of three Lots of Aroclor 1260.

-- = not applicable
A = Aroclor
GPL = Green Point Landfill Property
HxCB = hexachlorobiphenyl
ND = not detected
PCB = polychlorinated biphenyl
PeCB = pentachlorobiphenyl
TCB = tetrachlorobiphenyl
TCDD = tetrachlorodibenzo-p-dioxin
TEF = toxic equivalency factor
TEQ = toxic equivalents
µg/kg = microgram per kilogram

APPENDIX I

Data Used for Constituent-Specific Evaluations and ProUCL Output



Table I-1
Soil Data Used for Constituent-specific Evaluations - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Vanadium
			µg/kg
Recreational Direct Contact Criteria (DCC)			27,000
SB-304	0 - 1	02/08/95	17,000
SB-304	2 - 4	02/08/95	16,000
SB-304	6 - 8	02/08/95	9,710
SB-305	0 - 1	02/08/95	8,870
SB-305	2 - 4	02/08/95	20,000
SB-305	6 - 8	02/08/95	9,000
SB-305	10 - 12	02/08/95	19,900
BBL-MW1	4 - 6	05/02/96	NA
BBL-MW2	4 - 6	05/02/96	NA
BBL-MW3	6 - 8	05/02/96	NA
BBL-MW4	4 - 6	05/03/96	NA
BBL-MW5	4 - 6	05/03/96	NA
BBL-SB1	4 - 6	05/06/96	NA
BBL-SB1	8 - 10	05/06/96	NA
BBL-SB2	0 - 2	05/07/96	NA
BBL-SB3	6 - 8	05/07/96	NA
BBL-SB3	8 - 10	05/07/96	NA
BBL-SB4	0 - 2	05/07/96	NA
BBL-SB4	8 - 10	05/07/96	NA
BBL-SB5	0 - 2	05/06/96	NA
BBL-SB5	20 - 22	05/06/96	NA
NS-7	0 - 4.5	06/21/95	5,970
NS-8	0 - 10	06/21/95	10,100
NS-9	0 - 4.5	06/21/95	5,920
NS-10	0 - 10	06/21/95	26,600
NS-1	0 - 14	06/23/95	32,300
PL-1	0.75 - 1.21	08/10/01	45,000
PL-2	0.75 - 1.67	08/10/01	28,000 [31,000]
PL-3	0.67 - 1.67	08/10/01	38,000
PL-4	0.75 - 1.5	08/10/01	12,000
RS-2-1	0 - 1	06/10/96	NA
RS-2-2	0 - 1	06/10/96	NA
RS-2-3	0 - 1	06/10/96	NA
RS-2-4	0 - 1	06/10/96	NA
RS-2-5	0 - 1	06/10/96	NA
RS-2-6	0 - 1	06/10/96	NA
RS-2-7	0 - 1	06/10/96	NA
RS-2-8	0 - 1	06/10/96	NA
BH7	0 - 2	03/06/07	12,700
BH7	2 - 4	03/06/07	8,500
BH8	0 - 2	03/06/07	4,900
BH8	2 - 4	03/06/07	5,100
BH9	1 - 2	03/06/07	9,300
BH9	2 - 4	03/06/07	10,000
BH10	1 - 2	03/06/07	30,400

Table I-1
Soil Data Used for Constituent-specific Evaluations - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Vanadium
			µg/kg
Recreational Direct Contact Criteria (DCC)			27,000
BH10	2 - 4	03/06/07	41,000
BH11	0 - 2	03/06/07	11,500
BH11	2 - 4	03/06/07	26,500
BH12	0 - 2	03/06/07	33,900
BH12	2 - 4	03/06/07	22,00
SOIL FILL1	not available	10/06/04	11,900
SOIL FILL2	not available	10/06/04	14,500
SB-01A	1 - 3	08/23/01	5,200 B
SB-01A	5 - 7	08/23/01	5,200 B
SB-02-SMI	1.2 - 3.2	08/23/01	20,400
SB-02-SMI	9 - 11	08/23/01	19,000
SB-03-SMI	4.7 - 6.7	08/23/01	23,600
SB-03-SMI	0.7 - 2.7	08/23/01	11,900 [11,300]
SB-04-SMI	0.3 - 2.3	08/23/01	1,800 B
SB-04-SMI	8.3 - 10	08/23/01	21,100
SB-351	0 - 2	06/27/95	10,300
SB-352	0 - 2	06/28/95	10,600
SB-354	0 - 2	06/28/95	7,300
SB-362	0 - 2	09/28/95	19,000
SB-362	4 - 6	09/28/95	13,800
SB-362	8 - 10	09/28/95	10,700
SB-363	0 - 2	09/28/95	14,600
SB-363	4 - 6	09/28/95	7,460
SB-363	8 - 10	09/28/95	12,100
SB-374	9.5 - 10.5	07/24/00	17,200
SB-375	6.5 - 7.5	07/24/00	13,300 [11,400]
SB-376	7 - 8	07/25/00	14,200
SB-377	0 - 0.5	07/25/00	29,000
SB-377	0.5 - 1	07/25/00	9,700 [25,600]
SB-379	0 - 0.5	07/25/00	19,900
SB-379	0.5 - 1	07/25/00	8,900
SB-382	0 - 0.5	07/25/00	20,100
SB-382	0.5 - 1	07/25/00	21,100
SB-383	0 - 0.5	07/25/00	4,800 B
SB-383	0.5 - 1	07/25/00	4,400 B
SB-384	0 - 0.5	07/25/00	17,800
SB-384	0.5 - 1	07/25/00	12,00
SB-385	0 - 0.5	07/25/00	11,500
SB-385	0.5 - 1	07/25/00	9,300
SB-386	0 - 0.5	07/25/00	9,500
SB-386	0.5 - 1	07/25/00	9,000
SB-387	0 - 0.5	07/25/00	10,500
SB-387	0.5 - 1	07/25/00	9,400
SB-388	0 - 0.5	07/25/00	17,200
SB-388	0.5 - 1	07/25/00	9,000

Table I-1
Soil Data Used for Constituent-specific Evaluations - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Vanadium
			µg/kg
Recreational Direct Contact Criteria (DCC)			27,000
FS-1	0 - 1	06/12/95	7,370
FS-2	0 - 1	06/12/95	7,880
FS-3	0 - 1	06/12/95	10,600
FS-4	0 - 1	06/12/95	13,100
FS-5	0 - 1	06/12/95	13,200
FS-6	0 - 1	06/12/95	8,220 [8,640]
FS-7	0 - 1	06/12/95	5,890
FS-8	0 - 1	06/12/95	16,100
US-1	0 - 1	06/12/95	16,000
US-2	0 - 1	06/12/95	13,100
US-3	0 - 1	06/12/95	10,700
US-4	0 - 1	06/12/95	5,010
US-6	0 - 1	06/12/95	8,560
US-7	0 - 1	06/12/95	4,100
US-8	0 - 1	06/12/95	7,040
RS-1	0 - 1	06/13/95	10,400
RS-2	0 - 1	06/13/95	32,100
RS-3	0 - 1	06/13/95	24,500
RS-4	0 - 1	06/13/95	16,700 J [17,800 J]
RS-6	0 - 1	06/13/95	22,500 J
RS-7	0 - 1	06/13/95	11,200 J
RS-8	0 - 1	06/13/95	23,900 J
NS-RS-4	2.5 - 3	06/13/95	26,900 J
VE-1	0.75 - 1.58	08/10/01	4,200
VE-2	0.92 - 1.67	08/10/01	12,000
AR-1	2 - 3	6/3/2015	17,000 B
AR-2	3 - 4	6/3/2015	39,000 B
AR-2	14 - 14.5	6/3/2015	4,700 B
AR-3	2 - 3	6/3/2015	23,000 B
AR-3	2 - 3	6/3/2015	7,000 B
AR-4	3 - 4	6/4/2015	6,900 B
AR-4	3 - 4	6/4/2015	6,600 B
AR-4	13 - 13.5	6/4/2015	5,400 B
AR-5	3 - 4	6/4/2015	9,000 B
AR-5	12 - 13	6/4/2015	11,000 B
AR-6	3 - 4	6/4/2015	9,300 B
AR-6	9.5 - 10	6/4/2015	29,000 B
AR-7	3 - 4	6/4/2015	21,000 B
AR-7	12 - 13	6/4/2015	4,500 B
AR-8	2 - 3	6/4/2015	16,000 B
NS-SD-18	1 - 14	06/20/95	19,400 [17,100]
NS-SD-19	4 - 5.1	06/20/95	24,500
NS-SD-20	1.9 - 2.5	06/20/95	31,400
NS-SD-21	1.8 - 2.4	06/20/95	17,000
NS-SD-14	2.3 - 3.1	06/20/95	17,300

Table I-1
Soil Data Used for Constituent-specific Evaluations - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Vanadium
			µg/kg
Recreational Direct Contact Criteria (DCC)			27,000
NS-SD-15	2.3 - 3.4	06/20/95	28,400
NS-SD-16	2.7 - 3.7	06/20/95	17,100
NS-SD-17	2.4 - 3	06/20/95	35,100
NS-SD-13	3.4 - 4.1	06/20/95	30,100
NS-SD-12	2.6 - 3.4	06/20/95	25,600
NS-SD-11	2.3 - 2.9	06/20/95	33,400
NS-SD-10	2 - 3.4	06/20/95	17,000
UST4-MW1	10 - 12	06/01/94	NA
UST4-MW2	8 - 10	06/01/94	NA
UST4-MW3	10 - 12	06/01/94	NA
UST4-MW4	10 - 12	06/02/94	NA
T07-B108	1 - 3	07/13/92	NA
T07-B109	9 - 11	07/13/92	NA
T07-B109	13 - 15	07/13/92	NA
T07-B110	5 - 7	07/13/92	NA
T07-B110	13 - 15	07/13/92	NA
T07-B111	9 - 11	07/13/92	NA
T07-B111	13 - 15	07/13/92	NA
T07-B112	9 - 11	07/13/92	NA
T07-B112	13 - 15	07/13/92	NA
UST7-MW1	4 - 6	06/03/94	NA
UST7-MW2	5 - 7	06/03/94	NA
UST7-MW3	6 - 8	07/07/94	NA
UST7-MW4	2 - 4	07/07/94	NA
UST7-MW5	4 - 6	07/07/94	NA
UST8-MW1	0 - 2	05/25/94	NA
UST8-MW1	2 - 4	05/25/94	NA
UST8-MW2	0 - 2	05/25/94	NA
UST8-MW3	1 - 3	05/31/94	NA
UST8-SB1	2 - 3	04/01/94	NA
UST8-SB2	0 - 1.2	04/01/94	NA
UST8-SB3	0.7 - 1.1	04/01/94	NA
UST8-SB4	1.8 - 2.3	04/01/94	NA
UST8-SB5	4 - 6	05/31/94	NA

Notes:

Values are in micrograms per kilogram (µg/kg).

Blue-shaded results exceed the recreational soil direct contact criterion (DCC).

Duplicate sample results are shown in square brackets.

B = analyte was detected in an associated blank sample

E = estimated value

F1 = Matrix spike and/or matrix spike duplicate recovery is outside acceptable limits

J = estimated value above the method detection limit and below the reporting limit

NA = not analyzed

Output Sheet I-1
ProUCL Output for Soil - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

UCL Statistics for Data Sets with Non-Detects

User Selected Options
Date/Time of Computation ProUCL 5.13/29/2017 10:30:56 PM
From File SMI Pb-V for ProUCL.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Result (vanadium)

General Statistics			
Total Number of Observations	120	Number of Distinct Observations	98
		Number of Missing Observations	0
Minimum	1200	Mean	15438
Maximum	45000	Median	12525
SD	9414	Std. Error of Mean	859.4
Coefficient of Variation	0.61	Skewness	0.938

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.914	Data Not Normal at 5% Significance Level	
5% Shapiro Wilk P Value	5.4642E-9	Lilliefors GOF Test	
Lilliefors Test Statistic	0.13	Data Not Normal at 5% Significance Level	
5% Lilliefors Critical Value	0.0812		

Data Not Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	16931
95% Student's-t UCL	16863	95% Modified-t UCL (Johnson-1978)	16875

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.393	Detected data appear Gamma Distributed at 5% Significance Level	
5% A-D Critical Value	0.761	Kolmogorov-Smirnov Gamma GOF Test	
K-S Test Statistic	0.0605	Detected data appear Gamma Distributed at 5% Significance Level	
5% K-S Critical Value	0.085		

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma Statistics	
k hat (MLE)	2.67	k star (bias corrected MLE)	2.609
Theta hat (MLE)	5782	Theta star (bias corrected MLE)	5918
nu hat (MLE)	640.8	nu star (bias corrected)	626.1
MLE Mean (bias corrected)	15438	MLE Sd (bias corrected)	9558
		Approximate Chi Square Value (0.05)	569.1
Adjusted Level of Significance	0.048	Adjusted Chi Square Value	568.4

Assuming Gamma Distribution		Assuming Gamma Distribution	
95% Approximate Gamma UCL (use when n>=50)	16986	95% Adjusted Gamma UCL (use when n<50)	17006

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.967	Data Not Lognormal at 5% Significance Level	
5% Shapiro Wilk P Value	0.0476	Lilliefors Lognormal GOF Test	
Lilliefors Test Statistic	0.0698	Data appear Lognormal at 5% Significance Level	
5% Lilliefors Critical Value	0.0812		

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics		Lognormal Statistics	
Minimum of Logged Data	7.09	Mean of logged Data	9.446
Maximum of Logged Data	10.71	SD of logged Data	0.672

Assuming Lognormal Distribution		Assuming Lognormal Distribution	
95% H-UCL	17888	90% Chebyshev (MVUE) UCL	19026
95% Chebyshev (MVUE) UCL	20475	97.5% Chebyshev (MVUE) UCL	22487
99% Chebyshev (MVUE) UCL	26439		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Output Sheet I-1
ProUCL Output for Soil - SMI
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Nonparametric Distribution Free UCLs

95% CLT UCL	16852	95% Jackknife UCL	16863
95% Standard Bootstrap UCL	16848	95% Bootstrap-t UCL	16896
95% Hall's Bootstrap UCL	16977	95% Percentile Bootstrap UCL	16915
95% BCA Bootstrap UCL	16938		
90% Chebyshev(Mean, Sd) UCL	18017	95% Chebyshev(Mean, Sd) UCL	19184
97.5% Chebyshev(Mean, Sd) UCL	20805	99% Chebyshev(Mean, Sd) UCL	23989

Suggested UCL to Use

95% Approximate Gamma UCL 16986

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Table I-2
Soil Data Used for Constituent-specific Evaluations - GPL
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Vanadium
			µg/kg
Recreational Direct Contact Criteria (DCC)			27,000
MW-126WT	14 - 16	02/08/95	34,100
WMB-1	3 - 3.5	01/22/97	11,600
WMB-2	3 - 3.5	01/22/97	21,700
WMB-3	5 - 5.5	01/22/97	9,640
WMB-6	4 - 4.5	01/22/97	21,900
MW-183WT	8 - 8.5	07/24/00	13,900
SB-389	0 - 0.5	08/11/00	14,300
SB-390	0 - 0.5	08/11/00	16,900
SB-391	0 - 0.5	08/11/00	14,200
SB-392	0 - 0.5	08/11/00	17,500
SB-393	0 - 0.5	08/11/00	26,100
SB-394	0 - 0.5	08/11/00	13,900
SB-395	0 - 0.5	08/11/00	18,000
SB-396	0 - 0.5	08/11/00	13,000
SB-397	0 - 0.5	08/11/00	13,100
SB-398	0 - 0.5	08/11/00	13,400
SB-399	0 - 0.5	08/11/00	15,300
SB-400	0 - 0.5	08/11/00	15,100
SB-406	0 - 0.5	08/11/00	12,300
SB-412	0 - 0.5	08/11/00	28,300
SB-418	0 - 0.5	08/11/00	22,800 [20,600]
TP1	0 - 4	05/22/98	6,200
TP1	4 - 8	05/22/98	5,900
TP2	0 - 4	05/22/98	8,300
TP2	4 - 8	05/22/98	6,800
TP3	0 - 4	05/22/98	5,500
TP3	4 - 8	05/22/98	5,400
TP4	0 - 4	05/22/98	6,600
TP4	4 - 8	05/22/98	6,800
TP5	0 - 4	05/22/98	5,400
TP5	4 - 8	05/22/98	6,300
TP6	0 - 4	05/22/98	7,900
TP6	4 - 8	05/22/98	7,400
TP7	0 - 4	05/22/98	8,300
BH01	0 - 2	11/26/97	3,300
BH02	2 - 4	11/26/97	31,000

Table I-2

Soil Data Used for Constituent-specific Evaluations - GPL

RACER Saginaw

Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties

Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Vanadium
			µg/kg
Recreational Direct Contact Criteria (DCC)			27,000
BH03	2 - 4	11/26/97	34,000
BH04	2 - 4	11/26/97	15,000
BH05	2 - 4	11/26/97	8,400
BH06	2 - 4	11/26/97	24,000
SS-007-17	0 - 0.5	06/07/17	18,000
SS-008-17	0 - 0.5	06/07/17	10,000
SS-010-17	0 - 0.5	06/07/17	17,000
SS-013-17	0 - 0.5	06/07/17	3,500
SS-015-17	0 - 0.5	06/07/17	2,700
BH-03-17	0 - 0.5	06/07/17	17,000

Notes:

Values are in micrograms per kilogram (µg/kg).

Blue-shaded results exceed the recreational soil direct contact criterion (DCC).

Duplicate sample results are shown in square brackets.

Output Sheet I-2
ProUCL Output for Soil - GPL
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

UCL Statistics for Uncensored Full Data Sets

User Selected Options
Date/Time of Computation ProUCL 5.16/23/2017 3:07:18 PM
From File Vanadium for proUCL.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Result (vanadium)

General Statistics			
Total Number of Observations	46	Number of Distinct Observations	39
		Number of Missing Observations	0
Minimum	2700	Mean	13840
Maximum	34100	Median	13250
SD	8080	Std. Error of Mean	1191
Coefficient of Variation	0.584	Skewness	0.892

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.914		
5% Shapiro Wilk Critical Value	0.945	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.119	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.129	Data appear Normal at 5% Significance Level	

Data appear Approximate Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	15967
95% Student's-t UCL	15841	95% Modified-t UCL (Johnson-1978)	15867

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	0.333		
5% A-D Critical Value	0.756	Detected data appear Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.094	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.131	Detected data appear Gamma Distributed at 5% Significance Level	

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	2.989	k star (bias corrected MLE)	2.808
Theta hat (MLE)	4631	Theta star (bias corrected MLE)	4928
nu hat (MLE)	275	nu star (bias corrected)	258.4
MLE Mean (bias corrected)	13840	MLE Sd (bias corrected)	8259
		Approximate Chi Square Value (0.05)	222.1
Adjusted Level of Significance	0.0448	Adjusted Chi Square Value	221.1

Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when $n \geq 50$)	16097	95% Adjusted Gamma UCL (use when $n < 50$)	16175

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.965		
5% Shapiro Wilk Critical Value	0.945	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.116	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.129	Data appear Lognormal at 5% Significance Level	

Data appear Lognormal at 5% Significance Level

Lognormal Statistics			
Minimum of Logged Data	7.901	Mean of logged Data	9.359
Maximum of Logged Data	10.44	SD of logged Data	0.625

Assuming Lognormal Distribution			
95% H-UCL	16950	90% Chebyshev (MVUE) UCL	18200
95% Chebyshev (MVUE) UCL	20089	97.5% Chebyshev (MVUE) UCL	22711
99% Chebyshev (MVUE) UCL	27860		

Nonparametric Distribution Free UCL Statistics
Data appear to follow a Discernible Distribution at 5% Significance Level

Output Sheet I-2

ProUCL Output for Soil - GPL

RACER Saginaw

Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties

Saginaw, Michigan

Nonparametric Distribution Free UCLs

95% CLT UCL	15800	95% Jackknife UCL	15841
95% Standard Bootstrap UCL	15805	95% Bootstrap-t UCL	16104
95% Hall's Bootstrap UCL	16074	95% Percentile Bootstrap UCL	15792
95% BCA Bootstrap UCL	15828		
90% Chebyshev(Mean, Sd) UCL	17414	95% Chebyshev(Mean, Sd) UCL	19033
97.5% Chebyshev(Mean, Sd) UCL	21280	99% Chebyshev(Mean, Sd) UCL	25694

Suggested UCL to Use

95% Student's-t UCL 15841

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Table I-3
Soil Data Used for Constituent-specific Evaluations - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Cobalt µg/kg	Iron µg/kg	Manganese µg/kg	Vanadium µg/kg
Recreational Direct Contact Criteria (DCC)			1,670,000	100,000,000	26,700,000	27,000
SB97-111	2 - 4	11/17/97	NA	62,000,000	NA	NA
SB97-111	24 - 26	11/18/97	NA	10,000,000	NA	NA
MW98-108S1	4 - 6	09/21/98	NA	8,800,000	NA	NA
MW98-110S1	0.5 - 1	09/22/98	NA	21,000,000	NA	NA
MW98-110S1	4 - 6	09/22/98	NA	270,000,000 D	NA	NA
MW98-111S1	0.5 - 1	09/22/98	NA	12,000,000	NA	NA
MW98-111S1	2 - 4	09/22/98	NA	66,000,000 D	NA	NA
MW98-109S1	0.5 - 1	09/23/98	NA	110,000,000 D	NA	NA
MW98-109S1	6 - 8	09/23/98	NA	11,000,000	NA	NA
SB98-120	0.5 - 1	09/23/98	NA	250,000,000 D	NA	NA
SB98-120	4 - 6	09/23/98	NA	83,000,000 D	NA	NA
SB98-119	0.5 - 1	09/23/98	NA	12,000,000	NA	NA
SB98-119	2 - 4	09/23/98	NA	31,000,000	NA	NA
MW98-108S1	0.5 - 1	09/24/98	NA	20,000,000	NA	NA
MW01-118WT	0 - 2	11/05/01	4,900 B [4,500 B]	59,600,000 [52,900,000]	3,790,000 J [3,530,000 J]	13,300 [10,500]
MW01-118WT	4 - 6	11/05/01	3,100 B	35,900,000	4,420,000 J	12,600
SB00-121	0 - 0.5	08/17/00	NA	62,400,000	NA	NA
SB00-122	0 - 0.5	08/17/00	NA	10,800,000	NA	NA
SB00-123	0 - 0.5	08/17/00	NA	38,500,000 [35,700,000]	NA	NA
SB00-124	0 - 0.5	08/17/00	NA	37,600,000	NA	NA
SB10-100	0 - 2	01/19/10	1,500	33,600,000 J	20,400,000 J	18,400
SB10-101	0 - 2	01/19/10	5,400	18,000,000 J	291,000 J	18,300
SB10-102	0 - 2	01/19/10	6,000	22,900,000 J	523,000 J	20,300
SB10-103	0 - 2	01/19/10	5,100	21,000,000 J	918,000 J	15,600
SB10-105	0 - 2	01/19/10	4,200	63,300,000 J	19,500,000 J	20,100
SB10-106	0 - 2	01/19/10	1,600	31,300,000 J	16,200,000 J	18,200
SB10-107	0 - 2	01/20/10	4,900	67,700,000 J	3,550,000 J	21,200
SB10-108	0 - 2	01/20/10	4,100	22,700,000 J	1,950,000 J	14,400
SB10-109	0 - 2	01/21/10	14,000	141,000,000	2,770,000	27,200 J
SB10-110	0 - 2	01/21/10	10,700	49,500,000	1,660,000	10,600 J
SB10-111	0 - 2	01/22/10	2,200 J	40,800,000	12,700,000	17,400
SB10-112	0 - 2	01/19/10	2,400	32,200,000 J	3,530,000 J	7,000
SB10-115	0 - 2	01/21/10	6,100 [8,000 J]	13,900,000 [19,300,000]	287,000 [335,000]	19,400 J [28,200]
SB10-116	0 - 2	01/21/10	3,300	36,100,000	4,120,000	16,900 J
SB10-117	0 - 2	01/22/10	9,600 J	126,000,000	15,100,000	20,900
SB10-118	0 - 2	01/19/10	2,700	40,700,000 J	15,600,000 J	19,900
SB10-120	0 - 2	01/20/10	4,800	18,700,000 J	696,000 J	15,900
SB10-121	0 - 2	01/21/10	4,800	27,800,000	2,510,000	16,300 J
SB10-122	0 - 2	01/21/10	5,500 J	21,600,000	840,000	22,500
SB10-123	0 - 2	01/22/10	7,300 J	89,100,000	21,000,000	24,200
SB10-124	0 - 2	01/19/10	2,300	27,000,000 J	5,340,000 J	9,200
SB10-125	0 - 2	01/20/10	3,940,000	236,000,000 J	2,530,000 J	34,600
SB10-126	0 - 2	01/20/10	5,600 [6,000]	30,400,000 J [28,800,000 J]	2,420,000 J [1,450,000 J]	17,400 [14,100]
SB10-127	0 - 2	01/21/10	5,600	34,800,000	2,190,000	14,500 J
SB10-128	0 - 2	01/21/10	4,400 J	28,700,000	2,210,000	13,500
SB10-129	0 - 2	01/22/10	2,600 J	45,500,000	9,950,000	12,700
SB10-130	0 - 2	01/19/10	1,200	10,700,000 J	3,210,000 J	6,600
SB10-131	0 - 2	01/20/10	5,800	14,400,000 J	293,000 J	23,100
SB10-132	0 - 2	01/20/10	3,500	12,100,000 J	448,000 J	13,500
SB10-133	0 - 2	01/21/10	4,300	12,700,000	230,000	17,200 J
SB10-134	0 - 2	01/21/10	5,400 J	22,500,000	1,000,000	17,100
SB10-135	0 - 2	01/22/10	18,500 J	133,000,000	7,940,000	29,100
SB10-136	0 - 2	01/19/10	2,500	33,600,000 J	10,400,000 J	13,000
SB10-137	0 - 2	01/20/10	33,000	92,300,000 J	2,820,000 J	24,400
SB10-138	0 - 2	01/20/10	2,300	8,340,000 J	374,000 J	9,400
SB10-139	0 - 2	01/21/10	4,100	19,600,000	732,000	13,600 J
SB10-140	0 - 2	01/21/10	4,800 J	33,000,000	3,430,000	19,600
SB10-141	0 - 2	01/22/10	1,700 J [2,700 J]	52,600,000 [42,800,000]	19,500,000 [12,700,000]	19,700 [15,300]
SB10-142	0 - 2	01/19/10	3,700	29,500,000 J	10,200,000 J	18,600
SB10-143	0 - 2	01/19/10	18,600	238,000,000 J	3,220,000 J	7,000
SB10-144	0 - 2	01/20/10	16,700 [2,700]	154,000,000 J [42,800,000 J]	1,660,000 J [12,700,000 J]	26,200 [15,300]
SB10-145	0 - 2	01/20/10	4,700	50,400,000 J	1,530,000 J	14,800
SB10-146	0 - 2	01/21/10	24,700 J	265,000,000	5,480,000	72,300
SB10-147	0 - 2	01/21/10	2,800 J	42,300,000	14,200,000	15,400
SB10-148	0 - 2	01/19/10	11,900	161,000,000 J	1,780,000 J	47,400

Table I-3
Soil Data Used for Constituent-specific Evaluations - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth (feet)	Date Collected	Cobalt	Iron	Manganese	Vanadium
			µg/kg	µg/kg	µg/kg	µg/kg
SB10-149	0 - 2	01/19/10	18,800 [20,800]	132,000,000 J [167,000,000 J]	24,20,000 J [2,920,000 J]	35,900 [32,500]
SB10-150	0 - 2	01/20/10	6,100	11,800,000 J	357,000 J	22,200
SB10-151	0 - 2	01/20/10	4,000	15,900,000 J	1,070,000 J	17,600
SB10-152	0 - 2	01/21/10	11,900 J	137,000,000	2,530,000	16,300
SB10-153	0 - 2	01/21/10	5,400 J	81,200,000	7,240,000	14,800
SB10-154	0 - 2	01/19/10	1,400	50,200,000 J	27,700,000 J	18,400
SB10-155	0 - 2	01/19/10	8,500	84,800,000 J	3,170,000 J	13,500
SB10-156	0 - 2	01/20/10	6,900	16,400,000 J	309,000 J	27,000
SB10-157	0 - 2	01/20/10	6,300	37,700,000 J	978,000 J	19,600
SB10-158	0 - 2	01/21/10	9,300 J	93,500,000	4,930,000	24,600
SB10-159	0 - 2	01/21/10	2,200 J	20,100,000 J	2,770,000 J	9,000
SB10-160	0 - 2	01/21/10	1,300	27,900,000 J	26,300,000 J	17,000
SB10-161	0 - 2	01/19/10	1,100	33,700,000 J	26,600,000 J	18,100
SB10-162	0 - 2	01/20/10	2,600	30,500,000 J	3,610,000 J	9,300
SB10-163	0 - 2	01/20/10	2,400	23,800,000 J	874,000 J	4,300
SB10-164	0 - 2	01/21/10	5,100 J	15,200,000	258,000	21,800
SB10-165	0 - 2	01/21/10	3,300 J	35,800,000	5,210,000	11,300
SB15-01	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-02	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-03	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-04	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-05	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-06	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-07	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-08	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-09	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-10	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-11	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-14	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-15	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-16	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-17	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-18	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-19	0 - 0.5	11/23/15	NA	NA	NA	NA
SB-17-01	0 - 0.5	07/13/17	NA	NA	NA	16,000
SB-17-02	0 - 0.5	07/13/17	NA	NA	7,900,000 B	NA
SB-17-03	0 - 0.5	07/13/17	NA	NA	15,000,000 B [17,000,000 B]	NA
SB-17-04	0 - 0.5	07/13/17	NA	NA	7,400,000 B	NA
SB-17-05	0 - 0.5	07/13/17	NA	NA	2,800,000 B	NA
SB97-110	18 - 20	11/17/97	NA	2,900,000 [3,300,000]	NA	NA
SB97-110	22 - 24	11/17/97	NA	12,000,000	NA	NA
SB10-104	0 - 2	01/19/10	10,700	75,200,000 J	2,060,000 J	11,000
SB10-113	0 - 2	01/20/10	13,700	92,000,000 J	1,440,000 J	13,600
SB10-114	0 - 2	01/20/10	10,200	67,300,000 J	1,450,000 J	13,500
SB10-119	0 - 2	01/20/10	13,400	113,000,000 J	4,120,000 J	15,700
SB15-12	0 - 0.5	11/23/15	NA	NA	NA	NA
SB15-13	0 - 0.5	11/23/15	NA	NA	NA	NA

Notes:

Values are in micrograms per kilogram (µg/kg).

Gray-shaded samples are located in an area with an exposure barrier or in a hot spot and were excluded from the calculations for the average or 95 percent upper confidence limit on the mean.

Blue-shaded results exceed the recreational soil direct contact criterion (DCC).

Duplicate sample results are shown in square brackets.

B = analyte was detected in an associated blank sample

J = estimated value above the method detection limit and below the reporting limit

NA = not analyzed

Output Sheet I-3
ProUCL Output for Soil - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

UCL Statistics for Data Sets with Non-Detects

User Selected Options
Date/Time of Computation ProUCL 5.17/25/2017 11:56:29 AM
From File updated Peninsula for ProUCL.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Result (cobalt)

General Statistics			
Total Number of Observations	64	Number of Distinct Observations	49
		Number of Missing Observations	0
Minimum	1100	Mean	67765
Maximum	3940000	Median	4800
SD	491747	Std. Error of Mean	61468
Coefficient of Variation	7.257	Skewness	7.998

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.133		
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.513	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.111	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution		95% UCLs (Adjusted for Skewness)	
95% Normal UCL		95% Adjusted-CLT UCL (Chen-1995)	234537
95% Student's-t UCL	170380	95% Modified-t UCL (Johnson-1978)	180623

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	17.35		
5% A-D Critical Value	0.878	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.412	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics			
k hat (MLE)	0.273	k star (bias corrected MLE)	0.271
Theta hat (MLE)	248198	Theta star (bias corrected MLE)	250381
nu hat (MLE)	34.95	nu star (bias corrected)	34.64
MLE Mean (bias corrected)	67765	MLE Sd (bias corrected)	130258
		Approximate Chi Square Value (0.05)	22.18
Adjusted Level of Significance	0.0463	Adjusted Chi Square Value	21.95

Assuming Gamma Distribution		95% Adjusted Gamma UCL (use when n<50)	
95% Approximate Gamma UCL (use when n>=50))	105847		106957

Lognormal GOF Test		Shapiro Wilk Lognormal GOF Test	
Shapiro Wilk Test Statistic	0.758		
5% Shapiro Wilk P Value	5.840E-14	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.167	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.111	Data Not Lognormal at 5% Significance Level	

Data Not Lognormal at 5% Significance Level

Lognormal Statistics			
Minimum of Logged Data	7.003	Mean of logged Data	8.559
Maximum of Logged Data	15.19	SD of logged Data	1.119

Assuming Lognormal Distribution			
95% H-UCL	13434	90% Chebyshev (MVUE) UCL	14543
95% Chebyshev (MVUE) UCL	16779	97.5% Chebyshev (MVUE) UCL	19883
99% Chebyshev (MVUE) UCL	25980		

Output Sheet I-3
ProUCL Output for Soil - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Nonparametric Distribution Free UCL Statistics
Data do not follow a Discernible Distribution (0.05)

Nonparametric Distribution Free UCLs

95% CLT UCL	168871	95% Jackknife UCL	170380
95% Standard Bootstrap UCL	165938	95% Bootstrap-t UCL	6998669
95% Hall's Bootstrap UCL	3098777	95% Percentile Bootstrap UCL	190782
95% BCA Bootstrap UCL	252784		
90% Chebyshev(Mean, Sd) UCL	252170	95% Chebyshev(Mean, Sd) UCL	335699
97.5% Chebyshev(Mean, Sd) UCL	451635	99% Chebyshev(Mean, Sd) UCL	679367

Suggested UCL to Use

95% Chebyshev (Mean, Sd) UCL 335699

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.
These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (iron - surface soil)

General Statistics

Total Number of Observations	67	Number of Distinct Observations	66
		Number of Missing Observations	0
Minimum	8340000	Mean	55461045
Maximum	2.650E+8	Median	33700000
SD	55731794	Std. Error of Mean	6808722
Coefficient of Variation	1.005	Skewness	2.158

Normal GOF Test

Shapiro Wilk Test Statistic	0.721
5% Shapiro Wilk P Value	0
Lilliefors Test Statistic	0.253
5% Lilliefors Critical Value	0.108

Shapiro Wilk GOF Test

Data Not Normal at 5% Significance Level

Lilliefors GOF Test

Data Not Normal at 5% Significance Level

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 66819834

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 68578550
95% Modified-t UCL (Johnson-1978) 67119028

Gamma GOF Test

A-D Test Statistic	2.103
5% A-D Critical Value	0.769
K-S Test Statistic	0.164
5% K-S Critical Value	0.111

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics

k hat (MLE)	1.533
Theta hat (MLE)	36177323
nu hat (MLE)	205.4
MLE Mean (bias corrected)	55461045
Adjusted Level of Significance	0.0464

k star (bias corrected MLE)	1.474
Theta star (bias corrected MLE)	37617532
nu star (bias corrected)	197.6
MLE Sd (bias corrected)	45676116
Approximate Chi Square Value (0.05)	166
Adjusted Chi Square Value	165.4

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when n>=50)) 65989344

95% Adjusted Gamma UCL (use when n<50) 66241508

Lognormal GOF Test

Shapiro Wilk Test Statistic	0.957
5% Shapiro Wilk P Value	0.0508
Lilliefors Test Statistic	0.11
5% Lilliefors Critical Value	0.108

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data Not Lognormal at 5% Significance Level

Data appear Approximate Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data	15.94
Maximum of Logged Data	19.4

Mean of logged Data	17.47
SD of logged Data	0.818

Output Sheet I-3
ProUCL Output for Soil - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Assuming Lognormal Distribution

95% H-UCL 66874139
95% Chebyshev (MVUE) UCL 80171469
99% Chebyshev (MVUE) UCL 1.141E+8
90% Chebyshev (MVUE) UCL 71917378
97.5% Chebyshev (MVUE) UCL 91627827

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL 66660396
95% Standard Bootstrap UCL 66523892
95% Hall's Bootstrap UCL 68710971
95% BCA Bootstrap UCL 68649254
90% Chebyshev(Mean, Sd) UCL 75887212
97.5% Chebyshev(Mean, Sd) UCL 97981502
95% Jackknife UCL 66819834
95% Bootstrap-t UCL 70006446
95% Percentile Bootstrap UCL 67024478
95% Chebyshev(Mean, Sd) UCL 85139577
99% Chebyshev(Mean, Sd) UCL 1.232E+8

Suggested UCL to Use

95% H-UCL 66874139

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.

H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.

It is therefore recommended to avoid the use of H-statistic based 95% UCLs.

Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Result (iron - soil column)

General Statistics			
Total Number of Observations	82	Number of Distinct Observations	79
		Number of Missing Observations	0
Minimum	8340000	Mean	57543780
Maximum	2.700E+8	Median	33650000
SD	61446157	Std. Error of Mean	6785593
Coefficient of Variation	1.068	Skewness	2.12

Normal GOF Test		Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic	0.706		
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.241		
5% Lilliefors Critical Value	0.098	Data Not Normal at 5% Significance Level	

Data Not Normal at 5% Significance Level

Assuming Normal Distribution

95% Normal UCL	95% UCLs (Adjusted for Skewness)
95% Student's-t UCL 68834220	95% Adjusted-CLT UCL (Chen-1995) 70402886
	95% Modified-t UCL (Johnson-1978) 69099042

Gamma GOF Test		Anderson-Darling Gamma GOF Test	
A-D Test Statistic	2.431		
5% A-D Critical Value	0.774	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.161		
5% K-S Critical Value	0.101	Data Not Gamma Distributed at 5% Significance Level	

Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics		Gamma Statistics	
k hat (MLE)	1.35	k star (bias corrected MLE)	1.309
Theta hat (MLE)	42617105	Theta star (bias corrected MLE)	43960730
nu hat (MLE)	221.4	nu star (bias corrected)	214.7
MLE Mean (bias corrected)	57543780	MLE Sd (bias corrected)	50295791
Adjusted Level of Significance	0.0471	Approximate Chi Square Value (0.05)	181.8
		Adjusted Chi Square Value	181.2

Output Sheet I-3
ProUCL Output for Soil - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

95% Approximate Gamma UCL (use when n>=50)) 67961965		95% Adjusted Gamma UCL (use when n<50) 68163801	
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.949	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0.007	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.102	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.098	Data Not Lognormal at 5% Significance Level	
Data Not Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	15.94	Mean of logged Data	17.45
Maximum of Logged Data	19.41	SD of logged Data	0.88
Assuming Lognormal Distribution			
95% H-UCL	68982774	90% Chebyshev (MVUE) UCL	74444220
95% Chebyshev (MVUE) UCL	82942459	97.5% Chebyshev (MVUE) UCL	94737684
99% Chebyshev (MVUE) UCL	1.179E+8		
Nonparametric Distribution Free UCL Statistics			
Data do not follow a Discernible Distribution (0.05)			
Nonparametric Distribution Free UCLs			
95% CLT UCL	68705088	95% Jackknife UCL	68834220
95% Standard Bootstrap UCL	68821804	95% Bootstrap-t UCL	71199509
95% Hall's Bootstrap UCL	71068130	95% Percentile Bootstrap UCL	68830488
95% BCA Bootstrap UCL	70877195		
90% Chebyshev(Mean, Sd) UCL	77900559	95% Chebyshev(Mean, Sd) UCL	87121494
97.5% Chebyshev(Mean, Sd) UCL	99919795	99% Chebyshev(Mean, Sd) UCL	1.251E+8
Suggested UCL to Use			
95% Chebyshev (Mean, Sd) UCL 87121494			

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (manganese)

General Statistics			
Total Number of Observations	68	Number of Distinct Observations	66
		Number of Missing Observations	0
Minimum	230000	Mean	6141868
Maximum	27700000	Median	3190000
SD	7099669	Std. Error of Mean	860961
Coefficient of Variation	1.156	Skewness	1.578
Normal GOF Test			
Shapiro Wilk Test Statistic	0.765	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	1.010E-14	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.24	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.107	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			
Assuming Normal Distribution			
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	7577879	95% Adjusted-CLT UCL (Chen-1995)	7734009
		95% Modified-t UCL (Johnson-1978)	7605329
Gamma GOF Test			
A-D Test Statistic	0.88	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.789	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.122	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.112	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamma Distributed at 5% Significance Level			

Output Sheet I-3
ProUCL Output for Soil - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Gamma Statistics			
k hat (MLE)	0.821	k star (bias corrected MLE)	0.795
Theta hat (MLE)	7477621	Theta star (bias corrected MLE)	7726264
nu hat (MLE)	111.7	nu star (bias corrected)	108.1
MLE Mean (bias corrected)	6141868	MLE Sd (bias corrected)	6888664
Adjusted Level of Significance	0.0465	Approximate Chi Square Value (0.05)	85.11
		Adjusted Chi Square Value	84.67
Assuming Gamma Distribution			
95% Approximate Gamma UCL (use when n>=50))	7801392	95% Adjusted Gamma UCL (use when n<50)	7841970
Lognormal GOF Test			
Shapiro Wilk Test Statistic	0.946	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0.0104	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0798	Lilliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.107	Data appear Lognormal at 5% Significance Level	
Data appear Approximate Lognormal at 5% Significance Level			
Lognormal Statistics			
Minimum of Logged Data	12.35	Mean of logged Data	14.91
Maximum of Logged Data	17.14	SD of logged Data	1.323
Assuming Lognormal Distribution			
95% H-UCL	10149915	90% Chebyshev (MVUE) UCL	11385070
95% Chebyshev (MVUE) UCL	13366974	97.5% Chebyshev (MVUE) UCL	16117779
99% Chebyshev (MVUE) UCL	21521203		
Nonparametric Distribution Free UCL Statistics			
Data appear to follow a Discernible Distribution at 5% Significance Level			
Nonparametric Distribution Free UCLs			
95% CLT UCL	7558023	95% Jackknife UCL	7577879
95% Standard Bootstrap UCL	7552108	95% Bootstrap-t UCL	7823304
95% Hall's Bootstrap UCL	7612655	95% Percentile Bootstrap UCL	7621279
95% BCA Bootstrap UCL	7718044		
90% Chebyshev(Mean, Sd) UCL	8724752	95% Chebyshev(Mean, Sd) UCL	9894711
97.5% Chebyshev(Mean, Sd) UCL	11518569	99% Chebyshev(Mean, Sd) UCL	14708325
Suggested UCL to Use			
95% H-UCL	10149915		

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

ProUCL computes and outputs H-statistic based UCLs for historical reasons only.
H-statistic often results in unstable (both high and low) values of UCL95 as shown in examples in the Technical Guide.
It is therefore recommended to avoid the use of H-statistic based 95% UCLs.
Use of nonparametric methods are preferred to compute UCL95 for skewed data sets which do not follow a gamma distribution.

Result (vanadium)

General Statistics			
Total Number of Observations	65	Number of Distinct Observations	58
		Number of Missing Observations	0
Minimum	4300	Mean	18603
Maximum	72300	Median	17200
SD	9799	Std. Error of Mean	1215
Coefficient of Variation	0.527	Skewness	3.018
Normal GOF Test			
Shapiro Wilk Test Statistic	0.77	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	1.472E-13	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.165	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.11	Data Not Normal at 5% Significance Level	
Data Not Normal at 5% Significance Level			

Output Sheet I-3
ProUCL Output for Soil - Peninsula
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Assuming Normal Distribution

95% Normal UCL

95% Student's-t UCL 20632

95% UCLs (Adjusted for Skewness)

95% Adjusted-CLT UCL (Chen-1995) 21088

95% Modified-t UCL (Johnson-1978) 20707

Gamma GOF Test

A-D Test Statistic 1.095

5% A-D Critical Value 0.754

K-S Test Statistic 0.103

5% K-S Critical Value 0.111

Anderson-Darling Gamma GOF Test

Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov Gamma GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Detected data follow Appr. Gamma Distribution at 5% Significance Level

Gamma Statistics

k hat (MLE) 5.052

Theta hat (MLE) 3682

nu hat (MLE) 656.8

MLE Mean (bias corrected) 18603

Adjusted Level of Significance 0.0463

k star (bias corrected MLE) 4.829

Theta star (bias corrected MLE) 3852

nu star (bias corrected) 627.8

MLE Sd (bias corrected) 8465

Approximate Chi Square Value (0.05) 570.7

Adjusted Chi Square Value 569.5

Assuming Gamma Distribution

95% Approximate Gamma UCL (use when $n \geq 50$) 20465

95% Adjusted Gamma UCL (use when $n < 50$) 20509

Lognormal GOF Test

Shapiro Wilk Test Statistic 0.969

5% Shapiro Wilk P Value 0.248

Lilliefors Test Statistic 0.098

5% Lilliefors Critical Value 0.11

Shapiro Wilk Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Lilliefors Lognormal GOF Test

Data appear Lognormal at 5% Significance Level

Data appear Lognormal at 5% Significance Level

Lognormal Statistics

Minimum of Logged Data 8.366

Maximum of Logged Data 11.19

Mean of logged Data 9.729

SD of logged Data 0.449

Assuming Lognormal Distribution

95% H-UCL 20593

95% Chebyshev (MVUE) UCL 23244

99% Chebyshev (MVUE) UCL 29269

90% Chebyshev (MVUE) UCL 21780

97.5% Chebyshev (MVUE) UCL 25276

Nonparametric Distribution Free UCL Statistics

Data appear to follow a Discernible Distribution at 5% Significance Level

Nonparametric Distribution Free UCLs

95% CLT UCL 20602

95% Standard Bootstrap UCL 20613

95% Hall's Bootstrap UCL 23287

95% BCA Bootstrap UCL 21191

90% Chebyshev (Mean, Sd) UCL 22249

97.5% Chebyshev (Mean, Sd) UCL 26193

95% Jackknife UCL 20632

95% Bootstrap-t UCL 21487

95% Percentile Bootstrap UCL 20828

95% Chebyshev (Mean, Sd) UCL 23901

99% Chebyshev (Mean, Sd) UCL 30696

Suggested UCL to Use

95% Approximate Gamma UCL 20465

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test

When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Table I-4
Sediment Data Used for Constituent-specific Evaluations
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth	Sample Date	Copper	Vanadium
			µg/kg	µg/kg
Recreational Direct Contact Criteria (DCC)			1,110,000	35,800
SD-1	(0 - 1.5')	6/15/95	66,700 J	12,400
SD-1	(1.5 - 3')	6/15/95	87,000 J	17,600
SD-1	(3 - 4.5')	6/15/95	41,200 J	19,600
SD-2	(0 - 1.7')	6/15/95	40,400 J	18,300
SD-2	(1.7 - 3.4')	6/15/95	60,800 UJ	12,600
SD-2	(3.4 - 5')	6/15/95	33,200 J	26,400
SD-3	(0 - 1.3')	6/15/95	59,700 J [63,700 J]	10,100 [11,100]
SD-3	(1.3 - 2.6')	6/15/95	26,800 J	7,560
SD-3	(2.6 - 3.9')	6/15/95	14,700 J	10,400
SD-4	(0 - 1.5')	6/19/95	22,600 J	18,600
SD-4	(1.5 - 3')	6/19/95	4,520 J	11,500
SD-5	(0 - 1.8')	6/21/95	19,000	23,700
SD-5	(1.8 - 3.6')	6/21/95	43,300	8,830
SD-5	(3.6 - 5.4')	6/21/95	11,700	14,500
SD-6	(0 - 1.6')	6/21/95	31,000	1,790
SD-6	(1.6 - 3.2')	6/21/95	43,300	5,510
SD-6	(3.2 - 4.8')	6/21/95	13,100	9,020
SD-7	(0 - 1.3')	6/21/95	28,000	17,400
SD-7	(1.3 - 2.6')	6/21/95	35,000	3,020
SD-7	(2.6 - 3.9')	6/21/95	40,800	6,180
SD-8	(0 - 1.5')	6/21/95	49,800	4,870
SD-8	(1.5 - 3')	6/21/95	44,100	1,680 U
SD-8	(3 - 4.5')	6/21/95	38,300	8,790
SD-9	(0 - 1.5')	6/21/95	17,100 [23,400]	16,400 [25,400]
SD-9	(1.5 - 3')	6/21/95	5,740	9,850
SD-10	(0 - 0.5')	6/20/95	65,600	11,300
SD-10	(0.75 - 1.25')	6/20/95	51,300	15,400
SD-10	(1.5 - 2')	6/20/95	13,000	14,300
SD-11	(0 - 0.5')	6/20/95	50,800	7,850
SD-11	(0.9 - 1.4')	6/20/95	45,700	13,500
SD-11	(1.8 - 2.3')	6/20/95	52,600	23,100
SD-12	(0 - 0.5')	6/20/95	79,500	12,800
SD-12	(1.05 - 1.55')	6/20/95	52,600 [54,700]	16,800 [18,000]
SD-12	(2.1 - 2.6')	6/20/95	40,700	29,600
SD-13	(0 - 0.5')	6/20/95	72,200	16,900
SD-13	(1.45 - 1.95')	6/20/95	60,600	22,000
SD-13	(2.9 - 3.4')	6/20/95	42,900	21,900
SD-14	(0 - 0.5')	6/20/95	73,100 J	7,770
SD-14	(0.9 - 1.4')	6/20/95	46,600 J	10,700
SD-14	(1.8 - 2.3')	6/20/95	52,300 J	26,000
SD-15	(0 - 0.5')	6/20/95	69,200	17,500
SD-15	(0.9 - 1.4')	6/20/95	51,900	21,400
SD-15	(1.8 - 2.3')	6/20/95	25,600	19,200
SD-16	(0 - 0.5')	6/20/95	42,200 [27,300]	15,900 [17,600]
SD-16	(0.95 - 1.45')	6/20/95	36,100	15,300
SD-17	(1.9 - 2.4')	6/20/95	56,600	20,500
SD-17	(0 - 0.5')	6/20/95	51,000	13,000
SD-17	(1.1 - 1.6')	6/20/95	47,500	15,400
SD-17	(2.2 - 2.7')	6/20/95	41,000	17,900
SD-18	(0 - 0.5')	6/20/95	37,400	5,770
SD-18	(2.25 - 2.75')	6/20/95	58,000 J	11,700

Table I-4
Sediment Data Used for Constituent-specific Evaluations
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth	Sample Date	Copper	Vanadium
			µg/kg	µg/kg
Recreational Direct Contact Criteria (DCC)			1,110,000	35,800
SD-18	(4.5 - 5')	6/20/95	28,200 J	15,900
SD-19	(0 - 0.5')	6/20/95	66,900 J	8,500
SD-19	(1.75 - 2.25')	6/20/95	64,900 J	7,790
SD-19	(3.5 - 4')	6/20/95	30,000 J	6,960
SD-20	(0 - 0.5')	6/20/95	79,900 J	6,750
SD-20	(0.7 - 1.2')	6/20/95	58,000 J	11,600
SD-20	(1.4 - 1.9')	6/20/95	36,600 J	19,400
SD-21	(0 - 0.5')	6/20/95	93,800 J	7,400
SD-21	(0.65 - 1.15')	6/20/95	40,900 J	12,800
SD-21	(1.3 - 1.8')	6/20/95	25,900 J	19,300
SD-22	(0 - 1.2')	6/19/95	4,900 J	17,100
SD-22	(1.2 - 2.4')	6/19/95	24,400 J	16,000
SD-22	(2.4 - 3.6')	6/19/95	6,830 J	15,000
SD-23	(0 - 1.2')	6/19/95	27,300 J	21,500
SD-23	(1.2 - 2.4')	6/19/95	16,200	15,700
SD-23	(2.4 - 3.6')	6/19/95	3,800 J	8,550
SD-24	(0 - 1.5')	6/19/95	15,200 J	24,900
SD-24	(1.5 - 3')	6/19/95	7,860 J	12,300
SD-25	(0 - 1.1')	6/19/95	8,600 J	17,300
SD-25	(1.1 - 2.2')	6/19/95	4,020 J	12,100
SD-25	(2.2 - 3.3')	6/19/95	4,280 J	14,400
SD-26	(0 - 1.2')	6/19/95	12,800 J	18,200
SD-26	(1.2 - 2.4')	6/19/95	10,300 J	19,000
SD-26	(2.4 - 3.6')	6/19/95	3,770 J	7,920
SD-27	(0 - 1.3')	6/19/95	15,400 J	24,800
SD-27	(1.3 - 2.6')	6/19/95	4,870 J	9,150
SD-27	(2.6 - 3.9')	6/19/95	2,620 J	6,210
SD-28	(0 - 1.2')	6/19/95	21,500 J	33,500
SD-28	(1.2 - 2.4')	6/19/95	14,200 J	20,600
SD-28	(2.4 - 3.6')	6/19/95	4,570 J	8,930
SD-29	(0 - 1.2')	6/19/95	12,700 J	17,600
SD-29	(1.2 - 2.4')	6/19/95	7,410 J	13,700
SD-29	(2.4 - 3.6')	6/19/95	16,600 J	13,300
SD-30	(0 - 1.1')	6/19/95	12,200 J	22,000
SD-30	(1.1 - 2.2')	6/19/95	1,330 J	4,210
SD-30	(2.2 - 3.3')	6/19/95	4,050 J	8,090
SD-31	(0 - 1.1')	6/19/95	15,600	22,300
SD-31	(1.1 - 2.2')	6/19/95	6,600	12,000
SD-31	(2.2 - 3.3')	6/19/95	2,460	5,960
SD-32	(0 - 1.4')	6/19/95	22,800 [22,200]	36,300 [27,800]
SD-32	(1.4 - 2.8')	6/19/95	7,850	10,700
SD-32	(2.8 - 4.2')	6/19/95	3,680	6,730
SD-33	(0 - 1.3')	6/19/95	25,700	38,200
SD-33	(1.3 - 2.6')	6/19/95	18,300	29,100
SD-33	(2.6 - 3.9')	6/19/95	2,840	7,030
SD-34	(0 - 1.3')	6/21/95	14,700	10,900
SD-34	(1.3 - 2.6')	6/21/95	13,700	16,100
SD-34	(2.6 - 3.9')	6/21/95	8,040	13,200
SD-35	(0 - 1.5')	6/21/95	26,900	17,600
SD-35	(1.5 - 3')	6/21/95	20,000	11,700
SD-35	(3 - 4.5')	6/21/95	15,500	16,400

Table I-4
Sediment Data Used for Constituent-specific Evaluations
RACER Saginaw
Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

Sample Location	Sample Depth	Sample Date	Copper	Vanadium
			µg/kg	µg/kg
Recreational Direct Contact Criteria (DCC)			1,110,000	35,800
SD-36	(0 - 1.2')	6/19/95	7,070	11,700
SD-36	(1.2 - 2.4')	6/19/95	6,700	12,100
SD-36	(2.4 - 3.6')	6/19/95	11,700	19,000
SD-37	(0 - 1.3')	6/19/95	8,910	12,900
SD-37	(1.3 - 2.6')	6/19/95	9,450 [9,920]	16,100 [21,300]
SD-37	(2.6 - 3.9')	6/19/95	9,030	13,800
SD-38	(0 - 1.2')	6/19/95	36,800	28,600
SD-38	(1.2 - 2.4')	6/19/95	10,800	15,600
SD-39	(0 - 1')	6/22/95	2,690	3,480
SD-39	(1 - 2')	6/22/95	19,300 J [1,490 J]	20,000 J [3,030 J]
SD-40	(0 - 1.1')	6/22/95	17,800	22,300
SD-40	(1.1 - 2.2')	6/22/95	14,700	27,600
SD-41	(0 - 1')	6/22/95	38,300	20,400
SD-41	(1 - 2')	6/22/95	11,500	8,290
SD-42	(0 - 1')	6/22/95	10,700	4,510
SD-42	(1 - 2')	6/22/95	18,500	17,700
SD-43	(0 - 0.8')	6/15/95	47,000 J	1,410 U
SD-43	(0.8 - 1.6')	6/15/95	22,300 J	10,300
SD-44	(0 - 0.9')	6/15/95	45,000 J	23,400
SD-44	(0.9 - 1.8')	6/15/95	24,900 J	32,700
SD-45	(0 - 0.7')	6/15/95	11,600 J	24,100
SD-45	(0.7 - 1.4')	6/15/95	11,300 J	23,800
SD-46	(0 - 1.5')	6/15/95	33,400 J	19,800
SD-46	(1.5 - 3')	6/15/95	16,600 J	17,800
SD-46	(3 - 4.5')	6/15/95	6,760	12,000
SD-47	(0 - 1.5')	6/15/95	6,110	8,290
SD-47	(1.5 - 3')	6/15/95	6,880	10,100
SD-48	(0 - 1.3')	6/15/95	10,900 J	12,700
SD-48	(1.3 - 2.6')	6/15/95	12,900 J	18,900
SD-59	(0 - 0.5')	8/10/00	21,700	21,600
SD-60	(0 - 0.5')	8/10/00	24,400	6,300 B
SD-61	(0 - 0.5')	8/10/00	14,100	16,200
SD-62	(0 - 0.5')	8/10/00	1,140,000 [1,170,000]	15,400 [18,600]
SD-64	(0 - 0.5')	8/10/00	26,700	36,100
SD-65	(0 - 0.5')	8/10/00	8,700	7,100 B

Notes:

Values are in micrograms per kilogram (µg/kg).

Blue-shaded results exceed the recreational sediment direct contact criterion (DCC).

Duplicate sample results are shown in square brackets.

B = analyte was detected in an associated blank sample

J = estimated value above the method detection limit and below the reporting limit

U = not detected

Output Sheet I-4

ProUCL Output for Sediment

RACER Saginaw

Saginaw Malleable Industrial Land, Green Point Landfill, and Peninsula Properties
Saginaw, Michigan

UCL Statistics for Data Sets with Non-Detects

User Selected Options
Date/Time of Computation ProUCL 5.12/10/2017 4:29:21 PM
From File Sediment for ProUCL.xls
Full Precision OFF
Confidence Coefficient 95%
Number of Bootstrap Operations 2000

Result (copper)

General Statistics			
Total Number of Observations	137	Number of Distinct Observations	129
Number of Detects	136	Number of Non-Detects	1
Number of Distinct Detects	128	Number of Distinct Non-Detects	1
Minimum Detect	1330	Minimum Non-Detect	60800
Maximum Detect	1155000	Maximum Non-Detect	60800
Variance Detects	9.803E+9	Percent Non-Detects	0.73%
Mean Detects	35739	SD Detects	99010
Median Detects	21600	CV Detects	2.77
Skewness Detects	10.86	Kurtosis Detects	123.4
Mean of Logged Detects	9.888	SD of Logged Detects	0.991

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic 0.23
5% Shapiro Wilk P Value 0
Lilliefors Test Statistic 0.364
5% Lilliefors Critical Value 0.0763

Normal GOF Test on Detected Observations Only

Detected Data Not Normal at 5% Significance Level
Lilliefors GOF Test
Detected Data Not Normal at 5% Significance Level

Detected Data Not Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	35646	KM Standard Error of Mean	8430
KM SD	98300	95% KM (BCA) UCL	52326
95% KM (t) UCL	49608	95% KM (Percentile Bootstrap) UCL	51801
95% KM (z) UCL	49512	95% KM Bootstrap t UCL	86985
90% KM Chebyshev UCL	60937	95% KM Chebyshev UCL	72392
97.5% KM Chebyshev UCL	88293	99% KM Chebyshev UCL	119526

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic 3.054
5% A-D Critical Value 0.785
K-S Test Statistic 0.0983
5% K-S Critical Value 0.0826

Anderson-Darling GOF Test

Detected Data Not Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected Data Not Gamma Distributed at 5% Significance Level

Detected Data Not Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE) 0.972
Theta hat (MLE) 36773
nu hat (MLE) 264.4
Mean (detects) 35739

k star (bias corrected MLE) 0.955
Theta star (bias corrected MLE) 37409
nu star (bias corrected) 259.9

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs
GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)
For such situations, GROS method may yield incorrect values of UCLs and BTVs
This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1330	Mean	35577
Maximum	1155000	Median	21500
SD	98663	CV	2.773
k hat (MLE)	0.974	k star (bias corrected MLE)	0.958
Theta hat (MLE)	36508	Theta star (bias corrected MLE)	37135
nu hat (MLE)	267	nu star (bias corrected)	262.5
Adjusted Level of Significance (β)	0.0482	Adjusted Chi Square Value (262.50, β)	225.6
Approximate Chi Square Value (262.50, α)	226	95% Gamma Adjusted UCL (use when n<50)	41391
95% Gamma Approximate UCL (use when n>=50)	41326		

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	35646	SD (KM)	98300
Variance (KM)	9.663E+9	SE of Mean (KM)	8430
k hat (KM)	0.131	k star (KM)	0.133
nu hat (KM)	36.03	nu star (KM)	36.57
theta hat (KM)	271081	theta star (KM)	267046
80% gamma percentile (KM)	34958	90% gamma percentile (KM)	103607
95% gamma percentile (KM)	200310	99% gamma percentile (KM)	488085

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (36.57, α)	23.73	Adjusted Chi Square Value (36.57, β)	23.62
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	54937	95% Gamma Adjusted KM-UCL (use when $n < 50$)	55192

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic	0.974	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.157	Detected Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.0695	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0763	Detected Data appear Lognormal at 5% Significance Level	

Detected Data appear Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	35606	Mean in Log Scale	9.887
SD in Original Scale	98657	SD in Log Scale	0.988
95% t UCL (assumes normality of ROS data)	49565	95% Percentile Bootstrap UCL	52259
95% BCA Bootstrap UCL	61923	95% Bootstrap t UCL	86164
95% H-UCL (Log ROS)	38568		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	9.887	KM Geo Mean	19671
KM SD (logged)	0.987	95% Critical H Value (KM-Log)	2.185
KM Standard Error of Mean (logged)	0.0849	95% H-UCL (KM -Log)	38519
KM SD (logged)	0.987	95% Critical H Value (KM-Log)	2.185
KM Standard Error of Mean (logged)	0.0849		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale	35700
SD in Original Scale	98646
95% t UCL (Assumes normality)	49658

DL/2 Log-Transformed

Mean in Log Scale	9.891
SD in Log Scale	0.988
95% H-Stat UCL	38756

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Lognormal Distributed at 5% Significance Level

Suggested UCL to Use

KM H-UCL 38519

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).

However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

Result (vanadium)

General Statistics

Total Number of Observations	137	Number of Distinct Observations	123
Number of Detects	135	Number of Non-Detects	2
Number of Distinct Detects	121	Number of Distinct Non-Detects	2
Minimum Detect	1790	Minimum Non-Detect	1410
Maximum Detect	38200	Maximum Non-Detect	1680
Variance Detects	51795675	Percent Non-Detects	1.46%
Mean Detects	15257	SD Detects	7197
Median Detects	14500	CV Detects	0.472
Skewness Detects	0.687	Kurtosis Detects	0.433
Mean of Logged Detects	9.509	SD of Logged Detects	0.531

Normal GOF Test on Detects Only

Shapiro Wilk Test Statistic	0.957	Normal GOF Test on Detected Observations Only	
5% Shapiro Wilk P Value	0.00208	Detected Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.0675	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.0766	Detected Data appear Normal at 5% Significance Level	

Detected Data appear Approximate Normal at 5% Significance Level

Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs

KM Mean	15055	KM Standard Error of Mean	626.8
KM SD	7309	95% KM (BCA) UCL	16168

95% KM (t) UCL 16093
95% KM (z) UCL 16086
90% KM Chebyshev UCL 16935
97.5% KM Chebyshev UCL 18969

95% KM (Percentile Bootstrap) UCL 16088
95% KM Bootstrap t UCL 16119
95% KM Chebyshev UCL 17787
99% KM Chebyshev UCL 21291

Gamma GOF Tests on Detected Observations Only

A-D Test Statistic 0.311
5% A-D Critical Value 0.756
K-S Test Statistic 0.0561
5% K-S Critical Value 0.0807

Anderson-Darling GOF Test

Detected data appear Gamma Distributed at 5% Significance Level

Kolmogorov-Smirnov GOF

Detected data appear Gamma Distributed at 5% Significance Level

Detected data appear Gamma Distributed at 5% Significance Level

Gamma Statistics on Detected Data Only

k hat (MLE) 4.2
Theta hat (MLE) 3633
nu hat (MLE) 1134
Mean (detects) 15257

k star (bias corrected MLE) 4.112
Theta star (bias corrected MLE) 3711
nu star (bias corrected) 1110

Gamma ROS Statistics using Imputed Non-Detects

GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs

GROS may not be used when kstar of detects is small such as <1.0, especially when the sample size is small (e.g., <15-20)

For such situations, GROS method may yield incorrect values of UCLs and BTVs

This is especially true when the sample size is small.

For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates

Minimum	1790	Mean	15074
Maximum	38200	Median	14400
SD	7300	CV	0.484
k hat (MLE)	3.866	k star (bias corrected MLE)	3.786
Theta hat (MLE)	3899	Theta star (bias corrected MLE)	3981
nu hat (MLE)	1059	nu star (bias corrected)	1037
Adjusted Level of Significance (β)	0.0482		
Approximate Chi Square Value (N/A, α)	963.7	Adjusted Chi Square Value (N/A, β)	962.9
95% Gamma Approximate UCL (use when $n \geq 50$)	16228	95% Gamma Adjusted UCL (use when $n < 50$)	16241

Estimates of Gamma Parameters using KM Estimates

Mean (KM)	15055	SD (KM)	7309
Variance (KM)	53419657	SE of Mean (KM)	626.8
k hat (KM)	4.243	k star (KM)	4.155
nu hat (KM)	1163	nu star (KM)	1138
theta hat (KM)	3548	theta star (KM)	3624
80% gamma percentile (KM)	20666	90% gamma percentile (KM)	24953
95% gamma percentile (KM)	28892	99% gamma percentile (KM)	37289

Gamma Kaplan-Meier (KM) Statistics

Approximate Chi Square Value (N/A, α)	1061	Adjusted Chi Square Value (N/A, β)	1060
95% Gamma Approximate KM-UCL (use when $n \geq 50$)	16152	95% Gamma Adjusted KM-UCL (use when $n < 50$)	16164

Lognormal GOF Test on Detected Observations Only

Shapiro Wilk Approximate Test Statistic 0.964
5% Shapiro Wilk P Value 0.0148
Lilliefors Test Statistic 0.0832
5% Lilliefors Critical Value 0.0766

Shapiro Wilk GOF Test

Detected Data Not Lognormal at 5% Significance Level

Lilliefors GOF Test

Detected Data Not Lognormal at 5% Significance Level

Detected Data Not Lognormal at 5% Significance Level

Lognormal ROS Statistics Using Imputed Non-Detects

Mean in Original Scale	15084	Mean in Log Scale	9.489
SD in Original Scale	7284	SD in Log Scale	0.552
95% t UCL (assumes normality of ROS data)	16115	95% Percentile Bootstrap UCL	16147
95% BCA Bootstrap UCL	16180	95% Bootstrap t UCL	16190
95% H-UCL (Log ROS)	16800		

Statistics using KM estimates on Logged Data and Assuming Lognormal Distribution

KM Mean (logged)	9.476	KM Geo Mean	13044
KM SD (logged)	0.59	95% Critical H Value (KM-Log)	1.881
KM Standard Error of Mean (logged)	0.0506	95% H-UCL (KM -Log)	17079
KM SD (logged)	0.59	95% Critical H Value (KM-Log)	1.881
KM Standard Error of Mean (logged)	0.0506		

DL/2 Statistics

DL/2 Normal

Mean in Original Scale 15045
SD in Original Scale 7354
95% t UCL (Assumes normality) 16086

DL/2 Log-Transformed

Mean in Log Scale 9.467
SD in Log Scale 0.629
95% H-Stat UCL 17470

DL/2 is not a recommended method, provided for comparisons and historical reasons

Nonparametric Distribution Free UCL Statistics

Detected Data appear Approximate Normal Distributed at 5% Significance Level

Suggested UCL to Use

95% KM (t) UCL 16093

When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test
When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.
Recommendations are based upon data size, data distribution, and skewness.

These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).
However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician.

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