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RCRA Facility Investigation,
Corrective Measures Study,
Corrective Measures Implementation Work Plan

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MID 005 338 371

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List of Acronyms

BGS	Below Ground Surface
CALTA	Corrective Action Long-Term Agreement
CMIWP	Corrective Measures Implementation Work Plan
CMS	Corrective Measures Study
CFR	Code of Federal Regulations
EGLE	Michigan Department of Environment, Great Lakes, and Energy
DWMAD	Drinking Water and Municipal Assistance Division
DWPC	Drinking Water Protection Criteria
GEI	GEI Consultants, Inc.
GLWA	Great Lakes Water Authority
GSI	Groundwater / Surface Water Interface
GSIPC	Groundwater / Surface Water Interface Protection Criteria
GWNIAA	Groundwater Not In An Aquifer
MDEQ	Michigan Department of Environmental Quality
MDHHS	Michigan Department of Health and Human Services
MDNR	Michigan Department of Natural Resources
NREPA	Michigan's Natural Resources and Environmental Protection Act (P.A. 451 of 1994, as amended)
PFAS	per- and polyfluoroalkyl substances
RIASL	Recommended Interim Action Screening Levels
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
SVOC	Semi-Volatile Organic Compounds
SWMU	Solid Waste Management Unit
USEPA	United States Environmental Protection Agency
VIAP	Volatilization to Indoor Air Pathway
VOC	Volatile Organic Compounds

Executive Summary

A RCRA Facility Investigation was completed at the MacDermid facility, located in Ferndale, Michigan. This RFI indicated the presence of subsurface soil impacts associated with two former waste disposal lagoons, located to the south of the facility building. Interim remedial measures, in the form of soil excavation and disposal, was completed to remove the majority of these impacts. Sampling following the excavation revealed areas of remaining soil impacts at the site. The extent of these remaining impacts is delineated. The RFI data collection has indicated that groundwater beneath the site is present in limited quantities but has been designated as “groundwater not in an aquifer.”

The potential for exposure to contaminants at the site is very small. Subsurface impacts are limited to the areas adjacent to the former lagoons and surrounding areas. Site uses and conditions do not provide for an easy route for exposure to the contaminants. The site, as well as properties to the north and east, are located within an area zoned as “M-2 General Industrial”. Site activities are done within the site building and within the areas covered by concrete pavement. Access to and contact with the impacted soil does not occur as part of routine site operations.

Potential pathways of concern for remaining contaminants in the soil at the site include non-residential direct contact and volatilization to indoor air inhalation. Potential pathways of concern for remaining contaminants in the groundwater at the site include volatilization to indoor air inhalation. While exposure for these pathways is highly unlikely due to site conditions, the potential still exists for exposure and the contaminant concentrations exceed the applicable criteria. The proposed corrective action (Restrictive Covenant) will be used to limit the exposure potential posed by the remaining contaminants.

1. Introduction

1.1 Purpose and Objective

This report provides a combined RCRA Facility Investigation (RFI), Corrective Measures Study (CMS), and a Corrective Measures Implementation Work Plan (CMIWP). This combined document is intended to describe distribution of impacts at the site, and to provide a design and implementation of measures to address soil and groundwater contamination in the Solid Waste Management Units (SWMUs) which have been identified. These subsurface impacts have been identified through site investigation activities, and remaining impacts have the potential to pose a threat to human health and the environment.

The final corrective measures, as presented within this work plan, consist of the following components:

- Placing an institutional control in the form of a Restrictive Covenant on the property to prevent uses and activities that may result in exposure to concentrations of contaminants above applicable cleanup criteria.
- Due care compliance and long-term monitoring.

This CMIWP provides an overall summary of site conditions as determined through site investigation activities. A detailed description of the proposed corrective measures is included for final site corrective action complete with controls.

The objective of this CMIWP is to gain final corrective action complete with controls of the SWMU No. 1 and gain corrective action complete with controls for the site with respect to the Unites States Environmental Protection Agency (USEPA) 2020 Corrective Actions Universe listing. This report will establish that corrective actions have been completed and the site is not a source of on-going risk to human health or the environment.

1.2 Background

The Ferndale facility is included in the USEPA, Region 5, 2020 Corrective Action Universe of treatment, storage, or disposal facilities. This listing is a set of facilities that have national remediation goals which will culminate in the year 2020. Final corrective action remedies are expected to be in place by the year 2020. This MacDermid facility is included on this list because of its past operation as a hazardous waste storage facility licensed pursuant to Part 111, Hazardous Waste Management, of the Michigan Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended, MCL 324.11101 and its administrative rules, Michigan Administrative Code R 299.9101 et seq. and the Federal Resource Conservation and Recovery Act of 1976, as amended by the Hazardous and Solid Waste

Amendments of 1984 (RCRA). Although the hazardous waste storage facility (Part A) was certified clean closed (term used in 1999 documentation for this action) on August 3, 1999, that certification did not release the facility from the corrective action provisions of Part 111 and the RCRA.

USEPA records indicate that MacDermid initiated the corrective action process in 1991, with the submittal of a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Work Plan (OHM, 1991). This investigation and work plan was initiated as part of the Part B permit maintenance between MacDermid and USEPA. The goal of the investigation was focused on assessment, cleanup and/or control of the site-related constituents outside of the RCRA regulated treatment, storage, or disposal facility. The facility's Part B permit number is MID 005 338 371. However, the records do not indicate whether the work proposed in the 1991 RFI Work Plan was completed.

The 1991 RFI identified the potential for contaminants within three solid waste management units (SWMUs) based on previous investigations (prior to 1991). These three previously identified SWMUs are the focus of the USEPA 2020 Corrective Action initiatives for the facility.

In January 2019, the Michigan Department of Environmental Quality (MDEQ) changed its name to the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Prior to the MDEQ, the regulatory agency was known as the Michigan Department of Natural Resources (MDNR). Throughout this report, EGLE, MDEQ, and MDNR are used interchangeably.

1.3 Site Location

The MacDermid site is located at 1221 Farrow Street, in Ferndale, Oakland County, Michigan (Figure 1). The site is located at the south dead-end of Farrow Street, approximately ½ mile south of Nine Mile Road. The property is a triangular-shaped parcel of approximately 8.8 acres. It is bound on the north and east by various industrial properties and on the southwest by the Canadian National (former Grand Trunk) railroad line and container yard. The north and east boundaries of the property follow a historic railroad line/siding. Figure 2 illustrates the property and surrounding area.

1.4 Site Ownership

The MacDermid property is operated as MacDermid / Enthone, a subsidiary of Element Solutions, Inc.

The property identification number (PIN) is 25-35-155-002.

The legal description for property, as obtained from the City of Ferndale Assessor's office, is:

> T1N, R11E, SEC 35 PART OF NW 1/4 BEG AT PT DIST S 88-29-41 W 30 FT FROM INTER OF N & S WLY 1/8 LI & E & W NLY 1/8 LI, TH S 01-53-00 E 129.90 FT, TH S 53-01-06 W 29.65 FT, TH ALG CURVE TO RIGHT, RAD 406.98 FT, CHORD BEARS S 33-56-50 E 62.46 FT, DIST OF 62.52 FT, TH S 29-15-15 E 45.90 FT, S 01-53-00 E 470.99 FT, TH ALG CURVE TO LEFT, RAD 716.78 FT, CHORD BEARS S 16-30-48 E 362.08 FT, DIST OF 366.04 FT, TH S 31-08-35 E 54.71 FT, TH N 39-15-30 W 252.37 FT, TH N 01-53-00 W 641.40 FT, TH ALG CURVE TO LEFT, RAD 361.78 FT, CHORD BEARS N 58-51-53 W 438.80 FT, DIST OF 471.46 FT, TH S 89-37-30 W 40.09 FT, TH ALG CURVE TO RIGHT, RAD 595.13 FT, CHORD BEARS N 76-05-23 W 318.45 FT, DIST OF 322.38 FT, TH S 50-46-07 W 20 FT, TH N 39-15-30 W 486.67 FT, TH N 50-44-30 E 11.33 FT, TH N 87-45-36 E 12.51 FT, TH S 35-59-50 E 185.07 FT, TH ALG CURVE TO LEFT, RAD 818.51 FT, CHORD BEARS S 66-09-20 E 657.39 FT, DIST OF 676.48 FT, TH N 88-29-41 E 313.24 FT TO BEG, ALSO BEG AT PT DIST S 01-53-00 E 908.70 FT & S 88-07-00 W 35 FT FROM INTER OF E & W 1/8 LINE & N & S 1/8 LINE OF SD NW 1/4,TH N 01-53-00 W 641.40 FT, TH ALG CURVE TO LEFT, RAD 361.78 FT, CHORD BEARS N 58-51-53 W 438.80 FT, DIST OF 471.45 FT, TH S 88-22-27 W 40.49 FT, TH ALG CURVE TO RIGHT, RAD 595.13 FT, CHORD BEARS N 76-05-23 W 318.45 FT, DIST OF 320.48 FT, TH S 50-46-07 W 20 FT, TH S 39-15-30 E 1203.12 FT TO BEG 8.46 A1-13-97 FR 001 & 502-001

1.5 Site Conditions

The MacDermid property is used for the manufacture, blending and distribution of specialty chemicals for metal finishing, electronics and surface finishing industries. The property currently contains a 91,500-square-foot building in the center portion of the site, with paved parking to the east of the building and a paved shipping/receiving area along the north part of the building. Figure 3 illustrates the general layout of the building and includes the location of underground site utilities and surface drainage patterns.

The main building, constructed in 1966, is a high bay insulated steel-frame structure, which contains manufacturing, storage, and office operations. An annex was constructed in 1974, and a warehouse addition was added in 1995. A partially enclosed (steel frame with roof, concrete floor, and screen walls) storage unit was constructed on the southwest corner ("oxidizer shed") in approximately 2000, and a compressor room on the south side of the building was added in approximately 2005. The interior and exterior portions of the operation where chemicals are handled and stored is underlain by sealed concrete containment and floor drains, which direct water to the facility wastewater treatment plant. The buildings are all slab-on-grade with no basements.

An above-ground storage tank (AST) farm is located to the southeast of the main building and houses a variety of chemicals. This area is surrounded by a sealed concrete containment, and water from this area is directed to the wastewater treatment plant.

Treated wastewater is discharged to the City of Detroit's combined storm/sanitary sewer system. The facility is authorized to discharge this industrial wastewater via a permit issued by the Great Lakes Water Authority (GLWA). Surface drainage from the paved parking areas on the north and east side of the property is collected in catch basins connected to the storm sewer system. Surface drainage from paved areas on the south and west sides of the building is collected and treated by the wastewater treatment system.

The site is located within an area zoned as "M-2 General Industrial" on the City of Ferndale Zoning Map (Appendix A). The properties surrounding the site to the north and east are within this same "General Industrial" zone. General commercial and office/service properties are located along Nine Mile Road. The rail yard to the west and south is not zoned, while the properties immediately west of the rail yard are zoned as "Limited Industrial." Residential properties are located to the east of the industrial area, as well as to the west of the railroad yard. The nearest residential areas are located more than 1,000 feet from the facility.

The Ferndale facility submitted an application for a RCRA Part A permit in 1983, which was subsequently amended on June 10, 1985. The facility's Part B permit was issued by the USEPA in conjunction with the Michigan Department of Natural Resources (MDNR) on November 11, 1988. The facility's Part B permit number is MID 005 338 371. In 1996, the EPA authorized the MDEQ to regulate corrective actions at licensed treatment, storage, or disposal facilities.

The hazardous storage/staging area was certified clean closed (term used in 1999 documentation for this action) on August 3, 1999. This Part A closure was completed to comply with the requirements of 40 CFR 264.111 and consisted of an extensive cleaning of the hazardous waste storage/staging area.

1.6 Reporting History

Several investigations have been completed at the site, and the information within these reports has provided information related to the subsurface conditions at the site.

Site reporting prior to GEI Consultants (GEI) involvement includes the following:

January 24, 1989	MacDermid Incorporated Ferndale Facility Site Investigation, prepared by Techna Corporation
April 6, 1989	MacDermid Incorporated Ferndale Facility Lagoon Investigation Phase 2, prepared by Techna Corporation

February 26, 1991	RCRA Facility Investigation for MacDermid Incorporated at the Ferndale, Michigan, Facility, prepared by OHM Remediation Services Corp.
July 17, 1995	Summary Report of Findings, Subsurface Evaluation, MacDermid Chemical, Inc., Ferndale, Michigan, prepared by GZA GeoEnvironmental, Inc.
August 18, 1995	Letter report by MacDermid to MDEQ regarding an expansion of the warehouse, with associated soil borings
September 5, 1995	Letter report by MacDermid to the MDEQ regarding six soil borings around the perimeter of the facility, with soil borings and associated analytical data
July 13, 1999	Resource Conservation Recovery Act Closure Report for MacDermid, Inc., Ferndale, Michigan, prepared by Clayton Environmental Consultants

Reporting authored by GEI includes:

September 21, 2016	Current Conditions Summary and RCRA Facility Investigation Work Plan, MacDermid, Inc., Ferndale, Michigan
April 21, 2017	RCRA Facility Investigation – DRAFT – MacDermid, Inc. 1221 Farrow Ave., Ferndale, Michigan
September 7, 2017	RCRA Facility Investigation – FINAL REVISED – MacDermid, Inc. 1221 Farrow Ave., Ferndale, Michigan
April 25, 2018	Response to MDEQ Comments and Discussions MacDermid Ferndale Facility RCRA Facility Investigation
August 30, 2018	Response to Michigan Department of Environmental Quality Comments and Discussion RCRA Facility Investigation Report MacDermid, Incorporated, Ferndale, Michigan
October 9, 2018	Interim Remedial Measures Work Plan MacDermid, Inc. Facility, Ferndale, Michigan
October 11, 2018	PFAS Sample Results In Groundwater
April 25, 2019	Soil Excavation Remediation Summary Report MacDermid, Inc. 1221 Farrow Avenue, Ferndale, Michigan

1.7 Solid Waste Management Units

Three solid waste management units (SWMUs) were identified by the USEPA and the MDNR in the RCRA Part B permit application and described in the 1991 RCRA Facility Investigation (OHM, 1991) report. These areas include:

- SWMU No .1 – Two closed surface impoundments (Lagoon Nos. 1 and 2);
- SWMU No. 2 – Units that emit air contaminants – incinerator and scrubbers on recycle tanks; and
- SWMU No. 3 – Inactive railroad spur.

Figure 4 illustrates the location of these three SWMUs at the project site.

SWMU No. 1 is located in the south-southeast portion of the property. It encompasses approximately 2.2 acres (approximately 94,000 square feet) and contains two historic wastewater lagoons – Lagoon No.1 and Lagoon No. 2. Figure 5 illustrates the location of the SWMU, and the approximate location of the two lagoons within the SWMU.

Lagoon No. 1 was constructed at some time between 1969 and 1973. The lagoon was approximately 60 feet long, 40 feet wide, and 10 feet deep. The lagoon was excavated in native clay soil. The lagoon was not lined, and the native clay served as the only containment barrier. The lagoon was reportedly used as a pit for hydrochloric acid and sulfuric acid baths and processed wastewater. In 1976, sulfuric acid was accidentally added to a tank of hydrochloric acid, causing it to fume. The contents of the tank were pumped out into Lagoon No. 1, where it continued to fume. The lagoon had to be covered with soil to reduce the fuming, and was eventually filled in. Soil used to fill in Lagoon No. 1 was obtained from the excavation of Lagoon No. 2.

Lagoon No. 2 was excavated at the time when Lagoon No. 1 was closed in 1976. Lagoon No. 2 was located approximately 40 feet east of Lagoon No. 1 (Figure 5). The lagoon was approximately 55 feet long, 35 feet wide, and 10 feet deep. Lagoon No. 2 was used to contain processed wastewater, as well as hydrochloric and sulfuric acids. As with Lagoon No. 1, Lagoon No. 2 had no synthetic liner and used only the native clay soil as the only containment. Lagoon No. 2 was decommissioned in 1982. Liquids and sludge material were removed and sent through the on-site wastewater treatment system. Soil and sludge were excavated from the site and disposed in a landfill.

SWMU No. 2 was the historical incinerator unit used to dispose of paper, cardboard, and general trash at the facility. The first incinerator was installed in 1966 when the building was constructed and was located at the north-northwest corner of building. In 1973 this incinerator was removed due to the addition of a warehouse addition on the north side of the building. The incinerator was moved to a location due south of center of the building, along the southwestern property line. Figure 4 illustrates the location of these former incinerators.

The incinerator was used in this location until 1981, when it was dismantled and replaced by a trash compactor.

SWMU No. 3 is the former inactive railroad spur is a triangular-shaped area located on the southwest corner of building (Figure 4). This SWMU encompasses an area approximately 14,700 square feet (0.34 acres). It is located on the southwest side of the building and the railroad yard is located to the west across the perimeter site fence. This SWMU historically contained a railroad spur which branched off of the rail yard adjacent to the site. This spur was used to receive goods but was not used to transport materials or products from the facility. Records indicate that the spur was used between 1968 and 1981. Products received on rail cars at this location included borax, boric acid, filter power (diatomaceous earth), clean/new drums, clean/new containers, sodium chloride, cerelose (sugar), phosphates (SCD fluoride and SCD biflouoride) caustic potash, and soap. The rail spur has been inactive since 1981, and the rails have since been removed. In approximately 2000, the partially enclosed storage unit (oxidizer shed) was constructed in this SWMU. The structure is a steel-frame with a roof, concrete floor, and screened walls. The location of this storage area is illustrated on Figure 3.

1.8 Program Management Plan

The project team encompasses the facility, the regulators, and the consultants completing the project. Personnel include:

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1.8.1 Personnel Qualifications

Key personnel include Mr. Rich Nave, Corporate Director EH&S and Mr. Guy Racino, Associate Director EHS for Element Solutions, and Mr. Allan R. Blaske, P.G, CPG, Senior Project Geologist and Project Manager and Mr. Fred Johnson, LEP, Senior Vice President/Principal for GEI.

1.8.2 Overall Management Approach

GEI, as the environmental consultant, retains the primary responsibility for management of the CMI Work Plan process. GEI has been retained by Element Solutions to implement the CMI Work Plan process, and gain corrective action complete with controls for the site within the USEPA 2020 Corrective Action Universe. Staff from the Materials Management Division of the Michigan Department of Environment, Great Lakes, and Energy have been involved since the beginning of the corrective action process and have provided guidance and helpful and timely review of project documents.

2. Site Description

2.1 Site Geology

2.1.1 Regional Geology

The subsurface geology of the Ferndale area consists of a thin near-surface clay layer, underlain by a thick layer of clay-rich glacial till. The unconsolidated material overlying the bedrock was deposited during the Pleistocene Epoch by the Wisconsinan stage of continental glaciation. Bedrock is present beneath the glacial deposits, at depths of more than 50 feet below ground surface.

The upper-most glacial deposits are composed of a lacustrine clay unit (Rogers, 1996). This unit is described as bluish to medium to light olive-gray, mottled, with trace amounts of well-rounded pebbles. Near-vertical hairline fractures are present within the upper portions of the clay unit and decrease in frequency with depth. Root fragments are also present. Mottling is evident, due to zones of oxidation and fracturing of the clay. The unit ranges in thickness between approximately 10 and 30 feet. This clay was deposited at the bottom of a glacial lake, when levels of the Great Lakes were as much as 230 feet higher than the current levels.

Beneath the near-surface lacustrine clay unit is a thick clay unit which underlies the entire metropolitan Detroit area (Rogers, 1996). This unit ranges from 50 to more than 180 feet thick in southeast Michigan. The unit was deposited as a ground moraine by the Erie lobe of the continental glaciers. It is characterized as a medium bluish-gray clay with well-rounded to sub-angular pebbles and cobbles. The upper portions (less than one foot) may have a light olive-gray to reddish-brown color, related to iron staining and oxidation of the clay.

The thick section of silt/clay dominated material with pebbles and cobbles can be described as a massive matrix-supported diamicton. A diamicton is a descriptive term for poorly sorted deposits composed of gravel clasts within a finer-grained matrix. The uniform nature of the deposit, large aerial extent, lack of stratification or structure and grain size characteristics identify this material as a subglacial diamicton (Kemmis, 2008), meaning that it was deposited beneath the glacial ice. Deposition of the diamicton from glacial ice classifies it as a glacial till.

The lower clay unit can be differentiated from the upper clay unit by differences in pebble content and color. Pebbles within the lower clay (till) are more abundant and larger than those in the upper clay unit. Also, the pebbles in the upper clay unit are generally more rounded than those in the upper (lacustrine) clay unit.

Bedrock beneath the unconsolidated glacial soil is composed of upper Devonian-aged shale and limestone. The depth to the bedrock in the Ferndale area is reported to be between 130 to 160 feet below ground surface, based on historic oil wells in the area (Rogers, 1996).

Fill material may be present as the uppermost soil in the region, due to the extensive urbanization of the area. Fill material may be observed on site-specific occurrences, due to excavation and filling of ground for construction, water management, and landscaping activities. The character of this fill material is generally unique to individual sites. This "urban fill" is common in southeast Michigan.

Groundwater within the lacustrine clay unit is generally unconfined to semi-confined. When groundwater is encountered, it is generally present in discontinuous sand lenses. These sand layers are generally thin (less than 1 foot thick) and laterally discontinuous. Water may also be present associated with fracturing of the clay due to rooting activity, freeze-thawing, and wetting and drying cycles. The fractures decrease with depth within the unit and are often mottled and oxidized along the fracture surfaces. Hydraulic conductivity within the lacustrine clay unit is approximately $1x10^{-6}$ centimeters per second (cm/sec), and up to $1x10^{-3}$ cm/sec for the discontinuous sand layers. The probability of encountering pumpable quantities of groundwater within this unit is low (Rogers, 1996). Groundwater encountered is generally perched and discontinuous.

Groundwater is not common in the lower clay unit till. Measured hydraulic conductivity of this material is approximately $1x10^{-8}$ cm/sec, making this unit an effective aquitard (Rogers, 1996).

Due to the underlying regional aquitard of the lower clay till, water contained within the thin, near-surface units does not migrate to lower aquifers. If present, the shallow groundwater discharges to surface water.

Contaminants released into the upper clay unit generally do not move great distances from the release point, due to the lack of groundwater, low hydraulic conductivity, and discontinuous nature of the isolated sand layers within this unit. Contaminants may migrate to deeper portions of this unit along fractures and root traces.

The thickness, composition, and hydrogeologic characteristics of the lower clay (till) unit makes this unit an effective aquitard. The potential for contaminants to migrate through this unit is minimal.

2.1.2 Site-Specific Geology

The characterization of the site-specific geology was based on data collected during site assessment activities conducted by GEI between December 2016 and the present time. Figures 6a, 6b, and 6c illustrates the location of soil borings and soil sample locations, and

Figure 7 illustrates the location of monitoring wells installed by GEI. Soil boring logs and other site data are contained in the appropriate historic reports prepared by GEI.

Soil boring logs from the various historic subsurface investigations at the site reveal a thin layer of fill soil underlain by clay, sandy clay, and silty clay with trace amounts of gravel. The clay becomes stiffer with depth, with more pebbles noted. Groundwater is present within the upper portions of the soil, usually associated with the fill sand or thin sand layers. This generalized site-specific soil profile is consistent with that described for the regional area above.

Data obtained by GEI during soil sampling indicates the site is underlain by various thicknesses of fill soil, which is underlain by glacial till. The fill soil ranges in thickness between 3 and 6 feet, except within the areas of the former lagoons, where the fill was up to 9 feet thick. The fill soil has various characteristics, based on location, including:

- Silty clay topsoil,
- Brown silty clay with gravel,
- Silty fine sand with or without fragments of brick, concrete, wood, coal, glass, cinders, slag and organics,
- Black to tan-brown to rusty-red silty sand, and
- Tan, gray-brown, olive green, and gray-black silty clay.

This fill is typical of “urban fill” found within southeast Michigan.

Groundwater is generally absent in the fill soil, except within the footprint of the former lagoons where 2 to 3 feet of saturation was encountered at the bottom of the fill soil.

Beneath the fill soil is a tan-brown silty clay with gravel glacial till soil. This soil is generally mottled with gray to orange mottles. The tan-brown silty clay is generally hard and moist, except in rare cases where the overlying fill material is saturated. In these cases, only the upper 1 to 2 feet of the underlying silty clay soil are saturated, before changing to only moist conditions. This soil represents the upper, oxidized portion of the native glacial till beneath the site, with the mottles indicating varying degrees of infiltration by oxygen-rich precipitation water. Color was determined to be 2.5Y 5/2 (grayish brown) to 2.5Y 5/3 (light olive brown) using the Munsell Soil Color Chart. The thickness of this oxidized zone is generally 4 to 8 feet thick, except in areas beneath the former lagoons, where some of the upper portions of the native soil has been removed, and the thickness has been decreased to only 2 to 3 feet. Underlying the tan-brown silty clay with gravel till is a gray-brown silty clay with gravel. This soil represents the unoxidized native glacial till. The overlying tan-brown mottled silty clay generally grades downward into the unoxidized gray-brown till soil. Color of this lower till soil was determined to be 2.5Y 4/1 (dark gray) using the Munsell Soil Color Chart. The depth to the top of this soil relatively consistent across the site and is generally between 9 and 13 feet below ground surface. This soil was hard and moist but was never observed to be saturated. Laboratory testing indicates that the moisture content of the soil ranges between 10.1 and 15.2%.

Grain size analysis of the glacial till soil indicate a predominantly fine-grained soil. The soil was described as a sandy lean clay, with a USCS classification of CL. The grain size test results indicate that the tan-brown silty clay till contains between 63.2 and 66.8% silt and clay, 21.2 to 24.4% fine sand, and the remainder (11.2 to 12.8%) consisting of medium and coarse sand and fine gravel. Grain size tests indicate that the gray-brown silty clay till contains 50.2 to 66.7% silt and clay, 22.1 to 26.5% fine sand, and the remainder (11.2 to 12.5%) medium and coarse sand and fine gravel. The soil sample from MW-16-1D at a depth of 12 to 15 feet also contained 10.8% coarse gravel. Comparison of the grain size analysis curves for the five samples indicates that the material is nearly identical between the five samples collected from across the site, and from various depth levels. Grain size distribution curves are typical of those associated with regionally extensive subglacial tills. Grain size data are summarized in Table 1.

Figure 8 illustrates the location of three cross-section diagrams through the soil beneath the site, based on GEI soil boring data. These sections (Figures 9a and 9b) are through the area of the former lagoons and illustrate the subsurface relationships between the fill and native glacial till soil. These diagrams also include the location of monitoring wells, the former lagoon outlines, the sample intervals, and extent of impacted soil as identified during the RFI sampling.

Laboratory permeability testing of the glacial till soil indicates a very impermeable soil. Measured hydraulic conductivity on the five samples ranged between $1.5x10^{-8}$ and $5.0x10^{-9}$ cm/sec. The hydraulic conductivity of the upper, mottled tan-brown and gray silty clay till is between $1.9x10^{-8}$ and $9.2x10^{-8}$ cm/sec, whereas the hydraulic conductivity of the lower gray-brown silty clay till is between $1.5x10^{-8}$ and $5.0x10^{-9}$ cm/sec. The average value of all samples tested is $2.9x10^{-8}$ cm/sec. Laboratory test results are summarized in Table 2.

Slug testing was performed on the 5 monitoring wells at the site. Results of the testing is summarized in Table 3. The calculated hydraulic conductivity of the fill soil within the lagoons was $3.9x10^{-5}$ cm/sec (MW-16-1) and $1.4x10^{-5}$ cm/sec (MW-16-2). For wells in the upper portions of the glacial till soil (10 to 15 feet bgs), the calculated hydraulic conductivity was $3.1x10^{-5}$ cm/sec in MW-16-4 and $5.1x10^{-5}$ cm/sec in MW-16-5. The deeper portions of the glacial till soil, at a depth of 20 to 25 feet bgs in MW-16-3, had a hydraulic conductivity of $4.7x10^{-8}$ cm/sec. This result from the deeper well is characteristic of the native glacial till soil and is similar to that observed from the laboratory permeability samples summarized above. The results from wells MW-16-4 and MW-16-5 are approximately 3 orders of magnitude higher than that measured in MW-16-3 or from the laboratory analysis of soil cores. This is likely due to smearing of the soil along the borehole sidewalls during drilling, which increases hydraulic conductivity (McKay, et. al., 1993). The results from slug testing also represent a measurement of a bulk sample as compared to the laboratory analysis of soil cores. Slug testing of a monitoring well with a 5-foot section of screen and a 6 to 7-foot sand pack interval measures a much larger portion of the soil column than a laboratory measurement of a 3-inch soil core. The in-situ slug test results therefore are measuring a much larger volume of soil and can be influenced by thin layers of coarser material or overlying fill soil.

2.2 Site-Specific Hydrogeology

As noted above, groundwater was encountered in the soil within the lagoon areas. The fill material within the former lagoons contains up to 2 to 3 feet of water at the bottom of the fill, immediately above the underlying tan-brown silty clay till. Below this saturated fill, the silty clay till becomes moist (not saturated) within 1 to 2 feet below the bottom of the fill soil.

Groundwater measurement data from the monitoring wells is included in Table 4. Measurements were collected prior to groundwater sampling, 24 hours after bailing the wells for slug testing, and again 5 days later. The elevation of the water table beneath the site does not form a continuous level across the site. Rather, water levels in monitoring wells vary by as much as 2.3 feet between wells which are separated by only 70 feet (MW-16-1 and MW-16-2). Water levels in Wells MW-16-4 and MW-16-5 are more similar to the water level in MW-16-2. The water level in MW-16-3, screened at a depth 10 feet below that of MW-16-1 and MW-16-2, shows a water level which is as much as 8 feet below the shallow adjacent wells. Because of these large differences in water levels between wells, the direction and rate of groundwater flow have not been determined.

Based on the water level measurements, a distinct groundwater flow pattern is not discernable. It is likely that groundwater is present in small quantities in the glacial till soil, and slowly seeps into the monitoring wells. However, the presence of fill material, especially in the former lagoons, appears to contain groundwater independent of the surrounding glacial till soil. The former lagoons were acting like a bathtub and holding groundwater. This groundwater in the lagoons was likely influenced by precipitation on the ground surface, which is allowed to preferentially infiltrate the fill soil within the former lagoons.

The groundwater elevations between the deep well (MW-16-3) and the two shallow wells (MW-16-1 and MW-16-2) is significant. Water levels are between 8 and 16 feet different between the shallow and deep wells. The shallow wells are screened to a depth of 10 feet bgs, whereas the deep well is screened to a depth of 25 feet bgs. The deep well is located between the two lagoons, which contain the shallow wells. The distance between each shallow well and the deep well is no more than 40 feet. The large difference in water levels indicates that groundwater in the deeper portions of the glacial till soil is not directly connected to the groundwater in the fill soil within the lagoons. The low permeability and slow water level recovery rates following slug testing also support the lack of communication between the fill soil and glacial till soils.

2.2.1 Groundwater Not in An Aquifer

The MDEQ has prepared guidance for the designation of "Groundwater Not In An Aquifer" (GWNIAA) for consideration during siting criteria, pathway analysis, monitoring requirements, discharge authorizations, and remedial actions under parts of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Part 201 of the NREPA requires that all exposure routes and receptors at sites of environmental contamination be evaluated based on site conditions and characteristics. The GWNIAA designation can be used to illustrate that site conditions do not provide sufficient groundwater to be a valid pathway for drinking water criteria. At remediation sites where it has been determined that groundwater ingestion is not a relevant exposure pathway, it is necessary to evaluate all other transport mechanisms and exposure pathways that might result in unacceptable exposure. This guidance (MDEQ, 2000) outlines criteria which should be considered when evaluating whether groundwater encountered in a formation is or is not in an aquifer as well as information that should be used in applying those criteria. A copy of this guidance document is included in Appendix B.

To make the GWNIAA determination, site data must be used to demonstrate that the groundwater beneath the site is not contained in an aquifer. Per the MDEQ definition, and aquifer is:

> "A geological formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs."

If it can be demonstrated that the groundwater beneath a site is GWNIAA, the groundwater ingestion exposure pathways does not apply.

Demonstration of GWNIAA requires the demonstration that a formation yields an insignificant amount of water, using local and regional hydrogeology. The demonstration can use hydraulic conductivity data and pumping test information. It also must be demonstrated that the groundwater in question is not in hydraulic connection with groundwater in an aquifer. This can be demonstrated using a combination of regional and site-specific geology information, site pumping test data, and or connection of the groundwater to the surface water system.

A search for water wells surrounding the site using the MDEQ GeoWebFace - online Geologic Maps and Data system (http://www.michigan.gov/deq/0,4561,7-135-3311_60700-271891--,00.html), revealed a significant lack of water wells in the area surrounding the site. Only one well is present within a one-mile radius of the site. This well (well ID 20000001230) is located approximately 0.9 miles to the northwest of the site. The well log indicates it is a household well completed in 2002, to a total depth of 89 feet in sand and gravel. No other water-supply wells are present within a 1-mile radius of the site.

At the Ferndale Public Library, located approximately 0.75 miles northwest of the site, as many as 25 geothermal wells were installed in 2009. These wells penetrated as much as 125 feet of gray clay beneath 10 feet of sand (likely fill). Several of the wells encountered a 5-foot thick sand layer at a depth of 40 to 45 feet, underlain by more clay. Beneath the unconsolidated soil, bedrock was encountered at depths between 125 and 135 feet bgs and consisted of shale and limestone. Copies of these well logs are contained in in Appendix C.

Furthermore, the website for the MDEQ Office of Drinking Water & Municipal Assistance, Scanned Water Well Record Retrieval System (http://www.deq.state.mi.us/well-logs/default.asp?County=County&TownName=&Section=36&Qry=Select) contains logs for wells installed prior to the year 2000. A search of this database did not return any well within section 35 of T01N, R11E, where the project site is located. One drinking water well is located in the northeast corner of Section 25, T01N, R11E, at the southwest corner of 10 Mile Road and Dequindre Road at the Hazel Park Harness Raceway, approximately 2.8 miles to the northeast of the project site. This well was installed in 1967 and is 145 feet deep. This well encountered fill underlain by 65 feet of gray clay, hardpan, and more clay to a depth of 109 feet below ground surface. Thin layers of sand were then encountered to the total depth of the well.

GeoWebFace does not indicate the presence of a wellhead protection area in the Ferndale area. The nearest designated wellhead protection areas are located approximately 10 miles west-northwest of the site, in Farmington Hills area. On August 2, 2017, GEI contacted the MDEQ Drinking Water and Municipal Assistance Division (DWMAD), Water Wellhead Protection office via email. DEQ-DWMAD indicated that the project site is approximately 10 miles away from the nearest wellhead protection area. The inquiry email and response from DWMAD is included in Appendix D.

On August 3, 2017, GEI contacted the Oakland County Health Department via email to determine the presence of crock wells or drive wells in the vicinity of the project site. Although the request was for information specific to the presence of crock or driven wells in the area of the county specific to the site, the Oakland County Health Department considered it a Freedom of Information Act (FOIA) request, and that the language was too vague for a response. GEI spoke with Richard Peresky at the Oakland County Health Department via telephone, and he indicated that there are no crock or driven wells on the subject site, but in order to determine if any exist in the vicinity of the site, GEI would need to submit a written FOIA request for a list of each individual property surrounding the site. The inquiry email and response from Oakland County included in Appendix E. Based on the information contained in the guidance document for requirements for a GWNIAA designation (Appendix B), no crock wells exist in Oakland County and that the county does not authorize the installation of crock wells. Furthermore, the City of Ferndale does not know of any private wells within the city (Appendix F), and they purchase water from the City of Detroit system.

GEI searched the MDEQ on-line Environmental Mapper (http://www.mcgi.state.mi.us/environmentalmapper/) to determine the presence and location of sites of environmental contamination in the area surrounding the project site. The results of this search are included in Appendix G. The search revealed 14 sites within a ¼-mile radius of the site. These sites include 10 underground storage tank (UST) sites, 5 leaking underground storage tank (LUST) sites, and 4 Part 201 sites. Fifteen USTs were registered at the 10 UST sites, and all except one have been removed from the ground or closed in place. Of the 5 LUST sites, all have been closed (via a Tier I or Type B evaluation, with no land use restrictions), with the exception of the American Industrial Door site at 1501 Bonner Street, where the site is an Open LUST site, although the gasoline UST has been removed from the ground. In addition to these sites, two sites have been placed under Land Use Restrictions – the Bond Properties at 988 East Saratoga Street and the Former LTV Copperweld site at 965 Wanda Ave. Restrictive covenants have been placed on both of these properties to ensure an industrial land use category for the sites.

Currently, no land use restrictions have been placed on the subject property. The City of Ferndale does not have an ordinance preventing the installation of private wells but does not know of any wells within the City (Appendix F).

The data from GeoWebFace indicates the presence of a regional clay layer which has not been developed as a source of drinking water. This is consistent with the description of the regional geology described by Rogers (1996) and summarized above. This regional data demonstrates that the subsurface geology beneath the Ferndale and surrounding area is not a significant source of groundwater.

At the MacDermid site, groundwater has been encountered in the subsurface in the fill soil within the former lagoons of SWMU No. 1. Limited amounts of groundwater were also observed in thin layers of sandy fill, generally within the upper 5 feet of ground surface. This fill material is in non-continuous layers across the site.

Underlying all the fill soil is the native silty clay glacial till soil. This soil extends to a depth of at least 25 feet bgs beneath the site. The measured hydraulic conductivity of this glacial till is between 1.5×10^{-8} and 5.0×10^{-9} cm/sec as measured on laboratory samples, and 1.4×10^{-5} and 4.7×10^{-8} cm/sec as measured using in-situ slug testing of on-site monitoring wells. Grain size analysis indicates a regionally extensive subglacial till, with between 50 and 67% silt/clay fraction.

The slug test data for monitoring well MW-16-1, located within lagoon No. 1 indicated a hydraulic conductivity of 3.9×10^{-5} cm/sec in the fill material within the lagoon. The bottom of the well screen in this well was at 10 feet bgs. A sample collected at this location immediately below the well MW-16-1, at a depth of 12 to15 feet bgs, was gray silty clay with gravel glacial till. The measured hydraulic conductivity of this sample was 1.5×10^{-8} cm/sec. This indicates that the fill material within the lagoons act as a basin for groundwater, and that the groundwater is not present within native glacial till soil, even at a distance of 2 feet below the bottom of the lagoon.

During groundwater sampling, the water in the monitoring wells was significantly drawn down during low-flow pumping techniques. The water was lowered between 1.3 and 2.9 feet over intervals of only 20 minutes in the shallow monitoring wells and was drawn down by 8 feet over 20 minutes in well MW-16-3. This well was screened in the gray silty clay glacial till at a screened depth between 20 and 25 feet bgs. This indicates a lack of groundwater in the soil beneath the site.

Also, following groundwater sampling, the wells were bailed of water to perform rising-head slug testing. Wells were bailed over the course of 5 minutes until only approximately ½ of a bailer-full of water was available within the well. The wells were bailed so that only approximately 2 feet of water remained in the well, which would be a depth of approximately ½ of the well screened interval. Recovery of the water levels in the wells were then measured as discussed above.

Further evidence for the lack of groundwater movement can be gained by the distribution of contaminants beneath the site. Subsurface impacts were only found in the fill soil, both within the former lagoons and in thin layers of fill across the site. The most significant concentrations were detected in samples within the former lagoons, but samples collected beneath the lagoons, in the native silty clay glacial till, did not indicate that the impacts had migrated out of the lagoons themselves. Samples were collected to surround the lagoons, both adjacent to and below the lagoons. No impacts were observed in soil or groundwater in the area surrounding or beneath the lagoons. This indicates that silty clay glacial till soil has prevented the migration of contaminants over the more than 40 years since contaminants were placed into the lagoons.

The evidence from the regional geology and the site conditions indicates that the groundwater beneath the site can be considered not to be in an aquifer. Furthermore, no surface water bodies are present on the site or the surrounding area. Therefore, based on the evidence to support the GWNIAA determination, it is suggested that the groundwater beneath the site cannot be utilized into a viable source of drinking water. Therefore, the groundwater ingestion (drinking water) pathway does not apply to this site.

The following characteristics (as outlined in the MDEQ GWNIAA guidance (MDEQ 2000)), have been used to demonstrate the GWNIAA designation for the site:

- The in-situ hydraulic conductivity of the glacial till soil beneath the site is 4.7×10^{-8} cm/sec, and laboratory measurements of hydraulic conductivity on soil samples of the till ranged between 1.5×10^{-8} and 5.0×10^{-9} cm/sec.

- During slug testing, water in Monitoring Well MW-16-3 (within the glacial till soil) was bailed to within 1.75 feet of the bottom of the well. After 155 minutes, the water level had risen only 0.55 feet and after 1,159 minutes only 1.35 feet. After 19.3 hours, recovery was only 9.3% of the initial water level. Even after 5.4 days, the water level had only recovered to approximately 43% of the original level in the well.
- Regional geology indicates a thick sequence of gray clay till soil, overlying shale and limestone bedrock. These units have not been developed for potable water use.
- Data collected during the investigation indicates that the site-specific geology is fill material overlying silty clay glacial till.
- No drinking water wells are located within a ½-mile radius of the site.
- No surface water (rivers, streams, lakes, wetlands) is present at or near the site. Precipitation runs off to storm sewers or pools before evaporating or soaking into the shallow fill soil.
- Based on available information, no crock or driven wells are present in Oakland County.
- City of Ferndale purchases water from the City of Detroit system and is not aware of any private wells within the City.
- No designated wellhead protection areas are located within 10 miles of the site.

The MDEQ agreed that the site data meets the criteria for the GWNIAA determination. An MDEQ Resources Management Division, Remediation Advisory Team review of the data was summarized on September 27, 2017, which accepted the GWNIAA for the site. A copy of this memo is included in Appendix H.

2.2.2 Groundwater-Surface Water Conditions

The area surrounding the site is heavily urbanized and extensively covered by hard surfaces, including concrete and asphalt pavement as well as structures. The area is generally flat, with little change in topography.

Due to the urbanization, surface water bodies are not abundant. A review of USGS topographic maps indicates that a county drain is present along Woodward Heights Boulevard, approximately 1 mile to the north-northeast of the site, and another drain approximately 2.5 miles to the east of the site. These drains appear to drain to the east and eventually connect with Red Run. This information was obtained from the Oakland County Enterprise GIS site (http://accessoakland.oakgov.com/datasets). “Natural” streams include Red Run, located approximately 4.5 miles to the north of the site, and the Rouge River, located approximately 10 miles to the west of the site. The site is located in the Red Run sub-watershed of the Clinton River watershed. Two ponds are present in Woodland

Cemetery, located approximately 1 mile to the south-southwest of the site (obtained from US Fish and Wildlife NWI website (https://www.fws.gov/wetlands/Data/Data-Download.html)).

Figure 3 illustrates the surface drainage patterns of the site. Runoff of paved surfaces is directed to storm sewers. Runoff from the paved areas to the north and east of the site building drain to the City of Ferndale storm sewer system beneath the pavement and is carried off site to the northeast portion of the site. Surface runoff in the paved area on the south side of the building is directed to water treatment storm drains where the water is then directed to the on-site wastewater treatment plant. Treated water from this wastewater treatment plant is then discharged to the City of Ferndale storm sewer system. Storm sewers are only beneath the paved portion of the site and are between 3 and 6 feet below ground surface, based on information obtained from the Manager of Environment, Health and Safety at the facility.

MacDermid personnel also indicate that precipitation in the non-paved areas does not readily soak into the ground. Heavy precipitation generally pools in low areas and runs off or evaporates. A low area is present along the north property boundary, between the paved parking and the perimeter fence. This area collects surface water runoff, which eventually evaporates. The area is not connected to any surface water (ditch, storm sewer, culvert, etc.) and is just a low area where rainwater collects.

Figure 3 illustrates the location of storm sewers as well as other utility corridors at the site. Other subsurface utilities include natural gas and water, which enter the site from the south end of Farrow Street and connect to the northeast corner of the building. A fiber-optic line is present along railroad right-of-way along the southern side of the site but are not on MacDermid property. The depth of these utilities is not known.

The storm sewer lines are not located in areas where delineated subsurface volatile organic compounds (VOC) soil or groundwater impacts area present. Semi-volatile organic compounds (SVOCs) and metals impacts at concentrations above the Groundwater/Surface Water Impact criteria were observed in shallow fill soil adjacent to the wastewater treatment storm sewer in the area between the former lagoons and the building. These sewers, however, connect to the on-site wastewater treatment plant, and do not connect to the City of Ferndale storm/sanitary sewer lines. Therefore, the wastewater treatment system storm sewer lines are not expected to direct contaminants to other portions of the site, or to off-site locations.

It is unlikely that these subsurface utilities will act as migration pathways for contaminants. The subsurface utilities are not in areas where subsurface impacts have been delineated.

2.3 Summary of Previous Investigations

Several sampling events were conducted by GEI to characterize the subsurface and extent of impacts at the site. A summary of each sampling event is provided below.

2.3.1 RFI sampling

GEI conducted a RCRA Facility Investigation at the MacDermid property between late 2016 and early 2017. The investigation consisted of soil sampling, groundwater sampling, and laboratory testing to determine presence and extent of subsurface impacts beneath the site related to three SWMUs. The investigation consisted of collection of 72 soil samples from 36 direct-push soil borings and two soil samples during the installation of monitoring wells, the installation of 5 monitoring wells, and the collection of groundwater samples from the monitoring wells. These samples were analyzed for various chemical parameters to determine the presence of contaminants in the subsurface soil and groundwater. Samples were also collected to determine the physical characteristics of the soil to understand the potential for migration of the contaminants within the soil.

Subsurface impacts were discovered only in SWMU No. 1. VOCs were detected at concentrations above applicable criteria in the soil and groundwater within the footprint of the former lagoons. The impacts were generally confined to the fill soil within the former lagoons. Concentrations in samples from these areas exceeded the non-residential drinking water protection and groundwater-surface water protection criteria. SVOCs were found to exceed only the non-residential groundwater-surface water interface protection criteria. Likewise, metals were detected in the fill soil within SWMU No. 1.

The details of this investigation are contained in the April 21, 2017, report entitled “RCRA Facility Investigation – DRAFT – MacDermid, Inc. 1221 Farrow Ave., Ferndale, Michigan” and the September 7, 2017, report entitled “RCRA Facility Investigation – FINAL REVISED – MacDermid, Inc. 1221 Farrow Ave., Ferndale, Michigan”.

Figures 10a, 10b, 10c, and 11 illustrate the extent of impacts delineated during this investigation, and analytical results are summarized in Tables 5a through 5f. Soil within the former lagoons was excavated and removed from the site, as described in Section 2.4, below.

2.3.2 VIAP sampling

Several compounds were discovered in the subsurface soil during the RFI at concentrations which could allow them to volatilize and migrate to indoor air. To address the volatilization to indoor air pathway (VIAP), soil gas samples were collected in July 2018 from vapor probes at three locations between the former lagoons and the south side of the building (Figure 12). At several of the sampling depths, groundwater prevented collection of vapor samples (Table 6). However, concentrations of contaminants in soil vapor were below the Media-Specific Volatilization to Indoor Air Interim Action Screening Levels for Soil Gas at Non-residential exposure (Table 7). This data indicated that chemicals in the subsurface have not migrated trough the soil in vapor form to impact and indoor air health risk at the on-site structures.

2.3.3 Direct contact sampling

During sampling for the RFI, several samples contained metals (arsenic and lead) and VOCs (chlorobenzene) at concentrations above the Part 201 Non-residential Direct Contact Criteria (Figure 13). These samples were collected from several feet below ground surface in fill soil. Additional sampling was requested by MDEQ to confirm that no surficial soils contained concentrations above the DCC.

Soil samples were collected in July 2018 to determine the concentrations of contaminants in the surface soil (0 to 0.5 feet deep). The location of the samples is illustrated on Figure 13. Based on this sampling (summarized in Tables 8 and 9), no concentrations of metals of VOCs in the surface soil exceed the DCC. Direct contact exceedances remain in the fill soil but are isolated from the surface by several feet of soil.

2.3.4 PFAS soil and groundwater in lagoons

Prior to excavation of the former lagoons, MDEQ requested that samples of soil and groundwater be collected and analyzed for PFAS compounds.

Groundwater samples were collected from two monitoring wells within the former lagoons (MW-16-1 and MW-16-2) using low-flow sampling techniques on October 3, 2018. Samples were collected for analysis of the MDEQ 24-compound list of per- and polyfluoroalkyl substances (PFAS). Several of the PFAS substances were detected in the samples.

Soil samples were also collected from within the former lagoons prior to excavation, as requested by the disposal facility. Two samples of the fill soil were collected, one from each lagoon, from depths between 2.5 and 3.5 feet deep. The samples were analyzed for the MDEQ 24-compound list of PFAS. Results of this sampling are contained in the laboratory report, in Appendix I. Several of the PFAS compounds were detected in the samples, with concentrations generally higher in the sample from lagoon #1.

Soil and groundwater within the former lagoons was excavated and removed from the site, as described in Section 2.4, below.

2.3.5 Excavation Verification Sampling

Following excavation of the soil from the former lagoons (described below), samples were collected from each lagoon for verification of remedial efforts. Four samples were collected from the floor and one sample was collected from each sidewall from each lagoon. The location of the soil samples is illustrated on Figure 14.

2.3.5.1 Sampling Results – Lagoon #1

Tables 10a through 10d contain a summary of the verification sample analytical results from the samples collected from Lagoon #1.

Two of the collected samples (L1FNW and L1SWN) contained several VOCs which exceeded the non-residential drinking water protection criteria and/or the Groundwater Surface Water Interface (GSI) protection criteria. These compounds included benzene, chlorobenzene, 1,2-dichlorobenzene, ethylbenzene, methylene chloride, naphthalene, and xylenes. No concentrations exceed the direct contact criteria.

Sample L1FNW contained chlorobenzene and 1,4-dichlorobenzene in excess of the August 2017 Recommended Media-Specific Volatilization to Indoor Air Interim Action Screening Levels (RIASL) for non-residential exposure. The sample L1SWN contained benzene, chlorobenzene, ethylbenzene and xylenes at concentrations above the non-residential RIASL, and sample L1SWW contained chlorobenzene above the non-residential RIASL.

Sample L1FNW contained Bis(2-ethylhexyl)phthalate and 2-chlorophenol, and sample L1SWN contained fluorene, 2-methylnaphthalene, and phenanthrene above the laboratory reporting limit, but below all applicable criteria.

Several samples contained arsenic above the statewide default background and the drinking water and GSI protection criteria, but below the direct contact criteria. The arsenic, however, is believed to be naturally occurring, based on statistical analysis and facility-specific background concentrations, as discussed in the Remedial Investigation reporting. Selenium and silver were detected at concentrations above the GSI protection criteria in sample L1SWN. No other concentrations exceeded applicable criteria in any other samples.

Various PFAS compounds were detected in all soil samples collected from lagoon #1. The samples from the southwest corner of the floor, and the samples from each of the four sidewalls contained concentrations of PFOS which exceeds the GSI protection criteria. Currently, the MDEQ does not have criteria established for soil for the PFAS family of compounds, with two exceptions. In June 2018 the MDEQ updated the criteria tables, and this update included a groundwater surface water interface (GSI) protection criteria for two PFAS compounds. For perfluorooctanoic acid (PFOA), the soil criteria were established as 10,000,000 nanograms per kilogram (ng/kg) for GSI protection for soil not protective of surface water that is used as a drinking water source, and 350,000 ng/kg for soil which is protective of surface water that is used as a drinking water source. For perfluorooctane sulfonic acid (PFOS), the GSI protection numbers are 240 and 220 ng/kg, respectively. Concentrations in soil samples for these two compounds which exceed these criteria are highlighted in the table.

2.3.5.2 Sampling Results – Lagoon #2

Tables 11a through 11d contain a summary of the verification sample analytical results from the samples collected from lagoon #2.

The sample collected from the northeast corner of the excavation floor (L2FNE) contained vinyl chloride at a concentration exceeding the non-residential drinking water protection criteria, the Groundwater Surface Water Interface (GSI) protection criteria, and the non-residential RIASL.

The sample L2SWE contained ethylbenzene and xylenes above the laboratory reporting limit. The concentration of ethylbenzene in this sample was above the non-residential RIASL.

Sample L2SWS contained several SVOC compounds, but at concentrations below all applicable criteria, with the exception of phenanthrene, which was above the GSI protection criteria. The south wall of lagoon #2 from where this sample was collected contained a layer of urban fill (brown silty sand and clay, with brick, glass, slag, cinders, etc.). This material has been observed at various locations across the site and is different than the lagoon fill material being excavated during the remediation activities.

Several samples contained arsenic above the statewide default background and the drinking water and GSI protection criteria, but below the direct contact criteria. The arsenic, however, is believed to be naturally occurring as discussed above. Sample L2SWS contains mercury and silver at concentrations above the GSI protection criteria, and sample L2SWE contained mercury at a concentration above the GSI protection criteria. This sample also contains elevated concentrations (although below all applicable criteria) of barium, cadmium, chromium, copper, lead, selenium, and zinc. These concentrations of metals are related to the urban fill described above.

Various PFAS compounds were detected in all soil samples collected from lagoon #2. The samples from the southeast and southwest corners of the floor, and the samples from each of the four sidewalls contained concentrations of PFOS which exceeds the GSI protection criteria as discussed above. Currently, the MDEQ does not have criteria established for soil for the PFAS family of compounds, with two exceptions. In June 2018, the MDEQ updated the criteria tables, and this update included a groundwater surface water interface (GSI) protection criteria for two PFAS compounds. For perfluorooctanoic acid (PFOA), the soil criteria were established as 10,000,000 nanograms per kilogram (ng/kg) for GSI protection for soil not protective of surface water that is used as a drinking water source, and 350,000 ng/kg for soil which is protective of surface water that is used as a drinking water source. For perfluorooctane sulfonic acid (PFOS), the GSI protection numbers are 240 and 220 ng/kg, respectively. Concentrations in soil samples for these two compounds which exceed these criteria are highlighted in the table.

2.3.6 PFAS 2020 Soil Sampling

In February 2020, samples were collected along the south property boundary, and analyzed for PFAS compounds. Samples were collected using hand augering techniques, from the surface (0 to 0.5 feet) and at a depth at the top of the underlying glacial till (bottom of the urban fill layer). Figure 15 illustrates the location of these borings. Appendix J contains a copy of the laboratory report for these samples, and boring logs are contained in Appendix K. Table 12 contains a summary of the analytical results for these samples. PFAS compounds were detected above the laboratory reporting limit it all four samples. Concentrations are greatest in the sample collected from SB20-1, at a depth of 3.5 to 4 feet (SB20-1B), at the bottom of the fill layer and top of the underlying glacial till. This boring is located to the south of lagoon #2. Lower concentrations were detected in the two samples (one from each boring) from the surface soil (0 to 0.5 feet). The sample from SB20-2 at a depth of 3.5 to 4 feet (SB20-2B) contained very low concentrations. Concentrations in all samples (with the exception of SB20-2B) are above the non-residential GSI protection criteria for perfluorooctane sulfonic acid (PFOS).

2.4 Summary of Previous Remediation Activities

An interim remedial action was performed to remove identified subsurface impacts associated with the former lagoons. Remediation was performed in the location of two former waste disposal lagoons at the MacDermid facility in Ferndale, Michigan between November 2018 and February 2019. Soil was excavated from the two former lagoons. A total of 3,908.46 tons of soil were removed from the two excavations, one with an area of 3,345 square feet (lagoon #1) and the other with an area of 3,835 square feet (lagoon #2). Excavations were extended to a depth of approximately 9.5 feet below ground surface, and approximately 1 foot into the underlying native silty clay glacial till. Based on the size and depth of the excavations, approximately 2,393 cubic yards (in-place) soil was removed from the two lagoons. Figure 16 illustrates the location and extent of the soil excavations of the two former lagoons.

Soil excavated from the site was transported by U.S. Ecology to the Wayne Disposal facility in Belleville, Michigan for disposal. This facility is a sub-title C, commercial hazardous waste landfill. The address of the facility is 49350 North I-94 Service Drive, Belleville, MI 48111, and the EPA ID# is MID 048 090 633. No significant amounts of groundwater were encountered during excavation. Soil was solidified using bed ash for transportation and landfill acceptance purposes. Due to space limitations posed by existing structures and underground utilities, the excavations were shored using driven sheet piling.

During the excavation process, an unmarked storm sewer pipe was severed, and subsequently repaired. Also, a concrete bulkhead wall was present in lagoon #2, which was removed and disposed with the soil. Lagoon #1 contained various debris (including wood, concrete, and poly containers). The poly containers were removed from the excavation and placed into overpack drums for subsequent sampling and disposal at the US Ecology facility at Belleville, Michigan.

Following excavation, samples of soil were collected from the floor and sidewalls of the excavations for analysis of VOCs, SVOCs, metals and PFAS compounds, as described above. After completion of the removal of soil and verification sampling, the excavations were backfilled, and the site restored.

The results of these interim remedial measures were summarized in the April 25, 2019 report entitled “Soil Excavation Remediation Summary Report MacDermid, Inc. 1221 Farrow Avenue, Ferndale, Michigan”.

2.5 Cleanup Objectives

The objective of the corrective action is to remove the potential impact to human health and the environment so that exposure cannot occur. Based on the zoning of the property as “M-2 General Industrial”, the Part 201 Generic Non-Residential Criteria apply to site cleanup. Removal of contaminants from the soil and groundwater and/or removal of exposure pathways will be used to prevent human and environmental exposure to the contaminants in the subsurface at the site.

2.5.1 Current and Future Use of Site and Surrounding Land

The property is zoned as “M-2 General Industrial” within the City of Ferndale (Appendix A).

The property is bound on the north and east by various industrial properties (also zoned M-2) and on the south and west by the Canadian National (former Grand Trunk) railroad line and container yard.

Current land uses and zoning are not expected to change in the future.

2.6 Chemicals of Concern (CoC)

2.6.1 Remaining CoC in Soil and Groundwater

Contaminants remain in the subsurface soil at the site within SWMU No. 1. Table 13 provides summary of the concentrations of contaminants which remain in the soil above applicable criteria. This table does not include samples collected from within the footprint of the former lagoons, which were excavated as described above. Soil from within the lagoons was removed from the site. Contaminants are not present in the groundwater beneath the site. Groundwater is found in limited amounts within the fill soil. Groundwater sampling was conducted within fill soil within the former lagoons, which have subsequently been removed via excavation. Groundwater occurrence has been determined to be GWNIAA, and no additional groundwater sampling has been conducted.

The remaining impacts in soil include:

Volatile Organic Compounds

Sample SB-16-101A (4 to 5 feet) – located adjacent to the east edge of Lagoon #2

- Ethylbenzene at a concentration above the nonresidential Recommended Interim Action Screening Levels (RIASL) for volatilization to indoor air.

Sample SB-16-113A (5 to 6 feet) – located adjacent to the west edge of Lagoon #1

- Chlorobenzene above the non-residential RIASL for volatilization to indoor air.

Sample L1FNW (8 feet) – floor, northwest corner of Lagoon #1

- Chlorobenzene and methylene chloride at a concentration above the non-residential drinking water protection criteria
- Chlorobenzene and 1,2-dichlorobenzene at a concentration above the non-residential groundwater surface water interface protection criteria
- Chlorobenzene, and 1,4-dichlorobenzene at a concentration above the nonresidential Recommended Interim Action Screening Levels (RIASL) for volatilization to indoor air

Sample L1SWN (6-7 feet) – north sidewall of Lagoon #1

- Benzene, chlorobenzene, ethylbenzene, and xylenes at a concentration above the non-residential drinking water protection criteria
- Chlorobenzene, 1,2-dichlorobenzene, ethylbenzene, naphthalene, and xylenes at a concentration above the non-residential groundwater surface water interface protection criteria
- Benzene, chlorobenzene, ethylbenzene, and xylenes at a concentration above the nonresidential Recommended Interim Action Screening Levels (RIASL) for volatilization to indoor air

Sample L2FNE (9.5 feet) – floor, northeast corner of Lagoon #2

- Vinyl chloride at a concentration above the non-residential drinking water protection criteria, the non-residential groundwater surface water interface protection criteria, and the non-residential Recommended Interim Action Screening Levels (RIASL) for volatilization to indoor air

Sample L2SWE (5 to 6 feet) – east sidewall, Lagoon #2

- Ethylbenzene at a concentration above the non-residential Recommended Interim Action Screening Levels (RIASL) for volatilization to indoor air
- Xylenes at a concentration above the non-residential groundwater surface water interface protection criteria

Semi-Volatile Organic Compounds

Sample SB-16-102A (4 to 5 feet) – located south of the south edge of the excavation for Lagoon #2

- Phenanthrene at a concentration above the nonresidential groundwater surface water interface protection criteria.

Sample SB-16-105A (1 to 2 feet) – located north of the north side of Lagoon #2

- Fluoranthene and phenanthrene at a concentration above the nonresidential groundwater surface water interface protection criteria.

Sample SB-16-115A (3 to 4 feet) – located south of the southeast corner of Lagoon #1

- Phenanthrene at a concentration above the nonresidential groundwater surface water interface protection criteria.

Sample SB-16-116A (4 to 5 feet) – located south of the of Lagoon #2

- 2-Methylnaphthalene and phenanthrene at a concentration above the nonresidential groundwater surface water interface protection criteria.

Sample MW-16-4 (4 to 5 feet) – located south of the of Lagoon #2

- Fluoranthene and phenanthrene at a concentration above the nonresidential groundwater surface water interface protection criteria.

Sample MW-16-5 (4 to 5 feet) – located southeast of the of Lagoon #2

- Carbazole, fluoranthene, and phenanthrene at a concentration above the nonresidential groundwater surface water interface protection criteria.

Sample L2SWS (4 to 5 feet) – south sidewall of Lagoon #2

- Phenanthrene at a concentration above the nonresidential groundwater surface water interface protection criteria.

Metals

Sample SB-16-116A (4 to 5 feet) – located south of the of Lagoon #2

- Lead at a concentration above the nonresidential direct contact criteria.

Sample SB-16-116C (4 to 5 feet) – duplicate of SB-16-116A

- Arsenic and lead at a concentration above the nonresidential direct contact criteria.

Sample MW-16-5 (4 to 5 feet) – located southeast of the of Lagoon #2

- Lead at a concentration above the nonresidential direct contact criteria.

Sample L1SWN (6 to 7 feet) – north sidewall of Lagoon #1

- Selenium and silver at a concentration above the nonresidential groundwater surface water interface protection criteria

Sample L2SWE (5 to 6 feet) – east sidewall of Lagoon #2

- Mercury at a concentration above the nonresidential groundwater surface water interface protection criteria and the non-residential Recommended Interim Action Screening Levels (RIASL) for volatilization to indoor air

Sample L2SWS (4 to 5 feet) – south sidewall of Lagoon #2

- Mercury at a concentration above the nonresidential groundwater surface water interface protection criteria
- Selenium at a concentration above the nonresidential groundwater surface water interface protection criteria

Arsenic was found in all verification soil samples except L1SWE, L1SWS, L2SWN, and L2SWW at a concentration above the non-residential drinking water protection criteria, groundwater surface water interface protection criteria, and the statewide default background concentration. No verification samples, however, contained arsenic at concentrations above direct contact criteria.

PFAS Compounds

PFAS compounds were found in nearly all excavation verification samples at concentrations above the laboratory reporting limit. Currently, the MDEQ does not have criteria established for soil for the PFAS family of compounds, with two exceptions. In June 2018 the MDEQ updated the criteria tables, and this update included a groundwater surface water interface

(GSI) protection criteria for two PFAS compounds. For perfluorooctanoic acid (PFOA), the soil criteria were established as 10,000,000 nanograms per kilogram (ng/kg) for GSI protection for soil not protective of surface water that is used as a drinking water source, and 350,000 ng/kg for soil which is protective of surface water that is used as a drinking water source. For perfluorooctane sulfonic acid (PFOS), the GSI protection numbers are 240 and 220 ng/kg, respectively.

Concentrations of PFOS in samples from borings SB20-1 and SB20-2 (with the exception of SB20-2B) are also above the non-residential GSI protection criteria.

2.6.1.1 Extent of Remaining Impacts

Figures 17 through 17d illustrate the location of the remaining impacts for VOCs, SVOCs, metals, and PFAS compounds. These figures illustrate the location of the compounds in excess of any applicable criteria, in samples which remain following the excavation of the lagoons. Samples which were located within the lagoons and subsequently excavated are not included in the illustrated extent of impacts.

Volatile organic compounds remain in the soil above applicable criteria in samples at the west and northwest corner of former lagoon #1 and the east side of former lagoon #2 (Figure 17a).

Semi-volatile organic compounds remain in the layer of sandy “urban fill” soil which contains brick, glass, cinders, etc. The SVOC impacts are generally found to the south of the former lagoons, with one sample north of lagoon #2 (Figure 17b).

Figure 17c illustrates the extent of metals in the soil at concentrations above direct contact and GSI protection criteria, with the exception of arsenic. Due to the low criteria values for drinking water protection and GSI protection, arsenic is present in nearly all samples above these criteria. Arsenic is also present above the statewide default background concentration, but below the facility-specific background value, calculated from samples collected from areas of the site which were not known to be impacted. Therefore, it is believed that the majority of the arsenic at the site is naturally occurring, with the exception of that in excess of the direct contact criteria found within the “urban fill” soil. The area of metals-impacted soil (with the exception of arsenic) is located on the east side of lagoon #2 and to the south and southeast of this former lagoon.

Figure 17d illustrates the location of PFAS compounds, as indicated by samples collected from the excavations as well as two soil borings along the south property boundaries. The concentrations of these compounds appear to be highest within with the layer of “urban fill” beneath the site.

Figures 18a through 18d illustrate the distribution of remaining impacts in the soil for concentrations which exceed various exposure criteria, in samples which remain following the excavation of the lagoons. Samples which were located within the lagoons and subsequently excavated are not included in the illustrated extent of impacts.

Figure 18a illustrates the location of contaminants within the soil which exceed the non-residential drinking water protection criteria. These areas include the west and northwest sides of former lagoon #1, as well as the east side of former lagoon #2. The compounds within these areas exceeding the criterial are predominantly volatile organic compounds.

Figure 18b illustrates the location of contaminants within the soil which exceed the non-residential groundwater / surface water protection criteria. These criteria are exceeded at much of the site, predominantly due to the presence of phenanthrene, fluoranthene and metals within the “urban fill” soil, as well as organic compounds and PFAS compounds in samples around the edges of the former lagoons and along the south property boundary.

Figure 18c illustrates the location of contaminants within the soil which exceed the non-residential direct contact criteria. Arsenic and lead are found within the “urban fill” soil in the area to the south and southeast of the former lagoon #2.

Figure 18d illustrates the location of contaminants within the soil which exceed the non-residential recommended interim action screening level (RIASL) for volatilization to indoor air (VIA). This criterium is exceed due to the presence of volatile organic compounds in the northwest and west edges of former lagoon #1, and the east side of former lagoon #2.

Based on the sampling conducted at the site, the extent of impacts has been delineated. The known extent is generally on the edges of the former lagoons for VOCs. SVOCs and metals are present within the layer of “urban fill” located to the south and southeast of the former lagoons. Contaminants do not extend off site. Some SVOCs and metals at concentrations in excess of applicable criteria may be present within the urban fill and may extend off site to the south, but these concentrations are not the result of releases from the former lagoons. Site conditions (hydrogeology, surface water, stormwater management, etc.) prevent contaminants from migrating from the MacDermid property to adjacent properties.

2.6.1.2 Potential Impacts to Adjacent Properties

The railroad property located to the southwest of the site is owned by Canadian National (CN) railroad and consists of a three-track main line and container yard. Soil samples collected from locations adjacent to the property boundary during the investigation contain contaminants above applicable criteria, including:

<u>PNA compounds</u>

- Phenanthrene in sample SB-16-115A at a depth of 3 to 4 feet,
- Fluoranthene and phenanthrene in sample MW-16-4 at a depth of 4 to 5 feet, and

- Carbazole, fluoranthene, and phenanthrene in sample MW-16-5 at a depth of 4 to 5 feet.

All concentrations of PNA compounds exceed only the non-residential GSI protection criteria.

Metals

- Lead was detected in the sample from MW-16-5 at a depth of 4 to 5 feet, at a concentration above the non-residential direct contact criteria

PFAS Compounds

- Perfluorooctane sulfonate (PFOS) was detected in soil samples from two locations, SB20-1 (depth 0 to 0.5 feet and 3.4 to 4 feet) and SB20-2 (depth 0 to 0.5 feet) at concentrations above the non-residential GSI protection criteria.

As discussed in the sections below, no exposure pathways exist regarding the GSI pathway or the drinking water pathway for the site. However, due to the location of samples adjacent to the property boundary which contain contaminant concentrations in excess of applicable criteria, a Notice of Migration has been sent to the adjacent property owner (Canadian National railroad) to inform them of the potential of contaminant migration. A copy of this notice is included in Appendix L. Furthermore, requests have been made to gain access to the property to delineate the extent of impacts on the railroad property which may have migrated from the sites. Letters were sent to CN requesting site access on August 3, 2021, and November 4, 2021. Copies of these requests are included in Appendix M. On November 11, 2021, an e-mail was received from CN directing MacDermid to an on-line portal to provide information to the railroad for potential access.

2.7 Applicable Cleanup Criteria

The Michigan Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), regulates facilities of environmental contamination in Michigan. A "facility" is defined as any area, place, or property where a hazardous substance in excess of the established state cleanup standard for residential property has been released, deposited, disposed of, or otherwise comes to be located. Property is no longer a facility when actions to remove, reduce or treat the contamination are completed, lowering the amount of contamination to a level that is below the state's unrestricted residential cleanup standards. The environmental remediation program authorizes the MDEQ to set cleanup standards by considering how the contaminated land will be used in the future. Michigan's cleanup standards are risk-based and reflect the potential for human health or ecological risks from exposure to potentially harmful substances at contamination sites.

There are currently five (5) categories of land use-based cleanup standards: Unrestricted Residential, Unrestricted Site-Specific, Restricted Residential, Restricted Non-Residential and Restricted Site-Specific.

The unrestricted residential cleanup standards are the most restrictive remediation criteria for the property, because it is assumed that there is the greatest opportunity for exposure to contamination in residential settings, especially for children. When a facility is cleaned up to residential standards, the property is considered safe for all uses. Cleanups using the non-residential standards must demonstrate that the future land use and zoning at the property does not allow residential uses. Restricted categories exist for circumstances that require restrictions on the use of the property, intended to restrict exposure to the identified impacts at the site.

The generic cleanup criteria are calculated using risk-based exposure models. The generic cleanup criteria established by the MDEQ is protective of the most sensitive toxic effect in a given exposure pathway for the hazardous substance in question. A background concentration may be substituted for a generic cleanup criterion when the background concentration is higher than a criterion shown. For metals, a statewide default background concentration has been calculated by the MDEQ which represents an average concentration for soils throughout the state. Site-specific cleanup criteria may be developed based on exposure conditions specific to the site.

Applicable criterion means a cleanup criterion for a relevant pathway. A criterion is not an applicable criterion if the exposure pathway is not a relevant pathway at the facility or if the exposure it addresses is reliably restricted by a restrictive covenant, institutional control or other mechanism.

The applicable cleanup criteria requirements for response activity are the Part 201 Generic Cleanup Criteria and Screening Levels, dated September 28, 2012. Although a more recent version of these criteria has been in place since December 30, 2013, the 2012 criteria are applicable to this site, due to the involvement with USEPA and the RCRA status of the site. All historic sampling results summarized in this report have been compared to the 2012 Part 201 Generic Cleanup Criteria and Screening Levels. Copies of the 2012 Part 201 Generic Cleanup Criteria and Screening Levels are contained in Appendix N.

Currently, EGLE does not have criteria established for soil for the PFAS family of compounds, with two exceptions. In June 2018 the MDEQ updated the criteria tables, and this update included a groundwater surface water interface (GSI) protection criteria for two PFAS compounds. For perfluorooctanoic acid (PFOA), the soil criteria were established as 10,000,000 nanograms per kilogram (ng/kg) for GSI protection for soil not protective of surface water that is used as a drinking water source, and 350,000 ng/kg for soil which is protective of surface water that is used as a drinking water source.

The soil volatilization to indoor air criteria (SVIIC) and the groundwater volatilization to indoor air criteria (GVIIC) have been determined by MDEQ to no longer be protective of human health, and therefore, may not be used to evaluate potential exposure risks. Part 111, R 299.9629(3) directs the use of the environmental protection standards which are necessary for the cleanup and protection of indoor air that are established pursuant to Part 201, Environmental Remediation, of Act 451 (Part 201), if the limits are not less stringent than allowed pursuant to the federal Resource Conservation and Recovery Act of 1976, as amended by the Hazardous and Solid Waste Amendments of 1984 (RCRA).

The Part 201 criteria for the volatilization to indoor air pathway (VIAP) are less stringent than allowed by RCRA and can no longer be used for vapor intrusion evaluations conducted under the Part 111 corrective action program. The Part 201 criteria are being updated and are likely to meet the RCRA stringency requirements when they are eventually promulgated. In the interim, the MDEQ is using screening values developed by the Michigan Department of Health and Human Services (MDHHS) to make time sensitive decisions to protect human health in those situations where there may be unacceptable risk from vapor intrusion. The MDHHS screening values are consistent with what the United States Environmental Protection Agency uses to make indoor air determinations. Copies of the August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels and the January 2017 Volatilization to Indoor Air Recommendations for Interim Action Screening Levels (RIASL) and Time-Sensitive Interim Action Screening Levels are included in Appendix O. For this project, it is appropriate to use the non-residential soil RIASL and the non-residential time-sensitive recommended interim action screening level (TRIASL) for exposures less than 12 hours for structures that were not formerly residential houses ($TRIASL_{12}$).

2.8 Summary of Areas Requiring Corrective Action

Investigation of the site has identified soil and groundwater impacts associated with the former lagoons within SWMU No. 1. Soil within and surrounding these former lagoons has been excavated. Residual impacts remain in the areas outside the excavation limits.

Sampling in SWMU No.2 and SWMU No. 3 did not indicate the presence of subsurface impacts.

Therefore, remaining impacts within SWMU No. 1 are the areas which require additional correction action measures.

2.9 Human and Environmental Receptors

Potential human receptors include workers at the facility and environmental receptors include surface water. The property is zoned as “M-2 General Industrial” within the City of Ferndale. Workers at the facility could be exposed to contaminants if performing specific activities which brings them in contact with the soil or groundwater. Likewise, site conditions or site activities could lead to migration of contaminants to surface water (via the storm sewer system).

2.10 Discussion of Transport and Exposure Pathways to Receptors

A relevant pathway means an exposure pathway that is reasonable and relevant because there is a reasonable potential for exposure to a hazardous substance to occur to a human or nonhuman receptor. The components of an exposure pathway are a source or release of a hazardous substance, an exposure point, and, if the exposure point is not the source or point of release, a transport medium. The existence of a municipal water supply, exposure barrier, or other similar feature does not automatically make an exposure pathway irrelevant.

2.10.1 Soil Exposure Pathways

For the soil at the site, potential exposure pathways include:

- Protection of drinking water from impact due to leaching of contaminants from the soil to the groundwater,
- Protection of the groundwater-surface interface, where contaminants could leach from the soil into the groundwater, and then enter a surface water body,
- Volatilization of contaminants to indoor air and subsequent breathing of contaminants by site workers, and;
- Direct contact of contaminated soil by site or construction workers.

Table 14 provides an evaluation of the potential exposure pathways for the soil at the site. Each exposure pathway is discussed below.

<u>Nonresidential Drinking Water Protection</u> – Contaminant concentrations in soil are above the non-residential drinking water protection criteria. However, the limited quantities of groundwater within the fill soil beneath the site are not suitable for use as potable water source. Also, the facility receives potable water from the municipality, and therefore no drinking water is used from the groundwater at the site. Groundwater beneath the site has been designated to be Groundwater Not In An Aquifer, based on the characteristics of the soil. Therefore, the groundwater ingestion (drinking water) pathway does not apply to this site.

<u>Groundwater-Surface Water Interface Protection</u> – Contaminant concentrations exceed the GSI protection criteria, and therefore could leach to the groundwater at concentrations which would exceed the GSI criteria. These contaminants could, in theory, impact surface water. Storm sewer and other utility corridors at the site, however, are not located in areas where subsurface contamination has been delineated. Furthermore, no surface water (rivers,

wetlands, etc.) are present within a mile of the subject site. Precipitation either runs off the site surface or evaporates from shallow pools in areas where surface flow does not enter the storm drain system. Storm drains in the area south of the site building collect water from the paved surfaces, and this water is directed to the on-site wastewater treatment plant. These storm drains are separate from those in the parking areas, located to the east and north of the building. These factors eliminate the GSI protection criteria from a potential exposure pathway.

Soil Volatilization to Indoor Air – There is a low potential for vapor intrusion to result in unacceptable indoor air health risk at onsite structures based on the distance between them and areas of known VOC and SVOC contamination. However, new building construction in areas with known VOCs and/or SVOCs in soil at concentrations that exceed recommended interim action screening levels could pose an exposure pathway. This exposure pathway is relevant, and the cleanup criteria is applicable, and the pathway is a concern.

Soil Direct Contact – Concentrations of arsenic and lead were found in the fill soil at concentrations in excess of the non-residential soil direct contact criteria. If excavations were to be performed in the soil within the impacted area, exposure to this soil could occur. This exposure pathway is relevant (due to potential exposure during excavation) and the cleanup criteria is applicable, and the pathway is a concern.

Pathways of concern for remaining contaminants in the soil at the site include non-residential direct contact and volatilization to indoor air inhalation.

While exposure for these pathways is highly unlikely due to site conditions, the potential still exists for exposure and the contaminant concentrations exceed the applicable criteria. The proposed corrective action (Restrictive Covenant) will be used to limit the exposure potential posed by the remaining contaminants.

2.10.2 Groundwater Exposure Pathways

For groundwater beneath the site, potential exposure pathways include:

- Drinking of water using site groundwater as a potable water source,
- Groundwater-surface water interface, where groundwater can enter the surface water and be harmful to receptors, and;
- Volatilization of contaminants from groundwater to indoor air and inhalation of these contaminants.

Table 15 provides an evaluation of the potential exposure scenarios for groundwater at the site. Each exposure pathway is discussed below.

<u>Non-Residential Drinking Water</u> – The site and surrounding area are served by municipal water. No water-supply wells are present on the site or the immediate surrounding area. Therefore, no drinking water is obtained from the subsurface at the site. Groundwater beneath the site has been designated to be Groundwater Not In An Aquifer, based on the characteristics of the soil. Therefore, the groundwater ingestion (drinking water) pathway does not apply to this site.

<u>Groundwater-Surface Water Interface</u> – Contaminant concentrations in groundwater exceed the groundwater-surface water interface (GSI) criteria. While the GSI pathway is relevant and the criteria is applicable, exposure is unlikely to occur, due to site conditions. Storm sewer and other utility corridors at the site, however, are not located in areas where subsurface contamination has been delineated. Furthermore, no surface water (rivers, wetlands, etc.) are present within a mile of the subject site. Precipitation either runs off the site surface or evaporates from shallow pools in areas where surface flow does not enter the storm drain system. Storm drains in the area south of the site building collect water from the paved surfaces, and this water is directed to the on-site wastewater treatment plant. These storm drains are separate from those in the parking areas, located to the east and north of the building. These factors eliminate the GSI protection criteria from a potential exposure pathway.

<u>Non-residential Groundwater Volatilization to Indoor Air</u> – There is a low potential for vapor intrusion to result in unacceptable indoor air health risk at onsite structures based on the distance between them and areas of known VOC and SVOC contamination. However, new building construction in areas with known VOCs and/or SVOCs in soil at concentrations that exceed recommended interim action screening levels could pose an exposure pathway. This exposure pathway is relevant, and the cleanup criteria is applicable, and the pathway is a concern.

Pathways of concern for remaining contaminants in the groundwater at the site is the volatilization to indoor air inhalation.

While exposure for these pathways is highly unlikely due to site conditions, the potential still exists for exposure and the contaminant concentrations exceed the applicable criteria. The proposed corrective action (Restrictive Covenant) will be used to limit the exposure potential posed by the remaining contaminants. Table 16 contains a summary of the Exposure Pathways and the Proposed Remedial Measures for the site.

2.11 Conceptual Site Model

The information in the previous sections provides a detailed description of the site conditions.

The subsurface geology beneath the site consists of various thicknesses of fill soil, underlain by glacial till. The fill soil consists fine to medium sand with brick, concrete, wood, coal, glass, cinders, slag and other debris. This "urban fill" is typical in southeast Michigan. Additional fill soil consists of silty clay with gravel, topsoil, and various colored silty clay. The underlying glacial till is tan-brown grading to gray silty clay with gravel. The glacial till is more than 130 feet thick over the underlying shale and limestone bedrock. The thickness, composition, and hydrogeologic characteristics of the glacial till make an effective aquitard.

Limited amounts of groundwater are present in the fill soil. This groundwater is present in thin, discontinuous layers. Significant groundwater is not present within the underlying glacial till soil. The evidence from the site supports a determination of groundwater not in an aquifer, and that the groundwater beneath the site cannot be utilized as a viable source of drinking water.

The area of subsurface contaminants was the former seepage lagoons. The soil and limited groundwater within these lagoons were removed via excavation in late 2018 and early 2019. Residual impacts exist, scattered around the edges of the former lagoons and within the fill soil.

The black sand fill soil (with brick, cinders, glass, etc.) is known to contain concentrations of arsenic and lead in the area to the southeast of the former lagoons. It is therefore possible that this fill may contain excessive concentrations at other locations beneath the site. However, the fill soil is covered by several feet of clean fill soil across the site, so access and exposure to the fill is limited.

Concentrations of some volatile compounds are present at concentrations above the volatilization to indoor air criteria. The location of these contaminants, however, is currently located away from existing buildings, and vapor sampling has indicated that the risk to volatilization is low. If new structures were to be constructed in areas where these contaminants remain, vapor mitigation measures may be required if additional testing would indicate that this pathway is relevant.

The potential for exposure to contaminants at the site is very small. Subsurface impacts are limited to the areas adjacent to the former lagoons and surrounding areas. Site uses and conditions do not provide for an easy route for exposure to the contaminants. The site, as well as properties to the north and east, is located in an area zoned as "M-2 General Industrial". The rail yard, located to the west and south of the site is not zoned, while the properties immediately west of the rail yard are zoned as "Limited Industrial." Residential properties are located to the east of the industrial area, as well as to the west of the railroad yard. The site is currently used for the manufacture, blending and distribution of specialty chemicals for the metal finishing, electronics and surface finishing industries. Work is done within the site building and within the areas covered by concrete pavement. Access to and contact with the impacted soil does not occur as part of routine site operations.

Remaining subsurface impacts at the site are limited to the fill soil immediately adjacent to and surrounding the former lagoons. Concentration of VOCs in soil samples exceeded the non-residential drinking water protection and groundwater-surface water protection criteria, and SVOCs exceed only the non-residential groundwater-surface water interface protection criteria. Soil impacted with metals was found to exceed the non-residential drinking water protection criteria, groundwater-surface water interface protection criteria, non-residential direct contact criteria, and the statewide default background concentrations. Metals impacts are confined to the fill soil. Groundwater impacts are isolated within the fill soil at concentrations above the non-residential drinking water criteria and the groundwater-surface water interface criteria. The characteristics of the native soil surrounding the former lagoons prevent large-scale migration of contaminants. The groundwater system beneath the site has been designated groundwater not in an aquifer, by way of the soil characteristics. Furthermore, there are no surface water bodies within one mile of the site. No storm sewers or utilities exist in the areas of known remaining contamination. Residual contaminants within the soil are unlikely to migrate to a surface water body, so the groundwater / surface water pathway is not complete.

Exposure to remaining subsurface impacts is limited, based on:

- Groundwater beneath the site has been determined to be groundwater not in an aquifer, and groundwater use is not expected.
- Impacts within the fill soil are covered by several feet of clean soil and concrete pavement
- Volatilization of contaminants to existing structures is not expected, due to the contaminant concentrations and distance of these contaminants to the existing buildings.

The site conditions (hydrogeology, surface water, stormwater management, etc.) prevent contaminants from migrating from the MacDermid property to adjacent properties. While exposure is limited due to site conditions, the proposed corrective measure (restrictive covenant) will remove the routes of exposure to the remaining impacts.

3. Corrective Action Plan Overview

The proposed corrective measures for the site are designed to remove exposure to remaining contaminants in the subsurface. Sampling has indicated that residual contaminant levels remain in the areas surrounding the former lagoons. Additional impacts are present within the layer of "urban fill" which is found across the site. Therefore, to remove exposure to the remaining subsurface impacts, a restrictive covenant has been prepared and placed on the property. Table 16 contains a summary of the Exposure Pathways and the Proposed Remedial Measures to mitigate the potential exposure.

Due care measures will also be put in place to ensure that exposure does not occur, and the extent of impacts is not made worse by site activities.

3.1 Restrictive Covenant

An institutional control (in the form of a restrictive covenant) has been filed to remove the potential for exposure to the remaining subsurface impacts. An institutional control is a non-engineered instrument, such as administrative and legal controls, that help to minimize the potential for human exposure to contamination, and to protect the integrity of the remedy. Because impacts remain in the subsurface at concentrations which are not protective of an unrestricted use exposure scenario, and institutional control will be necessary to prevent or limit exposure at the site. The restrictive covenant has been prepared to:

1. Ensure that the property use will remain consistent with EGLE non-residential land use conditions.
2. Restrict access to drinking water by stipulating that no water wells are installed for potable water use. Wells for groundwater sampling and monitoring and construction dewatering will be allowed.
3. Provide for management and proper handling of any soil excavated from the site.
4. Provide for investigation of subsurface contaminant concentrations prior to construction of new structures at the site. If concentrations are found to be above applicable criteria which could impact indoor air quality via volatilization, a vapor mitigation system will be required for the new construction.

The restrictive covenant was filed with the Oakland County Register of Deeds on September 28, 2021, on Liber 56912 and Page 797. A copy of the filed restrictive covenant and proof of filing is contained in Appendix P.

3.2 Due Care Documentation – Long-term Monitoring Plan

Due care compliance requirements of a property owner or operator within provisions of Section 20107a of the NREPA and the rules developed pursuant to this act apply to an owner or operator when the conditions of soil or groundwater at their property meet the definition of a “facility”. Documentation of due care compliance includes an analysis of property conditions and an evaluation of potential human exposures to hazardous substances to have been released at the property. An analysis is also included for measures which may be taken to prevent exacerbation of the facility conditions, mitigate unacceptable exposures of hazardous substances to humans, mitigate any fire or explosion hazards which are present, and comply with other provisions of Section 7a.

A person who owns or operates property that he or she has knowledge is a facility shall do all of the following with respect to hazardous substances at the facility:

- Undertake measures as are necessary to prevent exacerbation.
- Exercise due care by undertaking response activity necessary to mitigate unacceptable exposure to hazardous substances, mitigate fire and explosion hazards due to hazardous substances, and allow for the intended use of the facility in a manner that protects the public health and safety.
- Take reasonable precautions against the reasonably foreseeable acts or omissions of a third party and the consequences that foreseeably could result from those acts or omissions.
- Provide reasonable cooperation, assistance, and access to the persons that are authorized to conduct response activities at the facility, including the cooperation and access necessary for the installation, integrity, operation, and maintenance of any complete or partial response activity at the facility. Nothing in this subdivision shall be interpreted to provide any right of access not expressly authorized by law, including access authorized pursuant to a warrant or a court order, or to preclude access allowed pursuant to a voluntary agreement.
- Comply with any land use or resource use restrictions established or relied on in connection with the response activities at the facility.
- Not impede the effectiveness or integrity of any land use or resource use restriction employed at the facility in connection with response activities.

The long-term monitoring plan for the site includes provisions to prevent exposure to known and suspected subsurface impacts. The plan is intended as an annual site inspection to verify the integrity of site conditions and to minimize exposure to suspected subsurface impacts. The inspection will also ensure that the selected remedies remain functional and effective, so that conditions remain protective of human health and the environment. This annual inspection is intended to conform with the corrective actions approved by the Michigan

Department of Environment, Great Lakes, and Energy, and set forth in the Restrictive Covenant which has been placed on the site and filed with the Oakland County Register of Deeds. This monitoring also documents Due Care Responsibilities in accordance with Section 20107a of the NREPA. Based on site hydrogeological conditions and the distribution of remaining impacts, no on-going or long-term sampling of soil or groundwater is required.

A monitoring checklist for use by the facility is included as Appendix Q. The long-term monitoring to minimize exposure to subsurface impacts includes:

- Maintain surface cover over fill soil – the fill soil beneath the site is known to contain impacts of metals in excess of direct contact criteria. The fill soil, however, is currently covered by several feet of soil and in various places, concrete pavement. The integrity of the surface cover needs to be maintained. Fill soil is characteristically black to dark brown fine to medium sand with silt, and contains various amounts of brick, concrete, glass, cinders, slag, and other debris.
- Concrete inspection – stormwater in the area south of the existing building is collected within storm drains and directed to the on-site wastewater treatment plant for processing. Stormwater on the east and north parking areas is directed to storm sewer drains which flow directly to the municipal system. The concrete surfaces should be inspected to ensure that these flow patterns are maintained, and that the water from the different areas is flowing to the appropriate catchments. Any changes to building or pavement areas should be designed to maintain these drainage patterns.
- Soil management plan – should excavation at the site be necessary, soil should be handled in a way as not to spread contaminants to various places across the site. All soil excavated from the site should be tested for chemical constituents (VOCs, SVOCs, metals) to determine the extent of impacts (if any). If soil is found to be impacted, appropriate procedures need to be followed to handle and manage the soil. Soil may be used for backfill of the excavation, sent off-site to a landfill for disposal, or used as at other areas of the site. But all soil excavated from the site must be characterized to determine the appropriate management plan.
- VI sampling if new building – contaminants remaining at various locations beneath the site are above the non-residential Recommended Interim Action Screening Levels (RIASL) for volatilization to indoor air. The Part 201 non-residential volatilization to indoor air inhalation criteria are not exceeded. If new construction is planned for the various areas of the site, these areas should be sampled to determine if contaminant concentrations beneath the proposed building footprint exist which would require mitigation steps. New construction will require EGLE approval prior to the potential for any human exposures. If new construction is planned at the site, the construction will include engineering controls designed to eliminate the potential for subsurface vapor phase hazardous substances to migrate into the new structure at concentrations

greater than the appropriate concentrations protective of public health, or prior to construction of any structure, an evaluation of the potential for any hazardous substances to volatilize into indoor air will assure the protection of persons who may be present in the buildings. The timing of any potential new construction is not known and the screening levels which may be in place at the time of the new construction are also not known. Site characterization will be necessary prior to design and construction, to either clear the proposed building of potential VI issues, or design engineering controls to be placed on the construction to eliminate VIAP exposure. This site screening and design will rely on the RIASL numbers applicable to the site conditions at the time of construction.

This monitoring plan is intended to be used in conjunction with established plans for Emergency Response, Spill and Stormwater Pollution Prevention Control and Countermeasures, Materials Storage, Hazard Protection, Spill Containment and Emergency Countermeasures, and other operational emergency, health, safety and environmental measures already implemented at the facility.

4. Schedule

The corrective actions for the site, as outlined within this document, are essentially complete. The final remedy for site correction action complete with controls is the finalization and recording of the Restrictive Covenant on the property.

With submittal of the this RFI/CMS/CMIWP document, the EGLE project team will coordinate with relevant teams within the department for review of the document. Once any necessary revisions are completed and the RFI/CMS/CMIWP has been deemed sufficient, a public participation process will be initiated to provide for public review and comment.

The Restrictive Covenant was filed with the Oakland County Register of Deeds on September 28, 2021. A copy of the filed RC is included with this document. A Corrective Action Long-Term Agreement (CALTA) will then be completed, which will reference the CMIWP and serve as part of the institutional controls for the facility.

It is anticipated that final corrective action complete with controls of the site will be completed by the end of 2021.

5. References

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TABLE 1
Soil Grain Size Distribution Summary
MacDermid, Ferndale, Michigan

Particle Size Analysis - ASTM D 422									
Boring	Depth (feet)	USCS	%Gravel		%Sand			%Fines	
			Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
MW-16-1D	12 to 15	CL	10.8	2.3	2.9	7.3	26.5	25.1	25.1
MW-16-3	8 to 11	CL	0.0	1.9	2.5	7.0	24.4	34.7	29.7
MW-16-3	22 to 25	CL	0.0	1.9	2.1	7.2	22.1	29.9	36.8
MW-16-5	8 to 11	CL	0.0	2.9	2.6	7.3	24.0	32.0	31.2
MW-16-5	12 to 15	CL	0.0	4.8	2.4	4.7	20.9	28.1	39.1

Notes:
USCS = Unified Soil Classification System
CL = Clay
ASTM D 422 = Standard Test Method for Particle-Size Analysis of Soils

TABLE 2
Summary of Laboratory Permeability and Particle Size
MacDermid, Ferndale, Michigan

Sample Location	Depth of Sample (feet bgs)	Description of Material	% Moisture Content (as received)	% Silt and Clay (% passing #200 screen)	Laboratory Hydraulic Conductivity (cm/sec)
MW-16-1(D)	12 to 15	gray-brown silty clay with sand and gravel (till)	10.07	50.2	1.5E-08
MW-16-3	8 to 11	mottled tan-brown silty clay with sand and gravel (till)	14.1	64.4	1.9E-08
MW-16-3	22 to 25	gray-brown silty clay with sand and gravel (till)	12.51	66.7	5.0E-09
MW-16-5	8 to 11	mottled tan-brown silty clay with sand and gravel (till)	14.1	63.2	9.2E-08
MW-16-5	12 to 15	gray-brown silty clay with sand and gravel (till)	15.2	67.2	1.5E-08

Average Hydraulic Conductivity 2.9E-08

TABLE 3
Summary of Slug Test Results
MacDermid, Ferndale, Michigan

Monitoring Well	Depth of Well Screen (feet bgs)	Depth of Well Filter Pack (feet bgs)	Hydrogeologic Unit Measured	Hydraulic Conductivity (cm/s)
MW-16-1	5 to 10	4 to 10	Black silty fine sand FILL	3.9E-05
MW-16-2	5 to 10	4 to 10	Black silty fine sand FILL and tan-gray silty clay FILL	1.4E-05
MW-16-3	20 to 25	18 to 25	Gray-Brown Silty Clay with Gravel Till	4.7E-08
MW-16-4	10 to 15	9 to 15	Gray-Brown Silty Clay with Gravel Till	3.1E-05
MW-16-5	10 to 15	8 to 15	Gray-Brown Silty Clay with Gravel Till	5.1E-05

TABLE 4
Monitoring Well and Groundwater Elevation Data
MacDermid, Ferndale, Michigan

Well	Top of Casing Elevation (feet)	Ground Surface Elevation (feet)	Total Depth (feet BTOC)	Depth of Well Screen (feet BGS)	2/15/2017[1]		2/16/2017[2]		2/21/17	
					Depth to GW (ft. BTOC)	Static GW Elev. (ft.)	Depth to GW (ft. BTOC)	Static GW Elev. (ft.)	Depth to GW (ft. BTOC)	Static GW Elev. (ft.)
MW-16-1	100.39	100.54	9.52	5-10	4.02	96.37	2.65	97.74	2.76	97.63
MW-16-2	97.14	97.42	9.15	5-10	2.75	94.39	1.87	95.27	1.85	95.29
MW-16-3	97.76	98.31	24.70	20-25	8.90	88.86	21.60	76.16	16.68	81.08
MW-16-4	99.26	99.57	14.65	10-15	3.70	95.56	3.78	95.48	3.99	95.27
MW-16-5	99.22	99.55	14.70	10-15	6.52	92.70	3.50	95.72	3.71	95.51

Elevation measured to site Bench Mark, set at 100.00 feet, located on corner of concrete at SW corner of AST farm

1 = upon opening of well

2 = approximately 24 hours after bailing for slug testing

BTOC = Below top of casing.

BGS = Below ground surface.

ft. = feet

TABLE 5a
SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-101A	SB-16-101B	SB-16-102A	SB-16-102B	SB-16-103A	SB-16-103B	SB-16-104A	SB-16-104B	SB-16-105A	SB-16-105B	SB-16-105C	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	4-5	14-15	4-5	19-20	6-7	19-20	6-7	19-20	1-2	14-15	Duplicate	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of 105B	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation		
Volatiles by 8260 (µg/Kg)																
Acetone	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	42,000	34,000	110,000,000	1.7.E+11	73,000,000
Acrylonitrile	<120	<110	<130	<120	<120	<110	<130	<110	<120	<110	<110	200	100 (M); 40	35,000	58,000,000	74,000
Benzene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	4,000	8,400	470,000,000	400,000
Bromobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	1,500	NA	580,000	240,000,000	760,000
Bromochloromethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	NA	NA	NA	NA	NA
Bromodichloromethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	1,600	ID	6,400	110,000,000	490,000
Bromoform	<120	<120	<130	<120	<120	<120	<130	<120	<120	<110	<110	1,600	ID	770,000	3,600,000,000	870,000
Bromomethane	<240	<230	<240	<230	<250	<230	<260	<230	<240	<230	<230	580	700	1,600	150,000,000	1,000,000
2-Butanone	<750	<750	<750	<750	<750	<750	<750	<750	<750	<750	<750	760,000	44,000	27,000,000	2.9.E+10	27,000,000
n-Butylbenzene	**89**	<50	<50	<50	<50	<50	<50	<50	**63**	<50	<50	4,600	ID	ID	880,000,000	8,000,000
sec-Butylbenzene	<50	<50	<50	<50	<50	<50	<50	<50	**54**	<50	<50	4,600	ID	ID	180,000,000	8,000,000
tert-Butylbenzene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	4,600	ID	ID	290,000,000	8,000,000
Carbon Disulfide	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	46,000	ID	140,000	2.1E+10	280,000
Carbon Tetrachloride	<59	<56	<63	<58	<62	<57	<65	<57	<60	<57	<57	100	900	990	170,000,000	390,000
Chlorobenzene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	2,000	500	220,000	2,100,000,000	260,000
Chloroethane	<300	<280	<320	<290	<310	<280	<320	<280	<300	<280	<280	34,000	22,000	950,000	2.9E+11	950,000
Chloroform	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	1,600	7,000	38,000	1,600,000,000	1,500,000
Chloromethane	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	22,000	ID	10,000	2,600,000,000	1,100,000
2-Chlorotoluene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	9,300	ID	500,000	2,100,000,000	500,000
Dibromochloromethane	<120	<120	<130	<120	<120	<110	<130	<110	<120	<110	<110	1,600	ID	21,000	160,000,000	500,000
1,2-Dibromo-3-chloropropane	<300	<280	<320	<290	<310	<280	<320	<280	<300	<280	<280	10 (M); 4.0	ID	1,200	700,000	1,200
Dibromomethane	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	4,600	NA	ID	ID	2,000,000
1,2-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	14,000	280	210,000	4.4.E+10	210,000
1,3-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	480	680	48,000	88,000,000	170,000
1,4-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	1,700	360	100,000	570,000,000	1,900,000
Dichlorodifluoromethane	<300	<280	<320	<290	<310	<280	<320	<280	<300	<280	<280	270,000	ID	1,700,000	1.5E+12	1,000,000
1,1-Dichloroethane	<59	<56	<63	<58	<62	<57	<65	<57	<60	<57	<57	50,000	15,000	430,000	1.5E+10	890,000
1,2-Dichloroethane	<50	<50	<50	<50	<50	<50	**280**	<50	<50	<50	<50	100	7,200	11,000	150,000,000	420,000
1,1-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	140	2,600	330	78,000,000	570,000
cis-1,2-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	1,400	12,000	41,000	1,000,000,000	640,000
trans-1,2-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	2,000	30,000	43,000	2,100,000,000	1,400,000
1,2-Dichloropropane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	4,600	7,400	120,000,000	550,000
cis-1,3-Dichloropropene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	700	180	5,400	590,000,000	240,000
trans-1,3-Dichloropropene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	700	180	5,400	590,000,000	240,000
Ethylbenzene	**120**	<50	<50	<50	<50	<50	**500**	<50	<50	<50	<50	1,500	360	140,000	1.3E+10	140,000
Ethylene Dibromide	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	20 (M); 10	110	3,600	18,000,000	430
2-Hexanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	58,000	ID	1,800,000	1,200,000,000	2,500,000
Isopropylbenzene	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	280,000	3,200	390,000	2,600,000	390,000
Methylene Chloride	<100	<100	<100	<100	<100	<100	**940**	<100	<100	<100	<100	100	30,000	240,000	8,300,000,000	2,300,000
4-Methyl-2-pentanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	100,000	ID	2,700,000	6.0E+10	2,700,000
MTBE	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	800	140,000	5,900,000	8.8E+10	5,900,000
Naphthalene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	100,000	730	470,000	88,000,000	52,000,000

TABLE 5a
SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-101A	SB-16-101B	SB-16-102A	SB-16-102B	SB-16-103A	SB-16-103B	SB-16-104A	SB-16-104B	SB-16-105A	SB-16-105B	SB-16-105C	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	4-5	14-15	4-5	19-20	6-7	19-20	6-7	19-20	1-2	14-15	Duplicate	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of 105B	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation		
Volatiles by 8260 (µg/Kg)																
n-Propylbenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	4,600	ID	ID	590,000,000	8,000,000
Styrene	<59	<56	<63	<58	<62	<57	<65	<57	<60	<57	<57	2,700	2,100	520,000	6,900,000,000	520,000
1,1,1,2-Tetrachloroethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	6,400	ID	33,000	530,000,000	440,000
1,1,2,2-Tetrachloroethane	<59	<56	<63	<58	<62	<57	<65	<57	<60	<57	<57	700	1,600	23,000	68,000,000	240,000
Tetrachloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	1,200	21,000	1,200,000,000	88,000
Toluene	<50	<50	<50	<50	<50	<50	**53**	<50	<50	<50	<50	16,000	5,400	250,000	1.2E+10	250,000
1,2,4-Trichlorobenzene	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	4,200	5,900	1,100,000	1.1E+10	1,100,000
1,1,1-Trichloroethane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	4,000	1,800	460,000	2.9E+10	460,000
1,1,2-Trichloroethane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	6,600	24,000	250,000,000	840,000
Trichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	4,000	1,900	59,000,000	500,000
Trichlorofluoromethane	<120	<110	<130	<120	<120	<110	<130	<110	<120	<110	<110	150,000	NA	560,000	1.7E+12	560,000
1,2,3-Trichloropropane	<120	<110	<130	<120	<120	<110	<130	<110	<120	<110	<110	2,400	NA	7,500	8,800,000	830,000
1,2,3-Trimethylbenzene	**110**	<100	<100	<100	<100	<100	**140**	<100	<100	<100	<100	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	**120**	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	2,100	570	110,000	3.6E+10	110,000
1,3,5-Trimethylbenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	1,800	1,100	94,000	3.6E+10	94,000
Vinyl Chloride	<40	<40	<40	<40	<40	<40	**160**	<40	<40	<40	<40	40	260	2,800	890,000,000	34,000
m&p-Xylene	**260**	<100	<100	<100	<100	<100	**2,000**	<100	<100	<100	<100	NA	NA	NA	NA	NA
o-Xylene	**180**	<50	**57**	<50	<50	<50	**940**	<50	<50	<50	<50	NA	NA	NA	NA	NA
Xylenes	**440**	<150	<150	<150	<150	<150	**3,000**	<150	<150	<150	<150	5,600	820	150,000	1.3E+11	150,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5a
SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-106A	SB-16-106B	SB-16-107A	SB-16-107B	SB-16-108A	SB-16-108B	SB-16-109A	SB-16-109B	SB-16-110A	SB-16-110B	SB-16-110C	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	6-7	13-14	5-6	19-20	5-6	19-20	2-3	12-13	4-5	13-14	Duplicate	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of 110A	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation		
Volatiles by 8260 (µg/Kg)																
Acetone	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	42,000	34,000	110,000,000	1.7.E+11	73,000,000
Acrylonitrile	<120	<120	<120	<110	<120	<110	<100	<100	<100	<100	<100	200	100 (M); 40	35,000	58,000,000	74,000
Benzene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	4,000	8,400	470,000,000	400,000
Bromobenzene	<100	<100	<100	<100	<100	<100	<140	<110	<120	<110	<130	1,500	NA	580,000	240,000,000	760,000
Bromochloromethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	NA	NA	NA	NA	NA
Bromodichloromethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	1,600	ID	6,400	110,000,000	490,000
Bromoform	<120	<120	<120	<120	<120	<110	<100	<100	<100	<120	<120	1,600	ID	770,000	3,600,000,000	870,000
Bromomethane	<250	<240	<240	<230	<240	<230	<280	<230	<250	<220	<250	580	700	1,600	150,000,000	1,000,000
2-Butanone	<750	<750	<750	<750	<750	<750	<750	<750	<750	<750	<750	760,000	44,000	27,000,000	2.9.E+10	27,000,000
n-Butylbenzene	<50	<50	<50	<50	<50	<50	<70	<57	<62	<56	<63	4,600	ID	ID	880,000,000	8,000,000
sec-Butylbenzene	<50	<50	<50	<50	<50	<50	<70	<57	<62	<56	<63	4,600	ID	ID	180,000,000	8,000,000
tert-Butylbenzene	<50	<50	<50	<50	<50	<50	<50	<57	<50	<56	<63	4,600	ID	ID	290,000,000	8,000,000
Carbon Disulfide	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	46,000	ID	140,000	2.1E+10	280,000
Carbon Tetrachloride	<61	<60	<60	<57	<61	<57	<50	<50	<50	<50	<50	100	900	990	170,000,000	390,000
Chlorobenzene	<50	<50	<50	<50	<50	<50	<70	<57	<62	<56	<63	2,000	500	220,000	2,100,000,000	260,000
Chloroethane	<310	<300	<300	<280	<310	<290	<350	<280	<310	<280	<310	34,000	22,000	950,000	2.9E+11	950,000
Chloroform	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	1,600	7,000	38,000	1,600,000,000	1,500,000
Chloromethane	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	22,000	ID	10,000	2,600,000,000	1,100,000
2-Chlorotoluene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	9,300	ID	500,000	2,100,000,000	500,000
Dibromochloromethane	<120	<120	<120	<110	<120	<110	<100	<100	<100	<100	<100	1,600	ID	21,000	160,000,000	500,000
1,2-Dibromo-3-chloropropane	<310	<300	<300	<280	<310	<290	<140	<110	<120	<110	<130	10 (M); 4.0	ID	1,200	700,000	1,200
Dibromomethane	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	4,600	NA	ID	ID	2,000,000
1,2-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	14,000	280	210,000	4.4.E+10	210,000
1,3-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	480	680	48,000	88,000,000	170,000
1,4-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	1,700	360	100,000	570,000,000	1,900,000
Dichlorodifluoromethane	<310	<300	<300	<280	<310	<290	<250	<250	<250	<250	<250	270,000	ID	1,700,000	1.5E+12	1,000,000
1,1-Dichloroethane	<61	<60	<60	<57	<61	<57	<70	<57	<62	<56	<63	50,000	15,000	430,000	1.5E+10	890,000
1,2-Dichloroethane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	7,200	11,000	150,000,000	420,000
1,1-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	140	2,600	330	78,000,000	570,000
cis-1,2-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	1,400	12,000	41,000	1,000,000,000	640,000
trans-1,2-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	2,000	30,000	43,000	2,100,000,000	1,400,000
1,2-Dichloropropane	<50	<50	<50	<50	<50	<50	<70	<57	<62	<56	<63	100	4,600	7,400	120,000,000	550,000
cis-1,3-Dichloropropene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	700	180	5,400	590,000,000	240,000
trans-1,3-Dichloropropene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	700	180	5,400	590,000,000	240,000
Ethylbenzene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	1,500	360	140,000	1.3E+10	140,000
Ethylene Dibromide	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	20 (M); 10	110	3,600	18,000,000	430
2-Hexanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	58,000	ID	1,800,000	1,200,000,000	2,500,000
Isopropylbenzene	<250	<250	<250	<250	<250	<250	<350	<280	<310	<280	<310	280,000	3,200	390,000	2,600,000	390,000
Methylene Chloride	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	100	30,000	240,000	8,300,000,000	2,300,000
4-Methyl-2-pentanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	100,000	ID	2,700,000	6.0E+10	2,700,000
MTBE	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	800	140,000	5,900,000	8.8E+10	5,900,000
Naphthalene	<330	<330	<330	<330	<330	<330	<350	<330	<330	<330	<330	100,000	730	470,000	88,000,000	52,000,000

TABLE 5a
SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-106A	SB-16-106B	SB-16-107A	SB-16-107B	SB-16-108A	SB-16-108B	SB-16-109A	SB-16-109B	SB-16-110A	SB-16-110B	SB-16-110C	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	6-7	13-14	5-6	19-20	5-6	19-20	2-3	12-13	4-5	13-14	Duplicate	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of 110A	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation		
Volatiles by 8260 (µg/Kg)																
n-Propylbenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	4,600	ID	ID	590,000,000	8,000,000
Styrene	<61	<60	<60	<57	<61	<57	<70	<57	<62	<56	<63	2,700	2,100	520,000	6,900,000,000	520,000
1,1,1,2-Tetrachloroethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	6,400	ID	33,000	530,000,000	440,000
1,1,2,2-Tetrachloroethane	<61	<60	<60	<57	<61	<57	<70	<57	<62	<56	<63	700	1,600	23,000	68,000,000	240,000
Tetrachloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	1,200	21,000	1,200,000,000	88,000
Toluene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	16,000	5,400	250,000	1.2E+10	250,000
1,2,4-Trichlorobenzene	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250	4,200	5,900	1,100,000	1.1E+10	1,100,000
1,1,1-Trichloroethane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	4,000	1,800	460,000	2.9E+10	460,000
1,1,2-Trichloroethane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	100	6,600	24,000	250,000,000	840,000
Trichloroethene	<50	<50	<50	<50	<50	<50	<70	<57	<62	<56	<63	100	4,000	1,900	59,000,000	500,000
Trichlorofluoromethane	<120	<120	<120	<110	<120	<110	<100	<100	<100	<120	<100	150,000	NA	560,000	1.7E+12	560,000
1,2,3-Trichloropropane	<120	<120	<120	<110	<120	<110	<100	<100	<100	<100	<100	2,400	NA	7,500	8,800,000	830,000
1,2,3-Trimethylbenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	<100	<100	<100	<100	<100	<100	<140	<110	<120	<110	<130	2,100	570	110,000	3.6E+10	110,000
1,3,5-Trimethylbenzene	<100	<100	<100	<100	<100	<100	<140	<100	<120	<110	<130	1,800	1,100	94,000	3.6E+10	94,000
Vinyl Chloride	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40	40	260	2,800	890,000,000	34,000
m&p-Xylene	<100	<100	<100	<100	<100	<100	<140	<100	<120	<110	<130	NA	NA	NA	NA	NA
o-Xylene	<50	<50	<50	<50	<50	<50	<70	<57	<62	<56	<63	NA	NA	NA	NA	NA
Xylenes	<150	<150	<150	<150	<150	<150	<210	<170	<190	<170	<190	5,600	820	150,000	1.3E+11	150,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5a
SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-111A	SB-16-111B	SB-16-112A	SB-16-112B	SB-16-113A	SB-16-113B	SB-16-114A	SB-16-114B	SB-16-115A	SB-16-115B	SB-16-116A	Drinking Water Protection	Groundwater Surface Water Interface Protection	Soil Volatilization to Indoor Air Inhalation	Particulate Soil Inhalation	Direct Contact
Depth (feet)	5-6	19-20	5-6	24-25	5-6	14-15	6-7	14-15	3-4	14-15	4-5					
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil					
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16					
Volatiles by 8260 (µg/Kg)																
Acetone	<1,000	<1,000	<3,100	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	42,000	34,000	110,000,000	1.7.E+11	73,000,000
Acrylonitrile	<120	<110	<1,300	<110	<120	<110	<120	<110	<140	<110	<120	200	100 (M); 40	35,000	58,000,000	74,000
Benzene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	100	4,000	8,400	470,000,000	400,000
Bromobenzene	<100	<100	<630	<100	<100	<100	<100	<100	<100	<100	<100	1,500	NA	580,000	240,000,000	760,000
Bromochloromethane	<100	<100	<310	<100	<100	<100	<100	<100	<100	<100	<100	NA	NA	NA	NA	NA
Bromodichloromethane	<100	<100	<310	<100	<100	<100	<100	<100	<100	<100	<100	1,600	ID	6,400	110,000,000	490,000
Bromoform	<120	<110	<1,300	<110	<120	<110	<120	<110	<140	<110	<120	1,600	ID	770,000	3,600,000,000	870,000
Bromomethane	<240	<230	<2,500	<220	<250	<220	<250	<230	<280	<220	<240	580	700	1,600	150,000,000	1,000,000
2-Butanone	<750	<750	<3,100	<750	<750	<750	<750	<750	<750	<750	<750	760,000	44,000	27,000,000	2.9.E+10	27,000,000
n-Butylbenzene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	4,600	ID	ID	880,000,000	8,000,000
sec-Butylbenzene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	4,600	ID	ID	180,000,000	8,000,000
tert-Butylbenzene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	4,600	ID	ID	290,000,000	8,000,000
Carbon Disulfide	<250	<250	**1,100**	<250	<250	<250	<250	<250	<250	<250	<250	46,000	ID	140,000	2.1E+10	280,000
Carbon Tetrachloride	<61	<57	<630	<55	<62	<56	<61	<56	<69	<56	<60	100	900	990	170,000,000	390,000
Chlorobenzene	**110**	<50	**880,000**	<50	**460**	<50	<50	<50	<50	<50	<50	2,000	500	220,000	2,100,000,000	260,000
Chloroethane	<300	<280	<3,100	<280	<310	<280	<310	<280	<350	<280	<300	34,000	22,000	950,000	2.9E+11	950,000
Chloroform	<50	<50	**4,100**	<50	<50	<50	<50	<50	<50	<50	<50	1,600	7,000	38,000	1,600,000,000	1,500,000
Chloromethane	<250	<250	<630	<250	<250	<250	<250	<250	<250	<250	<250	22,000	ID	10,000	2,600,000,000	1,100,000
2-Chlorotoluene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	9,300	ID	500,000	2,100,000,000	500,000
Dibromochloromethane	<120	<110	<1,300	<110	<120	<110	<120	<110	<140	<110	<120	1,600	ID	21,000	160,000,000	500,000
1,2-Dibromo-3-chloropropane	<310	<280	<3,100	<280	<310	<280	<310	<280	<350	<280	<300	10 (M); 4.0	ID	1,200	700,000	1,200
Dibromomethane	<250	<250	<310	<250	<250	<250	<250	<250	<250	<250	<250	4,600	NA	ID	ID	2,000,000
1,2-Dichlorobenzene	**160**	<100	**100,000**	<100	**110**	<100	<100	<100	<100	<100	<100	14,000	280	210,000	4.4.E+10	210,000
1,3-Dichlorobenzene	<100	<100	<310	<100	<100	<100	<100	<100	<100	<100	<100	480	680	48,000	88,000,000	170,000
1,4-Dichlorobenzene	<100	<100	**14,000**	<100	<100	<100	<100	<100	<100	<100	<100	1,700	360	100,000	570,000,000	1,900,000
Dichlorodifluoromethane	<310	<280	<3,100	<280	<310	<280	<310	<280	<350	<280	<300	270,000	ID	1,700,000	1.5E+12	1,000,000
1,1-Dichloroethane	<61	<57	<630	<55	<62	<56	<61	<56	<69	<56	<60	50,000	15,000	430,000	1.5E+10	890,000
1,2-Dichloroethane	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	100	7,200	11,000	150,000,000	420,000
1,1-Dichloroethene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	140	2,600	330	78,000,000	570,000
cis-1,2-Dichloroethene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	1,400	12,000	41,000	1,000,000,000	640,000
trans-1,2-Dichloroethene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	2,000	30,000	43,000	2,100,000,000	1,400,000
1,2-Dichloropropane	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	100	4,600	7,400	120,000,000	550,000
cis-1,3-Dichloropropene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	700	180	5,400	590,000,000	240,000
trans-1,3-Dichloropropene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	700	180	5,400	590,000,000	240,000
Ethylbenzene	<50	<50	**4,900**	<50	<50	<50	<50	<50	<50	<50	<50	1,500	360	140,000	1.3E+10	140,000
Ethylene Dibromide	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	20 (M); 10	110	3,600	18,000,000	430
2-Hexanone	<2,500	<2,500	<3,100	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	58,000	ID	1,800,000	1,200,000,000	2,500,000
Isopropylbenzene	<250	<250	<310	<250	<250	<250	<250	<250	<250	<250	<250	280,000	3,200	390,000	2,600,000	390,000
Methylene Chloride	<100	<100	**90,000**	<100	<100	<100	<100	<100	<100	<100	<100	100	30,000	240,000	8,300,000,000	2,300,000
4-Methyl-2-pentanone	<2,500	<2,500	<3,100	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	100,000	ID	2,700,000	6.0E+10	2,700,000
MTBE	<250	<250	<310	<250	<250	<250	<250	<250	<250	<250	<250	800	140,000	5,900,000	8.8E+10	5,900,000
Naphthalene	<330	<330	<1,300	<330	<330	<330	<330	<330	<330	<330	<330	100,000	730	470,000	88,000,000	52,000,000

TABLE 5a
SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-111A	SB-16-111B	SB-16-112A	SB-16-112B	SB-16-113A	SB-16-113B	SB-16-114A	SB-16-114B	SB-16-115A	SB-16-115B	SB-16-116A	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	5-6	19-20	5-6	24-25	5-6	14-15	6-7	14-15	3-4	14-15	4-5	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16		Protection	Inhalation		
Volatiles by 8260 (µg/Kg)																
n-Propylbenzene	<100	<100	<310	<100	<100	<100	<100	<100	<100	<100	<100	4,600	ID	ID	590,000,000	8,000,000
Styrene	<61	<57	<630	<55	<62	<56	<61	<56	<69	<56	<60	2,700	2,100	520,000	6,900,000,000	520,000
1,1,1,2-Tetrachloroethane	<100	<100	<630	<100	<100	<100	<100	<100	<100	<100	<100	6,400	ID	33,000	530,000,000	440,000
1,1,2,2-Tetrachloroethane	<61	<57	<630	<55	<62	<56	<61	<56	<69	<56	<60	700	1,600	23,000	68,000,000	240,000
Tetrachloroethene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	100	1,200	21,000	1,200,000,000	88,000
Toluene	<50	<50	**1,900**	<50	<50	<50	<50	<50	<50	<50	<50	16,000	5,400	250,000	1.2E+10	250,000
1,2,4-Trichlorobenzene	<250	<250	**970**	<250	<250	<250	<250	<250	<250	<250	<250	4,200	5,900	1,100,000	1.1E+10	1,100,000
1,1,1-Trichloroethane	<50	<50	**390**	<50	<50	<50	<50	<50	<50	<50	<50	4,000	1,800	460,000	2.9E+10	460,000
1,1,2-Trichloroethane	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	100	6,600	24,000	250,000,000	840,000
Trichloroethene	<50	<50	<310	<50	<50	<50	<50	<50	<50	<50	<50	100	4,000	1,900	59,000,000	500,000
Trichlorofluoromethane	<120	<110	<1,300	<110	<120	<110	<120	<110	<140	<110	<120	150,000	NA	560,000	1.7E+12	560,000
1,2,3-Trichloropropane	<120	<110	<1,300	<110	<120	<110	<120	<110	<140	<110	<120	2,400	NA	7,500	8,800,000	830,000
1,2,3-Trimethylbenzene	<100	<100	<310	<100	<100	<100	<100	<100	<100	<100	<100	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	<100	<100	**640**	<100	<100	<100	<100	<100	<100	<100	<100	2,100	570	110,000	3.6E+10	110,000
1,3,5-Trimethylbenzene	<100	<100	<310	<100	<100	<100	<100	<100	<100	<100	<100	1,800	1,100	94,000	3.6E+10	94,000
Vinyl Chloride	<40	<40	<310	<40	<40	<40	<40	<40	<40	<40	<40	40	260	2,800	890,000,000	34,000
m&p-Xylene	<100	<100	**18,000**	<100	<100	<100	<100	<100	<100	<100	<100	NA	NA	NA	NA	NA
o-Xylene	<50	<50	**7,700**	<50	<50	<50	<50	<50	<50	<50	<50	NA	NA	NA	NA	NA
Xylenes	<150	<150	**26,000**	<150	<150	<150	<150	<150	<150	<150	<150	5,600	820	150,000	1.3E+11	150,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5a
SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-116B	SB-16-116C	SB-16-117A	SB-16-117B	SB-16-118A	SB-16-118B	SB-16-119A	SB-16-119B	MW-16-4	MW-16-5		Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	14-15	Duplicate	4-5	14-15	4-5	14-15	5-6	14-15	4-5	4-5		Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	of 116A	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	1/25/17	1/26/17			Protection	Inhalation		
Volatiles by 8260 (µg/Kg)																
Acetone	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000		42,000	34,000	110,000,000	1.7.E+11	73,000,000
Acrylonitrile	<110	<120	<130	<120	<120	<110	<110	<110	<100	<100		200	100 (M); 40	35,000	58,000,000	74,000
Benzene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50		100	4,000	8,400	470,000,000	400,000
Bromobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<130	<130		1,500	NA	580,000	240,000,000	760,000
Bromochloromethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		NA	NA	NA	NA	NA
Bromodichloromethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		1,600	ID	6,400	110,000,000	490,000
Bromoform	<110	<120	<130	<120	<120	<110	<110	<110	<100	<100		1,600	ID	770,000	3,600,000,000	870,000
Bromomethane	<220	<230	<260	<240	<240	<230	<230	<230	<250	<250		580	700	1,600	150,000,000	1,000,000
2-Butanone	<750	<750	<750	<750	<750	<750	<750	<750	<750	<750		760,000	44,000	27,000,000	2.9.E+10	27,000,000
n-Butylbenzene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		4,600	ID	ID	880,000,000	8,000,000
sec-Butylbenzene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		4,600	ID	ID	180,000,000	8,000,000
tert-Butylbenzene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		4,600	ID	ID	290,000,000	8,000,000
Carbon Disulfide	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250		46,000	ID	140,000	2.1E+10	280,000
Carbon Tetrachloride	<56	<58	<65	<59	<60	<56	<57	<56	<63	<64		100	900	990	170,000,000	390,000
Chlorobenzene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		2,000	500	220,000	2,100,000,000	260,000
Chloroethane	<280	<290	<320	<290	<300	<280	<290	<280	<250	<250		34,000	22,000	950,000	2.9E+11	950,000
Chloroform	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		1,600	7,000	38,000	1,600,000,000	1,500,000
Chloromethane	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250		22,000	ID	10,000	2,600,000,000	1,100,000
2-Chlorotoluene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		9,300	ID	500,000	2,100,000,000	500,000
Dibromochloromethane	<110	<120	<130	<120	<120	<110	<110	<110	<100	<100		1,600	ID	21,000	160,000,000	500,000
1,2-Dibromo-3-chloropropane	<280	<290	<320	<290	>300	<280	<290	<280	<310	<320		10 (M); 4.0	ID	1,200	700,000	1,200
Dibromomethane	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250		4,600	NA	ID	ID	2,000,000
1,2-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		14,000	280	210,000	4.4.E+10	210,000
1,3-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		480	680	48,000	88,000,000	170,000
1,4-Dichlorobenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		1,700	360	100,000	570,000,000	1,900,000
Dichlorodifluoromethane	<280	<290	<320	<290	<300	<280	<290	<280	<250	<250		270,000	ID	1,700,000	1.5E+12	1,000,000
1,1-Dichloroethane	<56	<58	<65	<59	<60	<56	<57	<56	<63	<64		50,000	15,000	430,000	1.5E+10	890,000
1,2-Dichloroethane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50		100	7,200	11,000	150,000,000	420,000
1,1-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50		140	2,600	330	78,000,000	570,000
cis-1,2-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50		1,400	12,000	41,000	1,000,000,000	640,000
trans-1,2-Dichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50		2,000	30,000	43,000	2,100,000,000	1,400,000
1,2-Dichloropropane	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		100	4,600	7,400	120,000,000	550,000
cis-1,3-Dichloropropene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		700	180	5,400	590,000,000	240,000
trans-1,3-Dichloropropene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		700	180	5,400	590,000,000	240,000
Ethylbenzene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		1,500	360	140,000	1.3E+10	140,000
Ethylene Dibromide	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		20 (M); 10	110	3,600	18,000,000	430
2-Hexanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500		58,000	ID	1,800,000	1,200,000,000	2,500,000
Isopropylbenzene	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250		280,000	3,200	390,000	2,600,000	390,000
Methylene Chloride	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		100	30,000	240,000	8,300,000,000	2,300,000
4-Methyl-2-pentanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500		100,000	ID	2,700,000	6.0E+10	2,700,000
MTBE	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250		800	140,000	5,900,000	8.8E+10	5,900,000
Naphthalene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		100,000	730	470,000	88,000,000	52,000,000

TABLE 5a
SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-116B	SB-16-116C	SB-16-117A	SB-16-117B	SB-16-118A	SB-16-118B	SB-16-119A	SB-16-119B	MW-16-4	MW-16-5		Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	14-15	Duplicate	4-5	14-15	4-5	14-15	5-6	14-15	4-5	4-5		Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	of 116A	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	1/25/17	1/26/17			Protection	Inhalation		
Volatiles by 8260 (µg/Kg)																
n-Propylbenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		4,600	ID	ID	590,000,000	8,000,000
Styrene	<56	<58	<65	<59	<60	<56	<57	<56	<63	<64		2,700	2,100	520,000	6,900,000,000	520,000
1,1,1,2-Tetrachloroethane	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		6,400	ID	33,000	530,000,000	440,000
1,1,2,2-Tetrachloroethane	<56	<58	<65	<59	<60	<56	<57	<56	<63	<64		700	1,600	23,000	68,000,000	240,000
Tetrachloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		100	1,200	21,000	1,200,000,000	88,000
Toluene	<50	**100**	<50	<50	<50	<50	<50	<50	<63	<64		16,000	5,400	250,000	1.2E+10	250,000
1,2,4-Trichlorobenzene	<250	<250	<250	<250	<250	<250	<250	<250	<250	<250		4,200	5,900	1,100,000	1.1E+10	1,100,000
1,1,1-Trichloroethane	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50		4,000	1,800	460,000	2.9E+10	460,000
1,1,2-Trichloroethane	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		100	6,600	24,000	250,000,000	840,000
Trichloroethene	<50	<50	<50	<50	<50	<50	<50	<50	<63	<64		100	4,000	1,900	59,000,000	500,000
Trichlorofluoromethane	<110	<120	<130	<120	<120	<110	<110	<110	<110	<110		150,000	NA	560,000	1.7E+12	560,000
1,2,3-Trichloropropane	<110	<120	<130	<120	<120	<110	<110	<110	<130	<130		2,400	NA	7,500	8,800,000	830,000
1,2,3-Trimethylbenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		2,100	570	110,000	3.6E+10	110,000
1,3,5-Trimethylbenzene	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100		1,800	1,100	94,000	3.6E+10	94,000
Vinyl Chloride	<40	<40	<40	<40	<40	<40	<40	<40	<40	<40		40	260	2,800	890,000,000	34,000
m&p-Xylene	<100	**140**	<100	<100	<100	<100	<100	<100	<130	<130		NA	NA	NA	NA	NA
o-Xylene	<50	**84**	<50	<50	<50	<50	<50	<50	<63	<64		NA	NA	NA	NA	NA
Xylenes	<150	**220**	<150	<150	<150	<150	<150	<150	<190	<190		5,600	820	150,000	1.3E+11	150,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5b
SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-101A	SB-16-101B	SB-16-102A	SB-16-102B	SB-16-103A	SB-16-103B	SB-16-104A	SB-16-104B	SB-16-105A	SB-16-105B	SB-16-105C	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	4-5	14-15	4-5	19-20	6-7	19-20	6-7	19-20	1-2	14-15	Duplicate	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of 105B	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation		
BNA Semivolatiles by 8270 (µg/Kg)																
Acenaphthene	<330	<330	<420	<330	<410	<330	<330	<330	**1,300**	<330	<330	880,000	8,700	350,000,000	6,200,000,000	130,000,000
Acenaphthylene	<330	<330	**460**	<330	<410	<330	<330	<330	<400	<330	<330	17,000	ID	3,000,000	1,000,000,000	5,200,000
Aniline	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	4,400	330 (M); 80	NLV	29,000,000	150,000
Anthracene	<330	<330	730	<330	<410	<330	<330	<330	**1,300**	<330	<330	41,000	ID	1,000,000,000	2.9.E+10	730,000,000
Azobenzene	<330	<330	<450	<330	<450	<330	<330	<330	<430	<330	<330	17,000	ID	32,000,000	130,000,000	660,000
Benzo(a)anthracene	<330	<330	**2,200**	<330	<410	<330	<330	<330	**3,000**	<330	<330	NLL	NLL	NLV	ID	80,000
Benzo(a)pyrene	<330	<330	**3,000**	<330	<410	<330	<330	<330	**5,200**	<330	<330	NLL	NLL	NLV	1,900,000	8,000
Benzo(b)fluoranthene	<330	<330	**4,900**	<330	<410	<330	**500**	<330	**6,900**	<330	<330	NLL	NLL	NLV	ID	80,000
Benzo(ghi)perylene	<330	<330	**1,800**	<330	<410	<330	<330	<330	**3,200**	<330	<330	NLL	NLL	NLV	350,000,000	7,000,000
Benzo(k)fluoranthene	<330	<330	**1,500**	<330	<410	<330	<330	<330	**1,800**	<330	<330	NLL	NLL	NLV	ID	800,000
Benzyl Alcohol	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	580,000	NA	NLV	1.5.E+11	580,000
Bis(2-chloroethoxy)methane	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	<330	<330	<440	<330	<430	<330	<330	<330	<420	<330	<330	170	100 (M); 20	44,000	12,000,000	58,000
Bis(2-chloroisopropyl) Ether	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	**350**	<330	<420	<330	<410	<330	**1,000**	<330	<400	<330	<330	NLL	NLL	NLV	890,000,000	10,000,000
4-Bromophenyl Phenylether	<330	<330	<450	<330	<440	<330	<330	<330	<430	<330	<330	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	310,000	120,000	NLV	2.1E+10	310,000
Carbazole	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	39,000	1,100	NLV	78,000,000	2,400,000
4-Chloro-3-methylphenol	<280	<280	<420	<280	<410	<280	<280	<280	<400	<280	<280	16,000	280	NLV	ID	15,000,000
2-Chloronaphthalene	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	1,800,000	NA	ID	ID	180,000,000
2-Chlorophenol	<330	<330	<450	<330	<440	<330	<330	<330	<430	<330	<330	2,600	360	800,000	530,000,000	4,500,000
4-Chlorophenyl Phenylether	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	NA	NA	NA	NA	NA
Chrysene	<330	<330	**2,700**	<330	<410	<330	<330	<330	**3,400**	<330	<330	NLL	NLL	ID	ID	8,000,000
Dibenzo(a,h)anthracene	<330	<330	**480**	<330	<410	<330	<330	<330	**670**	<330	<330	NLL	NLL	NLV	ID	8,000
Dibenzofuran	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	ID	1,700	3,600,000	2,900,000	ID
2,4-Dichlorophenol	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	4,200	330 (M); 220	NLV	2,300,000,000	1,800,000
Diethyl Phthalate	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	320,000	2,200	NLV	1,500,000,000	740,000
Dimethyl Phthalate	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	790,000	NA	NLV	1,500,000,000	790,000
2,4-Dimethylphenol	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	20,000	7,600	NLV	2,100,000,000	36,000,000
Di-n-butyl Phthalate	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	760,000	11,000	NLV	1,500,000,000	760,000
2,4-Dinitrophenol	<830	<830	<8,400	<830	<8,200	<830	<830	<830	<8,000	<830	<830	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	<330	<330	<840	<330	<820	<330	<330	<330	<800	<330	<330	640	NA	NLV	20,000,000	220,000
2,6-Dinitrotoluene	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	140,000,000	ID	NLV	1.4E+10	20,000,000
Fluoranthene	<330	<330	**3,900**	<330	<410	<330	**560**	<330	**5,600**	<330	<330	730,000	5,500	1,000,000,000	4,100,000,000	130,000,000
Fluorene	<330	<330	<420	<330	**420**	<330	<330	<330	**2,600**	<330	<330	890,000	5,300	1,000,000,000	4,100,000,000	87,000,000
Hexachlorobenzene	<330	<330	<450	<330	<440	<330	<330	<330	<430	<330	<330	1,800	350	220,000	8,500,000	37,000
Hexachlorobutadiene	<330	<330	<450	<330	<410	<330	<330	<330	<400	<330	<330	72,000	91	350,000	180,000,000	350,000
Hexachlorocyclopentadiene	<330	<330	<840	<330	<820	<330	<330	<330	<800	<330	<330	320,000	ID	56,000	5,900,000	720,000
Hexachloroethane	<330	<330	<610	<330	<600	<330	<330	<330	<580	<330	<330	1,200	1,800	79,000	100,000,000	730,000
Indeno(1,2,3-cd)pyrene	<330	<330	<420	<330	<410	<330	<330	<330	**2,300**	<330	<330	NLL	NLL	NLV	ID	80,000

TABLE 5b
SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-101A	SB-16-101B	SB-16-102A	SB-16-102B	SB-16-103A	SB-16-103B	SB-16-104A	SB-16-104B	SB-16-105A	SB-16-105B	SB-16-105C	Drinking Water Protection	Groundwater Surface Water Interface Protection	Soil Volatilization to Indoor Air Inhalation	Particulate Soil Inhalation	Direct Contact
Depth (feet)	4-5	14-15	4-5	19-20	6-7	19-20	6-7	19-20	1-2	14-15	Duplicate of 105B					
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil						
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16					
BNA Semivolatiles by 8270 (μg/Kg)																
Isophorone	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	62,000	26,000	NLV	8,200,000,000	2,400,000
2-Methyl-4,6-dinitrophenol	<830	<830	<8,400	<830	<8,200	<830	<830	<830	<8,000	<830	<830	830 (M); 400	NA	NLV	59,000,000	260,000
2-Methylnaphthalene	<330	<330	**1,100**	<330	**1,900**	<330	**2,500**	<330	**2,800**	<330	<330	170,000	4,200	4,900,000	290,000,000	26,000,000
2-Methylphenol	<660	<660	<470	<660	<460	<660	<660	<660	<450	<660	<660	20,000	1,000 (M);600	NLV	2,900,000,000	36,000,000
3&4-Methylphenol	<330	<330	<660	<330	<660	<330	<330	<330	<660	<330	<330	20,000	1,000 (M);600	NLV	2,900,000,000	36,000,000
2-Nitroaniline	<330	<330	<2,100	<330	<2,100	<330	<330	<330	<2,000	<330	<330	NA	NA	NA	NA	NA
3-Nitroaniline	<830	<830	<2,100	<830	<2,100	<830	<830	<830	<2,000	<830	<830	NA	NA	NA	NA	NA
4-Nitroaniline	<830	<830	<8,400	<830	<8,200	<830	<830	<830	<8,000	<830	<830	NA	NA	NA	NA	NA
Nitrobenzene	<330	<330	<430	<330	<420	<330	<330	<330	<410	<330	<330	330 (M); 190	3,600	170,000	21,000,000	340,000
2-Nitrophenol	<330	<330	<840	<330	<820	<330	<330	<330	<800	<330	<330	1,200	ID	NLV	ID	2,000,000
4-Nitrophenol	<830	<830	<4,200	<830	<4,100	<830	<830	<830	<4,000	<830	<830	NA	NA	NA	NA	NA
N-Nitrosodimethylamine	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	330 (M); 100	NA	NLV	2,000,000	5,400
N-Nitrosodiphenylamine	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	22,000	NA	NLV	2,800,000,000	7,800,000
Pentachlorophenol	<800	<800	<2,100	<800	<2,100	<800	<1,100	<800	<2,000	<800	<800	22	(G, X)	NLV	130,000,000	320,000
Phenanthrene	<330	<330	**2,500**	<330	<410	<330	**560**	<330	**5,400**	<330	<330	160,000	2,100	5,100,000	2,900,000	5,200,000
Phenol	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	260,000	9,000	NLV	1.8E+10	12,000,000
Pyrene	<330	<330	**3,500**	<330	<410	<330	**560**	<330	<400	<330	<330	480,000	ID	1,000,000,000	2,900,000,000	84,000,000
Pyridine	<330	<330	<2,100	<330	<2,100	<330	<1,100	<330	<2,000	<330	<330	42	NA	2,000	100,000,000	37,000
2,4,5-Trichlorophenol	<330	<330	<840	<330	<820	<330	<330	<330	<800	<330	<330	110,000	NA	NLV	1.0E+10	73,000,000
2,4,6-Trichlorophenol	<330	<330	<420	<330	<410	<330	<330	<330	<400	<330	<330	9,400	330 (M); 100	NLV	1,300,000,000	3,300,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5b
SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-106A	SB-16-106B	SB-16-107A	SB-16-107B	SB-16-108A	SB-16-108B	SB-16-109A	SB-16-109B	SB-16-110A	SB-16-110B	SB-16-110C	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	6-7	13-14	5-6	19-20	5-6	19-20	2-3	12-13	4-5	13-14	Duplicate	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of 110A	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation		
BNA Semivolatiles by 8270 (μg/Kg)																
Acenaphthene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	880,000	8,700	350,000,000	6,200,000,000	130,000,000
Acenaphthylene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	17,000	ID	3,000,000	1,000,000,000	5,200,000
Aniline	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	4,400	330 (M); 80	NLV	29,000,000	150,000
Anthracene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	41,000	ID	1,000,000,000	2.9.E+10	730,000,000
Azobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	17,000	ID	32,000,000	130,000,000	660,000
Benzo(a)anthracene	<330	<330	<330	<330	<330	<330	**340**	<330	<330	<330	<330	NLL	NLL	NLV	ID	80,000
Benzo(a)pyrene	<330	<330	<330	<330	<330	<330	**440**	<330	<330	<330	<330	NLL	NLL	NLV	1,900,000	8,000
Benzo(b)fluoranthene	<330	<330	<330	<330	<330	<330	**600**	<330	<330	<330	<330	NLL	NLL	NLV	ID	80,000
Benzo(ghi)perylene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	NLV	350,000,000	7,000,000
Benzo(k)fluoranthene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	NLV	ID	800,000
Benzyl Alcohol	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	580,000	NA	NLV	1.5.E+11	580,000
Bis(2-chloroethoxy)methane	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	170	100 (M); 20	44,000	12,000,000	58,000
Bis(2-chloroisopropyl) Ether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	<330	<330	<330	<330	<330	<330	<330	<330	**1,400**	<330	**1,200**	NLL	NLL	NLV	890,000,000	10,000,000
4-Bromophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	310,000	120,000	NLV	2.1E+10	310,000
Carbazole	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	39,000	1,100	NLV	78,000,000	2,400,000
4-Chloro-3-methylphenol	<280	<280	<280	<280	<280	<280	<280	<280	<280	<280	<280	16,000	280	NLV	ID	15,000,000
2-Chloronaphthalene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,800,000	NA	ID	ID	180,000,000
2-Chlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	2,600	360	800,000	530,000,000	4,500,000
4-Chlorophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Chrysene	<330	<330	<330	<330	<330	<330	**350**	<330	<330	<330	<330	NLL	NLL	ID	ID	8,000,000
Dibenzo(a,h)anthracene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	NLV	ID	8,000
Dibenzofuran	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	ID	1,700	3,600,000	2,900,000	ID
2,4-Dichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	4,200	330 (M); 220	NLV	2,300,000,000	1,800,000
Diethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	320,000	2,200	NLV	1,500,000,000	740,000
Dimethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	790,000	NA	NLV	1,500,000,000	790,000
2,4-Dimethylphenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	20,000	7,600	NLV	2,100,000,000	36,000,000
Di-n-butyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	760,000	11,000	NLV	1,500,000,000	760,000
2,4-Dinitrophenol	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	640	NA	NLV	20,000,000	220,000
2,6-Dinitrotoluene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	140,000,000	ID	NLV	1.4E+10	20,000,000
Fluoranthene	<330	<330	<330	<330	<330	<330	**590**	<330	<330	<330	<330	730,000	5,500	1,000,000,000	4,100,000,000	130,000,000
Fluorene	<330	<330	<330	<330	<330	<330	<330	<330	**340**	<330	<330	890,000	5,300	1,000,000,000	4,100,000,000	87,000,000
Hexachlorobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,800	350	220,000	8,500,000	37,000
Hexachlorobutadiene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	72,000	91	350,000	180,000,000	350,000
Hexachlorocyclopentadiene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	320,000	ID	56,000	5,900,000	720,000
Hexachloroethane	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,200	1,800	79,000	100,000,000	730,000
Indeno(1,2,3-cd)pyrene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	NLV	ID	80,000

TABLE 5b
SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-106A	SB-16-106B	SB-16-107A	SB-16-107B	SB-16-108A	SB-16-108B	SB-16-109A	SB-16-109B	SB-16-110A	SB-16-110B	SB-16-110C	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	6-7	13-14	5-6	19-20	5-6	19-20	2-3	12-13	4-5	13-14	Duplicate	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of 110A	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation		
BNA Semivolatiles by 8270 (µg/Kg)																
Isophorone	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	62,000	26,000	NLV	8,200,000,000	2,400,000
2-Methyl-4,6-dinitrophenol	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	830 (M); 400	NA	NLV	59,000,000	260,000
2-Methylnaphthalene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	170,000	4,200	4,900,000	290,000,000	26,000,000
2-Methylphenol	<660	<660	<660	<660	<660	<660	<660	<660	<660	<660	<660	20,000	1,000 (M);600	NLV	2,900,000,000	36,000,000
3&4-Methylphenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	20,000	1,000 (M);600	NLV	2,900,000,000	36,000,000
2-Nitroaniline	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
3-Nitroaniline	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA	NA	NA
4-Nitroaniline	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA	NA	NA
Nitrobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	330 (M); 190	3,600	170,000	21,000,000	340,000
2-Nitrophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,200	ID	NLV	ID	2,000,000
4-Nitrophenol	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA	NA	NA
N-Nitrosodimethylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	330 (M); 100	NA	NLV	2,000,000	5,400
N-Nitrosodiphenylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	22,000	NA	NLV	2,800,000,000	7,800,000
Pentachlorophenol	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	<800	22	(G, X)	NLV	130,000,000	320,000
Phenanthrene	<330	<330	<330	<330	<330	<330	**340**	<330	<330	<330	<330	160,000	2,100	5,100,000	2,900,000	5,200,000
Phenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	260,000	9,000	NLV	1.8E+10	12,000,000
Pyrene	<330	<330	<330	<330	<330	<330	**520**	<330	<330	<330	<330	480,000	ID	1,000,000,000	2,900,000,000	84,000,000
Pyridine	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	42	NA	2,000	100,000,000	37,000
2,4,5-Trichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	110,000	NA	NLV	1.0E+10	73,000,000
2,4,6-Trichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	9,400	330 (M); 100	NLV	1,300,000,000	3,300,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5b
SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-111A	SB-16-111B	SB-16-112A	SB-16-112B	SB-16-113A	SB-16-113B	SB-16-114A	SB-16-114B	SB-16-115A	SB-16-115B	SB-16-116A	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	5-6	19-20	5-6	24-25	5-6	14-15	6-7	14-15	3-4	14-15	4-5	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16		Protection	Inhalation		
BNA Semivolatiles by 8270 (µg/Kg)																
Acenaphthene	**390**	<330	**660**	<330	<330	<330	<330	<330	<330	<330	**480**	880,000	8,700	350,000,000	6,200,000,000	130,000,000
Acenaphthylene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	**360**	17,000	ID	3,000,000	1,000,000,000	5,200,000
Aniline	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	4,400	330 (M); 80	NLV	29,000,000	150,000
Anthracene	<330	<330	<330	<330	<330	<330	<330	<330	**500**	<330	**1,100**	41,000	ID	1,000,000,000	2.9.E+10	730,000,000
Azobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	17,000	ID	32,000,000	130,000,000	660,000
Benzo(a)anthracene	**410**	<330	**340**	<330	<330	<330	<330	<330	**1,400**	<330	**2,400**	NLL	NLL	NLV	ID	80,000
Benzo(a)pyrene	**410**	<330	<330	<330	<330	<330	<330	<330	**1,600**	<330	**2,400**	NLL	NLL	NLV	1,900,000	8,000
Benzo(b)fluoranthene	**620**	<330	**350**	<330	<330	<330	**350**	<330	**2,800**	<330	**3,900**	NLL	NLL	NLV	ID	80,000
Benzo(ghi)perylene	**410**	<330	<330	<330	<330	<330	<330	<330	**1,300**	<330	**1,700**	NLL	NLL	NLV	350,000,000	7,000,000
Benzo(k)fluoranthene	<330	<330	<330	<330	<330	<330	<330	<330	**780**	<330	**1,200**	NLL	NLL	NLV	ID	800,000
Benzyl Alcohol	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	580,000	NA	NLV	1.5.E+11	580,000
Bis(2-chloroethoxy)methane	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	170	100 (M); 20	44,000	12,000,000	58,000
Bis(2-chloroisopropyl) Ether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	<1,000	<330	**4,300**	<330	<330	<330	<330	<330	<1,200	<330	<1,000	NLL	NLL	NLV	890,000,000	10,000,000
4-Bromophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	<410	<330	<330	<330	<330	<330	**350**	<330	<460	<330	<400	310,000	120,000	NLV	2.1E+10	310,000
Carbazole	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	39,000	1,100	NLV	78,000,000	2,400,000
4-Chloro-3-methylphenol	<410	<280	<280	<280	<280	<280	<280	<280	<460	<280	<400	16,000	280	NLV	ID	15,000,000
2-Chloronaphthalene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,800,000	NA	ID	ID	180,000,000
2-Chlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	2,600	360	800,000	530,000,000	4,500,000
4-Chlorophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
Chrysene	**340**	<330	<330	<330	<330	<330	<330	<330	**1,500**	<330	**2,600**	NLL	NLL	ID	ID	8,000,000
Dibenzo(a,h)anthracene	<330	<330	<330	<330	<330	<330	<330	<330	**350**	<330	**410**	NLL	NLL	NLV	ID	8,000
Dibenzofuran	<330	<330	<330	<330	<330	<330	<330	<330	**330**	<330	**390**	ID	1,700	3,600,000	2,900,000	ID
2,4-Dichlorophenol	<410	<330	<330	<330	<330	<330	<330	<330	<460	<330	<400	4,200	330 (M); 220	NLV	2,300,000,000	1,800,000
Diethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	320,000	2,200	NLV	1,500,000,000	740,000
Dimethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	790,000	NA	NLV	1,500,000,000	790,000
2,4-Dimethylphenol	<330	<330	**800**	<330	<330	<330	<330	<330	<330	<330	<330	20,000	7,600	NLV	2,100,000,000	36,000,000
Di-n-butyl Phthalate	<410	<330	**890**	<330	<330	<330	<330	<330	<460	<330	**750**	760,000	11,000	NLV	1,500,000,000	760,000
2,4-Dinitrophenol	<4,100	<830	<4,200	<830	<830	<830	<830	<830	<4,600	<830	<4,000	NA	NA	NA	NA	NA
2,4-Dinitrotoluene	<1,000	<330	<330	<330	<330	<330	<330	<330	<1,200	<330	<1,000	640	NA	NLV	20,000,000	220,000
2,6-Dinitrotoluene	<1,000	<330	<330	<330	<330	<330	<330	<330	<1,200	<330	<1,000	NA	NA	NA	NA	NA
Di-n-octyl Phthalate	<410	<330	<330	<330	<330	<330	<330	<330	<460	<330	<400	140,000,000	ID	NLV	1.4E+10	20,000,000
Fluoranthene	**720**	<330	**570**	<330	<330	<330	<330	<330	**2,300**	<330	**4,900**	730,000	5,500	1,000,000,000	4,100,000,000	130,000,000
Fluorene	**820**	<330	**4,700**	<330	<330	<330	<330	<330	<330	<330	**610**	890,000	5,300	1,000,000,000	4,100,000,000	87,000,000
Hexachlorobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,800	350	220,000	8,500,000	37,000
Hexachlorobutadiene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	72,000	91	350,000	180,000,000	350,000
Hexachlorocyclopentadiene	<1,000	<330	<330	<330	<330	<330	<330	<330	<1,200	<330	<1,000	320,000	ID	56,000	5,900,000	720,000
Hexachloroethane	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,200	1,800	79,000	100,000,000	730,000
Indeno(1,2,3-cd)pyrene	**350**	<330	<330	<330	<330	<330	<330	<330	<1,400	<330	**1,700**	NLL	NLL	NLV	ID	80,000

GEI Consultants

TABLE 5b
SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-111A	SB-16-111B	SB-16-112A	SB-16-112B	SB-16-113A	SB-16-113B	SB-16-114A	SB-16-114B	SB-16-115A	SB-16-115B	SB-16-116A	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	5-6	19-20	5-6	24-25	5-6	14-15	6-7	14-15	3-4	14-15	4-5	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16		Protection	Inhalation		
BNA Semivolatiles by 8270 (µg/Kg)																
Isophorone	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	62,000	26,000	NLV	8,200,000,000	2,400,000
2-Methyl-4,6-dinitrophenol	<4,100	<830	<4,200	<830	<830	<830	<830	<830	<4,600	<830	<4,000	830 (M); 400	NA	NLV	59,000,000	260,000
2-Methylnaphthalene	**1,000**	<330	**23,000**	<330	<330	<330	<330	<330	**2,400**	<330	**4,600**	170,000	4,200	4,900,000	290,000,000	26,000,000
2-Methylphenol	<330	<660	**770**	<660	<660	<660	<660	<660	<330	<660	<330	20,000	1,000 (M);600	NLV	2,900,000,000	36,000,000
3&4-Methylphenol	<660	<330	**3,300**	<330	<330	<330	<330	<330	<660	<330	<660	20,000	1,000 (M);600	NLV	2,900,000,000	36,000,000
2-Nitroaniline	<1,000	<330	<330	<330	<330	<330	<330	<330	<1,200	<330	<1,000	NA	NA	NA	NA	NA
3-Nitroaniline	<4,100	<830	<830	<830	<830	<830	<830	<830	<4,600	<830	<4,000	NA	NA	NA	NA	NA
4-Nitroaniline	<4,100	<830	<4,200	<830	<830	<830	<830	<830	<4,600	<830	<4,000	NA	NA	NA	NA	NA
Nitrobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	330 (M); 190	3,600	170,000	21,000,000	340,000
2-Nitrophenol	<1,000	<330	<330	<330	<330	<330	<330	<330	<1,200	<330	<1,000	1,200	ID	NLV	ID	2,000,000
4-Nitrophenol	<2,000	<830	<1,000	<830	<830	<830	<830	<830	<2,300	<830	<2,000	NA	NA	NA	NA	NA
N-Nitrosodimethylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	330 (M); 100	NA	NLV	2,000,000	5,400
N-Nitrosodiphenylamine	<1,000	<330	<330	<330	<330	<330	<330	<330	<1,200	<330	<1,000	22,000	NA	NLV	2,800,000,000	7,800,000
Pentachlorophenol	<4,100	<800	<1,000	<800	<800	<800	<800	<800	<4,600	<800	<4,000	22	(G, X)	NLV	130,000,000	320,000
Phenanthrene	**900**	<330	**2,000**	<330	<330	<330	<330	<330	**2,100**	<330	**4,700**	160,000	2,100	5,100,000	2,900,000	5,200,000
Phenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330	260,000	9,000	NLV	1.8E+10	12,000,000
Pyrene	**600**	<330	**480**	<330	<330	<330	<330	<330	**2,000**	<330	**5,800**	480,000	ID	1,000,000,000	2,900,000,000	84,000,000
Pyridine	<1,000	<330	<330	<330	<330	<330	<330	<330	<1,200	<330	<1,000	42	NA	2,000	100,000,000	37,000
2,4,5-Trichlorophenol	<1,000	<330	<330	<330	<330	<330	<330	<330	<1,200	<330	<1,000	110,000	NA	NLV	1.0E+10	73,000,000
2,4,6-Trichlorophenol	<410	<330	<330	<330	<330	<330	<330	<330	<460	<330	<400	9,400	330 (M); 100	NLV	1,300,000,000	3,300,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5b
SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-116B	SB-16-116C	SB-16-117A	SB-16-117B	SB-16-118A	SB-16-118B	SB-16-119A	SB-16-119B	MW-16-4	MW-16-5		Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	14-15	Duplicate	4-5	14-15	4-5	14-15	5-6	14-15	4-5	4-5		Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	of 116A	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	1/25/17	1/26/17			Protection	Inhalation		
BNA Semivolatiles by 8270 (µg/Kg)																
Acenaphthene	<330	<330	<330	<330	<330	<330	<330	<330	**590**	**1,400**		880,000	8,700	350,000,000	6,200,000,000	130,000,000
Acenaphthylene	<330	<330	**460**	<330	<330	<330	<330	<330	**820**	**590**		17,000	ID	3,000,000	1,000,000,000	5,200,000
Aniline	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		4,400	330 (M); 80	NLV	29,000,000	150,000
Anthracene	<330	**510**	**940**	<330	<330	<330	<330	<330	**1,700**	**2,800**		41,000	ID	1,000,000,000	2.9.E+10	730,000,000
Azobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		17,000	ID	32,000,000	130,000,000	660,000
Benzo(a)anthracene	<330	**1,500**	**3,300**	<330	<330	<330	<330	<330	**4,200**	**5,300**		NLL	NLL	NLV	ID	80,000
Benzo(a)pyrene	<330	**1,600**	**3,400**	<330	<330	<330	<330	<330	**5,000**	**5,200**		NLL	NLL	NLV	1,900,000	8,000
Benzo(b)fluoranthene	<330	**2,300**	**5,600**	<330	<330	<330	<330	<330	**7,300**	**7,200**		NLL	NLL	NLV	ID	80,000
Benzo(ghi)perylene	<330	**1,300**	**2,000**	<330	<330	<330	<330	<330	**2,200**	**1,700**		NLL	NLL	NLV	350,000,000	7,000,000
Benzo(k)fluoranthene	<330	**770**	**1,600**	<330	<330	<330	<330	<330	**2,500**	**2,500**		NLL	NLL	NLV	ID	800,000
Benzyl Alcohol	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300		580,000	NA	NLV	1.5.E+11	580,000
Bis(2-chloroethoxy)methane	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		170	100 (M); 20	44,000	12,000,000	58,000
Bis(2-chloroisopropyl) Ether	<330	<330	<430	<330	<330	<330	<330	<330	<330	<330		NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	<330	<960	<330	<330	<330	<330	<330	<330	<1,000	**2,400**		NLL	NLL	NLV	890,000,000	10,000,000
4-Bromophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		NA	NA	NA	NA	NA
Butyl Benzyl Phthalate	<330	<390	<330	<330	<330	<330	<330	<330	<420	**760**		310,000	120,000	NLV	2.1E+10	310,000
Carbazole	<330	<330	<330	<330	<330	<330	<330	<330	**540**	**1,200**		39,000	1,100	NLV	78,000,000	2,400,000
4-Chloro-3-methylphenol	<280	<390	<280	<280	<280	<280	<280	<280	<420	<420		16,000	280	NLV	ID	15,000,000
2-Chloronaphthalene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		1,800,000	NA	ID	ID	180,000,000
2-Chlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		2,600	360	800,000	530,000,000	4,500,000
4-Chlorophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		NA	NA	NA	NA	NA
Chrysene	<330	**1,600**	**3,300**	<330	<330	<330	<330	<330	**3,800**	**5,400**		NLL	NLL	ID	ID	8,000,000
Dibenzo(a,h)anthracene	<330	<330	**530**	<330	<330	<330	<330	<330	**630**	**550**		NLL	NLL	NLV	ID	8,000
Dibenzofuran	<330	**440**	<330	<330	<330	<330	<330	<330	**950**	**1,300**		ID	1,700	3,600,000	2,900,000	ID
2,4-Dichlorophenol	<330	<390	<330	<330	<330	<330	<330	<330	<420	<420		4,200	330 (M); 220	NLV	2,300,000,000	1,800,000
Diethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		320,000	2,200	NLV	1,500,000,000	740,000
Dimethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		790,000	NA	NLV	1,500,000,000	790,000
2,4-Dimethylphenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		20,000	7,600	NLV	2,100,000,000	36,000,000
Di-n-butyl Phthalate	<330	**640**	<330	<330	<330	<330	<330	<330	<420	**1,800**		760,000	11,000	NLV	1,500,000,000	760,000
2,4-Dinitrophenol	<830	<3,900	<4,300	<830	<830	<830	<830	<830	<4,200	<4,200		NA	NA	NA	NA	NA
2,4-Dinitrotoluene	<330	<960	<430	<330	<330	<330	<330	<330	<1,000	<1,100		640	NA	NLV	20,000,000	220,000
2,6-Dinitrotoluene	<330	<960	<430	<330	<330	<330	<330	<330	<1,000	<1,100		NA	NA	NA	NA	NA
Di-n-octyl Phthalate	<330	<390	<330	<330	<330	<330	<330	<330	<420	<420		140,000,000	ID	NLV	1.4E+10	20,000,000
Fluoranthene	<330	**2,700**	**3,400**	<330	<330	<330	<330	<330	**8,800**	**12,000**		730,000	5,500	1,000,000,000	4,100,000,000	130,000,000
Fluorene	<330	<330	<330	<330	<330	<330	<330	<330	**670**	**1,500**		890,000	5,300	1,000,000,000	4,100,000,000	87,000,000
Hexachlorobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		1,800	350	220,000	8,500,000	37,000
Hexachlorobutadiene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		72,000	91	350,000	180,000,000	350,000
Hexachlorocyclopentadiene	<330	<960	<430	<330	<330	<330	<330	<330	<1,000	<1,100		320,000	ID	56,000	5,900,000	720,000
Hexachloroethane	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		1,200	1,800	79,000	100,000,000	730,000
Indeno(1,2,3-cd)pyrene	<330	**1,200**	**2,200**	<330	<330	<330	<330	<330	**2,700**	**2,100**		NLL	NLL	NLV	ID	80,000

GEI Consultants

TABLE 5b
SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

												Part 201 Generic Cleanup Criteria*				
												Non-Residential				
Sample ID	SB-16-116B	SB-16-116C	SB-16-117A	SB-16-117B	SB-16-118A	SB-16-118B	SB-16-119A	SB-16-119B	MW-16-4	MW-16-5		Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	14-15	Duplicate	4-5	14-15	4-5	14-15	5-6	14-15	4-5	4-5		Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	of 116A	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil		Protection	Interface	to Indoor Air	Inhalation	
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	1/25/17	1/26/17			Protection	Inhalation		
BNA Semivolatiles by 8270 (µg/Kg)																
Isophorone	<330	<330	<330	<330	<330	<330	<330	<330	<330	**360**		62,000	26,000	NLV	8,200,000,000	2,400,000
2-Methyl-4,6-dinitrophenol	<830	<3,900	<4,300	<830	<830	<830	<830	<830	<4,200	<4,200		830 (M); 400	NA	NLV	59,000,000	260,000
2-Methylnaphthalene	<330	**2,900**	**2,200**	<330	<330	<330	<330	<330	**1,400**	**1,500**		170,000	4,200	4,900,000	290,000,000	26,000,000
2-Methylphenol	<660	<330	<330	<660	<660	<660	<660	<660	<330	<330		20,000	1,000 (M);600	NLV	2,900,000,000	36,000,000
3&4-Methylphenol	<330	<660	<660	<330	<330	<330	<330	<330	<660	<660		20,000	1,000 (M);600	NLV	2,900,000,000	36,000,000
2-Nitroaniline	<330	<960	<330	<330	<330	<330	<330	<330	<1,000	<1,100		NA	NA	NA	NA	NA
3-Nitroaniline	<830	<3,900	<830	<830	<830	<830	<830	<830	<4,200	<4,200		NA	NA	NA	NA	NA
4-Nitroaniline	<830	<3,900	<4,300	<830	<830	<830	<830	<830	<4,200	<4,200		NA	NA	NA	NA	NA
Nitrobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		330 (M); 190	3,600	170,000	21,000,000	340,000
2-Nitrophenol	<330	<960	<430	<330	<330	<330	<330	<330	<1,000	<1,100		1,200	ID	NLV	ID	2,000,000
4-Nitrophenol	<830	<1,900	<1,100	<830	<830	<830	<830	<830	<2,100	<2,100		NA	NA	NA	NA	NA
N-Nitrosodimethylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		NA	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		330 (M); 100	NA	NLV	2,000,000	5,400
N-Nitrosodiphenylamine	<330	<960	<330	<330	<330	<330	<330	<330	<1,000	<1,100		22,000	NA	NLV	2,800,000,000	7,800,000
Pentachlorophenol	<800	<3,900	<1,100	<800	<800	<800	<800	<800	<2,100	<2,100		22	(G, X)	NLV	130,000,000	320,000
Phenanthrene	<330	**2,300**	**1,900**	<330	<330	<330	<330	<330	**5,000**	**11,000**		160,000	2,100	5,100,000	2,900,000	5,200,000
Phenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	<330		260,000	9,000	NLV	1.8E+10	12,000,000
Pyrene	<330	**2,900**	**3,600**	<330	<330	<330	<330	<330	**6,400**	**9,700**		480,000	ID	1,000,000,000	2,900,000,000	84,000,000
Pyridine	<330	<960	<330	<330	<330	<330	<330	<330	<1,000	<1,100		42	NA	2,000	100,000,000	37,000
2,4,5-Trichlorophenol	<330	<960	<330	<330	<330	<330	<330	<330	<1,000	<1,100		110,000	NA	NLV	1.0E+10	73,000,000
2,4,6-Trichlorophenol	<330	<390	<330	<330	<330	<330	<330	<330	<420	<420		9,400	330 (M); 100	NLV	1,300,000,000	3,300,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5c
SOIL SAMPLE ANALYTICAL RESULTS - Metals
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

										Part 201 Generic Cleanup Criteria*						
										Non-Residential						
Sample ID	SB-16-101A	SB-16-101B	SB-16-102A	SB-16-102B	SB-16-103A	SB-16-103B	SB-16-104A	SB-16-104B	SB-16-105A	Drinking	Groundwater	Soil	Particulate	Direct	Statewide	Calculated
Depth (feet)	4-5	14-15	4-5	19-20	6-7	19-20	6-7	19-20	1-2	Water	Surface Water	Volatilization	Soil	Contact	Default	Facility
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Protection	Interface	to Indoor Air	Inhalation		Background	Specific
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation				Background
Total Metals (µg/Kg)																
Arsenic	1,900	7,300	17,000	6,500	7,000	6,500	6,600	6,600	18,000	4,600	4,600	NLV	910,000	37,000	5,800	23,949
Barium	22,000	49,000	200,000	49,000	77,000	45,000	65,000	45,000	190,000	1,300,000	(G)	NLV	150,000,000	130,000,000	75,000	89,552
Cadmium	280	160	5,700	95	1,200	140	640	120	4,900	6,000	(G, X)	NLV	2,200,000	2,100,000	1,200	424
Chromium	630,000	17,000	28,000	15,000	1,600,000	16,000	1,700,000	18,000	29,000	1,000,000,000	(G, X)	NLV	150,000,000	1,000,000,000	18,000	22,691
Copper	230,000	15,000	700,000	14,000	580,000	14,000	390,000	15,000	300,000	5,800,000	(G)	NLV	59,000,000	73,000,000	32,000	23,411
Lead	3,200	8,300	750,000	7,000	120,000	6,800	160,000	7,400	520,000	700,000	(G, X)	NLV	44,000,000	900,000	21,000	13,113
Mercury	<50	<50	660	<50	<50	<50	310	<50	280	1,700	50 (M); 1.2	89,000	8,800,000	580,000	130	
Nickel	86,000	20,000	65,000	20,000	140,000	20,000	160,000	20,000	210,000	100,000	(G)	NLV	16,000,000	150,000,000	20,000	34,611
Selenium	640	<200	1,400	<200	1,400	<200	1,100	<200	1,300	4,000	400	NLV	59,000,000	9,600,000	410	696
Silver	230	<100	650	<100	9,400	<100	14,000	<100	440	13,000	100 (M); 27	NLV	2,900,000	9,000,000	1,000	
Zinc	520,000	50,000	3,100,000	40,000	4,000,000	86,000	1,700,000	42,000	1,600,000	5,000,000	(G)	NLV	ID	630,000,000	47,000	69,900

										Part 201 Generic Cleanup Criteria*						
										Non-Residential						
Sample ID	SB-16-105B	SB-16-105C	SB-16-106A	SB-16-106B	SB-16-107A	SB-16-107B	SB-16-108A	SB-16-108B	SB-16-109A	Drinking	Groundwater	Soil	Particulate	Direct	Statewide	Calculated
Depth (feet)	14-15	Duplicate	6-7	13-14	5-6	19-20	5-6	19-20	2-3	Water	Surface Water	Volatilization	Soil	Contact	Default	Facility
Matrix	Soil	of 105B	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Protection	Interface	to Indoor Air	Inhalation		Background	Specific
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16	12/5/16		Protection	Inhalation				Background
Total Metals (µg/Kg)																
Arsenic	6,900	6,100	2,500	10,000	2,900	7,000	3,900	7,700	23,000	4,600	4,600	NLV	910,000	37,000	5,800	23,949
Barium	55,000	47,000	41,000	60,000	49,000	53,000	42,000	55,000	120,000	1,300,000	(G)	NLV	150,000,000	130,000,000	75,000	89,552
Cadmium	100	110	290	150	62	120	200	130	20,000	6,000	(G, X)	NLV	2,200,000	2,100,000	1,200	424
Chromium	16,000	15,000	8,900	22,000	12,000	16,000	450,000	18,000	370,000	1,000,000,000	(G, X)	NLV	150,000,000	1,000,000,000	18,000	22,691
Copper	14,000	14,000	10,000	20,000	6,600	14,000	130,000	16,000	370,000	5,800,000	(G)	NLV	59,000,000	73,000,000	32,000	23,411
Lead	6,900	7,200	7,800	9,300	6,500	6,800	4,400	7,000	350,000	700,000	(G, X)	NLV	44,000,000	900,000	21,000	13,113
Mercury	<50	<50	110	<50	<50	<50	<50	<50	340	1,700	50 (M); 1.2	89,000	8,800,000	580,000	130	
Nickel	21,000	20,000	7,200	29,000	150,000	21,000	20,000	21,000	31,000	100,000	(G)	NLV	16,000,000	150,000,000	20,000	34,611
Selenium	<200	<200	380	290	<200	<200	260	<200	1,000	4,000	400	NLV	59,000,000	9,600,000	410	696
Silver	<100	<100	<100	<100	<100	<100	<100	<100	960	13,000	100 (M); 27	NLV	2,900,000	9,000,000	1,000	
Zinc	40,000	36,000	22,000	62,000	27,000	40,000	220,000	41,000	2,200,000	5,000,000	(G)	NLV	ID	630,000,000	47,000	69,900

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ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.

TABLE 5c
SOIL SAMPLE ANALYTICAL RESULTS - Metals
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

										Part 201 Generic Cleanup Criteria*						
										Non-Residential						
Sample ID	SB-16-109B	SB-16-110A	SB-16-110B	SB-16-110C	SB-16-111A	SB-16-111B	SB-16-112A	SB-16-112B	SB-16-113A	Drinking	Groundwater	Soil	Particulate	Direct	Statewide	Calculated
Depth (feet)	12-13	4-5	13-14	Duplicate	5-6	19-20	5-6	24-25	5-6	Water	Surface Water	Volatilization	Soil	Contact	Default	Facility
Matrix	Soil	Soil	Soil	of 110A	Soil	Soil	Soil	Soil	Soil	Protection	Interface	to Indoor Air	Inhalation		Background	Specific
Date Collected	12/5/16	12/5/16	12/5/16	12/5/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16		Protection	Inhalation				Background
Total Metals (µg/Kg)																
Arsenic	5,800	1,700	6,400	1,300	9,900	7,800	5,300	6,400	7,800	4,600	4,600	NLV	910,000	37,000	5,800	23,949
Barium	45,000	40,000	25,000	39,000	87,000	46,000	58,000	36,000	110,000	1,300,000	(G)	NLV	150,000,000	130,000,000	75,000	89,552
Cadmium	100	270	87	180	2,400	110	720	75	490	6,000	(G, X)	NLV	2,200,000	2,100,000	1,200	424
Chromium	16,000	8,800	13,000	9,600	73,000	16,000	210,000	14,000	20,000	1,000,000,000	(G, X)	NLV	150,000,000	1,000,000,000	18,000	22,691
Copper	14,000	8,300	13,000	5,700	80,000	17,000	150,000	13,000	19,000	5,800,000	(G)	NLV	59,000,000	73,000,000	32,000	23,411
Lead	7,200	5,500	5,900	4,800	140,000	7,100	92,000	12,000	8,500	700,000	(G, X)	NLV	44,000,000	900,000	21,000	13,113
Mercury	<50	60	<50	94	110	<50	93	<50	<50	1,700	50 (M); 1.2	89,000	8,800,000	580,000	130	
Nickel	20,000	7,400	17,000	8,500	36,000	21,000	190,000	16,000	32,000	100,000	(G)	NLV	16,000,000	150,000,000	20,000	34,611
Selenium	<200	410	220	330	560	<200	1,000	<200	220	4,000	400	NLV	59,000,000	9,600,000	410	696
Silver	<100	<100	<100	<100	250	<100	21,000	240	<100	13,000	100 (M); 27	NLV	2,900,000	9,000,000	1,000	
Zinc	39,000	25,000	36,000	26,000	470,000	40,000	640,000	35,000	51,000	5,000,000	(G)	NLV	ID	630,000,000	47,000	69,900

										Part 201 Generic Cleanup Criteria*						
										Non-Residential						
Sample ID	SB-16-113B	SB-16-114A	SB-16-114B	SB-16-115A	SB-16-115B	SB-16-116A	SB-16-116B	SB-16-116C	SB-16-117A	Drinking	Groundwater	Soil	Particulate	Direct	Statewide	Calculated
Depth (feet)	14-15	6-7	14-15	3-4	14-15	4-5	14-15	Duplicate	4-5	Water	Surface Water	Volatilization	Soil	Contact	Default	Facility
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of 116A	Soil	Protection	Interface	to Indoor Air	Inhalation		Background	Specific
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16		Protection	Inhalation				Background
Total Metals (µg/Kg)																
Arsenic	6,900	5,700	6,100	16,000	8,900	20,000	5,000	140,000	18,000	4,600	4,600	NLV	910,000	37,000	5,800	23,949
Barium	44,000	58,000	50,000	190,000	34,000	270,000	56,000	800,000	160,000	1,300,000	(G)	NLV	150,000,000	130,000,000	75,000	89,552
Cadmium	110	630	120	2,200	79	6,200	130	3,400	2,600	6,000	(G, X)	NLV	2,200,000	2,100,000	1,200	424
Chromium	17,000	20,000	15,000	29,000	14,000	110,000	14,000	69,000	35,000	1,000,000,000	(G, X)	NLV	150,000,000	1,000,000,000	18,000	22,691
Copper	15,000	59,000	17,000	260,000	13,000	380,000	14,000	260,000	150,000	5,800,000	(G)	NLV	59,000,000	73,000,000	32,000	23,411
Lead	7,100	61,000	6,900	310,000	8,200	1,100,000	9,300	6,100,000	400,000	700,000	(G, X)	NLV	44,000,000	900,000	21,000	13,113
Mercury	<50	70	<50	260	<50	150	<50	290	440	1,700	50 (M); 1.2	89,000	8,800,000	580,000	130	
Nickel	20,000	19,000	24,000	43,000	18,000	63,000	18,000	41,000	44,000	100,000	(G)	NLV	16,000,000	150,000,000	20,000	34,611
Selenium	<200	430	<200	710	<200	950	<200	1,200	1,000	4,000	400	NLV	59,000,000	9,600,000	410	696
Silver	140	390	<100	300	<100	470	<100	550	390	13,000	100 (M); 27	NLV	2,900,000	9,000,000	1,000	
Zinc	43,000	180,000	42,000	450,000	36,000	1,100,000	36,000	1,800,000	620,000	5,000,000	(G)	NLV	ID	630,000,000	47,000	69,900

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G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.

TABLE 5c
SOIL SAMPLE ANALYTICAL RESULTS - Metals
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

										Part 201 Generic Cleanup Criteria*						
										Non-Residential						
Sample ID	SB-16-117B	SB-16-118A	SB-16-118B	SB-16-119A	SB-16-119B	MW-16-4	MW-16-5			Drinking	Groundwater	Soil	Particulate	Direct	Statewide	Calculated
Depth (feet)	14-15	4-5	14-15	5-6	14-15	4-5	4-5			Water	Surface Water	Volatilization	Soil	Contact	Default	Facility
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil			Protection	Interface	to Indoor Air	Inhalation		Background	Specific
Date Collected	12/7/16	12/7/16	12/7/16	12/7/16	12/7/16	1/25/17	1/26/17				Protection	Inhalation				Background
Total Metals (μg/Kg)																
Arsenic	6,100	2,700	6,600	5,500	6,600	9,800	30,000			4,600	4,600	NLV	910,000	37,000	5,800	23,949
Barium	83,000	28,000	56,000	44,000	49,000	140,000	350,000			1,300,000	(G)	NLV	150,000,000	130,000,000	75,000	89,552
Cadmium	150	170	200	76	120	1,400	10,000			6,000	(G, X)	NLV	2,200,000	2,100,000	1,200	424
Chromium	23,000	6,800	15,000	14,000	16,000	28,000	150,000			1,000,000,000	(G, X)	NLV	150,000,000	1,000,000,000	18,000	22,691
Copper	19,000	3,700	16,000	11,000	14,000	140,000	510,000			5,800,000	(G)	NLV	59,000,000	73,000,000	32,000	23,411
Lead	9,500	4,800	7,900	6,100	13,000	270,000	1,700,000			700,000	(G, X)	NLV	44,000,000	900,000	21,000	13,113
Mercury	<50	<50	<50	<50	<50	330	2,400			1,700	50 (M); 1.2	89,000	8,800,000	580,000	130	
Nickel	30,000	5,300	26,000	17,000	20,000	19,000	73,000			100,000	(G)	NLV	16,000,000	150,000,000	20,000	34,611
Selenium	310	240	200	200	220	900	2,100			4,000	400	NLV	59,000,000	9,600,000	410	696
Silver	<100	<100	<100	<100	<100	200	590			13,000	100 (M); 27	NLV	2,900,000	9,000,000	1,000	
Zinc	57,000	18,000	44,000	33,000	39,000	300,000	1,600,000			5,000,000	(G)	NLV	ID	630,000,000	47,000	69,900

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.

TABLE 5d
GROUNDWATER SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

						Part 201 Generic Cleanup Criteria*			
						Non-Residential			
Sample ID	MW-16-1	MW-16-2	MW-16-3	MW-16-4	MW-16-5	Drinking Water	Groundwater Surface Water Interface	GW Volatilization to Indoor Air Inhalation	GW Contact
Matrix	GW	GW	GW	GW	GW				
Date Collected	2/15/17	2/15/17	2/15/17	2/15/17	2/15/17				
Volatiles by 8260 (µg/L)									
Acetone	**210**	**160**	<50	<50	<50	2,100	1,700	1,000,000,000	31,000,000
Acrylonitrile	<40	<40	<2.0	<2.0	<2.0	11	2.0 (M); 1.2	190,000	14,000
Benzene	<20	<20	<1.0	<1.0	<1.0	5.0	200	35,000	11,000
Bromobenzene	<20	<20	<1.0	<1.0	<1.0	50	NA	390,000	12,000
Bromochloromethane	<20	<20	<1.0	<1.0	<1.0	NA	NA	NA	NA
Bromodichloromethane	<20	<20	<1.0	<1.0	<1.0	80	ID	37,000	14,000
Bromoform	<20	<20	<1.0	<1.0	<1.0	80	ID	3,100,000	140,000
Bromomethane	<100	<100	<5.0	<5.0	<5.0	29	35	9,000	70,000
2-Butanone	**1,600**	<25	<25	<25	<25	38,000	2,200	240,000,000	240,000,000
n-Butylbenzene	<20	<20	<1.0	<1.0	<1.0	230	ID	ID	5,900
sec-Butylbenzene	<20	<20	<1.0	<1.0	<1.0	230	ID	ID	4,000
tert-Butylbenzene	<20	<20	<1.0	<1.0	<1.0	230	ID	ID	8,900
Carbon Disulfide	<20	<20	<5.0	<5.0	<5.0	2,300	ID	550,000	1,200,000
Carbon Tetrachloride	<20	<20	<1.0	<1.0	<1.0	5.0	45	2,400	4,600
Chlorobenzene	**2,300**	<20	<1.0	<1.0	<1.0	100	25	470,000	86,000
Chloroethane	<40	<40	<5.0	<5.0	<5.0	1,700	1,100	5,700,000	440,000
Chloroform	<20	<20	<1.0	<1.0	<1.0	80	350	180,000	150,000
Chloromethane	<40	<40	<5.0	<5.0	<5.0	1,100	ID	45,000	490,000
2-Chlorotoluene	<10	<10	<5.0	<5.0	<5.0	420	ID	370,000	44,000
Dibromochloromethane	<20	<20	<5.0	<5.0	<5.0	80	ID	110,000	18,000
1,2-Dibromo-3-chloropropane	<20	<20	<1.0	<1.0	<1.0	NA	NA	NA	NA
Dibromomethane	<20	<20	<5.0	<5.0	<5.0	230	NA	ID	530,000
1,2-Dichlorobenzene	**140**	<20	<1.0	<1.0	<1.0	600	13	160,000	160,000
1,3-Dichlorobenzene	<20	<20	<1.0	<1.0	<1.0	19	28	41,000	2,000
1,4-Dichlorobenzene	<20	<20	<1.0	<1.0	<1.0	75	17	74,000	6,400
Dichlorodifluoromethane	<20	<20	<5.0	<5.0	<5.0	4,800	ID	300,000	300,000
1,1-Dichloroethane	<20	<20	<1.0	<1.0	<1.0	2,500	740	2,300,000	2,400,000
1,2-Dichloroethane	<20	**23**	<1.0	<1.0	<1.0	5.0	360	59,000	19,000
1,1-Dichloroethene	<20	<20	<1.0	<1.0	<1.0	7	130	1,300	11,000
cis-1,2-Dichloroethene	<20	<20	<1.0	<1.0	<1.0	70	620	210,000	200,000
trans-1,2-Dichloroethene	<10	<10	<1.0	<1.0	<1.0	100	1,500	200,000	220,000
1,2-Dichloropropane	<10	<10	<1.0	<1.0	<1.0	5.0	230	36,000	16,000
cis-1,3-Dichloropropene	<20	<20	<1.0	<1.0	<1.0	35	9.0	26,000	5,500
trans-1,3-Dichloropropene	<20	<20	<1.0	<1.0	<1.0	35	9.0	26,000	5,500
Ethylbenzene	**37**	**25**	<1.0	<1.0	<1.0	74	18	170,000	170,000
Ethylene Dibromide	<20	<20	<1.0	<1.0	<1.0	0.05	5.7	15,000	25
2-Hexanone	<100	<100	<50	<50	<50	2,900	ID	8,700,000	5,200,000
Isopropylbenzene	<20	<20	<5.0	<5.0	<5.0	2,300	28	56,000	56,000
Methylene Chloride	**1,500**	**160**	<5.0	<5.0	<5.0	5.0	1,500	1,400,000	220,000
4-Methyl-2-pentanone	<100	<100	<50	<50	<50	5,200	ID	20,000,000	13,000,000
MTBE	<10	<10	<5.0	<5.0	<5.0	40	7,100	47,000,000	610,000
Naphthalene	<100	<100	<5.0	<5.0	<5.0	1,500	11	31,000	31,000

TABLE 5d

GROUNDWATER SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs

RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI

SWMU-1

						Part 201 Generic Cleanup Criteria*			
						Non-Residential			
Sample ID	MW-16-1	MW-16-2	MW-16-3	MW-16-4	MW-16-5	Drinking	Groundwater	GW	GW
Matrix	GW	GW	GW	GW	GW	Water	Surface Water	Volatilization	Contact
Date Collected	2/15/17	2/15/17	2/15/17	2/15/17	2/15/17		Interface	to Indoor Air	
								Inhalation	
Volatiles by 8260 (µg/L)									
n-Propylbenzene	<10	<10	<1.0	<1.0	<1.0	230	ID	ID	15,000
Styrene	<20	<20	<1.0	<1.0	<1.0	100	80	310,000	9,700
1,1,1,2-Tetrachloroethane	<10	<10	<1.0	<1.0	<1.0	320	ID	96,000	30,000
1,1,2,2-Tetrachloroethane	<20	<20	<1.0	<1.0	<1.0	35	78	77,000	4,700
Tetrachloroethene	<10	<10	<1.0	<1.0	<1.0	5.0	60	170,000	12,000
Toluene	**71**	<20	<1.0	<1.0	<1.0	790	270	530,000	530,000
1,2,4-Trichlorobenzene	<100	<100	<5.0	<5.0	<5.0	70	99	300,000	19,000
1,1,1-Trichloroethane	<10	<10	<1.0	<1.0	<1.0	200	89	1,300,000	1,300,000
1,1,2-Trichloroethane	<20	<20	<1.0	<1.0	<1.0	5.0	330	110,000	21,000
Trichloroethene	<10	<10	<1.0	<1.0	<1.0	5.0	200	4,900	22,000
Trichlorofluoromethane	<20	<20	<1.0	<1.0	<1.0	7,300	NA	1,100,000	1,100,000
1,2,3-Trichloropropane	<20	<20	<1.0	<1.0	<1.0	120	NA	18,000	84,000
1,2,3-Trimethylbenzene	<20	<20	<1.0	<1.0	<1.0	NA	NA	NA	NA
1,2,4-Trimethylbenzene	<20	<20	<1.0	<1.0	<1.0	63	17	56,000	56,000
1,3,5-Trimethylbenzene	<20	<20	<1.0	<1.0	<1.0	72	45	61,000	61,000
Vinyl Chloride	<10	**17**	<1.0	<1.0	<1.0	2.0	13	13,000	1,000
m&p-Xylene	**96**	**93**	<2.0	<2.0	<2.0	NA	NA	NA	NA
o-Xylene	**45**	**41**	<1.0	<1.0	<1.0	NA	NA	NA	NA
Xylenes	**140**	**130**	<3.0	<3.0	<3.0	280	41	190,000	190,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012

ID = insufficient data to develop criterion

NA = a criterion or value is not available

M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit

Shaded cell indicates concentration exceeds one or more applicable criteria.

Bold cells indicates concentrations in excess of the laboratory reporting limit.

GEI Consultants

TABLE 5e

GROUNDWATER SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES

RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI

SWMU-1

						Part 201 Generic Cleanup Criteria*			
						Non-Residential			
Sample ID	MW-16-1	MW-16-2	MW-16-3	MW-16-4	MW-16-5	Drinking	Groundwater	GW	GW
Matrix	GW	GW	GW	GW	GW	Water	Surface Water	Volatilization	Contact
Date Collected	2/15/17	2/15/17	2/15/17	2/15/17	2/15/17		Interface	to Indoor Air	
								Inhalation	
BNA Semivolatiles by 8270 (µg/L)									
Acenaphthene	<26	<5.0	<5.0	<5.0	<5.0	3,800	38	4,200	4,200
Acenaphthylene	<5.2	<5.0	<5.0	<5.0	<5.0	150	ID	3,900	3,900
Aniline	<4.0	<4.0	<4.0	<4.0	<4.0	220	4.0	NLV	140,000
Anthracene	<5.0	<5.0	<5.0	<5.0	<5.0	43	ID	43	43
Azobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	94	ID	6,400	1,600
Benzo(a)anthracene	<1.0	<1.1	<1.8	<1.0	<1.0	8.5	ID	NLV	9.4
Benzo(a)pyrene	<1.0	<1.1	<1.8	<1.0	<1.0	5.0	ID	NLV	1.0
Benzo(b)fluoranthene	**1.5**	<1.1	<1.8	<1.0	<1.0	1.5	ID	ID	1.5
Benzo(ghi)perylene	<1.0	<1.1	<1.8	<1.0	<1.0	1.0	ID	NLV	1.0
Benzo(k)fluoranthene	<1.0	<1.1	<1.8	<1.0	<1.0	1.0	NA	NLV	1.0
Benzyl Alcohol	<5.0	<5.0	<5.0	<5.0	<5.0	29,000	NA	NLV	44,000,000
Bis(2-chloroethoxy)methane	<5.0	<5.3	<5.0	<5.0	<5.0	NA	NA	NA	NA
Bis(2-chloroethyl)ether	<1.0	<1.1	<1.8	<1.0	<1.0	8.3	1.0 (M); 0.79	210,000	5,700
Bis(2-chloroisopropyl) Ether	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	**28**	<5.0	<5.0	<5.0	<5.0	6.0	25	NLV	320
4-Bromophenyl Phenylether	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
Butyl Benzyl Phthalate	<5.0	<5.0	<5.0	<5.0	<5.0	2,700	67	NLV	2,700
Carbazole	<5.0	<5.0	<5.0	<5.0	<5.0	350	10	NLV	7,400
4-Chloro-3-methylphenol	<5.0	<27	<5.0	<5.0	<5.0	420	7.4	NLV	79,000
2-Chloronaphthalene	<5.2	<5.0	<5.0	<5.0	<5.0	5,200	NA	ID	6,700
2-Chlorophenol	**6.8**	<5.0	<5.0	<5.0	<5.0	130	18	1,100,000	94,000
4-Chlorophenyl Phenylether	<26	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
Chrysene	**1.4**	<1.1	<1.8	<1.0	<1.0	1.6	ID	ID	1.6
Dibenzo(a,h)anthracene	<2.0	<2.0	<2.0	<2.0	<2.0	2.0 (M); 0.85	ID	NLV	2.0 (M); 0.31
Dibenzofuran	<5.2	<4.0	<4.0	<4.0	<4.0	ID	4.0	10,000	ID
2,4-Dichlorophenol	<5.0	<27	<5.0	<5.0	<5.0	210	11	NLV	48,000
Diethyl Phthalate	<5.2	<5.0	<5.0	<5.0	<5.0	16,000	110	NLV	1,100,000
Dimethyl Phthalate	<5.2	<5.0	<5.0	<5.0	<5.0	210,000	NA	NLV	4,200,000
2,4-Dimethylphenol	**15**	<5.3	<5.0	<5.0	<5.0	1,000	380	NLV	520,000
Di-n-butyl Phthalate	<5.0	<5.0	<5.0	<5.0	<5.0	2,500	9.7	NLV	11,000
2,4-Dinitrophenol	<100	<20	<20	<20	<20	NA	NA	NA	NA
2,4-Dinitrotoluene	<26	<5.0	<5.0	<5.0	<5.0	32	NA	NLV	8,600
2,6-Dinitrotoluene	<10	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
Di-n-octyl Phthalate	<5.0	<5.0	<5.0	<5.0	<5.0	380	ID	NLV	400
Fluoranthene	**3.0**	<1.1	<1.8	<1.0	<1.0	210	1.6	210	210
Fluorene	**7.3**	<5.0	<5.0	<5.0	<5.0	2,000	12	2,000	2,000
Hexachlorobenzene	<5.0	<5.0	<5.0	<5.0	<5.0	1.0	0.2	3,000	4.6
Hexachlorobutadiene	<5.0	<27	<5.0	<5.0	<5.0	42	0.053	3,200	400
Hexachlorocyclopentadiene	<26	<5.0	<5.0	<5.0	<5.0	50	ID	420	1,600
Hexachloroethane	<1.0	<1.1	<1.8	<1.0	<1.0	21	6.7	50,000	1,900
Indeno(1,2,3-cd)pyrene	<2.0	<2.0	<2.0	<2.0	<2.0	2.0	ID	NLV	2.0

TABLE 5e

GROUNDWATER SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES

RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI

SWMU-1

						Part 201 Generic Cleanup Criteria*			
						Non-Residential			
Sample ID	MW-16-1	MW-16-2	MW-16-3	MW-16-4	MW-16-5	Drinking	Groundwater	GW	GW
Matrix	GW	GW	GW	GW	GW	Water	Surface Water	Volatilization	Contact
Date Collected	2/15/17	2/15/17	2/15/17	2/15/17	2/15/17		Interface	to Indoor Air	
								Inhalation	
BNA Semivolatiles by 8270 (µg/L)									
Isophorone	<5.0	<5.3	<5.0	<5.0	<5.0	3,100	1,300	NLV	990,000
2-Methyl-4,6-dinitrophenol	<20	<20	<20	<20	<20	20 (M); 2.6	NA	NLV	9,500
2-Methylnaphthalene	**37**	<27	<5.0	<5.0	<5.0	750	19	25,000	25,000
2-Methylphenol	**57**	<5.0	<5.0	<5.0	<5.0	1,000	30 (M); 25	NLV	810,000
3&4-Methylphenol	**180**	**21**	<10	<10	<10	1,000	30 (M); 25	NLV	810,000
2-Nitroaniline	<26	<20	<20	<20	<20	NA	NA	NA	NA
3-Nitroaniline	<26	<20	<20	<20	<20	NA	NA	NA	NA
4-Nitroaniline	<26	<20	<20	<20	<20	NA	NA	NA	NA
Nitrobenzene	<3.0	<23	<3.0	<3.0	<3.0	10	180	550,000	11,000
2-Nitrophenol	<5.0	<27	<5.0	<5.0	<5.0	58	ID	NLV	79,000
4-Nitrophenol	<100	<20	<20	<20	<20	NA	NA	NA	NA
N-Nitrosodimethylamine	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA
N-Nitrosodi-n-propylamine	<5.0	<5.0	<5.0	<5.0	<5.0	5.0	NA	NLV	360
N-Nitrosodiphenylamine	<5.0	<5.0	<5.0	<5.0	<5.0	1,100	NA	NLV	35,000
Pentachlorophenol	<20	<20	<20	<20	<20	1.0	(G, X)	NLV	200
Phenanthrene	**5.4**	<2.0	<2.0	<2.0	<2.0	150	2.0	1,000	1,000
Phenol	**38**	**8.9**	<5.0	<5.0	<5.0	13,000	450	NLV	29,000,000
Pyrene	<5.0	<5.0	<5.0	<1.0	<1.0	140	ID	140	140
Pyridine	<5.0	<5.0	<5.0	<1.0	<1.0	21	NA	12,000	94,000
1,2,4-Trichlorobenzene	<5.0	<27	<5.0	<1.0	<1.0	70	99	300,000	19,000
2,4,5-Trichlorophenol	<26	<5.0	<5.0	<1.0	<1.0	2,100	NA	NLV	170,000
2,4,6-Trichlorophenol	<5.2	<4.0	<4.0	<1.0	<1.0	470	5.0	NLV	10,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 5f
GROUNDWATER SAMPLE ANALYTICAL RESULTS - Metals
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

						Part 201 Generic Cleanup Criteria*			
						Non-Residential			
Sample ID	MW-16-1	MW-16-2	MW-16-3	MW-16-4	MW-16-5	Drinking	Groundwater	GW	GW
Matrix	GW	GW	GW	GW	GW	Water	Surface Water	Volatilization	Contact
Date Collected	2/15/17	2/15/17	2/15/17	2/15/17	2/15/17		Interface	to Indoor Air	
								Inhalation	
Total Metals (μg/L)									
Arsenic	**32**	**58**	**5**	<5.0	<5.0	10	10	NLV	4,300
Barium	**440**	<100	<100	<100	**130**	2,000	(G)	NLV	14,000,000
Cadmium	**1.9**	<1.0	<1.0	<1.0	<1.0	5	(G, X)	NLV	190,000
Chromium	**7,000**	**98**	**11**	<10	**11**	100	(G, X)	NLV	290,000,000
Copper	**82**	**4.0**	<4.0	**13**	**24**	1,000	(G)	NLV	7,400,000
Lead	**190**	**11**	<3.0	<3.0	**39**	4	(G, X)	NLV	ID
Mercury	<0.20	<0.20	<0.20	<0.20	<0.20	2	0.0013	56	56
Nickel	**4,400**	**870**	**110**	**530**	**25**	100	(G)	NLV	74,000,000
Selenium	**7.2**	<5.0	<5.0	<5.0	<5.0	50	5	NLV	970,000
Silver	**0.60**	<0.20	<0.20	<0.20	<0.20	98	0.2 (M); 0.06	NLV	1,500,000
Zinc	**17,000**	**140**	<50	<50	**140**	5,000	(G)	NLV	110,000,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

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TABLE 6
SOIL GAS PROBE INSTALLATION SUMMARY
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI

Proposed Locations/Depths		*Installed Locations/Depths*		
Vapor Probe Location	**Depth (feet)**	**Vapor Probe**	**Depth (feet)**	**Notes**
SV-1 (at boring SB-16-110)	5	**SV-1**	3	Water encountered in subsurface at 3.8 feet bgs. Vapor sample collected from probe at depth of 3 feet.
	10		10	Vapor sample collected.
	15		15	Probe and tubing would not purge. No sample collected.
SV-2 (at boring SB-16-109)	5	**SV-2**	3	Water encountered in subsurface at 3.8 feet bgs. Probe and tubing would not purge. No sample collected.
	10			No probe installed.
	15			No probe installed.
SV-3 (at boring SB-16-105)	5	**SV-3**	5	Vapor sample collected.
	10		10	Probe and tubing would not purge. No sample collected.
	15		15	Water coming out of tubing at ground surface. No vapor sample collected.

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TABLE 7
SOIL GAS ANALYTICAL RESULTS
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

				Part 201 Generic Cleanup Criteria*		
				Non-Residential		
Sample ID	SV-1	SV-1	SV-3	RIASL	$RIASL_{12}$	$TSRIASL_{12}$
Depth (feet)	3	10	5			
Matrix	Soil Gas	Soil Gas	Soil Gas			
Date Collected	7/24/18	7/24/18	7/24/18			
Volatiles by TO-15 ($\mu g/m^3$)						
Acetone	**630**	<57	**740**	1,000,000	1,000,000	1,000,000
Benzene	**160**	**47**	**61**	260	510	1,800
Benzyl Chloride	<6.2	<6.2	<6.2	NA	NA	NA
Bromodichloromethane	<8.0	<8.0	<8.0	NA	NA	NA
Bromoform	<62	<62	<62	NA	NA	NA
Bromomethane	<23	<23	<23	NA	NA	NA
1,3-Butadiene	<1.3	<1.3	<1.3	NA	NA	NA
2-Butanone	**120**	<35	**91**	NA	NA	NA
Carbon Disulfide	**1,600**	**300**	**410**	NA	NA	NA
Carbon Tetrachloride	<7.5	<7.5	<7.5	NA	NA	NA
Chlorobenzene	**130**	<28	<28	2,600	5,100	15,000
Chloroethane	<16	<16	<16	200,000	410,000	1,200,000
Chloroform	<5.9	<5.9	**35**	87	170	1,700
Chloromethane	<12	<12	<12	4,600	9,200	14,000
Cyclohexane	**560**	<41	**67**	NA	NA	NA
Dibromochloromethane	<5.4	<5.4	<5.4	NA	NA	NA
1,2-Dichlorobenzene	<36	<36	<36	NA	NA	NA
1,3-Dichlorobenzene	<36	<36	<36	150	610	920
1,4-Dichlorobenzene	<36	<36	<36	510	1,000	10,000
Dichlorodifluoromethane	<30	<30	<30	NA	NA	NA
1,1-Dichloroethane	<24	<24	<24	1,200	2,500	25,000
1,2-Dichloroethane	<4.9	<4.9	<4.9	NA	NA	NA
1,1-Dichloroethene	<24	<24	<24	10,000	20,000	61,000
cis-1,2-Dichloroethene	<24	<24	<24	410	820	2,500
trans-1,2-Dichloroethene	<24	<24	<24	26,000	26,000	26,000
1,2-Dichloropropane	<28	<28	<28	NA	NA	NA
cis-1,3-Dichloropropene	<27	<27	<27	NA	NA	NA
trans-1,3-Dichloropropene	<27	<27	<27	NA	NA	NA
1,4-Dioxane	<22	<22	<22	NA	NA	NA
Ethyl Acetate	<43	<43	<43	NA	NA	NA
Ethylbenzene	**170**	**140**	**220**	800	1,600	16,000
Ethylene Dibromide	<2.0	<2.0	<2.0	NA	NA	NA
n-Heptane	**570**	**84**	**89**	NA	NA	NA
Hexachlorobutadiene	<7.2	<7.2	<7.2	NA	NA	NA
n-Hexane	**1,100**	**170**	**88**	36,000	72,000	210,000
2-Hexanone	<49	<49	<49	NA	NA	NA
Isoprobanol	<29	<29	<29	NA	NA	NA
Methylene Chloride	<42	<42	<42	31,000	61,000	97,000
2-Methylnaphthalene	<140	<140	<140	NA	NA	NA
4-Methyl-2-pentanone	<49	<49	**100**	NA	NA	NA
MTBE	<22	<22	<22	7,700	15,000	150,000
Naphthalene	**87**	<28	<28	NA	NA	NA

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TABLE 7
SOIL GAS ANALYTICAL RESULTS
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

				Part 201 Generic Cleanup Criteria*		
				Non-Residential		
Sample ID	SV-1	SV-1	SV-3	RIASL	$RIASL_{12}$	$TSRIASL_{12}$
Depth (feet)	3	10	5			
Matrix	Soil Gas	Soil Gas	Soil Gas			
Date Collected	7/24/18	7/24/18	7/24/18			
Volatiles by TO-15 ($\mu g/m^3$)						
Styrene	<51	<51	<51	NA	NA	NA
1,1,2,2-Tetrachloroethane	<3.3	<3.3	<3.3	NA	NA	NA
Tetrachloroethene	<41	<41	<41	1,400	2,700	2,700
Tetrahydrofuran	**8.4**	<3.5	**8.5**	NA	NA	NA
Toluene	**770**	**740**	**1,100**	250,000	250,000	250,000
1,2,4-Trichlorobenzene	<89	<89	<89	100	200	610
1,1,1-Trichloroethane	<33	<33	<33	230,000	230,000	230,000
1,1,2-Trichloroethane	<6.5	<6.5	<6.5	NA	NA	NA
Trichloroethene	**29**	<1.6	**6.9**	67	130	400
Trichlorofluoromethane	<34	<34	<34	NA	NA	NA
1,1,2-Trichlorotrifluoroethane	**53**	<46	**53**	NA	NA	NA
1,2,4-Trimethylbenzene	<29	**74**	**260**	3,100	6,100	18,000
1,3,5-Trimethylbenzene	<29	<29	**110**	3,100	6,100	18,000
Vinyl Acetate	<42	<42	<42	10,000	20,000	61,000
Vinyl Chloride	<15	<15	<15	450	910	9,100
m&p-Xylene	**320**	**450**	**680**	NA	NA	NA
o-Xylene	**160**	**120**	**240**	NA	NA	NA
Xylenes	**480**	**580**	**920**	11,000	22,000	67,000

*Part 201 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, August 2017
NA = a criterion or value is not available
RIASL = Recommended Interim Action Screening Levels
$RIASL_{12}$ = Nonresidential Recommended Interim Action Screening Levels appropriate for exposures less than 12 hours
$TSRIASL_{12}$ = Time-sensitive RIASLs appropriate for exposures less than 12 hours for buildings not formerly residential houses
Yellow shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 8
SURFACE SOIL SAMPLE ANALYTICAL RESULTS - Metals
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI
SWMU-1

							Part 201 Generic Cleanup Criteria*					
							Non-Residential					
Sample ID	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	Drinking Water Protection	Groundwater Surface Water Interface Protection	Soil Volatilization to Indoor Air Inhalation	Particulate Soil Inhalation	Direct Contact	Statewide Default Background
Depth (feet)	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5	0 - 0.5						
Matrix	Soil	Soil	Soil	Soil	Soil	Soil						
Date Collected	7/18/18	7/18/18	7/18/18	7/18/18	7/18/18	7/18/18						
Total Metals (μg/Kg)												
Arsenic	5,000	8,300	5,600	18,000	8,300	7,000	4,600	4,600	NLV	910,000	37,000	5,800
Barium	60,000	80,000	69,000	100,000	50,000	49,000	1,300,000	(G)	NLV	150,000,000	130,000,000	75,000
Cadmium	490	5,700	720	730	280	420	6,000	(G, X)	NLV	2,200,000	2,100,000	1,200
Chromium	67,000	82,000	520,000	110,000	77,000	68,000	1,000,000,000	(G, X)	NLV	150,000,000	1,000,000,000	18,000
Copper	41,000	110,000	160,000	57,000	110,000	44,000	5,800,000	(G)	NLV	59,000,000	73,000,000	32,000
Lead	72,000	550,000	110,000	390,000	21,000	66,000	700,000	(G, X)	NLV	44,000,000	900,000	21,000
Mercury	89	92	140	120	53	72	1,700	50 (M); 1.2	89,000	8,800,000	580,000	130
Selenium	260	430	590	350	340	370	4,000	400	NLV	59,000,000	9,600,000	410
Silver	260	460	2,500	1,200	200	600	13,000	100 (M); 27	NLV	2,900,000	9,000,000	1,000
Zinc	260,000	580,000	850,000	280,000	320,000	180,000	5,000,000	(G)	NLV	ID	630,000,000	47,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Green shaded cell indicates concentration exceeds direct contact criteria

TABLE 9

SURFACE SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs

RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI

SWMU-1

			Part 201 Generic Cleanup Criteria*				
			Non-Residential				
Sample ID	SS-7	SS-8	Drinking	Groundwater	Soil	Particulate	Direct
Depth (feet)	0 - 0.5	0 - 0.5	Water	Surface Water	Volatilization	Soil	Contact
Matrix	Soil	Soil	Protection	Interface	to Indoor Air	Inhalation	
Date Collected	7/18/18	7/18/18		Protection	Inhalation		
Volatiles by 8260 (µg/Kg)							
Acetone	<1,000	<1,000	42,000	34,000	110,000,000	1.7.E+11	73,000,000
Acrylonitrile	<130	<120	200	100 (M); 40	35,000	58,000,000	74,000
Benzene	<50	<50	100	4,000	8,400	470,000,000	400,000
Bromobenzene	<100	<100	1,500	NA	580,000	240,000,000	760,000
Bromochloromethane	<100	<100	NA	NA	NA	NA	NA
Bromodichloromethane	<100	<100	1,600	ID	6,400	110,000,000	490,000
Bromoform	<130	<120	1,600	ID	770,000	3,600,000,000	870,000
Bromomethane	<200	<200	580	700	1,600	150,000,000	1,000,000
2-Butanone	<750	<750	760,000	44,000	27,000,000	2.9.E+10	27,000,000
n-Butylbenzene	<65	<62	4,600	ID	ID	880,000,000	8,000,000
sec-Butylbenzene	<65	<62	4,600	ID	ID	180,000,000	8,000,000
tert-Butylbenzene	<50	<50	4,600	ID	ID	290,000,000	8,000,000
Carbon Disulfide	<250	<250	46,000	ID	140,000	2.1E+10	280,000
Carbon Tetrachloride	<50	<50	100	900	990	170,000,000	390,000
Chlorobenzene	<65	<62	2,000	500	220,000	2,100,000,000	260,000
Chloroethane	<320	<310	34,000	22,000	950,000	2.9E+11	950,000
Chloroform	<50	<50	1,600	7,000	38,000	1,600,000,000	1,500,000
Chloromethane	<250	<250	22,000	ID	10,000	2,600,000,000	1,100,000
2-Chlorotoluene	<50	<50	9,300	ID	500,000	2,100,000,000	500,000
Dibromochloromethane	<100	<100	1,600	ID	21,000	160,000,000	500,000
1,2-Dibromo-3-chloropropane	<320	<310	10 (M); 4.0	ID	1,200	700,000	1,200
Dibromomethane	<250	<250	4,600	NA	ID	ID	2,000,000
1,2-Dichlorobenzene	<100	<100	14,000	280	210,000	4.4.E+10	210,000
1,3-Dichlorobenzene	<100	<100	480	680	48,000	88,000,000	170,000
1,4-Dichlorobenzene	<100	<100	1,700	360	100,000	570,000,000	1,900,000
Dichlorodifluoromethane	<250	<250	270,000	ID	1,700,000	1.5E+12	1,000,000
1,1-Dichloroethane	<50	<50	50,000	15,000	430,000	1.5E+10	890,000
1,2-Dichloroethane	<50	<50	100	7,200	11,000	150,000,000	420,000
1,1-Dichloroethene	<50	<50	140	2,600	330	78,000,000	570,000
cis-1,2-Dichloroethene	<50	<50	1,400	12,000	41,000	1,000,000,000	640,000
trans-1,2-Dichloroethene	<50	<50	2,000	30,000	43,000	2,100,000,000	1,400,000
1,2-Dichloropropane	<65	<62	100	4,600	7,400	120,000,000	550,000
cis-1,3-Dichloropropene	<50	<50	700	180	5,400	590,000,000	240,000
trans-1,3-Dichloropropene	<65	<62	700	180	5,400	590,000,000	240,000
Ethylbenzene	<50	<50	1,500	360	140,000	1.3E+10	140,000
Ethylene Dibromide	<50	<50	20 (M); 10	110	3,600	18,000,000	430
2-Hexanone	<2,500	<2,500	58,000	ID	1,800,000	1,200,000,000	2,500,000
Isopropylbenzene	<250	<250	280,000	3,200	390,000	2,600,000	390,000
Methylene Chloride	<100	<100	100	30,000	240,000	8,300,000,000	2,300,000
4-Methyl-2-pentanone	<2,500	<2,500	100,000	ID	2,700,000	6.0E+10	2,700,000
MTBE	<250	<250	800	140,000	5,900,000	8.8E+10	5,900,000
Naphthalene	<330	<330	100,000	730	470,000	88,000,000	52,000,000
n-Propylbenzene	<100	<100	4,600	ID	ID	590,000,000	8,000,000
Styrene	<65	<62	2,700	2,100	520,000	6,900,000,000	520,000
1,1,1,2-Tetrachloroethane	<100	<100	6,400	ID	33,000	530,000,000	440,000
1,1,2,2-Tetrachloroethane	<65	<62	700	1,600	23,000	68,000,000	240,000
Tetrachloroethene	<50	<50	100	1,200	21,000	1,200,000,000	88,000
Toluene	<50	<50	16,000	5,400	250,000	1.2E+10	250,000
1,2,4-Trichlorobenzene	<250	<250	4,200	5,900	1,100,000	1.1E+10	1,100,000
1,1,1-Trichloroethane	<50	<50	4,000	1,800	460,000	2.9E+10	460,000
1,1,2-Trichloroethane	<65	<62	100	6,600	24,000	250,000,000	840,000
Trichloroethene	<50	<50	100	4,000	1,900	59,000,000	500,000
Trichlorofluoromethane	<100	<100	150,000	NA	560,000	1.7E+12	560,000
1,2,3-Trichloropropane	<130	<120	2,400	NA	7,500	8,800,000	830,000
1,2,3-Trimethylbenzene	<100	<100	NA	NA	NA	NA	NA
1,2,4-Trimethylbenzene	<100	<100	2,100	570	110,000	3.6E+10	110,000
1,3,5-Trimethylbenzene	<100	<100	1,800	1,100	94,000	3.6E+10	94,000
Vinyl Chloride	<45	<43	40	260	2,800	890,000,000	34,000
m&p-Xylene	<100	<100	NA	NA	NA	NA	NA
o-Xylene	<50	<50	NA	NA	NA	NA	NA
Xylenes	<150	<150	5,600	820	150,000	1.3E+11	150,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012

ID = insufficient data to develop criterion

NA = a criterion or value is not available

NLL = substance not likely to leach under most soil conditions

NLV = substance not likely to volatilize under most soil conditions

G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water

M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit

X = GSI criterion shown is not protective for surface water that is used as a drinking water source

Yellow shaded cell indicates concentration exceeds one or more applicable criteria.

Green shaded cell indicates concentration in excess of direct contact criteria

Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 10a

VERFICATION SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs

Soil Excavation, MacDermid, Ferndale, Oakland County, MI

LAGOON #1

										Part 201 Generic Cleanup Criteria*			
										Non-Residential			
Sample ID	L1FNW	L1FNE	L1FSE	L1FSW	L1SWN	L1SWE	L1SWED	L1SWS	L1SWW	Drinking	Groundwater	RAISL+	Direct
Depth (feet)	8	8	7	9	6-7	5-6	Duplicate	5-6	5-6	Water	Surface Water	Volatilization	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	of L1SWE	Soil	Soil	Protection	Interface	to Indoor	
Date Collected	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19		1/8/19	1/8/19		Protection	Air	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East		Sidewall South	Sidewall West				
Volatiles by 8260 (µg/Kg)													
Acetone	<1,000	<1,000	<1,000	<1,000	<1,500	<1,000	<1,000	<3,600	<1,000	42,000	34,000	780,000	73,000,000
Acrylonitrile	<140	<140	<130	<120	<600	<130	<130	<1,400	<140	200	100 (M); 40	NA	74,000
Benzene	<50	<50	<50	<50	**110**	<50	<50	<180	<50	100	4,000	12	400,000
Bromobenzene	<100	<100	<100	<100	<300	<100	<100	<720	<100	1,500	NA	NA	760,000
Bromochloromethane	<100	<100	<100	<100	<300	<100	<100	<720	<100	NA	NA	NA	NA
Bromodichloromethane	<100	<100	<100	<100	<300	<100	<100	<720	<100	1,600	ID	NA	490,000
Bromoform	<140	<140	<130	<120	<600	<130	<130	<1,400	<140	1,600	ID	NA	870,000
Bromomethane	<200	<200	>200	<230	<600	>200	<200	<1,400	<200	580	700	NA	1,000,000
2-Butanone	<750	<750	<750	<750	<750	<750	<750	<720	<750	760,000	44,000	NA	27,000,000
n-Butylbenzene	<71	<69	<66	<60	<300	<66	<66	<720	<70	4,600	ID	NA	8,000,000
sec-Butylbenzene	<71	<69	<66	<60	<300	<66	<66	<720	<70	4,600	ID	NA	8,000,000
tert-Butylbenzene	<50	<50	<50	<50	<150	<50	<50	<360	<50	4,600	ID	NA	8,000,000
Carbon Disulfide	<360	<360	<330	<250	<1,500	<330	<330	<3,600	<360	46,000	ID	NA	280,000
Carbon Tetrachloride	<50	<50	<50	<50	<210	<50	<50	<500	<50	100	900	NA	390,000
Chlorobenzene	**85,000**	<69	<66	<60	**83,000**	<66	<66	<720	**250**	2,000	500	360	260,000
Chloroethane	<360	<360	<330	<290	<1,500	<330	<330	<3,600	<360	34,000	22,000	1,500	950,000
Chloroform	<50	<50	<50	<50	<210	<50	<50	<500	<50	1,600	7,000	1.9	1,500,000
Chloromethane	<360	<360	<330	<250	<1,500	<330	<330	<3,600	<360	22,000	ID	31	1,100,000
2-Chlorotoluene	<50	<50	<50	<50	<150	<50	<50	<360	<50	9,300	ID	NA	500,000
Dibromochloromethane	<100	<100	<100	<120	<300	<100	<100	<720	<100	1,600	ID	NA	500,000
1,2-Dibromo-3-chloropropane	<360	<360	<330	<290	<1,500	<330	<330	<3,600	<360	10 (M); 4.0	ID	NA	1,200
Dibromomethane	<250	<250	<250	<250	<250	<250	<250	<360	<250	4,600	NA	NA	2,000,000
1,2-Dichlorobenzene	**520**	<100	<100	<100	**2,600**	<100	<100	<360	<100	14,000	280	NA	210,000
1,3-Dichlorobenzene	<100	<100	<100	<100	<150	<100	<100	<360	<100	480	680	45	170,000
1,4-Dichlorobenzene	**170**	<100	<100	<100	<300	<100	<100	<720	<100	1,700	360	160	1,900,000
Dichlorodifluoromethane	<250	<250	<250	<290	<300	<250	<250	<720	<250	270,000	ID	NA	1,000,000
1,1-Dichloroethane	<50	<50	<50	<58	<210	<50	<50	<500	<50	50,000	15,000	19	890,000
1,2-Dichloroethane	<50	<50	<50	<50	<150	<50	<50	<360	<50	100	7,200	NA	420,000
1,1-Dichloroethene	<71	<69	<66	<60	<300	<66	<66	<720	<70	140	2,600	54	570,000
cis-1,2-Dichloroethene	<71	<69	<66	<60	<300	<66	<66	<720	<70	1,400	12,000	9.2	640,000
trans-1,2-Dichloroethene	<71	<69	<66	<60	<300	<66	<66	<720	<70	2,000	30,000	340	1,400,000
1,2-Dichloropropane	<71	<69	<66	<60	<300	<66	<66	<720	<70	100	4,600	NA	550,000
cis-1,3-Dichloropropene	<50	<50	<50	<50	<210	<50	<50	<500	<50	700	180	NA	240,000
trans-1,3-Dichloropropene	<71	<69	<66	<60	<300	<66	<66	<720	<70	700	180	NA	240,000
Ethylbenzene	<50	<50	<50	<50	**2,100**	<50	<50	<360	<50	1,500	360	86	140,000
Ethylene Dibromide	<71	<69	<66	<60	<300	<66	<66	<720	<70	20 (M); 10	110	NA	430
2-Hexanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<3,600	<2,500	58,000	ID	NA	2,500,000
Isopropylbenzene	<250	<250	<250	<250	<250	<250	<250	<360	<250	280,000	3,200	NA	390,000
Methylene Chloride	**150**	<100	<100	<100	<300	<100	<100	<3,600	<100	100	30,000	570	2,300,000
4-Methyl-2-pentanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<3,600	<2,500	100,000	ID	NA	2,700,000
MTBE	<250	<250	<250	<250	<250	<250	<250	<250	<250	800	140,000	520	5,900,000

TABLE 10a
VERFICATION SOIL SAMPLE ANALYTICAL RESULTS - FULL SCAN VOCs
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #1

										Part 201 Generic Cleanup Criteria*			
										Non-Residential			
Sample ID	L1FNW	L1FNE	L1FSE	L1FSW	L1SWN	L1SWE	L1SWED	L1SWS	L1SWW	Drinking	Groundwater	RAISL[+]	Direct
Depth (feet)	8	8	7	9	6-7	5-6	Duplicate	5-6	5-6	Water	Surface Water	Volatilization	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	of L1SWE	Soil	Soil	Protection	Interface	to Indoor	
Date Collected	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19		1/8/19	1/8/19		Protection	Air	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East		Sidewall South	Sidewall West				
Volatiles by 8260 (µg/Kg)													
Naphthalene	<330	<330	<330	<330	**950**	<330	<330	<1,400	<330	100,000	730	NA	52,000,000
n-Propylbenzene	<100	<100	<100	<100	<300	<100	<100	<720	<100	4,600	ID	NA	8,000,000
Styrene	<71	<69	<66	<60	<300	<66	<66	<720	<70	2,700	2,100	NA	520,000
1,1,1,2-Tetrachloroethane	<100	<100	<100	<100	<300	<100	<100	<720	<100	6,400	ID	NA	440,000
1,1,2,2-Tetrachloroethane	<71	<69	<66	<60	<300	<66	<66	<720	<70	700	1,600	NA	240,000
Tetrachloroethene	<71	<69	<66	<60	<300	<66	<66	<720	<70	100	1,200	19	88,000
Toluene	<50	<50	<50	<50	**1,600**	<50	<50	<500	<50	16,000	5,400	16,000	250,000
1,2,4-Trichlorobenzene	<270	<270	<250	<250	<1,100	<250	<250	<2,700	<270	4,200	5,900	230	1,100,000
1,1,1-Trichloroethane	<71	<69	<66	<60	<300	<66	<66	<720	<70	4,000	1,800	1,900	460,000
1,1,2-Trichloroethane	<71	<69	<66	<60	<300	<66	<66	<720	<70	100	6,600	NA	840,000
Trichloroethene	<71	<69	<66	<60	<300	<66	<66	<720	<70	100	4,000	1	500,000
Trichlorofluoromethane	<100	<100	<100	<120	<300	<100	<100	<720	<100	150,000	NA	NA	560,000
1,2,3-Trichloropropane	<140	<140	<130	<120	<600	<130	<130	<1,400	<140	2,400	NA	NA	830,000
1,2,3-Trimethylbenzene	<100	<100	<100	<100	<300	<100	<100	<720	<100	NA	NA	1,200	NA
1,2,4-Trimethylbenzene	<100	<100	<100	<100	**530**	<100	<100	<720	<100	2,100	570	650	110,000
1,3,5-Trimethylbenzene	<100	<100	<100	<100	<300	<100	<100	<720	<100	1,800	1,100	450	94,000
Vinyl Chloride	<50	<49	<47	<42	<210	<46	<46	<500	<49	40	260	2	34,000
m&p-Xylene	**430**	<100	<100	<100	**6,500**	<100	<100	<720	<100	NA	NA	NA	NA
o-Xylene	**160**	<50	<50	<50	**3,000**	<50	<50	<360	<50	NA	NA	NA	NA
Xylenes	**580**	<150	<150	<150	**9,500**	<150	<150	<1,100	<150	5,600	820	1,200	150,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012

[+] RAISL = Recommended Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, August 2017

ID = insufficient data to develop criterion

NA = a criterion or value is not available

NLL = substance not likely to leach under most soil conditions

NLV = substance not likely to volatilize under most soil conditions

G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water

M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit

X = GSI criterion shown is not protective for surface water that is used as a drinking water source

Yellow-shaded cell indicates concentration exceeds one or more applicable criteria.

Blue-shaded cell indicates reporting limit exceeds one or more applicable critera.

Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 10b

VERIFICATION SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES

Soil Excavation, MacDermid, Ferndale, Oakland County, MI

LAGOON #1

										Part 201 Generic Cleanup Criteria*		
										Non-Residential		
Sample ID	L1FNW	L1FNE	L1FSE	L1FSW	L1SWN	L1SWE	L1SWED	L1SWS	L1SWW	Drinking	Groundwater	Direct
Depth (feet)	8	8	7	9	6-7	5-6	Duplicate	5-6	5-6	Water	Surface Water	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	of L1SWE	Soil	Soil	Protection	Interface	
Date Collected	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19		1/8/19	1/8/19		Protection	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East		Sidewall South	Sidewall West			
BNA Semivolatiles by 8270 (µg/Kg)												
Acenaphthene	<330	<330	<330	<330	<330	<330	<330	<330	<330	880,000	8,700	130,000,000
Acenaphthylene	<330	<330	<330	<330	<330	<330	<330	<330	<330	17,000	ID	5,200,000
Aniline	<330	<330	<330	<330	<330	<330	<330	<330	<330	4,400	330 (M); 80	150,000
Anthracene	<330	<330	<330	<330	<330	<330	<330	<330	<330	41,000	ID	730,000,000
Azobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	17,000	ID	660,000
Benzo(a)anthracene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	80,000
Benzo(a)pyrene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	8,000
Benzo(b)fluoranthene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	80,000
Benzo(ghi)perylene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	7,000,000
Benzo(k)fluoranthene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	800,000
Benzyl Alcohol	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	580,000	NA	580,000
Bis(2-chloroethoxy)methane	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Bis(2-chloroethyl)ether	<100	<330	<330	<330	<330	<330	<330	<330	<330	170	100 (M); 20	58,000
Bis(2-chloroisopropyl) Ether	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Bis(2-ethylhexyl)phthalate	**350**	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	10,000,000
4-Bromophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Butyl Benzyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	310,000	120,000	310,000
Carbazole	<330	<330	<330	<330	<330	<330	<330	<330	<330	39,000	1,100	2,400,000
4-Chloro-3-methylphenol	<280	<280	<280	<280	<280	<280	<280	<280	<280	16,000	280	15,000,000
2-Chloronaphthalene	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,800,000	NA	180,000,000
2-Chlorophenol	**330**	<330	<330	<330	<330	<330	<330	<330	<330	2,600	360	4,500,000
4-Chlorophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Chrysene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	8,000,000
Dibenzo(a,h)anthracene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	8,000
Dibenzofuran	<330	<330	<330	<330	<330	<330	<330	<330	<330	ID	1,700	ID
2,4-Dichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	4,200	330 (M); 220	1,800,000
Diethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	320,000	2,200	740,000
Dimethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	790,000	NA	790,000
2,4-Dimethylphenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	20,000	7,600	36,000,000
Di-n-butyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	760,000	11,000	760,000
2,4-Dinitrophenol	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA
2,4-Dinitrotoluene	<330	<330	<330	<330	<330	<330	<330	<330	<330	640	NA	220,000
2,6-Dinitrotoluene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Di-n-octyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	140,000,000	ID	20,000,000
Fluoranthene	<330	<330	<330	<330	<330	<330	<330	<330	<330	730,000	5,500	130,000,000
Fluorene	<330	<330	<330	<330	**450**	<330	<330	<330	<330	890,000	5,300	87,000,000
Hexachlorobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,800	350	37,000
Hexachlorobutadiene	<330	<330	<330	<330	<330	<330	<330	<330	<330	72,000	91	350,000
Hexachlorocyclopentadiene	<330	<330	<330	<330	<330	<330	<330	<330	<330	320,000	ID	720,000
Hexachloroethane	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,200	1,800	730,000

TABLE 10b
VERIFICATION SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #1

										Part 201 Generic Cleanup Criteria*		
										Non-Residential		
Sample ID	L1FNW	L1FNE	L1FSE	L1FSW	L1SWN	L1SWE	L1SWED	L1SWS	L1SWW	Drinking	Groundwater	Direct
Depth (feet)	8	8	7	9	6-7	5-6	Duplicate	5-6	5-6	Water	Surface Water	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	of L1SWE	Soil	Soil	Protection	Interface	
Date Collected	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19		1/8/19	1/8/19		Protection	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East		Sidewall South	Sidewall West			
BNA Semivolatiles by 8270 (μg/Kg)												
Indeno(1,2,3-cd)pyrene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NLL	NLL	80,000
Isophorone	<330	<330	<330	<330	<330	<330	<330	<330	<330	62,000	26,000	2,400,000
2-Methyl-4,6-dinitrophenol	<830	<830	<830	<830	<830	<830	<830	<830	<830	830 (M); 400	NA	260,000
2-Methylnaphthalene	<330	<330	<330	<330	**1,500**	<330	<330	<330	<330	170,000	4,200	26,000,000
2-Methylphenol	<660	<660	<660	<660	<660	<660	<660	<660	<660	20,000	1,000 (M);600	36,000,000
3&4-Methylphenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	20,000	1,000 (M);600	36,000,000
2-Nitroaniline	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
3-Nitroaniline	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA
4-Nitroaniline	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA
Nitrobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	330 (M); 190	3,600	340,000
2-Nitrophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,200	ID	2,000,000
4-Nitrophenol	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA
N-Nitrosodimethylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
N-Nitrosodi-n-propylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	330 (M); 100	NA	5,400
N-Nitrosodiphenylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	22,000	NA	7,800,000
Pentachlorophenol	<800	<800	<800	<800	<800	<800	<800	<800	<800	22	(G, X)	320,000
Phenanthrene	<330	<330	<330	<330	**490**	<330	<330	<330	<330	160,000	2,100	5,200,000
Phenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	260,000	9,000	12,000,000
Pyrene	<330	<330	<330	<330	<330	<330	<330	<330	<330	480,000	ID	84,000,000
Pyridine	<330	<330	<330	<330	<330	<330	<330	<330	<330	42	NA	37,000
2,4,5-Trichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	110,000	NA	73,000,000
2,4,6-Trichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	9,400	330 (M); 100	3,300,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 10c
VERFICATION SOIL SAMPLE ANALYTICAL RESULTS - Metals
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #1

										Part 201 Generic Cleanup Criteria*				
										Non-Residential				
Sample ID	L1FNW	L1FNE	L1FSE	L1FSW	L1SWN	L1SWE	L1SWED	L1SWS	L1SWW	Drinking Water Protection	Groundwater Surface Water Interface Protection	RAISL+ Volatilization to Indoor Air	Direct Contact	Statewide Default Background
Depth (feet)	8	8	7	9	6-7	5-6	Duplicate of L1SWE	5-6	5-6					
Matrix	Soil	Soil	Soil	Soil	Soil	Soil		Soil	Soil					
Date Collected	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19		1/8/19	1/8/19					
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East		Sidewall South	Sidewall West					
Total Metals (μg/Kg)														
Arsenic	9,900	9,100	9,500	8,600	7,600	1,200	1,500	1,400	10,000	4,600	4,600	NA	37,000	5,800
Barium	44,000	41,000	83,000	56,000	74,000	15,000	14,000	17,000	77,000	1,300,000	(G)	NA	130,000,000	75,000
Cadmium	130	140	99	100	280	59	69	59	180	6,000	(G, X)	NA	2,100,000	1,200
Chromium	14,000	14,000	19,000	15,000	360,000	130,000	110,000	60,000	19,000	1,000,000,000	(G, X)	NA	1,000,000,000	18,000
Copper	13,000	16,000	13,000	13,000	340,000	290,000	320,000	100,000	14,000	5,800,000	(G)	NA	73,000,000	32,000
Lead	7,700	6,600	6,800	7,900	33,000	2,200	2,000	370	7,300	700,000	(G, X)	NA	900,000	21,000
Mercury	<50	<50	<50	<50	<50	<50	<50	<50	<50	1,700	50 (M); 1.2	0.12	580,000	130
Selenium	250	260	320	210	430	<200	<200	200	240	4,000	400	NA	9,600,000	410
Silver	<100	<100	<100	<100	220	<100	<100	<100	<100	13,000	100 (M); 27	NA	9,000,000	1,000
Zinc	39,000	51,000	39,000	40,000	1,800,000	120,000	150,000	350,000	40,000	5,000,000	(G)	NA	630,000,000	47,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
+ RAISL = Recommended Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, August 2017
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.

GEI Consultants

TABLE 10d
VERIFICATION SOIL SAMPLE ANALYTICAL RESULTS - PFAS COMPOUNDS
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #1

										Part 201 Generic Cleanup Criteria		
										Non-Residential		
Sample ID	L1FNW	L1FNE	L1FSE	L1FSW	L1SWN	L1SWE	L1SWED	L1SWS	L1SWW	Drinking	Groundwater	Direct
Depth (feet)	8	8	7	9	6-7	5-6	Duplicate	5-6	5-6	Water	Surface Water	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	of L1SWE	Soil	Soil	Protection	Interface	
Date Collected	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19	1/8/19		1/8/19	1/8/19		Protection*	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East		Sidewall South	Sidewall West			
PFAS by ASTM D7968-17a (ng/Kg)												
N-EtFOSAA	<30	<30	<29	<28	**1,700**	<29	<29	**130**	<30	NA	NA	NA
FtS 4:2	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
FtS 6:2	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
FtS 8:2	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
N-MeFOSAA	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
PFBA	**150**	**320**	**310**	**66**	**830**	**29**	<29	**53**	<30	NA	NA	NA
PFBS	**63**	<30	**52**	**57**	**210**	<29	<29	**44**	<30	NA	NA	NA
PFDA	<120	<120	<120	<110	<120	<120	<120	<120	<120	NA	NA	NA
PFDoA	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
PFDS	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
PFHpA	**110**	**82**	**100**	**190**	**110**	<29	<29	**72**	**44**	NA	NA	NA
PFHpS	<30	<30	<29	<28	<31	<29	<29	<31	**220**	NA	NA	NA
PFHxA	**330**	**550**	**550**	**370**	**700**	**40**	**45**	**100**	**33**	NA	NA	NA
PFHxS-Branched	**33**	<30	<29	<28	<31	<29	<29	<31	**90**	NA	NA	NA
PFHxS-Linear	**120**	<30	**39**	**81**	**100**	<29	<29	**170**	**360**	NA	NA	NA
PFHxS-Total	**150**	<60	<58	**81**	**100**	<58	<57	**170**	**450**	NA	NA	NA
PFNA	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
PFNS	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
PFOA	**440**	**270**	**220**	**760**	**750**	**170**	**170**	**860**	**820**	NA	10,000,000/350,000	NA
PFOSA	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
PFOS-Branched	**86**	**71**	<29	**190**	**930**	**150**	**170**	**860**	**3,000**	NA	NA	NA
PFOS-Linear	**59**	**59**	<29	**29**	**2,000**	**320**	**330**	**1,500**	**3,200**	NA	NA	NA
PFOS-Total	**150**	**130**	<29	**220**	**3,000**	**470**	**500**	**2,300**	**6,200**	NA	240/220	NA
PFPeA	**220**	**520**	**370**	**140**	**700**	**31**	**32**	**50**	<30	NA	NA	NA
PFPeS	**83**	**110**	**81**	**59**	**68**	<29	<29	**37**	**39**	NA	NA	NA
PFTeA	<120	<120	<120	<110	<120	<120	<120	<120	<120	NA	NA	NA
PFTriA	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA
PFUnA	<30	<30	<29	<28	<31	<29	<29	<31	<30	NA	NA	NA

* Groundwater-surface water interface (GSI) protection criteria and GSI protection criteria for receiving waters used as human drinking water source
NA = a criterion or value is not available
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 11a
VERIFICATION SOIL ANALYTICAL RESULTS - FULL SCAN VOCs
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #2

										Part 201 Generic Cleanup Criteria*			
										Non-Residential			
Sample ID	L2FNW	L2FNE	L2FSE	L2FSW	L2SWN	L2SWE	L2SWS	L2SWSD	L2SWW	Drinking	Groundwater	RAISL+	Direct
Depth (feet)	9	9.5	9.5	9.5	4	5-6	4-5	Duplicate	5-6	Water	Surface Water	Volatilization	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of L2SWS	Soil	Protection	Interface	to Indoor	
Date Collected	1/2/19	1/2/19	1/4/19	1/4/19	1/2/19	1/8/19	1/8/19		1/8/19		Protection	Air	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East	Sidewall South		Sidewall West				
Volatiles by 8260 (µg/Kg)													
Acetone	<1,000	<1,000	<1,000	<1,000	<1,000	<1,500	<1,600	<1,600	<1,000	42,000	34,000	780,000	73,000,000
Acrylonitrile	<130	<120	<130	<110	<150	<610	<640	<620	<140	200	100 (M); 40	NA	74,000
Benzene	<50	<50	<50	<50	<50	<76	<80	<78	<50	100	4,000	12	400,000
Bromobenzene	<100	<100	<100	<100	<100	<300	<320	<310	<100	1,500	NA	NA	760,000
Bromochloromethane	<100	<100	<100	<100	<100	<300	<320	<310	<100	NA	NA	NA	NA
Bromodichloromethane	<100	<100	<100	<100	<100	<300	<320	<310	<100	1,600	ID	NA	490,000
Bromoform	<130	<120	<130	<110	<150	<610	<640	<620	<140	1,600	ID	NA	870,000
Bromomethane	<200	<200	<200	<220	<200	<610	<640	<620	<200	580	700	NA	1,000,000
2-Butanone	<750	<750	<750	<750	<750	<750	<750	<750	<750	760,000	44,000	NA	27,000,000
n-Butylbenzene	<64	<62	<65	<65	<74	<300	<320	<310	<70	4,600	ID	NA	8,000,000
sec-Butylbenzene	<64	<62	<65	<50	<74	<300	<320	<310	<70	4,600	ID	NA	8,000,000
tert-Butylbenzene	<50	<50	<50	<50	<50	<150	<160	<160	<50	4,600	ID	NA	8,000,000
Carbon Disulfide	<320	<310	<320	<250	<370	<1,500	<1,600	<1,600	<350	46,000	ID	NA	280,000
Carbon Tetrachloride	<50	<50	<50	<65	<52	<210	<230	<220	<50	100	900	NA	390,000
Chlorobenzene	<64	<62	<65	<65	<74	<300	<320	<310	<70	2,000	500	360	260,000
Chloroethane	<320	<310	<320	<280	<370	<1,500	<1,600	<1,600	<350	34,000	22,000	1,500	950,000
Chloroform	<50	<50	<50	<65	<52	<210	<230	<220	<50	1,600	7,000	1.9	1,500,000
Chloromethane	<320	<310	<320	<250	<370	<1,500	<1,600	<1,600	<350	22,000	ID	31	1,100,000
2-Chlorotoluene	<50	<50	<50	<50	<50	<150	<160	<160	<50	9,300	ID	NA	500,000
Dibromochloromethane	<320	<100	<320	<110	<100	<300	<320	<310	<100	1,600	ID	NA	500,000
1,2-Dibromo-3-chloropropane	<320	<310	<320	<280	<370	<1,500	<1,600	<1,600	<350	10 (M); 4.0	ID	NA	1,200
Dibromomethane	<250	<100	<250	<250	<250	<250	<250	<250	<250	4,600	NA	NA	2,000,000
1,2-Dichlorobenzene	<100	<250	<100	<100	<100	<150	<160	<160	<100	14,000	280	NA	210,000
1,3-Dichlorobenzene	<100	<100	<100	<100	<100	<150	<160	<160	<100	480	680	45	170,000
1,4-Dichlorobenzene	<100	<100	<100	<100	<100	<300	<320	<310	<100	1,700	360	160	1,900,000
Dichlorodifluoromethane	<250	<250	<250	<280	<250	<300	<320	<310	<250	270,000	ID	NA	1,000,000
1,1-Dichloroethane	<50	<50	<50	<65	<52	<210	<230	<220	<50	50,000	15,000	19	890,000
1,2-Dichloroethane	<50	<50	<50	<65	<50	<150	<160	<160	<50	100	7,200	NA	420,000
1,1-Dichloroethene	<64	<62	<65	<50	<74	<300	<320	<310	<70	140	2,600	54	570,000
cis-1,2-Dichloroethene	<64	<62	<65	<50	<74	<300	<320	<310	<70	1,400	12,000	9.2	640,000
trans-1,2-Dichloroethene	<64	<62	<65	<50	<74	<300	<320	<310	<70	2,000	30,000	340	1,400,000
1,2-Dichloropropane	<64	<62	<65	<65	<74	<300	<320	<310	<70	100	4,600	NA	550,000
cis-1,3-Dichloropropene	<50	<50	<50	<65	<52	<210	<230	<220	<50	700	180	NA	240,000
trans-1,3-Dichloropropene	<64	<62	<65	<50	<74	<300	<320	<310	<70	700	180	NA	240,000
Ethylbenzene	<50	<50	<50	<50	<50	**220**	<160	<160	<50	1,500	360	86	140,000
Ethylene Dibromide	<64	<62	<65	<50	<74	<300	<320	<310	<70	20 (M); 10	110	NA	430
2-Hexanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	58,000	ID	NA	2,500,000
Isopropylbenzene	<250	<250	<250	<250	<250	<250	<250	<250	<250	280,000	3,200	NA	390,000
Methylene Chloride	<100	<100	<100	<100	<100	<300	<320	<310	<100	100	30,000	570	2,300,000
4-Methyl-2-pentanone	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	<2,500	100,000	ID	NA	2,700,000
MTBE	<250	<250	<250	<250	<250	<250	<250	<250	<250	800	140,000	520	5,900,000

TABLE 11a
VERIFICATION SOIL ANALYTICAL RESULTS - FULL SCAN VOCs
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #2

										Part 201 Generic Cleanup Criteria*			
										Non-Residential			
Sample ID	L2FNW	L2FNE	L2FSE	L2FSW	L2SWN	L2SWE	L2SWS	L2SWSD	L2SWW	Drinking	Groundwater	RAISL+	Direct
Depth (feet)	9	9.5	9.5	9.5	4	5-6	4-5	Duplicate	5-6	Water	Surface Water	Volatilization	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of L2SWS	Soil	Protection	Interface	to Indoor	
Date Collected	1/2/19	1/2/19	1/4/19	1/4/19	1/2/19	1/8/19	1/8/19		1/8/19		Protection	Air	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East	Sidewall South		Sidewall West				
Volatiles by 8260 (μg/Kg)													
Naphthalene	<330	<330	<330	<330	<330	<610	<640	<620	<350	100,000	730	NA	52,000,000
n-Propylbenzene	<100	<100	<100	<100	<100	<300	<320	<310	<100	4,600	ID	NA	8,000,000
Styrene	<64	<62	<65	<65	<74	<300	<620	<310	<70	2,700	2,100	NA	520,000
1,1,1,2-Tetrachloroethane	<100	<100	<100	<100	<100	<300	<320	<310	<100	6,400	ID	NA	440,000
1,1,2,2-Tetrachloroethane	<64	<62	<65	<65	<74	<300	<320	<310	<70	700	1,600	NA	240,000
Tetrachloroethene	<64	<62	<65	<50	<74	<300	<320	<310	<70	100	1,200	19	88,000
Toluene	<50	<50	<50	<65	<52	<210	<230	<220	<50	16,000	5,400	16,000	250,000
1,2,4-Trichlorobenzene	<250	<250	<250	<250	<280	<1,200	<1,200	<1,200	<270	4,200	5,900	230	1,100,000
1,1,1-Trichloroethane	<64	<62	<65	<65	<74	<300	<320	<310	<70	4,000	1,800	1,900	460,000
1,1,2-Trichloroethane	<64	<62	<65	<65	<74	<300	<320	<310	<70	100	6,600	NA	840,000
Trichloroethene	<64	<62	<65	<50	<74	<300	<320	<310	<70	100	4,000	1	500,000
Trichlorofluoromethane	<100	<100	<100	<110	<100	<300	<320	<310	<100	150,000	NA	NA	560,000
1,2,3-Trichloropropane	<130	<120	<130	<110	<150	<610	<640	<640	<140	2,400	NA	NA	830,000
1,2,3-Trimethylbenzene	<100	<100	<100	<100	<100	<300	<320	<310	<100	NA	NA	1,200	NA
1,2,4-Trimethylbenzene	<100	<100	<100	<100	<100	<300	<320	<310	<100	2,100	570	650	110,000
1,3,5-Trimethylbenzene	<100	<100	<100	<100	<100	<300	<320	<310	<100	1,800	1,100	450	94,000
Vinyl Chloride	<45	**1,500**	<40	<40	<52	<210	<230	<220	<49	40	260	2	34,000
m&p-Xylene	<100	<100	<100	<100	<100	**570**	<320	<310	<100	NA	NA	NA	NA
o-Xylene	<50	<50	<50	<50	<50	**290**	<160	<160	<50	NA	NA	NA	NA
Xylenes	<150	<150	<150	<150	<150	**850**	<480	<470	<150	5,600	820	1,200	150,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
+ RAISL = Recommended Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, August 2017
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Yellow-shaded cell indicates concentration exceeds one or more applicable criteria.
Blue-shaded cell indicates reporting limit exceeds one or more applicable critera.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 11b
VERIFICATION SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #2

										Part 201 Generic Cleanup Criteria*		
										Non-Residential		
Sample ID	L2FNW	L2FNE	L2FSE	L2FSW	L2SWN	L2SWE	L2SWS	L2SWSD	L2SWW	Drinking	Groundwater	Direct
Depth (feet)	9	9.5	9.5	9.5	4	5-6	4-5	Duplicate	5-6	Water	Surface Water	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of L2SWS	Soil	Protection	Interface	
Date Collected	1/2/19	1/2/19	1/4/19	1/4/19	1/2/19	1/8/19	1/8/19		1/8/19		Protection	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East	Sidewall South		Sidewall West			
BNA Semivolatiles by 8270 (µg/Kg)												
Acenaphthene	<330	<330	<330	<330	<330	<330	<330	**520**	<330	880,000	8,700	130,000,000
Acenaphthylene	<330	<330	<330	<330	<330	<330	<330	**740**	<330	17,000	ID	5,200,000
Aniline	<330	<330	<330	<330	<330	<330	<330	<1,100	<330	4,400	330 (M); 80	150,000
Anthracene	<330	<330	<330	<330	<330	<330	**1,200**	**540**	<330	41,000	ID	730,000,000
Azobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	17,000	ID	660,000
Benzo(a)anthracene	<330	<330	<330	<330	<330	<330	**2,800**	**1,200**	<330	NLL	NLL	80,000
Benzo(a)pyrene	<330	<330	<330	<330	<330	<330	**2,600**	**1,200**	<330	NLL	NLL	8,000
Benzo(b)fluoranthene	<330	<330	<330	<330	<330	<330	**4,300**	**2,300**	<330	NLL	NLL	80,000
Benzo(ghi)perylene	<330	<330	<330	<330	<330	<330	**2,000**	**1,000**	<330	NLL	NLL	7,000,000
Benzo(k)fluoranthene	<330	<330	<330	<330	<330	<330	**1,500**	**750**	<330	NLL	NLL	800,000
Benzyl Alcohol	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	<3,300	580,000	NA	580,000
Bis(2-chloroethoxy)methane	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Bis(2-chloroethyl)ether	<100	<100	<330	<330	<100	<100	<330	<330	<330	170	100 (M); 20	58,000
Bis(2-chloroisopropyl) Ether	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Bis(2-ethylhexyl)phthalate	<330	<330	<330	<330	<330	<330	**1,600**	**1,500**	<330	NLL	NLL	10,000,000
4-Bromophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Butyl Benzyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	310,000	120,000	310,000
Carbazole	<330	<330	<330	<330	<330	<330	**360**	<330	<330	39,000	1,100	2,400,000
4-Chloro-3-methylphenol	<280	<280	<280	<280	<280	<280	<280	<280	<280	16,000	280	15,000,000
2-Chloronaphthalene	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,800,000	NA	180,000,000
2-Chlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	2,600	360	4,500,000
4-Chlorophenyl Phenylether	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Chrysene	<330	<330	<330	<330	<330	<330	**2,700**	**1,300**	<330	NLL	NLL	8,000,000
Dibenzo(a,h)anthracene	<330	<330	<330	<330	<330	<330	**500**	<330	<330	NLL	NLL	8,000
Dibenzofuran	<330	<330	<330	<330	<330	<330	**780**	**1,000**	<330	ID	1,700	ID
2,4-Dichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	4,200	330 (M); 220	1,800,000
Diethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	320,000	2,200	740,000
Dimethyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	790,000	NA	790,000
2,4-Dimethylphenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	20,000	7,600	36,000,000
Di-n-butyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	760,000	11,000	760,000
2,4-Dinitrophenol	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA
2,4-Dinitrotoluene	<330	<330	<330	<330	<330	<330	<330	<330	<330	640	NA	220,000
2,6-Dinitrotoluene	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
Di-n-octyl Phthalate	<330	<330	<330	<330	<330	<330	<330	<330	<330	140,000,000	ID	20,000,000
Fluoranthene	<330	<330	<330	<330	<330	<330	**5,300**	**2,900**	<330	730,000	5,500	130,000,000
Fluorene	<330	<330	<330	<330	<330	<330	**1,200**	**1,400**	<330	890,000	5,300	87,000,000
Hexachlorobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,800	350	37,000
Hexachlorobutadiene	<330	<330	<330	<330	<330	<330	<330	<330	<330	72,000	91	350,000
Hexachlorocyclopentadiene	<330	<330	<330	<330	<330	<330	<330	<330	<330	320,000	ID	720,000
Hexachloroethane	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,200	1,800	730,000
Indeno(1,2,3-cd)pyrene	<330	<330	<330	<330	<330	<330	**2,100**	**1,100**	<330	NLL	NLL	80,000

TABLE 11b
VERIFICATION SOIL SAMPLE ANALYTICAL RESULTS - BASE / NEUTRAL / ACID SEMIVOLATILES
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #2

										Part 201 Generic Cleanup Criteria*		
										Non-Residential		
Sample ID	L2FNW	L2FNE	L2FSE	L2FSW	L2SWN	L2SWE	L2SWS	L2SWSD	L2SWW	Drinking	Groundwater	Direct
Depth (feet)	9	9.5	9.5	9.5	4	5-6	4-5	Duplicate	5-6	Water	Surface Water	Contact
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil	of L2SWS	Soil	Protection	Interface	
Date Collected	1/2/19	1/2/19	1/4/19	1/4/19	1/2/19	1/8/19	1/8/19		1/8/19		Protection	
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East	Sidewall South		Sidewall West			
BNA Semivolatiles by 8270 (µg/Kg)												
Isophorone	<330	<330	<330	<330	<330	<330	<330	<330	<330	62,000	26,000	2,400,000
2-Methyl-4,6-dinitrophenol	<850	<850	<850	<850	<850	<850	<830	<830	<830	830 (M); 400	NA	260,000
2-Methylnaphthalene	<330	<330	<330	<330	<330	**1,800**	**2,000**	**1,900**	<330	170,000	4,200	26,000,000
2-Methylphenol	<660	<660	<660	<660	<660	<660	<660	<660	<330	20,000	1,000 (M);600	36,000,000
3&4-Methylphenol	<330	<330	<330	<330	<330	<330	<330	<330	<660	20,000	1,000 (M);600	36,000,000
2-Nitroaniline	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
3-Nitroaniline	<850	<850	<850	<850	<850	<850	<850	<850	<830	NA	NA	NA
4-Nitroaniline	<850	<850	<850	<850	<850	<850	<850	<850	<830	NA	NA	NA
Nitrobenzene	<330	<330	<330	<330	<330	<330	<330	<330	<330	330 (M); 190	3,600	340,000
2-Nitrophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	1,200	ID	2,000,000
4-Nitrophenol	<830	<830	<830	<830	<830	<830	<830	<830	<830	NA	NA	NA
N-Nitrosodimethylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	NA	NA	NA
N-Nitrosodi-n-propylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	330 (M); 100	NA	5,400
N-Nitrosodiphenylamine	<330	<330	<330	<330	<330	<330	<330	<330	<330	22,000	NA	7,800,000
Pentachlorophenol	<800	<800	<800	<800	<800	<800	<800	<800	<800	22	(G, X)	320,000
Phenanthrene	<330	<330	<330	<330	<330	<330	**3,100**	**1,300**	<330	160,000	2,100	5,200,000
Phenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	260,000	9,000	12,000,000
Pyrene	<330	<330	<330	<330	<330	<330	**5,500**	**2,600**	<330	480,000	ID	84,000,000
Pyridine	<330	<330	<330	<330	<330	<330	<330	<330	<330	42	NA	37,000
2,4,5-Trichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	110,000	NA	73,000,000
2,4,6-Trichlorophenol	<330	<330	<330	<330	<330	<330	<330	<330	<330	9,400	330 (M); 100	3,300,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012
ID = insufficient data to develop criterion
NA = a criterion or value is not available
NLL = substance not likely to leach under most soil conditions
NLV = substance not likely to volatilize under most soil conditions
G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water
M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit
X = GSI criterion shown is not protective for surface water that is used as a drinking water source
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 11c
VERIFICATION SOIL SAMPLE ANALYTICAL RESULTS - Metals
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #2

										Part 201 Generic Cleanup Criteria*				
										Non-Residential				
Sample ID	L2FNW	L2FNE	L2FSE	L2FSW	L2SWN	L2SWE	L2SWS	L2SWSD	L2SWW	Drinking Water Protection	Groundwater Surface Water Interface Protection	RAISL+ Volatilization to Indoor Air	Direct Contact	Statewide Default Background
Depth (feet)	9	9.5	9.5	9.5	4	5-6	4-5	Duplicate of L2SWS	5-6					
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil		Soil					
Date Collected	1/2/19	1/2/19	1/4/19	1/4/19	1/2/19	1/8/19	1/8/19		1/8/19					
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East	Sidewall South		Sidewall West					
Total Metals (µg/Kg)														
Arsenic	11,000	9,700	9,200	8,200	1,800	5,500	25,000	24,000	1,700	4,600	4,600	NA	37,000	5,800
Barium	35,000	53,000	64,000	59,000	41,000	34,000	190,000	180,000	27,000	1,300,000	(G)	NA	130,000,000	75,000
Cadmium	99	190	140	150	320	290	2,600	1,900	97	6,000	(G, X)	NA	2,100,000	1,200
Chromium	16,000	16,000	23,000	18,000	10,000	89,000	44,000	42,000	8,700	1,000,000,000	(G, X)	NA	1,000,000,000	18,000
Copper	12,000	16,000	15,000	17,000	7,600	15,000	240,000	190,000	5,600	5,800,000	(G)	NA	73,000,000	32,000
Lead	6,500	6,800	7,000	8,000	6,000	4,100	370,000	330,000	3,300	700,000	(G, X)	NA	900,000	21,000
Mercury	<50	<50	<50	<50	<50	53	370	410	<50	1,700	50 (M); 1.2	0.12	580,000	130
Selenium	320	340	260	330	430	330	1,700	1,500	<200	4,000	400	NA	9,600,000	410
Silver	<100	<100	<100	<100	<100	<100	410	410	<100	13,000	100 (M); 27	NA	9,000,000	1,000
Zinc	38,000	40,000	50,000	52,000	26,000	670,000	650,000	740,000	15,000	5,000,000	(G)	NA	630,000,000	47,000

*Part 201 Generic Cleanup Criteria and Screening Levels, MDEQ Administrative Rules, September 28, 2012

+ RAISL = Recommended Media-Specific Volatilization to Indoor Air Interim Action Screening Levels, August 2017

ID = insufficient data to develop criterion

NA = a criterion or value is not available

NLL = substance not likely to leach under most soil conditions

NLV = substance not likely to volatilize under most soil conditions

G = GSI criterion depends on the pH or water hardness, or both, of the receiving surface water

M = Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit

X = GSI criterion shown is not protective for surface water that is used as a drinking water source

Shaded cell indicates concentration exceeds one or more applicable criteria.

TABLE 11d
VERIFICATION SOIL ANALYTICAL RESULTS - PFAS COMPOUNDS
Soil Excavation, MacDermid, Ferndale, Oakland County, MI
LAGOON #2

										Part 201 Generic Cleanup Criteria		
										Non-Residential		
Sample ID	L2FNW	L2FNE	L2FSE	L2FSW	L2SWN	L2SWE	L2SWS	L2SWSD	L2SWW	Drinking Water Protection	Groundwater Surface Water Interface Protection*	Direct Contact
Depth (feet)	9	9.5	9.5	9.5	4	5-6	4-5	Duplicate of L2SWS	5-6			
Matrix	Soil	Soil	Soil	Soil	Soil	Soil	Soil		Soil			
Date Collected	1/2/19	1/2/19	1/4/19	1/4/19	1/2/19	1/8/19	1/8/19		1/8/19			
Location	Floor NW	Floor NE	Floor SE	Floor SW	Sidewall North	Sidewall East	Sidewall South		Sidewall West			
PFAS by ASTM D7968-17a (ng/Kg)												
N-EtFOSAA	<28	<28	<29	**88**	**15,000**	**15,000**	**510**	**310**	**52**	NA	NA	NA
FtS 4:2	<28	<28	<29	<29	<30	<31	<33	<32	<30	NA	NA	NA
FtS 6:2	<28	<28	<29	<29	**200**	<31	<33	<32	<30	NA	NA	NA
FtS 8:2	<28	<28	<29	<29	<30	<31	<33	<32	<30	NA	NA	NA
N-MeFOSAA	<28	<28	<29	<29	<30	<31	<33	<32	<30	NA	NA	NA
PFBA	<28	**310**	**250**	**430**	<30	**85**	**67**	**68**	**39**	NA	NA	NA
PFBS	**58**	**58**	**50**	**160**	**47**	**3,200**	**42**	**37**	<30	NA	NA	NA
PFDA	<110	<110	<120	<120	<120	<120	**160**	**150**	<120	NA	NA	NA
PFDoA	<28	**42**	<29	<29	**33**	<31	<33	<32	<30	NA	NA	NA
PFDS	<28	<28	<29	<29	<30	<31	<31	<32	<30	NA	NA	NA
PFHpA	<28	**54**	**58**	**86**	**77**	**59**	**72**	**47**	**32**	NA	NA	NA
PFHpS	<28	<28	**35**	**98**	**60**	**49**	**60**	**58**	<30	NA	NA	NA
PFHxA	**170**	**590**	**420**	**510**	**130**	**220**	**190**	**140**	**53**	NA	NA	NA
PFHxS-Branched	<28	<28	**55**	**210**	**32**	**36**	**86**	**76**	<30	NA	NA	NA
PFHxS-Linear	<28	<28	**240**	**710**	**130**	**200**	**430**	**310**	**33**	NA	NA	NA
PFHxS-Total	<56	<56	**300**	**910**	**160**	**230**	**510**	**380**	<60	NA	NA	NA
PFNA	<28	**36**	<29	<29	**35**	<31	<33	<32	<30	NA	NA	NA
PFNS	<28	<28	<29	<29	<30	<31	<33	<32	<30	NA	NA	NA
PFOA	<110	**160**	**580**	**800**	**500**	**1,000**	**1,100**	**760**	**400**	NA	10,000,000/350,000	NA
PFOSA	<28	<28	<29	<29	**430**	**130**	**36**	<32	<30	NA	NA	NA
PFOS-Branched	<28	<28	**1,200**	**2,600**	**2,500**	**3,500**	**2,300**	**2,500**	**190**	NA	NA	NA
PFOS-Linear	<28	<28	**2,000**	**4,100**	**9,000**	**14,000**	**8,300**	**10,000**	**340**	NA	NA	NA
PFOS-Total	<56	<56	**3,100**	**6,700**	**12,000**	**17,000**	**11,000**	**13,000**	**530**	NA	240/220	NA
PFPeA	**91**	**570**	**410**	**480**	**85**	**180**	**230**	**130**	<30	NA	NA	NA
PFPeS	**34**	**52**	**71**	**250**	**39**	**41**	**50**	<32	<30	NA	NA	NA
PFTeA	<110	<110	<120	<120	<120	<120	<130	<130	<120	NA	NA	NA
PFTriA	<28	<28	<29	<29	<30	<31	<33	<32	<30	NA	NA	NA
PFUnA	<28	<28	<29	<29	<30	<31	<33	<32	<30	NA	NA	NA

* Groundwater-surface water interface (GSI) protection criteria and GSI protection criteria for receiving waters used as human drinking water source
NA = a criterion or value is not available
Shaded cell indicates concentration exceeds one or more applicable criteria.
Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 12

SOIL SAMPLE ANALYTICAL RESULTS - PFAS COMPOUNDS

MacDermid, Ferndale, Oakland County, MI

					Part 201 Generic Cleanup Criteria		
					Non-Residential		
Sample ID	SB20-1A	SB20-1B	SB20-2A	SB20-2B	Drinking	Groundwater	Direct
Depth (feet)	0 to 0.5	3.5 to 4	0 to 0.5	3.5 to 4	Water	Surface Water	Contact
Matrix	Soil	Soil	Soil	Soil	Protection	Interface	
Date Collected	2/24/20	2/24/20	2/24/20	2/24/20		Protection*	
PFAS by ASTM D7968-17a (ng/Kg)							
N-EtFOSAA	<25	<25	<25	<25	NA	NA	NA
FtS 4:2	<25	<25	<25	<25	NA	NA	NA
FtS 6:2	<25	<25	<25	<25	NA	NA	NA
FtS 8:2	<25	<25	<25	<25	NA	NA	NA
N-MeFOSAA	<25	<25	<25	<25	NA	NA	NA
PFBA	**470**	**91**	**110**	<25	NA	NA	NA
PFBS	<25	<25	<25	<25	NA	NA	NA
PFDA	<100	<100	<100	<100	NA	NA	NA
PFDoA	**64**	<25	<25	<25	NA	NA	NA
PFDS	<25	<25	<25	<25	NA	NA	NA
PFHpA	**57**	**120**	**79**	<25	NA	NA	NA
PFHpS	<25	**260**	<25	<25	NA	NA	NA
PFHxA	**69**	**560**	**190**	**33**	NA	NA	NA
PFHxS-Branched	<10	**44**	<10	<10	NA	NA	NA
PFHxS-Linear	<21	**260**	<21	<21	NA	NA	NA
PFHxS-Total	<31	**300**	<31	<31	NA	NA	NA
PFNA	**81**	**82**	**160**	<25	NA	NA	NA
PFNS	<25	<25	<25	<25	NA	NA	NA
PFOA	**280**	**3,500**	**800**	**120**	NA	10,000,000/350,000	NA
PFOSA	<25	<25	<25	<25	NA	NA	NA
PFOS-Branched	**160**	**5,600**	**1,700**	<11	NA	NA	NA
PFOS-Linear	**2,200**	**20,000**	**3,700**	<20	NA	NA	NA
PFOS-Total	**2,400**	**25,000**	**5,400**	<31	NA	240/220	NA
PFPeA	**42**	**300**	**66**	<25	NA	NA	NA
PFPeS	<25	<25	<25	<25	NA	NA	NA
PFTeA	<100	<100	<100	<100	NA	NA	NA
PFTriA	<25	<25	<25	<25	NA	NA	NA
PFUnA	<25	<25	<25	<25	NA	NA	NA

* Groundwater-surface water interface (GSI) protection criteria and GSI protection criteria for receiving waters used as human drinking water source

NA = a criterion or value is not available

Shaded cell indicates concentration exceeds one or more applicable criteria.

Bold cells indicates concentrations in excess of the laboratory reporting limit.

TABLE 13
Summary of Remaining Impacts in Soil
MacDermid, Ferndale, MI

Sample Location	Depth of Sample (feet bgs)	Compound	Remaining Concentration (ug/kg)*	Exceeded Criteria (concentration in ug/kg)*
Volatile Organic Compounds				
Sample SB-16-101A	4 to 5	Ethylbenzene	120	non-residential RIASL for volatilization to indoor air (86)
Sample SB-16-113A	5 to 6	Chlorobenzene	460	non-residential RIASL for volatilization to indoor air (360)
Sample L1FNW	8	Chlorobenzene	85,000	non-residential drinking water protection criteria (2,000), GSI protection (500), and RIASL for volatilization to indoor air (360)
		Methylene chloride	150	non-residential drinking water protection criteria (100)
		1,2-dichlorobenzene	520	non-residential GSI protection criteria (280)
		1,4-dichlorobenzene	170	non-residential RIASL for volatilization to indoor air (160)
Sample L1SWN	6 to 7	Benzene	110	non-residential drinking water protection criteria (100) and RIASL for volatilization to indoor air (12)
		Chlorobenzene	83,000	non-residential drinking water protection criteria (2,000), GSI protection (500), and RIASL for volatilization to indoor air (360)
		Ethylbenzene	2,100	non-residential drinking water protection criteria (1,500), GSI protection (360), and RIASL for volalitization to indoor air (86)
		Xylenes	9,500	non-residential drinking water protection criteria (5,600), GSI protection (820), and RIASL for volatilization to indoor air (1,200)
		1,2-dichlorobenzene	2,600	non-residential GSI protection criteria (280)
		Naphthalene	950	non-residential GSI protection criteria (730)
Sample L2FNE	9.5	Vinyl chloride	1,500	non-residential drinking water protection criteria (40), GSI protection (260), and RIASL for volatilization to indoor air (2)
Sample L2SWE	5 to 6	Ethylbenzene	220	non-residential RIASL for volatilization to indoor air (86)
		Xylenes	850	non-residential GSI protection criteria (820)

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TABLE 13
Summary of Remaining Impacts in Soil
MacDermid, Ferndale, MI

Sample Location	Depth of Sample (feet bgs)	Compound	Remaining Concentration (ug/kg)*	Exceeded Criteria (concentration in ug/kg)*
Semi-Volatile Organic Compounds				
Sample SB-16-102A	4 to 5	Phenanthrene	2,500	non-residential GSI protection criteria (2,100)
Sample SB-16-105A	1 to 2	Fluoranthene	5,600	non-residential GSI protection criteria (5,500)
		Phenanthrene	5,400	non-residential GSI protection criteria (2,100)
Sample SB-16-115A	3 to 4	Phenanthrene	2,100	non-residential GSI protection criteria (2,100)
Sample SB-16-116A	4 to 5	2-Methylnaphthalene	4,600	non-residential GSI protection criteria (4,200)
		Phenanthrene	4,700	non-residential GSI protection criteria (2,100)
Sample MW-16-4	4 to 5	Fluoranthene	8,800	non-residential GSI protection criteria (5,500)
		Phenanthrene	5,000	non-residential GSI protection criteria (2,100)
Sample MW-16-5	4 to 5	Carbazole	1,200	non-residential GSI protection criteria (1,100)
		Fluoranthene	12,000	non-residential GSI protection criteria (5,500)
		Phenanthrene	11,000	non-residential GSI protection criteria (2,100)
Sample L2SWS	4 to 5	Phenanthrene	3,100	non-residential GSI protection criteria (2,100)

TABLE 13
Summary of Remaining Impacts in Soil
MacDermid, Ferndale, MI

Sample Location	Depth of Sample (feet bgs)	Compound	Remaining Concentration (ug/kg)*	Exceeded Criteria (concentration in ug/kg)*
Metals				
Sample SB-16-116A	4 to 5	Lead	1,100,000	non-residential direct contact criteria (900,000)
Sample SB-16-116C	4 to 5	Arsenic	140,000	non-residential direct contact criteria (37,000)
		Lead	1,800,000	non-residential direct contact criteria (900,000)
Sample MW-16-5	4 to 5	Lead	1,700,000	non-residential direct contact criteria (900,000)
Sample L1SWN	6 to 7	Selenium	430	non-residential GSI protection criteria (400)
		Silver	220	non-residential GSI protection criteria (100)
Sample L2SWE	5 to 6	Mercury	53	non-residential GSI protection (50), and RIASL for volatilization to indoor air (0.12)
Sample L2SWS	4 to 5	Mercury	370	non-residential GSI protection criteria (50)
		Selenium	410	non-residential GSI protection criteria (400)

Arsenic was found in all verification soil samples except L1SWE, L1SWS, L2SWN, and L2SWW at a concentration above the non-residential drinking water protection criteria (4,600), groundwater surface water interface protection criteria (4,600), and the statewide default background concentration (5,800). No verification samples, however, contained arsenic at concentrations above direct contact criteria.

TABLE 13

Summary of Remaining Impacts in Soil
MacDermid, Ferndale, MI

Sample Location	Depth of Sample (feet bgs)	Compound	Remaining Concentration (ug/kg)*	Exceeded Criteria (concentration in ug/kg)*
PFAS Compounds (concentration in nanogram / kilogram (ng/kg))				
Sample L1FSW	9	PFOS	220	non-residential GSI protection criteria (240/220)+
Sample L1SWN	6 to 7	PFOS	3,000	non-residential GSI protection criteria (240/220)+
Sample L1SWE	5 to 6	PFOS	470	non-residential GSI protection criteria (240/220)+
Sample L1SWS	5 to 6	PFOS	2,300	non-residential GSI protection criteria (240/220)+
Sample L1SWW	5 to 6	PFOS	6,200	non-residential GSI protection criteria (240/220)+
Sample L2FSE	9.5	PFOS	3,100	non-residential GSI protection criteria (240/220)+
Sample L2FSW	9.5	PFOS	6,700	non-residential GSI protection criteria (240/220)+
Sample L2SWN	4	PFOS	12,000	non-residential GSI protection criteria (240/220)+
Sample L2SWE	5 to 6	PFOS	17,000	non-residential GSI protection criteria (240/220)+
Sample L2SWS	4 to 5	PFOS	11,000	non-residential GSI protection criteria (240/220)+
Sample L2SWW	5 to 6	PFOS	530	non-residential GSI protection criteria (240/220)+
Sample SB20-1A	0 to 0.5	PFOS	2,400	non-residential GSI protection criteria (240/220)+
Sample SB20-1B	3.5 to 4	PFOS	25,000	non-residential GSI protection criteria (240/220)+
Sample SB20-2A	0 to 0.5	PFOS	5,400	non-residential GSI protection criteria (240/220)+

Notes:
* ug/kg = micrograms per kilogram for all compounds, except PFAS compounds, which are in nanograms/kilogram (ng/kg)
+ GSI protective of surface water not used as a drinking water source / GSI protective of surface water used as a drinking water source (ng/kg)
RIASL = Recommended Interim Action Screening Levels
GSI = Groundwater/Surface Water Protection Criteria

TABLE 14
SOIL EXPOSURE PATHWAY CHARACTERIZATION
RCRA FACILITY INVESTIGATION - MacDERMID
FERNDALE, MICHIGAN

Nonresidential Exposure Pathway	Criteria Exceeded?[1]	Exposure Pathway Relevant?[2]	Criteria Applicable?[3]	Pathway of Concern?[4]
Nonresidential Drinking Water Protection	Yes	No	No	No
GSI Protection	Yes	No	Yes	No
Soil Volatilization to Indoor Air Inhalation/RIASL	Yes	Yes	Yes	Yes
Direct Contact	Yes	Yes	Yes	Yes

Notes
1 Does any regulated compound detected at the site exceed the RBSL?
2 Pathway is relevant when exposure can occur (even if exposure controls are relied upon, and even if concentrations are below applicable criteria).
3 Criteria associated with a relevant pathway are applicable unless land use restrictions or institutional controls are relied upon to prevent exposures.
4 Is the pathway a concern, based on contaminant concentrations, relevant pathways, and applicability of the RBSL?

TABLE 15
GROUNDWATER EXPOSURE PATHWAY CHARACTERIZATION
RCRA FACILITY INVESTIGATION - MacDERMID
FERNDALE, MICHIGAN

Nonresidential Exposure Pathway	Criteria Exceeded?[1]	Exposure Pathway Relevant?[2]	Criteria Applicable?[3]	Pathway of Concern?[4]
Nonresidential Drinking Water	Yes	No	No	No
Groundwater/Surface Water Interface	Yes	No	Yes	No
Nonresidential GW Volatilization to Indoor Air	No	Yes	Yes	Yes

Notes
1 Does any regulated compound detected at the site exceed the RBSL?
2 Pathway is relevant when exposure can occur (even if exposure controls are relied upon, and even if concentrations are below applicable criteria).
3 Criteria associated with a relevant pathway are applicable unless land use restrictions or institutional controls are relied upon to prevent exposures.
4 Is the pathway a concern, based on contaminant concentrations, relevant pathways, and applicability of the RBSL?

TABLE 16
Summary of Exposure Pathways and Remedial Measures
MacDermid, Ferndale, MI

Media/Pathway	Remedial Measure / Mitigation Method
Non-residential Critera	
Non-residential Exposure	Currently zoned "M-2 General Industrial" Restrictive Covenant to limit future land use to current zoning (non-residential land use)
Soil	
Drinking Water Protection	No Current Exposure - No drinking water wells on site Groundwater Not In An Aquifer Restrictive Covenant prohibiting potable well installation
Groundwater/Surface Water Protection	No Current Exposure - No surface water bodies or connection to surface water Long-term monitoring program for surface water management
Soil Volatilization to Indoor Air	No Current Exposure - No structures over soil impacts Restrictive Covenant to require soil vapor investigation for new structures Vapor mitigation measures required if necessary
Direct Contact	No Current Exposure - Soil at concentrations above criteira covered with clean soil Restrictive Covenant for soil management Long-term monitoring program for soil exposure and soil management
Groundwater	
Drinking Water Ingestion	No Current Exposure - No drinking water wells on site Groundwater Not In An Aquifer Restrictive Covenant prohibiting potable well installation
Groundwater/Surface Water Interface	No Current Exposure - No surface water bodies or connection to surface water Long-term monitoring program for surface water management
Groundwater Volatilization to Indoor Air	No Current Exposure - No groundwater concentrations above criteria Restrictive Covenant to require soil vapor investigation for new structures Vapor mitigation measures required if necessary

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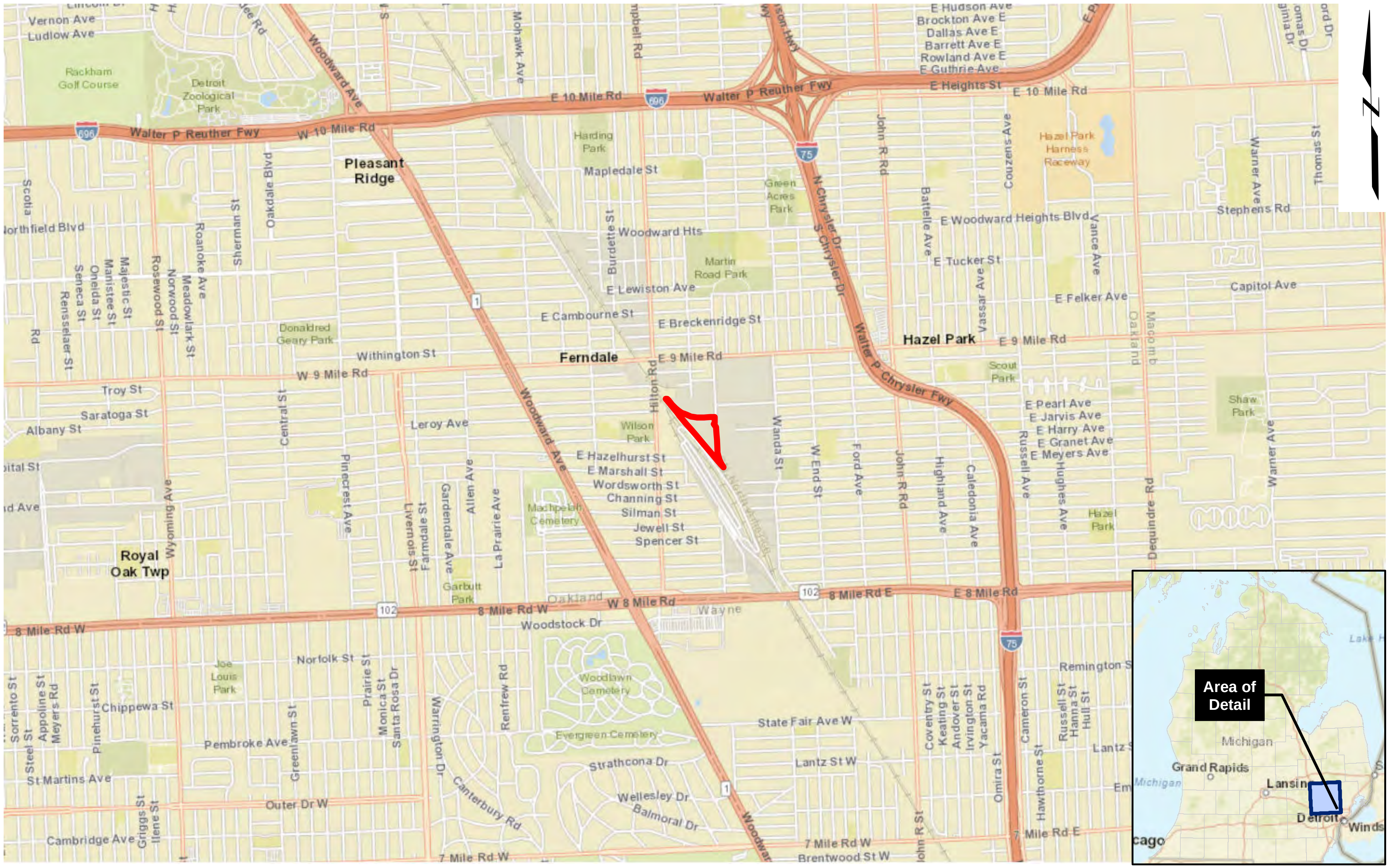

Approximate Property Boundary

0 1,500 3,000

Feet

RCRA Facility Investigation
Corrective Measures Implementation Work Plan
MID 005 338 371

MacDermid, Inc.
Ferndale, Michigan

GEI Consultants

Project 1601470

SITE LOCATION

March 2020

Fig. 1

W:\MacDermid_Ferndale\GIS\Fig1_Site_Location.mxd

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,

Approximate Property Boundary

0 125 250

Feet

RCRA Facility Investigation
Corrective Measures Implementation Work Plan
MID 005 338 371

MacDermid, Inc.
Ferndale, Michigan

GEI Consultants

Project 1601470

SITE PROPERTY LAYOUT
AND SURROUNDING AREA

March 2020

Fig. 2

W:\MacDermid_Ferndale\GIS\Fig2_PropertyLayout.mxd

Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

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GEI Consultants

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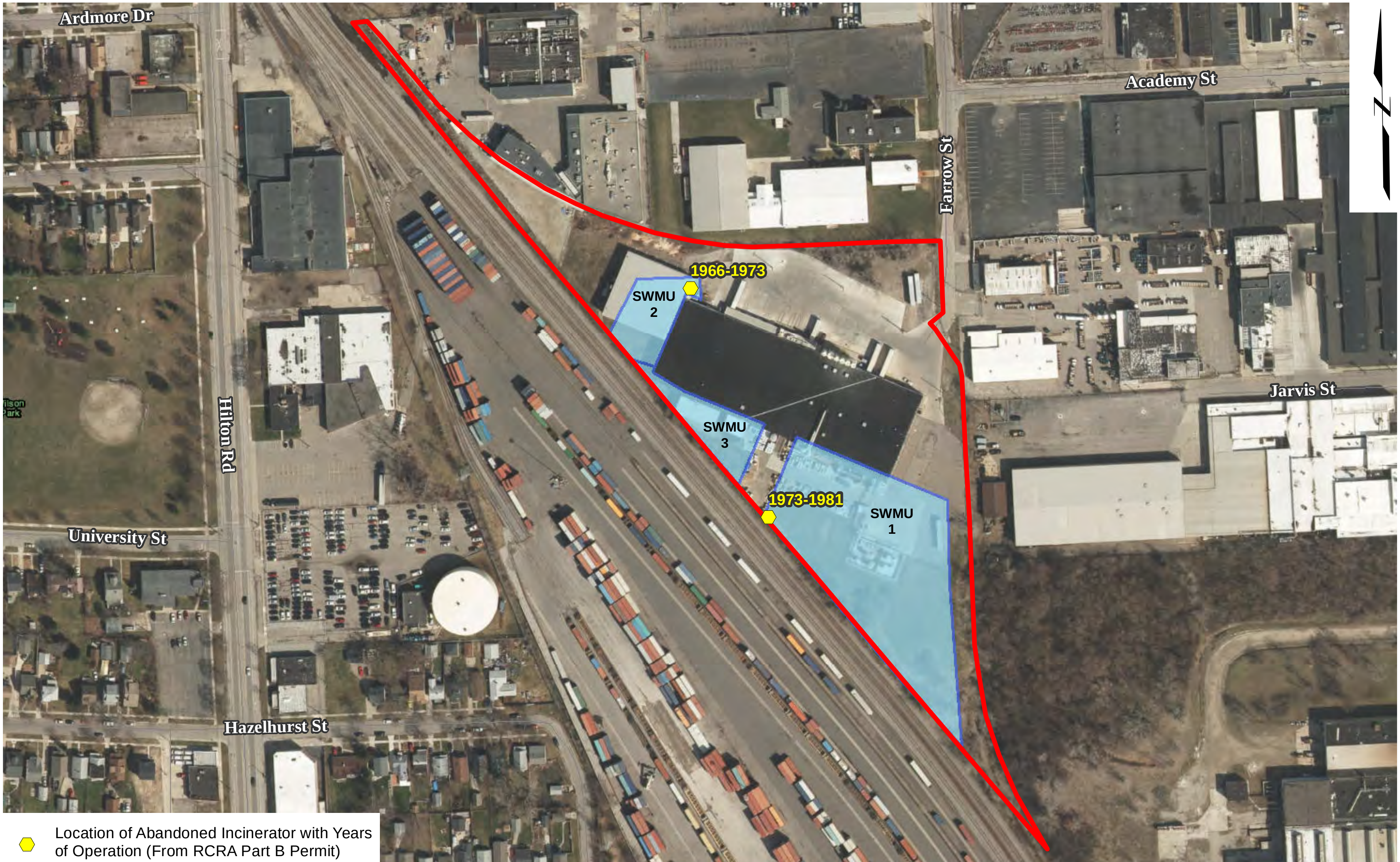
GENERALIZED LAYOUT OF THE SITE BUILDING

March 2020

Fig. 3

W:\MacDermid_Ferndale\GIS\Fig3_BldgLayout.mxd

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA,



Location of Abandoned Incinerator with Years of Operation (From RCRA Part B Permit)

Approximate Property Boundary

Solid Waste Management Unit (SWMU)

0 125 250

Feet

RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	LOCATION OF THE THREE SWMUs	
MacDermid, Inc. Ferndale, Michigan	Project 1601470	March 2020	Fig. 4

W:\MacDermid_Ferndale\GIS\Fig4_SWMU_Layout.mxd

Approximate Location of Former Lagoons
Approximate Property Boundary
Solid Waste Management Unit (SWMU)

0 50 100
Feet

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MID 005 338 371

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SWMU NO. 1 WITH LOCATION OF FORMER LAGOONS

March 2020

Fig. 5

W:\MacDermid_Ferndale\GIS\Fig5_SWMU_1.mxd

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RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	LOCATION OF RFI SOIL BORINGS, SWMU NO. 1	
MacDermid, Inc. Ferndale, Michigan	Project 1601470	March 2020	Fig. 6A

W:\MacDermid_Ferndale\GIS\Fig6A_SB_SWMU_1.mxd

Soil Boring
Approximate Property Boundary
Solid Waste Management Unit (SWMU)

0 37.5 75
Feet

RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	LOCATION OF RFI SOIL BORINGS, SWMU NO. 2	
MacDermid, Inc. Ferndale, Michigan	Project 1601470	March 2020	Fig. 6B

W:\MacDermid_Ferndale\GIS\Fig6B_SB_SWMU_2.mxd

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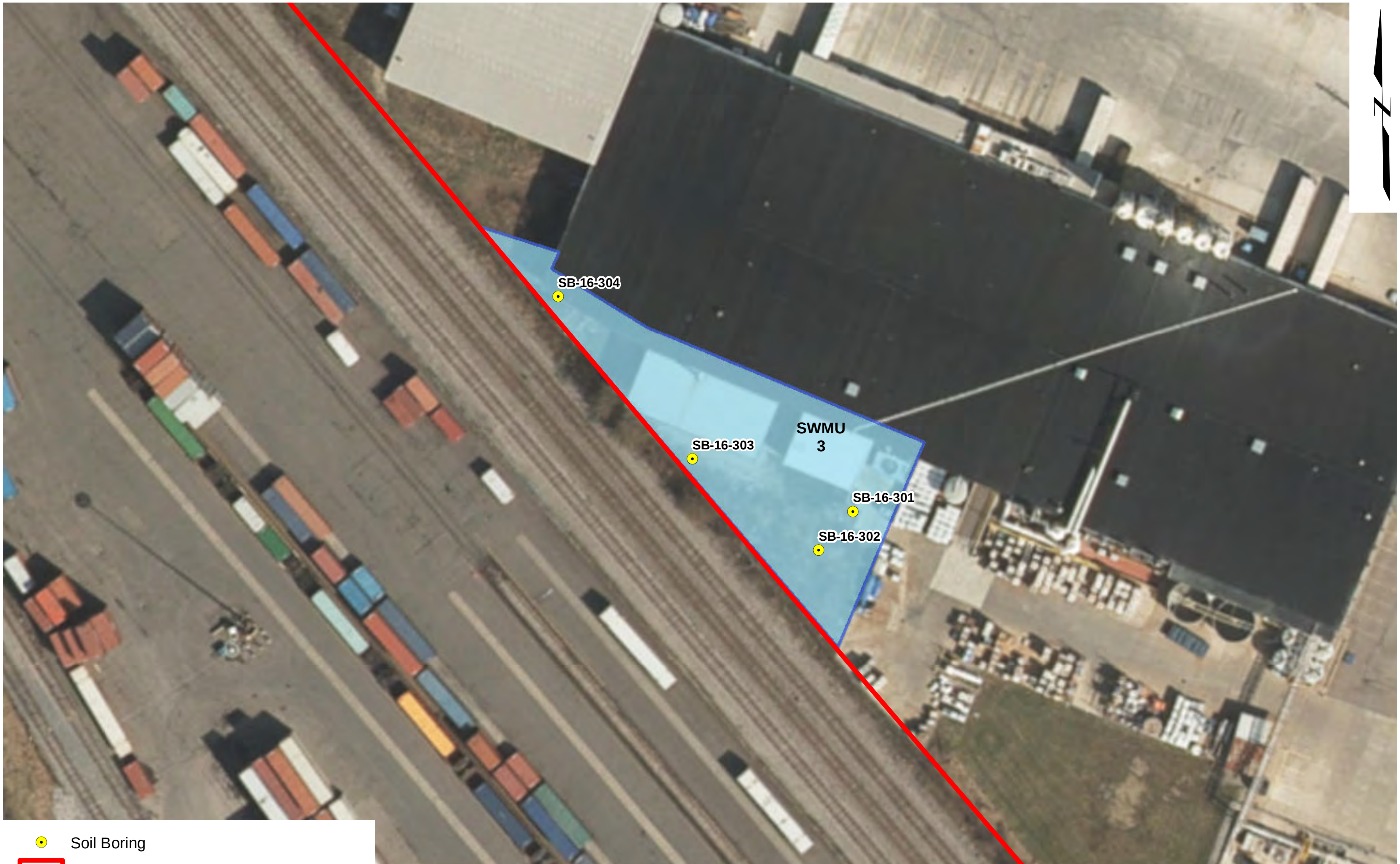

Soil Boring
Approximate Property Boundary
Solid Waste Management Unit (SWMU)

0 37.5 75
Feet

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Corrective Measures Implementation Work Plan
MID 005 338 371

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Ferndale, Michigan

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LOCATION OF RFI SOIL BORINGS, SWMU NO. 3

March 2020

Fig. 6C

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Monitoring Wells
Approximate Location of Former Lagoons
Approximate Property Boundary
Solid Waste Management Unit (SWMU)

0 50 100
Feet

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LOCATION OF MONITORING WELLS, SWMU NO. 1

March 2020

Fig. 7

W:\MacDermid_Ferndale\GIS\Fig7_MW_SWMU_1.mxd

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LOCATION OF GEOLOGIC CROSS SECTIONS

Project 1601470

March 2020

Fig. 8

W:\MacDermid_Ferndale\GIS\Fig8_CrossSections.mxd

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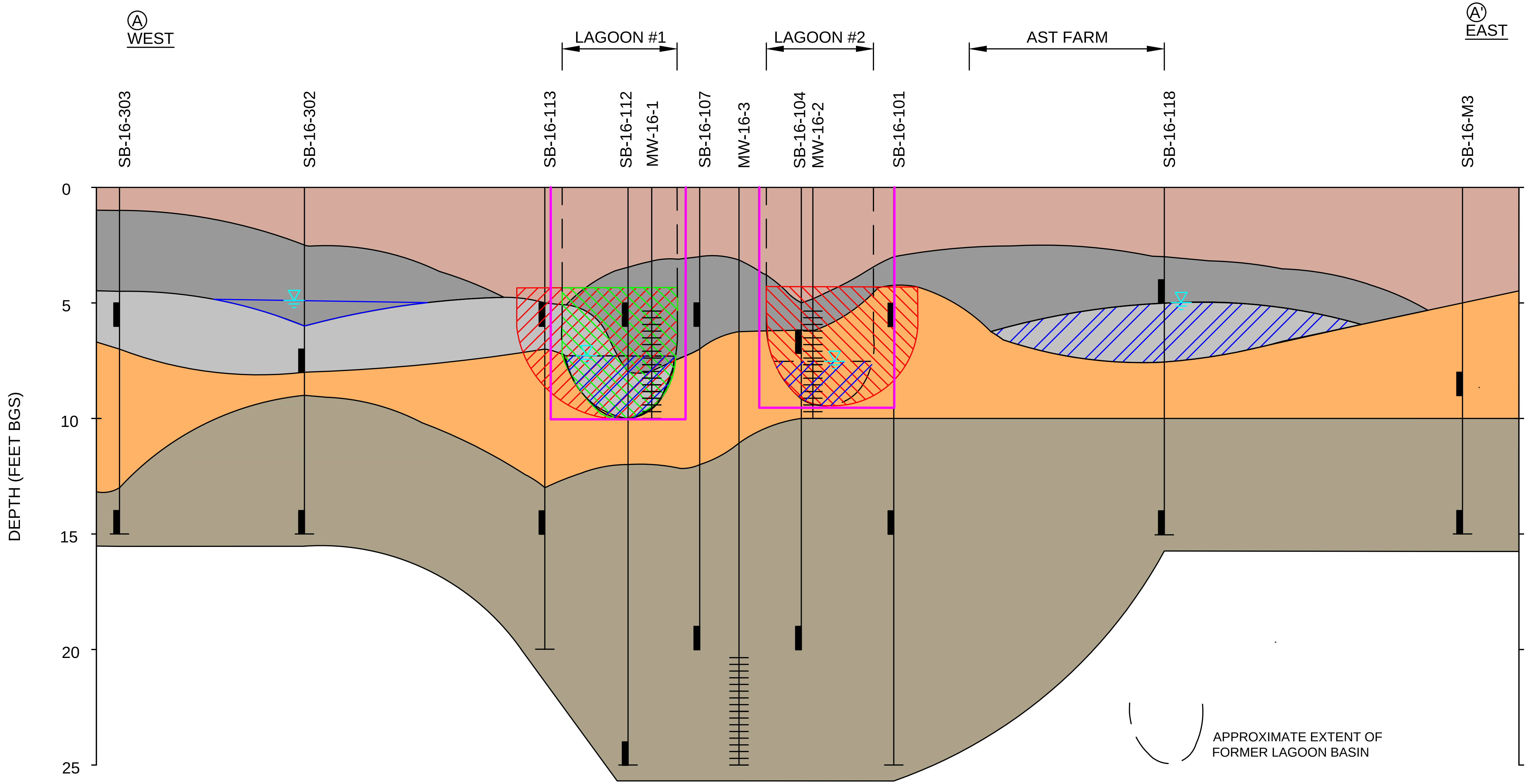


EXTENT OF SOIL EXCAVATION NOV 2018-JAN 2019

WATER LEVEL AND SATURATED INTERVAL OBSERVED WHILE SAMPLING

SOIL SAMPLE INTERVAL

MONITORING WELL SCREEN INTERVAL

HORIZONTAL SCALE: 1" = 50'
0 50' 100'

0 5' 10'
VERTICAL SCALE: 1" = 5'
NOTE: 10x VERTICAL EXAGGERATION

FILL

ARTIFICIAL FILL SOIL, INCLUDING:

- SILTY CLAY TOPSOIL,
- BROWN SILTY CLAY WITH GRAVEL

- SILTY FINE SAND WITH OR WITHOUT FRAGMENTS OF BRICK, CONCRETE, WOOD, COAL, GLASS, CINDERS, SLAG AND ORGANICS
- BLACK TO TAN-BROWN TO RUSTY-RED SILTY SAND

- TAN, GRAY-BROWN, OLIVE GREEN, AND GRAY-BLACK SILTY CLAY

VOC IMPACTS > APPLICABLE CRITERIA

GLACIAL TILL

TAN-BROWN SILTY CLAY WITH GRAVEL

SILTY CLAY WITH GRAVEL, GENERALLY WITH GRAY TO ORANGE MOTTLES. HARD AND MOIST, EXCEPT IN RARE CASES WHERE THE OVERLYING FILL MATERIAL IS SATURATED. REPRESENTS THE UPPER, OXIDIZED PORTION OF THE NATIVE GLACIAL TILL. MUNSELL COLOR 2.5Y 5/2 (GRAYISH BROWN) TO 2.5Y 5/3 (LIGHT OLIVE BROWN). COLOR GRADES INTO UNDERLYING GRAY-BROWN SILTY CLAY WITH GRAVEL TILL.

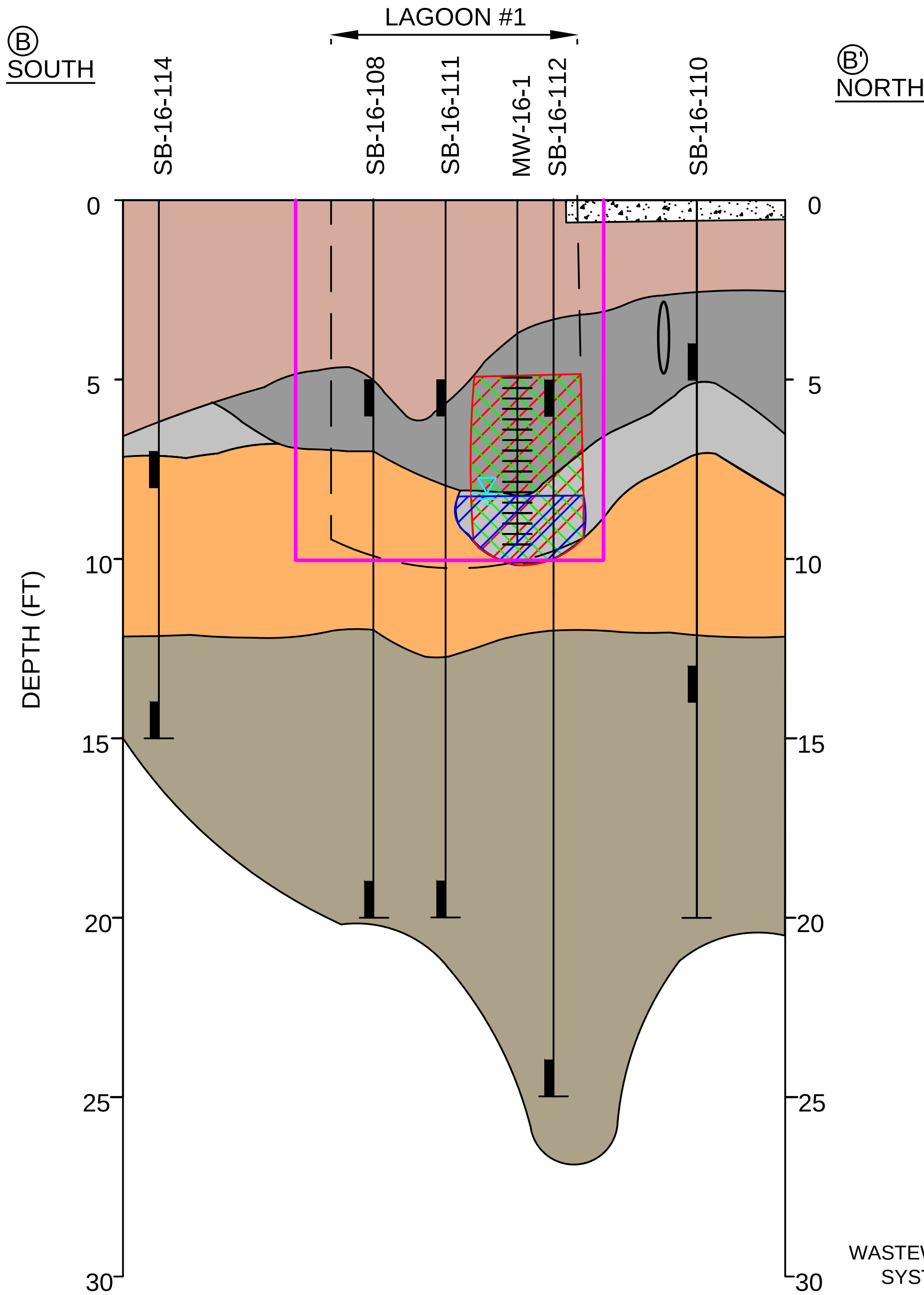
GRAY-BROWN SILTY CLAY WITH GRAVEL

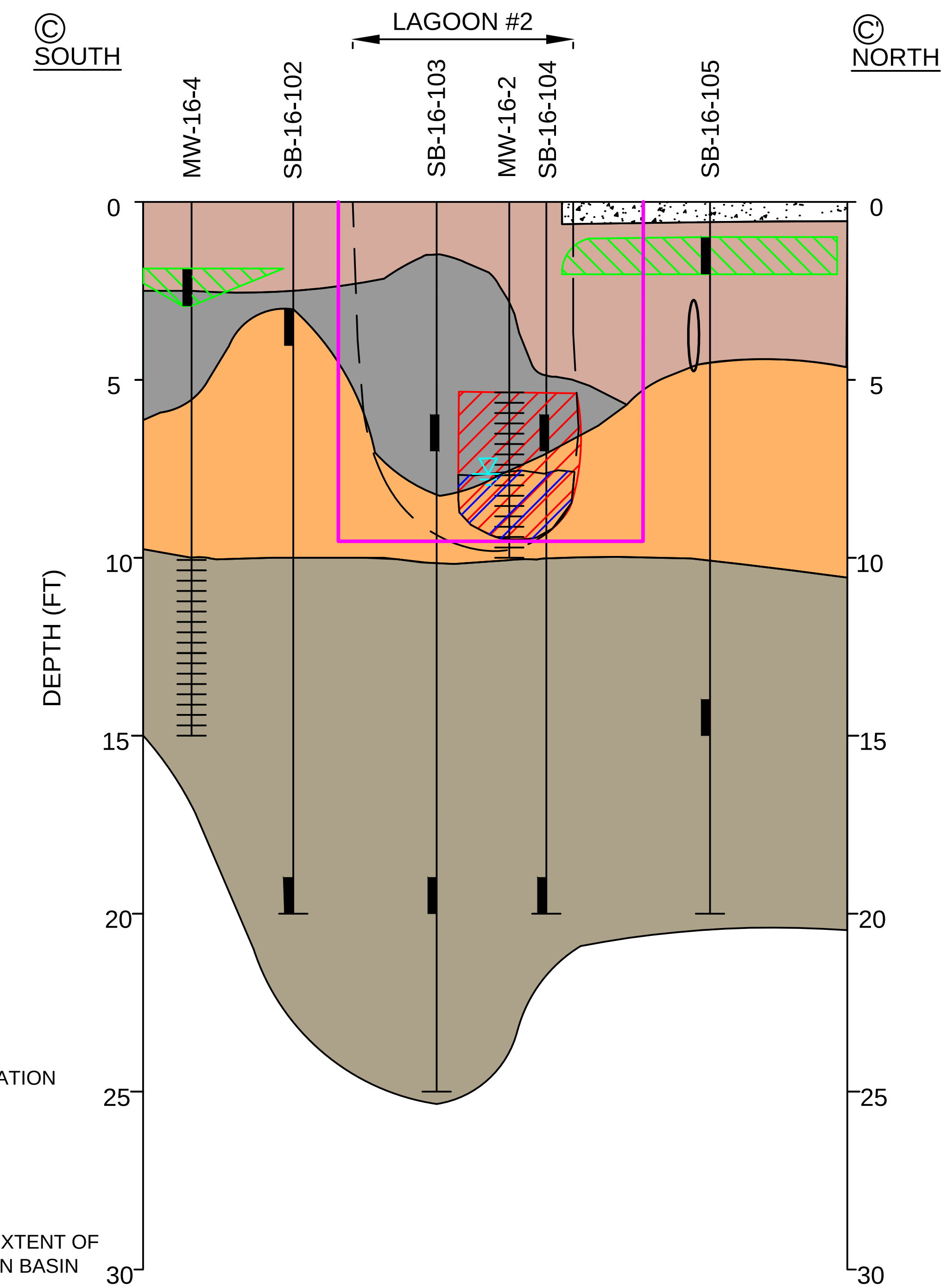
SILTY CLAY WITH GRAVEL. HARD AND MOIST. REPRESENTS THE UNOXIDIZED NATIVE GLACIAL TILL. MUNSELL COLOR 2.5Y 4/1 (DARK GRAY).

SVOC IMPACTS > APPLICABLE CRITERIA

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN MID 005 338 371	GEI Consultants	SECTION A-A'
MACDERMID, INC. FERNDALE, MICHIGAN	Project 1601470	March, 2020 Fig. 9a

\\MQT1L-GCARV W:\MacDermid_Ferndale\CAD\Figures\Ferndale_Section_B1.dwg - 3/10/2020





EXTENT OF SOIL EXCAVATION
NOV 2018-JAN 2019

WASTEWATER TREATMENT
SYSTEM STORM SEWER

APPROXIMATE EXTENT OF
FORMER LAGOON BASIN

FILL

ARTIFICIAL FILL SOIL, INCLUDING:

- SILTY CLAY TOPSOIL,
- BROWN SILTY CLAY WITH GRAVEL

- SILTY FINE SAND WITH OR WITHOUT FRAGMENTS OF BRICK, CONCRETE, WOOD, COAL, GLASS, CINDERS, SLAG AND ORGANICS
- BLACK TO TAN-BROWN TO RUSTY-RED SILTY SAND

- TAN, GRAY-BROWN, OLIVE GREEN, AND GRAY-BLACK SILTY CLAY

VOC IMPACTS > APPLICABLE CRITERIA

GLACIAL TILL

TAN-BROWN SILTY CLAY WITH GRAVEL

SILTY CLAY WITH GRAVEL, GENERALLY WITH GRAY TO ORANGE MOTTLES. HARD AND MOIST, EXCEPT IN RARE CASES WHERE THE OVERLYING FILL MATERIAL IS SATURATED. REPRESENTS THE UPPER, OXIDIZED PORTION OF THE NATIVE GLACIAL TILL. MUNSELL COLOR 2.5Y 5/2 (GRAYISH BROWN) TO 2.5Y 5/3 (LIGHT OLIVE BROWN). COLOR GRADES INTO UNDERLYING GRAY-BROWN SILTY CLAY WITH GRAVEL TILL.

GRAY-BROWN SILTY CLAY WITH GRAVEL

SILTY CLAY WITH GRAVEL. HARD AND MOIST. REPRESENTS THE UNOXIDIZED NATIVE GLACIAL TILL. MUNSELL COLOR 2.5Y 4/1 (DARK GRAY).

SVOC IMPACTS > APPLICABLE CRITERIA

CONCRETE

WATER LEVEL AND SATURATED INTERVAL OBSERVED WHILE SAMPLING

SOIL SAMPLE INTERVAL

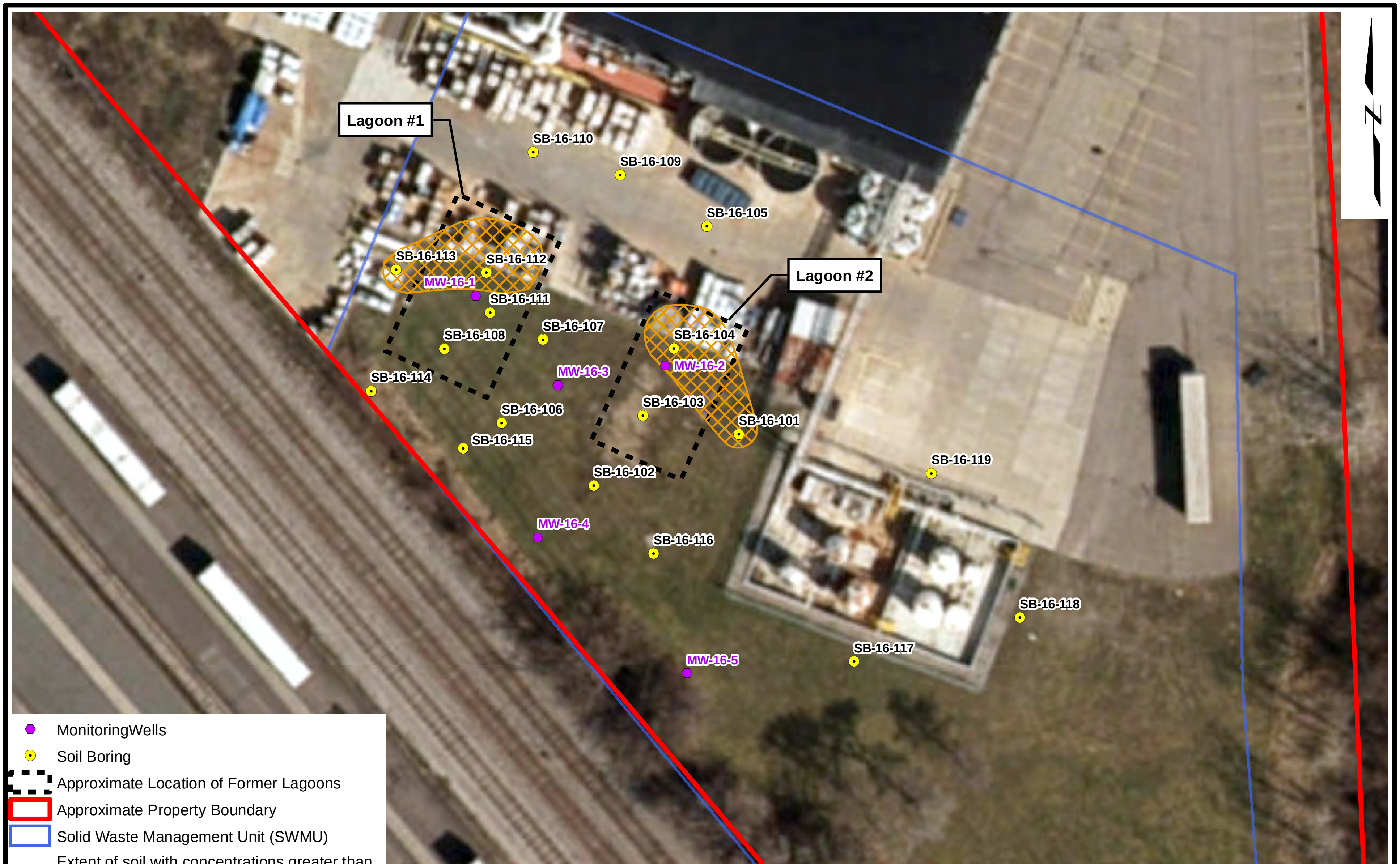
MONITORING WELL SCREEN INTERVAL

HORIZONTAL SCALE: 1" = 50'
0 50' 100'

0 5' 10'
VERTICAL SCALE: 1" = 5'
NOTE: 10x VERTICAL EXAGGERATION

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN MID 005 338 371	GEI Consultants	SECTION B-B' & SECTION C-C'
MACDERMID, INC. FERNDALE, MICHIGAN	Project 1601470	March, 2020 Fig. 9b

\\MQT1L-GCARV W:\MacDermid_Ferndale\CAD\Figures\Ferndale_Section_B1.dwg - 3/10/2020



RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	EXTENT OF VOC IMPACTS, SWMU NO. 1 FROM RFI	
MacDermid, Inc. Ferndale, Michigan	Project 1601470	March 2020	Fig. 10A

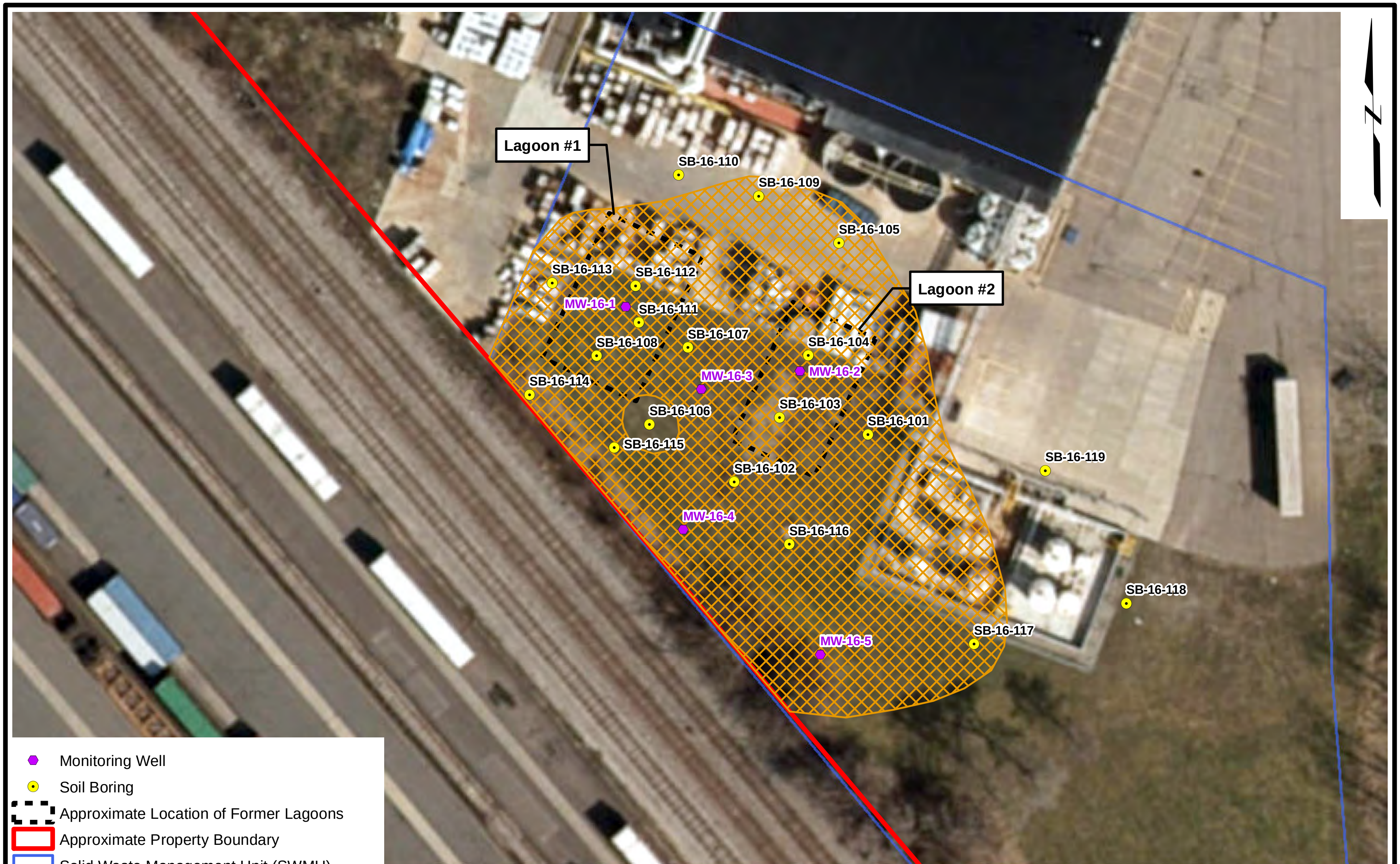
W:\MacDermid_Ferndale\GIS\Fig10A_VOC_SWMU_1.mxd

Monitoring Well
Soil Boring
Approximate Location of Former Lagoons
Approximate Property Boundary
Solid Waste Management Unit (SWMU)
Extent of soil with concentrations greater than non-residential drinking water protection and groundwater-surface water interface protection criteria

0 25 50
Feet

RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	EXTENT OF SVOC IMPACTS, SWMU NO. 1 FROM RFI
MacDermid, Inc. Ferndale, Michigan	Project 1601470	March 2020 Fig. 10B

W:\MacDermid_Ferndale\GIS\Fig10B_SVOC_SWMU_1.mxd



RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	EXTENT OF METALS IMPACTS, SWMU NO. 1 FROM RFI	
MacDermid, Inc. Ferndale, Michigan	Project 1601470	March 2020	Fig. 10C

W:\MacDermid_Ferndale\GIS\Fig10C_Metals_SWMU_1.mxd

Monitoring Well
Approximate Location of Former Lagoons
Approximate Property Boundary
Solid Waste Management Unit (SWMU)
Extent of soil with concentrations greater than non-residential drinking water protection, groundwater-surface water interface protection, and/or direct contact criteria

0 25 50
Feet

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EXTENT OF GROUNDWATER IMPACTS, SWMU NO. 1

March 2020

Fig. 11

W:\MacDermid_Ferndale\GIS\Fig11_Groundwater_SWMU_1.mxd

Soil Gas Probe Location
Monitoring Well
Soil Boring
Approximate Location of Former Lagoons
Approximate Property Boundary

0 25 50
Feet

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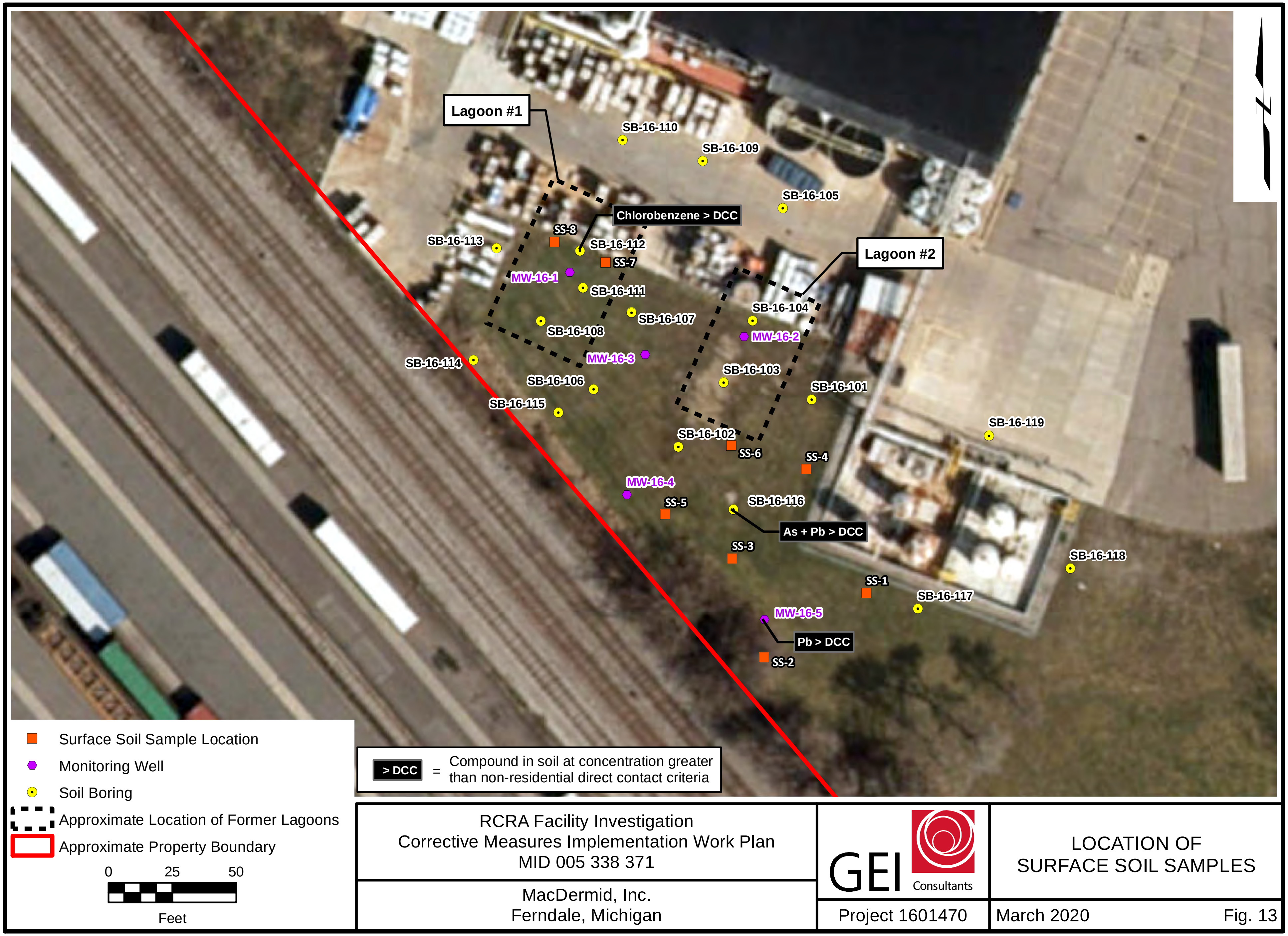
LOCATION OF SOIL VAPOR SAMPLES

March 2020

Fig. 12

W:\MacDermid_Ferndale\GIS\Fig12_SoilVaporProbes.mxd



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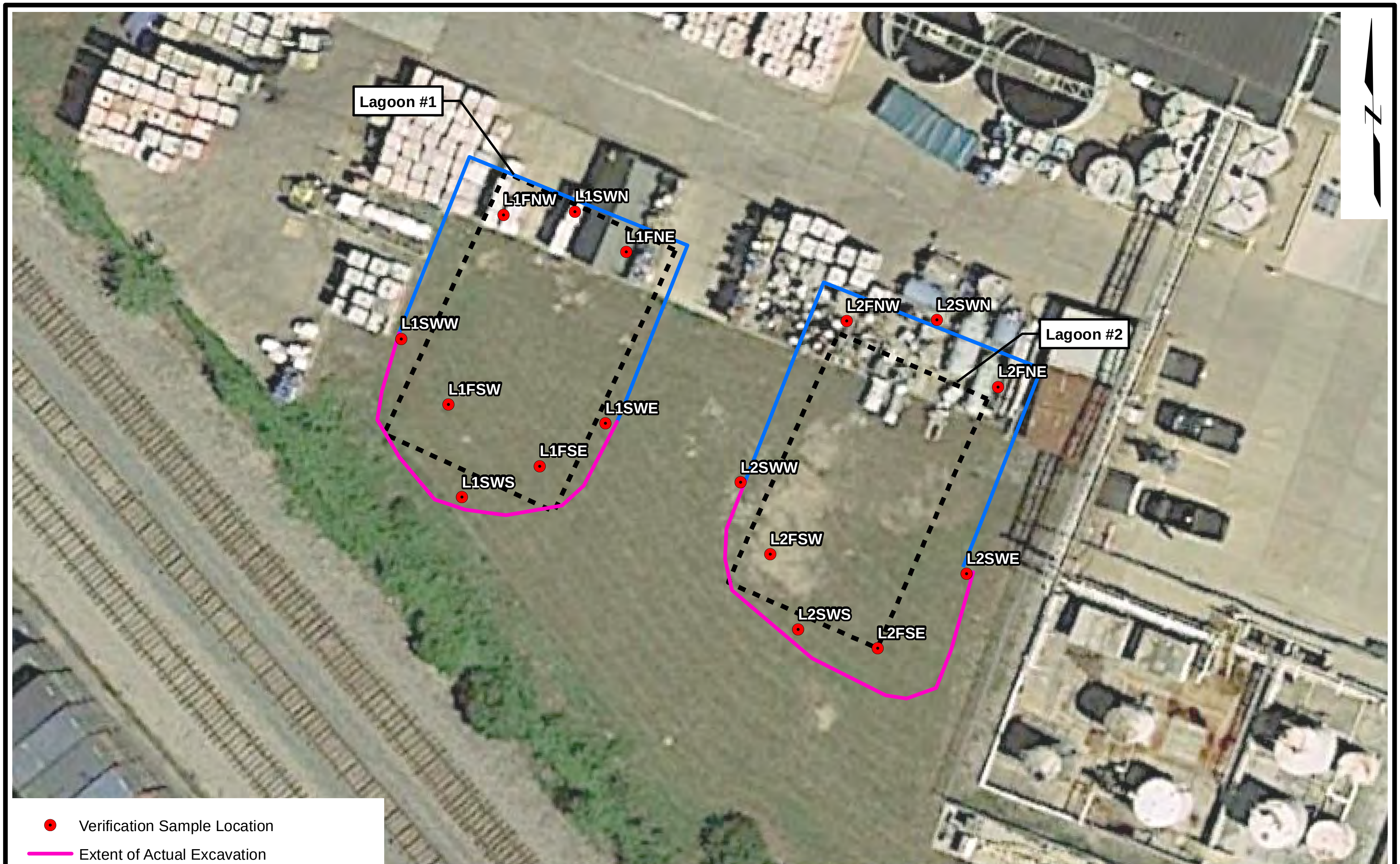
LOCATION OF
SURFACE SOIL SAMPLES

March 2020 | Fig. 13

W:\MacDermid_Ferndale\GIS\Fig13_Soil_Samples.mxd



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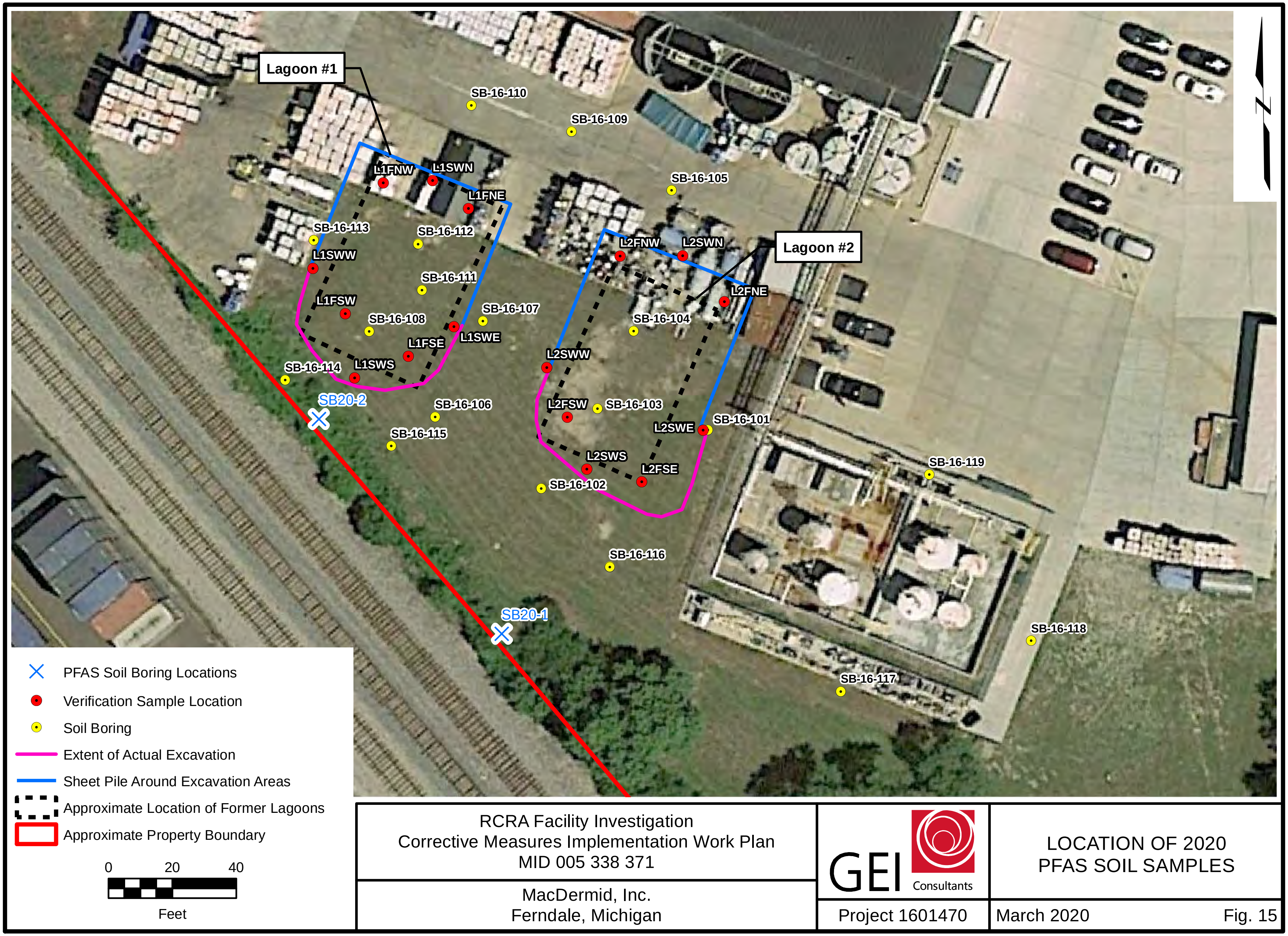
LOCATION OF EXCAVATION VERIFICATION SAMPLES

March 2020

Fig. 14

W:\MacDermid_Ferndale\GIS\Fig14_Excavation_Verification_Samples.mxd



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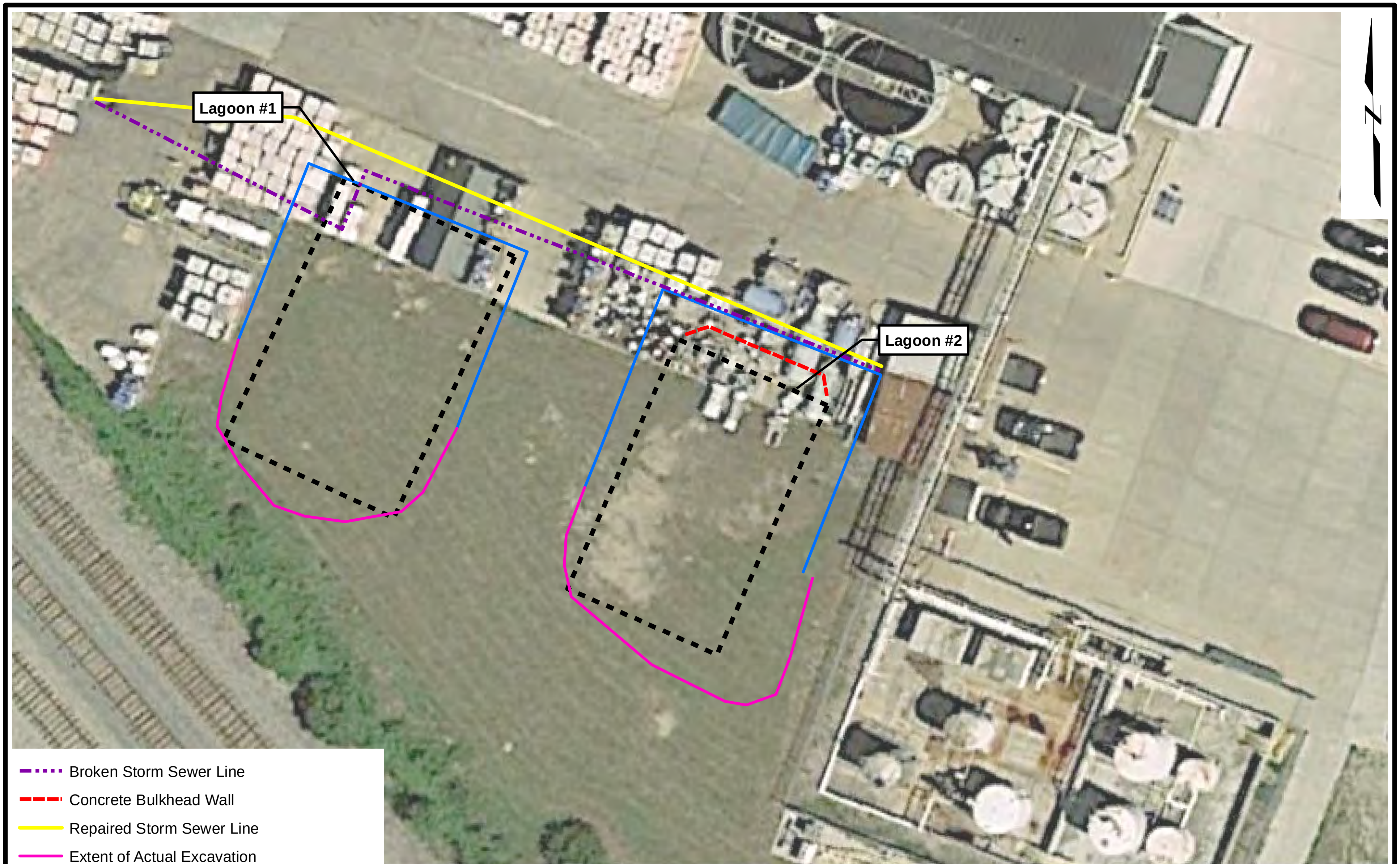
LOCATION OF 2020
PFAS SOIL SAMPLES

March 2020

Fig. 15

W:\MacDermid_Ferndale\GIS\Fig15_2020_PFAS_Samples.mxd



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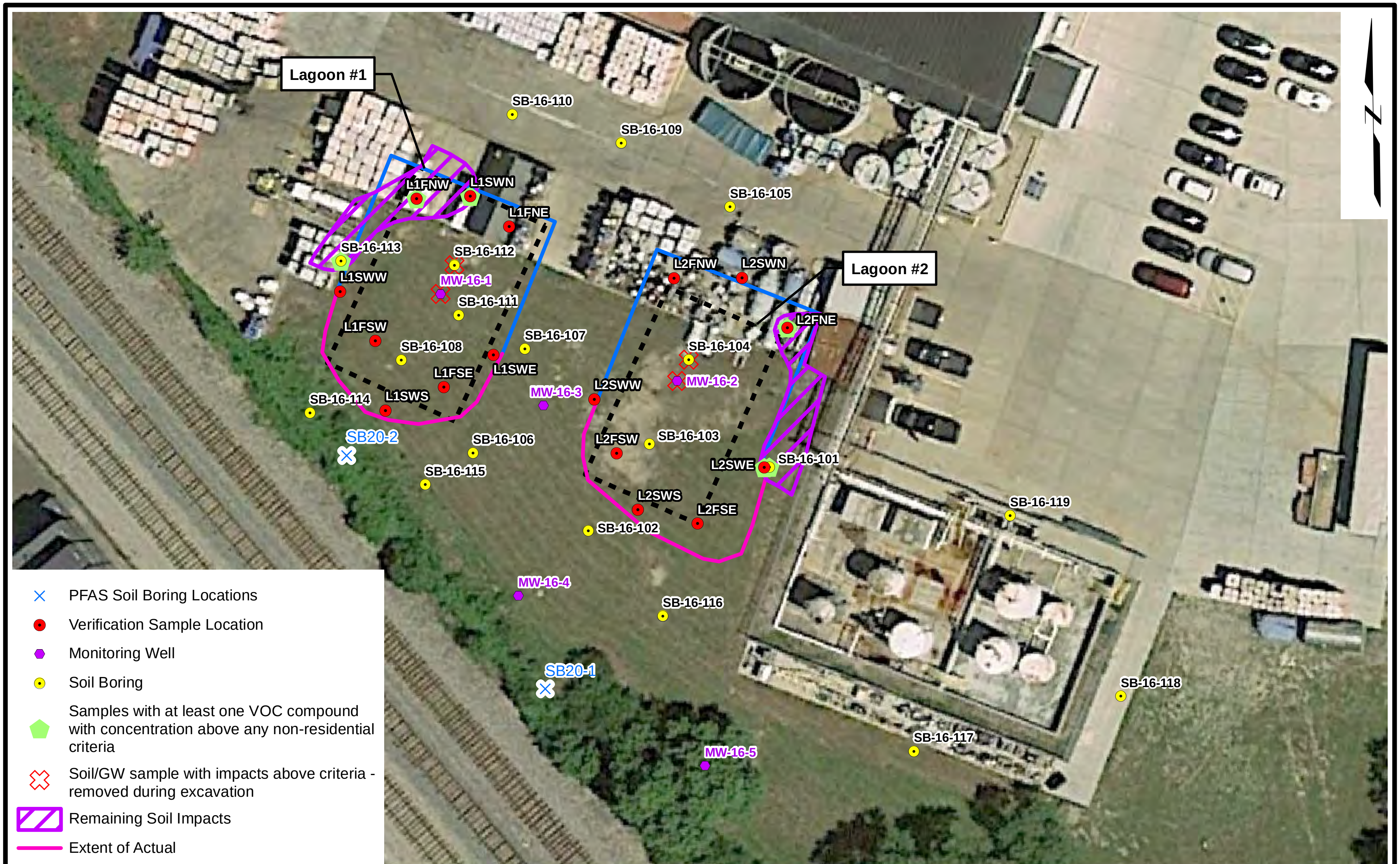
LOCATION AND EXTENT OF LAGOON EXCAVATIONS

March 2020

Fig. 16

W:\MacDermid_Ferndale\GIS\Fig16_Lagoon_Excavations.mxd



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MID 005 338 371

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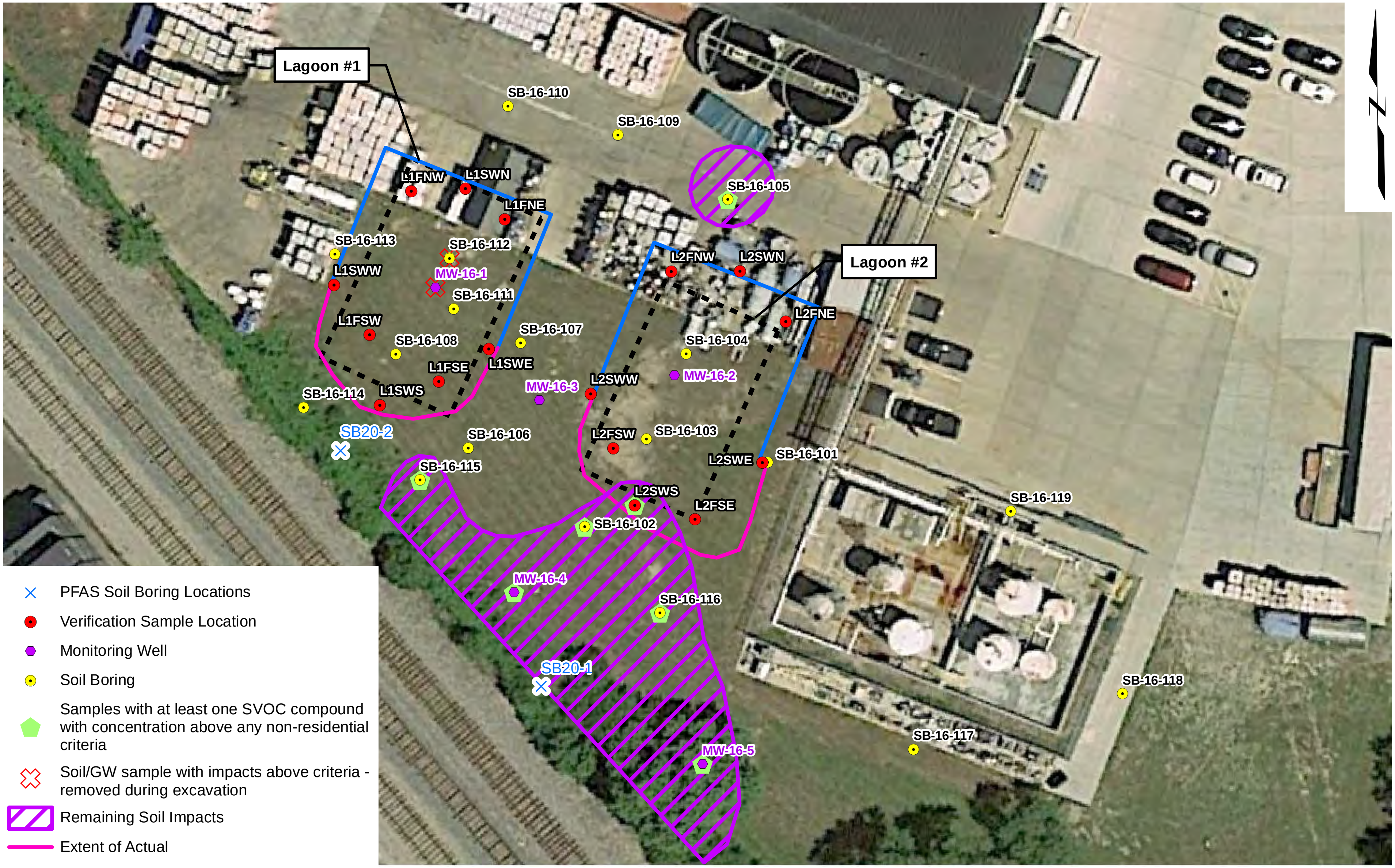
EXTENT OF REMAINING SOIL IMPACTS - VOCs

March 2020

Fig. 17A

W:\MacDermid_Ferndale\GIS\Fig17A_Remaining_Soil_Impacts_VOCs.mxd



PFAS Soil Boring Locations
Verification Sample Location
Monitoring Well
Soil Boring
Samples with at least one SVOC compound with concentration above any non-residential criteria
Soil/GW sample with impacts above criteria - removed during excavation
Remaining Soil Impacts
Extent of Actual
Sheet Pile Around Excavation
Approximate Location of Former Lagoons

0 20 40
Feet

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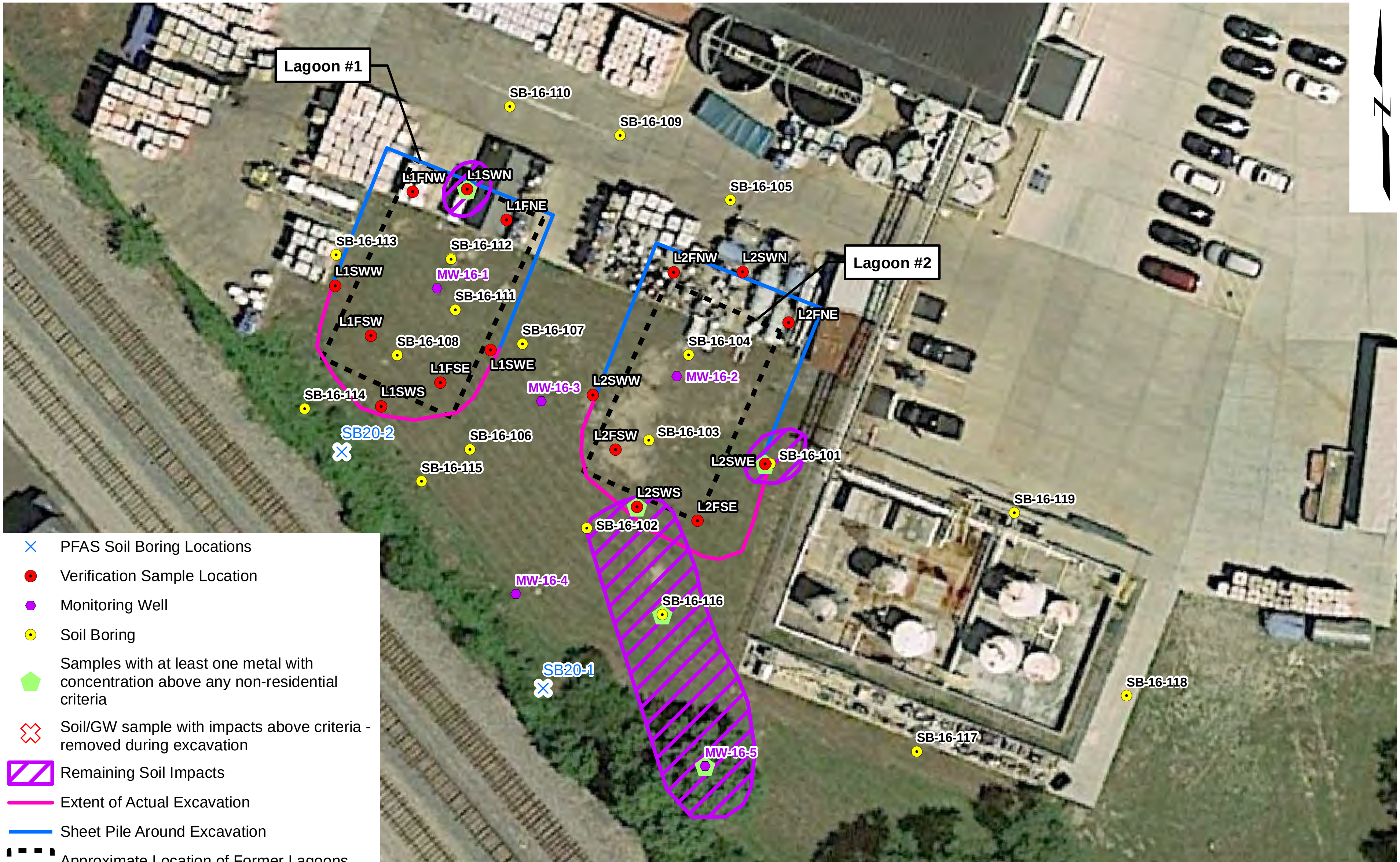
EXTENT OF REMAINING SOIL IMPACTS - SEMI VOCs

March 2020

Fig. 17B

W:\MacDermid_Ferndale\GIS\Fig17B_Remaining_Soil_Impacts_semi_VOCs.mxd



PFAS Soil Boring Locations
Verification Sample Location
Monitoring Well
Soil Boring
Samples with at least one metal with concentration above any non-residential criteria
Soil/GW sample with impacts above criteria - removed during excavation
Remaining Soil Impacts
Extent of Actual Excavation
Sheet Pile Around Excavation
Approximate Location of Former Lagoons

Arsenic present in nearly all samples above DWP and GSI protection and statewide default background, but below facility-specific background.

0 20 40
Feet

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Ferndale, Michigan

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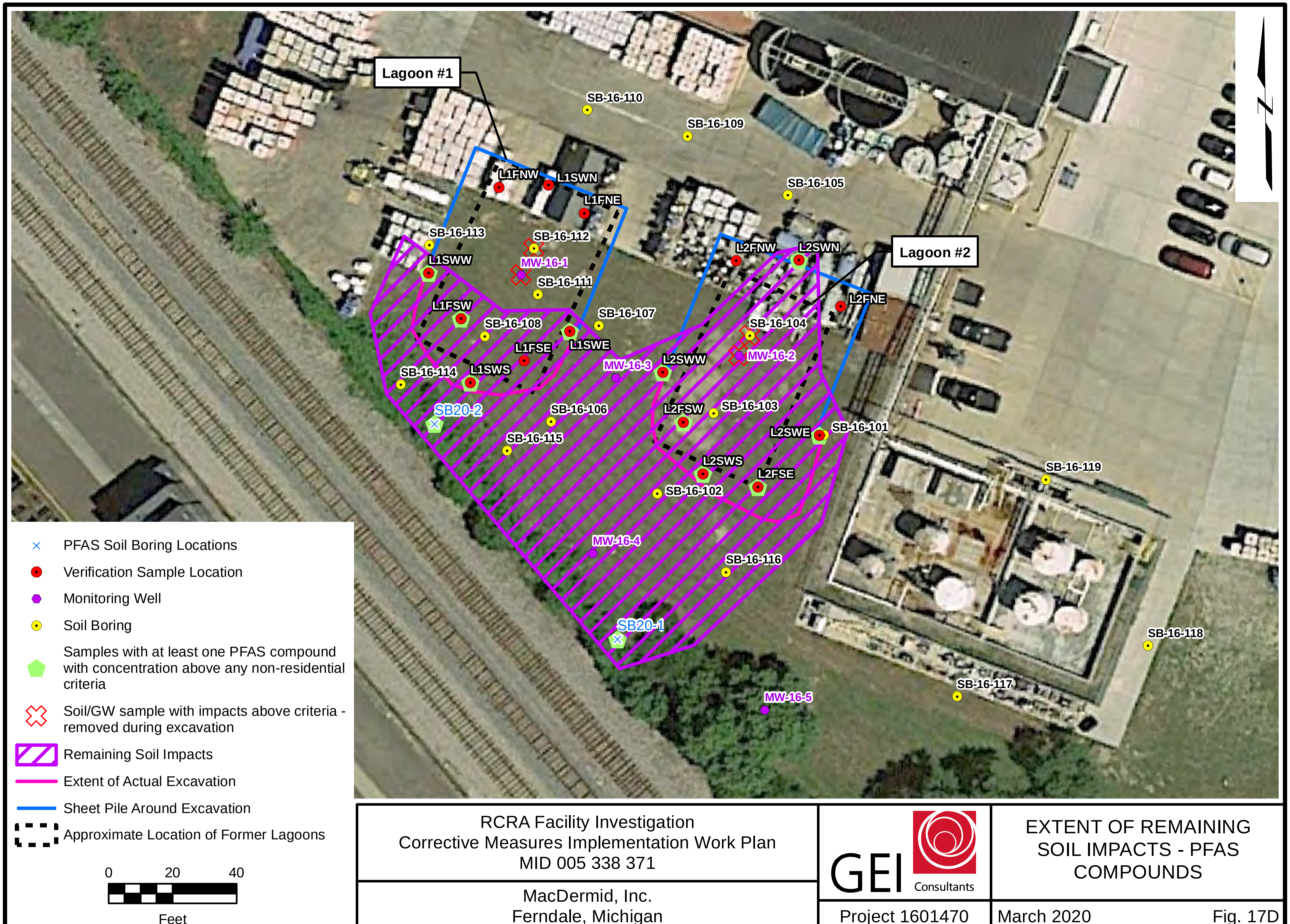
EXTENT OF REMAINING SOIL IMPACTS - METALS

March 2020

Fig. 17C

W:\MacDermid_Ferndale\GIS\Fig17C_PostEx_Soil_Impacts_metals.mxd



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EXTENT OF REMAINING SOIL IMPACTS - PFAS COMPOUNDS

March 2020

Fig. 17D

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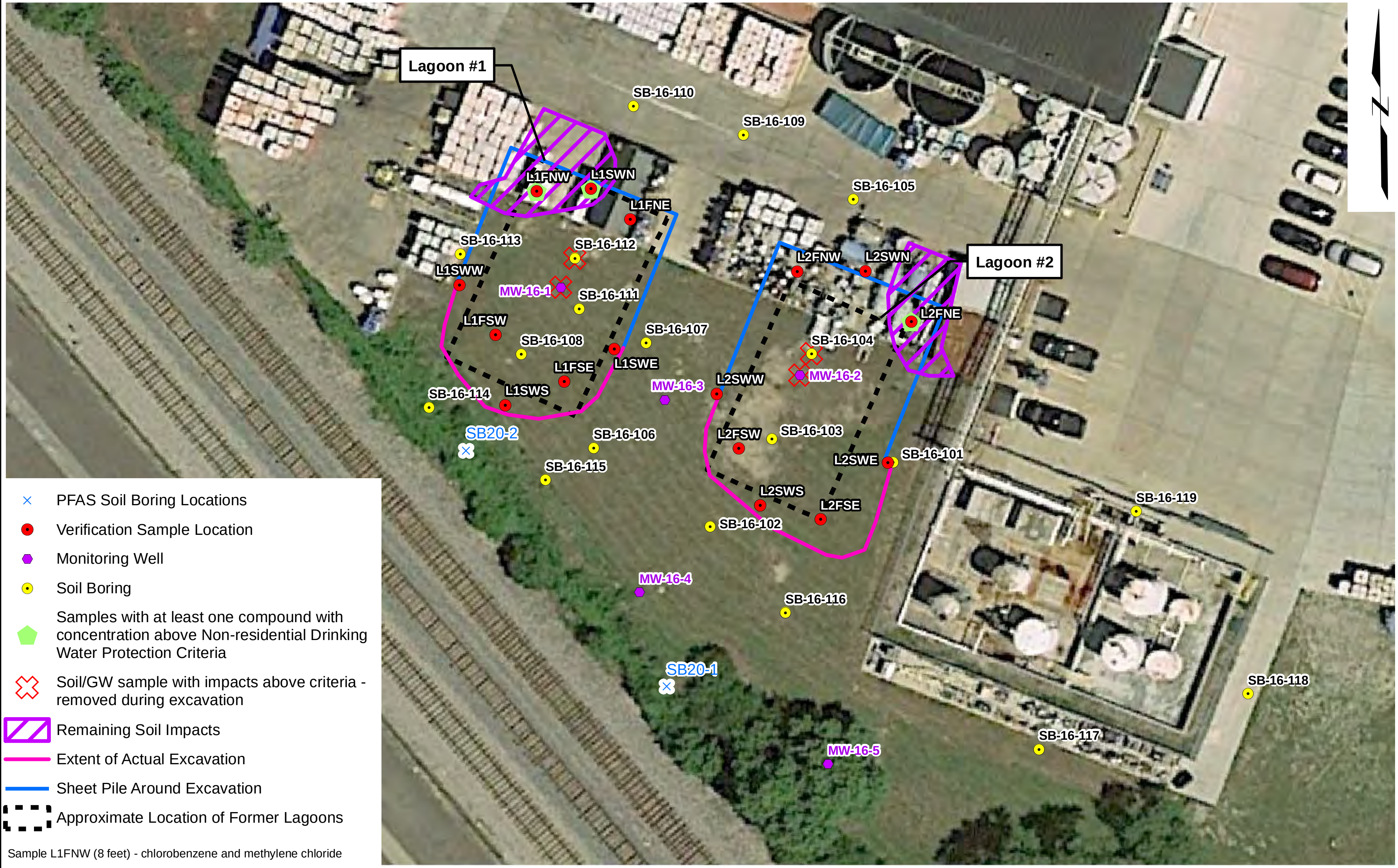

× PFAS Soil Boring Locations

Verification Sample Location

Monitoring Well

Soil Boring

Samples with at least one compound with concentration above Non-residential Drinking Water Protection Criteria

Soil/GW sample with impacts above criteria - removed during excavation

Remaining Soil Impacts

Extent of Actual Excavation

Sheet Pile Around Excavation

Approximate Location of Former Lagoons

Sample L1FNW (8 feet) - chlorobenzene and methylene chloride

Sample L1SWN (6-7 feet) - benzene, chlorobenzene, thylbenzene, and xylenes

Sample L2FNE (9.5 feet) - Vinyl chloride

0 20 40

Feet

RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	EXTENT OF REMAINING SOIL IMPACTS EXCEEDING NON-RESIDENTIAL DRINKING WATER PROTECTION CRITERIA
MacDermid, Inc. Ferndale, Michigan	Project 1601470	March 2020 Fig. 18A

W:\MacDermid_Ferndale\GIS\Fig18A_Remaining_Soil_Impacts_DWPC.mxd

PFAS Soil Boring Locations

Verification Sample Location

Monitoring Well

Soil Boring

Samples with at least one compound with concentration above Non-residential Groundwater Surface Water Interface Protection Criteria

Soil/GW sample with impacts above criteria - removed during excavation

Remaining Soil Impacts

Extent of Actual Excavation

Sheet Pile Around Excavation

Approximate Location of Former Lagoons

Phenanthrene, fluoranthene, 2-Methylnaphthalene, carbazole, metals, chlorobenzene and 1,2-dichlorobenzene, ethylbenzene, naphthalene, and xylenes, vinyl chloride, PFAS compounds in various samples

0 20 40

Feet

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Ferndale, Michigan

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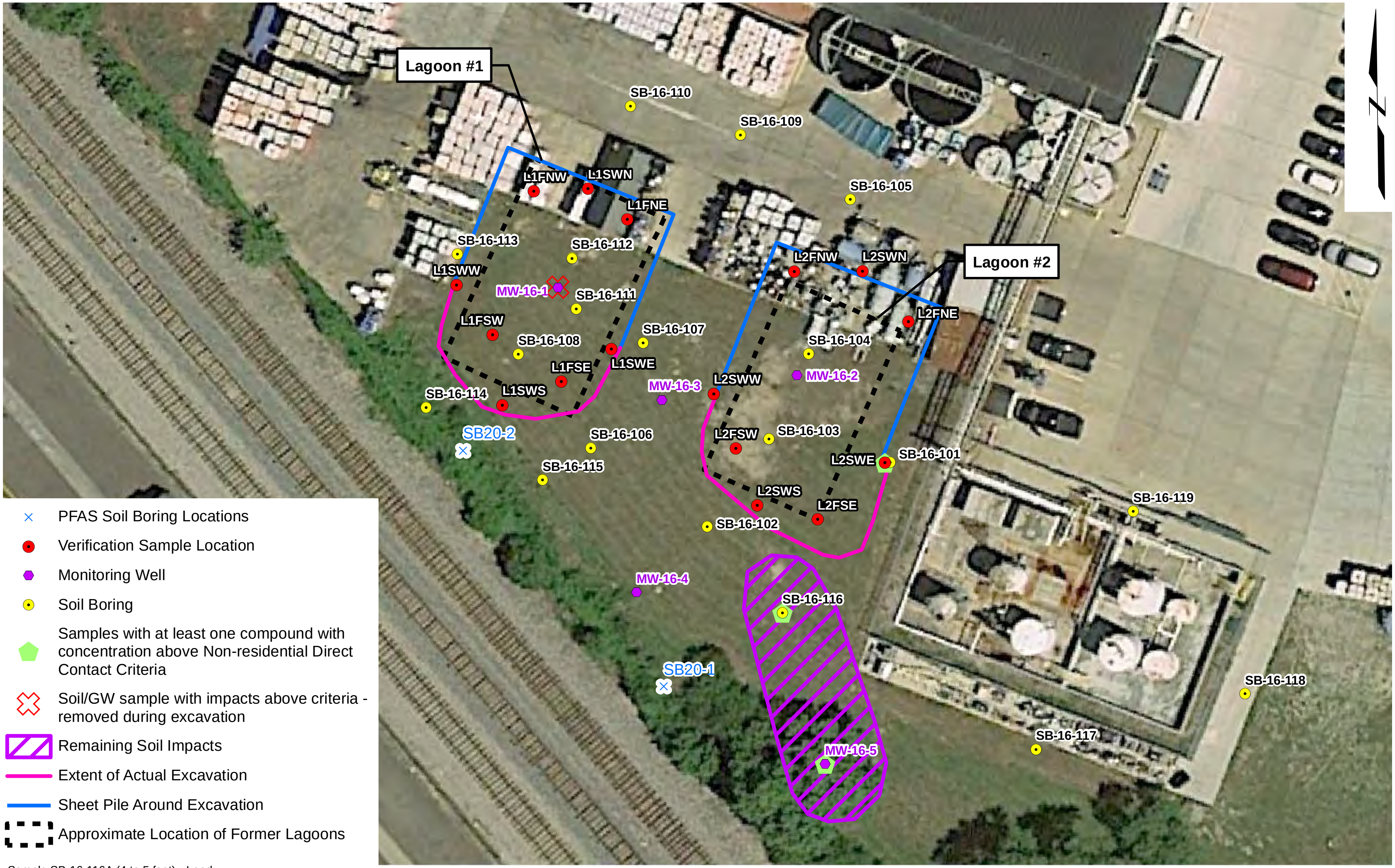
EXTENT OF REMAINING SOIL IMPACTS - IN EXCESS OF NON-RESIDENTIAL GROUNDWATER SURFACE WATER INTERFACE PROTECTION CRITERIA

March 2020

Fig. 18B

D:\GIS_Data\Projects\MacDermid_Ferndale\GIS\Fig18B_Remaining_Soil_Impacts_GWSWIPC.mxd



PFAS Soil Boring Locations

Verification Sample Location

Monitoring Well

Soil Boring

Samples with at least one compound with concentration above Non-residential Direct Contact Criteria

Soil/GW sample with impacts above criteria - removed during excavation

Remaining Soil Impacts

Extent of Actual Excavation

Sheet Pile Around Excavation

Approximate Location of Former Lagoons

Sample SB-16-116A (4 to 5 feet) - Lead

Sample SB-16-116C (4 to 5 feet) - Arsenic and lead

Sample MW-16-5 (4 to 5 feet) - Lead

0 20 40

Feet

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EXTENT OF REMAINING SOIL IMPACTS - IN EXCESS OF DIRECT CONTACT CRITERIA

March 2020

Fig. 18C

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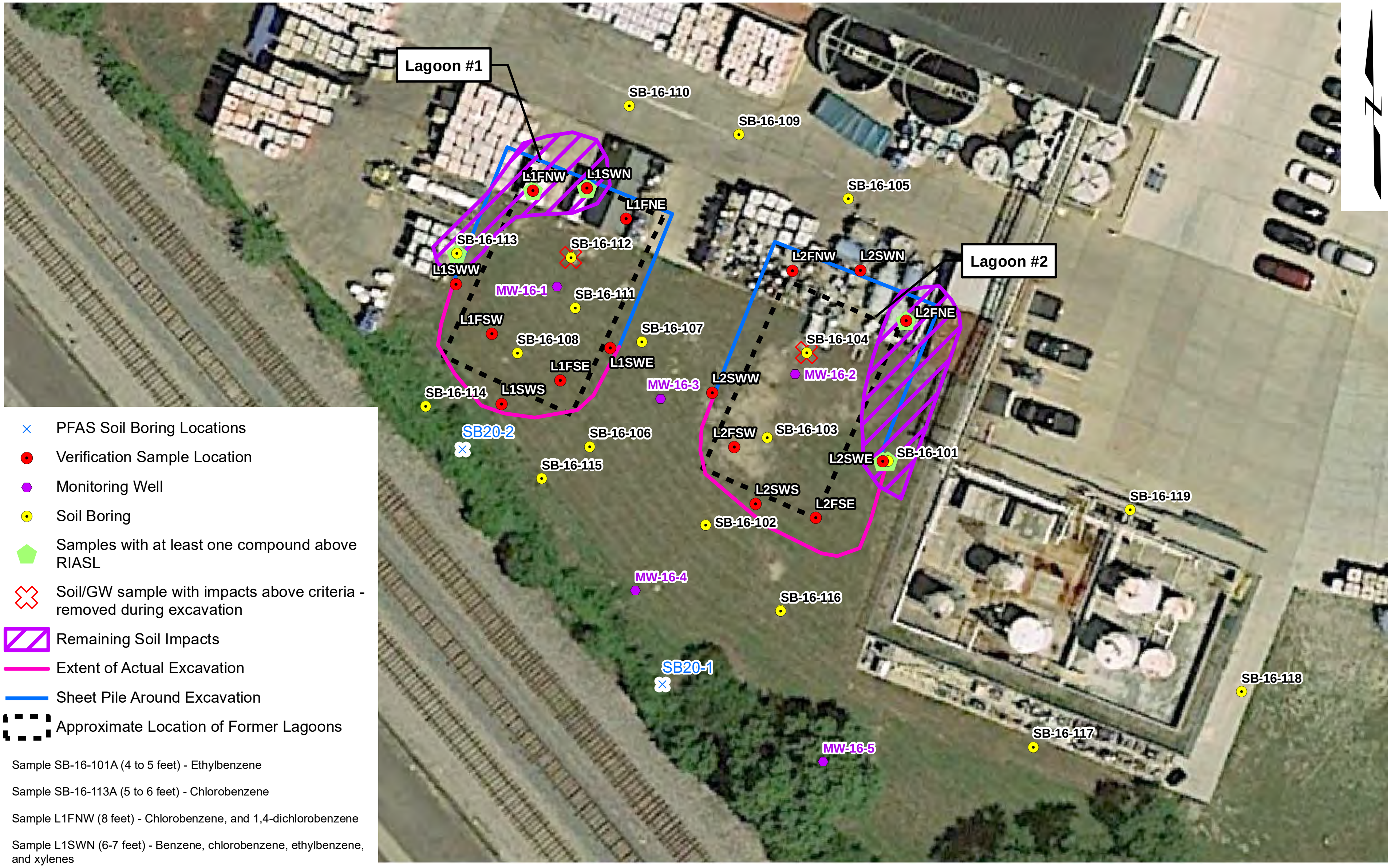

PFAS Soil Boring Locations
Verification Sample Location
Monitoring Well
Soil Boring
Samples with at least one compound above RIASL
Soil/GW sample with impacts above criteria - removed during excavation
Remaining Soil Impacts
Extent of Actual Excavation
Sheet Pile Around Excavation
Approximate Location of Former Lagoons

Sample SB-16-101A (4 to 5 feet) - Ethylbenzene

Sample SB-16-113A (5 to 6 feet) - Chlorobenzene

Sample L1FNW (8 feet) - Chlorobenzene, and 1,4-dichlorobenzene

Sample L1SWN (6-7 feet) - Benzene, chlorobenzene, ethylbenzene, and xylenes

Sample L2FNE (9.5 feet) - Vinyl chloride

Sample L2SWE (5 to 6 feet) – Ethylbenzene, mercury

0 20 40
Feet

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Ferndale, Michigan

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EXTENT OF REMAINING SOIL IMPACTS - IN EXCESS OF RECOMMENDED INTERIM ACTION SCREENING LEVEL

March 2020

Fig. 18D

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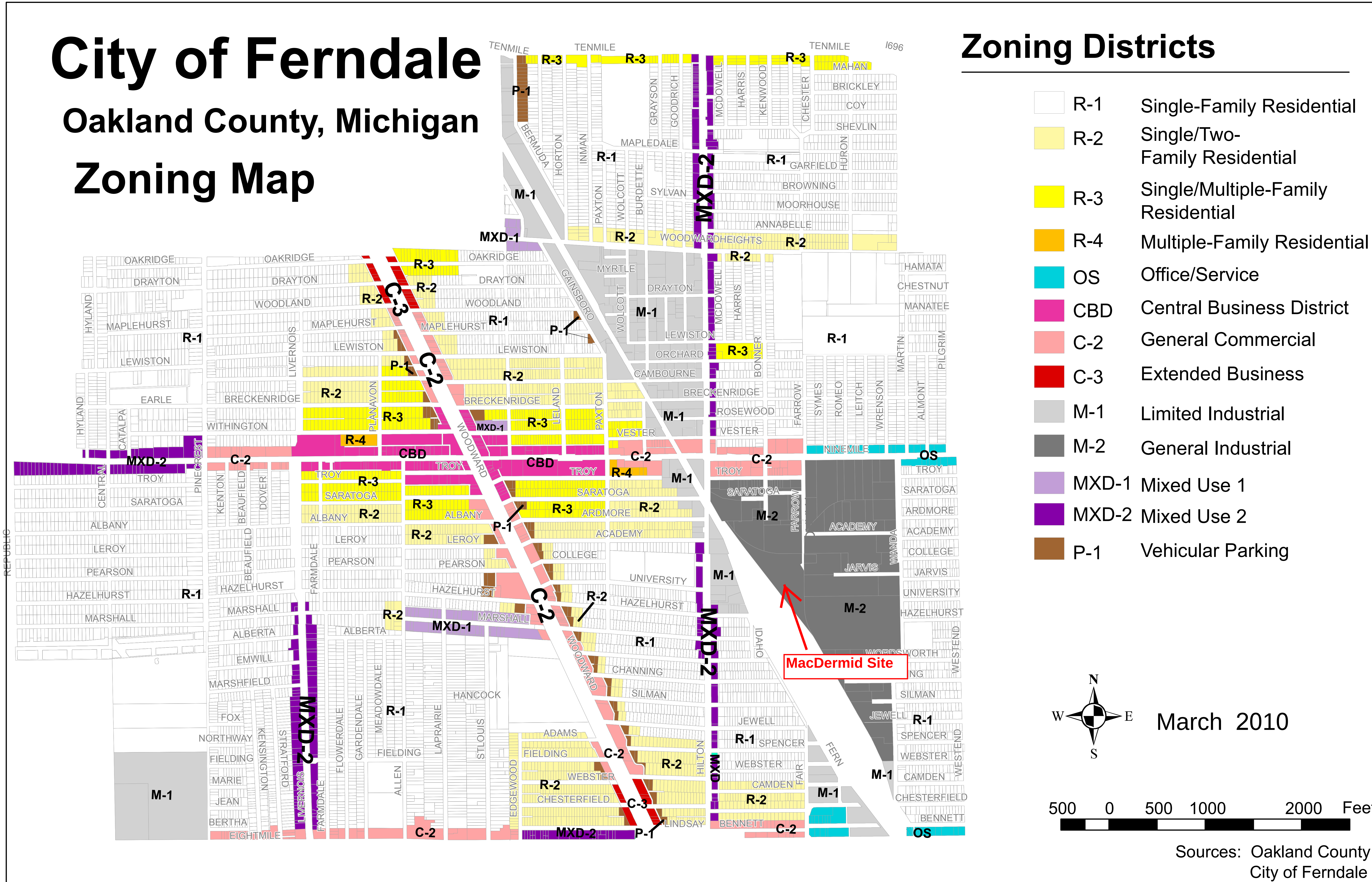
Appendix A

City of Ferndale Zoning Map


City of Ferndale
Oakland County, Michigan
Zoning Map
Zoning Districts
R-1 Single-Family Residential
R-2 Single/Two-Family Residential
R-3 Single/Multiple-Family Residential
R-4 Multiple-Family Residential
OS Office/Service
CBD Central Business District
C-2 General Commercial
C-3 Extended Business
M-1 Limited Industrial
M-2 General Industrial
MXD-1 Mixed Use 1
MXD-2 Mixed Use 2
P-1 Vehicular Parking
MacDermid Site
N
S
E
W
March 2010
500 0 500 1000 2000 Feet
Sources: Oakland County
City of Ferndale

Appendix B

GWNIAA Guidance Document

A Department of Environmental Quality (DEQ) Policy and Procedure cannot establish regulatory requirements for parties outside of the DEQ. This document provides direction to DEQ staff regarding the implementation of rules and laws administered by the DEQ. It is merely explanatory; does not affect the rights of, or procedures and practices available to, the public; and does not have the force and effect of law.

INTRODUCTION, PURPOSE, OR ISSUE:

This document is guidance for the use of Office of Waste Management and Radiological Protection (OWMRP) staff, to consistently apply the requirements for a Groundwater Not In An Aquifer (GWNIAA) designation for siting criteria, pathway analysis, monitoring requirements, discharge authorizations, corrective action, and other pertinent determinations under the following parts of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA): Part 31, Water Resources Protection; Part 111, Hazardous Waste Management; and Part 115, Solid Waste Management. This guidance describes the criteria that should be considered when evaluating whether groundwater encountered in a formation is, or is not, in an aquifer in addition to information that should be used in applying those criteria.

The OWMRP reserves the right to use site specific data in review of all cases, in order to decide the most appropriate determination for each site or formation. If it becomes necessary to remediate any media within the hazardous waste, solid waste, or other programs of the OWMRP, the environmental protection standards pursuant to Part 201, Environmental Remediation, of the NREPA, apply. Part 201 requires all exposure routes and receptors at sites of environmental contamination to be evaluated based upon site conditions and characteristics. At a remediation site where it is determined that groundwater ingestion is not a relevant exposure pathway, it still will be necessary to evaluate all other transport mechanisms and exposure pathways that might result in unacceptable exposure. Monitoring of a saturated zone that is "GWNIAA" may still be necessary in relation to other pathways such as groundwater surface water interface (GSI) criteria or indoor air inhalation.

This guidance does not apply to an area that has been determined by the Part 31 Groundwater Discharge Permit Program to be a monitoring zone.

AUTHORITY:

Part 111, Hazardous Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

DEFINITIONS:

- Aquifer: A geological formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs.

- Crock Well: A well traditionally constructed by excavating or boring a large diameter hole and placing vitrified clay tiles, pre-cast concrete pipe, or stone as casing or side walls to keep the excavation from collapsing.

- Driven Well (or Stab/Point Well): Consists of a well point (screen) that is attached to the bottom of the well casing and is pushed into the ground by hand or mechanical methods.

- Formation: a unique lithologic unit that can be mapped, but does not include a unit composed of material that has been physically or chemically altered, transformed, or used during a manufacturing process, such that they would impact the potable quality of the groundwater.

- Groundwater: Water below the land surface in a zone of saturation.

- Monitoring Zone: Area(s) beneath the subsurface where the hydrogeologic environment allows the movement of groundwater and potentially entrained contaminants and is capable of yielding a representative groundwater sample. A monitoring zone may or may not be naturally saturated and may be influenced by regulated surface activities.

- Owner/Operator: The person who owns the facility, or part of the facility, including the titleholder of the land on which the facility is located or the person responsible for the overall operation of the facility.

- Geologist or Qualified Groundwater Scientist: A scientist or engineer who has received a baccalaureate or postgraduate degree in the natural sciences or engineering and who has sufficient training and experience in groundwater hydrology and related fields, as demonstrated by state registration, professional certification(s), or completion of accredited university programs, to make sound professional judgments regarding groundwater monitoring, geological conditions, contaminant fate and transport, and corrective action.

- Staff Geologist: the OWMRP geologist assigned to the project in question.

- Venting: the discharge of groundwater to surface water or the ground surface.

PROCEDURES:

Criteria

It is the responsibility of the owner/operator of a site to demonstrate that the groundwater beneath the site is GWNIAA and that the groundwater ingestion exposure pathway does not apply. Both of the following criteria must be met to make this demonstration:

1. The formation yields an insignificant amount of water below the site (considering local and regional hydrogeology). This criterion can be met by any one or a combination of the following:

    a. All site monitoring wells installed in the formation bail or pump dry (at a maximum pumping rate of 0.1 gallons per minute [gpm]) and do not recharge to within 80 percent of the original well volumes within 24 hours. Monitoring wells must be shown to have been installed properly and are presently in good operational condition and the screens must fully penetrate the saturated zone. The Staff Geologist, on a case-by-case basis, can approve different pumping and recharge rates.

    b. The *in situ* hydraulic conductivity is to be based on a minimum of five site-specific tests, each of which is less than 1.0×10^{-6} centimeters per second (cm/s). The test results are not to be averaged. Well locations must be approved in advance and cover the formation of concern across the site. The exact number of tests will depend on the size and complexity of the site and will need to be approved by the staff Geologist. The staff Geologist, on a case-by-case basis, can consider different hydraulic conductivity values for use.

    c. A site pumping test, designed appropriately to test the formation in question, yields less than 0.1 gpm. Pumping tests must be run by an individual qualified to conduct such tests. Pumping tests must be run by an individual qualified to conduct such tests. These tests must be run for sufficient time to determine if boundary conditions (e.g., impermeable boundaries, recharge from leaky confining layers) are encountered. Plotting the drawdown versus time graphs in the field during the pumping test is recommended as a means of determining when the pumping test can be terminated. Wells to be used (or plans for proposed wells) must be approved by the Staff Geologist, before the test is performed.

2. The groundwater in question is not in hydraulic communication with groundwater in an aquifer. This criterion can be met through any one or a combination of the following:

    a. Sufficient knowledge is demonstrated concerning the regional geology supplemented with adequate site-specific information (boring/monitoring well logs, geophysical information, etc.) and is approved by the OWMRP.

    b. A site pumping test demonstrates that any water bearing seams of concern are isolated and are not in communication with an aquifer.

c. A demonstration that the groundwater is a totally discharging system and is venting to a surface water body (that is not locally recharging an aquifer) can be used to show that the formation in question does not connect to another aquifer laterally. This demonstration must also show that all GSI criteria are/will be met or that a mixing zone evaluation by the DEQ, Water Resource Division, Permits Section, has been accepted. This demonstration would only eliminate the horizontal concerns with connection to other aquifers. It would still need to be demonstrated that the unit (or the receiving surface water body) in question does not connect to another aquifer vertically. There are many areas along the larger river systems where shallow saturated units with significant quantities of groundwater discharge directly to the river. It would be difficult to comply with both criteria number 1 and number 2 under these conditions, but it may still be possible to eliminate the drinking water pathway.

Information Requirements

The demonstration that groundwater beneath a site is not in an aquifer, does not need to be monitored and, if applicable, that the groundwater ingestion exposure pathway does not apply, is made in a Groundwater/Hydrogeological Investigation (GI) Report and/or Remedial Action Plan (RAP) or Corrective Measures Implementation Plan (CMI). In order to make this demonstration the GI and/or RAP or CMI must address the two criteria listed above and provide all of the applicable components identified below. The GI and/or RAP or CMI are subject to review and approval by the Staff Geologist (or other OWMRP staff), and additional information may be required to support a finding on the criteria described above.

1. Facility boring and well logs and all private water well logs within a minimum of half mile of the facility property boundaries. These should substantiate the continuity of the lower, competent confining layer.

2. At least two scaled cross-sectional drawings; one down the centerline axis of the plume or contaminated area (or parallel to groundwater flow if there is no plume) and one perpendicular to this axis, showing topography, geology, groundwater, and other pertinent features.

3. Scaled isopach maps showing the thickness of the saturated zone and aquiclude/aquitard across the site.

4. A scaled site map showing all buried utility corridors and other subsurface structures, including wells or drainage tiles that may act as contaminant migration routes or artificially lower the water table due to their depth or proximity to the groundwater. The depths of all such features should be identified and/or included on the cross-sections listed in item 2, above.

5. A summary of the regional geology and topography. Information to support a conclusion that the groundwater ingestion exposure pathway is not relevant should include a well-documented evaluation of site and regional characteristics.

6. A comparison of the formation groundwater elevations with the local aquifer groundwater elevations to sufficiently demonstrate the lack of hydraulic communication. These should also identify the groundwater flow direction at the site and indicate any seasonal variations.

7. Written response from the local health department indicating (1) whether they were contacted to make a determination on whether crock wells or driven wells for any private water usage exist in the vicinity of the facility, (2) what that determination was, and (3) any concerns they may have regarding the site and/or the GWNIAA determination.

8. Written response from the DEQ, Office of Drinking Water and Municipal Assistance (ODWMA), indicating whether they were contacted to determine if the facility is located in an approved Local Wellhead Protection Area (LWPA) and what determination was made (see Web site ***http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3695---,00.html/***).

9. Any available groundwater quality analyses, including conditions upgradient, downgradient, and outside any area of on-site contamination.

10. Documentation of any other characteristics of the site that would assist in making this determination.

Additional Considerations

1. When conducting this review as part of a site remediation, some programs may use an evaluation of the relative risk with respect to toxicity, concentration, volume, mass, or quantity of the hazardous substance in determining whether the groundwater poses a threat to the environment or the public health and safety. The Staff Geologist may request this information as part of the review for a GWNIAA determination.

2. With Michigan's highly-variable geology, this decision-making process is often a localized consideration. There are some formations around the state in which groundwater availability is limited, but which may still be used as a water source by the use of crock wells or driven wells. Some of these formations may be used as a drinking water source, while others may be used for other purposes (sprinklers, cooling, swimming pools, etc.). If the site is in an area served by crock wells or driven wells or if the area groundwater is used for drinking water or other purposes, the owner/operator must assess whether the water source(s) may be impacted by site activity and whether sampling such water supplies is warranted. The documentation required to support a determination that the groundwater is not in an aquifer at this type of site would also be more extensive. The assigned Staff Geologist may require additional information and consultation with the local health department to help in the decision making process for areas of the state where crock or driven wells are used. See attached map of "Crock Well Counties" in Michigan.

3. If the groundwater beneath a site is determined to be not in an aquifer, it may be necessary to place a deed notification or restriction on the property to allow the higher degree of contamination (if existing) to remain. The deed notification or restriction should alert any

existing or future owner of the condition of the groundwater, that it has been determined to be unusable, and that it will not impact neighboring properties. The staff geologist and/or the OWMRP must approve the wording of any deed notification or restriction before it is filed. Proof of filing must be supplied to the OWMRP. On-site soils that are remediated to levels that do not consider the groundwater pathway must not be removed to a different site where groundwater may be vulnerable.

4. The Owner/Operator must contact the DEQ, ODWMA to determine if the site is located in an approved LWPA (see Web site ***http://www.michigan.gov/deq/0,1607,7-135-3313_3675_3695---,00.html***). If the site is located in such an area, the need for adequate documentation, data collection and assessment is greatly increased, and comments will be required from the Field Operations Section before a final decision can be made.

5. Monitoring wells used in this evaluation must be properly constructed, developed, and maintained in accordance with OWMRP approved methods and approved for use by the Staff Geologist.

6. Site characteristics vary. Therefore, depending on the characteristics of the specific site, additional information could be submitted to, or requested by, the OWMRP or the Staff Geologist. The owner/operator should contact the Staff Geologist concerning site-specific issues.

7. The formation may be naturally saturated, seasonally saturated, or only saturated due to a regulated discharge. These possibilities should be considered by the owner/operator during their evaluation. The Staff Geologist must determine whether the formation is a monitoring zone before concluding their evaluation.

Conclusion

This document is intended to assist the OWMRP staff to foster consistent application of the Part 31, Part 111, and Part 115 of the NREPA regarding designations of GWNIAA. This document is not intended to convey any rights to any parties, nor create any duties or responsibilities under law. This document and matters addressed herein are subject to revision.

Responsibility for periodic review and revisions to this document lies with the OWMRP, Hazardous Waste Section, Permit and Corrective Action Unit.

OFFICE CHIEF APPROVAL:

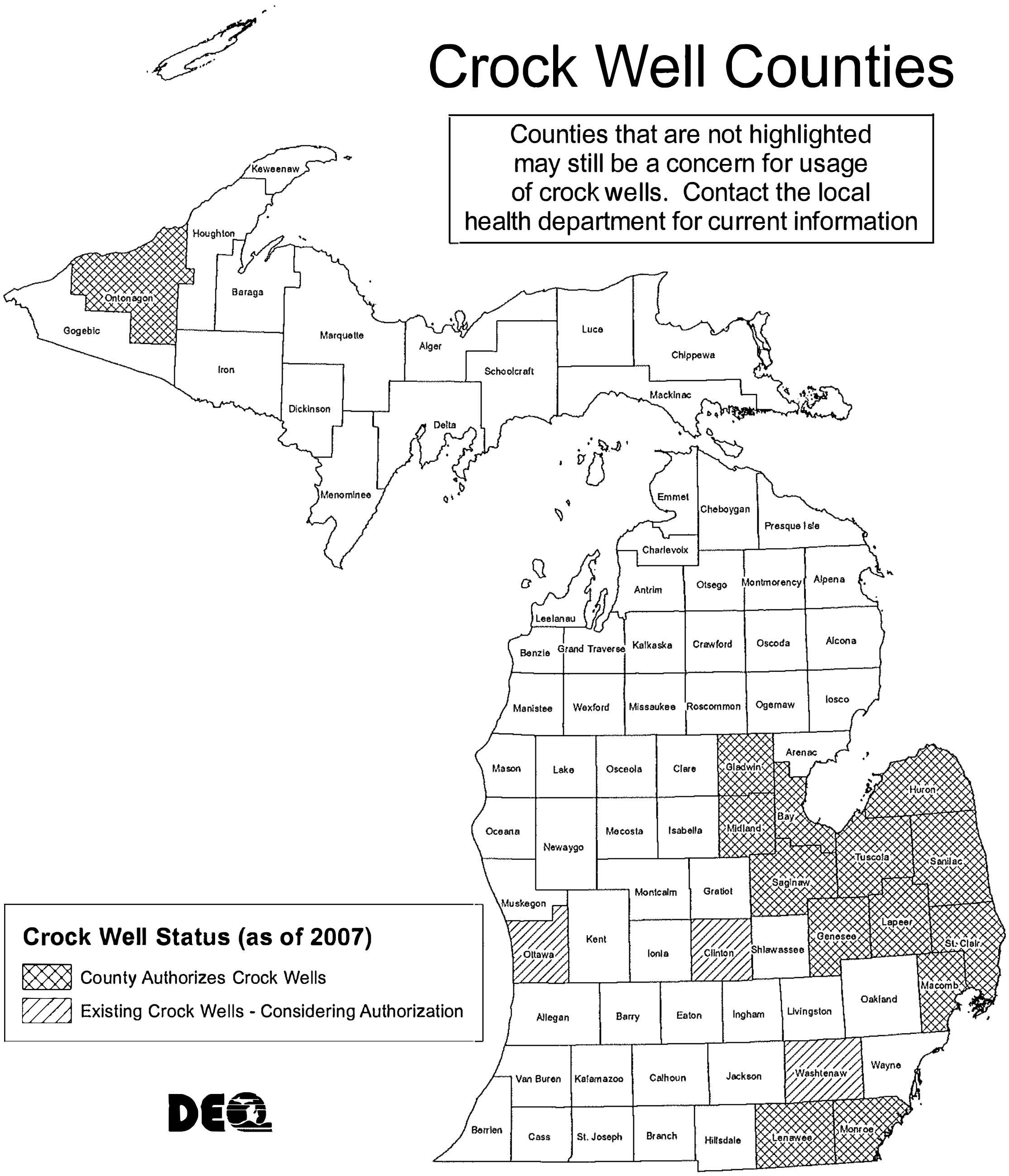
Elizabeth M. Browne

Elizabeth M. Browne, Chief
Office of Waste Management and Radiological Protection

November 16, 2012
Date

Crock Well Counties

Counties that are not highlighted may still be a concern for usage of crock wells. Contact the local health department for current information



Crock Well Status (as of 2007)

- County Authorizes Crock Wells
- Existing Crock Wells - Considering Authorization

DEQ

Appendix C

Area Water Well Logs

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: 20-010-144-000-02600 | **Permit No:** 20-00638 | **County:** Crawford | **Township:** Lovells

Town/Range: 27N 01W | **Section:** 13 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 20000001230

Elevation:

Latitude: 42.4642079

Longitude: -83.13262935

Method of Collection: Address Matching-House Number

Distance and Direction from Road Intersection:
TIMBERLANE TRAIL; NORTHERN HEIGHTS 26

Well Owner: ROBERT PHINNEY

Well Address:
427 EAST LEWISTON
FERNDALE, MI 48220

Owner Address:
427 EAST LEWISTON
FERNDALE, MI 48220

Drilling Method: Rotary
Well Depth: 89.00 ft. **Well Use:** Household
Well Type: New **Date Completed:** 11/19/2002

Casing Type: PVC plastic **Height:**
Casing Joint: Unknown
Casing Fitting: None

Diameter: 5.00 in. to 82.00 ft. depth

Borehole: 8.00 in. to 89.00 ft. depth

Pump Installed: Yes **Pump Installation Only:** No
Pump Installation Date: **HP:** 0.50
Manufacturer: Aermotor **Pump Type:** Submersible
Model Number: T-12 **Pump Capacity:** 12 GPM
Drop Pipe Length: 70.00 ft. **Pump Voltage:**
Drop Pipe Diameter: **Drilling Record ID:**
Draw Down Seal Used: No

Pressure Tank Installed: Yes
Pressure Tank Type: Unknown
Manufacturer: Challenger
Model Number: PC66 **Tank Capacity:** 20.0 Gallons
Pressure Relief Valve Installed: No

Static Water Level: 52.00 ft. Below Grade
Well Yield Test: **Yield Test Method:** Air
1.00 hrs. at 30 GPM

Formation Description	Thickness	Depth to Bottom
Sand & Cobbles	15.00	15.00
Sand	40.00	55.00
Sand & Gravel	34.00	89.00

Screen Installed: Yes **Filter Packed:** Yes
Screen Diameter: 5.00 in. **Blank:**
Screen Material Type: PVC-wire wrapped

Slot	Length	Set Between
15.00	7.00 ft.	82.00 ft. and 89.00 ft.

Fittings: Unknown

Well Grouted: Yes **Grouting Method:** Unknown

Grouting Material	Bags	Additives	Depth
Bentonite slurry	5.00	None	0.00 ft. to 75.00 ft.

Geology Remarks:

Wellhead Completion: Pitless adapter

Nearest Source of Possible Contamination:

Type	Distance	Direction
Septic tank	50 ft.	North

Drilling Machine Operator Name: MIKE DILLEY
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 72-1948
Business Name: GAGE WELL DRLG
Business Address:

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:
Other Remarks:

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 2534201001 | **Permit No:** 0125601 | **County:** Oakland | **Township:** Royal Oak

Town/Range: 01N 11E | **Section:** 34 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 63000038055

Elevation: 642 ft.
Latitude: 42.46016
Longitude: -83.13232
Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of woodward on the south side of nine mile

Well Owner: Ferndale Library

Well Address:
222 E. nine mile
Ferndale, MI 48220

Owner Address:
222 E. nine mile
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 9/8/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Formation Description	Thickness	Depth to Bottom
Brown Sand	10.00	10.00
Gray Clay	125.00	135.00
Shale	45.00	180.00
Limestone Hard	111.00	291.00
Blue Shale	111.00	402.00

Screen Installed: No **Intake:**

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Other	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Drilling Machine Operator Name: Dan Cesal r
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Abandoned Well Plugged: No

Reason Not Plugged: Other

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: Cementatious grout 26 bags portland cement 104 bags sand 26 lbs 200 mesh bentonite

Other Remarks: Well Use:Closed Loop Geothermal Bore , Casing Type:none, Grouting Material 1:111 cementatious grout, Wellhead Completion:No casing, Not Plugged Reason:No old well to plug, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: 2534201001 | **Permit No:** 125627 | **County:** Oakland | **Township:** Royal Oak

Well ID: 63000038058

Elevation: 647 ft.

Latitude: 42.46013

Longitude: -83.132

Method of Collection: GPS Std Positioning Svc SA On

Town/Range:	**Section:**	**Well Status:**	**WSSN:**	**Source ID/Well No:**
01N 11E	34	Active		

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 Mile #2

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile
Ferndale, MI 48220

Owner Address:
222 E. 9 Mile
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 9/11/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 400.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	125.00	135.00
Shale	45.00	180.00
Limestone	111.00	291.00
Shale & Limestone Layered	111.00	402.00

Screen Installed: No **Intake:**

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	**Bags**	**Additives**	**Depth**
Other	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	**Distance**	**Direction**
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 26 - 94 lbs bags portland cement 104 - 50 lbs bag sand 1" loop 400' long

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Grouting Material 1:M-111, Wellhead Completion:Geothermal Bore, Not Plugged Reason:Geothermal Bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: 2534201001	**Permit No:** 0125628	**County:** Oakland	**Township:** Royal Oak

Well ID: 63000038059

Elevation: 650 ft.

Latitude: 42.46011

Longitude: -83.13219

Method of Collection: GPS Std Positioning Svc SA On

Town/Range:	**Section:**	**Well Status:**	**WSSN:**	**Source ID/Well No:**
01N 11E	34	Active		

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 Mile #3

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile
Ferndale, MI 48220

Owner Address:
222 E. 9 Mile
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 9/15/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 400.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	125.00	135.00
Shale	45.00	180.00
Limestone	111.00	291.00
Sandstone & Limestone Layered	111.00	402.00

Screen Installed: No **Intake:**

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Other	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Drilling Machine Operator Name: Dan Cesal Jr
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Abandoned Well Plugged: No

Reason Not Plugged: Other

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 26 - 94 lbs bags portland cement 104 - 50 lbs bag sand 1" loop 400' long

Other Remarks: Well Use:Closed loop geothermal, Casing Type:Geothermal bore, Grouting Material 1:M-111, Wellhead Completion:Geothermal Bore, Not Plugged Reason:no well to plug, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: 2534201001 | **Permit No:** 0125629 | **County:** Oakland | **Township:** Royal Oak

Town/Range: 01N 11E | **Section:** 34 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 63000038061

Elevation: 645 ft.

Latitude: 42.46013

Longitude: -83.13225

Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 Mile #4

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile
Ferndale, MI 48220

Owner Address:
222 E. 9 Mile
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 9/17/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	125.00	135.00
Shale	45.00	180.00
Limestone	111.00	291.00
Shale & Limestone Layered	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Other	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 26 - 94 lbs bags of Portland Cement 104 - 50 lbs bags of Sand 1" loop 400' long

Other Remarks: Well Use:Closed Loop Geothermal, Casing Type:Closed loop geothermal, Grouting Material 1:M-111, Wellhead Completion: Closed loop geothermal, Not Plugged Reason:no well to plug, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: 2534201001 | **Permit No:** 0125631 | **County:** Oakland | **Township:** Royal Oak

Town/Range: 01N 11E | **Section:** 34 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 63000038063

Elevation: 650 ft.
Latitude: 42.46011
Longitude: -83.13223
Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 Mile #6

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile rd
Ferndale, MI 48220

Owner Address:
222 E. 9 Mile rd
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 10/1/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	125.00	135.00
Shale	45.00	180.00
Limestone	111.00	291.00
Shale & Limestone Layered	111.00	402.00

Screen Installed: No **Intake:**

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Other	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 26 - 94 lbs bags of Portland Cement 104 - 50 lbs bags of Sand 1" loop 400' long

Other Remarks: Well Use:Closed Loop Geothermal, Casing Type:Closed loop geothermal, Grouting Material 1:M-111, Wellhead Completion:closed loop geothermal, Not Plugged Reason:no well to plug, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: 2534201001 | **Permit No:** 0125634 | **County:** Oakland | **Township:** Royal Oak

Town/Range: 01N 11E | **Section:** 34 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 63000038066

Elevation: 667 ft.

Latitude: 42.46007

Longitude: -83.13234

Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 Mile #9

Well Owner: City of Ferndale

Well Address:
222 E. 9 mile rd
Ferndale, MI 48220

Owner Address:
222 E. 9 mile rd
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 10/8/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	125.00	135.00
Shale	45.00	180.00
Limestone	111.00	291.00
Shale & Limestone	111.00	402.00

Screen Installed: No **Intake:**

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Other	26.00	None	

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Drilling Machine Operator Name: Dan Cesal Jr
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Abandoned Well Plugged: No

Reason Not Plugged: Other

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 26 - 94 lbs bags of Portland Cement 104 - 50 lbs bags of Sand 1" loop 400' long

Other Remarks: Well Use:closed loop geothermal, Casing Type:closed loop geothermal, Grouting Material 1:M-111, Wellhead Completion:closed loop geothermal, Not Plugged Reason:no well to plug, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: 2534201001 **Permit No:** 0125636 **County:** Oakland **Township:** Royal Oak

Well ID: 63000038068

Town/Range: 01N 11E **Section:** 34 **Well Status:** Active **WSSN:** **Source ID/Well No:**

Elevation: 651 ft.

Latitude: 42.46007

Longitude: -83.13223

Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 Mile #11

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile
Ferndale, MI 48220

Owner Address:
222 E. 9 Mile
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 10/14/2009
Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	125.00	135.00
Shale	45.00	180.00
Limestone	111.00	291.00
Shale & Limestone Layered	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Other	26.00	None	

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 26 - 94 lbs bags of Portland Cement 104 - 50 lbs bags of Sand 1" loop 400' long

Other Remarks: Well Use:closed loop geothermal, Casing Type:closed loop geothermal, Grouting Material 1:M-111, Wellhead Completion:closed loop geothermal, Not Plugged Reason:no well to plug, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: 2534201001	**Permit No:** 0125638	**County:** Oakland	**Township:** Royal Oak

Well ID: 63000038070

Elevation: 664 ft.

Latitude: 42.46002

Longitude: -83.13235

Method of Collection: GPS Std Positioning Svc SA On

Town/Range:	**Section:**	**Well Status:**	**WSSN:**	**Source ID/Well No:**
01N 11E	34	Active		

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 mile #13

Well Owner: City of Ferndale

Well Address:
222 E 9 Mile
Ferndale, MI 48220

Owner Address:
222 E 9 Mile
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 10/22/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	125.00	135.00
Shale	45.00	180.00
Limestone	111.00	291.00
Shale & Limestone Layered	111.00	402.00

Screen Installed: No **Intake:**

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Other	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 26 - 94 lbs bags of Portland Cement 104 - 50 lbs bags of Sand 1" loop 400' long

Other Remarks: Well Use:Close loop geothermal, Casing Type:closed loop geothermal, Grouting Material 1:M-111, Wellhead Completion:closed loop geothermal, Not Plugged Reason:no well to plug, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: | **Permit No:** 125687 | **County:** Oakland | **Township:** Royal Oak

Well ID: 63000038162

Elevation: 798 ft.

Latitude: 42.46015

Longitude: -83.13172

Method of Collection: GPS Std Positioning Svc SA On

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
01N 11E	34	Active		

Distance and Direction from Road Intersection:
East of Woodeard on the South side of 9 mile rd #15

Well Owner: City of Ferndale

Well Address:
222 E 9 Mile
Ferndale, MI 48220

Owner Address:
222 E 9 Mile
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/2/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Abandoned Well Plugged: No

Reason Not Plugged: Other

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks:

Other Remarks: Well Use:Geothermal, Casing Type:Geothermal bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:No well to plug, geothermal bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: | **Permit No:** 125688 | **County:** Oakland | **Township:** Royal Oak

Well ID: 63000038163

Elevation: 888 ft.

Latitude: 42.46013

Longitude: -83.13182

Method of Collection: GPS Std Positioning Svc SA On

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
01N 11E	34	Active		

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 mile rd #16

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile Rd
Ferndale , MI 48220

Owner Address:
222 E. 9 Mile Rd
Ferndale , MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/2/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 111 Grout Mixture

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:No well to plug, geothermal bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No:	**Permit No:** 125689	**County:** Oakland	**Township:** Royal Oak

Town/Range: 01N 11E | **Section:** 34 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 63000038164

Elevation: 798 ft.

Latitude: 42.46016

Longitude: -83.13192

Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward, south side of 9 mile #17

Well Owner: City of Ferndale

Well Address:
222 E 9 Mile Rd
Ferndald, MI 48220

Owner Address:
222 E 9 Mile Rd
Ferndald, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/5/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Abandoned Well Plugged: No

Reason Not Plugged: Other

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 111 Grout Mixture

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:No well to plug, Geothermal Bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: | **Permit No:** 125692 | **County:** Oakland | **Township:** Royal Oak

Town/Range: 01N 11E | **Section:** 34 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 63000038165

Elevation: 708 ft.
Latitude: 42.46019
Longitude: -83.13202
Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward south side of 9 mile rd #18

Well Owner: City of Ferndale

Well Address:
222 E.9 mile rd
Ferndale, MI 48220

Owner Address:
222 E.9 mile rd
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/5/2009
Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 111 Grout Mixture

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:No well to plug, Geothermal Bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: | **Permit No:** 125693 | **County:** Oakland | **Township:** Royal Oak

Town/Range: 01N 11E | **Section:** 34 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 63000038166

Elevation: 618 ft.

Latitude: 42.4604

Longitude: -83.13216

Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward, south side of 9 mile rd #19

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile rd
Ferndale, MI 48220

Owner Address:
222 E. 9 Mile rd
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/5/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Abandoned Well Plugged: No

Reason Not Plugged: Other

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 111 Grout Mixture

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:No well to plug, Geothermal Bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: | **Permit No:** 125694 | **County:** Oakland | **Township:** Royal Oak

Well ID: 63000038167

Elevation: 694 ft.

Latitude: 42.46046

Longitude: -83.13203

Method of Collection: GPS Std Positioning Svc SA On

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
01N 11E	34	Active		

Distance and Direction from Road Intersection:
East of Woodward, south side of 9 mile rd #20

Well Owner: City of Ferndale

Well Address:
222 E,. 9 Mile Rd
Ferndale, MI 48220

Owner Address:
222 E,. 9 Mile Rd
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/9/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 111 Grout Mixture

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:No Well to plug, Geothermal Bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No: | Permit No: 125700 | County: Oakland | Township: Royal Oak

Town/Range: 01N 11E | Section: 34 | Well Status: Active | WSSN: | Source ID/Well No:

Well ID: 63000038168

Elevation:

Latitude: 42.46053

Longitude: -83.13223

Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward, South side of 9 mile rd #21

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile Rd
Ferndale, MI 48220

Owner Address:
222 E. 9 Mile Rd
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/9/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Screen Installed: No **Intake:**

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 111 Grout Mixture

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:Geothermal Bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Wellogic

Import ID:

Tax No: | **Permit No:** 125701 | **County:** Oakland | **Township:** Royal Oak

Town/Range: 01N 11E | **Section:** 34 | **Well Status:** Active | **WSSN:** | **Source ID/Well No:**

Well ID: 63000038169

Elevation:

Latitude: 42.46057

Longitude: -83.13229

Method of Collection: GPS Std Positioning Svc SA On

Distance and Direction from Road Intersection:
East of Woodward, South side of 9 Mile Rd

Well Owner: City of Ferndale

Well Address:
222 E. 9 Mile Rd
Ferndale, MI 48220

Owner Address:
222 E. 9 Mile Rd
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/9/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Abandoned Well Plugged: No

Reason Not Plugged: Other

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 111 Grout Mixture

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:Geothermal Bore, Map Scale:Unknown, Elevation Datum:Unknown

Water Well And Pump Record

Completion is required under authority of Part 127 Act 368 PA 1978.
Failure to comply is a misdemeanor.

Import ID:

Tax No:	Permit No: 125703	County: Oakland	Township: Royal Oak

Well ID: 63000038171

Elevation:

Latitude: 42.4606

Longitude: -83.13237

Method of Collection: GPS Std Positioning Svc SA On

Town/Range:	Section:	Well Status:	WSSN:	Source ID/Well No:
01N 11E	34	Active		

Distance and Direction from Road Intersection:
East of Woodward on the South side of 9 Mile #24

Well Owner: City of Ferndale

Well Address:
222 E. 9 mile Rd
Ferndale, MI 48220

Owner Address:
222 E. 9 mile Rd
Ferndale, MI 48220

Drilling Method: Rotary
Well Depth: 402.00 ft. **Well Use:** Other
Well Type: Boring (No Casing) **Date Completed:** 11/10/2009

Casing Type: Other **Height:**
Casing Joint:
Casing Fitting:

Diameter:

Borehole: 5.50 in. to 402.00 ft. depth

Pump Installed: No
Pressure Tank Installed: No
Pressure Relief Valve Installed: No

Static Water Level: Below Grade
Well Yield Test: **Yield Test Method:**

Screen Installed: No **Intake:**

Formation Description	Thickness	Depth to Bottom
Sand	10.00	10.00
Clay	30.00	40.00
Sand	5.00	45.00
Clay	80.00	125.00
Shale	55.00	180.00
Limestone Hard	111.00	291.00
Shale	111.00	402.00

Well Grouted: Yes **Grouting Method:** Grout pipe outside casing

Grouting Material	Bags	Additives	Depth
Bentonite slurry	26.00	None	0.00 ft. to 402.00 ft.

Geology Remarks:

Wellhead Completion: Other

Nearest Source of Possible Contamination:

Type	Distance	Direction
Sewer line	65 ft.	East

Abandoned Well Plugged: No

Reason Not Plugged: Other

Drilling Machine Operator Name: Dan Cesal Jr.
Employment: Employee

Contractor Type: Water Well Drilling Contractor **Reg No:** 78-2224
Business Name: Cesal Well Drilling
Business Address: 5331 N Byron, Corunna, MI, 48817

Water Well Contractor's Certification

This well was drilled under my supervision and this report is true to the best of my knowledge and belief.

Signature of Registered Contractor **Date**

General Remarks: 111 Grout Mixture

Other Remarks: Well Use:Geothermal Bore, Casing Type:Geothermal Bore, Wellhead Completion:Geothermal Bore, Not Plugged Reason:Geothermal Bore, Map Scale:Unknown, Elevation Datum:Unknown

Appendix D

DWMAD Correspondence

Blaske, Allan

From: Berndt, Jason (DEQ) <BERNDTJ1@michigan.gov>
Sent: Thursday, August 03, 2017 8:04 AM
To: Blaske, Allan
Subject: RE: wellhead protection area, Ferndale, Michigan

Allan,

The location is about 10 miles away from the nearest wellhead protection area.

Jason Berndt, Environmental Quality Specialist
DEQ-Drinking Water and Municipal Assistance Division
Source Water Unit
Gaylord Field Office
989-705-3420

From: Blaske, Allan [mailto:ablaske@geiconsultants.com]
Sent: Wednesday, August 02, 2017 3:08 PM
To: Berndt, Jason (DEQ)
Subject: wellhead protection area, Ferndale, Michigan

I am preparing a Groundwater Not In An Aquifer (GWNIAA) determination for a site located in Ferndale, Michigan. I am requesting a determination of the location of designated wellhead protection areas near the site. The project is located at 1221 Farrow Avenue, Ferndale, Oakland County, Michigan.

Review of the GeoWebFace on-line geology maps does not indicate the presence of a wellhead protection area within at least 10 miles of the site. However, to document the GWNIAA status, a written response from your office is needed to indicate that no wellhead protection areas are located near the site.

If you could please respond to this email with your determination regarding the wellhead protection area status, as well as your contact information, I would greatly appreciate it.

I can be reached by return email or the telephone numbers below should you have any questions. Thank you.

Allan R. Blaske, P.G., CPG
Senior Project Geologist

GEI Consultants
Consulting Engineers & Scientists

GEI Consultants of Michigan, P.C.
230 N. Washington Square, Suite 201 | Lansing, MI 48933
T: 517.803.2839 | **M:** 517.974.2891
www.geiconsultants.com | vCard | LinkedIn | Twitter | Facebook

Appendix E

Oakland County Correspondence

Blaske, Allan

From: Peresky, Richard C <pereskyr@oakgov.com>
Sent: Thursday, August 24, 2017 10:58 AM
To: Blaske, Allan
Subject: RE: Groundwater not in an aquifer determination

Mr. Blaske,

Based on your written inquiry, it is considered a Freedom of Information Act request. The Oakland County Health Division (OCHD) performs a search for records based on type of record and specific addresses, Parcel Identification Numbers, or other unique identifiers provided. The word 'Vicinity' as presented in your e-mail below does not sufficiently identify the properties you are interested in for obtaining records. As referenced in the FOIA response letter, 'any concerns' is considered vague. To enable a further search, be specific regarding the type of record you are trying to find. The search was performed to account for crock and driven wells. No water well permits or well logs were identified for the referenced property. Contact me with any further questions. Thank you. Have a good day.

OAKLAND COUNTY MICHIGAN
HEALTH DIVISION
OakGov.com/Health

Richard Peresky, REHS, MS
Senior Public Health Sanitarian
Oakland County Health Division
1200 N Telegraph Bldg 34E Pontiac MI 48341
phone 248.858.1097 / cell 248.431.3679 / fax 248.452.9758
pereskyr@oakgov.com

OAKLAND COUNTY HEALTH DIVISION

PUBLIC HEALTH . . . It's for all of us PUBLICHEALTHOC

From: Blaske, Allan [mailto:ablaske@geiconsultants.com]
Sent: Thursday, August 24, 2017 10:05 AM
To: Peresky, Richard C
Subject: RE: Groundwater not in an aquifer determination

Mr. Peresky,
I just received a response via the FOIA system regarding the request if made below. The FOIA response was this:
Dear Allan Blaske:
The Oakland County Health Division (OCHD) has denied your request because information regarding "...1-mile radius..." and "...any concerns..." does not describe a public record sufficiently to enable the public body to find the public record. No information regarding water well permits or well logs were found for the captioned property.

If you wish to modify your request by providing a complete list of specific concerns and properties, with date ranges for the information you desire, OCHD will provide available information in compliance with the FOIA.
It is recommended that you contact the Michigan Department of Environmental Quality as the agency has regulatory authority over certain environmental pollutants and monitoring activities. It is advised that you contact the local water supply as it may have authority over certain aspects of the captioned property. If you have any questions, please contact this Division at (248) 858-1312.

In my original request, I had inquired about the presence of crock or driven wells for private usage in the vicinity of the facility. This is the specific request that the MDEQ is asking for evidence of. I have contacted the MDEQ (multiple divisions), but they are requiring me to ask the Health Department specifically these questions. The exact language from the MDEQ which I am required to respond to is:

Written response from the local health department indicating (1) whether they were contacted to make a determination on whether crock wells or driven wells for any private usage exist in the vicinity of the facility, (2) what that determination was, and (3) any concern there may be regarding the site and/or the GWNIAA determination.

Is it possible to get an determination on these issues, without going through the FOIA process? I had sent an email originally with this request, but it got put into the FOIA system as “Phase one or well requests for 1221 Farrow Ave, Ferndale” which is not exactly what I am looking for.

If I could get an answer to the above MDEQ questions, I would be most appreciative. Thank you.

Allan R. Blaske, P.G., CPG
Senior Project Geologist

GEI Consultants
Consulting Engineers & Scientists

GEI Consultants of Michigan, P.C.
230 N. Washington Square, Suite 201 | Lansing, MI 48933
T: 517.803.2839 | **M:** 517.974.2891
www.geiconsultants.com | vCard | LinkedIn | Twitter | Facebook

Blaske, Allan

From: Oakland County Record Center <oaklandcountymi@mycusthelp.net>
Sent: Thursday, August 24, 2017 9:08 AM
To: Blaske, Allan
Subject: Freedom of Information Act (FOIA) Request :: F002983-080317

--- Please respond above this line ---

08/24/2017

Allan Blaske
GEI Consultants
230 N Washington, Suite 201
Lansing, MI 48933
ablaske@geiconsultants.com

RE: FOIA REQUEST
1221 FARROW AVENUE
FERNDALE, OAKLAND COUNTY, MI
PARCEL #: 25-35-155-002
REFERENCE NUMBER: F002983-080317

Dear Allan Blaske:

The Oakland County Health Division (OCHD) has denied your request because information regarding "…1-mile radius…" and "...any concerns..." does not describe a public record sufficiently to enable the public body to find the public record. No information regarding water well permits or well logs were found for the captioned property.

If you wish to modify your request by providing a complete list of specific concerns and properties, with date ranges for the information you desire, OCHD will provide available information in compliance with the FOIA.

It is recommended that you contact the Michigan Department of Environmental Quality as the agency has regulatory authority over certain environmental pollutants and monitoring activities. It is advised that you contact the local water supply as it may have authority over certain aspects of the captioned property. If you have any questions, please contact this Division at (248) 858-1312.

<u>YOUR FURTHER LEGAL RIGHTS</u>

To the extent that this response, in your opinion, constitutes a denial of your Freedom of Information Act (FOIA) rights, your statutory remedies are as follows:

For FOIA denials, you may submit to the head of the public body a written appeal that specifically states the word "appeal" and identifies the reason or reasons for reversal of the denial. Within 10 business days after the head of the public body receives a written appeal he or she will do one of the following:
1. Reverse the denial.
2. Issue a written notice to you upholding the denial.
3. Reverse the denial in part and issue a written notice to you upholding the denial in part.
4. Under unusual circumstances, issue a notice extending for not more than 10 business days the time to respond.

You may begin a civil action in circuit court to compel the public body’s disclosure of the public records within 180 days after a public body’s final determination to deny a request.
You have the right to receive attorneys' fees and damages as provided in MCL 15.240 if, after judicial review, the court determines that the public body has not complied with MCL 15.235 and orders disclosure of all or a portion of a public record.

For fee appeals, if the public body requires a fee that, in your opinion, exceeds the amount permitted under its procedures and guidelines or MCL 15.234, you may submit to the head of the public body a written fee appeal for a fee reduction that specifically states the word "appeal" and identifies how the required fee exceeds the amount permitted. Within 10 business days after the head of the public body receives a written fee appeal, he or she will do one of the following:
1. Waive the fee.
2. Reduce the fee and issue a written determination to the requesting person indicating the basis for the remaining fee.
3. Uphold the fee and issue a written determination to the requesting person indicating the basis for upholding the fee.
4. If necessary, issue a notice extending for not more than 10 business days the time to respond.

Within 45 days after the head of the public body issues a written determination on the fee appeal or if the head of the public body failed to respond to the fee appeal, you may begin a civil action in circuit court.

Oakland County’s FOIA Procedures and Guidelines, and its Public Summary, can be found at www.oakgov.com/FOIA.

Sincerely,

OAKLAND COUNTY HEALTH DIVISION
Department of Health and Human Services

Richard Peresky
Public Health Senior Sanitarian
Environmental Health Services

To monitor the progress or update this request please log into the FOIA Record Center.

Blaske, Allan

From: Blaske, Allan
Sent: Thursday, August 03, 2017 8:34 AM
To: 'health@oakgov.com'
Subject: Groundwater not in an aquifer determination

I am preparing a Groundwater Not In An Aquifer (GWNIAA) determination for a site located in Ferndale, Michigan. The project is located at 1221 Farrow Avenue, Ferndale, Oakland County, Michigan.

The GWNIAA designation can be used to illustrate that site conditions do not provide sufficient groundwater to be a valid pathway for drinking water criteria. Demonstration of GWNIAA requires the demonstration that a formation yields an insignificant amount of water, using local and regional hydrogeology. Review of the available on-line sources for water well logs do not indicate the presence of any water-supply wells within a 1-mile radius of the site.

As part of this submittal to MDEQ for the project, I am trying to determine if crock wells or driven wells for any private usage exist in the vicinity of the facility. I will also need to know if your office has any concerns regarding the site and/or the GWNIAA determination.

If you could please respond to this email with your responses to the inquiry above, as well as your contact information, I would greatly appreciate it.

I can be reached by return email or the telephone numbers below should you have any questions. Thank you.

Allan R. Blaske, P.G., CPG
Senior Project Geologist
GEI Consultants
GEI Consultants of Michigan, P.C.
230 N. Washington Square, Suite 201 | Lansing, MI 48933
T: 517.803.2839 | **M:** 517.974.2891
www.geiconsultants.com | vCard | LinkedIn | Twitter | Facebook

Appendix F

City of Ferndale Correspondence

Blaske, Allan

From: Barb Miller <bmiller@ferndalemi.gov>
Sent: Thursday, August 17, 2017 10:58 AM
To: Blaske, Allan
Subject: FW: installation of drinking water wells

Good morning Allan,

Below is the information from our DPW Supervisor. That would be the extent of our records. If you have any questions, please don't hesitate to contact our office.

Thank you.

Barbara Miller
Deputy City Clerk
City of Ferndale
(248) 336-4366

From: Dan Harper
Sent: Thursday, August 17, 2017 10:10 AM
To: Barb Miller <bmiller@ferndalemi.gov>
Subject: RE: installation of drinking water wells

Barb, the city does not have and ordinance on private wells nor do we know of any private wells. What we do is refer residents to Oakland County for their rules and regulations and Also the Safe Drinking Water Act. Also we do not have municipal wells we purchase our water from the City of Detroit.

Daniel Harper
D.P.W. Supervisor
City of Ferndale
248-546-2519

From: Loyd Cureton
Sent: Thursday, August 17, 2017 9:28 AM
To: Barb Miller <bmiller@ferndalemi.gov>; Dan Harper <dharper@ferndalemi.gov>
Subject: RE: installation of drinking water wells

Hi Dan, if you need assistance or wish to discuss, I am available.

From: Barb Miller
Sent: Thursday, August 17, 2017 9:26 AM
To: Dan Harper <dharper@ferndalemi.gov>; Loyd Cureton <lcureton@ferndalemi.gov>
Subject: FW: installation of drinking water wells
Importance: High

Good morning,

Were you able to find any information? I need to respond today.

Thanks.

Barbara Miller
Deputy City Clerk
City of Ferndale
(248) 336-4366

From: Barb Miller
Sent: Wednesday, August 9, 2017 9:10 AM
To: Loyd Cureton - City of Ferndale (lcureton@ferndalemi.gov) <lcureton@ferndalemi.gov>; Dan Harper <dharper@ferndalemi.gov>
Subject: FW: installation of drinking water wells

Good morning!

Can either of you help me out with the following request? I can check for ordinances but I don't know about any wells.

Thanks.

Barbara Miller
Deputy City Clerk
City of Ferndale
(248) 336-4366

From: Blaske, Allan [mailto:ablaske@geiconsultants.com]
Sent: Wednesday, August 9, 2017 8:59 AM
To: Barb Miller <bmiller@ferndalemi.gov>
Subject: installation of drinking water wells

I am an environmental consultant working for an industrial client located within the City of Ferndale. As part of an environmental site investigation, we have identified subsurface soil contamination at the facility. We are in the process of determining potential exposure pathways related to the site and the identified contaminants. One potential exposure pathway is the leaching of contaminants from the soil to the groundwater, and the groundwater used as a source of drinking water. Due to the subsurface soil conditions observed at the site and within the area surrounding the site, the use of groundwater is unlikely. However, I am trying to determine if the possibility exists for the use of groundwater for drinking water. While the City is on a municipal water source, it may still be possible for an individual to install a water-supply well for potable water. I need to close this potential exposure pathway. Therefore, could you please provide a response to the following questions:

Does the City of Ferndale have an ordinance or restriction which prevents the installation of private or municipal drinking water wells within the city limits?

Do you know of any crock wells or driven wells within the city limits?

A response to these questions which includes your contact information would be most appreciated. I can be reached via the information below if you should have any questions. Thank you.

Allan R. Blaske, P.G., CPG
Senior Project Geologist

GEI Consultants of Michigan, P.C.
230 N. Washington Square, Suite 201 | Lansing, MI 48933
T: 517.803.2839 | **M:** 517.974.2891
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Appendix G

Sites of Environmental Contamination

Summary of MDEQ Environmental Mapper Results*
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI

Environmental Management Layer Search

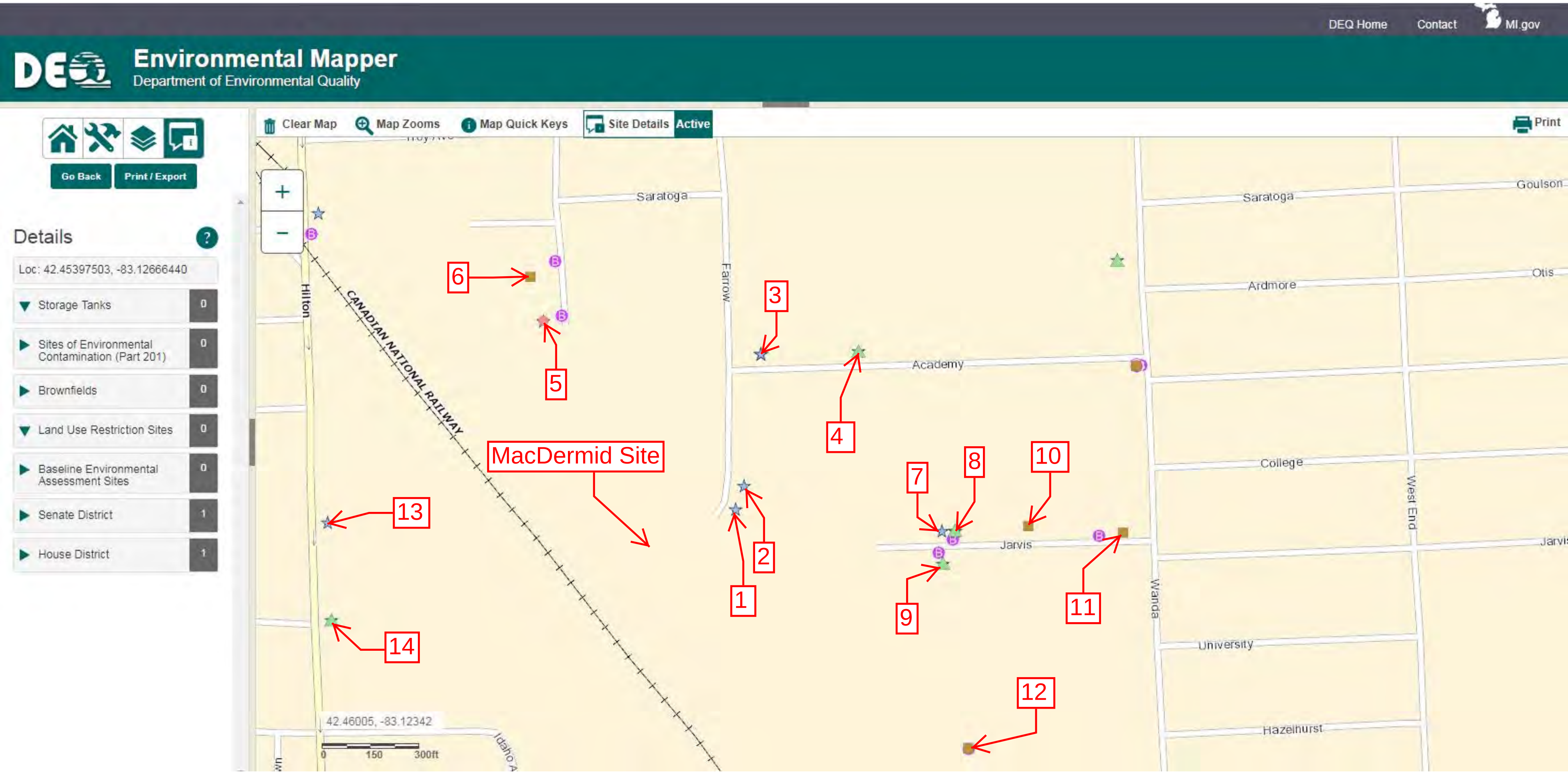
Map ID	Site Name	Site Address	Facility ID No.	Notes
1	Detroit Gas Products	1200 Farrow St.	00011187	10,000 gallon diesel UST, removed from ground
2	Michigan Acetylene Products	1250 Farrow St.	00013750	1,500 gallon UST with "hazardous substance", removed from ground
3	Detroit Cornice and Slate	1315 Academy St.	00033417	2,000 gallon gasoline UST, removed from ground
			00033259	2,000 gallon gasoline UST, removed from ground
			00033394	3,000 gallon UST, removed from ground
4	Brafco Forging Co.	1405 Academy St.	00004128	8,000 gallon fuel oil UST, closed in ground
				LUST release C-0164-93, heating oil, discovered 1/21/93, closed 3/5/96, Tier I Evaluation, no land use restrictions
5	American Industrial Door	1501 Bonner St.	00038460	LUST release C-0510-95, gasoline UST, removed from ground, no size listed, discovered 5/5/96, status = Open LUST
6	Powerfone	1441 Bonner St.	63000944	Part 201 site, Bond Properties restrictive covenant (see below)
7	Jarvis Investment Co.	1365 Jarvis St.	50000190	LUST release C-1192-90, discovered 7/3/90, closed 11/4/93, Type B evaluation, no land use restrictions
8	Brass Forgings	1351 Jarvis St.	00035955	1,500 gallon UST closed in ground
9	Uni-Bond Brake Inc.	1350 Jarvis St.	00001060	LUST release C-2488-91, discovered 11/21/91, closed 4/5/94, Type Be evaluation, no land use restrictions, 1,000 gallon gasoline UST removed from ground
10	1365-1395 Jarvis St.	1365-1395 Jarvis St.	63005470	Part 201 site, no contaminants listed
11	1515 Jarvis St.	1515 Jarvis St.	63005462	Part 201 site, no contaminants listed
12	LTV Copperweld Facility	965 Wanda Ave.	63005873	Part 201 site, no contaminants listed, land use restriction (see below)
13	Tri-Hilton Construction	1300 Hilton Rd.	00033210	3 USTs removed from ground: 12,000, 6,000 and 6,000 gallons, no contents listed
14	Gage Oldsmobile	1200 Hilton	00040762	LUST release C-055-95, 4,000 gallon gasoline UST, removed from ground, discovered 5/19/95, closed 8/15/97, Tier I evaluation, no land use restrictions

Summary of MDEQ Environmental Mapper Results*
RCRA Facility Investigation, MacDermid, Ferndale, Oakland County, MI

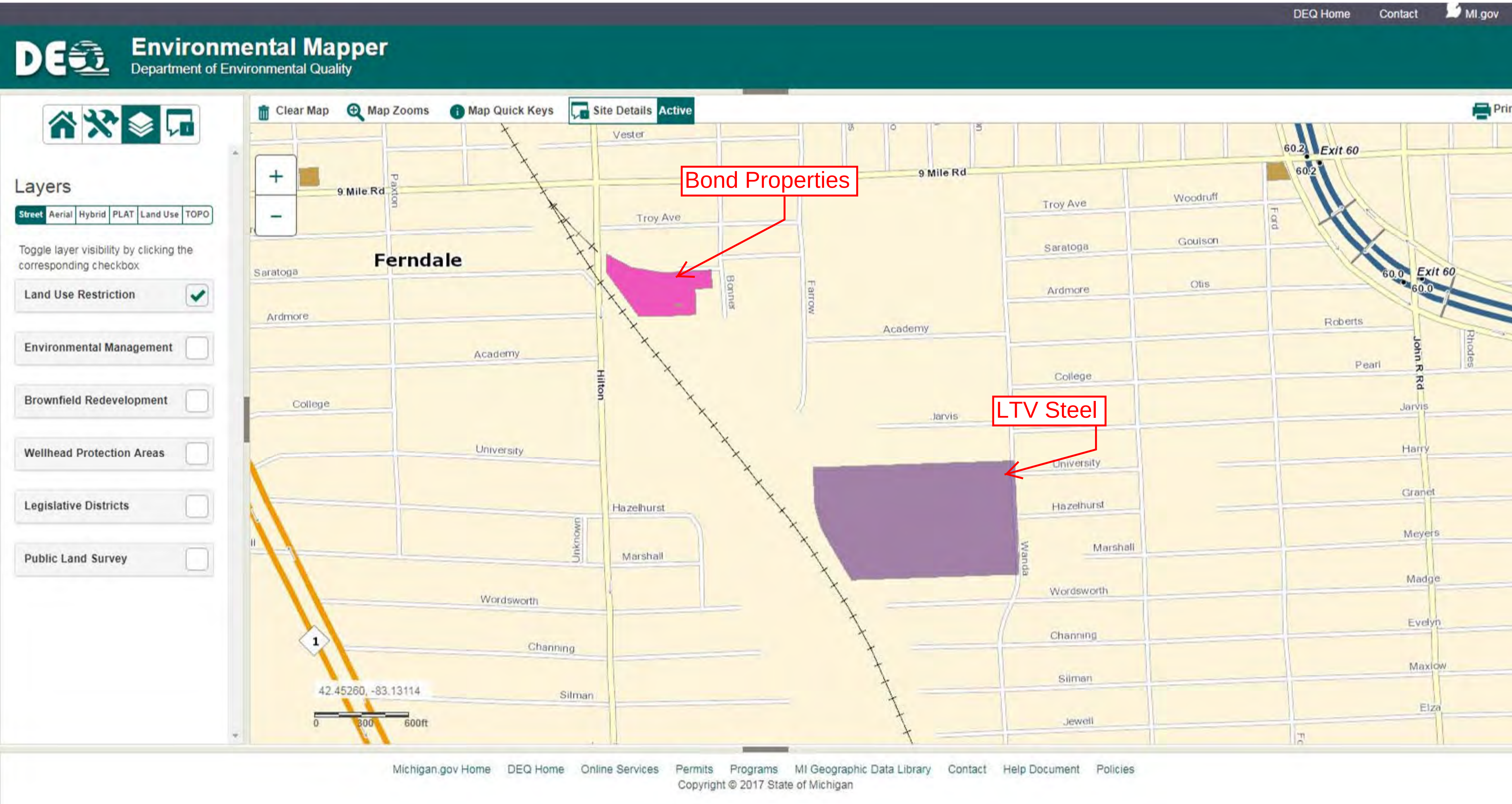
Land Use Restrictions Layer Search

Map ID	Site Name	Site Address	Facility ID No.	Notes
Bond Properties	Bond Properties LLC	988 East Saratoga	63005351	Notice of Approved Environmental Remediation (NAER EDR 99-005) - land use restriction for industrial land-use category, dated October 13, 1999
LTV Steel	Former LTV Copperweld	965 Wanda Ave.	63005873	Notice of Approved Environmental Remediation (NAER-ERD-07-001) - land use restriction for industrial land use catetory, dated Noverber 13, 2007. VOCs, SVOCs and metals. Corrective Action Notice to Register of Deeds, dated May 4, 2000.

* http://www.mcgi.state.mi.us/environmentalmapper/ - accessed on August 1, 2017



DEQ Home
Contact
MI.gov
Environmental Mapper
Department of Environmental Quality
Go Back
Print / Export
Details
Loc: 42.45397503, -83.12666440
Storage Tanks 0
Sites of Environmental Contamination (Part 201) 0
Brownfields 0
Land Use Restriction Sites 0
Baseline Environmental Assessment Sites 0
Senate District 1
House District 1
Clear Map
Map Zooms
Map Quick Keys
Site Details
Active
Print
Saratoga
Ardmore
Academy
College
Jarvis
University
Hazelhurst
Goulson
Otis
Farrow
Hilton
Wanda
West End
CANADIAN NATIONAL RAILWAY
MacDermid Site
1
2
3
4
5
6
7
8
9
10
11
12
13
14
42.46005, -83.12342
0
150
300ft


DEQ Home
Contact
MI.gov
Environmental Mapper
Department of Environmental Quality
Clear Map
Map Zooms
Map Quick Keys
Site Details
Active
Print
Layers
Street
Aerial
Hybrid
PLAT
Land Use
TOPO
Toggle layer visibility by clicking the corresponding checkbox
Land Use Restriction
Environmental Management
Brownfield Redevelopment
Wellhead Protection Areas
Legislative Districts
Public Land Survey
Bond Properties
LTV Steel
Ferndale
9 Mile Rd
Troy Ave
Saratoga
Ardmore
Academy
College
University
Hazelhurst
Marshall
Wordsworth
Channing
Silman
Jewell
Jarvis
Vester
Woodruff
Goulson
Otis
Roberts
Pearl
Harry
Granet
Meyers
Madge
Evelyn
Maxlow
Elza
Hilton
Farrow
Wanda
Paxton
John R Rd
Rhodes
Exit 60
42.45260, -83.13114
0
300
600ft
Michigan.gov Home
DEQ Home
Online Services
Permits
Programs
MI Geographic Data Library
Contact
Help Document
Policies
Copyright © 2017 State of Michigan

Appendix H

DEQ Memo with GWNIAA Determination

Resources Management Division
Remediation Advisory Team - Single Entry Report

Site:	MacDermid Incorporated	**District:**	Southeast Michigan	**County:**	Wayne
Review Type:	Initial Consultation	**Clean-up Type:**	201 Non-Residential	**Program:**	Part 111 of 1994 P.A. 451
Meeting Date:	9/27/2017	**RA TEAM:**	Kimberly Tyson, Becky Kocsis, Brett Coulter, Deb MacKenzie-Taylor, Dave Slayton, Kristen Kellock, Jim Arduin, Al Taylor, Margie Ring, Andrew Bertapelle, Joe Victory, John McCabe		

Project Description: Soils are primarily the affected medium of interest. Small isolated quantities of contaminated groundwater exist within the former lagoons. Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and metals exceedances were detected in the fill.

Notes:
1. MacDermid was regulated as a former hazardous waste container storage facility. MacDermid manufactured, blended, and distributed chemicals.
2. The regulated unit was clean closed in 1999.
3. The solid waste management units are two former surface impoundments (lagoons), a former incinerator, and a railroad spur.
4. Lagoons were closed in 1976 and 1982.
5. Incinerator was closed in 1981.
6. Rail spur last used in 1981.
7. Manufacturing building interior floor is sealed concrete.
8. Soils in the lagoons contained high metals concentrations. Sampling was done in 2016/2017.
9. MacDermid installed 5 groundwater monitoring wells.
10. MacDermid found VOCs in groundwater in the former lagoons area.
11. MacDermid is considering a facility expansion over the lagoons area. This makes the volatilization to indoor air pathway a concern.
12. There is a possibility that MacDermid may remove the contaminated soils to allow them to build over the lagoons area.
13. There is no off-site contamination.
14. Direct contact exceedances occur in and adjacent to the lagoons area.
15. Project staff asked MacDermid to map utility corridors.
16. MacDermid requested a groundwater not in an aquifer determination.
17. There was only 5 of 30 borings that had water. There is no hydraulic communication between shallow and deep wells.

Recommendations:

1. Project staff should confirm whether MacDermind used per- and polyfluoroalkyl substances (PFAS) in facility operations. If they did, additional investigation will be needed.
2. Project staff should confirm that direct contact criteria are not exceeded in surface soil samples.
3. If direct contact criteria exceedances are detected, MacDermid will need to remove the affected soils, or propose another remedy.
4. The RAT agrees the site meets the criteria for a groundwater not in an aquifer determination.
5. Project staff should ask MacDermid to submit the utility corridors maps to demonstrate that they are not a pathway for off-site migration.
6. Once the RFI Report is approved, MacDermid will need to provide a corrective measure implementation work plan that includes a schedule for implementing final corrective measures.

Chair's Signature: Kimberly M. Tyson **Date Signed:** 10/9/2017

Appendix I

2018 Soil Sample PFAS Laboratory Report

Report ID: S97230.01(02)
Generated on 12/13/2018

Report to

Attention: Allan Blaske
GEI Consultants
230 N. Washington Squ. Suite 200
Lansing, MI 48933

Phone: 517-803-2839 FAX:
Email: ablaske@geiconsultants.com

Report produced by

Merit Laboratories, Inc.
2680 East Lansing Drive
East Lansing, MI 48823

Phone: (517) 332-0167 FAX: (517) 332-6333

Contacts for report questions:
John Laverty (johnlaverty@meritlabs.com)
Barbara Ball (bball@meritlabs.com)

Report Summary

Lab Sample ID(s): S97230.01-S97230.02
Project: Ferndale / 1601470
Collected Date: 11/30/2018
Submitted Date/Time: 11/30/2018 13:10
Sampled by: Unknown
P.O. #:

Table of Contents

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General Report Notes (Page 2)
Report Narrative (Page 2)
Laboratory Certifications (Page 3)
Qualifier Descriptions (Page 3)
Glossary of Abbreviations (Page 3)
Method Summary (Page 4)
Sample Summary (Page 5)

Maya Murshak
Technical Director

General Report Notes

Analytical results relate only to the samples tested, in the condition received by the laboratory.

Methods may be modified for improved performance.

Results reported on a dry weight basis where applicable.

'Not detected' indicates that parameter was not found at a level equal to or greater than the reporting limit (RL).

40 CFR Part 136 Table II Required Containers, Preservation Techniques and Holding Times for the Clean Water Act specify that samples for acrolein and acrylonitrile need to be preserved at a pH in the range of 4 to 5 or if not preserved, analyzed within 3 days of sampling.

QA/QC corresponding to this analytical report is a separate document with the same Merit ID reference and is available upon request.

Full accreditation certificates are available upon request. Starred (*) analytes are not NELAP accredited.

Samples are held by the lab for 30 days from the final report date unless a written request to hold longer is provided by the client.

Report shall not be reproduced except in full, without the written approval of Merit Laboratories, Inc.

Limits for drinking water samples, are listed as the MCL Limits (Maximum Contaminant Level Concentrations)

Report Narrative

All analyses completed

Laboratory Certifications

Authority	Certification ID
Michigan DEQ	#9956
DOD ELAP/ISO 17025	#69699
WBENC	#2005110032
Ohio VAP	#CL0002
Indiana DOH	#C-MI-07
New York NELAC	#11814
North Carolina DENR	#680
North Carolina DOH	#26702
Alaska CSLAP	#17-001

Qualifier Descriptions

Qualifier	Description
!	Result is outside of stated limit criteria
B	Compound also found in associated method blank
E	Concentration exceeds calibration range
F	Analysis run outside of holding time
G	Estimated result due to extraction run outside of holding time
H	Sample submitted and run outside of holding time
I	Matrix interference with internal standard
J	Estimated value less than reporting limit, but greater than MDL
L	Elevated reporting limit due to low sample amount
M	Result reported to MDL not RDL
O	Analysis performed by outside laboratory. See attached report.
R	Preliminary result
S	Surrogate recovery outside of control limits
T	No correction for total solids
X	Elevated reporting limit due to matrix interference
Y	Elevated reporting limit due to high target concentration
b	Value detected less than reporting limit, but greater than MDL
e	Reported value estimated due to interference
j	Analyte also found in associated method blank
p	Benzo(b)Fluoranthene and Benzo(k)Fluoranthene integrated as one peak.
x	Preserved from bulk sample

Glossary of Abbreviations

Abbreviation	Description
RL/RDL	Reporting Limit
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
SW	EPA SW 846 (Soil and Wastewater) Methods
E	EPA Methods
SM	Standard Methods
LN	Linear
BR	Branched

Method Summary

Method	Version
ASTM D7968-17M	
SM2540B	Standard Method 2540 B 2011

Sample Summary (2 samples)

Sample ID	Sample Tag	Matrix	Collected Date/Time
S97230.01	Lagoon #1 Soil	Soil	11/30/18 09:57
S97230.02	Lagoon #2 Soil	Soil	11/30/18 10:15

Lab Sample ID: S97230.01
Sample Tag: Lagoon #1 Soil
Collected Date/Time: 11/30/2018 09:57
Matrix: Soil
COC Reference: 120303

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	15ml Centrifuge Tube	None	Yes	5.8	IR
1	4oz Glass	None	Yes	5.8	IR

Inorganics

Method: SM2540B, Run Date: 12/03/18 13:45, Analyst: JBL

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Total Solids*	83	1	1	%	1		

Organics - Volatiles

24 PFAs, Method: ASTM D7968-17M, Run Date: 12/11/18 16:35, Analyst: JGH

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
PFBA*	Not detected	50		ng/kg	4.62	375-22-4	
PFPeA*	Not detected	20		ng/kg	4.62	2706-90-3	
4:2 FTSA*	Not detected	20		ng/kg	4.62	757124-72-4	I
PFHxA*	60	20		ng/kg	4.62	307-24-4	
PFBS*	50	20		ng/kg	4.62	375-73-5	
PFHpA*	80	20		ng/kg	4.62	375-85-9	
PFPeS*	160	20		ng/kg	4.62	2706-91-4	
6:2 FTSA*	Not detected	20		ng/kg	4.62	27619-97-2	I
PFOA*	1,440	20		ng/kg	4.62	335-67-1	
PFHxS*	1,100	20		ng/kg	4.62	355-46-4	
PFHxS-LN*	950	20		ng/kg	4.62	355-46-4-LN	
PFHxS-BR*	90	20		ng/kg	4.62	355-46-4-BR	
PFNA*	50	20		ng/kg	4.62	375-95-1	
8:2 FTSA*	Not detected	20		ng/kg	4.62	39108-34-4	
PFHpS*	510	20		ng/kg	4.62	375-92-8	
PFDA*	Not detected	20		ng/kg	4.62	335-76-2	
N-MeFOSAA*	Not detected	20		ng/kg	4.62	2355-31-9	
EtFOSAA*	2,140	20		ng/kg	4.62	2991-50-6	
PFOS*	59,290	20		ng/kg	4.62	1763-23-1	E
PFOS-LN*	43,810	20		ng/kg	4.62	1763-23-1-LN	
PFOS-BR*	19,460	20		ng/kg	4.62	1763-23-1-BR	
PFUnDA*	Not detected	20		ng/kg	4.62	2058-94-8	
PFNS*	Not detected	20		ng/kg	4.62	474511-07-4	
PFDoDA*	Not detected	20		ng/kg	4.62	307-55-1	
PFDS*	Not detected	20		ng/kg	4.62	335-77-3	
PFTrDA*	Not detected	20		ng/kg	4.62	72629-94-8	
FOSA*	18,400	20		ng/kg	4.62	754-91-6	
PFTeDA*	Not detected	20		ng/kg	4.62	376-06-7	

24 PFAs (Replicate 01), Method: ASTM D7968-17M, Run Date: 12/13/18 13:08, Analyst: JGH

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
PFBA*	Not detected	600		ng/kg	55.7	375-22-4	Y

I-Matrix interference with internal standard
E-Concentration exceeds calibration range
Y-Elevated reporting limit due to high target concentration

Lab Sample ID: S97230.01 (continued)
Sample Tag: Lagoon #1 Soil

24 PFAs (Replicate 01), Method: ASTM D7968-17M, Run Date: 12/13/18 13:08, Analyst: JGH (continued)

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
PFPeA*	Not detected	300		ng/kg	55.7	2706-90-3	Y
4:2 FTSA*	Not detected	300		ng/kg	55.7	757124-72-4	Y
PFHxA*	Not detected	300		ng/kg	55.7	307-24-4	Y
PFBS*	Not detected	300		ng/kg	55.7	375-73-5	Y
PFHpA*	Not detected	300		ng/kg	55.7	375-85-9	Y
PFPeS*	Not detected	300		ng/kg	55.7	2706-91-4	Y
6:2 FTSA*	Not detected	300		ng/kg	55.7	27619-97-2	Y
PFOA*	1,600	300		ng/kg	55.7	335-67-1	Y
PFHxS*	1,400	300		ng/kg	55.7	355-46-4	Y
PFHxS-LN*	1,200	300		ng/kg	55.7	355-46-4-LN	Y
PFHxS-BR*	Not detected	300		ng/kg	55.7	355-46-4-BR	Y
PFNA*	Not detected	300		ng/kg	55.7	375-95-1	Y
8:2 FTSA*	Not detected	300		ng/kg	55.7	39108-34-4	Y
PFHpS*	600	300		ng/kg	55.7	375-92-8	Y
PFDA*	Not detected	300		ng/kg	55.7	335-76-2	Y
N-MeFOSAA*	Not detected	300		ng/kg	55.7	2355-31-9	Y
EtFOSAA*	1,400	300		ng/kg	55.7	2991-50-6	Y
PFOS*	56,100	300		ng/kg	55.7	1763-23-1	Y
PFOS-LN*	38,400	300		ng/kg	55.7	1763-23-1-LN	Y
PFOS-BR*	18,600	300		ng/kg	55.7	1763-23-1-BR	Y
PFUnDA*	Not detected	300		ng/kg	55.7	2058-94-8	Y
PFNS*	Not detected	300		ng/kg	55.7	474511-07-4	Y
PFDoDA*	Not detected	300		ng/kg	55.7	307-55-1	Y
PFDS*	Not detected	300		ng/kg	55.7	335-77-3	Y
PFTrDA*	Not detected	300		ng/kg	55.7	72629-94-8	Y
FOSA*	16,900	300		ng/kg	55.7	754-91-6	Y
PFTeDA*	Not detected	300		ng/kg	55.7	376-06-7	Y

Y-Elevated reporting limit due to high target concentration

Lab Sample ID: S97230.02
Sample Tag: Lagoon #2 Soil
Collected Date/Time: 11/30/2018 10:15
Matrix: Soil
COC Reference: 120303

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	15ml Centrifuge Tube	None	Yes	5.8	IR
1	4oz Glass	None	Yes	5.8	IR

Inorganics

Method: SM2540B, Run Date: 12/03/18 13:45, Analyst: JBL

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
Total Solids*	85	1	1	%	1		

Organics - Volatiles

24 PFAs, Method: ASTM D7968-17M, Run Date: 12/11/18 16:55, Analyst: JGH

Parameter	Result	RL	MDL	Units	Dilution	CAS#	Flags
PFBA*	Not detected	40		ng/kg	4.11	375-22-4	
PFPeA*	40	20		ng/kg	4.11	2706-90-3	
4:2 FTSA*	Not detected	20		ng/kg	4.11	757124-72-4	
PFHxA*	40	20		ng/kg	4.11	307-24-4	
PFBS*	Not detected	20		ng/kg	4.11	375-73-5	
PFHpA*	30	20		ng/kg	4.11	375-85-9	
PFPeS*	Not detected	20		ng/kg	4.11	2706-91-4	
6:2 FTSA*	Not detected	20		ng/kg	4.11	27619-97-2	I
PFOA*	200	20		ng/kg	4.11	335-67-1	
PFHxS*	60	20		ng/kg	4.11	355-46-4	
PFHxS-LN*	50	20		ng/kg	4.11	355-46-4-LN	
PFHxS-BR*	Not detected	20		ng/kg	4.11	355-46-4-BR	
PFNA*	Not detected	20		ng/kg	4.11	375-95-1	
8:2 FTSA*	Not detected	20		ng/kg	4.11	39108-34-4	
PFHpS*	Not detected	20		ng/kg	4.11	375-92-8	
PFDA*	Not detected	20		ng/kg	4.11	335-76-2	
N-MeFOSAA*	Not detected	20		ng/kg	4.11	2355-31-9	
EtFOSAA*	30	20		ng/kg	4.11	2991-50-6	
PFOS*	4,550	20		ng/kg	4.11	1763-23-1	
PFOS-LN*	3,810	20		ng/kg	4.11	1763-23-1-LN	
PFOS-BR*	710	20		ng/kg	4.11	1763-23-1-BR	
PFUnDA*	Not detected	20		ng/kg	4.11	2058-94-8	
PFNS*	Not detected	20		ng/kg	4.11	474511-07-4	
PFDoDA*	Not detected	20		ng/kg	4.11	307-55-1	
PFDS*	Not detected	20		ng/kg	4.11	335-77-3	
PFTrDA*	Not detected	20		ng/kg	4.11	72629-94-8	
FOSA*	Not detected	20		ng/kg	4.11	754-91-6	
PFTeDA*	Not detected	20		ng/kg	4.11	376-06-7	

I-Matrix interference with internal standard

Merit Laboratories Login Checklist

Lab Set ID: S97230
Client: GEI (GEI Consultants)
Project: Ferndale / 1601470
Submitted: 11/30/2018 13:10 Login User: SRS

Attention: Allan Blaske
Address: GEI Consultants
230 N. Washington Squ. Suite 200
Lansing, MI 48933

Phone: 517-803-2839 FAX:
Email: ablaske@geiconsultants.com

Selection				Description	Note
Sample Receiving					
01.	[X] Yes	[ ] No	[ ] N/A	Samples are received at 4C +/- 2C Thermometer #	IR 5.8
02.	[X] Yes	[ ] No	[ ] N/A	Received on ice/ cooling process begun	
03.	[ ] Yes	[X] No	[ ] N/A	Samples shipped	
04.	[ ] Yes	[X] No	[ ] N/A	Samples left in 24 hr. drop box	
05.	[ ] Yes	[ ] No	[X] N/A	Are there custody seals/tape or is the drop box locked	
Chain of Custody					
06.	[X] Yes	[ ] No	[ ] N/A	COC adequately filled out	
07.	[X] Yes	[ ] No	[ ] N/A	COC signed and relinquished to the lab	
08.	[X] Yes	[ ] No	[ ] N/A	Sample tag on bottles match COC	
09.	[ ] Yes	[X] No	[ ] N/A	Subcontracting needed? Subcontacted to:	
Preservation					
10.	[ ] Yes	[ ] No	[X] N/A	Do sample have correct chemical preservation	
11.	[ ] Yes	[ ] No	[X] N/A	Completed pH checks on preserved samples? (no VOAs)	
12.	[ ] Yes	[X] No	[ ] N/A	Did any samples need to be preserved in the lab?	
Bottle Conditions					
13.	[X] Yes	[ ] No	[ ] N/A	All bottles intact	
14.	[X] Yes	[ ] No	[ ] N/A	Appropriate analytical bottles are used	
15.	[X] Yes	[ ] No	[ ] N/A	Merit bottles used	
16.	[X] Yes	[ ] No	[ ] N/A	Sufficient sample volume received	
17.	[ ] Yes	[X] No	[ ] N/A	Samples require laboratory filtration	
18.	[X] Yes	[ ] No	[ ] N/A	Samples submitted within holding time	
19.	[ ] Yes	[ ] No	[X] N/A	Do water VOC or TOX bottles contain headspace	

Corrective action for all exceptions is to call the client and to notify the project manager.

Client Review By: ______________________________ Date:______________

 Prepared by Merit Laboratories

Merit Laboratories, Inc.

2680 East Lansing Dr., East Lansing, MI 48823
Phone (517) 332-0167 Fax (517) 332-4034
www.meritlabs.com

C.O.C. PAGE # 1 OF 1

120303

CHAIN OF CUSTODY RECORD

REPORT TO

CONTACT NAME: Allan Blaske
COMPANY: GEI Consultants
ADDRESS: 230 N. Washington Squ. Suite 201
CITY: Lansing STATE: MI ZIP CODE:
PHONE NO.: 517-974-2891 FAX NO.: P.O. NO.:
E-MAIL ADDRESS: ablaske@geiconsultants.com QUOTE NO.:

INVOICE TO

CONTACT NAME: Same ☐ SAME
COMPANY:
ADDRESS:
CITY: STATE: ZIP CODE:
PHONE NO.: E-MAIL ADDRESS:

PROJECT NO./NAME: Ferndale / 1601470
SAMPLER(S) - PLEASE PRINT/SIGN NAME:

TURNAROUND TIME REQUIRED ☐ 1 DAY ☐ 2 DAYS ☐ 3 DAYS ☐ STANDARD ☒ OTHER 5 day

DELIVERABLES REQUIRED ☒ STD ☐ LEVEL II ☐ LEVEL III ☐ LEVEL IV ☐ EDD ☐ OTHER

MATRIX CODE: GW=GROUNDWATER WW=WASTEWATER S=SOIL L=LIQUID SD=SOLID SL=SLUDGE DW=DRINKING WATER O=OIL WP=WIPE A=AIR W=WASTE

ANALYSIS (ATTACH LIST IF MORE SPACE IS REQUIRED)

MERIT LAB NO. (FOR LAB USE ONLY)	DATE	TIME	SAMPLE TAG IDENTIFICATION-DESCRIPTION	MATRIX	# OF BOTTLES	NONE	HCl	HNO_3	H_2SO_4	NaOH	MeOH	OTHER	PFAS 24
97230.01	11/30/18	957	Lagoon #1 soil	S	4								X
.02	11/30/18	1015	Lagoon #2 soil	S	4								X

Certifications: ☐ OHIO VAP ☐ Drinking Water ☐ DoD ☐ NPDES
Project Locations: ☐ Detroit ☐ New York ☐ Other
Special Instructions

RELINQUISHED BY: SIGNATURE/ORGANIZATION Allan R. Blaske ☒ Sampler	DATE 11/30/18	TIME 1310	
RECEIVED BY: SIGNATURE/ORGANIZATION [signature]	DATE 11/30/18	TIME 1310	
RELINQUISHED BY: SIGNATURE/ORGANIZATION	DATE	TIME	
RECEIVED BY: SIGNATURE/ORGANIZATION	DATE	TIME	

RELINQUISHED BY: SIGNATURE/ORGANIZATION		DATE	TIME
RECEIVED BY: SIGNATURE/ORGANIZATION		DATE	TIME
SEAL NO.	SEAL INTACT YES ☐ NO ☐	INITIALS	
SEAL NO.	SEAL INTACT YES ☐ NO ☐	INITIALS	

NOTES: TEMP. ON ARRIVAL 5.8

PLEASE NOTE: SIGNING ACKNOWLEDGES ADHERENCE TO MERIT'S SAMPLE ACCEPTANCE POLICY ON REVERSE SIDE

Rev. 5.18.12

Appendix J

2020 Soil Sample PFAS Laboratory Report

Fibertec environmental services

Monday, March 16, 2020

Fibertec Project Number:	95156
Project Identification:	Ferndale (1601470) Ferndale, MI/1601470
Submittal Date:	02/24/2020

Mr. Allan Blaske
GEI Consultants of Michigan, P.C.
230 N. Washington Square
Suite 201
Lansing, MI 48933

Dear Mr. Blaske,

Thank you for selecting Fibertec Environmental Services as your analytical laboratory. The samples you submitted have been analyzed in accordance with NELAC standards and the results compiled in the attached report. Any exceptions to NELAC compliance are noted in the report. These results apply only to those samples submitted. Please note TO-15 samples will be disposed of 7 calendar days after the reporting date. All other samples will be disposed of 30 days after the reporting date.

If you have any questions regarding these results or if we may be of further assistance to you, please contact me at (517) 699-0345.

Sincerely,

Stephan. Wallace

By Stephannie Wallace at 3:29 PM, Mar 16, 2020

For Daryl P. Strandbergh
Laboratory Director

Enclosures

Fibertec environmental services

Analytical Laboratory Report
Laboratory Project Number: 95156
Laboratory Sample Number: 95156-001

Client Identification:	**GEI Consultants of Michigan, P.C.**	Sample Description:	**SB20-1A**	Chain of Custody:	**187223**
Client Project Name:	**Ferndale (1601470)**	Sample No:		Collect Date:	**02/24/20**
Client Project No:	**1601470**	Sample Matrix:	**Soil/Solid**	Collect Time:	**10:23**

Sample Comments: **Soil results have been calculated and reported on a dry weight basis unless otherwise noted.**

Definitions: Q: Qualifier (see definitions at end of report) NA: Not Applicable ‡: Parameter not included in NELAC Scope of Analysis.

PFAS **Aliquot ID: 95156-001** **Matrix: Soil/Solid**
Method: ASTM D7968-17a **Description: SB20-1A**

Parameter(s)	Result	Q	Units	Reporting Limit	Dilution	Preparation P. Date	Preparation P. Batch	Analysis A. Date	Analysis A. Batch	Init.
‡ 1. N-EtFOSAA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 2. FtS 4:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 3. FtS 6:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 4. FtS 8:2	U	EIS+	ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 5. N-MeFOSAA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 6. PFBA	**470**		ng/kg	25	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 7. PFBS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 8. PFDA	U		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 9. PFDoA	**64**	IB	ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 10. PFDS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 11. PFHpA	**57**		ng/kg	25	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 12. PFHpS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 13. PFHxA	**69**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 14. PFHxS-Branched	U	ISC-	ng/kg	10	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 15. PFHxS-Linear	U		ng/kg	21	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 16. PFHxS-Total	U		ng/kg	31	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 17. PFNA	**81**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 18. PFNS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 19. PFOA	**280**		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 20. PFOSA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 21. PFOS-Branched	**160**	ISC-	ng/kg	11	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 22. PFOS-Linear	**2200**		ng/kg	20	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 23. PFOS-Total	**2400**		ng/kg	31	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 24. PFPeA	**42**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 25. PFPeS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 26. PFTeA	U		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 27. PFTriA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 28. PFUnA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR

Client Identification:	**GEI Consultants of Michigan, P.C.**	Sample Description:	**SB20-1B**	Chain of Custody:	**187223**
Client Project Name:	**Ferndale (1601470)**	Sample No:		Collect Date:	**02/24/20**
Client Project No:	**1601470**	Sample Matrix:	**Soil/Solid**	Collect Time:	**11:10**

Sample Comments: **Soil results have been calculated and reported on a dry weight basis unless otherwise noted.**

Definitions: Q: Qualifier (see definitions at end of report) NA: Not Applicable ‡: Parameter not included in NELAC Scope of Analysis.

PFAS **Aliquot ID: 95156-002** **Matrix: Soil/Solid**

Method: ASTM D7968-17a **Description: SB20-1B**

Parameter(s)	Result	Q	Units	Reporting Limit	Dilution	Preparation P. Date	Preparation P. Batch	Analysis A. Date	Analysis A. Batch	Init.
‡ 1. N-EtFOSAA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 2. FtS 4:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 3. FtS 6:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 4. FtS 8:2	U	EIS+	ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 5. N-MeFOSAA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 6. PFBA	**91**		ng/kg	25	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 7. PFBS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 8. PFDA	U		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 9. PFDoA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 10. PFDS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 11. PFHpA	**120**		ng/kg	25	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 12. PFHpS	**260**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 13. PFHxA	**560**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 14. PFHxS-Branched	**44**	ISC-	ng/kg	10	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 15. PFHxS-Linear	**260**		ng/kg	21	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 16. PFHxS-Total	**300**		ng/kg	31	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 17. PFNA	**82**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 18. PFNS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 19. PFOA	**3500**		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 20. PFOSA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 21. PFOS-Branched	**5600**	ISC-	ng/kg	110	10	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 22. PFOS-Linear	**20000**		ng/kg	200	10	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 23. PFOS-Total	**25000**		ng/kg	310	10	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 24. PFPeA	**300**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 25. PFPeS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 26. PFTeA	U		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 27. PFTriA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 28. PFUnA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR

Client Identification:	**GEI Consultants of Michigan, P.C.**	Sample Description:	**SB20-2A**	Chain of Custody:	**187223**
Client Project Name:	**Ferndale (1601470)**	Sample No:		Collect Date:	**02/24/20**
Client Project No:	**1601470**	Sample Matrix:	**Soil/Solid**	Collect Time:	**11:25**

Sample Comments: **Soil results have been calculated and reported on a dry weight basis unless otherwise noted.**

Definitions: Q: Qualifier (see definitions at end of report) NA: Not Applicable ‡: Parameter not included in NELAC Scope of Analysis.

PFAS **Aliquot ID: 95156-003** **Matrix: Soil/Solid**

Method: ASTM D7968-17a **Description: SB20-2A**

Parameter(s)	Result	Q	Units	Reporting Limit	Dilution	Preparation P. Date	Preparation P. Batch	Analysis A. Date	Analysis A. Batch	Init.
‡ 1. N-EtFOSAA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 2. FtS 4:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 3. FtS 6:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 4. FtS 8:2	U	EIS+	ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 5. N-MeFOSAA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 6. PFBA	**110**		ng/kg	25	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 7. PFBS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 8. PFDA	U		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 9. PFDoA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 10. PFDS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 11. PFHpA	**79**		ng/kg	25	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 12. PFHpS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 13. PFHxA	**190**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 14. PFHxS-Branched	U	ISC-	ng/kg	10	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 15. PFHxS-Linear	U		ng/kg	21	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 16. PFHxS-Total	U		ng/kg	31	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 17. PFNA	**160**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 18. PFNS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 19. PFOA	**800**		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 20. PFOSA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 21. PFOS-Branched	**1700**	ISC-	ng/kg	11	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 22. PFOS-Linear	**3700**		ng/kg	20	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 23. PFOS-Total	**5400**		ng/kg	31	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 24. PFPeA	**66**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 25. PFPeS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 26. PFTeA	U		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 27. PFTriA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 28. PFUnA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR

Client Identification:	**GEI Consultants of Michigan, P.C.**	Sample Description:	**SB20-2B**	Chain of Custody:	**187223**
Client Project Name:	**Ferndale (1601470)**	Sample No:		Collect Date:	**02/24/20**
Client Project No:	**1601470**	Sample Matrix:	**Soil/Solid**	Collect Time:	**11:45**

Sample Comments: **Soil results have been calculated and reported on a dry weight basis unless otherwise noted.**

Definitions: Q: Qualifier (see definitions at end of report) NA: Not Applicable ‡: Parameter not included in NELAC Scope of Analysis.

PFAS **Aliquot ID: 95156-004** **Matrix: Soil/Solid**
Method: ASTM D7968-17a **Description: SB20-2B**

Parameter(s)	Result	Q	Units	Reporting Limit	Dilution	Preparation P. Date	P. Batch	Analysis A. Date	A. Batch	Init.
‡ 1. N-EtFOSAA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 2. FtS 4:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 3. FtS 6:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 4. FtS 8:2	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 5. N-MeFOSAA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 6. PFBA	U		ng/kg	25	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 7. PFBS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 8. PFDA	U		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 9. PFDoA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 10. PFDS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 11. PFHpA	U		ng/kg	25	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 12. PFHpS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 13. PFHxA	**33**		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 14. PFHxS-Branched	U	ISC-	ng/kg	10	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 15. PFHxS-Linear	U		ng/kg	21	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 16. PFHxS-Total	U		ng/kg	31	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 17. PFNA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 18. PFNS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 19. PFOA	**120**		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 20. PFOSA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 21. PFOS-Branched	U	ISC-	ng/kg	11	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 22. PFOS-Linear	U		ng/kg	20	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 23. PFOS-Total	U		ng/kg	31	1.0	02/27/20	PS20B27H	03/01/20	SM20B29A	DAR
‡ 24. PFPeA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 25. PFPeS	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 26. PFTeA	U		ng/kg	100	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 27. PFTriA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR
‡ 28. PFUnA	U		ng/kg	25	1.0	02/27/20	PS20B27H	02/27/20	SM20B27A	DAR

Definitions/ Qualifiers:

- **A:** Spike recovery or precision unusable due to dilution.
- **B:** The analyte was detected in the associated method blank.
- **E:** The analyte was detected at a concentration greater than the calibration range, therefore the result is estimated.
- **J:** The concentration is an estimated value.
- **M:** Modified Method
- **U:** The analyte was not detected at or above the reporting limit.
- **X:** Matrix Interference has resulted in a raised reporting limit or distorted result.
- **W:** Results reported on a wet-weight basis.
- ***:** Value reported is outside QC limits

Exception Summary:

- **EIS+** : The Isotope Dilution/Extracted Internal Standard area exceeds the upper control limit.
- **IB** : Analyte detected in the instrument blank at a level greater than 1/2 the LOQ.
- **ISC-** : Recovery in the associated Instrument Sensitivity Check (ISC) exceeds the lower control limit. Results may be biased low.

Analysis Locations:

All analyses performed in Holt.

Accreditation Number(s):

T104704518-19-8 (TX)

Fibertec environmental services

Analytical Laboratory
1914 Holloway Drive, Holt, MI 48842, Phone: 517 699 0345, Fax: 517 699 0388, email: lab@fibertec.us
8660 S. Mackinaw Trail, Cadillac, MI 49601, Phone: 231 775 8368, Fax: 231 775 8584

Industrial Hygiene Services, Inc.
1914 Holloway Drive, Holt, MI 48842, Phone: 517 699 0345, Fax: 517 699 0382, email: asbestos@fibertecihs.com

Geoprobe
11766 E. Grand River Rd., Brighton, MI 48116, Phone: 810 220 3300, Fax: 810 220 3311

Chain of Custody # 187223

PAGE 1 of 1

Client Name: GEI Consultants
Contact Person: Allan Blaske
Project Name/ Number: Ferndale 1601470 T12.1
Email distribution list: ablaske@geiconsultants.com
Quote#
Purchase Order#

Date	Time	Sample #	Client Sample Descriptor	MATRIX (SEE RIGHT CORNER FOR CODE)	# OF CONTAINERS	PFAS										HOLD SAMPLE	Remarks:
2/24/20	1023		SB20-1A	S	2	X											
2/24/20	1110		SB20-1B	S	2	X											
2/24/20	1125		SB20-2A	S	2	X											
2/24/20	1145		SB20-2B	S	2	X											

Matrix Code

S	Soil	GW	Ground Water
A	Air	SW	Surface Water
O	Oil	WW	Waste Water
P	Wipe	X	Other: Specify

Deliverables
- Level 2
- Level 3
- Level 4
- EDD

RCVD BY LAB
FEB 24 2020
Initial: JS

Comments:

Sampled/Relinquished By: Allan Blaske	Date/ Time 2/24/20 1326 ~~1326~~	Received By: [signature]
Relinquished By:	Date/ Time	Received By:
Relinquished By:	Date/ Time	Received By Laboratory:

Turnaround Time ALL RESULTS WILL BE SENT BY THE END OF THE BUSINESS DAY

___1 bus. day ___2 bus. days ___3 bus. days ___4 bus. days

X ~~5-7~~ bus. days (standard) for PFAS

Other (specify time/date requirement): _____

LAB USE ONLY
Fibertec project number: 95156
Temperature upon receipt at Lab: 4.5°C
RCV'D ON ICE

Please see back for terms and conditions

Appendix K

2020 Soil Sample PFAS Soil Borings

Boring Location

NORTHING: -- **EASTING:** -- **STATION:** **OFFSET:**
HORIZONTAL DATUM: NAD83 Michigan State Plane South International Feet
VERTICAL DATUM: -- **GROUND SURFACE ELEVATION (FT):** --
LOCATION: South Property Line, south of Lagoon #2

Drilling Information

DATE START / END: 2/24/2020 - 2/24/2020
TOTAL DEPTH (FT): 4.25
CONTRACTOR: **DRILLER:**
LOGGED BY: A. Blaske
EQUIPMENT: Hand Auger
BORING METHOD: Hand Auger
AUGER ID/OD: 3.5 in / NA **CASING ID/OD:** NM / NM
CORE INFO:
HAMMER TYPE: NA **HAMMER WEIGHT (lbs):** NA **HAMMER DROP (inch):** NA
WATER LEVEL ELEVATIONS (ft):
GENERAL NOTES:

ABBREVIATIONS: ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot; S = Split Spoon; DP = Direct Push Sample; U = Undistrubed Tube Sample; C = Rock Core; V = Field Vane Shear; SC = Sonic Core; WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; OVM = Organic Vapor Meter; Q_P = Pocket Penetrometer Strength; S_v = Pocket Torvane Shear Strength; F_v = Field Vane Shear Strength; NA, NM = Not Applicable, Not Measured

Elev. (ft)	Depth (ft)	Sample No.	Type	Depth (ft)	Pen./Rec. (in)	Blows Count or RQD	PID (ppm)	GRAPHIC LOG	Sample Description & Classification	Remarks
		SB20-1		0 to 4	48/4				Brown silty clay with gravel	Soil Sample SB20-1A collected at 0 to 0.5'
									Black fine sandy fill with gravel, bricks, slag, glass, coal	Soil Sample SB20-1B collected at 3.5 to 4.0'
									Gray-brown mottled silty clay	
	5								End of Boring Boring backfilled with soil cuttings	

Strata lines represent the approximate boundaries between soil types. Actual transitions may be gradual. Water level readings have been made at times stated. Water levels may be different at other times.

CLIENT: MacDermid - Ferndale
PROJECT NAME: MacDermid - Ferndale
CITY/STATE: Ferndale, Michigan
GEI PROJECT NUMBER: 1601470

GEI Consultants of Michigan, P.C.
230 N. Washington Square,
Ste. 201 Lansing, MI 48933
(517) 803-4600

Boring Location

NORTHING: -- **EASTING:** -- **STATION:** **OFFSET:**
HORIZONTAL DATUM: NAD83 Michigan State Plane South International Feet
VERTICAL DATUM: -- **GROUND SURFACE ELEVATION (FT):** --
LOCATION: South Property Line, south of Lagoon #1

BORING
SB20-2

Drilling Information

DATE START / END: 2/24/2020 - 2/24/2020 **TOTAL DEPTH (FT):** 4.0
CONTRACTOR: **DRILLER:** **LOGGED BY:** A. Blaske
EQUIPMENT: Hand Auger **BORING METHOD:** Hand Auger
AUGER ID/OD: 3.5 in / NA **CASING ID/OD:** NM / NM **CORE INFO:**
HAMMER TYPE: NA **HAMMER WEIGHT (lbs):** NA **HAMMER DROP (inch):** NA
WATER LEVEL ELEVATIONS (ft):
GENERAL NOTES:

ABBREVIATIONS: ID = Inside Diameter; OD = Outside Diameter; Pen. = Penetration Length; Rec. = Recovery Length; bpf = Blows per Foot; mpf = Minute per Foot; S = Split Spoon; DP = Direct Push Sample; U = Undistrubed Tube Sample; C = Rock Core; V = Field Vane Shear; SC = Sonic Core; WOR = Weight of Rods; WOH = Weight of Hammer; RQD = Rock Quality Designation; OVM = Organic Vapor Meter; Q_P = Pocket Penetrometer Strength; S_v = Pocket Torvane Shear Strength; F_v = Field Vane Shear Strength; NA, NM = Not Applicable, Not Measured

Elev. (ft)	Depth (ft)	Sample No.	Type	Depth (ft)	Pen./ Rec. (in)	Blows Count or RQD	PID (ppm)	GRAPHIC LOG	Sample Description & Classification	Remarks
		SB20-2		0 to 4	48/4				Brown silty clay topsoil with concrete	Soil Sample SB20-2A collected at 0 to 0.5'
									Black sandy fill with cinders, slag, gravel	
									Tan-gray mottled silty clay	Soil Sample SB20-2B collected at 3.5 to 4.0'
									End of Boring Boring backfilled with soil cuttings	
	5									

Strata lines represent the approximate boundaries between soil types. Actual transitions may be gradual. Water level readings have been made at times stated. Water levels may be different at other times.

CLIENT: MacDermid - Ferndale
PROJECT NAME: MacDermid - Ferndale
CITY/STATE: Ferndale, Michigan
GEI PROJECT NUMBER: 1601470

GEI Consultants of Michigan, P.C.
230 N. Washington Square,
Ste. 201 Lansing, MI 48933
(517) 803-4600

Appendix L

Notice of Migration to Adjacent Property Owner

For DEQ Use Only
ITS # _______________
Site ID #_______________
Category Code: _________

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
REMEDIATION AND REDEVELOPMENT DIVISION

NOTICE OF MIGRATION OF CONTAMINATION (FORM EQP4482 REV. 4/16)

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

An owner or operator of property that is a facility, and/or who is subject to MCL324.20107a, and who has reason to believe that a hazardous substance is emanating from, has emanated from, or is likely to be emanating from the property and migrating beyond the boundaries of the property that he or she owns or operates is required under R 299.51017(1) and MCL 324.20114(1)(b)(ii) & (iii) to notify the Michigan Department of Environmental Quality (DEQ) and affected property owners. Submission of this notice does not fulfill the notification requirements of MCL 324.21309a.

The notice must be provided within 45 days (MCL 324.20107a) or within 30 days (MCL 324.20114) after the owner or operator has reason to believe that hazardous substances have migrated, or are likely to have migrated, to or beyond the boundary of his or her property (see R 299.51017 for exceptions that apply to parties subject to MCL 324.20107a).

Use of this form is mandatory for the notice required by R 299.51017(1) and may also be used by parties subject to MCL 324.20114(1)(b)(ii) & (iii). This form may also be used to provide notice to affected property owners as required by those rules.

If a person holds a permit for an oil and gas well under Part 615, Supervisor of Wells, of the NREPA and there is a release from the oil and gas exploration or production activities, that person shall give notice to the DEQ and to the owner of the surface rights of the property.

If a person holds an easement and there is a release from the easement holder's activities, that person shall provide notice to the DEQ and to the grantor of the easement, or the grantor's successor in interest, if any.

Completing this notice in no way relieves a person who is subject to MCL 324.20114 from the responsibility to undertake required response activities.

This notice must be sent to the DEQ office that serves the county in which the property is located. A list of DEQ offices is available at www.michigan.gov/deqduecare, or by calling the Remediation and Redevelopment Division's Lansing office at 517-284-5187. The DEQ will not prepare acknowledgement of receipt of these notices. The sender is responsible for sending the report using a method that provides proof of delivery if such proof is desired. Please label the outside of the envelope "Migration Notice." Additional guidelines for the compliance with the requirements of R 299.51017(1) or MCL 324.20114(1)(b)(ii) & (iii) are available at www.michigan.gov/deqduecare.

THIS NOTICE IS PROVIDED PURSUANT TO: **R 299.51017** ☐ **MCL 324.20114(1)** ☒
(check both, if applicable)

Please provide the following information as completely as possible.

1. Name and location of the property that hazardous substances are emanating from:

   Name: MacDermid, Inc.
   Address: 1221 Farrow Avenue
   Location:
   City/County: Ferndale/Oakland
   Property Tax Identification Number, or if applicable, the ward and item number: 25-35-155-002

   Latitude (decimal degrees): -83.119067 Longitude (decimal degrees): 42.456726

   Reference Point for Latitude and Longitude:
   Center of Site: ☒ Main/front door: ☐ Front gate/main entrance: ☐ Other: ☐

   Collection Method: Survey: ☐ Interpolation: ☒ GPS: ☐

2. Status relative to the property:
   (Check one or both, as applicable.)

   Owner ☒
   Operator ☒

2. Provide any additional ID numbers associated with the property (e.g., EPA ID No., BEA No., Part 213 facility ID No., etc.):
   MID 005 338 371

3. Name, address, and telephone number of the property owner, operator, or other party submitting the notice:
   Name: MacDermid, Inc.
   Address: 245 Freight Street
   City/State: Waterbury, CT 06702
   Telephone Number: (203) 575-5747

4. Name, address and telephone number of a contact person familiar with the content of the notice:
   Name: Mr. Richard Nave, CHMM, Corporate Director EH&S
   Address: 245 Freight Street
   City/State: Waterbury, CT 06702
   Telephone Number: (203) 575-5747

5. If this Notice is provided pursuant to R 299.51017, provide the address and other location information for the *adjacent* property(s) onto which contamination is migrating, has migrated, or is likely to migrate.

   If this Notice is provided pursuant to MCL Section 324.20114(1), provide the address and other location information for *each* property onto which contamination has migrated. Notice should be sent to the property owner of record. If the impacted property is owned by the State of Michigan, notice should be sent to the department managing the property (e.g., a prison, state park, etc.). Notices to the Michigan Department of Transportation (MDOT) for state owned roadways should be sent to Contaminated Site Specialist, Environmental Services Section, MDOT-Bureau of Development, 425 W. Ottawa Street, P.O. Box 30050, Lansing, MI 48909. If the impacted property is owned by the State of Michigan, notice should be sent to the department managing the property (i.e. a prison, state park, etc.).

Address: 2800 Livernois, Suite 200
City/State: Troy, Michigan 48083
Property Tax ID number: No property tax ID number
Other: Canadian National (CN) railroad property adjacent to the southwest of the facility

Notified? No ☐ Yes ☒ Date: 8/3/21

6. Complete the Table on Page 3 of this Form for each hazardous substance which has migrated, or is likely to have migrated, beyond the property boundary at a concentration that exceeds a Generic Residential Cleanup Criterion developed by the DEQ pursuant to MCL 324.20120a(1). Complete and attach additional copies of Page 3, if necessary, to list all hazardous substances that must be reported. Include a scaled map or drawing that shows the location of sampling points identified on the Table on Page 3, the property boundaries, and the adjacent property owners if providing notice pursuant to R 299.1017(1) or all impacted property owners if providing notice pursuant to MCL 324.20114(1).

7. Provide a summary of the information which shows that contamination is emanating from, or has emanated from, and is present beyond the boundary of the source property at a concentration which exceeds the generic residential criteria developed by the DEQ pursuant to MCL 324.20120a(1)(a). This summary shall identify the environmental media affected, specific hazardous substances, and the concentrations of those hazardous substances in all affected environmental media at the property boundary and in any sample locations beyond the property boundary. The summary shall also describe the basis for the conclusion that the contamination is emanating, has emanated, or is present beyond the boundary of the source property, including whether the conclusion is based on groundwater analytical data or fate and transport modeling, both, or neither.

   A RCRA Facility Investigation has been conducted at the MacDermid property. The investigation consisted of soil sampling, groundwater sampling, and laboratory testing to determine presence and extent of subsurface impacts. VOCs were detected at concentrations above applicable criteria in the soil and groundwater within the footprint and generally confined to the former lagoons. Subsequently, soil and groundwater within the former lagoons was excavated and removed from the site, and samples collected from each lagoon excavation for verification of remedial efforts. Contaminants remain in the subsurface soil at the site. Groundwater is found in limited amounts within the fill soil beneath the site and has been determined to be groundwater not in an aquifer (GWNIAA). Soil samples collected from locations near the property boundary during the investigation contain contaminants above applicable criteria, as outlined in the table below. Sample locations are illustrated on the attached Figure. Contaminants near the property boundary are contained within a layer of "urban fill" soil, containing glass, slag, concrete, coal, and other debris. No exposure pathways exist regarding the groundwater/surface water interface (GSI) pathway or the drinking water pathway for the site. Contaminants are present in soil within the "urban fill" soil, and potential migration of contaminants may be occurring within this layer through periodic movement of groundwater within this thin, discontinuous layer.

8. If the person making this notice has reason to believe that a migrating hazardous substance has affected, or is likely to affect, a private or public water supply, then that water supply must be identified here:

   N/A

	YES	NO
9. Is this notice being submitted within the timeframes established under R 299.51017 and/or MCL 324.20114(1), as applicable?	☒	☐
10. Is this notice in addition to a notice that was submitted prior to *December 21, 2002?* (R 299.51017(4)(c))	☐	☒
11. Is this notice related to an oil and gas well permit (R 299.51017(2))? Permit #:	☐	☒
12. Is this notice related to an easement (R 299.51017(3))? (NOTE: All easement grantors *must* receive this notice.)	☐	☒
13. Has surface water been affected (R 299.51017(1)? (If yes, please identify the affected surface water body.)	☐	☒

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
REMEDIATION AND REDEVELOPMENT DIVISION

CERTIFICATION:

With my signature below, I certify that I am the owner of the facility or that I am legally authorized to execute this notice on behalf of the owner or operator named on this form, and that to the best of my knowledge and belief the above representations are complete and accurate. I understand that intentionally submitting false information to the DEQ is a felony and may result in fines up to $25,000 for each violation.

Signature Richard A. Nave Date August 3, 2021
(Owner or person legally authorized to bind the person making this report)

Name (Typed or Printed) Richard A. Nave, CHMM

Title (Typed or Printed) Corporate Director EH&S

See Item 6 on Page 3 of this Form for instructions to be used in completing this table. Attach additional pages if necessary. The information to be included in each column of the table is:

Column A Name of hazardous substance.
Column B Chemical Abstract Service (CAS) Number for the hazardous substance.
Column C Maximum hazardous substance concentration measured on the property, expressed in parts per billion (e.g., ug/L or ug/Kg). Report maximum concentration separately for each environmental medium.
Column D Sample location for Column C (relate to label on map).
Column E Environmental medium in which concentration reported in Column C was measured (e.g., soil or groundwater).
Column F Distance from point of maximum measured concentration (Column D) to property boundary, in direction of contaminant migration, if direction is known or can reasonably be inferred. If direction is unknown, list distance to nearest property boundary.
Column G Direction of contaminant migration, if known.
Column H Concentration closest to property boundary, if known. If a concentration lower than the maximum concentration reported in Column C has been measured at a point closer to the property boundary in the direction of contaminant migration, use Column I to list the concentration that was measured closest to the property boundary in the direction of contaminant migration.
Column I Sample location for Column H (relate to label on map).
Column J Environmental medium for measurement reported in Column H, if applicable.

A Hazardous Substance	B CAS Number	C Maximum Concentration	D Sample Location for "C"	E Environmental Medium for "C"	F Distance to Property Boundary	G Direction of Migration	H Boundary Concentration	I Sample Location for "H"	J Environmental Medium for "H"
Phenanthrene	85018	11,000	MW-16-5	Soil	23.5 feet	N/A	2,100	SB-16-115	Soil
Fluoranthene	206440	8,800	MW-16-4	Soil	14.2 feet	N/A	8,800	MW-16-4	Soil
Carbazole	86748	1,200	MW-16-5	Soil	23.5 feet	N/A	1,200	MW-16-5	Soil
Lead	7439921	1,700,000	MW-16-5	Soil	23.5 feet	N/A	1,700,000	MW-16-5	Soil
PFOS	1763231	25	SB20-1	Soil	2.6 feet	N/A	25,000	SB20-1	Soil

Total Number Samples Collected: 81 Total Number of Samples Exceeding Criteria: 26

A scaled map or drawing showing these locations and the property boundaries must be submitted with this Notice

PFAS Soil Boring Locations
Verification Sample Location
Surface Soil Sample Location
Monitoring Well
Soil Boring
Approximate Property Boundary

0 20 40
Feet

RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	SOIL SAMPLING LOCATIONS	
MacDermid, Inc. Ferndale, Michigan	Project 1601470	July 2021	Fig. 3

W:\MacDermid_Ferndale\GIS\Fig3_soil_sampling_locations.mxd

Appendix M

Request for Access to Adjacent Property Owner

Consulting
Engineers and
Scientists

August 3, 2021
Project 1601470

Mr. Curtis Bartz
CN
2800 Livernois, Suite 200
Troy, MI 48083

RE: Delineation of Potential Soil Impacts
CN Property adjacent to MacDermid Facility
1221 Farrow Avenue, Ferndale, Michigan

Dear Mr. Bartz:

GEI Consultants of Michigan, P.C. (GEI) has been performing a site investigation and remedial activities at the MacDermid facility, located at 1221 Farrow Avenue, in Ferndale Michigan. Sampling at locations along the property boundary indicate the presence of several compounds at concentrations which exceed the Part 201 of Michigan's Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended.

The property located to the southwest of the MacDermid facility is the CN railroad and associated container yard. Figures 1 and 2 illustrate the location of the site and surrounding area.

Contaminants identified in soil samples along the southwestern property boundary, adjacent to the CN railroad, include:

<u>PNA Compounds</u>

- Phenanthrene in sample SB-16-115A at a depth of 3 to 4 feet,
- Fluoranthene and phenanthrene in sample MW-16-4 at a depth of 4 to 5 feet, and
- Carbazole, fluoranthene, and phenanthrene in sample MW-16-5 at a depth of 4 to 5 feet.

All concentrations of PNA compounds exceed only the non-residential Groundwater-Surface water Interface (GSI) protection criteria.

<u>Metals</u>

- Lead was detected in the sample from MW-16-5 at a depth of 4 to 5 feet, at a concentration above the non-residential direct contact criteria

<u>PFAS Compounds</u>

- Perfluorooctane sulfonate (PFOS) was detected in soil samples from two locations, SB20-1 (depth 3.5 to 4 feet) and SB20-2 (depth 0 to 0.5 feet) at concentrations above the non-residential GSI protection criteria.

Figure 3 illustrates the location of the soil samples referenced above.

An analysis of human and environmental receptors and potential exposure pathways was performed for the site, and indicated the following:

- No surface water bodies are present surrounding the site, so the GSI pathway is incomplete,
- A layer of "urban fill" (soil containing glass, brick, slag, concrete, etc.) underlies the site, and PNA compounds and metals are elevated in this fill soil,
- Groundwater within the subsurface is limited to thin, discontinuous layers, and the groundwater beneath the site has been designated "Groundwater Not in an Aquifer", following the protocol outlined by the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Therefore, groundwater use is not a valid exposure pathway at the site.

Nonetheless, EGLE has requested that we provide a Notice of Migration to adjacent property owners. The Notice of Migration form is attached to this letter.

Furthermore, EGLE has requested that we demonstrate best efforts to obtain access to the rail property to investigate contamination which may be originating from the MacDermid property. Therefore, GEI and MacDermid, Inc. hereby request access to your property to collect soil samples to delineate the extent of impacts which may be migrating onto your property from the MacDermid site.

The extent of investigative activities is not known at this time but would likely consist of surface (0 to 0.5 feet) and subsurface (up to 8 feet deep) soil samples, collected from 6 to 8 locations. These samples would be collected using hand-auger techniques. No drilling equipment would be utilized. No groundwater samples would be collected, and no monitoring wells would be installed.

Thank you for your consideration of this request. We ask for a response to this request, so that we can document to EGLE our efforts to obtain access to your property. I can be reached at 517-9784-2891 or ablaske@geiconsultants.com if you have any questions regarding this letter or would like to further discuss the site and this request.

Sincerely,

GEI CONSULTANTS OF MICHIGAN, P.C.

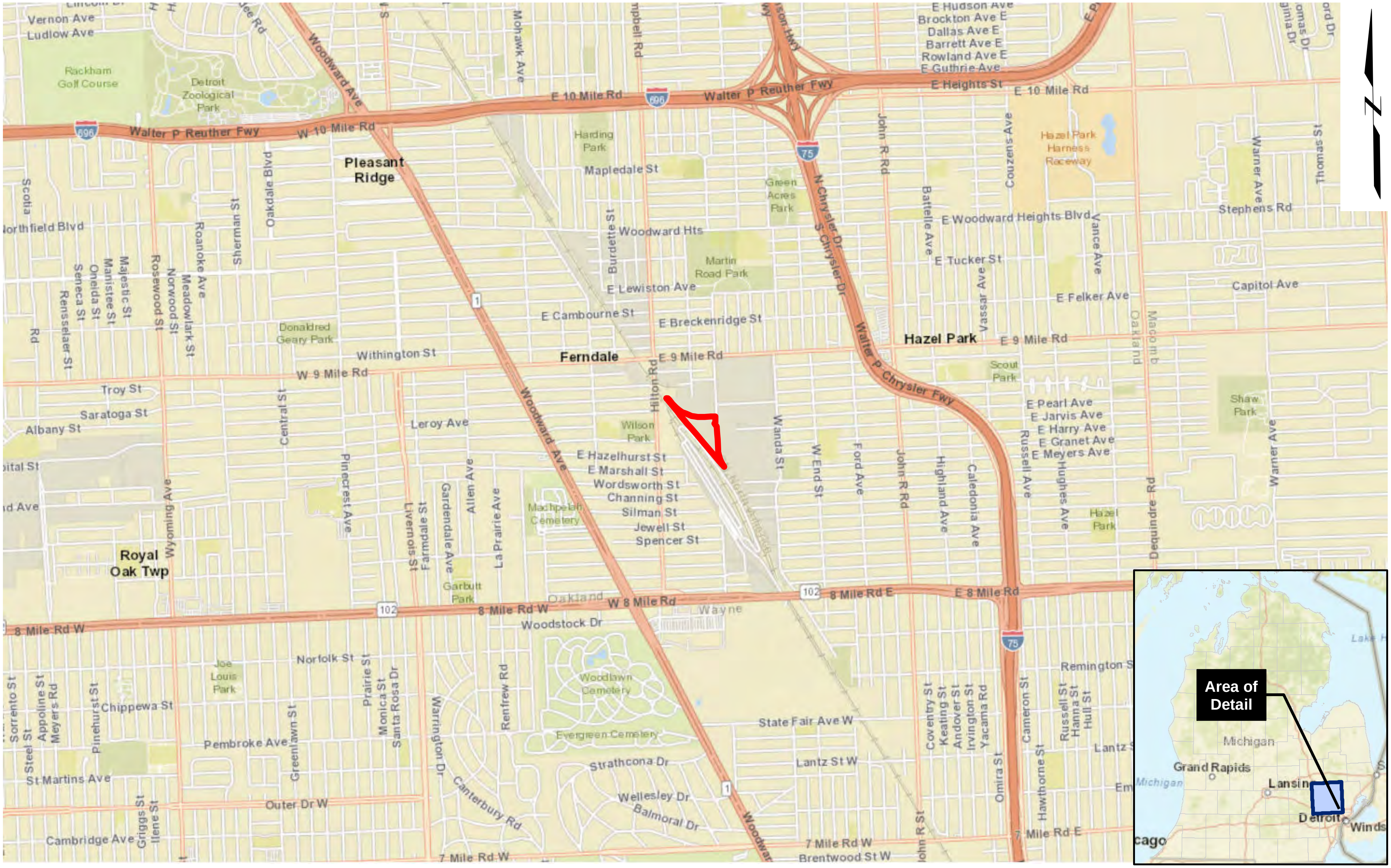
Allan R. Blaske

Allan R. Blaske, P.G., CPG
Senior Geologist

Paul R. Blindauer

Paul R. Blindauer
Vice President/Sr. Consultant

cc: Mr. Rich Nave, CHMM, Corporate Director, EH&S, Element Solutions
Mr. Guy Racino, CHMM, Associate Director, EH&S, Element Solutions



Approximate Property Boundary

0 1,500 3,000

Feet

RCRA Facility Investigation
Corrective Measures Implementation Work Plan
MID 005 338 371

MacDermid, Inc.
Ferndale, Michigan

GEI Consultants

Project 1601470

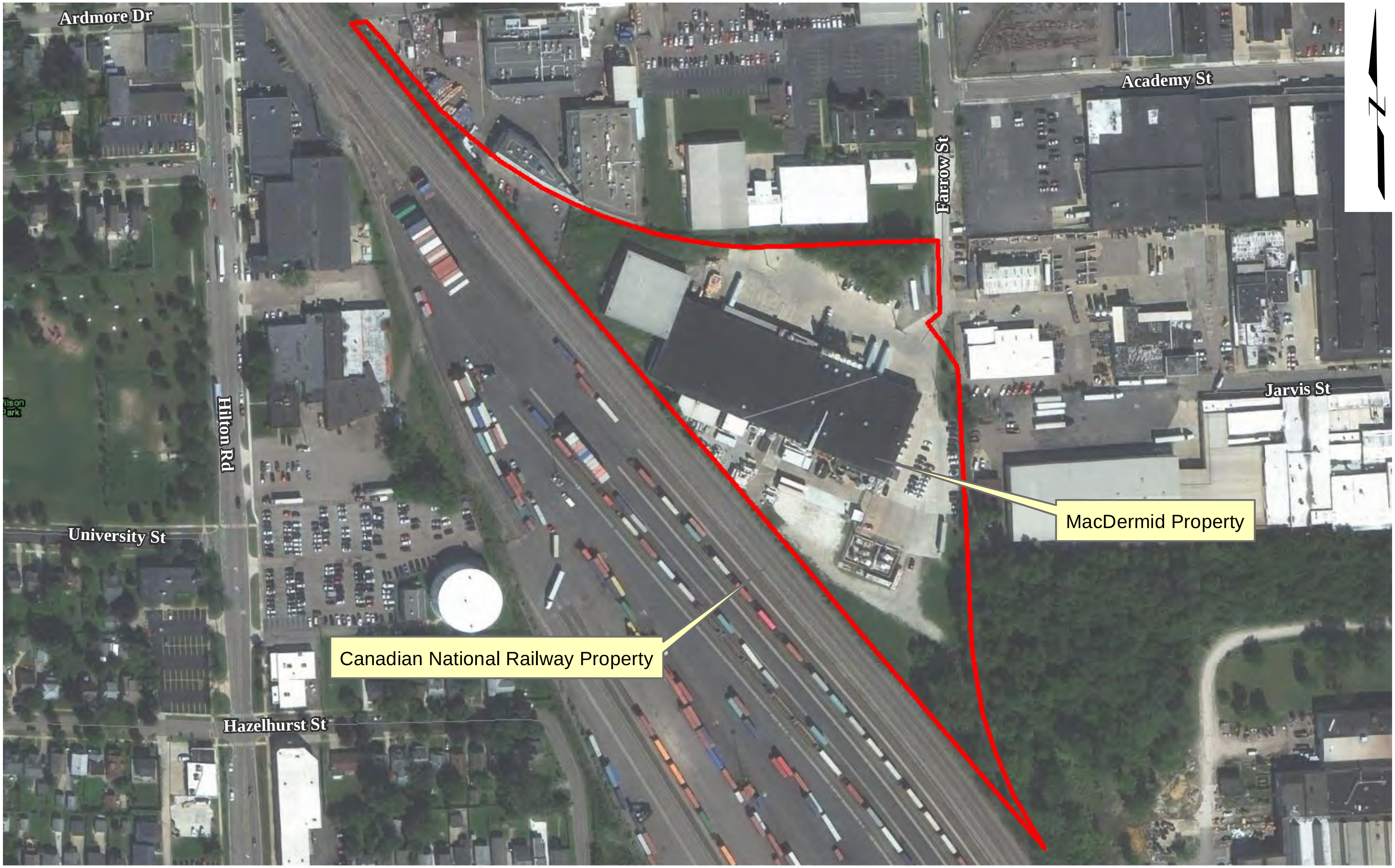
SITE LOCATION

March 2020

Fig. 1

W:\MacDermid_Ferndale\GIS\Fig1_Site_Location.mxd

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,



Approximate Property Boundary

0 125 250

Feet

RCRA Facility Investigation Corrective Measures Implementation Work Plan MID 005 338 371	GEI Consultants	SITE PROPERTY LAYOUT AND SURROUNDING AREA	
MacDermid, Inc. Ferndale, Michigan	Project 1601470	July 2021	Fig. 2

W:\MacDermid_Ferndale\GIS\Fig2_PropertyLayout.mxd

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

PFAS Soil Boring Locations

Verification Sample Location

Surface Soil Sample Location

Monitoring Well

Soil Boring

Approximate Property Boundary

0 20 40

Feet

RCRA Facility Investigation
Corrective Measures Implementation Work Plan
MID 005 338 371

MacDermid, Inc.
Ferndale, Michigan

GEI Consultants

Project 1601470

SOIL SAMPLING LOCATIONS

July 2021

Fig. 3

W:\MacDermid_Ferndale\GIS\Fig3_soil_sampling_locations.mxd

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GRAND LEDGE, MI 48837-9998
(800)275-8777

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Troy, MI 48083			
Weight: 0 lb 2.40 oz			
Estimated Delivery Date Fri 08/06/2021			
Certified Mail®			$3.60
Tracking #: 70192280000215600700			
Return Receipt			$2.85
Tracking #: 9590 9402 3624 7305 5330 38			
Total			$7.85
Grand Total:			$7.85
Cash			$20.00
Change			-$12.15

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Troy, MI 48083

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- Adult Signature Required $ $0.00
- Adult Signature Restricted Delivery $

Postage $1.40
Total Postage and Fees $7.85

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08/03/2021

Sent To Mr. Curtis Bartz
Street and Apt. No., or PO Box No. 2800 Livernois, Suite 200
City, State, ZIP+4® Troy, MI 48083

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

SENDER: *COMPLETE THIS SECTION*

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- Print your name and address on the reverse so that we can return the card to you.
- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Curtis Bartz
2800 Livernois, Suite 200
Troy, MI 48083

9590 9402 3624 7305 5330 38

2. Article Number *(Transfer from service label)*

7019 2280 0002 1560 0700

COMPLETE THIS SECTION ON DELIVERY

A. Signature

X

☐ Agent
☐ Addressee

B. Received by *(Printed Name)*

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
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- ☐ Certified Mail Restricted Delivery
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- ☐ Collect on Delivery Restricted Delivery
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- ☐ ...sured Mail Restricted Delivery ...ver $500)
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- ☐ Registered Mail™
- ☐ Registered Mail Restricted Delivery
- ☐ Return Receipt for Merchandise
- ☐ Signature Confirmation™
- ☐ Signature Confirmation Restricted Delivery

Consulting
Engineers and
Scientists

November 4, 2021
Project 1601470

Mr. Curtis Bartz
CN
2800 Livernois, Suite 200
Troy, MI 48083

RE: Access for Investigation – Second Request
CN property adjacent to MacDermid Facility
1221 Farrow Avenue, Ferndale, Michigan

Dear Mr. Bartz:

GEI Consultants of Michigan, P.C. (GEI) has been performing a site investigation and remedial activities at the MacDermid facility, located at 1221 Farrow Avenue, in Ferndale Michigan. Sampling at locations along the property boundary indicate the presence of several compounds at concentrations which exceed the Part 201 of Michigan's Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended.

The property located to the southwest of the MacDermid facility is the CN railroad and associated container yard. Figures 1 and 2 illustrate the location of the site and surrounding area.

Contaminants identified in soil samples along the southwestern property boundary, adjacent to the CN railroad, include the compounds phenanthrene, fluoranthene, and carbazole, at concentrations which exceed only the non-residential Groundwater-Surface water Interface (GSI) protection criteria. In addition, lead was detected in soil at a concentration above the non-residential direct contact criteria, and perfluorooctane sulfonate (PFOS) was detected in soil samples at concentrations above the non-residential GSI protection criteria.

An analysis of human and environmental receptors and potential exposure pathways was performed for the site, and indicated the following:

- No surface water bodies are present surrounding the site, so the GSI pathway is incomplete,
- A layer of "urban fill" (soil containing glass, brick, slag, concrete, etc.) underlies the site, and PNA compounds and metals are elevated in this fill soil,
- Groundwater within the subsurface is limited to thin, discontinuous layers, and the groundwater beneath the site has been designated "Groundwater Not in an Aquifer", following the protocol outlined by the Michigan Department of Environment, Great Lakes, and Energy (EGLE). Therefore, groundwater use is not a valid exposure pathway at the site.

GEI Consultants of Michigan, P.C.
230 N. Washington Square, Suite 201, Lansing, MI 48933
517.803.4600

Nonetheless, EGLE has requested that we demonstrate best efforts to obtain access to the rail property to investigate contamination which may be originating from the MacDermid property. Therefore, GEI and MacDermid, Inc. hereby request access to your property to collect soil samples to delineate the extent of impacts which may be migrating onto your property from the MacDermid site.

The extent of investigative activities is not known at this time but would likely consist of surface (0 to 0.5 feet) and subsurface (up to 8 feet deep) soil samples, collected from 6 to 8 locations. These samples would be collected using hand-auger techniques. No drilling equipment would be utilized. No groundwater samples would be collected, and no monitoring wells would be installed.

Thank you for your consideration of this request. We ask for a response to this request, so that we can document to EGLE our efforts to obtain access to your property. I can be reached at 517-9784-2891 or ablaske@geiconsultants.com if you have any questions regarding this letter or would like to further discuss the site and this request.

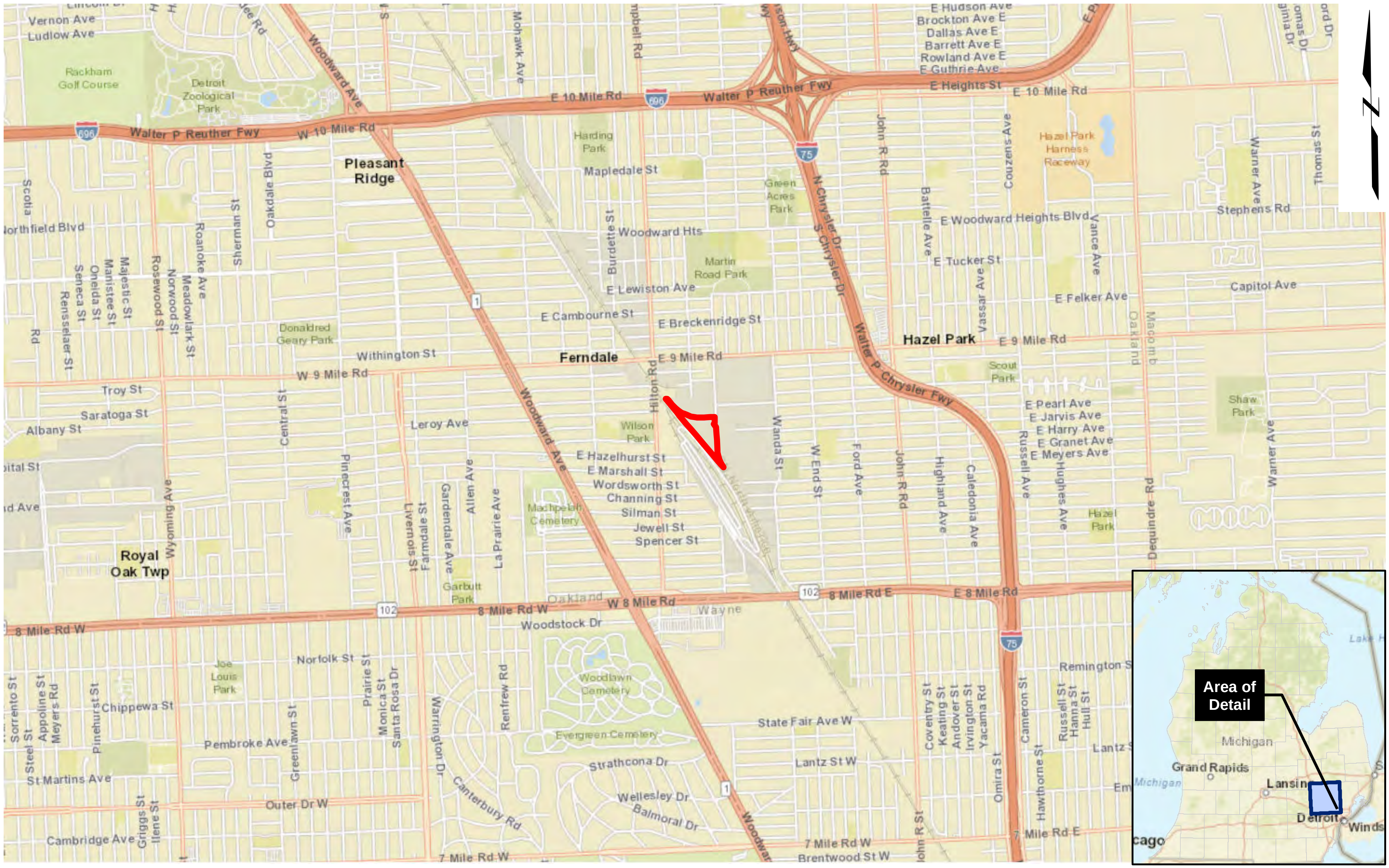
Sincerely,

GEI CONSULTANTS OF MICHIGAN, P.C.

Allan R. Blaske, P.G., CPG
Senior Geologist

Paul R. Blindauer
Vice President/Senior Consultant

ARB:plw
U:\Blaske_Allan\1601470-CN Access Request Nov. 2021_11-04-2021_FINAL.docx



Approximate Property Boundary

0 1,500 3,000

Feet

RCRA Facility Investigation
Corrective Measures Implementation Work Plan
MID 005 338 371

MacDermid, Inc.
Ferndale, Michigan

GEI Consultants

SITE LOCATION

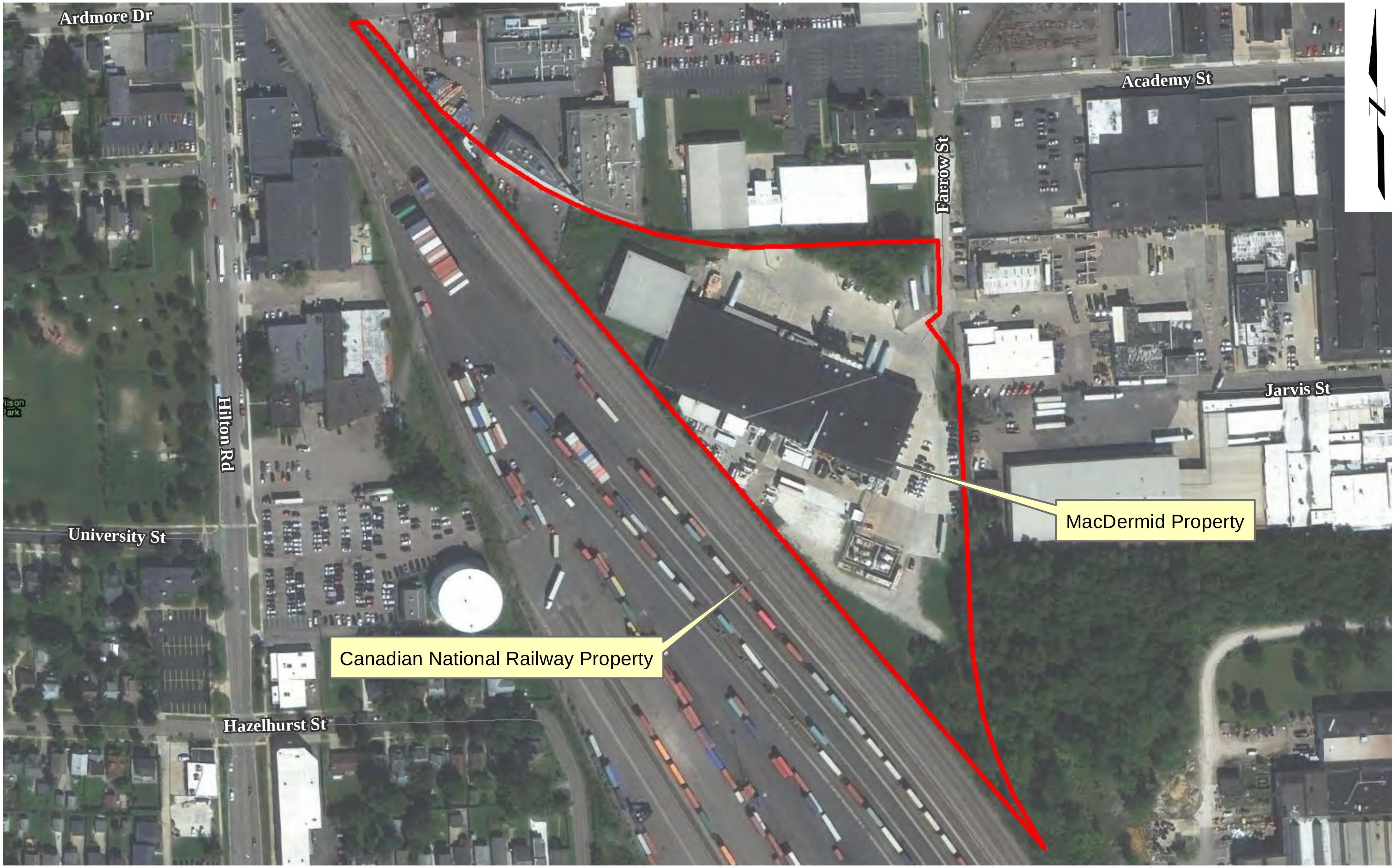
Project 1601470

March 2020

Fig. 1

W:\MacDermid_Ferndale\GIS\Fig1_Site_Location.mxd

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI,



Approximate Property Boundary

0 125 250

Feet

RCRA Facility Investigation
Corrective Measures Implementation Work Plan
MID 005 338 371

MacDermid, Inc.
Ferndale, Michigan

GEI Consultants

Project 1601470

SITE PROPERTY LAYOUT AND SURROUNDING AREA

July 2021

Fig. 2

W:\MacDermid_Ferndale\GIS\Fig2_PropertyLayout.mxd

Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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Weight: 0 lb 0.90 oz			
Estimated Delivery Date Mon 11/08/2021			
Certified Mail®			$3.75
Tracking #: 70200640000192182534			
Return Receipt			$3.05
Tracking #: 9590 9402 6585 1028 9568 70			
Total			$7.38

Grand Total: $7.38

Credit Card Remitted $7.38
Card Name: MasterCard
Account #: XXXXXXXXXXXX9642
Approval #: 08740T
Transaction #: 401
AID: A0000000041010 Chip
AL: MASTERCARD
PIN: Not Required CAPITAL ONE

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- ☐ Return Receipt (electronic) $ $0.00
- ☐ Certified Mail Restricted Delivery $ $0.00
- ☐ Adult Signature Required $ $0.00
- ☐ Adult Signature Restricted Delivery $

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11/04/2021

Postage $0.58

Total Postage and Fees $7.38

Sent To Curtis Bartz, CN

Street and Apt. No., or PO Box No. 2800 Livernois, Suite 200

City, State, ZIP+4® Troy, MI 48083

PS Form 3800, April 2015 PSN 7530-02-000-9047 See Reverse for Instructions

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TROY, MI 48083

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- Attach this card to the back of the mailpiece, or on the front if space permits.

1. Article Addressed to:

Curtis Bartz
CN
2800 Livernois, Suite 200
Troy, MI 48083

9590 9402 6585 1028 9568 70

2. Article Number *(Transfer from service label)*

7020 0640 0001 9218 2534

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X TJ 8349 C19
☐ Agent
☐ Addressee

B. Received by *(Printed Name)*

C. Date of Delivery
11-8-21

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

3. Service Type
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☐ Adult Signature Restricted Delivery
☐ Certified Mail®
☐ Certified Mail Restricted Delivery
☐ Collect on Delivery
☐ Collect on Delivery Restricted Delivery
☐ Insured Mail
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00)
☐ Priority Mail Express®
☐ Registered Mail™
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☐ Signature Confirmation™
☐ Signature Confirmation Restricted Delivery

PS Form 3811, July 2020 PSN 7530-02-000-9053 Domestic Return Receipt

Appendix N

2012 Part 201 Generic Cleanup Criteria

Attachment 1
TABLE 1. GROUNDWATER: RESIDENTIAL AND NONRESIDENTIAL
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to one microgram per liter (ug/L). Criteria with six or more digits are expressed in scientific notation. For example, 200,000 is presented as 2.0E+5. The lowest generic groundwater criterion for a given hazardous substance is presented in a bold box. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (R 299.5707). In these cases, two numbers are present in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based or solubility value, whichever is lower (R299.5708). Criteria were originally promulgated December 21, 2002 within the Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This table reflects revisions to the criteria pursuant to the December 2010 Part 201 amendments and new criteria consistent with the provisions of R299.5706a. The effective dates of the criteria and screening levels in this table vary. Please contact the Remediation Division Toxicology Unit for additional information.

Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
Hazardous Substance	Chemical Abstract Service Number	Residential Drinking Water Criteria & RBSLs	Nonresidential Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSLs	Residential Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Nonresidential Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Groundwater Contact Criteria & RBSLs	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
Acenaphthene	83329	1,300	3,800	**38**	4,200 (S)	4,200 (S)	4,200 (S)	4,240	ID	ID
Acenaphthylene	208968	52	150	ID	3,900 (S)	3,900 (S)	3,900 (S)	3,930	ID	ID
Acetaldehyde (I)	75070	950	2,700	**130**	1.1E+6	2.3E+6	4.2E+7	1.0E+9	8.9E+6	2.6E+7
Acetate	71501	4,200	12,000	(G)	ID	ID	ID	ID	ID	ID
Acetic acid	64197	4,200	12,000	(G)	NLV	NLV	1.8E+8	6.0E+9	1.0E+9 (D)	1.0E+9 (D)
Acetone (I)	67641	**730**	2,100	1,700	1.0E+9 (D,S)	1.0E+9 (D,S)	3.1E+7	1.0E+9	1.5E+7	1.0E+9 (D)
Acetonitrile	75058	140	400	NA	2.4E+7	4.5E+7	5.6E+6	2.00E+8	2.1E+7	2.0E+8
Acetophenone	98862	1,500	4,400	ID	6.1E+6 (S)	6.1E+6 (S)	6.1E+6 (S)	6.1E+6	ID	ID
Acrolein (I)	107028	120	330	NA	2,100	4,200	3.4E+6	2.10E+8	6.7E+6	3.4E+5
Acrylamide	79061	0.5 (A)	0.5 (A)	10 (X)	NLV	NLV	13,000	2.20E+9	NA	ID
Acrylic acid	79107	3,900	11,000	NA	1.2E+7	2.8E+7	7.6E+7	1.0E+9	1.0E+9 (D)	ID
Acrylonitrile (I)	107131	**2.6**	11	2.0 (M); 1.2	34,000	1.9E+5	14,000	7.50E+7	6.4E+6	ID
Alachlor	15972608	**2.0 (A)**	2.0 (A)	11 (X)	NLV	NLV	1,700	1.83E+5	ID	ID
Aldicarb	116063	3.0 (A)	3.0 (A)	NA	NLV	NLV	1.2E+5	6.00E+6	ID	ID
Aldicarb sulfone	1646884	2.0 (A)	2.0 (A)	NA	NLV	NLV	2.1E+6	7.80E+6	ID	ID
Aldicarb sulfoxide	1646873	4.0 (A)	4.0 (A)	NA	NLV	NLV	2.7E+6	2.80E+7	ID	ID
Aldrin	309002	0.098	0.4	**0.01 (M); 8.7E-6**	180 (S)	180 (S)	0.34 (AA)	180	ID	ID
Aluminum (B)	7429905	50 (V)	50 (V)	NA	NLV	NLV	6.4E+7	NA	ID	ID
Ammonia	7664417	10,000 (N)	10,000 (N)	(CC)	3.2E+6	7.1E+6	ID	5.30E+8	ID	3.5E+6
t-Amyl methyl ether (TAME)	994058	190 (E)	190 (E)	NA	2.6E+5	5.7E+5	2.6E+6 (S)	2.64E+6	NA	NA
Aniline	62533	53	220	**4.0**	NLV	NLV	1.4E+5	3.60E+7	NA	ID

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Anthracene	120127	43 (S)	43 (S)	ID	43 (S)	43 (S)	43 (S)	43.4	ID	ID
Antimony	7440360	6.0 (A)	6.0 (A)	130 (X)	NLV	NLV	68,000	NA	ID	ID
Arsenic	7440382	10 (A)	10 (A)	10	NLV	NLV	4,300	NA	ID	ID
Asbestos (BB)	1332214	7.0E+6 f/ml (A)	7.0E+6 f/ml (A)	NA	NLV	NLV	ID	NA	NA	ID
Atrazine	1912249	3.0 (A)	3.0 (A)	7.3	NLV	NLV	5,400	70,000	ID	ID
Azobenzene	103333	23	94	ID	6,400 (S)	6,400 (S)	1,600	6,400	ID	ID
Barium (B)	7440393	2,000 (A)	2,000 (A)	(G)	NLV	NLV	1.4E+7	NA	ID	ID
Benzene (I)	71432	5.0 (A)	5.0 (A)	200 (X)	5,600	35,000	11,000	1.75E+6	68,000	67,000
Benzidine	92875	0.3 (M); 0.0037	0.3 (M); 0.015	0.3 (M); 0.073	NLV	NLV	7.1	5.20E+5	ID	ID
Benzo(a)anthracene (Q)	56553	2.1	8.5	ID	NLV	NLV	9.4 (S,AA)	9.4	ID	ID
Benzo(b)fluoranthene (Q)	205992	1.5 (S,AA)	1.5 (S,AA)	ID	ID	ID	1.5 (S,AA)	1.5	ID	ID
Benzo(k)fluoranthene (Q)	207089	1.0 (M); 0.8 (S)	1.0 (M); 0.8 (S)	NA	NLV	NLV	1.0 (M,AA); 0.8 (S)	0.8	ID	ID
Benzo(g,h,i)perylene	191242	1.0 (M); 0.26 (S)	1.0 (M); 0.26 (S)	ID	NLV	NLV	1.0 (M,AA); 0.26 (S)	0.26	ID	ID
Benzo(a)pyrene (Q)	50328	5.0 (A)	5.0 (A)	ID	NLV	NLV	1.0 (M,AA); 0.64	1.62	ID	ID
Benzoic acid	65850	32,000	92,000	NA	NLV	NLV	3.5E+6 (S)	3.50E+6	ID	ID
Benzyl alcohol	100516	10,000	29,000	NA	NLV	NLV	4.4E+7 (S)	4.40E+7	ID	ID
Benzyl chloride	100447	7.7	32	NA	12,000	77,000	3,600	4.90E+5	NA	ID
Beryllium	7440417	4.0 (A)	4.0 (A)	(G)	NLV	NLV	2.9E+5	NA	ID	ID
bis(2-Chloroethoxy)ethane	112265	ID	ID	ID	NLV	NLV	ID	1.89E+7	ID	ID
bis(2-Chloroethyl)ether (I)	111444	2.0	8.3	1.0 (M); 0.79	38,000	2.1E+5	5,700	1.72E+7	1.7E+7 (S)	1.7E+7 (S)
bis(2-Ethylhexyl)phthalate	117817	6.0 (A)	6.0 (A)	25	NLV	NLV	320 (AA)	340	NA	340 (S)

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Boron (B)	7440428	**500 (F)**	500 (F)	7,200 (X)	NLV	NLV	6.2E+7	NA	ID	ID
Bromate	15541454	**10 (A)**	10 (A)	40 (X)	NLV	NLV	4,800	38,000	ID	ID
Bromobenzene (I)	108861	18	50	NA	1.8E+5	3.9E+5	12,000	4.13E+5	ID	ID
Bromodichloromethane	75274	80 (A,W)	80 (A,W)	ID	4,800	37,000	14,000	6.74E+6	ID	ID
Bromoform	75252	80 (A,W)	80 (A,W)	ID	4.7E+5	3.1E+6 (S)	1.4E+5	3.10E+6	ID	ID
Bromomethane	74839	**10**	29	35	4,000	9,000	70,000	1.45E+7	ID	ID
n-Butanol (I)	71363	950	2,700	9,800 (X)	NLV	NLV	8.8E+6	7.40E+7	4.7E+7	7.4E+7 (S)
2-Butanone (MEK) (I)	78933	13,000	38,000	**2,200**	2.4E+8 (S)	2.4E+8 (S)	2.4E+8 (S)	2.40E+8	ID	2.4E+8 (S)
n-Butyl acetate	123864	550	1,600	NA	6.7E+6 (S)	6.7E+6 (S)	1.8E+6	6.70E+6	2.5E+6	6.7E+6 (S)
t-Butyl alcohol	75650	3,900	11,000	NA	1.0E+9 (D,S)	1.0E+9 (D,S)	7.9E+7	1.0E+9	6.1E+7	ID
Butyl benzyl phthalate	85687	1,200	2,700 (S)	**67 (X)**	NLV	NLV	2,700 (S)	2,690	ID	ID
n-Butylbenzene	104518	80	230	ID	ID	ID	5,900	NA	ID	ID
sec-Butylbenzene	135988	80	230	ID	ID	ID	4,400	NA	ID	ID
t-Butylbenzene (I)	98066	80	230	ID	ID	ID	8,900	NA	ID	ID
Cadmium (B)	7440439	5.0 (A)	5.0 (A)	(G,X)	NLV	NLV	1.9E+5	NA	ID	ID
Camphene (I)	79925	ID	ID	NA	440	1,000	ID	33,400	ID	ID
Caprolactam	105602	5,800	17,000	NA	NLV	NLV	3.9E+8	5.25E+9	NA	1.0E+9 (D)
Carbaryl	63252	700	2,000	NA	ID	ID	1.3E+5 (S)	1.26E+5	ID	ID
Carbazole	86748	85	350	**10 (M); 4.0**	NLV	NLV	7,400	7,480	ID	ID
Carbofuran	1563662	40 (A)	40 (A)	NA	NLV	NLV	3.4E+5	7.00E+5	ID	ID
Carbon disulfide (I,R)	75150	800	2,300	ID	2.5E+5	5.5E+5	1.2E+6 (S)	1.19E+6	13,000	ID

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Carbon tetrachloride	56235	**5.0 (A)**	5.0 (A)	45 (X)	370	2,400	4,600	7.93E+5	ID	96,000
Chlordane (J)	57749	2.0 (A)	2.0 (A)	2.0 (M); 0.00025	56 (S)	56 (S)	15 (AA)	56	ID	ID
Chloride	16887006	2.5E+5 (E)	2.5E+5 (E)	(FF)	NLV	NLV	ID	NA	ID	ID
Chlorobenzene (I)	108907	100 (A)	100 (A)	25	2.1E+5	4.7E+5 (S)	86,000	4.72E+5	1.6E+5	ID
p-Chlorobenzene sulfonic acid	98668	7,300	21,000	ID	ID	ID	ID	NA	ID	ID
1-Chloro-1,1-difluoroethane	75683	15,000	44,000	NA	3.9E+6 (S)	3.9E+6 (S)	3.9E+6 (S)	3.9E+06	NA	ID
Chloroethane	75003	430	1,700	1,100 (X)	5.7E+6 (S)	5.7E+6 (S)	4.4E+5	5.74E+6	1.1E+5	ID
2-Chloroethyl vinyl ether	110758	ID	ID	NA	ID	ID	ID	1.50E+7	ID	ID
Chloroform	67663	**80 (A,W)**	80 (A,W)	350	28,000	1.8E+5	1.5E+5	7.92E+6	ID	ID
Chloromethane (I)	74873	260	1,100	ID	8,600	45,000	4.9E+5	6.34E+6	36,000	2.1E+5
4-Chloro-3-methylphenol	59507	150	420	**7.4**	NLV	NLV	79,000	3.90E+6	ID	ID
beta-Chloronaphthalene	91587	1,800	5,200	NA	ID	ID	6,700 (S)	6,740	ID	ID
2-Chlorophenol	95578	45	130	**18**	4.9E+5	1.1E+6	94,000	2.20E+7	ID	ID
o-Chlorotoluene (I)	95498	150	420	ID	2.2E+5	3.7E+5 (S)	44,000	3.73E+5	ID	ID
Chlorpyrifos	2921882	22	63	**2.0 (M); 0.002**	2.9	6.6	1,100 (S)	1,120	ID	ID
Chromium (III) (B,H)	16065831	100 (A)	100 (A)	(G,X)	NLV	NLV	2.9E+8	NA	ID	ID
Chromium (VI)	18540299	100 (A)	100 (A)	**11**	NLV	NLV	4.6E+5	NA	ID	ID
Chrysene (Q)	218019	1.6 (S)	1.6 (S)	ID	ID	ID	1.6 (S,AA)	1.6	ID	ID
Cobalt	7440484	**40**	100	100	NLV	NLV	2.4E+6	NA	ID	ID
Copper (B)	7440508	1,000 (E)	1,000 (E)	(G)	NLV	NLV	7.4E+6	NA	ID	ID
Cyanazine	21725462	**2.3**	9.4	56 (X)	NLV	NLV	2,800	1.70E+5	ID	ID

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Cyanide (P,R)	57125	200 (A)	200 (A)	5.2	NLV	NLV	57,000	NA	ID	ID
Cyclohexanone	108941	33,000	94,000	NA	1,500	3,300	2.3E+7 (S)	2.30E+7	NA	ID
Dacthal	1861321	73	210	NA	NLV	NLV	500 (S)	500	ID	ID
Dalapon	75990	200 (A)	200 (A)	NA	NLV	NLV	1.2E+7	5.02E+8	ID	ID
4-4'-DDD	72548	9.1	37	NA	NLV	NLV	44 (AA)	90	ID	ID
4-4'-DDE	72559	4.3	15	NA	NLV	NLV	27 (AA)	120	ID	ID
4-4'-DDT	50293	3.6	10	0.02 (M); 1.1E-5	NLV	NLV	13 (AA)	25	NA	ID
Decabromodiphenyl ether	1163195	30 (S)	30 (S)	NA	30 (S)	30 (S)	30 (S)	30	ID	ID
Di-n-butyl phthalate	84742	880	2,500	9.7	NLV	NLV	11,000 (S)	11,200	NA	ID
Di(2-ethylhexyl) adipate	103231	400 (A)	400 (A)	ID	NLV	NLV	470 (S)	471	ID	ID
Di-n-octyl phthalate	117840	130	380	ID	NLV	NLV	400	3,000	ID	ID
Diacetone alcohol (I)	123422	ID	ID	NA	NLV	NLV	ID	1.0E+9	1.0E+9 (S)	ID
Diazinon	333415	1.3	3.8	1.0 (M); 0.004	NLV	NLV	1,300	68,800	NA	ID
Dibenzo(a,h)anthracene (Q)	53703	2.0 (M); 0.21	2.0 (M); 0.85	ID	NLV	NLV	2.0 (M,AA); 0.31	2.49	ID	ID
Dibenzofuran	132649	ID	ID	4.0	10,000 (S)	10,000 (S)	ID	10,000	ID	ID
Dibromochloromethane	124481	80 (A,W)	80 (A,W)	ID	14,000	1.1E+5	18,000	2.60E+6	ID	ID
Dibromochloropropane	96128	0.2 (A)	0.2 (A)	ID	220	1,200 (S)	390	1,230	NA	ID
Dibromomethane	74953	80	230	NA	ID	ID	5.3E+5	1.10E+7	ID	ID
Dicamba	1918009	220	630	NA	NLV	NLV	5.9E+5	4.5E+6	ID	ID
1,2-Dichlorobenzene	95501	600 (A)	600 (A)	13	1.6E+5 (S)	1.6E+5 (S)	1.6E+5 (S)	1.56E+5	NA	1.6E+5 (S)
1,3-Dichlorobenzene	541731	6.6	19	28	18,000	41,000	2,000	1.11E+5	ID	ID

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1,4-Dichlorobenzene	106467	75 (A)	75 (A)	**17**	16,000	74,000 (S)	6,400	73,800	NA	ID
3,3'-Dichlorobenzidine	91941	1.1	4.3	**0.3 (M); 0.2**	NLV	NLV	180	3,110	ID	ID
Dichlorodifluoromethane	75718	1,700	4,800	ID	2.2E+5	3.0E+5 (S)	3.0E+5 (S)	3.00E+5	ID	ID
1,1-Dichloroethane	75343	880	2,500	**740**	1.0E+6	2.3E+6	2.4E+6	5.06E+6	3.8E+5	ID
1,2-Dichloroethane (I)	107062	**5.0 (A)**	5.0 (A)	360 (X)	9,600	59,000	19,000	8.52E+6	2.5E+6	ID
1,1-Dichloroethylene (I)	75354	**7.0 (A)**	7.0 (A)	130	200	1,300	11,000	2.25E+6	97,000	1.4E+5
cis-1,2-Dichloroethylene	156592	**70 (A)**	70 (A)	620	93,000	2.1E+5	2.0E+5	3.50E+6	5.3E+5	ID
trans-1,2-Dichloroethylene	156605	**100 (A)**	100 (A)	1,500 (X)	85,000	2.0E+5	2.2E+5	6.30E+6	2.3E+5	ID
2,6-Dichloro-4-nitroaniline	99309	2,200	6,300	NA	NLV	NLV	7,000 (S)	7,000	ID	ID
2,4-Dichlorophenol	120832	73	210	**11**	NLV	NLV	48,000	4.50E+6	ID	ID
2,4-Dichlorophenoxyacetic acid	94757	**70 (A)**	70 (A)	220	NLV	NLV	1.2E+5	6.80E+5	ID	ID
1,2-Dichloropropane (I)	78875	**5.0 (A)**	5.0 (A)	230 (X)	16,000	36,000	16,000	2.80E+6	5.5E+5	2.8E+6 (S)
1,3-Dichloropropene	542756	8.5	35	9.0 (X)	3,900	26,000	5,500	2.80E+6	1.3E+5	ID
Dichlorovos	62737	1.6	6.7	NA	NLV	NLV	5,900	1.60E+7	NA	ID
Dicyclohexyl phthalate	84617	ID	ID	NA	ID	ID	ID	4,000	ID	ID
Dieldrin	60571	0.11	0.43	**0.02 (M); 6.5E-6**	200 (S)	200 (S)	2.4 (AA)	195	ID	ID
Diethyl ether	60297	10 (E)	10 (E)	ID	6.1E+7 (S)	6.1E+7 (S)	3.5E+7	6.10E+7	6.5E+5	6.1E+7 (S)
Diethyl phthalate	84662	5,500	16,000	**110**	NLV	NLV	1.1E+6 (S)	1.08E+6	NA	ID
Diethylene glycol monobutyl ether	112345	88	250	NA	NLV	NLV	4.0E+6	1.0E+9	ID	ID
Diisopropyl ether	108203	30	86	ID	8,000 (S)	8,000 (S)	8,000 (S)	8,041	8,000 (S)	ID
Diisopropylamine (I)	108189	5.6	16	NA	2.1E+7	3.7E+7 (S)	21,000	3.69E+7	4.6E+6	ID

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Dimethyl phthalate	131113	73,000	2.1E+5	NA	NLV	NLV	4.2E+6 (S)	4.19E+6	NA	ID
N,N-Dimethylacetamide	127195	**180**	520	4,100 (X)	NLV	NLV	2.3E+7	1.0E+9	NA	ID
N,N-Dimethylaniline	121697	16	46	NA	2.4E+5	1.3E+6 (S)	20,000	1.27E+6	NA	1.3E+6 (S)
Dimethylformamide (I)	68122	700	2,000	NA	NLV	NLV	1.1E+8	1.0E+9	ID	ID
2,4-Dimethylphenol	105679	**370**	1,000	380	NLV	NLV	5.2E+5	7.87E+6	ID	ID
2,6-Dimethylphenol	576261	4.4	13	NA	NLV	NLV	6,300	6.14E+6	ID	ID
3,4-Dimethylphenol	95658	10	29	25	NLV	NLV	18,000	4.93E+6	ID	ID
Dimethylsulfoxide	67685	2.2E+5	6.3E+5	**1.9E+5**	NLV	NLV	1.7E+8 (S)	1.66E+8	ID	ID
2,4-Dinitrotoluene	121142	7.7	32	NA	NLV	NLV	8,600	2.70E+5	ID	ID
Dinoseb	88857	7.0 (A)	7.0 (A)	**1.0 (M); 0.48**	NLV	NLV	7,000	52,000	ID	ID
1,4-Dioxane (I)	123911	**85**	350	2,800 (X)	NLV	NLV	1.7E+6	9.00E+8	1.4E+8	ID
Diquat	85007	20 (A)	20 (A)	20 (M); 6.0	NLV	NLV	7.0E+5 (S)	7.00E+5	ID	ID
Dissolved oxygen (DO)	NA	ID	ID	(EE)	ID	ID	ID	NA	NA	NA
Diuron	330541	31	90	NA	NLV	NLV	37,000 (S)	37,300	ID	ID
Endosulfan (J)	115297	44	130	**0.03 (M); 0.029**	ID	ID	510 (S)	510	ID	ID
Endothall	145733	100 (A)	100 (A)	NA	NLV	NLV	2.5E+7 (AA)	1.00E+8	ID	ID
Endrin	72208	2.0 (A)	2.0 (A)	ID	NLV	NLV	160 (AA)	250	ID	ID
Epichlorohydrin (I)	106898	5.0 (M); 2.0 (A)	5.0 (M); 2.0 (A)	NA	3.2E+5	6.3E+5	11,000	6.60E+7	4.7E+7	ID
Ethanol (I)	64175	1.9E+6	3.8E+6	ID	NLV	NLV	1.0E+9 (D,S)	1.0E+9	9.7E+7	ID
Ethyl acetate (I)	141786	6,600	19,000	NA	6.4E+7 (S)	6.4E+7 (S)	6.4E+7 (S)	6.40E+7	4.2E+6	ID
Ethyl-tert-butyl ether (ETBE)	637923	49 (E)	49 (E)	ID	2.9E+6	5.6E+6 (S)	ID	5.63E+6	ID	ID

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Ethylbenzene (I)	100414	74 (E)	74 (E)	**18**	1.1E+5	1.7E+5 (S)	1.7E+5 (S)	1.69E+5	43,000	1.7E+5 (S)
Ethylene dibromide	106934	**0.05 (A)**	0.05 (A)	5.7 (X)	2,400	15,000	25	4.20E+6	ID	ID
Ethylene glycol	107211	**15,000**	42,000	1.9E+5 (X)	NLV	NLV	1.0E+9 (D,S)	1.0E+9	NA	1.0E+9 (D,S)
Ethylene glycol monobutyl ether	111762	3,700	10,000	NA	2.9E+6	6.5E+6	5.3E+7	2.24E+8	NA	ID
Fluoranthene	206440	210 (S)	210 (S)	**1.6**	210 (S)	210 (S)	210 (S)	206	ID	ID
Fluorene	86737	880	2,000 (S)	**12**	2,000 (S)	2,000 (S)	2,000 (S)	1,980	ID	ID
Fluorine (soluble fluoride) (B)	7782414	2,000 (E)	2,000 (E)	ID	NLV	NLV	1.2E+7	NA	ID	ID
Formaldehyde	50000	1,300	3,800	**120**	63,000	3.6E+5	3.0E+7	5.50E+8	ID	61,000
Formic acid (I,U)	64186	10,000	29,000	ID	7.7E+6	1.5E+7	6.0E+8	1.0E+9	1.0E+9 (D)	3.5E+8
1-Formylpiperidine	2591868	80	230	NA	ID	ID	ID	NA	ID	ID
Gentian violet	548629	15	63	NA	NLV	NLV	1.0E+6 (S)	1.00E+6	ID	ID
Glyphosate	1071836	700 (A)	700 (A)	NA	NLV	NLV	1.2E+7 (S,AA)	1.16E+7	ID	ID
Heptachlor	76448	0.4 (A)	0.4 (A)	**0.01 (M); 0.0018**	180 (S)	180 (S)	2.9 (AA)	180	ID	ID
Heptachlor epoxide	1024573	0.2 (A)	0.2 (A)	ID	NLV	NLV	9.0 (AA)	200	ID	ID
n-Heptane	142825	2,700 (S)	2,700 (S)	NA	2,700 (S)	2,700 (S)	2,700 (S)	2,690	200	2,700 (S)
Hexabromobenzene	87821	0.17 (S); 20	0.17 (S); 58	ID	ID	ID	0.17 (S); 1,500	0.17	ID	ID
Hexachlorobenzene (C-66)	118741	1.0 (A)	1.0 (A)	**0.2 (M); 0.0003**	440	3,000	4.6	6,200	ID	ID
Hexachlorobutadiene (C-46)	87683	15	42	**0.053**	1,600	3,200 (S)	400	3,230	ID	ID
alpha-Hexachlorocyclohexane	319846	0.43	1.7	ID	2,000 (S)	2,000 (S)	60	2,000	ID	ID
beta-Hexachlorocyclohexane	319857	0.88	3.6	ID	NLV	NLV	120	240	ID	ID
Hexachlorocyclopentadiene (C-56)	77474	50 (A)	50 (A)	ID	130	420	1,600	1,800	ID	ID

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Hexachloroethane	67721	7.3	21	6.7 (X)	27,000	50,000 (S)	1,900	50,000	ID	ID
n-Hexane	110543	3,000	8,600	NA	12,000 (S)	12,000 (S)	12,000 (S)	12,000	12,000 (S)	ID
2-Hexanone	591786	1,000	2,900	ID	4.2E+6	8.7E+6	5.2E+6	1.60E+7	NA	ID
Indeno(1,2,3-cd)pyrene (Q)	193395	2.0 (M); 0.022 (S)	2.0 (M); 0.022 (S)	ID	NLV	NLV	2.0 (M,AA); 0.022 (S)	0.022	ID	ID
Iron (B)	7439896	300 (E)	300 (E)	NA	NLV	NLV	5.8E+7	NA	ID	ID
Isobutyl alcohol (I)	78831	2,300	6,700	NA	7.6E+7 (S)	7.6E+7 (S)	2.5E+7	7.60E+7	ID	ID
Isophorone	78591	770	3,100	1,300 (X)	NLV	NLV	9.9E+5	1.20E+7	ID	1.2E+7 (S)
Isopropyl alcohol (I)	67630	470	1,300	57,000 (X)	NLV	NLV	1.3E+7	1.0E+9	6.0E+7	1.0E+9 (D,S)
Isopropyl benzene	98828	800	2,300	28	56,000 (S)	56,000 (S)	56,000 (S)	56,000	29,000	ID
Lead (B)	7439921	4.0 (L)	4.0 (L)	(G,X)	NLV	NLV	ID	NA	ID	ID
Lindane	58899	0.2 (A)	0.2 (A)	0.03 (M); 0.026	ID	ID	190	6,800	ID	ID
Lithium (B)	7439932	170	350	440	NLV	NLV	5.4E+6	NA	ID	ID
Magnesium (B)	7439954	4.0E+5	1.1E+6	NA	NLV	NLV	1.0E+9 (D)	NA	ID	ID
Manganese (B)	7439965	50 (E)	50 (E)	(G,X)	NLV	NLV	9.1E+6	NA	ID	ID
Mercury (Total) (B,Z)	Varies	2.0 (A)	2.0 (A)	0.0013	56 (S)	56 (S)	56 (S)	56	ID	ID
Methane	74828	ID	ID	NA	(K)	(K)	ID	NA	520	ID
Methanol	67561	3,700	10,000	5.9E+5 (X)	2.9E+7 (S)	2.9E+7 (S)	2.9E+7 (S)	2.90E+7	4.5E+6	2.9E+7 (S)
Methoxychlor	72435	40 (A)	40 (A)	NA	ID	ID	45 (S)	45	ID	ID
2-Methoxyethanol (I)	109864	7.3	21	NA	NLV	NLV	8.3E+5	1.0E+9	ID	ID
2-Methyl-4-chlorophenoxyacetic acid	94746	7.3	21	NA	NLV	NLV	9,200	9.24E+5	ID	ID
2-Methyl-4,6-dinitrophenol	534521	20 (M); 2.6	20 (M); 7.3	NA	NLV	NLV	9,500	2.00E+5	ID	ID

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N-Methyl-morpholine (I)	109024	20	56	NA	NLV	NLV	1.5E+6	1.0E+9	ID	ID
Methyl parathion	298000	1.8	5.2	NA	NLV	NLV	3,000	50,000	ID	ID
4-Methyl-2-pentanone (MIBK) (I)	108101	1,800	5,200	ID	2.0E+7 (S)	2.0E+7 (S)	1.3E+7	2.00E+7	ID	2.0E+7 (S)
Methyl-tert-butyl ether (MTBE)	1634044	40 (E)	40 (E)	7,100 (X)	4.7E+7 (S)	4.7E+7 (S)	6.1E+5	4.68E+7	ID	ID
Methylcyclopentane (I)	96377	ID	ID	NA	22,000	49,000	ID	73,890	ID	ID
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	1.1	4.5	NA	NLV	NLV	110 (AA)	14,000	ID	ID
Methylene chloride	75092	5.0 (A)	5.0 (A)	1,500 (X)	2.2E+5	1.4E+6	2.2E+5	1.70E+7	ID	ID
2-Methylnaphthalene	91576	260	750	19	25,000 (S)	25,000 (S)	25,000 (S)	24,600	ID	ID
Methylphenols (J)	1319773	370	1,000	30 (M); 25	NLV	NLV	8.1E+5	2.80E+7	NA	ID
Metolachlor	51218452	240	990	15	NLV	NLV	91,000	5.30E+5	ID	ID
Metribuzin	21087649	180	520	NA	ID	ID	1.2E+6 (S)	1.2E+6	ID	ID
Mirex	2385855	0.02 (M); 6.8E-6 (S)	0.02 (M); 6.8E-6 (S)	).02 (M); 6.8E-6 (S	ID	ID	0.02 (M); 6.8E-6 (S)	6.8E-6	NA	ID
Molybdenum (B)	7439987	73	210	3,200 (X)	NLV	NLV	9.7E+5	NA	ID	ID
Naphthalene	91203	520	1,500	11	31,000 (S)	31,000 (S)	31,000 (S)	31,000	NA	31,000 (S)
Nickel (B)	7440020	100 (A)	100 (A)	(G)	NLV	NLV	7.4E+7	NA	ID	ID
Nitrate (B,N)	14797558	10,000 (A,N)	10,000 (A,N)	ID	NLV	NLV	3.1E+8	NA	ID	ID
Nitrite (B,N)	14797650	1,000 (A,N)	1,000 (A,N)	NA	NLV	NLV	ID	NA	ID	ID
Nitrobenzene (I)	98953	3.4	9.6	180 (X)	2.8E+5	5.5E+5	11,000	2.09E+6	NA	ID
2-Nitrophenol	88755	20	58	ID	NLV	NLV	79,000	2.50E+6	ID	ID
n-Nitroso-di-n-propylamine	621647	5.0 (M); 0.19	5.0 (M); 0.77	NA	NLV	NLV	360	9.89E+6	ID	ID

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N-Nitrosodiphenylamine	86306	270	1,100	NA	NLV	NLV	35,000 (S)	35,100	ID	ID
Oxamyl	23135220	200 (A)	200 (A)	NA	NLV	NLV	6.2E+7	2.80E+8	ID	ID
Oxo-hexyl acetate	88230357	73	210	NA	ID	ID	ID	NA	ID	ID
Pendimethalin	40487421	280 (S)	280 (S)	NA	NLV	NLV	280 (S)	275	ID	ID
Pentachlorobenzene	608935	6.1	17	5.0 (M); 0.019	ID	ID	240	650	ID	ID
Pentachloronitrobenzene	82688	32 (S)	32 (S)	NA	32 (S)	32 (S)	32 (S)	32	ID	ID
Pentachlorophenol	87865	1.0 (A)	1.0 (A)	(G,X)	NLV	NLV	200	1.85E+6	ID	ID
Pentane	109660	ID	ID	NA	38,000 (S)	38,000 (S)	ID	38,200	340	38,000 (S)
2-Pentene (I)	109682	ID	ID	NA	ID	ID	ID	2.03E+5	ID	ID
pH	NA	6.5 to 8.5 (E)	6.5 to 8.5 (E)	6.5 to 9.0	ID	ID	ID	NA	NA	NA
Phenanthrene	85018	52	150	2.0 (M); 1.4	1,000 (S)	1,000 (S)	1,000 (S)	1,000	ID	ID
Phenol	108952	4,400	13,000	450	NLV	NLV	2.9E+7	8.28E+7	NA	ID
Phenytoin	57410	17	68	89 (X)	NLV	NLV	14,000	3.2E+4	ID	ID
Phosphorus (Total)	7723140	63,000	2.4E+5	(EE)	NLV	NLV	ID	NA	ID	ID
Phthalic acid	88993	14,000	40,000	NA	NLV	NLV	1.4E+7 (S)	1.42E+7	ID	ID
Phthalic anhydride	85449	15,000	44,000	NA	NLV	NLV	6.2E+6 (S)	6.2E+6	NA	ID
Picloram	1918021	500 (A)	500 (A)	46	NLV	NLV	4.3E+5 (S)	4.30E+5	ID	ID
Piperidine	110894	3.2	9.2	NA	NLV	NLV	34,000	1.0E+9	ID	ID
Polybrominated biphenyls (J)	67774327	0.03	0.09	ID	NLV	NLV	ID	1.66E+7	ID	ID
Polychlorinated biphenyls (PCBs) (J,T)	1336363	0.5 (A)	0.5 (A)	0.2 (M); 2.6E-5	45 (S)	45 (S)	3.3 (AA)	44.7	ID	ID
Prometon	1610180	160	460	NA	NLV	NLV	1.8E+5	7.50E+5	ID	ID

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Guidesheet Number →		#1	#2	#3	#4	#5	#6	#7	#8	#9
Hazardous Substance	Chemical Abstract Service Number	Residential Drinking Water Criteria & RBSLs	Nonresidential Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSLs	Residential Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Nonresidential Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Groundwater Contact Criteria & RBSLs	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
Propachlor	1918167	95	270	NA	NLV	NLV	4.4E+5	6.55E+5	ID	ID
Propazine	139402	200	560	NA	NLV	NLV	8,600 (S)	8,600	ID	ID
Propionic acid	79094	12,000	35,000	ID	NLV	NLV	2.8E+8	1.0E+9	1.0E+9 (D)	ID
Propyl alcohol (I)	71238	1,400	4,000	NA	NLV	NLV	2.8E+7	1.0E+9	7.1E+7	1.0E+9 (D,S)
n-Propylbenzene (I)	103651	80	230	ID	ID	ID	15,000	NA	ID	ID
Propylene glycol	57556	1.5E+5	4.2E+5	2.9E+5	NLV	NLV	1.0E+9 (D,S)	1.0E+9	ID	ID
Pyrene	129000	140 (S)	140 (S)	ID	140 (S)	140 (S)	140 (S)	135	ID	ID
Pyridine (I)	110861	20 (M); 7.3	21	NA	5,500	12,000	94,000	3.00E+5	81,000	ID
Selenium (B)	7782492	50 (A)	50 (A)	5.0	NLV	NLV	9.7E+5	NA	ID	ID
Silver (B)	7440224	34	98	0.2 (M); 0.06	NLV	NLV	1.5E+6	NA	ID	ID
Silvex (2,4,5-TP)	93721	50 (A)	50 (A)	30	NLV	NLV	43,000	1.40E+5	ID	ID
Simazine	122349	4.0 (A)	4.0 (A)	17	NLV	NLV	4,500 (S)	4,470	ID	ID
Sodium	17341252	1.2E+5	3.5E+5	NA	NLV	NLV	1.0E+9 (D)	NA	ID	ID
Sodium azide	26628228	88	250	50 (M); 7.3	ID	ID	ID	NA	ID	ID
Strontium (B)	7440246	4,600	13,000	21,000	NLV	NLV	1.2E+8	NA	ID	ID
Styrene	100425	100 (A)	100 (A)	80 (X)	1.7E+5	3.1E+5 (S)	9,700	3.10E+5	1.4E+5	3.1E+5 (S)
Sulfate	14808798	2.5E+5 (E)	2.5E+5 (E)	NA	NLV	NLV	ID	NA	ID	ID
Tebuthiuron	34014181	510	1,500	NA	NLV	NLV	2.5E+6 (S)	2.50E+6	ID	ID
2,3,7,8-Tetrabromodibenzo-p-dio (O)	50585416	(O)	(O)	(O)	NLV	NLV	(O)	0.00996	ID	ID
1,2,4,5-Tetrachlorobenzene	95943	1,300 (S)	1,300 (S)	2.9 (X)	1,300 (S)	1,300 (S)	1,300 (S)	1,300	ID	ID
2,3,7,8-Tetrachlorodibenzo-p-dio (O)	1746016	3.0E-5 (A)	3.0E-5 (A)	1.0E-5 (M); 3.1E-9	NLV	NLV	1.0E-5 (M,O,AA)	0.019	ID	ID

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Hazardous Substance	Chemical Abstract Service Number	Residential Drinking Water Criteria & RBSLs	Nonresidential Drinking Water Criteria & RBSLs	Groundwater Surface Water Interface Criteria & RBSLs	Residential Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Nonresidential Groundwater Volatilization to Indoor Air Inhalation Criteria & RBSLs	Groundwater Contact Criteria & RBSLs	Water Solubility	Flammability and Explosivity Screening Level	Acute Inhalation Screening Level
1,1,1,2-Tetrachloroethane	630206	77	320	ID	15,000	96,000	30,000	1.10E+6	ID	ID
1,1,2,2-Tetrachloroethane	79345	**8.5**	35	78 (X)	12,000	77,000	4,700	2.97E+6	ID	ID
Tetrachloroethylene	127184	**5.0 (A)**	5.0 (A)	60 (X)	25,000	1.7E+5	12,000	2.0E+5	ID	2.0E+5 (S)
Tetrahydrofuran	109999	**95**	270	11,000 (X)	6.9E+6	1.6E+7	1.6E+6	1.0E+9	60,000	3.6E+6
Tetranitromethane	509148	ID	ID	NA	580	3,200	ID	85,000	ID	ID
Thallium (B)	7440280	**2.0 (A)**	2.0 (A)	3.7 (X)	NLV	NLV	13,000	NA	ID	ID
Toluene (I)	108883	790 (E)	790 (E)	**270**	5.3E+5 (S)	5.3E+5 (S)	5.3E+5 (S)	5.26E+5	61,000	ID
p-Toluidine	106490	15	62	NA	NLV	NLV	24,000	7.60E+6	NA	ID
Total dissolved solids (TDS)	NA	5.0E+5 (E)	5.0E+5 (E)	(EE)	ID	ID	ID	NA	NA	NA
Toxaphene	8001352	3.0 (A)	3.0 (A)	**1.0 (M); 6.8E-5**	NLV	NLV	44	740	ID	740 (S)
Triallate	2303175	95	270	NA	ID	ID	4,000 (S)	4,000	ID	ID
Tributylamine	102829	10	29	ID	14,000	32,000	2,300	75,400	ID	ID
1,2,4-Trichlorobenzene	120821	70 (A)	70 (A)	**99 (X)**	3.0E+5 (S)	3.0E+5 (S)	19,000	3.00E+5	NA	3.0E+5 (S)
1,1,1-Trichloroethane	71556	**200 (A)**	200 (A)	89	6.6E+5	1.3E+6 (S)	1.3E+6 (S)	1.33E+6	ID	1.3E+6 (S)
1,1,2-Trichloroethane	79005	**5.0 (A)**	5.0 (A)	330 (X)	17,000	1.1E+5	21,000	4.42E+6	NA	ID
Trichloroethylene	79016	**5.0 (A)**	5.0 (A)	200 (X)	2,200	4,900	22,000	1.10E+6	ID	1.1E+6 (S)
Trichlorofluoromethane	75694	2,600	7,300	NA	1.1E+6 (S)	1.1E+6 (S)	1.1E+6 (S)	1.10E+6	ID	1.1E+6 (S)
2,4,5-Trichlorophenol	95954	730	2,100	NA	NLV	NLV	1.7E+5	1.20E+6	ID	ID
2,4,6-Trichlorophenol	88062	120	470	**5.0**	NLV	NLV	10,000	8.00E+5	ID	ID
1,2,3-Trichloropropane	96184	42	120	NA	8,300	18,000	84,000	1.90E+6	NA	ID
1,1,2-Trichloro-1,2,2-trifluoroetha	76131	1.7E+5 (S)	1.7E+5 (S)	**32**	1.7E+5 (S)	1.7E+5 (S)	1.7E+5 (S)	1.70E+5	ID	1.7E+5 (S)

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Triethanolamine	102716	3,700	10,000	NA	NLV	NLV	1.0E+9 (D,S)	1.0E+9	ID	ID
Triethylene glycol	112276	4,300	12,000	NA	NLV	NLV	1.0E+6 (S)	1.00E+6	ID	ID
3-Trifluoromethyl-4-nitrophenol	88302	4,500	13,000	NA	NLV	NLV	5.0E+6 (S)	5.00E+6	ID	ID
Trifluralin	1582098	37	110	NA	ID	ID	2,400	8,100	ID	ID
2,2,4-Trimethyl pentane	540841	ID	ID	NA	2,300 (S)	2,300 (S)	ID	2,330	160	ID
2,4,4-Trimethyl-2-pentene (I)	107404	ID	ID	NA	ID	ID	ID	11,900	ID	ID
1,2,4-Trimethylbenzene (I)	95636	63 (E)	63 (E)	**17**	56,000 (S)	56,000 (S)	56,000 (S)	55,890	56,000 (S)	ID
1,3,5-Trimethylbenzene (I)	108678	72 (E)	72 (E)	**45**	61,000 (S)	61,000 (S)	61,000 (S)	61,150	ID	ID
Triphenyl phosphate	115866	1,200	1,400 (S)	NA	NLV	NLV	1,400 (S)	1,430	ID	ID
tris(2,3-Dibromopropyl)phosphate	126727	10 (M); 0.71	10 (M); 2.9	ID	4,700 (S)	4,700 (S)	2,100	4,700	ID	ID
Urea	57136	ID	ID	NA	NLV	NLV	ID	NA	ID	ID
Vanadium	7440622	**4.5**	62	27	NLV	NLV	9.7E+5	NA	ID	ID
Vinyl acetate (I)	108054	640	1,800	NA	4.1E+6	8.9E+6	8.0E+6	2.00E+7	1.8E+6	4.8E+6
Vinyl chloride	75014	**2.0 (A)**	2.0 (A)	13 (X)	1,100	13,000	1,000	2.76E+6	33,000	ID
White phosphorus (R)	12185103	0.11	0.31	NA	NLV	NLV	2,900	NA	ID	ID
Xylenes (I)	1330207	280 (E)	280 (E)	**41**	1.9E+5 (S)	1.9E+5 (S)	1.9E+5 (S)	1.86E+5	70,000	1.9E+5 (S)
Zinc (B)	7440666	2,400	5,000 (E)	(G)	NLV	NLV	1.1E+8	NA	ID	ID

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ⟶>		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Acenaphthene	83329	NA	3.0E+5	**8,700**	9.7E+5	1.9E+8	8.1E+7	8.1E+7	8.1E+7	1.4E+10	4.1E+7	NA
Acenaphthylene	208968	NA	5,900	ID	4.4E+5	1.6E+6	2.2E+6	2.2E+6	2.2E+6	2.3E+9	1.6E+6	NA
Acetaldehyde (I)	75070	NA	19,000	**2,600**	1.1E+8 (C)	2.2E+5	1.7E+5	1.7E+5	2.8E+5	6.0E+8	2.9E+7	1.1E+8
Acetate	71501	NA	ID	(G)	ID	ID	ID	ID	ID	ID	ID	ID
Acetic acid	64197	NA	84,000	(G)	6.5E+8 (C)	NLV	NLV	NLV	NLV	1.7E+10	1.3E+8	6.5E+8
Acetone (I)	67641	NA	**15,000**	34,000	1.1E+8 (C)	1.1E+8 (C)	1.3E+8	1.3E+8	1.9E+8	3.9E+11	2.3E+7	1.1E+8
Acetonitrile	75058	NA	2,800	NA	2.2E+7 (C)	4.8E+6	1.6E+6	1.6E+6	2.1E+6	4.0E+9	4.3E+6	2.2E+7
Acetophenone	98862	NA	30,000	ID	1.1E+6 (C)	1.1E+6 (C)	4.4E+7	4.4E+7	4.4E+7	3.3E+10	1.1E+6 (C)	1.1E+6
Acrolein (I)	107028	NA	2,400	NA	2.3E+7 (C)	410	310	310	610	1.3E+6	3.6E+6	2.3E+7
Acrylamide	79061	NA	10	200 (X)	2.6E+5	NLV	NLV	NLV	NLV	2.4E+6	1,900	NA
Acrylic acid	79107	NA	78,000	NA	1.1E+8 (C)	2.4E+6	1.9E+5	2.3E+5	2.3E+5	6.7E+7	3.5E+7 (DD)	1.1E+8
Acrylonitrile (I)	107131	NA	**100 (M); 52**	100 (M); 40	2.8E+5	6,600	5,000	5,100	10,000	4.6E+7	16,000	8.3E+6
Alachlor	15972608	NA	**52**	290 (X)	44,000	NLV	NLV	NLV	NLV	ID	93,000	NA
Aldicarb	116063	NA	60	NA	2.4E+6	NLV	NLV	NLV	NLV	ID	2.3E+5	NA
Aldicarb sulfone	1646884	NA	200 (M); 40	NA	4.2E+7	NLV	NLV	NLV	NLV	ID	2.5E+5	NA
Aldicarb sulfoxide	1646873	NA	200(M); 80	NA	5.4E+7	NLV	NLV	NLV	NLV	ID	2.9E+5	NA
Aldrin	309002	NA	NLL	NLL	NLL	1.3E+6	58,000	58,000	58,000	6.4E+5	**1,000**	NA
Aluminum (B)	7429905	6.9E+6	1,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	5.0E+7 (DD)	NA
Ammonia	7664417	NA	ID	(CC)	ID	ID	ID	ID	ID	6.7E+9	ID	1.0E+7
t-Amyl methyl ether (TAME)	994058	NA	3,900	NA	4.4E+5 (C)	58,000	3.4E+5	7.6E+5	1.8E+6	4.1E+9	4.4E+5 (C)	4.4E+5
Aniline	62533	NA	1,100	**330 (M); 80**	2.8E+6	NLV	NLV	NLV	NLV	6.7E+7	3.3E+5	4.5E+6

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Anthracene	120127	NA	41,000	ID	41,000	1.0E+9 (D)	1.4E+9	1.4E+9	1.4E+9	6.7E+10	2.3E+8	NA
Antimony	7440360	NA	**4,300**	94,000 (X)	4.9E+7	NLV	NLV	NLV	NLV	1.3E+7	1.8E+5	NA
Arsenic	7440382	5,800	**4,600**	4,600	2.0E+6	NLV	NLV	NLV	NLV	7.2E+5	7,600	NA
Asbestos (BB)	1332214	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	**1.0E+7 (M); 68,000**	ID	NA
Atrazine	1912249	NA	**60**	150	1.1E+5	NLV	NLV	NLV	NLV	ID	71,000 (DD)	NA
Azobenzene	103333	NA	4,200	ID	3.0E+5	6.1E+6	6.3E+5	6.3E+5	6.3E+5	1.0E+8	1.4E+5	NA
Barium (B)	7440393	75,000	1.3E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	3.3E+8	3.7E+7	NA
Benzene (I)	71432	NA	**100**	4,000 (X)	2.2E+5	1,600	13,000	34,000	79,000	3.8E+8	1.8E+5	4.0E+5
Benzidine	92875	NA	1,000 (M); 6.0	1,000 (M); 6.0	1,000 (M); 140	NLV	NLV	NLV	NLV	46,000	1,000 (M); 23	NA
Benzo(a)anthracene (Q)	56553	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	**20,000**	NA
Benzo(b)fluoranthene (Q)	205992	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	20,000	NA
Benzo(k)fluoranthene (Q)	207089	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	**2.0E+5**	NA
Benzo(g,h,i)perylene	191242	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.0E+8	**2.5E+6**	NA
Benzo(a)pyrene (Q)	50328	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.5E+6	**2,000**	NA
Benzoic acid	65850	NA	6.4E+5	NA	7.0E+7	NLV	NLV	NLV	NLV	ID	9.9E+8	NA
Benzyl alcohol	100516	NA	2.0E+5	NA	5.8E+6 (C)	NLV	NLV	NLV	NLV	3.3E+11	5.8E+6 (C)	5.8E+6
Benzyl chloride	100447	NA	150	NA	72,000	6,300	14,000	14,000	17,000	6.2E+7	48,000	2.3E+5
Beryllium	7440417	NA	51,000	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+6	4.1E+5	NA
bis(2-Chloroethoxy)ethane	112265	NA	ID	ID	ID	NLV	NLV	NLV	NLV	ID	ID	2.7E+6
bis(2-Chloroethyl)ether (I)	111444	NA	**100**	100 (M); 20	1.1E+5	8,300	3,800	3,800	3,800	9.4E+6	13,000	2.2E+6
bis(2-Ethylhexyl)phthalate	117817	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	7.0E+8	**2.8E+6**	1.0E+7

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Boron (B)	7440428	NA	**10,000**	1.4E+5 (X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	4.8E+7 (DD)	NA
Bromate	15541454	NA	**200**	800 (X)	96,000	NLV	NLV	NLV	NLV	ID	17,000	NA
Bromobenzene (I)	108861	NA	550	NA	3.6E+5	3.1E+5	4.5E+5	4.5E+5	4.5E+5	5.3E+8	5.4E+5	7.6E+5
Bromodichloromethane	75274	NA	1,600 (W)	ID	2.8E+5	1,200	9,100	9,700	19,000	8.4E+7	1.1E+5	1.5E+6
Bromoform	75252	NA	1,600 (W)	ID	8.7E+5 (C)	1.5E+5	9.0E+5	9.0E+5	9.0E+5	2.8E+9	8.2E+5	8.7E+5
Bromomethane	74839	NA	**200**	700	1.4E+6	860	11,000	57,000	1.4E+5	3.3E+8	3.2E+5	2.2E+6
n-Butanol (I)	71363	NA	19,000	2.0E+5	8.7E+6 (C)	NLV	NLV	NLV	NLV	2.3E+10	8.7E+6 (C)	8.7E+6
2-Butanone (MEK) (I)	78933	NA	2.6E+5	**44,000**	2.7E+7 (C)	2.7E+7 (C)	2.9E+7	2.9E+7	3.5E+7	6.7E+10	2.7E+7 (C,DD)	2.7E+7
n-Butyl acetate	123864	NA	11,000	NA	1.1E+6 (C)	1.1E+6 (C)	1.1E+8	2.6E+8	3.2E+8	4.7E+11	1.1E+6 (C)	1.1E+6
t-Butyl alcohol	75650	NA	78,000	NA	1.1E+8 (C)	1.1E+8 (C)	9.7E+7	2.0E+8	2.0E+8	1.3E+11	1.1E+8 (C)	1.1E+8
Butyl benzyl phthalate	85687	NA	3.1E+5 (C)	**1.2E+5 (X)**	3.1E+5 (C)	NLV	NLV	NLV	NLV	4.7E+10	3.1E+5 (C)	3.1E+5
n-Butylbenzene	104518	NA	1,600	ID	1.2E+5	ID	ID	ID	ID	2.0E+9	2.5E+6	1.0E+7
sec-Butylbenzene	135988	NA	1,600	ID	88,000	ID	ID	ID	ID	4.0E+8	2.5E+6	1.0E+7
t-Butylbenzene (I)	98066	NA	1,600	ID	1.8E+5	ID	ID	ID	ID	6.7E+8	2.5E+6	1.0E+7
Cadmium (B)	7440439	1,200	6,000	(G,X)	2.3E+8	NLV	NLV	NLV	NLV	1.7E+6	5.5E+5	NA
Camphene (I)	79925	NA	ID	NA	ID	3,700	1.5E+5	9.1E+5	2.2E+6	5.3E+9	ID	NA
Caprolactam	105602	NA	1.2E+5	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	6.7E+8	5.3E+7 (DD)	NA
Carbaryl	63252	NA	14,000	NA	2.6E+6	ID	ID	ID	ID	ID	2.2E+7	NA
Carbazole	86748	NA	9,400	**1,100**	8.2E+5	NLV	NLV	NLV	NLV	6.2E+7	5.3E+5	NA
Carbofuran	1563662	NA	800	NA	6.8E+6	NLV	NLV	NLV	NLV	ID	1.1E+6	NA
Carbon disulfide (I,R)	75150	NA	16,000	ID	2.8E+5 (C)	76,000	1.3E+6	7.9E+6	1.9E+7	4.7E+10	2.8E+5 (C,DD)	2.8E+5

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Carbon tetrachloride	56235	NA	100	900 (X)	92,000	190	3,500	12,000	28,000	1.3E+8	96,000	3.9E+5
Chlordane (J)	57749	NA	NLL	NLL	NLL	1.1E+7	1.2E+6	1.2E+6	1.2E+6	3.1E+7	31,000	NA
Chloride	16887006	NA	5.0E+6	(X)	ID	NLV	NLV	NLV	NLV	ID	5.0E+5 (F)	NA
Chlorobenzene (I)	108907	NA	2,000	500	2.6E+5 (C)	1.2E+5	7.7E+5	9.9E+5	2.1E+6	4.7E+9	2.6E+5 (C)	2.6E+5
p-Chlorobenzene sulfonic acid	98668	NA	1.5E+5	ID	NA	ID	ID	ID	ID	ID	2.3E+8	ID
1-Chloro-1,1-difluoroethane	75683	NA	3.0E+5	NA	9.6E+5 (C)	9.6E+5 (C)	7.9E+7	5.6E+8	1.4E+9	3.3E+12	9.6E+5 (C)	9.6E+5
Chloroethane	75003	NA	8,600	22,000 (X)	9.5E+5 (C)	9.5E+5 (C)	3.0E+7	1.2E+8	2.8E+8	6.7E+11	9.5E+5 (C)	9.5E+5
2-Chloroethyl vinyl ether	110758	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	1.9E+6
Chloroform	67663	NA	1,600 (W)	7,000	1.5E+6 (C)	7,200	45,000	1.2E+5	2.7E+5	1.3E+9	1.2E+6	1.5E+6
Chloromethane (I)	74873	NA	5,200	ID	1.1E+6 (C)	2,300	40,000	4.1E+5	1.0E+6	4.9E+9	1.1E+6 (C)	1.1E+6
4-Chloro-3-methylphenol	59507	NA	5,800	280	3.0E+6	NLV	NLV	NLV	NLV	ID	4.5E+6	NA
beta-Chloronaphthalene	91587	NA	6.2E+5	NA	2.3E+6	ID	ID	ID	ID	ID	5.6E+7	NA
2-Chlorophenol	95578	NA	900	360	1.9E+6	4.3E+5	9.6E+5	9.6E+5	9.6E+5	1.2E+9	1.4E+6	1.9E+7
o-Chlorotoluene (I)	95498	NA	3,300	ID	5.0E+5 (C)	2.7E+5	1.2E+6	2.9E+6	6.3E+6	4.7E+9	5.0E+5 (C)	5.0E+5
Chlorpyrifos	2921882	NA	17,000	1,500	8.4E+5	130	4,600	23,000	55,000	1.3E+8	1.1E+7	NA
Chromium (III) (B,H)	16065831	18,000 (total)	1.0E+9 (D)	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	3.3E+8	7.9E+8	NA
Chromium (VI)	18540299	NA	30,000	3,300	1.4E+8	NLV	NLV	NLV	NLV	2.6E+5	2.5E+6	NA
Chrysene (Q)	218019	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	2.0E+6	NA
Cobalt	7440484	6,800	800	2,000	4.8E+7	NLV	NLV	NLV	NLV	1.3E+7	2.6E+6	NA
Copper (B)	7440508	32,000	5.8E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+8	2.0E+7	NA
Cyanazine	21725462	NA	200	1,100 (X)	56,000	NLV	NLV	NLV	NLV	ID	14,000	NA

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Cyanide (P,R)	57125	390 (total)	4,000	**100**	2.5E+5	NLV	NLV	NLV	NLV	2.5E+5	12,000	NA
Cyclohexanone	108941	NA	5.2E+6	NA	2.2E+8 (C)	17,000	1.0E+6	1.1E+7	2.7E+7	6.7E+10	2.2E+8 (C)	2.2E+8
Dacthal	1861321	NA	50,000	NA	3.4E+5	NLV	NLV	NLV	NLV	ID	2.3E+6	NA
Dalapon	75990	NA	4,000	NA	5.9E+7 (C)	NLV	NLV	NLV	NLV	ID	1.9E+7	5.9E+7
4-4'-DDD	72548	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.4E+7	**95,000**	NA
4-4'-DDE	72559	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.2E+7	**45,000**	NA
4-4'-DDT	50293	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.2E+7	**57,000**	NA
Decabromodiphenyl ether	1163195	NA	1.4E+5	NA	1.4E+5	1.0E+9 (D)	8.6E+7	8.6E+7	8.6E+7	2.3E+9	3.8E+6	NA
Di-n-butyl phthalate	84742	NA	7.6E+5 (C)	**11,000**	7.6E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.6E+5 (C)	7.6E+5
Di(2-ethylhexyl) adipate	103231	NA	9.6E+5 (C)	ID	9.6E+5 (C)	NLV	NLV	NLV	NLV	9.2E+9	9.6E+5 (C,DD)	9.6E+5
Di-n-octyl phthalate	117840	NA	1.0E+8	ID	1.4E+8 (C)	NLV	NLV	NLV	NLV	3.1E+10	6.9E+6	1.4E+8
Diacetone alcohol (I)	123422	NA	ID	NA	ID	NLV	NLV	NLV	NLV	1.6E+11	ID	1.1E+8
Diazinon	333415	NA	95	72	95,000	NLV	NLV	NLV	NLV	ID	12,000 (DD)	3.1E+5
Dibenzo(a,h)anthracene (Q)	53703	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	**2,000**	NA
Dibenzofuran	132649	NA	ID	1,700	ID	2.0E+6	1.3E+5	1.3E+5	1.3E+5	6.7E+6	ID	NA
Dibromochloromethane	124481	NA	1,600 (W)	ID	3.6E+5	3,900	24,000	24,000	33,000	1.3E+8	1.1E+5	6.1E+5
Dibromochloropropane	96128	NA	10 (M); 4.0	ID	1,200 (C)	220	260	260	260	5.6E+5	1,200 (C)	1,200
Dibromomethane	74953	NA	1,600	NA	2.0E+6 (C)	ID	ID	ID	ID	ID	2.0E+6 (C)	2.0E+6
Dicamba	1918009	NA	4,400	NA	1.2E+7	NA	NLV	NLV	NLV	ID	3.4E+6	NA
1,2-Dichlorobenzene	95501	NA	14,000	**280**	2.1E+5 (C)	2.1E+5 (C)	3.9E+7	3.9E+7	5.2E+7	1.0E+11	2.1E+5 (C)	2.1E+5
1,3-Dichlorobenzene	541731	NA	170	680	51,000	26,000	79,000	79,000	1.1E+5	2.0E+8	1.7E+5 (C)	1.7E+5

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1,4-Dichlorobenzene	106467	NA	1,700	**360**	1.4E+5	19,000	77,000	77,000	1.1E+5	4.5E+8	4.0E+5	NA
3,3'-Dichlorobenzidine	91941	NA	**2,000 (M); 28**	2,000 (M); 7.4	4,600	NLV	NLV	NLV	NLV	6.5E+6	6,600	NA
Dichlorodifluoromethane	75718	NA	95,000	ID	1.0E+6 (C)	9.0E+5	5.3E+7	5.5E+8	1.4E+9	3.3E+12	1.0E+6 (C)	1.0E+6
1,1-Dichloroethane	75343	NA	18,000	**15,000**	8.9E+5 (C)	2.3E+5	2.1E+6	5.9E+6	1.4E+7	3.3E+10	8.9E+5 (C)	8.9E+5
1,2-Dichloroethane (I)	107062	NA	**100**	7,200 (X)	3.8E+5	2,100	6,200	11,000	26,000	1.2E+8	91,000	1.2E+6
1,1-Dichloroethylene (I)	75354	NA	140	2,600	2.2E+5	**62**	1,100	5,300	13,000	6.2E+7	2.0E+5	5.7E+5
cis-1,2-Dichloroethylene	156592	NA	**1,400**	12,000	6.4E+5 (C)	22,000	1.8E+5	4.2E+5	9.9E+5	2.3E+9	6.4E+5 (C)	6.4E+5
trans-1,2-Dichloroethylene	156605	NA	**2,000**	30,000 (X)	1.4E+6 (C)	23,000	2.8E+5	8.3E+5	2.0E+6	4.7E+9	1.4E+6 (C)	1.4E+6
2,6-Dichloro-4-nitroaniline	99309	NA	44,000	NA	1.4E+5	NLV	NLV	NLV	NLV	ID	6.8E+7	NA
2,4-Dichlorophenol	120832	NA	1,500	**330 (M); 220**	9.6E+5	NLV	NLV	NLV	NLV	5.1E+9	6.6E+5 (DD)	1.8E+6
2,4-Dichlorophenoxyacetic acid	94757	NA	**1,400**	4,400	2.4E+6	NLV	NLV	NLV	NLV	6.7E+9	2.5E+6	NA
1,2-Dichloropropane (I)	78875	NA	**100**	4,600 (X)	3.2E+5	4,000	25,000	50,000	1.1E+5	2.7E+8	1.4E+5	5.5E+5
1,3-Dichloropropene	542756	NA	170	180 (X)	1.1E+5	1,000	18,000	68,000	1.6E+5	7.8E+8	10,000	6.2E+5
Dichlorovos	62737	NA	50 (M); 32	NA	1.2E+5	NLV	NLV	NLV	NLV	3.3E+7	10,000	2.2E+6
Dicyclohexyl phthalate	84617	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	NA
Dieldrin	60571	NA	NLL	NLL	NLL	1.4E+5	19,000	19,000	19,000	6.8E+5	**1,100**	NA
Diethyl ether	60297	NA	200	ID	7.4E+6 (C)	7.4E+6 (C)	8.5E+7	1.5E+8	3.4E+8	8.0E+11	7.4E+6 (C)	7.4E+6
Diethyl phthalate	84662	NA	1.1E+5	**2,200**	7.4E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.4E+5 (C)	7.4E+5
Diethylene glycol monobutyl ether	112345	NA	1,800	NA	8.0E+7	NLV	NLV	NLV	NLV	1.3E+9	2.7E+6	1.1E+8
Diisopropyl ether	108203	NA	600	ID	1,300 (C)	1,300 (C)	3.4E+5	7.6E+5	1.8E+6	4.1E+9	1,300 (C)	1,300
Diisopropylamine (I)	108189	NA	110	NA	4.2E+5	5.5E+6	6.2E+6	6.2E+6	7.3E+6	1.3E+10	1.7E+5	6.7E+6

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Dimethyl phthalate	131113	NA	7.9E+5 (C)	NA	7.9E+5 (C)	NLV	NLV	NLV	NLV	3.3E+9	7.9E+5 (C)	7.9E+5
N,N-Dimethylacetamide	127195	NA	**3,600**	82,000 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	ID	5.6E+6	1.1E+8
N,N-Dimethylaniline	121697	NA	320	NA	4.0E+5	1.7E+5	1.5E+5	1.5E+5	1.5E+5	2.6E+8	5.0E+5	8.0E+5
Dimethylformamide (I)	68122	NA	14,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.0E+9	2.2E+7	1.1E+8
2,4-Dimethylphenol	105679	NA	**7,400**	7,600	1.0E+7	NLV	NLV	NLV	NLV	4.7E+9	1.1E+7	NA
2,6-Dimethylphenol	576261	NA	330 (M); 88	NA	1.3E+5	NLV	NLV	NLV	NLV	1.3E+8	1.4E+5	NA
3,4-Dimethylphenol	95658	NA	330 (M); 200	500	3.6E+5	NLV	NLV	NLV	NLV	2.3E+8	3.2E+5	NA
Dimethylsulfoxide	67685	NA	4.4E+6	**3.8E+6**	1.8E+7 (C)	NLV	NLV	NLV	NLV	1.3E+9	1.8E+7 (C)	1.8E+7
2,4-Dinitrotoluene	121142	NA	430	NA	1.7E+5	NLV	NLV	NLV	NLV	1.6E+7	48,000	NA
Dinoseb	88857	NA	300	**200 (M); 43**	1.4E+5 (C)	NLV	NLV	NLV	NLV	2.7E+8	66,000 (DD)	1.4E+5
1,4-Dioxane (I)	123911	NA	**1,700**	56,000 (X)	3.4E+7	NLV	NLV	NLV	NLV	5.7E+8	5.3E+5	9.7E+7
Diquat	85007	NA	400	400	1.4E+7	NLV	NLV	NLV	NLV	ID	5.0E+5	NA
Diuron	330541	NA	620	NA	7.4E+5	NLV	NLV	NLV	NLV	4.7E+8	9.7E+5	NA
Endosulfan (J)	115297	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	1.4E+6	NA
Endothall	145733	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	2.3E+9	**3.8E+6**	NA
Endrin	72208	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	**65,000**	NA
Epichlorohydrin (I)	106898	NA	100	NA	2.2E+5	64,000	31,000	31,000	35,000	6.7E+7	8,900	7.3E+6
Ethanol (I)	64175	NA	3.8E+7	ID	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.3E+12	1.1E+8 (C,DD)	1.1E+8
Ethyl acetate (I)	141786	NA	1.3E+5	NA	7.5E+6 (C)	7.5E+6 (C)	4.9E+7	4.9E+7	9.8E+7	2.1E+11	7.5E+6 (C)	7.5E+6
Ethyl-tert-butyl ether (ETBE)	637923	NA	980	ID	ID	5.4E+5	1.9E+6	4.5E+6	1.1E+7	2.5E+10	ID	6.5E+5
Ethylbenzene (I)	100414	NA	1,500	**360**	1.4E+5 (C)	87,000	7.2E+5	1.0E+6	2.2E+6	1.0E+10	1.4E+5 (C)	1.4E+5

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ⟶		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Ethylene dibromide	106934	NA	20 (M); 1.0	110 (X)	500	670	1,700	1,700	3,300	1.4E+7	92	8.9E+5
Ethylene glycol	107211	NA	3.0E+5	3.8E+6 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	6.7E+10	1.1E+8 (C)	1.1E+8
Ethylene glycol monobutyl ether	111762	NA	74,000	NA	4.1E+7 (C)	7.4E+5	1.8E+7	1.5E+8	3.6E+8	8.7E+11	4.1E+7 (C)	4.1E+7
Fluoranthene	206440	NA	7.3E+5	5,500	7.3E+5	1.0E+9 (D)	7.4E+8	7.4E+8	7.4E+8	9.3E+9	4.6E+7	NA
Fluorene	86737	NA	3.9E+5	5,300	8.9E+5	5.8E+8	1.3E+8	1.3E+8	1.3E+8	9.3E+9	2.7E+7	NA
Fluorine (soluble fluoride) (B)	7782414	NA	40,000	ID	2.4E+8	NLV	NLV	NLV	NLV	ID	9.0E+6 (DD)	NA
Formaldehyde	50000	NA	26,000	2,400	6.0E+7 (C)	12,000	13,000	23,000	52,000	2.4E+8	4.1E+7	6.0E+7
Formic acid (I,U)	64186	NA	2.0E+5	ID	1.1E+8 (C)	1.5E+6	2.1E+5	1.4E+5	1.4E+5	1.3E+8	1.1E+8 (C)	1.1E+8
1-Formylpiperidine	2591868	NA	1,600	NA	ID	ID	ID	ID	ID	ID	2.5E+6	1.0E+7
Gentian violet	548629	NA	300	NA	2.0E+7	NLV	NLV	NLV	NLV	ID	96,000	NA
Glyphosate	1071836	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.1E+7 (DD)	NA
Heptachlor	76448	NA	NLL	NLL	NLL	3.5E+5	62,000	62,000	62,000	2.4E+6	5,600	NA
Heptachlor epoxide	1024573	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.2E+6	3,100	NA
n-Heptane	142825	NA	2.4E+5 (C)	NA	2.4E+5 (C)	2.4E+5 (C)	2.1E+7	4.4E+7	1.0E+8	2.3E+11	2.4E+5 (C)	2.4E+5
Hexabromobenzene	87821	NA	5,400	ID	5,400	ID	ID	ID	ID	ID	1.1E+6	NA
Hexachlorobenzene (C-66)	118741	NA	1,800	350	8,200	41,000	17,000	17,000	17,000	6.8E+6	8,900	NA
Hexachlorobutadiene (C-46)	87683	NA	26,000	91	3.5E+5 (C)	1.3E+5	1.3E+5	1.3E+5	1.3E+5	1.4E+8	1.0E+5	3.5E+5
alpha-Hexachlorocyclohexane	319846	NA	18	ID	2,500	30,000	12,000	22,000	25,000	1.7E+6	2,600	NA
beta-Hexachlorocyclohexane	319857	NA	37	ID	5,100	NLV	NLV	NLV	NLV	5.9E+6	5,400	NA
Hexachlorocyclopentadiene (C-56)	77474	NA	3.2E+5	ID	7.2E+5 (C)	30,000	50,000	50,000	50,000	1.3E+7	7.2E+5 (C)	7.2E+5
Hexachloroethane	67721	NA	430	1,800 (X)	1.1E+5	40,000	5.5E+5	9.3E+5	9.3E+5	2.3E+8	2.3E+5	NA

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n-Hexane	110543	NA	44,000 (C)	NA	44,000 (C)	44,000 (C)	3.0E+6	3.2E+6	6.2E+6	1.3E+10	44,000 (C)	44,000
2-Hexanone	591786	NA	20,000	ID	2.5E+6 (C)	9.9E+5	1.1E+6	1.1E+6	1.4E+6	2.7E+9	2.5E+6 (C)	2.5E+6
Indeno(1,2,3-cd)pyrene (Q)	193395	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	**20,000**	NA
Iron (B)	7439896	1.2E+7	6,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.6E+8	NA
Isobutyl alcohol (I)	78831	NA	46,000	NA	8.9E+6 (C)	8.9E+6 (C)	7.9E+7	7.9E+7	7.9E+7	1.0E+11	8.9E+6 (C)	8.9E+6
Isophorone	78591	NA	15,000	**26,000 (X)**	2.4E+6 (C)	NLV	NLV	NLV	NLV	1.2E+10	2.4E+6 (C)	2.4E+6
Isopropyl alcohol (I)	67630	NA	**9,400**	1.1E+6 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.5E+10	1.4E+7	1.1E+8
Isopropyl benzene	98828	NA	91,000	3,200	3.9E+5 (C)	3.9E+5 (C)	1.7E+6	1.7E+6	2.8E+6	5.8E+9	3.9E+5 (C)	3.9E+5
Lead (B)	7439921	21,000	7.0E+5	(G,X)	ID	NLV	NLV	NLV	NLV	1.0E+8	4.0E+5	NA
Lindane	58899	NA	20 (M); 7.0	20 (M); 1.1	7,100	ID	ID	ID	ID	ID	8,300	NA
Lithium (B)	7439932	9,800	3,400	**8,800**	1.1E+8	NLV	NLV	NLV	NLV	2.3E+9	4.2E+6 (DD)	NA
Magnesium (B)	7439954	NA	8.0E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	6.7E+9	1.0E+9 (D)	NA
Manganese (B)	7439965	4.4E+5	1,000	(G,X)	1.8E+8	NLV	NLV	NLV	NLV	3.3E+6	2.5E+7	NA
Mercury (Total) (B,Z)	Varies	130	1,700	**50 (M); 1.2**	47,000	48,000	52,000	52,000	52,000	2.0E+7	1.6E+5	NA
Methane	74828	NA	ID	NA	ID	8.4E+6 ug/m3 (GG)	ID	ID	ID	ID	ID	ID
Methanol	67561	NA	74,000	3.1E+6 (C)	3.1E+6 (C)	3.1E+6 (C)	3.1E+7	4.4E+7	9.6E+7	2.2E+11	3.1E+6 (C)	3.1E+6
Methoxychlor	72435	NA	16,000	NA	18,000	ID	ID	ID	ID	ID	1.9E+6	NA
2-Methoxyethanol (I)	109864	NA	150	NA	1.7E+7	NLV	NLV	NLV	NLV	1.3E+9	2.3E+5	1.1E+8
2-Methyl-4-chlorophenoxyacetic acid	94746	NA	390	NA	4.9E+5	NLV	NLV	NLV	NLV	ID	2.3E+5	NA
2-Methyl-4,6-dinitrophenol	534521	NA	830 (M); 400	NA	1.9E+5	NLV	NLV	NLV	NLV	1.3E+8	79,000	NA
N-Methyl-morpholine (I)	109024	NA	400	NA	3.0E+7	NLV	NLV	NLV	NLV	ID	6.1E+5	1.1E+8

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Methyl parathion	298000	NA	46	NA	76,000	NLV	NLV	NLV	NLV	ID	56,000	NA
4-Methyl-2-pentanone (MIBK) (I)	108101	NA	**36,000**	ID	2.7E+6 (C)	2.7E+6 (C)	4.5E+7	4.5E+7	6.7E+7	1.4E+11	2.7E+6 (C)	2.7E+6
Methyl-tert-butyl ether (MTBE)	1634044	NA	**800**	1.4E+5 (X)	5.9E+6 (C)	5.9E+6 (C)	2.5E+7	3.9E+7	8.7E+7	2.0E+11	1.5E+6	5.9E+6
Methylcyclopentane (I)	96377	NA	ID	NA	ID	92,000	2.3E+6	8.2E+6	2.0E+7	4.7E+10	ID	3.5E+5
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.4E+7	**6,800**	NA
Methylene chloride	75092	NA	**100**	30,000 (X)	2.3E+6 (C)	45,000	2.1E+5	5.9E+5	1.4E+6	6.6E+9	1.3E+6	2.3E+6
2-Methylnaphthalene	91576	NA	57,000	4,200	5.5E+6	2.7E+6	1.5E+6	1.5E+6	1.5E+6	6.7E+8	8.1E+6	NA
Methylphenols (J)	1319773	NA	7,400	**1,000 (M); 600**	1.6E+7	NLV	NLV	NLV	NLV	6.7E+9	1.1E+7	NA
Metolachlor	51218452	NA	4,800	300	4.4E+5 (C)	NLV	NLV	NLV	NLV	ID	4.4E+5 (C,DD)	4.4E+5
Metribuzin	21087649	NA	3,600	NA	2.4E+7	ID	ID	ID	ID	ID	9.6E+6	NA
Mirex	2385855	NA	NLL	NLL	NLL	ID	ID	ID	ID	ID	9,600	NA
Molybdenum (B)	7439987	NA	**1,500**	64,000 (X)	1.9E+7	NLV	NLV	NLV	NLV	ID	2.6E+6	NA
Naphthalene	91203	NA	35,000	**730**	2.1E+6	2.5E+5	3.0E+5	3.0E+5	3.0E+5	2.0E+8	1.6E+7	NA
Nickel (B)	7440020	20,000	1.0E+5	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.3E+7	4.0E+7	NA
Nitrate (B,N)	14797558	NA	2.0E+5 (N)	ID	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	ID	NA
Nitrite (B,N)	14797650	NA	20,000 (N)	NA	3.8E+8	NLV	NLV	NLV	NLV	ID	ID	NA
Nitrobenzene (I)	98953	NA	**330 (M); 68**	3,600 (X)	2.2E+5	91,000	54,000	54,000	54,000	4.7E+7	1.0E+5	4.9E+5
2-Nitrophenol	88755	NA	400	ID	1.6E+6	NLV	NLV	NLV	NLV	ID	6.3E+5	NA
n-Nitroso-di-n-propylamine	621647	NA	330 (M); 100	NA	7,200	NLV	NLV	NLV	NLV	1.6E+6	1,200	1.5E+6
N-Nitrosodiphenylamine	86306	NA	5,400	NA	7.0E+5	NLV	NLV	NLV	NLV	2.2E+9	1.7E+6	NA

Attachment 1
TABLE 2. SOIL: RESIDENTIAL
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to one microgram per kilogram (ug/kg). Criteria with six or more digits are expressed in scientific notation. For example, 200,000 is presented as 2.0E+5. The lowest generic soil criterion for a given hazardous substance is presented in a bold box. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (R 299.5707). In these cases, two numbers are present in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based value. Criteria were originally promulgated December 21, 2002 within the Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This table reflects revisions to the criteria pursuant to the December 2010 Part 201 amendments and new criteria consistent with the provisions of R299.5706a. The effective dates of the criteria and screening levels in this table vary. Please contact the Remediation Division Toxicology Unit for additional information.

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ⟶		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Oxamyl	23135220	NA	4,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	8.6E+6	NA
Oxo-hexyl acetate	88230357	NA	1,500	NA	ID	ID	ID	ID	ID	5.4E+9	2.3E+6	1.0E+7
Pendimethalin	40487421	NA	1.1E+6	NA	1.1E+6	NLV	NLV	NLV	NLV	ID	4.6E+7	NA
Pentachlorobenzene	608935	NA	29,000	9,500	1.9E+5 (C)	ID	ID	ID	ID	ID	1.9E+5 (C)	1.9E+5
Pentachloronitrobenzene	82688	NA	37,000	NA	37,000	1.2E+5	2.3E+5	2.3E+5	2.3E+5	3.3E+8	1.7E+6	NA
Pentachlorophenol	87865	NA	22	(G,X)	4,300	NLV	NLV	NLV	NLV	1.0E+8	90,000	NA
Pentane	109660	NA	ID	NA	ID	2.4E+5 (C)	3.7E+7	3.1E+8	5.8E+8	1.2E+12	ID	2.4E+5
2-Pentene (I)	109682	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	2.2E+5
Phenanthrene	85018	NA	56,000	**2,100**	1.1E+6	2.8E+6	1.6E+5	1.6E+5	1.6E+5	6.7E+6	1.6E+6	NA
Phenol	108952	NA	88,000	**9,000**	1.2E+7 (C)	NLV	NLV	NLV	NLV	4.0E+10	1.2E+7 (C,DD)	1.2E+7
Phenytoin	57410	NA	830	4300 (X)	6.8E+5	NLV	NLV	NLV	NLV	2.2E+8	1.0E+5	NA
Phosphorus (Total)	7723140	NA	1.3E+6	(EE)	ID	NLV	NLV	NLV	NLV	6.7E+7	1.0E+9 (D)	NA
Phthalic acid	88993	NA	2.8E+5	NA	1.7E+6 (C)	NLV	NLV	NLV	NLV	ID	1.7E+6 (C)	1.7E+6
Phthalic anhydride	85449	NA	3.0E+5	NA	1.1E+6 (C)	NLV	NLV	NLV	NLV	ID	1.1E+6 (C)	1.1E+6
Picloram	1918021	NA	10,000	**920**	8.6E+6	NLV	NLV	NLV	NLV	ID	1.6E+7	NA
Piperidine	110894	NA	64	NA	6.8E+5	NLV	NLV	NLV	NLV	9.3E+9	99,000	1.2E+8
Polybrominated biphenyls (J)	67774327	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	**1,200**	NA
Polychlorinated biphenyls (PCBs) (J,T)	1336363	NA	NLL	NLL	NLL	3.0E+6	2.4E+5	7.9E+6	7.9E+6	5.2E+6	**(T)**	NA
Prometon	1610180	NA	4,900	NA	5.5E+6	NLV	NLV	NLV	NLV	ID	5.0E+6	NA
Propachlor	1918167	NA	1,900	NA	8.8E+6	NLV	NLV	NLV	NLV	ID	2.9E+6	NA
Propazine	139402	NA	4,000	NA	1.7E+5	NLV	NLV	NLV	NLV	ID	6.1E+6	NA

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DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to one microgram per kilogram (ug/kg). Criteria with six or more digits are expressed in scientific notation. For example, 200,000 is presented as 2.0E+5. The lowest generic soil criterion for a given hazardous substance is presented in a bold box. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (R 299.5707). In these cases, two numbers are present in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based value. Criteria were originally promulgated December 21, 2002 within the Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This table reflects revisions to the criteria pursuant to the December 2010 Part 201 amendments and new criteria consistent with the provisions of R299.5706a. The effective dates of the criteria and screening levels in this table vary. Please contact the Remediation Division Toxicology Unit for additional information.

			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ⟶		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Propionic acid	79094	NA	2.4E+5	ID	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.0E+10	1.1E+8 (C)	1.1E+8
Propyl alcohol (I)	71238	NA	28,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	4.9E+10	1.3E+7 (DD)	1.1E+8
n-Propylbenzene (I)	103651	NA	1,600	ID	3.0E+5	ID	ID	ID	ID	1.3E+9	2.5E+6	1.0E+7
Propylene glycol	57556	NA	**3.0E+6**	5.8E+6	1.1E+8 (C)	NLV	NLV	NLV	NLV	4.0E+11	1.1E+8 (C)	1.1E+8
Pyrene	129000	NA	4.8E+5	ID	4.8E+5	1.0E+9 (D)	6.5E+8	6.5E+8	6.5E+8	6.7E+9	2.9E+7	NA
Pyridine (I)	110861	NA	400	NA	37,000 (C)	1,100	8,200	40,000	97,000	2.3E+8	37,000 (C)	37,000
Selenium (B)	7782492	410	4,000	**400**	7.8E+7	NLV	NLV	NLV	NLV	1.3E+8	2.6E+6	NA
Silver (B)	7440224	1,000	4,500	**100 (M); 27**	2.0E+8	NLV	NLV	NLV	NLV	6.7E+6	2.5E+6	NA
Silvex (2,4,5-TP)	93721	NA	3,600	**2,200**	3.1E+6	NLV	NLV	NLV	NLV	ID	1.7E+6	NA
Simazine	122349	NA	80	340	90,000	NLV	NLV	NLV	NLV	ID	1.2E+6	NA
Sodium	17341252	NA	2.5E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	NA
Sodium azide	26628228	NA	1,800	1,000	ID	ID	ID	ID	ID	ID	2.7E+6	NA
Strontium (B)	7440246	NA	92,000	**4.2E+5**	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	3.3E+8	NA
Styrene	100425	NA	2,700	**2,100 (X)**	2.7E+5	2.5E+5	9.7E+5	9.7E+5	1.4E+6	5.5E+9	4.0E+5	5.2E+5
Sulfate	14808798	NA	5.0E+6	NA	ID	NLV	NLV	NLV	NLV	ID	ID	NA
Tebuthiuron	34014181	NA	10,000	NA	5.0E+7	NLV	NLV	NLV	NLV	ID	4.6E+6 (DD)	NA
2,3,7,8-Tetrabromodibenzo-p-dio (O)	50585416	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	(O)	(O)	NA
1,2,4,5-Tetrachlorobenzene	95943	NA	1.5E+6	3,400 (X)	1.5E+6	5.8E+5	2.3E+5	2.3E+5	2.3E+5	6.7E+7	7.7E+7	NA
2,3,7,8-Tetrachlorodibenzo-p-dio (O)	1746016	NA	NLL	NLL	NLL	NLV	NLV	NLV	NLV	71 (O)	**0.09 (O)**	NA
1,1,1,2-Tetrachloroethane	630206	NA	1,500	ID	4.4E+5 (C)	6,200	36,000	54,000	1.0E+5	4.2E+8	4.4E+5 (C)	4.4E+5
1,1,2,2-Tetrachloroethane	79345	NA	**170**	1,600 (X)	94,000	4,300	10,000	10,000	14,000	5.4E+7	53,000	8.7E+5

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PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ⟶		#10	#11	#12	#13	#14	#15	#16	#17	#18	#19	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Tetrachloroethylene	127184	NA	**100**	1,200 (X)	88,000 (C)	11,000	1.7E+5	4.8E+5	1.1E+6	2.7E+9	88,000 (C)	88,000
Tetrahydrofuran	109999	NA	**1,900**	2.2E+5 (X)	3.2E+7	1.3E+6	1.3E+7	6.7E+7	1.6E+8	3.9E+11	2.9E+6	1.2E+8
Tetranitromethane	509148	NA	ID	NA	ID	500(M); 110	500 (M); 51	ID	ID	2.1E+5	ID	ID
Thallium (B)	7440280	NA	**2,300**	4,200 (X)	1.5E+7	NLV	NLV	NLV	NLV	1.3E+7	35,000	NA
Toluene (I)	108883	NA	16,000	**5,400**	2.5E+5 (C)	2.5E+5 (C)	2.8E+6	5.1E+6	1.2E+7	2.7E+10	2.5E+5 (C)	2.5E+5
p-Toluidine	106490	NA	660 (M); 300	NA	4.8E+5	NLV	NLV	NLV	NLV	1.0E+8	94,000	1.2E+6
Toxaphene	8001352	NA	24,000	**8,200**	3.6E+5	NLV	NLV	NLV	NLV	9.7E+6	20,000	NA
Triallate	2303175	NA	95,000	NA	2.5E+5 (C)	ID	ID	ID	ID	ID	2.5E+5 (C)	2.5E+5
Tributylamine	102829	NA	7,800	ID	1.8E+6	5.8E+5	6.0E+5	6.0E+5	6.0E+5	4.7E+8	7.9E+5	3.7E+6
1,2,4-Trichlorobenzene	120821	NA	4,200	**5,900 (X)**	1.1E+6 (C)	1.1E+6 (C)	2.8E+7	2.8E+7	2.8E+7	2.5E+10	9.9E+5 (DD)	1.1E+6
1,1,1-Trichloroethane	71556	NA	4,000	1,800	4.6E+5 (C)	2.5E+5	3.8E+6	1.2E+7	2.8E+7	6.7E+10	4.6E+5 (C)	4.6E+5
1,1,2-Trichloroethane	79005	NA	**100**	6,600 (X)	4.2E+5	4,600	17,000	21,000	44,000	1.9E+8	1.8E+5	9.2E+5
Trichloroethylene	79016	NA	**100**	4,000 (X)	4.4E+5	1,000	11,000	25,000	57,000	1.3E+8	5.0E+5 (C,DD)	5.0E+5
Trichlorofluoromethane	75694	NA	52,000	NA	5.6E+5 (C)	5.6E+5 (C)	9.2E+7	6.3E+8	1.5E+9	3.8E+12	5.6E+5 (C)	5.6E+5
2,4,5-Trichlorophenol	95954	NA	39,000	NA	9.1E+6	NLV	NLV	NLV	NLV	2.3E+10	2.3E+7	NA
2,4,6-Trichlorophenol	88062	NA	2,400	330 (M); 100	2.0E+5	NLV	NLV	NLV	NLV	1.0E+9	7.1E+5	NA
1,2,3-Trichloropropane	96184	NA	840	NA	8.3E+5 (C)	4,000	9,200	9,200	11,000	2.0E+7	8.3E+5 (C)	8.3E+5
1,1,2-Trichloro-1,2,2-trifluoroetha	76131	NA	5.5E+5 (C)	**1,700**	5.5E+5 (C)	5.5E+5 (C)	1.8E+8	8.8E+8	2.1E+9	5.1E+12	5.5E+5 (C)	5.5E+5
Triethanolamine	102716	NA	74,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	3.3E+9	1.1E+8	1.1E+8
Triethylene glycol	112276	NA	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C,DD)	1.1E+5
3-Trifluoromethyl-4-nitrophenol	88302	NA	1.1E+5	NA	1.2E+8	NLV	NLV	NLV	NLV	ID	4.1E+7 (DD)	NA

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			Groundwater Protection			Indoor Air	Ambient Air (Y)				Direct Contact	
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Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Trifluralin	1582098	NA	1.9E+5	NA	1.2E+7	ID	ID	ID	ID	ID	2.0E+6	NA
2,2,4-Trimethyl pentane	540841	NA	ID	NA	ID	19,000 (C)	5.2E+6	3.9E+7	9.6E+7	2.3E+11	ID	19,000
2,4,4-Trimethyl-2-pentene (I)	107404	NA	ID	NA	ID	ID	ID	ID	ID	ID	ID	56,000
1,2,4-Trimethylbenzene (I)	95636	NA	2,100	**570**	1.1E+5 (C)	1.1E+5 (C)	2.1E+7	5.0E+8	5.0E+8	8.2E+10	1.1E+5 (C)	1.1E+5
1,3,5-Trimethylbenzene (I)	108678	NA	1,800	**1,100**	94,000 (C)	94,000 (C)	1.6E+7	3.8E+8	3.8E+8	8.2E+10	94,000 (C)	94,000
Triphenyl phosphate	115866	NA	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C)	1.1E+5
tris(2,3-Dibromopropyl)phosphate	126727	NA	930	ID	27,000 (C)	27,000 (C)	18,000	18,000	18,000	5.9E+6	4,400	27,000
Urea	57136	NA	ID	NA	ID	NLV	NLV	NLV	NLV	ID	ID	NA
Vanadium	7440622	NA	**72,000**	4.3E+5	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	7.5E+5 (DD)	NA
Vinyl acetate (I)	108054	NA	13,000	NA	2.4E+6 (C)	7.9E+5	1.7E+6	2.6E+6	5.8E+6	1.3E+10	2.4E+6 (C,DD)	2.4E+6
Vinyl chloride	75014	NA	**40**	260 (X)	20,000	270	4,200	30,000	73,000	3.5E+8	3,800	4.9E+5
White phosphorus (R)	12185103	NA	2.2	NA	58,000	NLV	NLV	NLV	NLV	ID	2,300 (DD)	NA
Xylenes (I)	1330207	NA	5,600	**820**	1.5E+5 (C)	1.5E+5 (C)	4.6E+7	6.1E+7	1.3E+8	2.9E+11	1.5E+5 (C)	1.5E+5
Zinc (B)	7440666	47,000	2.4E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.7E+8	NA

Attachment 1
TABLE 3. SOIL: NONRESIDENTIAL
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PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
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			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ——>		#10	#11	#21	#12	#13	#22	#23	#24	#25	#26	#27	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Acenaphthene	83329	NA	3.0E+5	8.8E+5	8,700	9.7E+5	3.5E+8	9.7E+7	9.7E+7	9.7E+7	6.2E+9	1.3E+8	NA
Acenaphthylene	208968	NA	5,900	17,000	ID	4.4E+5	3.0E+6	2.7E+6	2.7E+6	2.7E+6	1.0E+9	5.2E+6	NA
Acetaldehyde (I)	75070	NA	19,000	54,000	2,600	1.1E+8 (C)	4.0E+5	2.1E+5	2.1E+5	2.9E+5	2.6E+8	9.5E+7	1.1E+8
Acetate	71501	NA	ID	ID	(G)	ID	ID	ID	ID	ID	ID	ID	ID
Acetic acid	64197	NA	84,000	2.4E+5	(G)	6.5E+8 (C)	NLV	NLV	NLV	NLV	7.4E+9	4.2E+8	6.5E+8
Acetone (I)	67641	NA	15,000	42,000	34,000	1.1E+8 (C)	1.1E+8 (C)	1.6E+8	1.6E+8	2.0E+8	1.7E+11	7.3E+7	1.1E+8
Acetonitrile	75058	NA	2,800	8,000	NA	2.2E+7 (C)	8.8E+6	1.9E+6	1.9E+6	2.2E+6	1.8E+9	1.4E+7	2.2E+7
Acetophenone	98862	NA	30,000	88,000	ID	1.1E+6 (C)	1.1E+6 (C)	5.2E+7	5.2E+7	5.2E+7	1.4E+10	1.1E+6 (C)	1.1E+6
Acrolein (I)	107028	NA	2,400	6,600	NA	2.3E+7 (C)	760	370	370	630	5.9E+5	1.2E+7	2.3E+7
Acrylamide	79061	NA	10	10	200 (X)	2.6E+5	NLV	NLV	NLV	NLV	3.0E+6	8,700	NA
Acrylic acid	79107	NA	78,000	2.2E+5	NA	1.1E+8 (C)	5.5E+6	2.2E+5	2.7E+5	2.7E+5	2.9E+7	1.1E+8 (C,DD)	1.1E+8
Acrylonitrile (I)	107131	NA	100 (M); 52	220	100 (M); 40	2.8E+5	35,000	17,000	17,000	31,000	5.8E+7	74,000	8.3E+6
Alachlor	15972608	NA	52	52	290 (X)	44,000	NLV	NLV	NLV	NLV	ID	3.9E+5	NA
Aldicarb	116063	NA	60	60	NA	2.4E+6	NLV	NLV	NLV	NLV	ID	7.3E+5	NA
Aldicarb sulfone	1646884	NA	200 (M); 40	200 (M); 40	NA	4.2E+7	NLV	NLV	NLV	NLV	ID	8.0E+5	NA
Aldicarb sulfoxide	1646873	NA	200(M); 80	200 (M); 80	NA	5.4E+7	NLV	NLV	NLV	NLV	ID	9.5E+5	NA
Aldrin	309002	NA	NLL	NLL	NLL	NLL	7.1E+6	2.0E+5	2.0E+5	2.0E+5	8.0E+5	4,300	NA
Aluminum (B)	7429905	6.9E+6	1,000	1,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	3.7E+8 (DD)	NA
Ammonia	7664417	NA	ID	ID	(CC)	ID	ID	ID	ID	ID	2.9E+9	ID	1.0E+7
t-Amyl methyl ether (TAME)	994058	NA	3,900	3,900	NA	4.4E+5 (C)	1.1E+5	4.0E+5	7.8E+5	1.8E+6	1.8E+9	4.4E+5 (C)	4.4E+5
Aniline	62533	NA	1,100	4,400	330 (M); 80	2.8E+6	NLV	NLV	NLV	NLV	2.9E+7	1.5E+6	4.5E+6

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			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number —>		#10	#11	#21	#12	#13	#22	#23	#24	#25	#26	#27	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Anthracene	120127	NA	41,000	41,000	ID	41,000	1.0E+9 (D)	1.6E+9	1.6E+9	1.6E+9	2.9E+10	7.3E+8	NA
Antimony	7440360	NA	4,300	4,300	94,000 (X)	4.9E+7	NLV	NLV	NLV	NLV	5.9E+6	6.7E+5	NA
Arsenic	7440382	5,800	4,600	4,600	4,600	2.0E+6	NLV	NLV	NLV	NLV	9.1E+5	37,000	NA
Asbestos (BB)	1332214	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.0E+7 (M); 85,000	ID	NA
Atrazine	1912249	NA	60	60	150	1.1E+5	NLV	NLV	NLV	NLV	ID	3.3E+5 (DD)	NA
Azobenzene	103333	NA	4,200	17,000	ID	3.0E+5	3.2E+7	2.1E+6	2.1E+6	2.1E+6	1.3E+8	6.6E+5	NA
Barium (B)	7440393	75,000	1.3E+6	1.3E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.5E+8	1.3E+8	NA
Benzene (I)	71432	NA	100	100	4,000 (X)	2.2E+5	8,400	45,000	99,000	2.3E+5	4.7E+8	4.0E+5 (C)	4.0E+5
Benzidine	92875	NA	1,000 (M); 6.0	1,000 (M); 6.0	1,000 (M); 6.0	1,000 (M); 140	NLV	NLV	NLV	NLV	59,000	1,000 (M); 110	NA
Benzo(a)anthracene (Q)	56553	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	80,000	NA
Benzo(b)fluoranthene (Q)	205992	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	80,000	NA
Benzo(k)fluoranthene (Q)	207089	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	8.0E+5	NA
Benzo(g,h,i)perylene	191242	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	3.5E+8	7.0E+6	NA
Benzo(a)pyrene (Q)	50328	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.9E+6	8,000	NA
Benzoic acid	65850	NA	6.4E+5	1.8E+6	NA	7.0E+7	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	NA
Benzyl alcohol	100516	NA	2.0E+5	5.8E+5	NA	5.8E+6 (C)	NLV	NLV	NLV	NLV	1.5E+11	5.8E+6 (C)	5.8E+6
Benzyl chloride	100447	NA	150	640	NA	72,000	33,000	48,000	48,000	52,000	7.8E+7	2.2E+5	2.3E+5
Beryllium	7440417	NA	51,000	51,000	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	5.9E+5	1.6E+6	NA
bis(2-Chloroethoxy)ethane	112265	NA	ID	ID	ID	ID	NLV	NLV	NLV	NLV	ID	ID	2.7E+6
bis(2-Chloroethyl)ether (I)	111444	NA	100	170	100 (M); 20	1.1E+5	44,000	13,000	13,000	13,000	1.2E+7	58,000	2.2E+6

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			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
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Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
bis(2-Ethylhexyl)phthalate	117817	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	8.9E+8	1.0E+7 (C)	1.0E+7
Boron (B)	7440428	NA	10,000	10,000	1.4E+5 (X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	3.5E+8 (DD)	NA
Bromate	15541454	NA	200	200	800 (X)	96,000	NLV	NLV	NLV	NLV	ID	91,000	NA
Bromobenzene (I)	108861	NA	550	1,500	NA	3.6E+5	5.8E+5	5.4E+5	5.4E+5	5.4E+5	2.4E+8	7.6E+5 (C)	7.6E+5
Bromodichloromethane	75274	NA	1,600 (W)	1,600 (W)	ID	2.8E+5	6,400	31,000	31,000	57,000	1.1E+8	4.9E+5	1.5E+6
Bromoform	75252	NA	1,600 (W)	1,600 (W)	ID	8.7E+5 (C)	7.7E+5	3.1E+6	3.1E+6	3.1E+6	3.6E+9	8.7E+5 (C)	8.7E+5
Bromomethane	74839	NA	200	580	700	1.4E+6	1,600	13,000	57,000	1.4E+5	1.5E+8	1.0E+6	2.2E+6
n-Butanol (I)	71363	NA	19,000	54,000	2.0E+5	8.7E+6 (C)	NLV	NLV	NLV	NLV	1.0E+10	8.7E+6 (C)	8.7E+6
2-Butanone (MEK) (I)	78933	NA	2.6E+5	7.6E+5	44,000	2.7E+7 (C)	2.7E+7 (C)	3.5E+7	3.5E+7	3.6E+7	2.9E+10	2.7E+7 (C,DD)	2.7E+7
n-Butyl acetate	123864	NA	11,000	32,000	NA	1.1E+6 (C)	1.1E+6 (C)	1.4E+8	3.1E+8	3.5E+8	2.1E+11	1.1E+6 (C)	1.1E+6
t-Butyl alcohol	75650	NA	78,000	2.2E+5	NA	1.1E+8 (C)	1.1E+8 (C)	1.2E+8	2.4E+8	2.4E+8	5.6E+10	1.1E+8 (C)	1.1E+8
Butyl benzyl phthalate	85687	NA	3.1E+5 (C)	3.1E+5 (C)	1.2E+5 (X)	3.1E+5 (C)	NLV	NLV	NLV	NLV	2.1E+10	3.1E+5 (C)	3.1E+5
n-Butylbenzene	104518	NA	1,600	4,600	ID	1.2E+5	ID	ID	ID	ID	8.8E+8	8.0E+6	1.0E+7
sec-Butylbenzene	135988	NA	1,600	4,600	ID	88,000	ID	ID	ID	ID	1.8E+8	8.0E+6	1.0E+7
t-Butylbenzene (I)	98066	NA	1,600	4,600	ID	1.8E+5	ID	ID	ID	ID	2.9E+8	8.0E+6	1.0E+7
Cadmium (B)	7440439	1,200	6,000	6,000	(G,X)	2.3E+8	NLV	NLV	NLV	NLV	2.2E+6	2.1E+6	NA
Camphene (I)	79925	NA	ID	ID	NA	ID	6,700	1.8E+5	9.1E+5	2.2E+6	2.4E+9	ID	NA
Caprolactam	105602	NA	1.2E+5	3.4E+5	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	2.9E+8	3.1E+8 (DD)	NA
Carbaryl	63252	NA	14,000	40,000	NA	2.6E+6	ID	ID	ID	ID	ID	7.0E+7	NA
Carbazole	86748	NA	9,400	39,000	1,100	8.2E+5	NLV	NLV	NLV	NLV	7.8E+7	2.4E+6	NA
Carbofuran	1563662	NA	800	800	NA	6.8E+6	NLV	NLV	NLV	NLV	ID	3.6E+6	NA

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Carbon disulfide (I,R)	75150	NA	16,000	46,000	ID	2.8E+5 (C)	1.4E+5	1.6E+6	8.0E+6	1.9E+7	2.1E+10	2.8E+5 (C,DD)	2.8E+5
Carbon tetrachloride	56235	NA	100	100	900 (X)	92,000	990	12,000	34,000	79,000	1.7E+8	3.9E+5 (C)	3.9E+5
Chlordane (J)	57749	NA	NLL	NLL	NLL	NLL	5.9E+7	4.2E+6	4.2E+6	4.2E+6	2.1E+7	1.5E+5	NA
Chloride	16887006	NA	5.0E+6	5.0E+6	(X)	ID	NLV	NLV	NLV	NLV	ID	5.0E+5 (F)	NA
Chlorobenzene (I)	108907	NA	2,000	2,000	500	2.6E+5 (C)	2.2E+5	9.2E+5	1.1E+6	2.1E+6	2.1E+9	2.6E+5 (C)	2.6E+5
p-Chlorobenzene sulfonic acid	98668	NA	1.5E+5	4.2E+5	ID	NA	ID	ID	ID	ID	ID	7.3E+8	ID
1-Chloro-1,1-difluoroethane	75683	NA	3.0E+5	8.8E+5	NA	9.6E+5 (C)	9.6E+5 (C)	9.4E+7	5.7E+8	1.4E+9	1.5E+12	9.6E+5 (C)	9.6E+5
Chloroethane	75003	NA	8,600	34,000	22,000 (X)	9.5E+5 (C)	9.5E+5 (C)	3.6E+7	1.2E+8	2.8E+8	2.9E+11	9.5E+5 (C)	9.5E+5
2-Chloroethyl vinyl ether	110758	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	1.9E+6
Chloroform	67663	NA	1,600 (W)	1,600 (W)	7,000	1.5E+6 (C)	38,000	1.5E+5	3.4E+5	7.9E+5	1.6E+9	1.5E+6 (C)	1.5E+6
Chloromethane (I)	74873	NA	5,200	22,000	ID	1.1E+6 (C)	10,000	1.2E+5	1.0E+6	2.5E+6	2.6E+9	1.1E+6 (C)	1.1E+6
4-Chloro-3-methylphenol	59507	NA	5,800	16,000	280	3.0E+6	NLV	NLV	NLV	NLV	ID	1.5E+7	NA
beta-Chloronaphthalene	91587	NA	6.2E+5	1.8E+6	NA	2.3E+6	ID	ID	ID	ID	ID	1.8E+8	NA
2-Chlorophenol	95578	NA	900	2,600	360	1.9E+6	8.0E+5	1.1E+6	1.1E+6	1.1E+6	5.3E+8	4.5E+6	1.9E+7
o-Chlorotoluene (I)	95498	NA	3,300	9,300	ID	5.0E+5 (C)	5.0E+5 (C)	1.5E+6	3.1E+6	6.4E+6	2.1E+9	5.0E+5 (C)	5.0E+5
Chlorpyrifos	2921882	NA	17,000	48,000	1,500	8.4E+5	240	5,500	23,000	56,000	5.9E+7	3.4E+7	NA
Chromium (III) (B,H)	16065831	18,000 (total)	1.0E+9 (D)	1.0E+9 (D)	(G,X)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.5E+8	1.0E+9 (D)	NA
Chromium (VI)	18540299	NA	30,000	30,000	3,300	1.4E+8	NLV	NLV	NLV	NLV	2.4E+5	9.2E+6	NA
Chrysene (Q)	218019	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	8.0E+6	NA
Cobalt	7440484	6,800	800	2,000	2,000	4.8E+7	NLV	NLV	NLV	NLV	5.9E+6	9.0E+6	NA
Copper (B)	7440508	32,000	5.8E+6	5.8E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	5.9E+7	7.3E+7	NA

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Cyanazine	21725462	NA	200	200	1,100 (X)	56,000	NLV	NLV	NLV	NLV	ID	66,000	NA
Cyanide (P,R)	57125	390 (total)	4,000	4,000	100	2.5E+5	NLV	NLV	NLV	NLV	2.5E+5	2.5E+5	NA
Cyclohexanone	108941	NA	5.2E+6	1.5E+7	NA	2.2E+8 (C)	32,000	1.3E+6	1.1E+7	2.7E+7	2.9E+10	2.2E+8 (C)	2.2E+8
Dacthal	1861321	NA	50,000	1.4E+5	NA	3.4E+5	NLV	NLV	NLV	NLV	ID	7.3E+6	NA
Dalapon	75990	NA	4,000	4,000	NA	5.9E+7 (C)	NLV	NLV	NLV	NLV	ID	5.9E+7 (C)	5.9E+7
4-4'-DDD	72548	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	5.6E+7	4.0E+5	NA
4-4'-DDE	72559	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.0E+7	1.9E+5	NA
4-4'-DDT	50293	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	4.0E+7	2.8E+5	NA
Decabromodiphenyl ether	1163195	NA	1.4E+5	1.4E+5	NA	1.4E+5	1.0E+9 (D)	1.0E+8	1.0E+8	1.0E+8	1.0E+9	1.1E+7	NA
Di-n-butyl phthalate	84742	NA	7.6E+5 (C)	7.6E+5 (C)	11,000	7.6E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.6E+5 (C)	7.6E+5
Di(2-ethylhexyl) adipate	103231	NA	9.6E+5 (C)	9.6E+5 (C)	ID	9.6E+5 (C)	NLV	NLV	NLV	NLV	1.2E+10	9.6E+5 (C,DD)	9.6E+5
Di-n-octyl phthalate	117840	NA	1.0E+8	1.4E+8 (C)	ID	1.4E+8 (C)	NLV	NLV	NLV	NLV	1.4E+10	2.0E+7	1.4E+8
Diacetone alcohol (I)	123422	NA	ID	ID	NA	ID	NLV	NLV	NLV	NLV	7.1E+10	ID	1.1E+8
Diazinon	333415	NA	95	280	72	95,000	NLV	NLV	NLV	NLV	ID	70,000 (DD)	3.1E+5
Dibenzo(a,h)anthracene (Q)	53703	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	8,000	NA
Dibenzofuran	132649	NA	ID	ID	1,700	ID	3.6E+6	1.6E+5	1.6E+5	1.6E+5	2.9E+6	ID	NA
Dibromochloromethane	124481	NA	1,600 (W)	1,600 (W)	ID	3.6E+5	21,000	80,000	80,000	98,000	1.6E+8	5.0E+5	6.1E+5
Dibromochloropropane	96128	NA	10 (M); 4.0	10 (M); 4.0	ID	1,200 (C)	1,200 (C)	900	900	900	7.0E+5	1,200 (C)	1,200
Dibromomethane	74953	NA	1,600	4,600	NA	2.0E+6 (C)	ID	ID	ID	ID	ID	2.0E+6 (C)	2.0E+6
Dicamba	1918009	NA	4,400	13,000	NA	1.2E+7	NLV	NLV	NLV	NLV	ID	1.7E+7	NA
1,2-Dichlorobenzene	95501	NA	14,000	14,000	280	2.1E+5 (C)	2.1E+5 (C)	4.6E+7	4.6E+7	5.5E+7	4.4E+10	2.1E+5 (C)	2.1E+5

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DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

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			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ——>		#10	#11	#21	#12	#13	#22	#23	#24	#25	#26	#27	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
1,3-Dichlorobenzene	541731	NA	170	480	680	51,000	48,000	94,000	94,000	1.1E+5	8.8E+7	1.7E+5 (C)	1.7E+5
1,4-Dichlorobenzene	106467	NA	1,700	1,700	360	1.4E+5	1.0E+5	2.6E+5	2.6E+5	3.4E+5	5.7E+8	1.9E+6	NA
3,3'-Dichlorobenzidine	91941	NA	2,000 (M); 28	2,000 (M); 110	2,000 (M); 7.4	4,600	NLV	NLV	NLV	NLV	8.2E+6	30,000	NA
Dichlorodifluoromethane	75718	NA	95,000	2.7E+5	ID	1.0E+6 (C)	1.7E+6	6.3E+7	5.5E+8	1.4E+9	1.5E+12	1.0E+6 (C)	1.0E+6
1,1-Dichloroethane	75343	NA	18,000	50,000	15,000	8.9E+5 (C)	4.3E+5	2.5E+6	6.0E+6	1.4E+7	1.5E+10	8.9E+5 (C)	8.9E+5
1,2-Dichloroethane (I)	107062	NA	100	100	7,200 (X)	3.8E+5	11,000	21,000	33,000	74,000	1.5E+8	4.2E+5	1.2E+6
1,1-Dichloroethylene (I)	75354	NA	140	140	2,600	2.2E+5	330	3,700	15,000	37,000	7.8E+7	5.7E+5 (C)	5.7E+5
cis-1,2-Dichloroethylene	156592	NA	1,400	1,400	12,000	6.4E+5 (C)	41,000	2.1E+5	4.3E+5	1.0E+6	1.0E+9	6.4E+5 (C)	6.4E+5
trans-1,2-Dichloroethylene	156605	NA	2,000	2,000	30,000 (X)	1.4E+6 (C)	43,000	3.3E+5	8.4E+5	2.0E+6	2.1E+9	1.4E+6 (C)	1.4E+6
2,6-Dichloro-4-nitroaniline	99309	NA	44,000	1.3E+5	NA	1.4E+5	NLV	NLV	NLV	NLV	ID	2.2E+8	NA
2,4-Dichlorophenol	120832	NA	1,500	4,200	330 (M); 220	9.6E+5	NLV	NLV	NLV	NLV	2.3E+9	1.8E+6 (C,DD)	1.8E+6
2,4-Dichlorophenoxyacetic acid	94757	NA	1,400	1,400	4,400	2.4E+6	NLV	NLV	NLV	NLV	2.9E+9	8.6E+6	NA
1,2-Dichloropropane (I)	78875	NA	100	100	4,600 (X)	3.2E+5	7,400	30,000	51,000	1.2E+5	1.2E+8	5.5E+5 (C)	5.5E+5
1,3-Dichloropropene	542756	NA	170	700	180 (X)	1.1E+5	5,400	60,000	2.0E+5	4.7E+5	5.9E+8	2.4E+5	6.2E+5
Dichlorovos	62737	NA	50 (M); 32	130	NA	1.2E+5	NLV	NLV	NLV	NLV	1.5E+7	47,000	2.2E+6
Dicyclohexyl phthalate	84617	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	NA
Dieldrin	60571	NA	NLL	NLL	NLL	NLL	7.2E+5	64,000	64,000	64,000	8.5E+5	4,700	NA
Diethyl ether	60297	NA	200	200	ID	7.4E+6 (C)	7.4E+6 (C)	1.0E+8	1.6E+8	3.5E+8	3.5E+11	7.4E+6 (C)	7.4E+6
Diethyl phthalate	84662	NA	1.1E+5	3.2E+5	2,200	7.4E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.4E+5 (C)	7.4E+5
Diethylene glycol monobutyl ether	112345	NA	1,800	5,000	NA	8.0E+7	NLV	NLV	NLV	NLV	5.9E+8	8.7E+6	1.1E+8
Diisopropyl ether	108203	NA	600	1,300 (C)	ID	1,300 (C)	1,300 (C)	3.2E+6	4.8E+6	1.0E+7	1.1E+10	1,300 (C)	1,300

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			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ⟶		#10	#11	#21	#12	#13	#22	#23	#24	#25	#26	#27	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Diisopropylamine (I)	108189	NA	110	320	NA	4.2E+5	6.7E+6 (C)	7.4E+6	7.4E+6	7.7E+6	5.9E+9	5.6E+5	6.7E+6
Dimethyl phthalate	131113	NA	7.9E+5 (C)	7.9E+5 (C)	NA	7.9E+5 (C)	NLV	NLV	NLV	NLV	1.5E+9	7.9E+5 (C)	7.9E+5
N,N-Dimethylacetamide	127195	NA	3,600	10,000	82,000 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	ID	1.8E+7	1.1E+8
N,N-Dimethylaniline	121697	NA	320	920	NA	4.0E+5	8.0E+5 (C)	5.2E+5	5.2E+5	5.2E+5	3.3E+8	8.0E+5 (C)	8.0E+5
Dimethylformamide (I)	68122	NA	14,000	40,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	8.8E+8	7.0E+7	1.1E+8
2,4-Dimethylphenol	105679	NA	7,400	20,000	7,600	1.0E+7	NLV	NLV	NLV	NLV	2.1E+9	3.6E+7	NA
2,6-Dimethylphenol	576261	NA	330 (M); 88	330 (M); 260	NA	1.3E+5	NLV	NLV	NLV	NLV	5.9E+7	4.4E+5	NA
3,4-Dimethylphenol	95658	NA	330 (M); 200	580	500	3.6E+5	NLV	NLV	NLV	NLV	1.0E+8	1.0E+6	NA
Dimethylsulfoxide	67685	NA	4.4E+6	1.3E+7	3.8E+6	1.8E+7 (C)	NLV	NLV	NLV	NLV	5.9E+8	1.8E+7 (C)	1.8E+7
2,4-Dinitrotoluene	121142	NA	430	640	NA	1.7E+5	NLV	NLV	NLV	NLV	2.0E+7	2.2E+5	NA
Dinoseb	88857	NA	300	300	200 (M); 43	1.4E+5 (C)	NLV	NLV	NLV	NLV	1.2E+8	1.4E+5 (C,DD)	1.4E+5
1,4-Dioxane (I)	123911	NA	1,700	7,000	56,000 (X)	3.4E+7	NLV	NLV	NLV	NLV	7.1E+8	2.4E+6	9.7E+7
Diquat	85007	NA	400	400	400	1.4E+7	NLV	NLV	NLV	NLV	ID	1.6E+6	NA
Diuron	330541	NA	620	1,800	NA	7.4E+5	NLV	NLV	NLV	NLV	2.1E+8	3.1E+6	NA
Endosulfan (J)	115297	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	4.4E+6	NA
Endothall	145733	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.0E+9	1.2E+7	NA
Endrin	72208	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	1.9E+5	NA
Epichlorohydrin (I)	106898	NA	100	100	NA	2.2E+5	1.2E+5	37,000	37,000	37,000	2.9E+7	41,000	7.3E+6
Ethanol (I)	64175	NA	3.8E+7	7.6E+7	ID	1.1E+8 (C)	NLV	NLV	NLV	NLV	5.6E+11	1.1E+8 (C,DD)	1.1E+8
Ethyl acetate (I)	141786	NA	1.3E+5	3.8E+5	NA	7.5E+6 (C)	7.5E+6 (C)	5.9E+7	5.9E+7	1.0E+8	9.4E+10	7.5E+6 (C)	7.5E+6
Ethyl-tert-butyl ether (ETBE)	637923	NA	980	980	ID	ID	6.5E+5 (C)	2.3E+6	4.6E+6	1.1E+7	1.1E+10	ID	6.5E+5

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Ethylbenzene (I)	100414	NA	1,500	1,500	360	1.4E+5 (C)	1.4E+5 (C)	2.4E+6	3.1E+6	6.5E+6	1.3E+10	1.4E+5 (C)	1.4E+5
Ethylene dibromide	106934	NA	20 (M); 1.0	20 (M); 1.0	110 (X)	500	3,600	5,800	5,800	9,800	1.8E+7	430	8.9E+5
Ethylene glycol	107211	NA	3.0E+5	8.4E+5	3.8E+6 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.9E+10	1.1E+8 (C)	1.1E+8
Ethylene glycol monobutyl ether	111762	NA	74,000	2.0E+5	NA	4.1E+7 (C)	1.4E+6	2.1E+7	1.5E+8	3.6E+8	3.8E+11	4.1E+7 (C)	4.1E+7
Fluoranthene	206440	NA	7.3E+5	7.3E+5	5,500	7.3E+5	1.0E+9 (D)	8.9E+8	8.8E+8	8.8E+8	4.1E+9	1.3E+8	NA
Fluorene	86737	NA	3.9E+5	8.9E+5	5,300	8.9E+5	1.0E+9 (D)	1.5E+8	1.5E+8	1.5E+8	4.1E+9	8.7E+7	NA
Fluorine (soluble fluoride) (B)	7782414	NA	40,000	40,000	ID	2.4E+8	NLV	NLV	NLV	NLV	ID	6.7E+7 (DD)	NA
Formaldehyde	50000	NA	26,000	76,000	2,400	6.0E+7 (C)	65,000	43,000	69,000	1.5E+5	2.6E+8	6.0E+7 (C)	6.0E+7
Formic acid (I,U)	64186	NA	2.0E+5	5.8E+5	ID	1.1E+8 (C)	2.8E+6	2.6E+5	1.6E+5	1.6E+5	5.9E+7	1.1E+8 (C)	1.1E+8
1-Formylpiperidine	2591868	NA	1,600	4,600	NA	ID	ID	ID	ID	ID	ID	8.0E+6	1.0E+7
Gentian violet	548629	NA	300	1,300	NA	2.0E+7	NLV	NLV	NLV	NLV	ID	4.4E+5	NA
Glyphosate	1071836	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	5.7E+7 (DD)	NA
Heptachlor	76448	NA	NLL	NLL	NLL	NLL	1.9E+6	2.1E+5	2.1E+5	2.1E+5	3.0E+6	23,000	NA
Heptachlor epoxide	1024573	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.5E+6	9,500	NA
n-Heptane	142825	NA	2.4E+5 (C)	2.4E+5 (C)	NA	2.4E+5 (C)	2.4E+5 (C)	2.5E+7	4.5E+7	1.0E+8	1.0E+11	2.4E+5 (C)	2.4E+5
Hexabromobenzene	87821	NA	5,400	5,400	ID	5,400	ID	ID	ID	ID	ID	3.1E+6	NA
Hexachlorobenzene (C-66)	118741	NA	1,800	1,800	350	8,200	2.2E+5	56,000	56,000	56,000	8.5E+6	37,000	NA
Hexachlorobutadiene (C-46)	87683	NA	26,000	72,000	91	3.5E+5 (C)	3.5E+5 (C)	4.6E+5	4.6E+5	4.6E+5	1.8E+8	3.5E+5 (C)	3.5E+5
alpha-Hexachlorocyclohexane	319846	NA	18	71	ID	2,500	1.6E+5	41,000	86,000	86,000	2.1E+6	12,000	NA
beta-Hexachlorocyclohexane	319857	NA	37	150	ID	5,100	NLV	NLV	NLV	NLV	7.4E+6	25,000	NA
Hexachlorocyclopentadiene (C-56)	77474	NA	3.2E+5	3.2E+5	ID	7.2E+5 (C)	56,000	60,000	60,000	60,000	5.9E+6	7.2E+5 (C)	7.2E+5

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Hexachloroethane	67721	NA	430	1,200	1,800 (X)	1.1E+5	79,000	6.6E+5	1.4E+6	1.4E+6	1.0E+8	7.3E+5	NA
n-Hexane	110543	NA	44,000 (C)	44,000 (C)	NA	44,000 (C)	44,000 (C)	3.5E+6	3.5E+6	6.4E+6	5.9E+9	44,000 (C)	44,000
2-Hexanone	591786	NA	20,000	58,000	ID	2.5E+6 (C)	1.8E+6	1.3E+6	1.3E+6	1.5E+6	1.2E+9	2.5E+6 (C)	2.5E+6
Indeno(1,2,3-cd)pyrene (Q)	193395	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	80,000	NA
Iron (B)	7439896	1.2E+7	6,000	6,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	5.8E+8	NA
Isobutyl alcohol (I)	78831	NA	46,000	1.3E+5	NA	8.9E+6 (C)	8.9E+6 (C)	9.5E+7	9.5E+7	9.5E+7	4.4E+10	8.9E+6 (C)	8.9E+6
Isophorone	78591	NA	15,000	62,000	26,000 (X)	2.4E+6 (C)	NLV	NLV	NLV	NLV	8.2E+9	2.4E+6 (C)	2.4E+6
Isopropyl alcohol (I)	67630	NA	9,400	26,000	1.1E+6 (X)	1.1E+8 (C)	NLV	NLV	NLV	NLV	6.5E+9	4.7E+7	1.1E+8
Isopropyl benzene	98828	NA	91,000	2.6E+5	3,200	3.9E+5 (C)	3.9E+5 (C)	2.0E+6	2.0E+6	3.0E+6	2.6E+9	3.9E+5 (C)	3.9E+5
Lead (B)	7439921	21,000	7.0E+5	7.0E+5	(G,X)	ID	NLV	NLV	NLV	NLV	4.4E+7	9.0E+5 (DD)	NA
Lindane	58899	NA	20 (M); 7.0	20 (M); 7.0	20 (M); 1.1	7,100	ID	ID	ID	ID	ID	42,000	NA
Lithium (B)	7439932	9,800	3,400	7,000	8,800	1.1E+8	NLV	NLV	NLV	NLV	1.0E+9	3.1E+7 (DD)	NA
Magnesium (B)	7439954	NA	8.0E+6	2.2E+7	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	2.9E+9	1.0E+9 (D)	NA
Manganese (B)	7439965	4.4E+5	1,000	1,000	(G,X)	1.8E+8	NLV	NLV	NLV	NLV	1.5E+6	9.0E+7	NA
Mercury (Total) (B,Z)	Varies	130	1,700	1,700	50 (M); 1.2	47,000	89,000	62,000	62,000	62,000	8.8E+6	5.8E+5	NA
Methane	74828	NA	ID	ID	NA	ID	8.4E+6 ug/m3 (GG)	ID	ID	ID	ID	ID	ID
Methanol	67561	NA	74,000	2.0E+5	3.1E+6 (C)	3.1E+6 (C)	3.1E+6 (C)	3.7E+7	4.6E+7	9.7E+7	9.6E+10	3.1E+6 (C)	3.1E+6
Methoxychlor	72435	NA	16,000	16,000	NA	18,000	ID	ID	ID	ID	ID	5.6E+6	NA
2-Methoxyethanol (I)	109864	NA	150	420	NA	1.7E+7	NLV	NLV	NLV	NLV	5.9E+8	7.3E+5	1.1E+8
2-Methyl-4-chlorophenoxyacetic acid	94746	NA	390	1,100	NA	4.9E+5	NLV	NLV	NLV	NLV	ID	7.3E+5	NA
2-Methyl-4,6-dinitrophenol	534521	NA	830 (M); 400	830 (M); 400	NA	1.9E+5	NLV	NLV	NLV	NLV	5.9E+7	2.6E+5	NA

TABLE 3. SOIL: NONRESIDENTIAL
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS; PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to one microgram per kilogram (ug/kg). Criteria with six or more digits are expressed in scientific notation. For example, 200,000 is presented as 2.0E+5. The lowest generic soil criterion for a given hazardous substance is presented in a bold box. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (R 299.5707). In these cases, two numbers are present in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based value. Criteria were originally promulgated December 21, 2002 within the Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This table reflects revisions to the criteria pursuant to the December 2010 Part 201 amendments and new criteria consistent with the provisions of R299.5706a. The effective dates of the criteria and screening levels in this table vary. Please contact the Remediation Division Toxicology Unit for additional information.

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number —>		#10	#11	#21	#12	#13	#22	#23	#24	#25	#26	#27	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
N-Methyl-morpholine (I)	109024	NA	400	1,100	NA	3.0E+7	NLV	NLV	NLV	NLV	ID	2.0E+6	1.1E+8
Methyl parathion	298000	NA	46	130	NA	76,000	NLV	NLV	NLV	NLV	ID	1.8E+5	NA
4-Methyl-2-pentanone (MIBK) (I)	108101	NA	36,000	1.0E+5	ID	2.7E+6 (C)	2.7E+6 (C)	5.3E+7	5.3E+7	7.0E+7	6.0E+10	2.7E+6 (C)	2.7E+6
Methyl-tert-butyl ether (MTBE)	1634044	NA	800	800	1.4E+5 (X)	5.9E+6 (C)	5.9E+6 (C)	3.0E+7	4.1E+7	8.9E+7	8.8E+10	5.9E+6 (C)	5.9E+6
Methylcyclopentane (I)	96377	NA	ID	ID	NA	ID	1.7E+5	2.8E+6	8.3E+6	2.0E+7	2.1E+10	ID	3.5E+5
4,4'-Methylene-bis-2- chloroaniline (MBOCA)	101144	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	1.1E+8	32,000	NA
Methylene chloride	75092	NA	100	100	30,000 (X)	2.3E+6 (C)	2.4E+5	7.0E+5	1.7E+6	4.0E+6	8.3E+9	2.3E+6 (C)	2.3E+6
2-Methylnaphthalene	91576	NA	57,000	1.7E+5	4,200	5.5E+6	4.9E+6	1.8E+6	1.8E+6	1.8E+6	2.9E+8	2.6E+7	NA
Methylphenols (J)	1319773	NA	7,400	20,000	1,000 (M); 600	1.6E+7	NLV	NLV	NLV	NLV	2.9E+9	3.6E+7	NA
Metolachlor	51218452	NA	4,800	20,000	300	4.4E+5 (C)	NLV	NLV	NLV	NLV	ID	4.4E+5 (C,DD)	4.4E+5
Metribuzin	21087649	NA	3,600	10,000	NA	2.4E+7	ID	ID	ID	ID	ID	2.8E+7	NA
Mirex	2385855	NA	NLL	NLL	NLL	NLL	ID	ID	ID	ID	ID	40,000	NA
Molybdenum (B)	7439987	NA	1,500	4,200	64,000 (X)	1.9E+7	NLV	NLV	NLV	NLV	ID	9.6E+6	NA
Naphthalene	91203	NA	35,000	1.0E+5	730	2.1E+6	4.7E+5	3.5E+5	3.5E+5	3.5E+5	8.8E+7	5.2E+7	NA
Nickel (B)	7440020	20,000	1.0E+5	1.0E+5	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	1.6E+7	1.5E+8	NA
Nitrate (B,N)	14797558	NA	2.0E+5 (N)	2.0E+5 (N)	ID	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	ID	NA
Nitrite (B,N)	14797650	NA	20,000 (N)	20,000 (N)	NA	3.8E+8	NLV	NLV	NLV	NLV	ID	ID	NA
Nitrobenzene (I)	98953	NA	330 (M); 68	330 (M); 190	3,600 (X)	2.2E+5	1.7E+5	64,000	64,000	64,000	2.1E+7	3.4E+5	4.9E+5
2-Nitrophenol	88755	NA	400	1,200	ID	1.6E+6	NLV	NLV	NLV	NLV	ID	2.0E+6	NA
n-Nitroso-di-n-propylamine	621647	NA	330 (M); 100	330 (M); 100	NA	7,200	NLV	NLV	NLV	NLV	2.0E+6	5,400	1.5E+6
N-Nitrosodiphenylamine	86306	NA	5,400	22,000	NA	7.0E+5	NLV	NLV	NLV	NLV	2.8E+9	7.8E+6	NA

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			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ⟶		#10	#11	#21	#12	#13	#22	#23	#24	#25	#26	#27	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Oxamyl	23135220	NA	4,000	4,000	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	2.8E+7	NA
Oxo-hexyl acetate	88230357	NA	1,500	4,200	NA	ID	ID	ID	ID	ID	2.4E+9	7.3E+6	1.0E+7
Pendimethalin	40487421	NA	1.1E+6	1.1E+6	NA	1.1E+6	NLV	NLV	NLV	NLV	ID	1.3E+8	NA
Pentachlorobenzene	608935	NA	29,000	81,000	9,500	1.9E+5 (C)	ID	ID	ID	ID	ID	1.9E+5 (C)	1.9E+5
Pentachloronitrobenzene	82688	NA	37,000	37,000	NA	37,000	2.2E+5	2.8E+5	2.8E+5	2.8E+5	1.5E+8	5.5E+6	NA
Pentachlorophenol	87865	NA	22	22	(G,X)	4,300	NLV	NLV	NLV	NLV	1.3E+8	3.2E+5	NA
Pentane	109660	NA	ID	ID	NA	ID	1.8E+5	4.4E+7	3.4E+8	6.0E+8	5.3E+11	ID	2.4E+5
2-Pentene (I)	109682	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	2.2E+5
Phenanthrene	85018	NA	56,000	1.6E+5	2,100	1.1E+6	5.1E+6	1.9E+5	1.9E+5	1.9E+5	2.9E+6	5.2E+6	NA
Phenol	108952	NA	88,000	2.6E+5	9,000	1.2E+7 (C)	NLV	NLV	NLV	NLV	1.8E+10	1.2E+7 (C,DD)	1.2E+7
Phenytoin	57410	NA	830	3300	4300 (X)	6.8E+5	NLV	NLV	NLV	NLV	2.8E+8	4.8E+5	NA
Phosphorus (Total)	7723140	NA	1.3E+6	4.8E+6	(EE)	ID	NLV	NLV	NLV	NLV	2.9E+7	1.0E+9 (D)	NA
Phthalic acid	88993	NA	2.8E+5	8.0E+5	NA	1.7E+6 (C)	NLV	NLV	NLV	NLV	ID	1.7E+6 (C)	1.7E+6
Phthalic anhydride	85449	NA	3.0E+5	8.8E+5	NA	1.1E+6 (C)	NLV	NLV	NLV	NLV	ID	1.1E+6 (C)	1.1E+6
Picloram	1918021	NA	10,000	10,000	920	8.6E+6	NLV	NLV	NLV	NLV	ID	5.1E+7	NA
Piperidine	110894	NA	64	180	NA	6.8E+5	NLV	NLV	NLV	NLV	4.1E+9	3.2E+5	1.2E+8
Polybrominated biphenyls (J)	67774327	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	ID	4,800	NA
Polychlorinated biphenyls (PCBs) (J,T)	1336363	NA	NLL	NLL	NLL	NLL	1.6E+7	8.1E+5	2.8E+7	2.8E+7	6.5E+6	(T)	NA
Prometon	1610180	NA	4,900	14,000	NA	5.5E+6	NLV	NLV	NLV	NLV	ID	1.6E+7	NA
Propachlor	1918167	NA	1,900	5,400	NA	8.8E+6	NLV	NLV	NLV	NLV	ID	9.5E+6	NA
Propazine	139402	NA	4,000	11,000	NA	1.7E+5	NLV	NLV	NLV	NLV	ID	2.0E+7	NA

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DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

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			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ——>		#10	#11	#21	#12	#13	#22	#23	#24	#25	#26	#27	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Propionic acid	79094	NA	2.4E+5	7.0E+5	ID	1.1E+8 (C)	NLV	NLV	NLV	NLV	8.8E+9	1.1E+8 (C)	1.1E+8
Propyl alcohol (I)	71238	NA	28,000	80,000	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	2.1E+10	7.4E+7 (DD)	1.1E+8
n-Propylbenzene (I)	103651	NA	1,600	4,600	ID	3.0E+5	ID	ID	ID	ID	5.9E+8	8.0E+6	1.0E+7
Propylene glycol	57556	NA	3.0E+6	8.4E+6	5.8E+6	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.8E+11	1.1E+8 (C)	1.1E+8
Pyrene	129000	NA	4.8E+5	4.8E+5	ID	4.8E+5	1.0E+9 (D)	7.8E+8	7.8E+8	7.8E+8	2.9E+9	8.4E+7	NA
Pyridine (I)	110861	NA	400	420	NA	37,000 (C)	2,000	9,800	40,000	97,000	1.0E+8	37,000 (C)	37,000
Selenium (B)	7782492	410	4,000	4,000	400	7.8E+7	NLV	NLV	NLV	NLV	5.9E+7	9.6E+6	NA
Silver (B)	7440224	1,000	4,500	13,000	100 (M); 27	2.0E+8	NLV	NLV	NLV	NLV	2.9E+6	9.0E+6	NA
Silvex (2,4,5-TP)	93721	NA	3,600	3,600	2,200	3.1E+6	NLV	NLV	NLV	NLV	ID	5.5E+6	NA
Simazine	122349	NA	80	80	340	90,000	NLV	NLV	NLV	NLV	ID	3.8E+6	NA
Sodium	17341252	NA	2.5E+6	7.0E+6	NA	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	NA
Sodium azide	26628228	NA	1,800	5,000	1,000	ID	ID	ID	ID	ID	ID	8.7E+6	NA
Strontium (B)	7440246	NA	92,000	2.6E+5	4.2E+5	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	1.0E+9 (D)	NA
Styrene	100425	NA	2,700	2,700	2,100 (X)	2.7E+5	5.2E+5 (C)	3.3E+6	3.3E+6	4.2E+6	6.9E+9	5.2E+5 (C)	5.2E+5
Sulfate	14808798	NA	5.0E+6	5.0E+6	NA	ID	NLV	NLV	NLV	NLV	ID	ID	NA
Tebuthiuron	34014181	NA	10,000	30,000	NA	5.0E+7	NLV	NLV	NLV	NLV	ID	2.7E+7 (DD)	NA
2,3,7,8-Tetrabromodibenzo-p-dioxin (O)	50585416	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	(O)	(O)	NA
1,2,4,5-Tetrachlorobenzene	95943	NA	1.5E+6	1.5E+6	3,400 (X)	1.5E+6	1.1E+6	2.7E+5	2.7E+5	2.7E+5	2.9E+7	2.5E+8	NA
2,3,7,8-Tetrachlorodibenzo-p-dioxin (O)	1746016	NA	NLL	NLL	NLL	NLL	NLV	NLV	NLV	NLV	59 (O)	0.99 (O)	NA
1,1,1,2-Tetrachloroethane	630206	NA	1,500	6,400	ID	4.4E+5 (C)	33,000	1.2E+5	2.1E+5	3.3E+5	5.3E+8	4.4E+5 (C)	4.4E+5
1,1,2,2-Tetrachloroethane	79345	NA	170	700	1,600 (X)	94,000	23,000	34,000	34,000	34,000	6.8E+7	2.4E+5	8.7E+5

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Tetrachloroethylene	127184	NA	100	100	1,200 (X)	88,000 (C)	21,000	2.1E+5	4.9E+5	1.1E+6	1.2E+9	88,000 (C)	88,000
Tetrahydrofuran	109999	NA	1,900	5,400	2.2E+5 (X)	3.2E+7	2.4E+6	1.5E+7	6.7E+7	1.6E+8	1.7E+11	9.5E+6	1.2E+8
Tetranitromethane	509148	NA	ID	ID	NA	ID	600	500 (M); 180	ID	ID	2.6E+5	ID	ID
Thallium (B)	7440280	NA	2,300	2,300	4,200 (X)	1.5E+7	NLV	NLV	NLV	NLV	5.9E+6	1.3E+5	NA
Toluene (I)	108883	NA	16,000	16,000	5,400	2.5E+5 (C)	2.5E+5 (C)	3.3E+6	3.6E+7	3.6E+7	1.2E+10	2.5E+5 (C)	2.5E+5
p-Toluidine	106490	NA	660 (M); 300	1,200	NA	4.8E+5	NLV	NLV	NLV	NLV	1.3E+8	4.3E+5	1.2E+6
Toxaphene	8001352	NA	24,000	24,000	8,200	3.6E+5	NLV	NLV	NLV	NLV	1.2E+7	85,000	NA
Triallate	2303175	NA	95,000	2.5E+5 (C)	NA	2.5E+5 (C)	ID	ID	ID	ID	ID	2.5E+5 (C)	2.5E+5
Tributylamine	102829	NA	7,800	23,000	ID	1.8E+6	1.1E+6	7.2E+5	7.2E+5	7.2E+5	2.1E+8	2.6E+6	3.7E+6
1,2,4-Trichlorobenzene	120821	NA	4,200	4,200	5,900 (X)	1.1E+6 (C)	1.1E+6 (C)	3.4E+7	3.4E+7	3.4E+7	1.1E+10	1.1E+6 (C,DD)	1.1E+6
1,1,1-Trichloroethane	71556	NA	4,000	4,000	1,800	4.6E+5 (C)	4.6E+5	4.5E+6	1.5E+7	3.1E+7	2.9E+10	4.6E+5 (C)	4.6E+5
1,1,2-Trichloroethane	79005	NA	100	100	6,600 (X)	4.2E+5	24,000	57,000	57,000	1.2E+5	2.5E+8	8.4E+5	9.2E+5
Trichloroethylene	79016	NA	100	100	4,000 (X)	4.4E+5	1,900	14,000	25,000	58,000	5.9E+7	5.0E+5 (C,DD)	5.0E+5
Trichlorofluoromethane	75694	NA	52,000	1.5E+5	NA	5.6E+5 (C)	5.6E+5 (C)	1.1E+8	1.4E+11	1.4E+11	1.7E+12	5.6E+5 (C)	5.6E+5
2,4,5-Trichlorophenol	95954	NA	39,000	1.1E+5	NA	9.1E+6	NLV	NLV	NLV	NLV	1.0E+10	7.3E+7	NA
2,4,6-Trichlorophenol	88062	NA	2,400	9,400	330 (M); 100	2.0E+5	NLV	NLV	NLV	NLV	1.3E+9	3.3E+6	NA
1,2,3-Trichloropropane	96184	NA	840	2,400	NA	8.3E+5 (C)	7,500	11,000	11,000	12,000	8.8E+6	8.3E+5 (C)	8.3E+5
1,1,2-Trichloro-1,2,2-trifluoroethane	76131	NA	5.5E+5 (C)	5.5E+5 (C)	1,700	5.5E+5 (C)	5.5E+5 (C)	2.1E+8	8.9E+8	2.1E+9	2.3E+12	5.5E+5 (C)	5.5E+5
Triethanolamine	102716	NA	74,000	2.0E+5	NA	1.1E+8 (C)	NLV	NLV	NLV	NLV	1.5E+9	1.1E+8 (C)	1.1E+8
Triethylene glycol	112276	NA	1.1E+5 (C)	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C,DD)	1.1E+5
3-Trifluoromethyl-4-nitrophenol	88302	NA	1.1E+5	3.1E+5	NA	1.2E+8	NLV	NLV	NLV	NLV	ID	2.4E+8 (DD)	NA

Attachment 1
TABLE 3. SOIL: NONRESIDENTIAL
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

All criteria, unless otherwise noted, are expressed in units of parts per billion (ppb). One ppb is equivalent to one microgram per kilogram (ug/kg). Criteria with six or more digits are expressed in scientific notation. For example, 200,000 is presented as 2.0E+5. The lowest generic soil criterion for a given hazardous substance is presented in a bold box. A footnote is designated by a letter in parentheses and is explained in the footnote pages that follow the criteria tables. When the risk-based criterion is less than the target detection limit (TDL), the TDL is listed as the criterion (R 299.5707). In these cases, two numbers are present in the cell. The first number is the criterion (i.e., TDL), and the second number is the risk-based value. Criteria were originally promulgated December 21, 2002 within the Administrative Rules for Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This table reflects revisions to the criteria pursuant to the December 2010 Part 201 amendments and new criteria consistent with the provisions of R299.5706a. The effective dates of the criteria and screening levels in this table vary. Please contact the Remediation Division Toxicology Unit for additional information.

			Groundwater Protection				Indoor Air	Ambient Air (Y)				Direct Contact	
Guidesheet Number ——>		#10	#11	#21	#12	#13	#22	#23	#24	#25	#26	#27	#20
Hazardous Substance	Chemical Abstract Service Number	Statewide Default Background Levels	Residential Drinking Water Protection Criteria & RBSLs	Non-Residential Drinking Water Protection Criteria & RBSLs	Groundwater Surface Water Interface Protection Criteria & RBSLs	Groundwater Contact Protection Criteria & RBSLs	Soil Volatilization to Indoor Air Inhalation Criteria & RBSLs	Infinite Source Volatile Soil Inhalation Criteria (VSIC) & RBSLs	Finite VSIC for 5 Meter Source Thickness	Finite VSIC for 2 Meter Source Thickness	Particulate Soil Inhalation Criteria & RBSLs	Direct Contact Criteria & RBSLs	Soil Saturation Concentration Screening Levels
Trifluralin	1582098	NA	1.9E+5	5.7E+5	NA	1.2E+7	ID	ID	ID	ID	ID	5.7E+6	NA
2,2,4-Trimethyl pentane	540841	NA	ID	ID	NA	ID	19,000 (C)	6.3E+6	4.0E+7	9.6E+7	1.0E+11	ID	19,000
2,4,4-Trimethyl-2-pentene (I)	107404	NA	ID	ID	NA	ID	ID	ID	ID	ID	ID	ID	56,000
1,2,4-Trimethylbenzene (I)	95636	NA	2,100	2,100	570	1.1E+5 (C)	1.1E+5 (C)	2.5E+7	6.0E+8	6.0E+8	3.6E+10	1.1E+5 (C)	1.1E+5
1,3,5-Trimethylbenzene (I)	108678	NA	1,800	1,800	1,100	94,000 (C)	94,000 (C)	1.9E+7	4.6E+8	4.6E+8	3.6E+10	94,000 (C)	94,000
Triphenyl phosphate	115866	NA	1.1E+5 (C)	1.1E+5 (C)	NA	1.1E+5 (C)	NLV	NLV	NLV	NLV	ID	1.1E+5 (C)	1.1E+5
tris(2,3-Dibromopropyl)phosphate	126727	NA	930	930	ID	27,000 (C)	27,000 (C)	60,000	60,000	60,000	7.4E+6	20,000	27,000
Urea	57136	NA	ID	ID	NA	ID	NLV	NLV	NLV	NLV	ID	ID	NA
Vanadium	7440622	NA	72,000	9.9E+5	4.3E+5	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	5.5E+6 (DD)	NA
Vinyl acetate (I)	108054	NA	13,000	36,000	NA	2.4E+6 (C)	1.5E+6	2.0E+6	2.7E+6	5.9E+6	5.9E+9	2.4E+6 (C,DD)	2.4E+6
Vinyl chloride	75014	NA	40	40	260 (X)	20,000	2,800	29,000	1.7E+5	4.2E+5	8.9E+8	34,000	4.9E+5
White phosphorus (R)	12185103	NA	2.2	6.0	NA	58,000	NLV	NLV	NLV	NLV	ID	17,000 (DD)	NA
Xylenes (I)	1330207	NA	5,600	5,600	820	1.5E+5 (C)	1.5E+5 (C)	5.4E+7	6.5E+7	1.3E+8	1.3E+11	1.5E+5 (C)	1.5E+5
Zinc (B)	7440666	47,000	2.4E+6	5.0E+6	(G)	1.0E+9 (D)	NLV	NLV	NLV	NLV	ID	6.3E+8	NA

Attachment 1
TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

Developed pursuant to R 299.5752 of the Administrative Rules for Part 201 Environmental Remediation of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Scientific notation is represented by E+ or E- a value, for example 200,000 is presented as 2.0E+5. Units are as indicated in each column heading. The dataset for each hazardous substance requires 22 columns. Review all 22 columns across 2 pages when evaluating data for a specific hazardous substance.

Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Acenaphthene	83329	1.8E-1	NA	2.1E+2	NA	NA	0.2	1.0	0.1	1.0	3.92	7,140
Acenaphthylene	208968	7.1E-3	NA	3.5E+1	NA	NA	0.2	1.0	0.1	1.0	3.6	3,460
Acetaldehyde (I)	75070	1.3E-1	NA	9.0E+0	2.2E-6	4.5E+4	0.2	1.0	0.1	1.0	-0.367	0.613
Acetate	71501	5.7E-1	NA	NA	NA	NA	0.2	NA	NA	NA	NA	NA
Acetic acid	64197	5.7E-1	NA	2.5E+2	NA	3.7E+4	0.2	1.0	0.1	1.0	-0.23	0.595
Acetone (I)	67641	1.0E-1	NA	5.9E+3	NA	1.7E+6	0.2	1.0	0.1	1.0	-0.240	0.581
Acetonitrile	75058	1.9E-2	NA	6.0E+1	NA	1.01E+5	0.2	1.0	0.1	1.0	-0.337	0.648
Acetophenone	98862	2.1E-1	NA	4.9E+2	NA	NA	0.2	1.0	0.1	1.0	1.6	37.4
Acrolein (I)	107028	1.6E-2	NA	2.0E-2	NA	6.9E+2	0.2	1.0	0.1	1.0	-0.01	1.18
Acrylamide	79061	2.0E-4	2.8E+0	6	1.3E-3	NA	0.2	1.0	0.1	1.0	-0.96	0.114
Acrylic acid	79107	5.3E-1	NA	1.0E+0	NA	NA	0.2	1.0	0.1	1.0	0.35	2.21
Acrylonitrile (I)	107131	NA	3.3E-1	2.0E+0	6.8E-5	NA	0.2	1.0	0.1	1.0	0.255	1.78
Alachlor	15972608	1.0E-2	9.6E-2	NA	NA	NA	0.2	0.5	0.1	1.0	3.52	734
Aldicarb	116063	1.0E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.1	12.1
Aldicarb sulfone	1646884	1.1E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-0.57	0.275
Aldicarb sulfoxide	1646873	1.3E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-0.67	0.22
Aldrin	309002	2.5E-5	8.7E+0	NA	4.9E-3	NA	0.2	0.5	0.1	1.0	6.5	2.45E+6
Aluminum (B)	7429905	3.3E-1	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Ammonia	7664417	NA	NA	1.0E+2	NA	2.4E+4	0.2	1.0	0.1	1.0	NA	NA
t-Amyl methyl ether (TAME)	994058	1.3E-1	NA	6.2E+1	NA	NA	0.2	1.0	0.1	1.0	1.73	28.1
Aniline	62533	NA	1.6E-2	1.0E+0	1.6E-6	NA	0.2	1.0	0.1	1.0	0.978	9.15

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PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
Acenaphthene	83329	NR	NR	1.55E-4	0.0421	7.69E-6	NA	NA	4,240	Solid	154.2
Acenaphthylene	208968	NR	NR	1.48E-3	0.08	8.0E-6	NA	NA	3,930	Solid	152.271
Acetaldehyde (I)	75070	NR	NR	7.95E-5	0.08	8.0E-6	0.04	-36	1.0E+9	Liquid	44.1
Acetate	71501	NA	NA	NA	NA	NA	NA	NA	ID	NA	NA
Acetic acid	64197	NR	NR	1.00E-7	0.08	8.0E-6	0.04	103	6.0E+9	Liquid	60.05
Acetone (I)	67641	NR	NR	3.88E-5	0.124	1.14E-5	0.025	0.0	1.0E+9	Liquid	58.08
Acetonitrile	75058	NR	NR	2.40E-5	0.13	1.7E-5	0.03	42	2.00E+8	Liquid	41.05
Acetophenone	98862	NR	NR	1.1E-5	0.08	8.0E-6	NA	NA	6.1E+6	Liquid	120.2
Acrolein (I)	107028	NR	NR	9.40E-5	0.11	1.2E-5	0.028	-15	2.10E+8	Liquid	56.06
Acrylamide	79061	NR	NR	3.22E-10	0.097	1.1E-4	NA	280	2.20E+9	Solid	71.08
Acrylic acid	79107	NR	NR	3.20E-7	0.08	8.0E-6	0.024	121	1.0E+9	Liquid	72.06
Acrylonitrile (I)	107131	NR	NR	1.00E-4	0.12	1.3E-5	0.03	30	7.50E+7	Liquid	53.06
Alachlor	15972608	NR	NR	8.32E-9	0.08	8.0E-6	NA	NA	1.83E+5	Solid	269.77
Aldicarb	116063	NR	NR	4.17E-9	0.08	8.0E-6	NA	NA	6.00E+6	Solid	190.25
Aldicarb sulfone	1646884	NR	NR	3.37E-9	0.08	8.0E-6	NA	NA	7.80E+6	Solid	222.27
Aldicarb sulfoxide	1646873	NR	NR	9.69E-10	0.08	8.0E-6	NA	NA	2.80E+7	Solid	206.27
Aldrin	309002	NR	NR	1.70E-4	0.0132	4.86E-6	NA	NA	180	Solid	364.9
Aluminum (B)	7429905	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	26.982
Ammonia	7664417	NR	NR	3.20E-4	0.08	8.0E-6	0.15	NA	5.30E+8	Liquid	17.04
t-Amyl methyl ether (TAME)	994058	NR	NR	2.68E-3	0.08	8.0E-6	NA	NA	2.64E+6	Liquid	102.18
Aniline	62533	NR	NR	2.30E-6	0.07	8.3E-6	0.013	158	3.60E+7	Liquid	93.13

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PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	(mg/Kg-day)$^{-1}$	ug/m^3	(ug/m^3)$^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Anthracene	120127	1.0E+0	NA	1.0E+3	NA	NA	0.2	1.0	0.1	1.0	4.55	29,700
Antimony	7440360	3.5E-4	NA	2.0E-1	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Arsenic	7440382	2.7E-4	1.5E+0	NA	4.3E-3	NA	0.2	0.5	0.03	1.0	NR	NR
Asbestos (BB)	1332214	NA	NA	NA	4.6E-2	NA	1.0	1.0	0	1.0	NR	NR
Atrazine	1912249	3.5E-2	7.4E-2	NA	NA	NA	0.2	1.0	0.1	1.0	2.7	451
Azobenzene	103333	NA	3.7E-2	NA	3.1E-5	NA	0.2	1.0	0.1	1.0	3.82	5,690
Barium (B)	7440393	7.0E-2	NA	5.0E+0	NA	NA	1.0	0.5	0.01	1.0	NR	NR
Benzene (I)	71432	NA	2.9E-2	30	8.3E-6	8.0E+3	0.2	1.0	0.1	1.0	2.13	58.2
Benzidine	92875	2.7E-3	2.3E+2	NA	6.7E-2	NA	0.2	1.0	0.1	1.0	1.66	42.9
Benzo(a)anthracene (Q)	56553	NA	4.1E-1	NA	NA	NA	0.2	0.5	0.13	1.0	5.7	4.01E+5
Benzo(b)fluoranthene (Q)	205992	NA	4.1E-1	NA	NA	NA	0.2	0.5	0.13	1.0	6.2	1.24E+6
Benzo(k)fluoranthene (Q)	207089	NA	4.1E-2	NA	NA	NA	0.2	0.5	0.13	1.0	6.2	1.24E+6
Benzo(g,h,i)perylene	191242	7.1E-3	NA	1.2E+1	NA	NA	0.2	0.5	0.13	1.0	6.7	3.86E+6
Benzo(a)pyrene (Q)	50328	NA	4.1E+0	NA	2.1E-3	NA	0.2	0.5	0.13	1.0	6.11	1.01E+6
Benzoic acid	65850	4.4E+0	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.86	0.6
Benzyl alcohol	100516	1.4E+0	NA	5.0E+3	NA	NA	0.2	1.0	0.1	1.0	1.11	12.3
Benzyl chloride	100447	NA	1.1E-1	NA	5.0E-5	NA	0.2	1.0	0.1	1.0	2.30	182
Beryllium	7440417	1.5E-3	NA	2.0E-2	2.4E-3	1.0E+1	0.2	1.0	0	1.0	NR	NR
bis(2-Chloroethoxy)ethane	112265	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.28	18.1
bis(2-Chloroethyl)ether (I)	111444	NA	4.2E-1	NA	3.3E-4	5.8E+4	0.2	1.0	0.1	1.0	1.21	10.9
bis(2-Ethylhexyl)phthalate	117817	1.9E-2	3.2E-3	NA	4.43E-6	1.0E+4	0.2	0.5	0.1	1.0	7.3	1.50E+7

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at $25^{o}C$ (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
Anthracene	120127	NR	NR	6.50E-5	0.0324	7.74E-6	NA	NA	43.4	Solid	178.24
Antimony	7440360	NR	45	NR	NR	NR	NA	NA	NA	Inorganic	121.760
Arsenic	7440382	NR	29	NR	NR	NR	NA	NA	NA	Inorganic	74.922
Asbestos (BB)	1332214	NR	NA	NR	NR	NR	NR	NR	NA	Inorganic	NA
Atrazine	1912249	NR	NR	2.63E-9	0.08	8.0E-6	NA	NA	70,000	Solid	215.72
Azobenzene	103333	NR	NR	1.35E-5	0.08	8.0E-6	NA	NA	6,400	Solid	182.23
Barium (B)	7440393	NR	41	NR	NR	NR	NA	NA	NA	Inorganic	137.327
Benzene (I)	71432	NR	NR	5.55E-3	0.088	9.8E-6	0.012	12	1.75E+6	Liquid	78.11
Benzidine	92875	NR	NR	3.90E-11	0.08	1.5E-5	NA	NA	5.20E+5	Solid	184.24
Benzo(a)anthracene (Q)	56553	NR	NR	3.35E-6	0.051	9.0E-6	NA	NA	9.4	Solid	228.3
Benzo(b)fluoranthene (Q)	205992	NR	NR	1.11E-4	0.0226	5.56E-6	NA	NA	1.5	Solid	252.32
Benzo(k)fluoranthene (Q)	207089	NR	NR	8.29E-7	0.0226	5.56E-6	NA	NA	0.8	Solid	252.32
Benzo(g,h,i)perylene	191242	NR	NR	5.34E-8	0.08	8.0E-6	NA	NA	0.26	Solid	276.34
Benzo(a)pyrene (Q)	50328	NR	NR	1.13E-6	0.043	9.0E-6	NA	NA	1.62	Solid	252.32
Benzoic acid	65850	0.6	NR	1.54E-6	0.0536	7.97E-6	NA	NA	3.50E+6	Solid	122.1
Benzyl alcohol	100516	NR	NR	3.90E-7	0.08	8.0E-6	NA	NA	4.40E+7	Liquid	108.13
Benzyl chloride	100447	NR	NR	4.00E-4	0.075	7.8E-6	0.011	153	4.90E+5	Liquid	126.58
Beryllium	7440417	NR	790	NR	NR	NR	NA	NA	NA	Inorganic	9.012
bis(2-Chloroethoxy)ethane	112265	NR	NR	7.81E-7	0.08	8.0E-6	NA	NA	1.89E+7	Liquid	187.07
bis(2-Chloroethyl)ether (I)	111444	NR	NR	1.80E-5	0.0692	7.53E-6	0.027	131	1.72E+7	Liquid	143.01
bis(2-Ethylhexyl)phthalate	117817	NR	NR	1.02E-7	0.0351	3.66E-6	NA	420	340	Liquid	390.57

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TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

Developed pursuant to R 299.5752 of the Administrative Rules for Part 201 Environmental Remediation of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Scientific notation is represented by E+ or E- a value, for example 200,000 is presented as 2.0E+5. Units are as indicated in each column heading. The dataset for each hazardous substance requires 22 columns. Review all 22 columns across 2 pages when evaluating data for a specific hazardous substance.

Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Boron (B)	7440428	3.2E-1	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Bromate	15541454	4.0E-3	7.0E-1	NA	NA	NA	0.2	0.5	0.01	1.0	0.63	NR
Bromobenzene (I)	108861	2.4E-3	NA	8.0E+0	NA	NA	0.2	1.0	0.1	1.0	2.99	870
Bromodichloromethane	75274	1.8E-2	5.0E-2	NA	3.7E-5	NA	0.2	1.0	0.1	1.0	2.1	55.1
Bromoform	75252	1.8E-2	6.4E-3	NA	1.1E-6	NA	0.2	1.0	0.1	1.0	2.35	87.0
Bromomethane	74839	1.4E-3	NA	5.0E+0	NA	NA	0.2	1.0	0.1	1.0	1.18	14.5
n-Butanol (I)	71363	1.3E-1	NA	3.5E+2	NA	1.52E+5	0.2	1.0	0.1	1.0	0.851	5.65
2-Butanone (MEK) (I)	78933	1.8E+0	NA	1.0E+3	NA	8.85E+5	0.2	1.0	0.1	1.0	0.279	1.99
n-Butyl acetate	123864	7.6E-2	NA	7.1E+3	NA	9.5E+5	0.2	1.0	0.1	1.0	1.78	30.8
t-Butyl alcohol	75650	5.4E-1	NA	1.89E+3	NA	NA	0.2	1.0	0.1	1.0	0.35	2.27
Butyl benzyl phthalate	85687	1.6E-1	NA	7.0E+2	NA	NA	0.2	1.0	0.1	1.0	4.84	57,300
n-Butylbenzene	104518	1.1E-2	NA	30	NA	NA	0.2	1.0	0.1	1.0	4.38	20,200
sec-Butylbenzene	135988	1.1E-2	NA	6E+0	NA	NA	0.2	1.0	0.1	1.0	4.57	31,100
t-Butylbenzene (I)	98066	1.1E-2	NA	10	NA	NA	0.2	1.0	0.1	1.0	4.11	11,000
Cadmium (B)	7440439	1.0E-3	NA	NA	1.8E-3	NA	0.2	0.5	0.001	1.0	NR	NR
Camphene (I)	79925	NA	NA	80	NA	NA	0.2	1.0	0.1	1.0	3.53	2,950
Caprolactam	105602	8.0E-1	NA	1.0E+1	NA	4.6E+4	0.2	1.0	0.1	1.0	-0.19	0.65
Carbaryl	63252	9.6E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.4	229
Carbazole	86748	NA	1.0E-2	NA	5.0E-5	NA	0.2	1.0	0.1	1.0	3.59	3,380
Carbofuran	1563662	5.0E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.6	37.4
Carbon disulfide (I,R)	75150	1.1E-1	NA	7.0E+2	NA	NA	0.2	1.0	0.1	1.0	2	45.9

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PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25^{o}C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
Boron (B)	7440428	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	10.811
Bromate	15541454	NR	NA	1.00E+0	NR	NR	NA	NA	38,000	Solid	79.9
Bromobenzene (I)	108861	NR	NR	4.74E-4	0.08	8.0E-6	NA	NA	4.13E+5	Liquid	157.015
Bromodichloromethane	75274	NR	NR	1.60E-3	0.0298	1.06E-5	NA	NA	6.74E+6	Liquid	163.8
Bromoform	75252	NR	NR	5.35E-4	0.0149	1.03E-5	NA	NA	3.10E+6	Liquid	252.8
Bromomethane	74839	NR	NR	1.42E-2	0.08	8.0E-6	0.1	NA	1.45E+7	Liquid	94.94
n-Butanol (I)	71363	NR	NR	8.81E-6	0.08	9.6E-6	0.014	84	7.40E+7	Liquid	74.14
2-Butanone (MEK) (I)	78933	NR	NR	3.60E-5	0.081	9.8E-6	NA	16	2.40E+8	Liquid	72.1
n-Butyl acetate	123864	NR	NR	3.20E-4	0.08	8.0E-6	0.017	72	6.70E+6	Liquid	116.16
t-Butyl alcohol	75650	NR	NR	1.17E-5	0.08	8.0E-6	0.024	52	1.0E+9	Liquid	74.12
Butyl benzyl phthalate	85687	NR	NR	1.26E-6	0.0174	4.83E-6	NA	NA	2,690	Liquid	312.37
n-Butylbenzene	104518	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	134.22
sec-Butylbenzene	135988	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	134.22
t-Butylbenzene (I)	98066	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	134.22
Cadmium (B)	7440439	NR	75	NR	NR	NR	NA	NA	NA	Inorganic	112.411
Camphene (I)	79925	NR	NR	2.05E+0	0.08	8.0E-6	NA	NA	33,400	Solid	136.26
Caprolactam	105602	NR	NR	2.53E-8	0.08	8.0E-6	0.014	282	5.25E+9	Solid	113.2
Carbaryl	63252	NR	NR	6.80E-4	0.08	8.0E-6	NA	NA	1.26E+5	Solid	201.24
Carbazole	86748	NR	NR	1.53E-8	0.039	7.03E-6	NA	NA	7,480	Solid	167.21
Carbofuran	1563662	NR	NR	3.90E-10	0.08	8.0E-6	NA	NA	7.00E+5	Solid	221.3
Carbon disulfide (I,R)	75150	NR	NR	3.03E-2	0.104	1.0E-5	0.013	-22	1.19E+6	Liquid	76.14

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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	(mg/Kg-day)$^{-1}$	ug/m^3	(ug/m^3)$^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Carbon tetrachloride	56235	7.1E-4	5.5E-2	100	2.36E-5	6.3E+4	0.2	1.0	0.1	1.0	2.73	174
Chlordane (J)	57749	1.5E-3	3.5E-1	7.0E-1	1.0E-4	NA	0.2	0.5	0.04	1.0	6.32	1.21E+5
Chloride	16887006	NA	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Chlorobenzene (I)	108907	1.9E-2	NA	7.0E+1	NA	NA	0.2	1.0	0.1	1.0	2.86	220
p-Chlorobenzene sulfonic acid	98668	1.0E+0	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-0.52	4.64E-1
1-Chloro-1,1-difluoroethane	75683	2.1E+0	NA	5.0E+4	NA	NA	0.2	1.0	0.1	1.0	1.81	32.5
Chloroethane	75003	1.8E+1	2.0E-3	1.0E+4	NA	NA	0.2	1.0	0.1	1.0	1.4	23.8
2-Chloroethyl vinyl ether	110758	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.07	8.43
Chloroform	67663	1.3E-2	4.4E-3	NA	2.4E-6	NA	0.2	1.0	0.1	1.0	1.92	39.7
Chloromethane (I)	74873	NA	3.3E-3	9.0E+1	6.39E-7	2.07E+5	0.2	1.0	0.1	1.0	0.91	6.30
4-Chloro-3-methylphenol	59507	2.0E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	3.1	1,120
beta-Chloronaphthalene	91587	2.5E-1	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.1	10,700
2-Chlorophenol	95578	6.2E-3	NA	1.8E+1	NA	NA	0.2	1.0	0.1	1.0	2.15	388
o-Chlorotoluene (I)	95498	2.0E-2	NA	7.0E+1	NA	NA	0.2	1.0	0.1	1.0	3.42	612
Chlorpyrifos	2921882	3.0E-2	NA	2.0E+0	NA	NA	0.2	0.5	0.1	1.0	5.3	18,900
Chromium (III) (B,H)	16065831	1.5E+0	NA	5.0E+0	NA	NA	0.7	0.5	0.01	1.0	NR	NR
Chromium (VI)	18540299	4.8E-3	NA	8.0E-3	1.2E-2	NA	0.7	0.5	0.01	1.0	NR	NR
Chrysene (Q)	218019	NA	4.1E-3	NA	NA	NA	0.2	0.5	0.13	1.0	5.7	4.01E+5
Cobalt	7440484	5.0E-3	NA	2.0E-1	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Copper (B)	7440508	3.8E-2	NA	2.0E+0	NA	NA	1.0	0.5	0.01	1.0	NR	NR
Cyanazine	21725462	3.0E-3	3.7E-1	NA	NA	NA	0.2	1.0	0.1	1.0	2.2	146

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25^{o}C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
Carbon tetrachloride	56235	NR	NR	3.04E-2	0.078	8.8E-6	NA	NA	7.93E+5	Liquid	153.92
Chlordane (J)	57749	NR	NR	4.86E-5	0.0118	4.37E-6	NA	NA	56	Solid	409.8
Chloride	16887006	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	35.453
Chlorobenzene (I)	108907	NR	NR	3.70E-3	0.073	8.7E-6	0.013	82	4.72E+5	Liquid	112.56
p-Chlorobenzene sulfonic acid	98668	NR	NR	NA	NA	NA	NA	226	NA	Solid	192.62
1-Chloro-1,1-difluoroethane	75683	NR	NR	6.16E-2	0.08	8.0E-6	0.06	NA	3.9E+06	Gas	100.5
Chloroethane	75003	NR	NR	8.80E-3	0.08	8.0E-6	0.038	-58	5.74E+6	Liquid	64.52
2-Chloroethyl vinyl ether	110758	NR	NR	6.25E-4	0.08	8.0E-6	NA	NA	1.50E+7	Liquid	106.55
Chloroform	67663	NR	NR	3.67E-3	0.104	1.0E-5	NA	NA	7.92E+6	Liquid	119.38
Chloromethane (I)	74873	NR	NR	4.52E-2	0.13	6.5E-6	0.081	-60.8	6.34E+6	Liquid	50.49
4-Chloro-3-methylphenol	59507	NR	NR	4.00E-7	0.08	8.0E-6	NA	NA	3.90E+6	Solid	142.6
beta-Chloronaphthalene	91587	NR	NR	3.10E-4	0.08	8.0E-6	NA	NA	6,740	Solid	162.62
2-Chlorophenol	95578	388	NR	3.91E-4	0.0501	9.46E-6	NA	NA	2.20E+7	Liquid	128.56
o-Chlorotoluene (I)	95498	NR	NR	3.57E-3	0.08	8.0E-6	NA	96	3.73E+5	Liquid	126.58
Chlorpyrifos	2921882	NR	NR	7.80E+0	0.08	8.0E-6	NA	NA	1,120	Solid	350.59
Chromium (III) (B,H)	16065831	NR	1.8E+6	NR	NR	NR	NA	NA	NA	Inorganic	51.996
Chromium (VI)	18540299	NR	19	NR	NR	NR	NA	NA	NA	Inorganic	51.996
Chrysene (Q)	218019	NR	NR	9.46E-5	0.0248	6.21E-6	NA	NA	1.6	Solid	228.3
Cobalt	7440484	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	58.933
Copper (B)	7440508	NR	360	NR	NR	NR	NA	NA	NA	Inorganic	63.546
Cyanazine	21725462	NR	NR	1.00E-10	0.08	8.0E-6	NA	NA	1.70E+5	Solid	241

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		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Cyanide (P,R)	57125	5.4E-3	NA	5.0E+1	NA	NA	0.2	1.0	0	1.0	NA	NA
Cyclohexanone	108941	4.5E+0	NA	1.0E+3	NA	NA	0.2	1.0	0.1	1.0	0.81	6.26
Dacthal	1861321	1.0E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.4	21,200
Dalapon	75990	8.5E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	0.77	5.72
4-4'-DDD	72548	3.0E-3	9.4E-2	NA	7.0E-5	NA	0.2	0.5	0.1	1.0	6.1	81,100
4-4'-DDE	72559	7.0E-4	2.0E-1	NA	9.7E-5	NA	0.2	0.5	0.1	1.0	6.76	2.70E+5
4-4'-DDT	50293	5.0E-4	2.0E-1	NA	9.7E-5	NA	0.2	0.5	0.03	1.0	6.53	1.78E+5
Decabromodiphenyl ether	1163195	1.0E-2	NA	3.5E+1	4.0E-7	NA	0.2	0.5	0.1	1.0	5.24	1.42E+5
Di-n-butyl phthalate	84742	1.2E-1	NA	5.0E+1	NA	NA	0.2	1.0	0.1	1.0	4.61	34,000
Di(2-ethylhexyl) adipate	103231	1.7E+0	5.9E-4	NA	3.4E-7	NA	0.2	0.5	0.1	1.0	6.11	1.01E+6
Di-n-octyl phthalate	117840	1.8E-2	NA	4.7E+2	NA	NA	0.2	0.5	0.1	1.0	7.51	2.41E+7
Diacetone alcohol (I)	123422	NA	NA	2.4E+3	NA	NA	0.2	1.0	0.1	1.0	-0.34	0.464
Diazinon	333415	1.8E-4	NA	NA	NA	NA	0.2	1.0	0.1	1.0	3.4	2,200
Dibenzo(a,h)anthracene (Q)	53703	NA	4.1E+0	NA	NA	NA	0.2	0.5	0.13	1.0	6.69	3.77E+6
Dibenzofuran	132649	NA	NA	1E-1	NA	NA	0.2	1.0	0.1	1.0	4.2	13,500
Dibromochloromethane	124481	2.1E-2	4.9E-2	NA	2.45E-5	NA	0.2	1.0	0.1	1.0	2.17	62.6
Dibromochloropropane	96128	NA	1.2E+0	2.0E-1	5.6E-3	NA	0.2	1.0	0.1	1.0	2.68	431
Dibromomethane	74953	1.1E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.62	39.2
Dicamba	1918009	3.0E-2	NA	NA	NA	NA	0.2	0.5	0.1	1.0	2.4	95.3
1,2-Dichlorobenzene	95501	8.6E-2	NA	1.5E+3	NA	3.01E+5	0.2	1.0	0.1	1.0	3.43	623
1,3-Dichlorobenzene	541731	9.0E-4	NA	3E+0	NA	NA	0.2	1.0	0.1	1.0	3.5	708

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25^{o}C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
Cyanide (P,R)	57125	NR	NR	NR	0.08	8.0E-6	NA	NA	NA	Inorganic	26.02
Cyclohexanone	108941	NR	NR	7.80E+0	0.08	8.0E-6	NA	146	2.30E+7	Liquid	98.14
Dacthal	1861321	NR	NR	2.18E-6	0.08	8.0E-6	NA	NA	500	Solid	331
Dalapon	75990	NR	NR	6.43E-8	0.08	8.0E-6	NA	NA	5.02E+8	Liquid	142.97
4-4'-DDD	72548	NR	NR	4.00E-6	0.0169	4.76E-6	NA	NA	90	Solid	320.05
4-4'-DDE	72559	NR	NR	2.10E-5	0.0144	5.87E-6	NA	NA	120	Solid	518.03
4-4'-DDT	50293	NR	NR	8.10E-6	0.0137	4.95E-6	NA	162	25	Solid	354.49
Decabromodiphenyl ether	1163195	NR	NR	4.02E-5	0.08	8.0E-6	NA	NA	30	Solid	959.22
Di-n-butyl phthalate	84742	NR	NR	9.38E-10	0.0438	7.86E-6	NA	315	11,200	Liquid	278.34
Di(2-ethylhexyl) adipate	103231	NR	NR	4.34E-7	0.08	8.0E-6	NA	NA	471	Liquid	370
Di-n-octyl phthalate	117840	NR	NR	7.66E-7	0.0151	3.58E-6	NA	NA	3,000	Liquid	390.62
Diacetone alcohol (I)	123422	NR	NR	2.61E-7	0.08	8.0E-6	0.018	125	1.0E+9	Liquid	116.2
Diazinon	333415	NR	NR	1.13E-7	0.08	8.0E-6	NA	180	68,800	Liquid	304.3
Dibenzo(a,h)anthracene (Q)	53703	NR	NR	1.47E-8	0.0202	5.18E-6	NA	NA	2.49	Solid	278.36
Dibenzofuran	132649	NR	NR	1.30E-5	0.08	8.0E-6	NA	NA	10,000	Solid	168.21
Dibromochloromethane	124481	NR	NR	7.83E-4	0.0229	1.05E-5	NA	NA	2.60E+6	Liquid	208.29
Dibromochloropropane	96128	NR	NR	1.90E-4	0.08	8.0E-6	NA	170	1,230	Liquid	236.34
Dibromomethane	74953	NR	NR	9.00E-4	0.08	8.6E-6	NA	NA	1.10E+7	Liquid	173.85
Dicamba	1918009	NR	NR	7.90E-9	0.08	8.0E-6	NA	NA	4.5E+6	Solid	221.04
1,2-Dichlorobenzene	95501	NR	NR	1.90E-3	0.069	7.9E-6	0.022	151	1.56E+5	Liquid	147.01
1,3-Dichlorobenzene	541731	NR	NR	1.80E-3	0.08	8.0E-6	NA	NA	1.11E+5	Liquid	147.01

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg-day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
1,4-Dichlorobenzene	106467	NA	1.3E-2	8E+2	6.9E-6	NA	0.2	1.0	0.1	1.0	3.42	612
3,3'-Dichlorobenzidine	91941	NA	8.0E-1	NA	4.8E-4	NA	0.2	1.0	0.1	1.0	3.51	721
Dichlorodifluoromethane	75718	2.3E-1	NA	4.95E+4	NA	NA	0.2	1.0	0.1	1.0	2.15	60.4
1,1-Dichloroethane	75343	1.2E-1	NA	5.0E+2	NA	NA	0.2	1.0	0.1	1.0	1.79	31.3
1,2-Dichloroethane (I)	107062	NA	5.8E-2	NA	2.6E-5	NA	0.2	1.0	0.1	1.0	1.47	17.5
1,1-Dichloroethylene (I)	75354	9.0E-4	NA	2E+2	5.0E-5	7.9E+4	0.2	1.0	0.1	1.0	2.13	58.2
cis-1,2-Dichloroethylene	156592	1.1E-2	NA	3.4E+1	NA	NA	0.2	1.0	0.1	1.0	1.86	35.6
trans-1,2-Dichloroethylene	156605	1.7E-2	NA	7.0E+1	NA	NA	0.2	1.0	0.1	1.0	2.07	52.2
2,6-Dichloro-4-nitroaniline	99309	3.0E-1	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.76	517
2,4-Dichlorophenol	120832	1.0E-2	NA	7.7E+1	NA	NA	0.2	1.0	0.1	1.0	3.08	147
2,4-Dichlorophenoxyacetic acid	94757	1.0E-2	NA	1.0E+2	NA	NA	0.2	1.0	0.05	1.0	2.7	451
1,2-Dichloropropane (I)	78875	4.4E-1	3.7E-2	4.0E+0	NA	5.08E+5	0.2	1.0	0.1	1.0	1.97	43.5
1,3-Dichloropropene	542756	3.4E-2	1.0E-1	2.0E+1	4.0E-6	NA	0.2	1.0	0.1	1.0	2.0	45.9
Dichlorovos	62737	4.0E-4	5.2E-1	5.0E-1	NA	NA	0.2	1.0	0.1	1.0	1.4	15.4
Dicyclohexyl phthalate	84617	NA	NA	NA	NA	NA	0.2	0.5	0.1	1.0	6.2	1.24E+6
Dieldrin	60571	7.6E-5	8.0E+0	NA	4.6E-3	NA	0.2	0.5	0.1	1.0	5.37	21,400
Diethyl ether	60297	5.0E-1	NA	1.2E+4	NA	1.52E+6	0.2	1.0	0.1	1.0	0.83	6.55
Diethyl phthalate	84662	7.5E-1	NA	5.0E+1	NA	NA	0.2	1.0	0.1	1.0	2.5	287
Diethylene glycol monobutyl ether	112345	1.2E-2	NA	2.0E+1	NA	NA	0.2	1.0	0.1	1.0	0.32	2.06
Diisopropyl ether	108203	4.1E-3	NA	3.58E+2	NA	NA	0.2	1.0	0.1	1.0	1.67	25.2
Diisopropylamine (I)	108189	7.7E-4	NA	2E+2	NA	NA	0.2	1.0	0.1	1.0	1.6	37.4

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25^oC (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^oF	ug/L	unitless	g/mol
1,4-Dichlorobenzene	106467	NR	NR	2.43E-3	0.069	7.9E-6	0.025	150	73,800	Solid	147
3,3'-Dichlorobenzidine	91941	NR	NR	4.00E-9	0.0194	6.74E-6	NA	NA	3,110	Solid	253.1
Dichlorodifluoromethane	75718	NR	NR	2.60E+0	0.08	8.0E-6	NA	NA	3.00E+5	Liquid	120.91
1,1-Dichloroethane	75343	NR	NR	5.62E-3	0.0742	1.05E-5	0.054	2.0	5.06E+6	Liquid	98.96
1,2-Dichloroethane (I)	107062	NR	NR	9.79E-4	0.104	9.9E-6	0.062	56	8.52E+6	Liquid	98.97
1,1-Dichloroethylene (I)	75354	NR	NR	2.61E-2	0.09	1.04E-5	0.065	-2	2.25E+6	Liquid	96.94
cis-1,2-Dichloroethylene	156592	NR	NR	4.08E-3	0.0736	1.13E-5	0.056	36	3.50E+6	Liquid	96.94
trans-1,2-Dichloroethylene	156605	NR	NR	9.38E-3	0.0707	1.19E-5	0.056	36	6.30E+6	Liquid	96.94
2,6-Dichloro-4-nitroaniline	99309	NR	NR	4.67E-8	0.08	8.0E-6	NA	NA	7,000	Solid	207.02
2,4-Dichlorophenol	120832	147	NR	3.16E-6	0.0346	8.77E-6	NA	NA	4.50E+6	Liquid	163
2,4-Dichlorophenoxyacetic acid	94757	NR	NR	4.50E-6	0.059	6.5E-6	NA	NA	6.80E+5	Solid	221.04
1,2-Dichloropropane (I)	78875	NR	NR	2.80E-3	0.0782	8.73E-6	0.034	60	2.80E+6	Liquid	112.99
1,3-Dichloropropene	542756	NR	NR	1.77E-2	0.0626	1.0E-5	0.053	77	2.80E+6	Liquid	110.97
Dichlorovos	62737	NR	NR	9.58E-7	0.08	8.0E-6	NA	175	1.60E+7	Liquid	220.98
Dicyclohexyl phthalate	84617	NR	NR	7.61E-5	0.08	8.0E-6	NA	NA	4,000	Solid	330.43
Dieldrin	60571	NR	NR	1.51E-5	0.0125	4.74E-6	NA	NA	195	Solid	380.9
Diethyl ether	60297	NR	NR	8.70E-4	0.074	9.3E-6	0.019	-49	6.10E+7	Liquid	74.12
Diethyl phthalate	84662	NR	NR	4.50E-7	0.0256	6.35E-6	NA	322	1.08E+6	Liquid	222.23
Diethylene glycol monobutyl ether	112345	NR	NR	1.52E-9	0.08	8.0E-6	NA	NA	1.0E+9	Liquid	162.23
Diisopropyl ether	108203	NR	NR	1.3E-3	0.08	8.0E-6	0.014	-18	8,041	Liquid	102.18
Diisopropylamine (I)	108189	NR	NR	9.60E-5	0.08	8.0E-6	0.011	20	3.69E+7	Liquid	101.22

Attachment 1
TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	(mg/Kg-day)$^{-1}$	ug/m^3	(ug/m^3)$^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Dimethyl phthalate	131113	1.0E+1	NA	5.0E+1	NA	NA	0.2	1.0	0.1	1.0	1.64	41.0
N,N-Dimethylacetamide	127195	2.5E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-0.77	0.175
N,N-Dimethylaniline	121697	2.2E-3	NA	NA	1.18E-5	5.0E+4	0.2	1.0	0.1	1.0	2.46	262
Dimethylformamide (I)	68122	9.6E-2	NA	3.0E+1	NA	NA	0.2	1.0	0.1	1.0	-1.01	0.102
2,4-Dimethylphenol	105679	5.0E-2	NA	7.0E+1	NA	NA	0.2	1.0	0.1	1.0	2.36	209
2,6-Dimethylphenol	576261	6.0E-4	NA	2E+0	NA	NA	0.2	1.0	0.1	1.0	2.36	209
3,4-Dimethylphenol	95658	1.4E-3	NA	3.5E+0	NA	NA	0.2	1.0	0.1	1.0	2.23	156
Dimethylsulfoxide	67685	3.0E+1	NA	2E+1	NA	NA	0.2	1.0	0.1	1.0	-1.66	0.0234
2,4-Dinitrotoluene	121142	2.0E-3	1.1E-1	2.0E+0	2.0E-4	NA	0.2	1.0	0.1	1.0	2.01	94.6
Dinoseb	88857	1.0E-3	NA	4E+0	NA	NA	0.2	1.0	0.1	1.0	3.15	1,250
1,4-Dioxane (I)	123911	NA	1.0E-2	100	5.5E-6	NA	0.2	1.0	0.1	1.0	-0.39	0.588
Diquat	85007	2.2E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-2.82	0.00169
Dissolved oxygen (DO)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Diuron	330541	4.3E-3	NA	7.0E+0	NA	NA	0.2	1.0	0.1	1.0	2.77	187
Endosulfan (J)	115297	6.0E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.1	2,110
Endothall	145733	1.7E-2	NA	3.5E+1	NA	NA	0.2	1.0	0.1	1.0	-0.55	0.288
Endrin	72208	1.7E-4	NA	NA	NA	NA	0.2	0.5	0.1	1.0	5.06	12,200
Epichlorohydrin (I)	106898	1.0E-3	5.9E-1	1.0E+0	1.2E-6	NA	0.2	1.0	0.1	1.0	0.26	1.92
Ethanol (I)	64175	6.2E+1	NA	1.9E+4	NA	NA	1.0	1.0	0.1	1.0	-0.31	0.496
Ethyl acetate (I)	141786	9.0E-1	NA	3.2E+3	NA	NA	0.2	1.0	0.1	1.0	0.69	4.77
Ethyl-tert-butyl ether (ETBE)	637923	NA	NA	3.73E+2	NA	NA	NA	1.0	0.1	1.0	1.92	3.97

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		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
Dimethyl phthalate	131113	NR	NR	5.78E-7	0.067	6.3E-6	NA	295	4.19E+6	Liquid	194.19
N,N-Dimethylacetamide	127195	NR	NR	1.31E-8	0.08	8.0E-6	NA	158	1.0E+9	Liquid	87.14
N,N-Dimethylaniline	121697	NR	NR	8.12E-5	0.08	8.0E-6	NA	142	1.27E+6	Liquid	121.18
Dimethylformamide (I)	68122	NR	NR	7.39E-8	0.08	8.0E-6	NA	136	1.0E+9	Liquid	73.1
2,4-Dimethylphenol	105679	NR	NR	2.0E-6	0.0584	8.69E-6	NA	NA	7.87E+6	Solid	122.16
2,6-Dimethylphenol	576261	NR	NR	5.02E-6	0.08	8.0E-6	NA	NA	6.14E+6	Solid	122.16
3,4-Dimethylphenol	95658	NR	NR	3.78E-7	0.08	8.0E-6	NA	NA	4.93E+6	Solid	122.16
Dimethylsulfoxide	67685	NR	NR	5.80E-8	0.08	8.0E-6	NA	NA	1.66E+8	Liquid	78.14
2,4-Dinitrotoluene	121142	NR	NR	9.26E-8	0.203	7.06E-6	NA	NA	2.70E+5	Solid	183.15
Dinoseb	88857	NR	NR	4.60E-7	0.08	8.0E-6	NA	NA	52,000	Liquid	240.2
1,4-Dioxane (I)	123911	NR	NR	4.90E-6	0.23	1.0E-5	0.02	55	9.00E+8	Liquid	88.11
Diquat	85007	NR	NR	1.42E-13	0.08	8.0E-6	NA	NA	7.00E+5	Solid	344.08
Dissolved oxygen (DO)	NA	NR	NA	NR	NA	NA	NA	NA	NA	NA	NA
Diuron	330541	NR	NR	2.70E-6	0.08	8.0E-6	NA	NA	37,300	Solid	233.1
Endosulfan (J)	115297	NR	NR	1.12E-5	0.0115	4.55E-6	NA	NA	510	Solid	406.9
Endothall	145733	NR	NR	2.60E-10	0.08	8.0E-6	NA	NA	1.00E+8	Solid	186.18
Endrin	72208	NR	NR	7.52E-6	0.0125	4.74E-6	NA	NA	250	Solid	380.9
Epichlorohydrin (I)	106898	NR	NR	3.00E-5	0.086	9.8E-6	0.038	93	6.60E+7	Liquid	92.53
Ethanol (I)	64175	NR	NR	6.29E-6	0.08	8.0E-6	0.033	55	1.0E+9	Liquid	46.07
Ethyl acetate (I)	141786	NR	NR	1.70E-4	0.073	9.7E-6	0.02	24	6.40E+7	Liquid	88.12
Ethyl-tert-butyl ether (ETBE)	637923	NR	NR	1.389E-3	0.08	8.0E-6	NA	NA	5.63E+6	Liquid	102.18

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		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Ethylbenzene (I)	100414	9.7E-2	NA	1.0E+3	3.1E-7	5.43E+5	0.2	1.0	0.1	1.0	3.14	367
Ethylene dibromide	106934	NA	5.7E+1	9E+0	2.2E-4	NA	0.2	1.0	0.1	1.0	1.75	52.5
Ethylene glycol	107211	2.0E+0	NA	1.0E+3	NA	1.0E+5	0.2	1.0	0.1	1.0	-1.4	0.0421
Ethylene glycol monobutyl ether	111762	5.0E-1	NA	1.3E+4	NA	NA	0.2	1.0	0.1	1.0	0.83	6.55
Fluoranthene	206440	1.2E-1	NA	1.4E+2	NA	NA	0.2	0.5	0.1	1.0	5.12	1.08E+05
Fluorene	86737	1.2E-1	NA	1.4E+2	NA	NA	0.2	1.0	0.1	1.0	4.21	13,800
Fluorine (soluble fluoride) (B)	7782414	6.0E-2	NA	NA	NA	3.1E+3	1.0	0.5	0.01	1.0	NR	NR
Formaldehyde	50000	1.8E-1	NA	9.0E+0	1.3E-5	3.7E+2	0.2	1.0	0.1	1.0	-0.051	1.09
Formic acid (I,U)	64186	1.4E+0	NA	2.0E+0	NA	1.9E+4	0.2	1.0	0.1	1.0	-0.538	0.449
1-Formylpiperidine	2591868	1.1E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	NA	NA
Gentian violet	548629	1.4E-1	5.5E-2	NA	NA	NA	0.2	1.0	0.1	1.0	0.51	3.17
Glyphosate	1071836	1.0E-1	NA	NA	NA	NA	0.2	0.5	0.1	1.0	-4.47	4.04E-5
Heptachlor	76448	2.3E-3	1.6E+0	NA	1.3E-3	NA	0.2	0.5	0.1	1.0	6.26	1.43E+6
Heptachlor epoxide	1024573	8.5E-6	2.9E+0	NA	2.6E-3	NA	0.2	0.5	0.1	1.0	5.0	82,300
n-Heptane	142825	4.4E+0	NA	3.5E+3	NA	2.05E+6	0.2	1.0	0.1	1.0	4.72	43,700
Hexabromobenzene	87821	2.8E-3	NA	NA	NA	NA	0.2	0.5	0.1	1.0	6.1	9.92E+5
Hexachlorobenzene (C-66)	118741	8.0E-4	1.0E+0	NA	4.6E-4	NA	0.2	0.5	0.1	1.0	5.89	55,300
Hexachlorobutadiene (C-46)	87683	2.0E-3	5.2E-2	NA	2.2E-5	NA	0.2	1.0	0.1	1.0	4.81	53,500
alpha-Hexachlorocyclohexane	319846	NA	2.0E+0	NA	1.83E-3	NA	0.2	1.0	0.1	1.0	3.8	1,220
beta-Hexachlorocyclohexane	319857	NA	9.7E-1	NA	5.3E-4	NA	0.2	1.0	0.1	1.0	3.81	1,250
Hexachlorocyclopentadiene (C-56)	77474	6.0E-3	NA	2.0E-1	NA	NA	0.2	0.5	0.1	1.0	5.39	1.99E+05

Attachment 1
TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25^{o}C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
Ethylbenzene (I)	100414	NR	NR	7.88E-3	0.075	7.8E-6	0.008	55	1.69E+5	Liquid	106.17
Ethylene dibromide	106934	NR	NR	4.60E-4	0.08	8.0E-6	NA	NA	4.20E+6	Liquid	187.9
Ethylene glycol	107211	NR	NR	6.00E-8	0.08	8.0E-6	0.032	232	1.0E+9	Liquid	62.07
Ethylene glycol monobutyl ether	111762	NR	NR	5.13E-2	0.08	8.0E-6	NA	143	2.24E+8	Liquid	118.2
Fluoranthene	206440	NR	NR	1.61E-5	0.0302	6.35E-6	NA	NA	206	Solid	202.24
Fluorene	86737	NR	NR	6.36E-5	0.0363	7.88E-6	NA	NA	1,980	Solid	166.23
Fluorine (soluble fluoride) (B)	7782414	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	38
Formaldehyde	50000	NR	NR	2.80E-4	0.18	2.0E-5	0.07	NA	5.50E+8	Liquid	30.03
Formic acid (I,U)	64186	NR	NR	2.50E-6	0.079	1.4E-6	0.18	122	1.0E+9	Liquid	46.03
1-Formylpiperidine	2591868	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	113.2
Gentian violet	548629	NR	NR	3.06E-16	0.08	8.0E-6	NA	NA	1.00E+6	Solid	408
Glyphosate	1071836	NR	NR	1.50E-9	0.08	8.0E-6	NA	NA	1.16E+7	Solid	169.09
Heptachlor	76448	NR	NR	1.48E-3	0.0112	5.69E-6	NA	NA	180	Solid	373.4
Heptachlor epoxide	1024573	NR	NR	9.50E-6	0.0132	4.23E-6	NA	NA	200	Solid	389.32
n-Heptane	142825	NR	NR	2.11E+0	0.08	8.0E-6	0.0105	25	2,690	Liquid	100.2
Hexabromobenzene	87821	NR	NR	1.30E-5	0.08	8.0E-6	NA	NA	0.17	Solid	551
Hexachlorobenzene (C-66)	118741	NR	NR	1.32E-3	0.0542	5.91E-6	NA	NA	6,200	Solid	284.78
Hexachlorobutadiene (C-46)	87683	NR	NR	8.15E-3	0.0561	6.16E-6	NA	NA	3,230	Liquid	260.76
alpha-Hexachlorocyclohexane	319846	NR	NR	1.06E-5	0.0142	7.34E-6	NA	NA	2,000	Solid	290.82
beta-Hexachlorocyclohexane	319857	NR	NR	7.43E-7	0.0142	7.34E-6	NA	NA	240	Solid	290.82
Hexachlorocyclopentadiene (C-56)	77474	NR	NR	2.70E-2	0.0161	7.21E-6	NA	NA	1,800	Liquid	272.77

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
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PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Hexachloroethane	67721	1.0E-3	8.5E-3	3.5E+0	4.0E-6	NA	0.2	1.0	0.1	1.0	4.0	1,760
n-Hexane	110543	4.1E-1	NA	2.0E+2	NA	NA	0.2	1.0	0.1	1.0	4.0	1,760
2-Hexanone	591786	1.4E-1	NA	4.0E+1	NA	NA	0.2	1.0	0.1	1.0	1.4	23.8
Indeno(1,2,3-cd)pyrene (Q)	193395	NA	4.1E-1	NA	NA	NA	0.2	0.5	0.13	1.0	6.65	3.45E+6
Iron (B)	7439896	3.0E-1	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Isobutyl alcohol (I)	78831	3.2E-1	NA	1.5E+3	NA	NA	0.2	1.0	0.1	1.0	0.75	5.46
Isophorone	78591	1.5E-1	1.1E-3	2.8E+2	2.7E-7	2.8E+4	0.2	1.0	0.1	1.0	1.699	46.8
Isopropyl alcohol (I)	67630	6.4E-2	NA	2.2E+2	NA	1.23E+6	0.2	1.0	0.1	1.0	0.05	1.31
Isopropyl benzene	98828	1.1E-1	NA	8.7E+1	NA	NA	0.2	1.0	0.1	1.0	3.6	3,460
Lead (B)	7439921	NA	NA	1.5E+0	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Lindane	58899	3.3E-4	7.1E-1	NA	NA	NA	0.2	1.0	0.04	1.0	3.73	1,080
Lithium (B)	7439932	2.8E-2	NA	3.5E+1	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Magnesium (B)	7439954	1.1E+1	NA	1.0E+2	NA	NA	1.0	0.5	0.01	1.0	NR	NR
Manganese (B)	7439965	4.7E-2	NA	5.0E-2	NA	NA	0.5	0.5	0.01	1.0	NR	NR
Mercury (Total) (B,Z)	Varies	3.0E-4	NA	3.0E-1	NA	NA	0.2	0.5	0.01	1.0	5.95	NR
Methane	74828	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.09	11.8
Methanol	67561	5.0E-1	NA	3.25E+3	NA	3.28E+6	0.2	1.0	0.1	1.0	-0.72	0.196
Methoxychlor	72435	5.0E-3	NA	NA	NA	NA	0.2	0.5	0.1	1.0	5.08	12,600
2-Methoxyethanol (I)	109864	1.0E-3	NA	2.0E+1	NA	NA	0.2	1.0	0.1	1.0	-0.77	0.175
2-Methyl-4-chlorophenoxyacetic acid	94746	1.0E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	3.25	1,570
2-Methyl-4,6-dinitrophenol	534521	3.5E-4	NA	2.0E+0	NA	NA	0.2	1.0	0.1	1.0	2.1	116

TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	°F	ug/L	unitless	g/mol
Hexachloroethane	67721	NR	NR	3.89E-3	0.0025	6.8E-6	NA	NA	50,000	Solid	236.74
n-Hexane	110543	NR	NR	1.40E-2	0.08	8.0E-6	0.011	-7	12,000	Liquid	86.18
2-Hexanone	591786	NR	NR	9.57E-5	0.08	8.0E-6	NA	77	1.60E+7	Liquid	100.16
Indeno(1,2,3-cd)pyrene (Q)	193395	NR	NR	1.60E-6	0.019	5.66E-6	NA	NA	0.022	Solid	276.34
Iron (B)	7439896	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	55.845
Isobutyl alcohol (I)	78831	NR	NR	1.30E-5	0.08	8.0E-6	NA	82	7.60E+7	Liquid	74.14
Isophorone	78591	NR	NR	6.20E-6	0.0623	6.76E-6	0.008	184	1.20E+7	Liquid	138.23
Isopropyl alcohol (I)	67630	NR	NR	8.07E-6	0.08	8.0E-6	0.02	53	1.0E+9	Liquid	60.09
Isopropyl benzene	98828	NR	NR	1.50E-2	0.086	7.1E-6	0.009	96	56,000	Liquid	122.16
Lead (B)	7439921	NR	11,000	NR	NR	NR	NA	NA	NA	Inorganic	207.2
Lindane	58899	NR	NR	1.40E-5	0.0176	7.34E-6	NA	NA	6,800	Solid	290.9
Lithium (B)	7439932	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	6.941
Magnesium (B)	7439954	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	24.305
Manganese (B)	7439965	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	54.938
Mercury (Total) (B,Z)	Varies	NR	52	7.10E-10	0.037	6.3E-6	NA	NA	56	Inorganic	200.59
Methane	74828	NR	NR	6.58E-1	0.08	8.0E-6	0.053	-306	NA	Gas	16.04
Methanol	67561	NR	NR	1.70E-4	0.15	1.3E-5	0.06	52	2.90E+7	Liquid	32.05
Methoxychlor	72435	NR	NR	1.58E-5	0.0156	4.46E-6	NA	NA	45	Solid	345.7
2-Methoxyethanol (I)	109864	NR	NR	9.51E-7	0.08	8.0E-6	NA	NA	1.0E+9	Liquid	76.1
2-Methyl-4-chlorophenoxyacetic acid	94746	NR	NR	1.33E-9	0.08	8.0E-6	NA	NA	9.24E+5	Solid	305.79
2-Methyl-4,6-dinitrophenol	534521	NR	NR	4.30E-7	0.08	8.0E-6	NA	NA	2.00E+5	Solid	198.13

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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	(mg/Kg-day)$^{-1}$	ug/m^3	(ug/m^3)$^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
N-Methyl-morpholine (I)	109024	2.7E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-0.33	0.474
Methyl parathion	298000	2.5E-4	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.9	710
4-Methyl-2-pentanone (MIBK) (I)	108101	2.5E-1	NA	2.05E+3	NA	3.07E+6	0.2	1.0	0.1	1.0	1.18	14.5
Methyl-tert-butyl ether (MTBE)	1634044	3.3E-2	3.4E-3	3.0E+3	NA	NA	0.2	1.0	0.1	1.0	0.99	9.41
Methylcyclopentane (I)	96377	NA	NA	700	NA	NA	0.2	1.0	0.1	1.0	3.37	2,060
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	7.3E-4	7.7E-1	NA	3.7E-5	NA	0.2	1.0	0.1	1.0	3.92	7,140
Methylene chloride	75092	5.8E-2	4.2E-3	2.0E+3	4.7E-7	NA	0.2	1.0	0.1	1.0	1.26	11.9
2-Methylnaphthalene	91576	3.6E-2	NA	1E+1	NA	NA	0.2	1.0	0.1	1.0	3.9	6,820
Methylphenols (J)	1319773	5.0E-2	NA	1.0E+2	NA	NA	0.2	1.0	0.1	1.0	1.99	45.1
Metolachlor	51218452	2.3E-1	3.5E-3	NA	NA	NA	0.2	1.0	0.1	1.0	3.13	361
Metribuzin	21087649	2.5E-2	NA	NA	NA	NA	0.2	0.5	0.1	1.0	1.7	46.9
Mirex	2385855	2.3E-4	9.3E-1	NA	NA	NA	0.2	0.5	0.1	1.0	6.70	3.86E+6
Molybdenum (B)	7439987	5.0E-3	NA	NA	NA	NA	0.4	0.5	0.01	1.0	NR	NR
Naphthalene	91203	7.1E-2	NA	3.0E+0	3.1E-6	7.9E+4	0.2	1.0	0.1	1.0	3.36	2,010
Nickel (B)	7440020	7.6E-2	NA	NA	2.4E-4	NA	0.2	0.5	0.01	1.0	NR	NR
Nitrate (B,N)	14797558	1.6E+0	NA	NA	NA	NA	1.0	0.5	0.01	1.0	NR	NR
Nitrite (B,N)	14797650	1.0E-1	NA	NA	NA	NA	1.0	0.5	0.01	1.0	NR	NR
Nitrobenzene (I)	98953	4.6E-4	NA	7.0E-1	2.0E-5	NA	0.2	1.0	0.1	1.0	1.84	64.4
2-Nitrophenol	88755	2.8E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.8	58.8
n-Nitroso-di-n-propylamine	621647	2.5E-1	4.5E+0	NA	2.0E-3	NA	0.2	1.0	0.1	1.0	1.4	23.8
N-Nitrosodiphenylamine	86306	2.5E-1	3.1E-3	NA	1.4E-6	NA	0.2	1.0	0.1	1.0	3.16	381

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25^{o}C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
N-Methyl-morpholine (I)	109024	NR	NR	2.50E-7	0.08	8.0E-6	NA	NA	1.0E+9	Liquid	101.17
Methyl parathion	298000	NR	NR	1.10E-7	0.08	8.0E-6	NA	NA	50,000	Solid	263.23
4-Methyl-2-pentanone (MIBK) (I)	108101	NR	NR	1.20E-4	0.075	7.8E-6	NA	64	2.00E+7	Liquid	100.2
Methyl-tert-butyl ether (MTBE)	1634044	NR	NR	6.39E-4	0.08	8.0E-6	NA	NA	4.68E+7	Liquid	88.15
Methylcyclopentane (I)	96377	NR	NR	3.63E-1	0.08	8.0E-6	NA	NA	73,890	Liquid	84.16
4,4'-Methylene-bis-2-chloroaniline (MBOCA)	101144	NR	NR	4.10E-11	0.08	8.0E-6	NA	NA	14,000	Solid	267.17
Methylene chloride	75092	NR	NR	2.40E-3	0.101	1.17E-5	0.13	NA	1.70E+7	Liquid	50.5
2-Methylnaphthalene	91576	NR	NR	4.99E-4	0.08	8.0E-6	NA	NA	24,600	Solid	142.2
Methylphenols (J)	1319773	NR	NR	1.60E-6	0.074	8.3E-6	NA	178	2.80E+7	Solid	108.13
Metolachlor	51218452	NR	NR	9.90E-9	0.08	8.0E-6	NA	NA	5.30E+5	Liquid	283.83
Metribuzin	21087649	NR	NR	8.80E-2	0.08	8.0E-6	NA	NA	1.2E+6	Solid	214.29
Mirex	2385855	NR	NR	5.16E-4	0.08	8.0E-6	NA	NA	6.8E-6	Solid	545.54
Molybdenum (B)	7439987	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	95.94
Naphthalene	91203	NR	NR	4.83E-4	0.059	7.5E-6	0.009	174	31,000	Solid	128.17
Nickel (B)	7440020	NR	65	NR	NR	NR	NA	NA	NA	Inorganic	58.7
Nitrate (B,N)	14797558	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	62
Nitrite (B,N)	14797650	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	46
Nitrobenzene (I)	98953	NR	NR	2.40E-5	0.076	8.6E-6	NA	190	2.09E+6	Liquid	123.11
2-Nitrophenol	88755	NR	NR	3.50E-6	0.08	8.0E-6	NA	NA	2.50E+6	Solid	139.11
n-Nitroso-di-n-propylamine	621647	NR	NR	2.25E-6	0.0545	8.17E-6	NA	NA	9.89E+6	Liquid	130.22
N-Nitrosodiphenylamine	86306	NR	NR	5.00E-6	0.0312	6.35E-6	NA	NA	35,100	Solid	198.22

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TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Oxamyl	23135220	3.8E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-0.47	0.508
Oxo-hexyl acetate	88230357	1.0E-2	NA	3.1E+1	NA	NA	0.2	1.0	0.1	1.0	NA	NA
Pendimethalin	40487421	1.2E-1	NA	NA	NA	NA	0.2	0.5	0.1	1.0	5.18	1.24E+5
Pentachlorobenzene	608935	8.3E-4	NA	NA	NA	NA	0.2	0.5	0.1	1.0	5.26	1.48E+5
Pentachloronitrobenzene	82688	7.5E-3	NA	5.0E+0	NA	NA	0.2	1.0	0.1	1.0	4.64	36,400
Pentachlorophenol	87865	3.0E-2	6.8E-2	1.0E+2	3.0E-5	NA	0.2	0.5	0.25	1.0	5.09	592
Pentane	109660	NA	NA	1.8E+4	NA	2.21E+6	0.2	1.0	0.1	1.0	3.42	2,300
2-Pentene (I)	109682	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.58	344
pH	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR
Phenanthrene	85018	7.1E-3	NA	1.0E-1	NA	NA	0.2	1.0	0.1	1.0	4.6	33,300
Phenol	108952	6.0E-1	NA	6.0E+2	NA	NA	0.2	1.0	0.1	1.0	1.48	17.8
Phenytoin	57410	3.0E-2	5.1E-2	NA	1.4E-5	NA	0.2	1.0	0.1	1.0	2.47	1473
Phosphorus (Total)	7723140	1.1E+1	NA	1E+0	NA	NA	0.2	0.5	0.1	1.0	NR	NA
Phthalic acid	88993	1.9E+0	NA	NA	NA	NA	0.2	1.0	0.1	1.0	0.73	5.22
Phthalic anhydride	85449	2.1E+0	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.6	37.4
Picloram	1918021	7.0E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	0.3	1.97
Piperidine	110894	4.4E-4	NA	1.4E+2	NA	NA	0.2	1.0	0.1	1.0	0.84	6.7
Polybrominated biphenyls (J)	67774327	4.3E-6	7.2E+0	NA	NA	NA	0.2	0.5	0.1	1.0	7.07	8.91E+6
Polychlorinated biphenyls (PCBs) (J,T)	1336363	2.0E-5	2.0E+0	NA	6.0E-4	NA	0.2	0.5	0.14	1.0	5.58	3.06E+5
Prometon	1610180	2.2E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.99	870
Propachlor	1918167	1.3E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.01	94.6

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25°C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	°F	ug/L	unitless	g/mol
Oxamyl	23135220	NR	NR	2.37E-10	0.08	8.0E-6	NA	NA	2.80E+8	Solid	219.29
Oxo-hexyl acetate	88230357	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	144.2
Pendimethalin	40487421	NR	NR	8.56E-7	0.08	8.0E-6	NA	NA	275	Solid	281.31
Pentachlorobenzene	608935	NR	NR	8.40E-4	0.067	6.3E-6	NA	NA	650	Liquid	250.3
Pentachloronitrobenzene	82688	NR	NR	2.90E-2	0.08	8.0E-6	NA	NA	32	Solid	295.32
Pentachlorophenol	87865	592	NR	2.44E-8	0.056	6.1E-6	NA	NA	1.85E+6	Solid	266.32
Pentane	109660	NR	NR	1.26E+0	0.08	8.0E-6	0.015	-57	38,200	Liquid	72.15
2-Pentene (I)	109682	NR	NR	2.3E-1	0.08	8.0E-6	NA	NA	2.03E+5	Liquid	70.13
pH	NA	NR	NA	NR	NA	NA	NA	NA	NA	NA	NA
Phenanthrene	85018	NR	NR	2.3E-5	0.08	8.0E-6	NA	NA	1,000	Solid	178.24
Phenol	108952	NR	NR	3.97E-7	0.082	9.1E-6	0.018	175	8.28E+7	Liquid	147.01
Phenytoin	57410	NA	NR	1.02E-11	0.08	8.0E-6	NA	NA	3.2E+4	Solid	252.2718
Phosphorus (Total)	7723140	NR	NR	NR	0.08	8.0E-6	NA	NA	NA	Solid	30.974
Phthalic acid	88993	NR	NR	2.18E-12	0.08	8.0E-6	NA	NA	1.42E+7	Liquid	166.13
Phthalic anhydride	85449	NR	NR	1.63E-8	0.08	8.0E-6	1.7E+7	305	6.2E+6	Liquid	148.1
Picloram	1918021	NR	NR	4.05E-11	0.08	8.0E-6	NA	NA	4.30E+5	Solid	241.48
Piperidine	110894	NR	NR	4.45E-6	0.08	8.0E-6	NA	NA	1.0E+9	Liquid	85.15
Polybrominated biphenyls (J)	67774327	NR	NR	3.90E-6	0.08	8.0E-6	NA	NA	1.66E+7	Solid	NA
Polychlorinated biphenyls (PCBs) (J,T)	1336363	NR	NR	4.20E-4	0.08	8.0E-6	NA	NA	44.7	Solid	268.4
Prometon	1610180	NR	NR	1.98E-9	0.08	8.0E-6	NA	NA	7.50E+5	Solid	225.29
Propachlor	1918167	NR	NR	1.09E-7	0.08	8.0E-6	NA	NA	6.55E+5	Solid	211.69

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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Propazine	139402	2.7E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.75	505
Propionic acid	79094	1.7E+0	NA	3.0E+2	NA	NA	0.2	1.0	0.1	1.0	0.28	1.89
Propyl alcohol (I)	71238	1.9E-1	NA	7.3E+2	NA	6.14E+5	0.2	1.0	0.1	1.0	0.25	1.89
n-Propylbenzene (I)	103651	1.1E-2	NA	2.0E+1	NA	NA	0.2	1.0	0.1	1.0	3.69	4,240
Propylene glycol	57556	2.0E+1	NA	6.0E+3	NA	NA	0.2	1.0	0.1	1.0	-0.92	0.125
Pyrene	129000	7.5E-2	NA	1.0E+2	NA	NA	0.2	0.5	0.1	1.0	5.11	1.06E+5
Pyridine (I)	110861	1.0E-3	NA	3.5E+0	NA	NA	0.2	1.0	0.1	1.0	0.67	4.56
Selenium (B)	7782492	5.0E-3	NA	2.0E+0	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Silver (B)	7440224	4.7E-3	NA	1.0E-1	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Silvex (2,4,5-TP)	93721	7.5E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	3.4	2,200
Simazine	122349	5.2E-3	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.93	79.0
Sodium	17341252	3.4E+1	NA	NA	NA	NA	0.1	0.5	0.01	1.0	NR	NR
Sodium azide	26628228	1.2E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	NA	NA
Strontium (B)	7440246	6.3E-1	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Styrene	100425	2.0E-1	1.3E-2	1.0E+3	5.7E-7	1.7E+5	0.2	1.0	0.1	1.0	2.94	777
Sulfate	14808798	NA	NA	NA	NA	NA	NA	0.5	0.1	1.0	NR	NR
Tebuthiuron	34014181	7.0E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	1.78	56.2
2,3,7,8-Tetrabromodibenzo-p-dio (O)	50585416	NA	7.5E+4	NA	NA	NA	0.2	0.5	0.03	1.0	7.24	1.31E+7
1,2,4,5-Tetrachlorobenzene	95943	3.4E-1	NA	1E+0	NA	NA	0.2	1.0	0.1	1.0	4.64	36,400
2,3,7,8-Tetrachlorodibenzo-p-dio: (O)	1746016	NA	7.5E+4	2.0E-6	4.4E+1	NA	0.2	0.5	0.03	1.0	7.04	8.33E+6
1,1,1,2-Tetrachloroethane	630206	8.9E-2	1.1E-2	NA	7.4E-6	NA	0.2	1.0	0.1	1.0	2.63	145

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		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^oF	ug/L	unitless	g/mol
Propazine	139402	NR	NR	4.60E-9	0.08	8.0E-6	NA	NA	8,600	Solid	229.75
Propionic acid	79094	NR	NR	4.45E-7	0.08	8.0E-6	0.029	126	1.0E+9	Liquid	74.09
Propyl alcohol (I)	71238	NR	NR	7.41E-6	0.08	8.0E-6	0.022	72	1.0E+9	Liquid	60.11
n-Propylbenzene (I)	103651	NR	NR	NA	0.08	8.0E-6	NA	NA	NA	Liquid	120.19
Propylene glycol	57556	NR	NR	1.24E-8	0.08	8.0E-6	NA	NA	1.0E+9	Liquid	76.1
Pyrene	129000	NR	NR	1.10E-5	0.0272	7.24E-6	NA	NA	135	Solid	202.26
Pyridine (I)	110861	NR	NR	7.00E-3	0.091	7.6E-6	0.018	68	3.00E+5	Liquid	79.11
Selenium (B)	7782492	NR	5	NR	NR	NR	NA	NA	NA	Inorganic	78.96
Silver (B)	7440224	NR	8.3	NR	NR	NR	NA	NA	NA	Inorganic	107.868
Silvex (2,4,5-TP)	93721	NR	NR	1.30E-8	0.08	8.0E-6	NA	NA	1.40E+5	Solid	269.51
Simazine	122349	NR	NR	3.37E-9	0.08	8.0E-6	NA	NA	4,470	Solid	201.67
Sodium	17341252	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	23
Sodium azide	26628228	NR	NA	NA	0.08	8.0E-6	NA	NA	NA	Solid	65.01
Strontium (B)	7440246	NR	NA	NR	NA	NA	NA	NA	NA	Inorganic	87.62
Styrene	100425	NR	NR	2.75E-3	0.071	8.0E-6	0.009	88	3.10E+5	Liquid	104.15
Sulfate	14808798	NR	NA	NR	0.08	8.0E-6	NA	NA	NA	Inorganic	96.066
Tebuthiuron	34014181	NR	NR	2.40E-10	0.08	8.0E-6	NA	NA	2.50E+6	Solid	228.31
2,3,7,8-Tetrabromodibenzo-p-dio (O)	50585416	NR	NR	2.95E-7	0.08	8.0E-6	NA	NA	0.00996	Solid	499.6
1,2,4,5-Tetrachlorobenzene	95943	NR	NR	1.20E-3	0.08	8.0E-6	NA	NA	1,300	Solid	215.28
2,3,7,8-Tetrachlorodibenzo-p-dio: (O)	1746016	NR	NR	9.20E-6	0.047	8.0E-6	NA	NA	0.019	Solid	322
1,1,1,2-Tetrachloroethane	630206	NR	NR	2.40E-3	0.071	7.9E-6	NA	NA	1.10E+6	Liquid	167.85

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		mg/Kg-day	$(mg/Kg\text{-}day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
1,1,2,2-Tetrachloroethane	79345	NA	1.0E-1	NA	5.8E-5	NA	0.2	1.0	0.1	1.0	2.39	93.5
Tetrachloroethylene	127184	1.0E-2	2.6E-2	4.0E+1	5.8E-7	6.85E+5	0.2	1.0	0.1	1.0	2.67	156
Tetrahydrofuran	109999	1.3E-2	NA	5.9E+3	2.0E-6	7.37E+5	0.2	1.0	0.1	1.0	0.46	2.83
Tetranitromethane	509148	NA	NA	4E-1	1.5E-2	NA	0.2	NA	NA	1.0	-2.05	9.66E-3
Thallium (B)	7440280	6.7E-5	NA	0.2	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Toluene (I)	108883	2.2E-1	NA	4.0E+2	NA	NA	0.2	1.0	0.1	1.0	2.75	180
p-Toluidine	106490	NA	5.6E-2	NA	3.1E-5	NA	0.2	1.0	0.1	1.0	1.39	23.3
Total dissolved solids (TDS)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NR
Toxaphene	8001352	NA	4.4E-1	NA	3.2E-4	1.0E+3	0.2	0.5	0.1	1.0	5.5	2.55E+5
Triallate	2303175	1.3E-2	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.57	31,100
Tributylamine	102829	3.5E-3	NA	7.0E+0	NA	NA	0.2	1.0	0.1	1.0	4.46	24,200
1,2,4-Trichlorobenzene	120821	1.5E-2	NA	3.7E+2	NA	3.7E+4	0.2	1.0	0.1	1.0	4.01	1,790
1,1,1-Trichloroethane	71556	2.2E+0	NA	1.0E+3	NA	2.46E+6	0.2	1.0	0.1	1.0	2.48	110
1,1,2-Trichloroethane	79005	3.9E-3	2.9E-2	NA	1.6E-5	NA	0.2	1.0	0.1	1.0	2.05	50.3
Trichloroethylene	79016	1.7E-3	1.0E-2	2.0E+0	1.7E-6	5.37E+5	0.2	1.0	0.1	1.0	2.71	168
Trichlorofluoromethane	75694	3.5E-1	NA	5.62E+4	NA	5.62E+6	0.2	1.0	0.1	1.0	2.53	121
2,4,5-Trichlorophenol	95954	1.0E-1	NA	3.5E+2	NA	NA	0.2	1.0	0.1	1.0	3.9	1,597
2,4,6-Trichlorophenol	88062	NA	7.4E-3	NA	3.1E-6	NA	0.2	1.0	0.1	1.0	3.7	381
1,2,3-Trichloropropane	96184	5.7E-3	NA	0.3	NA	NA	0.2	1.0	0.1	1.0	2.26	167
1,1,2-Trichloro-1,2,2-trifluoroetha	76131	2.7E+1	NA	7.67E+4	NA	9.59E+6	0.2	1.0	0.1	1.0	3.15	1,250
Triethanolamine	102716	5.0E-1	NA	5.0E+1	NA	NA	0.2	1.0	0.1	1.0	-1.38	0.044

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PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
DOCUMENT RELEASE DATE: SEPTEMBER 28, 2012

Developed pursuant to R 299.5752 of the Administrative Rules for Part 201 Environmental Remediation of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. Scientific notation is represented by E+ or E- a value, for example 200,000 is presented as 2.0E+5. Units are as indicated in each column heading. The dataset for each hazardous substance requires 22 columns. Review all 22 columns across 2 pages when evaluating data for a specific hazardous substance.

Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25^{o}C (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^{o}F	ug/L	unitless	g/mol
1,1,2,2-Tetrachloroethane	79345	NR	NR	3.45E-4	0.071	7.9E-6	NA	NA	2.97E+6	Liquid	167.85
Tetrachloroethylene	127184	NR	NR	1.84E-2	0.072	8.2E-6	NA	NA	2.0E+5	Liquid	165.83
Tetrahydrofuran	109999	NR	NR	9.63E-3	0.08	8.0E-6	0.02	6.0	1.0E+9	Liquid	72.12
Tetranitromethane	509148	NR	NR	2.60E-5	0.08	8.0E-6	NA	NA	85,000	Liquid	196.03
Thallium (B)	7440280	NR	71	NR	NR	NR	NA	NA	NA	Inorganic	204.383
Toluene (I)	108883	NR	NR	6.64E-3	0.087	8.6E-6	0.011	40	5.26E+5	Liquid	92.14
p-Toluidine	106490	NR	NR	6.10E-6	0.08	8.0E-6	NA	188	7.60E+6	Liquid	107.17
Total dissolved solids (TDS)	NA	NR	NA	NR	NA	NA	NA	NA	NA	NA	NA
Toxaphene	8001352	NR	NR	6.00E-6	0.0116	4.34E-6	NA	NA	740	Solid	414
Triallate	2303175	NR	NR	1.93E-5	0.08	8.0E-6	NA	NA	4,000	Liquid	304.66
Tributylamine	102829	NR	NR	5.60E-3	0.08	8.0E-6	NA	NA	75,400	Liquid	185.4
1,2,4-Trichlorobenzene	120821	NR	NR	1.42E-3	0.03	8.23E-6	NA	222	3.00E+5	Liquid	181.45
1,1,1-Trichloroethane	71556	NR	NR	1.72E-2	0.078	8.8E-6	0.075	NA	1.33E+6	Liquid	133.4
1,1,2-Trichloroethane	79005	NR	NR	9.13E-4	0.078	8.8E-6	0.06	NA	4.42E+6	Liquid	133.4
Trichloroethylene	79016	NR	NR	1.03E-2	0.079	9.1E-6	0.08	NA	1.10E+6	Liquid	131.39
Trichlorofluoromethane	75694	NR	NR	1.3E-1	0.087	9.7E-6	NA	NA	1.10E+6	Liquid	137.38
2,4,5-Trichlorophenol	95954	1,597	NR	4.33E-6	0.0291	7.03E-6	NA	NA	1.20E+6	Solid	197.5
2,4,6-Trichlorophenol	88062	381	NR	7.79E-6	0.0318	6.25E-6	NA	NA	8.00E+5	Solid	197.5
1,2,3-Trichloropropane	96184	NR	NR	3.80E-4	0.071	7.9E-6	NA	160	1.90E+6	Liquid	147.43
1,1,2-Trichloro-1,2,2-trifluoroetha	76131	NR	NR	5.30E-1	0.078	8.2E-6	NA	NA	1.70E+5	Liquid	187.38
Triethanolamine	102716	NR	NR	3.38E-19	0.08	8.0E-6	NA	NA	1.0E+9	Liquid	149.19

Attachment 1
TABLE 4. TOXICOLOGICAL AND CHEMICAL-PHYSICAL DATA
PART 201 GENERIC CLEANUP CRITERIA AND SCREENING LEVELS;
PART 213 TIER 1 RISK-BASED SCREENING LEVELS (RBSLs)
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Hazardous Substance	Chemical Abstract Service Number	Oral Reference Dose (RFD)	Oral Slope Factor (SF)	Chronic Inhalation Reference Concentration (RfC)	Inhalation Unit Risk Factor (IURF)	Occupational Short Term Exposure Level (STEL)	Relative Source Contribution for Drinking Water (RSC)	Ingestion Absorption Efficiency (AEi)	Dermal Absorption Efficiency (AEd)	Relative Source Contribution for Soil (RSC)	Log Octanol-Water Partition Coefficient (Log Kow)	Soil Organic Carbon-Water Partition Coefficients for Organic Compounds (Koc)
		mg/Kg-day	$(mg/Kg-day)^{-1}$	ug/m^3	$(ug/m^3)^{-1}$	ug/m^3	unitless	unitless	unitless	unitless	unitless	L/Kg
Triethylene glycol	112276	5.9E-1	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-1.69	0.0218
3-Trifluoromethyl-4-nitrophenol	88302	6.2E-1	NA	NA	NA	NA	0.2	1.0	0.1	1.0	2.87	663
Trifluralin	1582098	5.1E-3	4.5E-3	NA	NA	NA	0.2	0.5	0.1	1.0	5.3	1.62E+5
2,2,4-Trimethyl pentane	540841	NA	NA	3.5E+3	NA	NA	0.2	1.0	0.1	1.0	4.09	2,080
2,4,4-Trimethyl-2-pentene (I)	107404	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.0	1,760
1,2,4-Trimethylbenzene (I)	95636	1.4E-1	NA	1.23E+3	NA	NA	0.2	1.0	0.1	1.0	3.67	965
1,3,5-Trimethylbenzene (I)	108678	1.4E-1	NA	1.23E+3	NA	NA	0.2	1.0	0.1	1.0	3.5	708
Triphenyl phosphate	115866	1.6E-1	NA	NA	NA	NA	0.2	1.0	0.1	1.0	4.67	39,000
tris(2,3-Dibromopropyl)phosphate	126727	NA	1.2E+0	NA	5.3E-4	NA	0.2	1.0	0.1	1.0	3.51	2,820
Urea	57136	NA	NA	NA	NA	NA	0.2	1.0	0.1	1.0	-2.11	0.0256
Vanadium	7440622	5.0E-3	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Vinyl acetate (I)	108054	8.8E-2	NA	2.0E+2	NA	5.3E+4	0.2	1.0	0.1	1.0	0.73	5.22
Vinyl chloride	75014	3.0E-3	1.4E+0	1.0E+2	8.8E-6	NA	0.2	1.0	0.1	1.0	1.5	18.5
White phosphorus (R)	12185103	1.5E-5	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR
Xylenes (I)	1330207	1.8E+0	NA	4.4E+3	NA	6.51E+5	0.2	1.0	0.1	1.0	3.11	348
Zinc (B)	7440666	3.3E-1	NA	NA	NA	NA	0.2	0.5	0.01	1.0	NR	NR

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Hazardous Substance	Chemical Abstract Service Number	Soil Koc for Ionizing Organic Compounds at pH=6.8	Soil-Water Distribution Coefficients for Inorganic Compounds at pH=6.8 (Kd)	Henry's Law Constant at 25^oC (HLC)	Air Diffusivity (D_i or D_a or D^{air})	Water Diffusivity (D_w)	Lower Explosive Limit in Air (LEL)	Flash Point (FP)	Water Solubility (S)	Physical State at Standard Temperature & Pressure	Molecular Weight (MW)
		L/Kg	L/Kg	atm-m^3/mol	cm^2/s	cm^2/s	unitless	^oF	ug/L	unitless	g/mol
Triethylene glycol	112276	NR	NR	2.61E-10	0.0427	8.06E-6	NA	NA	1.00E+6	Liquid	150.17
3-Trifluoromethyl-4-nitrophenol	88302	NR	NR	1.92E-8	0.08	8.0E-6	NA	NA	5.00E+6	Solid	207
Trifluralin	1582098	NR	NR	2.60E-5	0.08	8.0E-6	NA	NA	8,100	Solid	335.29
2,2,4-Trimethyl pentane	540841	NR	NR	3.13E+0	0.08	8.0E-6	0.011	10	2,330	Liquid	114.23
2,4,4-Trimethyl-2-pentene (I)	107404	NR	NR	8.81E-1	0.08	8.0E-6	NA	NA	11,900	Liquid	112.2
1,2,4-Trimethylbenzene (I)	95636	NR	NR	5.87E-3	0.08	8.0E-6	0.009	112	55,890	Liquid	120.2
1,3,5-Trimethylbenzene (I)	108678	NR	NR	7.38E-3	0.08	8.0E-6	NA	122	61,150	Liquid	120.2
Triphenyl phosphate	115866	NR	NR	3.60E-7	0.08	8.0E-6	NA	NA	1,430	Liquid	326.3
tris(2,3-Dibromopropyl)phosphate	126727	NR	NR	3.00E-5	0.08	8.0E-6	NA	NA	4,700	Liquid	697.67
Urea	57136	NR	NR	NR	0.08	8.0E-6	NA	NA	NA	Solid	60.07
Vanadium	7440622	NR	1,000	NR	NR	NR	NA	NA	NA	Inorganic	50.942
Vinyl acetate (I)	108054	NR	NR	5.11E-4	0.085	9.2E-6	0.026	18	2.00E+7	Liquid	86.09
Vinyl chloride	75014	NR	NR	2.70E-2	0.106	1.23E-5	0.036	NA	2.76E+6	Liquid	62.5
White phosphorus (R)	12185103	NR	NA	NR	NR	NR	NA	NA	NA	Inorganic	123.9
Xylenes (I)	1330207	NR	NR	6.04E-3	0.078	3.21E-5	NA	NA	1.86E+5	Liquid	106.17
Zinc (B)	7440666	NR	62	NR	NR	NR	NA	NA	NA	Inorganic	65.39

FOOTNOTES
for
Part 201 Criteria and Part 213 Risk-Based Screening Levels
Document Release Date: September 28, 2012

(A) Criterion is the state of Michigan drinking water standard established pursuant to Section 5 of 1976 PA 399, MCL 325.1005.

(B) Background, as defined in R 299.5701(b), may be substituted if higher than the calculated cleanup criterion. Background levels may be less than criteria for some inorganic compounds.

(C) Value presented is a screening level based on the chemical-specific generic soil saturation concentration (C_{sat}) since the calculated risk-based criterion is greater than C_{sat}. Concentrations greater than C_{sat} are acceptable cleanup criteria for this pathway where a site-specific demonstration indicates that free-phase material containing a hazardous substance is not present.

(D) Calculated criterion exceeds 100 percent, hence it is reduced to 100 percent or 1.0E+9 parts per billion (ppb).

(E) Criterion is the aesthetic drinking water value, as required by Section 20120a(5) of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). A notice of aesthetic impact may be employed as an institutional control mechanism if groundwater concentrations exceed the aesthetic drinking water criterion, but do not exceed the applicable health-based drinking water value provided in the following table:

Hazardous Substance	Chemical Abstract Service Number	Residential Health-Based Drinking Water Value	Non-Residential Health-Based Drinking Water Value
Aluminum	7429905	300	4,100
tertiary Amyl methyl ether	994058	910	2,600
Copper	7440508	1,400	4,000
Diethyl ether	60297	3,700	10,000
Ethylbenzene	100414	700	700
Iron	7439896	2,000	5,600
Manganese	7439965	860	2,500
Methyl-tert-butyl ether (MTBE)	1634044	240	690
Toluene	108883	1,000	1,000
1,2,4-Trimethylbenzene	95636	1,000	2,900
1,3,5-Trimethylbenzene	108678	1,000	2,900
Xylenes	1330207	10,000	10,000

(F) Criterion is based on adverse impacts to plant life and phytotoxicity.

(G) Groundwater surface water interface (GSI) criterion depends on the pH or water hardness, or both, of the receiving surface water. The final chronic value (FCV) for the protection of aquatic life shall be calculated based on the pH or hardness of the receiving surface water. Where water hardness exceeds 400 mg $CaCO_3$/L, use 400 mg $CaCO_3$/L for the FCV calculation. The FCV formula provides values in units of ug/L or ppb. The generic GSI criterion is the lesser of the calculated FCV, the wildlife value (WV), and the surface water human non-drinking water value (HNDV). The soil GSI protection criteria for these hazardous substances are the greater of the 20 times the GSI criterion or the GSI soil-water partition values using the GSI criteria developed with the procedure described in this footnote.

Hazardous Substance	FCV Formula ug/L	FCV Conversion Factor (CF)	WV ug/L	HNDV ug/L
Acetate	EXP(0.2732*(pH) + 7.0362)	NA	NA	1.3E+6
Acetic Acid	EXP(0.2732*(pH) + 7.0362)	NA	NA	1.3E+6
Barium	EXP(1.0629*(LnH)+1.1869)	NA	NA	1.6E+5
Beryllium	EXP(2.5279*(LnH)-10.7689)	NA	NA	1,200
Cadmium⊗	(EXP(0.7852*(LnH)-2.715))*CF	1.101672-((LnH)*(0.041838))	NA	130
Chromium (III) ⊗	(EXP(0.819*(LnH)+0.6848))*CF	0.86	NA	9,400
Copper	(EXP(0.8545*(LnH)-1.702)) *CF	0.96	NA	38,000
Lead⊗	(EXP(0.9859*(LnH)-1.270))*CF	1.46203-((LnH)*(0.14571))	NA	190
Manganese⊗	EXP(0.8784*(LnH)+3.5385)	NA	NA	59,000
Nickel	(EXP(0.846*(LnH)+0.0584))*CF	0.997	NA	2.1E+5
Pentachlorophenol⊗	EXP(1.005*(pH)-5.134)	NA	NA	2.8
Zinc	(EXP(0.8473*(LnH)+0.884))*CF	0.986	NA	16,000

where,

EXP(x) = The base of the natural logarithm raised to power x (e^x).
LnH = The natural logarithm of water hardness in mg $CaCO_3$/L.
* = The multiplication symbol.
⊗ = The GSI criterion developed here may not be protective for surface water that is used as a drinking water source. Refer to footnote (X) for further guidance.

A spreadsheet that may be used to calculate GSI and GSI protection criteria for (G)-footnoted hazardous substances is available on the Department of Environmental Quality (DEQ) internet web site.

(H) Valence-specific chromium data (Cr III and Cr VI) shall be compared to the corresponding valence-specific cleanup criteria. If both Cr III and Cr VI are present in groundwater, the total concentration of both cannot exceed the drinking water criterion of 100 ug/L. If analytical data are provided for total chromium only, they shall be compared to the cleanup criteria for Cr VI. Cr III soil cleanup criterion for protection of drinking water can only be used at sites where groundwater is prevented from being used as a public water supply, currently and in the future, through an approved land or resource use restriction.

(I) Hazardous substance may exhibit the characteristic of ignitability as defined in 40 C.F.R. §261.21 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these rules of $45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, Remediation and Redevelopment Division (RRD), 525 West Allegan Street, Lansing, Michigan 48933, at cost.

(J) Hazardous substance may be present in several isomer forms. Isomer-specific concentrations shall be added together for comparison to criteria.

(K) Hazardous substance may be flammable or explosive, or both.

(L) Criteria for lead are derived using a biologically based model, as allowed for under Section 20120a(10) of the NREPA, and are not calculated using the algorithms and assumptions specified in pathway-specific rules. The generic residential drinking water criterion of 4 ug/L is linked to the generic residential soil direct contact criterion of 400 mg/kg. A higher concentration in the drinking water, up to the state action level of 15 ug/L, may be allowed as a site-specific remedy and still allow for drinking water use, under Section 20120a(2) of the NREPA if soil concentrations are appropriately lower than 400 mg/kg. If a site-specific criterion is approved based on this subdivision, a notice shall be filed on the deed for all property where the groundwater concentrations will exceed 4 ug/L to provide notice of the potential for unacceptable risk if soil or groundwater concentrations increase. Acceptable combinations of site-specific soil and drinking water concentrations are presented in the following table:

Acceptable Combinations of Lead in Drinking Water and Soil

Drinking Water Concentration (ug/L)	Soil Concentration (mg/kg)
5	386-395
6	376-385
7	376-385
8	366-375
9	356-365
10	346-355
11	336-345
12	336-345
13	326-335
14	316-325
15	306-315

(M) Calculated criterion is below the analytical target detection limit, therefore, the criterion defaults to the target detection limit.

(N) The concentrations of all potential sources of nitrate-nitrogen (e.g., ammonia-N, nitrite-N, nitrate-N) in groundwater that is used as a source of drinking water shall not, when added together, exceed the nitrate drinking water criterion of 10,000 ug/L. Where leaching to groundwater is a relevant pathway, soil concentrations of all potential sources of nitrate-nitrogen shall not, when added together, exceed the nitrate drinking water protection criterion of 2.0E+5 ug/kg.

(O) The concentration of all polychlorinated and polybrominated dibenzodioxin and dibenzofuran isomers present at a facility, expressed as an equivalent concentration of 2,3,7,8-tetrachlorodibenzo-p-dioxin based upon their relative potency, shall be added together and compared to the criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin. The generic cleanup criteria for 2,3,7,8-tetrachlorodibenzo-p-dioxin are not calculated according to the algorithms presented in R 299.5714 to R 299.5726. The generic cleanup criteria are being held at the values that the DEQ has used since August 1998, in recognition of the fact that national efforts to reassess risks posed by dioxin are not yet complete. Until these studies are complete, it is premature to select a revised slope factor and/or reference dose for calculation of generic cleanup criteria.

(P) Amenable cyanide methods or method OIA-1677 shall be used to quantify cyanide concentrations for compliance with all groundwater criteria. Total cyanide methods or method OIA-1677 shall be used to quantify cyanide concentrations for compliance with soil criteria. Nonresidential direct contact criteria may not be protective of the potential for release of hydrogen cyanide gas. Additional land or resource use restrictions may be necessary to protect for the acute inhalation concerns associated with hydrogen cyanide gas.

(Q) Criteria for carcinogenic polycyclic aromatic hydrocarbons were developed using relative potential potencies to benzo(a)pyrene.

(R) Hazardous substance may exhibit the characteristic of reactivity as defined in 40 C.F.R. §261.23 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these rules of $45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost.

(S) Criterion defaults to the hazardous substance-specific water solubility limit.

(T) Refer to the federal Toxic Substances Control Act (TSCA), 40 C.F.R. §761, Subpart D and 40 C.F.R. §761, Subpart G, to determine the applicability of TSCA cleanup standards. Subpart D and Subpart G of 40 C.F.R. §761 (July 1, 2001) are adopted by reference in these rules and are available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulations may be purchased, at a cost as of the time of adoption of these rules of $55, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401, or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost. Alternatives to compliance with the TSCA standards listed below are possible under 40 C.F.R. §761 Subpart D. New releases may be subject to the standards identified in 40 C.F.R. §761, Subpart G. Use Part 201 soil direct contact cleanup criteria in the following table if TSCA standards are not applicable.

Land Use Category	**TSCA, Subpart D Cleanup Standards**	**Part 201 Soil Direct Contact Cleanup Criteria**
Residential	1,000 ppb, or 10,000 ppb if capped	4,000 ppb
Nonresidential	1,000 ppb, or 10,000 ppb if capped	16,000 ppb

(U) Hazardous substance may exhibit the characteristic of corrosivity as defined in 40 C.F.R. §261.22 (revised as of July 1, 2001), which is adopted by reference in these rules and is available for inspection at the DEQ, 525 West Allegan Street, Lansing, Michigan. Copies of the regulation may be purchased, at a cost as of the time of adoption of these rules of $45, from the Superintendent of Documents, Government Printing Office, Washington, DC 20401 (stock number 869-044-00155-1), or from the DEQ, RRD, 525 West Allegan Street, Lansing, Michigan 48933, at cost.

(V) Criterion is the aesthetic drinking water value as required by Section 20120(a)(5) of the NREPA. Concentrations up to 200 ug/L may be acceptable, and still allow for drinking water use, as part of a site-specific cleanup under Section 20120a(2) of the NREPA.

(W) Concentrations of trihalomethanes in groundwater shall be added together to determine compliance with the Michigan drinking water standard of 80 ug/L. Concentrations of trihalomethanes in soil shall be added together to determine compliance with the drinking water protection criterion of 1,600 ug/kg.

(X) The GSI criterion shown in the generic cleanup criteria tables is not protective for surface water that is used as a drinking water source. For a groundwater discharge to the Great Lakes and their connecting waters or discharge in close proximity to a water supply intake in inland surface waters, the generic GSI criterion shall be the surface water human drinking water value (HDV) listed in the table in this footnote, except for those HDV indicated with an asterisk. For HDV with an asterisk, the generic GSI criterion shall be the lowest of the HDV, the WV, and the calculated FCV. See formulas in footnote (G). Soil protection criteria based on the HDV shall be as listed in the table in this footnote, except for those values with an asterisk. Soil GSI protection criteria based on the HDV shall be as listed in the table in this footnote, except for those values with an asterisk. Soil GSI protection criteria for compounds with an asterisk shall be the greater of 20 times the GSI criterion or the GSI soil-water partition values using the GSI criteria developed with the procedure described in this footnote.

Hazardous Substance	Chemical Abstract Service Number	Surface Water Human Drinking Water Values (HDV) (ug/L)	Soil GSI Protection Criteria for HDV (ug/kg)
Acrylamide	79061	0.5 (M); 0.12	10
Alachlor	15972608	3.5	88
Antimony	7440360	2.0 (M); 1.7	1,200
Benzene	71432	12	240
Boron	7440428	4,000	80,000
Bromate	15541454	10 (M); 0.5	200
n-Butanol	71363	3,500	70,000
Butyl benzyl phthalate	85687	6.9	13,000
Cadmium	7440439	2.5*	*
Carbon tetrachloride	56235	5.6	110
Chloride	16887006	50,000	1.0E+6
Chloroethane	75003	170	3,400
Chromium (III)	16065831	120*	*
Cyanazine	21725462	2.0 (M); 0.93	200 (M); 40
1,2-Dichloroethane	107062	6.0	120
trans-1,2-Dichloroethylene	156605	470	9,400
1,2-Dichloropropane	78875	9.1	180
1,3-Dichloropropene	542756	3.3	100 (M); 66
N,N-Dimethylacetamide	127195	700	14,000
1,4-Dioxane	123911	34	680
Ethylene dibromide	106934	0.17	20 (M); 3.4
Ethylene glycol	107211	56,000	1.1E+6
Hexachloroethane	67721	5.3	310
Isophorone	78591	310	6,200
Isopropyl alcohol	67630	28,000	5.6E+5
Lead	7439921	14*	*
Manganese	7439965	1,300*	*
Methanol	67561	14,000	2.8E+5
Methyl-tert-butyl ether (MTBE)	1634044	100	2,000
Methylene chloride	75092	47	940
Molybdenum	7439987	120	2,400
Nitrobenzene	98953	4.7	330 (M); 94
Pentachlorophenol	87865	1.8*	*
Styrene	100425	20	530
1,2,4,5-Tetrachlorobenzene	95943	2.8	3,300
1,1,2,2-Tetrachloroethane	79345	3.2	64
Tetrachloroethylene	127184	11	220
Tetrahydrofuran	109999	350	7,000
Thallium	7440280	2.0 (M); 1.2	1,400
1,2,4-Trichlorobenzene	120821	80	4,700
1,1,2-Trichloroethane	79005	12	240
Trichloroethylene	79016	29	580
Vinyl chloride	75014	1.0 (M); 0.25	40 (M); 20

(Y) Source size modifiers shown in the following table shall be used to determine soil inhalation criteria for ambient air when the source size is not one-half acre. The modifier shall be multiplied by the generic soil inhalation criteria shown in the table of generic cleanup criteria to determine the applicable criterion.

Source Size sq. feet or acres	Modifier
400 sq feet	3.17
1000 sq feet	2.2
2000 sq feet	1.76
1/4 acre	1.15
1/2 acre	1
1 acre	0.87
2 acre	0.77
5 acre	0.66
10 acre	0.6
32 acre	0.5
100 acre	0.43

(Z) Mercury is typically measured as total mercury. The generic cleanup criteria, however, are based on data for different species of mercury. Specifically, data for elemental mercury, chemical abstract service (CAS) number 7439976, serve as the basis for the soil volatilization to indoor air criteria, groundwater volatilization to indoor air, and soil inhalation criteria. Data for methyl mercury, CAS number 22967926, serve as the basis for the GSI criterion; and data for mercuric chloride, CAS number 7487947, serve as the basis for the drinking water, groundwater contact, soil direct contact, and the groundwater protection criteria. Comparison to criteria shall be based on species-specific analytical data only if sufficient facility characterization has been conducted to rule out the presence of other species of mercury.

(AA) Comparison to these criteria may take into account an evaluation of whether the hazardous substances are adsorbed to particulates rather than dissolved in water and whether filtered groundwater samples were used to evaluate groundwater.

(BB) The state drinking water standard for asbestos is in units of fibers per milliliter of water (f/mL) longer than 10 millimicrons. Soil concentrations of asbestos are determined by polarized light microscopy.

(CC) Groundwater: The generic GSI criteria are based on the toxicity of unionized ammonia (NH_3); the criteria are 29 ug/L and 53 ug/L for cold water and warm water surface water, respectively. As a result, the GSI criterion shall be compared to the percent of the total ammonia concentration in the groundwater that will become NH_3 in the surface water. This percent NH_3 is a function of the pH and temperature of the receiving surface water and can be estimated using the following table, taken from Emerson, et al., (Journal of the Fisheries Research Board of Canada, Volume 32(12):2382, 1975).

Percent NH_3 in Aqueous Ammonia Solutions for 0-30 ^oC and pH 6-10

Temp (^oF)	Temp (^oC)	pH 6.0	6.5	7.0	7.5	8.0	8.5	9.0	9.5	10.0
32.0	0	0.00827	0.0261	0.0826	0.261	0.820	2.55	7.64	20.7	45.3
33.8	1	0.00899	0.0284	0.0898	0.284	0.891	2.77	8.25	22.1	47.3
35.6	2	0.00977	0.0309	0.0977	0.308	0.968	3.00	8.90	23.6	49.4
37.4	3	0.0106	0.0336	0.106	0.335	1.05	3.25	9.60	25.1	51.5
39.2	4	0.0115	0.0364	0.115	0.363	1.14	3.52	10.3	26.7	53.5
41.0	5	0.0125	0.0395	0.125	0.394	1.23	3.80	11.1	28.3	55.6
42.8	6	0.0136	0.0429	0.135	0.427	1.34	4.11	11.9	30.0	57.6
44.6	7	0.0147	0.0464	0.147	0.462	1.45	4.44	12.8	31.7	59.5
46.4	8	0.0159	0.0503	0.159	0.501	1.57	4.79	13.7	33.5	61.4
48.2	9	0.0172	0.0544	0.172	0.542	1.69	5.16	14.7	35.3	63.3
50.0	10	0.0186	0.0589	0.186	0.586	1.83	5.56	15.7	37.1	65.1
51.8	11	0.0201	0.0637	0.201	0.633	1.97	5.99	16.8	38.9	66.8
53.6	12	0.0218	0.0688	0.217	0.684	2.13	6.44	17.9	40.8	68.5
55.4	13	0.0235	0.0743	0.235	0.738	2.30	6.92	19.0	42.6	70.2
57.2	14	0.0254	0.0802	0.253	0.796	2.48	7.43	20.2	44.5	71.7
59.0	15	0.0274	0.0865	0.273	0.859	2.67	7.97	21.5	46.4	73.3
60.8	16	0.0295	0.0933	0.294	0.925	2.87	8.54	22.8	48.3	74.7
62.6	17	0.0318	0.101	0.317	0.996	3.08	9.14	24.1	50.2	76.1
64.4	18	0.0343	0.108	0.342	1.07	3.31	9.78	25.5	52.0	77.4
66.2	19	0.0369	0.117	0.368	1.15	3.56	10.5	27.0	53.9	78.7
68.0	20	0.0397	0.125	0.396	1.24	3.82	11.2	28.4	55.7	79.9
69.8	21	0.0427	0.135	0.425	1.33	4.10	11.9	29.9	57.5	81.0
71.6	22	0.0459	0.145	0.457	1.43	4.39	12.7	31.5	59.2	82.1
73.4	23	0.0493	0.156	0.491	1.54	4.70	13.5	33.0	60.9	83.2
75.2	24	0.0530	0.167	0.527	1.65	5.03	14.4	34.6	62.6	84.1
77.0	25	0.0569	0.180	0.566	1.77	5.38	15.3	36.3	64.3	85.1
78.8	26	0.0610	0.193	0.607	1.89	5.75	16.2	37.9	65.9	85.9
80.6	27	0.0654	0.207	0.651	2.03	6.15	17.2	39.6	67.4	86.8
82.4	28	0.0701	0.221	0.697	2.17	6.56	18.2	41.2	68.9	87.3
84.2	29	0.0752	0.237	0.747	2.32	7.00	19.2	42.9	70.4	88.3
86.0	30	0.0805	0.254	0.799	2.48	7.46	20.3	44.6	71.8	89.0

The generic approach for estimating NH_3 assumes a default pH of 8 and default temperatures of 68°F and 85°F for cold water and warm water surface water, respectively. The resulting percent NH_3 is 3.8 percent and 7.2 percent for cold water and warm water, respectively. This default percentage shall be multiplied by the total ammonia-nitrogen (NH_3-N) concentration in the groundwater and the resulting NH_3 concentration compared to the applicable GSI criterion. As an alternative, the maximum pH and temperature data from the specific receiving surface water can be used to estimate, from the table in this footnote, a lower percent unionized ammonia concentration for comparison to the generic GSI.

Soil: The generic soil GSI protection criteria for unionized ammonia are 580 ug/kg and 1,100 ug/kg for cold water and warm water surface water, respectively.

(DD) Hazardous substance causes developmental effects. Residential direct contact criteria are protective of both prenatal and postnatal exposure. Nonresidential direct contact criteria are protective for a pregnant adult receptor.

(EE) The following are applicable generic GSI criteria as required by Section 20120a(15) of the NREPA.

Hazardous Substance	GSI (ug/L)	Notes
Phosphorus	1,000	Criteria applicable unless receiving water is a surface water that has a phosphorus waste load allocation or is an inland lake. In those cases, contact the department for applicable values.
Total dissolved solids (TDS)	5.0E+5	If TDS data are not available, the TDS criterion may be used a screening level for the sum of the concentrations of the following substances: Calcium, Chlorides, Iron, Magnesium, Potassium, Sodium, Sulfate.
Dissolved Oxygen (DO): Cold receiving waters Warm receiving waters	 ≥ 7,000 ≥ 5,000	Since a low level of DO can be harmful to aquatic life, the criterion represents a minimum level that on-site samples must exceed. This is in contrast to other criteria which represent "not to exceed" concentrations. DO criteria are not applicable if groundwater Carbonaceous Biochemical Oxygen Demand (CBOD) is less than 10,000 ug/L and groundwater ammonia concentration is less than 2,000 ug/L.

(FF) The chloride GSI criterion shall be 125 mg/l when the discharge is to surface waters of the state designated as public water supply sources or 50 mg/l when the discharge is to the Great Lakes or connecting waters. Chloride GSI criteria shall not apply for surface waters of the state that are not designated as a public water supply source, however, the total dissolved solids criterion is applicable.

(GG) Risk-based criteria are not available for methane due to insufficient toxicity data. An acceptable soil gas concentration (presented for both residential and nonresidential land uses) was derived utilizing 25 percent of the lower explosive level for methane. This equates to 1.25 percent or 8.4E+6 ug/m^3.

"ID" means insufficient data to develop criterion.
"NA" means a criterion or value is not available or, in the case of background and CAS numbers, not applicable.
"NLL" means hazardous substance is not likely to leach under most soil conditions.
"NLV" means hazardous substance is not likely to volatilize under most conditions.

Appendix O

August 2017 Media Specific VIA RIASL Guidance

Media-Specific Volatilization to Indoor Air Interim Action Screening Levels

August 2017

CAS #	Hazardous Substance	INDOOR AIR RES RIASL $\mu g/m^3$	INDOOR AIR RES TSRIASL $\mu g/m^3$	INDOOR AIR NONRES RIASL $\mu g/m^3$	INDOOR AIR NONRES $RIASL_{12}$ $\mu g/m^3$	INDOOR AIR NONRES $TSRIASL_{12}$ $\mu g/m^3$	SOIL VAPOR (INCLUDING SUBSLAB) RES RIASL $\mu g/m^3$	SOIL VAPOR (INCLUDING SUBSLAB) RES TS RIASL $\mu g/m^3$	SOIL VAPOR (INCLUDING SUBSLAB) NONRES RIASL $\mu g/m^3$	SOIL VAPOR (INCLUDING SUBSLAB) NONRES $RIASL_{12}$ $\mu g/m^3$	SOIL VAPOR (INCLUDING SUBSLAB) NONRES $TSRIASL_{12}$ $\mu g/m^3$
67641	Acetone	31,000	31,000	31,000	31,000	31,000	1.0E+06	1.0E+06	1.0E+06	1.0E+06	1.0E+06
7664417	Ammonia	520	1,200	1,200	1,200	1,200	17,000	40,000	40,000	40,000	40,000
71432	Benzene	3.3	19.0	7.7	15	54	110	630	260	510	1,800
57749	Chlordane	0.20	0.20	0.28	0.56	0.56	6.7	6.7	9.3	19	19
108907	Chlorobenzene	52	160	77	150	460	1,700	5,200	2,600	5,100	15,000
75003	Chloroethane	4,200	13,000	6,100	12,000	36,000	1.4E+05	4.2E+05	2.0E+05	4.1E+05	1.2E+06
67663	Chloroform	1.1	11	2.6	5.2	52	37	370	87	170	1,700
74873	Chloromethane	94	280	140	280	410	3,100	9,400	4,600	9,200	14,000
541731	1,3-Dichlorobenzene	3.1	9.3	4.6	9.2	28	100	310	150	310	920
106467	1,4-Dichlorobenzene	6.5	65	15	30	300	220	2,200	510	1,000	10,000
75343	1,1-Dichloroethane	16	160	37	74	740	530	5,300	1,200	2,500	25,000
75354	1,1-Dichloroethylene	210	630	310	620	1,900	7,000	21,000	10,000	20,000	61,000
156592	cis-1,2-Dichloroethylene	8.3	25	12	24	72	280	830	410	820	2,500
156605	trans-1,2-Dichloroethylene	270	790	790	790	790	9,000	26,000	26,000	26,000	26,000
64175	Ethanol	19,000	19,000	19,000	19,000	19,000	6.3E+05	6.3E+05	6.3E+05	6.3E+05	6.3E+05
100414	Ethylbenzene	10	100	24	48	480	340	3,400	800	1,600	16,000
110543	n-Hexane	730	2,200	1,100	2,200	6,600	24,000	73,000	36,000	72,000	2.1E+05
Varies	Mercury (total)	0.31	0.93	0.46	0.92	2.8	10	31	15	31	92
1634044	Methyl-tert-butyl ether (MTBE)	98	980	230	460	4600	3300	33,000	7700	15,000	1.5E+05

Media-Specific Volatilization to Indoor Air Interim Action Screening Levels

August 2017

		INDOOR AIR					SOIL VAPOR (INCLUDING SUBSLAB)				
		RES		NONRES			RES		NONRES		
CAS #	Hazardous Substance	RIASL µg/m^3	TSRIASL µg/m^3	RIASL µg/m^3	$RIASL_{12}$ µg/m^3	$TSRIASL_{12}$ µg/m^3	RIASL µg/m^3	TS RIASL µg/m^3	RIASL µg/m^3	$RIASL_{12}$ µg/m^3	$TSRIASL_{12}$ µg/m^3
75092	Methylene chloride	630	1,000	920	1,800	2,900	21,000	33,000	31,000	61,000	97,000
127184	Tetrachloroethylene	41	41	41	82	82	1,400	1,400	1,400	2,700	2,700
108883	Toluene	5,200	7,500	7,500	7,500	7,500	1.7E+05	2.5E+05	2.5E+05	2.5E+05	2.5E+05
120821	1,2,4-Trichlorobenzene	2.1	6.3	3.1	6.2	19	70	210	100	200	610
71556	1,1,1-Trichloroethane	5,000	5,000	7,000	7,000	7,000	1.7E+05	1.7E+05	2.3E+05	2.3E+05	2.3E+05
79016	Trichloroethylene	2.0	6.0	2.0	4.0	12	67	200	67	130	400
526738	1,2,3-Trimethylbenzene	63	190	92	180	560	2,100	6,300	3,100	6,100	18,000
95636	1,2,4-Trimethylbenzene	63	190	92	180	560	2,100	6,300	3,100	6,100	18,000
108678	1,3,5-Trimethylbenzene	63	190	92	180	560	2,100	6,300	3,100	6,100	18,000
108054	Vinyl acetate	210	630	310	620	1,900	7,000	21,000	10,000	20,000	61,000
75014	Vinyl chloride	1.6	16	14	28	280	54	540	450	910	9,100
1330207	Xylenes	230	690	340	680	2,000	7,600	23,000	11,000	22,000	67,000

Footnote **RIASL**: Recommended Interim Action Screening Levels. Nonresidential RIASL for soil vapor, soil, shallow groundwater, and groundwater is based on a former residential structure that is now nonresidential use that has an unoccupied basement.

Footnote **$RIASL_{12}$**: Nonresidential Recommended Interim Action Screening Levels appropriate for exposures less than 12 hours.

Footnote **TSRIASL**: Time-Sensitive Recommended Interim Action Screening Levels.

Footnote **$TSRIASL_{12}$**: Time-Sensitive Recommended Interim Action Screening Levels appropriate for exposures less than 12 hours for structures that were not formerly residential houses. It may be appropriate to take expedited response actions at former residential structures when concentrations are less than those identified.

Footnote **GW**: The calculated value for a hazardous substance based upon shallow groundwater is considered protective when it is greater than the calculated value for groundwater.

Footnote **M**: Site-specific criterion may be below target detection limits (TDL).

Footnote **S**: Calculated health-based value exceeds the hazardous substance-specific water solubility limit; therefore, the water solubility limit is the criterion.

Media-Specific Volatilization to Indoor Air Interim Action Screening Levels

August 2017

		SOIL		SHALLOW GROUNDWATER		GROUNDWATER				
		RES	NONRES	RES	NONRES	RES		NONRES		
		RIASL	RIASL	RIASL	RIASL	RIASL	TSRIASL	RIASL	$RIASL_{12}$	$TSRIASL_{12}$
CAS #	Hazardous Substance	µg/kg	µg/kg	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
67641	Acetone	2.6E+05	7.8E+05	50,000	62,000	1.2E+07	1.2E+07	4.7E+07	4.7E+07	1.6E+08
7664417	Ammonia	NA	NA	1,900	2,200	2.5E+05	5.7E+05	2.3E+06	2.3E+06	8.9E+06
71432	Benzene	1.7 (M)	12 (M)	1.0	3.0	14	82	120	230	2,600
57749	Chlordane	13,000	55,000	18	26	56 (S)	56 (S)	56 (S)	56 (S)	56 (S)
108907	Chlorobenzene	82	360	33	54	540	1,600	2,700	5,400	50,000
75003	Chloroethane	330	1,500	620	1,300	6,700	20,000	35,000	69,000	6.7E+05
67663	Chloroform	0.26 (M)	1.9 (M)	0.49 (M)	1.3	7.6	76	61	120	3,800
74873	Chloromethane	6.9 (M)	31 (M)	15	30	160	470	810	1,600	8,000
541731	1,3-Dichlorobenzene	10 (M)	45 (M)	2.6	4.2	52	150	250	510	4,600
106467	1,4-Dichlorobenzene	23 (M)	160	5.9	15	120	1,200	930	1,900	57,000
75343	1,1-Dichloroethane	2.6 (M)	19 (M)	4.7	14	67	670	540	1,100	34,000
75354	1,1-Dichloroethylene	12 (M)	54	18	45	170	510	860	1,700	16,000
156592	cis-1,2-Dichloroethylene	2.1 (M)	9.2 (M)	3.4	5.8	48	140	240	490	4,600
156605	trans-1,2-Dichloroethylene	39 (M)	340	27	78	650	1,900	6,500	6,500	21,000
64175	Ethanol	1.3E+06	4.0E+06	1.0E+05	1.2E+05	5.0E+07	5.0E+07	2.0E+08	2.0E+08	7.7E+08
100414	Ethylbenzene	12 (M)	86	2.8	8.5	45	450	360	710	22,000
110543	n-Hexane	25	110	29	130	29 (GW)	33	130 (GW)	130 (GW)	6,000 (GW)
Varies	Mercury (total)	2.7E-02	0.12	8.8E-02	0.14	1.4	4.3	7.2	14	60 (S)
1634044	Methyl-tert-butyl ether (MTBE)	74 (M)	520	2.5E+02	610	4,000	40,000	32,000	65,000	2.0E+06

Media-Specific Volatilization to Indoor Air Interim Action Screening Levels

August 2017

CAS #	Hazardous Substance	SOIL		SHALLOW GROUNDWATER		GROUNDWATER				
		RES	NONRES	RES	NONRES	RES		NONRES		
		RIASL	RIASL	RIASL	RIASL	RIASL	TSRIASL	RIASL	$RIASL_{12}$	$TSRIASL_{12}$
		µg/kg	µg/kg	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l	µg/l
75092	**Methylene chloride**	130	570	79	490	3,900	6,200	20,000	40,000	2.0E+05
127184	**Tetrachloroethylene**	6.2 (M)	19 (M)	1.5	4.4	96	96	320	640	1,900
108883	**Toluene**	3,700	16,000	300	850	23,000	33,000	1.1E+05	1.1E+05	3.5E+05
120821	**1,2,4-Trichlorobenzene**	53 (M)	230 (M)	3.8 (M)	5.8	95	290	460	920	8,100
71556	**1,1,1-Trichloroethane**	450	1,900	180	750	8,600	8,600	41,000	41,000	1.2E+05
79016	**Trichloroethylene**	0.33 (M)	1.0 (M)	7.3E-02 (M)	0.21 (M)	6.1	18	21	41	380
526738	**1,2,3-Trimethylbenzene**	270	1,200	43	71	800	2,400	3,900	7,900	72,000
95636	**1,2,4-Trimethylbenzene**	150	650	25	44	440	1,300	2,200	4,400	40,000
108678	**1,3,5-Trimethylbenzene**	100	450	18	34	310	940	1,500	3,100	28,000
108054	**Vinyl acetate**	160 (M)	720 (M)	690	1,000	10,000	30,000	52,000	1.0E+05	9.9E+05
75014	**Vinyl chloride**	8.2E-02 (M)	2.0 (M)	0.12 (M)	1.8	0.96 (M)	9.6	28	56	1,800
1330207	**Xylenes**	280	1,200	75	140	1,200	3,600	6,000	12,000	1.1E+05 (S)

Footnote **RIASL**: Recommended Interim Action Screening Levels. Nonresidential RIASL for soil vapor, soil, shallow groundwater, and groundwater is based on a former residential structure that is now nonresidential use that has an unoccupied basement.

Footnote **$RIASL_{12}$**: Nonresidential Recommended Interim Action Screening Levels appropriate for exposures less than 12 hours.

Footnote **TSRIASL**: Time-Sensitive Recommended Interim Action Screening Levels.

Footnote **$TSRIASL_{12}$**: Time-Sensitive Recommended Interim Action Screening Levels appropriate for exposures less than 12 hours for structures that were not formerly residential houses. It may be appropriate to take expedited response actions at former residential structures when concentrations are less than those identified.

Footnote **GW**: The calculated value for a hazardous substance based upon shallow groundwater is considered protective when it is greater than the calculated value for groundwater.

Footnote **M**: Site-specific criterion may be below target detection limits (TDL).

Footnote **S**: Calculated health-based value exceeds the hazardous substance-specific water solubility limit; therefore, the water solubility limit is the criterion.

STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY

Volatilization to Indoor Air
Recommendations for Interim Action Screening Levels and Time-Sensitive Interim Action Screening Levels

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Recommendations from the Toxics Steering Group
Volatilization to Indoor Air Workgroup
January 2017

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Chlordane (CAS# 57-74-9; 12789-03-06) C-11

Chlorobenzene (CAS# 108-90-7) C-13

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Chloroform (CAS#67-66-3) C-158

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Tetrachloroethylene (PCE) (CAS # 127-18-4) C-56
Toluene (CAS# 108-88-3) C-60
1,2,4-Trichlorobenzene (CAS # 120-82-1) C-63
1,1,1-Trichloroethane (CAS# 71-55-6) C-65
Trichloroethylene (CAS # 79-01-6) C-69
Trimethylbenzenes – 1,2,3-trimethylbenzene; 1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene combined (CAS #s 25551-13-7; 526-73-8; 95-63-6; 108-67-8) C-72
Vinyl acetate (CAS#108-05-4) C-74
Vinyl Chloride (CAS# 75-01-4) C-76
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Volatilization to Indoor Air
Toxics Steering Group Volatilization to Indoor Air Workgroup Recommendations for Interim Action Screening Levels and Time-Sensitive Interim Action Screening Levels

1. Background and Purpose

This document is intended to provide recommended interim action screening levels for indoor air and to serve as guidance to staff of the Michigan Department of Environmental Quality (MDEQ) for using these screening levels to evaluate indoor air concentrations associated with volatilization to indoor air that may require interim actions (interim response activity or corrective actions) for protection of public health. The appendices of this document provide the process, basis, and chemical-specific justifications for the recommended interim action screening levels for indoor air.

The volatilization to indoor air pathway (VIAP) (e.g., vapor intrusion, volatilization from groundwater in sumps) is the migration of volatile substances from the subsurface into the indoor air of overlying structures. The VIAP is a highly complex and complicated exposure pathway. The pathway is relevant when a vapor source, a migration route, and human receptors are present. A pathway is relevant even if receptors are not currently occupying a site, but can be expected to in the future. When receptors are present and concentrations of a volatile substance is or is likely to be above screening levels, the VIAP is a substantial concern for public health and generally short-term exposure control may require evacuation/relocation or immediate mitigation to reduce concentrations to acceptable levels. For groundwater (drinking water) contamination, an alternate drinking water supply (e.g., bottled water) can be provided quickly or for soil (direct contact) contamination measures to prevent contact with contaminated soils (e.g., covering, fencing, keeping children away) are rapidly available mitigation measures. Occupants of a building affected by contaminated vapors may require relocation to prevent breathing hazardous concentrations of volatile substances before a mitigation system can be completed. As with other exposure pathways, source control, removal measures, in-situ treatment, or other response activities may be needed to complete cleanup while mitigation measures control exposure in the short term.

The cleanup programs under Part 111, Hazardous Waste Management, Part 201, Environmental Remediation, and Part 213, Leaking Underground Storage Tanks, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, require interim actions as necessary to protect public health and safety. In addition the Public Health Code, PA 368 of 1978, requires public health protection including control of environmental health hazards.

The Toxics Steering Group (TSG) VIAP Workgroup is tasked by the MDEQ and the Michigan Department of Health and Human Services (MDHHS) to evaluate and develop indoor air screening levels for volatile substances that are protective against human health effects that may result from ongoing VIAP exposures. Two sets of screening levels were requested, those requiring expedited mitigation as interim actions and those requiring immediate mitigation or evacuation. The request was to develop screening values that are supported by both the MDEQ and the MDHHS, consistent with the Memorandum of Understanding between the agencies.

A well-developed conceptual site model, as it relates to the potential for VIAP, is critical for a thorough receptor evaluation and the identification of data gaps that need to be filled in order to make response decisions (MDEQ, 2013; U.S. EPA, 2012a, 2012b, 2015). Investigation of the VIAP is conducted using various types of data including the concentrations of contaminants in groundwater, soil gas, sub-slab vapor, and modeled and/or analytical indoor air data. Without measured indoor air data, concentrations reported in the other datasets that are greater than the applicable VIAP screening levels could indicate a potential unacceptable health risk and require collection of indoor air data to more fully characterize current risk to human receptors and sensitive subpopulations. Indoor air data collection should be paired with sub-slab vapor data to assist in determining that concentrations detected in indoor air are resulting from the VIAP and not from other sources (e.g., consumer products). Evaluation of the VIAP may result in expedited mitigation efforts or, in some instances, coordination with the MDHHS for further action. Collection of indoor air data for comparison to the TSG recommended interim action screening levels for indoor air is usually necessary for the MDHHS to make time-sensitive health-based decisions regarding human exposure at or near a contaminated VIAP site.

The initial set of recommended interim action screening levels (RIASLs) and time-sensitive recommended interim action screening levels (TS RIASLs) for residential and nonresidential indoor air exposure scenarios are presented in Tables 1 and 2, respectively. These screening levels are health-based values that represent best available science that, when exceeded, may result in an unacceptable risk to indoor air and a public health concern. The screening levels have been developed and evaluated by the TSG VIAP Workgroup using the decision framework presented in Appendix A. This initial set of chemicals includes hazardous substances frequently detected at sites subject to cleanup requirements under Parts 111, 201, or 213.

The hazardous substances identified in Tables 1 and 2 include developmental toxicants and substances with an Agency for Toxic Substances and Disease Registry (ATSDR) acute or intermediate inhalation minimal risk levels (MRL) or United States Environmental Protection Agency (U.S. EPA) acute or short-term reference concentrations (RfC), as well as those with chronic cancer and noncancer MRLs, RfCs or other health-based values. Since indoor air concentration data and health-based values are reported in different units (e.g., ug/m^3, ppb_{vol}), the RIASLs and TS RIASLs are provided in both types of units. The health-based values are adjusted, as appropriate, in the units from the original source, then converted to the other units. The TSG VIAP Workgroup will develop and recommend indoor air interim action screening levels for additional volatile hazardous substances, with priority given to chemicals of concern, that are identified by field staff during review and investigation of sites with VIAP concerns.

2. Guidance and Implementation of Recommended Interim Action Screening Levels for Indoor Air and Time-Sensitive Recommended Interim Action Screening Levels

2.1 Guidance

Two sets of interim action screening levels for indoor air are recommended by the TSG VIAP Workgroup: RIASL and TS RIASL for both residential and nonresidential exposure scenarios. As mentioned above, these screening levels represent a scientifically-based health protective value that, when exceeded, may result in an unacceptable risk from chemical concentrations in indoor air and a public health concern.

The exceedance of an indoor air RIASL(s) from a VIAP source may require interim response activity or interim measures to be initiated expeditiously to mitigate the exposure(s). Consult your supervisor for guidance on your division's process for filling out an awareness/screening form, prioritization, further evaluation, and/or notification to the MDHHS, as appropriate. It may not be necessary to complete an awareness/screening form in all cases.

The exceedance of an indoor air TS RIASL(s) will require more rapid exposure mitigation, such as immediately increased ventilation, and/or may require a decision to evacuate building occupants in collaboration with the MDHHS. Immediately inform your supervisor for expedited review, action, and/or notification to the MDHHS, as appropriate. If an immediate concern for public health is indicated by any other available data and the conceptual site model, immediately inform your supervisor for guidance on prioritization to proceed with further sampling (i.e., sub-slab vapor and/or indoor air sampling), take other actions, and/or for MDHHS notification, as appropriate.

The MDEQ program contacts are:

- For Remediation and Redevelopment Division (RRD), Field Operations Section Managers
- For Waste Management and Radiological Protection Division (WMRPD), Hazardous Waste Section Manager

The MDHHS with MDEQ support will coordinate with the respective local public health agency for public health decisions and can provide assistance in gaining site access in time-sensitive situations.

The RIASLs were developed consistent with the acceptable risk levels from Part 201 (MCL 324.20120a(4)), concentrations that represent an upper bound cancer risk of one in 100,000 or a hazard quotient (HQ) of one for the most sensitive adverse effect for each hazardous substance. The RIASLs may be different than the acceptable indoor air concentration that served as the basis of the 2002/2013 cleanup criteria for volatilization to indoor air, as the TSG evaluation included updated toxicity information when available for a hazardous substance. The TS RIASLs have been developed to be consistent with U.S. EPA guidance for time-sensitive actions (e.g., removal actions). These RIASLs and TS RIASLs are recommended screening levels to initiate interim actions. These RIASLs and TS RIASLs

are not meant to define protective levels and are not de facto cleanup levels. Nonresidential screening levels are calculated based on a healthy adult worker and assume no dwellings, schools, daycares, doctor's offices, or other locations where sensitive populations are present. Residential screening levels are intended to address places where people live and/or children or other sensitive populations are present (e.g., daycares, schools, doctor's offices).

Indoor air volatile chemical levels can vary substantially (10 to 100 times) within a single building over time due to varying conditions, including weather, building ventilation, diurnal or seasonal conditions (Holton *et al.*, 2013; U.S. EPA, 2012a, 2015). Because of the significant variation in indoor air concentrations, continued sampling and further evaluation is necessary for sites where indoor air concentrations are measured below RIASLs if soil vapor or groundwater concentrations and the conceptual site model indicate there is likely to be a risk. One sampling event resulting in values below a RIASL does not remove the building from further consideration when other information indicates that the VIAP is relevant (ATSDR, 2016; MDEQ, 2013). Further evaluation, including the collection of samples that represent the range of conditions expected at the facility and/or interim actions may need to be considered. Consult your supervisor for guidance on your division's process for filling out an awareness/screening form, further evaluation (e.g., sampling), different prioritization, response action, and/or notification/coordination with the MDHHS.

In some cases, where a building is not currently occupied but soil vapor, groundwater, or soil concentrations indicate it is highly likely that indoor air concentrations will exceed RIASLs or measured indoor air levels exceed RIASLs, interim actions such as presumptive mitigation, a restrictive covenant, or some other reliable exposure control mechanism should be employed to assure public health is protected before the building is reoccupied. Acceptable uses (e.g., nonconforming residential or mixed use) under existing zoning may also require a restrictive covenant or other reliable exposure control be implemented as an interim action if residential RIASLs are exceeded, but not nonresidential RIASLs.

2.2 Implementation

When a VIAP exposure is discovered, in most cases, exposures have been occurring for the building occupants for a long period of time (months to many years). Some exposures have occurred for decades by the time a VIAP assessment has been conducted. Chronic exposure values are appropriate for screening levels if they are lower than acute or short-term inhalation toxicity values. Based on this information, the RIASLs that are recommended are based on the lowest of the calculated developmental, noncancer, cancer or mutagenic acceptable air values (AAVs) as determined by the equations presented in Appendix A appropriate to each hazardous substance unless an acute, short-term, or intermediate health-based inhalation toxicity value is lower (e.g., ATSDR acute or intermediate inhalation MRLs, U.S. EPA acute or short-term RfC). The TS RIASLs are the lowest of three times (3x) an AAV based on a noncancer or developmental endpoint; or ten times (10x) an AAV based on cancer or mutagenic endpoints; or an acute, short-term, or intermediate health-based value (see Appendix A for further details).

For nonresidential RIASLS and TS RIASLs, the assumption of a continuous 24-hour per day exposure time is used in the determination of nonresidential health-based AAVs (Appendix A, equations 6-8). To reflect a more typical, reasonable maximum worker exposure, these values were adjusted to reflect a 12-hour per day exposure at a work place by multiplying the calculated AAV by an additional factor of two (Table A-1); however, this modifying factor is not shown in the equations. The adjusted value remains the generic nonresidential $AAV_{adj,}$ used as above, for determining the nonresidential RIASLs and TS RIASLs. Acute MRLs or RfCs that are based on or adjusted for continuous (24-hour) exposure were adjusted for a 12-hour per day at the work place also. Exposure assumptions for the nonresidential AACs and RIASLs for toluene and 1,1,1-trichloroethane incorporate acute inhalation reference values for exposures lasting less than 12 hours and are not to be adjusted. Intermediate MRLs adjusted for continuous exposure are adjusted for 12-hour per day at the work place and five days at the work place per week. Other adjustment factors for the number of hours per day at the work place may be proposed that reflect site-specific exposure times. If additional adjustments to the residential or nonresidential RIASLs or TS RIASLs are proposed, consult an appropriate MDEQ toxicologist.

If soil vapor and/or other source (e.g., groundwater and/or soil) concentrations in combination with a conceptual site model indicate there is likely to be an unacceptable risk for indoor air exposures for an occupied building (e.g., exceedance of appropriate VIAP media-specific screening levels for soil vapor, groundwater, or soil), it is essential to collect indoor air data as soon as possible to determine if there are unacceptable levels of human exposure. If soil or groundwater data slightly exceed an appropriate media specific screening level, it may be acceptable to collect sub-slab vapor samples to determine if indoor air samples are necessary. Public health decisions require indoor air data as a necessary line of evidence that there is a clear public health hazard. If indoor air sampling is planned, a courtesy notification (awareness/ screening form) to the MDHHS should be provided through the respective Divisions' designated contact. The MDHHS can coordinate with the local health department to facilitate site access and provide public health education. Local public health makes relocation and evacuation decisions, so it is necessary to keep MDHHS advised of indoor air sampling activities in homes and businesses with public access.

Typically, indoor air samples are 24-hour samples. In some cases, other sampling times may be appropriate depending on chemical-specific and site-specific considerations (e.g., 12-hour samples to evaluate workplace exposure scenarios). Prior to collecting samples that are not 24-hour durations, consult with an appropriate toxicologist, the RRD Vapor Intrusion (VI) Technical and Program Support team and/or the WMRPD VI Work Group to confirm the acceptability of the sampling strategy.

Summary of Guidance for Comparing Indoor Air Data to the RIASLs and TS RIASLs:

1. **Indoor Air Concentrations below the RIASLs:** This indicates that immediate action may not be necessary. However, detected indoor air levels below the RIASLs indicate that people are being exposed to chemicals in the indoor air. As noted above, indoor air

levels can vary significantly over time, and be 10 to 100 times higher or lower than measured levels from a single sampling event (U.S. EPA, 2012a, 2015; Holton *et al.*,2013). Additional sampling and evaluation may need to be conducted based on measured values in multiple media (e.g., indoor air, soil vapor, and groundwater), the long- and short-term toxicity considerations of the hazardous substance(s) present, and the conceptual site model to determine the need for mitigation or other exposure control measures. Consult your supervisor for guidance to follow your division's process for filling out an awareness/screening form, different prioritization, further evaluation (e.g., sampling), response action, and/or notification/coordination with the MDHHS. It may not be necessary to complete an awareness/screening form in all cases. Although the indoor air concentrations measured at this time are not likely to be an immediate public health threat, the MDHHS may be able to assist with public health education, access for continued monitoring, and coordination with the local public health agency.

2. **Indoor Air Concentrations above the RIASL but below the TS RIASL:** Mitigation of people's exposure should begin as soon as possible, as levels could vary over time and possibly be higher. Continued sampling will be needed until the mitigation is complete and documented to be effective in reducing the chemical levels in the indoor air below the RIASL(s). Consult your supervisor for guidance to follow your division's process for filling out an awareness/screening form, prioritization, further evaluation, response action and/or notification to the MDHHS, as appropriate.

3. **Indoor Air Concentrations above the TS RIASL:** VIAP mitigation should begin immediately. Immediately inform your supervisor for expedited review, response action, and/or notification to the MDHHS, as appropriate. The MDHHS may determine occupants should not be in the buildings. Continued sampling will be needed until mitigation is complete and documented to be effective in reducing the chemical levels in the indoor air below the RIASL(s) as occupants' actual exposure could have already been months to years.

2.3 Limitations

These RIASLs and TS RIASLs are not intended to define protective levels and are not de facto cleanup levels.

These screening levels are for exposure to a single chemical only. At certain sites, volatilization to indoor air of more than one chemical could be occurring. Lower, more protective screening levels may need to be developed for those sites when the toxicity values are based on the same endpoint (target organ or critical effect(s)) (U.S. EPA 2015; ATSDR 2016). The MDHHS may recommend different screening levels to address human exposure to multiple chemicals and multiple exposure pathways.

Additionally, the MDHHS may recommend different screening levels when addressing sites with sensitive populations. Sensitive populations include, but are not limited to, elderly, women who are or may become pregnant, infants and children, people with chronic illness, or those populations with multiple sources of exposure to chemicals (e.g., environmental justice considerations) (U.S. EPA 2012, 2015).

Table 1 Initial List of Residential (Res) Recommended Interim Action Screening Levels (RIASLs) and Time-Sensitive Recommended Interim Action Screening Levels (TS RIASLs)

Hazardous Substance	Chemical Abstract Service Number	Molecular Weight	Residential RIASL		Basis for Residential RIASL	Residential Time-Sensitive RIASL		Basis for Residential TS RIASL
		g/mol	µg/m³	ppb_{vol}#		µg/m³	ppb_{vol}#	
Acetone	67641	58.08	**31,000**	**13,000**	ATSDR MRL Intermediate	**31,000**	**13,000**	ATSDR MRL Intermediate
Ammonia	7664417	17.03	**520@**	**750@**	Res AAV Noncancer	**1,200@**	**1,700@**	ATSDR MRL Acute
Benzene	71432	78.11	**3.3**	**1.0**	Res AAV Cancer	**19**	**6.0**	ATSDR MRL Intermediate
Chlordane	57749	409.78	**0.20**	**0.012**	ATSDR MRL Intermediate	**0.20**	**0.012**	ATSDR MRL Intermediate
Chlorobenzene*	108907	112.56	**52**	**11**	Res AAV Noncancer	**160**	**35**	3× Res AAV Noncancer
Chloroethane	75003	64.52	**4,200**	**1,600**	Res AAV Noncancer	**13,000**	**4,900**	3× Res AAV Noncancer
Chloroform	67663	119.38	**1.1**	**0.23**	Res AAV Cancer	**11**	**2.3**	10× Res AAV Cancer
Chloromethane	74873	50.49	**94**	**46**	Res AAV Noncancer	**280**	**140**	3× Res AAV Noncancer
1,3-Dichlorobenzene*	541731	147	**3.1**	**0.52**	Res AAV Noncancer	**9.3**	**1.5**	3× Res AAV Noncancer
1,4-Dichlorobenzene	106467	147	**6.5**	**1.1**	Res AAV Cancer	**65**	**11**	10× Res AAV Cancer
1,1-Dichloroethane	75343	98.96	**16**	**4.0**	Res AAV Cancer	**160**	**40**	10× Res AAV Cancer
1,1-Dichloroethylene	75354	96.94	**210**	**53**	Res AAV Noncancer	**630**	**160**	3× Res AAV Noncancer
cis-1,2-Dichloroethylene*	156592	96.94	**8.3**	**2.1**	Res AAV Noncancer	**25**	**6.3**	3× Res AAV Noncancer
trans-1,2-Dichloroethylene*	156605	96.94	**270**	**68**	Res AAV Noncancer	**790**	**200**	ATSDR MRL Acute
Ethanol	64175	46.07	**19,000**	**10,000**	AQD Acute ITSL	**19,000**	**10,000**	AQD Acute ITSL
Ethylbenzene	100414	106.17	**10**	**2.3**	Res AAV Cancer	**100**	**23**	10× Res AAV Cancer
n-Hexane	110543	86.18	**730**	**210**	Res AAV Noncancer	**2,200**	**620**	3× Res AAV Noncancer

Hazardous Substance	Chemical Abstract Service Number	Molecular Weight	Residential RIASL		Basis for Residential RIASL	Residential Time-Sensitive RIASL		Basis for Residential TS RIASL
		g/mol	**µg/m³**	**ppb$_{vol}$#**		**µg/m³**	**ppb$_{vol}$#**	
Mercury, elemental	7439976	200.59	**0.31**	**0.038**	Res AAV Noncancer	**0.93**	**0.11**	3× Res AAV Noncancer
Methylene chloride	75092	84.93	**630**	**180**	Res AAV Noncancer	**1,000**	**300**	ATSDR MRL Intermediate
Methyl tert-butyl ether (MTBE)	1634044	88.15	**98**	**27**	Res AAV Cancer	**980**	**270**	10× Res AAV Cancer
Tetrachloroethylene (PCE)	127184	165.83	**41**	**6.0**	ATSDR MRL Acute	**41**	**6.0**	ATSDR MRL Acute
Toluene*	108883	92.14	**5,200**	**1,400**	Res AAV Noncancer	**7,500**	**2,000**	ATSDR MRL Acute
1,2,4-Trichlorobenzene*	120821	181.45	**2.1**	**0.28**	Res AAV Noncancer	**6.3**	**0.85**	3× Res AAV Noncancer
1,1,1-Trichloroethane*	71556	133.41	**5,000**	**920**	IRIS RfC Short-term	**5,000**	**920**	IRIS RfC Short-term
Trichloroethylene (TCE)	79016	131.39	**2.0**	**0.37**	Res AAV Developmental (SE)	**6.0**	**1.1**	3× Res AAV Developmental (SE)
Trimethylbenzenes*	95636	120.2	**63**	**13**	Res AA Noncancer	**190**	**39**	3× Res AAV Noncancer
Vinyl acetate	108054	86.09	**210**	**60**	Res AAV Noncancer	**630**	**180**	3× Res AAV Noncancer
Vinyl chloride	75014	62.5	**1.6**	**0.63**	Res AAV Cancer	**16**	**6.3**	10× Res AAV Cancer
Xylenes*	1330207	106.17	**230**	**53**	Res AAV Noncancer	**690**	**160**	3× Res AAV Noncancer

RIASL ppb$_{vol}$ = [RIASL (ug/m^3) × (Molecular Weight)]/24.45 at standard temperature and pressure

@ **Respiratory irritation may occur at lower levels for some of the population. Please do not disregard complaints by building occupants at levels lower than the RIASL and TS RIASL. There is an Air Quality Division (AQD) acute Initial Threshold Screening Level (ITSL) of 350 ug/m^3.**

*may be subject to change

Res AAV – Residential Acceptable Air Value calculated from equations in Appendix A, based on **Cancer**, **Mutagenic** cancer, **Noncancer**, single event **Developmental (SE)** or full-term **Developmental (FT)** toxicity

ATSDR MRL – Agency for Toxic Substances and Disease Registry Inhalation Minimum Risk Level for Acute Inhalation (**Acute**) or Intermediate Inhalation (**Intermediate**) exposure durations

IRIS RfC Short-term –U.S. Environmental Protection Agency Integrated Risk Information System Reference Concentration for short-term exposure

TBD – to be determined

Table 2 Initial List of Nonresidential (NR) Recommended Interim Action Screening Levels (RIASLs) and Time-Sensitive Recommended Interim Action Screening Levels (TS RIASLs)

Hazardous Substance	Chemical Abstract Service Number	Molecular Weight	Nonresidential RIASL (24-hour exposure day)	Nonresidential RIASL (12-hour exposure day)		Basis for NR RIASL	Nonresidential Time-Sensitive RIASL (12-hour exposure day)		Basis for NR TS RIASL
		g/mol	µg/m3	µg/m3	ppb_{vol}#		µg/m^3	ppb_{vol}	
Acetone	67641	58.08	31,000	**31,000**	**13,000**	ATSDR MRL Intermediate	**31,000**	**13,000**	ATSDR MRL Intermediate
Ammonia	7664417	17.03	1,200@	**1,200@**	**1,700@**	ATSDR MRL Acute	**1,200@**	**1,700@**	ATSDR MRL Acute
Benzene	71432	78.11	7.7	**15**	**4.7**	NR AAV_{adj} Cancer	**54**	**17**	ATSDR MRL $Intermediate_{adj}$
Chlordane	57749	409.78	0.28	**0.56**	**0.033**	ATSDR MRL $Intermediate_{adj}$	**0.56**	**0.033**	ATSDR MRL $Intermediate_{adj}$
Chlorobenzene*	108907	112.56	77	**150**	**33**	NR AAV_{adj} Noncancer	**460**	**100**	3× NR AAV_{adj} Noncancer
Chloroethane	75003	64.52	6,100	**12,000**	**4,500**	NR AAV_{adj} Noncancer	**36,000**	**14,000**	3× NR AAV_{adj} Noncancer
Chloroform	67663	119.38	2.6	**5.2**	**1.1**	NR AAV_{adj} Cancer	**52**	**11**	10× NR AAV_{adj} Cancer
Chloromethane	74873	50.49	140	**280**	**140**	NR AAV_{adj} Noncancer	**410**	**200**	ATSDR MRL Intermediate
1,3-Dichlorobenzene*	541731	147	4.6	**9.2**	**1.5**	NR AAV_{adj} Noncancer	**28**	**4.7**	3× NR AAV_{adj} Noncancer
1,4-Dichlorobenzene	106467	147	15	**30**	**5**	NR AAV_{adj} Cancer	**300**	**50**	10× NR AAV_{adj} Cancer
1,1-Dichloroethane	75343	98.96	37	**74**	**18**	NR AAV_{adj} Noncancer	**740**	**180**	10× NR AAV_{adj} Cancer
1,1-Dichloroethylene	75354	96.94	310	**620**	**160**	NR AAV_{adj} Noncancer	**1,900**	**480**	3× NR AAV_{adj} Noncancer
cis-1,2-Dichloroethylene*	156592	96.94	12	**24**	**6.1**	NR AAV_{adj} Noncancer	**72**	**18**	3× NR AAV_{adj} Noncancer
trans-1,2-Dichloroethylene*	156605	96.94	790	**790**	**200**	ATSDR MRL Acute	**790**	**200**	ATSDR MRL Acute
Ethanol	64175	46.07	**19,000**	**19,000**	**10,000**	AQD Acute ITSL	**19,000**	**10,000**	AQD Acute ITSL
Ethylbenzene	100414	106.17	24	**48**	**11**	NR AAV_{adj} Cancer	**480**	**110**	10× NR AAV_{adj} Cancer

Hazardous Substance	Chemical Abstract Service Number	Molecular Weight	Nonresidential RIASL (24-hour exposure day)	Nonresidential RIASL (12-hour exposure day)		Basis for NR RIASL	Nonresidential Time-Sensitive RIASL (12-hour exposure day)		Basis for NR TS RIASL
		g/mol	µg/m3	µg/m3	ppb_{vol}#		µg/m^3	ppb_{vol}	
n-Hexane	110543	86.18	1,100	**2,200**	**620**	NR AAV_{adj} Noncancer	**6,600**	**1,900**	3× NR AAV_{adj} Noncancer
Mercury, elemental	7439976	200.59	0.46	**0.92**	**0.11**	NR AAV_{adj} Noncancer	**2.8**	**0.34**	3× NR AAV_{adj} Noncancer
Methylene chloride	75092	84.93	920	**1,800**	**520**	NR AAV_{adj} Noncancer	**2,900**	**840**	ATSDR MRL Intermediate
Methyl tert-butyl ether (MTBE)	1634044	88.15	230	**460**	**130**	NR AAV_{adj} Cancer	**4,600**	**1,300**	10× NR AAV_{adj} Cancer
Tetrachloroethylene	127184	165.83	41	**82**	**12**	ATSDR MRL Acute	**82**	**12**	ATSDR MRL Acute
Toluene*	108883	92.14	7,500	**7,500**	**2,000**	ATSDR MRL Acute	**7,500**	**2,000**	ATSDR MRL Acute
1,2,4-Trichlorobenzene*	120821	181.45	3.1	**6.2**	**0.84**	NR AAV_{adj} Noncancer	**19**	**2.6**	3× NR AAV_{adj} Noncancer
1,1,1-Trichloroethane*	71556	133.41	7,000	**7,000**	**1,300**	IRIS RfC Acute 8-hour	**7,000**	**1,300**	IRIS RfC Acute 8-hour
Trichloroethylene	79016	131.39	2.0	**4.0**	**0.74**	NR AAV_{adj} Developmental (SE)	**12**	**2.2**	3× NR AAV_{adj} Developmental (SE)
Trimethylbenzenes	95636	120.2	92	**180**	**37**	NR AAV_{adj} Noncancer	**560**	**110**	3× NR AAV_{adj} Noncancer
Vinyl acetate	108054	86.09	310	**620**	**180**	NR AAV_{adj} Noncancer	**1,900**	**540**	3× NR AAV_{adj} Noncancer
Vinyl chloride	75014	62.5	14	**28**	**11**	NR AAV_{adj} Cancer	**280**	**110**	10× NR AAV_{adj} Cancer
Xylenes*	1330207	106.17	340	**680**	**160**	NR AAV_{adj} Noncancer	**2,000**	**460**	3× NR AAV_{adj} Noncancer

RIASL ppb_{vol} = [RIASL (ug/m^3) ×24.45] ÷ (Molecular Weight) at standard temperature and pressure

@ **Respiratory irritation may occur at lower levels for some of the population. Please do not disregard complaints by building occupants at levels lower than the RIASL and TS RIASL. There is an AQD acute ITSL of 350 ug/m^3.**

* may be subject to change

ug/m^3 – microgram per meter cubed

ppb_{vol} – part per billion by volume

Res AAV – Residential Acceptable Air Value calculated from equations in Appendix A, based on **Cancer**, **Mutagenic** cancer, **Noncancer**, single event **Developmental (SE)** or full-term **Developmental (FT)** toxicity

ATSDR MRL – Agency for Toxic Substances and Disease Registry Inhalation Minimum Risk Level for Acute (**Acute**) or Intermediate (**Intermediate**) exposure durations

IRIS RfC Acute 8-hour – U.S. Environmental Protection Agency Integrated Risk Information System Reference Concentration for acute 8-hour exposure duration

TBD – to be determined

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Appendix A: Process for Developing Recommended Interim Action Screening Levels (RIASLs) and Time-Sensitive Recommended Interim Action Screening Levels (TS RIASLs) for Volatilization to Indoor Air Sites

This process considers that most volatilization to indoor air sites, at the time of the evaluation with these recommended screening levels, will have buildings that have been occupied by residents or workers for an extended period of time (years to decades). Therefore, in most cases, chronic inhalation health-based values are appropriate for public health risk decisions. Recent VIAP evaluations have demonstrated that for a few hazardous substances there are some short-term health benchmarks (e.g., ATSDR intermediate and acute inhalation MRLs, U.S. EPA acute and short-term RfCs) that are lower than chronic health benchmarks and/or calculated acceptable air values based on chronic health benchmarks. To make sure the RIASLs and the TS RIASLs are adequately protective of public health for both short-term and longer term exposures, the recommended levels will be the lower of these values. Health benchmarks may be provided in mg/m^3, ug/m^3, ppm_{vol}, or ppb_{vol}. Both ug/m^3, and ppb_{vol} values are provided as final Acceptable Air Concentrations (AACs), RIASLs, and TS RIASLs. These values are developed using the steps below with any exposure adjustments (e.g., nonresidential exposure hours/day) to the original value before unit conversion.

Step 1. Determine the health-based residential and nonresidential AACs and RIASLs. The **lowest** of the values (AAVs, acute or intermediate MRL, and acute or short-term RfC) identified below becomes the AAC and **RIASL**. Adjustments may be used to account for work day exposures described below. There are no exposure time based adjustments for residential AACs and RIASLs.

- Acceptable Air Values (AAVs):
  - Identify the calculated health-based AAVs for non-carcinogenic, developmental, carcinogenic, and mutagenic health effects developed by RRD using the inhalation toxicity endpoints (RfC and Inhalation Unit Risk Factor (IURF)) and algorithms presented below (*See Determination of AAVs*). These AAVs are based on a noncancer hazard quotient (HQ) of one or a cancer target risk (TR) of 1 in 100,000 (10^{-5}).
  - The nonresidential AAVs are adjusted by multiplying the AAV value by two to adjust for a 12 hour/day exposure at the work place instead of a 24-hour exposure day (NR $AAV_{12\text{-}hr}$).
- ATSDR acute inhalation MRL (MRL_{acute})
  - For nonresidential only, the acute inhalation MRL is adjusted to account for a 12 hour/day exposure at the work place ($MRL_{acute,adj}$), if the MRL_{acute} is based on or has been adjusted for continuous exposure.
- ATSDR intermediate inhalation MRL (MRL_{int})
  - For nonresidential only, the intermediate inhalation MRL is multiplied by two to account for a 12-hour/day exposure at the work place, if the MRL_{int} is based on or has been adjusted for continuous exposure. Additional adjustment may be applied to account for a five out of seven day work week ($MRL_{int,adj}$) as the MRL_{int} addresses exposure greater than two weeks to less than a year.

- U.S. EPA acute RfC (RfC_{acute}) or short-term RfC (RfC_{short})
    - For nonresidential only, the acute or short-term RfC may or may not be adjusted to account for a 12-hour exposure at the work place using the following considerations:
        - If RfC_{acute} or RfC_{short} is based on a duration of exposure in the critical study of 12 hours or less, no adjustment is applied.
        - If RfC_{acute} or RfC_{short} is based on a study with exposure duration greater than 12 hours or adjusted for continuous exposure, the RfC is multiplied by two to account for a 12-hour/day exposure at the work place, ($RfC_{acute,adj}$ or $RfC_{short,adj}$) as appropriate.
        - If RfC_{short} is based on a study with exposure duration greater than two weeks and adjusted for continuous exposure, the RfC_{short} is multiplied by two to account for a 12-hour/day exposure at the work place and further divided by a five out of seven day work week ($RfC_{short,adj}$).
- Other appropriate acute or short-term health-based inhalation value as determined and justified by the TSG VIAP workgroup.

Step 2. Determine the **TS RIASLs**. The **lowest** of the available values identified below is the TS RIASL for residential and nonresidential land use:

- 3× the noncancer or developmental Res AAVs or NR $AAVs_{12\text{-}hr}$ determined in Step 1.
- 10× the cancer or mutagenic Res AAV and NR $AAVs_{12\text{-}hr}$ determined in Step 1.
- Acute inhalation MRL (MRL_{acute} or $MRL_{acute,adj}$) as determined in Step 1.
- Intermediate inhalation MRL (MRL_{int} or $MRL_{int,adj}$) as determined in Step 1.
- Acute or short-term RfC determined in Step 1.
- Other appropriate short-term health-based value as determined and justified by the TSG VIAP workgroup.

Other Considerations

Considerations when evaluating the AAVs, acute and intermediate MRLs, and acute and short-term RfCs for use as RIASLs and TS RIASLs include:

- The duration of exposure and effects/endpoint in the critical study are evaluated to determine whether adjustment for nonresidential hours/day and days/week exposure is appropriate and if the use of 3× or 10× the AAV will protect for acute or short-term toxicity.
- For developmental toxicants, it is important to note if a critical effect may be a result of a single exposure event.
- Additional available literature and various health outcomes are evaluated to determine if further considerations for appropriate use of the toxicity values (RfC, IURF, MRLs) are required.
- The sensitivity of the methods used to establish the point of departure (e.g., no observed adverse effect level or NOAEL, lowest observed adverse effect level or LOAEL, lower confidence level on the benchmark concentration or BMCL) is evaluated. The BMCL is preferred, when appropriate. Other methods are also evaluated including estimation of the human equivalent dose or continuous exposure dose.

- The uncertainty factors applied and level of confidence in the toxicity endpoint are examined to understand the limitation of or degree of uncertainty in the risk estimate.

Calculation of the AAVs:

RESIDENTIAL:

1. EQUATION FOR CARCINOGENIC EFFECTS:

$$AAV_{ca} = \frac{TR \times AT_{ca}}{IURF \times ED_{res} \times EF_{res}}$$

where,

AAV_{ca}	(Acceptable air value)	=	chemical-specific, µg/m^3
TR	(Target risk level)	=	10^{-5}
AT_{ca}	(Averaging time)	=	28,470 days
IURF	(Inhalation unit risk factor)	=	chemical-specific, (µg/m^3)$^{-1}$
ED_{res}	(Exposure duration)	=	32 years
EF_{res}	(Exposure frequency)	=	350 days/year

2. EQUATION FOR CARCINOGENS WITH MUTAGENIC EFFECTS:

$$AAV_{mut} = \frac{TR \times AT_{ca}}{IURF \times EF_{res} \times \left[\left(ED_{<2} \times ADAF_{<2}\right) + \left(ED_{2-6} \times ADAF_{2-6}\right) + \left(ED_{6-16} \times ADAF_{6-16}\right) + \left(ED_{16-32} \times ADAF_{16-32}\right)\right]}$$

where,

AAV_{mut}	(Acceptable air value)	=	chemical-specific, µg/m^3
TR	(Target risk level)	=	10^{-5}
AT_{ca}	(Averaging time)	=	28,470 days
IURF	(Inhalation unit risk factor)	=	chemical-specific, (µg/m^3)$^{-1}$
EF_{res}	(Exposure frequency)	=	350 days/year
$ED_{age <2}$	(Exposure duration, age <2 years)	=	2 years
$ADAF_{<2}$	(Age-dependent adjustment factor for cancer potency, age <2 years)	=	10
$ED_{age\ 2-6}$	(Exposure duration, age 2-6 years)	=	4 years
$ADAF_{2-6}$	(Age-dependent adjustment factor for cancer potency, age 2-6 years)	=	3
$ED_{age\ 6-16}$	(Exposure duration, age 6-16 years)	=	10 years
$ADAF_{6-16}$	(Age-dependent adjustment factor for cancer potency, age 6-16 years)	=	3
$ED_{age\ 16-32}$	(Exposure duration, age 16-32 years)	=	16 years
$ADAF_{16-32}$	(Age-dependent adjustment factor for cancer potency, age 16-32 years)	=	1

3. EQUATION FOR NON-CARCINOGENIC EFFECTS:

$$AAV_{nc} = \frac{THQ \times AT_{res} \times RfC \times RSC}{ED_{res} \times EF_{res}}$$

where,

AAV_{nc}	(Acceptable air value)	=	chemical-specific, µg/m^3
THQ	(Target hazard quotient)	=	1

AT_{res}	(Averaging time)	=	11,680 days
RfC	(Reference concentration)	=	chemical-specific, μg/m^3
RSC	(Relative source contribution)	=	1 or chemical-specific
ED_{res}	(Exposure duration)	=	32 years
EF_{res}	(Exposure frequency)	=	350 days/year

4. EQUATION FOR DEVELOPMENTAL EFFECTS - CHILD:

$$AAV_{dev} = \frac{THQ \times AT_{child} \times RfC_{dev} \times RSC}{ED_{child} \times EF_{child}}$$

where,

AAV_{dev}	(Acceptable air value)	=	chemical-specific, μg/m^3
THQ	(Target hazard quotient)	=	1
AT_{child}	(Averaging time)	=	2,190 days
RfC_{dev}	(Reference concentration, developmental)	=	chemical-specific, μg/m^3
RSC	(Relative source contribution)	=	1 or chemical-specific
ED_{child}	(Exposure duration)	=	6 years
EF_{child}	(Exposure frequency)	=	350 days/year

5. EQUATION FOR DEVELOPMENTAL EFFECTS – PREGNANT RESIDENT:

$$AAV_{dev} = \frac{THQ \times AT_{preg} \times RfC_{dev} \times RSC}{ED_{preg} \times EF_{preg}}$$

where,

AAV_{dev}	(Acceptable air value)	=	chemical-specific, μg/m^3
THQ	(Target hazard quotient)	=	1
$AT_{preg,FT}$	(Averaging time, full-term pregnancy)	=	280 days or chemical-specific
$AT_{preg,SE}$	(Averaging time, single event exposure during pregnancy)	=	1 day or chemical-specific
RfC_{dev}	(Reference concentration, developmental)	=	chemical-specific, μg/m^3
RSC	(Relative source contribution)	=	chemical-specific or 1
$ED_{preg,FT}$	(Exposure duration, full-term pregnancy)	=	0.767 year or chemical-specific
$ED_{preg,SE}$	(Exposure duration, single event exposure during pregnancy)	=	1 day or chemical-specific
$EF_{preg,FT}$	(Exposure frequency, full-term pregnancy)	=	268.5 days/year or chemical-specific
$EF_{preg,SE}$	(Exposure frequency, single event exposure during pregnancy)	=	1 day/day or chemical-specific

NONRESIDENTIAL:

6. EQUATION FOR CARCINOGENIC EFFECTS:

$$AAV_{ca} = \frac{TR \times AT_{ca}}{IURF \times ED_{nr} \times EF_{nr}}$$

where,

AAV_{ca}	(Acceptable air value)	=	chemical-specific, µg/m^3
TR	(Target risk level)	=	10^{-5}
AT_{ca}	(Averaging time)	=	28,470 days
IURF	(Inhalation unit risk factor)	=	chemical-specific, (µg/m^3)$^{-1}$
ED_{nr}	(Exposure duration)	=	20 years
EF_{nr}	(Exposure frequency)	=	238 days/year

Note: To adjust for a 12 hour/day exposure at the work place, multiply the AAV by a factor of two, as appropriate. This is done instead of including a 12 hours/24 hours term in the denominator of the equation.

7. EQUATION FOR NON-CARCINOGENIC EFFECTS:

$$AAV_{nc} = \frac{THQ \times AT_{nr} \times RfC \times RSC}{EF_{nr} \times ED_{nr}}$$

where,

AAV_{nc}	(Acceptable air value)	=	chemical-specific, µg/m^3
THQ	(Target hazard quotient)	=	1
AT_{nr}	(Averaging time)	=	7,300 days
RfC	(Reference concentration)	=	chemical-specific, µg/m^3
RSC	(Relative source contribution)	=	1 or chemical-specific
EF_{nr}	(Exposure frequency)	=	238 days/year
ED_{nr}	(Exposure duration)	=	20 years

Note: To adjust for a 12 hour/day exposure at the work place, multiply the AAV by a factor of two, as appropriate. This is done instead of including a 12 hours/24 hours term in the denominator of the equation.

8. EQUATION FOR DEVELOPMENTAL EFFECTS – PREGNANT WORKER:

$$AAV_{dev} = \frac{THQ \times AT_{dev} \times RfC_{dev} \times RSC}{ED_{dev} \times EF_{dev}}$$

where,

AAV_{dev}	(Acceptable air value)	=	chemical-specific, µg/m^3
THQ	(Target hazard quotient)	=	1
$AT_{dev,FT}$	(Averaging time, pregnant worker, full-term pregnancy)	=	280 days or chemical-specific

$AT_{dev,SE}$	(Averaging time, pregnant worker, single event exposure during pregnancy)	=	1 day or chemical-specific
RfC_{dev}	(Reference concentration)	=	chemical-specific, μg/m^3
RSC	(Relative source contribution)	=	chemical-specific or 1
$ED_{dev,FT}$	(Exposure duration, pregnant worker, full-term pregnancy)	=	0.767 year or chemical-specific
$ED_{dev,SE}$	(Exposure duration, pregnant worker, single event exposure during pregnancy)	=	1 day or chemical-specific
$EF_{dev,FT}$	(Exposure frequency, pregnant worker, full-term pregnancy)	=	183 days/year or chemical-specific
$EF_{dev,SE}$	(Exposure frequency, pregnant worker, single event exposure during pregnancy)	=	1 day/day or chemical-specific

Note: To adjust for a 12 hour/day exposure at the work place, multiply the AAV by a factor of two, as appropriate. This is done instead of including a 12 hours/24 hours term in the denominator of the equation.

Appendix B: Basis for Developing the RIASLs and TS RIASLs

In Michigan, unacceptable human exposure is indicated when chemical levels represent cancer risks greater than 10^{-5} or a HQ greater than one pursuant to Part 201 (MCL 324.20120a(4)). The RIASLs are developed to evaluate continued exposure related to the VIAP when indoor air concentrations of hazardous substances exceed these unacceptable risk levels. The acceptable air concentrations that represent a 10^{-5} cancer risk or a HQ of one are determined for residential and nonresidential[1] land use using the process outlined in Appendix A. In general, the U.S. EPA considers unacceptable human exposures as occurring when chemical levels result in cancer risks greater than 10^{-4} to 10^{-6} or a HQ of one for noncancer effects (U.S. EPA, 2015).

As many of the sites potentially have had contamination for multiple decades and complete remediation may take additional months to years, people may have had unacceptable indoor air exposure for an extended period of time. To address this potential exposure, interim action levels are necessary to ensure that when unacceptable exposures are identified, they are stopped as soon as possible. This is especially important when short-term exposure could result in health effects, such as in the case of developmental toxicants or mutagenic carcinogens.

Since many of these ongoing exposures are already chronic, the TS RIASLs in this document were patterned after levels recommended for the U.S. EPA removal activities (Regional Removal Management Levels or RMLs; U.S. EPA, 2016). These generic RMLs correspond to a cancer risk level of 10^{-4} or HQ of three for noncancer effects.

The U.S. EPA VI site guidance includes the need for prompt action due to human health risks at certain VI sites (U.S. EPA, 2015). Specifically the
U.S. EPA VI Guidance states:

> EPA has emphasized the importance of interim actions and site stabilization in the RCRA corrective action program to control or abate “ongoing risks” to human health and the environment while site characterization is underway or before a final remedy is selected (see the *Federal Register* of May 1, 1996 [61 FR 19446]). Interim actions encompass a wide range of institutional and physical corrective action activities to achieve stabilization and can be implemented at any time during the corrective action process. EPA recommends that interim actions, including PEM *{presumptive mitigation}*, be employed as early in the corrective action process as possible, consistent with the human health and environmental protection objectives and priorities for the site. EPA recommends that, as further information is collected, program implementers continue to look for opportunities to conduct additional interim response actions.

[1] Nonresidential screening levels are calculated based on a healthy adult worker and assume no dwellings, schools, daycares, doctor’s offices, or other locations where other sensitive populations are present. Residential screening levels are intended to address places where people live and/or children or other sensitive populations are present (e.g., daycares, schools, doctor’s offices, hospitals).

The 2015 U.S. EPA VI Guidance document addresses situations when indoor air concentrations are higher than health-protective screening levels for acute or short-term exposure. Therefore, to determine when urgent action is needed, time-sensitive interim action levels are required. In an U.S. EPA memo, the recommended response action at sites with trichloroethylene, a hazardous substance linked to developmental health effects after a short-term exposure, is accelerated response when indoor air levels are above a HQ of one. Completion of mitigation measures are recommended within a few weeks. An urgent response is recommended when indoor air levels are above a HQ of three. For urgent response, mitigation measures were recommended within a few days, with the possibility of temporary relocation for the residents (U.S. EPA, 2014).

<u>Limitations of these screening levels</u>

The RIASLs and TS RIASLs are not intended to define protective levels in all conditions and are not de facto cleanup levels. They address exposure to a single chemical only. At certain sites, volatilization to indoor air of more than one chemical could be occurring. Different screening levels may need to be developed for those sites when the toxicity values of co-occurring hazardous substances are based on the same health endpoint, target organ or system (U.S. EPA 2015, 2016). The MDHHS may recommend different screening levels to address human exposure to multiple chemicals.

Additionally, the MDHHS may recommend different screening levels when addressing sites with sensitive and vulnerable populations. These populations include, but are not limited to: elderly, women who are or may become pregnant, infants and children, people with chronic illness, or those populations with multiple sources of exposure to chemicals (e.g., environmental justice considerations) (U.S. EPA 2012, 2015).

References:

U.S. Environmental Protection Agency (U.S. EPA). December 3, 2012 memorandum transmits OSWER Directive 9200.2-84, entitled "Assessing Protectiveness at Sites for Vapor Intrusion. Supplement to the Comprehensive Five-Year Review Guidance." https://semspub.epa.gov/work/HQ/176385.pdf

U.S. EPA. July 9, 2014 memorandum EPA Region 9 Response Action Levels and Recommendations to Address Near-Term Inhalation Exposures to TCE in Air from Subsurface Vapor Intrusion. https://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/6a24ed351efe25b888257d16007659e8/$FILE/R9%20TCE%20Action%20Levels%20and%20Recs%20Memo%207_14.pdf

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U.S. EPA. 2016. Regional Removal Management Levels (RMLs) User's Guide. https://www.epa.gov/risk/regional-removal-management-levels-rmls-users-guide Last Updated 25 May 2016.

Appendix C: Chemical-specific Justifications for RIASLs and TS RIASLs

The justifications for the RIASLs and TS RIASLs of each hazardous substance include a summary table of the residential and nonresidential screening levels in two different units (μg/m^3 and ppb$_{vol}$), the basis of these screening levels, the sources and basis for the toxicity values, and a discussion of uncertainties related to the toxicity estimates. Also presented at the end of each justification is a summary of the toxicity assessment for each inhalation toxicity value considered in developing the RIASLs and TS RIASLs.

Acetone (CAS# 67-64-1)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	31,000 μg/m^3	13,000 ppb$_{vol}$	31,000 μg/m^3	13,000 ppb$_{vol}$
Basis	Change in visual evoked response (ATSDR MRL Intermediate)		Change in visual evoked response (ATSDR MRL Intermediate)	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	31,000 μg/m^3	13,000 ppb$_{vol}$	31,000 μg/m^3	13,000 ppb$_{vol}$
Basis	Change in visual evoked response (ATSDR MRL Intermediate)		Change in visual evoked response (ATSDR MRL Intermediate)	

Discussion of Basis

The basis of the RIASLs and TS RIASL is the ATSDR intermediate inhalation MRL of 31,000 μg/m^3. This MRL is also the chronic inhalation MRL used to develop the risk-based residential and nonresidential AAC of 32,000 and 95,000 μg/m^3, respectively. The intermediate MRL is selected over the AAC to appropriately protect for less than chronic inhalation exposures.

Humans were exposed to acetone for four weeks or less, up to four days per week and 1, 3, or 7.5 hours per day. A LOAEL of 1250 ppm (2969 mg/m^3) was identified based on changes in the visual evoked response, a measure of neurological effects. The group exposed to 1,250 ppm acetone 7.5 hours a day had visual evoked response testing during the first and fifth hour on exposure days two and four. The authors reported changes after five hours of exposure. The LOAEL was not adjusted to a continuous exposure. Supporting studies identified additional neurological and behavioral effects in humans exposed to 250 ppm acetone for a single day (5.25 hours) or for six days (6 hours a day) in humans exposed to 237 ppm.

Uncertainties in the toxicity estimate:

The intermediate inhalation MRL is not adjusted to a continuous exposure, but has a total uncertainty factor (UF) of 100 for use of a LOAEL (10) and human variability (10). The studies used to develop the MRLs are intermittent exposures for less than one week. Humans exposed to the LOAEL had changes in their visual evoked response after less than an exposure of 7.5

hours for four days. This is the best available information, but it is unclear if exposures at or over a year could result in a more sensitive endpoint. The UFs may be protective for this.

Source of the Toxicity Values
ATSDR Chronic and intermediate MRL = 13 ppm or 30.9 mg/ m^3 (3.1E+4 µg/m^3); (13pmm*58.08g/mol) /24.45L (SATP) = 30.9 mg/m^3.
Critical Study: Stewart, RD; Hake, CL; Wu, A; et al. (1975) Acetone: development of a biologic standard for the industrial worker by breath analysis. Medical College of Wisconsin, Inc., Milwaukee. Dept. of Environmental Medicine. U.S Dept. of Commerce. NTIS PB82172917. (Stewart et al. 1975)
Method(s): human volunteers were exposed to acetone <1,250 ppm for <7.5 hours/day, 2-5 days/week for 6 weeks.
Critical effect: neurological effects (increased visual evoked response)
End point or Point of Departure (POD): LOAEL = 1,250 ppm
Uncertainty Factors: UF = 100; 10 -fold for use of a LOAEL and 10-fold for human variability
Source and date: ATSDR, 5/1994

ATSDR Acute MRL = 26 ppm or 61.76 mg/m^3 (61,762 µg/m^3); (26 ppm*58.08 g/mol) /24.45L (SATP) = 61.76 mg/m^3.
Critical Study: Dick RB, Brown WD, Setzer JV, et al. 1989. Neurobehavioral effects of short duration exposures to acetone and methyl ethyl ketone. Br J Ind Med 46: 1 1 I- 12.
Method(s): human volunteers (11 men and 11 women) were exposed to 237 ppm acetone 4 hours on one day.
Critical effect: neurobehavioral effects (increases in response and percent false negatives in auditory discrimination; increased anger, hostility)
End point or Point of Departure (POD): LOAEL = 237 ppm
Uncertainty Factors: UF = 9; 3 each for use of a minimal LOAEL and human variability
Source and date: ATSDR, 5/1994

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: data are inadequate for an assessment of the human carcinogenic potential of acetone
IRIS WOE Basis: based on the availability of one human study of limited utility, no chronic animal studies, and no additional information on structural analogues with known carcinogenic potential. Acetone has tested negative in almost all genotoxicity studies.
Source and Date: IRIS, Last revision date - 7/31/2003.

Ammonia (CAS#7664-41-7)

Residential RIASLs

	Residential RIASL		Residential TS RIASL	
Action Level	**520 µg/m^3**	**750 ppb$_{vol}$**	**1,200 µg/m^3**	**1,700 ppb$_{vol}$**
Basis	**Respiratory effects from worker exposure (Res AAV Noncancer – EPA IRIS RfC)**		**Eye, nose, and throat irritation (ATSDR MRL Acute)**	

Nonresidential RIASLs

	Nonresidential RIASL		Nonresidential TS RIASL	
Action Level	**1,200 µg/m^3**	**1,700 ppb$_{vol}$**	**1,200 µg/m^3**	**1,700 ppb$_{vol}$**
Basis	**Eye, nose, and throat irritation (ATSDR MRL Acute)**		**Eye, nose, and throat irritation (ATSDR MRL Acute)**	

Discussion of Basis

The residential RIASLs are based on the 2016 IRIS RfC of 500 µg/m^3 based on a duration adjusted (continuous exposure) NOAEL of 4.9 mg/m^3 for respiratory effects in an occupational exposure study (Holness et al., 1989). Holness et al. (1989) identified three exposure groups amongst the entire group of exposed workers: low (< 6.25 ppm), medium (6.25-12.5 ppm), and high (>12.5 ppm). No statistically significant differences were seen between the control group and any of the exposure groups (either the subgroups or the overall exposed group). While a LOAEL was not identified in this study, the larger body of evidence supports the findings identified therein (Ali, 1989; Ballal, 1998; Rahman, 2007; U.S. EPA, 2016). ATSDR has also derived chronic MRLs for ammonia using the Holness et al. (1989) study as the key study.

The Holness et al. (1989) study was used to derive both the U.S. EPA IRIS RfC and the ATSDR chronic MRL (ATSDR, 2004; EPA, 2016). Differences in benchmark values reside within the POD, and application of different modifying factors and exposure duration adjustment factors.

The U.S. EPA RfC value would be used for deriving the ammonia RIASLs and TS RIASLs for the following reasons:

1) It is the most recent peer-reviewed health benchmark evaluation for ammonia. With this, it has a comprehensive review of the toxicological literature.

2) Although ATSDR (2004) applied a modifying factor of 3, the U.S EPA (2016) provides adequate reasoning for why a modifying factor was not used for the lack of reproductive and developmental studies. Their justification for not using an uncertainty factor for the lack of reproductive and developmental studies is as follows:

> *"The inhalation ammonia database includes one limited study of reproductive and developmental toxicity in pigs that did not examine a complete set of reproductive or developmental endpoints. Normally, confidence in a database lacking reproductive and developmental toxicity studies is considered to be lower… However, the likelihood of*

reproductive, developmental, and other systemic effects at the RfC is considered small because it is well documented that ammonia is endogenously produced in humans and animals, and any changes in blood ammonia levels at the POD would be small relative to normal blood ammonia levels. Further, EPA is not aware of any mechanisms by which effects at the point of contact (i.e., respiratory system) could directly or indirectly impact tissues or organs distal to the point of contact."

3) ATSDR used an estimate of the time weighted average (TWA) of the overall exposed group as the POD. However, U.S. EPA used an estimate of the NOAEL identified by Holness et al. (1989) from the most highly exposed subgroup within that study (EPA, 2016; Holness et al., 1989). It is more appropriate to use an exposure estimate from the NOAEL identified from the most highly exposed subgroup as the POD. Therefore, U.S. EPA's POD is preferred.

The risk-based AAV based on the IRIS RfC was not chosen for the basis of the nonresidential RIASL or the TS RIASLs because the ATSDR acute inhalation MRL is lower. There is an AQD acute ITSL also based on acute respiratory irritation. It should be noted that short-term health effects are possible after an acute exposure to levels lower than values based on the RfC, possibly due to people's adaptation during longer exposure times and healthy worker considerations.

The residential TS RIASL and nonresidential RIASL and TS RIASL are based on the ATSDR acute inhalation MRL of 1.7 ppm or 1,200 $\mu g/m^3$. It is based on a human study where 16 volunteers were exposed for a maximum of two hours to 50, 80, 110, and 140 ppm ammonia (Verberk, 1977; ATSDR, 2004). Subjects were surveyed for sensitivity to ammonia every 15 minutes, and 50 ppm was identified as the LOAEL where eye, nose and throat irritation and general discomfort were considered the critical effects.

There is also an MDEQ AQD acute ITSL of 350 $\mu g/m^3$. The MDEQ AQD (2017) acute ITSL is based on a LOAEL of 5 ppm ($\approx$3.5 mg/m^3) for respiratory symptoms after acute exposure to ammonia in a controlled human study (Sundblad et al., 2004). Twelve healthy volunteers were randomly exposed to sham or ammonia on three separate occasions for three hours each time. The ammonia group was exposed to 5 and 25 ppm ammonia. A dose-dependent relationship was identified for respiratory irritation. This should be considered for building occupants that complain of respiratory irritation.

Uncertainties in the toxicity estimate:
The U.S. EPA RfC has an UF of 10 for human variability, since the studies were all in healthy adult workers.

The ATSDR acute MRL has a total UF of 30, 10 for human variability and 3 for the use of a LOAEL.

For the MDEQ AQD ITSL, the total UF applied is 10. UFs of 3 each for human variability and LOAEL to NOAEL extrapolation were used.

Source of the Toxicity Values

Noncancer:

Basis: The IRIS RfC was selected as the basis for the noncancer AAC, because it is a Tier 1 source, and a more recent assessment of ammonia.

IRIS RfC = 5.0E-1 mg/m^3 (500 µg/m^3).

Critical Studies:

Holness, DL; Purdham, JT; Nethercott, JR. 1989. Acute and chronic respiratory effects of occupational exposure to ammonia. The American Industrial Hygiene Association Journal, 50(12), 646-650.

Supporting Studies:

1) Ali, BA; Ahmed, HO; Ballal, SG; Albar, AA. 2001. Pulmonary function of workers exposed to ammonia: A study in the Eastern Province of Saudi Arabia. Int J Occup Environ Health 7: 19-22.
2) Ballal, SG; Ali, BA; Albar, AA; Ahmed, HO; Al-Hasan, AY. 1998. Bronchial asthma in two chemical fertilizer producing factories in eastern Saudi Arabia. Int J Tuberc Lung Dis 2: 330-335.
3) Rahman, MH; Bråtveit, M; Moen, BE. 2007. Exposure to ammonia and acute respiratory effects in a urea fertilizer factory. Int J Occup Environ Health 13: 153-159.

Methods: A cross sectional epidemiology study of soda ash plant workers. Male workers exposed to ammonia (n=58) and controls (n=31 from stores and office areas of plant). Average exposure was 12.2 yrs. Exposure was measured using personal samples, one work-shift/person for an average of 8.4 hours. Two analytical methods were used for measuring ammonia concentrations in workplace air. The American Thoracic Society questionnaire was used to identify respiratory symptoms. Average exposure for exposed workers was 6.5 mg/m3.

Critical effect: Decreased lung function and respiratory effects (cough, wheezing, and other asthma-related symptoms) in workers

End point or Point of Departure (POD): NOAEL = 13.6 mg/m^3; NOAEL(ADJ) = 4.9 mg/m^3

Uncertainty Factors: UF = 10 for intraspecies

Source and date: IRIS, Last revision date – 9/20/2016

MRL:

Per ATSDR (9/2004), chronic inhalation MRL = 0.1 ppm = 0.07 mg/m^3 = 70 µg/m^3 based on respiratory effects.

Critical Study: Holness DL, Purdham JT, Nethercott JR. 1989. Acute and chronic respiratory effects of occupational exposure to ammonia. Am Ind Hyg Assoc J 50:646-650.

Methods: Workers exposed for an average of 12.2 years in a soda ash plant were evaluated for sense of smell, prevalence of respiratory symptoms (cough, bronchitis, wheeze, dyspnea, and others), eye and throat irritation, and lung function parameters (FVC, FEV1, FEV1/FVC, FEF50, and FEF75). The cohort consisted of 52 workers and 35 controls. The subjects were assessed on two workdays: on the first workday of their workweek and on the last workday of their workweek; the average sample collection period was 8.4 hours. All of the participants in the study were males.

Critical effect: No significant alterations in lung function in chronically exposed workers

End point or Point of Departure (POD): NOAEL = 9.2 ppm (mean TWA exposure concentration); NOAEL adjusted for continuous exposure (9.2 x 8/24 hours x 5/7 days)=2.2 ppm

Uncertainty Factors: UF = 30; 10 for intraspecies variability and 3 for database deficiencies – lack of reproductive and developmental studies)

Source and date: ATSDR, 9/2004

Per ATSDR (9/2004) acute inhalation MRL = 1.7 ppm=1.2 mg/m^3=1200 µg/m^3 based on respiratory effects.
Critical Study: Verberk MM. 1977. Effects of ammonia in volunteers. Int Arch Occup Environ Health 39:73-81.
Methods: Male and female volunteers (N=16) were exposed to 50, 80, 110, and 140 ppm ammonia for up to two hours. Exposure related differences were determined using lung function testing as measured by VC, FEV1 and FIV1; subjective reports of respiratory symptoms; and airway hyper-responsiveness as measured by the DeVries (1971) method for histamine threshold.
Critical effect: respiratory symptoms
End point or Point of Departure (POD): LOAEL = 50 ppm
Uncertainty Factors: UF = 30; 10 for intraspecies variability and 3 for use of a LOAEL
Source and date: ATSDR, 9/2004

MDEQ:
Per MDEQ-CCD, AQD derived ITSL from controlled human study by Sundblad et al., 2004
AQD acute ITSL=350 µg/m^3
Critical Study: Sundblad, B.M., F. Acevedo, L. Ernstgård, G. Johanson, K. Larsson, L. Palmberg. 2004. Acute respiratory effects of exposure to ammonia on healthy subjects. Scand J Work Environ Health. 4: 313-321.
Method(s): 12 male and female, healthy volunteers were exposed to a sham exposure or ammonia exposure (5 and 25 ppm) for three hours. Lung spirometry, methacholine challenge provocation testing, inflammatory cell count and complement factor C3 and C3b in peripheral blood, cytokines in nasal lavage, exhaled nitric oxide, and self-reported respiratory symptoms were evaluated.
Critical effect: respiratory symptoms of irritation
End point or Point of Departure (POD): LOAEL = 5 ppm
Uncertainty Factors: UF = 10; (3 for intraspecies variability and 3 for LOAEL to NOAEL extrapolation). A factor of 3 was used for human variability based on guidance that indicates " for direct-acting chemicals whose site of action is the point of first contact…√10 may be sufficient" (Office of Environmental Health Hazard Assessment (OEHHA), 2008). Similarly, for their derivation of an acute health benchmark for ammonia, an UF of 3 for human variability was used by both the Texas Commission on Environmental Quality (TCEQ) and the Office of Environmental Health Hazard Assessment or OEHHA (OEHHA, 1999; TCEQ, 2016). The UF of 3 for a LOAEL to NOAEL extrapolation was used for minimal adverse effects of irritation. The low exposure group (5 ppm) was regarded as a LOAEL for slight severity.
Source and date: MDEQ Chemical Criteria Database or CCD (1/2017)

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: Inadequate for an assessment of human carcinogenic potential.
WOE Basis: Human data are not available. Among animals, no evidence for carcinogenicity was observed in two strains of mice administered ammonium hydroxide in drinking water for two

years or in a urethane-sensitive strain of mice administered ammonia in water by gavage for four weeks. There is some indication that ammonia contributes to the development of cancer when co-administered with diethyl pyrocarbonate (via formation of urethane) or N-methyl-N'-nitro-N-nitrosoguanidine (via stimulation of cell proliferation in the gastric mucosa). Limited genotoxicity testing has produced mixed results.
Source and Date: PPRTV, 2/02/2005

IRIS: Per IRIS (9/20/2016), no value at this time.
Provisional Peer Reviewed Toxicity Values (**PPRTV):** Per PPRTV (2/02/2005), no value at this time.
MRL: Per ATSDR (9/2004), no value at this time.

MDEQ: Per MDEQ-CCD, no value at this time.

Benzene (CAS# 71-43-2)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	3.3 μg/m^3	1.0 ppb_{vol}	19 μg/m^3	6.0 ppb_{vol}
Basis	Increased incidence of human leukemia (Res AAV Cancer – U.S. EPA IRIS IURF)		Delayed reaction of mouse splenic lymphocytes to foreign antigens (ATSDR MRL Intermediate Inhalation)	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	15 μg/m^3	4.7 ppb_{vol}	54 μg/m^3	17 ppb_{vol}
Basis	Increased incidence of human leukemia (NR AAV_{adj} Cancer – U.S. EPA IRIS IURF)		Delayed reaction of mouse splenic lymphocytes to foreign antigens (ATSDR MRL $Intermediate_{adj}$ Inhalation)	

Discussion of Basis

The U.S. EPA's IRIS IURF is the basis of the residential and nonresidential AACs and RIASLs for benzene. Benzene is a "known" human carcinogen (U.S. EPA Category A) for all routes of exposure. The U.S. EPA's IURF is based on leukemia development in exposed workers. The AACs calculated for carcinogenic effects is lower than those calculated for non-carcinogenic effects, based on immunotoxicity (decreased mouse B cell count for the ATSDR chronic inhalation MRL and decreased human lymphocyte count for the U.S. EPA IRIS RfC) which have been identified as the most sensitive non-carcinogenic effects.

The residential and nonresidential TS RIASLs are developed from the ATSDR intermediate inhalation MRL of 6.0 ppbv (19 μg/m^3) as this value is lower than ten times the cancer risk based AACs. The MRL is based on delayed reaction of mouse splenic lymphocytes to foreign antigens. A LOAEL of 10 ppm was identified for that reaction, and with adjustment for a continuous human equivalent concentration results in a LOAEL (HEC-ADJ) of 1.8 ppm. This is slightly lower, but similar, to the continuous human equivalent concentration calculated for the ATSDR chronic inhalation MRL (LOAEL [HEC-ADJ] of 2.55 ppm) and the BMCL (8.2 mg/m^3 [2.57 ppm]) for the U.S. EPA IRIS RfC.

Uncertainties in the toxicity estimate:

The U.S. EPA IURF was estimated using linear extrapolation of occupational data from Rinsky *et al*. (1981, 1987). The U.S. EPA published a range of risk estimates, 2.2E-6 to 7.8E-6 (μg/m3)$^{-1}$. The MDEQ used the high end of the range of IURFs (i.e., 7.8E-6). The U.S. EPA indicated that at the time of their assessment "the true cancer risk from exposure to benzene cannot be ascertained, even though dose-response data are used in the quantitative cancer risk analysis, because of uncertainties in the low-dose exposure scenarios and lack of clear understanding of the mode of action."

The ATSDR intermediate inhalation MRL has a total UF of 300, 10 for human variability, 3 for animal to human dosimetric conversion, and 10 for use of a LOAEL.

Source of the Toxicity Values
Chronic Inhalation Noncancer:
Basis: ATSDR is based on a more current study than IRIS.
ATSDR chronic inhalation MRL/RfC = 0.01 mg/m^3 (1.0E+1 μg/m^3)
MRL: ATSDR (08/2007), chronic inhalation MRL = 0.003 ppm or 0.01 mg/m^3:
Critical Study: Lan Q, Zhang L, Li G, *et al*. 2004a. Hematotoxicity in workers exposed to low levels of benzene. Science 306:1774-1776.
Method(s): A cross-sectional study on 250 workers (approximately two-thirds female) exposed to benzene at two shoe manufacturing facilities in Tianjin, China, and 140 age- and gender-matched workers in clothing manufacturing facilities that did not use benzene. The benzene exposed workers had been employed for an average of 6.1±2.9 years. Benzene exposure was monitored by individual organic vapor monitors (full shift) 5 or more times during 16 months prior to phlebotomy.
Critical effect: decreased B cell count
End point or Point of Departure (POD): $BMCL_{0.25sdADJ}$ = 0.03 ppm
Uncertainty Factors: UF = 10 for intraspecies (human) variability
Source and date: ATSDR, 08/2007. From 12/2014 MRL list.

Intermediate Inhalation Noncancer
Basis: ATSDR developed intermediate (subchronic) MRL.
MRL: ATSDR (08/2007), intermediate inhalation MRL = 0.006 ppm or 0.019 mg/m^3 (1.9E+1 μg/m^3)
Critical Study: Rosenthal GJ, Snyder CA. 1987. Inhaled benzene reduces aspects of cell-mediated tumor surveillance in mice. Toxicol Appl Pharmacol 88:35-43.
Method(s): A 20 exposure day (6 hours/day, 5 days/week) inhalation study in male C57Bl/6 mice. Mice were exposed to 10, 30, or 100 ppm benzene and had number of lymphocytes and functional capacity of splenic lymphocytes evaluated by mixed-lymphocyte culture (capacity to mount an immune response against foreign antigens) and 51Cr-release cytotoxicity assay.
Critical effect: delayed MLC activity and lysing capacity of splenic lymphocytes
End point or Point of Departure (POD): $LOAEL_{ADJ}$ = 1.8 ppm
Uncertainty Factors: UF = 300 (10 for use of a LOAEL, 3 for animal to human dosimetric conversion, 10 for intraspecies [human] variability)
Source and date: ATSDR, 08/2007. From 3/2016 MRL list.

Cancer:
Basis: IRIS is a Tier 1 value and a more recent review than the MDEQ.
IRIS IURF: Ranges from 2.2E-6 to 7.8E-6 (μg/m^3)$^{-1}$. The MDEQ applied the high end of the range of IURFs (i.e., 7.8E-6) to both the residential and nonresidential risk based values calculation.

Critical Studies:
1) Rinsky, RA; Young, RJ; Smith, AB. 1981 Leukemia in benzene workers. Am J Ind Med 2:217-245;
2) Rinsky, RA; Smith, AB; Horning, R; *et al*. 1987 Benzene and leukemia: an epidemiologic risk assessment. N Engl J Med 316:1044-1050; and
3) Crump, KS. (1994) Risk of benzene-induced leukemia: a sensitivity analysis of the Pliofilm cohort with additional follow-up and new exposure estimates. J Toxicol Environ Health 42:219-242.
Method(s):
1) *Dose response data*: *Tumor Type* - leukemia; *Test Species* - human; *Route* - inhalation, occupational exposure
2) *Extrapolation method*: Low-dose linearity utilizing maximum likelihood estimates (Crump, 1992, 1994).

Carcinogen Weight-of-Evidence (WOE) Class: A known human carcinogen for all routes of exposure
Basis: IRIS WOE: convincing human evidence as well as supporting evidence from animal studies
Source and Date: IRIS, Last revision date - 1/19/2000. IRIS Toxicological Review is available.

Chlordane (CAS# 57-74-9; 12789-03-6)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	0.20 µg/m^3	0.012 ppb$_{vol}$	0.20 µg/m^3	0.012 ppb$_{vol}$
Basis	centrilobular hypertrophy, hepatocellular vacuolization, increased P450, decreased albumin, decreased albumin/globulin ratio (ATSDR MRL Intermediate Inhalation)		ATSDR MRL Intermediate Inhalation	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	0.56 µg/m^3	0.033 ppb$_{vol}$	0.56 µg/m^3	0.033 ppb$_{vol}$
Basis	ATSDR MRL Intermediate$_{adj}$ Inhalation		ATSDR MRL Intermediate$_{adj}$ Inhalation	

Discussion of Basis

The basis of the residential and nonresidential RIASLs is the ATSDR intermediate inhalation MRL. The intermediate inhalation MRL is based on hepatic effects (centrilobular hypertrophy, hepatocellular vacuolization, increased P450, decreased albumin, decreased albumin/globulin ratio) exposed to chlordane for 90 days (5 days a week for 8 hours a day). The NOAEL (0.1 mg/m^3) for hepatic effects is also a NOAEL for hematopoietic/immunological effects (increased leukocyte count, decreased platelet count in females). For the residential RIASLs, the intermediate inhalation MRL is a more protective value than AACs calculated with an U.S. EPA IRIS RfC or IURF. It should be noted that the RfC is based on the same study selected by ATSDR. The NOAEL selected by ATSDR is the lowest exposure group, 0.1 mg/m^3, while the U.S. EPA RfC is based on a NOAEL of 1.0 mg/m^3.

For nonresidential RIALs, the intermediate inhalation MRL was adjusted for an occupational exposure (12/24 hours and 5/7 days). The adjusted MRL is approximately half of the nonresidential AAVs based on the U.S. EPA RfC or IURF.

Uncertainties in the toxicity estimate:
The intermediate inhalation MRL had a total UFof 100 (10 to account for animal model and 10 to account for human variability).

Source of the Toxicity Values

Noncancer:
IRIS RfC = 7.0E-4 mg/m^3.
Critical Study: Khasawinah, A., C. Hardy, and G. Clark. 1989b. Comparative inhalation toxicity of technical chlordane in rats and monkeys. J. Toxicol. Environ. Health 28(3): 327-347. (The 90-day rat study.)
Method(s): Wistar rats (35 47/sex/group) were exposed to 0, 0.1, 1.0, or 10 mg/cu.m technical chlordane, 8 hours/day, 5 days/week, for 13 weeks, followed by a 13-week recovery period.

Critical effect: hepatic effects
End point or Point of Departure (POD): NOAEL **=** 1.0 mg/m3; NOAEL (HEC) **=** 0.65 mg/m3.
Uncertainty Factors: UF = 1,000 (10 each for interspecies variability, interspecies extrapolation, and use of a sub chronic study)
Source and date: IRIS, Last revision date - 2/07/1998

MRL: Per ATSDR (5/1994), chronic inhalation MRL = 2.0E-5 mg/m3. An intermediate-duration inhalation MRL = 2.0E-4 mg/m^3 is available based on the same studies used for the chronic MRL.
Critical Study: Khasawinah, A., C. Hardy, and G. Clark. 1989a. Comparative inhalation toxicity of technical chlordane in rats and monkeys. J. Toxicol. Environ. Health 28(3): 327-347. (The 90-day rat study.)
Method(s): Wistar rats (35 47/sex/group) were exposed to 0, 0.1, 1.0, or 10 mg/m3 technical chlordane, 8 hours/day, 5 days/week, for 13 weeks (90 days), followed by a 13-week recovery period.
Critical effect: hepatic effects (hepatocellular hypertrophy and increased cytochrome P-450)
End point or Point of Departure (POD): NOAEL = 0.1 mg/m3
Uncertainty Factors for the Chronic MRL: UF = 1,000 (10 each for intraspecies variability, interspecies extrapolation, and use of a sub chronic study)
Uncertainty factors for the intermediate MRL: UF = 100 (10 for interspecies variability, 10 for interspecies extrapolation)
Source and date: ATSDR, 5/1994 (Tox Profile); ATSDR Addendum 12/2013a.

Cancer:
IRIS IURF = 1.0E-4 (µg/m^3)$^{-1}$.
IRIS IURF Basis: IRIS used the oral cancer slope factor (CSF) to estimate an IURF as no chronic inhalation bioassays are available. The estimation assumed 100% absorption of inhaled chlordane and a breathing rate of 20 m^3/day. IRIS is the only available value.
Oral CSF Critical Study(ies):
1) Khasawinah, A.M. and J.F. Grutsch. 1989a. Chlordane: 24-month tumorigenicity and chronic toxicity test in mice. Reg. Toxicol. Pharmacol. 10: 244-254.
2) Velsicol Chemical Corporation. 1983. Twenty-four month chronic toxicity and tumorigenicity test in mice by chlordane technical. Unpublished study by Research Institute for Animal Science in Biochemistry and Toxicology, Japan. MRID No. 00144312, 00132566. Available from U.S. EPA.
Method(s): ICR mice (80/sex/group) were given 0, 1, 5, or 12.5 ppm (0, 0.15, 0.75, and 1.875 mg/kg-day) chlordane in the diet for 104 weeks.
1) *Dose response data*: *Tumor Type* - hepatocellular carcinoma; *Test Species* - mouse/CD-1 (IRDC), mouse/B6C3F1 (NCI), mouse/ICR (Khasawinah and Grutsch); *Route* - diet
2) *Extrapolation method*: Linearized multistage procedure, extra risk

Carcinogen Weight-of-Evidence (WOE) Class: B2; probable human carcinogen
IRIS WOE Basis: Human carcinogenicity data: inadequate. Animal carcinogenicity data: sufficient
Source and Date: IRIS, Last revision date: 2/07/1998. IRIS literature review in 2001 did not identify any significant new studies.

Chlorobenzene (CAS# 108-90-7)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	52 $\mu g/m^3$	11 ppb_{vol}	160 $\mu g/m^3$	35 ppb_{vol}
Basis	renal tubule dilation (Res AAV Noncancer – PPRTV RfC)		3x Res AAV Noncancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	150 $\mu g/m^3$	33 ppb_{vol}	460 $\mu g/m^3$	100 ppb_{vol}
Basis	Renal tubule dilation (NR $AAV_{\mathbf{adj}}$ Noncancer – PPRTV RfC)		3x NR $AAV_{\mathbf{adj}}$ Noncancer	

Discussion of Basis

The residential and nonresidential AACs, RIASLs, and TS RIASLs for chlorobenzene are developed from the PPRTV (2006) RfC (RfC = 50 $\mu g/m^3$). This RfC was based on a two-generation reproduction study (Nair *et al.*, 1987) exposing rats to chlorobenzene for 6 hours/day, 7 days/week for 10 weeks prior to mating, through mating, gestation and lactation. The critical effect observed was renal tubular dilation in male rats. A $LED_{10\ HEC}$ = 4 6 mg/m^3 was calculated based on this effect. Liver effects were also seen at the same doses. Similar kidney effects were also seen in dogs, male and female rats, and male and female mice. The MDEQ AQD adopted the PPRTV RfC in 2013 as the ITSL.

Uncertainties in the toxicity estimate:
Per PPRTV, for the chronic p-RfC derivation, the $BMCL_{[HEC]}$ was divided by a UF of 1,000, including: 10 for human variability, 3 for extrapolation from rats-to-humans using dosimetric adjustments, 10 for use of a subchronic study, and 3 for database deficiencies. PPRTV identifies the confidence in the database as low based on the absence of well-documented studies evaluating the full respiratory tract and neurotoxicity after exposure to chlorobenzene. Available human data indicates neurotoxicity may be a sensitive endpoint for chlorobenzene. PPRTV assigned the confidence in the key study as high.

Source of the Toxicity Values
Noncancer:
Basis: PPRTV RfC
PPRTV (10/12/2006): RfC = 5.0E-2 mg/m^3 (5.0E+1 $\mu g/m^3$.) derived as follows:
Critical Study:
Nair, R.S., J.A. Barter, R.E. Schroeder *et al*. 1987. A two-generation reproduction study with monochlorobenzene vapor in rats. Fund. Appl. Toxicol. 9: 678-686.
Method(s): Two-generation reproductive study in rats: CD Sprague-Dawley rats (30/sex/group) were exposed by inhalation (dynamic air chamber) at 0, 50, 150, or 450 ppm (0, 230, 691, or 2072 mg/m^3) chlorobenzene for 6 hours/day, 7 days/week for 10 weeks before mating, and during mating, gestation, and lactation. The male and female F0 rats were sacrificed after the lactation period. F1 rats (30/sex/group) were exposed to the same concentrations of

chlorobenzene (beginning 1 week post-weaning) for 11 weeks before mating and during mating, gestation, and lactation. The F1 rats were also sacrificed after the lactation period. The F2 pups were sacrificed after weaning.
Critical effect: renal tubular dilation
End point or Point of Departure (POD): $LED_{10\ HEC}$ = 46 mg/m^3
Uncertainty Factors: UF = 1,000 (10 each for intraspecies variability and use of subchronic study and 3 each for interspecies extrapolation using dosimetric adjustments and database uncertainties).

Cancer:
IRIS (1991): Carcinogen Weight-of-Evidence (WOE) Class: D; not classifiable as to human carcinogenicity.
Basis: IRIS WOE: No human data, inadequate animal data and predominantly negative genetic toxicity data in bacterial, yeast, and mouse lymphoma cells.
Source and Date: IRIS, 3/01/1991

Chloroethane (CAS#75-00-3)

Residential

	Residential RIASL		Residential TS RIASL	
Action Level	4,200 µg/m^3	1,600 ppb$_{vol}$	13,000 µg/m^3	4,900 ppb$_{vol}$
Basis	delayed fetal ossification (foramina of the skull bones) (Res AAV Noncancer –PPRTV RfC)		3x Res AAV Noncancer	

Nonresidential

	Nonresidential RIASL		Nonresidential TS RIASL	
Action Level	12,000 µg/m^3	4,500 ppb$_{vol}$	36,000 µg/m^3	14,000 ppb$_{vol}$
Basis	delayed fetal ossification (foramina of the skull bones) (NR AAV$_{adj}$ Noncancer –PPRTV RfC)		3x NR AAV$_{adj}$ Noncancer	

Discussion of Basis

The residential and nonresidential noncancer AACs, RIASLs and TS RIASLs for chloroethane are based on the U.S. EPA PPRTV subchronic RfC of 4,000 µg/m^3. The 2007 PPRTV subchronic RfC is based on a human equivalent concentration of the lower 95% confidence limit of the Effect Concentration ($LEC_{10(HEC)}$) of 1,078 mg/m^3 for delayed fetal ossification (foramina of the skull bones) in female mice exposed to chloroethane for 6 hours/day on days 6 through 15 of gestation (Scortichini et al., 1986). The PPRTV subchronic RfC is adjusted for intermittent exposure. An IRIS (1991) RfC of 1.0E+7 µg/m^3 is also based on the Scortichini et al. study and critical effect but used a NOAEL = 4,000 mg/m^3 to derive a chronic RFC. The PPRTV RfC was selected as it a newer evaluation than IRIS and was established using a benchmark dose analysis approach.

The 1998 ATSDR acute Inhalation MRL is 15 ppm (40 mg/m^3) based on the study of Scortichini et al. (1986). The MRL was based on a NOAEL of 1,504 ppm (4,000 mg/m^3) and per ATSDR (1998), no adjustment for intermittent exposure was used since fetotoxic effects may be due to peak concentrations. Compared to the ATSDR, the PPRTV used dosimetric adjustments to derive a human equivalent concentration (HEC). The developmental AAC based on the PPRTV RfC is protective of subchronic and acute exposures and therefore selected as basis for the RIASL and TS RIASL.

Uncertainties in the toxicity estimate:
The total UF applied is 300 for the PPRTV subchronic RfC. A UF of 10 is used to account for intraspecies variability, 3 for interspecies extrapolation because of the use of dosimetric adjustments, and 10 for database deficiencies. No additional UF to account for subchronic to chronic extrapolation was applied since the critical effect is developmental and the exposure was during gestation. The confidence assigned to the RfC estimate is medium although the critical study is considered a well-conducted one due to lack of longer exposure toxicity and reproductive studies and the absence of a strong exposure-response relationship and maternal

toxicity level. For the ATSDR acute inhalation MRL the total UF applied is 100, 10 each to account for human variability and interspecies extrapolation.

Source of the Toxicity Values

Non-cancer:

Tier 2 Source:

Basis: PPRTV subchronic pRfC = 4.0E+0 mg/m^3. No additional UF to account for subchronic extrapolation is applied since the critical effect is developmental effect from gestational exposure (developmental study). The IRIS (1991) RfC = 1.0E+4 µg/m^3 is based on the same study (Scortichini et al., 1986) using the NOAEL approach. PPRTV used benchmark dose modeling to generate the POD.
Critical Study: Scortichini, B.H., K.A. Johnson, J.J. Momany-Pfruender, and T.R. Hanley, Jr. 1986. Ethyl chloride: Inhalation teratology study in CF-1 mice. Dow Chemical Co. EPA Document #86-870002248.
Method(s): 30 CF-1 mice were exposed to 0, 491 +/-37 ppm (1.3 g/m^3), 1,504 +/- 84 ppm (4,000 mg/m^3), and 4,946 +/- 159 ppm (13,000 mg/m^3) ethyl chloride for 6 hours/day on days 6 through 15 of gestation. The animals were sacrificed on the 18th day of gestation.
Critical effect: delayed fetal ossification (foramina of the skull bones)
End point or Point of Departure (POD): $LEC_{10(HEC)}$ = 1,078 mg/m^3 derived using benchmark dose (BMDS) analysis and adjusted for intermittent exposure.
Uncertainty Factors: UF = 300 (10 each for interspecies variability and database deficiencies; and 3 for interspecies extrapolation)
Source and date: PPRTV, 7/24/2007

Tier 1 Source:
IRIS: Per IRIS (1991), RfC = 1.0E+1 mg/m^3.
Critical Study: Scortichini, B.H., K.A. Johnson, J.J. Momany-Pfruender, and T.R. Hanley, Jr. 1986. Ethyl chloride: Inhalation teratology study in CF-1 mice. Dow Chemical Co. EPA Document #86-870002248.
Method(s): 30 CF-1 mice were exposed to 0, 491 +/-37 ppm (1.3 g/m^3), 1504 +/- 84 ppm (4000 mg/m^3), and 4,946 +/- 159 ppm (13,000 mg/m^3) ethyl chloride for 6 hours/day on days 6 through 15 of gestation. The animals were sacrificed on the 18th day of gestation.
Critical effect: delayed fetal ossification
End point or Point of Departure (POD): NOAEL = 4,000 mg/m^3 (1504 ppm); $NOAEL_{HEC}$ = 4,000 mg/m^3 not adjusted for intermittent exposure.
Uncertainty Factors: UF = 300 (10 each for interspecies variability and database deficiencies; and 3 for interspecies extrapolation)
Source and date: IRIS, Last revision date: 4/01/1991

MRL: Per ATSDR (12/1998), no inhalation chronic or intermediate MRL at this time.
ATSDR acute MRL = 15 ppm (40 mg/m^3) is available based on the study of Scortichini et al. (1986):
Critical Study: Scortichini, B.H., K.A. Johnson, J.J. Momany-Pfruender, and T.R. Hanley, Jr. 1986. Ethyl chloride: Inhalation teratology study in CF-1 mice. Dow Chemical Co. EPA Document #86-870002248.
Method(s): 23-26 pregnant mice were exposed to 0, 491 +/-37 ppm (1.3 g/m^3), 1504 +/- 84 ppm (4000 mg/m^3), and 4,946 +/- 159 ppm (13,000 mg/m^3) ethyl chloride for 6 hours/day on days 6 through 15 of gestation. The animals were sacrificed on the 18th day of gestation.
Critical effect: very slight fetotoxicity (delayed ossification)
End point or Point of Departure (POD): NOAEL = 1504 ppm or 4,000 mg/m^3

“Because fetotoxic effects may result from peak concentrations rather than total duration of exposure, the NOAEL was not adjusted for intermittent exposure”.
Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation)
Source and date: ATSDR, 1998

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: likely to be carcinogenic to humans
IRIS WOE Basis: increased incidences of uterine carcinomas in chloroethane-exposed mice are considered relevant to human health but marginally suitable for quantitative cancer assessment of chloroethane. The only available inhalation carcinogenicity bioassay (NTP, 1989) used a single choloroethane exposure level (15,000 ppm) at which a high proportion (86%) of female mice developed uterine tumors. Because a mutagenic mode of action cannot be discounted and no other mode of action has been proposed, a linear non-threshold dose-response model would be appropriate.
Source and Date: PPRTV, 7/24/2007.

Chloroform (CAS#67-66-3)

Residential RIASLs

	Residential RIASL		**Residential TS RIASL**	
Action Level	**1.1 μg/m³**	**0.23 ppb_{vol}**	**11 μg/m³**	**2.3 ppb_{vol}**
Basis	**Hepatocellular carcinoma (Res AAV Cancer – U.S. EPA IRIS IURF)**		**10 x Res AAV Cancer**	

Nonresidential RIASLs

	Nonresidential RIASL		**Nonresidential TS RIASL**	
Action Level	**5.2 μg/m³**	**1.1 ppb_{vol}**	**52 μg/m³**	**11 ppb_{vol}**
Basis	**Hepatocellular carcinoma (NR AAV_{adj} Cancer – U.S. EPA IRIS RfC)**		**10 x NR AAV_{adj} Cancer**	

Discussion of Basis

The residential and nonresidential AACs, RIASLs and TS RIASLs for chloroform are based on the IRIS IURF of 2.3E-5 per μg/m³. The IURF is based on a cancer study by the National Cancer Institute (NCI, 1976). The cancer AACs are lower than the chronic, intermediate and acute noncancer MRLs and are therefore more appropriate. The ATSDR chronic MRL of 98 μg/m³ is based on hepatic effects (hepatomegaly) observed in 68 workers exposed to chloroform for one to four years. The Intermediate Inhalation MRL of 240 μg/m³ is based on liver toxicity in mostly female workers exposed to chloroform for 6 months. The acute MRL of 490 μg/m³ is based on hepatic effects in female mice exposed to chloroform for one week. The AAC for cancer effects also protects for subchronic and acute exposure noncancer effects.

Uncertainties in the toxicity estimate:
Per IRIS (2001), chloroform is likely to be carcinogenic to humans **by all routes of exposure** under high-exposure conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissues. The IURF is derived using a gavage cancer study. However, inhalation studies used in determining the noncancer MRLs support the high likelihood of hepatic effects including cytotoxicity resulting from inhalation of chloroform.

Source of the Toxicity Values
Cancer:
IURF = 2.4E-6 (μg/m³)⁻¹
Basis: IRIS is a Tier 1 source.
Critical Study: National Cancer Institute (NCI). (1976) Report on carcinogenesis bioassay of chloroform. Bethesda, MD: National Cancer Institute.
Methods: This IURF is based on data from a gavage study. The incidence data for both male and female mice were used to derive slope factors of 3.3E-2 and 2.0E-1 per (mg/kg)/day, respectively.

1) *Dose response data*: *Tumor Type* - — hepatocellular carcinoma; *Test Species* - mouse, B6C3F1, female; *Route* - oral, gavage

2) *Extrapolation method*: linearized multistage procedure, extra risk.

Carcinogen Weight-of-Evidence (WOE) Class: Chloroform is likely to be carcinogenic to humans by all routes of exposure under high-exposure conditions that lead to cytotoxicity and regenerative hyperplasia in susceptible tissues (U.S. EPA, 1998a, b). Chloroform is not likely to be carcinogenic to humans by any route of exposure under exposure conditions that do not cause cytotoxicity and cell regeneration.

IRIS WOE Basis: Based on: 1) observations in animals exposed by both oral and inhalation pathways which indicate that sustained or repeated cytotoxicity with secondary regenerative hyperplasia precedes, and is probably required for, hepatic and renal neoplasia; 2) there are no epidemiological data specific to chloroform and, at most, equivocal epidemiological data related to drinking water exposures that cannot necessarily be attributed to chloroform amongst multiple other disinfection byproducts; and 3) genotoxicity data on chloroform are essentially negative.

Source and Date: IRIS, 10/19/2011

Noncancer:

RfC/MRL = 9.8E+1 μg/m^3

Basis: ATSDR is a Tier 2 source, no Tier 1 available. Inhalation chronic MRL = 0.02 ppm or 9.8E-2mg/m^3 (at 25°C and 1 atm). An intermediate-duration inhalation MRL = 0.05 ppm (2.4E-1 mg/m^3) is available based on a LOAEL of 14 ppm for toxic hepatitis in workers exposed to up to 400 ppm for less than 6 months (Phoon et al. 1983).

Chronic MRL derivation:

Critical Study: Bomski H, Sobolewska A, Strakowski A. 1967. Toxic damage of the liver by chloroform in chemical industry workers. Int Arch F Gewerbepathologie u. Gewerbehygiene 24: 127- 134 (German)

Methods: A group of 68 workers were occupationally exposed to chloroform for one to four years. Doses ranged from 2 to 205 ppm and air concentrations ranged from 0.01 to 1.0 mg/L.

Critical effect: hepatomegaly

End point or Point of Departure (POD): LOAEL **=** 2 ppm

Uncertainty Factors: UF = 100 (for interspecies variability and LOAEL to NOAEL extrapolation)

Source and date: ATSDR, 9/1997. A Toxicological Profile is available.

ATSDR Intermediate and Acute MRLs:

Intermediate MRL = 0.05 ppm (2.4E-1 mg/m^3)

Critical Study: Phoon WH, Goh KT, Lee LT, et al. 1983. Toxic jaundice from occupational exposure to chloroform. Med J Malaysia 38:31-34.

Methods: Workers in two outbreaks of toxic hepatitis, in workers occupationally exposed to chloroform, were studied. The workers were mostly women. Blood chloroform levels of workers and workplace concentrations were measured. All workers were exposed for at less six months.

Critical effect: hepatic effects

End point or Point of Departure (POD): LOAEL = 14 ppm

Uncertainty Factors: UF = 100 (for interspecies variability and LOAEL to NOAEL extrapolation) and Modifying Factor (MF) of 3 for insufficient data to determine the seriousness of the hepatic effects.

Acute MRL = 0.1 ppm or 4.9E-2mg/m^3 (at 25°C and 1 atm).

Critical Study: Larso JL, Wolf DC, Morgan KT, et al., 1994. The toxicity of 1-week exposures to inhaled chloroform in female B6C3F1 mice and male F-344 rats. Fund Appl Toxicol 22:431-446.

Methods: Animals (5/group) were exposed to 0, 1, 3, 30, 100 or 300 chloroform via inhalation for 6 hours a day for 7 consecutive days. Actual concentrations were 1.2, 3, 10, 29.5, 101 and 228 ppm for mice and 1.5, 3.1, 10.4, 29.3, 100 and 271 ppm for rats. Cell proliferation was quantitated as the % cells in S-phase using immunohistochemical detection of BrdU-labeled nuclei.

Critical effect: hepatic effects in mice

End point or Point of Departure (POD): NOAEL = 3 ppm; $NOAEL_{HEC}$ = 3 ppm

Uncertainty Factors: UF = 30 (10 for human variability and 3 for interspecies variability)

Chloromethane (CAS# 74-87-3)

Residential

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	94 µg/m^3	46 ppb$_{vol}$	280 µg/m^3	140 ppb$_{vol}$
Basis	Cerebellar lesions (Res AAV Noncancer – U.S. EPA IRIS RfC)		3x Res AAV Noncancer	

Nonresidential

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	280 µg/m^3	140 ppb$_{vol}$	410 µg/m^3	200 ppb$_{vol}$
Basis	Cerebellar lesions (NR AAV$_{\mathbf{adj}}$ Noncancer – U.S. EPA IRIS RfC)		Hepatic toxicity (increased ALT levels) (ATSDR MRL Intermediate Inhalation)	

Discussion of Basis

The U.S. EPA's IRIS RfC of 90 µg/m^3 is the basis of the AAC, residential RIASL and TS RIASL, and nonresidential RIASL for chloromethane. The RfC was derived from two critical studies (Landry et al. 1983, 1985) where female mice were intermittently (5.5 hours/day) or continuously (22 hours/day) exposed to methyl chloride (chloromethane) over 11 days. The critical effect was determined to be cerebellar lesions with a NOAEL of 50 ppm (103 mg/m^3) and NOAEL$_{HEC}$ of 95 mg/m^3.

The nonresidential TS RIASL was developed from the ATSDR intermediate inhalation MRL of 0.2 ppm (410 µg/m^3). This MRL was based on a LOAEL of 51 ppm (24,700 µg/m^3) for the critical effect of hepatic toxicity (increased alanine aminotransferase (ALT) levels) in mice at 12, 18, and 24 months. Rats and mice were exposed for two years to chloromethane (CIIT 1981 unpublished study). The intermediate MRL was selected over the 3x AAC value of 828 µg/m^3 to be protective of time-sensitive shorter exposure of nonresidential receptors to chloromethane. The POD was not adjusted for continuous exposure based on the toxicokinetics of chloromethane.

Uncertainties in the toxicity estimate:
The IRIS RfC contained a total UF of 1000. A UF of 10 was used to protect sensitive human subpopulations (intraspecies variability), 10 to extrapolate from an 11-day continuous exposure to a lifetime inhalation exposure study, and 3 ($10^{1/2}$) each for a total of 10 to account for interspecies variability and database insufficiency.

The ATSDR intermediate inhalation MRL has a total uncertainty of 300, 3 for use of a minimal LOAEL, 10 for extrapolation from animals to humans, and 10 for human variability.

Source of the Toxicity Values
Chronic Inhalation Noncancer:
IRIS:
Basis: IRIS (7/17/2001) is a tier 1 source. RfC = 9.0E-2 mg/m^3 (9.0E+1 µg/m^3).
Critical Studies:
1) Landry, TD; Quast, JF; Gushow, TS; et al. (1983) Methyl chloride: inhalation toxicity in female C57BL/6 mice continuously or intermittently exposed for 11 days. EPA/OTS Doc #878213687, NTIS/OTS0206357. (unpublished)
2) Landry, TD; Quast, JF; Gushow, TS; et al. (1985) Neurotoxicity of methyl chloride in continuously versus intermittently exposed female C57BL/6 mice. Fundam Appl Toxicol 5(1): 87-98.
Method(s): Female C57BL/6 mice (12/group) were exposed continuously (22-22.5 hours/day for 11 days) to 15, 50, 100, 150,or200, ppm methyl chloride. Mice were also exposed intermittently (5.5 hours/day) for 11 days to 0, 150, 400, 800, 1,600, or 2,400 ppm.
Critical effect: cerebellar lesions
End point or Point of Departure (POD): NOAEL = 50 ppm (103.2 mg/m^3) $NOAEL_{HEC}$ = 94.6 mg/m^3
Uncertainty Factors: UF = 1,000 (10 each for intraspecies variability , and 11 day to chronic exposure extrapolation and 3 ($10^{1/2}$) each for a total of 10 to account for interspecies extrapolation and database deficiency.)
Source and date: IRIS, 7/17/2001

Tier 2 Sources:
PPRTV: PPRTV (12/4/2012) refers to the IRIS chronic RfC. A sub chronic p-RfC = 3.0 mg/m^3 is available:
Critical Study(ies): Landry et al. (1983, 1985)
Method(s): Female C57BL/6 mice (12/group) were "continuously" (22−22.5 hours/day) exposed to 0, 15, 50, 100, 150, or 200ppm (0, 28.4, 94.6, 189.3, 283.9, or 378.6mg/m^3), or "intermittently" (5.5 hours/day) to 0, 150, 400, 800, 1600, or 2400 ppm (0, 71.0, 189.3, 378.6, 757.2, or 1135.8 mg/m3) of chloromethane (purity = 99.5%) for whole body during 11 days. Neurofunctional testing was conducted during the course of the study.
Critical effect: cerebellar lesions in female C57BL/6 mice
End point or Point of Departure (POD): NOAEL = 50 ppm; $NOAEL_{ADJ}$ = 94.6 mg/m^3; $NOAEL_{HEC}$ = 94.6 mg/m^3
Uncertainty Factors: UF = 30 (10 for interspecies variability and 3 for interspecies extrapolation).
MRL: Per ATSDR (12/1998), inhalation chronic MRL = 0.05 ppm. The 2009 ATSDR Addendum for chloromethane reported that very little new information was found that is relevant to the Toxicological Profile.
Critical Study: CIIT. 1981. Final report on a chronic inhalation toxicology study in rats and mice exposed to methyl chloride. Unpublished study prepared by Battelle-Columbus Laboratories, Columbus, OH. OTS Submission Document ID 40-8120717
Method(s): F344 rats and B6C3F1 mice (120/sex/species/concentration) were exposed to 0, 50, 225, or 1000 ppm (0, 18, 83, or 368 mg/m^3) chloromethane 6 hours/day, 5 days/week, for up

to 24 months. Interim sacrifices and toxicological evaluations were scheduled for 6, 12, and 18 months after initiation of the study. Due to high mortality in the 1000-ppm mice, this group was euthanized after 21 or 22 months of exposure. A 6-month interim report of this study was prepared by Mitchell et al. (1979b). The results of the chronic-duration study were presented in the unpublished final report by CIIT (1981).
Critical effect: neurological effects (swelling and degeneration of the axons of the spinal cord) in male and female mice
End point or Point of Departure (POD): NOAEL = 50 ppm
Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation)
Source and date: ATSDR, 12/1998
MRL: Per ATSDR (12/1998), intermediate inhalation MRL = 0.2 ppm. The 2009 ATSDR Addendum for chloromethane reported that very little new information was found that is relevant to the Toxicological Profile.
Critical Study: CIIT. 1981. Final report on a chronic inhalation toxicology study in rats and mice exposed to methyl chloride. Unpublished study prepared by Battelle-Columbus Laboratories, Columbus, OH. OTS Submission Document ID 40-8120717
Method(s): Fischer 344 rats and B6C3F1 mice. Animals (120 per sex per exposure level) were exposed to chloromethane in whole body inhalation exposure chambers at target concentrations of 0 (control), 50, 225, or 1,000 ppm, 6 hours/day, 5 days/week for up to two years.
Critical effect: increased ALT levels
End point or Point of Departure (POD): LOAEL = 51 ppm
Uncertainty Factors: UF = 300 (3 for use of a LOAEL, 10 each for intraspecies variability and interspecies extrapolation)
Source and date: ATSDR, 12/1998
MRL: Per ATSDR (12/1998), acute inhalation MRL = 0.5 ppm. The 2009 ATSDR Addendum for chloromethane reported that very little new information was found that is relevant to the Toxicological Profile.
Critical Study: Landry DL, Quast JF, Gushow TS, Mattsson. 1985. Neurotoxicity of methyl chloride in continuously versus intermittently exposed female C57BL/6 mice. Fundamental and Applied Toxicology 5:87-98.
Method(s): Groups of 12 mice each were exposed to chloromethane in whole body inhalation chambers for 11 days either continuously 22 hours/day at 0, 15, 50, 100, 150, 200, or 400 ppm or intermittently 5.5 hours/day at 0, 150, 400, 800, 1,600, or 2,400 ppm. The mice were subjected to neurofunctional testing (ability to stay on a rotating 4 cm diameter rod) on days 4, 8, and 11.
Critical effect: no neurological effects or histopathologic damage observed
End point or Point of Departure (POD): NOAEL = 50 ppm
Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation)
Source and date: ATSDR, 12/1998

Tier 3 Source:
MDEQ: DEQ-CCD-AQD (09/03/2013) adopted IRIS RfC of 90 µg/m^3.

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: "Inadequate Information to Assess Carcinogenic Potential"
IRIS WOE Basis: Little pertinent information and/or conflicting evidence. In animals, only a single 2-year study (CIIT, 1981) was conducted, resulting in tumors in the kidneys of male mice but no tumors at any other site or in female mice or rats of either sex. Human studies were limited to an epidemiological study in which pancreatic cancer was not associated with chloromethane exposure (Kernan et al., 1999), along with other studies either confounded by exposure to other chemicals (Dow Corning Corporation, 1992; Olsen et al., 1989), by demonstrating a "healthy worker" effect (Holmes et al., 1986), or by having wide variability (Rafnsson and Gudmundsson, 1997), thus precluding meaningful conclusions.
Source and Date: PPRTV, 12/14/2012; IRIS, 2001

<u>1,3-Dichlorobenzene (CAS# 541-73-1)</u>

Residential

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	3.1 μg/m^3	0.52 ppb$_{vol}$	9.3 μg/m^3	1.5 ppb$_{vol}$
Basis	Decreased density of thyroid colloid from 90 day oral administration (Res AAV Noncancer – MDEQ ITSL)		3x Res AAV Noncancer	

Nonresidential

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	9.2 μg/m^3	1.5 ppb$_{vol}$	28 μg/m^3	4.7 ppb$_{vol}$
Basis	Decreased density of thyroid colloid from 90 day oral administration (NR AAV$_{\mathbf{adj}}$ Noncancer – MDEQ ITSL)		3x NR AAV$_{\mathbf{adj}}$ Noncancer	

Discussion of Basis
The residential and nonresidential AACs, RIASLs and TS RIASLs for 1,3-dichlorobenzene are based on the MDEQ AQD's chronic ITSL, 3.0 μg/m^3 (MDEQ, 2006). The ITSL is based on a 90-day oral rat study in which the critical effect was thyroid reduction of follicular colloidal density in male rats given 1,3-dichlorobenzene at 9 mg/kg per day (McCauley *et al*., 1995b).

There are very few studies on the toxicity of 1,3-dichlorobenzene. Other state agencies have also derived screening levels for chronic exposure to 1,3-dichlorobenzene at 10 μg/m^3 (NYSDEC, 2005) and 27 μg/m^3 (TCEQ, 2015), but they are either derived via route extrapolation, as well, or they are derived from another compound (1,4-dichlorobenzene). As a result, the basis for these other health benchmarks are not more appropriate than the MDEQ ITSL. Furthermore, the values are higher than the MDEQ ITSL, so they may not be as health-protective.

Uncertainties in the toxicity estimate:
The AAC is based on route extrapolation from a 90-day oral rat study, where the LOAEL was 9 mg/kg per day. The ratio of body weight to daily inhalation volume was assumed to be 1 kg/0.9 m^3, the ratio of oral absorption to inhalation absorption was assumed to be 1/1 and a total UF of 3,000 was used, where a UF of 3 was used for LOAEL to NOAEL extrapolation, a UF of 10 was used for subchronic to chronic extrapolation, a UF of 10 was used for interspecies extrapolation and a UF of 10 was used for intraspecies extrapolation.

Source of the Toxicity Values
Noncancer:
Basis: MDEQ AQD derived its value by route extrapolation from a 90-day oral study in rats. No IRIS RfC, U.S. EPA PPRTVs, or ATSDR MRLs were available.

MDEQ: chronic ITSL = 3.0 µg/m³ with annual averaging time. This screening level is based on oral rat 90-day study (McCauley *et al*., 1995). Calculated using R232(1)(e) equation and default rat inhalation rate.
Critical Study: McCauley, P.T., M. Robinson, F.B. Daniel, and G.R. Olson 1995b. Toxicity studies of 1,3-dichlorobenzene in Sprague-Dawley rats. Drug Chem. Toxicol. 18(2&3): 201-221.
Method(s): Groups of 10 male and 10 female Sprague-Dawley rats were administered 1,3-Dichlorobenzene in gavage doses of 0, 9, 37, 147, or 588 mg/kg per day in corn oil for 90 consecutive days.
Critical effect: thyroid pathology even at lowest dose tested
End point or Point of Departure (POD): LOAEL = 9 mg/kg
Uncertainty Factors: UF=3,000 (3 for LOAEL-to-NOAEL, 100 for inter and intra-species extrapolation and 10 for subchronic to chronic exposure).
Source and date: MDEQ-CCD/AQD, 8/02/2006

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: not classifiable as to human carcinogenicity (classification D)
Basis: IRIS WOE: no human data, no animal data and limited genetic data
Source and Date: Per IRIS (9/01/1990) and IRIS external review draft (2003), no value at this time.

<u>1,4-Dichlorobenzene (CAS # 106-46-7)</u>

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	6.5 μg/m^3	1.1 ppb_{vol}	65 μg/m^3	11 ppb_{vol}
Basis	Increased incidence of hepatocarcinoma and adenoma (Res AAV Cancer - MDEQ IURF)		10 x Res AAV Cancer	

Nonresidential RIASLs

	NonResidential **RIASL**		NonResidential **TS RIASL**	
Action Level	30 μg/m^3	5.0 ppb_{vol}	300 μg/m^3	50 ppb_{vol}
Basis	Increased incidence of hepatocarcinoma and adenoma (NR $AAV_{\mathbf{adj}}$ Cancer, MDEQ IURF)		10 x Res $AAV_{\mathbf{adj}}$ Cancer	

Discussion of Basis

The residential and nonresidential RIASLs and TS RIASLs for 1,4-dichlorobenzene are based on the IURF developed by the MDEQ based on a carcinogenicity study in mice and rats exposed to para-dichlorobenzene for approximately two years (NTP, 1987), resulting in increased incidence of hepatocarcinoma and adenoma in male mice. The ATSDR chronic, intermediate and acute MRLs for 1,4-dichlorobenzene (60, 1,200, and 12,000 μg/m^3, respectively) are based on noncancer effects and higher than the residential and nonresidential RIASLs and TS RIASLs; therefore, these recommended screening levels should be health-protective for the noncancer adverse effects also.

Uncertainties in the toxicity estimate:
The 2016 MDEQ IURF of 3.9E-6 (μg/m^3)$^{-1}$ is based on the hepatocarcinoma and adenoma incidence data in male mice (NTP, 1987) and using the U.S. EPA Benchmark Dose Software using the cancer multistage model. California (OEHHA, 2009) has an inhalation unit risk = 1.1 E-5 (ug/m3)-1. The difference is due to differing methods: 1) They used a linearized multistage procedure developed by Crump *et al*., (1982); MDEQ used the U.S.EPA's Benchmark Dose Software using the cancer multistage model and 2) OEHHA used a scaling factor of q_{human} x q_{animal} x (bw_h/bw_a)1/3; MDEQ used an U.S. EPA method which uses an exponent of (¼) in the calculation.

Source of the Toxicity Values
Noncancer:
Basis: This value is based on more current studies compared to the IRIS RfC basis.
ATSDR (7/2006), chronic inhalation MRL = 0.01 ppm or 0.06 mg/m^3: (Molecular weight = 147 g/mol).
Critical Studies:
1) Aiso S, Takeuchi T, Arito H, *et al*. 2005b. Carcinogenicity and chronic toxicity in mice and rats exposed by inhalation to para-dichlorobenzene for two years. J Vet Med Sci 67(10):1019-1029.

2) Japan Bioassay Research Center. 1995. Toxicology and carcinogenesis studies of p-dichlorobenzene in 344/DuCrj rats and Crj:BDF1 mice. Two-year inhalation studies. Japan Industrial Safety and Health Association. Study carried under contract with the Ministry of Labour of Japan.
Method(s): F344/DuCrj rats and Crj:BDF1 mice (50/sex/dose) were exposed to 1,4-dichlorobenzene in target concentrations of 0, 20, 75, or 300 ppm for 6 hours/day, 5 days/week for 104 weeks.
Critical effect: increased incidences of nasal lesions in female rats
End point or Point of Departure (POD): $BMCL_{10}$ = 9.51 ppm; $BMCL_{ADJ}$ = 1.7 ppm; $BMCL_{HEC}$ = 0.27 ppm (1.62 mg/m^3; MW = 147 g/mol)
Uncertainty Factors: UF = 30 (10 for intraspecies variability and 3 for interspecies extrapolation)
Source and date: ATSDR, 7/2006

Cancer:
MDEQ AQD
Basis: MDEQ IURF = 3.9E-6 (μg/m^3)$^{-1}$.
Critical Study: NTP (National Toxicology Program). 1987. Toxicology and carcinogenesis studies of 1,4-dichlorobenzene in F344/N rats and B6C3F1 mice (gavage studies). NTP TR 319. NIH Publ.
Method(s): Groups of 50 male and female F344/N rats and B6C351 mice were exposed in corn oil by gavage to 1,4-DCB 5 days/week at doses of 0, 150, or 300 mg/kg-day for two years.
1) *Dose response data: Tumor Type* – male mouse hepatocarcinoma and adenoma data (see AQD justification, 11/2016)
2) *Extrapolation method:* EPA benchmark dose software
Carcinogen Weight-of-Evidence (WOE) Class:
IRIS WOE Basis: This substance/agent has not undergone a complete evaluation and determination under the U.S EPA's IRIS program for evidence of human carcinogenic potential.
Source and Date: MDEQ AQD Screening Level for 1,4-dichlorobenzene dated December 1, 2016.

1,1-Dichloroethane (CAS# 75-34-3)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	16 µg/m^3	4.0 ppb$_{vol}$	160 µg/m^3	40 ppb$_{vol}$
Basis	mammary gland adenocarcinomas observed in female rats (Res AAV Cancer; Cal EPA)		10X Res AAV Cancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	74 µg/m^3	18 ppb$_{vol}$	740 µg/m^3	180 ppb$_{vol}$
Basis	mammary gland adenocarcinomas observed in female rats (Nonres AAV$_{adj}$ Cancer; Cal EPA)		10X Nonres AAV$_{adj}$ Cancer	

Discussion of Basis

The residential and nonresidential RIASLs and TS RIASLs for 1,1-dichloroethane are based on the AAC values for cancer effects used by the MDEQRRD. The IURF used in the AAC calculation was a California EPA (Cal EPA) IURF value of 1.6E-6 (µg/m^3)$^{-1}$ derived from a 1977 National Cancer Institute study that exposed male and female rats and mice to 1,1-dichloroethane by gavage.

MDEQ AQD calculated a noncancer inhalation initial threshold screening level (ITSL) based on an annual averaging time equal to 500 µg/m^3 (MDEQ, 1997) based on Hoffman et al.'s (1971) subchronic mammalian inhalation study. The critical effects for a NOAEL of 138 mg/kg-day were increased Blood Urea Nitrogen (BUN) and abnormal kidney histopathology. The calculated cancer RIASL values are considered health-protective for noncancer adverse effects as they are lower than the ITSL. No ATSDR MRL is available at this time.

Uncertainties in the toxicity estimate:
Per Cal EPA, an expedited Proposition 65 methodology (with cross-route extrapolation) was used to derive a cancer potency factor from an NCI bioassay (1977). The IURF was then extrapolated from the oral cancer potency factor using a reference human body weight of 70 kg and an inspiration rate of 20 m^3/day.

Source of the Toxicity Values
Noncancer:
MDEQ:
Basis: Cal EPA, a Tier 3 source. No Tier 1 or Tier 2 sources at this time.
Agencies that adopted Cal EPA IURF without modification include New Jersey, New York, Texas, and USEPA RSL (see details below).

IRIS: Per IRIS (12/01/1996), no value at this time.

PPRTV: Per PPRTV (9/27/2006), no value at this time. Hofmann et al. (1971) identified renal effects in the cat as the most sensitive species for 1,1-dichloroethane in a subchronic study. However, the data are inadequate to identify the 500 ppm level as either a LOAEL or a NOAEL. No effects on the kidneys or other organs were found in other species tested in this study or in other repeated exposure inhalation studies (Dow Chemical, 1990; AIHA, 1986; Union Carbide, 1947).
MRL: Per ATSDR April 2015 list, no MRL at this time.

MDEQ: DEQ-CCD/AQD (1997) ITSL = 5.0E+2 µg/m³: Averaging time = annual.
Critical Study: Hofmann, H.T., H. Birnstiel and P. Jobst. 1971. Inhalation toxicity of 1,1- and 1,2-dichloroethane. Arch. Toxicol. 27: 248-265.
Methods: Sprague-Dawley rats, Pirbright-White guinea pigs, "colored" rabbits and cats were exposed to 0 or 500 ppm of 1,1-dichloroethane (2024 mg/m^3) for 6 hours/day, 5 days/week for 13 weeks. Each species was composed of an equal number of males and females (2 each for cats and rabbits, 5 each for guinea pigs and rats).
Critical effect: increased BUN and abnormal kidney histopathology
End point or Point of Departure (POD): NOAEL = 2025 µg/m^3; duration adjusted NOAEL = 138 mg/kg/day (based on a cat inhalation rate and body weight of 1.26 m^3/day and 3.3 kg, respectively).
Uncertainty Factors: UF = 1,000 (10 each for intraspecies variability, interspecies extrapolation and use of a subchronic study)
Source and date: DEQ-CCD/AQD, 8/25/1997

HEAST: RfC= 5E-1 µg/m³ based on HEAST Summary, 1997.

California DTSC: RfC= 8.0E+02 µg/m³ based on RfD and route extrapolation.

New York DEC: RfC= 500 µg/m³ based on a POD of 5E+5 µg/m^3 (NOEL) and UF = 1000. Based on kidney damage in cats exposed by inhalation six hours/d, 5 d/wk for 13 wks. Study LOEL = 1E+6 µg/m^3. (USEPA HEAST, 1997)

Texas CEQ: RfC= 2.4E+03 µg/m³. TCEQ adopted the ATSDR MRL of 2.4 mg/m3 for 1,2-dichloroethane, a surrogate chemical for 1,1-dichloroethane (TCEQ Justification, 2011).

Other Tier 3: No value is available at this time from these Tier 3 sources/databases: NTP ROC, health and environmental agencies of Massachusetts, Minnesota and New Jersey, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), ECHA (REACH) and OECD HPV.

Cancer:
Cal EPA: CSF = 1.6E-06 (µg/m^3)$^{-1}$
Critical Studies: National Cancer Institute (NCI, 1977). Bioassay of 1,1-Dichloroethanefor Possible Carcinogenicity. Carcinogenesis Technical Report Series No. 66. NTIS Publication No. P:B 283345. US Department of Health, Education and Welfare, NCI Carcinogenesis Testing Program, Beth, MD.
Methods: Gavage studies in male and female B6C3F1 mice and Osborne Mendel rats. Cancer potency is based on mammary gland adenocarcinomas observed in female rats, the most sensitive of the species/sex combinations tested. Because survival was poor for the female rats, the potency was derived using a time-to-tumor analysis (Crump et al., 1991).

Route-to-route extrapolation was used to develop IURF from the cancer potency factor using a reference human body weight of 70 kg and an inhalation rate of 20 m^3/day.
Source: Cal EPA: Office of Environmental Health Hazard Assessment OEHHA 2009. Air Toxics Hot Spots Program Technical Support Document for Cancer Potencies. Appendix B. Chemical-specific summaries of the information used to derive unit risk and cancer potency values (page B-245). Updated 2011.

USEPA RSL: IURF = 1.6E-06 $(\mu g/m^3)^{-1}$ based on Cal EPA 2009 (RSL, 2017)

New Jersey DEP: IURF = 5.7E-03$(\mu g/m^3)^{-1}$ based on Cal EPA 2009 (NJDEP Toxicity Values for Inhalation Exposure, 2011)

New York DEC: IURF = 1.6E-06 $(\mu g/m^3)^{-1}$ based on Cal EPA 2002/2009 (NYDOH, 2004)

Texas CEQ: IURF = 1.6E-06 $(\mu g/m^3)^{-1}$ based on Cal EPA 2009 (TCEQ, 2014)

Other Tier 3 sources: No value is available at this time from these Tier 3 sources/databases: HEAST, NTP ROC, health and environmental agencies of Massachusetts, Minnesota, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), OECD HPV, and ECHA (REACH).

1,1-Dichloroethylene (CAS#75-35-4)

Residential RIASLs

	Residential RIASL		Residential TS RIASL	
Action Level	210 µg/m^3	53 ppb$_{vol}$	630 µg/m^3	160 ppb$_{vol}$
Basis	Liver toxicity, fatty change (Res AAV Noncancer – U.S. EPA IRIS RfC)		3 x Res AAV Noncancer	

Nonresidential RIASLs

	Nonresidential RIASL		Nonresidential TS RIASL	
Action Level	620 µg/m^3	160 ppb$_{vol}$	1,900 µg/m^3	480 ppb$_{vol}$
Basis	Liver toxicity, fatty change (NR AAV$_{adj}$ Noncancer – U.S. EPA IRIS RfC)		3 x NR AAV$_{adj}$ Noncancer	

Discussion of Basis

The residential and nonresidential AACs, RIASLs and TS RIASLs for 1,1-dichloroethylene are based on the U.S. EPA IRIS chronic RfC of 200 µg/m^3. The IRIS RfC of 200 µg/m^3 is based on a NOAEL of 25 ppm (NOAEL$_{HEC}$ = 17.7 mg/m^3, BMCL$_{10HEC}$ = 6.9 mg/m^3) and LOAEL of 75 ppm for fatty liver change in female rats after 18 months of exposure for 6 hours/day and 5 days/week (Quast et al 1986). The ATSDR Intermediate Inhalation MRL is based on hepatic effects (increased liver enzymes and mottled livers) reported at a NOAEL of 5 ppm and a LOAEL of 15 ppm after 90 days of continuous exposure in guinea pigs (Prendergast et al, 1967). A review of Prendergast et al, 1967 identifies that the biochemical evaluations were only conducted at 2 doses, 20 mg/m^3 (5 ppm) and 189 mg/m^3 (48 ppm), with significant increases in liver enzymes only observed at 189 mg/m^3 continuous exposure. Liver histological changes were observed at 189 mg/m^3 in multiple species, but not at lower doses. So the LOAEL for this study for 1,1-dichloroethylene is 189 mg/m^3 (48 ppm) and the NOAEL is 101 mg/m^3 (25 ppm). Although there is evidence that continuous exposure results in adverse effects at lower doses, the similarities in the NOAELs and LOAELs for both studies indicate use of the IRIS RfC is appropriate for 1,1-dichloroethylene for the RIASLs and TS RIASLs.

Uncertainties in the toxicity estimate:
The total UF applied is 30 for the IRIS RfC. A UF of 10 is used to account for intraspecies variability and a UF of 3 for interspecies variability because of the use of dosimetric adjustments. The confidence assigned by IRIS to the RfC estimate is high due to an adequate number of animals in a chronic 2-year study that identified both a NOAEL and LOAEL and was thorough in reporting experimental and exposure details. The animal database provides sufficient supporting data for the RfC.

For the ATSDR intermediate inhalation MRL the total UF applied is 100. A UF of 10 each was used for human variability and interspecies extrapolation.

Source of the Toxicity Values
Noncancer:
Basis: IRIS is the only available chronic value and a Tier 1 source.
IRIS RfC = 2.0E-1 mg/m³.
Critical Study: Quast, JF; Mckenna, MJ; Rampy, LW; et al. (1986) Chronic toxicity and oncogenicity study on inhaled vinylidene chloride in rats. Fundam Appl Toxicol 6:105-144.
Method(s): Sprague-Dawley rats (Spartan sub strain, 86 animals/sex/dose) to 1,1-dichloroethylene by inhalation 6 hrs./day, 5 days/wk., for up to 18 months. Rats were exposed to 1,1- dichloroethylene concentrations of 10 ppm and 40 ppm for the first 5 weeks of the study. Based on the absence of observable treatment-related effects among rats sacrificed after 1 month of exposure, the concentrations were increased to 25 and 75 ppm through the 18th month of the study. The surviving animals were then held without exposure to 1,1-dichloroethylene until 24 months.
Critical effect: liver toxicity (fatty change) in rats
End point or Point of Departure (POD): $NOAEL_{HEC}$ = 17.7 mg/m^3; $BMCL_{10HEC}$ = 6.9 mg/m^3
Uncertainty Factors: UF = 30 (10 for intraspecies variability and 3 for interspecies extrapolation).
Source and date: IRIS, Last revision date – 8/13/2002

MRL: Per ATSDR (5/1994; 7/2009), Intermediate inhalation MRL = 0.02 ppm
Critical Study: Prendergast, JA; Jones, RA; Jenkins, JR Jr, et al. (1967) Effects on experimental animals of long-term inhalation of trichloroethylene, carbon tetrachloride, 1,1,1-trichloroethane, dichlorodifluoromethane, and 1,1-dichloroethene. Toxicol Appl Pharmacol 10:270-289.
Method(s): Long-Evans or Sprague-Dawley rats, Hartley guinea pigs, beagle dogs, New Zealand albino rabbits, and squirrel monkeys (15 rats/group, 15 guinea pigs/group, 3 rabbits/group, 2 dogs/group, or 3 or 9 monkeys/group) were exposed continuously for 90 days to 1,1-DCE vapors at 189 ± 6.2, 101 ± 4.4, 61 ± 5.7, or 20 ± 2.1 mg/m3. The concurrent controls included 304 rats, 314 guinea pigs, 48 rabbits, 34 dogs, and 57 monkeys. The age of the animals was not specified.
Critical effect: hepatic effects in guinea pigs (increased SGPT and alkaline phosphatase activity and decreased lipid content)
End point or Point of Departure (POD): NOAEL = 5 ppm
Uncertainty Factors: UF = 300 (10 each for intraspecies variability and interspecies extrapolation, and 3 as modifying factor for the close proximity of serious effects at 10-25 ppm range))
Source and date: ATSDR Tox Profile (5/1994); ADDENDUM for 1,1-Dichloroethene Supplement to the 1994 Toxicological Profile for 1,1-Dichloroethene (7/2009)

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: C (Possible human carcinogen); Suggestive evidence of carcinogenicity, but not sufficient to assess human carcinogenic potential (Inhalation route). Not assessed under the IRIS Program
Source and Date: IRIS, 8/13/2002

cis-1,2-Dichloroethylene (CAS#156-59-2)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	8.3 µg/m^3	2.1 ppb_{vol}	25 µg/m^3	6.3 ppb_{vol}
Basis	Increased relative kidney weight from 90 day oral administration (Res AAV Noncancer – California DTSC RfC)		3 x Res AAV Noncancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	24 µg/m^3	6.1 ppb_{vol}	72 µg/m^3	18 ppb_{vol}
Basis	Increased relative kidney weight from 90 day oral administration (NR AAV_{adj} Noncancer – California DTSC RfC)		3 x NR AAV_{adj} Noncancer	

Discussion of Basis

The residential and nonresidential AACs, RIASLs and TS RIASLs for cis-1,2-dichloroethylene are based on the California Department of Toxic Substances Control's (DTSC's) RfC of 8.0 µg/m^3. The DTSC's RfC is based on route extrapolation from the U.S. EPA IRIS's reference dose (RfD) derived from an oral, rat study in which increased relative kidney weight was observed in male rats (CA DTSC, 2015; McCauley *et al*., 1995a; U.S. EPA, 2010). There are very few studies on the toxicity of cis-1,2-dichloroethylene. As a result, U.S. EPA's RfD provided the most appropriate benchmark with which to derive an RfC. Benchmark dose modeling was performed to determine the dose at which a 10% change in relative kidney weight would be expected to occur in exposed rats as compared to the control counterparts.

The MDEQ AQD has also derived an RfC using route extrapolation from the same RfD. However the MDEQ AQD RfC is 18 µg/m^3 because the database UF of 3 that was used by U.S. EPA was removed, and 70 kg body weight for a person was used in the route conversion. Given U.S. EPA guidance to use 80 kg body weight, and the lack of studies provided on cis-1,2-dichloroethylene, the California DTSC will be used for the residential and nonresidential AACs (U.S. EPA, 2011).

Uncertainties in the toxicity estimate:
The AACs are based on an RfC that was derived from extrapolation of the oral toxicity value (IRIS RfD of 2.0E-03 mg/kg-day) assuming an 80 kg body weight and breathing rate of 20 m^3/day (CA DTSC, 2015). In the absence of inhalation exposure studies, route to route extrapolation is generally an alternative method by which a toxicity endpoint could be developed. The IRIS oral RfD is based on an endpoint benchmark dose level (BMDL) that is preferred by U.S. EPA and ATSDR. The total UF applied is 3,000 to account for intraspecies variability (10), interspecies extrapolation (10), use of a subchronic study (10), and database

deficiencies (3). The confidence assigned by IRIS to the RfD estimate is low due to lack of chronic, reproductive and developmental studies. By extension, the uncertainties in the RfC estimate are high for the same reasons and the assumption that the toxicity resulting from oral exposure is the same for that from inhalation exposure.

Source of the Toxicity Values
Noncancer:
Basis: Both the MDEQ and CALEPA derived their values by extrapolating the IRIS RfD. However, the CALEPA value assumed an 80 kg body weight (BW), the recent U.S. EPA OSWER recommended BW while the MDEQ used 70 kg. NY, TX and RIVM use surrogates. See details below.
California DTSC-EPA: RfC = 8.0E+00 μg/m³. The MDEQ also used route extrapolation of the same IRIS value; however, California used a body weight of 80 kg (OSWER, 2013) while the MDEQ used 70 kg. RIVM (2009) used the surrogate method.
Source: HHRA Note Number: 3, DTSC Modified Screening Levels, 5/2015

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: "inadequate information to assess the carcinogenic potential"
IRIS WOE Basis: absence of epidemiological studies in humans and lack of animal studies
Source and Date: IRIS, 9/30/2010

trans-1,2-Dichloroethylene (CAS# 156-60-5)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	270 μg/m^3	68 ppb_{vol}	790 μg/m^3	200 ppb_{vol}
Basis	Fatty degeneration of liver cells from 8-16 week inhalation exposure (Res AAV Noncancer – ATSDR MRL)		Fatty degeneration of liver cells (ATSDR MRL Acute Inhalation)	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	790 μg/m^3	200 ppb_{vol}	790 μg/m^3	200 ppb_{vol}
Basis	Fatty degeneration of liver cells (ATSDR MRL Acute Inhalation)		Fatty degeneration of liver cells (ATSDR MRL Acute Inhalation)	

Discussion of Basis

The residential RIASLs for trans-1,2-dichloroethylene is based on the residential AAC. The residential TS RIASL and nonresidential RIASL and TS RIASL are based on the intermediate inhalation MRL of 790 μg/m^3. This intermediate inhalation MRL coupled with MDEQ adjustment is the chronic inhalation toxicity value (260 μg/m^3) used to develop the residential and nonresidential AACs. The acute inhalation MRL is selected over the nonresidential AAC (800 μg/m^3) or 3x AAVs to appropriately protect for acute inhalation exposures.

The ATSDR's intermediate inhalation MRL of 0.2 ppm (790 μg/m^3) is based on an 8-week inhalation study in female rats in which fatty degeneration (steatosis) of the hepatic lobules and fatty accumulation in the Kupffer cells was observed in three out of the six exposed rats (ATSDR, 1996; Freundt *et al*., 1977). After a longer 16 week exposure at the same 200 ppm concentration, both the severity of steatosis and number of rats affected had increased. Since 200 ppm was the only exposure concentration, a NOAEL was not established. A total UF of 1000 was applied, where a UF of 10 each was given for LOAEL to NOAEL extrapolation, extrapolation from animals to humans and extrapolation for human variability. For further extrapolation of the intermediate study to consider chronic exposure, the MDEQ RRD applied a UF of 3 for subchronic to chronic extrapolation. This exposure duration extrapolation is further supported by the increased severity of effect observed after 16 weeks as compared to 8 weeks of exposure.

The acute MRL based on the eight-hour exposure studies published as part of the same overall project from Freundt *et al*. (1977), where the critical effect was observed to be fatty degeneration of liver cells with exposure to ≥200 ppm trans-1,2-dichloroethylene. Since the same UFs were applied, the acute MRL is the same value as the intermediate MRL, 0.2 ppm.

There is an MDEQ AQD ITSL, 200 μg/m^3 (assigned an annual averaging time) for trans-1,2-dichloroethylene (MDEQ, 2016). The ITSL was extrapolated from the U.S. EPA IRIS RfD for trans-1,2-dichloroethylene. The residential and nonresidential AACs are derived using the modified ATSDR's intermediate inhalation MRL because the MRL was derived from an inhalation study and ATSDR is a preferred source (Tier 2) of inhalation toxicity values compared to MDEQ AQD (Tier 3 source).

Uncertainties in the toxicity estimate:
The ATSDR MRL (0.2 ppm) is based on an 8- and 16-week inhalation exposure of rats to trans-1,2-dichloroethylene (Freundt, 1977). The point of departure, LOAEL of 200 ppm, is applied a total uncertainty factor of 1000 to account for human variability (10), interspecies extrapolation (10), and use of a LOAEL (10). An additional UF of 3 for subchronic to chronic extrapolation and 1 for databased deficiency were applied by the MDEQ to this MRL to derive a chronic inhalation toxicity value. The total UF is 3,000.

Source of the Toxicity Values
Chronic Inhalation Noncancer:
Basis: ATSDR is a Tier 2 source, no Tier 1 available. Intermediate inhalation MRL of 7.9E-1 mg/m³ was applied an additional UF = 3 by the MDEQ (3 for subchronic to chronic extrapolation and 1 for database deficiency) to derive a chronic inhalation MRL = 2.6E-1 mg/m³ (2.6E+2 μg/m³). The total UF is 3,000.
MRL: Per ATSDR, no inhalation chronic MRL value at this time. Inhalation intermediate MRL = 0.2 ppm (0.79 mg/m³) was derived as follows:
Critical Study: Freundt, KI, Liebaldt, GP, and Lieberwirth, E. 1977. Toxicity Studies on Trans-1, 2-Dichloroethylene. Toxicology, 7, pp. 141-153.
Methods: Female, mature SPF Wistar rats (6/group) were exposed 5 days per week, for either 8 or 16 weeks, at or 200 ppm of trans-1,2-dichloroethene by inhalation.
Critical effect: fatty degeneration of liver cells
End point or Point of Departure (POD): LOAEL = 200 ppm
Uncertainty Factors: UF = 1,000 (10 each for intraspecies variability, interspecies extrapolation and LOAEL to NOAEL extrapolation)
Source and date: ATSDR, 8/1996

Acute Inhalation Noncancer:
MRL: Per ATSDR 8/96, an acute inhalation MRL = 0.2 ppm = 0.79 mg/m³ = 790 μg/m³ is derived as follows.
Critical Study: Freundt, KI, Liebaldt, GP, and Lieberwirth, E. 1977. Toxicity Studies on Trans-1, 2-Dichloroethylene. Toxicology, 7, pp. 141-153.
Methods: 1) Female, mature SPF Wistar Rats, 2) Exposure for 8 hours; 0, 200, 1,000, and 3,000 ppm of trans-1,2-dichloroethene by inhalation, 3) 6 rats/group, 4) Animals were sacrificed immediately following exposure and examined for gross pathology including lung, heart, liver, kidney, spleen, brain, quadriceps muscle and sciatic nerve. Standard hematological tests, clinical chemistry tests, and tests of clearance of bromosulphthalein in bile were carried out.
Critical effect: Fatty degeneration of liver cells.
End point or Point of Departure (POD): LOAEL = 200 ppm, not adjusted for continuous exposure due to acute effect after 8 hours of exposure.

Uncertainty Factors: UF = 1000 (10 each for interspecies extrapolation, intraspecies variability, and use of a LOAEL.
Source and date: ATSDR, 8/96

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: “inadequate to assess the carcinogenic potential”
IRIS WOE Basis: absence of epidemiological studies in humans and lack of animal studies
Source and Date: IRIS, 9/30/2010

Ethanol (CAS# 64-17-5)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	19,000 µg/m^3	10,000 ppb_{vol}	19,000 µg/m^3	10,000 ppb_{vol}
Basis	Worker eye and respiratory tract irritation (MDEQ, AQD Acute ITSL)		MDEQ, AQD Acute ITSL	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	19,000 µg/m^3	10,000 ppb_{vol}	19,000 µg/m^3	10,000 ppb_{vol}
Basis	Worker eye and respiratory tract irritation (MDEQ, AQD Acute ITSL)		MDEQ, AQD Acute ITSL	

Discussion of Basis
The MDEQ ITSL is the basis of the AAC and Residential and Nonresidential RIASLs. The MDEQ ITSL is based on the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV). With an adjustment for an eight hour averaging time, the ITSL is 19,000 µg/m^3. This value is based on worker complaints of irritation to the eyes and respiratory tract. Based on a comparison with human oral data (NOAEL of 1 ounce of ethanol [23.3 grams per day]), this is also considered protective against the most sensitive human endpoint, fetal alcohol syndrome.

The ACGIH considers ethanol a confirmed animal carcinogen, but the relevance to human health is unknown.

Uncertainties in the toxicity estimate:
The MDEQ ITSL is based on the ACGIH Threshold Limit Value Short-Term Exposure Level (STEL; 15 minutes) of 1,000 ppm (1,880,000 µg/m^3). People exposed to 1,000 ppm resulted in no respiratory irritation, but levels between 100 and 1,920 ppm were reported as "annoying." A STEL was selected as irritant effects occur at levels lower than those that are associated with long-term health effects. The MDEQ ITSL incorporates a total UF of 100 to account for human variability (10) and exposure time between the worker and the general population (10).

The National Institute for Occupational Safety and Health Recommended Exposure Limit for a 10 hour time-weighted average is 1,000 ppm (1,900,000 µg/m^3).

Source of the Toxicity Values
MDEQ: 1.9E+4 µg/m^3
MDEQ: AQD (1992) ITSL = 1.9E+4 µg/m^3:
Basis: Best available data is MDEQ ACGIH TLV (Browning [1956] and Lester & Greenberg [1951]). The use of one hundredth of the TLV of 1000 ppm (1900 µg/m^3) is also sufficiently protective of the most sensitive human endpoint - Fetal Alcohol Syndrome. MDEQ was chosen

due to the availability of supporting information. Documents for MA, MN, RIVM and ECHA are not available.

ITSL Derivation and Justification: Per MDEQ AQD (1992), the poor quality of inhalation toxicity data for animals makes identification of a NOAEL difficult, with little confidence for the derived number. The human oral data clearly identify Fetal Alcohol Syndrome as the most sensitive of human effects. However, there is no human inhalation data on fetal effects from this route. The bolus effect from drinking alcohol with resultant high short term blood concentrations, plus questionable self-reporting of alcohol doses, makes use of this data of rather limited value for deriving an AAC [ITSL]. The use of one hundredth of the TLV for the AAC [ITSL] is considered the best available alternative at this time. From the one ounce per day alcohol consumption rate converted to an air concentration, an AAC [ITSL] based on the TLV should be sufficiently protective for fetal effects. Therefore, the ITSL is 19 mg/m3 with an eight hour average.
Source and date: MDEQ-CCD/AQD, 4/16/1992; 64-17-5 ITSL Justification document is available.

IRIS: No IRIS file is available at this time.
PPRTV: No PPRTV record is available at this time.
MRL: No MRL record is available at this time.

Massachusetts DEP: RfC= 51.24 μg/m^3 based on 1990 Method. Supporting information could not be found.
Minnesota: RfC= 15000 μg/m^3. Supporting information could not be found.
RIVM: RfC= 30800 μg/m^3. Supporting information could not be found.
ECHA (REACH): RfC= 114 mg/m^3. A critical study with supporting information could not be found.
Other Tier 3: No value is available at this time from these Tier 3 sources/databases: HEAST, NTP ROC, health and environmental agencies of California, New Jersey, New York, and Texas, WHO (IARC), WHO (IPCS/INCHEM), Canada, and OECD HPV.

Ethylbenzene (CAS# 100-41-4)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	10 µg/m^3	2.3 ppb$_{vol}$	100 µg/m^3	23 ppb$_{vol}$
Basis	Renal tubule neoplasms from chronic exposure (Res AAV Cancer – OEHHA IUR)		10 x Res AAV Cancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	48 µg/m^3	11 ppb$_{vol}$	480 µg/m^3	110 ppb$_{vol}$
Basis	Renal tubule neoplasms from chronic exposure (NR AAV$_{\mathbf{adj}}$ Cancer – OEHHA IUR)		10 x NR AAV$_{\mathbf{adj}}$ Cancer	

Discussion of Basis

The residential and nonresidential AACs, RIASLs, and TS RIASLs for ethylbenzene are derived from the IURF developed by the CalEPA (2011) of 2.50E-06 (µg/m^3)$^{-1}$. The CalEPA IURF is based on the renal tubule carcinoma or adenoma incidence data in male rats (NTP, 1999).

The U.S. EPA IRIS' RfC (1000 µg/m^3) is based on rabbit and rat studies where developmental toxicity was suggested but not clearly evident (Hardin *et al*., 1981; U.S. EPA, 1990). Furthermore, the U.S. EPA's confidence in this RfC was classified as "low", and at the time of the IRIS' RfC derivation, there was no human or animal carcinogenicity data available (U.S. EPA, 1990). The ATSDR's acute and intermediate inhalation MRLs (22,000 and 8700 µg/m^3, respectively) are based on ototoxicity in rats (Cappaert *et al*., 2000; Gagnaire *et al*., 2007), and the chronic MRL (260 µg/m^3) is based on nephropathy in female rats (NTP, 1999). As compared to the IRIS' RfC and ATSDR's acute, intermediate and chronic MRLs for ethylbenzene, the RIASLs and TS RIASLs derived from the CalEPA IURF are lower and would therefore be health protective for effects seen above these other health benchmarks.

Uncertainties in the toxicity estimate:
The 2011 CalEPA IURF of 2.50E-06 (µg/m^3)$^{-1}$ is based on the renal tubule carcinoma or adenoma incidence data in male rats (NTP, 1999) and using the linearized multistage (LMS) model methodology. The values and the process used to derive them have undergone public and peer review, and were approved by the California Scientific Review Panel for Toxic Air Contaminants. Therefore, the cancer potency estimate was well vetted in relation to use of available data and methodology and the value could be assigned medium level of confidence.

Source of the Toxicity Values
Noncancer:
Basis: ATSDR is a more current assessment than IRIS.
ATSDR inhalation chronic MRL = 0.06 ppm or 2.6E-1 mg/m^3.

Critical Study: NTP. 1999. NTP technical report on the toxicology and carcinogenesis studies of ethylbenzene in F344/N rats and B6C3F1 mice (inhalation studies). Research Triangle Park, NC: National Toxicology Program, U.S. Department of Health and Human Services.
NTP TR 466.
Methods: F344/N rats (50/sex/ group) were exposed to 0, 75, 250, or 750 ppm ethylbenzene by inhalation for 6 hours/day, 5 days/week for 104 weeks.
Critical effect: increased severity of chronic progressive nephropathy in female rats
End point or Point of Departure (POD): $LOAEL_{HEC}$ = 17.45 ppm
Uncertainty Factors: UF = 300 (10 each for intraspecies variability and use of a LOAEL and 3 for interspecies extrapolation)
Additional data: ATSDR acute MRL (5ppm) and intermediate MRLs (2 ppm) are based on neurological effects (Cappaert *et al*., 1999 and Gagnaire *et al*., 2007, respectively).
Source and date: ATSDR, 11/2010

Cancer:
Basis: CALEPA IUR is based on a 2011 assessment using different models and dose metrics. The final value is based on the most appropriate model. CALEPA, the MDEQ, and NY used the same key study but the models used to derive the values varied. Minnesota and New Jersey adopted the CALEPA value. See details below.
California DTSC (CALEPA): IURF= 0.0000025 or 2.5E-6 $(\mu g/m^3)^{-1}$.
Using either the LMS or BMD with different dose metrics, the 95% upper confidence bound on the unit risk value for purposes of calculating cancer risks associated with exposure to ethylbenzene is in the range 5.5 x 10-4 to 6.6 x 10-3 (mg/m3)-1, based on the incidence data from the NTP (1999). The unit risk value of 2.5 $\times 10^{-3}$ $(mg/m^3)^{-1}$, or 2.5 $\times 10^{-6}$ $(\mu g/m^3)^{-1}$, based on the renal tubule carcinoma or adenoma incidence data in male rats and using the LMS methodology applied to lifetime weighted average (LTWA) doses is considered most appropriate.
Key study: National Toxicology Program (NTP), 1999. Toxicology and Carcinogenesis Studies of Ethylbenzene (CAS No. 100-41-4) in F344/N Rats and in B6C3F1 Mice (Inhalation Studies). Technical Report Series No. 466. NIH Publication No. 99-3956. U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health. NTP, Research Triangle Park, NC.
Carcinogen Weight-of-Evidence (WOE) Class: The IARC (Vol.: 77. 2000, p. 227) has concluded that there is inadequate evidence to classify ethylbenzene as a carcinogen in humans and sufficient evidence in experimental animals (Group 2B).
An NTP (1999) bioassay exposed male and female rats and mice to 0, 75, 250, or 750 ppm ethylbenzene for up to 2 years. NTP reported that ethylbenzene showed clear evidence of carcinogenic activity in male rats based on increased incidences of renal tubule neoplasms and testicular adenomas, some evidence of carcinogenic activity in female rats based on increased incidences of renal tubule adenomas, some evidence of carcinogenic activity in male mice based on increased incidences of alveolar/bronchiolar neoplasms, and some evidence of carcinogenic activity in female mice based on increased incidences of hepatocellular neoplasms.

Hexane (CAS# 110-54-3)

Residential

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	730 µg/m^3	210 ppb$_{vol}$	2,200 µg/m^3	620 ppb$_{vol}$
Basis	Peripheral neuropathy (decreased MCV at 12 weeks) in male rats (Res AAV Noncancer – U.S. EPA IRIS RfC)		3x Res AAV Noncancer	

Nonresidential

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	2,200 µg/m^3	620 ppb$_{vol}$	6,600µg/m^3	1,900 ppb$_{vol}$
Basis	Peripheral neuropathy (decreased MCV at 12 weeks) in male rats (NR AAV$_{adj}$ Noncancer – U.S. EPA IRIS RfC)		3x NR AAV$_{adj}$ Noncancer	

Discussion of Basis

The AAC for hexane is based on the U.S. EPA IRIS RfC of 700 µg/m^3. The IRIS RfC is based on 16-week subchronic rat inhalation study by Huang et al. 1989. The critical effect reported was peripheral neuropathy (decreased motor nerve conduction velocity or MCV in male rats. The U.S. EPA's Toxicological Review of n-Hexane (EPA, 2005) indicates that based on available human and animal n-hexane inhalation exposure, the nervous system is the primary target of toxicity. A 12 hours/day, 7 days/week duration adjustment of exposure concentration was applied by the U.S. EPA to the BMCL of 430 mg/m^{3,} resulting in a POD BMCL$_{ADJ}$ of 215 mg/m^3. There are no acute or intermediate MRLs currently available.

An ATSDR chronic inhalation MRL of 2115 µg/m^3 (ATSDR, 1999) was derived from an epidemiology study of factory workers exposed to hexane over an average 6-year period (Sanagi et al 1980). Generally, human exposure studies are preferable to animals; however, per IRIS (EPA 2005) studies showed that solvents including toluene, methyl ethyl ketone, acetone, and xylene potentiate neurotoxicity resulting from the n-hexane exposure. From these findings, IRIS indicated that the severity of the neurological changes observed in Sanagi (1980) may be attributed to exposure to both n-hexane and acetone. IRIS also noted that studies had shown that n-hexane metabolism and neurotoxicity are affected by acetone. Therefore, the 3x AAC (3,300 µg/m^3) is used as the basis for the TS RIASL for n-hexane.

Uncertainties in the toxicity estimate:
For the U.S. EPA IRIS value a total UF of 300 was applied to the POD of 215 mg/m^3: 10 for intraspecies variation; 3 for interspecies differences; 3 to extrapolate to chronic exposure from data in a less-than lifetime study; and 3 to account for database deficiencies. The subchronic study used to derive the RfC is a 16-week study. Per IRIS, "16 weeks is half of the time required for a newly synthesized neurofilament protein to be transported from the neuronal cell body to the axon terminal in the longest axons of the central nervous system and the peripheral

nervous system of an adult rat (Griffin et al. 1984)". Therefore, only a factor of 3 was used to extrapolate the POD to a chronic exposure dose.

Source of the Toxicity Values
Noncancer:
Basis: IRIS is a Tier 1 source.

Tier 1/IRIS Source (12/23/2005)**:** RfC = 7E+2 µg/m^3.
Critical Study: Huang, J; Kato, K; Shibata, E; et al. (1989) Effects of chronic n-hexane exposure on nervous system-specific and muscle-specific proteins. Arch Toxicol 63:381-385.
Methods: Male Wistar rats (8/group) were exposed to 0, 500, 1,200, or 3,000 ppm (0, 1,762, 4,230, 10,574 mg/m^3) n-hexane (>99% pure) for 12 hours/day, 7 days/week for 16 weeks. The authors measured MCV in the tail nerve along with body weight before exposure and after 4, 8, 12, and 16 weeks of exposure to n-hexane. One animal from each group was sacrificed at 16 weeks exposure for histopathological evaluation of the nerve fibers in the tail. In addition, Huang et al. (1989) measured the levels of neuron-specific enolase and beta-S-100. These nervous system-specific proteins are a family of calcium binding proteins that are involved in processes such as cell-to-cell communication, cell growth, intracellular signal transduction, and development and maintenance of the central nervous system.
Critical effect: Peripheral neuropathy (decreased MCV at 12 weeks) in male rats.
End point or Point of Departure (POD): The Huang et al. (1989) data set provided an adequate dose response for BMD modeling with an estimated point of departure of a $BMCL_{HEC}$ of 215 mg/m^3 (Section 5.2.2 and Appendix B of the Toxicological Review of n-Hexane [U.S. EPA, 2005a]). The neurophysiological deficits and histopathological effects that were evident in mid- and high-dose rats indicate a NOAEL of 500 ppm.
Uncertainty Factors: A total UF of 300 was applied to the POD of 215 mg/m^3: 10 for intraspecies variation; 3 for interspecies extrapolation; 3 to extrapolate to chronic exposure from data in a less than lifetime study; and 3 to account for database deficiencies. Per IRIS, the subchronic study used for deriving the RfC is a 16-week study. However, 16 weeks is half of the time required for a newly synthesized neurofilament protein to be transported from the neuronal cell body to the axon terminal in the longest axons of the central nervous system and the peripheral nervous system of an adult rat (Griffin et al., 1984).

Tier 2 Sources:
PPRTV: Per PPRTV, 09/30/2009, a subchronic p-RfC of 2 mg/m^3 (2E+3 µg/m^3) was derived using the same study and data as used by the U.S. EPA IRIS to derive the chronic RfC. A total UF of 100 was applied to derive the subchronic p-RfC (10 for intraspecies variability, 3 for intraspecies variability, and 3 for database deficiency). The critical effect was peripheral neuropathy. Updated literature searches did not reveal additional data beyond those that were evaluated in the previous IRIS assessment.

MRL: Per ATSDR (7/1999), the chronic inhalation MRL = 0.6 ppm (= 2 mg/m^3 [based on 1 ppm = 3.52 mg/m^3] = 2E+3 µg/m^3)
Critical study: Sanagi, S. et al. (1980) Peripheral nervous system functions of workers exposed to n-hexane at a low level. Int. Arch. Occup. Environ. Health 47(1): 69-79.
Method(s): This is an epidemiology study on two age-matched groups consisting of 14 control workers and 14 exposed workers employed in a factory producing tungsten carbide alloys. Exposure was estimated with 22 personal samples taken from the breathing zones over a period of 2 years. The 8-hour time-weighted average exposure to solvent vapors consisted of n-hexane at 58±41 ppm and acetone at 39±30 ppm. The exposure duration ranged from 1 to 12

years, with an average of 6.2 years. Both groups completed questionnaires and underwent clinical neurological examinations and neurophysiological and nerve stimulation studies.
Critical Effect: neurotoxicity; reduced motor nerve conduction velocity in occupationally exposed workers
End point or point of departure (POD): The LOAEL was identified as 58 ppm.
Uncertainty factors: 100 (10 for LOAEL-to-NOAEL extrapolation, 10 for intraspecies variability).

Tier 3 Source:
MDEQ AQD: Per DEQ-CCD, AQD ITSL = 700 ug/m^3 (24 hr. averaging time). Based on the U.S. EPAs RfC, from Huang et al (1989) - a 16 week rat inhalation study that change motor nerve conduction velocity. BMDS methods were used to develop this RfC. AQD calculation date: 01/04/2006.

Cancer:
IRIS 12/23/2005:
WOE Characterization: There is inadequate information to assess the carcinogenic potential of n-hexane. Studies indicate that n-hexane is mostly nongenotoxic in short-term testing protocols. n-Hexane showed a minimal response in Saccharomyces cerevisiae D61.M (Mayer and Goin, 1994) and induced an increased incidence in the number of chromosomal mutations in albino rat bone marrow cells (Hazleton Laboratories, 1992). Also, the low pKa of exocyclic amino functional groups of DNA (<5) would preclude reaction with 2,5-hexanedione to yield pyrrole adducts. Thus, these data suggest a lack of mutagenic potential of n-hexane.

Mercury, Elemental (CAS# 7439-97-6)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	0.31 μg/m^3	0.038 ppb$_{vol}$	0.93 μg/m^3	0.11 ppb$_{vol}$
Basis	Hand tremor and increased memory disturbance, also considered protective for neurodevelopmental effects (Res AAV Noncancer – U.S. EPA IRIS RfC)		3× Res AAV Noncancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	0.92 μg/m^3	0.11 ppb$_{vol}$	2.8 μg/m^3	0.34 ppb$_{vol}$
Basis	NR AAV$_{adj}$ Noncancer		3× NC NR AAV$_{adj}$ Noncancer	

Discussion of Basis

The AACs and residential and nonresidential RIASLs and TS RIASLs were developed from the U.S. EPA's IRIS RfC, which is based on hand tremor and increased memory disturbance in workers. The U.S. EPA converted the LOAEL to a continuous exposure (LOAEL of 0.025 mg/m^3 xMVho/MVh x 5 days/7 days = 0.009 mg/ m^3 LOAEL [adj]; where breathing volume for occupational exposure [MVho] = 10 m^3/day, breathing volume for a day [MVh] = 20 m^3/day), and calculated an RfC of 0.3 μg/m^3. The RfC is very similar to the ATSDR chronic inhalation MRL of 0.2 μg/m^3, based on hand tremors in workers (LOAEL$_{(ADJ)}$ = 0.026 mg/m^3 x [8 hr/24 hr] x [5 days/7 days] = 0.0062 mg/m^3).

These values are basically equivalent, the only difference is how the U.S. EPA and ATSDR accounted for the less than 24 hour workday. Currently, the U.S. EPA value adjusts based on inhalation volume and may be a more appropriate adjustment. It should be noted that elemental mercury is a developmental toxicant, and this value is protective of neurodevelopmental effects in fetuses and children. Additionally, these values also line up with screening levels used by MDHHS to respond to elemental mercury spills. Typically, after all elemental mercury sources are removed from a home, MDHHS typically considers that clean-up is complete when the source mercury has been removed and mercury levels in the indoor air drop below 1.0 μg/m^3. With all sources of elemental mercury removed, the air levels will drop to below the ATSDR chronic MRL within a few days. In occupational settings, cleanup is considered complete when all sources of mercury are removed and the mercury levels in the indoor air are below 3 μg/m^3. In volatilization to indoor air scenarios, the indoor air levels may vary widely (see main text) with no mercury sources in the home to remove resulting in exposures that could be harmful to fetuses and children.

Uncertainties in the toxicity estimate:
The U.S. EPA RfC has an uncertainty factor of 10 for human variability and 3 for database deficiency (total of 30). The ATSDR chronic inhalation MRL includes an UF of 3 for a minimal LOAEL and a 10 for human variability (total of 30).
Both the U.S. EPA and IARC have listed elemental mercury as not classifiable as to carcinogenicity.

Source of the Toxicity Values

IRIS: RfC = 3.0E-4 mg/m^3

Critical Studies:

1. Fawer, R.F., U. DeRibaupierre, M.P. Guillemin, M. Berode and M. Lobe. 1983. Measurement of hand tremor induced by industrial exposure to metallic mercury. J. Ind. Med. 40: 204-208.
2. Piikivi, L. and U. Tolonen. 1989. EEG findings in chlor-alkali workers subjected to low long term exposure to mercury vapor. Br. J. Ind. Med. 46: 370-375.
3. Piikivi, L. and H. Hanninen. 1989. Subjective symptoms and psychological performance of chlorine-alkali workers. Scand. J. Work Environ. Health. 15: 69-74.
4. Piikivi, L. 1989. Cardiovascular reflexes and low long-term exposure to mercury vapor. Int. Arch. Occup. Environ. Health. 61: 391-395.
5. Ngim, C.H., S.C. Foo, K.W. Boey and J. Jeyaratnam. 1992. Chronic neurobehavioral effects of elemental mercury in dentists. Br. J. Ind. Med. 49: 782-790.
6. Liang, Y-X., R-K. Sun, Y. Sun, Z-Q. Chen and L-H. Li. 1993. Psychological effects of low exposure to mercury vapor: Application of a computer-administered neurobehavioral evaluation system. Environ. Res. 60: 320-327.

Method(s): Human occupational inhalation studies

1. Fawer et al. (1983) used a sensitive objective electronic measure of intention tremor (tremors that occur at the initiation of voluntary movements) in 26 male workers (mean age of 44 years) exposed to low levels of mercury vapor in various occupations: fluorescent tube manufacture (n=7), chloralkali plants (n=12), and acetaldehyde production (n=7). Controls (n=25; mean age of 44.6 years) came from the same factories but were not exposed occupationally. Personal air samples (two per subject) were used to characterize an average exposure concentration of 0.026 mg/m^3. It should be noted that it is likely that the levels of mercury in the air varied during the period of exposure and historical data indicate that previous exposures may have been higher. Exposure measurements for the control cohort were not performed. The average duration of exposure was 15.3 years.
2. Piikivi and Tolonen (1989) used electroencephalograms (EEGs) to study the effects of long-term exposure to mercury vapor in 41 chloralkali workers exposed for a mean of 15.6 +/- 8.9 years as compared with matched referent controls. They found that the exposed workers, who had mean blood Hg levels of 12 ug/L and mean urine Hg levels of 20 ug/L, tended to have an increased number of EEG abnormalities when analyzed by visual inspection only.
3. Piikivi and Hanninen (1989) studied the subjective symptoms and psychological performances on a computer-administered test battery in 60 chloralkali workers exposed to mercury vapor for a mean of 13.7 ± 5.5 years as compared with matched referent controls. The exposed workers had mean blood Hg levels of 10 ug/L and mean urine Hg levels of 17 ug/L. Both subjective and objective symptoms of autonomic dysfunction were investigated in 41 chloralkali workers exposed to mercury vapor for a mean of 15.6 ± 8.9 years as compared with matched referent controls (Piikivi, 1989).
4. Ngim et al. (1992) assessed neurobehavioral performance in a cross-sectional study of 98 dentists (38 female, 60 male; mean age 32, range 24-49 years) exposed to TWA concentrations of 0.014 mg/m^3 (range 0.0007 to 0.042 mg/m^3) versus 54 controls (27 female, 27 male; mean age 34, range 23-50 years) with no history of occupational exposure to mercury. Air concentrations were measured with personal sampling badges over typical working hours (8-10 hours) and converted to an 8-hour TWA.
5. Liang et al. (1993) investigated workers in a fluorescent lamp factory with a computer-administered neurobehavioral evaluation system and a mood inventory profile. The exposed cohort (mean age 34.2 years) consisted of 19 females and 69 males exposed uninterruptedly for at least 2 years prior to the study. Exposure was monitored with area

samplers and ranged from 0.008 to 0.085 mg/m^3 across worksites. No details on how the exposure profiles to account for time spent in different worksites were constructed. The average exposure was estimated at 0.033 mg/m^3 (range 0.005 to 0.19 mg/m^3). The average duration of working was 15.8 years for the exposed cohort.

Critical effect: Hand tremor, increases in memory disturbance, slight subjective and objective evidence of autonomic dysfunction

End point or Point of Departure (POD):

1. The TWA of 0.025 mg/m^3 was designated a LOAEL. Using the TWA and adjusting for occupational ventilation rates and workweek, the resultant LOAEL (HEC) is 0.009 mg/m^3.
2. The authors extrapolated an exposure level associated with these EEG changes of 0.025 mg/m^3 from blood levels based on the conversion factor calculated by Roels et al. (1987).
3. The authors extrapolated an exposure level associated with these subjective measures of memory disturbance of 0.025 mg/m^3 from blood levels based on the conversion factor calculated by Roels et al. (1987).
4. The authors extrapolated an exposure level associated with these subjective and objective measures of autonomic dysfunction of 0.030 mg/m^3 from blood levels based on the conversion factor calculated by Roels et al. (1987).
5. These neurobehavioral effects are consistent with central and peripheral neurotoxicity and the TWA is considered a LOAEL. Using the TWA and adjusting for occupational ventilation rates and the reported 6-day workweek, the resultant LOAEL (HEC) is 0.006 mg/m^3.
6. Based on these neurobehavioral effects, the TWA of 0.033 mg/m^3 is designated as LOAEL. Using the TWA and adjusting for occupational ventilation rates and workweek, the resultant LOAEL (HEC) is 0.012 mg/m^3.

CONCLUSION: The TWA level of 0.025 mg/m^3 was used to represent the exposure for the synthesis of the studies described above. Using this TWA and taking occupational ventilation rates and workweek into account results in a LOAEL (HEC) of 0.009 mg/m^3.

Uncertainty Factors: UF = 30; an UF of 10 was used for the protection of sensitive human subpopulations (including concern for acrodynia) together with the use of a LOAEL. An UF of 3 was used for lack of database, particularly developmental and reproductive studies.

Source and date: IRIS, 06/01/1995.

MRL: Per ATSDR, March 1999, MRL = 0.0002 mg/m^3 (= 0.2 μg/m^3).

Critical Study: Fawer RF, de Ribaupierre Y, Guillemin MP, et al. 1983. Measurement of hand tremor induced by industrial exposure to metallic mercury. British Journal of Industrial Medicine 40:204-208.

Methods: Hand tremors were measured in 26 male workers exposed to metallic mercury and 25 control males working in the same facilities but not exposed to mercury. Workers had been exposed to mercury through the manufacture of fluorescent tubes, chloralkali, or acetaldehyde. Hg-exposed workers had a duration of exposure of 15.3 ± 2.6 years, blood Hg of 41.3 ± micromoles Hg/L, and urinary Hg of 11.3 ± 1.2 micromoles Hg/mole of creatinine. Mean Hg level measured using personal air monitors was 0.026± 0.0926 ± 0.004 mg/m^3 (3 subjects were exposed to greater than 0.05 mg/m^3.)

Critical Effects: Increased frequency of tremors

End Point or Point of Departure: LOAEL = 0.026 mg/m^3 (= 2.6E+1 μg/m^3).

Uncertainty Factors: UF = 30; 3 for use of a minimal LOAEL; 10 for human variability.

Methylene Chloride (CAS # 75-09-2)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	630 μg/m^3	180ppb$_{vol}$	1,000 μg/m^3	300 ppb$_{vol}$
Basis	Hepatic vacuolation in rats after chronic exposure (Res AAV Noncancer-U.S. EPA IRIS RfC)		Hepatic effects in rats after 90 day exposure (ATSDR MRL Intermediate Inhalation)	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	1,800 μg/m^3	520 ppb$_{vol}$	2,900 μg/m^3	840 ppb$_{vol}$
Basis	Hepatic vacuolation in rats after chronic exposure (Res AAV$_{\mathbf{adj}}$ Noncancer-U.S. EPA IRIS RfC)		Hepatic effects in rats after 90 day exposure (ATSDR MRL Intermediate$_{\mathbf{adj}}$ Inhalation)	

Discussion of Basis

The U.S. EPA's IRIS RfC is the basis of the AACs and RIASLs for methylene chloride. The RfC was derived from a 2-year inhalation study, where male and female rats were exposed to 0, 50, 200 or 500 ppm methylene chloride for 6 hours/day, 5 days/week (U.S. EPA, 2011c). Physiologically based pharmacokinetic (PBPK) modeling was used to derive the point of departure for the critical effect of hepatic vacuolation. Methylene chloride is likely to be carcinogenic in humans and there is a U.S. EPA IRIS IURF based on hepatocellular or bronchoalveolar carcinomas and adenomas. However, the AACs calculated for carcinogenic effects are higher than those calculated for non-carcinogenic effects.

The residential and nonresidential TS RIASLS are developed from the ATSDR intermediate inhalation MRL of 300 ppbv (1,000 μg/m^3). It is based on hepatic effects (cytoplasmic vacuolization and fatty infiltration in rats) and is also protective for kidney damage. A LOAEL of 25 ppm was identified from the continuous 90 day exposure.

Uncertainties in the toxicity estimate:

The IRIS RfC is based on a PBPK model-derived point of departure, 17.2 mg/m^3 (U.S. EPA, 2011c). An UF of 3 ($10^{0.5}$) was used for interspecies extrapolation, an uncertainty factor of 3 ($10^{0.5}$) was used for interspecies extrapolation, and an UF of 3 was used for database deficiency.

The ATSDR intermediate inhalation MRL has a total uncertainty of 30, 10 for human variability and 3 for extrapolation from animals to human.

Source of the Toxicity Values
Chronic Inhalation Noncancer:
Basis: IRIS is a Tier 1 source.
IRIS: RfC = 6 $x10^{-1}$ mg/m^3
Critical Study: Nitschke, KD; Burek, JD; Bell, TJ; *et al*. (1988a) Methylene chloride: a 2-year inhalation toxicity and oncogenicity study in rats. Fundam Appl Toxicol 11:48–59.
Methods: Nitschke *et al*. (1988a) exposed groups of 90 male and 90 female Sprague-Dawley rats to 0, 50, 200, or 500 ppm dichloromethane (>99.5% pure) for 6 hours/day, 5 days/week for 2 years. Interim sacrifices were conducted at 6, 12, 15, and 18 months (five rats/sex/interval). A PBPK model for the rat (Andersen *et al*., 1991, modified by U.S. EPA) was used to estimate rat internal doses from the Nitschke *et al*. (1988a) study. The dose metric used to conduct the modeling was mg dichloromethane metabolized via the Cytochrome P450 (CYP) pathway/liter of liver tissue/day. Incidence data for hepatic effects (hepatic vacuolation) in the rat from Nitschke *et al*. (1988a) were fit to the available dichotomous models in BMDS version 2.0 (using internal dose as the dose measure) to obtain the rat internal BMDL10. Because the dose metric is a rate of metabolism and the clearance of these metabolites may be slower per volume tissue in the human compared with the rat, this rodent internal dose metric was adjusted by dividing by a pharmacokinetic allometric scaling factor of body weight (BW)0.75 (operationalized as [BWhuman/BWrat]0.25 ≈ 4.09) to obtain a human equivalent internal BMDL10.
Critical effect: Hepatic effects (hepatic vacuolation).
End point or Point of Departure (POD): $BMDL_{10}$(HEC) = 17.2 mg/m^3. The human equivalent internal BMDL10 was then converted to the human equivalent concentration (HEC) using a human PBPK model (adapted from David *et al*., 2006) that provided a distribution of HECs. The 1st percentile of the distribution of HECs, 17.2 mg/m3, was used as a POD for the RfC. See Section 5.2.3 of the Toxicological Review of Dichloromethane (U.S. EPA, 2011) for further details.
Uncertainty Factors: UF = 30. UF = 3 for extrapolation from lab animals to humans; UF = 3 for sensitive individuals; UF = 3 for database deficiencies.
Source: IRIS, 11/18/2011

Intermediate Inhalation Noncancer:
Basis: ATSDR developed and intermediate (subchronic) inhalation MRL.
ATSDR intermediate inhalation MRL = 0.3 ppm (1.04 mg/m^3 [1.04E-03 µg/ m^3])
Critical Study: Haun CC, Vernot EH, Darmer KI, *et al*. 1972. Continuous animal exposure to low levels of dichloromethane. AMRL-TR-72-130, paper no. 12.
Methods: Rats (20/group – no details on sex or strain) were exposed continuously for 14 weeks at 0, 25, or 100 ppm. Histopathological examination of the tissues was carried out and relative organ weights were determined at the end of the exposure. Cytoplasmic vacuolization and indication of fatty infiltration (positive-oil-red stain) were reported in animals exposed to 25 and 100 ppm.
Critical effect: hepatic effects - cytoplasmic vacuolization and fatty infiltration
End point or Point of Departure (POD): LOAEL(HEC) = 25 ppm

Uncertainty Factors: UF = 90. (3 for use of a minimal LOAEL, 3 for extrapolation from animals to humans, 10 for intraspecies [human] variability)
Source: ATSDR, 09/2000. From 3/2016 MRL list.

Cancer:
Basis: IRIS is a Tier 1 source.
Critical Studies:
1) Mennear, JH; McConnell, EE; Huff, JE; *et al*. 1988. Inhalation and carcinogenesis studies of methylene chloride (dichloromethane) in F344/n rats and B6C3F1 mice. Ann NY Acad Sci 534: 343–351.
2) NTP (National Toxicology Program). 1986. Toxicology and carcinogenesis studies of dichloromethane (methylene chloride) (CAS No. 75-09-2) in F344/N rats and B6C3F1 mice (inhalation studies). Public Health Service, U.S. Department of Health and Human Services; NTP TR 306.
Methods: A 2-year inhalation exposure study in B6C3F1 mice, similar to that in F344/N rats, was also conducted by NTP. The mice (50/sex/exposure level) were exposed to dichloromethane (>99% pure) by inhalation at concentrations of 0, 2,000, or 4,000 ppm in exposure chambers 6 hours/day, 5 days/week for 2 years. As with the study in rats, mean daily concentrations in the mice never exceeded 110% of the target and were <90% of the target in only 23 of 1,476 analyses. Endpoints monitored included clinical signs, mortality, and gross and microscopic examinations of 32 tissues at study termination. Clinical examinations were conducted weekly for 3.5 months and biweekly until month 8. After 8 months, the animals were clinically examined and palpated monthly for tumors and masses until the end of the study.
Extrapolation Method: Multistage model with linear extrapolation from the point of departure (BMDL10).
Tumor Types — Hepatocellular carcinomas or adenomas, bronchoalveolar carcinomas or adenomas
Carcinogen Weight-of-Evidence (WOE) Class: Likely to be carcinogenic in humans.
Basis: IRIS WOE: Following U.S. EPA (2005a) Guidelines for Carcinogen Risk Assessment, dichloromethane is "likely to be carcinogenic in humans," based predominantly on evidence of carcinogenicity at two sites in 2-year bioassays in male and female B6C3F1 mice (liver and lung tumors) with inhalation exposure (NTP, 1986) and at one site in male B6C3F1 mice (liver tumors) with drinking water exposure (Serota *et al*., 1986b; Hazleton Laboratories, 1983).
Source and Date: IRIS 11/18/2011

Methyl tert-butyl ether (MTBE) (CAS # 1330-20-7)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	98 µg/m^3	27 ppb$_{vol}$	980 µg/m^3	270 ppb$_{vol}$
Basis	Kidney adenomas and carcinomas, Leydig interstitial cell tumors, and leukemia and lymphomas Res AAV Cancer – CAL EPA IURF		10× Res AAV Cancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Levels	460 µg/m^3	130 ppb$_{vol}$	4,600 µg/m^3	1,300 ppb$_{vol}$
Basis	Kidney adenomas and carcinomas, Leydig interstitial cell tumors, and leukemia and lymphomas NR AAV$_{\mathbf{adj}}$ Cancer – CAL EPA IURF		10× NR AAV$_{\mathbf{adj}}$ Cancer	

Discussion of Basis

The residential and nonresidential AAC and RIASLs and TS RIASLs for MTBE are based on the California EPA IURF. The IURF of 2.6E-07 per µg/m^3 is based on an extrapolated CSF value of 2.6E-07 per µg/m^3. This value was derived using the geometric mean of potency estimates for male rat kidney adenomas and carcinomas combined, male rat Leydig interstitial cell tumors, and leukemia and lymphomas in female rats from four oral and inhalation studies. See study details below.

There is an ATSDR intermediate inhalation MRL for MTBE (2,500 µg/m^3) is based on neurotoxicity (central nervous system (CNS) sedation) in rats exposed to MTBE for 6 hours/day, 5-7 days/week for 14-19 weeks in a reproductive study (Neeper-Bradley, 1991).

Uncertainties in the toxicity estimate:
The Cal EPA IURF was based on an oral CSF that used rat oral and inhalation data. The mode of action for MTBE carcinogenesis was not known and the parent compound MTBE was used for determining the dose metrics. The internal doses were estimated using a simplified PBPK model (Borghoff et al. 1996). For absorbed doses, 100% and 50% of oral and inhaled MTBE, respectively were the assumptions for uptake. A 70 kg human inhaling 20 m^3 per day was used to extrapolate the IURF estimate. All these considerations and assumptions contribute to uncertainties in the cancer potency estimate (OEHHA, 1999).

The ATSDR intermediate MRL is derived using a NOAEL for neurotoxicity (no CNS sedation) that was multiplied by 6 hour/24 hour/day and 5 days/7 days/week to yield an adjusted NOAEL$_{(ADJ)}$ of 71 ppm. A total uncertainty factor of 100 was applied to address interspecies extrapolation and intraspecies variability. A 13-week study (Dood 1989) also showed neurotoxicity symptoms. In the absence of human data, developmental toxicity reported in animal studies indicates there may be a potential for developmental effects due to MTBE exposure.

Source of the Toxicity Values

Chronic Inhalation Noncancer:

IRIS (09/01/1993): RfC = 3.0E+0 mg/m^3 (= 3E+3 µg/m^3)
Critical Study: Chun, J.S., H.D. Burleigh-Flayer, and W.J. Kintigh. (1992) Methyl tertiary butyl ether: Vapor inhalation oncogenicity study in Fischer 344 rats (unpublished material). Prepared for the MTBE Committee by Bushy Run Research Center, Union Carbide Chemicals and Plastics Company Inc. Docket No. OPTS- 42098.
Method(s): Fischer 344 rats (50/sex/group) were exposed to analytical mean concentrations of 403, 3,023, or 7,977 ppm MTBE vapors (1,453, 10,899, or 28,760 mg/m^3) 6 hours/day, 5 days/week for 24 months (duration-adjusted values are 259, 1946, 5136 mg/m^3, respectively).
Critical effect: Increased absolute and relative liver and kidney weights and increased severity of spontaneous renal lesions (females), increased prostration (females) and swollen periocular tissue (males and females).
Point of Departure (POD): NOAEL = 1,453 mg/m^3 (403 ppm); NOAEL(ADJ) = 259 mg/m^3; NOAEL(HEC) = 259 mg/m^3.
Uncertainty Factors: UF = 100 (10 for intraspecies variability; 3 for interspecies extrapolation rather than 10 because dosimetric adjustments were made; and 3 for database deficiencies because of the lack of certain information from the chronic exposure bioassay).
Source: IRIS, 9/01/1993

PPRTV: No PPRTV record for MTBE is available at this time.

ATSDR chronic MRL (07/1996): Chronic inhalation MRL = 7E-1 ppm (= 2.5 mg/m^3 = 2.5E+3 µg/m^3)
Critical study: Chun et al., (1992) Methyl tertiary butyl ether: Vapor inhalation oncogenicity study in Fischer 344 rats. Bushy Run Research Center, Export, PA. Project No. 91N0013B.
Method: Fischer 344 rats (50/sex/group) were exposed to 0, 400, 3,000, or 8,000 ppm MTBE 6 hours/day, 5 days/week for up to 24 months. (Conversion: 1 ppm = 3.61 mg/m^3).
Critical effect: Chronic progressive nephropathy
Point of departure (POD): NOAEL = 400 ppm; The NOAEL was multiplied by 6 hour/24 hour/day and 5 days/7 days/week to yield a NOAEL(ADJ) of 71 ppm.
Uncertainty factors: 100 (10 each for interspecies extrapolation and intraspecies variability).

Intermediate Inhalation Noncancer:

MRL (07/1996): Intermediate inhalation MRL = 7E-1 ppm (= 2.5 mg/m^3 = 2.5E+3 µg/m^3)
Critical study: Neeper-Bradley, (1991) Two-generation reproduction study of inhaled methyl tert-butyl ether in CD Sprague-Dawley rats. Project ID 53-594. Bushy Run Research Center, Export, PA..
Method: Rats (25/sex/group) were exposed to 0, 400, 3,000, or 8,000 ppm MTBE 6 hours/day, 5 days/week for 10 days prior to mating through gestation da 19.
Critical effect: Chronic progressive nephropathy
Point of departure (POD): NOAEL = 400 ppm; The NOAEL was multiplied by 6 hour/24 hour/day and 5 days/7 days/week to yield a NOAEL(ADJ) of 71 ppm.
Uncertainty factors: 100 (10 each for interspecies extrapolation and intraspecies variability).

Acute Inhalation Noncancer:
MRL (1996): Acute inhalation MRL = 2 ppm (= 2.5 mg/m^3 = 7.21E+3 µg/m^3) based on neurological effects.
Critical study: Gill, 1989
Method: Fischer 344 rats (22/sex/group) were exposed to 0, 800, 4,000, or 8,000 ppm MTBE for six hours.
Critical effect: No CNS sedation
Point of departure (POD): NOAEL = 800 ppm; The NOAEL was multiplied by six hour/24 hours to yield a NOAEL(ADJ) of 200 ppm.
Uncertainty factors: 100 (10 each for interspecies extrapolation and intraspecies variability).

Cancer:
IRIS (12/01/1991): A cancer assessment for MTBE is not available at this time.
PPRTV: No PPRTV record for MTBE is available at this time.
MRL: NA; MRLs are for noncancer effects only.

Cal EPA: IURF = 2.6E-07 (µg/m^3)$^{-1}$. The IURF was extrapolated from an oral CSF value.
Critical Studies for CSF:
1)Belpoggi F, Soffritti M, Maltoni C (1998). Pathological characterization of testicular tumours and lymphomas-leukaemias, and of their precursors observed in Sprague-Dawley rats exposed to methyl tertiary-butyl ether (MTBE). Eur. J. Oncol. 3(3): 201-206.
2) Belpoggi F, Soffritti M, Maltoni C (1995). Methyl tertiary-butyl ether (MtBE) - a gasoline additive - causes testicular and lymphohaematopoietic cancers in rats. Toxicol. Ind. Hlth. 11(2): 119-149. March.
3) Belpoggi F, Soffritti M, Filippini F, Maltoni C (1997). Results of long-term experimental studies on the carcinogenicity of methyl tert-butyl ether. Annals N. Y. Acad. Sci. 837: 77-95. December 26.
4) Chun JS, Burleigh-Flayer HD and Kintigh WJ. 1992. Methyl tertiary ether: vapor inhalation oncogenicity study in Fisher 344 rats. Bushy Run Research Center Report No. 91N0013B. Union Carbide Chemicals and Plastics Company, Inc. submitted to the United States Environmental Protection Agency under TSCA Section 4 Testing Consent Order 40 CFR 799.5000 with cover letter dated November 19, 1992. EPA/OPTS#42098.
Methods:
The CSF was the geometric mean of the potency estimates for the male rat kidney adenomas and carcinomas combined (1.8 ×10^{-3} (mg/kg-day)$^{-1}$) (Chun et al. 1992), and the male rat Leydig interstitial cell tumors (1.55 × 10^{-3} (mg/kg-day)$^{-1}$) and the leukemia and lymphomas in female rats (2.09 × 10^{-3} (mg/kg-day)$^{-1}$) (Belpoggi et al. 1995, 1998). The combined data yielded a CSF of 1.8x10^{-3} (mg/kg-day)$^{-1}$. Assuming a 70 kg human inhaling 20 m^3 per day, the oral CSF was converted to an inhalation cancer unit risk factor or URF of 9.3 × 10^{-7} ppb^{-1}, or **2.6E-7 (µg/m^3)$^{-1}$.**
Source: Cal EPA OEHHA, 1999

New Jersey DEP: IURF = 2.6E-7 (µg/m^3)$^{-1}$. Based on OEHHA (CAL EPA).
New York DEC: IURF = 2.6E-7 (µg/m3)$^{-1}$. Based on OEHHA (CAL EPA).
Texas CEQ: IURF = 2.6E-7 (µg/m^3)$^{-1}$. Based on OEHHA (CAL EPA).

U.S. EPA RSL: IURF = 2.6E-7 $(\mu g/m^3)^{-1}$. Based on OEHHA (CAL EPA).
Other Tier 3 Sources: No value is available at this time from these Tier 3 sources/databases: HEAST, NTP ROC, health and environmental agencies of Massachusetts, Minnesota, WHO (IARC), WHO (IPCS/INCHEM), Canada, The Netherlands (RIVM), OECD HPV, and ECHA (REACH).

Tetrachloroethylene (PCE) (CAS # 127-18-4)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	41 μg/m^3	6 ppb_{vol}	41 μg/m^3	6 ppb_{vol}
Basis	Neurotoxicity (reaction time, cognitive effects; color vision) in occupationally-exposed adults (ATSDR MRL Acute Inhalation, U.S. EPA IRIS RfC)		ATSDR MRL Acute Inhalation	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	82 μg/m^3	12 ppb_{vol}	82 μg/m^3	12 ppb_{vol}
Basis	Neurotoxicity (reaction time, cognitive effects; color vision) in occupationally-exposed adults (ATSDR MRL $Acute_{adj}$ Inhalation)		ATSDR MRL $Acute_{adj}$ Inhalation	

Discussion of Basis

The residential and nonresidential RIASLs and TS RIASLs for PCE are based on the ATSDR acute inhalation MRL (41 μg/m^3). The intermediate and chronic MRL are also equal to 41 μg/m^3. The acute MRL is based on a human occupational study (Cavalleri, *et al*., 1994). Per ATSDR (2014), color vision was evaluated in 35 PCE-exposed workers (22 dry cleaners and 13 ironers) with an average of 106 months of exposure. There also is an U.S. EPA IRIS RfC available (40 μg/m^3) based on two studies, one of which was the study used to derive the acute MRL (Cavalleri, *et al*.,1994; Echeverria, *et al*., 1995). The midpoint from the two studies candidate RfCs was used as the final RfC (IRIS, 2012). The critical effects are neurotoxicity (reaction time, cognitive effects, and color vision) in occupationally-exposed adults.

The calculated AACs are based on the IRIS RfC. The PCE residential RIASL and TS RIASL for indoor air (41 μg/m^3) are based on the acute MRL. Although the IRIS RfC and MRL values are the same, it is important to use the acute MRL as the basis for the action levels as it represents a 1-14 day short-term exposure. Further studies supporting an acute MRL value include three human exposure studies (Hake and Stewart 1977; Altmann 1990, 1992) that reported neurological deficiencies following PCE exposures ranging from 4 – 7.5 hours for 4 – 5 days (see PCE Tox Profile MRLs for further detail). Furthermore, although the critical effect is neurotoxicity, information concerning neurological, developmental, and immunological effects is lacking to provide evidence that a more susceptible population is indeed not at risk of short-term effects. Per IRIS (2012), immunotoxicity is associated with other chemicals that are structurally similar to PCE, and therefore this adds a layer of concern for short-term exposures of susceptible subpopulations (e.g., children, pregnant women).

Uncertainties in the toxicity estimate:
The ATSDR acute inhalation MRL was estimated using a LOAEL (Cavalleri 1994) and total UFs of 100 for human variability and for use of a LOAEL. Altman (1990) identified a NOAEL of 2 ppm, which is almost equal to the LOAEL of 1.7 ppm; however, ATSDR indicated the uncertainty of this NOAEL in adequately protecting for longer exposures (up to two weeks) as other studies indicated that continuous or repeated exposures over durations longer than four days may yield higher blood levels. Therefore, ATSDR concluded that "the chronic-duration LOAEL of 1.7 ppm (continuous equivalent exposure concentration) from Cavalleri (1994) may represent a better basis for acute and intermediate-duration MRLs. "In addition, simulation demonstrated that steady-state is reached at about 2 weeks of continuous exposure and 99% of steady-state at 90 days and the blood concentration-time values are "very similar" for acute and chronic exposure, therefore, ATSDR used the chronic MRL as the acute-duration MRL.

Source of the Toxicity Values
Chronic Inhalation Noncancer:
IRIS:
Basis: IRIS is a Tier 1 source.
IRIS tetrachloroethylene RfC= 4.0E+1 μg/m^3.
Critical Studies:
1) Echeverria, D; White, RF; Sampaio, C. (1995). A behavioral evaluation of PCE exposure in patients and dry cleaners: A possible relationship between clinical and preclinical effects. J Occup Environ Med 37: 667-680.
2) Cavalleri, A; Gobba, F; Paltrinieri, M; Fantuzzi, G; Righi, E; Aggazzotti, G. (1994). Perchloroethylene exposure can induce color vision loss. Neurosci Lett 179: 162-166. http://dx.doi.org/10.1016/0304-3940 (94)90959-8.
Methods:
1) Echeverria *et al*. (1995) examined 65 dry cleaners in Detroit, MI, using a standardized neurobehavioral battery.
2) Cavalleri *et al*. (1994) tested the color vision among 35 dry cleaning and laundry workers compared to 35 controls matched on age, alcohol consumption, and smoking. The candidate RfCs from these two studies ranged from 0.015 to 0.056 mg/m3. The RfC, 0.04 mg/m^3, is the midpoint of this range rounded to one significant figure.
Critical effect: 1) neurotoxicity (reaction time, cognitive effects) in occupationally-exposed adults, and 2) neurotoxicity (color vision) in occupationally-exposed adults
End point or Point of Departure (POD): 1) $LOAEL_{HEC}$ = 56 mg/m^3, 2) $LOAEL_{HEC}$ = 15 mg/m^3
Uncertainty Factors: UF = 1, 000 (10 each for intraspecies variability, LOAEL to NOAEL extrapolation and database deficiencies)
Source and date: IRIS, Last revision date - 02/10/2012. An IRIS Toxicological Review is available.

MRL: Per ATSDR List (12/2014), a DRAFT chronic inhalation MRL = 6.0E-3 ppm (41 µg/m^3) is derived as follows.
Critical Studies:
1) Cavalleri A; Gobba F; Paltrinieri M; *et al*. 1994. Perchloroethylene exposure can induce color vision loss. Neurosci Lett 179:162-166.
2) Gobba F; Righi E; Fantuzzi G; *et al*. 1998. Two-year evolution of perchloroethylene-induced color-vision loss. Arch Environ Health 53:196-198.
Methods: Color vision was evaluated in 35 tetrachloroethylene-exposed workers (22 dry cleaners and 13 ironers) with an average of 106 months of exposure. Concentrations were measured in the breathing zone by personal passive samplers. The TWA concentrations for all workers ranged from 0.38–31.19 ppm, with mean exposures of 6.23, 7.27, and 4.80 ppm for all workers, dry cleaners, and ironers, respectively. Controls included an equal number (35) of workers without occupational exposure to solvents, and were matched for sex, age, alcohol consumption, and cigarette smoking. The subjects were reexamined 2 years later using the same test; results were reported by Gobba et al. (1998).
Critical effect: increased CCI scores (decreased color vision)
End point or Point of Departure (POD): LOAEL = 1.7 ppm. The 7.3 ppm concentration was multiplied by 8/24 hours and 5/7 days to yield an equivalent continuous exposure concentration of 1.7 ppm.
Uncertainty Factors: UF = 100 (10 each for intraspecies variability and use of a LOAEL); MF = 3 for database deficiencies
Source and date: ATSDR, 3/2015 draft **from 4/2015 MRL list.**

Acute Inhalation Noncancer:
MRL: Per ATSDR List (12/2014), a DRAFT acute inhalation MRL = 6.0E-3 ppm is derived as follows.
Critical Study: Cavalleri A; Gobba F; Paltrinieri M; *et al*. 1994. Perchloroethylene exposure can induce colour vision loss. Neurosci Lett 179:162-166.
Methods: Color vision was evaluated in 35 tetrachloroethylene-exposed workers (22 dry cleaners and 13 ironers) with an average of 106 months of exposure. Concentrations were measured in the breathing zone by personal passive samplers. The TWA concentrations for all workers ranged from 0.38–31.19 ppm, with mean exposures of 6.23, 7.27, and 4.80 ppm for all workers, dry cleaners, and ironers, respectively. Controls included an equal number (35) of workers without occupational exposure to solvents, and were matched for sex, age, alcohol consumption, and cigarette smoking. Color vision was evaluated by the Lanthany 15 Hue desaturated panel (D-15d) test, which is designed for early detection of acquired dyschromatopsia. The results of the test were expressed as color confusion index (CCI). The subjects were reexamined 2 years later using the same test; results were reported by Gobba *et al*. (1998).
Critical effect: increased CCI scores (decreased color vision)
End point or Point of Departure (POD): LOAEL = 1.7 ppm. The 7.3 ppm concentration was multiplied by 8/24 hours and 5/7 days to yield an equivalent continuous exposure concentration of 1.7 ppm.

Uncertainty Factors: UF = 100 (10 each for intraspecies variability and use of a LOAEL); MF = 3 for database deficiencies
Source and date: ATSDR, 10/14 draft **from 3/2016 MRL list**

Cancer:
IRIS:
Basis: IRIS is a Tier 1 source.
IRIS tetrachloroethylene IURF= 3.0E-7 ($\mu g/m^3)^{-1}$
Critical Study (ies): JISA (Japan Industrial Safety Association). (1993). Carcinogenicity study of tetrachloroethylene by inhalation in rats and mice. Hadano, Japan.
Method(s): 2-year (104-week) carcinogenicity study; F344DuCrj (Fischer) rats and Crj:BDF1 mice (400 rats and 400 mice) were used in a total of four groups, three study sample treatment groups and one control group, of 50 males and females each. Based on two-week and 13-week preliminary studies, the concentration was set at 600 ppm, 200 ppm and 50 ppm in rats and 250 ppm, 50 ppm, and 10 ppm in mice, and administered for 6 hours/day, 5 days a week for 104 weeks.

1) *Dose response data*: *Tumor Type* - Hepatocellular adenomas or carcinomas; *Test Species* - Male Crj:BDF1 mice; *Route* - inhalation
2) *Extrapolation method*: Multistage model (with linear extrapolation from the point of departure ($BMCL_{10}$), followed by extrapolations to humans using the PBPK model of Chiu and Ginsberg (2011)

Carcinogen Weight-of-Evidence (WOE) Class: "likely to be carcinogenic in humans by all routes of exposure."
Basis: IRIS WOE: based on suggestive evidence of carcinogenicity in epidemiologic studies and conclusive evidence that the administration of PCE, either by ingestion or by inhalation to sexually mature rats and mice, increases tumor incidence.
Source and Date: IRIS, Last revision date - 02/10/2012. An IRIS Toxicological Review is available.

Toluene (CAS# 108-88-3)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	5,200 $\mu g/m^3$	1,400 ppb_{vol}	7,500 $\mu g/m^3$	2,000 ppb_{vol}
Basis	Neurological impairments from multiple occupational studies with chronic exposure (Res AAV Noncancer – U.S. EPA IRIS RfC)		Cognitive impairments in toluene sensitive people after 20 minutes (ATSDR MRL Acute Inhalation)	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	7,500 $\mu g/m^3$	2,000 ppb_{vol}	7,500 $\mu g/m^3$	2,000 ppb_{vol}
Basis	Cognitive impairments in toluene sensitive people after 20 minutes (ATSDR MRL Acute Inhalation)		ATSDR MRL Acute Inhalation	

Discussion of Basis

The residential RIASL for toluene is based on the residential AAC for non-carcinogenic effects. The residential TS RIASL, nonresidential RIASL and nonresidential TS RIASL are based on the ATSDR acute inhalation MRL.

The residential AAC is based on the U.S. EPA IRIS RfC. The U.S. EPA IRIS RfC of 5 mg/m3 (5,000 $\mu g/m^3$ or 2,000 ppb_v is derived from ten occupational studies demonstrating deficits in neurological function after years (1-21 years) of worker exposure.

The ATSDR draft chronic inhalation MRL is based on a single series of occupational studies that had a NOAEL of 45 ppm determined but no adverse effects observed. The NOAEL used by ATSDR is higher than the NOAEL of 34 ppm used for the U.S. EPA IRIS RfC that is based on an average NOAEL from a number of occupational studies that observed a number of neurological impairments. Although the NOAEL is higher, the ATSDR chronic inhalation MRL is lower since the conversion to continuous exposure uses 8 hours per work day/24 hours and 5 days/7 days. The U.S. EPA IRIS RfC uses 10 m^3 per work day out of 20 m^3 per day inhalation rate to adjust for continuous exposure and 5 days/7 days. The U.S. EPA IRIS RfC accounts for a higher breathing rate during working hours as compared to nonworking that includes sleeping hours at a lower breathing rate and is the best available information for the residential RIASL.

The ATSDR acute inhalation MRL of 2 ppm or 7,500 $\mu g/m^3$ is based on a study of 20 human subjects with a history of solvent exposure with adverse reactions to toluene (i.e., clinically sensitive to toluene) (Little *et al.*, 1999). Statistically significant cognitive impairments were measured after a 20 minute exposure to 15 ppm of toluene as compared to pre-exposure scores for three of six tests. Another test had a near-significant increase in reaction time. A combined uncertainty factor of 9 was used to extrapolate from a LOAEL (3) and for human variability (3). No adjustment was made for continuous exposure for this acute value. This draft

ATSDR acute inhalation MRL is recommended for the residential TS RIASL I and both of the nonresidential interim action screening levels as it is slightly lower than the nonresidential AAC (7,700 μg/m^3).

Uncertainties in the toxicity estimate:
The U.S. EPA IRIS RfC had a total UF of ten applied to account for human variability. The ATSDR acute inhalation MRL had a total UF of 9, 3 for human variability and 3 for extrapolating from a LOAEL to a NOAEL.

Source of the Toxicity Values
Chronic Inhalation Noncancer:
IRIS:
Basis: IRIS is a Tier 1 source.
IRIS RfC= 5.0E+3 μg/m³
Critical Study: Multiple occupational human studies: Abbate *et al*. (1993); Boey *et al*. (1997); Cavalleri *et al*. (2000); Eller *et al*. (1999); Foo *et al*. (1990); Murata *et al*. (1993); Nakatsuka *et al*. (1992); Neubert *et al*. (2001); Vrca *et al*. (1995) and; Zavalic *et al*. (1998).
Methods: An arithmetic mean of the NOAEL values derived from the principal studies (refer to Table 1 of IRIS Toxicological Review) was chosen to represent an average point of departure. The highest NOAEL was identified as 44 ppm (Nakatsuka *et al*., 1992). The lowest LOAELs were identified as 40-42 ppm (Vrca *et al*., 1995, 1997; Cavalleri *et al*., 2000). The average exposure level of 34 ppm is used as POD for the RfC.
Critical effect: neurological effects in occupationally-exposed workers
End point or Point of Departure (POD): NOAEL (average) = 34 ppm (128 mg/m^3); $NOAEL_{ADJ}$ = 46 mg/m^3
Uncertainty Factors: UF = 10 for intraspecies variability
Source and date: IRIS, Last revision date - 9/23/2005

MRL: ATSDR (9/2015), inhalation chronic MRL = 1 ppm (3.8 mg/m^3) derived as follows:
Critical Studies: Series of human occupational studies: Schäper *et al*. (2003), Schäper *et al*. (2004), Schäper *et al*. (2008), Seeber *et al*. (2004), Seeber *et al*. (2005), Zupanic *et al.* (2002).
Method(s): A NOAEL was determined from a series of studies that assessed subjective neurological symptoms, performance on psychomotor tasks, color vision, and hearing in groups of German photogravure printers employed for an average duration of 13.5 years (Schäper *et al*. 2003, 2004, 2008; Seeber *et al*. 2004, 2005; Zupanic *et al*. 2002). These studies compared neurological end points in workers with high exposure to toluene (printers, n=106–181) with workers with low exposure to toluene (end-processors, n=86–152). Using job history and current exposure and historical exposure levels, individual TWA exposure levels were calculated. The average TWA levels for printers and end-processors were calculated to be 45 and 10 ppm for subjects included in analyses by Schäper *et al*. (2003, 2008), 45 and 9 ppm for subjects included in analyses by Seeber *et al*. (2004, 2005) and Zupanic *et al*. (2002), and 43 and 9 ppm for subjects included in analyses by Schäper *et al*. (2004)
Critical effect: neurological effects
End point or Point of Departure (POD): NOAEL = 45 ppm; $NOAEL_{ADJ}$ = 45 ppm x 5 days/7 days x 8 hours/24 hours

Uncertainty Factors: UF = 10 (10 for human variability).
Source and date: ATSDR, 9/2015

Acute Inhalation Noncancer
MRL: ATSDR (9/2015), acute inhalation MRL = 2 ppm (7.5 mg/m^3) derived as follows:
Critical Study: Little CH, Georgiou GM, Shelton MJ, *et al*. 1999. Clinical and immunological responses in subjects sensitive to solvents. Arch Environ Health 54(1):6-14.
Method(s): Twenty subjects with a history of solvent exposure and adverse reactions to toluene (i.e., clinically sensitive to toluene) were assessed in a battery of neuropsychological tests prior to and after a 20-minute exposure to 15 ppm toluene. The battery of tests included immediate and delayed prose memory, reaction time, letter cancellations, digit symbol, focal length, and STROOP color and color-word tasks.
Critical effect: neurological effects
End point or Point of Departure (POD): LOAEL = 15 ppm
Uncertainty Factors: UF = 9 (3 each for human variability and LOAEL to NOAEL).
Source and date: ATSDR, 9/2015

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: “inadequate information to assess the carcinogenic potential”
Basis: IRIS WOE: studies of humans chronically exposed to toluene are inconclusive, toluene was not carcinogenic in adequate inhalation cancer bioassays of rats and mice exposed for life (CIIT, 1980; NTP, 1990; Huff, 2003), and increased incidences of mammary cancer and leukemia were reported in a lifetime rat oral bioassay at a dose level of 500 mg/kg-day but not at 800 mg/kg-day (Maltoni *et al*., 1997).
Source and Date: IRIS, 9/23/2005

1,2,4-Trichlorobenzene (CAS # 120-82-1)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	2.1 µg/m^3	0.28 ppb$_{vol}$	6.3 µg/m^3	0.85 ppb$_{vol}$
Basis	increased urinary excretion of porphyrins (Res AAV Noncancer – PPRTV RfC)		3 x Res AAV Noncancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	6.2 µg/m^3	0.84 ppb$_{vol}$	19 µg/m^3	2.6 ppb$_{vol}$
Basis	increased urinary excretion of porphyrins (NR AAV$_{adj}$ Noncancer – PPRTV RfC)		3 x NR AAV$_{adj}$ Noncancer	

Discussion of Basis
The residential and nonresidential AACs, RIASLs and TS RIASLS for 1,2,4-trichlorobenzene are based on the PPRTV (2009) RfC (RfC = 2 µg/m^3). The PPRTV RfC critical studies were two (1977; 1978) subchronic inhalation studies exposing rats to 1,2,4-trichlorobenzene for 6 hours/day, 5 days/week for three months. The critical effect observed was increased urinary excretion of porphyrins and a BMCL$_{HEC}$ = 4.6 mg/m^3 was calculated. The MDEQ AQD also generated a 2006 ITSL. The ITSL = 4.0 µg/m³ based on rat NOAEL of 21 mg/m^3 reported by Watanabe *et al*. (1977) for increased urinary porphyrins at 76 mg/m^3. Use of RfC methodology with total UF of 1000 resulted in the ITSL.

Uncertainties in the toxicity estimate:
Per PPRTV, for the chronic p-RfC derivation, the BMCL$_{[HEC]}$ was divided by a UF of 3000, including 3 for extrapolation from rats-to-humans using dosimetric adjustments, 10 for protection of sensitive individuals and 10 for database deficiencies, as well as an additional UF of 10 for use of a subchronic study. The absence of a well-documented chronic study in a sensitive species (such as rat) is accounted for by the use of a full 10-fold UF for extrapolation from subchronic-to-chronic effects. PPRTV assigned the confidence in the key study as medium.

Source of the Toxicity Values
Noncancer:
Basis: PPRTV RfC
PPRTV (6/16/2009): RfC = 2E-3 mg/m^3 (2 µg/m^3) derived as follows:
Critical Studies:
1) Watanabe, P.G., H.O. Yankel and R.J. Kociba. 1977. Subchronic toxicity study of inhaled 1,2,4-trichlorobenzene in rats. Toxicology Research Center, Health and Environmental Research, Dow Chemical Company, Midland, MI. Produced 11/18/77. Submitted 12/20/82. TSCATS 20327. EPA Doc. #878221105.
2) Watanabe, P.G., R.J. Kociba, R.E. Hefner Jr. *et al*. 1978. Subchronic toxicity studies of 1,2,4-trichlorobenzene in experimental animals. Toxicol. Appl. Pharmacol. 45:332-333.

Method(s): Groups of 10 male and 26 female Sprague-Dawley rats were exposed by inhalation to 0, 2.8, or 10.2 ppm 1,2,4-trichlorobenzene (0, 21 or 76 mg/m3) 6 hours/day, 5 days/week, for 3 months. Between four and five females/group were sacrificed after two weeks, one month, or two months of exposure and two or four months post-exposure for assessment of total liver porphyrins. Urine was collected at these same intervals from the rats maintained for the entire experiment. The NOAELs and LOAELs from Watanabe *et al*. (1977, 1978) were first adjusted to an equivalent continuous exposure concentration, then converted to HECs.
Critical effect: increased urinary excretion of porphyrins
End point or Point of Departure (POD): $BMCL_{HEC}$ = 4.6 mg/m^3
Uncertainty Factors: UF = 3,000 (10 each for intraspecies variability, use of a subchronic study and database deficiencies, and 3 for interspecies extrapolation)

Cancer:

PPRTV (2009): Carcinogen Weight-of-Evidence (WOE) Class: “Likely to Be Carcinogenic to Humans” by the oral route of exposure based on a finding of increased tumor incidence in mice. Only one chronic inhalation study is identified (Coate *et al*., 1977) and, in the study, the neoplastic changes are not reported.
Source and Date: PPRTV, 6/16/2009

1,1,1-Trichloroethane (CAS# 71-55-6)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	5,000 µg/m^3	920 ppb$_{vol}$	5,000 µg/m^3	920 ppb$_{vol}$
Basis	Neurological effects in people from short-term exposures (24 hours - 30 days) (U.S. EPA IRIS Short-term RfC)		U.S. EPA IRIS Short-term RfC	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	7,000 µg/m^3	1,300 ppb$_{vol}$	7,000 µg/m^3	1,300 ppb$_{vol}$
Basis	Neurological effects in people from short-term exposures (8 hour) (U.S. EPA IRIS Acute 8-hour RfC)		U.S. EPA IRIS Acute 8-hour RfC	

Discussion of Basis

The residential RIASL and TS RIASL for 1,1,1-trichloroethane are based on the U.S. EPA IRIS RfC for short-term neurobehavioral effects (reaction time being most sensitive) in human volunteers in a controlled setting. Although the subchronic and chronic inhalation studies in rodents resulted in liver histopathologic changes at higher concentrations, the acute/short-term RfCs of 5-9 mg/m^3 are lower than the calculated subchronic and chronic IRIS RfCs. Therefore , U.S. EPA has these longer-term RfCs default to the 5 mg/m^3 short-term RfC (24 hours to 30 days) that is also protective of the liver effects observed in rodents after longer-term exposure. In addition, developmental toxicity studies in three species also indicated developmental toxicity occurred at higher concentrations. As such the noncancer U.S. EPA short-term RfC of 5,000 µg/m^3 is appropriate for the RIASL and the TS RIASL based on short-term neurobehavioral effects including reaction time. There is an acute MRL of 6,300 µg/m^3 based on the same studies and endpoints. The U.S. EPA short-term RfC is preferred since the acute MRL does not include the PBPK model adjustment for peak blood steady state used for the U.S. EPA IRIS short-term RfC of 5 mg/m^3. An intermediate MRL of 3,800 µg/m^3 is available based on increase in glial fibrillary acid protein in gerbils with a NOAEL of 70 ppm and a LOAEL of 210 ppm. The human studies LOAEL was at 175 ppm. Since the LOAELs of these neurological endpoints in both rodents and humans are similar, the human data based value is an appropriately protective value for both endpoints and is based on data in the species of concern.

The nonresidential RIASL and TS RIASL for 1,1,1-trichlorethane are based on the acute U.S. EPA IRIS RfC for 8-hours of 7,000 µg/m^3. This value is not adjusted for time duration for nonresidential use since it represents an exposure period per day in the work place with a typical range of 8-12 hours and is more reasonable than the short-term value for 24 hours or longer for most nonresidential scenarios. This value is more appropriate than the use of a calculated nonresidential AAC (7,700 µg/m^3) based on the short-term, subchronic, and chronic RfC that serves the basis of the residential AAC. The acute 8-hour RfC is based on adverse neurological effects in people from a one hour exposure to 1,1,1-trichloroethylene and has been predicted for an 8-hour exposure duration using a PBPK model.

Uncertainties in the toxicity estimate:
The IRIS acute and short-term RfCs are based on an acute study evaluating neurobehavioral effects (reaction time being most sensitive) in human volunteers in a controlled setting (Mackay 1987). The POD was derived using PBPK modeling to arrive at an extrapolated 8-hour and steady-state (14-day) air concentration that would result in the blood concentration resulting in adverse effects. A total UF of 100 was applied to the POD to account for intraspecies differences (UF=10) and extrapolation from LOAEL to NOAEL (UF=10). The latter is needed because the POD for the lowest exposure concentration examined was associated with adverse effects. A UF to extrapolate from a shorter to a longer exposure duration was not necessary because the acute RfC was derived from a study using an acute exposure protocol. A database UF was not applied because the acute database for this chemical was considered complete. Per IRIS, the neurological effects are well demonstrated in acute animal studies and are shown to be the most sensitive endpoints in these studies. The level of confidence assigned by IRIS to the acute RfC is medium. Overall, the overall uncertainties relating to the RfC and its basis are considered low.

Source of the Toxicity Values
Chronic Inhalation Noncancer:
Basis: IRIS is a Tier 1 value.
IRIS: 1,1,1-Trichloroethane IRIS, 2007, RfC= 5.0E+3 µg/m^3.
Critical Studies:
1) Quast, JF; Calhoun, LL; McKenna, MJ. 1984. Chlorothene VG: a chronic inhalation toxicity and oncogenicity study in rats and mice (part 1 and 2) with cover letter dated 082184. The Dow Chemical Company, Midland, MI. Submitted under TSCA Section 4; EPA Document No. 40-8424496; NTIS No. OTS0510656.
2) Quast, JF; Calhoun, LL; Frauson, LE. 1988. 1,1,1-Trichloroethane formulation: a chronic inhalation toxicity and oncogenicity study in Fischer 344 rats and B6C3F1 mice. Fundam Appl Toxicol 11: 611-625.
3) McNutt, NS; Amster, RL; McConnell, EE; *et al*. 1975. Hepatic lesions in mice after continuous inhalation exposure to 1,1,1-trichloroethane. Lab Invest 32: 642-654.
Methods: 1) Quast *et al*. (1988, 1984) exposed groups of 80 male and 80 female F344 rats and B6C3F1 mice to 0, 150, 500, or 1500 ppm (0, 820, 2730, or 8190 mg/m3) production-grade (94%) 1,1,1-trichloroethane vapor for 6 hours/day, 5 days/week for 2 years. Ten rats and ten mice of each sex from each exposure group were scheduled for interim sacrifices after 6, 12, and 18 months of exposure, and the remaining 50 rats and 50 mice/sex/group were scheduled for sacrifice after 24 months of exposure.
2) McNutt *et al*. (1975) chamber-exposed male CF-1 mice to 0, 250, or 1000 ppm (0, 1370, or 5460 mg/m^3) technical grade 1,1,1-trichloroethane (94—97% pure, 2.4—3.0% dioxane, 0.12—0.30% butanol) continuously for up to 14 Serial sacrifices were performed on ten mice/concentration at weekly intervals during the exposure period and at post exposure weeks two and four.
Critical effect: Liver histopathologic changes
End point or Point of Departure (POD): $NOAEL_{HEC}$ = 1,553

Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation)
Note: Because the chronic RfC based on liver histopathologic changes following repeated exposure (16 mg/m^3) was higher than the short-term RfC (5 mg/m^3), the chronic RfC was set at 5 mg/m^3 so as not to exceed the limiting reference value derived for short-term exposure. The short-term RfC applies to exposures for more than 24 hrs up to 30 days. See below for more details.
Source and date: IRIS, Last revision date - 9/28/2007. An IRIS Toxicological Review is available.

Short-term Inhalation Noncancer
IRIS:
Basis: IRIS is a Tier 1 value.
1,1,1-Trichloroethane IRIS, 2007, short-term RfC= 5.0E+3 μg/m^3.
Critical Study:
1) Mackay, CJ; Campbell, L; Samuel, AM; *et al*. (1987) Behavioral changes during exposure to 1,1,1-trichloroethane: time-course and relationship to blood solvent levels. Am J Ind Med 11: 223—239.
Methods: Mackay *et al*. (1987) chamber-exposed 12 adult male volunteers to 0, 950, and 1900 mg/m3 (0, 175, and 350 ppm) of 1,1,1-trichloroethane (purity not reported) for 3.5 hours. Neurobehavioral tests were performed 25 minutes before exposure and four times during exposure, starting at 20, 60, 120, and 180 minutes. Each test battery took 20—25 minutes to complete. Testing included five psychomotor performance tests (simple reaction time, four-choice reaction time, Stroop test [a measure of susceptibility to distraction], syntactic reasoning [via analysis of grammatical statements], and digital step-input tracking [a measure of eye-hand coordination]) and a subjective measure of mood (stress-arousal checklist).
Critical effect: impaired psychomotor performance, especially increased reaction time
End point or Point of Departure (POD): $LOAEL_{pbpkadj}$ = 526 mg/m^3 adjusted based on PBPK modeling of inhaled concentration at steady-state to achieve blood level causing adverse effects (Yang, 2006; Reitz *et al*., 1988).
Uncertainty Factors: UF = 100 (10 each for human variability and LOAEL to NOAEL)
Source and date: IRIS, Last revision date - 9/28/2007. An IRIS Toxicological Review is available.

Acute Inhalation Noncancer
Basis: IRIS is a Tier 1 value.
IRIS: 1,1,1-Trichloroethane IRIS, 2007, 8 hour Acute RfC= 7.0E+3 μg/m³.
Critical Study:
1) Mackay, CJ; Campbell, L; Samuel, AM; *et al*. (1987) Behavioral changes during exposure to 1,1,1-trichloroethane: time-course and relationship to blood solvent levels. Am J Ind Med 11: 223—239.
Methods: Mackay *et al*. (1987) chamber-exposed 12 adult male volunteers to 0, 950, and 1900 mg/m3 (0, 175, and 350 ppm) of 1,1,1-trichloroethane (purity not reported) for 3.5 hours. Neurobehavioral tests were performed 25 minutes before exposure and four times during exposure, starting at 20, 60, 120, and 180 minutes. Each test battery took 20—25 minutes to complete. Testing included five psychomotor performance tests (simple reaction time, four-choice reaction time, Stroop test [a measure of susceptibility to distraction], syntactic reasoning [via analysis of grammatical statements], and digital step-input tracking [a measure of eye-hand coordination]) and a subjective measure of mood (stress-arousal checklist).
Critical effect: impaired psychomotor performance, especially increased reaction time
End point or Point of Departure (POD): $LOAEL_{pbpkadj}$ = 693 mg/m^3
Uncertainty Factors: UF = 100 (10 each for human variability and LOAEL to NOAEL)
Source and date: IRIS, Last revision date - 9/28/2007. An IRIS Toxicological Review is available.

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: "inadequate information to assess carcinogenic potential."
Basis: IRIS WOE: Epidemiologic studies of humans chronically exposed to 1,1,1-trichloroethane are inconclusive. A 2-year inhalation bioassay showed no treatment-related increase in tumors in rats and mice at an exposure concentration below the maximum tolerated dose. The two available oral cancer bioassays in rats and mice are considered inadequate for evaluation of carcinogenic potential.
Source and Date: IRIS, 9/28/2007

Trichloroethylene (CAS # 79-01-6)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	2.0 µg/m^3	0.37 ppb$_{vol}$	6.0 µg/m^3	1.1 ppb$_{vol}$
Basis	Immunotoxic and developmental effects from hours-days of exposure (Res AAV SE Dev – U.S. EPA IRIS RfC)		3 x Res AAV SE Dev	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	4.0 µg/m^3	0.74 ppb$_{vol}$	12 µg/m^3	2.2 ppb$_{vol}$
Basis	Immunotoxic and developmental effects from hours-days of exposure (NR AAV$_{adj}$ SE Dev – U.S. EPA IRIS RfC)		3 x NR AAV$_{adj}$ SE Dev	

Discussion of Basis

The U.S. EPA IRIS chronic RfC (2 µg/m^3) is the basis of the residential and nonresidential AACs, RIASLs, and TS RIASLS for trichloroethylene (TCE). The RfC is based on two rodent studies. The first study is a 30-week drinking water study resulting in decreased thymus weight in female mice (immunotoxicity). The second is a developmental study where pregnant female rats were exposed to TCE in drinking water during gestation and resulted in fetal cardiac malformations. The ATSDR intermediate and chronic inhalation MRLs are available and are both 2 µg/m^3 also. The MRLs are based on the same IRIS studies and endpoints. AQD has an ITSL of 2 µg/m^3 based on the IRIS RfC.

Uncertainties in the toxicity estimate:
Two different studies with different adverse effects and UFs are the basis of the U.S. EPA IRIS RfC. Both are based on oral toxicity studies, but with PBPK modeling to extrapolate between routes, species and account for variability within species. The RfC calculation from the study that resulted in decreased thymus weight in female mice (Kiel *et al*.; 2009) used a total UF of 100, 3 each for human variability and mouse to human extrapolation based on PBPK modeling to account for toxicokinetic differences, and 10 for a LOAEL. This RfC has a medium to high confidence due to high confidence in the immunotoxic hazard coupled with quantitative uncertainties in the dose-response assessment.

The RfC calculation based on cardiac malformations from prenatal exposure (Johnson et al, 2003) includes a total uncertainty factor of 10, 3 each for human variability and rat to human extrapolation based on PBPK modeling to account for toxicokinetic differences. The overall confidence in this RfC is medium due to important limitations with the study, overall weight of evidence supporting the adverse effect of TCE on cardiac development, and higher confidence in the dose-response analysis.

Source of the Toxicity Values
Noncancer:
Basis: IRIS is a Tier 1 source**.**
IRIS RfC = 2.0E-3 mg/m^3.
Critical Studies and Methods:
1) 30-week drinking water study, Keil *et al*., 2009 (immunotoxicity);
2) drinking water exposure from GD 1 to 22, Johnson *et al*., 2003 (heart malformations)
Multiple Critical effects, Point of Departure (POD), Uncertainty Factors (UF), and candidates RfCs:

1) Female B6C3F1 Mice: IMMUNOTOXICITY. Point of Departure: LOAEL (HEC99) = 0.19 mg/m3 with UF of 100 yields candidate RfC of 0.0019 mg/m3.
2) Fetal Sprague-Dawlery Rats: INCREASED FETAL CARDIAC MALFORMATIONS. Point of Departure: BMDL01 (HEC99) = 0.021 mg/m3 with UF of 10 yields candidate RfC of 0.0021 mg/m3

Final RfC Basis: The average of these two candidate RfCs yields a final RfC of 0.002 mg/m^3 or 2 µg/m^3.
Source and date: IRIS, 9/28/2011. An IRIS Toxicological Review is available.

Cancer:
Basis: IRIS is a Tier 1 Source.
IRIS IURF = 4.1E-6 (adult-based IURF); IURF = 3.1E-6 for liver and NHL tumors; and IURF = 1.0E-6 for kidney (mutagenic MOA).
Note: TCE is carcinogenic at multiple sites. For kidney tumors, TCE acts via a mutagenic mode of action (MOA). For liver and other TCE-induced tumors, the MOA is not clear. Increased early-life susceptibility is assumed for kidney cancer and, therefore, the age-dependent adjustment factors (ADAFs) should be applied to the kidney cancer component of the total cancer risk. For liver and non-Hodgkin lymphoma (NHL), the cancer risk is calculated without ADAF. The U.S. EPA (2015) Regional Screening Level (RSL) generated adjustment factors for cancer and cancer with mutagenic effects: CAF = 0.756 and MAF = 0.244, respectively to facilitate calculating inhalation exposure risk. These factors are based on the ratio of the NHL and liver-based IURF or kidney-based IURF to the adult-based IURF estimate. These factors should be applied in calculating the risk-based health values for TCE exposure via inhalation.
Critical Studies: Charbotel *et al*. (2006); U.S. EPA (2011); and Raaschou-Nielsen *et al*. (2003).
Methods:

3) *Dose response data*: *Tumor Type* - Renal cell carcinoma, non-Hodgkin's lymphoma, and liver tumors; *Test Species* - Human (epidemiological studies); *Route* - Inhalation
4) *Extrapolation method*: Low-dose linear extrapolation from the point of departure (LEC01) with a factor of 4 applied to include non-Hodgkin's lymphoma (NHL) and liver cancer risks, combined risk,

Carcinogen Weight-of-Evidence (WOE) Class: "carcinogenic to humans" by all routes of exposure; carcinogenic by a mutagenic MOA for induction of kidney tumors; Increased early-life susceptibility is assumed therefore, age-dependent adjustment factors (ADAFs) should be used for the kidney cancer component of the total cancer risk.

Basis: IRIS WOE: convincing evidence of a causal association between TCE exposure in humans and kidney cancer, but there is also human evidence of TCE carcinogenicity in the liver and lymphoid tissues.
Source and Date: IRIS, 9/28/2011. An IRIS Toxicological Review is available.

Trimethylbenzenes – 1,2,3-trimethylbenzene; 1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene combined (CAS #s 25551-13-7; 526-73-8; 95-63-6; 108-67-8)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	63 μg/m^3	13 ppb_{vol}	190 μg/m^3	39 ppb_{vol}
Basis	Decreased pain sensitivity from subchronic exposure (Res AAV Noncancer – U.S. EPA IRIS RfC)		3× Res AAV Noncancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	180 μg/m^3	37 ppb_{vol}	560 μg/m^3	110 ppb_{vol}
Basis	Decreased pain sensitivity from subchronic exposure (NR AAV_{adj} NoncancerC – U.S. EPA IRIS RfC)		3× NR AAV_{adj} Noncancer	

Discussion of Basis
The 2016 U.S. EPA IRIS RfC for all trimethylbenzene (TMB) isomers combined of 60 μg/m^3 is the basis of the residential and nonresidential AACs, RIASLs and TS RIASLs. The IRIS RfC was derived using benchmark dose modeling with PBPK modeling or default dosimetric methods. The principal IRIS study used was a subchronic 1996 study with decreased pain sensitivity as the critical effect. The MDEQ's AQD has an ITSL of 50 μg/m^3 which is partially based on PPRTVs chronic values for 1,2,3-TMB (5 μg/m^3) and 1,2,4-TMB (7 μg/m^3). AQD did not employ a database UF of 10 as PPRTV did and grouped the three TMB isomers together.

Uncertainties in the toxicity estimate:
The IRIS chronic RfC is based on a developmental and four subchronic studies, which demonstrated neurological, hematological, respiratory, developmental and maternal toxicity endpoints. The neurological effect was the most sensitive effect and was used as basis for the overall RfC. An RfC value was derived for each of the subchronic studies using a composite UF of 300 to account for human variability (10), interspecies variability (3), database deficiency (3) and use of a subchronic study. The UF for subchronic to chronic extrapolation and lack of data increased the uncertainties in the estimate. IRIS assigned a low to medium confidence on the chronic RfC.

A subchronic RfC for TMB was set to 200 μg/m3 based on neurological effects.

Source of the Toxicity Values
Noncancer:
Basis: IRIS (9/9/2016):
IRIS: RfC = 5E-2 mg/m^3 (5E+1 μg/m^3) derived as follows:

Critical Study: Korsak, Z. and K. Rydzynski. (1996) Neurotoxic effects of acute and subchronic inhalation exposure to Trimethylbenzene isomers (pseudocumene, mesitylene, hemimellitene) in rats. Int. J. Occup. Med. Environ. Health. 9:341–349.
Method(s): Rats were exposed to 0, 123, 492, or 1,230 mg/m^3 1,2,4-TMB for 6 hours/day, 5 days/week, for 3 months. Neurobehavioral effects were assessed using performance testing.
Critical effect: Decreased pain sensitivity in male rats (neurotoxicity)
End point or Point of Departure (POD): A deterministic rat PBPK model was used to was used to convert non-continuous external inhalation concentrations (in mg/m^3) of 1,2,4-TMB to the internal blood dose metric of average weekly venous blood concentration (in mg/L) of 1,2,4-TMB. Internal doses were modeled using BMDS. The resulting POD was adjusted for the non-continuous exposures in this study, POD_{ADJ} = 0.099 mg/L, and then converted to HECs using a human PBPK model, POD_{HEC} = 18.15 mg/m^3.
Uncertainty Factors: UF = 300 (10 for intraspecies variability and 3 each for use of a subchronic study, interspecies extrapolation, and database deficiencies).

Cancer:

IRIS (9/9/2016): No IRIS file is available at this time. Per the September 2016 IRIS Toxicological Review of Trimethylbenzenes, the database for TMBs provides "inadequate information to assess carcinogenic potential". This characterization is based on the limited and equivocal genotoxicity findings, and the lack of data indicating carcinogenicity in experimental animal species via any route of exposure. Information available on which to base a quantitative cancer assessment is lacking, and thus, no cancer risk estimates for either oral or inhalation exposures are derived.

Vinyl acetate (CAS#108-05-4)

Residential RIASLs

	Residential RIASL		Residential TS RIASL	
Action Level	210 µg/m^3	60 ppb_{vol}	630 µg/m^3	180 ppb_{vol}
Basis	Nasal epithelial lesions (Res AAC Noncancer – U.S. EPA IRIS RfC)		3× Res AAV Noncancer	

Nonresidential RIASLs

	Nonresidential RIASL		Nonresidential TS RIASL	
Action Level	620 µg/m^3	180 ppb_{vol}	1,900 µg/m^3	540 ppb_{vol}
Basis	Nasal epithelial lesions (NR AAV_{adj} Noncancer – U.S. EPA IRIS RfC)		3× NR AAV_{adj} Noncancer	

Discussion of Basis

The residential and nonresidential AACs, RIASLs and TS RIASLs for vinyl acetate are based on the U.S. EPA IRIS chronic RfC of 200 µg/m^3. The IRIS RfC of 200 µg/m^3 is based on a NOAEL of 50 ppm (176 mg/m^3; $NOAEL_{HEC}$ = 5 mg/m^3) and LOAEL of 200 ppm (704 mg/m^3) for nasal epithelial lesions in rats and mice after 104 weeks of exposure for 6 hours/day and 5 days/week (Owen et al 1988). The ATSDR Intermediate Inhalation MRL is based on respiratory effects (respiratory distress, slight inflammation in the nasal turbinates and mild multifocal bronchitis) reported at a NOAEL of 50 ppm and a LOAEL of 200 ppm after 90 days of exposure in mice (Hazelton, 1979) from the same research group as the IRIS critical studies. Since the ATSDR and IRIS NOAELs and LOAELs are the same, the proposed RIASLs and TS RIASLs are based on the IRIS RfC. The IRIS RfC is based on a chronic study and includes dosimetric adjustment.

Uncertainties in the toxicity estimate:
The total UF applied is 30 for the IRIS RfC. A UF of 10 is used to account for intraspecies variability and a UF of 3 for interspecies variability because of the use of dosimetric adjustments. The confidence assigned by IRIS to the RfC estimate is high due to an adequate number of animals in a chronic 2-year study that identified both a NOAEL and LOAEL and was thorough in reporting experimental and exposure details. The animal database provides sufficient supporting data for the RfC.

For the ATSDR intermediate inhalation MRL the total UF applied is 100. A UF of 10 each was used for human variability and interspecies extrapolation.

Source of the Toxicity Values
Noncancer:
Basis: The IRIS RfC was selected because it is based on a chronic inhalation study. IRIS is a Tier 1 source.
IRIS RfC = 2.0E-1 mg/m^3.
Critical Studies: 1) Owen, P.E. 1988. Vinyl acetate: 104 week inhalation combined chronic toxicity and carcinogenicity study in the rat and mouse. Report prepared by Hazleton

Laboratories Europe Ltd., Harrogate, England for the Society of the Plastics Industry, Inc., New York. Report No.: 5547-51/15. November 1988.
2) Dreef-van der Meulen, H.C. 1988. Report No. V 88.033/270836: Histopathology of the respiratory tract of rats used in a 104 week inhalation study (Owen, 1988) with vinyl acetate: Revised version. (TNO-CIVO Institutes, October 1988).
3) Beems, R.B. 1988. Report No. V 88.133: Histopathology of the respiratory tract of mice used in a 104-week inhalation study (Owen, 1988) with vinyl acetate. (TNO-CIVO Institutes, April 1988).
Methods: Sprague-Dawley rats (Crl:CD[SD]BR) and mice (Crl:CD-1[ICR]BR) (90 animals/sex/dose, 60 for the main study and 30 for laboratory testing) were exposed to 0, 50, 200, or 600 ppm of 99.9% vinyl acetate for 6 hours/day, 5 days/week for 104 weeks. Interim sacrifices were done at 51 and 81 weeks and recovery. Values corresponded to 0, 176, 704, and 2113 mg/m^3, and duration- adjusted values were 0, 31, 126, and 378 mg/m^3.
Critical effect: nasal epithelial lesions
End point or Point of Departure (POD): NOAEL = 176 mg/m^3 (50 ppm); NOAEL(HEC) = 5 mg/m^3
Uncertainty Factors: UF = 30 (10 for interspecies variability and 3 for interspecies extrapolation)
Source and date: IRIS, Last revision date - 10/01/1990

MRL: Per ATSDR (7/1992), no chronic inhalation MRL at this time. Intermediate inhalation MRL = 0.01 ppm
Critical Study: Hazleton. 1980b. Vinyl acetate: 3 month inhalation toxicity study in the mouse. U.S. EPA/OTS public files. Hazleton Labs Europe Ltd. Document no. FYI-OTS-0184-0278.
Methods: Mice were exposed to vinyl acetate in drinking water at doses up to 950 mg/kg-day 6hr/day, 5days/week for 3 months.
Critical effect: inflammation of nasal turbinate epithelium; mild multi-focal bronchitis
End point or Point of Departure (POD): NOAEL = 50 ppm concentration corrected for intermittent exposure and HEC)
Uncertainty Factors: UF = 100 (10 each for interspecies variability and interspecies extrapolation)
Source and date: ATSDR, 7/1992

Cancer:
Carcinogen Weight-of-Evidence (WOE) Class: Not assessed under the IRIS Program
Source and Date: IRIS, 10/01/1990

Vinyl Chloride (CAS# 75-01-4)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	1.6 µg/m^3	0.63 ppb$_{vol}$	16 µg/m^3	6.3 ppb$_{vol}$
Basis	mutagenic liver cancer risk from early-life exposure (Res AAV Mutagenic Cancer – U.S. EPA IRIS IURF)		10 x Res AAV Mutagenic Cancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	28 µg/m^3	11 ppb$_{vol}$	280 µg/m^3	110 ppb$_{vol}$
Basis	liver cancer risk from exposure during adulthood (NR AAV$_{adj}$ Cancer – U.S. EPA IRIS IURF)		10 x NR AAV$_{adj}$ Cancer	

Discussion of Basis

The residential AAC, RIASL and TS RIASL are based on the mutagenic cancer risk using the U.S. EPA IRIS's IURF for exposures beginning from birth. The nonresidential AAC, RIASL, and TS RIASL are based on the U.S. EPA IRIS IURF for exposures during adulthood. Both of the U.S. EPA IRIS IURFs are estimated from increased incidence of liver angiosarcomas, angiomas, hepatomas, and neoplastic nodules in female rats after inhalation exposure. These values are lower than any other health-based values for noncancer adverse effects.

Vinyl chloride (VC) has chemical-specific data showing that short-term early life exposures result in cancer risk greater or equivalent to that of long-term adult exposures. Combined with long-term exposure risk observed in adults, the cancer risk for young children is assumed to be double that of adults (combined short-term exposure and long-term exposure risk). Human occupational studies (adults) have shown increased cancer risk from vinyl chloride is dose and time-dependent.

The carcinogenic health-based values for vinyl chloride (VC) are calculated using unique equations that considers lifetime averaging (prorated) of continuous exposure from birth to adulthood (age-adjusted segment) and no averaging (non-prorated) for childhood exposure (child segment) due to greater sensitivity to VC exposure during early life. The equations are based on those currently used for deriving the EPA cancer RSL for vinyl chloride.

$$AAV_{ca,VC} = \frac{TR}{\left(\frac{IURF \times ED_{res} \times EF_{res}}{AT_{ca}}\right) + (IURF)}$$

where,

$AAV_{ca,VC}$	(Acceptable air value for vinyl chloride)	=	1.631 µg/m^3
TR	(Target risk level)	=	10^{-5}
AT_{ca}	(Averaging time)	=	28,470 days
IURF	(Inhalation unit risk factor)	=	4.4E-06 (µg/m^3)$^{-1}$
ED_{res}	(Exposure duration)	=	32 years
EF_{res}	(Exposure frequency)	=	350 days/year

Uncertainties in the toxicity estimate:
The IRIS IURF is based on the 95% upper confidence limit on risk for female r rats. Human equivalent doses are calculated for a gas: extra respiratory effect based on a PBPK model of Clewell (1995). The risk values based on the animal dose metric are assumed to correspond to the same risk for the same human dose metric. It is assumed that the linear relationship between the dose metric and the low concentrations demonstrated by PBPK modeling is valid. Per IRIS, confidence is high that "the steady-state concentration of the active metabolite in the liver is accurately modeled, although the possibility of cancer induction at sites other than the liver is of some concern". The values are recommended for lifetime exposure beginning at adulthood. To address vinyl chloride's genotoxicity, an additional twofold safety factor is added to address risk from early life exposures to vinyl chloride.

Source of the Toxicity Values
Noncancer:
Basis: ATSDR is the most current value and therefore the best available.
ATSDR intermediate-duration inhalation MRL = 0.03 ppm (7.67 E-2 mg/m^3. rounded off to 8.0E-2 mg/m^3). Per ATSDR, no chronic inhalation MRL at this time
Critical Study: Thornton SR, Schroeder RE, Robison RL, *et al*. 2002. Embryo-fetal developmental and reproductive toxicology of vinyl chloride in rats. Toxicol Sci 68: 207-219.
Method(s): Sprague-Dawley rats (30/sex/group) were exposed to vinyl chloride vapor concentrations of 0, 10, 100, or 1,100 ppm, 6 hours/day for 10 weeks prior to mating and during a 3-week mating period. F0 males were exposed during the gestational period and sacrificed following the completion of parturition. F0 females were exposed during gestation and lactation (with the exception of a break in exposure from gestation day 21 through postnatal days 4 to allow for delivery of litters).
Critical effect: hepatic centrilobular hypertrophy
End point or Point of Departure (POD): LEC_{10} = 5 ppm; LEC_{10HEC} = 1 ppm
Uncertainty Factors: UF = 30 (10 for intraspecies variability and 3 for interspecies extrapolation)
Source and Date: ATSDR, 7/2006

Cancer:
Basis: IRIS is the only available IURF and a Tier 1 source. The MDEQ AQD adopted the IRIS value.
IRIS presented two IURF values: 8.8E-6 per mg/kg-day for continuous lifetime exposure from birth (incorporates a 2-fold adjustment), and 4.4E-6 per mg/kg-day for continuous lifetime

exposure during adulthood. IRIS recommends a twofold adjustment to account for greater responsiveness to VC exposure during early life. Per IRIS, animal evidence indicates age-dependent sensitivity and therefore, concern for young children potentially exposed to VC. The MDEQ used IURF = 4.4E-6 per mg/kg-day for both residential and nonresidential inhalation criteria. As described above, a different equation is used for the residential cancer health-based value due to increased cancer risk for exposure during childhood .

Critical Studies:

1) Maltoni, C; Lefemine, G; Ciliberti, A; *et al*. 1981. Carcinogenicity bioassays of vinyl chloride monomer, a model of risk assessment on an experimental basis. Environ Health Perspect 41: 3-29.

2) Maltoni, C; Lefemine, G; Ciliberti, A; *et al*. 1984. Experimental research on vinyl chloride carcinogenesis, Vol. 1 and 2. In: Archives of research on industrial carcinogenesis. Princeton, NJ: Princeton Scientific Publishers, Inc.

Method(s): Sprague-Dawley rats (30/sex/group) were exposed to 0, 1, 5, 10, 25, 50, 100, 150, 200, 250, 500, 2500, 6000, or 10,000 ppm VC by inhalation for 4 hours/day, 5 days/week for 52 weeks (Maltoni *et al*., 1981, 1984).

1) *Dose response data*: *Tumor Type* - liver angiosarcoma, hepatocellular carcinoma, and neoplastic nodules; *Test Species* – Female Sprague-Dawley rats; *Route* - Inhalation
2) *Extrapolation method*: a) Linearized multistage (b) LED 10/linear method

Carcinogen Weight-of-Evidence (WOE) Class: known human carcinogen by the inhalation route of exposure and the oral route by analogy because of positive animal bioassay data

Basis: IRIS WOE: (1) consistent epidemiologic evidence of a causal association between occupational exposure via inhalation and the development of angiosarcoma, an extremely rare tumor; (2) consistent evidence of carcinogenicity in rats, mice, and hamsters by both the oral and inhalation routes; (3) mutagenicity and DNA adduct formation by VC and its metabolites in numerous in vivo and in vitro test systems; and (4) efficient VC absorption via all routes of exposure tested, followed by rapid distribution throughout the body.

Note: The recommended slope factors should not be used if the water concentration exceeds 10+05 µg/L, because above this concentration the slope factor may differ.

Source and Date: IRIS, Last revision date - 8/7/2000. A Toxicological Review is available. An IRIS screening-level review in 2003 did not identify any critical new studies.

Xylenes (CAS # 1330-20-7)

Residential RIASLs

	Residential **RIASL**		Residential **TS RIASL**	
Action Level	230 µg/m^3	53 ppb_{vol}	690 µg/m^3	160 ppb_{vol}
Basis	Subjective symptoms of neurotoxicity, respiratory toxicity, and eye irritation. (Res AAV Noncancer– ATSDR chronic MRL)		3× Res AAV Noncancer	

Nonresidential RIASLs

	Nonresidential **RIASL**		Nonresidential **TS RIASL**	
Action Level	680 µg/m^3	160 ppb_{vol}	2,000 µg/m^3	460 ppb_{vol}
Basis	Subjective symptoms of neurotoxicity, respiratory toxicity, and eye irritation. (NR AAV_{adj} Noncancer – ATSDR chronic MRL)		3 x NR AAV_{adj} Noncancer	

Discussion of Basis

The residential and nonresidential AACs, RIASLs and TS RIASLs for xylenes are developed from the ATSDR chronic MRL (2015) that is based on a study of workers exposed to mixed xylenes reporting adverse subjective symptoms of neurotoxicity (anxiety, forgetfulness, floating sensation), respiratory toxicity, (nasal irritation and sore throat) and eye irritation. The ATSDR acute and intermediate MRLs (2,600 and 8,700 µg/m^3, respectively) are higher than the AAC value; therefore, the RIASLs and TS RIASLs are based on the AAC.

Uncertainties in the toxicity estimate:
The chronic MRL of 0.05 ppm was derived using a LOAEL from an occupational study (Uchida 1993) and a total UF of 300 to account for human variability (10), use of a LOAEL (10) and database deficiencies (3). The database deficiency uncertainty is due to the lack of supporting studies on the chronic neurotoxicity of xylenes and use of a LOAEL contributes to the uncertainty in the estimate. The neurotoxicity symptoms were supported by observations in a short exposure human study (Ernstgard 2002). This study is the basis for the acute-duration inhalation MRL. A repeated intermediate-duration human exposure study (NIOSH 1981) also reported the subjective symptoms for irritation of the nose and throat observed in the Uchida study. Studies in animals also confirm that the nervous system is a sensitive target of inhalation exposure to xylenes.

Source of the Toxicity Values

Noncancer:

Basis: ATSDR, is a Tier 1 source. The MRL RfC was selected because it is based on human data.
Chronic inhalation MRL = 0.05 ppm (2.2E+2 µg/m^3, where 1 ppm = 4.34 mg/m^3) is derived as follows:

Critical Study(ies): Uchida Y, Nakatsuka H, Ukai H, *et al*. 1993. Symptoms and signs in workers exposed predominantly to xylenes. Int Arch Occup Environ Health 64:597-605.
Method(s): 175 workers (107 men, 68 women) were exposed to mixed xylenes in Chinese factories during the production of rubber boots, plastic coated wire, or in printing work. Nonexposed workers (116 men, 125 women) were recruited from the same or other factories as a comparison population. Exposures, measured with a diffusive sampler, indicated that xylenes accounted for >70% of total exposure, with m-xylene accounting for 50% of the xylene exposure, followed by p- and o-xylenes. Toluene exposure and ethylbenzene exposure were about 1 and 3 ppm, respectively, with no benzene exposure.
Critical effect: subjective symptoms of neurotoxicity (anxiety, forgetfulness, floating sensation) and respiratory toxicity (nasal irritation and sore throat) and
eye irritation. These symptoms were observed in Ernstgard *et al.* (2002), the principal study used for deriving the acute-duration inhalation exposure MRL
End point or Point of Departure (POD): LOAEL = 14 ppm
Uncertainty Factors: UF = 300 (10 each for intraspecies variability and use of a LOAEL and 3 for database deficiencies)
Additional note: Note: A single chronic-duration inhalation MRL has been derived based on data for mixed xylenes that applies to mixed xylenes and all of the individual isomers. The justification for deriving a common value is that the isomers have similar toxicokinetic properties and elicit similar toxicological effects, with no isomer consistently exhibiting the greatest potency, depending on the end point.
Source and date: ATSDR, 8/2007

Cancer:

Carcinogen Weight-of-Evidence (WOE) Class: inadequate for an assessment of the carcinogenic potential of xylenes.
Basis: IRIS WOE: Adequate human data on the carcinogenicity of xylenes are not available, and the available animal data are inconclusive as to the ability of xylenes to cause a carcinogenic response. Evaluations of the genotoxic effects of xylenes have consistently given negative results.
Source and Date: IRIS, Last revision date - 2/21/2003. An IRIS Toxicological Review is available.

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Appendix D: Authorities

Summary of response authority

Public Health Code, PA 368 of 1978

In addition to the MDEQ's responsibilities to the health and welfare of Michigan residents, the MDHHS has their own legal responsibilities to the health and welfare of Michigan residents. Under the Public Health Code, Act 368 of 1978, the state health department has a responsibility to "continually and diligently endeavor to prevent disease, prolong life, and promote the public health." Additionally, the department shall "have general supervision of the interests of the health and life of the people of this state" and "make investigations and inquiries as to the causes, prevention, and control of environmental health hazards, nuisances, and sources of illness." See below for citations of PA 368.

Part 201

Interim response activity is for actions taken prior to the implementation of a remedial action, as necessary to prevent, minimize, or mitigate injury to public health, safety, or welfare, or to the environment. Interim response activities can include temporary relocation of people and/or access limitations. See below for citations of Part 201 and the associated administrative rules.

Part 213

Requires immediate and expeditious identification and mitigation of acute vapor risks and any other action necessary to abate an immediate threat to public health, safety, or welfare, or the environment.

Part 111

Corrective action includes actions determined by the department as necessary to protect public health, safety, or welfare or the environment including temporary relocation of people. This includes requirements to meet environmental protection standards established by the director for indoor air. Resource Conservation and Recovery Act (RCRA) corrective action guidance includes interim actions to control or abate ongoing risks to human health and the environment in advance of the final remedy selection. See below for citations of Part 111, the associated administrative rules and RCRA corrective action guidance citations.

Relevant sections of the Public Health Code PA 386, Part 201 and associated administrative rules, Part 213, Part 111 and associated administrative rules, and RCRA corrective action guidance.

Public Health Code, PA 368 of 1978
MCL 333.2221(1) …The department shall continually and diligently endeavor to prevent disease, prolong life, and promote public health through organized programs, including prevention and control of environmental health hazards; prevention and control of diseases; prevention and control of health problems of particularly vulnerable population groups…

(2) The department shall:
(a) Have general supervision of the interests of the health and life of the people of this state.
(d) Make investigations and inquiries as to:
(i) The causes, prevention, and control of environmental health hazards, nuisances, and sources of illness.
(e) Plan, implement, and evaluate health education by the provision of expert technical assistance…

Part 201 citations for interim response activities related to volatilization to indoor air:

324.20101 Definitions.

Sec. 20101. (1) As used in this part:

(y) "Interim response activity" means the cleanup or removal of a released hazardous substance or the taking of other actions, prior to the implementation of a remedial action, as may be necessary to prevent, minimize, or mitigate injury to the public health, safety, or welfare, or to the environment. Interim response activity also includes, but is not limited to, measures to limit access, replacement of water supplies, and temporary relocation of people as determined to be necessary by the department. In addition, interim response activity means the taking of other actions as may be necessary to prevent, minimize, or mitigate a threatened release.

324.20107a Duties of owner or operator having knowledge of facility; hazardous substances; obligations based on current numeric cleanup or site-specific criteria; liability for costs and damages; compliance with section; applicability of subsection (1)(a) to (c) to state or local unit of government; "express public purpose" explained.

Sec. 20107a. (1) A person who owns or operates property that he or she has knowledge is a facility shall do all of the following with respect to hazardous substances at the facility:

(b) Exercise due care by undertaking response activity necessary to mitigate unacceptable exposure to hazardous substances, mitigate fire and explosion hazards due to hazardous substances, and allow for the intended use of the facility in a manner that protects the public health and safety.

(2) The owner's or operator's obligations under this section shall be based upon the current numeric cleanup criteria under section 20120a(1) or site-specific criteria approved under section 20120b.

324.20114 Owner or operator of facility; duties; response activity without prior approval; easement; applicability of subsections (1) and (3); effect of section on authority of department to conduct response activities or on liability of certain persons; determination of nature and extent of hazardous substance; "available analytical method" defined.

Sec. 20114. (1) Except as provided in subsection (4), an owner or operator of property who has knowledge that the property is a facility shall do all of the following with respect to a release for which the owner or operator is liable under section 20126:

(e) Immediately identify and eliminate any threat of fire or explosion or any direct contact hazards.

(h) Upon written request by the department, take 1 or more of the following actions:

(i) Provide a response activity plan containing a plan for undertaking interim response activities and undertake interim response activities consistent with that plan.

(iv) Take any other response activity determined by the department to be technically sound and necessary to protect the public health, safety, welfare, or the environment.

324.20118 Response activity; remedial action; purposes; selection or approval; conditions.

Sec. 20118. (1) The department may take response activity or approve of response activity proposed by a person that is consistent with this part and the rules promulgated under this part relating to the selection and implementation of response activity that the department concludes is necessary and appropriate to protect the public health, safety, or welfare, or the environment.

(3) Remedial action undertaken under subsection (1) shall accomplish all of the following:

(a) Assure the protection of the public health, safety, and welfare, and the environment with respect to the environmental contamination addressed by the remedial action.

324.20119 Action to abate danger or threat; administrative order; noncompliance; liability; petition for reimbursement; action in court of claims; evidence.

Sec. 20119. (1) In accordance with this section, if the department determines that there may be an imminent and substantial endangerment to the public health, safety, or welfare, or the environment, because of a release or threatened release, the department may require persons who are liable under section 20126 to take necessary action to abate the danger or threat.

324.20120a Cleanup criteria.

(16) Remedial actions that rely on categorical cleanup criteria developed pursuant to subsection (1) shall also consider other factors necessary to protect the public health, safety, and welfare, and the environment as specified by the department, if the department determines based on data and existing information that such considerations are relevant to a specific facility. These factors include, but are not limited to, the protection of surface water quality and consideration of ecological risks if pertinent to the facility based on the requirements of this part.

R 299.28 Cleanup criteria for contaminated environmental media based on other injury which requires consideration.

Rule 28. (1) To assure that hazardous substances in contaminated environmental media do not pose unacceptable risks not accounted for by other rules in this part, the concentration of a hazardous substance in a given environmental medium shall meet cleanup criteria based on sound scientific principles and determined by the department to be necessary to protect the public health, safety, and welfare and the environment from any of the following:

(e) Nonsystemic or acute toxicity.

(h) Other injury that requires consideration.

(2) The basis for and information used by the department to develop cleanup criteria under this rule shall be made available to the public upon request.

<u>Part 213</u>

324.21304c Duty of owner or operator of property; basis; liability for corrective action activity costs and natural resource damages; applicability of subsection (1)(a) to (c) to state or local unit of government.

Sec. 21304c. (1) A person that owns or operates property that the person has knowledge is contaminated shall do all of the following with respect to regulated substances at the property:

(b) Exercise due care by undertaking corrective action necessary to mitigate unacceptable exposure to regulated substances, mitigate fire and explosion hazards due to regulated substances, and allow for the intended use of the property in a manner that protects the public health and safety.

324.21307 Report of release; initial response actions; duties of owner or operator liable under MCL 324.21323a.

(2) After a release has been reported under subsection (1), the owner or operator that is liable under section 21323a shall immediately begin and expeditiously perform all of the following initial actions:

(a) Identify and mitigate immediate fire, explosion hazards, and acute vapor hazards.

(e) Take any other action necessary to abate an immediate threat to public health, safety, or welfare, or the environment.

(3) Immediately following initiation of initial response actions under this section, the owner or operator that is liable under section 21323a shall do all of the following:

(b) Continue to monitor and mitigate any additional immediate fire and safety hazards posed by vapors or NAPL that have migrated from the underground storage tank system excavation zone and entered into subsurface structures.

324.21308a Initial assessment report; discovery of migrating or mobile NAPL; additional information; supporting documentation upon request.

Sec. 21308a. (1) Within 180 days after a release has been discovered, the owner or operator that is liable under section 21323a shall complete an initial assessment report and submit the report to the department on a form created pursuant to section 21316. The report shall include the following information:

(a) Results of initial actions taken under section 21307(2).

(b) Site information and site characterization results. The following items shall be included as appropriate given the site conditions:

(*xv*) Whether toxic or explosive vapors or migrating or mobile NAPL was found and what steps were taken to evaluate those conditions and the current levels of toxic or explosive vapors or migrating or mobile NAPL in nearby structures.

<u>Part 111 citations for interim actions/early actions related to volatilization to indoor air:</u>

324.11102 Definitions; B to F.

(2) "Contaminant" means any of the following:

(a) Hazardous waste as defined in R 299.9203 of the Michigan administrative code.

(b) Any hazardous waste or hazardous constituent listed in appendix VIII of part 261 or appendix IX of part 264 of title 40 of the code of federal regulations.

(3) "Corrective action" means an action determined by the department to be necessary to protect the public health, safety, or welfare, or the environment, and includes, but is not limited to, investigation, evaluation, cleanup, removal, remediation, monitoring, containment, isolation, treatment, storage, management, temporary relocation of people, and provision of alternative water supplies, or any corrective action allowed under title II of the solid waste disposal act or regulations promulgated pursuant to that act.

R 299.9629 Corrective action.

Rule 629. (1) Owners or operators of facilities that treat, store, or dispose of hazardous waste shall conduct corrective action as necessary to protect the public health, safety, welfare, and the environment pursuant to a corrective action program approved by the director, unless otherwise specified in this rule. The corrective action program shall be conducted as follows:

(a) Owners or operators of facilities that apply for, or have been issued, an operating license pursuant to part 111 of the act shall institute corrective action for all releases of a contaminant from any waste management units at the facility, regardless of when the contaminant may have been placed in or released from the waste management unit.

(b) Owners or operators of facilities that are not included in subdivision (a) of this subrule and for which the owner or operator, or both, is or was subject to the interim status requirements defined in RCRA, except for facilities that have received formal written approval of the withdrawal of their EPA part A hazardous waste permit application from the director or the EPA, shall institute corrective action for all releases of hazardous waste from the facility, regardless of when the hazardous waste may have been placed in or released from the facility.

(2) Owners or operators shall implement corrective action beyond the facility boundary if the releases referenced in subrule (1) of this rule have or may have migrated, or otherwise have or may have been emitted, beyond the facility boundary, unless the owner or operator demonstrates, to the satisfaction of the director, that, despite the owner's or operator's best efforts, the owner or operator is unable to obtain the necessary permissions to undertake such actions. The owner or operator shall not be relieved of all responsibility to clean up a release that has migrated or been emitted beyond the facility boundary where off-site access is

denied. On-site measures to address such releases shall be determined on a case-by-case basis. Assurances of financial responsibility for such corrective action shall be provided.

(3) The owners or operators who are required to establish a corrective action program pursuant to part 111 of the act and these rules shall, at a minimum, do the following, as applicable:

(a) For facilities that are specified in subdivision (a) of subrule (1) of this rule, the owner or operator, or both, shall take corrective action to ensure compliance with the groundwater protection standards, and, if necessary, other applicable environmental protection standards, established by the director….

(iii) The environmental protection standards which are necessary for the cleanup and protection of soil, surface water, sediments, and ambient and indoor air that are established pursuant to part 201 of the act on the effective date of these rules if the limits are not less stringent than allowed pursuant to RCRA.

(b) For facilities that are specified in subdivision (b) of subrule (1) of this rule, the owner or operator, or both, shall take corrective action to ensure compliance with the groundwater protection standards, and, if necessary, other applicable environmental protection standards, established by the director….

(iii) The environmental protection standards which are necessary for the cleanup and protection of soil, surface water, sediments, and ambient and indoor air that are established pursuant to part 201 of the act on the effective date of these rules if the limits are not less stringent than allowed pursuant to RCRA.

R 299.9502 Operating licenses; applicability and general application requirements.

(12)… (a) If the director determines that even a short delay in the implementation of a remedy would adversely affect human health or the environment, the director may delay compliance with the public notice and public comment requirements of this subrule and implement the remedy immediately. However, the director shall assure involvement of the public at the earliest opportunity, and, in all cases, upon making the decision that additional remedial action is not needed at the facility.

R 299.9901 "Hazardous waste emergency" defined.

Rule 901. "Hazardous waste emergency" means an actual or potential escape of hazardous wastes or hazardous waste constituents into the environment for which the director, or his or her designee, determines that immediate corrective action to remove or contain the wastes or waste constituents is required to prevent or correct environmental damage.

R 299.9902 Declaration of hazardous waste emergency.

Rule 902. (1) The director, or his or her designee, shall declare a hazardous waste emergency based on the following criteria:

(a) The waste meets the criteria of section 3(3) of part 111 of the act.

(b) A determination and oral or written report by on-scene emergency response staff to the director, or his or her designee, that the hazardous wastes or hazardous waste constituents have entered the environment or might enter the environment without corrective action or that corrective action must be taken to eliminate a threat to the environment or public health, safety, and welfare.

(2) If a hazardous waste emergency is declared, it shall be declared ended by the director, or his or her designee, when the threat to the environment has ended.

R 299.9903 Report by the on-scene coordinator.

Rule 903. A written report shall be filed with the director, or his or her designee, by the on-scene coordinator summarizing the tasks accomplished, including an evaluation of the effectiveness of the action to control the hazardous waste emergency.

RCRA – CA Website
https://www.epa.gov/hw/learn-about-corrective-action
While site characterization is underway or before a final remedy is selected, corrective action facilities often need interim actions. Interim actions are used to control or abate ongoing risks to human health and the environment in advance of the final remedy selection. For example, actual or potential contamination of drinking water supplies may necessitate an interim action to provide alternative drinking water sources. U.S. EPA issued Interim Actions documents to assist in this process.

2015 OSWER Technical Guide for Assessing and Mitigating the Vapor Intrusion Pathway from Subsurface Vapor Sources to Indoor Air
1.2.2 Taking Action with Limited Data under RCRA Corrective Action
EPA has emphasized the importance of interim actions and site stabilization in the RCRA corrective action program to control or abate “ongoing risks” to human health and the environment while site characterization is underway or before a final remedy is selected (see the *Federal Register* of May 1, 1996 [61 FR 19446]). Interim actions encompass a wide range of institutional and physical corrective action activities to achieve stabilization and can be implemented at any time during the corrective action process. EPA recommends that interim actions, including PEM, be employed as early in the corrective action process as possible, consistent with the human health and environmental protection objectives and priorities for the site. EPA recommends that, as further information is collected, program implementers continue to look for opportunities to conduct additional interim response actions.

Appendix P

Filed Restrictive Covenant

RECEIVED
OAKLAND COUNTY
REGISTER OF DEEDS

2021 SEP 28 AM 9:24

230918
LIBER 56912 PAGE 797
$26.00 MISC RECORDING
$4.00 REMONUMENTATION
09/28/2021 09:59:53 A.M. RECEIPT# 182038
PAID RECORDED - OAKLAND COUNTY
LISA BROWN, CLERK/REGISTER OF DEEDS

EGLE Revised 5/31/2019

DECLARATION OF RESTRICTIVE COVENANT

EGLE Reference No.: RC-OWMRP-111-21-004
EPA Identification Number: MID-005-338-371
EGLE Approval Date: August 2, 2021

This Declaration of Restrictive Covenant is made to protect public health, safety, or welfare, or the environment pursuant to the provisions of Part 111, Hazardous Waste Management, Michigan Compiled Laws (MCL) 324.11101 *et seq.* (Part 111) and the applicable sections of Part 201, Environmental Remediation, MCL 324.20101 *et seq.* (Part 201), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), MCL 324.101 *et seq.* and the adminstrative rules promulgated pursuant to those Parts, MAC R 299.9101 *et seq.* and MAC R 299.5101 *et seq.* and the Solid Waste Disposal Act, commonly referred to as the Resource Conservation and Recovery Act of 1976 (RCRA), as amended by the Hazardous and Solid Waste Amendments of 1984, 42 U.S.C. §§ 6901 *et seq.*

This Declaration of Restrictive Covenant (Restrictive Covenant) is made on Sept 9, 2021 (date) by MacDermid, Inc., the Grantor(s), whose address is 245 Freight Street, Waterbury, CT 06702, for the benefit of the Grantee, Michigan Department of Environment, Great Lakes, and Energy (EGLE), whose address is 525 West Allegan Street, P.O. Box 30473, Lansing, Michigan
48909-7973.

This Restrictive Covenant has been made to prohibit or restrict activities that could result in unacceptable exposure to environmental contamination present at the property located at 1221 Farrow Street, , in the Township of Ferndale, County of Oakland, Michigan, and legally described in Exhibit 1 (Property). The Property Number (Property's Tax ID Number) is 25-35-155-002.

The Property is associated with MacDermid Enthone, Inc., MID 005 338 371 for which a draft Corrective Measure Implementation Plan (CMIP) was submitted on August 12, 2021. The corrective measures being implemented to address environmental contamination are fully described in the CMIP entitled *RCRA Facility Investigation, Corrective Measures Study, and Corrective Measures Implementation Work Plan MacDermid Enthone, Inc., 1221 Farrow Avenue, Ferndale, Michigan, MID 005 338 371* submitted by GEI Consultants of Michigan, P.C. on behalf of MacDermid, Inc.

28P

The CMIP requires the recording of this Restrictive Covenant to: (1) restrict potentially unacceptable exposures to hazardous substances located on the Property; and (2) assure that the use of Property is consistent with the exposure assumptions utilized in the development of nonresidential cleanup criteria and the exposure control measures relied upon in the CMIP; and (3) to prevent damage or disturbance of monitoring wells or any other element of the corrective measures constructed on the Property.

The land or resource use restrictions contained in this Restrictive Covenant are based upon information available to EGLE at the time the CMIP was approved by EGLE. Failure of the corrective measures to achieve and maintain the cleanup criteria, exposure controls, and requirements specified in the CMIP; future changes in the environmental condition of the Property or changes in the cleanup criteria; the discovery of environmental conditions at the Property that were not accounted for in the CMIP; or use of the Property in a manner inconsistent with the restrictions described herein, may result in this Restrictive Covenant not being protective of public health, safety, or welfare, or the environment. Additional restrictions may become necessary. Information pertaining to the environmental conditions at the Property and the corrective actions undertaken at the Property is on file with EGLE, Materials Management Division.

OK LB

Exhibit 2, attached hereto, provides a survey and a map that identifies those portions of the Property that are subject to land use or resource use restrictions as specified herein.

This Restrictive Covenant was prepared by:
Allan R. Blaske, P.G., CPG
Senior Geologist
GEI Consultants of Michigan, P.C.
230 N. Washington Square, Suite 201
Lansing, MI 48933

Summary of Corrective Measures

A RCRA Facility Investigation was conducted on the property between late 2016 and early 2017. The investigation consisted of soil sampling, groundwater sampling, and laboratory testing to determine presence and extent of subsurface impacts beneath the site related to three SWMUs. The details of this investigation are contained in the April 21, 2017 report entitled "RCRA Facility Investigation – DRAFT – MacDermid, Inc. 1221 Farrow Ave., Ferndale, Michigan" and the September 7, 2017 report entitled "RCRA Facility Investigation – FINAL REVISED – MacDermid, Inc. 1221 Farrow Ave., Ferndale, Michigan".

Additional sampling was conducted subsequent to the submittal of these reports to EGLE, and included subsurface vapor sampling adjacent to the building (July 2018), sampling of surficial soil (July 2018), and sampling of groundwater and soil for PFAS compounds (October and November, 2018, and February 2020).

An interim remedial action was performed to remove identified subsurface impacts associated with waste disposal lagoons in SWMU-1. Soil was excavated from the former lagoon areas between November 2018 and February 2019. A total of 3,908.46 tons of soil were removed from the two excavations. Excavations were extended to a depth of approximately 9.5 feet below ground surface, and approximately 1 foot into the underlying native silty clay glacial till. Soil excavated from the site was transported by U.S. Ecology to the Wayne Disposal facility (49350 North I-94 Service Drive, Belleville, MI 48111) for disposal. No significant amounts of groundwater were encountered during excavation. Post excavation sampling was conducted on the sidewalls and floor of the excavations. The interim remedial measures were summarized in the April 25, 2019 report entitled "Soil Excavation Remediation Summary Report MacDermid, Inc. 1221 Farrow Avenue, Ferndale, Michigan".

Hazardous substances listed in Exhibit 3 have been found in soils or groundwater at the Property in concentrations above the cleanup criteria for unrestricted residential use for relevant exposure pathways. Applicable cleanup criteria for soil and groundwater are the Part 201 Generic Non-residential Cleanup Criteria and Screening Levels, dated September 28, 2012. For volatile organic compounds which may migrate to structures on the site, the volatilization to indoor air inhalation pathway (VIAP) screening levels include the August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels and the January 2017 Volatilization to Indoor Air Recommendations for Interim Action Screening Levels (RIASL) and Time-Sensitive Interim Action Screening Levels. These RIASLs are screening levels, and not cleanup criteria. Areas of the Property described in Exhibit 2 may contain hazardous substances in excess of the concentrations that satisfy the cleanup criteria for unrestricted residential use.

Despite the corrective measures named above, hazardous substances remain present in soils at levels that require controls to prevent unacceptable exposures. The following corrective measures have been or will be undertaken to minimize the migration of hazardous substances, as described in the CMIP:

1. Soil excavation and disposal from former lagoons has been completed.
2. Exposure to impacts remaining in the subsurface is minimized via this Restrictive Covenant.

Definitions

"Grantee" shall mean EGLE, their respective successor entities, and those persons or entities acting on their behalf.

"Grantor" shall mean MacDermid Inc., the title holder of the Property at the time this Restrictive Covenant was executed, any persons or entities authorized to act on the title holder's behalf, and any future title holder of the Property or some relevant sub-portion of the Property.

"EGLE" means the Michigan Department of Environment, Great Lakes, and Energy, its successor entities, and those persons or entities acting on its behalf.

"Owner" means at any given time the then current title holder of the Property or any portion thereof, including any lessees and those persons or entities authorized to act on the title holder's behalf.

"Part 111" means Part 111, Hazardous Waste Management, of the NREPA in effect at the time of the recording of this Restrictive Covenant.

All other terms used in this document which are defined in Part 111 of the NREPA and the Part 111 Administrative Rules, or Part 201 of the NREPA and the Part 201 Administrative Rules solely to the extent not inconsistent with the definitions in Part 111 or the Part 111 Administrative Rules, shall have the same meaning in this document as in those statutes and rules as on the date this Restrictive Covenant is made.

NOW THEREFORE,

Declaration of Land Use or Resource Use Restrictions

The Grantor(s) hereby declare(s) and covenant(s) that the Property, shall be subject to those restrictions on use described below and intends that said restrictions and covenants shall run with the land, and may be enforced in perpetuity against the Owner by the following entities: (1) the Grantor, if it is no longer owner; and (2) EGLE.

1. Land Use Prohibitions. The Owner shall prohibit all uses of the Property that are not compatible or consistent with the exposure assumptions for the nonresidential cleanup criteria. Uses that are compatible with nonresidential cleanup criteria are generally described in the Description of Allowable Uses, attached hereto as Exhibit 4.

   The property is zoned M-2, general industrial, which is designed to accommodate manufacturing, assembly, industrial, wholesale, industrial warehouses and similar uses.

   The following uses allowed under the city of Ferndale zoning code (Chapter 24, Article VI, Sections 24-101 and 24-102) designations (M-2, general industrial) are prohibited:

   a. Greenhouse and retail landscaping establishments
   b. Pet boarding facility
   c. Production facilities that have a minimum of 20% floor area dedicated to retail sales
   d. Shops of interior decorators, building trades, caterers, blue printers and similar services
   e. Vehicle repair, major and minor
   f. Wireless communication facilities
   g. Business and technical schools
   h. Trade and vocational schools
   i. Commercial laundry facilities, but not including dry-cleaning plants
   j. Provisioning center and safety compliance facility, as a marihuana facility

2. Activities Prohibited. The Owner shall prohibit activities on the Property that may result in exposures above levels established in the CMIP. These prohibited activities include:

   a. The installation of water wells for potable water use. (wells for groundwater sampling and monitoring and construction dewatering are allowed)
   b. Excavation and removal of subsurface soil without proper characterization and management.

3. The Owner shall prohibit activities on the Property that may interfere with any element of the CMIP, including prohibiting activities that may interfere with the performance of operation and maintenance activities, monitoring, or other measures necessary to ensure the effectiveness and integrity of the CMIP; including but not limited to:

   a. Excavation and removal of surface cover (soil, concrete, asphalt) over fill soil, except as necessary for short-term construction activities, and in accordance with the soil management plan.

4. Soil Vapor Management. The Owner shall prohibit the construction of new structures, basements, and/or the addition to existing structures on the Property, unless such construction incorporates engineering controls designed to eliminate the potential for subsurface vapor phase hazardous substances to migrate into the new structure at concentrations greater than the appropriate concentrations protective of public health; or unless prior to construction of any structure, an evaluation of the potential for any hazardous substances to volatilize into indoor air assures the protection of persons who may be present in the buildings. Prior to the potential for any human exposures, documentation of compliance with the above requirements must be submitted to EGLE for approval.

5. Monitoring Wells. The Owner shall not remove, disturb, or damage any monitoring wells on the Property, except as provided in the CMIP, without EGLE approval.

6. Contaminated Soil Management. The Owner shall manage contaminated soils, media, and/or debris and all other soils located on the Property in accordance with the requirements of Part 111, RCRA Subtitle C, the administrative rules promulgated pursuant to Part 111 and the RCRA, and all other relevant state and federal laws, including, but not limited to, MCL 324.20120c. This includes if the Owner elects to remove any slabs, pavement, or other impervious surface on the Property.

7. Access. The Owner shall grant to EGLE the right to enter the Property at reasonable times for the purpose of determining and monitoring compliance with the CMIP and this Restrictive Covenant, including the right to take samples, inspect the operation of the corrective measures, inspect any records relating thereto, and to perform any actions necessary to maintain compliance with the Part 111 and the CMIP.

8. Transfer of Interest. The Grantor shall provide notice at the address provided in this document to EGLE of the Grantor's intent to transfer any interest in the Property, or any portion thereof, at least fourteen (14) business days prior to consummating the conveyance. A conveyance of title, easement, or other interest in the Property shall not be consummated by the Grantor without adequate and complete provision for compliance with the terms and conditions of this Restrictive Covenant. The Grantor shall include in any instrument conveying any interest in any portion of the Property, including, but not limited to, deeds, leases, and mortgages, a notice which is in substantially the following form:

   NOTICE: THE INTEREST CONVEYED HEREBY IS SUBJECT TO A DECLARATION OF RESTRICTIVE COVENANT DATED 9/9/21 AND RECORDED WITH THE OAKLAND COUNTY REGISTER OF DEEDS, LIBER______, PAGE_______.

   A copy of this Restrictive Covenant shall be provided to all future owners, heirs, successors, lessees, easement holders, assigns, and transferees by the person transferring the interest.

9. Notices. Any notice, demand, request, consent, approval, or communication that is required to be made or obtained under this Restrictive Covenant shall be made in writing; include a statement that the notice is being made pursuant to the requirements of this Restrictive Covenant; include the Michigan facility identification number, MID 005-338-371, and EGLE Reference No. RC-OWMRP-111-21-004; and shall be served either personally, or sent via first class mail, postage prepaid, as follows:

   Hazardous Waste Section Manager
   Materials Management Division
   Michigan Department of Environment, Great Lakes, and Energy
   P.O. Box 30241
   Lansing, Michigan 48909-7741

10. Term. This Restrictive Covenant shall run with the Property and shall be binding on the Owner, and all current and future successors, lessees, easement holders, their assigns, and their authorized agents, employees, or

persons acting under their direction and control. This Restrictive Covenant may only be modified or rescinded with the written approval of EGLE, such approval shall not be unreasonably withheld, delayed or conditioned.

11. Enforcement. The Grantor is entitled to enforce the restrictions and covenants of this Restrictive Covenant by specific performance or other legal action in a court of competent jurisdiction against subsequent Owners of all or part of the Property. The Grantor, on behalf of itself, and its successors in title, intends and agrees that EGLE is entitled to enforce the restrictions and covenants in this Restrictive Covenant by specific performance or other legal action in a court of competent jurisdiction against the Grantor, as Owner, and thereafter against subsequent Owners of all or part of the Property. All remedies available hereunder shall be in addition to any and all other remedies at law or equity.

12. Modification/Release/Rescission. The Grantor or Owner may request in writing to EGLE, at the address provided herein, modifications to, or release or rescission of, this Restrictive Covenant. This Restrictive Covenant may be modified, released or rescinded only with the written approval of EGLE. Such approval shall not be unreasonably withheld, delayed or conditioned. Any approved modification to, or release or rescission of, this Restrictive Covenant shall be filed with the appropriate Registrar of Deeds by the Grantor or Owner and a certified copy shall be returned to EGLE at the address provided herein.

13. Severability. If any provision of this Restrictive Covenant is held to be invalid by a court of competent jurisdiction, the invalidity of such provision shall not affect the validity of any other provisions of this Restrictive Covenant and all other provisions shall continue to remain in full force and effect.

14. Authority to Execute Restrictive Covenant. The undersigned person(s) executing this Restrictive Covenant is the Owner and represent and certifies that he or she is duly authorized and has been empowered to execute and deliver this Restrictive Covenant.

IN WITNESS WHEREOF, Victor J. Michels has caused this Restrictive Covenant, RC-OWMRP-111-21-004, to be executed on this 9th day of September 2021

By: ______________________
Signature

Name: MacDermid, Inc.
Grantor

Its: Assistant Secretary
Title

STATE OF CONNECTICUT
COUNTY OF NEW HAVEN

The foregoing instrument was acknowledged before me this 9 Sept 2021 (date) by Victor J. Michels of MacDermid Inc., a Connecticut Corporation, on behalf of the corporation.

____
Notary Public

State of Connecticut, County of New Haven

Acting in the County of New Haven

My commission expires: 11/30/21

EXHIBIT 1

LEGAL DESCRIPTION OF PROPERTY

Property Owner:
MACDERMID, INC
245 FREIGHT ST
WATERBURY, CT 06702-0000

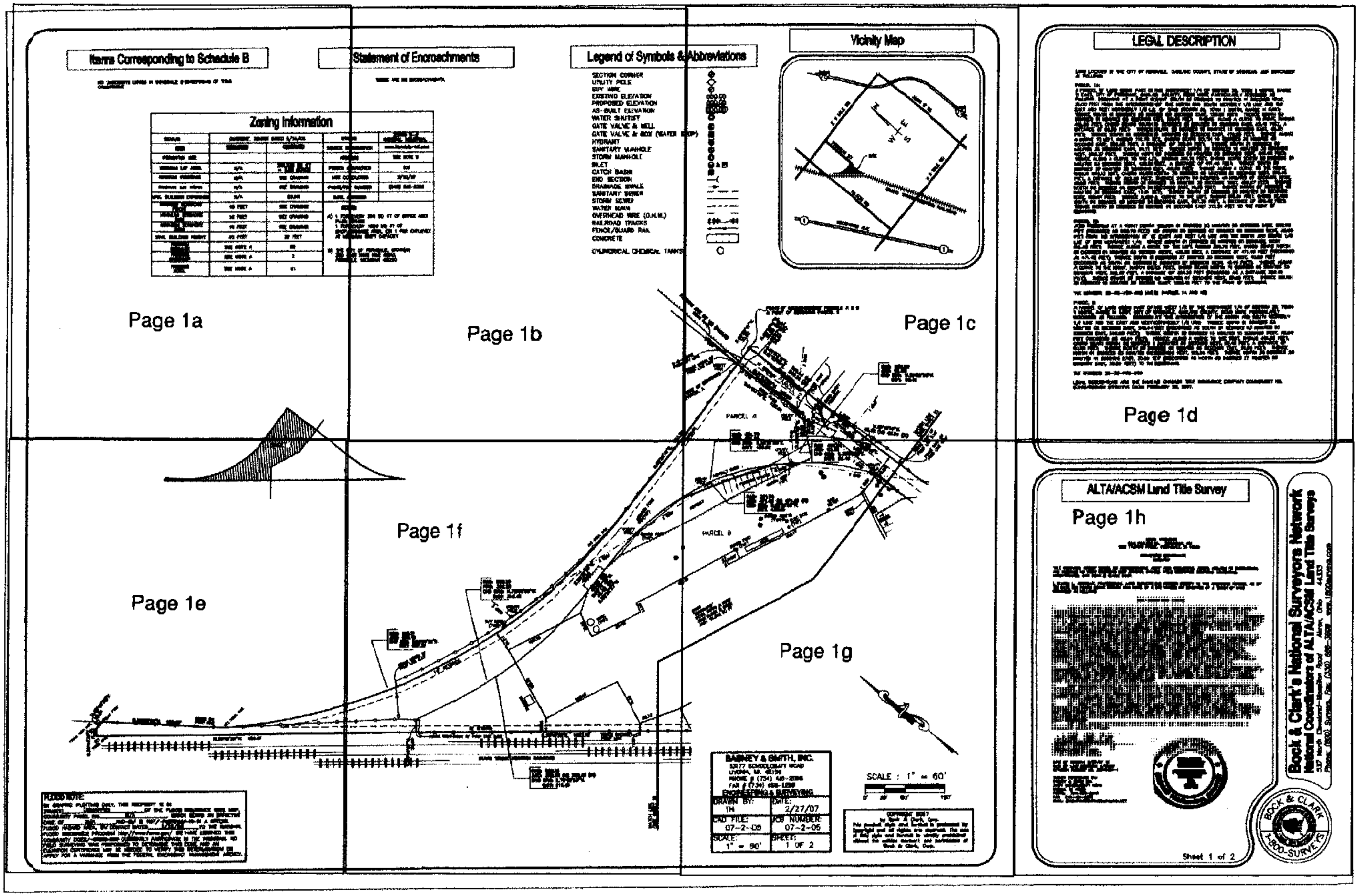
Property Address:
1221 FARROW ST., FERNDALE, MI 48220-1959

Property Identification Number (PIN) = 25-35-155-002

Legal Description:
T1N, R11E, SEC 35 PART OF NW 1/4 BEG AT PT DIST S 88-29-41 W 30 FT FROM INTER OF N & S WLY 1/8 LI & E & W NLY 1/8 LI, TH S 01-53-00 E 129.90 FT, TH S 53-01-06 W 29.65 FT, TH ALG CURVE TO RIGHT, RAD 406.98 FT, CHORD BEARS S 33-56-50 E 62.46 FT, DIST OF 62.52 FT, TH S 29-15-15 E 45.90 FT, S 01-53-00 E 470.99 FT, TH ALG CURVE TO LEFT, RAD 716.78 FT, CHORD BEARS S 16-30-48 E 362.08 FT, DIST OF 366.04 FT, TH S 31-08-35 E 54.71 FT, TH N 39-15-30 W 252.37 FT, TH N 01-53-00 W 641.40 FT, TH ALG CURVE TO LEFT, RAD 361.78 FT, CHORD BEARS N 58-51-53 W 438.80 FT, DIST OF 471.46 FT, TH S 89-37-30 W 40.09 FT, TH ALG CURVE TO RIGHT, RAD 595.13 FT, CHORD BEARS N 76-05-23 W 318.45 FT, DIST OF 322.38 FT, TH S 50-46-07 W 20 FT, TH N 39-15-30 W 486.67 FT, TH N 50-44-30 E 11.33 FT, TH N 87-45-36 E 12.51 FT, TH S 35-59-50 E 185.07 FT, TH ALG CURVE TO LEFT, RAD 818.51 FT, CHORD BEARS S 66-09-20 E 657.39 FT, DIST OF 676.48 FT, TH N 88-29-41 E 313.24 FT TO BEG, ALSO BEG AT PT DIST S 01-53-00 E 908.70 FT & S 88-07-00 W 35 FT FROM INTER OF E & W 1/8 LINE & N & S 1/8 LINE OF SD NW 1/4,TH N 01-53-00 W 641.40 FT, TH ALG CURVE TO LEFT, RAD 361.78 FT, CHORD BEARS N 58-51-53 W 438.80 FT, DIST OF 471.45 FT, TH S 88-22-27 W 40.49 FT, TH ALG CURVE TO RIGHT, RAD 595.13 FT, CHORD BEARS N 76-05-23 W 318.45 FT, DIST OF 320.48 FT, TH S 50-46-07 W 20 FT, TH S 39-15-30 E 1203.12 FT TO BEG 8.46 A1-13-97 FR 001 & 502-001

EXHIBIT 2

LEGAL DESCRIPTION AND SURVEY OF RESTRICTED AREAS OF THE PROPERTY



Items Corresponding to Schedule B
Statement of Encroachments
Legend of Symbols & Abbreviations
SECTION CORNER
UTILITY POLE
GUY WIRE
EXISTING ELEVATION
PROPOSED ELEVATION
AS-BUILT ELEVATION
WATER SHUTOFF
GATE VALVE & WELL
GATE VALVE & BOX (WATER STOP)
HYDRANT
SANITARY MANHOLE
STORM MANHOLE
INLET
CATCH BASIN
END SECTION
DRAINAGE SWALE
SANITARY SEWER
STORM SEWER
WATER MAIN
OVERHEAD WIRE (O.H.W.)
RAILROAD TRACKS
FENCE/GUARD RAIL
CONCRETE
CYLINDRICAL CHEMICAL TANKS
Vicinity Map
LEGAL DESCRIPTION
Zoning Information
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Page 1g
Page 1h
PARCEL A
PARCEL B
ALTA/ACSM Land Title Survey
FLOOD NOTE:
BARNEY & SMITH, INC.
ENGINEERING & SURVEYING
DRAWN BY: TH
DATE: 2/27/07
CAD FILE: 07-2-05
JOB NUMBER: 07-2-05
SCALE: 1" = 60'
SHEET: 1 OF 2
SCALE : 1" = 60'
Bock & Clark's National Surveyors Network
National Coordinators of ALTA/ACSM Land Title Surveys
BOCK & CLARK
1-800-SURVEYS
Sheet 1 of 2

Items Corresponding to Schedule B

NO EASEMENTS LISTED IN SCHEDULE B EXCEPTIONS OF TITLE COMMITMENT.

Zoning Information

STATUS	CURRENT, ZONING DATED 2/24/06		STA
ITEM	REQUIRED	OBSERVED	SOURCE IN
PERMITTED USE			ADD
MINIMUM LOT AREA	N/A	385,538 SQ FT = 8.85 ACRES	PERSON C
MINIMUM FRONTAGE	N/A	SEE DRAWING	DATE CO
MINIMUM LOT WIDTH	N/A	SEE DRAWING	PHONE/FA
MAX. BUILDING COVERAGE	N/A	23.9%	EMAIL A
MINIMUM SETBACKS FRONT	15 FEET	SEE DRAWING	NO
MINIMUM SETBACKS SIDE	10 FEET	SEE DRAWING	A) 1 FOR PLUS: 1 FOR SHOP/ AT MA
MINIMUM SETBACKS REAR	10 FEET	SEE DRAWING	
MAX. BUILDING HEIGHT	30 FEET	30 FEET	
PARKING REGULAR	SEE NOTE A	59	B) THE C 300 E FERNE
PARKING HANDICAP	SEE NOTE A	2	
PARKING TOTAL	SEE NOTE A	61	

Page 1a

Statement of Encroachments

THERE ARE NO ENCROACHMENTS.

US	ZONED M-2 GENERAL INDUSTRIAL
FORMATION	www.ferndale-mi.com
ESS	SEE NOTE 8
ONTACTED	KIM
DUCTED	2/23/07
NUMBER	(248) 546-2366
DDRESS	

ES:

EVERY 300 SQ FT OF OFFICE AREA
EITHER
EVERY 1000 SQ FT OF
STORAGE AREA, OR 1 PER EMPLOYEE
IMUM SHIFT CAPACITY

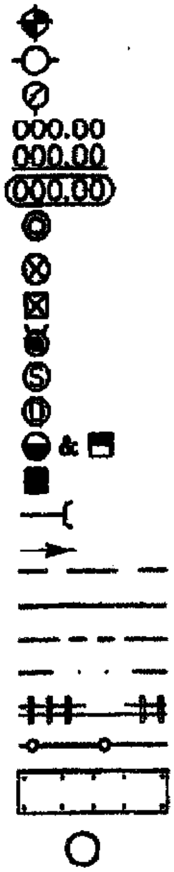
TY OF FERNDALE, MICHIGAN
AST NINE MILE ROAD,
LE, MICHIGAN 48220

Legend of Symbols &

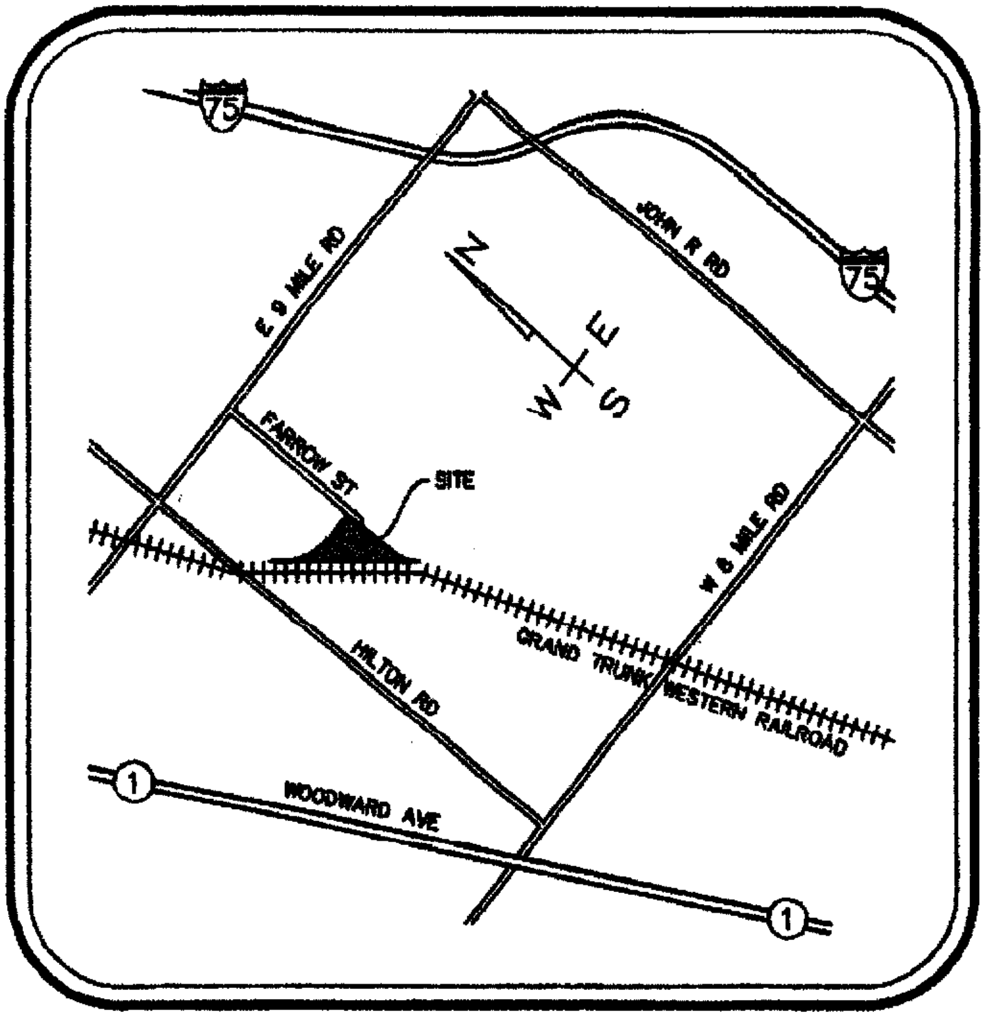
SECTION CORNER
UTILITY POLE
GUY WIRE
EXISTING ELEVATION
PROPOSED ELEVATION
AS-BUILT ELEVATION
WATER SHUTOFF
GATE VALVE & WELL
GATE VALVE & BOX (WATER S
HYDRANT
SANITARY MANHOLE
STORM MANHOLE
INLET
CATCH BASIN
END SECTION
DRAINAGE SWALE
SANITARY SEWER
STORM SEWER
WATER MAIN
OVERHEAD WIRE (O.H.W.)
RAILROAD TRACKS
FENCE/GUARD RAIL
CONCRETE

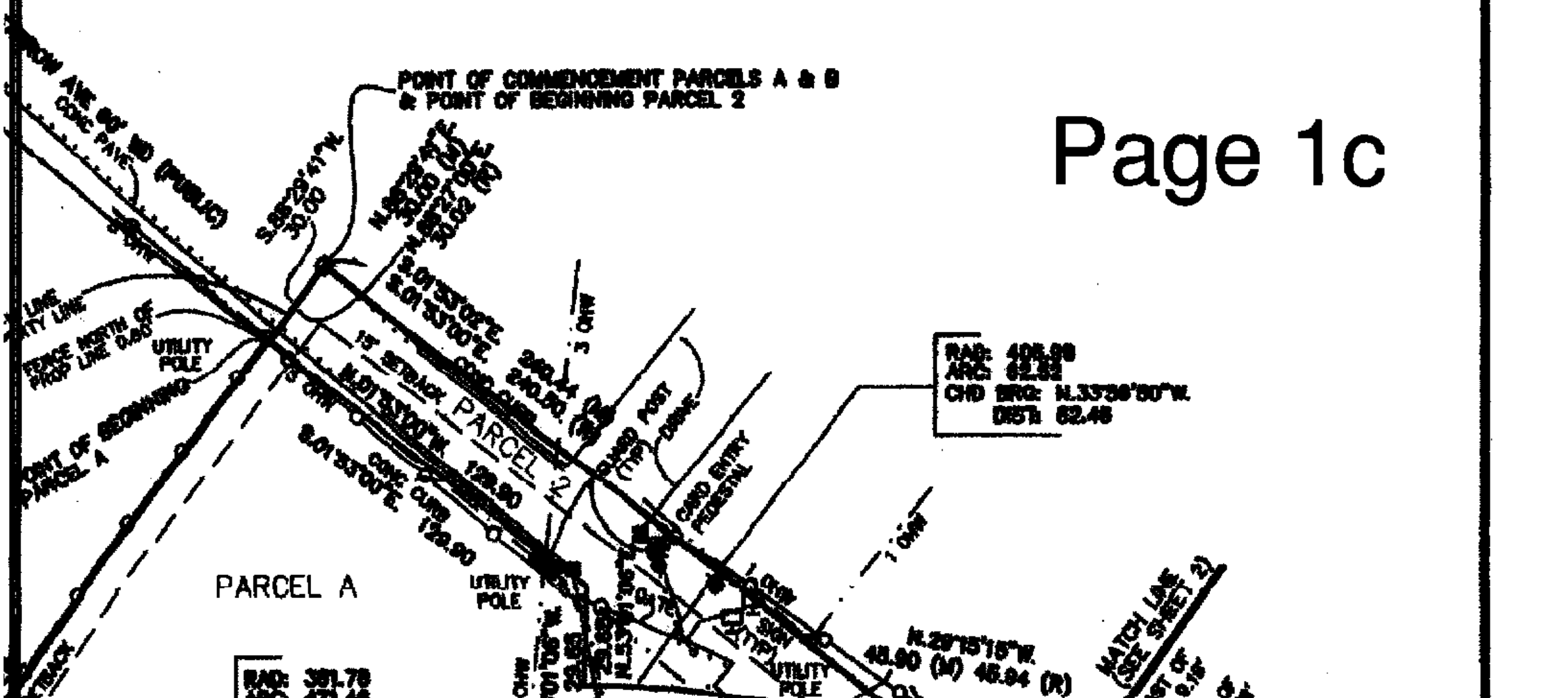
CYLINDRICAL CHEMICAL TANKS

Abbreviations



Vicinity Map





Page 1c

LEGAL DESCRIPTION

LAND LOCATED IN THE CITY OF FERNDALE, OAKLAND COUNTY, STATE OF MICHIGAN, AND DESCRIBED AS FOLLOWS:

PARCEL 1A:
A PARCEL OF LAND BEING PART OF THE NORTHWEST 1/4 OF SECTION 35, TOWN 1 NORTH, RANGE 11 EAST, CITY OF FERNDALE, OAKLAND COUNTY, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS: BEGINNING AT A POINT DISTANT SOUTH 88 DEGREES 29 MINUTES 41 SECONDS WEST, 30.00 FEET FROM THE INTERSECTION OF THE NORTH AND SOUTH WESTERLY 1/8 LINE AND THE EAST AND WEST NORTHERLY 1/8 LINE OF SAID SECTION 35, TOWN 1 NORTH, RANGE 11 EAST; THENCE SOUTH 01 DEGREES 53 MINUTES 00 SECONDS EAST, 129.90 FEET; THENCE SOUTH 53 DEGREES 01 MINUTES 06 SECONDS WEST, 29.65 FEET; THENCE ALONG A CURVE TO RIGHT, RADIUS 406.98 FEET, CHORD BEARS SOUTH 33 DEGREES 56 MINUTES 50 SECONDS EAST, 62.46 FEET, A DISTANCE OF 62.52 FEET; THENCE SOUTH 29 DEGREES 15 MINUTES 16 SECONDS EAST, 45.90 FEET; THENCE SOUTH 01 DEGREES 53 MINUTES 00 SECONDS EAST, 470.99 FEET; THENCE ALONG A CURVE TO LEFT, RADIUS 716.78 FEET, CHORD BEARS SOUTH 16 DEGREES 30 MINUTES 48 SECONDS EAST, 362.08 FEET, A DISTANCE OF 366.04 FEET; THENCE SOUTH 31 DEGREES 08 MINUTES 35 SECONDS EAST, 54.71 FEET; THENCE NORTH 39 DEGREES 15 MINUTES 30 SECONDS WEST, 292.37 FEET; THENCE NORTH 01 DEGREES 53 MINUTES 00 SECONDS WEST, 641.40 FEET; THENCE ALONG A CURVE TO THE LEFT, RADIUS 381.78 FEET, CHORD BEARS NORTH 58 DEGREES 51 MINUTES 53 SECONDS WEST, 438.80 FEET, A DISTANCE OF 471.46 FEET; THENCE SOUTH 89 DEGREES 37 MINUTES 30 SECONDS WEST, 40.09 FEET; THENCE ALONG A CURVE TO THE RIGHT, RADIUS 596.13 FEET, CHORD BEARS NORTH 76 DEGREES 05 MINUTES 23 SECONDS WEST, 318.45 FEET, A DISTANCE OF 322.38 FEET; THENCE SOUTH 50 DEGREES 46 MINUTES 07 SECONDS WEST, 20.00 FEET; THENCE NORTH 39 DEGREES 15 MINUTES 30 SECONDS WEST, 486.67 FEET; THENCE NORTH 50 DEGREES 44 MINUTES 30 SECONDS EAST, 11.33 FEET; THENCE NORTH 87 DEGREES 45 MINUTES 36 SECONDS EAST, 12.81 FEET; THENCE SOUTH 38 DEGREES 59 MINUTES 50 SECONDS EAST, 185.07 FEET; THENCE ALONG A CURVE TO THE LEFT, RADIUS 818.51 FEET, CHORD BEARS SOUTH 66 DEGREES 09 MINUTES 20 SECONDS EAST, 657.39 FEET, A DISTANCE OF 676.46 FEET; THENCE NORTH 88 DEGREES 29 MINUTES 41 SECONDS EAST 313.24 FEET TO THE POINT OF BEGINNING.

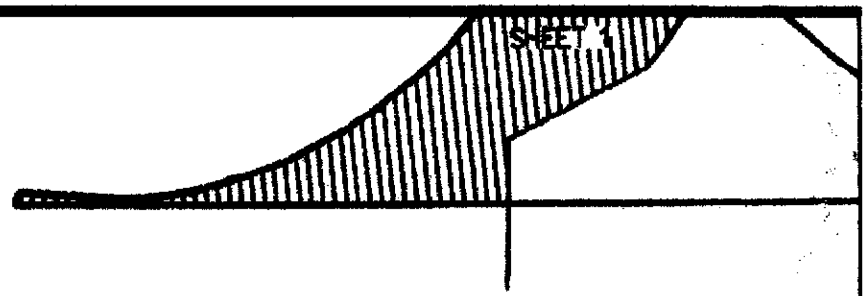
PARCEL 1B:
ALSO BEGINNING AT A POINT DISTANT SOUTH 01 DEGREES 53 MINUTES 00 SECONDS EAST, 908.85 FEET (RECORDED AS 908.70 FEET) AND SOUTH 88 DEGREES 07 MINUTES 00 SECONDS WEST, 35.00 FEET FROM THE INTERSECTION OF THE EAST AND WEST 1/8 LINE AND THE NORTH AND SOUTH 1/8 LINE OF SAID NORTHWEST 1/4; THENCE NORTH 01 DEGREES 53 MINUTES 00 SECONDS, WEST 641.40 FEET; THENCE ALONG A CURVE TO THE LEFT, RADIUS 381.78 FEET, CHORD BEARS NORTH 58 DEGREES 51 MINUTES 53 SECONDS WEST, 438.80 FEET, A DISTANCE OF 471.46 FEET (RECORDED AS 471.45 FEET); THENCE SOUTH 89 DEGREES 37 MINUTES 30 SECONDS WEST, 40.09 FEET (RECORDED AS SOUTH 88 DEGREES 22 MINUTES 27 SECONDS WEST, 40.49 FEET); THENCE ALONG A CURVE TO THE RIGHT, RADIUS 596.13 FEET, CHORD BEARS NORTH 76 DEGREES 05 MINUTES 23 SECONDS WEST, 318.45 FEET, A DISTANCE OF 322.38 FEET (RECORDED AS A DISTANCE 320.48 FEET); THENCE SOUTH 50 DEGREES 46 MINUTES 07 SECONDS WEST, 20.00 FEET; THENCE SOUTH 39 DEGREES 15 MINUTES 30 SECONDS EAST 1203.12 FEET TO THE POINT OF BEGINNING.

TAX NUMBER: 25-35-155-002 (AS TO PARCEL 1A AND 1B)

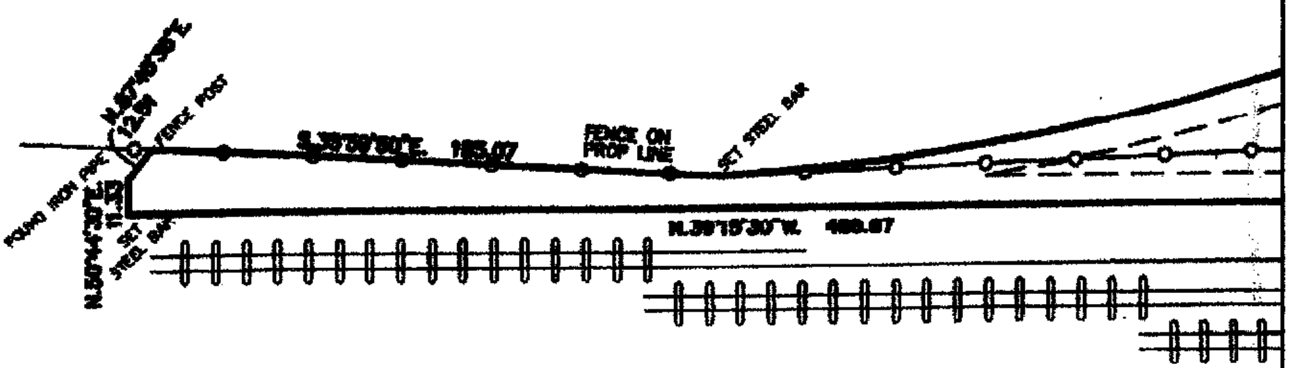
PARCEL 2:
A PARCEL OF LAND BEING PART OF THE WEST 1/2 OF THE NORTHWEST 1/4 OF SECTION 35, TOWN 1 NORTH, RANGE 11 EAST, CITY OF FERNDALE, OAKLAND COUNTY, BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS: BEGINNING AT THE INTERSECTION OF THE NORTH AND SOUTH WESTERLY 1/8 LINE AND THE EAST AND WEST NORTHERLY 1/8 LINE; THENCE SOUTH 01 DEGREES 53 MINUTES 02 SECONDS EAST, 240.44 FEET (RECORDED AS SOUTH 01 DEGREES 53 MINUTES 00 SECONDS EAST, 240.50 FEET); THENCE NORTH 29 DEGREES 15 MINUTES 16 SECONDS WEST, 45.90 FEET (RECORDED AS 45.94 FEET); THENCE ALONG A CURVE TO THE WEST, RADIUS 406.98 FEET, CHORD BEARS NORTH 33 DEGREES 56 MINUTES 50 SECONDS WEST, 62.46 FEET, A DISTANCE OF 62.52 FEET; THENCE NORTH 53 DEGREES 01 MINUTES 06 SECONDS EAST, 29.65 FEET; THENCE NORTH 01 DEGREES 53 MINUTES 00 SECONDS WEST, 129.90 FEET; THENCE NORTH 88 DEGREES 29 MINUTES 41 SECONDS EAST, 30.00 FEET (RECORDED AS NORTH 88 DEGREES 27 MINUTES 00 SECONDS EAST, 30.02 FEET) TO THE BEGINNING.

TAX NUMBER: 25-35-155-003

LEGAL DESCRIPTIONS ARE THE SAME AS CHICAGO TITLE INSURANCE COMPANY COMMITMENT NO. 630454529NBU EFFECTIVE DATE: FEBRUARY 26, 2007.



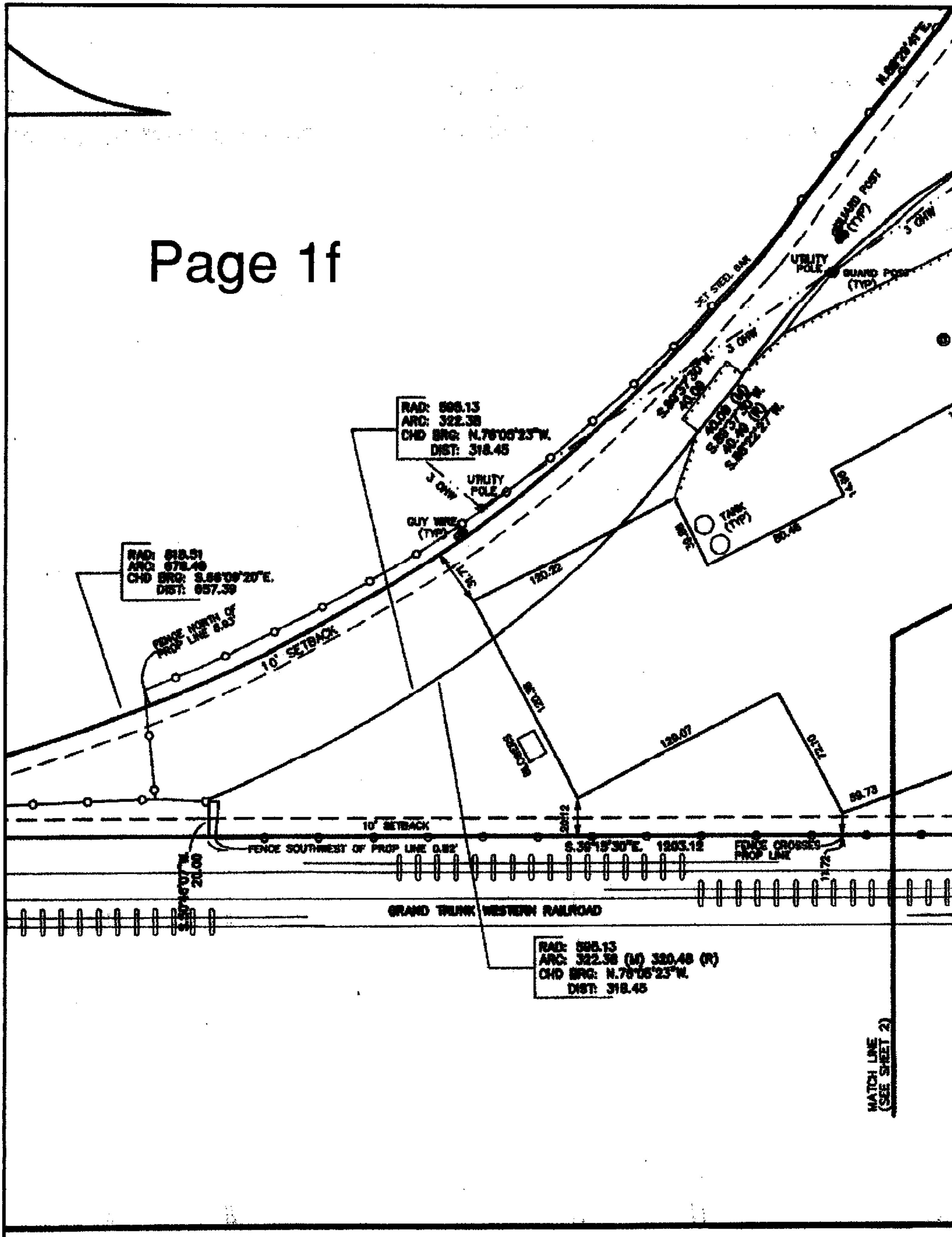
Page 1e

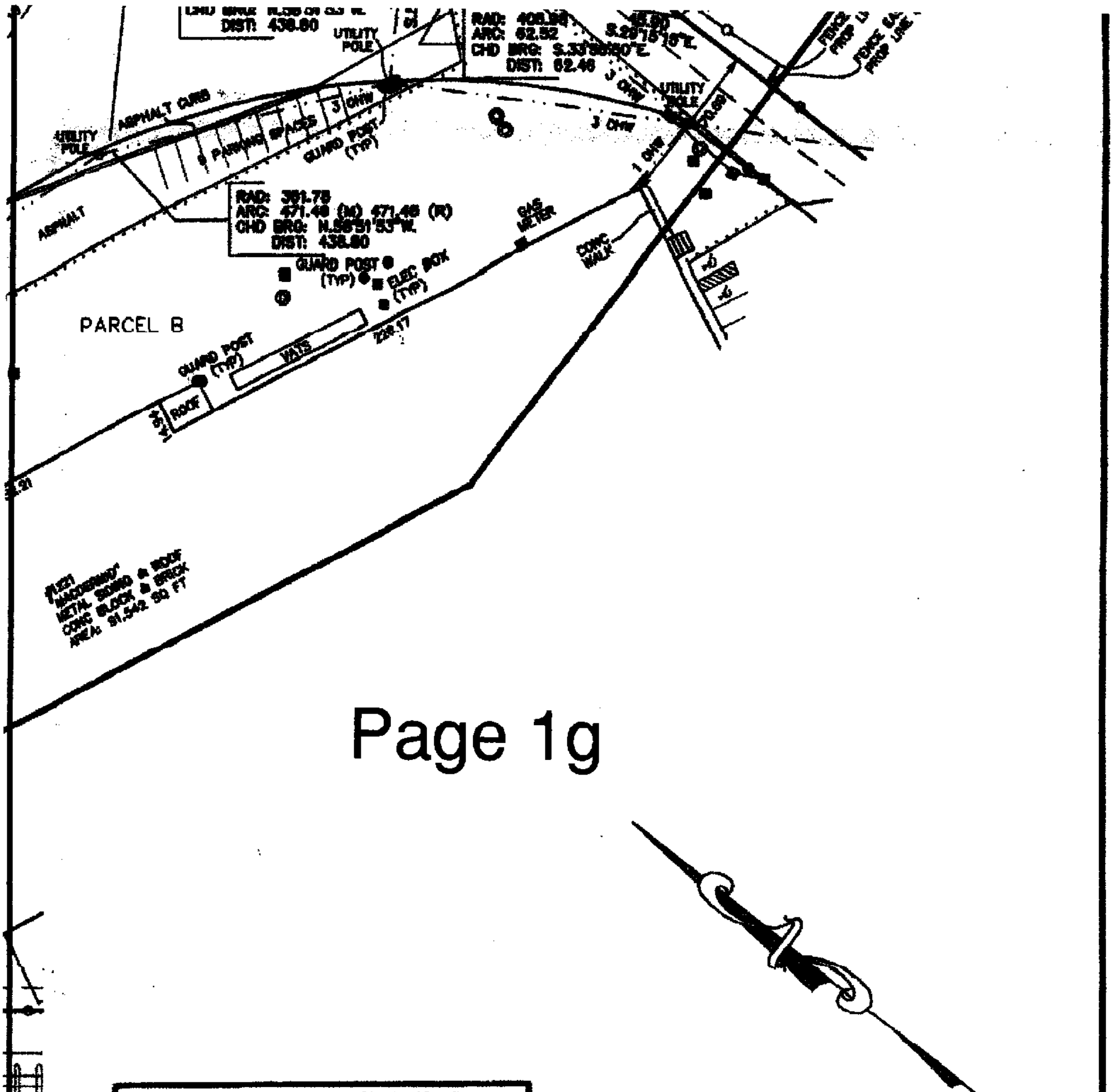


FLOOD NOTE:

BY GRAPHIC PLOTTING ONLY, THIS PROPERTY IS IN ZONE(S) UNMAPPED OF THE FLOOD INSURANCE RATE MAP, COMMUNITY PANEL No. N/A, WHICH BEARS AN EFFECTIVE DATE OF N/A AND ~~IS~~/ IS NOT/ ~~PARTIALLY IS~~ IN A SPECIAL FLOOD HAZARD AREA. BY CONTACT DATED 2/23/06 TO THE NATIONAL FLOOD INSURANCE PROGRAM http://www.fema.gov/ WE HAVE LEARNED THIS COMMUNITY DOES/ ~~DOES NOT~~ CURRENTLY PARTICIPATE IN THE PROGRAM. NO FIELD SURVEYING WAS PERFORMED TO DETERMINE THIS ZONE AND AN ELEVATION CERTIFICATE MAY BE NEEDED TO VERIFY THIS DETERMINATION OR APPLY FOR A VARIANCE FROM THE FEDERAL EMERGENCY MANAGEMENT AGENCY.

Page 1f


RAD: 598.13
ARC: 322.38
CHD BRG: N.78°08'23"W.
DIST: 318.45
RAD: 818.51
ARC: 678.49
CHD BRG: S.88°09'20"E.
DIST: 657.39
FENCE NORTH OF PROP LINE 0.93'
10' SETBACK
UTILITY POLE
GUY WIRE (TYP)
3 OHW
UTILITY POLE
GUARD POST (TYP)
TANK (TYP)
120.22
120.07
72.10
59.73
80.48
10' SETBACK
FENCE SOUTHWEST OF PROP LINE 0.82'
S.38°15'30"E. 1203.12
FENCE CROSSES PROP LINE
20.00
GRAND TRUNK WESTERN RAILROAD
RAD: 598.13
ARC: 322.38 (M) 320.48 (R)
CHD BRG: N.78°08'23"W.
DIST: 318.45
MATCH LINE (SEE SHEET 2)



Page 1g

BASNEY & SMITH, INC.
33177 SCHOOLCRAFT ROAD
LIVONIA, MI. 48150
PHONE # (734) 458-2098
FAX # (734) 458-2298
ENGINEERING & SURVEYING

DRAWN BY:	DATE:
TH	2/27/07
CAD FILE: 07-2-05	JOB NUMBER: 07-2-05
SCALE: 1" = 60'	SHEET: 1 OF 2

SCALE : 1" = 60'

0' 30' 60' 120'

ALTA/ACSM Land Title Survey

Page 1h

MATRIX PROJECT
B&C PROJECT NO. 20070107, 801
1221 FARROW AVENUE, FERNDALE, MI 48220

SURVEYOR'S CERTIFICATE
2/26/07

TITLE COMPANY: CREDIT SUISSE, AS ADMINISTRATIVE AGENT AND COLLATERAL AGENT, AND/OR ITS SUCCESSORS AND ASSIGNS, AS THEIR INTERESTS MAY APPEAR; CHICAGO TITLE INSURANCE COMPANY; MACDERMID, INCORPORATED; AND BOCK & CLARK CORP.

I, WILLIAM L. ROSKELLY, PROFESSIONAL LAND SURVEYOR DO HEREBY CERTIFY TO THE AFORESAID PARTIES, AS OF THE DATE SET FORTH ABOVE SURVEY WAS MADE BY ME OR UNDER MY DIRECTION OF A TRACT OF LAND DESCRIBED AS FOLLOWS:

[SEE DESCRIPTION ABOVE]

1. THIS IS TO CERTIFY THAT THIS MAP OR PLAT AND THE SURVEY ON WHICH IT IS BASED WERE MADE IN ACCORDANCE WITH THE "MINIMUM STANDARD DETAIL REQUIREMENTS FOR ALTA/ACSM LAND TITLE SURVEYS," JOINTLY ESTABLISHED AND ADOPTED BY ALTA AND NSPS IN 2005, AND INCLUDES ITEMS 1, 2, 3, 4, 6, 7(A)(B1)(C), 8, 9, 10, 11(A), 14, 16 AND 18 OF TABLE A THEREOF. PURSUANT TO THE ACCURACY STANDARDS AS ADOPTED BY ALTA AND NSPS AND IN EFFECT ON THE DATE OF THIS CERTIFICATION, UNDERSIGNED FURTHER CERTIFIES THAT IN MY PROFESSIONAL OPINION, AS A LAND SURVEYOR REGISTERED IN THE STATE OF THE RELATIVE POSITIONAL ACCURACY OF THIS SURVEY DOES NOT EXCEED THAT WHICH IS SPECIFIED THEREIN.
2. THE ACCOMPANYING SURVEY WAS MADE ON THE GROUND AND CORRECTLY SHOWS THE LOCATION OF ALL BUILDINGS, STRUCTURES AND OTHER IMPROVEMENTS SITUATED ON THE ABOVE PREMISES AND THERE DOES NOT APPEAR TO BE ANY USE OTHER THAN GENERAL INDUSTRIAL AS OBSERVED; UNLESS OTHERWISE SHOWN, THERE ARE NO VISIBLE ENCROACHMENTS ON THE SUBJECT PROPERTY OR UPON ADJACENT LAND ABUTTING SAID PROPERTY; THERE ARE NO STREAMS, RIVERS, SPRINGS, PONDS, LAKES, DITCHES OR DRAINS LOCATED OR BORDERING ON OR RUNNING THROUGH THE SUBJECT PREMISES; THERE ARE NO GAPS, GORES OR OVERLAPS BETWEEN PARCELS OR ROADS, HIGHWAYS, STREETS OR ALLEYS EXCEPT AS SHOWN HEREON AND SUCH SURVEY WAS MADE IN ACCORDANCE WITH LAWS AND/OR MINIMUM STANDARDS OF THE STATE OF MICHIGAN.
3. THE PROPERTY DESCRIBED HEREON IS NOT THE SAME AS THE PROPERTY DESCRIBED IN COMMITMENT NO. 6304540290MBU WITH AN EFFECTIVE DATE OF JANUARY 3, 2007 AT 8:00AM AND THAT ALL EASEMENTS, RIGHTS OF WAY COVENANTS AND RESTRICTIONS REFERENCED IN SAID TITLE COMMITMENT OR APPARENT FROM A CAREFUL PHYSICAL INSPECTION OF THE SITE OR OTHERWISE KNOWN TO ME HAVE BEEN PLOTTED HEREON OR OTHERWISE NOTED AS TO THEIR EFFECT ON THE SUBJECT PROPERTY.
4. SAID DESCRIBED PROPERTY IS LOCATED WITHIN AN AREA HAVING A ZONE DESIGNATION "UNMAPPED" BY THE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA), ON FLOOD INSURANCE RATE MAP NO. N/A, WITH A DATE OF IDENTIFICATION OF N/A, FOR COMMUNITY NO. 260262, IN OAKLAND COUNTY, STATE OF MICHIGAN, WHICH IS THE CURRENT FLOOD INSURANCE RATE MAP FOR THE COMMUNITY IN WHICH SAID PREMISES IS SITUATED.
5. THE PROPERTY HAS DIRECT ACCESS TO FARROW, A DEDICATED PUBLIC STREET OR HIGHWAY.
6. ALL PUBLIC ROADS, HIGHWAYS, STREETS AND ALLEYS RUNNING ADJACENT TO OR UPON THE SUBJECT PREMISES ARE SHOWN; ALL PHYSICAL EVIDENCE OF BOUNDARY LINES AND LINES OF POSSESSION OR OCCUPANCY HAVE BEEN SHOWN AND PROPER NOTATION MADE WHERE IN CONFLICT WITH THE LEGAL DESCRIPTION; THERE ARE NO BOUNDARY LINE DISCREPANCIES AND NO DEFICIENCIES IN THE QUANTITY OF THE LAND DESCRIBED IN THE LEGAL DESCRIPTION.
7. THE TOTAL NUMBER OF STRIPED PARKING SPACES ON THE SUBJECT PROPERTY IS 61 INCLUDING 2 DESIGNATED HANDICAP SPACES.

WILLIAM L. ROSKELLY
REGISTRATION NO. 10706
IN THE STATE OF MICHIGAN

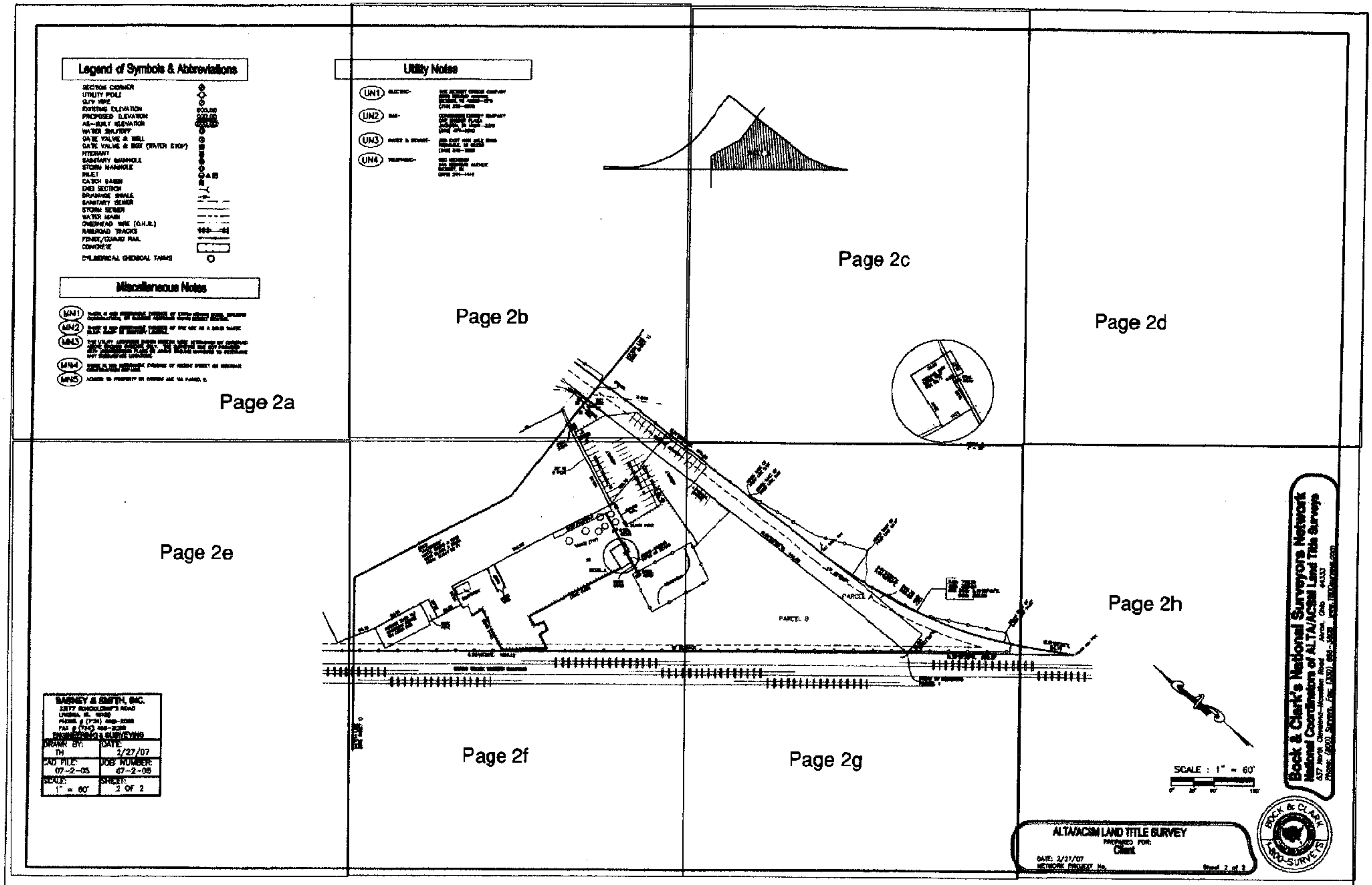
DATE OF SURVEY: 2/27/07 TH
DATE OF LAST REVISION: 4/10/07
NETWORK PROJECT NO. 20070107-1

SURVEY PERFORMED BY:
BASNEY & SMITH INC.
33177 SCHOOLCRAFT ROAD
LIVONIA, MI 48150
PHONE: 734-458-2095
FAX: 734-458-2299
EMAIL: BASNEYANDSMITH@EARTHLINK.NET

STATE OF MICHIGAN
WILLIAM L. ROSKELLY
PROFESSIONAL SURVEYOR
No.
10706
LICENSED PROFESSIONAL SURVEYOR

Bock & Clark's National Surveyors Network
National Coordinators of ALTA/ACSM Land Title Surveys
537 North Cleveland–Massillon Road Akron, Ohio 44333
Phone: (800) Surveys, Fax: (330) 666-3608 www.1800surveys.com

BOCK & CLARK
National Coordinators of ALTA/ACSM
Land Title Surveys
1-800-SURVEYS



Legend of Symbols & Abbreviations
SECTION CORNER
UTILITY POLE
GUY WIRE
EXISTING ELEVATION
PROPOSED ELEVATION
AS-BUILT ELEVATION
WATER SHUTOFF
GATE VALVE & WELL
GATE VALVE & BOX (WATER STOP)
HYDRANT
SANITARY MANHOLE
STORM MANHOLE
INLET
CATCH BASIN
END SECTION
DRAINAGE SWALE
SANITARY SEWER
STORM SEWER
WATER MAIN
OVERHEAD WIRE (O.H.E.)
RAILROAD TRACKS
FENCE/GUARD RAIL
CONCRETE
CYLINDRICAL CHEMICAL TANKS
Miscellaneous Notes
MN1
MN2
MN3
MN4
MN5
Utility Notes
UN1 ELECTRIC-
UN2 GAS-
UN3 WATER & SEWAGE-
UN4 TELEPHONE-
Page 2a
Page 2b
Page 2c
Page 2d
Page 2e
Page 2f
Page 2g
Page 2h
PARCEL A
PARCEL B
BASNEY & SMITH, INC.
ENGINEERING & SURVEYING
DRAWN BY: TH
DATE: 2/27/07
CAD FILE: 07-2-05
JOB NUMBER: 07-2-05
SCALE: 1" = 60'
SHEET: 2 OF 2
Bock & Clark's National Surveyors Network
National Coordinators of ALTA/ACSM Land Title Surveys
SCALE : 1" = 60'
ALTA/ACSM LAND TITLE SURVEY
PREPARED FOR:
Client
DATE: 2/27/07
NETWORK PROJECT No.
BOCK & CLARK
1-800-SURVEYS

Legend of Symbols & Abbreviations

SECTION CORNER	
UTILITY POLE	
GUY WIRE	
EXISTING ELEVATION	000.00
PROPOSED ELEVATION	000.00
AS-BUILT ELEVATION	000.00
WATER SHUTOFF	
GATE VALVE & WELL	
GATE VALVE & BOX (WATER STOP)	
HYDRANT	
SANITARY MANHOLE	
STORM MANHOLE	
INLET	&
CATCH BASIN	
END SECTION	
DRAINAGE SWALE	
SANITARY SEWER	
STORM SEWER	
WATER MAIN	
OVERHEAD WIRE (O.H.W.)	
RAILROAD TRACKS	
FENCE/GUARD RAIL	
CONCRETE	
CYLINDRICAL CHEMICAL TANKS	

Miscellaneous Notes

MN1 THERE IS NO OBSERVABLE EVIDENCE OF EARTH MOVING WORK, BUILDING CONSTRUCTION, OR BUILDING ADDITIONS WITHIN RECENT MONTHS.

MN2 THERE IS NO OBSERVABLE EVIDENCE OF SITE USE AS A SOLID WASTE DUMP, SUMP OR SANITARY LANDFILL.

MN3 THE UTILITY LOCATIONS SHOWN HEREON WERE DETERMINED BY OBSERVED ABOVE GROUND EVIDENCE ONLY. THE SURVEYOR WAS NOT PROVIDED WITH UNDERGROUND PLANS OR ABOVE GROUND MARKINGS TO DETERMINE ANY SUBSURFACE LOCATIONS.

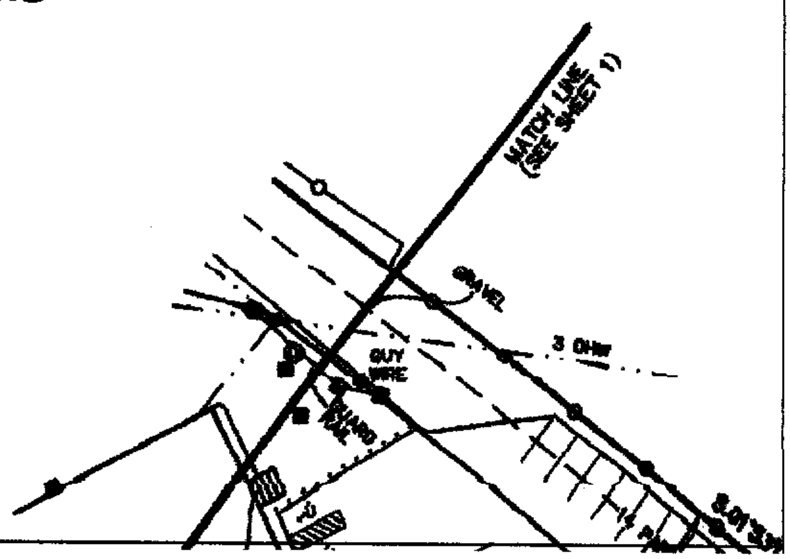
MN4 THERE IS NO OBSERVABLE EVIDENCE OF RECENT STREET OR SIDEWALK CONSTRUCTION REPAIRS.

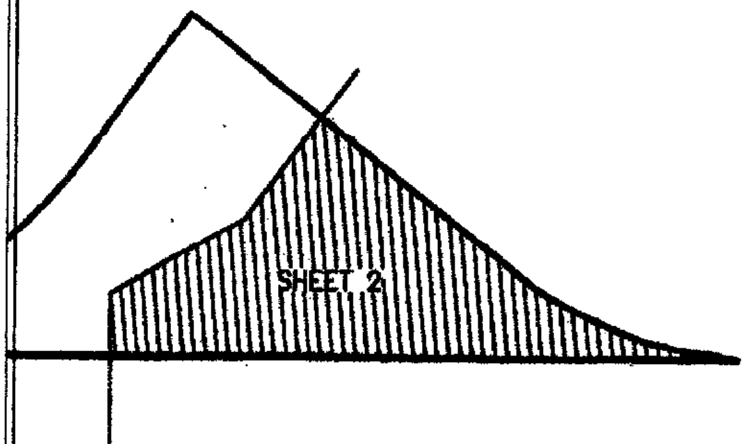
MN5 ACCESS TO PROPERTY ON FARROW AVE VIA PARCEL 2.

Utility Notes

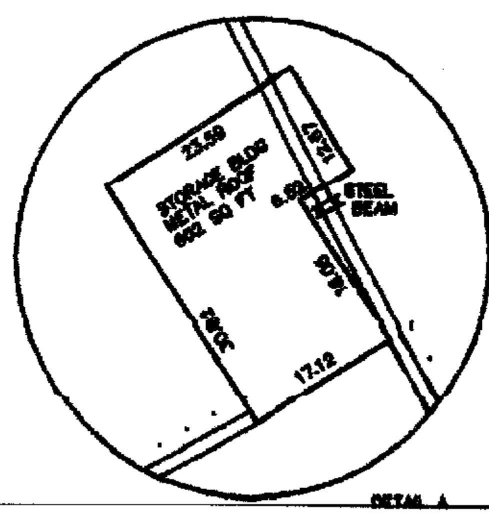
UN1	ELECTRIC--	THE DETROIT EDISON COMPANY 2000 SECOND AVENUE DETROIT, MI 48226-1279 (313) 235-8000
UN2	GAS--	CONSUMERS ENERGY COMPANY ONE ENERGY PLAZA JACKSON, MI 49201-2276 (800) 477-5050
UN3	WATER & SEWAGE--	300 EAST NINE MILE ROAD FERNDALE, MI 48220 (248) 546-2525
UN4	TELEPHONE--	SBC MICHIGAN 444 MICHIGAN AVENUE DETROIT, MI (800) 244-4444

Page 2b




SHEET 2

Page 2c

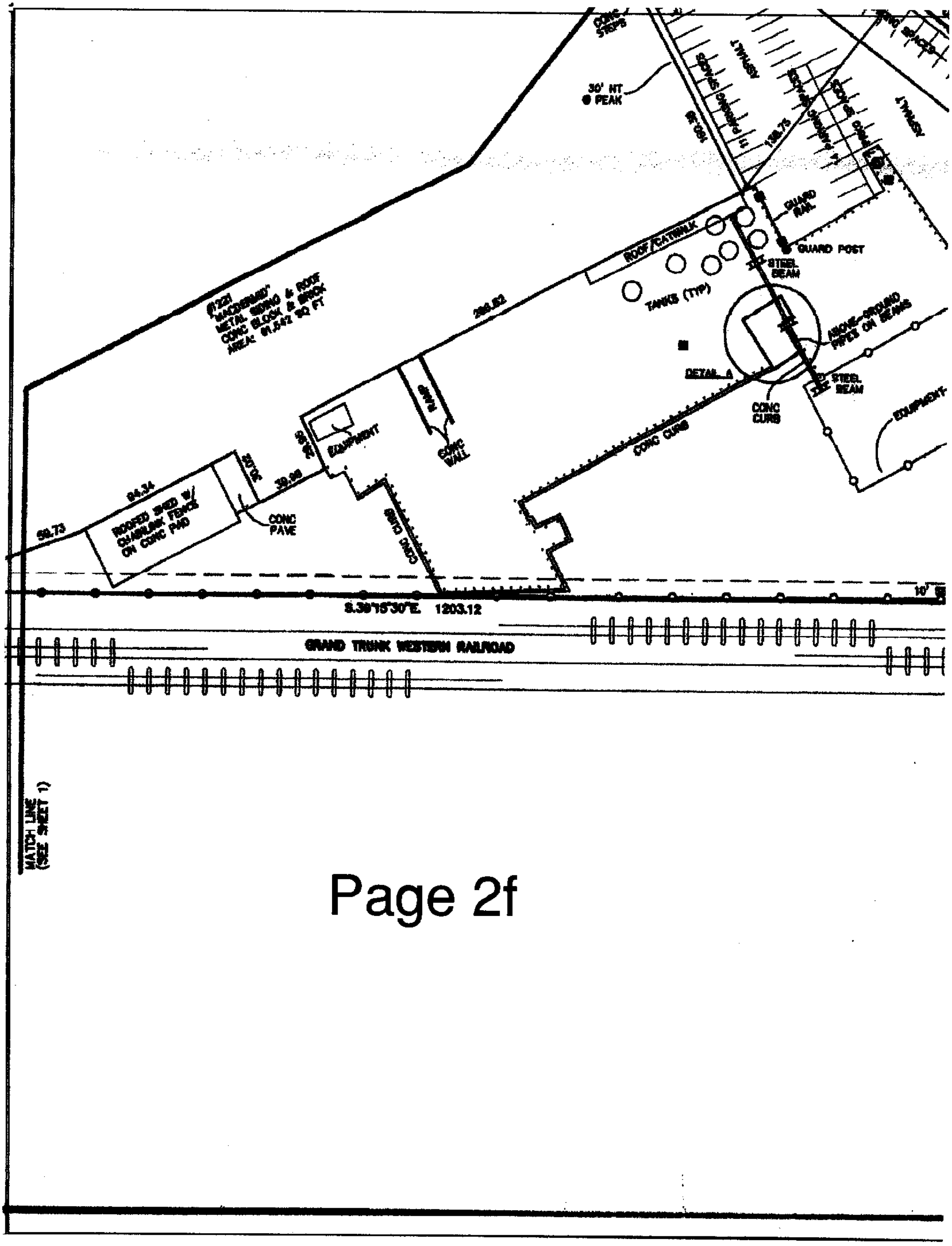

23.59
STORAGE BLDG
METAL ROOF
602 SQ FT
STEEL
BEAM
17.12

Page 2d

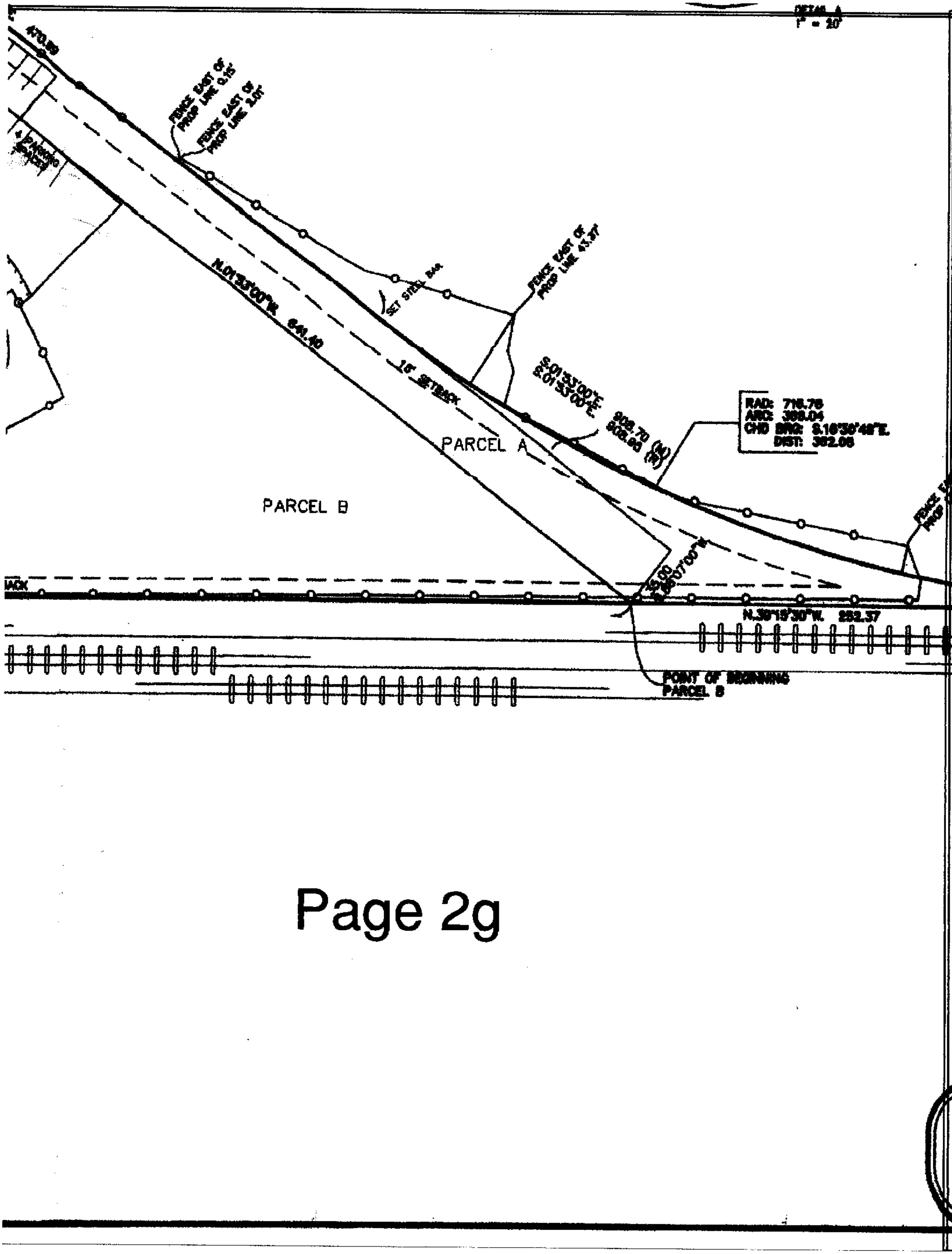
Page 2e

BASNEY & SMITH, INC.
33177 SCHOOLCRAFT ROAD
LIVONIA, MI. 48150
PHONE # (734) 458-2098
FAX # (734) 458-2298
ENGINEERING & SURVEYING

DRAWN BY: TH	DATE: 2/27/07
CAD FILE: 07-2-05	JOB NUMBER: 07-2-05
SCALE: 1" = 60'	SHEET: 2 OF 2


CONC STEPS
30' HT @ PEAK
ASPHALT
ROOF/CATWALK
GUARD RAIL
GUARD POST
STEEL BEAM
TANKS (TYP)
ABOVE-GROUND PIPES ON BEAMS
DETAIL A
CONC CURB
EQUIPMENT
RAMP
CONC WALL
CONC CURB
CONC PAVE
ROOFED SHED W/ CHAINLINK FENCE ON CONC PAD
94.34
59.73
39.98
286.62
S.39°15'30"E. 1203.12
GRAND TRUNK WESTERN RAILROAD
MATCH LINE (SEE SHEET 1)

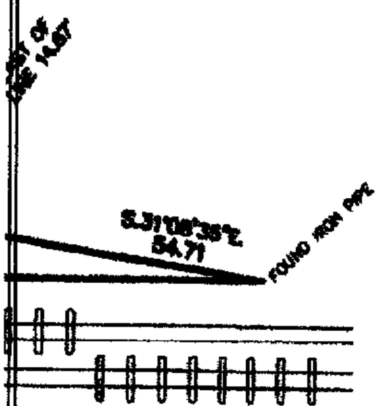
Page 2f

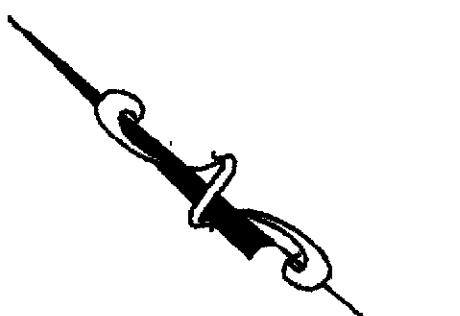


FENCE EAST OF PROP LINE 0.15'
FENCE EAST OF PROP LINE 2.01'
SET STEEL BAR
FENCE EAST OF PROP LINE 43.37'
N.01°53'00"W. 641.40
15' SETBACK
PARCEL A
PARCEL B
RAD: 716.78
ARC: 369.04
CHD BRG: S.16°30'48"E.
DIST: 362.06
N.39°15'30"W. 252.37
POINT OF BEGINNING PARCEL B

Page 2g

Page 2h





SCALE : 1" = 60'

0' 30' 60' 120'

Bock & Clark's National Surveyors Network
National Coordinators of ALTA/ACSM Land Title Surveys
537 North Cleveland—Massillon Road Akron, Ohio 44333
Phone: (800) Surveys, Fax: (330) 666-3608 www.1800surveys.com

BOCK & CLARK
1-800-SURVEYS

ALTA/ACSM LAND TITLE SURVEY
PREPARED FOR:
Client

DATE: 2/27/07
NETWORK PROJECT No.

EXHIBIT 3

LIST OF HAZARDOUS SUBSTANCES ABOVE CRITERIA IN SOILS OR GROUNDWATER

SOIL

Hazardous Substance	CAS Number	Applicable Criteria (ug/kg [ppb])
Arsenic	7440382	Non-residential direct contact (37,000), non-residential drinking water protection (4,600), and non-residential GSI protection
Benzene	71432	Non-residential drinking water protection (100) and RIASL for volatilization to indoor air (12)
Carbazole	86748	Non-residential GSI protection (1,100)
Chlorobenzene	108907	Non-residential drinking water protection ((2,000), non-residential GSI protection (500), and RIASL for volatilization to indoor air (360)
1,2-dichlorobenzene	95501	Non-residential GSI protection (280)
1,4-dichlorobenzene	106467	RIASL for volatilization to indoor air (160)
Ethylbenzene	100414	Non-residential drinking water protection (1,500), non-residential GSI protection (360), and RIASL for volatilization to indoor air (86)
Fluoranthene	206440	Non-residential GSI protection (5,500)
Lead	7439921	Non-residential direct contact (900,000)
Mercury	Varies	Non-residential GSI protection (50) and RIASL for volatilization to indoor air (0.12)
Methylene chloride	75092	Non-residential drinking water protection (100)
2-Methylnaphthalene	91576	Non-residential GSI protection (4,200)
Naphthalene	91203	Non-residential GSI protection (730)
Perfluorooctane sulfonic acid (PFOS)	1763231	Non-residential GSI protection (0.24)
Phenanthrene	85018	Non-residential GSI protection (2,100)
Selenium	7782492	Non-residential GSI protection (400)
Silver	7440224	Non-residential GSI protection (100)
Vinyl chloride	75014	Non-residential drinking water protection (40), non-residential GSI protection (260), and RIASL for volatilization to indoor air (2)
Xylenes	1330207	Non-residential drinking water protection (5,600), non-residential GSI protection (820), and RIASL for volatilization to indoor air (1,200)

Applicable Criteria are the Part 201 Generic Non-residential Cleanup Criteria and Screening Levels, dated September 28, 2012. Volatilization to indoor air inhalation pathway (VIAP) screening levels include the August 2017 Media-Specific Volatilization to Indoor Air Interim Action Screening Levels and the January 2017 Volatilization to Indoor Air Recommendations for Interim Action Screening Levels (RIASL) and Time-Sensitive Interim Action Screening Levels. These RIASLs are screening levels, and not cleanup criteria.

EXHIBIT 4

DESCRIPTION OF ALLOWABLE USES

Nonresidential Land Use: This land use is characterized by any use which is not residential in nature and is primarily characterized by industrial and commercial uses. Industrial uses typically involve manufacturing operations engaged in processing and manufacturing of materials or products. Other examples of industrial uses are utility companies, industrial research and development, and petroleum bulk storage. Commercial uses include any business or income-producing use, such as commercial warehouses, lumber yards, retail gas stations, auto dealerships, and service stations, as well as, office buildings, banks, and medical/dental offices (not including hospitals). Commercial uses also include retail businesses whose principal activity is the sale of food or merchandise within an enclosed building and personal service establishments that perform services indoors, such as health clubs, barber/beauty salons, photographic studios, etc.

Any residential use is specifically prohibited from the non-residential land use category. This would include the primary use of the property for human habitation and includes structures such as single-family dwellings, multiple family structures, mobile homes, condominiums, and apartment buildings. Any uses which are intended to house, educate, or provide care for children, the elderly, the infirm, or other sensitive populations, and therefore could include day care centers, educational facilities, hospitals, elder care facilities, and nursing homes, may not fit the nonresidential exposure assumptions. Residential or site-specific environmental protection standards may need to be considered. The use of any accessory building or portion of an existing building as a dwelling unit permitted for a proprietor or storekeeper and their families, located in the same building as their place of occupation, or for a watchman or caretaker is also prohibited. Any authority that allows for residential use of the Property as a legal non-conforming use is also restricted per the prohibitions contained in this restrictive covenant.

Under the city of Femdale zoning code (Chapter 24, Article VI, Sections 24-101 and 24-102), the property is zoned M-2, general industrial, which is designed to accommodate manufacturing, assembly, industrial, wholesale, industrial warehouses and similar uses.

RECEIPT-182038 DATE-09/28/2021
DRAWER: 01 TIME- 9:59:53
USER: JRUTH00001

OAKLAND REGISTER OF DEEDS
Lisa Brown
Office of Clerk/Register of Deeds

DOC. NUMBER	TYPE	REMARKS	AMOUNT
230918			
MISC RECORDING			21.00
Liber 56912 Page 797			
Received Date		9/28/2021	
MACDERMID INCORPORATED			
AUTOMATION			5.00
REMONUMENTATION			4.00
TOTAL FOR 230918			30.00
TOTAL ALL DOCUMENTS			30.00
CASH:			40.00
CHANGE:			10.00-
TOTAL COLLECTED			40.00

ALL SALES FINAL - NO REFUNDS
Thank You - Lisa Brown

CHANGE 10.00-

Appendix Q

Facility Long-Term Monitoring Checklist

LONG-TERM MONITORING PLAN

MacDermid / Enthone Facility, 1221 Farrow Street, Ferndale, MI

To be completed by site personnel annually or if significant site changes occur.

This checklist is intended as an annual site inspection to verify the integrity of site conditions and to minimize exposure to suspected subsurface impacts. The inspection will also ensure that the selected remedies remain functional and effective, so that conditions remain protective of human health and the environment. This inspection is intended to conform with the corrective actions approved by the Michigan Department of Environment, Great Lakes, and Energy, and set forth in the Restrictive Covenant which has been placed on the property and filed with the Oakland County Register of Deeds. This monitoring also documents Due Care Responsibilities in accordance with Section 20107a of Michigan's Natural Resources and Environmental Protection Act, as amended.

Yes	No	NA	*Maintenance of Surface Soil Cover*
			Is soil cover intact?
			Areas of significant erosion?
			Excavations?
			Any fill soil with brick, glass, cinders, slag, concrete, other debris observed?

Notes:

Yes	No	NA	*Concrete Surface and Drainage*
			Concrete surface in good condition?
			Flow patterns direct runoff to appropriate catch basins?

Notes:

LONG-TERM MONITORING PLAN

MacDermid / Enthone Facility, 1221 Farrow Street, Ferndale, MI

Yes	No	NA	*Soil Management*
			Any soil excavation at site?
			Any fill soil with brick, glass, cinders, slag, concrete, other debris observed?
			Excavated soil properly characterized?
			Excavated soil properly handled?
			If yes, what was final disposition of soil?

Notes:

Yes	No	NA	*Vapor Intrusion*
			New construction planned/anticipated in areas of known impacts?
			Soil and or soil gas sampled within proposed construction area?
			Subsurface characterized beneath the construction area?
			Vapor mitigation system required for new construction, based on test data?

Notes:

Inspected by: Date:

Signature:

Completed form should be filed with company records, and be available upon request by EGLE staff.