BARR

DRAFT Vapor Intrusion Pathway Investigation and Feasibility Study Work Plan

Sampling and Monitoring Work Plan

East Hennepin Avenue Site
Minneapolis, Minnesota

Prepared for
General Mills, Inc.

June 2014

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1.0 Introduction

This Work Plan describes a phased approach to the vapor intrusion pathway (VI pathway) investigation and feasibility study activities to be conducted by General Mills, Inc. in accordance with the Remedial Action Plan (RAP) Modification #1 (MPCA, 2014) to the Response Order by Consent between General Mills and the Minnesota Pollution Control Agency (MPCA), dated October 23, 1984 (Order) (MPCA, 1984). The purpose of the investigation is to further characterize volatile organic compound (VOC) concentrations in soil, soil gas and groundwater, including those due to up-gradient and off-Site sources from nearby industrial areas where elevated concentrations of trichloroethylene (TCE) have been identified in groundwater. The data will be used to support a feasibility study as set forth in the RAP Modification #1. The work to be performed under this Work Plan follows numerous soil, soil gas and groundwater investigations in connection with 2010 East Hennepin Avenue as well as groundwater remediation performed by General Mills pursuant to the 1984 Order.

The Order uses the term "Site" to refer to the former General Mills facility at 2010 East Hennepin Avenue. This terminology is retained in this document, and thus references to the Site are intended to refer only to the former facility at 2010 East Hennepin Avenue. "Off-Site" is intended to refer to the area around the Site.

1.1 Background

Following soil and groundwater investigations conducted by General Mills in the early 1980s, VOCs, primarily benzene, toluene, ethyl benzene and xylenes (BTEX), and to a lesser extent chlorinated hydrocarbons, including TCE, tetrachloroethylene (PCE), and 1,1,1-trichloroethane (1,1,1-TCA), were detected near a former disposal area on Site. TCE was primarily detected in shallow groundwater in the area. As a result, General Mills installed and operated a groundwater extraction and treatment system beginning in 1985 to limit the migration of those compounds. The system was installed, operated and monitored as a groundwater remedial action under the auspices of the Order. Approximately six billion gallons of groundwater were treated and approximately 7,000 pounds of TCE were effectively removed from the glacial drift and deeper bedrock aquifers. Upon approval from MPCA, the system was shut down in 2010 after meeting the remedial action objectives set forth in the Order.

In late 2011, General Mills conducted additional investigation of shallow groundwater to assess the potential for vapor intrusion. Starting in November 2013, General Mills began implementing its Sub-slab Investigation and Building Mitigation Work Plan (Barr, 2014a) under MPCA oversight.

On March 11, 2014, MPCA and General Mills entered into a modification of the Groundwater Remedial Action Plan portion of the Order (subsequently referred to in this Work Plan as RAP Modification #1). Part 3 of RAP Modification #1 (MPCA, 2014) outlines the investigation and feasibility study elements of the VI pathway program.

In April 2014, General Mills expanded the investigation of soil, soil gas and groundwater at locations northeast and south of the Site. The results of this work and additional information made available from

MPCA indicate that off-Site sources of contamination are impacting groundwater and soil gas conditions in the vicinity of the Site.

1.2 Objectives

Section 3.1 of Part 3 of RAP Modification #1 (MPCA, 2014) specifies that the Work Plan shall contain plans for the following:

1. Defining the magnitude and extent of VOC concentrations in soil gas and shallow groundwater emanating from the Site as required under Section 3.1.1 of Part 3;
2. Placing additional borings at the Site to define the spatial extent of VOCs in soil, soil gas and groundwater as required under Section 3.1.2;
3. Identifying and evaluating a range of alternatives to reduce VOC concentrations in soil, soil gas and groundwater concentrations as necessary to protect public health and the environment as required under Section 3.1.3; and
4. Performing treatability study(ies), if any are needed, to evaluate remedial technologies to reduce VOC concentrations in soil, soil gas, and groundwater as required under Section 3.1.4.

In accordance with Section 3.1.5 of RAP Modification #1 (MPCA, 2014), the Work Plan will be implemented in stages to refine the scope of the investigation and feasibility study activities based on the data collected, and as appropriate to meet the remedial action objectives.

This Work Plan describes plans for:

1. Further assessing the hydrogeologic setting of the glacial drift and the VOC concentrations in shallow groundwater, including impacts from off-Site sources;
2. Placing additional borings at the Site;
3. Establishing a sentinel groundwater and soil gas monitoring network; and
4. Reporting the results of initial investigation activities and developing approaches to subsequent stages of investigation and feasibility study activities, as necessary.

1.3 Work Plan Organization

Following this introductory section, Section 2 summarizes the available information about the Site and off-Site area as context for the proposed activities. The current conceptual model for the Site and surrounding area is described in Section 3, along with a discussion of additional data needs based on the available information. The investigation approach is detailed in Section 4, and the process for establishing a soil vapor monitoring network and augmenting the existing groundwater monitoring network is described in Section 5. The VI pathway investigation and feasibility study schedule and reporting are described in Sections 6 and 7, respectively. Details regarding investigation procedures are contained in the appendices.

As discussed in Section 7, a staged approach is proposed for conducting the VI pathway investigation. Information from each step will be used to develop and implement the subsequent activities, so this Work Plan focuses on describing the initial scope of effort and provides a more generalized approach to subsequent steps.

1.4 Stakeholder Communications

General Mills is committed to working cooperatively with MPCA, the Minnesota Department of Health (MDH) and other interested stakeholder groups as the investigation and feasibility study activities are implemented.

2.0 Summary of Existing Information

This section briefly summarizes the existing information available about conditions at the Site and the surrounding area based on information generated during investigation and response action work completed from the early 1980s to May 2014. Limited historical and regulatory information and geologic references were also reviewed and are discussed below.

2.1 Location and Surroundings

The Site is located at 2010 East Hennepin Avenue in Minneapolis, Hennepin County, Minnesota (Figure 1). It is situated along the southern edge of the almost 700-acre Mid-City Industrial area stretching from Interstate I-35W to the north, Highway 280 to the east and Johnson Street to the west. East Hennepin Avenue marks the approximate southern boundary of this industrial area.

The Site is an approximately 6.7-acre wedge-shaped parcel located on the south side of East Hennepin Avenue between 19th Avenue SE and 21st Avenue SE. It is bounded on the north and east by East Hennepin Avenue and 21st Avenue SE, respectively, and to the south and west by the railroad corridor currently owned by BNSF Railway. The BNSF railroad corridor has been present since General Mills' development of the Site. Residential and commercial properties are located adjacent to the Site to the east and across the rail corridor to the west and south. There are also current and former industrial areas identified to the south of Elm Street SE and east of 27th Avenue SE, south and east of the adjacent residential properties.

2.2 Historic and Current Topographic and Surface Water Features

The elevation of the Site is approximately 860 feet above mean sea level (msl). Based on interpretations from USGS Topographic Maps (HIG, 2014c), the topography within a one-mile radius surrounding the Site generally slopes toward the southwest. The nearest surface water feature located down slope is the Mississippi River, approximately 1.25 miles to the southwest. The elevation of the Mississippi River is approximately 725 feet above msl. The majority of the topographic relief between the Site and the river occurs at the bank of the river, which at this location, southwest of the Site, is at an elevation of approximately 830 feet above msl. Within the 1.25 mile distance between the Site and the river bank, there is approximately 30 feet of relief.

A plat map from 1867 indicates a large wetland once covered the Site, most of the surrounding area and portions of the present day industrial area to the north. This wetland appears to have drained southwest into the former Tuttle's Brook (Kestrel, 2006). As development in the area occurred, the area of the wetland decreased as depicted on historic aerial photos and maps. Based on historic topographic maps, the wetland that covered the Site and areas to the south in 1867 was no longer present in 1896. The wetland covering the industrial area to the north and northeast remained in 1896 but had been filled and developed by 1934. Surface water features and topography have not significantly changed since the area was developed (HIG, 2014c).

2.3 Historic and Current Land Use

The Site and surrounding property use has not changed significantly over the past 75 years. Based on features identified on a 1867 plat map, it appears the Site and surrounding area south of East Hennepin Avenue were first developed between 1867 and 1896 (Kestrel, 2006). Most of the current structures at the Site were constructed between 1930 and 1934 (HIG, 2013; HIG, 2014a; HIG 2014b).

Based on historic aerial photographs dating back to 1934, the Site was already surrounded by residential and commercial properties to the west, south and east at that time. As early as 1934, the Mid-City Industrial area was also under development, with several businesses already in place. The development of the Mid-City Industrial area to the north continued until most of the area appeared to be fully developed by the mid-1970s.

A rail yard was located south of Elm Street SE since at least 1892, and was subsequently developed into an industrial area between 1992 and 1995. The industrial area south of Elm Street SE and east of 27th Avenue SE has been used for industrial purposes since at least 1912.

2.4 Historic and Current Storm and Sanitary Sewers

The Site and surrounding area is served by the City of Minneapolis sanitary and storm sewer systems. Historically, the area was served by a combined sewer system that was built between approximately 1900 and 1920. Beginning in about 1960, the City of Minneapolis began constructing a new sewer system that separated the storm and sanitary sewers. The older system now carries the sanitary flow and the newer system carries the storm water flow. The alignments of the sanitary and storm sewers in the area with available GIS information provided by the City of Minneapolis are shown on Figure 2.

The sanitary and storm sewer systems are constructed in street rights-of-way and generally within unconsolidated fill and glacial drift material. The sanitary sewer is approximately 15 feet below the ground surface (bgs). The newer storm water system is constructed above the sanitary sewer system with several feet of separation between the two systems in most locations. The storm water system is generally above the water table except where it is connected to a deep interceptor tunnel. Deep interceptor tunnels for both the sanitary and the storm sewer systems are constructed in the St. Peter Sandstone, 100 feet or more bgs.

The flow direction of both the sanitary and the storm sewers in the area is generally from north to south on north-south aligned streets and from east to west on east-west aligned streets. Sanitary sewer mains flow south from the Mid-City Industrial area to the sewer main under East Hennepin Avenue. Sanitary sewer lines south of East Hennepin Avenue on 21st, 22nd and 23rd Avenues SE flow to the north towards the East Hennepin Avenue sewer main. The East Hennepin Avenue sanitary sewer main carries the flow west to 18th Avenue SE. The 18th Avenue SE sanitary sewer is a large main that serves as a collection point for all of the sanitary flow generated in the area. The 18th Avenue SE sewer flows south, discharging to the deep sanitary interceptor tunnel at University Avenue.

The storm sewer mains are located along East Hennepin, Talmage and Como Avenues and Elm Street SE. Flow is to the west to the deep storm water interceptor tunnel located along 18th Avenue SE that discharges to the Mississippi River.

2.5 Area Land Use and Potential Sources of Contamination

The Site and surrounding area have been used for commercial and industrial activities for the past 75 to 80 years. Recent soil, groundwater, and soil gas samples have indicated that off-Site sources are impacting soil vapor and groundwater in the area surrounding the Site.

The following summary of potential contaminant sources is based on regulatory records, Sanborn and fire insurance maps (FIM), Site environmental reports and facility records, city directories and a limited review of MPCA files.

2.5.1 Potential Site Sources

From approximately 1930 until the 1970s, General Mills and later General Mills Chemicals, Inc. operated a technical center and research laboratory at the Site. Laboratory wastes reportedly were disposed in a disposal area in the southeast portion of the Site. In 1977, Henkel, Inc. acquired General Mills Chemicals, Inc. and with it, the facility at 2010 East Hennepin Avenue.

The former disposal area was used to manage wastes at the facility in a manner that was generally consistent with industry practices at the time. It reportedly consisted of three empty 55-gallon drums that were perforated, stacked one on top of another, and constructed with the bottom of the deepest drum about 10 to 12 feet below the ground surface. The disposal area reportedly was used until approximately 1962. Site characterization work associated with the former disposal area began in 1981. The drums were reportedly excavated in 1981, and the bottom of the excavation is believed to have been about 12 feet deep (Barr, 1983).

Multiple investigations have occurred at the Site since the early 1980s and as recent as May 2014 to characterize the groundwater conditions associated with the former disposal area. A groundwater extraction system was installed in the mid-1980s to contain and reduce TCE concentrations in area groundwater. The concentrations have been significantly reduced over the years. In 2010, MPCA approved turning off the system after the remedial action objectives set forth in the Order were achieved.

The most recent investigation (May 2014) included installing four direct-push probe borings placed around the disposal area to characterize post remediation soil and groundwater conditions. The results of this May 2014 disposal area investigation were submitted by General Mills to MPCA on May 23, 2014 (Barr, 2014c). The results of this investigation did not show evidence of source material that would act as a continued source of TCE to shallow groundwater.

Buildings on the Site have historically been used for a variety of activities, including, but not limited to, laboratories and related areas, pilot plants, and offices. A review of city directories identified over 150 businesses that have operated on the Site (EDR, 2013; EDR 2014a).

The west and south sides of the Site were used for above-ground storage tanks in the 1970s and 1980s. Various chemical storage areas and underground fuel oil tanks existed on the Site. The fuel oil tanks were reported to have been removed in the 1980s and 1990s (EDR, 2014b).

The Site is currently occupied by a variety of commercial businesses. A review of regulatory filings for the Site indicates that the current occupants include RCRA hazardous waste generators.

2.5.2 Potential Off-Site Sources

Historical aerial photographs dating back to 1937 indicate that the property use surrounding the Site has not changed significantly over the past 75 years, with the exception of notable business and industry growth along East Hennepin Avenue and within the industrial area located north of the Site. The properties to the south, east and west have historically been residential with some mixed-use commercial. The railroad corridor which borders the Site on the south and west has also been present since the Site was developed. Further to the south, a former rail yard was located south of Elm Street. That area has now been developed for commercial and industrial use. A review of the city directories and a regulatory database search for the surrounding area identified over 70 businesses in the city directory listings and 380 facilities on the regulatory database listings as potential TCE users (EDR, 2013; EDR, 2014a; EDR, 2014b).

2.5.2.1 Potential Up-Gradient Sources

Groundwater samples collected along the north side of East Hennepin Avenue in April 2014 indicated that elevated levels of TCE are present in shallow groundwater up- and side-gradient from the Site. As summarized below, MPCA file review documentation for industrial properties located immediately northeast of the Site indicates detections of higher TCE concentrations than are currently detected at the Site. The locations of these properties relative to the Site are shown on Figure 3.

The following table provides a partial list of these up-gradient facilities that have documented concentrations of TCE, PCE and/or other VOCs in the groundwater:

Address	Site Name	MPCA File Regulatory Listing Type and Number
2100 E Hennepin Avenue	East Hennepin Auto	TANK 3054, LUST 2477, MND981534647
2314 E Hennepin Avenue	Franks Auto Repair	LUST 17726
2301 Traffic Street	Warehouse /Office	VP27480
359 Hoover Street	Anne Gendein Trust / Lend Leasing / Cedar Towing	TANK 1789, LUST 6600, VP13270, MND981527518
3255 Spring Street NE	Northwestern Warehouse	VP 13100, 13101
700 Industrial Boulevard	AmeriPride Services	VP24750, TANK 2479, LUST 16906, 17854
2700 Winter Street NE	Sears / Modular Office Solutions	TANK 1808, LUST 7043, 7095, MND093920171, MND985718154
2400 Traffic Street	2400 Traffic Street (Railroad Corridor)	VP22300, VP23301, VP23302
1024 27th Avenue SE	Como Student Housing	VP24930

A limited MPCA file review was completed for these properties. From this file review, the following information was obtained:

- 2100 E Hennepin Avenue: The East Hennepin Auto site was historically operated as an automotive service station. A petroleum release was discovered during the removal of several underground storage tanks in 1990. Remedial action and site investigation activities were completed between 1991 and 1994 and included removing approximately 200 cubic yards of soil and installing several soil borings and five monitoring wells. The depth to groundwater was reported to be approximately 18 feet bgs and the groundwater flow direction was calculated to be southwest. In 1994, groundwater samples from five wells were analyzed for VOCs and TCE was detected in four of the wells with concentrations ranging from 1.4 to 24 micrograms per liter (µg/L). The TCE detections were below the established groundwater standard when the MCPCA closed the site in July 1997.

- 2314 E Hennepin Avenue: In August 2009, a 560-gallon fuel oil tank was removed from this former service station location. The fuel oil tank had been taken out of service in 1971 when the facility heating source changed from fuel oil to natural gas. A property assessment was completed during the tank removal and a release was documented and reported to MPCA. A Limited Site Investigation was completed and found minimal petroleum contamination associated with the release; however, non-petroleum substances were detected. The highest TCE detection was identified in groundwater on the west side of the property at a concentration of 1,620 µg/L. The petroleum release was closed by MPCA on February 17, 2010, and the non-petroleum substances information was referred to the MPCA site assessment program for evaluation.

- 2301 Traffic Street: A Phase I environmental site assessment (ESA) was completed on this warehouse property which identified several potential recognized environmental conditions associated with adjacent off-property sources. A Phase II environmental investigation was completed to evaluate potential impacts to the property. Soil borings and vapor probes were installed in 2010 and 2011. TCE was not detected in soil, but was identified in groundwater in one of the borings on the west side of the property at a concentration of 2.7 µg/L. TCE was not detected in the vapor samples collected from three locations from 5 to 7 feet bgs. Although this property is not a suspected source of TCE, the fact that TCE was detected at this up-gradient location indicates a TCE source may be nearby.

- 359 Hoover Street: The past uses of the property were residential, truck leasing, and automotive repair. A petroleum release was reported on this property and an investigation of the soil and groundwater revealed the presence of non-petroleum compounds including TCE in the groundwater with concentrations as high as 3,600 µg/L in 2001. The TCE plume on this property was identified in a zone extending across the middle portion of the property roughly from the northeast to the southwest. Groundwater flow direction at the property was identified in the report as south to southwest. The TCE concentrations within this zone were of the same order of magnitude which was interpreted as suggesting that the source of the TCE may have originated off the property.

- 3255 Spring Street NE: The Northwestern Warehouse was originally constructed on this property in 1978. A Phase I ESA completed for the property identified the potential for petroleum and/or solvent contamination associated with the current and historical land use practices at and adjacent to the property. Soil and groundwater samples were collected. Chemical analyses of groundwater sampling detected the presence of TCE at concentrations ranging from 53 to 610 µg/L in three monitoring wells. The groundwater flow direction was reported to be to the west. The report concluded that higher concentrations were detected in the up-gradient well and combined with the absence of a significant on-property contaminant source; the groundwater contamination was attributed to an off-property source.

- 700 Industrial Boulevard: The Ameripride Laundry Service building was constructed at this location in 1969. Prior to this, the property was occupied by a gravel pit. Ameripride was a commercial laundry and drycleaning operation that used TCE and PCE in their operations. Several ASTs were historically or are currently located at the property with at least one containing PCE. The 2007 Phase II environmental investigation work at this property included seven soil borings with wells installed in six of them. The measured depth to groundwater at this property ranges from 60 to 70 feet bgs. A special permit was needed to install the wells because this property is situated within an MDH-designated special well permit area (due to regional TCE impacts in the deep bedrock aquifers from the TCAAP Superfund site located in Arden Hills, Minnesota). Six wells were installed and TCE was detected in five wells ranging in concentration from 1.6 to 7.2 µg/L. Because TCE was not detected in the sampling that was performed, MPCA concluded that the TCE detections in groundwater were attributed to the regional impacts associated with the TCAAP Superfund site.

- 2700 Winter Street NE: Several petroleum underground storage tanks were removed from this property in the mid-1990s. A petroleum release was detected and reported which resulted in a soil and groundwater investigation and limited corrective action excavation. Soil and groundwater sample analysis was limited to BTEX. The history of previous activities and chemical use on this property may have included solvent compounds such as TCE.

- 2400 Traffic Street: This property is a current and historical railroad corridor property. Environmental assessment work completed in association with a previous property transaction revealed the presence of TCE in groundwater with the highest detection of 41 µg/L. Based on the nature of the property use and the characterization of soil contamination at this property, the TCE was attributed to an off-property source and MPCA did not require further groundwater investigation. The Sears warehouse building (2700 Winter Street) is located directly up-gradient of the 2400 Traffic Street Property.

- 1024 27th Avenue SE: Como Student Community is active in the MPCA's Voluntary Investigation Cleanup (VIC) Program. Impacted soils were discovered surrounding building 11 in the fall of 2008 while a contractor was excavating along the building's perimeter as part of a waterproofing project. Subsurface investigations have shown ash mixed with soil and debris extending from near the surface to 14.5 feet bgs. The observed debris included metal, glass, pottery, bottles, containers, toys, and additional miscellaneous debris. Groundwater samples at the site indicated that TCE was detected at concentrations above the Health Risk Limits (HRLs) established by MDH.

2.5.2.2 Potential Other Sources

In addition to the up-gradient sources identified, a review of various sources including city directories, Fire Insurance / Sanborn maps and regulatory database reports identified the locations listed below as potential solvent sources or users. This should be considered a preliminary list based on limited available information. Approximate locations of these potential sources are shown on Figure 3.

Address	Site Name	Regulatory ID or Historical Source Reference
2000 East Elm Street	CNW East Minneapolis Yard	VP5812, VP5810, VP5811, LUST 1671
1410 Rollins Avenue SE	Jewel Coal Company	City Directory
1820 Como Avenue SE	Joe's Market	Property Observations
1901 E Hennepin Avenue	Glidden Paint	City Directory
2125 and 2126 E Hennepin Avenue	Minneapolis Casket Company	City Directory
Intersection of Como and 18th Avenues SE	Bowen Products	Fire Insurance Map / Sanborn Map
Intersection of Como and 21st Avenues SE	United Chemical Company and Pitcher Manufacturing Company	Fire Insurance Map / Sanborn Map
Intersection of Como and 13th Avenues SE	Kozebar Company and Cozy Baby Carriage	Fire Insurance Map / Sanborn Map
Intersection of Rollins and 15th Avenues SE	General Repair Shop	Fire Insurance Map / Sanborn Map
Intersection of Como and 17th Avenues SE	Stahl Manufacturing and M&M Wire Clamp Company	Fire Insurance Map / Sanborn Map
Intersection of Rollins and 17th Avenues SE	Cargill Inc. – Nurena Mills Inc. and International Sugar Feed Company	Fire Insurance Map / Sanborn Map
2501 / 2503 Winter Street NE	Excel Metal Finishing	Regulatory information
641 Hoover Street NE	Twin City Plating	TANK 2277, LUST 7105, VP4330, MND006256150

2.6 Hydrogeologic Setting

The uppermost geologic units at the Site and surrounding area consist of approximately 50 feet of unconsolidated materials, primarily sand, underlain by a fine-grained till and Decorah Shale in some areas, and deeper bedrock units. Fill and in some cases peat overlie the sandy materials. A bedrock contour map (Figure 4) illustrates the bedrock elevations measured in the vicinity of the Site. Geologic cross sections across the Site and surrounding area are shown on Figures 5 and 6. The depth to bedrock ranges between 40 and 70 feet bgs in the vicinity of the Site.

Because the RAP Modification #1 (MPCA, 2014) focuses on soil vapor, soil and groundwater contaminants in the glacial drift and overlying materials, the geologic and hydrogeologic characteristics of those materials are the focus of the summary below. Information on the underlying bedrock units has been documented in previous reports, and will be summarized as necessary in the upcoming VI Pathway Investigation and Feasibility Study Report.

2.6.1 Glacial Drift

Glacial drift generally consists of up to 50 feet of heterogeneous sediments consisting of fine- to medium-grained sand, with lesser amounts of coarse sand and gravelly sand, that in some locations is overlain by up to 20 feet of fill and peat deposits. A discontinuous clay, interpreted as glacial till, separates the shallow groundwater from the underlying bedrock at the Site and in portions of the surrounding area. In some locations (i.e., at Well QQ), a thin sand layer (approximately three feet thick) is present below the clay.

There are currently 13 active monitoring or former pump-out wells screened in the glacial drift on the Site or in the area surrounding the Site (Wells 2, 109, 110, 111, 112, 113, B, Q, S, T, V, W, and X). Historically, an additional 23 monitoring wells were placed in the glacial drift but have been abandoned (Table 1 and Figure 7). As the effectiveness of the pump-out systems was verified, the monitoring well network was reduced. Water level data from the current and previous wells are summarized in the 2012 Annual Report (Barr, 2013a).

The average depth to groundwater is approximately 15 to 25 feet bgs, with an approximate saturated thickness of the glacial drift of 20 to 25 feet. Water table contours as measured in April 2014 are shown on Figure 8. The horizontal groundwater flow direction in the glacial drift across the Site and surrounding area has been consistently southwest, based on the last 29 years of monitoring data (Barr, 2013a). Hydrographs of water-level data from the glacial drift monitoring wells show relatively stable water level trends (Barr, 2013a).

Potentiometric head differences between the glacial drift and wells finished in underlying bedrock (lower Carimona Member of the Decorah Shale) indicate that where present, the clay till and/or the upper bedrock units of the Decorah Shale act as a confining unit, restricting vertical groundwater flow between the glacial drift and lower bedrock units (Barr, 1983; Runkel et al., 2003). Hydraulic head differences between wells finished in the glacial drift and the bedrock during operation of the pump-out system indicated downward vertical hydraulic gradients between the glacial drift and the bedrock of approximately 0.3 to 0.4 feet per feet (ft/ft) (Barr, 2013a).

Several measurements of the hydraulic conductivity of the glacial drift have been completed. A pumping test at pump-out well 109 on the Site indicated a hydraulic conductivity of 2×10^{-3} centimeters per second (cm/sec) (Barr, 1985). Values ranging between 2×10^{-3} to 5×10^{-2} cm/sec were estimated based on approximations using the Hazen method utilizing grain size data from borings across the Site (Barr, 1985). Based on this range, an estimated hydraulic gradient of 0.01 ft/ft from the 2014 water table contours and an effective porosity estimate of 0.3, the ambient horizontal groundwater flow velocity is estimated between 70 and 2,000 feet per year (ft/yr).

2.6.2 Bedrock Hydrogeology

The upper-most bedrock unit across the Site and surrounding area is illustrated on Figure 4 and is based on previous investigations by the Minnesota Geologic Survey and Site borings.

The Decorah Shale is the upper-most bedrock at the Site. Although discontinuous across much of the area, the Decorah Shale together with the clayey till generally act as a confining unit across the area. It varies in thickness between 0 and 35 feet and is generally described as a fossiliferous shale with interbedded limestone (Barr, 1983; Mossler; 2008; Mossler, 2013). It is divided into two members: an upper unnamed member and the lower Carimona Member. Previous studies refer to the Carimona Member as part of the underlying Platteville Formation; however, the Carimona Member has since been formally recognized as a member of the Decorah Shale (Mossler, 2008). The upper member is primarily a fossiliferous shale and can be up to 90 feet thick in the Twin Cities metro area (Mossler, 2008); however, much of the upper member has been eroded at the Site. The lower Carimona Member is a thin-bedded limestone with interbedded shale and is typically four feet thick (Mossler, 2008). A thin, two- to five-inch K-bentonite bed is typically present near the base of the Carimona Member (Barr, 1983).

The Decorah Shale is underlain by the Platteville Formation, consisting of four distinct members: Magnolia, Hidden Falls, Mifflin, and Pecatonica (Barr, 1983; Mossler, 2008). The uppermost Magnolia Member is a medium- to thick-bedded dolostone approximately eight feet thick in the vicinity of the Site. The lower three members of the Platteville Formation (Hidden Falls, Mifflin, and Pecatonica) have a combined thickness of approximately 15 feet near the Site. The Platteville Formation is currently classified as a hybrid unit, both aquifer and aquitard (Anderson et al., 2011; Runkel et al., 2011).

Below the Platteville is the remaining sequence of Ordovician- and Cambrian-aged bedrock units including: Glenwood Formation, St. Peter Sandstone, Prairie du Chien Group, Jordan Sandstone, St. Lawrence Formation, Tunney City Group (formally Franconia Formation), Wonewoc Sandstone (formally Ironton and Galesville Sandstones), Eau Claire Formation, and the Mt. Simon Sandstone (Mossler, 2008; Mossler 2013).

2.7 Historic Groundwater Extraction in Glacial Drift

The groundwater pump-out systems installed in the glacial drift operated at the Site for over 25 years. Pump-out systems also operated in the Carimona and Magnolia Members. The pump-out wells and existing monitoring well network are shown on Figure 7. Five pump-out wells (109, 110, 111, 112, and 113) are screened in the glacial drift. Wells 109 and 110 are located nearest to the former disposal area and comprise the on-Site pump-out system. The down-gradient pump-out system consisted of wells 111, 112, and 113.

In general, TCE concentrations in samples from the glacial drift monitoring and pump-out wells significantly declined or remained below detection limits during pump-out system operation. The largest TCE concentration reductions measured during operation were at pump-out well 110 and monitoring wells S and V. Historic TCE concentrations in the glacial drift monitoring and pump-out wells are summarized in the 2012 Annual Report (Barr, 2013a) and are shown on Figures 9 and 10. During the operation of the groundwater pump-out systems, VOC concentrations in shallow groundwater both on and off the Site decreased by 80 to 90 percent in the glacial drift. This is a significant reduction in TCE concentrations from 1985 to 2010. Approximately six billion gallons of groundwater were extracted and approximately 7,000 pounds of TCE were effectively removed from the groundwater in the glacial drift and deeper bedrock aquifers.

2.8 Contaminant Distribution

The current contaminant distribution in soil, groundwater and soil gas are summarized in the following paragraphs, focusing on the vadose zone and glacial drift.

2.8.1 Soils

The following three soil investigations focusing on the former disposal area have been performed by Barr on the Site:

- Site Characterization Study and Remedial Action Plan, General Mills Solvent Disposal Site, 2010 East Hennepin Avenue, Minneapolis, Minnesota (Barr, 1983)
- Shallow Soil Investigation Around the Former Disposal Site – East Hennepin Avenue Site (Barr, 2001)
- Disposal Area Investigation Results, 2010 East Hennepin Avenue Site, Minnesota (SR3) (Barr, 2014c)

Based on the volatile nature of VOCs, natural degradation, infiltration and the remediation that has been performed on the Site, only the 2014 data is used to characterize current on-Site soil concentrations.

Based on the 2014 soil sampling data from the former disposal area, the highest VOC concentrations were measured in the soil samples collected in the vadose zone. Notably no chlorinated solvents were detected in the four samples collected from this zone.

Low concentrations (near the laboratory reporting limits) of TCE were measured in soil samples collected from the top of the confining clay till layer at the base of the glacial drift. TCE was detected at less than 1 mg/kg in the soil sample collected directly above the Decorah Shale. These concentrations are not indicative of the presence of TCE-source materials or dense non-aqueous phase liquids (DNAPL) and may be the result of soil contact with dissolved TCE in groundwater. No TCE was detected above the laboratory reporting limit in the soil sample collected from the top of the Decorah Shale below the former disposal area. Based on these results, additional investigation in this area is unnecessary.

Soil samples also were collected in 2014 along the north side of East Hennepin Avenue. The results are presented in the Summary of Phase 2G Investigation Results - East Hennepin Avenue Site (Barr, 2014b). Soil samples were collected at the locations shown on Figure 11 from depths ranging from 26.5 to 54.5 feet bgs, which are below the water table. The results from the Phase 2G investigation demonstrate that TCE concentrations in soils are present up-gradient of the Site.

2.8.2 Groundwater

From 1985 to 2012, groundwater monitoring was conducted at and around the Site. Groundwater monitoring included measuring the groundwater surface elevation and collecting groundwater samples. Annual reports summarizing the results of the groundwater monitoring were submitted to MPCA. In consultation with MPCA, the groundwater monitoring well network was modified over time as VOC concentrations in groundwater decreased in response to operation of the groundwater pump-out systems.

The most recent comprehensive monitoring round in December 2012 / January 2013 included collecting water samples from 11 wells installed in the glacial drift (wells Q, S, T, V, W, X, 109, 110, 111, 112, and 113); five wells installed in the Magnolia Member of the Platteville Formation (wells QQ, TT, 14, MG1, and MG2); and two wells in the St. Peter Sandstone (wells 200 and 203). These wells include monitoring wells and former pump-out wells.

Water samples from the glacial drift and Magnolia Member wells were analyzed for target compound VOCs and the samples from the St. Peter Sandstone wells were analyzed for TCE. Results from this sampling event are summarized in the 2012 Annual Report (Barr, 2013a). Historic TCE concentrations in the glacial drift wells are summarized in the 2012 Annual Report (Barr, 2013a) and are shown on Figures 9 and 10.

Following the shutdown of the pump-out system in September 2010, an increase in TCE concentrations in the glacial drift wells was not observed, with the exception of slight increases in pump-out wells 109 and 110. Based on the generally stable TCE concentrations observed following the shutdown of the pump-out system, the system remains idled as approved by MPCA.

In 2012, 2013, and 2014, groundwater samples were also collected from temporary wells installed in the glacial drift. This work is summarized in the following reports:

- Summary of Phase 2C Vapor Intrusion Evaluation Results – East Hennepin Avenue Site (Barr, 2013b)
- Summary of Phase 2E Vapor Intrusion Evaluation Results – East Hennepin Avenue Site (Barr, 2013c)
- Summary of Phase 2G Vapor Intrusion Evaluation Results – East Hennepin Avenue Site (Barr, 2014b)
- Disposal Area Investigation Results, 2010 East Hennepin Avenue Site, Minnesota (SR3) (Barr, 2014c)

During these investigations, groundwater samples were collected using direct push drilling methods at locations shown on Figure 11. The groundwater samples were typically collected from depths ranging from 10 to 20 feet bgs corresponding to the uppermost five feet of the glacial drift saturated zone, with the exception of the groundwater samples collected in the former disposal area. Groundwater samples from the direct push borings placed in the former disposal area included samples collected at depths extending to the base of the glacial drift.

Results from the groundwater samples collected at and around the former disposal area indicated the highest VOC concentrations in the samples collected at the water table. In these samples, TCE represented less than 5 percent of the total VOC concentrations. The results showed TCE concentrations at the surface of the water table ranged from 1.2 to 36.5 µg/L. TCE concentrations from below the water table ranged from 99.5 to 425 µg/L.

The approximate areal extent of TCE detected in the glacial drift includes areas north and east (up- and side-gradient of the Site) and extends south and west of the Site.

Based on current groundwater data, the highest TCE concentration measured in the shallow groundwater in the area (406 µg/L) was in a sample from a temporary well located more than 350 feet northeast of the Site (Barr, 2014b). Historical data indicate higher concentrations at locations approximately 880 feet northeast of the Site (1,620 µg/L) (Thatcher, 2009) and approximately 1,450 feet northeast of the Site (3,600 µg/L) (Peer, 2001). These levels are higher than are currently being detected on the Site. Recent levels measured at wells 109 and 110 following shutdown of the pump out system may reflect contribution from off-Site sources. Based on the identification of other significant up-gradient sources and the industrial nature of the businesses throughout the area to the northeast, off-Site TCE sources are impacting the shallow groundwater at the Site and the surrounding area.

2.8.3 Soil Gas

Since 2012, numerous soil gas investigations have been performed on and off the Site. As part of these investigations, 54 soil probes were drilled and soil gas samples were collected at various depths. The locations of these soil probes are shown on Figure 11. The majority of the soil probe investigations are summarized in the following reports:

- Summary of Phase 2C Vapor Intrusion Evaluation Results – East Hennepin Avenue Site, (Barr, 2013b)
- Summary of Phase 2E Vapor Intrusion Evaluation Results – East Hennepin Avenue Site, (Barr, 2013c)
- Summary of Phase 2G Vapor Intrusion Evaluation Results – East Hennepin Avenue Site, (Barr, 2014b)

In addition, since November 2013, sub-slab sampling has been performed on and off the Site in accordance with the Final Sub-Slab Sampling and Building Mitigation Work Plan (Barr, 2014a). The soil gas samples from the soil probes and sub-slabs were analyzed by U.S. EPA Method TO-15 for either TCE or the full Minnesota Soil Gas List. The results of the sub-slab sampling current as of June 13, 2014, are shown on Figure 12.

TCE has been identified in soil gas in the area. To date, more than 300 sub-slab samples have been collected, along with soil gas samples from 54 locations along street rights-of-way and other undeveloped areas. TCE concentrations in sub-slab soil gas samples greater than 20 micrograms per cubic meter ($\mu g/m^3$) are shown on Figure 12; this area is also referred to as the soil gas monitoring area. These data also indicate that TCE in soil gas is from off-Site sources:

- Elevated soil gas concentrations have been detected northeast of the Site, which indicates the existence of one or more up-gradient sources impacting the area.
- The TCE concentrations in soil gas samples collected along Elm Street SE are separated by approximately 300 feet from the main area of elevated sub-slab TCE concentrations. In addition, potential sources that may have used TCE have been identified south of Elm Street SE.
- The area west of 15th Avenue SE is also separated from the main area of elevated TCE concentrations in the soil gas by approximately 500 feet.

As with the groundwater, based on this data, the identification of numerous potential up-gradient and off-Site sources, the industrial nature of the businesses throughout the area to the northeast, and the remediation that has been performed on the Site, off-Site TCE sources are impacting the soil gas at the Site and the surrounding area.

3.0 Site Conceptual Model for Vapor Intrusion

The Site Conceptual Model (SCM) for vapor intrusion has been refined in consideration of recently obtained data that indicate the presence of significant off-Site sources of TCE as well as other technical information regarding geology and hydrogeology, spatial distribution of contaminant concentrations, area buildings and potential vapor transport mechanisms. This vapor intrusion SCM summarizes current understanding of Site characteristics and will be further refined and updated as additional characterization data are obtained as outlined in this Work Plan. Technical information used to refine this SCM is described earlier in this document or in other reports, and is summarized below.

3.1 Potential VOC Sources

Historic information indicates that predominantly toluene, xylene and other waste solvents from research labs were placed in the on-Site disposal area from about 1947 to 1962. Soil and groundwater investigations in 1981 and 1983 indicated that aromatic hydrocarbons (benzene, toluene, and xylenes) and to a lesser extent chlorinated hydrocarbons were detected. TCE in soil in the area of the former disposal area was found at levels representing a minor percentage of the hydrocarbons detected.

As described in Section 2.5.1, the former disposal area structure was reportedly removed in 1981, with excavation to a depth of approximately 12 feet bgs. Based on the current data from the former disposal area, it is not a continued source of TCE to the area. On-Site investigations have found no evidence of DNAPL present on the Site, including those conducted in the former disposal area.

General Mills has recently implemented some limited off-Site soil and groundwater investigations. In addition, Section 2.5.2 describes recently obtained information indicating that elevated TCE concentrations previously detected by others in the shallow groundwater are present at several up-gradient industrial operations. These facilities are impacting groundwater in the area.

3.2 Current Spatial Distribution of Contaminant Concentrations

Based on the recent investigation, TCE is not present in the unsaturated soils in the former disposal area and would not be expected in the unsaturated soils in the soil gas monitoring area.

Low concentrations of TCE (less than 1 mg/kg) have been reported in the soil beneath the water table in the former disposal area. These concentrations may be the result of the presence of dissolved TCE in the shallow groundwater and not due to a soil source on the Site.

A groundwater extraction system was installed in the mid-1980s to contain and reduce TCE concentrations in groundwater. MPCA approved the system shutdown in 2010 after remedial action objectives set forth in the Order were achieved.

Recent data (2014) for shallow groundwater indicate that TCE concentrations:

- On the Site in the vicinity of the former disposal area range to 36.5 µg/L;

- In the soil gas monitoring area range to 375 µg/L; and
- In the nearby industrial area located northeast of the Site range to 406 µg/L.

TCE concentrations in the shallow groundwater from the nearby industrial area up-gradient of the Site have been as high as 3,600 µg/L. Nearby industrial facilities are impacting TCE concentrations in shallow groundwater.

Based on the multi-depth soil gas samples collected as part of recent investigations in the area, the TCE concentrations in soil gas decrease with increasing distance from groundwater. These data support that shallow groundwater is a source of soil gas concentrations.

3.3 Geology/Hydrogeology

As described in Section 2.6, the uppermost geologic units at the Site and surrounding area consist of up to 50 feet of glacial sediments consisting of fine- to medium-grained sand, with lesser amounts of coarse sand and gravelly sand, that in some locations is overlain by up to 20 feet of fill and peat deposits. The glacial drift is underlain by a discontinuous clay-till and Decorah Shale in some areas and the deeper bedrock units. A bedrock contour map (Figure 4) illustrates the bedrock elevations measured in the vicinity of the Site. Geologic cross sections of the Site and surrounding area are shown on Figures 5 and 6. The depth to bedrock ranges between 40 and 70 feet bgs in the vicinity of the Site. The shallow groundwater is present at 15 to 25 feet bgs within the glacial sediments. The horizontal groundwater flow direction in the glacial drift across the Site and surrounding area is to the southwest.

3.4 Area Buildings

Although some commercial buildings are present, the area to the south and southwest of the Site between the Site and Elm Street SE is generally comprised of residences. The buildings in the area are typically single-family residential buildings with unfinished basements with concrete slabs. The basement floor slabs are approximately 10 feet or more above the groundwater table. Vapor intrusion mitigation systems have been or are being installed at properties in the area with sub-slab soil gas concentrations above MPCA's 10 times the intrusion screening value (10x ISV) for TCE as well as in adjacent properties within the soil gas monitoring area.

3.5 Potential Vapor Transport Mechanisms

There are two diffusion transport mechanisms that should be considered in a VI investigation. They are diffusion of vapors from sources in the unsaturated zone and diffusion of vapors from sources in shallow groundwater.

- Diffusion from sources in the unsaturated zone occurs as a result of a concentration gradient between the soil source and the surrounding area. Because significant levels of TCE have not been identified in the unsaturated soil at the Site, this mechanism does not have significant potential to affect vapor intrusion.

- Diffusion of vapors from sources in shallow groundwater occurs as a result of a concentration gradient between the groundwater source and the surrounding area. Because dissolved TCE concentrations in groundwater have been identified, this mechanism has potential to affect vapor intrusion.

Vapor migration through preferential pathways may occur via natural and man-made pathways in the subsurface (e.g., buried utilities) such that the feature creates a sufficiently direct pathway from a source to a receptor. Although utility plans indicate that sanitary sewers and other utilities are present, this potential pathway is unlikely since the utility bedding materials are likely similar to the native sandy soils.

This SCM will be refined as additional data are obtained and evaluated.

3.6 Additional Data Objectives

Additional data are sought to understand the impacts from off-Site sources. The current investigation is designed to address the following data objectives:

<u>2010 East Hennepin Avenue</u>

- Evaluate the presence of VOCs on the Site as informed by the sub-slab soil gas results and historic operations to assess potential VI risks.

<u>Off-Site</u>

- Verify the shallow groundwater flow direction in the glacial drift.
- Assess the TCE migrating to the soil gas monitoring area from off-Site sources.
- Evaluate the vertical profile and distribution of TCE in shallow groundwater in the soil gas monitoring area.

<u>Monitoring Network</u>

- Evaluate TCE concentration trends in groundwater and soil gas at the perimeter of the present soil gas monitoring area.

4.0 Proposed VI Pathway Investigation Activities

The VI pathway investigation will be performed using a staged approach. The focus of this first stage will be to collect information to evaluate impacts from off- and on-Site locations to shallow groundwater. This stage will also include further assessment of the hydrogeologic setting of the glacial drift to update the SCM and plan for additional stages of investigation as needed.

This investigation will be performed on and off the Site; the off-Site investigation area includes areas up- and down-gradient of the Site. The investigation methods will include direct push borings and shallow and deep monitoring wells. Details regarding the specific investigation areas and methods are described in the following sections.

4.1 Off-Site Groundwater Evaluation

A total of 26 monitoring wells will be installed in the glacial drift. Eleven locations are anticipated to be nested wells screened at two depths (a total of 22 wells) and four locations will be wells screened at the water table. Four wells will be installed on the Site and 22 wells will be installed at off-Site locations. The proposed locations are shown on Figure 13. Actual sampling locations may be updated based on field screening tools and additional off-Site information.

The proposed off-Site monitoring wells will be installed in locations up-gradient of the Site and also in locations within the soil gas monitoring area. The goal of the well placement will be to confirm the groundwater flow direction, understand the magnitude of the VOC impacts in groundwater in the soil gas monitoring area, and collect additional data to further characterize the impacts of multiple sources in the area.

4.2 2010 East Hennepin Avenue Evaluation

A total of ten borings and four monitoring wells will be installed at the Site. Two locations will be nested wells screened at two depths (a total of four wells). Proposed locations for direct-push soil borings and nested monitoring wells are shown on Figure 14. The proposed investigation activities will assess both unsaturated and saturated zone conditions in the glacial drift.

Existing groundwater and sub-slab vapor data are used as the primary indicators of potential additional source material along with historical land use information. Additional details regarding the investigation locations are provided below.

- Former Disposal Area. TCE concentrations in groundwater at the former disposal area have been significantly reduced over the years. The most recent investigation (May 2014) results found no TCE-source materials that would present a continued source of TCE to groundwater. As a result, additional soil delineation of the former disposal area is unnecessary. The vertical groundwater profile samples collected from the May 2014 borings indicated TCE concentrations in groundwater increased with depth. One well nest that includes one water table well and one deeper well screened at the top of the glacial till will be installed directly adjacent to the former disposal area to provide ongoing evaluation of this area (Figure 15).

- Buildings 11 and 12. Several Site buildings had TCE vapor readings above MPCA industrial 10x ISV of 60 µg/m^3. These include Building 8 with results from 100 – 500 µg/m^3, Buildings 10 and 14 with results from 500 to 2,000 µg/m^3, and Buildings 11 and 12 with results greater than 2,000 µg/m^3. In addition, TCE concentrations measured in the shallow groundwater at well B, located directly east of Building 12, were as high as 1,100 µg/L in the early 1980s (Barr, 1983), and in 2012, the TCE concentration measured 110 µg/L (Barr, 2013a). Therefore, the area around these buildings is targeted for further investigation. Four soil borings and one well nest will be drilled adjacent to Buildings 8, 11 and 12. The well nest will be installed south of Building 12.

- Buildings 10 and 14. Elevated sub-slab TCE vapor readings were identified in Buildings 10 and 14. Based on the past building use and elevated sub-slab TCE vapor readings in these locations, these buildings will be targeted for investigation. Four soil borings will be drilled adjacent to Buildings 10 and 14.

- Western Exterior Areas. Based on historical activities west of Building 9, including the presence of former Building 13, two borings will be drilled to assess this area.

4.3 Investigative Approach

Investigative approaches are described generally in the following sections. Additional procedural details are included in Barr's Standard Operating Procedures (SOPs) applicable to this field work in Appendix A.

Prior to collecting samples, boring and well installation permits will be obtained, a public utility locate will be performed using the Minnesota Gopher State One Call system, and a private utility locator will sweep each of the locations and mark the ground surface above detected underground utilities. It is anticipated that some locations may be modified based on utility clearances or other field observations.

4.3.1 Direct-Push Soil Borings

Ten borings will be drilled on the Site. The proposed investigative approach includes collecting soil and groundwater samples for laboratory analysis and visually / manually classifying soil stratigraphy. The soil and groundwater sampling plan for the borings is summarized in Table 2.

Soil and groundwater samples will be collected using direct-push methods as described in Barr's SOP for Direct-Push Soil and Groundwater Sample Collection (Geoprobe®). Soil will be continuously sampled for geologic characterization and field screening with a photoionization detector (PID) using methods described in Barr's SOP for Field Screening Soil Samples. Soil samples will be screened using the visual-manual procedures of ASTM Standard D2488 for guidance, which is based on the Unified Soil Classification System.

Groundwater samples will be collected from the borings with direct-push tooling fitted with a retractable screen (screen point). After collecting a groundwater sample, the drill rod and screen point will be removed and decontaminated.

Soil samples will be collected for laboratory analysis based on field screening results. Groundwater samples will be collected from multiple discrete vertical intervals from the water table down to the upper confining layer at approximately 40 feet bgs based on real-time field screening results. At minimum, one groundwater sample will be collected from the water table and a second will be collected from just above the upper confining layer.

4.3.2 Pilot Boring Advancement and Sample Logging

Pilot soil borings will be drilled using a hollow stem auger (HSA) drill rig at each planned well location prior to well installation. The proposed well locations are shown on Figures 13 and 14. Soil will be continuously sampled from the ground surface to the top of bedrock for geologic characterization and field screening. Soil samples will be screened with a PID and will be described using the visual-manual procedures of ASTM Standard D2488 for guidance. The soil descriptions will be used to verify planned well screen intervals. Soil samples from the vadose zone may be collected for laboratory analysis based on field screening results.

4.3.3 Well Installation and Development

Well installation will occur after the pilot borings have been completed. A total of 26 wells are planned as part of this investigation. It is anticipated that 11 locations will include nested wells with one well screened at the water table and one screened at the top of the upper confining layer. The deeper well for each nest will be completed in the pilot boring. Water table wells will be completed in a separate boring with screen intervals based on geologic characterization of the pilot boring and historical water table observations from nearby wells. The nested wells will be used to monitor vertical head and potential contaminant gradients within the glacial drift.

Well construction details are shown in Table 2, which also indicates the specific monitoring or testing purpose for each well. All wells will be installed by a licensed well contractor in accordance with Minnesota Department of Health Chapter 4725 – Wells and Borings using a HSA with continuous split spoon sampling. The wells will be constructed of flush threaded Schedule 40 PVC meeting the specifications of Chapter 4725. Wells will be finished a minimum of 2 feet above the ground surface with a locking outer protective steel casing.

A minimum of three days after the wells are installed, the drilling contractor and Barr will return to the Site to develop the wells and survey the top of casing and ground elevations at the wells. Each well will be developed by a combination of surging and pumping to remove fines from the well screen and ensure that an adequate hydraulic connection exists between the well screen and the formation. Elevations of the top of riser for each well will be surveyed to the nearest 0.01 of a foot above msl. The horizontal location of the wells will be horizontally surveyed into the existing control network.

Water levels in each new and existing well will be measured using an electronic water level indicator. The water levels will be used to determine groundwater elevations, flow directions, and gradients.

4.3.4 Glacial Drift Groundwater Monitoring

The glacial drift groundwater monitoring network will consist of the 26 new wells installed as described above and 13 existing glacial drift monitoring and pump-out wells (Table 2). A complete round of water samples will be collected from the glacial drift monitoring network after it is constructed. A second round of samples will be collected three months later for the purpose of assessing influence of well construction and development on the initial round of data. Groundwater samples will be collected using low flow methods described in Barr's SOP for Low-Flow Monitoring Well Purging.

4.3.5 Laboratory Analysis

Soil and groundwater samples will be placed in laboratory-supplied containers, stored in a cooler with ice, and submitted to a certified laboratory for chemical analysis. Soil and groundwater samples collected from the Site will be analyzed for specific VOC compounds listed in Attachment F in the RAP Modification #1 using U.S. EPA Method 8260. Off-Site soil and groundwater samples will be analyzed for the full VOC list using U.S. EPA Method 8260. All groundwater and soil samples will be delivered to the laboratory with a chain of custody to document handling.

4.3.6 Investigation Derived Waste

In general, soil generated from direct-push borings with less than 50 ppm headspace readings will be thin-spread on Site. Soils that exhibit greater than 50 ppm headspace readings or field screening evidence of contamination will be containerized and stored on Site for disposal. Soil cuttings generated from installing the off-Site monitoring wells and purge water from monitoring wells will be containerized and stored on Site for disposal. Containerized waste will be sampled in accordance with Barr's SOP for Investigative Derived Waste and disposed in accordance with federal, state, and local regulations.

4.4 Quality Assurance and Data Quality Objectives

The overall quality assurance (QA) objective for this work is to develop and implement procedures for sampling, sample custody, laboratory analysis, and reporting that will support decisions made for subsequent stages of investigation activities and feasibility studies. Data quality objectives (DQOs) for meeting the overall QA objective for the work are summarized in the Quality Assurance Project Plan (QAPP) that will be submitted as a separate report.

4.5 Safety/Security

The safety goal for the Work Plan, as with all work, is zero incidences. This goal will be accomplished through careful planning and preparation of the work. Work will be performed in accordance with the Project Health and Safety Plan (PHASP). All workers on the project will be required to review and sign the PHASP prior to starting work. The PHASP will be on-site at all times whenever work is occurring. A Field Risk Assessment Form will be completed prior to the commencement of each task, and when conditions or personnel change during an ongoing task.

General Mills and appropriate property owners will be notified before work begins. Safety tailgate meetings will be conducted prior to the start of work each day and Contractors will be required to have an orientation to familiarize them with the work areas. The buddy system will be used at all times for this work.

5.0 Sentinel Monitoring Network

Although not specifically required by the RAP Modification #1, this section presents an initial plan for installing and sampling a sentinel soil vapor and groundwater monitoring well network. The purpose of the sentinel monitoring network is to assess TCE concentrations in groundwater and soil vapor at the perimeter of the soil gas monitoring area. The function of the network is to identify potential trends in TCE concentrations in soil gas and groundwater that may be indicative of contaminant migration or attenuation.

5.1 Soil Vapor Monitoring Points

The sentinel monitoring network will include 24 soil vapor monitoring ports installed at or near the locations within the soil vapor monitoring area shown on Figure 16. The sampling plan for the vapor ports is summarized in Table 3.

5.1.1 Vapor Monitoring Ports

The vapor monitoring ports will be installed in general accordance with MPCA's Risk-Based Guidance for the Vapor Intrusion Pathway (MPCA, 2008) and the Vapor Intrusion Technical Support Document (MPCA, 2010). A licensed well driller will be contracted to install the soil vapor monitoring network using direct-push techniques. Prior to the installing the borings, the driller will conduct a public utility locate through Gopher State One Call and will also have a private utility locator identify the locations of private utilities in the work area.

Vapor monitoring points will be constructed from 0.5 inch diameter stainless steel implant screens and fluoropolymer resin tubing finished with a stainless steel valve at the surface. Vapor monitoring points will have a 1-foot screen located from 8 to 9 feet bgs, which is considered to be appropriate for the depth of the basements in the area. A filter pack will be placed from a minimum of 6 inches above the screen to 6 inches below the screen. A 1-foot bentonite seal will be placed above the filter pack and the remainder of the borehole space will be grouted to within 1 foot of the ground surface. Wells will be completed at surface grade and set in concrete with a locking steel vault.

Field screening will consist of visual soil classification, observation of field evidence of contamination (i.e., odor, discoloration, and sheen), and volatile organic headspace screening. Soil vapor headspace readings will be collected with a PID and soils encountered will be described in accordance with ASTM D-2488. Clean soil cuttings generated during drilling will be thin-spread near the borehole. Soils that exhibit greater than 50 ppm headspace readings or field screening evidence of contamination, if identified, will be containerized for disposal. Final location of all vapor monitoring points will be surveyed using GPS equipment.

5.1.2 Soil Vapor Monitoring

Soil vapor samples will be collected quarterly for the first year for laboratory analysis of TCE. Soil vapor samples will be collected in 1-liter Summa® canisters in general accordance with Barr's SOPs for the Air

Sample Collection from a Soil Gas/Soil Vapor Extraction Point or Implant (Appendix A). A certified laboratory will analyze the soil vapor samples using U.S. EPA Method TO-15.

5.2 Groundwater

The sentinel groundwater monitoring network will include 10 new groundwater wells and will also utilize existing glacial drift pump-out wells 111, 112, and 113. A vapor monitoring port will be installed at each new groundwater monitoring well. The locations of the monitoring wells are shown on Figure 16.

5.2.1 Groundwater Monitoring Wells

Sentinel groundwater monitoring wells will be installed by a licensed well contractor in accordance with Minnesota Department of Health Chapter 4725 – Wells and Borings using a (HSA) with continuous split spoon sampling. The wells will be constructed of flush threaded Schedule 40 PVC meeting the specifications of Chapter 4725. Wells will be finished a minimum of 2 feet above the ground surface with a locking outer protective steel casing. An airtight cap will be placed on the wells to eliminate the connection between ambient air at the ground surface and soil vapor around the portion of the well screen that is above the water table. The sentinel wells will be developed and surveyed in accordance with procedures described in Section 4.0.

Field screening will consist of visual soil classification, observation of field evidence of contamination (i.e., odor, discoloration, and sheen), and volatile organic headspace screening. Soil vapor headspace readings will be collected with a PID and soils encountered will be described in accordance with ASTM D-2488. Soil cuttings and purge water generated from installing the wells will be managed in accordance with procedures described in Section 4.3.3.6.

5.2.2 Groundwater Monitoring

The sentinel monitoring well network will be sampled quarterly for the first year. Groundwater samples will be analyzed for TCE by a certified laboratory using U.S. EPA Method 8260. The sampling plan for the sentinel monitoring wells is summarized in Table 3.

At locations where there is a co-located groundwater monitoring well and a vapor monitoring port, the vapor monitoring port will be sampled prior to the groundwater monitoring well to prevent groundwater monitoring activities from affecting adjacent soil vapor concentrations. Groundwater samples will be collected using low flow methods described in Barr's SOP for Low-Flow Monitoring Well Purging.

5.3 Data Evaluation and Reporting

The purpose of the sentinel monitoring network is to assess TCE concentrations in groundwater and soil vapor at the perimeter of the soil gas monitoring area to identify potential trends in TCE that may be indicative of contaminant migration or attenuation. Statistical methods will be used to identify trends that may exist. In addition, the spatial orientation of locations where trends are observed will be considered. For instance, the observation of an increasing trend at a limited number of locations randomly distributed throughout the sentinel network is not as meaningful as the observation of an increasing trend at several locations clustered at the down-gradient end of the soil vapor monitoring area. Based on these factors, multiple lines of evidence will be considered during data evaluation to identify whether soil vapor and/or groundwater contaminants are migrating beyond the soil vapor monitoring area.

Results from the sentinel monitoring will be reported to MPCA after one year of sampling, along with a proposal for future data collection and analysis.

6.0 Reporting

6.1 Progress Reporting

Weekly progress reports will continue to be submitted to MPCA during implementation of the Final Sub-Slab Sampling and Building Mitigation Work Plan and the Post-Mitigation Sampling Work Plan.

Monthly progress reports will be submitted to MPCA during implementation of the VI Pathway Investigation and Feasibility Study Work Plan. The progress reports will describe the activities performed in the preceding month and those activities scheduled for the upcoming month. The progress reports will be submitted by the 15th day of each month prior to submittal of the VI Pathway Investigation and Feasibility Study Report. These progress reports will discontinue upon submittal of the VI Pathway Investigation and Feasibility Study Report.

6.2 Interim Results Reporting

As contemplated in the RAP Modification #1, the VI Pathway Investigation and Feasibility Study Work Plan will be implemented in stages. Summary reports of the data collected during each stage will be submitted to MPCA. This report will also provide recommendations for subsequent stages of work. The summary report for this stage will be submitted within 12 weeks following receipt of the complete and validated analytical data set.

6.3 VI Pathway Investigation and Feasibility Study Report

The investigation and feasibility work will culminate in preparation of a final report in which the evaluation of alternatives will be presented along with the recommended alternative as appropriate. Sections of the report will present the methods used and results of those feasibility study tasks that were completed in support of the evaluation of alternatives. One section of the Feasibility Study Report will include additional detailed analysis and interpretation of the investigation data as it relates to feasibility of proposed remedies. Recommendations regarding project permitting and approval steps to be undertaken, supplemental engineering or other data-gathering needs, and the remedial design process will be presented in the VI Pathway Investigation and Feasibility Study Report.

7.0 Schedule

As contemplated in the Order, the work will be implemented in stages to refine the scope of the investigation and feasibility study activities based on the data collected, and as appropriate to meet the remedial action objectives. This Work Plan represents the first stage in this process and is designed to assess the contribution of on- and off-Site sources to the area and inform subsequent stages of this Work Plan. At this time, three stages are anticipated as outlined below; however, additional stages may be necessary as data is collected.

Implementation of this stage will follow approval of the Work Plan by MPCA. The VI pathway investigation activities and the sentinel monitoring network will be performed concurrently when different drilling methods and rigs are needed for the various installations. In general, the field work will utilize field staff dedicated to the project to maintain familiarity with the environmental conditions encountered. It is anticipated the field work and initial round of groundwater and soil vapor sampling will be completed in 20 to 25 weeks. This anticipated schedule is based on performing the field work over 6 to 8 weeks including drilling and installing the on- and off-Site wells and the sentinel network, and drilling the on-Site soil borings. The newly-installed monitoring wells will be developed and sampled following installation along with the existing glacial drift wells. The vapor ports will be sampled at the same time. The well and vapor port sampling will be completed over a 3-week period.

The second stage of work is predicated on understanding the contribution by various sources. As outlined by the Order, a second stage may include performing additional investigation to fill remaining data needs, if any, and screening remedial technologies, as necessary, to reduce VOC concentrations in soil, soil gas and groundwater associated with General Mills' past discontinued operations at the Site. Screening remedial alternatives may include identifying remedial technologies to be evaluated against appropriate criteria. The most promising technologies from this evaluation will be carried forward into a more detailed evaluation. Evaluation of remedial actions, if necessary, will require understanding the impact off-Site sources have to the area to assess the appropriateness and effectiveness of an action.

Subsequent stages may include continuing to fill remaining data needs, performing the treatability studies and finalizing an evaluation of a range of alternatives (at least three) to reduce VOC concentrations in soil, soil gas and groundwater associated with General Mills' past discontinued operations at the Site to concentrations necessary to achieve the purpose of RAP Modification #1. At the completion, a VI Pathway Investigation and Feasibility Study Report will be prepared. The Report will summarize the information collected during this and previous stages of investigation and will include an evaluation of alternatives and provide a recommendation identifying additional response action(s), if necessary, to adequately protect human health and the environment associated with General Mills' past discontinued operations at the Site.

8.0 References

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Tables

Table 1

EXISTING AND HISTORIC WELLS
East Hennepin Avenue Site
Minneapolis, Minnesota

Name	Well Type	Unique Number	Status	Year Installed	Total Depth (feet bgs)	Depth of Top of Screen (feet bgs)	Depth of Bottom of Screen (feet bgs)	Top of Casing Elevation[1] (feet NAVD88)	Geologic Unit
2	Monitoring Well	196722	Active	1981	27	16	26	857.10	Glacial Drift
B	Monitoring Well		Active	1981	26.6	16.6	26.6	864.22	Glacial Drift
Q	Monitoring Well		Active	1984	36.5	13.9	23.9	850.21	Glacial Drift
S	Monitoring Well		Active	1984	31.2	14.5	24.5	848.08	Glacial Drift
T-2	Monitoring Well		Active	1984	26.6	12	22	849.34	Glacial Drift
V	Monitoring Well		Active	1984	35.7	15.6	25.6	838.52	Glacial Drift
W	Monitoring Well		Active	1984	20.5	7.1	17.1	830.78	Glacial Drift
X	Monitoring Well		Active	1984	27	9	19	842.72	Glacial Drift
109	Pump-Out Well	191913	Active	1984	42	18	42	859.83	Glacial Drift
110	Pump-Out Well	256171	Active	1983	37	17	37	852.19	Glacial Drift
111	Pump-Out Well		Active	1984	46	20	40	846.81	Glacial Drift
112	Pump-Out Well		Active	1984	41	16	36	841.19	Glacial Drift
113	Pump-Out Well		Active	1984	46.5	20	40	841.10	Glacial Drift
14	Monitoring Well	616615	Active	1998	66	60.5	65.5	858.75	Magnolia
QQ	Monitoring Well		Active	1982	59.3	57.3	59.3	859.08	Magnolia
TT	Monitoring Well		Active	1982	68.9	66.9	68.9	860.70	Magnolia
VV	Monitoring Well		Active	1982	68.3	66.3	68.3	859.70	Magnolia
MG-1	Pump-Out Well	463016	Active	1991	72	62	72	848.98	Magnolia
MG-2	Pump-Out Well	463017	Active	1991	72	60	72	861.95	Magnolia
200	Monitoring Well	403277	Active	1984	200	120	200	851.11	St. Peter Sandstone
201	Monitoring Well	191920	Active	1984	142	116.3	136.6	885.05	St. Peter Sandstone
202	Monitoring Well	191937	Active	1985	114	84	104	843.18	St. Peter Sandstone
203	Monitoring Well	409573	Active	1985	116	96	116	849.66	St. Peter Sandstone
Henkel	Former Industrial Supply	200815	Active	1947	404	215	404	unknown	Prairie du Chien/Jordan
1	Monitoring Well	196721	Abandoned	1981	28	18	28	--	Glacial Drift
3	Monitoring Well	180917	Abandoned	1982	23.5	13.5	23.5	--	Glacial Drift
4	Monitoring Well	180916	Abandoned	1982	23	13	23	--	Glacial Drift
5	Monitoring Well	180918	Abandoned	1982	24	14	24	--	Glacial Drift
106	Monitoring Well		Abandoned	1983	26	16	26	--	Glacial Drift
107	Monitoring Well	122237	Abandoned	1983	40	34	39	--	Glacial Drift
A	Monitoring Well	242970	Abandoned	1981	27	17	27	--	Glacial Drift
C	Monitoring Well	242971	Abandoned	1981	26.5	16.5	26.5	--	Glacial Drift
D	Monitoring Well		Abandoned	1981	21	11	21	--	Glacial Drift
E	Monitoring Well	242972	Abandoned	1981	26.5	16.5	26.5	--	Glacial Drift
F	Monitoring Well		Abandoned	1981	33	23	33	--	Glacial Drift
G	Monitoring Well		Abandoned	1981	24	13.5	23.5	--	Glacial Drift
H	Monitoring Well		Abandoned	1981	25	15	25	--	Glacial Drift
J	Monitoring Well	242973	Abandoned	1982	25.5	22.1	24.1	--	Glacial Drift
K	Monitoring Well	242974	Abandoned	1982	23.5	20	22	--	Glacial Drift
L	Monitoring Well	242975	Abandoned	1982	24.5	20.2	22.2	--	Glacial Drift
M	Monitoring Well	242976	Abandoned	1982	26	22.4	24.4	--	Glacial Drift
N	Monitoring Well		Lost	1982	26	22.2	24.2	--	Glacial Drift
P	Monitoring Well	242977	Abandoned	1982	25	21.5	23.5	--	Glacial Drift
R	Monitoring Well		Abandoned	1984	31	10	20	--	Glacial Drift
T	Monitoring Well		Abandoned	1984	30.1	7.2	17.2	--	Glacial Drift
U	Monitoring Well		Abandoned	1984	36	11.5	21.5	--	Glacial Drift
Y	Monitoring Well	242978	Abandoned	1984	31.5	12.3	22.3	--	Glacial Drift
Z	Monitoring Well	242979	Abandoned	1984	36.5	18.9	28.9	--	Glacial Drift
8	Monitoring Well	122236	Abandoned	1983	61.6	58	61.6	--	Carimona
9	Monitoring Well	122206	Abandoned	1983	61	57	61	--	Carimona
10	Monitoring Well	122202	Abandoned	1983	62	57	62	--	Carimona
11	Monitoring Well	122203	Abandoned	1983	52	48.2	52	--	Carimona
12	Monitoring Well	12204	Abandoned	1983	60	56.5	59.5	--	Carimona
13	Monitoring Well	191905	Abandoned	1984	50	47	50	--	Carimona
108	Monitoring Well	122205	Abandoned	1983	59.5	56.5	59.5	--	Carimona
RR	Monitoring Well		Abandoned	1982	53	50.4	52.4	--	Carimona
SS	Monitoring Well		Abandoned	1982	59.9	57.9	59.9	--	Carimona
UU	Monitoring Well		Abandoned	1982	61.8	59.8	61.8	--	Carimona
WW	Monitoring Well		Abandoned	1982	59.3	57.3	59.3	--	Carimona
YY	Monitoring Well	235547	Abandoned	1983	63	UNKN	UNKN	--	Carimona
II	Monitoring Well	242980	Abandoned	1981	64.2	54.2	64.2	--	Carimona/Magnolia
BB	Monitoring Well		Abandoned	1981	69.8	69.8	64.8	--	Magnolia
LL	Monitoring Well	242981	Abandoned	1982	56.3	54.3	56.3	--	Magnolia
OO	Monitoring Well		Abandoned	1982	60.5	58.5	60.5	--	Magnolia
PP	Monitoring Well	242982	Abandoned	1982	55	53	55	--	Magnolia
ZZ	Monitoring Well	191906	Abandoned	1984	56.5	52	56	--	Magnolia
GG	Monitoring Well		Abandoned	1981	69	59	69	--	Magnolia/Hidden Falls

bgs = below ground surface

NAVD88 = North American Vertical Datum of 1988

[1]Surveyed by Barr in 2012

Table 2

SOIL AND GROUNDWATER SAMPLING PLAN
East Hennepin Avenue Site
Minneapolis, Minnesota

Sampling Location	Estimated Total Depth	Targeted Sampling Interval	Soil Sampling: Quantity / Parameters		Groundwater Sampling: Estimated Temporary Well Screen Intervals (feet bgs)			Estimated Permanent Well Screen Interval		
ID	(feet bgs)		PID Field Screening (2 foot interval)	Attachment F VOCs*	Water Table	Mid-Aquifer	Bottom	(feet bgs)	Sampling Frequency	Parameters
Glacial Drift Monitoring Network										
301GS	25	water table	12	-	-	-	-	15-25	two events	Attachment F VOCs*
301GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	Attachment F VOCs*
302GS	25	water table	12	-	-	-	-	15-25	two events	Attachment F VOCs*
302GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	Attachment F VOCs*
303GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
303GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
304GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
304SD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
305GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
305GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
306GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
307GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
307GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
308GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
308GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
309GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
309GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
310GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
310GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
311GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
311GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
312GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
313GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
314GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
315GS	25	water table	12	-	-	-	-	15-25	two events	VOCs
315GD	40	base of glacial drift aquifer	20	-	-	-	-	35-40	two events	VOCs
2	27	water table	-	-	-	-	-	16-26	two events	VOCs
109	42	glacial drift aquifer	-	-	-	-	-	18-42	two events	VOCs
110	37	glacial drift aquifer	-	-	-	-	-	17-37	two events	VOCs
111†	46	glacial drift aquifer	-	-	-	-	-	20-40	two events	VOCs
112†	41	glacial drift aquifer	-	-	-	-	-	16-36	two events	VOCs
113†	46.5	glacial drift aquifer	-	-	-	-	-	20-40	two events	VOCs
B	26.6	water table	-	-	-	-	-	16.6-26.6	two events	VOCs
Q	36.5	water table	-	-	-	-	-	13.9-23.9	two events	VOCs
S	31.2	water table	-	-	-	-	-	14.5-24.5	two events	VOCs
T-2	26.6	water table	-	-	-	-	-	12-22	two events	VOCs
V	35.7	water table	-	-	-	-	-	15.6-25.6	two events	VOCs
W	20.5	water table	-	-	-	-	-	7.1-17.1	two events	VOCs
X	27	water table	-	-	-	-	-	9-19	two events	VOCs

Table 2

SOIL AND GROUNDWATER SAMPLING PLAN
East Hennepin Avenue Site
Minneapolis, Minnesota

			Soil Sampling		Groundwater Sampling					
Sampling Location	**Estimated Total Depth**	**Targeted Sampling Interval**	Quantity / Parameters		Estimated Temporary Well Screen Intervals (feet bgs)			Estimated Permanent Well Screen Interval		
ID	(feet bgs)		PID Field Screening (2 foot interval)	Attachment F VOCs*	Water Table	Mid-Aquifer	Bottom	(feet bgs)	Sampling Frequency	Parameters
On-Site Investigation - Geoprobe Borings / Temporary Wells										
DP-058	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-059	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-060	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-061	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-062	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-063	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-064	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-065	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-066	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*
DP-067	40	vadose zone, glacial drift aquifer	continuous	0-2	20-23	30-32	38-40	-	one time	Attachment F VOCs*

- None or not applicable

* Samples will be analyzed for specific VOC compounds listed in Attachment F in the original Response Order by Consent for this Site (MPCA, 1984) and using U.S. EPA Method 8260.

† These existing wells will be used for both the glacial drift monitoring and sentinel well monitoring. They will be sampled for TCE on the schedule described in the sentinel monitoring program.

Table 3

SENTINEL VAPOR PORT AND SENTINEL WELL SAMPLING PLAN
East Hennepin Avenue Site
Minneapolis, Minnesota

Sampling Location	Estimated Total Depth	Targeted Sampling Interval	Soil Sampling	Groundwater Sampling			Vapor Sampling		
ID	(feet bgs)		PID Field Screening (2 foot interval w/ HSA)	Estimated Well Screen Interval (feet bgs)	Sampling Frequency*	Parameter	Estimated Vapor Port Screen Interval (feet bgs)	Sampling Frequency*	Parameter
Sentinel Vapor Port Network									
SVP1	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP2	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP3	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP4	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP5	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP6	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP7	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP8	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP9	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP10	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP11	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP12	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP13	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP14	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP15	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP16	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP17	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP18	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP19	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP20	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP21	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP22	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP23	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
SVP24	9	vadose zone	continuous	-	-	-	8-9	quarterly	TCE
Sentinel Monitoring Well Network									
SMW1	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW3	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW6	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW8	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW11	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW13	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW16	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW19	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW22	25	water table	12	15-25	quarterly	TCE	-	-	-
SMW24	25	water table	12	15-25	quarterly	TCE	-	-	-
111[†]	46	fully penetrating	-	20-40	quarterly	TCE[†]	-	-	-
112[†]	41	fully penetrating	-	16-36	quarterly	TCE[†]	-	-	-
113[†]	46.5	fully penetrating	-	20-40	quarterly	TCE[†]	-	-	-

- None or not applicable
* Assumes one year of sampling starting in August 2014 following MPCA approval of work plan and installation of wells and vapor ports.
† These existing wells will be used for both the glacial drift monitoring and sentinel well monitoring.