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RCRA Corrective Action

Corrective Measures Proposal

Former GM Delco Plant 5, Kokomo, IN

USEPA ID IND000806844

Prepared for:

RACER Trust

December 6, 2011

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Acronyms

AOI	Area of Interest
ASML	Above Mean Sea Level
AWC	American Water Company
bgs	below ground surface
cfs	cubic feet per second
cm/sec	centimeter/second
CMP	Corrective Measures Proposal
DOCC	Document of Current Conditions Report
ERH	Electrical Resistivity Heating
FLUTe	Flexible Liner Underground Technologies
F	Fahrenheit
ft	Feet
ft/day	feet per day
GM	General Motors Corporation
HI	Hazard Index
IAWC-NWF	Indiana American Water Company – Northwest Well Field
IAWC-SWF	Indiana American Water Company – South Well Field
IDEM	Indiana Department of Environmental Management
IDNR	Indiana Department of Natural Resources
MCL	Maximum Contaminant Level
MLC	Motors Liquidation Company
RACER	Revitalizing Auto Communities Environmental Response
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
SAA	Satallite Accumulation Area

SWWF	Significant Water Withdrawal Facility
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	Volatile Organic Compound
WH-OL	Wellhead Overlay
WR-OL	Well Restriction Overlay

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1 Introduction

1.1 General

ARCADIS U.S., Inc. (ARCADIS) has prepared this Resource Conservation and Recovery Act (RCRA) Corrective Measures Proposal (CMP) on behalf of RACER Trust (RACER) for the former GM Delco Plant 5 facility located at 1723 North Washington Street, Kokomo, Indiana (Drawing 1).

The United States Environmental Protection Agency (USEPA) and General Motors Corporation (GM) entered into a performance-based RCRA Corrective Action Agreement (Agreement) in March 2006. Pursuant to the Agreement, GM had worked in cooperation with USEPA to investigate releases of hazardous wastes or hazardous constituents at or from the Former GM Delco Plant 5 (the Facility) located in Kokomo, Indiana (USEPA ID IND000806844). As a result of GM's June 2009 bankruptcy, existing, non-continuing assets remain the property of "old" GM, which changed its name to Motors Liquidation Company in its capacity as a debtor-in-possession in the bankruptcy case. On March 31, 2011 the Revitalizing Auto Communities Environmental Response (RACER) Trust became effective. On that date, all assets and cleanup funding that had been the responsibility of MLC were transferred to RACER Trust. RACER Trust has responsibility for completing the Corrective Action activities at this Facility in accordance with the Cost Estimate and Settlement Agreement that are the basis for the Trust.

GM conducted a RCRA Facility Investigation (RFI) to investigate the areas of interest (AOIs) identified in the Facility's Description of Current Conditions (DOCC) (ARCADIS, 2005a) for the presence of releases of hazardous waste or hazardous constituents that could pose an unacceptable risk to human health and/or the environment. A table presenting the AOIs investigated is presented as Table 1. The RFI was conducted in accordance with an RFI Work Plan (ARCADIS, 2005b). Supplemental data work plans for additional phases of field investigation were submitted to the USEPA (see Section 7.0 – References). The final RFI Report (ARCADIS, 2010), which incorporated comments from USEPA, was submitted by MLC on March 31, 2010. An aerial photograph of the site and surrounding area is presented as Drawing 2. A drawing showing the AOIs and the sample locations is presented as Drawing 3. Documents submitted to USEPA during the Corrective Action activities have also been provided to the public repository, Kokomo-Howard County Public Library, located at 220 N. Union Street, Kokomo, Indiana. A listing of the documents submitted to the public repository as of the date of this report is presented in Table 2.

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This CMP describes the proposed Corrective Measures for the Facility. The details on the selection of the proposed Corrective Measures are provided in Section 5. USEPA will select the final Corrective Measures for the Facility after a public comment period. This CMP references information that can be found in the RFI Report (ARCADIS, 2010) and in other documents submitted to the USEPA during the RCRA Corrective Action process and are cited herein. A public repository of documents prepared as part of the RCRA Corrective Action has been maintained at the Kokomo Public Library located at 220 North Union Street, Kokomo, Indiana.

1.2 Report Organization

The remainder of this Report is organized as follows:

- Section 2 provides a summary of the proposed Corrective Measures.
- Section 3 provides a summary of the Site background information, a summary of groundwater modeling, an overview of the RFI including a summary of the areas investigated during the RFI, and a summary of the risk assessment.
- Section 4 provides a summary of the Corrective Measures alternatives.
- Section 5 provides an evaluation of the Corrective Measures against the nine corrective measures criteria and includes a sustainability evaluation.
- Section 6 presents the proposed Corrective Measures.
- Section 7 lists references identified in this report.
- Tables, figures, and appendices follow the text.

2 Proposed Final Corrective Measures

The proposed Final Corrective Measures for this Facility are discussed in detail in Section 4.1 (Soil), 4.2 (Groundwater) and 4.3 (Facility-wide) and include:

1. Implementation of land use restrictions for the entire Facility to ensure that the human health risk assessment assumptions regarding future on-site land use remain valid. Specifically, the Facility will be limited to commercial/industrial uses and groundwater use will be prohibited.

2. Implementation of a Well Restriction Overlay District to ensure that no new groundwater use wells will be installed in a designated area around the Facility.

3. Implementation of corrective measures to address soil contamination at or above a threshold treatment concentration of 400 milligrams per kilogram (mg/kg) of trichloroethene (TCE). The threshold treatment concentration was selected to 1) address areas (at and around soil borings SB-0746, SB-0749, SB-0756, SB-0757 and SB-0775) which indicated the potential for significant future exposure via vapor intrusion, and 2) address soil that could continue to leach TCE to groundwater at a rate that would create a TCE groundwater concentration of 1,000 micrograms per liter (µg/L) or higher. Corrective measures will consist of soil treatment with calcium oxide. A Work Plan will be submitted to USEPA prior to implementation.

4. Implementation of corrective measures to address groundwater contamination at or above a threshold treatment concentration of 4,000 µg/L of TCE. Corrective measures will consist of groundwater treatment using in-situ chemical oxidation. A Work Plan will be submitted to USEPA prior to implementation.

5. Implementation of groundwater and soil gas monitoring. Selected monitoring wells and soil gas ports at and in the vicinity of the Facility will be sampled semi-annually for two years to evaluate concentration trends in groundwater and evaluate the soil gas to confirm the conclusions of the RFI that potentially significant exposure is not occurring. The number of wells/soil gas ports included and frequency of monitoring will be evaluated after two years and may be terminated or extended considering need and available funding. RACER Trust will coordinate modifications to the monitoring plan with USEPA.

3 Facility Background

3.1 Facility Location

The Facility is bounded by Butler Street to the north, beyond which are residential and industrial properties; by an abandoned industrial property to the south (former Midwest Plating Corporation); a railroad to the west, beyond which are residential and

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commercial properties; and North Washington Street to the east, beyond which are residential properties.

The majority of the Facility is a vacant grass field with the exception of a 4.31-acre parking lot and abandoned road in the northern portion of the property. Figure 5 of the DOCC shows an overview of the land cover at the Facility. The abandoned road (Spraker Street) separates the parking lot on the north side of the property from the vacant grass field comprising the remainder of the property.

3.2 Climate

The Howard County climate is influenced by the Great Lakes and has a continental climate. Cool air from Canada collides with warmer air to from the south to bring changes in the climate within days and creates a variability of the seasons.

Frequent weather changes come from the passing of weather fronts and associated low and high centers of air pressure across the region. Winds are typically from the southwest, but during the winter months are dominantly from the northwest. The average daily temperature is 53.1º Fahrenheit (F). The average annual daily low temperature is 20.7º F in January. The average annual daily high temperature is 89.3º F in July.

The total annual precipitation for the county is 37.18 inches. Average annual snowfall is 23.7 inches. Average annual lake evaporation for the area is about 33 inches (United States Department of Agriculture 1971).

3.3 Surface Water Hydrology

There are no surface water bodies in the immediate vicinity of the Facility. The nearest major surface water body is Wildcat Creek, which is located approximately 1.5 miles south of the Facility and flows in a west-southwest direction.

The Wildcat Creek is a major tributary of the Wabash River in north central Indiana. Wildcat Creek consists of three main forks: North, South, and Middle, with two major tributaries: the Little Wildcat Creek and the Kokomo Creek. All forks flow in a general east-west direction through flat to gently rolling glacial plains which have been slightly modified by stream erosion (Smith 1985). Land uses of drainage basin include, cropland, pasture, forest and residential and industrial developed areas.

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The Wildcat Creek is one of the principal streams flowing through the outwash aquifer in Howard County. Wildcat Creek is a gaining stream. The surface water flow in the creek is influenced by groundwater infiltration, as well as by treated sewage discharge, diversion of surface water, lowhead dams, and two reservoirs located east of Kokomo (Smith 1985). The arithmetic mean annual discharge of Wildcat Creek (USGS Station 03333700, located on Wildcat Creek near the intersection of W. Markland Ave and S, Berkley Rd) as calculated by the United States Geological Survey from 1956 to 1982 is 230 cubic feet per second (cfs), and the seven day, ten year low flow (7Q10) of the creek is 12 cfs. (http://waterdata.usgs.gov/nwis/uv?03333600).

3.4 Geology and Hydrogeology

The Facility is located in Howard County, Indiana and the generalized elevation is approximately 826 feet above mean sea level, with the land surface being relatively flat. The Facility is located in the Upper Wabash Basin. The Facility lies within the Bluffton/Tipton Till Aquifer System physiographic unit (Scott 2008). The topography of this unit resulted from Pleistocene time Wisconsinan glacial advances (Wayne 1996). The regional geology of the area around the Facility consists of approximately 80 feet of alluvial and glacial deposits overlying sedimentary carbonate bedrock (Fenelon 1994). The Pleistocene glacial drift is characterized by clay tills and stream deposits consisting largely of sand and gravel. The discontinuous sand and gravel deposits are interspersed within the clay tills (Smith 1985).

3.4.1 Unconsolidated Deposits

According to the United States Department of Agriculture (USDA) *Soil Survey of Howard County*, the soil type at the Facility is classified as the Crosby Series and specifically the Crosby silt loam. The Crosby Series is described as poorly drained soils that formed in thin deposits of loess and in underlying glacial till. Runoff is very slow with a 0 to 2 percent slope. Typically, this soil has a high water capacity and a low permeability.

Geologic cross-sections and a cross-section reference drawing are presented as Drawings 3 through 6 of the RFI Report. Three sand units separated by clay layers have been identified at the Facility and have been designated units S1 through S3, with unit S1 being the shallowest and unit S3 being the deepest.

Sand unit S1 is the uppermost continuous water-bearing unit, and consists primarily of sand and gravel. Groundwater within the S1 unit is under confined conditions. The S1

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unit is generally encountered between approximately 10 to 25 ft below ground surface (bgs) (816 to 801 ft AMSL), and ranges in thickness from 1 ft near the southeastern margins of the investigated area and 35 ft near the center of the former operations area. Refer to cross sections provided on Drawings 4 and 6 of the RFI Report, and the isopach map of the S1 unit provided on Drawing 7 of the RFI Report.

Underlying the S1 unit is a hard clay (till), which has an approximate range in thickness of 10 to 40 ft. Underlying this hard clay (till) is the S2 unit, which is comprised of poorly sorted sands and gravels, and is generally encountered at 50 ft to 55 ft bgs. The S2 unit is fully saturated, and under confined conditions. The S2 unit ranges in thickness from 20 ft near the center of the Facility to 1.5 ft near the southeastern margins of the investigated area. The S2 unit ultimately pinches out, and is not present south of the Facility. Refer to cross sections provided on Drawings 4, 5, and 6 of the RFI Report and the isopach map of the S2 unit provided on Drawing 7 of the RFI Report.

The S3 unit is a deeper water-bearing unit that sits directly on top of the carbonate bedrock and is found exclusively in the northern portion of the investigated area at MW-0501-S3U. The S3 unit is separated from the S2 unit by 9 ft of a hard gray clayey silt, and is encountered at a depth of approximately 85 ft, with a thickness of 7 ft.

The potentiometric surface at the Facility is located at approximately 812 ft AMSL in the S1 unit and 808 ft AMSL in the S2 and S3 units (Refer to Drawings 9 through 11 of the RFI Report).

In addition to the sand units discussed above, several discontinuous pockets of sand were identified at various depths at the Facility. In general, these discontinuous sands were present either above the S1 unit (monitoring wells set within this upper discontinuous sand have a suffix “P1” assigned to the monitoring well identification) or between the S1 and S2 units (monitoring wells set within this intermediate discontinuous sand have a suffix “I2” assigned to the monitoring well identification). Examples of these discontinuous sand units can be seen on cross-sections provided on Drawing 4 of the RFI Report.

3.4.2 Bedrock Geology

Bedrock is encountered at a depth of approximately 85 ft bgs (741 ft AMSL) on the northern part of the Facility and approximately 60 ft bgs (766 ft AMSL) immediately south of the Facility. The bedrock surface continues to rise closer to the ground surface as you move south towards Wildcat Creek (see Drawing 8 of the RFI Report).

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Based on a review of available literature, the regional bedrock at the Facility is limestone and dolomite in the Wabash Formation of the Silurian System (Drawing 8 of the RFI Report). The thickness of the limestone and dolomite is approximately 375 feet thick (Fenelon 1994). Regionally, the Wabash limestone and dolomite has a sharp basal contact with underlying limestone and interbedded shale of the Ordovician System. Site-specifically, the presence of a weathered bedrock zone consisting of mechanically fractured parent limestone angular clasts imbedded and cemented within a lime mud matrix is encountered at the interface between the unconsolidated deposits and the bedrock. Throughout the Facility, the weathered bedrock zone ranges from 3 ft to 49 ft in thickness and is encountered at an elevation varying between 754 and 768 ft above mean sea level (AMSL). Based on boring logs from the Facility, water supply well records, and available literature, the local bedrock beneath the Facility is the Kokomo Limestone Member of the Wabash Formation. Characteristically, this dolomitic limestone is micritic with alternating thin bands of light gray and tan laminations. Across the Facility, interformational breccias have been observed that consist of vuggy limestone with increased fossilization that includes coral and sponge relicts and clasts. These features are associated with shallow subtidal to intertidal depositional environments (Tollefson 1979). These features can be readily identified in the rock core obtained and documented in the bedrock boring log from MW-0616-B1A. In general, it has been observed that the weathered bedrock zone exhibits increased fractures, crevices, and dissolution weathering features along joints and bedding planes, but the dolomitic limestone becomes increasingly competent (massive) and less vuggy with increased depth. These observations indicate that the majority of the hydrologic transmissivity is associated with the weathered, upper bedrock zone. This observation was confirmed by a series of hydrogeologic investigations that were performed, from August 2007 to November 2008, in order to identify major hydraulic pathways within the upper bedrock unit (discussed in more detail in Section 3.4.3).

3.4.3 Facility Hydrogeology

Regional groundwater flow in the unconsolidated saturated sand units is generally southeast towards Wildcat Creek in S1, and is divided and flows both south and northwest in S2. The divided nature of groundwater flow in the S2 unit represents a change in condition since the RFI, when groundwater flow in the S2 unit was southeast. A public water supply well field known as the northwest well field (IAWC-NWF) is located approximately 1.5 miles northwest (upgradient) of the Facility. The IAWC-NWF, which began operating in 2007, and has wells screened in the S2 and S3 sand units, appears to have an influence on groundwater flow at the Facility. Within

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the S1 and S2 sand units, the groundwater is under confined conditions due to the overlying clay till deposits.

The local potentiometric surface in the S1 unit is presented on Drawing 9 of the RFI Report. These groundwater elevation contour maps are based on depth to water measurements collected on March 8, 2007, November 11, 2008, February 17, 2009 and July 12, 2009, and illustrates the potentiometric surface of the first encountered saturated confined sand and gravel unit (unit S1). These potentiometric surface maps suggest that groundwater within the S1 unit flows toward the southeast. The S1 potentiometric surface at the Facility ranges from approximately 812 ft AMSL (November 11, 2008) and 817 ft AMSL (December 5, 2006). The local potentiometric surface in the S2 unit is presented on Drawing 10 of the RFI Report and is based on groundwater level measurements collected on March 8, 2007, November 11, 2008, February 17, 2009 and July 12, 2009. Sand unit S2, the second encountered saturated confined sand and gravel unit, has a shallow gradient, and has historically demonstrated a groundwater flow direction toward the southeast, as is illustrated in March 8, 2007. However, since November 11, 2008, the potentiometric surface suggests that groundwater flow within the S2 unit is divided and flows both south and northwest. The S2 unit potentiometric surface at the Facility ranges from 808 ft AMSL (November 11, 2008) to 816 ft AMSL (March 8, 2007). Regional groundwater flow within the bedrock unit is generally southeast towards Wildcat Creek. Potentiometric surface maps for the bedrock unit are provided as Drawing 11 of the RFI Report and are based on groundwater level measurements collected on March 8, 2007, November 11, 2008, February 17, 2009 and July 12, 2009.

An evaluation of groundwater uses at and in the vicinity of the Facility was performed and submitted to USEPA in April 2009 (Appendix F of the RFI Report). The evaluation included discussions of significant water withdrawal facilities relative to contaminant delineation and flow characteristics.

Based on the variable hydraulic gradient observed in sand unit S2, a groundwater potentiometric surface study was conducted at the Facility using pressure transducers placed within three monitoring well nests. Based on the results of the study (Appendix E of the RFI Report), groundwater flow direction in the S2 sand unit at the Facility flows from a divide in the central portion of the Facility toward the south and varying from the northeast to northwest. The northern flow components that were observed between the March 2007 and November 2008 monitoring events is believed to result from pumping activities at the municipal well field located to the northwest of the Facility that began pumping in April 2007.

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The hydrogeologic characteristics beneath the Facility have been assessed using data collected from a variety of field investigation techniques coupled with available published literature. From 1979 through 1982, the United States Geological Survey (USGS) completed a study of the availability of water from the confined sand and gravel units beneath Howard County (Smith 1985). The USGS averaged a total of 54 hydraulic conductivities in Howard County for an average hydraulic conductivity of 200 feet per day (ft/day), based on lithologic data (Smith 1985).

In November 2006, ARCADIS conducted slug tests on select monitoring wells to evaluate the saturated hydraulic conductivity of the S1, S2 and B1 units. The data collected was analyzed using AQTESOLV© aquifer test analysis software. The Bower and Rice and Butler 1998 methods were used to estimate hydraulic conductivity of the tested units. The estimated hydraulic conductivity for the S1 unit ranged from 4.91 x 10^{-3} centimeters per second (cm/sec) (13.9 ft/day) to 4.70 x10^{-2} cm/sec (133 ft/day). The average hydraulic conductivity of the S1 unit was 2.97 x 10^{-2} cm/sec (84.1 ft/day) and was generated by calculating the average of all test results (see Table 3.4.1 of the RFI Report). This hydraulic conductivity suggests well sorted sands and glacial outwash (Fetter 1994).

The estimated hydraulic conductivity for the S2 unit ranged from 6.09 x 10^{-4} cm/sec (1.73 ft/day) to 1.01 x 10^{-1} cm/sec (288 ft/day). The average hydraulic conductivity of the S2 unit was 4.84 x 10^{-2} cm/sec (137 ft/day) and was generated by calculating the average of all test results (Table 3.4.1 of the RFI Report). This hydraulic conductivity suggests well sorted sands and glacial outwash to silt, sandy silts and clayey sands (Fetter 1994).

The estimated hydraulic conductivity for the B1 unit ranged from 1.53 x 10^{-3} cm/sec (4.35 ft/day) to 4.85 x 10^{-2} cm/sec (138 ft/day). The average hydraulic conductivity of the B1 unit was 1.95 x 10^{-2} cm/sec (55.3 ft/day) and was generated by calculating the average of all test results (Table 3.4.1 of the RFI Report). This hydraulic conductivity is consistent with that of carbonate rocks.

Using historic groundwater elevation data, the hydraulic gradient beneath the Facility has been estimated and is provided in Table 3.4.1 of the RFI Report. Estimated total volume discharge (per unit width of saturated unit) and groundwater flow velocity is calculated and provided in Table 3.4.1 of the RFI Report for each of the abovementioned hydraulic conductivities.

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In order to identify major hydraulic pathways within the limestone bedrock, an additional series of aquifer tests were designed and performed from August of 2007 through August of 2008 on the following open bedrock boreholes: MW-0503-B1a, MW-0615-B1a, MW-0616-B1a and MW-0701-B1a. These tests involved the use of packer interval testing and Flexible Liner Underground Technologies (FLUTe) hydraulic profiling techniques. Details of both the packer interval testing and FLUTe hydraulic profiling, along with the results obtained, were presented in a series of technical memorandums sent to the USEPA (*Evaluation of Packer Testing versus FLUTe Hydraulic Profiling (ARCADIS 2007d)*, *Vertical Profiling of Flow Zones and Groundwater Contaminant Concentrations in Bedrock (ARCADIS 2008a)*, *Open Borehole Installation and Transmissivity Testing (ARCADIS 2008c),* and *Open Borehole Installation, Transmissivity Testing, and Isolated Packer Sampling (ARCADIS 2008d*). Based on the data collected between August 2007 and November 2008, the following zones were identified as potential groundwater flow pathways:

- MW-0503-B1A demonstrated relatively greater hydraulic conductivity in the following zones: 85.7 ft to 90 ft bgs, 122 ft to 127ft bgs, and 146 ft to 152 ft bgs,

- MW-0615-B1A demonstrated relatively greater hydraulic conductivity in the following zones: 80 ft to 90 ft bgs, 93 ft to 103 ft bgs, and 103 ft to 113 ft bgs,

- MW-0616-B1A demonstrated relatively greater hydraulic conductivity in the following zones: 110 ft to 117 ft bgs, 117 ft to 127 ft bgs, 127 ft to 137 ft bgs, and 137 ft to 150 ft bgs, and

- MW-0701-B1A demonstrated relatively greater hydraulic conductivity in the following zones: 88 ft to 98 ft bgs and 98 ft to 108 ft bgs.

A summary of hydrogeologic data at the Facility (i.e. hydraulic conductivity, gradient and calculated groundwater flow velocities) is provided as Table 3.4.1 of the RFI Report. Additionally, a table summarizing vertical gradients between selected monitoring well pairs (i.e. S1 unit to S2 unit and S2 unit to B1 unit) is provided as Tables 3.4.2 and 3.4.3 of the RFI Report.

3.5 Water Supply

Groundwater is not currently used at the Facility for potable or non-potable purposes. The expected future use of groundwater at the property is consistent with the current

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use and will be maintained via a deed restriction placed on the property and the establishment of a Well Restriction Overlay (WR-OL) District for the area, if possible. The WR-OL District is established and enforced by the City of Kokomo to protect the community from groundwater contaminated with chemicals. The WR-OL District restricts the drilling of water wells that may bring contaminated groundwater to the surface. These two controls (deed restriction and WR-OL District) are components of the proposed Corrective Measures.

A review of the available water well records maintained by the Indiana Department of Natural Resources (IDNR) was conducted during the RFI to identify any wells in the area surrounding the Facility. All available well construction logs were examined. The search included both low capacity wells (<70 gallons per minute [gpm]) and high capacity wells (>70 gpm) within a 1/2-mile radius. Subsequently a separate review was conducted during preparation of a groundwater model, which included a review of significant water withdrawal facilities (SWWFs) within Cass, Howard and Miami Counties. Additional information regarding the SWWFs during the model preparation is presented in Appendix A.

A total of ten water well records were identified within a ½ mile radius of the Facility. Five of the ten were identified as low capacity wells, and the other five are classified as high capacity wells. Complete details including water well locations and current status (i.e., active, inactive, etc) of identified water wells is provided as Appendix C of the RFI Report. The following is a summary of the known status of currently identified water wells:

- All five of identified low capacity water wells are known to be abandoned, no longer utilized, or used for manufacturing purposes only.

- Two of the five identified high capacity water wells are known to be utilized for manufacturing purposes only.

- The status (i.e., active or inactive) for three of the five high capacity wells is not currently known; however, the following information is known:

    - Based on records provided by Indiana American Water Company (AWC) (municipal water supplier for the City of Kokomo), the property where high capacity water well 168105 is located, receives a water bill. Further, the approximate location of this water well is 1,200 ft southwest of the Facility. The total depth of the well is 360 feet, with

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casing installed to a depth of 65 feet and the remaining 295 feet consisting of open borehole. No information was found regarding the depth at which the pump is set, but is likely set at a depth greater than 70 feet. The identified depth of groundwater impacts identified during the RFI was approximately 40 feet. Because the casing depth is greater than the depth of impacts and the well is located over 1,000 feet from the Facility, no further investigation is warranted at this time regarding this high capacity water well.

- High capacity water well 127486 is believed to be located approximately 1,500 to the northeast of the Facility. The total depth of the well is 160 feet, with casing installed to a depth of 85 feet and the remaining 75 feet consisting of open borehole. No information was found regarding the depth at which the pump is set, but is likely set at a depth greater than 90 feet. The identified depth of groundwater impacts identified during the RFI was approximately 40 feet. Because the casing depth is greater than the depth of impacts and the well is located over 1,000 feet from the Facility, no further investigation is warranted at this time regarding this high capacity water well.

- High capacity water well 127556 is believed to be located approximately 1,200 ft to the east of the Facility. The total depth of the well is 523 feet, with casing installed to a depth of 83.5 feet and the remaining 439.5 feet consisting of open borehole. No information was found regarding the depth at which the pump is set, but is likely set at a depth greater than 85 feet. The identified depth of groundwater impacts identified during the RFI was approximately 40 feet. Because the casing depth is greater than the depth of impacts and the well is located over 1,000 feet from the Facility, no further investigation is warranted at this time regarding this high capacity water well.

In addition to reviewing available records maintained by the IDNR, the following additional steps were completed to determine water uses in the vicinity of the Facility:

- Visually inspected 124 properties surrounding the Facility for the presence of a water well,

- Contacted the AWC to determine whether the 124 inspected properties received water bills, and

- Completed additional visual inspections at properties identified as not receiving water bills.

The following summarizes the results of these activities:

- 123 of the 124 inspected properties were either confirmed to be receiving a water bill from AWC or were determined to be a vacant lot.

- The one remaining location (1936 North Washington Street (The Beetle Shop)) was identified as not receiving a water bill from AWC. Several attempts to contact the Beetle Shop were made, but no response to-date has been received. However, based on conversations with a neighboring property owner, it is believed that this address is rarely occupied and is used primarily as storage. Additionally a water meter was noted in front of this building. Based on this property's proximity to the Facility and known groundwater impacts, the fact that no record of a registered water well (high or low capacity) with the IDNR is associated with this property, and the additional information gathered, no further investigation is warranted at this time regarding water use at this property.

Two municipal well fields were identified at a distance greater than ½-mile from the Facility. The south well field (IAWC-SWF) is located approximately 1.2 miles southeast (downgradient) of the facility and the northwest well field (IAWC-NWF) is located approximately 1.5 miles northwest (upgradient) of the Facility. The northwest well field, which began operating in 2007 and has wells screened in the S2 and S3 sand units, appears to have an influence on groundwater flow in the S2 and S3 units at the Facility. Pre-2007 groundwater flow direction in the S2 unit in the vicinity of the Facility was to the south.

Based on communication with the IDNR, the Facility is not located within a wellhead protection area (IDNR 2009). Based on communication with the AWC, the Facility is not within the 5-year or 10-year time of travel for either of the two municipal water well fields in Kokomo (see Drawing 1 of the RFI Report for these municipal well field locations).

A water tower was previously located on-site; however, there is no evidence of a historical water supply well on-site and no construction logs are available. Most likely, water from the water tower, including potable water, was supplied by AWC. A

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combined sanitary/storm sewer system is located along North Washington Street; however, the Facility does not currently generate sanitary wastewater.

3.6 Groundwater Modeling

A groundwater flow and solute transport model was developed as part of the corrective measures study for the Facility. Specific objectives of the groundwater flow and solute transport model were to:

1. Estimate the migration distance of existing site-related concentrations of trichloroethene (TCE) and its breakdown products in the groundwater at concentrations exceeding MCLs. This analysis served as the basis for refining the area that will be proposed for a WR-OL District, which is one of institutional controls proposed for groundwater management at the Facility.

2. Evaluate the potential future contribution of the Facility groundwater, if any, to the well fields.

3.6.1 Model Code and Model Domain

The code MODFLOW, a publicly available groundwater flow simulation program developed by the United States Geological Survey (USGS; McDonald and Harbaugh 1988), was selected to develop the groundwater flow model. The code MT3D (Zheng and Wang 1999) was used for the solute transport simulations. Both MODFLOW and MT3D are thoroughly documented; widely used by consultants, government agencies, and researchers; and are consistently accepted in regulatory and litigation proceedings. In addition, MODPATH (Pollock 1989) was also utilized in the modeling effort to conduct well field capture zone analysis. MODPATH is a particle tracking post-processing package that was developed for three-dimensional flow paths using output from groundwater flow simulations. It uses a semi-analytical tracking scheme that allows an analytical expression of the particle's flow path to be obtained within each finite-difference grid cell. MODPATH is one of the most widely-used particle tracking programs in delineating capture zones.

The numerical model consists of 201 rows, 272 columns, and eight layers which covers an area of approximately 9 miles by 20 miles. The model row and column widths vary throughout the model domain, with cell size being 50 ft by 50 ft in the vicinity of the city of Kokomo, and expanding to 500 ft by 500 ft towards the periphery of the model (Appendix A Figure A-11). This areal extent is considered sufficient to evaluate the regional flow regime for the objectives of this model, based on: 1.) the significant influence of hypothetical groundwater pumping modeled by Smith et. al., where drawdown was predicted to extend up to 4 miles from a pumping well, and, 2.) the distance to available stream boundary conditions, Deer Creek and Wildcat Creek, to the north and south, respectively. Vertically, there are eight layers in the numerical model. Layer elevations are based on saturated unit (S1, S2 and S3 units) and bedrock topography and thickness from Smith et al. (1985). The layer elevations were adjusted from those in Smith et al. in the vicinity of the Facility based on site-specific information.

3.6.2 Model Calibration

A flow model calibration for steady-state conditions was conducted to quantitatively match simulated potentiometric heads within each saturated unit (S1, S2, S3 and B1) to observed values presented in Smith et al. (1985). Residual statistics for the calibrated groundwater flow model indicate an acceptable agreement between simulated and measured groundwater elevations. Further, the flow model was calibrated under transient conditions using heads and gradients within each saturated unit (S1, S2 and S3) collected during the potentiometric study completed while the IAWC-NWF was operational (ARCADIS 2009). Finally, a qualitative solute model calibration was completed by comparing the distribution of TCE and cis-1,2-dichloroethene (cis-1,2-DCE) following 30 years of simulated transport with an initialized TCE plume in S1, based on the groundwater flow velocities of steady-state flow model (which excludes the effects of pumping at the IAWC-NWF), with the current observed distribution of each constituent (June 2009 conditions). Solute transport parameters were adjusted to match observed and predicted TCE and cis-1,2-DCE plume footprints and approximate concentrations. Calibrated transport parameters are summarized in Appendix A Table A-4. The details regarding the groundwater flow and solute transport model calibration are discussed in Appendix A.

Note that vinyl chloride has been detected at concentrations exceeding its MCL in groundwater samples collected from onsite and offsite monitoring wells. The maximum detected vinyl chloride concentrations are 150 µg/L, 4.1 µg/L and 3.6 µg/L, in units S1, S2 and B1, respectively. The relatively high vinyl chloride concentrations are measured in S1 unit only, where COC plumes are expected to be relatively stable. The majority of the COC transport is expected to occur in unit S2, where the detected concentrations of vinyl chloride are low compared to those of TCE and cis-1,2-DCE in S2 unit, indicating that the degradation of cis-1,2-DCE to vinyl chloride is not significant in S2 unit. Accordingly, as a conservative approach, degradation of cis-1,2-DCE to vinyl

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chloride was included using a relatively long half-life (i.e. slow degradation rate), which would not result in significant vinyl chloride concentrations. This agrees with the available data, as concentrations of vinyl chloride have not been observed in the S2 unit greater than 4.1 ug/l.

3.6.3 Model Simulations

Once the groundwater flow and solute transport models were calibrated, predictive solute fate and transport simulations were completed to evaluate the migration of both TCE and cis-1,2-DCE in response to pumping at the IAWC-NWF. Major solute transport parameters that will affect TCE and cis-1,2-DCE migration distance include: TCE source area initial concentrations, retardation factors for TCE and cis-1,2-DCE, half lives of TCE and cis-1,2-DCE, and IAWC-NWF pumping rates. To assess the sensitivity of these parameters and provide a conservative basis to estimate the WR-OL District, six model simulations were conducted for 50 years to represent six different scenarios, as summarized below (Table A-4 in Appendix A provides the major fate and transport input parameters for each scenario.):

- Scenario 1: Calibrated Solute Transport Parameters and IAWC-NWF Pumping at Average Rates
- Scenario 2: Reduced Retardation Factors and IAWC-NWF Pumping at Average Rates
- Scenario 3: Reduced Retardation Factors, No Degradation of cis-1,2-DCE, and IAWC-NWF Pumping at Average Rates
- Scenario 4: Reduced Retardation Factors, No degradation of cis-1,2-DCE, Reduced Source Concentration, and IAWC-NWF Pumping at Average Rates
- Scenario 5: Reduced Retardation Factors, No degradation of cis-1,2-DCE, Increased TCE Half-Life, and IAWC-NWF Pumping at Average Rates
- Scenario 6: Reduced Retardation Factors, No degradation of cis-1,2-DCE, and IAWC-NWF Pumping Rates Doubled

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3.6.4 Model Results

The model results for each scenario are discussed in detail in Appendix A, Section 6. In general, groundwater migration distance and the potential impact of TCE and cis-1,2-DCE contaminated groundwater on the two well fields located within the migration pathway : IAWC-NWF and Syndicate Sales, Inc. well field, were discussed for each scenario. The modeling results indicate that the extents of the impacted groundwater above the MCLs do not reach the model-simulated 5-year travel time boundary for five of the six modeled scenarios, with the exception of Scenario 5. Scenario 5, which had an increased half-life of TCE (5 years versus 2 years) and used the average pumping rates for the IAWC-NWF, predicted groundwater containing TCE concentrations greater than its MCL will migrate approximately 1,700 ft past the model-simulated 5-year travel time boundary, and extend approximately 800 ft into the established Wellhead Overlay (WH-OL) District. Scenario 4, which simulates a 79 % on-site source reduction due to the proposed soil treatment and used the average pumping rates for the IAWC-NWF, is the most likely scenario to occur at the Site. It is predicted that groundwater at TCE and cis-1,2-DCE concentrations greater than their respective MCLs would migrate approximately 720 and 700 ft, respectively, past the model-simulated 10-year travel time boundary in the S2 unit. No exceedance of TCE and cis-1,2-DCE is expected at the existing WH-OL. In addition, the predicted plume extents for TCE and cis-1,2-DCE do not migrate beyond the Kokomo city limits (Figure A-43 through A-46).

Furthermore, the modeling results show that groundwater from the Facility will not reach the IAWC-NWF at concentrations above MCLs for TCE and/or cis-1,2-DCE for any of the scenarios. The modeling results also indicate that (1) TCE impacted groundwater at concentrations slightly exceeding its MCL will migrate in sand unit S2 past the Syndicate Sales, Inc. well field in 5 scenarios of the 6 scenarios evaluated; and (2) cis-1,2-DCE impacted groundwater is expected to migrate in sand unit S2 past the Syndicate Sales, Inc. at concentrations slightly greater than its MCL in 4 scenarios of the 6 scenarios evaluated. However, model simulation results for all 6 scenarios demonstrate that no exceedance of TCE and/or cis-1,2-DCE impacted groundwater is predicted in the deeper bedrock B1 aquifer at and in the vicinity of the Syndicate Sales, Inc. well field, indicating that the influence of impacted groundwater migration from the sand unit S2 to the bedrock B1 unit is not significant. Therefore, groundwater extracted at Syndicate Sales, Inc, well field is not expected to be impacted with TCE and cis-1,2-DCE, due to the fact that Syndicate Sales, Inc. well field is screened in the bedrock unit B1.

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The primary objective of the numerical modeling effort was to provide the basis to delineate the WR-OL District. The proposed WR-OL District was defined as the envelope curve that encompasses the extents of model-simulated TCE and cis- 1,2 -DCE plumes in the S1 and S2 units for the most likely case, which is the 79% source reduction simulated in Scenario 4 , plus an additional 100 ft outward in all directions to provide a buffer zone. The buffer zone is less than 100 ft along the northwest extent of the WR-OL to keep it within the Kokomo city limits, which would simplify the permitting process. It is important to note that the model predicted TCE and cis-1,2-DCE plumes in the S2 unit for Scenario 4 do not extend beyond the Kokomo city limits in the northwest direction (Appendix A Figures A-43 and A-46). The proposed WR-OL District (shown on Drawing 4) is intended to prevent water supply wells from being installed within areas where TCE and/or cis -1,2 -DCE may exceed their respective MCLs based on the modeling results.

3.7 Land Use

The Facility is situated in an area zoned for medium intensity industrial use and is zoned MI (Moderate Intensity Industrial/Light Manufacturing). The Facility's future use is expected to remain consistent with the current use and will be maintained via a deed restriction placed on the property. The current zoning designation for the Facility and surrounding area is presented on Drawing 1c of the RFI Report. The deed restriction is a component of the proposed Corrective Measures.

As discussed in Section 1.2.1, the Facility occupies approximately 10.5 acres on the northern-side of Center Township in Howard County.

The land use patterns at and around the Facility; trends in population and development; the City's Comprehensive Plan for this area; and the implications of these factors for future land use at and around the Facility are discussed in the following Sections. The City of Kokomo Comprehensive Plan is depicted in Drawing 1d of the RFI Report.

3.7.1 Zoning and Land Use Patterns

Zoning in Center Township is divided into 17 districts, which include classes of industrial, commercial, dwelling, agricultural, institutional, and parks. Drawing 1c of the RFI Report shows the zoning districts for the Facility and surrounding area. The zoning districts are defined in the City of Kokomo Zoning Ordinance (City of Kokomo, *Zoning Ordinance, No. 6279*). The Facility is zoned as a *Moderate Intensity Industrial/Light Manufacturing* zoning district.

The area immediately surrounding the Facility includes the following industrial, commercial, dwelling, and special use zoning districts:

> **North of the Facility:** Small to Large Scale General Commercial, Low Intensity Industrial/Business Park, and High Density Urban Residential.
>
> **East of the Facility:** Small to Medium Scale General Commercial, Medium Density Urban Residential, Low Intensity Industrial/Business Park, Moderate Intensity Industrial/Light Manufacturing.
>
> **South of the Facility:** Small to Large Scale General Commercial, Moderate Intensity Industrial/ Light Manufacturing, Medium Density Residential, General Multifamily Residential, and Neighborhood Commercial.
>
> **West of the Facility:** Medium to High Density Urban Residential, Mobile Home Park, Small to Large Scale General Commercial, Low Intensity to High Intensity Industrial/Heavy Manufacturing.

The diverse range of properties surrounding the Facility, discussed in Section 3.1, is consistent with the current zoning districts. The City of Kokomo Comprehensive Plan identifies different areas of the City of Kokomo, and Center Township, as having different land use goals for future development and use, (City of Kokomo, *City of Kokomo Comprehensive Plan* 2001). As shown in Drawing 1d of the RFI Report, the Facility predominantly lies within a Heavy/Medium Industrial Development Area, which designates uses that manufacture or assemble products and that typically have moderate to significant traffic, environmental, or aesthetic impact on the surrounding areas.

Within the immediate vicinity of the Facility there are a variety of major transportation corridors, which include major roadways and an active railway. North Washington Street is a four lane road which runs north-south on the eastern border of the Facility. North Davis Avenue borders the Facility to the west and runs northwest-southeast, and is a two lane road. There is an active rail line that runs parallel to North Davis Avenue and borders the Facility to the west. Although such high traffic transportation corridors are unattractive to residential development, they provide essential support to industrial use of the area at and around the Facility.

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3.7.2 Population and Housing Trends

Center Township experienced its largest recorded growth period between 1900 and 1920. Center Township's population increased markedly between 1940 and 1960, while the 1990 population in Center Township saw a marked drop in comparison to the 1970 population. Between 1970 and 1990, the Township's population decreased by about 12%. However, between 1990 and 2000 the Township's population stabilized and weakly rebounded with 1% growth. Overall, the Township experienced a 25% increase in population between 1940 and 2000. The following shows the population trend in Center Township from 1940 to 2000.

Year	Population	Change	% Change
1940	36,125		
1950	42,435	6,310	15%
1960	51,393	8,958	17%
1970	53,282	1,889	4%
1980	52,504	-778	-1%
1990	47,354	-5,150	-11%
2000	47,619	265	1%

Population data obtained from: http://www.stats.indiana.edu/topic/population.asp

3.8 Ecology

An Ecological Habitat Characterization was conducted for the Facility and was presented in Appendix E of the DOCC. The assessment included a site visit and a review of historical analytical data. A habitat assessment decision matrix was developed to identify those areas at the Facility that may provide terrestrial and aquatic habitats. Based on the evaluation, the site does not provide potential habitat for wildlife and no further evaluation of ecological risks were conducted.

3.9 Summary of RFI

3.9.1 Pre-RFI

As described in the DOCC, a screening evaluation was performed using data collected during investigations previously performed at the Facility. The analytical results were compared to conservative screening criteria to determine the need for additional investigation or evaluation. Based on the results of the screening evaluation, further investigation was proposed in four (4) AOIs at the Facility and no further action or investigation was proposed for three (3) AOIs

The following AOIs were identified in the DOCC as requiring no further action or investigation:

- AOI 1 - Off-Site Drums
- AOI 3 - Former South Manufacturing Building Satellite Accumulation Area (SAA)
- AOI 4 - Former East Manufacturing Building SAA

As discussed in the DOCC, investigative activities were not originally proposed/completed within AOI 3 during Phase I and Phase II RFI activities. Based on data obtained in Phase I and Phase II activities, it was determined that data were needed from within the footprint of the Former North and South Manufacturing areas. Data collected as part of characterizing the Former North and South Manufacturing area, while currently assigned to AOI 3, may not be indicative of environmental impacts associated the historic satellite accumulation area which is defined as AOI 3.

3.9.2 RFI

The following AOIs were identified in the DOCC and the RFI Work Plan as requiring further investigation:

- AOI 2 – Fill Area
- AOI 5 - Former Hazardous Waste Storage Area
- AOI 6 - Former Waste Pile
- AOI 7 - Northern Portion of Former East Manufacturing Building
- Downgradient

The rationale for further investigation was discussed in the DOCC. During the RFI field investigation, additional investigation was recommended at AOI 3 and Upgradient. The RFI field investigation; therefore, included 7 AOIs. As discussed in Section 4.9 of the RFI Report, soil and groundwater were also investigated at the Former Midwest Plating facility during the RFI. The results of the RFI investigation indicate that groundwater contamination at the Former Midwest Plating facility is not related to activities at the former Kokomo Plant 5 Facility.

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The objective of the RFI field investigation was to determine whether a significant release of hazardous constituents to the environment has occurred from the AOIs being investigated. Based on the results of the initial phase of the RFI field investigation, three additional phases of field investigation were conducted to characterize the nature and extent of the releases found during the initial phase. The findings from the first three phases of investigation were provided to USEPA (ARCADIS 2006b, 2007b) and reviewed with USEPA to determine the scope of the next phase of field investigation. The findings from all four phases of the RFI field investigation (including Phase IV), are discussed in Section 4 of the RFI Report. Details of these investigations are presented in the RFI Report and summarized in the following subsections.

Upgradient Groundwater Evaluation

The Upgradient investigation activities consisted of four monitoring wells (MW-0501-P1, MW-0501-S2, and MW-0501-S3U) installed upgradient from the former Facility operations. Vinyl chloride was detected above the drinking water criteria in a groundwater sample collected during Phase II RFI activities at monitoring well MW-0501-P1. Vinyl chloride was not detected at any of the four monitoring wells at concentrations above the groundwater screening criteria during Phase III or after Phase IV of the RFI. The RFI Report concluded that the data collected meets the objectives of the RFI and adequately characterizes soil and groundwater upgradient of the former operations area. The groundwater data collected during the RFI indicated that concentrations in groundwater are stable. Detected concentrations in the monitoring wells did not exceed the drinking water criteria.

AOI 2

The scope of the RFI work completed at AOI 2 involved the sampling of an existing monitoring well (MW-0103-S1U) during Phases II and IV of the RFI to evaluate shallow groundwater quality in AOI 2. TCE, cis-1,2-DCE and vinyl chloride were detected above their respective drinking water criteria during the RFI at AOI 2. Downgradient from AOI 2, TCE, cis-1,2-DCE and vinyl chloride are bounded by monitoring wells that do not have concentrations higher than their respective drinking water criteria. The RFI Report concluded that the data collected meets the objectives of the RFI and adequately characterizes groundwater at and around AOI 2. The groundwater data collected during the RFI indicated that concentrations in groundwater are stable in this area.

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AOI 3

Investigative activities were not originally proposed or completed within AOI 3 during Phase I and Phase II RFI activities; because historic information (as detailed in the DOCC) indicated no additional investigation was warranted. One soil boring (SB-0506) was advanced west of AOI 3 during Phase I to collect metals background data. Six additional soil borings (SB-0622 through SB-0627) were advanced as part of Phase II of the RFI to delineate lead and volatile organic compounds (VOC) concentrations from the original background soil boring and a pre-RFI soil boring. Additionally, three monitoring wells installed during Phase II of the RFI (MW-0605-S1, MW-0605-S2 and MW-0605-B1) and originally associated with AOI 5 were reassigned to AOI 3 for data evaluation. Based on data obtained during Phase I and Phase II activities at nearby AOIs, it was determined that data was needed from within the footprint of the Former North and South Manufacturing areas. The scope of Phase III of the RFI included the installation of nine soil borings, collection of borehole water samples from three of the nine soil borings, and the installation and sampling of six monitoring wells. The scope of Phase IV of the RFI included the advancement of 102 soil borings in and around the Former North and South Manufacturing areas. It should be noted that data collected as part of characterizing the Former North and South Manufacturing area (during Phase III and Phase IV activities) while currently assigned to AOI 3 and encroaching into AOI 2, may not be indicative of environmental impacts associated the historic satellite accumulation area which is designated as AOI 3.

Lead, TCE, PCE, cis-1,2-DCE, methylene chloride and vinyl chloride were detected in soil at concentrations above the industrial PRG, industrial volatilization to indoor air, and/or migration to groundwater criteria for soil within AOI 3 during the RFI. Soil concentrations exceeding these soil criteria are bounded by locations with lower concentrations within AOI 3 or by AOIs to the north and east of AOI 3. Cadmium, TCE, cis-1,2-DCE, and vinyl chloride were detected above the drinking water criteria in AOI 3. Downgradient from AOI 3, Cadmium, TCE, cis-1,2-DCE, and vinyl chloride are bounded by monitoring wells that do not have concentrations higher than the drinking water criteria. The RFI Report concluded that the data collected meets the objectives of the RFI and adequately characterizes soil and groundwater at and around AOI 3. The groundwater data collected during the RFI indicated that concentrations in groundwater are stable in this area.

AOI 5

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The scope of the RFI at AOI 5 involved the advancement of fifteen soil borings and the installation and sampling of ten monitoring wells to characterize soil and water quality in the vicinity of and downgradient from AOI 5. TCE was detected in soil at concentrations above the Industrial PRG, industrial volatilization to indoor air, and/or migration to groundwater criteria for soil within AOI 5 during the RFI. Soil concentrations exceeding these soil criteria are bounded by locations with decreasing concentrations within AOI 5 or by AOIs to the east of AOI 5. TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride were detected at concentrations above their respective drinking water criteria in AOI 5. Downgradient from AOI 5, TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride are bounded by monitoring wells that do not have concentrations higher than their respective drinking water criteria. Further, based on the vertical groundwater data obtained within AOI 5, groundwater concentrations are delineated vertically within AOI 5. The RFI Report concluded that the data collected meets the objectives of the RFI and adequately characterizes soil and groundwater at and around AOI 5.

AOI 6

The scope of the RFI at AOI 6 involved the advancement of eighteen soil borings and the installation and sampling of four monitoring wells to characterize soil and water quality in the vicinity of and downgradient from AOI 6. TCE and PCE were detected in soil at concentrations above the industrial PRG, industrial volatilization to indoor air, and/or migration to groundwater criteria for soil within AOI 6 during the RFI. Soil concentrations exceeding these soil criteria are bounded by locations within AOI 6. TCE, cis-1,2-DCE and vinyl chloride were detected above their respective drinking water criteria in AOI 6. Downgradient from AOI 6, TCE, cis-1,2-DCE and vinyl chloride are bounded by monitoring wells that do not have concentrations higher than their respective groundwater screening criteria. The RFI Report concluded that the data collected meets the objectives of the RFI and adequately characterizes soil and groundwater at and around AOI 6. The groundwater data collected during the RFI indicated that concentrations in groundwater are stable at this area.

AOI 7

The scope of the RFI at AOI 7 involved the advancement of fifteen soil borings, the installation and sampling of five monitoring wells, and sampling of an existing monitoring well to characterize soil and water quality in the vicinity of and downgradient from AOI 7. TCE was detected in soil at concentrations above the Industrial PRG, industrial volatilization to indoor air, and/or migration to groundwater criteria for soil within AOI 7 during the RFI. Soil concentrations exceeding these soil criteria are bounded by locations within AOI 7. TCE, cis-1,2-DCE, and vinyl chloride were detected above their respective drinking water criteria in AOI 7. Downgradient from AOI 7, TCE, cis-1,2-DCE, and vinyl chloride are bounded by monitoring wells that do not have concentrations higher than their respective drinking water criteria. The RFI Report concluded that the data collected meets the objectives of the RFI and adequately characterizes soil and groundwater at and around AOI 7. The groundwater data collected during the RFI indicated that concentrations in groundwater are stable at this area.

Downgradient Investigation - Off-Site East

The Off-Site East Investigation consisted of monitoring wells, soil borings and soil gas vapor ports that are located downgradient and to the east of the former Facility. The scope of the RFI completed as part of the Off-Site East investigation included the advancement of nine soil borings, the installation and sampling of 22 monitoring wells, and the installation and sampling of eleven soil gas ports. No soil concentrations exceeded soil screening criteria. TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride were detected above their respective drinking water criteria for the Off-Site East area. TCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride are bounded by monitoring wells that do not have concentrations higher than the drinking water criteria. Further, based on the vertical groundwater data obtained from MW-0701-B1a, groundwater is bound vertically. No soil gas concentrations exceeded the soil gas screening criteria. The RFI Report concluded that the data collected meets the objectives of the RFI and adequately characterizes soil and groundwater at and around the Off-Site East area. The groundwater data collected during the RFI indicated that concentrations in groundwater are stable. Detected concentrations in groundwater collected at the furthest downgradient monitoring wells did not exceed the drinking water criteria.

Downgradient Investigation – Off-Site West

The Off-Site West Investigation consisted of monitoring wells and soil borings that are located downgradient and to the west of the former Facility. The scope of the RFI completed as part of the Off-Site West investigation included the advancement of one soil boring and the installation of thirteen monitoring wells to characterize soil and groundwater quality off-site and to the west of the former Facility. No soil concentrations exceeded soil screening criteria. TCE, cis-1,2-DCE, and vinyl chloride were detected above the drinking water criteria for the Off-Site West area. Based on data collected to date it would appear that these detections are not related to historic

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operations at the Facility. The RFI Report concluded that the data collected meets the objectives of the RFI and adequately characterizes soil and groundwater at and around the Off-Site West area. The groundwater data collected during the RFI indicated that concentrations in groundwater are stable. Detected concentrations in groundwater collected at the furthest downgradient monitoring wells did not exceed the drinking water criteria.

3.9.3 Summary of Risk Assessment

A baseline human health risk assessment was conducted as part of the RFI to evaluate the health significance of site-related constituent concentrations at all areas where soil, groundwater, and soil gas data were collected during the RFI field investigation. The purpose of the risk assessment is to determine whether any site-related concentrations pose a potentially significant risk based on current and reasonably expected future land use and groundwater use which would warrant corrective measures. The human health risk assessment discussed in Section 5 of the RFI Report assumed that future land and groundwater at the Facility remain consistent with the current use (commercial/industrial and no groundwater use) and that a WR-OL District would be implemented to prohibit new uses of groundwater in the vicinity of the Site.

The human health risk assessment concluded that none of the areas investigated during the RFI pose a potentially significant risk under current land use and groundwater use. The human health risk assessment also concluded that none of the areas investigated during the RFI pose a potentially significant risk under future land use and groundwater use, except via potential future vapor intrusion from soil at the sub-areas around boring locations SB-0746, SB-0749, SB-0756, SB-0757, and SB-0775. The human health risk assessment and its results are discussed in Section 5 of the RFI Report.

4 Summary of Corrective Measures Alternatives

The human health risk assessment in the RFI Report concluded that there was the potential for significant exposure to soil via vapor intrusion into future buildings at five soil boring locations (SB-0746, SB-0749, SB-0756, SB-0757 and SB-0775). The RFI Report concluded that evaluation of potential Corrective Measures at these five soil boring locations was required. Additionally, at the request of USEPA, aquifer restoration was also considered during the evaluation of potential Corrective Measures and the scope of soil remediation.

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The human health risk assessment in the RFI Report assumed no current or future uses of contaminated groundwater would occur at or in the vicinity of the site. This assumption is supported by the groundwater modeling which has predicted that while groundwater impacted with TCE and cis-1,2-DCE in the S2 unit is predicted to migrate beyond the Syndicate Sales, Inc. well field (Appendix A), the Syndicate Sales, Inc. well field is screened in the deeper bedrock B1 unit where no exceedance of the MCLs is predicted. The model-predicted concentrations of TCE and cis-1,2-DCE in the S3 unit and bedrock B1 unit are negligible. Additionally, vinyl chloride in excess of its MCL is not expected at potential groundwater supply wells because geochemical conditions are not conducive to significant generation of vinyl chloride at the site, as evidenced by the low concentrations observed (<10 ug/L) in the S2 unit. The vinyl chloride concentration in S3 unit and bedrock B1 unit is negligible as well. The alternatives evaluated for addressing contaminated groundwater are designed to meet the corrective measures objective of demonstrating no migration of groundwater at concentrations above the drinking water levels to potential groundwater users. In addition, at the request of USEPA, aquifer restoration was also considered as a goal when evaluating potential Corrective Measures.

4.1 Soil

Due to the size of the Facility, the soil information available prior to the RFI fieldwork (as summarized in the DOCC), and the need to evaluate potential source areas, the investigation of soil conditions during the RFI was conducted on an AOI-specific basis. The results of the RFI and baseline human health risk assessment found that contaminant concentrations in soil may pose a potentially significant future risk through one pathway (vapor intrusion), at only one AOI (AOI 3).

As discussed in Section 3.9.3, soil at and around locations SB-0746, SB-0749, SB-0756, SB-0757 and SB-0775 was initially identified for potential corrective measures as a result of potentially significant future vapor intrusion exposure, as discussed above. All five of these soil borings contain similar constituents, pose the same potential exposure risk (vapor intrusion), and are located in the same general area of the Facility, as shown on Drawing 5. Therefore, given their proximity and the uniformity in types of contaminants, these locations are grouped together for the evaluation of corrective measure alternatives. A proposed treatment area was developed, using Thiessen polygons. The proposed treatment area was established by first identifying the Thiessen polygons around soil borings SB-0746, SB-0749, SB-0756, SB-0757 and SB-0775, and then extending the area 75 percent of the way from the edge of the polygon around each of these locations to the next soil sampling location where

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cumulative risk estimates did not exceed the risk limits. This area initially proposed for soil remediation was approximately 10,000 square feet in aerial extent.

The proposed treatment area was discussed with USEPA during a November 17, 2010 meeting. In a letter dated January 7, 2011, USEPA requested that the treatment area be expanded to provide additional source control to foster aquifer restoration. ARCADIS reviewed the soil data from the RFI and identified several options for defining a revised treatment area:

1) Use of the 500 mg/kg TCE isoconcentration contour to define the treatment area. This TCE concentration represents the highest proportion of mass on site and focuses on capturing the area encompassing soil borings SB-0746, SB-0749, SB-0756, SB-0757 and SB-0775.

2) Use of the 400 mg/kg TCE isoconcentration contour to define the treatment area. This TCE concentration represents the soil concentration that, based on leaching calculations, could create a TCE groundwater concentration of 1,000 µg/L.

3) Use of the 61 mg/kg TCE contour to define the treatment area. This TCE concentration is the industrial/commercial direct contact screening criteria used to guide the field investigation during the RFI.

These options were evaluated using the following goals to revise the initially proposed treatment area:

- Addressing the soil within the areas of soil borings SB-0746, SB-0749, SB-0756, SB-0757 and SB-0775 to manage potentially significant future vapor intrusion exposure.

- Providing sufficient mass removal to foster groundwater restoration.

Based on these goals, a revised treatment area, using the 400 mg/kg TCE isoconcentration contour, was selected. The aerial extent of the revised treatment area is illustrated in Drawing 5, and is approximately 12,300 square feet in aerial extent.

Summary of Alternatives

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The following alternatives were evaluated to address the soil in the revised treatment area:

Alternative 1: Institutional Controls – Institutional controls would be adopted to limit land use in the area encompassing SB-0746, SB-0749, SB-0756, SB-0757 and SB-0775 to ensure that the human health risk assessment assumptions on future on-site land use remain valid. For example, a land use restriction could be adopted to prevent the construction of a building over the area encompassing SB-0746, SB-0749, SB-0756, SB-0757 and SB-0775, unless vapor mitigation controls are implemented at future buildings in this area. Additional institutional controls could also be adopted to support other corrective action alternatives. For example, if an asphalt cap (an Engineering Control, see Alternative 2) is installed to facilitate site redevelopment, a companion maintenance plan (i.e., an institutional control) would be developed to outline inspection and maintenance procedures.

Alternative 2: Engineering Controls – Engineering control, in the form of an asphalt cap, was identified as a potentially feasible alternative. The asphalt cap would stabilize the ground surface in the revised treatment area to prevent soil erosion, limit construction of structures that would be affected by vapor intrusion, and reduce infiltration and subsequent leaching of contaminants from soil to groundwater. A companion deed restriction would be adopted to prohibit construction of a building over the area to eliminate the vapor intrusion pathway. The revised treatment area would be cleared, rough-graded, covered with a 6-inch layer of gravel sub-base, and overlain with a 9-inch layer of asphalt pavement. The paved area would then be fenced for security. The asphalt cap would have to be maintained.

Alternative 3: Phytoremediation – Phytoremediation was identified as a potentially feasible alternative. Under this option, trees (TreeWells® or similar product) would be planted within the revised treatment area. Microorganisms within the rhizosphere formed by the tree roots would facilitate the biodegradation of the organic constituents and remove dissolved constituents through transpiration; however, there is some question as to whether phytoremediation would be able to meet the corrective measures endpoint. The clay soil and depth of impacts may limit the effectiveness of this alternative. This alternative scored well during the green remediation qualitative assessment and; therefore, was retained for further review.

Alternative 4: Direct Excavation and Disposal – Excavation and off-site disposal at a licensed facility was identified as a potentially feasible alternative. The soil within the revised treatment area would be excavated, characterized and transported off-site for proper disposal**.**

Alternative 5: Calcium Oxide Treatment and Reuse of Soil – On-site treatment of soil using calcium oxide was identified as a potentially feasible alternative. Under this option, soil within the revised treatment area would be treated in lifts. Calcium oxide would be placed on top of the soil lift to be treated, mixed with conventional construction equipment, and hydrated with water. The reaction between the calcium oxide and water is strongly exothermic, with the heat inducing volatilization of the organic contaminants. The calcium oxide and water will also react with soil minerals to create a binder that will reduce the permeability of the soil and immobilizes the contaminants. The treated soil is excavated to allow treatment of the next lift. Samples are collected from the stockpiled soil to verify that adequate reduction in constituent concentrations has been achieved. The treated soil is then used as backfill.

Alternative 6: Electrical Resistivity Heating (ERH) – In-situ treatment of soil using ERH was identified as a potentially feasible alternative. Under this option, a series of electrodes would be installed in the soil. An electrical current would be passed through the electrodes. The electrical resistance of the soil and soil moisture generates heat, which causes volatilization of organic constituents and water. The gases are captured by a companion vapor extraction system, which provides a pathway for the in-situ generated gases to exit the subsurface.

4.2 Groundwater

Due to the size of the Facility, the groundwater information available prior to the RFI fieldwork as summarized in the DOCC, and the potential need to evaluate downgradient groundwater quality at AOIs where a groundwater impact potential was indicated, the investigation of groundwater conditions during the RFI was initially conducted on an AOI-specific basis; however, the investigation was expanded to a facility-wide focus to monitor the CVOC plume. The groundwater analytical results were initially compared to drinking water criteria to evaluate the need for additional data collection.

As discussed in Section 3.9.3, the baseline human health risk assessment concluded that no potential significant exposures to groundwater exist under current and reasonably expected future land use at and around the Facility. The human health risk

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assessment assumed no current or future uses of contaminated groundwater would occur at or in the vicinity of the Site.

Based on the groundwater modeling results discussed in Section 3.6, impacted groundwater is not expected to reach the IAWC-NWF at concentrations exceeding the MCLs. Additionally, no exceedance of TCE, cis-1,2-DCE or vinyl chloride is expected in groundwater extracted from the two well fields located between the site and the IAWC-NWF: the Moon Fabricating Corporation well field and Syndicate Sales, Inc. well field, both of which extract groundwater from the bedrock B1 unit at a relatively insignificant rate (less than 10 gpm).

Based on the results of the baseline human health risk assessment and the groundwater modeling results, active groundwater remediation was not initially proposed during the November 17, 2010 meeting with USEPA. In a letter dated January 7, 2011, USEPA requested the evaluation of active groundwater corrective measures to foster aquifer restoration. As discussed above, the baseline human health risk assessment assumed no future use of groundwater and groundwater modeling results indicated that migration to current wells (i.e., potential receptors) was unlikely, ARCADIS selected a target TCE groundwater concentration based on contaminant distribution. Such an approach would address the USEPA's goal of aquifer restoration by focusing corrective measures on the area with the highest groundwater contaminant concentration and would minimize any increase in groundwater concentrations in the SI unit to the east.

ARCADIS reviewed the results from the RFI to identify a groundwater treatment area. The highest groundwater concentrations are located in the S1 unit, in the northern portion of the site and at one off-site monitoring well location to the east. TCE concentrations in this area range as high as 13,000 µg/L. Drawing 6 depicts the isoconcentration contours for TCE. Based on the TCE concentrations detected during the RFI and the distribution, a target concentration of 4,000 µg/L was selected to define the groundwater treatment area. This area is located within the S1 unit and is depicted in Drawing 6.

Summary of Alternatives

The following alternatives were evaluated to address groundwater in the groundwater treatment area:

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Alternative 1: Groundwater Extraction – Groundwater extraction was identified as a potentially feasible alternative. Under this option, a series of groundwater extraction wells would be installed along the downgradient edge of the site, within the S1 unit. Extracted groundwater would be pumped to an above-ground treatment system, and treated water would be discharged to the storm sewer system. Groundwater extraction typically results in low rates of mass recovery, but provides hydraulic control to limit migration of the contaminants.

Alternative 2: In-Situ Chemical Oxidation (ISCO) – ISCO was identified as a potentially feasible alternative. Under this option, a series of injection wells would be installed within the 4,000 µg/L TCE isoconcentration contours located within the northern and central portions of the site, and near off-site monitoring well MW-0612-S1 to the east. The injection wells would target the areas of groundwater TCE concentrations in the S1 unit that exceed 4,000 µg/L.

A mobile system would be used to inject a solution of sodium permanganate into the S1 unit via the injection wells. The sodium permanganate would react chemically with the contaminants, oxidizing the contaminants into innocuous byproducts including carbon dioxide and water. This alternative assumes that four quarterly injection events would be conducted.

Alternative 3: Enhanced Reductive Dechlorination (ERD) – ERD was identified as a potentially feasible alternative. Similar to Alternative 2, a series of injection wells would be installed within the 4,000 µg/L TCE isoconcentration contours located within the northern and central portions of the site, and near off-site monitoring well MW-0612-S1 to the east. The injection wells would target the areas of groundwater TCE concentrations in the S1 unit that exceed 4,000 µg/L.

A mobile system would be used to inject a carbon substrate such as molasses or whey into the S1 unit via the injection wells. The carbon substrate would be used as a food source by the indigenous microbial community, reducing the concentration of dissolved oxygen and creating strongly reducing conditions in the aquifer. These conditions promote the growth of microorganisms that biodegrade chlorinated alkenes. The process removes chlorine atoms sequentially from the alkene, with TCE being biodegraded to cis-1,2-dichloroethene, to vinyl chloride, and then to ethene. This alternative assumes that eight quarterly injection events would be conducted.

Alternative 4: Bentonite Cutoff Wall – A bentonite cutoff wall was identified as a potentially feasible alternative. Under this option, a bentonite cutoff wall would be installed along the east property boundary, extending from the ground surface to the clay unit at the base of the S1 unit. The bentonite cutoff wall would reduce the migration of contaminants off-site. To manage groundwater accumulating along the bentonite cutoff wall, groundwater extraction wells would installed at each end of the wall and at the midpoint Extracted groundwater would be pumped to an above-ground treatment system, and treated water would be discharged to the storm sewer system.

4.3 Facility-Wide Management Controls

Corrective measure alternatives for soil included institutional controls as an alternative, focusing on a relatively limited area and on managing potential risk associated with contaminated soil. Institutional controls can also be applied more broadly to limit land use and groundwater use on site and beyond the site. In addition, management systems may be needed to verify that the corrective measures have been effective and aquifer restoration is occurring.

The following alternatives were evaluated for use as facility-wide management controls, to be applied in conjunction with the soil and groundwater corrective measures:

Alternative 1: Groundwater Deed Restriction – Contaminants in groundwater at concentrations exceeding the drinking water standards exist on-site. If the use of contaminated groundwater for drinking water is prevented, the groundwater will not pose a risk to human health. A groundwater deed restriction could be placed on the property. This institutional control provides notification to potential future owners that the groundwater contamination is present, and that the installation of a water supply well is prohibited.

Alternative 2: Well Restriction Overlay District – Contaminants in groundwater at concentrations exceeding the drinking water standards also extend off-site, beneath multiple properties. It would be impractical to file a groundwater use restriction for each individual property. A WR-OL District is a unique and conservative tool for restricting groundwater use on a regional basis. The WR-OL District is established and enforced by the City of Kokomo to protect the community from groundwater contaminated with chemicals. The WR-OL District restricts the drilling of water wells that may bring contaminated groundwater to the surface. MLC discussed the establishment of the WR-OL District with the Director of the Kokomo Plan Commissions and has received general acceptance of the proposal; however, the plan

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will need to be presented to the Plan Commission and receive approval before being established.

Alternative 3: Land Use Restriction – The human health risk assessment discussed in Section 5 of the RFI Report assumed that future land at the Facility will remain consistent with the current use (commercial/industrial). To reduce the likelihood of a change in land use, a land use restriction would be entered onto the deed, limiting future land use to commercial/industrial.

Alternative 4: Monitoring Program – Once active corrective measures are completed for soil and groundwater, trends in contaminant concentrations will need to be evaluated over time to verify that assumptions made as part of the groundwater modeling and remediation effectiveness continue to be reasonable. Vapor monitoring would confirm that no significant risk to human health is present via vapor intrusion. Groundwater monitoring would demonstrate that contaminant concentrations and distribution are consistent with the model results and that the groundwater remedy was successful in fostering aquifer restoration and that no significant risk to human health is present via vapor intrusion. Analytical results will be compared to vapor intrusion screening criteria presented in Appendix B for soil vapor and groundwater data; however, an evaluation of the trends, concentrations and verification of the model will all be used to determine any adjustment in the monitoring scope or frequency. The vapor and groundwater monitoring program is generally outlined in Appendix C; however, specific details of the monitoring program will be provided in the Corrective Measures Implementation Work Plan.

5 Evaluation of Corrective Measures Alternatives

An evaluation of the Corrective Measures alternatives identified in Section 4 was performed. A summary of the Corrective Measures alternatives is presented in Table 3. The evaluation of alternatives considered the degree to which each potential corrective measure alternative satisfies the nine criteria outlined in the US EPA document entitled "RCRA Corrective Action Plan" (OSWER 9902.3-2A, May 1994). The RCRA Corrective Action evaluation criteria and the results of the evaluation for each of the potential Corrective Measures alternatives are presented in Table 4a (facility-wide controls/monitoring for soil, groundwater and vapor), Table 4b (soil corrective measure alternatives), and Table 4c (groundwater corrective measure alternatives), and summarized in Section 5.1. In addition, ARCADIS also completed a green remediation qualitative assessment (sustainability assessment) which is

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summarized in Section 5.2. The assessment was completed in accordance with the USEPA document entitled "Principles for Greener Clean-up" (August 2009).

5.1 Criteria for Evaluation of Corrective Measures Technologies

The RCRA Corrective Action evaluation criteria and the results of the evaluation for each of the potential Corrective Measures alternatives are summarized below.

1. Overall Protection

The human health risk assessment completed during the RFI concluded that the groundwater and soil conditions do not present significant exposure risks under current and reasonably expected future land use at and around the Facility, except via potential future vapor intrusion from soil at certain locations of the Facility.

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: Each of the control alternatives listed in Table 4a, with the exception of the 'no action' alternative, would be protective of human health and the environment. The groundwater/vapor monitoring program will be used to verify the results from the RFI and groundwater modeling. The risk assessment considered existing land and groundwater use restrictions for commercial/industrial land use and existing groundwater uses as of March 2010. A WR-OL District will be requested from the City of Kokomo in order to establish an enforceable mechanism to prevent groundwater at the Facility and the nearby area from being used in the future. A deed restriction will be placed on the property to limit future use of the property to commercial/industrial uses and prohibit all groundwater uses.

Soil Corrective Measure Alternatives: Each of the Corrective Measures alternatives for soil was evaluated to assess the degree of protection the alternative provides for limiting potential future exposure to soil via vapor intrusion at the locations identified in Section 3.9.3. Each of the alternatives listed in Table 4b, with the exception of the 'no action' and possibly 'phytoremediation' alternatives would be protective of human health and the environment. As mentioned in Section 4.1, the effectiveness of phytoremediation may be limited due to clay soil and depth of impacts.

Groundwater Corrective Measure Alternatives: Each of the Corrective Measures alternatives for groundwater was evaluated to assess the degree of protection the alternative provides to human health and the environment. Each of the alternatives listed in Table 4c, with the exception of the 'no action' alternative, would be protective of human health and the environment. Since there is no significant risk associated with the use of contaminated groundwater based on current and anticipated future use, even the 'no action' alternative would be protective of human health if institutional controls were adopted to restrict the installation of drinking water wells.

2. <u>Attainment of Media Cleanup Standards</u>

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: The endpoints for the facility-wide controls are limiting site use to commercial and industrial uses and prohibiting the ingestion of contaminated groundwater, as summarized on Table 5. Groundwater and vapor monitoring will be used to: 1.) confirm the groundwater model (concentrations above MCLs are limited to within the boundary of the WR-OL District and 2.) vapor concentrations in soil gas ports are below the soil gas screening levels identified in the RFI. Each of the alternatives listed in Table 4a, with the exception of the 'no action' alternatives, would be capable of meeting the endpoints.

Soil Corrective Measure Alternatives: The endpoint for the soil Corrective Measures is demonstration that no significant vapor intrusion exposure exists at the soil sample locations identified in Section 3.9.3, as summarized on Table 5. Additionally, a target treatment concentration of 400 mg/kg of TCE was selected to promote aquifer restoration. Each of the Corrective Measures alternatives for soil was evaluated to assess whether the endpoints will be attained. Each of the alternatives listed in Table 4b, with the exception of the 'no action' alternative, would be capable of meeting some Corrective Measures endpoints either through reduction of the CVOC concentrations in soil or through the elimination of the future potential for vapor intrusion exposure.

Groundwater Corrective Measures Alternatives: The endpoint for the groundwater Corrective Measures is the promotion of aquifer restoration, through the reduction of TCE groundwater concentrations to 1,000 µg/L or less, as summarized in Table 5. Each of the Corrective Measures alternatives for groundwater was evaluated to assess whether the endpoint will be

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attained. Each of the alternatives listed in Table 4c, with the exception of the 'no action' alternative, would be capable of meeting the endpoint either through reduction of the CVOC concentrations in groundwater or reducing off-site migration.

3. Controlling the Sources of Releases

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: Each of the Corrective Measures alternatives for facility-wide controls was evaluated to assess the degree to which source control will be attained. Of the alternatives listed in Table 4a, only the adoption of the WR-OL District would result in controlling the source of releases by eliminating the potential induced migration of impacted groundwater through groundwater pumping.

Soil Corrective Measure Alternatives: Each of the Corrective Measures alternatives for soil was evaluated to assess the degree to which source control will be attained. Each of the alternatives listed in Table 4b, with the exception of the 'no action' alternative, would be capable of providing some control of source releases.

Groundwater Corrective Measure Alternatives: Each of the Corrective Measures alternatives for groundwater was evaluated to assess the degree to which source control will be attained. Each of the alternatives listed in Table 4c, with the exception of the 'no action' alternative, would be capable of providing some control of source releases.

4. Compliance with Applicable Standards for Waste Management

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: Each of the Corrective Measures alternatives for facility-wide controls was evaluated to assess compliance with waste management standards. Of the alternatives listed in Table 4a, only the vapor/groundwater monitoring program would result in generation of waste. As part of any monitoring program, procedures would be adopted to verify management of waste in accordance with applicable standards.

Soil Corrective Measure Alternatives: Each of the Corrective Measures alternatives for soil was evaluated to assess compliance with waste management standards. Each of the alternatives listed in Table 4b, with the

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exception of the ‘no action’ alternative, would result in the generation of some waste. For all of the alternatives where waste would be generated, procedures will be adopted to verify management of waste in accordance with applicable standards.

Groundwater Corrective Measure Alternatives: Each of the Corrective Measures alternatives for groundwater was evaluated to assess compliance with waste management standards. Each of the alternatives listed in Table 4c, with the exception of the ‘no action’ alternative, would result in the generation of some waste, such as soil cuttings from well installation or extraction of contaminated groundwater. For all of the alternatives where waste would be generated, procedures will be adopted to verify management of waste in accordance with applicable standards

5. <u>Long Term Reliability and Effectiveness</u>

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: Each of the Corrective Measures alternatives for facility-wide controls was evaluated to assess long term reliability and effectiveness. Each of the alternatives listed in Table 4a, with the exception of the ‘no action’ alternative, would provide long term reliability and effectiveness.

Soil Corrective Measure Alternatives: Each of the Corrective Measures alternatives for soil was evaluated to assess long term reliability and effectiveness. Each of the alternatives listed in Table 4b, with the exception of the ‘no action’ alternative, would provide long term reliability and effectiveness.

Groundwater Corrective Measure Alternatives: Each of the Corrective Measures alternatives for groundwater was evaluated to assess long term reliability and effectiveness. Each of the alternatives listed in Table 4c, with the exception of the ‘no action’ alternative, would provide long-term reliability and effectiveness.

6. <u>Reduction of Toxicity, Mobility or Volumes of Wastes</u>

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: Each of the Corrective Measures alternatives for facility-wide controls was evaluated to assess ability to reduce toxicity, mobility or volume of waste. None of the

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alternatives listed in Table 4a would provide a reduction in the toxicity, mobility or volume of waste.

Soil Corrective Measure Alternatives: Each of the Corrective Measures alternatives for soil was evaluated to assess ability to reduce toxicity, mobility or volume of waste. As indicated in Table 4b, the 'no action', 'engineering controls', and 'institutional controls' alternatives would not provide a reduction in the toxicity, mobility or volume of waste. The remaining alternatives would provide varying reductions in the toxicity, volume, and/or mobility of waste.

Groundwater Corrective Measure Alternatives: Each of the Corrective Measures alternatives for groundwater was evaluated to assess ability to reduce toxicity, mobility or volume of waste. As indicated in Table 4c, the 'no action' would not provide a reduction in the toxicity, mobility or volume of waste. The remaining alternatives would provide varying reductions in the toxicity, volume, and/or mobility of waste. The groundwater extraction and funnel/gate alternatives would provided limited reductions in mass or toxicity, but would limit mobility. The ISCO and ERD alternatives would provide mass reduction, and would reduce mobility by reducing contaminant concentrations in the aquifer.

7. Short-Term Effectiveness

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: Each of the Corrective Measures alternatives for facility-wide controls was evaluated to assess short-term effectiveness. Each of the alternatives listed in Table 4a, with the exception of the 'no action' alternative, would provide short term effectiveness.

Soil Corrective Measure Alternatives: Each of the Corrective Measures alternatives for soil was evaluated to assess short-term effectiveness. As indicated in Table 4b, the 'no action' alternative would not provide short-term effectiveness, and the phytoremediation alternative would provide limited effectiveness in the short term.

Groundwater Corrective Measure Alternatives: Each of the Corrective Measures alternatives for groundwater was evaluated to assess short-term effectiveness. As indicated in Table 4c, the 'no action' alternative would not provide short-term effectiveness.

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8. Implementation

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: Each of the Corrective Measures alternatives for facility-wide controls was evaluated to assess practicality of implementation. Each of the alternatives listed in Table 4a can be practically implemented.

Soil Corrective Measure Alternatives: Each of the Corrective Measures alternatives for soil was evaluated to assess practicality of implementation. Each of the alternatives listed in Table 4b can be practically implemented. However, the presence of clay soil may limit the degree to which the vapor extraction component of the ERH system can be implemented.

Groundwater Corrective Measure Alternatives: Each of the Corrective Measures alternatives for groundwater was evaluated to assess practicality of implementation. Each of the alternatives listed in Table 4c can be practically implemented.

9. Costs

Facility-Wide Controls/Monitoring for Soil, Groundwater and Vapor: Each of the Corrective Measures alternatives for facility-wide controls was evaluated for cost. A summary of the costs for each alternative is presented in Table 6a. A detailed breakdown of the costs is presented in Appendix D. Each of the alternatives listed in Table 4a have a relatively low cost associated with implementation.

Soil Corrective Measure Alternatives: Each of the Corrective Measures alternatives for soil was evaluated for cost. A summary of the costs for each alternative is presented in Table 6b. A detailed breakdown of the costs is presented in Appendix D. Each of the alternatives listed in Table 4b have a low to moderate cost associated with implementation.

Groundwater Corrective Measure Alternatives: Each of the Corrective Measures alternatives for groundwater was evaluated for cost. A summary of the costs for each alternative is presented in Table 6c. A detailed breakdown of the costs is presented in Appendix D. Each of the alternatives listed in Table 4c have a moderate cost associated with implementation.

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5.2 Sustainability Criteria

In addition to the evaluation described above, a qualitative assessment of green remediation was completed. The assessment evaluated the potential impact each Corrective Measure alternative would have on the following five core elements:

- Energy requirements
- Air emissions
- Water requirements and impacts on water resources
- Land and ecosystem impacts
- Material consumption and waste generation

Appendix E presents the green remediation qualitative assessment. The qualitative assessment assigned numerical rankings to each element of each potential Corrective Measure alternative. The 'No Action' alternative was used as the baseline condition to which the impacts of the other six remedial alternatives were compared. A numerical ranking value was assigned to each core element to represent the relative impact. These values ranged from -3 (much less favorable to baseline conditions) to +3 (much more favorable to baseline conditions). Quantitative estimates of the predicted performance of the alternatives relative to the five core elements (e.g., life-cycle estimates for power demand, CO_2 discharge rates, water consumption, etc.) were not generated as part of this qualitative assessment. The aggregate of the rankings assigned to each core element was used to compare the overall environmental impacts of the alternatives. The results of the green remediation qualitative assessment and the scoring for each potential Corrective Measure alternative are provided in a Table in Appendix E. A summary of the green remediation qualitative assessment is provided for each alternative in Tables 4a, 4b and 4c under the heading of "sustainability".

The results of the green remediation assessment were used in conjunction with the core elements of the RCRA corrective action alternatives evaluation to identify Corrective Measures that would balance effectiveness and sustainability.

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6 Proposed Corrective Measures

Tables 4a, 4b and 4c present the Corrective Measures alternatives evaluated as part of RCRA Corrective Action. The proposed Final Corrective Measures for the Facility are summarized below and listed on Table 5.

- Facility-Wide Controls/Monitoring for Groundwater and Soil

  Well Restriction Overlay District (On-Site and Limited Off-Site) will restrict the installation of water wells that may bring contaminated groundwater to the surface.

  Deed Restriction - Groundwater Use (On-Site) will prohibit use of groundwater on the property.

  Deed Restriction - Land Use (On-Site) will limit the use of the property to commercial or industrial uses.

  Monitoring - Groundwater and Soil Vapor (On-Site and Limited Off-Site) will provide data for confirmation of the groundwater model and evaluation of risks to potential receptors (via soil vapor or groundwater).

- Soil Corrective Measure Alternatives

  Calcium Oxide Treatment will reduce the concentration of VOCs in soil within the revised treatment area.

- Groundwater Corrective Measure Alternatives

  ISCO will reduce the concentration of VOCs in groundwater within the treatment area.

Based on information currently available, these proposed Final Corrective Measures provide the best balance of the alternatives evaluated with respect to the evaluation criteria. The proposed Final Corrective Measures, the corrective measures endpoints, and information on how the confirmation of those endpoints will be achieved are presented in Table 5. As discussed above, work plans will be prepared and submitted to USEPA for the active Corrective Measures (Calcium Oxide, ISCO, groundwater/vapor monitoring). In the event that the selected Corrective Measures do not meet the target objectives, either through bench/pilot tests or during full-scale implementation, the corrective measures will be re-evaluated and a supplemental Corrective Measures Proposal will be submitted to USEPA.

7 Schedule

A Corrective Measures Implementation Work Plan will be submitted within 90-days after USEPA selects the final remedy. Implementation of final Corrective Measures will commence within 60-days of receiving USEPA's approval of the CMI Work Plan or within 60-days of submittal of the CMI Work Plan, if no response from USEPA is obtained. As much of the remediation work as practicable pertaining to the Corrective Measures proposed in the preceding sections of this CMP will be completed within three years after USEPA selects the final remedies, and all remedies will be completed within a reasonable period of time to protect human health. Monitoring activities may continue for up to 30 years based on need and funding; however, this timeframe can be adjusted with concurrence from USEPA. Final Remedy Construction Completion with Controls Report will be submitted within 90-days after attainment of Corrective Measures Endpoints.

RACER will provide quarterly progress reports to USEPA by the fifteenth day of the month after the end of each calendar quarter. The report will list work performed to date, data collected, problems encountered, project schedule, and percent project completed, unless otherwise agreed.

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Appendix A

Groundwater Modeling Evaluation

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Appendix B

Supplemental Information for Vapor Intrusion Criteria

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Appendix C

Vapor and Groundwater Monitoring Program

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Appendix D

Corrective Measures Detailed Cost Backup

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Appendix E

Green Remediation Qualitative Assessment