ARCADIS

Appendix A

Supporting Materials

Site Description and Background Information

1. Site Description

The Madison-Kipp site is approximately 7.5 acres in size. A 130,000-square ft building occupies much of the site, with asphalt parking lots located in the northeastern, southwestern, and southeastern portions of the site. The building has a 25,000-square ft second floor and a 25,000-square ft basement. The site is currently used as a metals casting facility. The site is located in the eastern portion of Madison in a mixed-use area of commercial, industrial, and residential land use. The site is also located at the northeast end of the Madison isthmus, approximately 1,500 ft north of Lake Monona and approximately 6,800 ft east of Lake Mendota.

2. Historical Site Operations and Land Use

2.1 Historical Madison-Kipp Site Operations

Historical site operations are summarized in multiple Phase I ESAs completed in 2002 (URS Corporation [URS] 2002a), 2006 (RSV Engineering [RSV] 2006b), and 2010 (RJN Environmental Services, LLC [RJN] 2010b). Additional information regarding current and historical site operations was obtained from interviews with multiple current and former Madison-Kipp employees. Information regarding land use and layout of the Madison-Kipp facility and the surrounding area was obtained from review of aerial photographs and Sanborn Fire Insurance Maps.

The site has been used as an industrial metal casting facility for more than 100 years, producing metal parts and components for military, automotive, and various industrial uses. Historically, the company included two divisions: 1) the Lubricator Division, which operated in the northern (Waubesa) end of the building; and 2) the Die Casting Division, which operated in the southern (Atwood) building. Currently, natural gas-fired furnaces are used for melting metals, which are then poured into molds to cast parts. The facility conducts limited post-casting processing of parts.

Initial development of the Madison-Kipp facility consisted of a building at the north end of the property (the Waubesa Building) and a second building along Atwood Avenue to the south (the Atwood building). Building additions were constructed in several phases, and ultimately the two buildings were connected by these additions. The current configuration of the building was established by 1968.

2.2 Historical Chemical Use and Handling

Facility operations and chemical use and waste handling procedures have changed over the years. Information regarding chemical use and waste handling was obtained from the 2002, 2006, and 2010 Phase I ESA reports (URS 2002; RSV 2006; RJN 2010) and from interviews in December 2012 and January 2013 with the following current and former Madison-Kipp employees:

- Marv Jellings (1956 to 2011) – Maintenance department, hydraulics specialist, crane operator, and machine maintenance (Jellings 2012)
- Dan Keyes (1976 to present) – Maintenance department and currently alloy manufacturing specialist (Keyes 2012, 2013)
- Walt Largen (1965 to 2005) – Die cast department, Maintenance department, electrical specialist (Largen 2013)
- Jim Lenz (1980 to 2011) – Facility Engineer, Manufacturing Engineer, Facilities Engineering and Environmental Manager (Lenz Dep. 2012; Lenz 2013)
- Doug Peterson (1973 to present) – Maintenance department (Peterson 2013)
- George Schluter (1971 to 2012) – Maintenance department and Group Leader (Schluter 2012).

Chemical usage at the facility has included hydraulic oils, chlorinated solvents including PCE, chlorine, caustic solutions, and other water-based compounds, as well as Stoddard solvent. Since at least 1971, waste liquids and sludge from spills, degreaser wastes, and other sources at the facility were transferred into a 500-gallon waste container, from which the waste was removed by a waste hauler for off-site treatment or disposal (Jellings 2012; Keyes 2012 ; Largen 2013; Lenz 2013; Schluter 2012). Spills that did occur were cleaned up using “oil-dri” absorbent and transferred to a waste container (Jellings 2012; Schluter 2012).

Waste oils from a central piping trench in the facility and any spill residues that may have occurred on the Madison-Kipp plant floor were recovered using an industrial vacuum machine (Seacor machine) and transferred into a 500-gallon waste container for off-site treatment or disposal (Jellings 2012; Keyes 2012; Lenz 2013; Schluter 2012).

Hydraulic oil and PCE waste liquids were recycled in the oil shed to recover and reuse the hydraulic oil and PCE (Jellings 2012). Mr. Joe Lindsay operated an oil separator, sand filter, and a centrifuge to recover hydraulic oils and used a still to recover PCE for reuse at the facility (Jellings 2012). PCE was reportedly recycled multiple times in this process, and waste residues from this process were placed in 55-gallon drums (Jellings 2012). For an unknown period prior to 1976 or 1977, when the parking and driveway areas were covered or paved, some oil wastes were periodically used for dust control and sprayed by employees in the parking lots and driveways (Lenz Dep. 2012, p. 73-74). After the parking areas and driveways were paved in 1976 or 1977, all wastes from the facility were collected for off-site disposal (Lenz Dep. 2012, p. 74).

If PCE used to clean die machines would drip onto the floor adjacent to the machine being cleaned, it was cleaned up using “oil-dri” (Lenz Dep. 2012, p 62). There were no floor drains in the area of the die machines; however, beneath some machines, there were shallow collection trenches that contained spills and led to a collection area in the facility (Lenz Dep. 2012, p. 62). Mr. Lenz testified that he was not aware that there were any spills to floor drains in the facility (Lenz Dep. 2012, p. 65). Mr. Lenz testified that since at least 1980, when he started working at Madison-Kipp, liquid wastes in this collection area were removed using an industrial vacuum and transferred to the 500-gallon waste tank, and that a waste hauler would pick up those wastes for off-site disposal (Lenz Dep. 2012, p. 62). Mr. George Schluter, Maintenance Department Group Manager, who worked at Madison-Kipp from 1971 to 2012, and Marv Jellings, Maintenance Department employee from 1956 to 2010, reported that they did not recall anyone disposing of PCE or oils outside the facility, other than oils applied to the parking area for dust control, and that all wastes during that period were removed for off-site disposal by a waste hauler (Jellings 2012; Largen 2013; Schluter 2012).

Historically, there was a central piping trench that ran from south to north through the center of the Atwood Building. This concrete-lined trench was constructed to house piping for natural gas, vacuum, hydraulic oil, and cooling water for the die machines (die water) (Keyes 2012; Lenz 2013; Schluter 2012). This trench, which was approximately 4 ft wide, 2 to 4 ft deep, and covered with steel plates, was not constructed for waste collection and drainage and did not connect to any sewer or drain systems in the facility (Keyes 2012). WDNR has concurred that wastes released to the piping trench were contained within the trench and did not discharge to any location (Schmoller Dep. 2012, p. 286). Wastes that could have entered the piping trench included spilled hydraulic oils, PCE, water, and other liquid wastes. These hydraulic oils may have contained PCBs. From some period prior to 1980 until the piping trench was closed, wastes from the piping trench were periodically removed and transferred to a dumpster or 500-gallon waste container in the facility prior to removal by a waste hauler for off-site disposal (Jellings 2012; Keyes 2012; Lenz Dep. 2012, p. 62; Lenz 2013; Schluter 2012).

2.3 PCE and Degreaser Use

Historically, prior to approximately 1987, PCE was used by Madison-Kipp to clean machines, equipment, and metal parts in the manufacturing process (Lenz Dep. 2012, p. 61). PCE was also used in vapor degreasers to clean metal parts prior to manufacturing (Lenz Dep. 2012, p. 37; Lenz 2013). Multiple wash tanks using water and other non-PCE cleaning compounds, such as Stanisol, were also commonly used to clean metal parts at the facility throughout its history (Lenz Dep. 2012, p. 61). During the period that it was used at the facility, PCE and other chemicals were also used for cleaning of grease and dirt from the die cast machines (Keyes 2012; Lenz Dep. 2012, p. 61). Machine operators used small buckets containing a “few inches” of PCE and a brush to clean these machines (Lenz Dep. 2012, p. 61).

PCE solvent degreasers were used at the facility from some unknown date prior to 1980 until the late 1980s. Degreasers and wash tanks were reportedly located in different locations at different times within the facility (Jellings 2012; Keyes 2012; Lenz 2013; Schluter 2012). A large vapor degreaser used by the Die Cast Division was located along the eastern wall of the southern (Atwood) building, close to the eastern property line (Lenz Dep. 2012, p. 42; Schluter 2012). The vapor degreaser vent discharged along an east exterior wall of the northern portion of the building (Lenz Dep. 2012, p. 42). There were reportedly no floor drains in the vicinity of this degreaser (Lenz Dep. 2012, p. 64).

Based on interviews with current and former employees, the large PCE vapor degreaser was approximately 8 ft long, 4 ft wide, and 4 ft high, with a ventilation hood and ducting that vented to the outside (Keyes 2012; Lenz Dep. 2012, p. 38). This large degreaser held an estimated 75 to 100 gallons (Lenz Dep. 2012, p. 41). The large vapor degreaser at the Madison-Kipp facility was heated by natural gas and included a cooling system (condenser) that produced the vapor cloud in the machine that the degreaser used to clean the metal parts (Keyes 2012; Schluter 2012). Based on employee descriptions, this vapor degreaser, which contained a condenser, was similar to that described in the 1948 and 1976 ASTM Vapor Degreaser Manuals, and also is consistent with my experience that all such vapor degreasers would use a cooling mechanism (condenser). PCE used in this degreaser was stored in an approximately 250-gallon AST located in the oil shed (Lenz Dep. 2012, p. 42). The PCE tank was situated on a concrete floor in the oil shed, and there were no floor drains in the area where the PCE tank was located (Lenz Dep. 2012, p. 68).

The large vapor degreaser was subsequently transferred from the Die Cast Division to the Lubricator Division in 1983 or 1984, and moved to a location in the northern (Waubesa) building (Lenz Dep. 2012, p. 34-35). Venting from this vapor degreaser was to the outside adjacent to the parking lot. There were reportedly no floor drains in the vicinity of this degreaser (Lenz Dep. 2012, p. 64), and I did not observe any floor drains in that area during my inspections of the facility. PCE was obtained from an AST located in the alcove outside the east wall of the northern (Waubesa) building (Lenz Dep. 2012, p. 42). This PCE AST was also situated in an area of concrete paving that sloped to a grassy drainage area along the northeast side of the building (Lenz Dep. 2012, p. 69). The degreaser in the north Waubesa Building was reportedly removed from the building when the Lubricator Division was sold in the late 1980s.

PCE was manually transferred from the approximately 250-gallon AST located in the oil shed to the degreaser located adjacent to the east side of the Waubesa Building (Lenz Dep. 2012, pp. 39, 43; Schluter 2012). PCE transfer was performed by employees using approximately 5-gallon buckets placed on a rolling cart and was poured into the degreaser (Lenz Dep. 2012, pp. 39, 41; Schluter 2012). Former employee Jim Lenz, who worked at the facility from 1980 to 2011, reported that he heard that that there were spills, including some spills near the PCE ASTs, but did not see any spills (Lenz Dep. 2012, pp. 44-45).

In addition to the large vapor degreaser, employees also report that there was a smaller PCE parts cleaner or degreaser, approximately 3 to 4 ft square and 4 ft tall (Keyes 2012). Metal parts were reportedly cleaned by dipping parts directly into the liquid PCE in this parts cleaner. This smaller parts cleaner was reportedly removed from the facility at some unknown time after 1976 (Keyes 2012).

2.4 PCE Waste Handling

Periodically, PCE degreasers were cleaned to remove the accumulated degreasing waste and sludge from the degreaser tank. Consistent with industry guidance for the operation of vapor degreasers (ASTM 1962, 1976), used PCE liquid from degreasers was routinely recycled and recovered by Madison-Kipp for reuse through the use of a still (Jellings 2012; Schluter 2012). Reclamation of PCE solvent from waste liquids and degreaser sludge was important for economic reasons and done whenever possible, to decrease PCE solvent costs (ASTM 1976). After removing the used PCE, the remaining wastes would have consisted of semi-solid sludge, comprised of oils, metal particles, dirt, and PCE residues (ASTM 1962, 1976). This sludge material was shoveled out of the degreaser at Madison-Kipp (Lenz 2013). Former employees recall that the sludge material that was shoveled out went into shallow trays or a rolling dumpster, to be sent off-site for treatment or disposal (Schluter 2012, Jellings 2012).

At the Madison-Kipp facility, former employees indicate that since at least 1971, no degreaser wastes were spread on the land surface (Schluter 2012). Further, since at least 1971, all spent PCE solvent and degreaser wastes were picked up by a waste hauler for off-site disposal (Schluter 2012). Although there is no direct evidence that it was done at Madison-Kipp, during the period from the 1940s to 1970s, industry guidance regarding the disposal of chlorinated solvent waste recommended that PCE waste be poured on the ground (ASTM 1962, 1976; MCA 1948). Thus, if this were done at Madison-Kipp, it would have been consistent with industry standard and guidance.

2.5 Chemical Storage and Recycling

Historically, chemicals, including hydraulic oils and PCE were stored in large ASTs in a separate facility building known as the “oil shed” (Jellings 2012; Keyes 2012; Schluter 2012). The oil shed is currently located at the northeast end of the eastern or Atwood Building, adjacent to the north parking lot. For many years prior to the 1970s, PCE and hydraulic oil were stored in the oil shed in approximately 250-gallon ASTs. PCE to be used in the facility was transferred from the AST using 5-gallon buckets placed on a rolling cart (Jellings 2012; Schluter 2012). In addition to chemical storage, operations in the oil shed also included recycling of waste hydraulic oils and PCE (Jellings 2012). Waste hydraulic oils were recycled there, using filters and a centrifuge, so that the oils could be used “many times over” (Schluter 2012). Waste PCE was also routinely recycled and recovered in the oil shed through the use of a still for reuse in the degreasers (Jellings 2012; Schluter 2012). The filters, centrifuge and still were operated at various times by Madison-Kipp former employee Joe Lindsay (Jellings 2012, Schluter 2012).

PCE used by the Lubricator Division was obtained from an AST located in an outside alcove on the northeast side of the Waubesa Building, where it remained until the AST was removed.

Prior to 1976 or 1977, when the parking lots and driveways were paved, waste oils from the facility were also periodically spread on the parking areas and driveways of the Madison-Kipp facility to help control dust. These wastes included waste oils collected in the facility from the waste tank, piping trench and spills using an industrial vacuum machine (“Seacor” machine) (Schluter 2012). It is likely that these oil wastes contained PCBs and PCE. The parking areas and driveways where these waste oils were placed have been covered by asphalt or concrete paving or buildings since at least 1976 or 1977.

2.6 Off-Site Commercial and Industrial Land Use

Immediately northwest of the Madison-Kipp facility, at 214 Waubesa Street, is Madison Brass Works, which has operated at that location since at least 1950 (ARCADIS 2012g). Releases of petroleum from leaking USTs have resulted in soil and groundwater contamination at Madison Brass Works, directly upgradient relative to groundwater flow from the Madison-Kipp property (Dames & Moore 1995b; Ruekert/Mielke 2011).

Directly north of the Madison-Kipp site, at 149 Waubesa Street, is the former location of Theo Kupfer Iron Works, where at least eight USTs ranging from 275 to 12,000 gallons were located (Ruekert/Mielke 2011). This former industrial facility is currently occupied by the Goodman Community Center.

On the south side of Atwood Avenue across from the Madison-Kipp facility is the location of a former Clark Oil service station (2801 Atwood Avenue, now operating as a BP service station), where site investigation and remediation activities have been conducted to address releases of petroleum hydrocarbons to the subsurface.

3. Hydrogeologic Conditions

The Madison area lies in a part of Wisconsin underlain by a thick sequence of Paleozoic sedimentary rock that was deeply eroded during Pleistocene glaciations (Clayton and Attig 1977). In the vicinity of the site, bedrock surface lies beneath approximately 35 ft of unconsolidated glacial sediments.

3.1 Geology

Glacial sediments in the site vicinity include interbedded lake sediments (e.g., stratified sand, silt, and clay) and glacial till (much denser and poorly sorted gravelly, clayey silty sand). Glacial sediments underlying the site area generally consist of the following:

- Surficial fill materials generally less than 5 ft thick
- Clay or silty clay at depths of approximately 5 to 15 ft bgs
- Sand at depths of approximately 10 ft bgs to the top of the underlying bedrock at approximately 35 ft bgs. The sand is typically fine-grained and silty, with occasional gravel beds.

While the sedimentary bedrock in the Madison area is nearly flat-lying, the bedrock surface was deeply eroded by glaciers. Lakes Mendota and Monona, located to the north and south of the site, respectively, occupy deep glacial valleys that were scoured into bedrock at least 200 ft deeper than the bedrock surface at the site (Bradbury et al.1999).

The site area is underlain by approximately 750 ft of Cambrian-aged sandstone, shale, and dolomite. The expected stratigraphy at the site is described in the following sections (Ruekert/Mielke 2011).

3.2 Hydrogeology

Sediments and bedrock units underlying the site and surrounding area have been divided into four primary hydrogeologic units (Bradbury et al. 1999):

- **Unconsolidated Zone (Upper Unconsolidated Aquifer)**
  This upper groundwater zone consists of discontinuous glacial sediments between the groundwater surface and the underlying bedrock. This zone is very thin or absent in the southern part of the site, where the groundwater surface is close to or below the bedrock surface and is as thick as 10 to 15 ft in the northern portion of the site, where it occurs within the coarser-grained sandy sediments of the unconsolidated zone.

  Results of hydraulic conductivity calculated from testing at the Madison Brass Works site were 0.85 ft per day (ft/d) for shallow silt sand sediments (Dames & Moore 1997a). The Wisconsin Geological and Natural History Survey (WGNHS) reported that the hydraulic conductivity of unconsolidated lake bed sediments in the area is 0.1 to 1.4 ft/d (Bradbury et al. 1999). Based on groundwater elevations measured at the site in July 2012, the horizontal hydraulic gradient in the shallow zone was 0.001 ft/ft (ARCADIS 2013b). Rates of groundwater vary depending on hydrogeologic conditions; however, based on a range of hydraulic conductivity from 0.1 to 1.4 ft/d, a horizontal hydraulic gradient of 0.001 ft/ft, and assumed effective porosity of 25 percent, the calculated rate of groundwater flow in this zone ranges from 0.2 to 2 ft/yr.

- **Upper Paleozoic Aquifer (Upper Bedrock Aquifer)**
  The Upper Bedrock Aquifer includes sediments of the Tunnel City Group and Wonewoc Formation, approximately 210 ft in total thickness. This unit is not used extensively for water supply in the Madison area; however, there is no groundwater use for water supply in the immediate vicinity of the Madison-Kipp facility.

Regionally, this unit is reported to be moderately permeable, with an estimated hydraulic conductivity ranging from 4.4 to 5 ft/d (Bradbury et al. 1999; Ruekert/Mielke 2011). However, site-specific hydraulic testing at the Madison-Kipp site indicated that the hydraulic conductivity of the Upper Bedrock Aquifer is 0.6 ft/d (Dames & Moore 1997a). The porosity of this unit has been estimated to be as low as 5 percent (Bradbury et al. 1999).

Based on groundwater elevations measured at the site in July 2012, the horizontal hydraulic gradient in the Upper Bedrock Aquifer ranged from 0.0003 to 0.001 ft/ft (ARCADIS 2013b). Rates of groundwater vary depending on hydrogeologic conditions. Based on a range of hydraulic conductivity from 0.6 to 5 ft/d, a horizontal hydraulic gradient ranging from 0.0003 to 0.001 ft/ft, and assumed effective porosity of 5 percent, the calculated rate of groundwater flow in this zone ranges from 1 to 36 ft/yr.

- **Eau Claire Aquitard**
  This low-permeability aquitard consists of thin shale layers near the top of the Eau Claire Formation. Where present, this aquitard separates the Upper Bedrock Aquifer from the Mt. Simon Aquifer below. The Eau Claire Aquitard is present beneath the immediate site vicinity, but has been eroded and may be absent in the glacial bedrock valleys beneath Lake Monona and Lake Mendota.

  The hydraulic conductivity of the Eau Claire Aquitard has been estimated to be 0.006 ft/d (Bradbury et al. 1999), indicating that, where present, this aquitard significantly restricts vertical groundwater flow.

- **Mt. Simon Aquifer (Lower Bedrock Aquifer)**
  The Lower Bedrock Aquifer includes the Mt. Simon Formation, the portion of the Eau Claire Formation below the Eau Claire Aquitard, and has a total thickness of approximately 500 ft. The Lower Bedrock Aquifer is the primary water-supply aquifer in the region and provides water to City of Madison water-supply wells.

  The hydraulic conductivity of the Mt. Simon Aquifer has been estimated to be approximately 10 ft/d (Bradbury et al. 1999), and the porosity is estimated to be 30 percent (Bradbury et al. 1999).

The sandstone bedrock aquifers are relatively permeable and have porosities generally ranging from 5 to 30 percent, providing significant groundwater flow and storage. However, significant groundwater flow also occurs through secondary fractures in the bedrock.

The average annual precipitation in the Madison area is approximately 30 inches per year (in/yr), and the average rate of recharge to groundwater is 6 in/yr (Ruekert/Mielke 2011). The groundwater surface beneath the site generally occurs at depths of ranging from 15 to 35 ft bgs and varies seasonally in response to changes in precipitation (ARCADIS 2013b). Shallow groundwater flow in the site area in the glacial sediments and Upper Bedrock varies somewhat, but is generally toward the south and southeast, and vertically downward in response to significant vertical hydraulic gradients. The horizontal hydraulic gradient in the shallow groundwater zone in the site vicinity ranges from 0.00003 to 0.001 ft/ft, while the downward vertical hydraulic gradient is significantly greater, ranging from 0.03 to 0.05 ft/ft (ARCADIS 2013b), reflecting the presence of lower-permeable sediments in the bedrock that restrict groundwater flow.

4. Summary of Previous Site Investigation and Remediation Activities

Extensive site investigations have been conducted at the Madison-Kipp since 1994 under the direction of WDNR. Following is a chronological summary of site investigations conducted by Madison-Kipp.

4.1 Site Investigations – 1994 to 1995

Site investigation activities were initiated by Madison-Kipp in 1994 in response to a July 18, 1994 WDNR letter (WDNR 1994), requesting that Madison-Kipp investigate the occurrence of VOCs found in shallow groundwater at two neighboring properties. Prior site investigations had been conducted at two adjacent properties and reported to the WDNR. Subsurface investigations in 1987 at the former Theo Kupfer Iron Works facility at 149 Waubesa Street, directly north of the site detected low concentrations of TCE up to 1.6 µg/L in shallow groundwater in the southeast corner of the property, and reported that shallow groundwater flow varied from east-southeast to west-southwest (Dames & Moore 1995b). A subsequent subsurface investigation was conducted in1993 at the Madison Brass Works facility, at 214 Waubesa Street, directly northwest of the Madison-Kipp property to investigate petroleum releases from a leaking UST (Ruekert/Mielke 2011). Investigations at the Madison Brass Works site also detected 11 µg/L PCE and 1.3 µg/L TCE in shallow groundwater. Groundwater flow at the Madison Brass Works was reported to be toward the west-southwest.

Madison-Kipp then retained the environmental consulting firm Dames & Moore to conduct a site investigation. Dames & Moore submitted a work plan for initial site investigation to the WDNR on September 14, 1994 (Dames & Moore 1994a). Following approval by WDNR, site investigations were initiated by Dames & Moore in September 1994 to evaluate the presence of VOCs, including PCE, in soil and groundwater the northern portion of the Madison-Kipp property. Based on the results of this initial investigation provided in the December 14, 1994 Progress Report, Dames & Moore recommended additional soil and groundwater samples (Dames & Moore 1994b).

These initial Dames & Moore site investigations included multiple soil borings, extensive soil and groundwater sampling, and installation of one monitoring well (MW-1). Results of these site investigations were presented to WDNR by Dames & Moore in a report dated April 20, 1995 (Dames & Moore 1995b). Based on groundwater elevation data from monitoring wells at Madison-Kipp and the Madison Brass Works site, groundwater was encountered at a depth of 18 ft and flow was generally toward the south. Elevated concentrations of VOCs were found in shallow groundwater in the vicinity of a former drainage ditch on the northern portion of the Madison-Kipp property. VOCs detected in shallow groundwater included PCE (860 µg/L), TCE (470 µg/L), cis-1,2-DCE (2,200 µg/L), and vinyl chloride (400 µg/L). Elevated concentrations of VOCs were also found in shallow groundwater in the northeast portion of the parking lot, including PCE (1,000 µg/L) and cis-1,2-DCE (6,900 µg/L). However, much lower VOC concentrations were found in groundwater monitoring well MW-1, a short distance away in the north parking area, including PCE(150 µg/L), and in downgradient well MW-3 at Madison Brass Works. Site investigations indicated that fine-grained soils at depths up to 8 ft bgs retarded the migration of contaminants.

Additional site investigation activities were conducted by Dames & Moore in 1995 and were presented to WDNR in the March 20, 1996 Dames & Moore Progress Report (Dames & Moore 1996a). Review of historical site information by Dames & Moore indicated that a PCE AST was formerly located outside the northern portion of the building. The former drainage ditch identified in the 1995 Site Investigation Report was located along the east side of the building and extended from the former AST area northward to the property boundary. This AST was reportedly taken out of service at an unknown date, the ditch was filled, and most of the area was paved in 1995. Based on this historical site information and results of the first phase of investigations, further soil and groundwater investigations, including the installation of three additional groundwater monitoring wells (MW-2, MW-2A, and MW-3), were conducted to further define the extent of subsurface VOCs in the northern portion of the site, in the vicinity of the former AST and ditch. Sampling of groundwater monitoring wells in August 1995 found PCE in shallow groundwater at concentrations ranging from 90 µg/L (MW-2A) to 2,600 µg/L (MW-3), and groundwater flow was toward the south and southeast.

4.2 Site Investigation and Remediation Activities – 1996 to 1999

Further site investigations were conducted in 1996 by Dames & Moore and presented in a report submitted to the WDNR March 18, 1997 (Dames & Moore 1997a). This report also presented an evaluation of soil remediation options and proposed the excavation of VOC-impacted soils from source areas.

These investigations included a review of historical information to identify potential sources of contamination. Based on historical site use information and results of prior investigations, in June 1996 Dames & Moore installed additional monitoring wells MW-4S and MW-4D at multiple depths along the south property boundary to define the lateral extent of shallow groundwater contamination in the bedrock and conducted additional soil sampling in suspected source areas. Dames & Moore also installed a groundwater extraction test well (EW-1) for hydraulic test purposes. Hydraulic pumping testing in July 1996 indicated a hydraulic conductivity of 0.6 ft/d for the shallow bedrock (Dames & Moore 1997a).

There was a former PCE vapor degreaser at the Madison-Kipp facility. The external vent for the vapor degreaser was located in the northern portion of the Waubesa building, along the east exterior wall. Dames & Moore found elevated concentrations of VOCs in soil in the vicinity of this former degreaser, including PCE (4 mg/kg), TCE (7.5 mg/kg), and cis-1,2-DCE (6.3 mg/kg). Based on the sampling results collected to date, Dames & Moore had identified two sources of chlorinated VOCs at the site: 1) the north end of the former drainage ditch at the northeast corner of the building, and 2) the vapor degreaser vent. A former fuel oil AST was also reported to be located in the northern portion of the Waubesa building; however, investigations by Dames & Moore found no evidence of any contamination attributable to this AST.

By July 1996, a total of six groundwater monitoring wells had been installed at the site. Results of groundwater sampling in July 1996 indicated that VOC concentrations in groundwater were generally similar to prior sampling results, with the highest concentration of PCE in monitoring well MW-3 (2,000 µg/L) in the north parking area (Dames & Moore 1997a). Groundwater flow was found to be toward the south-southeast. These further investigations were successful in defining the lateral downgradient extent of VOCs toward the south in shallow groundwater on the Madison-Kipp property. Monitoring Wells MW-4S and MW-4D, located along the south property boundary, contained only low concentrations of PCE (1.3 µg/L in MW-4S and 2.1 µg/L in MW-4D). Based on the measured groundwater flow direction toward the south and the much lower VOC concentrations found in MW-2, Dames & Moore concluded that the lateral definition of VOCs in shallow groundwater was also generally defined.

Dames & Moore conducted additional site investigations in April 1997, including extensive soil sampling in the area of the drainage ditch along the north property boundary and in the area of the former degreaser vent to further define the extent of contamination. The results were submitted to the WDNR in a report dated May 30, 1997 (Dames & Moore 1997c). Elevated PCE concentrations were found in shallow soil samples along the drainage ditch (6.44 mg/kg). However, much lower VOC concentrations were found in soil immediately to the south and east, generally defining the lateral extent of soil contamination in the drainage ditch area. VOC concentrations in soil from the area of the former degreaser vent were lower than the concentrations detected at the north end of the former drainage ditch.

Site-wide groundwater sampling of all monitoring wells was conducted in February 1998, May 1999, and August 1999. VOC concentrations remained stable in almost all monitoring wells, while VOC concentrations in MW-2S decreased significantly. Measurements of groundwater levels indicated that the direction of groundwater flow was generally toward the south and southeast with a horizontal hydraulic gradient of 0.005 ft/ft, and that there was a significant downward vertical gradient ranging from 0.01 to 0.034 ft/ft.

In 1999, two additional deeper monitoring wells (MW-3D and MW-4D2) were installed. A report presenting the results of well installation and sampling was submitted to WDNR on September 14, 1999 (Dames & Moore 1999c). Elevated PCE concentrations were found in MW-3D (1,400 µg/L); however, much lower PCE levels were found in deeper well MW-4D2 (15 µg/L), further defining the extent of PCE in shallow groundwater.

On August 12, 1999, WDNR sent a letter to residents in the Madison-Kipp vicinity summarizing results of soil and groundwater investigations (WDNR 1999a). In that letter, WDNR indicated that “The degree and extent of groundwater contamination at the facility has, for the most part, been determined.” WDNR also indicated that “Efforts to fully delineate the contaminated groundwater plume have been delayed due to the difficulty of finding appropriate locations to advance groundwater quality monitoring wells near the site which are not obstructed by utilities or other physical barriers.” Additionally, WDNR indicated that “Madison-Kipp has to date complied with requirements to investigate and remediate the contamination found at the site.”

4.3 Site Remediation Activities – 1996 to 1999

Several soil and groundwater remedial action options were evaluated during the early phases of the site investigation. The March 18, 1997, Dames & Moore report proposed excavation of VOC-impacted soils in source areas (Dames & Moore 1997a). Several groundwater remedial action options were also evaluated during these initial phases of site investigation. The March 18, 1997, Dames & Moore report initially proposed continued groundwater monitoring, with the potential installation of an ozone-sparge system for groundwater remediation at some time, if deemed necessary (Dames & Moore 1997a).

Based on additional site investigation activities and further evaluation of remedial alternatives for soil remediation, soil excavation in the area of the drainage ditch and degreaser vent was determined to be infeasible due to the close proximity of VOC-impacted soils to the building and the presence of underground utilities (Dames & Moore 1997c).

Based on further evaluation of remedial alternatives, Dames & Moore subsequently proposed in-situ remediation of VOC-impacted soils in the area of the former PCE UST, drainage ditch and the degreaser vent using the soil treatment process BiOx Process (BiOx – Deep Earth Technology) in a March 11, 1998, meeting with WDNR and in a Dames & Moore report to WDNR, dated April 6, 1998. BiOx results in oxidation and destruction of chlorinated VOCs, including PCE. WDNR approved the proposed soil remediation plan with a site-specific residual contaminant level (RCL) remedial goal of 1 mg/kg for PCE in soil. Three BiOx injections were completed at multiple locations during June and July 1998 within the two source areas. Additional injections of BiOx reagent were completed to further treat VOC-impacted soils in the former drainage ditch area in December 1998 and May 1999.

Confirmation soil sampling indicated that in-situ remediation was successful in reducing PCE concentrations in soil in these source areas to levels below the site-specific RCL of 1 mg/kg. Results of these soil remediation activities were submitted to WDNR in a March 21, 2000, report (Dames & Moore 2000). This report concluded that soil in both source areas were remediated to the extent practicable and recommended no further action for VOC-impacted soils in these areas. Additionally, this report concluded that the extent of PCE-impacted groundwater was adequately defined and recommended continued groundwater monitoring.

4.4 Site Investigation Activities – 2001 to 2003

From 2001 to 2003, further soil and groundwater investigations were conducted to better define the extent of VOCs in the subsurface and investigate additional possible VOC source areas. This work included installation of additional shallow and deeper monitoring wells (MW-3D2 in the north parking area, and wells MW-5 and MW-5D along the eastern side of the property) in March 2001 to further define groundwater conditions and the extent of VOCs in the bedrock.

In March 2001, Dames & Moore began routine groundwater monitoring at the site to evaluate groundwater conditions and to monitor natural attenuation of VOCs in groundwater. Groundwater monitoring results were presented to WDNR in a December 27, 2001, report (Dames & Moore 2001), which concluded that concentrations of chlorinated VOCs in groundwater were stable or decreasing.

Groundwater flow in the unconsolidated sediments was toward the south and toward the south-southwest in the shallow bedrock. Groundwater flow in the deeper bedrock was more variable, with flow directions toward the north, west, and south. Variably elevated PCE concentrations were found in newly installed groundwater monitoring wells MW-3D2 (1,900 µg/L in April 2001 and 450 µg/L in July 2001), but were lower than more shallow nearby wells MW-3S and MW-3D.

Significantly elevated PCE concentrations consistent with an additional VOC source area were unexpectedly found in 2001 in the two newly installed monitoring wells along the east property boundary (MW-5S 520 µg/L and MW-5D 8,800 µg/L). Review of facility operations indicated that there was an additional location where a vapor degreaser and vent was formerly located in the eastern portion of the building and loading dock area, very close to groundwater monitoring wells MW-5S and MW-5D.

An investigation was subsequently completed in 2002 (RSV 2002) to evaluate soil conditions in the area of this former vapor degreaser vent location. Extensive soil sampling was conducted in the area between the building and east property boundary to define the extent of VOCs in soil. PCE was detected in shallow soils at concentrations up to 782 mg/kg, and there were decreasing VOC concentrations with depth and distance from the loading dock. Results of this investigation were submitted to WDNR by RSV in a report dated August 30, 2002 (RSV 2002).

In February 2003, three additional monitoring wells (MW-5D2, MW-6S, and MW-6D) were installed at multiple depths at the site (URS 2003b). Groundwater flow in the unconsolidated soil and bedrock was generally toward the south and southwest and vertically downward. PCE concentrations in newly installed deep monitoring well MW-5D2 (35 µg/L) were much lower than in shallower nearby monitoring wells, further defining the vertical extent of VOCs in groundwater in the source areas. The lateral extent of PCE in shallow groundwater along the downgradient south property boundary was further defined by the low concentration of PCE in MW-6S (1.4µg/L) and relatively lower PCE concentration found in MW-6D (71 µg/L).

Soil sampling was conducted adjacent to the eastern property line on the Madison-Kipp property in November 2002 and provided to WDNR in December 2002 (URS 2002d). Soil sampling was also conducted in an off-site area in November 2002 at three adjacent residential properties (150, 154 and 162 South Marquette Street) directly adjacent to the eastern Madison-Kipp property boundary to further evaluate the extent of PCE in soils. Sampling was performed according to procedures reviewed and approved by WDNR (WDNR 2002). Sampling results from multiple soil borings indicated one sample exceeded 1 mg/kg (at 154 South Marquette Street), while all other samples contained much lower PCE concentrations (up to 0.221 mg/kg at 154 South Marquette Street). The homeowners were informed of the results in January 2003. Further sampling occurred at the same three residential properties in June 2003 and sampling results were provided to homeowners and WDNR in July 2003 (URS 2003c, 2003d, 2003e).

Additional soil sampling occurred at these three properties in July 2003 and Madison-Kipp shared the sampling results with WDNR and drafted transmittal letters to the homeowners for WDNR's review in October 2003 (URS 2003f). With WDNR's input, Madison-Kipp sent letters to homeowners of 150, 154 and 162 South Marquette with the sampling results (as well as the homeowner of 146 South Marquette as a neighboring property to the soil sampling) in December 2003 (URS 2003g). These letters informed residents that the WDNR, Wisconsin Department of Health and the City of Madison's Health Department had concluded that the low PCE concentrations in soil did not pose a public health concern.

4.5 Site Investigation and Remediation Activities – 2004 to 2005

4.5.1 Site Investigation Activities – 2004 to 2005

RSV, on behalf of Madison-Kipp, summarized the results of the 2003 groundwater sampling efforts in an April 12, 2004 report to WDNR (RSV 2004a). At the time, the monitoring network consisted of 14 monitoring wells at 6 locations. In their June 21, 2004, report submitted to WDNR on behalf of Madison-Kipp (RSV 2004b), RSV summarized prior site investigation results in a Proposal and Remedial Options Analysis for Soil and Groundwater Remediation. In a subsequent July 21, 2004 letter sent by WDNR to Madison-Kipp, WDNR concluded that "The network of monitoring wells has primarily defined the extent of groundwater contamination…" WDNR also concluded that "Groundwater contamination in the bedrock aquifer appears to be determined to the south, downgradient of the source of the PCE release," and that "The vertical extent of contamination has been investigated with the deepest on-site well MW-5D2 extending 170 feet BGS."

In 2004 and 2005, further site investigations were completed to better define the extent of VOCs in soils along the eastern property boundary near the loading dock driveway and former vapor degreaser vent location and were reported to WDNR in reports by RSV dated

March 25, 2005 (RSV 2005) and March 23, 2006 (RSV 2006a). Soil samples collected in 2004 contained PCE at concentrations up to 9.54 mg/kg. Subsequent soil sampling in 2005 was conducted in the loading dock area of the former degreaser vent to further define the extent of VOCs. The highest PCE concentration (74 mg/kg) was found in soil north of the loading dock.

In their May 7, 2004 letter, WDNR (WDNR 2004a) requested monitoring of soil vapor on the property boundary to assess migration of vapors onto adjacent property. Four shallow soil-vapor monitoring probes (VP-1S, VP-2S, VP-1N, and VP-2N) were subsequently installed along the east property boundary in 2005. PCE was detected in shallow soil vapor at concentrations between 7.2 and 48 parts per million by volume (ppmv) at locations immediately adjacent to areas of contaminated soil.

4.5.2 Soil Remediation Activities – 2004 to 2005

Based on the success of prior in-situ soil remediation activities in the on-site area in 1998 and 1999, RSV conducted an evaluation of remedial alternatives for soil and groundwater and submitted the June 21, 2004 Proposal and Remedial Options Analysis for Soil and Groundwater Remediation to WDNR. This report recommended chemical oxidation for in-situ soil treatment. WDNR approved the proposed remedial action options in a letter dated July 21, 2004 (WDNR 2004b). A pilot test was subsequently conducted by RSV in December 2004 for remediation of VOC-impacted soils in the loading dock area using Cool-Ox, an oxidizing agent similar to BiOx (RSV 2005). Cool-Ox reagent was injected into shallow soils at multiple locations in the area of the loading dock, and in a small off-site area in the back yard of 162 South Marquette Street. In August 2005, CoolOx was also injected into soils under the loading dock driveway. Confirmation soil sampling results indicated that in-situ treatment was successful in reducing PCE concentrations soil from 782 mg/kg range to as low as 0.2 mg/kg. Results of soil remediation activities were presented to WDNR in a report dated March 23, 2006 (RSV 2006a).

4.5.3 Off-Site Soil Investigation and Remediation Activities – 2004-2005

In 2004, soil samples were collected from multiple soil borings on three residential properties (150, 154, and 162 South Marquette Street) adjacent to the eastern boundary of the Madison-Kipp property. PCE concentrations in shallow soils ranged from nondetectable levels to 2.68 mg/kg. Based on these sampling results (which were provided to the homeowners in November 2004), a focused soil remediation program was conducted by RSV in December 2004 in the area of highest off-site PCE concentrations (RSV 2005). A reagent treatment compound was injected at 12 off-site locations. Based on prior soil sampling on the adjacent properties, reagent was also injected in the area of the one sampling location (at 162 South Marquette Street) where PCE was previously found to exceed 1 mg/kg. Results of this off-site sampling and remediation program were presented in several reports submitted to WDNR during 2003 to 2005, including the report dated March 25, 2005 (RSV 2005). Confirmation soil sampling conducted at the off-site residential properties in 2006 indicated that VOCs were not detected (RSV 2006a), and the residents were notified of these results in letters from WDNR in November 2006 (WDNR 2006).

4.6 Site Investigation and Remediation Activities – 2007 to 2009

4.6.1 Site Investigation Activities – 2007-2009

Groundwater monitoring activities continued in 2007-2009, and soil vapor samples continued to be collected from on-site and off-site soil vapor monitoring probes. Soil vapor samples were collected from vapor probes installed at multiple depths on three off-site properties (150, 154, and 162 South Marquette Street) between 2005 and 2009. Results of soil vapor sampling of on- and off-site soil vapor probes from October 2006 to April 2007 indicated that VOC concentrations decreased significantly at all locations since December 2006. Also, with the exception of one sample in December 2006 (150D), VOCs were not detected in soil vapor probes at off-site residential properties from October 2006 to April 2007 (RSV 2007b).

Beginning August 2007, lower laboratory detection limits were used for soil vapor samples collected on the neighboring properties. Subsequent sampling indicated that PCE was present in soil vapor probes on adjacent properties at concentrations ranging up to 110 parts per billion by volume (ppbv) (at 150 South Marquette Street) in August 2007; while samples from other soil vapor probes ranged from nondetect to 86 ppbv. In later soil vapor samples collected from the same locations in September 2009, PCE concentrations ranged from nondetect to 56 ppbv.

4.6.2 Site Remediation Activities – 2007-2009

In order to evaluate the feasibility of groundwater remediation, a pilot test was proposed and completed in 2007 by RSV to assess the performance of ozone sparging for in-situ VOC treatment of shallow and intermediate zone groundwater (RSV 2007a, 2007c). Results of the pilot test were submitted to WDNR in a report dated June 6, 2007 (RSV 2007c). The pilot test involving ozone injection was conducted for two weeks in April 2007 in the area of MW-3S, resulting in significant reductions in PCE concentrations in groundwater at MW-3S. Based on the success of the pilot test, a larger-scale ozone injection/sparge system, including three injection wells, was installed in the eastern portion of the site, north of MW-5S. An overview of the system installation and system component locations was provided to WDNR in a report dated February 11, 2009 (RSV 2009). This ozone sparge system operated from 2008 to 2012.

4.7 Site Investigation and Remedial Activities – 2010 to Present

4.7.1 Off-Site Sampling – 2010 to Present

4.7.1.1 Off-Site Soil Vapor Sampling

Additional soil vapor probes were installed by RJN in June 2011 on the properties at 142 and 202 South Marquette Street to further define the extent of VOCs in soil vapor (RJN 2011). Soil vapor samples were collected in June 2011 from off-site soil vapor probes at 142, 150, 154, and 202 South Marquette Street (the homeowner at 162 South Marquette Street had previously removed the vapor probe on that property). Sampling results indicated that PCE was the only VOC detected, and that PCE concentrations in the soil vapor probes ranged from 0.341 ppbv (202 South Marquette Street) to 188 ppbv (154 South Marquette Street) (RJN 2011e). Much lower PCE concentrations were found in soil vapor probes on the furthest north and south properties at 142 and 202 South Marquette Street.

The initial sampling of sub-slab soil vapor on adjacent residential properties was conducted in November 2010 at 150, 154 and 162 South Marquette Street. In February 2011, RJN collected samples of sub-slab soil vapor and indoor air at 150, 154 and 162 South Marquette Street, and sampled outdoor air at 150 South Marquette Street (RJN 2011e). Sampling results indicated that PCE was only detected in indoor air at one location (0.668 ppbv at 154 South Marquette Street), while PCE in sub-slab soil vapor samples ranged from 5.78 ppbv (150 South Marquette Street) to 470 ppbv (154 South Marquette Street).

In spring 2012, sampling of soil vapor and indoor air at residential properties adjacent to the eastern property boundary was conducted. Samples of sub-slab soil vapor and indoor air were collected for VOC analysis at ten residences located along the eastern portion of the site (102, 110, 114, 118, 126, 128, 130, and 134 South Marquette Street). Analytical results for indoor air samples were compared to the Wisconsin residential action levels, and the sub-slab vapor analytical results were compared to calculated screening levels in accordance with the guidelines presented in the WDNR's *Addressing Vapor Intrusion at Remediation and Redevelopment Sites in Wisconsin*. The action levels and calculated residential screening levels are based on USEPA Residential Air Screening Levels. None of the VOC detections in the indoor air or sub-slab vapor samples exceeded the Wisconsin residential vapor action levels or USEPA calculated residential screening levels.

4.7.1.2 Off-Site Soil Sampling

Soil samples were collected in May 2011 from the back yards of three adjacent properties (150, 154 and 162 South Marquette Street) by RJN, where prior sampling and soil remediation in 2003 had been conducted (RJN 2012). Sample results indicated that PCE concentrations ranged from nondetect (<0.031 mg/kg) at 162 South Marquette Street to 0.610 mg/kg at 154 South Marquette Street. No other VOCs were detected in the soil samples, indicating that the prior 2003 soil remediation was effective.

Soil samples were collected from back yards on South Marquette Street starting in April 2012 and from back yards on Waubesa Street starting in June 2012. In accordance with an August 3, 2012, letter from WDNR regarding *Additional Soil Investigation Requirements*, additional soil samples were collected in August 2012 from residential properties along South Marquette Street (206 through 230 South Marquette Street) and analyzed for PCBs, VOCs, PAHs, RCRA metals, and total cyanide. The details of all off-site investigation activities were provided to WDNR in the *Off-Site Soil Investigation Report*, dated October 9, 2012 (ARCADIS 2012o).

In summary, from April to August 2012, 121 soil samples were collected from 32 off-site residential properties during the period June through August 2012 (ARCADIS 2013b). Two off-site residential properties (237 and 269 Waubesa Street) have not been sampled as access was not granted by these property owners. At that time, PCBs were not detected above laboratory detection limits, above 1 mg/kg (USEPA's residential action level) or above 0.22 mg/kg (WDNR's non-industrial direct contact residual contaminant level) in any of the 121 soil samples collected from the 32 off-site residential properties. VOCs were detected in only one soil sample (102 South Marquette Street), including PCE (2.19 mg/kg), TCE (0.445 mg/kg), and cis-1,2-DCE (0.49 mg/kg). PAHs and VOCs were detected in soil samples from most of the residential properties (ARCADIS 2013b).

Subsequent soil sampling results indicated that PCBs in almost all residential soil samples were either not detected, or were detected at only low concentrations below the WDNR residential action level of 0.22 mg/kg and well below the USEPA residential action level of 1 mg/kg for PCBs. PCBs were detected in soil above the USEPA action level at only one off-site sample location (23 mg/kg at 245 Waubesa Street) (see discussion at 3.4.7.2 below). PCE and certain metals were detected in soils from some properties; however, these results were below protective WDNR screening levels (WDNR 2012, DNR Update 9/27/12).

Soil sampling results from residential properties during 2012 indicate that one or more PAH compounds have been detected in soils at concentrations above one or more WDNR PAH screening levels at most residential properties in the area and on the Madison-Kipp property. In September 2012, ARCADIS submitted results of further investigations regarding the off-site occurrence of PAHs to the WDNR in the letter report *Off-Site Residential Polycyclic Aromatic Hydrocarbon (PAH) Results Summary,* dated September 11, 2012 (ARCADIS 2012k). The ARCADIS letter also concluded that PAHs are ubiquitous in an urban environment from many different activities, the majority of which are not related to activities at Madison-Kipp. WDNR subsequently sent a December 7, 2012 letter (WDNR 2012aa) directing Madison-Kipp to submit a work plan "either…for determining whether any of the health-based direct contact exceedances can be attributed to background concentrations or…a remedial action plan to be employed by MKC…" On December 14, 2012, ARCADIS, on behalf of Madison-Kipp, submitted the *Polynuclear Aromatic Hydrocarbons (PAH) Work Plan, Determination of Whether Health-Based Direct Contact Exceedances Can Be Attributed to Background Concentrations* to evaluate background levels of PAHs in the site area (ARCADIS 2012s). Results of this study, which has included a review of PAH sources in the Madison area, statistical analysis of on-site and off-site PAH sampling data, and evaluation of fingerprint analyses of PAHs in urban area soils, indicate that PAHs in soils on residential properties are consistent with background levels in urban areas, and are not related to PAHs found in soils at Madison-Kipp (ARCADIS 2013a).

WDNR has consistently explained to the public that PAHs are present in soil in all urban settings, and result from any combustion process, including backyard grilling, fire pits, and automotive exhaust, as well as common industrial processes (WDNR 2012, DNR Update 9/27/12). WDNR also advises the public that it is important to note that the WDNR screening levels for PAHs, PCBs, PCE, and other contaminants are conservative and are highly protective of public health and the environment. The agency also advises that screening level exceedances do not mean there is a health or environmental risk, but rather help determine if additional actions are necessary (WDNR 2012, DNR Update 9/27/12).

4.7.1.3 Further Site Investigations – 2010 to Present

In 2011, four additional monitoring wells were installed in the surrounding off-site area to further define the extent of VOCs in groundwater (MW-7, MW-8, MW-9D, and MW-9D2). VOCs were not detected in groundwater at off-site monitoring wells MW-7, MW-8, or MW-9D. VOCs were only detected in the off-site upgradient deeper monitoring well MW-9D2 at relatively low concentrations, including 29 µg/L PCE.

On May 22, 2012, ARCADIS submitted a Bedrock Characterization Work Plan to further refine the conceptual site model regarding hydrogeologic conditions and the occurrence and migration of PCE and other VOCs in the underlying bedrock (ARCADIS 2012f). The work plan included the installation of additional deeper borings and monitoring wells in the vicinity of MW-3 and MW-5 to collect data on bedrock characteristics, VOC occurrence, and groundwater conditions throughout the bedrock aquifer. This work plan was approved by the WDNR in a letter dated June 7, 2012 (WDNR 2012x).

On May 31, 2012, ARCADIS submitted a *Site Investigation Work Plan* to WDNR for more comprehensive site investigations, including 37 soil borings to investigate PCBs in soil and VOCs in soil and groundwater, installation of six additional monitoring wells to further assess the horizontal and vertical extent of VOCs in groundwater, and continued sampling of soil vapor probes (ARCADIS 2012g). This work plan was approved by WDNR in a letter dated June 25, 2012 (WDNR 2012y).

On September 13, 2012, ARCADIS submitted a *Site Investigation Work Plan Addendum* to WDNR documenting the installation and sampling of additional on- and off-site groundwater monitoring wells (ARCADIS 2012k). Three additional shallow monitoring wells (MW-10S, MW-11S, and MW-12S) were installed by ARCADIS in 2012 at off-site locations west, east, and northeast of the Madison-Kipp facility. Groundwater samples from these wells contained only low or nondetectable concentrations of VOCs, further indicating that the extent of VOCs in shallow groundwater was defined, consistent with prior site investigations and groundwater sampling activities in the site area.

On September 28, 2012, ARCADIS submitted *a Site Investigation Work Plan Addendum, Building Subsurface Investigation* (ARCADIS 2012n), which included proposed additional site investigations of soil and groundwater conditions beneath or adjacent to the Madison-Kipp building. In October 2012, soil samples were collected from 42 soil borings at depths up to 15 ft beneath or adjacent to Madison-Kipp facility buildings (B-134 to B-174) (ARCADIS 2013). Soil boring locations were selected based on historical information regarding chemical use and handling at the facility and were approved by WDNR (Schmoller Dep. 2012, p. 247; WDNR 2012z). Soil samples were collected beneath areas of former solvent use and degreaser areas and analyzed for PCBs, VOCs, PAHs, RCRA metals, and cyanide.

Elevated concentrations of PCBs, PCE, and other VOCs were found in soil samples collected beneath or directly adjacent to facility buildings at depths ranging from approximately 2 to 8 ft bgs. PCB analysis results are discussed in the following section of this report. PCE and other VOCs were detected in soil samples from multiple sampling locations. Where found, the highest concentrations of PCE were generally found in shallow soil samples, including B-134 (26 mg/kg) and B-135 (19 mg/kg) from soil borings within the oil shed building. PCE concentrations in other soil samples were generally much lower or below laboratory detection limits.

4.7.2 PCB Investigations – 2010 to Present

4.7.2.1 Background – PCB Investigations

As part of ongoing remediation and interim actions, an SVE system was installed by ARCADIS on site in March 2012 to mitigate off-site migration of vapors. During installation of the SVE system (located along the northeastern property boundary), soil was excavated to install wells and conveyance piping. Excess soil that could not be placed back in the conveyance piping trenches was stockpiled, and a waste characterization sample was collected. The sample contained detectable concentrations of PCBs. WDNR was notified of the PCB results by ARCADIS via email on March 26, 2012. WDNR subsequently sent a letter to Madison-Kipp dated April 19, 2012, indicating that Madison-Kipp was responsible for investigation and cleanup of PCB contamination (WDNR 2012s).

PCBs appear to have been present in hydraulic oils historically used in Madison-Kipp operations that were periodically applied as a dust suppressant to the parking areas of the facility prior to the paving of these areas in 1976 or 1977. It is believed by WDNR that migration of PCBs onto some adjacent residential properties occurred as a result of rainfall runoff (Schmoller Dep. 2012, p. 95). It is also known that PCBs are present at varying levels in shallow soils throughout the Madison area (Schmoller Dep. 2012, p. 106) and are commonly present in shallow soils in urban areas.

In April 2012, at the request of WDNR, RJN collected soil samples from multiple locations on the adjacent properties at 102, 110, 114, 118, 126, 128, 130 (one sample at this address), 134 and 142 South Marquette Street (RJN 2012). Access was not granted for sampling at 106 and 138 South Marquette Street. Soil samples were analyzed for VOCs and PCBs. No PCBs were detected in any soil samples, and VOCs were detected in only one soil sample at 102 South Marquette Street, including 2.19 mg/kg PCE.

In a letter dated May 4, 2012, WDNR requested a work plan for conducting an investigation to evaluate the sources, and degree and extent of impacts associated with PCBs (WDNR 2012t). On May 11, 2012, WDNR sent a letter to Madison-Kipp outlining the requirements for the comprehensive investigation and remediation of the Madison-Kipp property (WDNR 2012v). This letter expanded on the WDNR's expectations presented in their May 4, 2012, letter regarding PCB investigations and remediation, addressed the broader scope of requirements for conducting site-wide environmental response actions.

A *Work Plan for Polychlorinated Biphenyl Investigation* dated May 21, 2012 (ARCADIS 2012e), was submitted to WDNR by ARCADIS for approval to complete site investigation activities associated with PCBs. The WDNR provided Conditional Approval of this work plan in a letter dated May 30, 2012 (WDNR 2012w), and investigation activities were initiated on June 1, 2012.

Results of PCB investigations through June 26, 2012, were submitted to the WDNR by ARCADIS on July 2012 (ARCADIS 2012i). In a telephone call on July 12, 2012, the WDNR subsequently requested a work plan for conducting supplemental investigation activities to further evaluate the extent of impacts associated with PCBs. ARCADIS submitted the requested *Work Plan for Supplemental Polychlorinated Biphenyl Investigation* to WDNR on July 23, 2012 (ARCADIS 2012i) to complete the requested supplemental site investigation. The WDNR provided final approval in a letter dated August 6, 2012 (WDNR 2012), for this work plan, and also sent a letter to Madison-Kipp regarding *Additional Soil Investigation Requirements* on August 3, 2012. This letter requested additional investigation activities, including PCB sampling, on residential properties immediately adjacent to the site.

4.7.2.2 Initial PCB Investigations – April 2012

As part of WDNR-approved ongoing site investigation activities since April 2012, soil sampling has been conducted at depths up to 4 ft bgs in the backyards of numerous residences adjacent to the site (ARCADIS 2013b). Additionally, soil sampling from 84 soil borings was completed on site at depths up to 35 ft bgs. These soil samples were analyzed for PCBs, VOCs, PAHs, RCRA metals, and total cyanide.

The PCB data were compared to WDNR's non-industrial direct contact residual contaminant level (0.22 mg/kg), WDNR's industrial direct contact residual contaminant level (0.74 mg/kg), USEPA's self-implementing high-occupancy cleanup level with no site restrictions (1 mg/kg), and the Toxic Substance Control Act (TSCA) disposal limit (50 mg/kg).

4.7.2.3 Supplemental PCB Investigation – August 2012

Supplemental on-site PCB investigation activities were completed in August 2012 and included sampling of 32 additional soil borings on site along the eastern property boundary, and 22 soil borings on site in the north parking lot at depths from 0 to 4 ft bgs (ARCADIS 2012r).

PCBs were not detected above laboratory detection limits nor above the USEPA's high occupancy cleanup level of 1 mg/kg in any soil samples from the area of the eastern fence line adjacent to the residential properties. Sampling of additional on-site soil borings in the north parking lot was successful in defining the extent of PCBs in on-site soils. PCBs were not detected above laboratory detection limits or above 1 mg/kg in the majority of shallow soil samples from 0 to 2 ft bgs. Soil samples from six shallow sampling locations contained PCB concentrations above 1 mg/kg, but below 50 mg/kg. Only one on-site shallow soil sample (B-101) contained PCB concentrations above 50 mg/kg, and PCBs were not detected above 50 mg/kg in any deeper soil samples.

The supplemental site investigation activities confirmed that PCBs are not present in shallow soils at the site eastern property line above 1 mg/kg, and the areas on site containing PCB concentrations above 50 mg/kg have been delineated and were limited in depth.

4.7.2.4 Additional On-Site and Off-Site PCB Investigation Activities – August 2012 to Present

Soil

In August 2012, additional soil sampling from multiple locations at depths up to 4 ft bgs was conducted in the southwest portion of the Madison-Kipp facility (ARCADIS 2012r). Soil samples were analyzed for PCBs, VOCs, PAHs, RCRA metals, and total cyanide. Twelve of these additional 23 soil samples contained PCB concentrations below laboratory detection limits or below 1 mg/kg. Eleven soil samples contained PCB concentrations above 1 mg/kg, but below 50 mg/kg.

Additional laboratory analysis of selected soil samples was conducted to provide information regarding concentrations of specific PCB isomers using PCB homolog Method 680 compared to the results of PCB laboratory analytical results from USEPA Method 8082. In all cases, the PCB homolog analysis results were lower than comparable PCB analysis results from Method 8082. Thus, utilizing the PCB results by Method 8082 provides a conservative approach for evaluating remedial actions.

On September 28, 2012, ARCADIS submitted *a Site Investigation Work Plan Addendum, Building Subsurface Investigation*, which included proposed additional site investigations of soil and groundwater conditions beneath or adjacent to the Madison-Kipp building. In

October 2012, soil samples were collected from 42 soil borings at depths up to 15 ft beneath or adjacent to Madison-Kipp facility buildings (B-134 to B-174) (ARCADIS 2012n). Soil samples were collected beneath areas of former solvent use and degreaser areas and analyzed for PCBs, VOCs, PAHs, RCRA metals, and cyanide.

Elevated concentrations of PCBs (above 50 mg/kg) were found in soil samples collected beneath or directly adjacent to facility buildings at six sampling locations at depths ranging from approximately 2 to 8 ft bgs. The highest concentrations of PCBs were found in soil samples from borings B-148 (20,000 mg/kg), B-149 (12,000 mg/kg), and B-150 (2,800 mg/kg), all in the area of the former central piping trench, and B-158 (1,900 mg/kg) in the southwestern portion of the building. PCE and other VOCs were also detected in soil samples from multiple sampling locations.

On December 14, 2012, ARCADIS submitted an *Addendum to the Final Revised Work Plan for Polychlorinated biphenyl Recommended Activities* to WDNR (ARCADIS 2012r). This report presented results of supplemental soil investigations in November 2011 on off-site residential properties west of Madison-Kipp to further refine the extent of PCBs in soil. A total of 27 soil samples were collected within 5 ft of the Madison-Kipp property line at 233 through 269 Waubesa Street, except for 237 and 269 Waubesa Street, where access was not granted. Results indicated that 22 of the 27 soil samples did not contain PCBs above detection limits or above 0.22 mg/kg at depths of 0 to 1 and 3 to 4 ft bgs. Seven soil samples contained PCBs above 0.22 mg/kg, but below 50 mg/kg (at 241, 245, 253, and 257 Waubesa Street), and the maximum (23 mg/kg) was found at 245 Waubesa Street. Based on these findings, ARCADIS recommended excavation and off-site disposal of soils in four areas where soil containing PCBs exceeding 0.22 mg/kg was found at depths up to 4 ft bgs. WDNR and USEPA are considering the December 14, 2012 *Addendum to the Final Revised Work Plan for Polychlorinated biphenyl Recommended Activities,* and Madison-Kipp will proceed with excavation activities when it receives agency approval to do so.

Groundwater

In addition to the recent soil sampling in the facility buildings, four groundwater monitoring wells were installed at two depth intervals at two locations in December 2012 to sample groundwater in the area where the highest concentrations of PCBs were found in soils beneath the building. Two groundwater monitoring wells were installed at depths of 25-35 ft bgs (MW-22S) and 45-50 ft (MW-22D) near boring B-148, in the area of the former central piping trench where the highest PCB concentrations were previously found in soil. Two groundwater monitoring wells were also installed at depths of 25-35 ft bgs (MW-23S) and 45-50 ft bgs (MW-23D) near boring B-158, in the southwest portion of the building. Soil samples collected during drilling of the borings for these monitoring wells indicated elevated concentrations of PCBs in soils below the building. Groundwater samples were collected from these monitoring wells on January 14, 2013, and chemical analysis results are expected by February 2013.

PCB Mobility

Studies by USEPA have demonstrated that PCBs are "insoluble in water," strongly adsorb to soils, and generally will not leach significantly in aqueous soil systems (USEPA 2012). As a result, PCBs are not expected to dissolve or migrate in groundwater. PCBs are soluble in oils and are able to migrate limited distances in soil or groundwater; however, oils containing PCBs also preferentially adsorb and are retarded by soils (USEPA 2009).

4.7.3 Site Remediation Activities – 2012 to Present

4.7.3.1 Soil Vapor Extraction (SVE)

In February 2012, a pilot test was conducted in by ARCADIS to evaluate SVE technology for removing subsurface VOCs and controlling the off-site migration of vapors at the site. Results of the pilot test were submitted to the WDNR in a report dated February 27, 2012 (ARCADIS 2012a). Following the pilot test, a full-scale SVE system was installed to address vapor migration in the northeast portion of the facility. The SVE system, which started continuous operation on March 9, 2012, includes nine SVE wells installed to depths ranging from 8 to 15 ft bgs and a carbon treatment system. The SVE system was designed to operate at a maximum flow rate of 288 standard cubic feet per minute and with a radius of influence of 35 ft for each extraction well. Monitoring data indicate the SVE system is operating as intended, and off-site vapor migration is being controlled.

4.7.3.2 Soil Remediation – 2012 to Present

Elevated concentrations of PCBs, PAHs, and VOCs have been detected in on-site and off-site soils (ARCADIS 2013b). WDNR has determined that remedial actions to address concerns regarding direct contact exposure will be conducted where required for VOCs and PCBs in soil at off-site residential properties (Schmoller Dep. 2012, Exhibit 30). WDNR sent a letter to Madison-Kipp dated December 7, 2012, requesting either a work plan for remediation of PAHs, or information documenting background levels of PAHs (WDNR 2012aa). Further studies have been conducted to investigate sources of PAHs in soils at the site in order to determine background levels of PAHs in soils (ARCADIS 2013a).

Remedial actions to address PCBs in on-site soils and further investigations to better define the subsurface extent of PCBs were proposed to WDNR in a final work plan dated December 4, 2012 (ARCADIS 2012u), and approved by USEPA and by WDNR in their December 5, 2012 letter. On-site soils containing PCB concentrations above 50 mg/kg were proposed to be excavated and disposed of at a TSCA-approved landfill. Excavation of shallow soils has recently been completed in two on-site areas in the north parking lot and near the eastern property boundary, where PCBs were previously found to exceed 50 mg/kg in shallow soils at depths of 0 to 2 ft bgs (ARCADIS 2013c). One excavation area, near soil boring B-40, was approximately 45 ft by 45 ft wide, while the another excavation area, near soil boring B-13, was approximately 125 ft by 25 ft wide. Soils in both areas were generally excavated to a depth of 2 ft, and up to 3 ft deep in some areas. The extent and depth of excavation was determined during excavation, in coordination with WDNR, based on confirmation soil samples collected throughout the excavation process to verify removal of soils meeting excavation criteria. Excavations have been backfilled with crushed stone and will be covered with asphalt, concrete, or 2 ft of clean fill.

For those areas where on-site soils contained PCB concentrations between 1 and 50 mg/kg, a combination of engineering and institutional controls (deed notification) will be utilized to address those soils that will remain in place. A Soil Management Plan, documenting the location of impacted soils, will provide procedures for handling any soils that may be encountered in possible future subsurface work in these areas. Institutional controls may include registration with the WDNR soil geographic information system, and/or a deed notification to notify current and future site owners regarding locations of impacted soil.

To further define the extent of PCBs in soils in the southwest portion of the site, additional investigations were completed in November 2011 on adjacent off-site residential properties (233 through 269 Waubesa Street), as described above.

4.7.3.3 Groundwater Remediation

In October 2012, ARCADIS submitted the *In-Situ Chemical Oxidation (ISCO) Groundwater Pilot Test Work Plan* (ARCADIS 2012t) for treatment of VOCs in groundwater plume. This pilot test, which was approved by WDNR (WDNR 2012z), was designed to determine the geologic and hydraulic design parameters necessary for full-scale remedial implementation and evaluating the effectiveness of ISCO as a potential groundwater treatment remedy. This pilot test will also provide critical information concerning aquifer characteristics such as fracture flow, hydraulics, bedrock storage capacity, and aquifer contaminant mass delineation. ISCO is a method of in-situ remediation that adds a chemical oxidant to the subsurface to break the carbon bonds in VOCs and allow complete degradation of chlorinated ethenes (e.g., PCE and TCE) to non-toxic compounds.

In accordance with regulatory requirements, ARCADIS submitted a *Request for a Temporary Exemption for Injection of Remedial Materials for an In-Situ Chemical Oxidation Groundwater Pilot Test* to WDNR on November 27, 2012 (ARCADIS 2012p). WDNR approved this temporary exemption on a letter dated December 7, 2012 (WDNR 2012dd), and approved Madison-Kipp's request for permit coverage for a general Wisconsin Pollutant Discharge Elimination System permit in a letter dated December 7, 2012 (WDNR 2012ee). Work on this pilot test began in December 2012.

4.8 Summary of Groundwater Monitoring Results

4.8.1 Site Groundwater Monitoring

Periodic site-wide groundwater monitoring has been ongoing since 1995. There are currently 58 groundwater monitoring wells, multi-port (MP) groundwater sampling wells, and pilot test injection wells (IW) at depths from 13 to 235 ft bgs on the Madison-Kipp property and in the surrounding area. Routine groundwater monitoring was initially conducted and reported on an annual basis, and a consistent monitoring schedule was established in 2006.

Groundwater monitoring wells have been grouped into the following general depth intervals based on the depths of well screens.

- Well screen intervals less than 50 ft bgs
  (MW-1, MW-2S, MW-2D, MW-3S, MW-4S, MW-5S, MW-6S, MW-7, MW-8, MW-9, MW-10S, MW-11S, MW-12S, MW-18S, MW-22S, MW-22D, MW-23S, MW-23D, MP13(44-48), and IW-1S)

- Well screen intervals from 50 to 75 ft bgs
  (MW-3D, MW-4D, MW-6D, MW-9D, MP13[67-71], and MP14[70-75])

- Well screen intervals greater than 75 ft bgs
  (MW-3D2, MW-3D3, MW-4D2, MW-5D, MW-5D2, MW-5D3, MW-17, MW-19D, MW-19D2, MW-20D, MW-20D2, MW-21D, MW-21D2, MP13[102-106], MP13[81-85], MP13[121-125], MP13[135-139], MP13[163-167], MP14[100-105], MP14[135-140], MP14[178-187], MP15[88-92], MP15[100-105], MP15[120-125], MP15[142-146],

MP15[183-187], MP16[80-84], MP16[106-116], MP16[140-144], MP16[175-179], IW2D, and IW2D2).

The following sections summarize the historical and recent groundwater conditions and monitoring results.

4.8.1.1 Groundwater Flow Directions

The lateral direction of shallow groundwater flow at the site has been variable. The lateral direction of shallow groundwater flow has been toward the north in the northernmost portion of the site; toward the northeast in the southwest corner of the site; and toward the south, southwest, and southeast beneath a majority of the site. The predominant direction of groundwater flow at the site, however, has consistently been downward from the shallow zone into deeper groundwater intervals throughout the site vicinity The lateral direction of deeper groundwater flow in the bedrock (at depths of 50 to 75 ft) has generally varied from northward in the northernmost portion of the site, to southeast and south-southwest in other areas of the site. The lateral direction of deeper groundwater flow in the bedrock (at depths more than 75 ft) has varied from north beneath portions of the site, to east to south-southwest. The lateral hydraulic gradient in this deeper zone has been very flat (0.0006 ft/ft in July 2010). Groundwater flows downward from shallow to deeper intervals in response to much greater vertical downward hydraulic gradients reported to range from 0.10 to 0.034 ft/ft.

4.8.1.2 Primary Constituents of Concern

The primary constituents of concern in groundwater are chlorinated VOCs, including PCE and the associated daughter products formed during biodegradation (TCE, DCE isomers, and vinyl chloride). Petroleum hydrocarbon compounds, including benzene (3,900 µg/L), have also been detected locally in monitoring wells in the southeastern portion of the site, near the location of a former gasoline service station on the site and another service station across Atwood Avenue where petroleum releases have occurred.

4.8.1.3 Extent of VOC-Impacted Groundwater

As a result of the varying directions of groundwater and the significant downward vertical hydraulic gradients and the significant downward vertical hydraulic gradients from shallow to deeper zones in the bedrock, the lateral extent of VOCs in shallow groundwater is limited and does not extend significant distances at the site. This is illustrated by the consistent and relatively limited lateral extent of VOCs in shallow groundwater, and the consistently low

VOC concentrations that have been found in downgradient shallow groundwater near the southern boundary of the Madison-Kipp property.

The extent of VOC contamination in the shallow groundwater interval is defined by the consistently low or nondetectable VOC concentrations found in off-site shallow groundwater monitoring wells. The highest VOC concentrations in shallow groundwater have consistently been found in the northern portion of the site, at MW-3S, where the PCE concentration was 1,600 µg/L in April 2012. However, VOC levels decrease rapidly in shallow groundwater with distance in all directions, and are very low in monitoring wells at the downgradient southern property boundary. In general, concentrations have also been stable or decreasing with time in shallow groundwater since well before 1994, and the extent of VOC-impacted groundwater in this interval has not increased significantly since that time.

The extent of chlorinated VOCs in groundwater at depths of 50 to 75 ft is defined in some locations by the relatively lower concentrations in MW-4D, MW-9D, MW-6D, and MW-9D. Lateral migration of VOC-impacted groundwater in this zone is also limited by the predominant downward flow of groundwater. Chlorinated VOC concentrations in groundwater wells in this interval have also remained relatively stable.

In the deep groundwater, investigations have been successful in generally defining the vertical extent of VOC-impacted groundwater in the deepest on-site monitoring wells (ARCADIS 2012j, 2013b). The maximum concentration of VOCs in this zone has been found in on-site monitoring well MW-3D2 (2,600 µg/L PCE in April 2012) at a depth of 76 to 81 ft bgs. Three additional deeper on-site monitoring wells (MW-3D3 from 214 to 224 ft bgs, MW-5D2 from 165 to 170 ft bgs, and MW-5D3 from 224 to 234 ft bgs) were installed to further define the vertical extent of VOCs in deep groundwater at the site. Sampling of these deeper wells in April and July 2012 revealed much lower VOC concentrations in MW-3D3 (6.6 µg/L), MW-5D3 (23 µg/L), and MW-5D2 (47 µg/L) than in shallower on-site wells.

4.9 City of Madison Water Supply Unit Well 8

City of Madison Unit Well 8 is located at 3206 Lakeland Avenue, approximately 1,500 ft southeast of the Madison-Kipp facility and 200 ft north of Lake Monona. Unit Well 8, which is used only seasonally, was constructed in 1945, is 774 ft deep, and obtains water from the Lower Bedrock Aquifer (sandstone) below the Eau Claire Aquitard (Ruekert/Mielke 2011). Bedrock was encountered below a thin layer of glacial and alluvial sediments at a depth of 110 ft bgs. The bedrock generally consists of sandstone, with an interval of lower-permeability siltstone and shale of the Eau Claire Formation (Eau Claire Aquitard) from 250 to 255 ft bgs. At the bottom of the well, low permeability clay was encountered from 760 to

774 ft bgs. The well has an annular seal and well casing extending from the surface to a depth of 280 ft bgs below the Eau Claire Aquitard and has an open borehole from 280 to 774 ft bgs. The Eau Claire Aquitard provides an important barrier to vertical movement of contaminants that might be present in the overlying Upper Bedrock Aquifer.

Unit Well 8, operated seasonally from June through September, has a design capacity of 1,800 gallons per minute and pumps to an adjacent storage reservoir. Other city wells are also available in this pressure zone in the event that Unit Well 8 is out of service.

A Wellhead Protection Plan (WHPP) report for Unit Well 8 was prepared in 2011 for Madison Water Utility (Ruekert/Mielke 2011). The WHPP describes regional groundwater conditions and presents results of regional groundwater flow modeling to evaluate zones of time-related potential contaminant contribution and protection for the well. The WHPP also includes a contaminant source inventory (CSI) of known and potential sources of contamination to the well. The CSI identified 51 known or potential sources of contamination in the wellhead protection area of Unit Well 8, including sanitary sewers, industrial sites, AST and UST sites, spill sites, landfills, solid waste sites, electrical transformers, remediation sites, RCRA sites, road salt use, and the use of pesticides and herbicides throughout the area.

The WHPP concludes that the general direction of groundwater flow in 2000 was toward Unit Well 8 from the east, northeast, and southwest (Ruekert/Mielke 2011). Routine sampling of Unit Well 8 conducted since at least 1990 has detected only very low concentrations of cis-1,2-DCE (approximately 0.25 µg/L), less than the laboratory reporting limit and far less than the MCL (70 µg/L) (WGNHS 2011). PCE has not been detected in water from this well. Sampling has also detected viruses in the water from this well, indicative of contamination from nearby near-surface sources. Based on these findings, WGNHS concluded that the very low levels of cis-1,2-DCE levels in this well were not increasing, and that this well is “vulnerable” to contamination (WGNHS 2011) from multiple nearby surface sources.

4.10 Summary of Soil Vapor Monitoring and Mitigation

Monitoring of chlorinated VOCs in soil vapor was initiated in 2004. Four vapor probes (VP-1S, VP-2S, VP-1N, and VP-2N) were installed along the east property boundary, near the loading dock where the highest VOC concentrations were found in on-site soils. PCE was detected in soil vapor at concentrations up to 48 ppmv. These probes were periodically sampled from 2004 to 2005, indicating that PCE concentrations in soil vapor were generally declining (RSV 2005).

In response to a WDNR letter dated September 2006, additional soil vapor monitoring probes were installed on three adjacent residential properties (WDNR 2006). Vapor sampling results in 2006 showed somewhat higher PCE concentrations in the on-site area; however, only low or nondetectable PCE concentrations were found in soil vapor on the residential properties. Sampling in April 2007 indicated significantly lower PCE concentrations in soil vapor from on-site and off-site locations (RSV 2009).

From 1994 to approximately 2010, soil vapor samples were analyzed for VOCs using standard laboratory procedures and detection limits under the oversight of the WDNR. The results indicated generally low or nondetectable VOC concentrations in most soil vapor samples. Based on these findings, RJN and RSV recommended no further off-site soil vapor sampling (RJN 2009; RSV 2009). Subsequently, however, soil vapor samples collected from on-site and off-site areas were analyzed for VOCs using lower laboratory detection limits, resulting in a greater number of detections and an increased number of VOCs in soil vapor in the on-site and off-site areas (Schmoller Dep. 2012, p. 187). Technical discussions occurred in 2010 and 2011 with WDNR regarding the significance of low VOC concentrations in sub-slab soil vapor samples and the need for further on-site and off-site soil vapor sampling (Schmoller Dep. 2012, pp. 194-195, 205).

The WDNR project manager has testified that the agency was not concerned with vapor intrusion and off-site vapor migration until sometime between 2010 and late 2011 (Schmoller Dep. 2012, p. 206). In 2010, soil vapor samples were collected beneath certain residences, indicating elevated concentrations of PCE. In spring 2011, soil vapor probes were installed at 146, 150, 154, 162, and 166 South Marquette Street. Since 2011, soil vapor samples have been collected from off-site residential properties. PCE has been detected in two areas along the Madison-Kipp property line at concentrations up to 4.6 ppmv.

In April 2012, soil vapor probes were installed along the bike path located north of the site. Sampling results of the vapor samples indicated that none of the samples contained VOC concentrations above the non-residential sub-slab screening levels.

WDNR has recently concluded that no further sampling of soil vapor is planned to be required in the areas east of South Marquette Street, west of Waubesa Street, or on Dixon Street (Schmoller Dep. 2012, p. 224).