# Record of Decision

# Spartan Chemical Company Superfund Site
# Wyoming, Michigan

**Prepared By:**

**Michigan Department of Environmental Quality**

**September 2007**

## SPARTAN CHEMICAL COMPANY
## RECORD OF DECISION
## ACRONYM LIST

| | |
|---|---|
| **AFS:** | **A**ddendum to **F**easibility **S**tudy |
| **ARI:** | **A**dditional **R**emedial **I**nvestigation |
| **ARAR:** | **A**pplicable or **R**elevant and **A**ppropriate **R**equirement |
| **AS:** | **A**ir **S**parging |
| **ASTs:** | **A**bove ground **S**torage **T**anks |
| **bgs:** | **B**elow **G**round **S**urface |
| **BTEX:** | **B**enzene/**T**oluene/**E**thylbenzene/**X**ylene |
| **CERCLA:** | **C**omprehensive **E**nvironmental **R**esponse, **C**ompensation and **L**iability **A**ct of 1980 |
| **COC:** | **C**hemicals **o**f **C**oncern |
| **Csat:** | Soil Saturation Screening Levels |
| **DCE:** | **Di**chloro**e**thylene |
| **EISB:** | **E**nhanced **I**n-**S**itu **B**ioremediation |
| **EPC:** | **E**xposure **P**oint **C**oncentration |
| **FS:** | **F**easibility **S**tudy |
| **GSIC:** | **G**roundwater/**S**urface **W**ater **I**nterface **C**riteria |
| **GSIPC:** | **G**roundwater/**S**urface **W**ater **I**nterface **P**rotection **C**riteria |
| **GVIIC:** | **G**roundwater **V**olat**i**lization to **I**ndoor Air **I**nhalation **C**riteria |
| **HRC:** | **H**ydrogen **R**eleasing **C**ompounds |
| **ICDCC:** | **I**ndustrial **C**ommercial **D**irect **C**ontact **C**riteria |
| **ISCO:** | **I**n-**S**itu **C**hemical **O**xidation |
| **MDEQ:** | **M**ichigan **D**epartment of **E**nvironmental **Q**uality |
| **MDNR:** | **M**ichigan **D**epartment of **N**atural **R**esources |
| **MEK:** | **M**ethyl **E**thyl **K**etone |
| **MNA:** | **M**onitored **N**atural **A**ttenuation |
| **MSL:** | **M**ean **S**ea **L**evel |
| **MW:** | **M**onitoring **W**ells |
| **NAPL:** | **N**on-**a**queous **P**hase **L**iquids |
| **NCP:** | **N**ational Oil and Hazardous Substances Pollution **C**ontingency **P**lan |
| **NPL:** | **N**ational **P**riorities **L**ist |
| **O&M:** | **O**peration **&** **M**aintenance |
| **Part 201:** | **Part 201**, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended |

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| | |
|---|---|
| **PCE:** | **P**er**c**hloro**e**thene |
| **ppb:** | **p**arts **p**er **b**illion |
| **ppm:** | **p**arts **p**er **m**illion |
| | |
| **RAOs:** | **R**emedial **A**ction **O**bjectives |
| **RD:** | **R**emedial **D**esign |
| **RDCC:** | **R**esidential **D**irect **C**ontact **C**riteria |
| **RDWC:** | **R**esidential **D**rinking **W**ater **C**riteria |
| **RDWPC:** | **R**esidential **D**rinking **W**ater **P**rotection **C**riteria |
| **RI:** | **R**emedial **I**nvestigation |
| **ROD:** | **R**ecord **o**f **D**ecision |
| | |
| **SB:** | **S**oil **B**orings |
| **SPLP:** | **S**ynthetic **P**recipitation **L**eaching **P**rocedure |
| **SQB:** | **S**oil **Q**uality **B**oring |
| **SVE:** | **S**oil **V**apor **E**xtraction |
| **SVIIC:** | **S**oil **V**olatilization to **I**ndoor Air **I**nhalation **C**riteria |
| | |
| **TCA:** | 1,1,1-**t**ri**c**hloroeth**a**ne |
| **TCE:** | **T**ri**c**hloro**e**thylene |
| **TCLP:** | **T**oxicity **C**haracteristic **L**eaching **P**rocedure |
| **TMBs:** | **T**ri**m**ethyl**b**enzene**s** |
| | |
| **U.S. EPA:** | **U**nited **S**tates **E**nvironmental **P**rotection **A**gency |
| **USTs:** | **U**nderground **S**torage **T**anks |
| | |
| **VOCs:** | **V**olatile **O**rganic **C**ompounds |
| **VSIC:** | **V**olatile **S**oil **I**nhalation **C**riteria |

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for the
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## PART 1: THE DECLARATION

### Site Name and Location

The Spartan Chemical Company Superfund site (Site) is located at 2539 28th Street, in the City of Wyoming, Michigan, which is situated approximately one block northwest of the intersection of Byron Center Avenue and 28th Street. The property is comprised of approximately five acres. The United States Environmental Protection Agency (U.S. EPA) Identification Number is MID079300125.

### Statement of Basis and Purpose

In this Record of Decision (ROD), the Michigan Department of Environmental Quality (MDEQ) is selecting a remedial action in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act, 1980 PL 96-510 (CERCLA) and, to the extent practicable, with the National Oil and Hazardous Substances Pollution Contingency Plan (in accordance with CERCLA Section 121(a)). The decisions herein are based on the Administrative Record for this Site. Occasional references are made to specific documents in the Administrative Record where the information is too voluminous to be provided here. The State of Michigan, represented by the MDEQ, is the lead agency for this project. The U.S. EPA, which is the support agency for this project, has indicated its concurrence with MDEQ's decision for this project. The concurrence letter from the U.S. EPA will be included in Appendix C of this ROD upon receipt. The U.S. EPA's Superfund Program is the source of cleanup monies, i.e., the cleanup is fund-financed.

### Assessment of the Site

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

### Description of the Selected Remedy

The major components of the selected remedy include the following remedial activities:

1. Institutional Controls Restricting Groundwater Use and Land Use.

2. Excavation and Off-site Disposal of Highly Contaminated Soils.

3. Expansion of the Soil Vapor Extraction (SVE) System for Mitigation of Vapors.

4. Air Sparging/SVE.

5. In-situ Chemical Oxidation.

6. Contingency for Enhanced In-situ Bioremediation (if necessary).

7. Monitored Natural Attenuation.

The selected remedy is site-wide in scope and addresses all contaminated media, i.e., soil and groundwater, at the Site. A limited portion of the soils on the Site are believed to contain principal threat wastes because of the high concentrations of highly mobile solvents that are present. A principal threat waste is a source material that is highly toxic and/or mobile that generally can not be reliably contained and presents a significant risk to human health and the environment. Such soils that can't be efficiently treated on-site will be excavated and disposed of off-site. The remaining contaminated soils and groundwater will be treated in-situ.

There is also a potential for another principal threat waste at the Site, i.e., non-aqueous phase liquid (NAPL) that can act as a reservoir for contamination migration to groundwater at the Site. Although NAPL has not been directly identified, the high concentrations of organic contaminants in groundwater suggest that it may be present.

**Statutory Determinations**

The selected remedy will be protective of human health and the environment, will comply with federal and state requirements that are applicable or relevant and appropriate to the remedial action, will be cost effective, and will utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

This remedy will also satisfy the statutory preference for treatment as a principal element of the remedy (i.e., will reduce the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants through treatment).

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

**ROD Data Certification Checklist**

The following information is included in the Decision Summary section of this ROD.

- The chemicals of concern and their concentration levels. (Tables 4 and 5)
- Cleanup levels established for the chemicals of concern and the basis for these levels. (Table 11)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and the ROD. (Page 14)
- Baseline risks represented by the chemicals of concern. (Pages 15-17)
- How source materials constituting principal threats are addressed. (Page 30)
- Potential land and groundwater use that will be available at the Site as a result of the selected remedy. (Page 34)

- Estimated capital, annual operation and maintenance, total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected. (Tables 1, 1A, and 10)

- Key factors that led to selecting the remedy, i.e., how the remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria. (Page 31)

Additional information is also included in the Administrative Record for the Site (see attached index in Appendix D of this ROD).

9-19-07

**Steven E. Chester, Director**
**Michigan Department of Environmental Quality**

**Date**

**Richard C. Karl, Director**
**Superfund Division, Region 5**
**United States Environmental Protection Agency**

**Date**

## PART 2: THE DECISION SUMMARY

### Site Name, Location, and Brief Description

The Spartan Chemical Company site (Site) is an industrial property including approximately five-acres located at 2539 28th Street, in the City of Wyoming, Michigan, which is situated approximately one block northwest of the intersection of Byron Center Avenue and 28$^{th}$ Street. The Spartan Chemical Company property is situated in the Grand River Drainage Basin and exhibits approximately 13 feet of topographic relief across the Site. Site elevations range from 615 to 628 feet above mean sea level (MSL) north to south across the property. Local surface drainage likely drains to the low-lying area on-site with possible drainage to the nearby storm sewer. Roy's Creek is located approximately 800 feet west of the Site. The United States Environmental Protection Agency (U.S. EPA) Identification Number is MID079300125.

The State of Michigan, represented by the Michigan Department of Environmental Quality (MDEQ), is the lead agency for this project. The U.S. EPA which is the support agency for this project, has indicated its concurrence with MDEQ's decision for this project. The concurrence letter from the U.S. EPA will be included with the Record of Decision (ROD) upon receipt. The U.S. EPA's Superfund Program is the source of cleanup monies, i.e., the cleanup is fund-financed.

### Site History and Enforcement Activities

From 1952 to 1992, the Spartan Chemical Company operated as a bulk chemical transfer, blending, and repackaging plant. During its operation, Spartan Chemical Company handled a variety of chemicals, including aromatic solvents, naphthas, alcohols, ketones, ethers, chlorinated solvents, and lacquer thinners. The Spartan Chemical Company filed for bankruptcy in 1992, and the Site has been vacant since that time.

The MDEQ, formerly known as the Michigan Department of Natural Resources (MDNR) reported that the Spartan Chemical Company discharged its wastewater to the groundwater prior to 1963. Groundwater contamination, consisting of various solvents, was detected in December 1975 during dewatering operations at an adjacent facility (former Slagboom Tool & Die facility, currently Ambassador Steel, located immediately west of the Spartan site). At that time, Spartan Chemical Company was the only known handler of solvents in the area. Specifically, the contamination included volatile organic compounds (VOCs) such as benzene, toluene, ethylbenzene, and xylene, (collectively referred to as BTEX compounds), as well as various ketones and alcohols. The MDEQ also reported that plant personnel documented three minor chemical spills before 1963.

In 1981, the Spartan Chemical Company retained STS Consultants to conduct a hydrogeologic investigation at the Site. From available information, 14 monitor wells (OW-1 through OW-14) were installed on or north of the Site and sampled in August 1981. The analyses identified the VOC contaminants methylene chloride, acetone, 1,1,1-trichloroethane (TCA), trichloroethylene (TCE), toluene, methyl ethyl ketone (MEK), and xylene.

On September 8, 1983, the U.S. EPA added the Site to the National Priorities List (NPL) of Superfund sites, a list of hazardous waste sites that are eligible for further study and remediation under the federal Superfund Program. The Spartan Chemical Company signed a Consent Order with the MDNR on September 20, 1984, to conduct an investigation and cleanup of contaminated groundwater originating from activities that had occurred at the Site.

The Spartan Chemical Company retained Prein & Newhof and later EDI (in 1986) to conduct additional investigations required by the Consent Order. Nineteen new monitor wells (OW-15 through OW-28 and MW-29 through MW-33) and four replacement monitor wells (MW-10, MW-11, MW-13, and MW-14) were installed as part of these investigations.

According to the MDNR, chemical spills were reported in 1987 and 1990. Both were a result of overfilling of tanker trucks. The 1987 spill was reportedly contained within the secondary containment walls, and the 1990 spill (estimated at 50 gallons of a solvent blend containing acetone, toluene, methyl isobutyl ketone, and cyclohexanone) was absorbed by sand and absorbent pads, which were removed by a licensed hazardous waste hauler.

An air stripping groundwater treatment system was installed on the Site in 1988, but the system was shut down in January 1993 because of concerns with the impact of the discharge on the City of Wyoming Wastewater Treatment Plant.

In October 1989, five underground storage tanks (USTs) at the Site were removed. The MDNR advised that the soils at the UST locations be addressed; however, due to financial constraints of the Spartan Chemical Company, no soils were reportedly removed.

In May 1992, the U.S. EPA conducted a site assessment, inclusive of groundwater sampling/analyses, to determine the need for emergency response action. A determination was made based on the threat to human health or the environment due to soil contamination, containers, and/or tanks at the Site. The U.S. EPA's assessment did not find emergency response action necessary.

A Final Remedial Investigation/Feasibility Study (RI/FS) Summary document was released by the MDNR in October 1992. This document simply summarized work performed in the various previous investigations and provided a summary of the proposed remedial action plan. The summary also indicated that the extent of soil contamination at the Site was difficult to determine because of limited soil sampling. It also stated that additional investigations were necessary to better define the boundaries of soil contamination and evaluate the potential source areas.

In June 1993, an Interim Action ROD was issued by the U.S. EPA and the MDNR for remediation of the groundwater. The ROD included an evaluation of the existing groundwater treatment system's ability to remediate the groundwater, discharge options available for the treated groundwater, and startup of the system after necessary modifications had been completed. The ROD also required additional investigations to better characterize the Site, focusing on potential source areas and stated that further remedial actions may be required to address any remaining site concerns.

The additional investigation to better characterize the Site was initiated in 1994. Malcolm Pirnie was retained by the MDNR at this time to conduct a thorough RI/FS. An RI Report was finalized in October 1996. This report summarized investigation activities, the nature and extent of soil and groundwater contamination, and addressed the potential risks associated with exposure to the contamination. A Focused FS Report, entailing an evaluation of remedial alternatives for the cleanup of the contaminated soil, was completed by Malcolm Pirnie in October 1997.

In November 1998, under a separate task assignment, DLZ was retained by the MDEQ to conduct a remedial design for the vadose zone (unsaturated) soils. DLZ was responsible for preparing a work plan and the remedial design for a soil vapor extraction (SVE) and treatment system to remediate the contaminated vadose zone soil at the Site. The SVE system construction was completed in the spring of 2001. The SVE system began full time operation in April 2003 following a lengthy wastewater permit approval process with the city, and subsequent noise mitigation of the system.

The U.S. EPA requested that the MDEQ conduct some additional studies prior to selecting a groundwater remedy to narrow the list of applicable technologies. Fieldwork for these studies began in November 1999. The additional remedial investigation (ARI) included source area identification, determination of hydrogeological conditions, soil and groundwater contamination identification and delineation, groundwater monitoring, and evaluation of select existing structures. In September/October 2000, DLZ conducted an evaluation of the subgrade storm drain/floor drain piping network at the Site to determine possible point source(s) of contamination. The findings of the ARI were presented to the MDEQ in the Final Technical Memorandum, the ARI, dated December 2003.

During the time of the ARI, the MDEQ also conducted pilot studies and evaluations of several potential technologies. In April 2004, DLZ documented the evaluation of several remedial alternatives to address threats or potential threats posed by soil and groundwater contaminants in the Addendum Feasibility Study (AFS). Weston Solutions, Inc. (WESTON) was contracted by the MDEQ in 2004 to evaluate existing technical documents and develop recommendations for the final remedy. WESTON also conducted additional source characterization tasks and managed the 2006 demolition.

In October 2003, Kent County (who is the current owner of the Spartan Chemical Company property through the tax reversion process) placed a Declaration of Restrictive Covenant on the deed to the property. This covenant placed a restriction on the use of the groundwater at the Spartan Chemical Company property and placed limitations on excavations and other activities on the southern half of the property (i.e., where there is soil contamination).

Kent County granted an easement to the State of Michigan in June 2003 to provide the State access to the property for implementation of response activities.

**Source Area Vadose Zone (unsaturated) Soils Remediation – SVE**

The SVE system includes 43 vapor extraction wells and associated above ground vapor collection piping located within the central source area on the former Spartan Chemical Company property. The treatment system has several above-grade components that are capable of freezing and therefore is typically operated only during the months of April through November.

The extracted soil vapor is processed through a catalytic oxidizer and acid gas scrubber prior to the treated vapor being emitted to the atmosphere. Generated scrubber water is periodically discharged (by permit) to the City of Wyoming Clean Water Plant.

Between October 2002 and November 2005, the system removed over 20,000 pounds of VOCs from the Site. The majority of this mass was removed during the first year of operation. Although total VOC concentrations from the individual vapor extraction well sampling performed in November 2005 confirmed that significant VOC contamination remains within the current SVE

well field, adjustments to the SVE system are required to improve the mass of contamination removed by the system (mass extraction rate).

Under certain conditions, the system is able to process up to 250 parts per million (ppm) dichloroethylene (DCE), 65 ppm, trichloroethylene (TCE) 55 ppm, perchloroethylene (PCE), and 1,900 ppm total BTEX. However, the combined concentration of these VOCs in the most recent vapor sample was less than 10 ppm. Although analytical results suggest that the mass extraction rate could be increased by closing less impacted wells and extracting only from the more highly impacted wells, previous attempts required the addition of dilution air to maintain system operation. This appears in part due to the limited oxygen concentration in the soil vapor at the most highly impacted wells. The low oxygen level in the extracted soil vapor is not sufficient for combustion in the catalytic oxidizer. In addition to the oxygen limitation, closing off less impacted wells without adding dilution air also reduces the air flow through the system to below the minimum system flow requirements.

Extracting from only the most highly impacted extraction wells is not feasible with the current well construction and SVE system configuration based on the minimum system flow rate requirements and the need to maintain sufficient oxygen in the process air stream to support combustion in the catalytic oxidizer. Running the system in its current configuration could require an additional 15 years or more to remediate the remaining central source area vadose zone. However, adjustments could be made to the system operation to improve mass extraction rates and the overall efficiency of the system and reduce the required remediation time frame.

If the system is modified and the mass extraction rates improve, it is still estimated that the SVE system will need to operate for at least five additional years to complete source area VOC reduction in the current well field area. However, this time could be significantly reduced if either or both of the following occurred:

- “Hot-Spot” soil removal in the central source area to remove the highest zone of contaminated soil just above the water table.

- Addition of air sparging in the central source area which would not only address submerged “smear zone” contamination just below the water table, but would also improve the subsurface oxygen concentration and improve combustion in the catalytic oxidizer.

These additional measures could reduce the required central source area SVE remediation time frame by an estimated two to four years.

Based on the individual well head sampling results and the continued VOC mass removal, SVE remains a viable technology for the Site. However, adjustments are necessary to improve the efficiency of the current system.

As noted on **Figure 1A (**attached), an office building, warehouse, drum/tank storage building, storage/maintenance buildings, tank farm area, and loading dock were demolished in 2006 as part of site restoration activities. One warehouse still remains. An inactive groundwater treatment system (air stripper) formerly located in the northwest corner of the Site was also

demolished in 2006. Thirty-four aboveground storage tanks (ASTs) were also removed from the site during the demolition activities. Funding for these restoration activities was provided by Kent County utilizing state brownfield grant money.

**Community Participation**

The various RI and FS reports, Proposed Plan, and other relevant documents for the Site were made available to the public in July 2007. They can be found in the Administrative Record file and the Information Repository at the Wyoming Public Library. The availability of these documents and date of the public meeting was published in a local newspaper on July 9, 2007. A public comment period was initially set up from July 10 to August 9, 2007. The end date of the public comment period was extended to August 16, 2007, because of a slight delay in the mailing of some of the proposed plans. A public meeting was held on July 30, 2007, to present the Proposed Plan to a broader community audience than those that had already been involved at the Site. At this meeting, the MDEQ and the U.S. EPA answered questions and also used this meeting to solicit a wider cross-section of community input on the reasonably anticipated future land use and potential beneficial groundwater uses at the Site. The response to the comments received during this period is included in the Responsiveness Summary section of this ROD.

**Scope and Role of Operable Unit or Response Action**

As discussed in the preceding site history section, interim RODs were previously issued for groundwater and soil. The remedy selected in this ROD is intended to be the final site-wide response action for this Site and addresses a principal threat at the Site through the removal and/or treatment of groundwater and soils contaminated with high concentrations of highly mobile solvents. The selected remedy will be implemented under remedial authority pursuant to CERCLA and the NCP.

The following is the planned sequence of the major components of the selected remedy:

1. Institutional Controls Restricting Groundwater Use and Land Use;

2. Excavation and Off-site Disposal of Highly Contaminated Soils;

3. Expansion of the SVE System for Mitigation of Vapors;

4. Air Sparging (AS)/SVE;

5. In-situ Chemical Oxidation;

6. Contingency for Enhanced In-situ Bioremediation (if necessary); and

7. Monitored Natural Attenuation.

This sequence may be modified based upon the design of the selected remedy.

**Site Characteristics**

The Site is an industrial property including approximately five acres located at 2539 28th Street, in the City of Wyoming, Michigan, which is situated approximately one block northwest of the intersection of Byron Center Avenue and 28th Street. The Spartan Chemical Company property is situated in the Grand River Drainage Basin and exhibits approximately 13 feet of topographic relief across the Site. Site elevations range from 615 to 628 feet above MSL, north to south across the property. Local surface drainage likely drains to the low-lying area on-site with possible drainage to the nearby storm sewer. Roy's Creek is located approximately 800 feet west of the Site. A Conceptual Site Model is presented in **Figure 8** of this ROD.

On-site work conducted during the RI phases included sampling of soil, groundwater, sediment, and surface water. On- and off-site sources of contamination were also characterized through the review of historical records, physical well surveys, and topographical surveys. Key findings of the RI phases are summarized in the following sections.

**Geology**

Surficial deposits in the Grand Rapids area consist primarily of lakebed sands, outwash, and moraines (Hydrogeologic Atlas of Michigan, Western Michigan University, 1981). The subsurface stratigraphy at the Site consists of a layer of sand and gravel underlain by a clay-rich till confining layer. Underlying the confining layer is a one-foot thick sand layer that is underlain by Marshall Sandstone bedrock.

The thickness of the unconfined sand and gravel layer is highly variable across the site (28 to 109 feet), depending on the depth to the lower confining till unit. The saturated portion of the sand and gravel layer constitutes the unconfined aquifer, which ranges in thickness from 21 to 95 feet. Top of the confining layer elevations typically range from approximately 515 to 590 feet above MSL. The thickness of the underlying till confining layer was determined to range from 56 feet to at least 84 feet. Depressions in the confining layer topography are present at the location of MW-101D, at the southwest corner of the property, and MW-108D, west of the site and Ambassador Steel. These bowl-like depressions are coincident with the deep groundwater contamination and may be acting to minimize migration of the deep groundwater plume. Between these two points, there appears to be a higher ridge in the confining layer that runs southwest-northeast, generally perpendicular to the groundwater flow direction. It has not been determined if this ridge is continuous. A map depicting lines of this section is shown on **Figure 1**. Cross Sections A-A' and B-B' depicting hydrostratigraphic conditions are included as **Figures 2 and 3**.

Bedrock was encountered once during RI phases, at a depth of approximately 137 feet below ground surface (bgs) [479 feet above MSL]. The bedrock (Marshall Sandstone Formation) was described as a greenish gray sandstone.

**Hydrogeology**

<u>Unconfined Aquifer</u>

Groundwater flow at the Site is generally toward the north-northwest; however, the flow direction can change temporarily due to recharge events, such as a large rainfall. Potentiometric surface

maps for the shallow and intermediate portions of the aquifer depict a fairly uniform piezometric surface.

Data from quarterly groundwater monitoring events performed between November 1999 and April 2003 indicated that the vertical gradients between the shallow (MW-101S) and the intermediate (MW-101I) portions of the aquifer were generally upward. Between the intermediate (MW-101I) and deep (MW-101D) portions of the aquifer, the vertical gradients were consistently downward. The vertical gradients between the shallow (MW-108S) and deep (MW-108D) portions of the aquifer were downward for all but one sampling event.

Based on the April 2003 groundwater elevations, the horizontal hydraulic gradients for the shallow, intermediate, and deep portions of the aquifer are 0.0018 feet/foot, 0.0016 feet/foot, and 0.001 feet/foot, respectively.

Based on the DLZ June 2000 short-term pump test, the average hydraulic conductivity was found to be 107 feet per day (feet/day). Using the results of the pump test, the bulk groundwater flow velocity was calculated to be approximately 1.1 feet/day.

Slug tests performed in October 2002 indicated that differences in hydraulic conductivity between the shallow, intermediate, and deep portions of the aquifer are relatively minor, indicating the aquifer is relatively homogeneous.

Confining Layer

The laboratory derived vertical hydraulic conductivity value for the confining layer sample VPB-1 (77.5 to 80 feet bgs) was 1.67E-07 centimeters per second. This value indicates that the till is relatively impermeable and may provide an effective barrier to downward migration of contaminants at the Site. However, if fractures are present in the till confining layer, vertical hydraulic conductivity would be expected to increase.

Bedrock

Groundwater elevations recorded at bedrock monitor well MW-122B indicated an upward-gradient is present between the bedrock sandstone aquifer and the drift aquifer, which would tend to limit or reduce the downward migration of dissolved-phase contaminants into the bedrock.

Surface Water: Roy’s Creek

A comparison of surface water elevations recorded at Roy’s Creek in August 2000 with quarterly groundwater elevation measurements recorded at the adjacent well cluster MW-128S/MW-128I suggests that Roy’s Creek is a losing stream. The surface water at Roy’s Creek was more than two feet higher than the groundwater elevation in the nearby monitoring wells, suggesting groundwater contaminant discharge to the creek is unlikely. The estimated surface water gradient of Roy’s Creek is 0.0026 feet/feet, and the flow is to the northwest.

Surface Water: Lamar Park & Downgradient Lakes

Five additional small lakes are located approximately 2,000 feet north and northwest of the site. Three of the lakes are located due north at Lamar Park. A comparison of Lamar Park Lake surface water elevations with groundwater elevation measurements indicates that groundwater likely discharges to these lakes.

**Soil Contamination**

The information presented in this section was primarily determined during the RI phase and subsequent Supplemental Geoprobe Sampling Investigation completed by the MDEQ in April/May 2002. Information obtained during the MDEQ's soil and soil gas sampling conducted during 2006 was used to supplement and provide additional information about the soil contamination.

Soil samples collected from the central source area in 2006 confirmed that concentrations above soil saturation levels persist in some areas. These saturated soils continue to provide a source for further groundwater contamination. A remedial design investigation would be required to determine the volume of soil above saturation levels to be removed.

Based on the individual well head sampling results and the continued VOC mass removal, SVE remains a viable technology for the Site. However, adjustments are necessary to improve the efficiency of the current system.

Presented below is a discussion of soil chemistry results compared to applicable Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 201) Generic Cleanup Criteria, including: Residential Drinking Water Protection Criteria (RDWPC), Soil Volatilization to Indoor Air Inhalation Criteria (SVIIC), Groundwater Surface Water Interface Protection Criteria (GSIPC), and Industrial Commercial Direct Contact Criteria (ICDCC). The soils on the Site are considered to be principle threat wastes because of the high concentrations and highly mobile solvents which are present. A principle threat is a source material that is highly toxic and/or mobile that generally can not be reliably contained and presents a significant risk to human health and the environment.

<u>Vadose Zone Soils</u>

Areas of soil contamination having organic contaminant concentrations (primarily VOCs) exceeding Part 201 criteria protective of groundwater continue to contribute to the contamination of site groundwater. Soil contamination is linked to historic chemical blending and industrial activities at the Site.

RDWPC: An evaluation of organic soil analytical data from the ARI and previous investigations indicated that the area of organic soil contamination exceeding Generic RDWPC is approximately 250 feet wide and 600 feet long, extending in a southeast to northwest direction from TH-4 (southeast) to SGP-9 (northwest). This area of contaminated soil extends off the Spartan Chemical Company property, onto the adjacent Ambassador Steel property to the west and onto the Conrail right-of-way to the east (**Figure 4A**). Assuming that the average contaminated depth is 10 feet, the volume of soil containing organic contaminants exceeding the RDWPC is approximately 56,000 cubic yards.

SVIIC: An area of organic soil contamination exceeding Generic SVIIC is approximately 215 feet wide by 320 feet long, extending in a southeast to northwest direction from SB-36 to SGP-6. This area of contaminated soil extends off the Spartan Chemical Company property and potentially onto the adjacent Ambassador Steel property as shown on **Figure 4A**. Assuming that the average contaminated depth is 10 feet, the volume of soil containing organic contaminants exceeding the SVIIC is approximately 25,000 cubic yards.

A portion of the soil VOC contamination that is on the Spartan property is being addressed by the operation of the SVE and treatment system. More than 20,000 pounds of VOCs have been removed by the SVE and treatment system as of November 2006. However, there still remains a large source area that will continue to impact the groundwater at the facility.

GSIPC: An area of organic soil contamination exceeding Generic GSIPC is approximately 200 feet wide by 400 feet long, extending in a northwest direction from SQB-7 to SGP-9. This area of contaminated soil extends off the Spartan Chemical Company property and onto the adjacent Ambassador Steel property. The area of soil contamination exceeding GSIPC is shown on **Figure 4B**. Assuming that the average contaminated depth is 10 feet, the volume of soil containing organic contaminants exceeding the GSIPC is approximately 30,000 cubic yards.

ICDCC: An area of organic soil contamination exceeding ICDCC is approximately 70 feet wide by 260 feet long, extending in a northwest direction from SQB-7 to SGP-6. This area of contaminated soil extends off the Spartan Chemical Company property and potentially onto the adjacent Ambassador Steel property. The area of soil contamination exceeding ICDCC is shown on **Figure 4B**. Assuming that the average contaminated depth is 10 feet, the volume of soil containing organic contaminants exceeding the ICDCC is approximately 7,000 cubic yards.

Inorganic soil contamination above ICDCC is less prevalent, with only one location showing elevated arsenic levels (SB-22 at a depth of 0 to two-feet bgs), and two locations showing elevated lead levels (TH-2 and TH-5 at depths 6.8 to 8-feet, and 0 feet bgs, respectively).

Additional Source Area:

In April/May 2002, the MDEQ conducted a supplemental Geoprobe sampling effort to characterize a newly identified on-site source area discovered during installation of sewer service for the SVE treatment building. This additional source area, approximately 50 feet by 100 feet, consisted of what appeared to be fill (**Figures 4A and 4B**). A total of six Geoprobe borings (TH-2, TH-7 through TH-11) were completed by MDEQ staff to define the suspected source area.

Both organic and inorganic soil contamination was identified in the soil sample collected from boring TH-2 above RDWPC and ICDCC. Specific VOCs detected above RDWPC include; DCE, TCA, TCE, methyl isobutyl ketone, chlorobenzene, acetone, BTEX, PCE, methylene chloride, styrene, iso-propylbenzene, n-propylbenzene, trimethylbenzenes (TMBs), sec-butylbenzene, and naphthalene. The only inorganic constituent detected above ICDCC within the additional source area was lead in sample TH-2.

Organic soil contamination above RDWPC was also identified in borings TH-3, TH-10, and TH-11. Specific organic compounds detected above RDWPC include the VOCs; chlorobenzene, DCE, methylene chloride, acetone, n-propylbenzene, sec-butylbenzene, ethylbenzene, toluene, TCA, TCE, TMBs, and xylenes.

Organic contamination was identified in soil samples collected from borings TH-2, TH-3, TH-10, and TH-11 above GSIPC. Specific organic constituents detected above GSIPC include; benzene, MEK, chlorobenzene, DCE, ethylbenzene, naphthalene, acetone, styrene, PCE, toluene, TCA, TCE, and xylenes.

Many of the highest soil contaminant detections within the additional source area are present within/near the top of the water table. Rising water table conditions will typically “deposit” groundwater contaminants onto soil particles after the water table subsequently falls.

Non-aqueous Phase Liquid (NAPL)

Soil saturation screening levels (Csat) were exceeded for the VOCs: PCE, toluene, xylene, and TMB in soil quality boring (SQB) sample SQB-7, in the south central area of the site, and SQB-8 toward the middle of the west property line. Ethylbenzene and TMB Csats were additionally exceeded in sample SQB-8. Various Csat exceedances were also noted in a number of soil borings, including SB-11, SB-12, SB-16, SB-17, SB-21, SB-23, SB-26, SB-31, SB-32, and SB-36. These results suggest that a variety of VOCs may be present as a NAPL in on-site soils at these locations, although no visual presence of NAPL was documented during the RI phases. The MDEQ observed potential free product during continuous Geoprobe coring on the Ambassador Steel property during a supplemental investigation.

**Groundwater Contamination**

Groundwater on and off-site is impacted with VOC contamination extending from the top of the water table to the top of the lower confining clay layer in some areas, a direct result of past chemical releases on-site and potentially off-site. This contamination is most concentrated in the upper and lower portions of the aquifer with a relatively cleaner portion in the middle of the aquifer. In addition, NAPLs remain within the aquifer that continue to provide a source to the dissolved-phase groundwater contamination.

A dissolved-phase VOC groundwater plume extends across the Spartan Chemical Company Superfund site. **Figures 5A, 5B, and 5C** include total VOC contours based on analytical results from the shallow, intermediate, and deep-screened wells sampled in 2005, respectively. The aerial extent of VOCs in groundwater exceeding the Part 201 Residential Drinking Water Criteria (RDWC) and the Groundwater/Surface Water Interface Criteria (GSIC) is shown on all three figures. Based on the 2005 sampling event, the dimension of the VOC plume that exceeds RDWC is approximately 850 feet long and 550 feet wide. Dissolved phase VOCs detected above RDWC and/or GSIC downgradient of the NAPL areas include petroleum constituents (BTEX, TMBs) at the highest concentrations, with lesser concentrations of chlorinated VOCs (chloroethane, vinyl chloride, dichloroethenes). The VOC plume extends to the bottom of the aquifer in several areas, for a maximum thickness of approximately 80 feet.

High concentrations of VOCs (including NAPLs) in groundwater at the base of the aquifer have migrated to/accumulated in depressions in the clay confining layer at the locations of monitor wells MW-101D and MW-108D. Cross sections shown in **Figures 2 and 3** depict total VOC contaminant concentrations at the base of the aquifer.

**Potential Off-site Source Area**

Recent historical research conducted by the MDEQ regarding the Ambassador Steel property yielded additional useful information regarding potential off-site contamination that could act as continuing sources of groundwater contamination. Records indicate that Slagboom Tool & Die operated at the Ambassador Steel property in 1975. In November 1975, Slagboom Tool & Die installed two dewatering wells to dewater the subsurface during the installation of two large presses and a building expansion. The discharge from the dewatering process was reportedly highly contaminated. The contaminated water was discharged to the local storm sewer, and

later redirected to an open pond constructed on-site after an order to discontinue sewer discharge was issued. The exact location of the pond is unknown; however, the only open space on the Slagboom Tool & Die/Ambassador Steel property at that time would have most likely been the area south of the building. The suspected dewatering pond location coincides with ARI findings of high levels of contamination south of the Ambassador Steel building; however, it is unclear if these actions significantly impacted the vadose zone.

According to historical documents, chemical spillage occurred at the Spartan Chemical Company property during which contaminants flowed over-land onto Slagboom property. In response to the spill(s), Slagboom Tool & Die filed complaints against the Spartan Chemical Company; however, available documentation does not specify the frequency or quantity of spillage.

**Other Contaminant Source Information**

An additional report indicated the Spartan Chemical Company disposed of sludge waste in an abandoned on-site gravel pit on the Spartan Chemical Company property located north of the operations. Further reports indicated that the Spartan Chemical Company discontinued on-site waste disposal in 1963. The Additional Source Area discovered by the MDEQ in April/May 2002 may be associated with the reported sludge waste.

Four soil samples collected from SQB-7, at the Additional Source Area, were analyzed for leaching potential of metals using Synthetic Precipitation Leaching Procedure (SPLP) and Toxicity Characteristic Leaching Procedure (TCLP). The TCLP results for lead indicated the potential for soils to leach lead to groundwater at concentrations exceeding RDWC. No other metal concentrations in TCLP or SPLP leachate samples exceeded RDWC although the detection limits for lead exceeded the RDWC.. The concentrations of lead in soil samples collected from the Site did not exceed RDWPC; however, impacted Site soils may have some potential to leach inorganic contaminants at levels above appropriate criteria.

A chromium groundwater plume exists to the west and south of the Site. This chromium contamination is not related to the Site and appears to originate from a source upgradient (south) of the Site. The MDEQ is investigating and addressing the chromium contamination as a separate action.

**Current and Potential Future Site and Resource Uses**

The Site property is comprised of approximately five acres and is bordered by a school and residential area to the east, commercial properties to the south, and industrial properties to the north and west. Nearby businesses/industries include metal stamping and finishing plants, construction industry suppliers, a former plating facility, and a former paper/packaging plant. The facility is currently closed and commercial operations ceased at the Site in 1992.

The area is serviced by the City of Wyoming municipal water supply and sanitary sewer system. The municipal water supply system draws its water from Lake Michigan. No private wells are known to exist in the general vicinity of the Site. Therefore, the use of groundwater as a drinking water source is not anticipated at this time.

Based upon current zoning, nearby land use, and dialogue with county officials, the anticipated future land use is industrial and/or commercial.

**Summary of Site Risks**

Based on data collected during the RI phase, the MDEQ conducted a baseline risk assessment to evaluate human health risks associated with contaminants detected in groundwater, soils, and surface water within and near the Site. A quantitative ecological risk assessment was not conducted for this site, due to the location and nature of the Site. No surface water is currently affected or threatened by the contamination, nor are there any other current environmental issues, other than protection of the groundwater aquifer as a resource.

The baseline risk assessment evaluated pathways in which humans could be exposed to site-related contaminants. See **Figure 8** presenting the conceptual site model summarizing the exposure pathways.

The purpose of the baseline risk assessment is to determine applicable exposure pathways and target cleanup criteria for the Site. An exposure pathway is the route that a contaminant takes from a source to a receptor and describes a unique mechanism by which the receptor may be potentially exposed to contaminant agents at or originating from the Site.

The original baseline risk assessment was included in the 1996 RI report. This risk assessment documented unacceptable risks associated with the soil contamination for the future residential scenario and the construction worker scenario. This unacceptable risk was the basis for selecting the soil remedy in the 1997 Interim Action ROD. The 1996 baseline risk assessment also documented unacceptable cancer and non-cancer risks associated with potential future ingestion of groundwater, dermal contact with groundwater, and with inhalation of chemicals volatilized from groundwater. Data gathered in the ARI is consistent with earlier data, such that the risks demonstrated in the 1996 risk assessment remain valid.

As part of the AFS, the MDEQ has assessed the current data, based on applicable exposure pathways, and identified target Part 201 cleanup criteria. The administrative rules promulgated pursuant to Part 201 include generic cleanup criteria for a number of exposure pathways and land use assumptions. Exceedance of the generic criteria is a general indicator of unacceptable risk.

The following exposure pathways, contaminants, and associated risks were identified during the baseline risk assessment and are presented as follows.

**Drinking Water**

Contaminant: Organic and inorganic contaminants in groundwater exceed the RDWC. Organic and inorganic contaminants in soil exceed the RDWPC.

Pathway: No known drinking water wells exist in the surrounding area. A residential well survey was conducted in November 2004 and no current residential wells were identified. Therefore, there are no known current exposures. However, neither the City of Wyoming nor Kent County restricts groundwater use; thus, a potential future drinking water pathway remains.

Risk: Although contamination exists above the RDWC and the RDWPC, there are no known current users of the impacted groundwater; therefore, there is currently no known risk to human health. Given the potential for pathway completion due to the absence of city and county groundwater restrictions at off-site parcels, the potential exists to complete this pathway, thereby presenting an unacceptable future risk to human health.

**Groundwater/Surface Water Interface**

Contaminant: Organic and inorganic contaminants in groundwater exceed the generic GSIC. Organic and inorganic contaminants in soil exceed the GSIPC.

Pathway: Roy's Creek is located approximately 800 feet west of the site. The ARI concluded that no apparent hydraulic communication exists between the plume and Roy's Creek; however, small lakes exists downgradient of the plume that are hydraulically connected to the groundwater. The groundwater/surface water interface pathway would therefore be considered complete.

Risk: Contamination exists above the GSIC and the GSIPC at and near the site; however, groundwater near the surface water does not exceed the generic GSIC. There is some potential that the groundwater venting to the lake surface water will exceed the generic GSIC; however, based on currently available data it appears unlikely this will occur. Therefore, the groundwater/surface water interface is not considered a relevant pathway at this time. Continued monitoring is suggested to identify if these conditions change in the future.

**Volatilization to Ambient/Indoor Air Inhalation**

Contaminant: Vadose zone soil sample results indicate the presence of organic contaminants at levels exceeding the SVIIC on- and off-site. Isolated areas also exceed the Ambient Air Infinite Source Volatile Soil Inhalation Criteria (VSIC). Groundwater contamination has also exceeded the generic criteria for groundwater volatilization to indoor air inhalation criteria (GVIIC) in isolated areas.

The 2006 soil gas study across the former plant site indicated elevated VOC levels remain present inhalation risks. Elevated VOC concentrations in the soil, groundwater, and soil vapor continue to provide the potential for volatilization to indoor air and ambient air.

Pathway: The current SVE system is addressing some of the on-site subsurface soil vapors. Organic soil contaminants remain at the Additional Source Area and at/beyond the western property boundary toward Ambassador Steel that are not addressed by the current SVE system. Groundwater also exceeds the GVIIC criteria off-site (near Ambassador Steel) where there are no land use restrictions; therefore, this pathway would be considered complete.

Risk: An SVE system to capture subsurface VOC vapors remains in place to ensure the pathway within that area of influence is incomplete. Although the system was shut down during the 2006 demolition activities, the system can be re-started in 2007. Risks to potential receptors are present east, north, and west of the SVE system area, and this pathway would be considered complete and present potential future unacceptable risk to human health.

**Direct Contact - Groundwater**

Contaminant: Most groundwater contaminants identified at concentrations that exceed the Groundwater Contact Criteria occur at depth within the NAPL areas at the base of the aquifer. Vinyl chloride was detected in the groundwater in one well downgradient of the NAPL areas at concentrations exceeding Groundwater Contact Criteria.

Pathway: Groundwater is present between 10 and 20 bgs. Some utilities extend to this depth; therefore, the pathway is complete.

Risk: Given the contaminant concentrations and the potential for a completed pathway, this pathway presents potential future unacceptable risk to human health.

**Direct Contact - Soil**

Contaminant: Organic and inorganic soil contaminants exist in excess of ICDCC both on and off the Spartan Chemical Company property. Most organic contaminants are being addressed by the SVE system. However, at the western Site boundary and beyond, toward the Ambassador Steel property, moderate to high levels of VOCs remain in the subsurface unaffected by the current SVE system. Additional VOC contamination exceeding ICDCC was identified east of the treatment building at the Additional Source Area. Inorganic contaminants are present above residential direct contact criteria (RDCC). The Site will likely be redeveloped as industrial/commercial property and a comparison of the inorganic concentrations to the ICDCC showed an exceedance of arsenic at a depth of 0 to 2 feet, and exceedances of lead at 0 feet, and 6.8 to 8 feet.

Comparison of the organic constituents identified in the Geoprobe soil borings conducted east of the on-site treatment building at the Additional Source Area showed VOC exceedances of ICDCC at TH-2, TH-10, and TH-11.

Pathway: Utility worker exposure is likely along the western site boundary where the SVE is the least effective; therefore, this exposure pathway is complete. The residential direct contact pathway is highly unlikely to occur given the industrial land use.

Risk: Organic and inorganic contaminants remain in the subsurface and a pathway exists for direct contact to soil; therefore, a risk to human health exists.

**Summary**

Potentially unacceptable risks to human health exist in both soil and groundwater due to site-related contamination. Remedial action is needed to address contamination at the Site to reduce the related potential risks. The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

For further details on the investigations, characterizations, and the baseline risk assessment please consult the tables in Appendix B of this ROD and the ARI and the AFS reports.

**Remedial Action Objectives**

The overall Remedial Action Objective (RAO) for the Site, as identified in the AFS, is to reduce contamination that originates from the Spartan Chemical Company property, as necessary, to protect human health and the environment and prevent human exposure to contaminated groundwater and soil. The specific RAOs are to:

- Restore the aquifer to drinking water standards within a reasonable time frame.
- Significantly reduce the concentrations of contaminants in the source area to levels that will naturally attenuate to drinking water standards within a reasonable time frame.

- Prevent or restrict the use of the groundwater on the Spartan Chemical Company property until drinking water standards are achieved.
- Reduce or eliminate further contamination of groundwater.
- Reduce or eliminate the direct contact threat associated with contaminated soil and groundwater.
- Reduce or eliminate threats associated with the volatilization of contaminants from soil or groundwater.

The selected remedy will reduce the excess cancer risk associated with exposure to contaminated soil and groundwater to one in one hundred thousand by achieving the Part 201 cleanup standards, which are applicable or relevant and appropriate requirements (ARARs) for the remedy at the Site. See **Tables 11** and **12** in Appendix B of this ROD for additional information.

**Description of Alternatives**

Evaluations and analyses conducted during and subsequent to the FS phase provided mechanisms for the development, screening, and detailed evaluation of remedial alternatives based on the results of the RI phase. The MDEQ identified and screened remedial measures for soil and groundwater contamination based on nine criteria described later in this document. For a complete description of contaminant areas, remedial measures, and remedial alternatives, please consult the AFS and other supporting documents.

**Summary of Groundwater Remedial Alternatives**

Each of the groundwater alternatives, other than the No Action alternative, includes continuation of the restrictions on groundwater use on the Spartan Chemical Company property, until drinking water standards are achieved. In addition, drinking water use restrictions will be sought for the property immediately to the west of the Site due to the highly concentrated source area on this property. Additionally, each of the alternatives will need performance/compliance monitoring and provisions to implement contingent remedial actions should the selected remedy fail to meet performance objectives.

<u>Alternative G1 - No Action</u>

The MDEQ includes the No Action alternative to provide a baseline comparison with the other alternatives. Under Alternative G1, the MDEQ would take no remedial action at the site. Therefore, the potential human health and environmental risks associated with groundwater contamination would be unchanged and could potentially increase if land use changed in the future or if contamination migrates.

There are no costs associated with this alternative. The MDEQ does not expect that this alternative will meet the RAOs in a foreseeable period of time.

<u>Alternative G2 - In-well Air Stripping with Vapor Treatment</u>

Under Alternative G2, the MDEQ would use in-well air stripping, also known as in-well vapor stripping, in-well aeration, in-well sparging, and vacuum vapor extraction, is an innovative in-situ technology designed to remove VOCs, including petroleum hydrocarbons and chlorinated

solvents, from groundwater and saturated soils. In-well air stripping involves the creation of a groundwater circulation pattern and simultaneous aeration using a groundwater circulation well to volatilize contaminants from circulating groundwater. Air-lift pumping is used to lift groundwater and strip it of VOCs. Contaminant vapors may be drawn off for ex-situ treatment or released to the vadose zone for biodegradation. Stripped groundwater is forced out of the well into the vadose zone where it re-infiltrates to the water table. Contaminated groundwater enters the well at its base, replacing the water lifted through pumping.

Total capital needed to install the system is estimated at $1,046,300 including a contingency of 15 percent ($136,470). The operation and maintenance (O&M) costs add an estimated at $83,200 per year with a present worth over a 10 year period of $584,362. The total present worth of installing and operating an in-well air stripping is estimated at $1,631,000. The construction timeframe is estimated at three months. The RAOs would not likely be achieved within a reasonable time frame since this alternative does not address deep groundwater contamination.

Alternative G3 - Enhanced Groundwater Extraction with Ex-situ Groundwater Treatment

Under Alternative G3, the MDEQ would use hydraulic containment and groundwater extraction requiring the installation of a series of extraction wells so the groundwater flowing through the impacted area is collected and controlled, to prevent further contaminant migration and allow for ex-situ treatment. For enhanced groundwater remediation, injection wells would be installed to increase the groundwater velocity through the impacted area; thus increasing the removal rate of groundwater contaminants.

Total capital needed to install the system is estimated at $613,000 including a contingency of 15 percent ($80,000). The O&M costs add an estimated at $87,000 per year with a present worth over a 25 year period of $1,013,000. The total present worth of installing and operating an enhanced groundwater extraction system with ex-situ groundwater treatment is estimated at $1,626,000. The construction timeframe is estimated at three months. The RAOs may never be achieved with this alternative since this technology is more effective at hydraulic control than remediation.

Alternative G4 - Enhanced In-situ Bioremediation (EISB)

Under Alternative G4, as modified since the issuance of the AFS, the MDEQ would include the injection of hydrogen releasing compounds (HRC®) such as: molasses, sodium lactate, vegetable oil, or other organic carbon sources and nutrients to stimulate and enhance biodegradation processes to further reduce dissolved-phase chlorinated VOC contamination remaining beyond the plume source/NAPL areas. Hydrogen is a key ingredient in an anaerobic contaminant degrading process known as reductive dechlorination. This process is the mechanism by which chlorinated compounds are biodegraded. Because the presence of toluene and other petroleum VOCs may beneficially enhance co-metabolic degradation processes, in-situ treatments typically associated with aerobic degradation processes are not typically implemented, until the chlorinated VOCs remedy is deemed adequate.

Total capital needed to implement enhanced in-situ bioremediation is estimated at $932,000 including a contingency of 15 percent ($122,000). The O&M costs were not included in this estimate, although groundwater monitoring would be required. The construction timeframe is estimated at one week, but repeat injection events may be required. The RAOs may not be achieved within a reasonable time frame based on the slow processes involved with application of this technology in areas with elevated contaminant concentrations.

Alternative G5 - In-situ Chemical Oxidation (ISCO)

Under Alternative G5, we would use ISCO involving the delivery of chemical oxidants to contaminated soils and groundwater in order to convert organic contaminants into innocuous compounds. Chemical oxidants typically used include potassium permanganate, hydrogen peroxide, caustic sodium persulfate, and ozone injection.

Total capital needed for ISCO implementation is estimated at $2,000,000. The O&M costs were not included in this estimate, and would be highly variable depending on the selected oxidation method (from $0 to greater than $45,000 per year). Groundwater monitoring costs were not included in this estimate, but would be required. The construction timeframe is estimated at two months for the first round of injections, but repeat injection events may be required. The RAOs may be difficult to achieve within a reasonable timeframe without multiple injection events, which would substantially increase costs.

Alternative G6 - Surfactant Flushing with Ex-situ Groundwater Treatment

Under Alternative G6, we would use surfactant flushing involving the injection of a selected surfactant solution into a contaminated aquifer through injection wells or trenches, followed by downgradient extraction of the groundwater and surfactant solution, and ex-situ groundwater treatment. The primary objective is to provide more efficient remediation of groundwater impacted by NAPLs.

The estimated capital cost is $1,149,300. The annual O&M cost is estimated at $90,000. The present worth cost is estimated at $1,972,000, assuming 15 years of system operation. The construction timeframe is estimated at two months. The RAOs would not likely be met in a reasonable time frame since pilot test results indicated the effectiveness of surfactant flushing with ex-situ groundwater treatment was similar to traditional pump and treat methods.

Alternative G7 - Air Sparging (AS) with SVE and Treatment

Under Alternative G7, we would use air sparging with SVE and treatment including the volatilization of contaminants in the groundwater through in-situ sparging of air or other gasses (such as nitrogen), and the capture of volatilized contaminants in the vadose zone with SVE. The injection of the gas aids in the volatilization of contaminants and can supply oxygen to the aquifer to stimulate aerobic biodegradation.

The estimated capital cost is $729,000. The annual O&M cost is estimated at $82,500. The present worth cost is $1,067,000 assuming five years of system operation. The construction timeframe is estimated at four months. The RAOs may not be met within a reasonable time frame for this alternative since the effectiveness of this technology would be limited in the areas of deep groundwater contamination.

Alternative G8 - Monitored Natural Attenuation (MNA)

Under Alternative G8, we would use monitored natural attenuation, also known as passive bioremediation or intrinsic bioremediation, in a process involving the natural degradation of contaminant constituents in soil and groundwater. Natural attenuation processes include aerobic and anaerobic biodegradation, dispersion, volatilization, and adsorption. Groundwater

samples would be analyzed for the contaminants of concern (e.g., VOCs), biological and chemical oxygen demand, chloride, organic carbon, pH, and suspended solids. The analytical results would be continually evaluated to determine the effectiveness and adequacy of natural attenuation over time.

The MNA may be used alone as in this alternative or combined with other more active alternatives as a follow-up to the active alternatives. Groundwater monitoring data from the Site indicates that contaminant plumes are no longer increasing in extent or are shrinking. The MDEQ believes that the "lines of evidence" for the selection of monitored attenuation have been demonstrated as required by OSWER Directive 9200.4-17P, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* Specifically, the following two lines of evidence have been demonstrated.

1) Historical groundwater and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points. (In the case of a groundwater plume, decreasing concentrations should not be solely the result of plume migration. In the case of inorganic contaminants, the primary attenuating mechanism should also be understood.)

2) Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the Site, and the rate at which such processes will reduce contaminant concentrations to required levels. For example, characterization data may be used to quantify the rates of contaminant sorption, dilution, or volatilization, or to demonstrate and quantify the rates of biological degradation processes occurring at the Site.

This alternative would not require capital expenditures, since the groundwater monitoring well network is already in place. The annual O&M cost is estimated at $16,000 for a single monitoring event sampling select monitoring wells. The present worth cost of this alternative over a 15 year period is approximately $146,000. The present worth cost increases to greater than $200,000 for a 50-year period. There would be no construction required. The RAOs would not likely be met within a reasonable time frame based on the relatively slow process and high contaminant concentrations at the Site.

**Summary of Soil Remedial Alternatives**

Each of the soil alternatives, other than the No Action alternative, includes continuation of the limitations on excavation and other disruptive activities in the southern half of the Site until the soil remedy is complete. At completion of the soil remedy, the need to continue use restrictions will be assessed. The costs associated with the implementation and monitoring of the institutional controls are not included in the cost estimates; however, the costs will be similar for each alternative (other than the No Action alternative). Costs estimates for the institutional controls will be developed in the institutional controls plan that will be drafted during the remedial design.

<u>Alternative S1 - No Action</u>

The MDEQ includes the No Action alternative to provide a baseline comparison with the other alternatives. Under Alternative S1, we would take no remedial action at the Site. Therefore, the potential human health and environmental risks associated with soil contamination would be

unchanged and could potentially increase if land use changed in the future. There are no costs associated with this alternative. The MDEQ does not expect that this alternative will meet the RAOs in a foreseeable period of time.

Alternative S2 - Excavation and Off-site Disposal with Institutional Controls

Under Alternative S2, we would excavate selected soil above the groundwater table containing excessive organic and/or inorganic contaminant concentrations. Not all soil that exceeds the RDWPC or the ICDCC would be removed. Excavation and off-site disposal would include excavation of impacted soils, handling, characterization, transportation, and appropriate disposal at a properly licensed disposal facility.

Excavation of soil contamination would be most applicable within the Additional Source Area identified east of the on-site treatment building. Both organic and inorganic contamination was identified at depths to 16 feet bgs. Excavation in this area would target the vadose zone source as opposed to soil impacted by groundwater contact. Non-hazardous disposal is assumed for this area. This will be confirmed during remedial design investigation activities.

Excavation of the most highly impacted soils in the central source area would also be applicable and would reduce the time required for remediation by the existing SVE system. In addition it would allow the SVE system to operate more efficiently over the remaining areas. Excavated soil would most likely be considered characteristically hazardous and would be required to be disposed of as a hazardous waste.

Institutional controls would still be required to be placed to prevent current and future contact within the affected area that could potentially result in human exposure to contaminated soil. These restrictions would be used as a mechanism for reducing the potential soil exposure pathway and would be effective in protecting human health by reducing risks such as direct contact and ingestion.

The present worth cost for a limited source area soil excavation is estimated at $600,000 to $987,000, depending upon the final soil volume removed. The construction timeframe is estimated at less than one month. The time to achieve the RAOs for soil excavation would be relatively short, but would be limited to the areas within the excavation.

Alternative S3 - Expansion of SVE System for Mitigation of Vapors and Institutional Controls

Under Alternative S3, we would include the installation of additional vertical extraction wells or a combination of various mitigation systems to prevent potential vapors from entering near-by structures. Additional extraction wells could be added to the existing SVE system and operated in zones to assist in the mitigation of the vapors.

In addition, institutional controls would be placed to prevent current and future contact within the affected area that could potentially result in human exposure to the contaminated soil. Upon completion of the SVE work, the institutional controls will be re-evaluated and any necessary changes to the restrictions will be made. These restrictions would be used as a mechanism for reducing the potential soil exposure pathway and would be effective in protecting human health by reducing risks such as direct contact and ingestion of VOCs from soil not treated by the expanded SVE system.

The estimated capital cost is $230,000. The annual O&M cost is estimated at $105,000. The present worth cost is estimated at $691,000, assuming five years of SVE system operation. The construction timeframe is three months. The time to achieve RAOs for SVE system operation is estimated at five years. The RAOs for inorganic soil contamination would not be addressed by this alternative.

Combination of Alternative S2 and Alternative S3

The MDEQ expects that implementation of Alternative S2 followed by Alternative S3 would significantly reduce the length of operating time for the SVE system.

The estimated capital cost is $967,000. The annual O&M cost is estimated at $105,000 (not including SVE operation in conjunction with AS operation). The present worth cost is $891,000-$1,278,000. The construction timeframe is estimated at three months. The time to achieve RAOs for soil remediation by the combined soil alternatives is estimated at two years.

**Comparative Analysis of Alternatives**

The alternatives were compared to determine the relative performance of the alternatives with respect to the following nine evaluation criteria.

**Overall Protection of Human Health and the Environment** This criterion is used to evaluate whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

**Compliance with ARARS** This criterion is used to evaluate whether the alternative meets federal and state environmental statutes, regulation, and other requirements that pertain to the Site or whether a waiver is justified.

**Long-term Effectiveness and Permanence** This criterion considers whether an alternative permanently maintains protection of human health and the environment, and the effectiveness of such protection.

**Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment** This criterion is used to evaluate whether a particular treatment reduces the harmful effects of principle contaminants; their ability to move in the environment; and the amount of contamination present.

**Short-term Effectiveness** This criterion considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.

**Implementability** This criterion is used to consider the technical and administrative feasibility of implementing the alternative, such as relative availability of goods and services.

**Cost** The MDEQ used this criterion to estimate capital and operation and maintenance costs, as well as present worth costs. Present worth cost is the total cost of an alternative over time in terms of today's dollars.

**Support Agency Acceptance** The MDEQ is the lead agency for this project and the U.S. EPA is the support agency. The U.S. EPA supports the selected remedy.

**Community Acceptance** This criterion evaluates the public comments. This ROD includes a responsiveness summary that presents public comments and the MDEQ responses to those comments. Acceptance of the recommended alternative was evaluated after the public comment period. The community supports the selected remedy.

**Groundwater Contamination**

**Table 1** provides a comparison of the remedial alternatives for groundwater. A comparative analysis of each alternative with respect to the nine evaluation criteria is included below. **Table 1A** presents a comparison of various combinations of Alternatives G3, G4, G5, and G8.

Overall Protection of Human Health and the Environment

Alternative G1 consists of No Action and is not effective in protecting human health and the environment. Alternative G8 provides a low level of protection for human health by the use of groundwater monitoring; however, contaminants remain in the groundwater. Alternatives G2 through G7 provide a high level of protection for human health and the environment.

Compliance with ARARs

Alternative G1 would not comply with the site-specific ARARs. G8 would comply with some of the ARARs but not all of the ARARs as required. Alternatives G2 through G7 would comply with all of the identified ARARs if they are able to achieve the cleanup standards.

Long-term Effectiveness and Permanence

Alternative G1 would result in adverse environmental impacts to groundwater, and potentially surface water and indoor air. Alternatives G2 and G7 could be very effective in dealing with the shallow groundwater contamination but may have some difficulty in remediating compounds in the deep portion of the aquifer. Alternative G3 could easily be implemented to influence the entire aquifer thickness; however, the efficiency of groundwater extraction for achieving clean-up of low concentrations in a reasonable time frame is poor. Alternative G8 would be effective in dealing with the leading edge of the contaminant plume but would not be effective at reducing VOC concentrations near the source area and at the center of the plume. Alternatives G4, G5, and G6 could affect the entire aquifer thickness and address contamination throughout the area, although G4 is primarily conducive to dissolved-phase VOC remediation and would have geochemical impacts on the aquifer that may affect the concentrations of inorganic compounds.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

Alternative 1 does not involve any remediation or treatment and would not reduce contaminant toxicity, mobility, or volume. Although Alternatives G2, G3, and G7 (and likely G4) effectively reduce VOCs, they would likely not be very effective in reducing the volume of the NAPL. Alternative G5 provides the most aggressive treatment for reducing the NAPL. Alternative G6 could be effective in dealing with the NAPL contamination, although pilot testing demonstrated that the contamination was already fairly mobile before the addition of surfactant. Alternative G8 does not reduce source area contamination; however, it may be coupled with an active treatment alternative for the purpose of long-term monitoring of natural attenuation in non-source areas.

Short-term Effectiveness

The No Action alternative would not alleviate any current risks at the site. Alternatives G2 and G7 would be immediately effective in removing dissolved-phase VOCs, but would not address NAPL source areas. Alternative G3 provides a higher level of short-term effectiveness as it provides immediate hydraulic control. Alternative G8 would not be effective in the short-term. Alternative G4 would not be as effective as Alternatives G2, G3, or G5. Although Alternative G5 requires extensive operation and maintenance during injection, the short-term effectiveness is the most immediate and addresses both dissolved-phase VOC and the NAPL contamination. Each of the remedies could be implemented in a fashion so as to not present substantive risks to on-site workers or to the community. Alternatives G2, G3, G4, G5, G6, and G7 involve some intrusive work such that care would need to be taken to ensure on-site workers are not impacted. Alternative G5 also has special care requirements associated with the handling of the oxidant and potential for off-gassing.

Implementability

There would be no associated construction for implementation of Alternative G1; therefore, this alternative is easily implemented. Alternative G2 is a patented technology; therefore, licensing agreements would be required. Special provisions would need to be implemented for public bidding. Alternatives G3 and G6 could be easily implemented but would require some additional groundwater modeling. Alternatives G4 and G7 could be easily implemented. Alternative G5 would require a pilot test prior to full-scale implementation. Alternative G8 is the most easily implemented alternative.

Cost

There are no costs associated with Alternative G1. Alternative G8 has the lowest cost at $146,000. Alternatives G4 and G7 are close in cost, approximately $1,000,000. Alternatives G2 and G3 are also close in cost, approximately $1.6 million. Alternative G5 has the highest total present worth cost at $2 million. The cost of Alternative G6 is slightly less than Alternative G5 at $1.97 million.

Support Agency Acceptance

The U.S. EPA is the support agency for this project. Final acceptance of the recommended alternative was determined after assessing public comment. The U.S. EPA supports the selected remedy.

Community Acceptance

Community acceptance of the recommended alternative was evaluated after the public comment period. The community supports the selected remedy.

**Soil Contamination**

**Table 2** provides a comparison of the soil remedial alternatives. An analysis comparing each alternative to the nine evaluation criteria is included below:

Overall Protection of Human Health and the Environment

Alternative S1 would provide no additional protection to public health and the environment. Alternatives S2 and S3 would reduce the risk to human health and the environment associated with the primary Site contaminants.

Compliance with ARARs

Alternative S1, No Action, does not comply with ARARs. Alternative S2 would not fully comply with the identified ARARs as soil above the RDWPC and the ICDCC would remain. Alternative S3 would not fully comply with ARARs as inorganic contamination exceeding Part 201 cleanup criteria would not be addressed. A combined alternative composed of Alternatives S2 and S3 would be expected to comply with ARARs.

Long-term Effectiveness and Permanence

Alternative S1 would provide no long-term protection to public health and the environment. Long-term effectiveness of Alternative S2 and S3 would be permanent. Alternative S3 does not address inorganic contamination and mainly addresses the issue of vapor mitigation. Alternative S2 addresses both organic and inorganic contamination, but only at select on-site areas.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

Alternative S1 does not involve any treatment and would not reduce contaminant toxicity, mobility, or volume. Although Alternative S2 reduces the mobility of the contaminant, the volume of the soil remains the same, with some of it being contained in a permitted off-site landfill. Toxicity may be reduced if the soil requires treatment before landfilling. Alternative S3 would reduce the toxicity, mobility, and volume of contaminated soil and soil vapor (e.g., VOCs).

Short-term Effectiveness

Alternative S1, No Action, would not alleviate any current risks at the Site. Implementation of Alternatives S2 or S3 would immediately decrease contaminant mass at the Site.

Implementability

Each of the soil alternatives is readily implementable. Alternative S2 involves excavation and off-site disposal which would entail the use of conventional excavating equipment, such as backhoes and front-end loaders, to excavate impacted soil. Alternative S3 involves expansion of the SVE system and would probably utilize conventional trench excavation methods.

Cost

There are no costs associated with the Alternative S1, No Action. The cost associated with Alternative S2, limited soil excavation, is estimated to be approximately $600,000; however, final costs will be dependent upon the final volume of soil that will be removed. The final volume can not be determined until a remedial design investigation has been completed (included in the estimate) to determine the actual excavation limits. The cost associated with Alternative S3, expansion of the SVE system, is estimated at $191,000 for the initial expansion, but would also include additional O&M costs for SVE system operation. The total cost for Alternative S3, assuming five additional years of system operation for soil treatment, is estimated at $691,000.

**Table 2** also includes an evaluation of a combined alternative (S2 and S3). Implementation of Alternative S2 followed by Alternative S3 would significantly reduce the length of operating time for the SVE system. The cost of the combined alternatives is estimated at approximately $891,000-$1,278,000.

Support Agency Acceptance

The U.S. EPA is the support agency for this project. The U.S. EPA has indicated its acceptance and support for the selected remedy.

Community Acceptance

Community acceptance of the recommended alternative was evaluated after the public comment period. The community supports the selected remedy.

## ADDITIONAL GROUNDWATER ALTERNATIVES

After evaluating the alternatives, the MDEQ decided it was necessary to combine certain alternatives presented in the AFS to provide the best balance of the nine criteria mentioned above. The alternatives, G1 – G8, do not individually fully address the various contaminants of concern in groundwater.

Based on the comparative analysis, the MDEQ prepared the following list of combined alternatives. Each of these additional groundwater alternatives includes continuation of the restrictions on groundwater use on the Spartan Chemical Company property, until drinking water standards are achieved. In addition, drinking water use restrictions should be sought for the property immediately to the west of the Site due to the highly concentrated source area on this property. Additionally, each of the alternatives will need performance monitoring and compliance monitoring as well as provisions for implementation of contingent remedial actions should the selected remedy fail to meet performance objectives.

Combination Alternative G9 – AS/SVE, ISCO, and MNA

Under Alternative G9, we would use a combination of Alternatives G5, G7, and G8. This alternative includes implementation of ISCO in the deep on-site source areas, and off-site areas with the highest groundwater/NAPL contamination. This alternative also includes AS/SVE in the central plume area (area of high dissolved-phase groundwater contamination) and additional source area. Once initial concentrations are reduced, AS/SVE would be converted to an ozone sparge system without SVE. Ozone sparging would provide a more cost-effective ISCO method for the shallow source area than repeat injections. The MNA would follow active treatment to monitor further reduction of contaminant concentrations.

The work under this alternative would be implemented in phases. The first phase of work would address the deep NAPL and shallow source area contamination. The MNA will be employed following active treatment to monitor the continued reduction and/or stabilization of the residual groundwater plume. This alternative also includes a contingency to implement EISB if needed following the initial ISCO and AS/SVE treatment.

The estimated capital cost is $2,312,000. The annual O&M cost will range from $50,000 for AS/ozone system operation alone to $150,000 for AS/SVE system operation. O&M costs for MNA will be approximately $16,000 per year. The present worth cost is $2,647,000, assuming one year of AS/SVE operation followed by two years of ozone sparge system operation and 10 years of MNA. The construction timeframe is two months. The time to achieve RAOs is estimated at 10 years.

Combination Alternative G10 - Enhanced Groundwater Extraction with Ex-situ Groundwater Treatment and MNA

Under Alternative G10, we would use a combination of Alternatives G3 and G8. This alternative involves utilizing Enhanced Groundwater Extraction with Ex-situ Groundwater Treatment for the higher concentration areas of the groundwater plume (source area and central plume area). This treatment would continue until concentrations are significantly reduced. The MNA would be used for the dilute portions of the plume and as a polishing step for the source and central plume areas.

The estimated capital cost is $920,000. The annual O&M cost is $139,000 for system operation and $16,000 for groundwater monitoring. The present worth cost is $3,000,000, based on 45 years of system operation. The construction timeframe is two months. The time to achieve RAOs is estimated at 45 years.

Combination Alternative G11 - Groundwater Extraction with Ex-situ Groundwater Treatment and MNA

Under Alternative G11, we would use a combination of Alternative G3 without the enhanced extraction component (injection upgradient) and Alternative G8.

The estimated capital cost is $830,000. The annual O&M cost is $139,000 for system operation and $16,000 for groundwater monitoring. The present worth cost is $2,941,000, based on 50 years of system operation. The construction timeframe is two months. The time to achieve RAOs is estimated at 50 years.

Combination Alternative G12 – ISCO and MNA

Under Alternative G12, we would use a combination of Alternatives G5 and G8. It is similar to Alternative G9 but does not include the AS/SVE or EISB components. This alternative would utilize MNA for the central plume area as well as the more dilute portions of the groundwater plume.

The estimated capital cost is $2,087,000. The annual O&M cost for groundwater monitoring is $16,000. The present worth cost is $2,238,000, assuming 20 years of MNA. The construction timeframe is three months. The time to achieve RAOs is estimated at 20 years.

## EVALUATING THE ADDITIONAL GROUNDWATER ALTERNATIVES

**Table 1A** provides a comparison of the additional combined remedial alternatives for groundwater. A comparative analysis of each alternative with respect to the nine evaluation criteria is included below:

Overall Protection of Human Health and the Environment

Alternative G9 provides the highest degree of overall protection of human health and the environment by addressing NAPL source area contamination and dissolved-phase contamination. Alternatives G10 and G11 provide the lowest level of protection as the NAPL source area remains untreated. Alternative G12 provides a higher degree of protection than G10 and G11, but does not aggressively treat the dissolved-phase contamination. All of the combination alternatives include MNA which could provide a high degree of protection if the other actions are successful in reducing concentrations in the source area and the central plume area.

Compliance with ARARs

Alternatives G10, G11, and G12 may have difficulty in achieving compliance with all the site-specific ARARs as these alternatives individually treat either the dissolved-phase contamination or the NAPL source contamination, but not both. Alternative G9 is the only alternative that aggressively treats both the source area and the central plume area and would fully comply with the site-specific ARARs.

Long-term Effectiveness and Permanence

Alternatives G9 and G12 provide long-term effectiveness and permanence by elimination of the NAPL source area contamination. The G9 also actively treats the dissolved-phase contamination in the central plume area whereas Alternative G12 does not. Alternatives G10 and G11 provide immediate hydraulic control and treatment of the dissolved-phase contamination; however, they do not aggressively address the NAPL contamination. Failure to address the NAPL source contamination may result in an indefinite period of groundwater extraction and MNA.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

Alternative G9 reduces the toxicity of both the NAPL source contamination and dissolved-phase contamination via ISCO technology, and the AS/SVE, respectively. Consequently both the mobility and volume of contamination is reduced. Although Alternatives G10 and G11 effectively reduce dissolved-phase contamination, they would likely not be very effective in reducing the volume of NAPL contamination. Alternative G12 effectively reduces NAPL source contamination but MNA may not be successful in reducing the dissolved-phase contamination in the central plume area.

Short-term Effectiveness

Alternatives G10 and G11 provide a high degree of short-term effectiveness due to the immediate hydraulic control of the dissolved-phase contaminant plume. Although Alternatives G9 and G12 require extensive O&M during injection, the short-term effectiveness is high and permanently addresses the NAPL source contamination. Alternatives G9 and G12 also have special care requirements associated with the handling of the oxidant and the potential for off-gassing. Each of the remedies could be implemented in a fashion so as to not present substantive risks to on-site workers or to the community.

Implementability

Alternatives G10 and G11 could be easily implemented but would require some additional groundwater modeling. Alternatives G9 and G12 could be easily implemented, but would require pilot testing prior to full-scale implementation. Overall, Alternative G12 would be the most easily implemented.

Cost

Alternative G12 has the lowest total present worth of $2.2 million, while Alternatives G10 and G11 have the highest total present worth at approximately $3 million. The cost of Alternative G9 is approximately $2.6 million.

Support Agency Acceptance

The U.S. EPA is the support agency for this project. Final acceptance of the recommended alternative was determined after assessing public comment. The U.S. EPA supports the selected remedy.

Community Acceptance

Community acceptance of the recommended alternative was evaluated after the public comment period. The community supports the selected remedy.

**Principal Threat Wastes**

The National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR Part 300) (NCP) establishes an expectation that the lead agency will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure.

Source materials constituting principal threat wastes at the site include highly contaminated soils and potentially NAPL that act as a reservoir for contamination migration to groundwater at the site. The source materials contain VOCs that are highly mobile. Such source materials must be addressed first to facilitate the cleanup.

Alternatives S2 and S3 provide for removal or treatment of soil and Alternatives G2 through G12 provide for the treatment of groundwater contaminated or potentially contaminated with high concentrations of highly mobile solvents, a principal threat waste. Therefore, these alternatives satisfy the statutory preference for treatment that reduces toxicity, mobility and volume as a principal element.

## Selected Remedy

### Summary of the Rationale for the Selected Remedy

The goal of this remedial action is to restore the land as necessary to allow its reuse and to restore the groundwater to its beneficial use, which is, at the Site, a potential future drinking water source. Based on information obtained during the remedial investigation and on a careful analysis of all remedial alternatives, the MDEQ believes that the selected remedy will achieve this goal. It may become apparent, during implementation or monitoring of the remedy, that contaminant levels have ceased to decline and are remaining constant at levels higher than the cleanup level over some portion of the contaminated plume. In such a case, the performance standards and/or the remedy may be reevaluated.

The selected remedy will include groundwater treatment during which the treatment technology's performance will be carefully monitored on a regular basis and adjusted as warranted by the performance data collected during operation. To ensure that cleanup levels continue to be maintained, the aquifer will be regularly monitored in those areas where treatment has ceased.

The MDEQ believes the selected remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria. The decisive factors that led to selecting the remedy include 1) the high level of protectiveness in a relatively short time frame, 2) the high level of compliance with ARARs, 3) the excellent long-term effectiveness while mitigating risks posed during implementation, 4) the high level of supporting agency and community acceptance, 5) the reasonable present worth cost, and 6) the low level of operation and maintenance compared to other alternatives.

### Description of the Selected Remedy

The selected remedy is a combination of Alternatives S2 and S3 for soils and G9 for groundwater and includes the following remedial components:

- Soil Excavation and Off-site Disposal
- Expansion of the SVE System for Mitigation of Vapors from Soils
- AS/SVE
- ISCO
- Contingency for the EISB
- Institutional Controls Restricting Groundwater Use and Land Use
- MNA

The selected remedy provides a step-wise approach for the implementation of only those remedial components that are necessary to achieve soil and groundwater cleanup levels in a reasonable period of time, i.e., approximately 15 years from the start of the remedial action at

the Site. Source materials constituting principal threat wastes at the site include highly contaminated soils and potentially NAPL that act as a reservoir for contamination migration to groundwater at the Site. The source materials contain VOCs that are highly mobile. Such source materials will be addressed first to facilitate the cleanup. For example, the removal of hot spots of soil contamination (that can't be efficiently treated on-site) during the implementation of soil Alternative S2 (limited excavation) will reduce the time frame for Alternative S3 (SVE operation) and its associated O&M costs. In addition, it will significantly improve groundwater treatment by removing the immediate source of groundwater contamination, and will allow for a more rapid transition to the MNA.

**Figure 7A** shows the proposed excavation areas and **Figure 7B** shows the proposed SVE treatment expansion area used for cost estimating purposes. Final details of soil remediation alternatives will be determined during the remedial design. This will include additional soil characterization prior to excavation, and further vapor sampling prior to SVE expansion. The magnitude of the identified off-site soil vapor impacts will determine whether off-site SVE expansion is necessary, or whether an alternative vapor mitigation system may be more applicable.

The demolition of all remaining below ground conveyance piping (as identified) will also be conducted during implementation of the response action. Note that the 2006 demolition project removed all above-ground piping, and there does not appear to be any buried product piping; however, unexpected pipes will be removed as they are encountered.

For groundwater, Alternative G9 (the combined Alternatives G5, G7, and G8 – AS/SVE and ISCO combined with MNA) with alternative G4 (EISB) being used as a contingency will be implemented as necessary to return groundwater to unrestricted use, i.e., drinking water standards of the Safe Drinking Water Act, 1976 PA 399, as amended, and Michigan's Part 201 standards. The approach will quickly address the remaining high concentration source areas through the ISCO and the AS/SVE. As site remediation progresses, some of these treatment technologies may no longer be necessary to achieve cleanup standards in a reasonable period of time, or cost benefit evaluations may indicate that continued operation of existing technologies for a slightly longer time period may provide the same benefit without the need for additional capital costs.

**Figure 6** shows the conceptual ISCO and the AS/SVE in-situ treatment areas for the combined groundwater alternative. Final details of the remedial design including number of injection points, depth, location, and duration of treatment will be determined during the remedial design.

The goal of the ISCO/AS/SVE will be to significantly reduce concentrations in the source area to levels that will naturally attenuate within a reasonable time frame. The full implementation will be preceded by pilot testing to evaluate the effectiveness of the AS on 1) mass recovery, and 2) destruction of contaminants via the existing treatment system. After the initial ISCO application, an assessment will be performed to determine if additional applications will be warranted or beneficial.

Remedial measures may include the ISCO for reduction of contaminant mass in soils and groundwater in two areas, on the Site, as well as on the adjacent Ambassador Steel property. The full implementation will be preceded by collection of the necessary access agreements, and development of a step-wise implementation plan. That plan shall include pilot testing to

evaluate 1) the effectiveness of mass destruction, and 2) the impact of oxidant introduction into the (currently reducing) groundwater environment. Such a plan will evaluate, at a scale consistent with known contaminant migration rates, the potential for chemical oxidants to enhance the migration of contaminants currently being controlled in part by reductive dechlorination and reductive processes (e.g. VOCs and hexavalent chromium). If applied, the complete ISCO implementation plan shall include requirements for 1) post-application monitoring of groundwater contamination downgradient of the application area for a period sufficient to detect any negative impacts on contaminant migration, and 2) contingency plans to address any such enhanced contaminant migration should it occur.

Depending on the success of the ISCO and the AS/SVE treatments, remaining concentrations may be addressed with Alternative G4, EISB. This would include the injection of HRC® and/or organic carbon sources and nutrients to stimulate and enhance biodegradation processes to further reduce dissolved-phase chlorinated VOC contamination.

The final phase of the groundwater remedy will be to allow natural attenuation processes to further reduce contamination. The ultimate goal will be reducing the concentration of contaminants of concern to levels at or below drinking water standards throughout the aquifer where it has been impacted by site-related contamination. The MDEQ expects that this goal will be achieved in a reasonable period of time i.e., approximately 15 years, compared to other alternatives. If the timeframe to achieve the cleanup standard extends beyond 15 years, the MDEQ still believes that monitored natural attenuation is an appropriate remedial component given that the use of the groundwater in the near future is unlikely. The following site-specific circumstances were considered in determining that the future use of the groundwater unlikely: an off-site chromium plume will continue to render the area's groundwater unusable until it is remediated; the area is served by a public water supply using Lake Michigan as its source water; and land use restrictions are in place and will be expanded as part of the selected remedy to prevent the use of groundwater throughout the area impacted by the contaminant plumes.

A key component of this phase is the monitoring of the progress of the natural attenuation process to document or ascertain if contaminant concentrations are reducing over time. The MDEQ believes that MNA is an appropriate follow-up to the active remediation components of the selected remedy. Groundwater monitoring data from the site indicates that contaminant plumes are no longer increasing in extent or are shrinking. The MDEQ believes that the "lines of evidence" for the selection of monitored attenuation have been demonstrated as required by OSWER Directive 9200.4-17P, *Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* Specifically, the following two lines of evidence have been demonstrated.

> 1) Historical groundwater and/or soil chemistry data that demonstrate a clear and meaningful trend of decreasing contaminant mass and/or concentration over time at appropriate monitoring or sampling points. (In the case of a groundwater plume, decreasing concentrations should not be solely the result of plume migration. In the case of inorganic contaminants, the primary attenuating mechanism should also be understood.)

(2) Hydrogeologic and geochemical data that can be used to demonstrate indirectly the type(s) of natural attenuation processes active at the Site, and the rate at which such processes will reduce contaminant concentrations to required levels. For example, characterization data may be used to quantify the rates of contaminant sorption, dilution, or volatilization, or to demonstrate and quantify the rates of biological degradation processes occurring at the Site.

The remedy may change somewhat as a result of the remedial design and construction processes. Changes to the remedy described in the ROD will be documented by using either a technical memorandum in the Administrative Record file, an Explanation of Significant Differences (ESD), or a ROD Amendment, as appropriate.

**Institutional Controls**

Institutional controls are necessary to ensure the protection of human health and to restrict activities at the Site that may interfere with the remedial action, O&M, monitoring, or other measures necessary to ensure the effectiveness and integrity of the remedial action. The selected remedy includes the continuation of the institutional controls including restrictions to prevent groundwater use and land use on the Spartan Chemical Company property, until drinking water standards and soil cleanup levels are achieved. In addition, an institutional controls plan will be drafted during the remedial design for the Site and the property immediately to the west of the Site. The institutional controls are needed to prevent direct contact with or ingestion of the contaminated soil and groundwater remaining at the Site.

**Summary of the Estimated Remedy Costs**

The overall present worth cost for the selected remedy is estimated to be between $3,538,392 and $3,925,392. The major capital and O&M cost elements for the selected remedy are presented in **Table 10** of Appendix B of this ROD. The information in this cost estimate table is based on the best available information regarding the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. Major changes may be documented in the form of either a memorandum in the Administrative Record file, an ESD, or a ROD Amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

**Expected Outcomes of the Selected Remedy**

The expected outcomes of the selected remedy include unrestricted use of groundwater and commercial or light industrial use of the land within 15 years from the start of the remedial action when cleanup levels are achieved. Exposure to soil will be controlled through excavation and off-site disposal, treatment, and institutional controls. Soil cleanup levels are the generic cleanup criteria provided by Michigan's Part 201 necessary for the protection of groundwater. Exposure to groundwater will be controlled through treatment and institutional controls. Groundwater cleanup levels are the drinking water standards of the Safe Drinking Water Act and Michigan's Part 201. For each media, **Table 11** provides the specific chemicals of concern, cleanup levels, basis for the cleanup level, and the risk at the cleanup level. The remedial action is expected to facilitate the community's socio-economic revitalization efforts by making the land available for reuse.

**Statutory Determinations**

Under CERCLA §121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following sections discuss how the selected remedy meets these statutory requirements.

**Protection of Human Health and the Environment**

The selected remedy will protect human health and the environment through the removal or treatment of contaminated soil by SVE. The selected remedy will also treat groundwater contamination through the ISCO to achieve state and federal drinking water standards in a reasonable period of time.

**Compliance with ARARs**

The selected remedy of in-situ chemical oxidation for groundwater and AS, SVE, and limited excavation for soils, complies with all ARARs. The ARARs analysis is presented in **Table 12** and the major ARARs are presented below:

- State of Michigan's Part 201 cleanup criteria
- State of Michigan's Air Pollution Control Rules
- Safe Drinking Water Act Maximum Contaminant Levels (MCLs) (40 CFR Part 141), which specify acceptable concentration levels in groundwater
- Clean Air Act requirements for emissions from AS and SVE units
- The State of Michigan Soil Erosion and Sedimentation Control Act (Act 347 of 1972)

The selected remedy will comply with ARARs by the treatment of soil and groundwater to meet the acceptable concentrations pursuant to Part 201 of PA 451. Specifically, the cleanup of contaminated groundwater to meet drinking water standards and removal and treatment of contaminated soils to meet generic residential cleanup criteria protective of groundwater as a drinking water source, would result in compliance with chemical-specific ARARs. The selected remedy will also comply with other ARARs that are applicable to the actual implementation of SVE and AS, including Michigan's Air Pollution Control Rules promulgated pursuant to Part 55, 1994 PA 451, as amended and federal fugitive dust control requirements (40 CFR 51). A Soil Erosion and Sedimentation Control implementation plan will be prepared to ensure all earth movement activities comply with state regulations.

### Cost-Effectiveness

The MDEQ has determined that the selected remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness.” (NCP §300.430(f)(1)(ii)(D)). This was accomplished by evaluating the “overall effectiveness” of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness).

Overall effectiveness was then compared to costs to determine cost-effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs and hence this alternative represents a reasonable value for the money to be spent.

### Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The MDEQ has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the MDEQ has determined that the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering state and community acceptance.

The selected remedy treats the source materials constituting principal threats at the Site, achieving significant reductions in solvent concentrations in soil and groundwater and will effectively reduce the mobility of and potential for exposure to contaminants remaining on-site. The selected remedy does not present short-term risks significantly different from the other treatment alternatives. There are no special implementability issues that set the selected remedy apart from any of the other alternatives evaluated, other than the requirement for pilot testing.

### Preference for Treatment as a Principal Element

By treating the contaminated soils by SVE and groundwater through ISCO, the selected remedy addresses principal threats posed by the Site through the use of treatment technologies. By utilizing treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

### Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

### Documentation of Significant Changes from Preferred Alternative of Proposed Plan

There were no significant changes in the selected remedy from the preferred alternative in the Proposed Plan.

## PART 3: RESPONSIVENESS SUMMARY

The public participation requirements of CERCLA sections 113 (k) (2) (i-v) and 117 of CERCLA have been met during the remedy selection process. CERCLA requires the lead agency to respond "...to each of the significant comments, criticisms, and new data submitted in written or oral presentations" on a Proposed Pplan for a remedial action. The Responsiveness Summary addresses concerns expressed by the public in written and oral comments received by the State and the U.S. EPA regarding the proposed remedy for the Site.

Background

The MDEQ issued the Proposed Plan to the public in July 2007. A public comment period was held from July 10 to August 16, 2007. A public meeting was held on July 30, 2007 to discuss the Proposed Plan. At this meeting, representatives from the MDEQ and the U.S. EPA and answered questions about the Site and the remedial alternatives under consideration. A court reporter was present to record any formal oral comments on the Proposed Plan. Written comments were also accepted at this meeting.

The availability of the Proposed Plan, supporting documents, and date of the public meeting were published in the Grand Rapids Press on July 9, 2007. During the public comment period the MDEQ received one written comment via electronic mail. No oral comments were made during the public meeting.

Stakeholder Issues and Lead Agency Responses

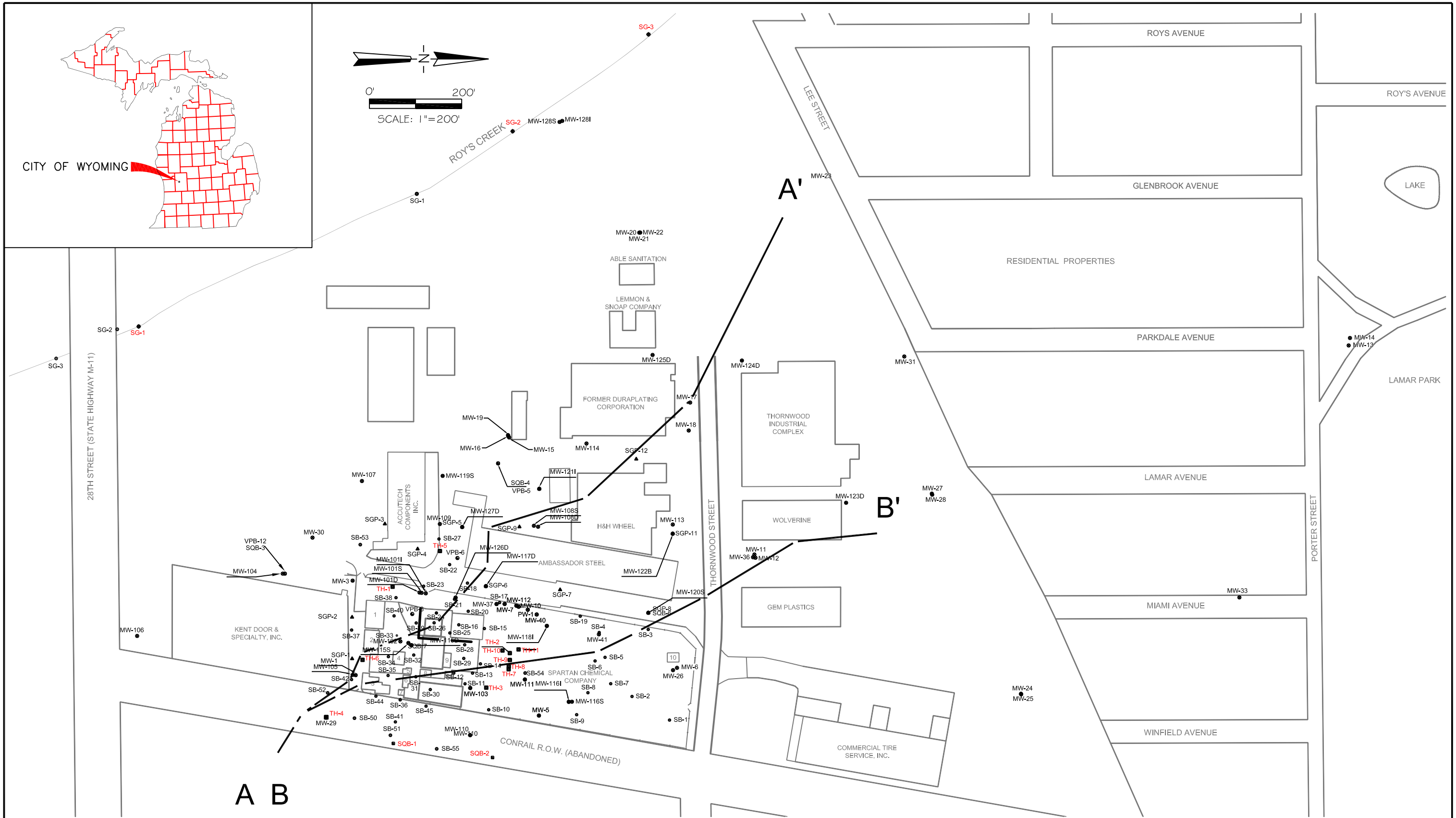
Comment: One comment was provided by a local resident that indicated support for the proposed alternative presented in the proposed plan.

Response: The MDEQ acknowledges this comment and appreciates the support indicated for the proposed alternative.

Technical and Legal Issues

No technical or legal issues were raised.

# APPENDIX A
# FIGURES




LEGEND

- Cross Section Locations
- Existing Monitor Well
- DLZ Monitor Well
- Existing Soil Boring
- DLZ Vertical Profile Soil Boring
- DLZ Soil Gas Probe Boring
- DLZ Soil Quality Boring
- DLZ Staff Gauge
- Test Holes

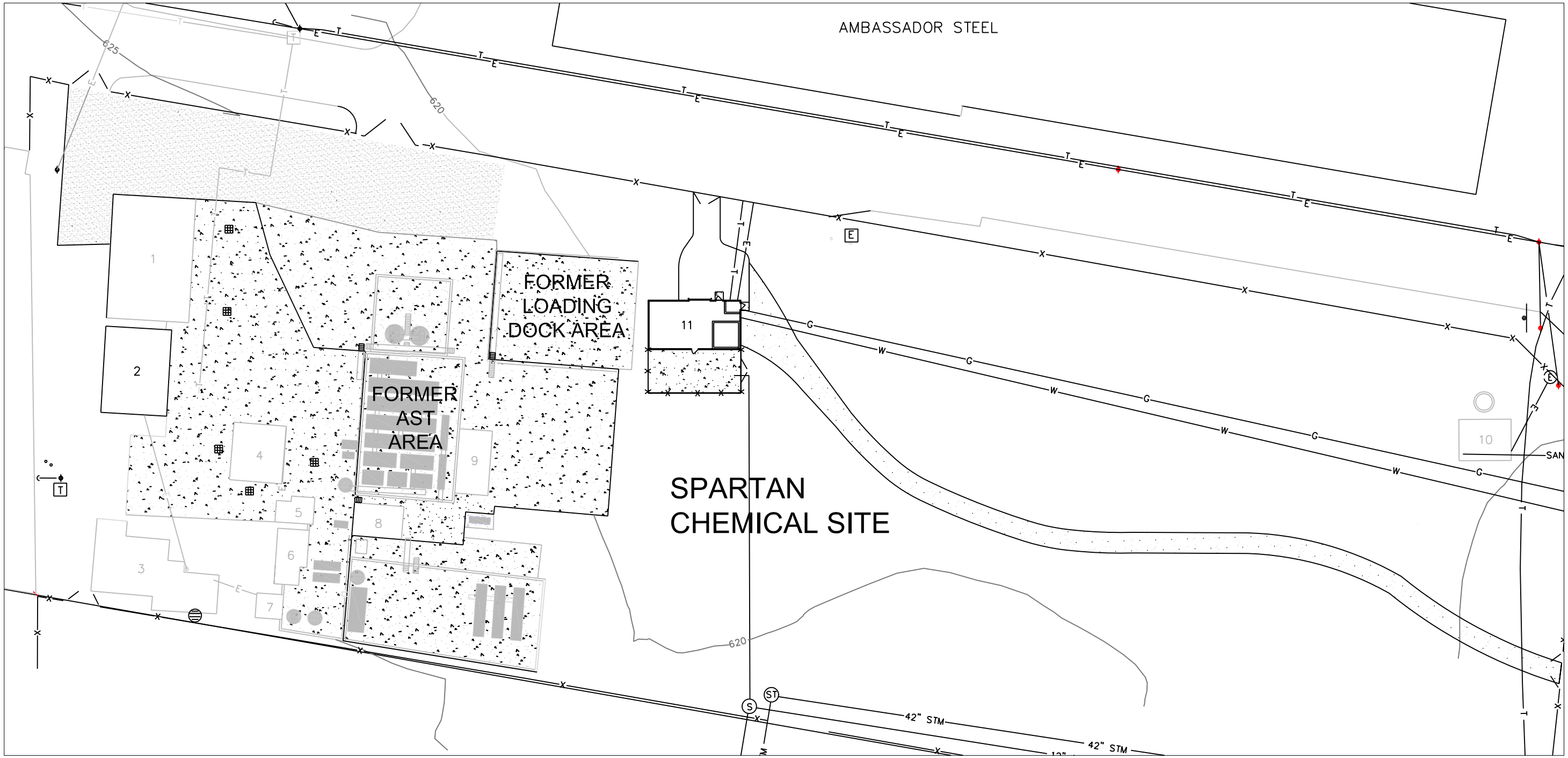
FIGURE 1

| File: HMI\Projects\SpartanChemical\Proposed Plan\PropPlanFigure1.dwg | Designed by: CSL | Drawn by: CSL/DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

2501 Jolly Road, Suite 100
Okemos, Michigan
48864

SPARTAN CHEMICAL SITE AND
CROSS SECTION LOCATION MAP
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN




## LEGEND

- Existing asphalt pavement
- Existing concrete pavement
- Existing gravel driveway
- Retaining Wall (Approximately 3-4 feet high)
- Catch Basin
- Utility Identifiers
- Sump (Plugged and Filled)
- Fencing
- Stairs

N

0' 50'

Scale: 1"=50'

## BUILDING KEY

1 Warehouse–Demolished
2 Warehouse–Existing
3 Office Building–Demolished
4 Drum Building–Demolished
5 Storage–Demolished
6 Locker Room–Demolished
7 Tool Crib–Demolished
8 Evaporator Building–Demolished
9 Warehouse–Demolished
10 Air Stripper Unit–Demolished
11 Treatment Building–Existing

FIGURE 1A

| File: HMI\Projects\SpartanChemical\Proposed Plan\PropPlanFigure1A.dwg | Designed by: CSL | Drawn by: CSL/DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

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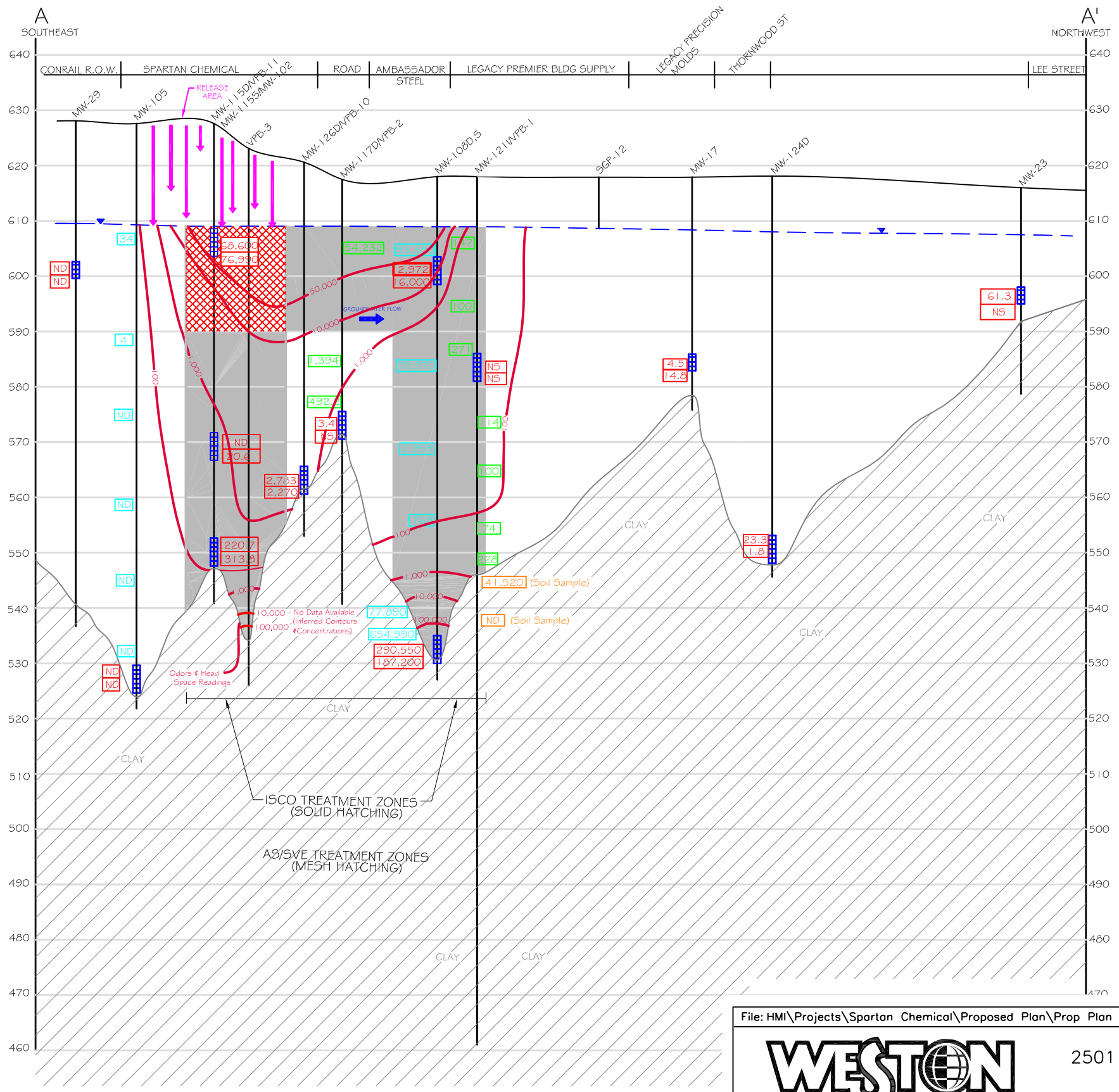
2006 DEMOLITION ACTIVITIES AND CURRENT SITE FEATURES
PROPOSED PLAN
SPARTAN CHEMICAL SITE–WYOMING, MICHIGAN




LEGEND

- SCREENED INTERVAL
- WATER LEVEL (OCTOBER 2002)
- GROUNDWATER ELEVATION (OCTOBER 2002)
- 1,000 — TOTAL VOCs IN GROUNDWATER VAS LOCATION (1994/1995) (Not Contoured)
- 1,000 — TOTAL VOCs IN GROUNDWATER VAS LOCATION (DECEMBER 1999/JANUARY 2000)
- 1,000 — TOTAL VOCs IN GROUNDWATER WELL SAMPLE (OCTOBER 2002)
- 1,000 — TOTAL VOCs IN GROUNDWATER WELL SAMPLE (JUNE - JULY 2005)
- 1,000 — TOTAL VOCs IN SOIL SAMPLE (DECEMBER 1999/JANUARY 2000)
- 100 — TOTAL GROUNDWATER VOCs CONTOUR (1999-2005 Data Only)
- CLAY UNIT
- SAND OR SAND AND GRAVEL UNITS

NOTES:

NS = NOT SAMPLED
ND = NO VOCs DETECTED
LITHOLOGY DESCRIPTIONS FROM DLZ
VOC DETECTIONS IN GROUNDWATER REPORTED IN ug/L
CROSS SECTION DERIVED AND EXPANDED FROM CROSS SECTION 1-1' OF ARI

THE VOC PLUME IS COMPRISED OF THE FOLLOWING PRIMARY CONTAMINANTS OF CONCERN:

CHLORINATED SOLVENTS
TETRACHLOROETHYLENE (PCE)
TRICHLOROETHYLENE (TCE)
cis-1,2-DICHLOROETHYLENE (cDCE)
1,1-DICHLOROETHANE
1,1,1-TRICHLOROETHANE
VINYL CHLORIDE

KETONES
ACETONE
METHYL ISOBUTYL KETONE (MIBK)
METHYL ETHYL KETONE (MEK)

FUEL CONSTITUENTS
BENZENE
TOLUENE
ETHYLBENZENE
XYLENES
1,2,4-TRIMETHYLBENZENE
1,3,5-TRIMETHYLBENZENE

Scale (Feet)

FIGURE 2

| File: HMI\Projects\Spartan Chemical\Proposed Plan\Prop Plan Figure 2 XS A-A'.dwg | Designed by: CSL | Drawn by: CSL/JMN | Checked by: MK/MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

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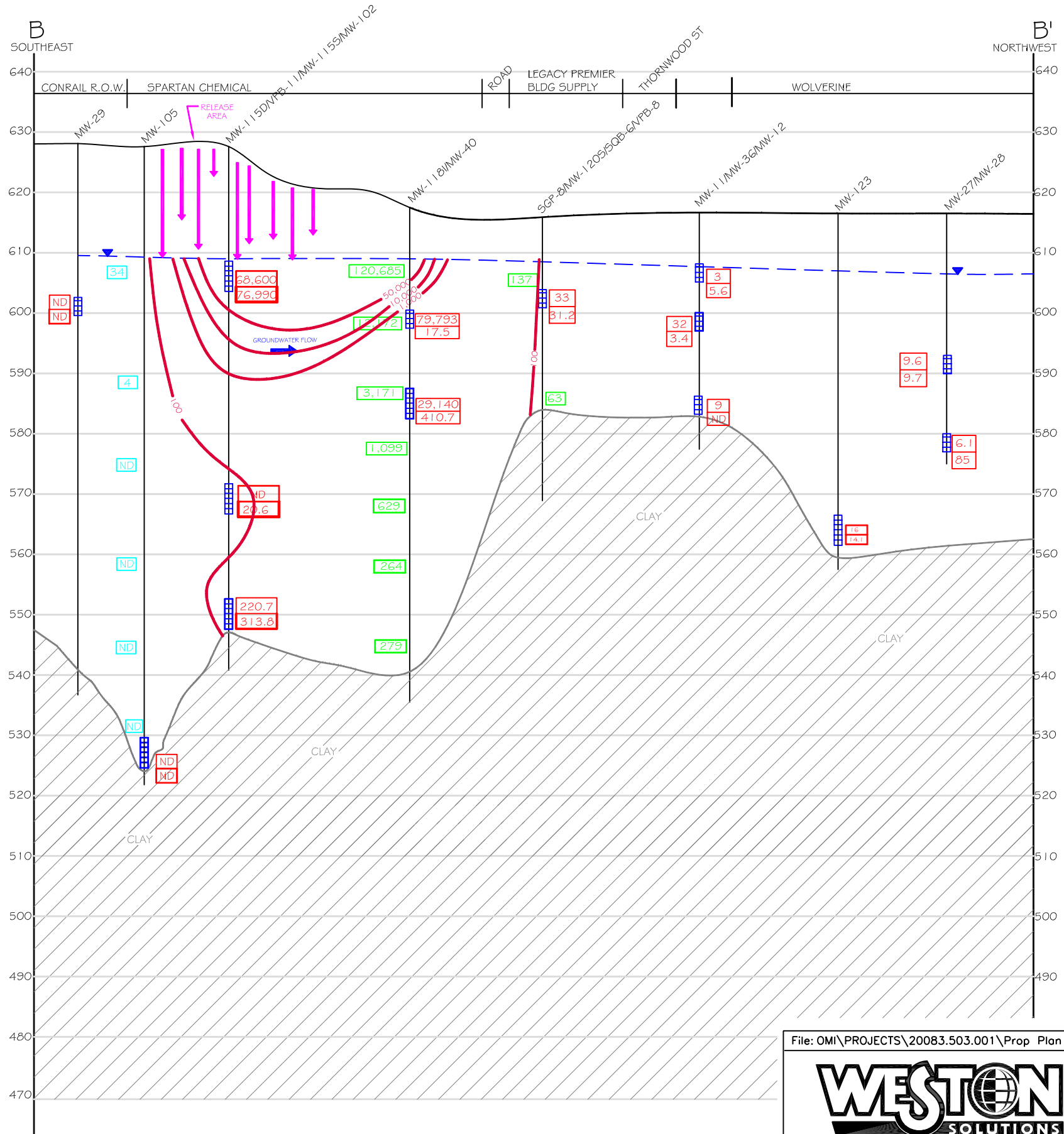
48864

CROSS SECTION A-A'
WITH TOTAL VOC CONCENTRATIONS
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN




LEGEND

- SCREENED INTERVAL
- WATER LEVEL (OCTOBER 2002)
- GROUNDWATER ELEVATION (OCTOBER 2002)
- 1,000 — TOTAL VOCs IN GROUNDWATER VAS LOCATION (1994/1995) (Not Contoured)
- 1,000 — TOTAL VOCs IN GROUNDWATER VAS LOCATION (DECEMBER 1999/JANUARY 2000)
- 1,000 — TOTAL VOCs IN GROUNDWATER WELL SAMPLE (OCTOBER 2002)
- 1,000 — TOTAL VOCs IN GROUNDWATER WELL SAMPLE (JUNE AND JULY 2005)
- 100 — TOTAL GROUNDWATER VOCs CONTOUR (1999-2005 Data Only)
- CLAY UNIT
- SAND OR SAND AND GRAVEL UNIT

NOTES:
NS = NOT SAMPLED
ND = NO VOCs DETECTED
LITHOLOGY DESCRIPTIONS FROM DLZ
VOC DETECTIONS IN GROUNDWATER REPORTED IN ug/L
CROSS SECTION DERIVED FROM ARI

THE VOC PLUME IS COMPRISED OF THE FOLLOWING PRIMARY CONTAMINANTS OF CONCERN:

CHLORINATED SOLVENTS
TETRACHLOROETHYLENE (PCE)
TRICHLOROETHYLENE (TCE)
cis-1,2-DICHLOROETHYLENE (cDCE)
1,1-DICHLOROETHANE
1,1,1-TRICHLOROETHANE
VINYL CHLORIDE

FUEL CONSTITUENTS
BENZENE
TOLUENE
ETHYLBENZENE
XYLENES
1,2,4-TRIMETHYLBENZENE
1,3,5-TRIMETHYLBENZENE

KETONES
ACETONE
METHYL ISOBUTYL KETONE (MIBK)
METHYL ETHYL KETONE (MEK)

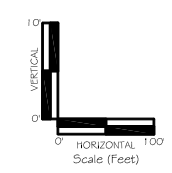



FIGURE 3

| File: OMI\PROJECTS\20083.503.001\Prop Plan Figure 3. xs B-B'dwg | Designed by: CSL | Drawn by: CSL | Checked by: MK | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

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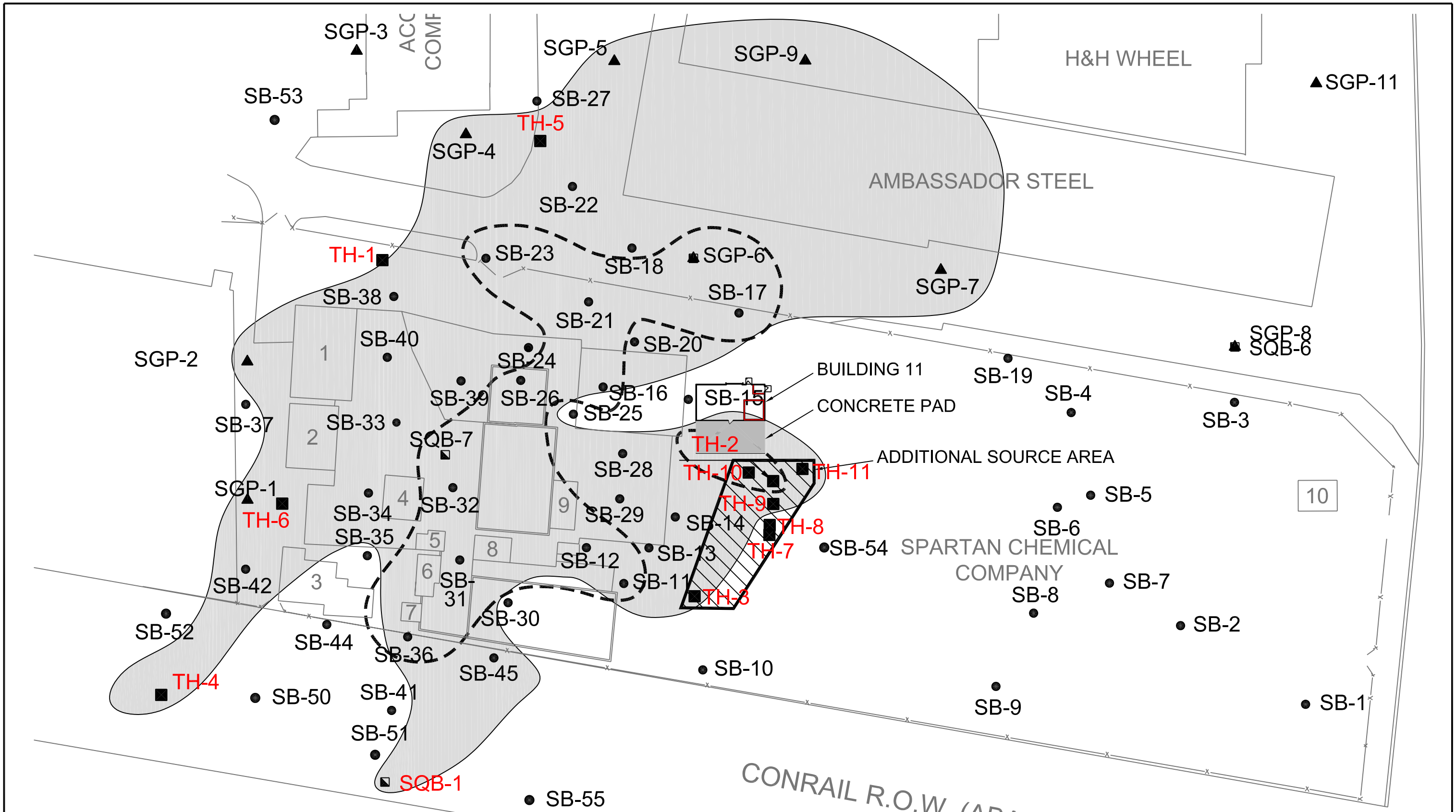
48864

CROSS SECTION B-B'
WITH TOTAL VOC CONCENTRATIONS
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN




LEGEND

SOIL EXCEEDING RESIDENTIAL DRINKING WATER PROTECTION CRITERIA (RDWPC)

SOIL EXCEEDING VOLATILIZATION TO INDOOR AIR INHALATION CRITERIA (SVIIC)

N

0' 60'

SCALE: 1"=60'

FIGURE 4A

| File: HMI\Projects\SpartanChemical\Proposed Plan\PropPlanFigures4and6.dwg | Designed by: CSL | Drawn by: CSL/DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

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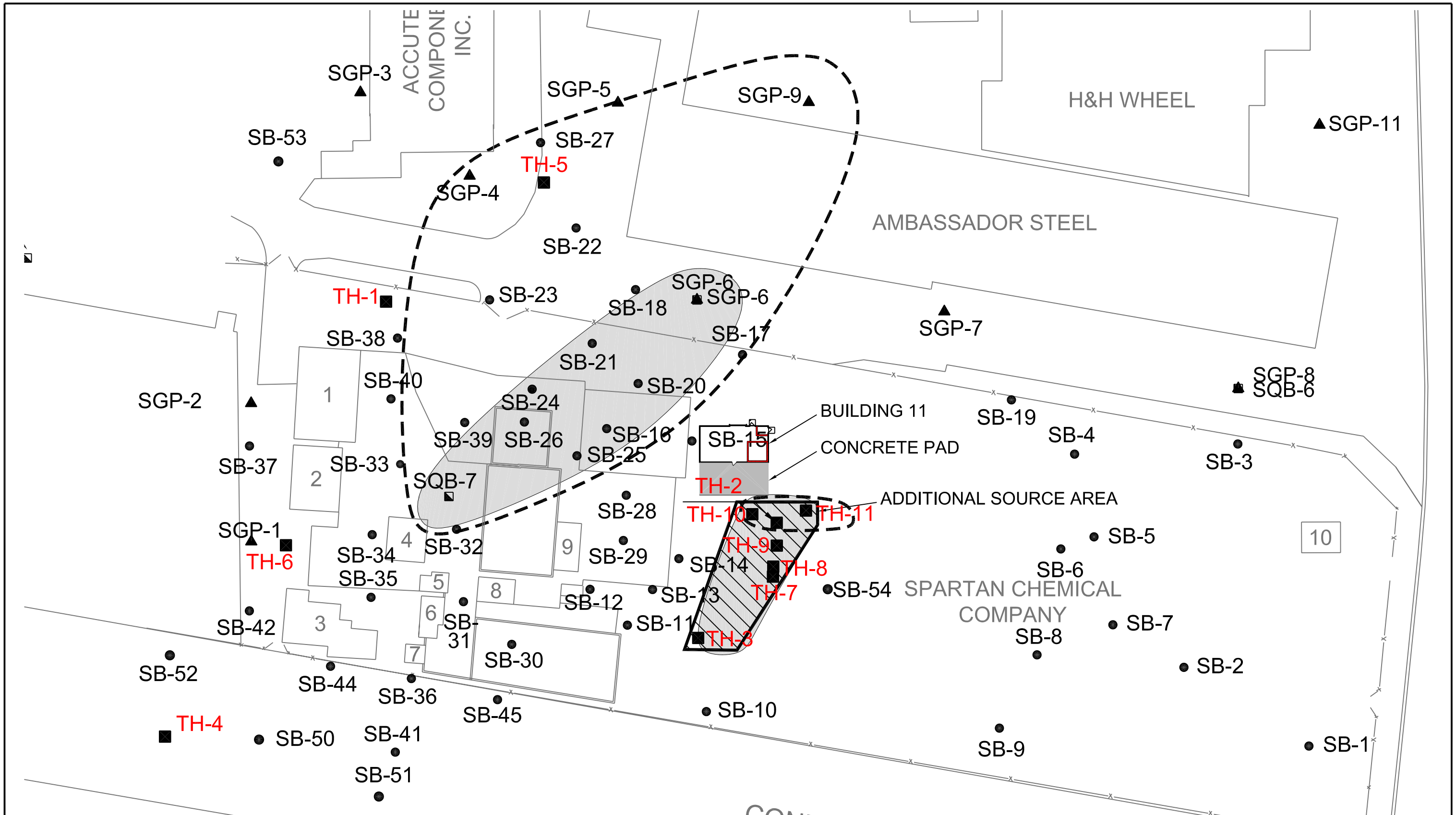
EXTENT OF ORGANIC SOIL CONTAMINATION
EXCEEDING RDWPC AND SVIIC
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN




LEGEND

SOIL EXCEEDING INDUSTRIAL COMMERCIAL DIRECT CONTACT CRITERIA (ICDCC)

SOIL EXCEEDING GROUNDWATER SURFACE WATER INTERFACE PROTECTION CRITERIA (GSIP)

N

0' 60'

SCALE: 1"=60'

FIGURE 4B

| File: HMI\Projects\SpartanChemical\Proposed Plan\PropPlanFigures4and6.dwg | Designed by: CSL | Drawn by: CSL/DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

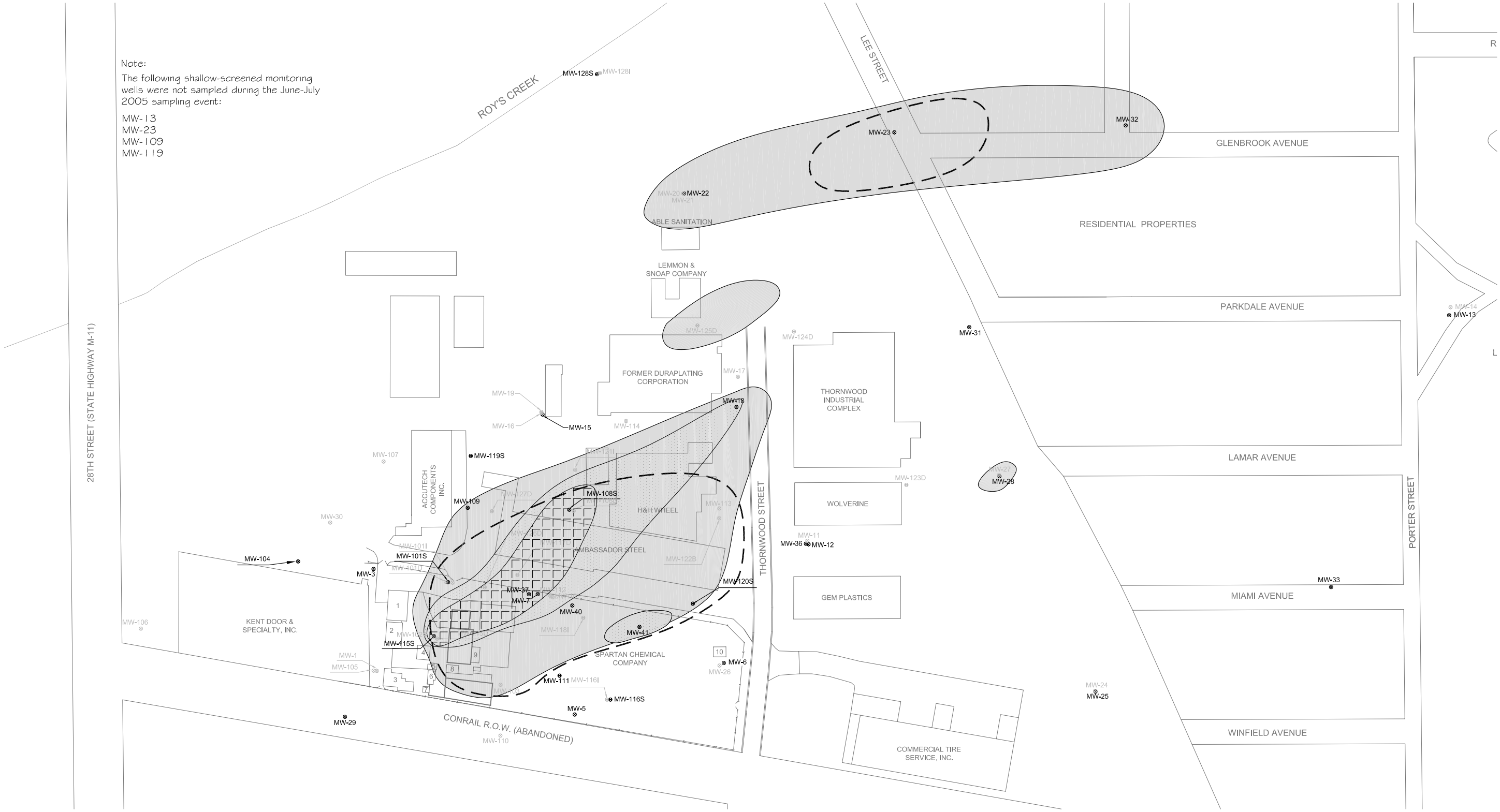
WESTON SOLUTIONS

2501 Jolly Road, Suite 100
Okemos, Michigan
48864

EXTENT OF ORGANIC SOIL CONTAMINATION
EXCEEDING ICDCC AND GSIP
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN

Note:
The following shallow-screened monitoring wells were not sampled during the June-July 2005 sampling event:

MW-13
MW-23
MW-109
MW-119




## LEGEND

- ESTIMATED EXTENT OF VOCs IN GROUNDWATER EXCEEDING DRINKING WATER CRITERA (RDWC) *
- ESTIMATED EXTENT OF VOCs IN GROUNDWATER EXCEEDING GROUNDWATER SURFACE WATER INTERFACE (GSI) *
- MW-29 GREY SHADED MONITORING WELLS ARE NOT INCLUDED IN TOTAL VOC CONTOURING
- MW-111 BOLD SHADED MONITORING WELLS ARE SHALLOW SCREENED MONITORING WELLS
- * Not depth specific-includes exceedance in any interval (shallow, intermediate, or deep-screened wells)
- EXTENT OF TOTAL VOCs GREATER THAN 1,000 ug/L AND LESS THAN 100,000 ug/L IN SHALLOW-SCREENED MONITORING WELLS
- EXTENT OF TOTAL VOCs GREATER THAN 100 ug/L IN SHALLOW-SCREENED MONITORING WELLS

Note: Total VOC contour lines based on analytical data from the June-July 2005 sampling event.

N

0' 200'

SCALE: 1"=200'

FIGURE 5A

| File: HMI\Projects\SpartanChemical\Proposed Plan\PropPlanFigure5A.dwg | Designed by: CSL | Drawn by: CSL/DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

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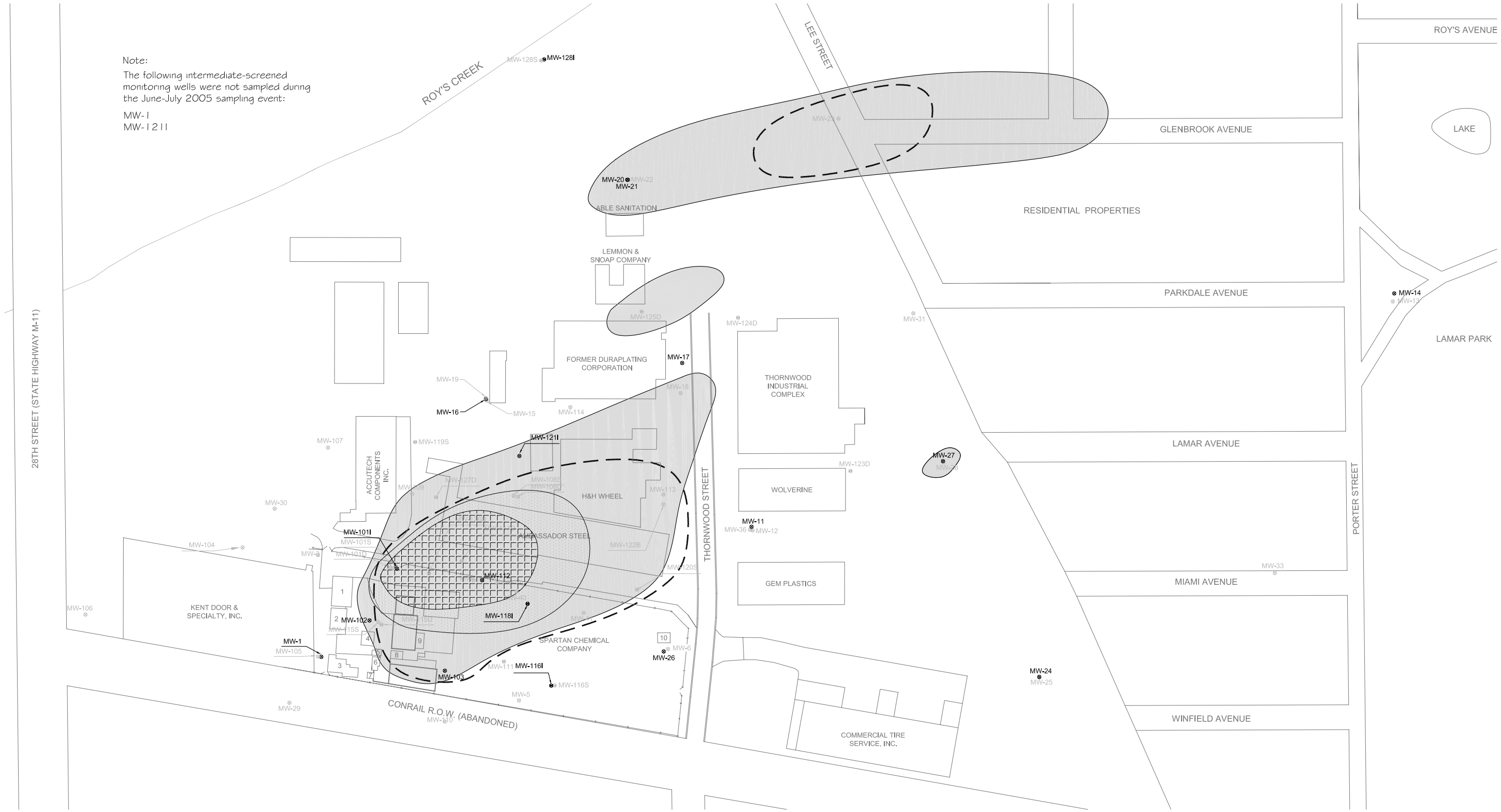
EXTENT OF ORGANIC GROUNDWATER CONTAMINATION EXCEEDING RDWC AND GSI SHALLOW MONITORING WELLS

PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN




## LEGEND

- ESTIMATED EXTENT OF VOCs IN GROUNDWATER EXCEEDING DRINKING WATER CRITERA (RDWC)*
- ESTIMATED EXTENT OF VOCs IN GROUNDWATER EXCEEDING GROUNDWATER SURFACE WATER INTERFACE (GSI)*
- MW-29 GREY SHADED MONITORING WELLS ARE NOT INCLUDED IN TOTAL VOC CONTOURING
- MW-111 BOLD SHADED MONITORING WELLS ARE INTERMEDIATE SCREENED MONITORING WELLS
- * Not depth specific-includes exceedance in any interval (shallow, intermediate, or deep-screened wells)
- EXTENT OF TOTAL VOCs GREATER THAN 1,000 ug/L AND LESS THAN 100,000 ug/L IN INTERMEDIATE-SCREENED MONITORING WELLS
- EXTENT OF TOTAL VOCs GREATER THAN 100 ug/L IN INTERMEDIATE-SCREENED MONITORING WELLS

Note: Total VOC contour lines based on analytical data from the June-July 2005 sampling event.

FIGURE 5B

| File: HMI\Projects\SpartanChemical\Proposed Plan\PropPlanFigure5B.dwg | Designed by: CSL | Drawn by: CSL/DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

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Okemos, Michigan
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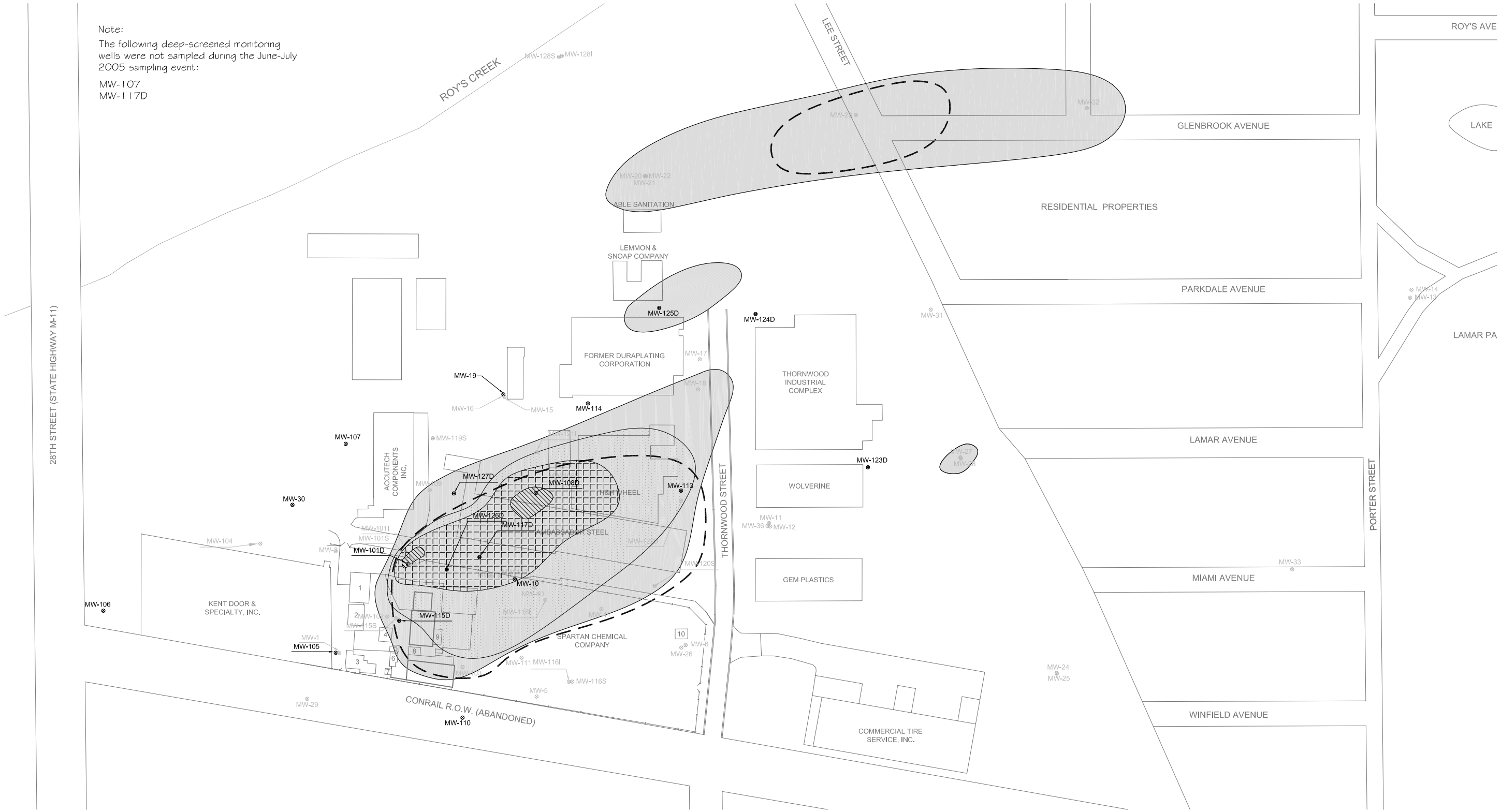
EXTENT OF ORGANIC GROUNDWATER CONTAMINATION EXCEEDING RDWC AND GSI INTERMEDIATE MONITORING WELLS
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN

Note:
The following deep-screened monitoring wells were not sampled during the June-July 2005 sampling event:
MW-107
MW-117D




LEGEND

- ESTIMATED EXTENT OF VOCs IN GROUNDWATER EXCEEDING DRINKING WATER CRITERA (RDWC) *
- ESTIMATED EXTENT OF VOCs IN GROUNDWATER EXCEEDING GROUNDWATER SURFACE WATER INTERFACE (GSI) *
- MW-29 GREY SHADED MONITORING WELLS ARE NOT INCLUDED IN TOTAL VOC CONTOURING
- MW-111 BOLD SHADED MONITORING WELLS ARE DEEP SCREENED MONITORING WELLS
- * Not depth specific-includes exceedance in any interval (shallow, intermediate, or deep-screened wells)
- EXTENT OF TOTAL VOCs GREATER THAN 100,000 ug/L IN DEEP-SCREENED MONITORING WELLS
- EXTENT OF TOTAL VOCs GREATER THAN 1,000 ug/L IN DEEP-SCREENED MONITORING WELLS
- EXTENT OF TOTAL VOCs GREATER THAN 100 ug/L IN DEEP-SCREENED MONITORING WELLS

Note: Total VOC contour lines based on analytical data from the June-July 2005 sampling event.

FIGURE 5C

| File: HMI\Projects\SpartanChemical\Proposed Plan\PropPlanFigure5C.dwg | Designed by: CSL | Drawn by: CSL/DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

2501 Jolly Road, Suite 100
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EXTENT OF ORGANIC GROUNDWATER CONTAMINATION EXCEEDING RDWC AND GSI
DEEP MONITORING WELLS
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN

ROYS AVENUE

ROY'S AVENUE

LEE STREET

ROY'S CREEK

GLENBROOK AVENUE

LAKE

RESIDENTIAL PROPERTIES

ABLE SANITATION

LEMMON & SNOAP COMPANY

(AREA OF LOW LEVEL AND/OR STABLE CONTAMINATION)

PARKDALE AVENUE

LAMAR PARK

28TH STREET (STATE HIGHWAY M-11)

FORMER DURAPLATING CORPORATION

THORNWOOD INDUSTRIAL COMPLEX

LAMAR AVENUE

PROPOSED IN-SITU CHEMICAL OXIDATION INJECTION AREAS (AREA OF NAPL CONTAMINATION)

ACCUTECH COMPONENTS INC.

H&H WHEEL

WOLVERINE

PORTER STREET

AMBASSADOR STEEL

THORNWOOD STREET

GEM PLASTICS

MIAMI AVENUE

KENT DOOR & SPECIALTY, INC.

1

2

3

6

7

10

SPARTAN CHEMICAL COMPANY

WINFIELD AVENUE

CONRAIL R.O.W. (ABANDONED)

COMMERCIAL TIRE SERVICE, INC.

LEGEND

ESTIMATED EXTENT OF VOCs IN GROUNDWATER EXCEEDING DRINKING WATER CRITERIA

PROPOSED IN-SITU CHEMICAL OXIDATION INJECTION AREA

PROPOSED SPARGE WELL LOCATION AND ESTIMATED RADIUS OF INFLUENCE

N

0' 200'

SCALE: 1"=200'

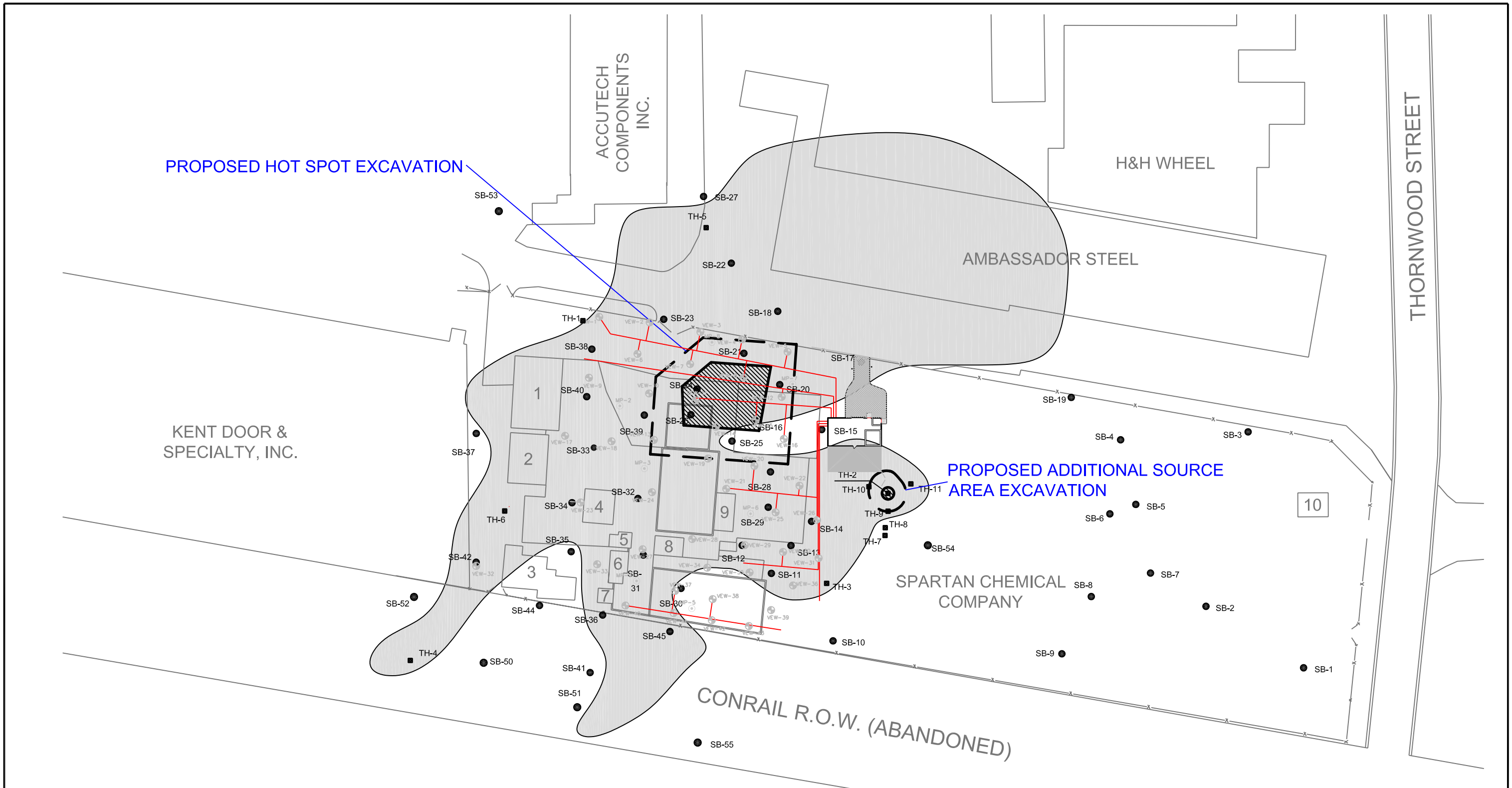
FIGURE 6

| File: HMI\Projects\Spartan Chemical\Proposed Plan\Figures 4 and 6 | Designed by: CSL | Drawn by: CSL/DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

2501 Jolly Road, Suite 100
Okemos, Michigan
48864

RECOMMENDED ALTERNATIVE FOR THE REMEDIATION OF NAPL & ORGANIC GROUNDWATER CONTAMINATION
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN




LEGEND

- SOIL BORING LOCATION
- TEST HOLE LOCATION
- SOIL EXCEEDING RESIDENTIAL DRINKING WATER PROTECTION CRITERIA
- EXISTING VAPOR EXTRACTION WELL
- SURFACE LIMITS OF EXCAVATION
- FLOOR OF EXCAVATION
- CONCRETE PAD
- EXISTING VAPOR EXTRACTION PIPING

N

0' 80'

SCALE: 1"=80'

Note: Area of soil exceeding Residential Drinking Water Protection Criteria based on historical data.

FIGURE 7A

| File: HMI\PROJECTS\SpartanChemical\Proposed Plan\PropPlanFigure7A.dwg | Designed by: CSL | Drawn by: CSL\DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

2501 Jolly Road, Suite 100
Okemos, Michigan
48864

RECOMMENDED ALTERNATIVE S2 FOR THE REMEDIATION OF ORGANIC AND INORGANIC SOIL CONTAMINATION
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN

LEGEND

- SB-4 SOIL BORING LOCATION (HISTORICAL)
- TH-4 TEST HOLE LOCATION (HISTORICAL)
- ORIGINAL DESIGN RADIUS OF INFLUENCE OF EXISTING VAPOR EXTRACTION WELL TO BE LEFT IN OPERATION
- SOIL EXCEEDING RESIDENTIAL DRINKING WATER PROTECTION CRITERIA
- EXISTING VAPOR EXTRACTION WELL
- PROPOSED HORIZONTAL WELL SCREEN
- PROPOSED VAPOR EXTRACTION PIPING
- CONCRETE PAD
- PROPOSED VAPOR EXTRACTION WELL
- ESTIMATED RADIUS OF INFLUENCE FOR PROPOSED VAPOR EXTRACTION WELL

Note: Area of soil exceeding Residential Drinking Water Protection Criteria based on historical data.

N

0' 80'

SCALE: 1"=80'

FIGURE 7B

| File: HMI\PROJECTS\SpartanChemical\Proposed Plan\PropPlanFigure7B.dwg | Designed by: CSL | Drawn by: CSL\DPL | Checked by: MMB | Approved by: PB |
|---|---|---|---|---|

WESTON SOLUTIONS

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48864

RECOMMENDED ALTERNATIVE S3 FOR THE REMEDIATION OF ORGANIC SOIL CONTAMINATION
PROPOSED PLAN
SPARTAN CHEMICAL SITE – WYOMING, MICHIGAN

# APPENDIX B
# TABLES

**TABLE 1**
**EVALUATION TABLE FOR GROUNDWATER ALTERNATIVES**
Proposed Plan for Remedial Action
Spartan Chemical Company Superfund Site

| Evaluation Criteria | Alternative G1: No Action | Alternative G2: In-well Air Stripping with Vapor Treatment | Alternative G3: Enhanced Groundwater Extraction with Ex-situ Groundwater Treatment | Alternative G4: Enhanced In-situ Bioremediation (EISB) | Alternative G5: In-situ Chemical Oxidation (ISCO) | Alternative G6: Surfactant Flushing with Ex-situ Groundwater Treatment | Alternative G7: Air Sparging with Soil Vapor Extraction and Treatment (AS w/SVE) | Alternative G8: Monitored Natural Attenuation (MNA) |
|---|---|---|---|---|---|---|---|---|
| **1. Overall Protection of Human Health & Environment** | Would provide no additional protection to public health and the environment. | Alternative G2 would be effective in removing dissolved-phase contaminants from the groundwater; however, G2 may not adequately address the deep non-aqueous phase liquids (NAPL) source areas and thus this alternative may not be fully protective of human health unless implemented with another alternative to address the deep NAPL source area. | Alternative G3 would be effective in removing organic and inorganic contaminants from the groundwater; thus, reducing contaminant concentrations. Immediate hydraulic containment of the contaminant plumes could be accomplished upon implementation; therefore minimizing potential risk to surface water. | Alternative G4 would effectively remove dissolved-phase VOC contaminants from the groundwater; thus, reducing contaminant concentrations. Risks to receptors via the use of groundwater for drinking water and groundwater volatilization to indoor environs would be eliminated once groundwater contaminant concentrations reach applicable criteria. | Alternative G5 would be effective in removing contamination. Concerns related to this technology are the potential ecological effects and chemical handling. However, proper control of reagents used for ISCO and monitoring of in-situ conditions during implementation minimizes related risks. | Alternative G6 would be more effective than G3 in removing inorganic and organic contaminants (especially NAPLs) from the groundwater; thus, reducing contaminant concentrations. Immediate hydraulic containment of the organic contaminant plume could be accomplished upon implementation; therefore minimizing risk to surface water. | Alternative G7 would be effective in removing dissolved-phase VOCs from shallow groundwater. This alternative may be less effective on deeper groundwater and deep NAPLs. Risks to receptors via the use of groundwater for drinking water and groundwater volatilization to indoor environs may remain if deep contamination is not fully addressed. | Natural attenuation would provide a low level of protection to human health and environment as a stand-alone remedy through groundwater monitoring. Although natural degradation of contaminants would reduce contaminant concentrations, natural attenuation would not meet remedial action objectives (RAOs) within a reasonable time frame. |
| **2. Compliance with applicable or relevant and appropriate requirements (ARARs)** | No Action does not comply with ARARs because groundwater is impacted with contaminant concentrations above RDWC, and impacted groundwater could migrate and possibly impact nearby surface water bodies. | Compliance with the site-specific ARARs previously identified would only be achieved should this alternative be implemented in conjunction with NAPL remediation. | Compliance with the site-specific ARARs previously identified would only be achieved should this alternative be implemented and NAPL source areas effectively remediated along with the dissolved-phase contaminants. | Compliance with the site-specific ARARs previously identified would only be achieved should this alternative be implemented in conjunction with NAPL remediation. | Compliance with the site-specific ARARs previously identified would be achieved should this alternative be implemented. Both dissolved-phase and NAPL contamination would be addressed. | Compliance with the site-specific ARARs previously identified would be achieved should this alternative be implemented and NAPLs are successfully removed. | Compliance with the site-specific ARARs previously identified would not be achieved should this alternative be implemented without addressing the NAPL source areas. | Compliance with the site-specific ARARs previously identified would not be achieved should this alternative be implemented alone. Even with the addition of water use restrictions natural attenuation alone does not comply with ARARs because groundwater presents risks via volatilization to indoor air and potentially with dermal exposure to the groundwater. |
| **3. Long-term Effectiveness and Permanence** | The No Action alternative would result in adverse environmental impacts to groundwater, and potentially surface water and indoor air, because there would be no engineered controls or systems to inhibit contaminant leaching, migration, or reduction in groundwater. | Alternative G2 is most applicable to address the shallow soluble organic contamination. This alternative would have difficulty in adequately addressing the deeper portions of the plume and the deep NAPL. | Alternative G3 would influence the entire thickness of the aquifer and address contamination throughout the area of influence. The efficiency of groundwater extraction for achieving low concentrations within a reasonable time frame is generally poor, although enhanced groundwater extraction would shorten the time needed to address the plume. | Alternative G4 can be used throughout the aquifer thickness impacted with dissolved-phase contaminants, or concentrated at particular aquifer depths and areas of highest dissolved-phase contamination. EISB would be effective in reducing dissolved-phase organic groundwater contaminants but would not directly address inorganic contaminant concerns. | Alternative G5 can be used to address the entire contaminant plume or be applied to select areas, such as source areas at the bottom of the aquifer. In theory, if the ISCO treatment system is operated successfully, remediation of organic groundwater contaminants may be completed within a few months, or additional applications can be made. Once completed, it is unlikely that any residual organic constituent would result in future groundwater contamination above acceptable levels. | Alternative G6 would affect the entire aquifer thickness and address contamination throughout the area of influence. Continual hydraulic containment of the organic contaminant plume would reduce the risk to off-site receptors and surface water. If NAPLs could be effectively removed, it is unlikely that any residual organic constituent would result in future groundwater contamination above acceptable levels. | This alternative could potentially be very effective for removing dissolved-phase contaminants, especially in the shallower portions of the aquifer. Effective treatment of NAPL contaminants at the bottom of the aquifer would be very difficult to achieve. AS/SVE would not effectively remediate compounds that are present in the deep portion of the aquifer or are not readily stripped (i.e., tetrahydrofuran, acetone, and alcohol, which are present at the bottom of the aquifer). | Natural attenuation would not provide adequate long term effectiveness and permanence as a stand-alone remedy. Although natural degradation of contaminants would reduce contaminant concentrations, natural attenuation would not meet RAOs within a reasonable time frame unless combined with another remedial technology. |

**TABLE 1**
**EVALUATION TABLE FOR GROUNDWATER ALTERNATIVES**
Proposed Plan for Remedial Action
Spartan Chemical Company Superfund Site

| Evaluation Criteria | Alternative G1: No Action | Alternative G2: In-well Air Stripping with Vapor Treatment | Alternative G3: Enhanced Groundwater Extraction with Ex-situ Groundwater Treatment | Alternative G4: Enhanced In-situ Bioremediation (EISB) | Alternative G5: In-situ Chemical Oxidation (ISCO) | Alternative G6: Surfactant Flushing with Ex-situ Groundwater Treatment | Alternative G7: Air Sparging with Soil Vapor Extraction and Treatment (AS w/SVE) | Alternative G8: Monitored Natural Attenuation (MNA) |
|---|---|---|---|---|---|---|---|---|
| **4. Reduction of Toxicity, Mobility, or Volume Through Treatment** | Contaminants in the groundwater could migrate vertically and laterally. Alternative G1 does not involve any treatment and would not reduce contaminant toxicity, mobility, or volume. | In-well air stripping technology is generally effective in removing dissolved-phase contaminants from a relatively thick contaminated aquifer with high permeability. Alternative G2 is not as effective in reducing the volume of NAPLs. | The efficiency of groundwater extraction for achieving low concentrations within a reasonable time frame is generally poor, especially with NAPLs present. Some contaminants have very low solubility in groundwater. Many contaminants sorb or adhere onto fine particles, further restricting their removal. Some contaminants form immiscible droplets within the unsaturated and saturated portions of the unconfined layer. | EISB would require the injection and transport of an electron donor (hydrogen) or carbon source to increase the anaerobic biodegradation of contaminants through reductive dechlorination and other biodegradation processes. The process is affected by soil permeability and compatible soil chemistry, along with groundwater biochemical conditions. NAPLs would not be readily reduced. | ISCO involves the delivery of chemical oxidants to contaminated soils and groundwater in order to convert organic contaminants into innocuous compounds. ISCO can provide rapid and aggressive treatment for high concentrations of organic contaminants and NAPLs. | Pilot testing indicated that surfactant flushing may work well at the site but noted that the surfactant solution did not significantly increase the contaminant recovery rate when compared to fresh water injection. Therefore, G6 effectiveness would be equal to or greater than G3, depending on actual surfactant results. | The injection of air aids in the volatilization of contaminants and supplies oxygen to the aquifer to stimulate aerobic biodegradation. Volatilized contaminants would then be captured by the SVE system and treated by the existing vapor treatment system. Alternative G7 is not effective in reducing the volume of NAPL. | Natural attenuation is a combination of aerobic and anaerobic biodegradation, dispersion, volatilization, and adsorption. Biodegradation is the most important natural attenuation mechanism; it is the only natural process that results in an actual reduction of contaminant mass. However, NAPL source areas would not naturally attenuate for a very long time and would continue to cause a dissolved-phase plume. |
| **5. Short-term Effectiveness** | The groundwater is impacted with contaminants that were detected above residential drinking water criteria (RDWC). No Action would not alleviate any current risks at the site. There would be no disturbance at the site or in the community associated with Alternative G1. | The thickness of the saturated zone affects the radius of influence. The high hydraulic conductivity (107 ft/day) and aquifer thickness (21 feet to 91 feet) indicate that Alternative G2 may be effective in removing dissolved-phase contaminants from the Spartan site, but does not address NAPL source areas. This alternative does not present substantive risks to on-site workers or to the community because of the minimal disturbance of the subsurface. There would be some short-term disturbances of the site and adjoining properties associated with the construction. Long-term disturbances would be minimal. | Although groundwater extraction and treatment is not a highly effective technique for subsurface remediation, this technology is most widely used because it provides immediate hydraulic control to prevent the spread of groundwater contamination. This alternative does not present substantive risks to on-site workers or to the community because of the relatively minimal disturbance of the subsurface. There would be some short-term disturbances of the site and adjoining properties associated with the construction. Long-term disturbances would be minimal. | Effectiveness for the treatment of dissolved-phase contaminants in groundwater under controlled conditions has been demonstrated. Performance relies on substrates and nutrients that would be introduced into the treatment zone. This alternative does not present substantive risks to on-site workers or to the community because of the minimal disturbance of the subsurface. There would be some short-term disturbances of the site and adjoining properties associated with the construction. Long-term disturbances would be minimal. | ISCO provides excellent short-term effectiveness within the treatment zone, with aerobic degradation processes continuing following treatment applications. ISCO also requires extensive operation and maintenance during chemical injection. On-site disruptions and inconvenience to the neighboring properties could occur throughout the system operation. During in-situ treatment, special care must be taken because hydrogen peroxide can easily decompose into water vapor and oxygen. This may lead to fugitive emission of contaminants and pressure buildup. | Based on the pilot test results, Surfactant-Enhanced Subsurface Remediation did not appear to provide a significant advantage over enhanced groundwater extraction for the remediation of organic compounds at the Spartan site. This alternative does not present substantive risks to on-site workers or to the community because of the minimal disturbance of the subsurface. Design of well and utilities locations should be such that the need for off-site easements is minimized. The use of a drill rig and other equipment during construction may be slightly disruptive to nearby residential areas. After the completion of construction activities, disturbance would be limited to the site property. | Iron precipitation can occur with air sparging, especially in areas of high dissolved iron concentrations, which can negatively impact sparge well performance. Dissolved iron concentrations are highest in the deeper groundwater at the Spartan site. Shallow groundwater dissolved iron concentrations are within the range suitable for air sparging. There would be some short-term disturbances of the site and adjoining properties associated with the construction. Long-term disturbances would be minimal. | MNA would provide the monitoring safeguards necessary to demonstrate that there are no complete exposure pathways; however, short-term effectiveness regarding aquifer remediation is minimal. This alternative does not present substantive risks to on-site workers or to the community because the future work would be limited to monitoring the natural processes. |

**TABLE 1**
**EVALUATION TABLE FOR GROUNDWATER ALTERNATIVES**
Proposed Plan for Remedial Action
Spartan Chemical Company Superfund Site

| Evaluation Criteria | Alternative G1: No Action | Alternative G2: In-well Air Stripping with Vapor Treatment | Alternative G3: Enhanced Groundwater Extraction with Ex-situ Groundwater Treatment | Alternative G4: Enhanced In-situ Bioremediation (EISB) | Alternative G5: In-situ Chemical Oxidation (ISCO) | Alternative G6: Surfactant Flushing with Ex-situ Groundwater Treatment | Alternative G7: Air Sparging with Soil Vapor Extraction and Treatment (AS w/SVE) | Alternative G8: Monitored Natural Attenuation (MNA) |
|---|---|---|---|---|---|---|---|---|
| **6. Implementability** | There would be no associated construction for implementation of Alternative G1. Elevated contaminant concentrations would remain in the groundwater and potentially migrate further downgradient. Therefore, Alternative G1 would not meet the RAOs of the Addendum to Feasibility Study (AFS).. | This alternative should be readily implemented. In-well air stripping is a patented technology, so a licensing agreement would be required for installation, and special provisions would need to be implemented in order for the project to be bid publicly by the State. Inorganic precipitates could also hinder implementation. | This alternative is readily implementable; however, it would likely require extensive groundwater modeling to identify pumping and injection rates, well locations and spacing, and anticipated groundwater flow patterns. Easements from off-site property owners may be necessary for some remedial components. | An EISB system could be readily implemented via injection of applicable substrates and nutrients. Prior to implementation, site-specific biochemical analyses would be required to design the optimal system. Due to the depth of groundwater contamination at the site, injection wells may be required. The wells could be re-used for multiple treatment applications. | ISCO technology, while still somewhat innovative, is now being implemented at many sites around the country. This alternative should be readily implementable. Prior to implementing a full-scale treatment system, a pilot test should be performed to evaluate the efficiency of ISCO at the site. A pilot test would be necessary to determine the most effective iron catalyst and hydrogen peroxide solution concentrations. On-site disruptions and inconvenience to the neighboring properties could occur throughout the system operation. | While still innovative, Surfactant Flushing has been used at several sites in recent years and should be implementable. Prior to implementation of Surfactant Flushing computer modeling should be conducted to predict natural and engineered groundwater flow, surfactant transport, and contaminant removal. Lab bench-scale testing should be performed to determine the appropriate surfactant, anticipated injection rate, and estimated critical micelle concentration, which is the surfactant concentration at which micelles will form in the aquifer. | Air Sparging with Soil Vapor Extraction is a technology that is routinely implemented at sites similar to Spartan Chemical. Prior to implementation, a pilot study would be required to determine the effective radius of influence and the sparge system would be designed accordingly. Inorganic precipitates within the aquifer could hinder implementation although this issue could be addressed by using a gas other than air. | MNA is readily implemented. An MNA evaluation program was implemented at the site from September 1999 through 2003. Contaminant concentration data and geochemical evidence indicate that natural attenuation has been moderately effective in reducing the dissolved-phase contaminants at the leading margin of the plume. |
| **7. Cost (Estimated)** | There are no costs associated with the No Action alternative. | $1,631,000 | $1,626,000 | $932,000 | $2,000,000 | $1,972,000 | $1,067,000 | $146,000 |
| **8. Support Agency Acceptance** | The U.S. EPA is the support agency for this project. The U.S. EPA will need to concur with any remedy before it can be implemented. Final acceptance will be determined after evaluating comments received from the public after the public comment period. | | | | | | | |
| **9. Community Acceptance** | Community acceptance of the recommended alternative will be evaluated after the public comment period. | | | | | | | |

**TABLE 1A**
**EVALUATION TABLE FOR COMBINATION GROUNDWATER ALTERNATIVES**
Proposed Plan for Remedial Action
Spartan Chemical Company Superfund Site

| Evaluation Criteria | Combination Alternative G9: In-situ Chemical Oxidation, AS/SVE, and MNA | Combination Alternative G10: Enhanced Groundwater Extraction with Ex-situ Groundwater Treatment and MNA | Combination Alternative G11: Groundwater Extraction with Ex-situ Groundwater Treatment and MNA without Enhanced Recirculation | Combination Alternative G12: In-situ Chemical Oxidation and MNA |
|---|---|---|---|---|
| **1. Overall Protection of Human Health & Environment** | Alternative G9 would likely provide the highest level of protection to human health and the environment. Alternative G9 would be the most effective in removing both NAPL and dissolved-phase VOC groundwater contamination. Risks to drinking water and volatilization to indoor environs would be eliminated most quickly with this combination alternative. | Alternative G10 could be protective of human health and the environment. This alternative would be effective in removing organic and inorganic contaminants from the groundwater; thus, reducing contaminant concentrations. Immediate hydraulic containment of the contaminant plumes could be accomplished upon implementation; therefore minimizing potential risk associated with the migration of groundwater contamination. However, it may not quickly achieve levels in groundwater that are protective of the volatilization to indoor pathway. With the implementation of MNA, drinking water risks would also be minimized but not eliminated. | The protectiveness of Alternative G11 is similar to Alternative G10. Alternative G11 would be effective in removing organic and inorganic contaminants. However, without injection wells, the contaminant reduction efficiency would likely be reduced. With the implementation of MNA, drinking water risks would be minimized, but not eliminated. | Alternative G12 would effectively treat the NAPL source areas with ISCO. The remaining dissolved-phase organic contaminants would not be actively treated but would be addressed through MNA. Risks to drinking water and volatilization to indoor environs would not be eliminated but monitored. |
| **2. Compliance with ARARs** | Compliance with the site-specific ARARs previously identified would be achieved should this alternative be implemented. Both dissolved-phase and NAPL contamination would be addressed. | This alternative may have difficulty in achieving compliance with all of the site-specific ARARs previously identified. NAPL source contamination would likely remain for an indefinite period of time acting as a continuing source for dissolved-phase contamination. | This alternative may have difficulty in achieving compliance with all of the site-specific ARARs previously identified. NAPL source contamination would likely remain for an indefinite period of time acting as a continuing source for dissolved-phase contamination. | This alternative may have difficulty in achieving compliance with the site-specific ARARs previously identified. NAPL source contamination would be eliminated, but dissolved-phase contamination in the central plume area would remain. The Natural Attenuation Evaluation conducted as part of the AFS concluded that MNA is not effective in addressing the central plume area. |
| **3. Long-term Effectiveness and Permanence** | Alternative G9 will provide the highest level of long-term effectiveness and permanence. This alternative provides for the permanent removal of both dissolved-phase and NAPL contaminants through active treatment. This alternative includes MNA to ensure the ISCO and AS/SVE treatments are effective in achieving cleanup goals. EISB would be implemented as a contingency to further reduce concentrations to levels more suitable to natural attenuation. | Alternative G10 may not achieve the cleanup criteria within a reasonable time frame. Low concentrations may not be achieved in a reasonable time frame as the NAPL source contamination is not effectively addressed by groundwater extraction. Failure to address the NAPL source contamination may result in an indefinite period of groundwater extraction and MNA. Implementation of long-term MNA would be used to monitor plume stability over the long-term. | Alternative G11 may not achieve the cleanup criteria within a reasonable time frame. Low concentrations may not be achieved in a reasonable time frame as the NAPL source contamination is not addressed effectively by groundwater extraction. Failure to address the NAPL source contamination may result in an indefinite period of groundwater extraction and MNA. Implementation of long-term MNA would be used to monitor plume stability over the long-term. | Alternative G12 would permanently remove NAPL source area contamination. Dissolved-phase contamination would remain for a long-period of time, but would be monitored via MNA. MNA may not be sufficient to reduce contaminant concentrations in the plume to drinking water standards. The Natural Attenuation Evaluation conducted as part of the AFS concluded that MNA would work for the leading edge of the plume but would not be effective for the central plume area. |
| **4. Reduction of Toxicity, Mobility, or Volume Through Treatment** | Alternative G9 would provide the most immediate reduction of toxicity, mobility and volume of dissolved-phase VOCs and NAPLs. Controlled chemical oxidation is the most effective alternative for treating NAPL contamination. | Alternative G10 would provide effective hydraulic control of dissolved-phase contamination. Since G10 does not address NAPL source contamination, continued operation of the extraction and treatment system may be indefinite. MNA would be used to monitor plume mobility over time. | Alternative G11 would provide to a lesser degree hydraulic control of dissolved-phase contamination. Since G11 does not address NAPL source contamination, continued operation of the extraction and treatment system may be indefinite. MNA would be used to monitor plume mobility over time. NAPL source contamination would remain in place indefinitely. | Alternative G12 would permanently remove NAPL source contamination. However, dissolved-phase contamination would likely remain. The toxicity and mobility of the dissolved-phase contamination would likely not be significantly reduced via MNA alone. |
| **5. Short-term Effectiveness** | ISCO provides excellent short-term effectiveness within the treatment zone. NAPL contamination would likely be reduced shortly after injection. AS/SVE is a proven technology for treatment of dissolved-phase contaminants. ISCO presents some risks during injection from pressure build-up and fugitive contaminant emissions. Some community disturbance may occur during implementation of both AS/SVE and ISCO injection well installation and injection activities. This alternative could be implemented in a fashion so as to not present substantive risks to on-site workers or to the community. | Alternative G10 would provide immediate short-term effectiveness as the groundwater extraction and injection system would provide immediate hydraulic control. Some disruption of the local residents may occur with the installation of the extraction system. It is not anticipated that there would be substantive short-term risks to on-site workers or the community associated with this alternative. This alternative may not quickly achieve groundwater criteria protective of the volatilization to indoor air pathway. | Alternative G11 would provide immediate short-term effectiveness as the groundwater extraction would provide hydraulic control. Some disruption of the local residents may occur with the installation of the extraction system. It is not anticipated that there would be substantive short-term risks to on-site workers or the community associated with this alternative. This alternative may not quickly achieve groundwater criteria protective of the volatilization to indoor air pathway. | ISCO would be immediately highly effective in reducing NAPL source contamination in the short-term; however, dissolved-phase contamination would not be addressed. Therefore, drinking water and volatilization to indoor environs risks remain. ISCO presents greater risks during injection from pressure build-up and fugitive contaminant emissions. Community disturbance may also occur during implementation of ISCO injection well installation and injection activities. |

**TABLE 1A**
**EVALUATION TABLE FOR COMBINATION GROUNDWATER ALTERNATIVES**
Proposed Plan for Remedial Action
Spartan Chemical Company Superfund Site

| Evaluation Criteria | Combination Alternative G9: In-situ Chemical Oxidation, AS/SVE, and MNA | Combination Alternative G10: Enhanced Groundwater Extraction with Ex-situ Groundwater Treatment and MNA | Combination Alternative G11: Groundwater Extraction with Ex-situ Groundwater Treatment and MNA without Enhanced Recirculation | Combination Alternative G12: In-situ Chemical Oxidation and MNA |
|---|---|---|---|---|
| **6. Implementability** | AS/SVE and ISCO technologies are easily implementable. Prior to full scale implementation of ISCO, a pilot study would be required to evaluate and select the most efficient ISCO treatment method. Alternative G9 would be implemented in a phased approach. AS/SVE would be applied in the central plume area. ISCO would be applied initially in the two deep NAPL areas. Following successful implementation of AS/SVE and ISCO, MNA would be implemented to provide long-term monitoring of the natural processes that would further reduce contaminant levels. EISB could also be implemented as a contingency. | This alternative is easily and readily implementable; however, extensive groundwater modeling may be required to identify pumping and injection rates, well locations and spacing, and anticipated groundwater flow patterns. Long-term easements from off-site property owners may be necessary for some remedial components. | This alternative is readily implementable; however, it would likely require extensive groundwater modeling to identify pumping and injection rates, well locations and spacing, and anticipated groundwater flow patterns. Long-term easements from off-site property owners may be necessary for some remedial components. | Both ISCO and MNA are readily implementable with the exception of the required pilot testing required for ISCO implementation. |
| **7. Cost (Estimated)** | $2,647,000 | $3,000,000 | $2,941,000 | $2,238,000 |
| **8. Support Agency Acceptance** | The U.S. EPA is the support agency for this project. The U.S. EPA will need to concur with any remedy before it can be implemented. Final acceptance will be determined after evaluating comments received from the public after the public comment period. | | | |
| **9. Community Acceptance** | Community acceptance of the recommended alternative will be evaluated after the public comment period. | | | |

**Table 2**

**EVALUATION TABLE FOR SOIL ALTERNATIVES**
**Proposed Plan for Remedial Action**
**Spartan Chemical Company Superfund Site**

| Evaluation Criteria | Alternative S1: No Action | Alternative S2: Excavation and Off-site Disposal with Institutional Controls | Alternative S3: Expansion of SVE System and Institutional Controls | Combined Alternative S2 and S3: Excavation/Disposal, SVE and Institutional Controls |
|---|---|---|---|---|
| **1. Overall Protection of Human Health & Environment** | Alternative S1 would provide no additional protection to public health and the environment. | Alternative S2 involves the removal of target contamination and disposal of excavated materials off-site. Risks to human health and environment would be reduced, contamination above RDWPC and ICDCC and those associated risks would remain. | Alternative S3 would remove VOC soil contamination and prevent further contamination from leaching to groundwater. Inorganic soil contamination would remain. Alternative S3 provides protection for both human health and the environment from VOC contamination. | Combined Alternatives S2 and S3 would reduce organic and inorganic soil contamination and prevent further contamination from leaching to groundwater. This alternative provides the highest protection for both human health and the environment. |
| **2. Compliance with ARARs** | The No Action alternative does not comply with ARARs because soil is impacted with contaminant concentrations above RDWPC and ICDCC, and soil contamination could leach to the groundwater and possibly migrate to nearby surface water bodies. | Complies with ARARs for the removal of organic and inorganic contamination in the Additional Source Area and the hot spot south of the on-site treatment building. However, contamination above RDWPC and ICDCC would remain. | Compliance with the site- specific ARARs previously identified would be partially achieved in the contaminated areas should this alternative be implemented | Compliance with ARARs would ultimately be achieved. |
| **3. Long-term Effectiveness and Permanence** | Alternative S1 would provide no additional protection to public health and the environment. The No Action alternative would result in adverse environmental impacts to soil, and potentially groundwater, surface water, and indoor air, because there would be no engineered controls or systems to inhibit contaminant leaching to groundwater or subsequent possible migration. | Select soils would be physically removed from the site; therefore, associated risks would be permanently eliminated. Alternative S2 does not destroy the contamination, but the contaminated soils would be disposed of at a licensed facility, where it would be properly managed, contained, and monitored. Contaminated soil would remain, including under the adjacent Ambassador Steel property. | VOC soil contamination, including contamination under the building on the adjacent Ambassador Steel property, would be permanently removed from the subsurface, thereby providing a high degree of long-term effectiveness. Inorganic contamination located east of the treatment building would not be addressed with this remedy alone. | VOC soil contamination, including contamination under the building on the adjacent Ambassador Steel property, would be permanently removed from the subsurface, thereby providing a high degree of long-term effectiveness. Excavation of highest soil contamination will reduce long-term leaching potential and required length of SVE operation. |

**Table 2**

**EVALUATION TABLE FOR SOIL ALTERNATIVES**
**Proposed Plan for Remedial Action**
**Spartan Chemical Company Superfund Site**

| Evaluation Criteria | Alternative S1: No Action | Alternative S2: Excavation and Off-site Disposal with Institutional Controls | Alternative S3: Expansion of SVE System and Institutional Controls | Combined Alternative S2 and S3: Excavation/Disposal, SVE and Institutional Controls |
|---|---|---|---|---|
| **4. Reduction of Toxicity, Mobility, or Volume Through Treatment** | Alternative S1 does not involve any treatment and would not reduce contaminant toxicity, mobility, or volume. | Physical removal of the designated soils would effectively reduce organic and inorganic soil contamination toxicity, mobility, and volume. Remaining residual soil contamination could continue to act as a source of groundwater contamination at the Spartan site. | Alternative S3 would physically remove the organic volume and reduce the potential for mobility (i.e. leaching). This alternative does not address inorganic soil contamination present above criteria at the Additional Source Area. | The combined alternative effectively reduces the toxicity, mobility, and volume of organic and inorganic soil contamination at the Spartan Site. |
| **5. Short-term Effectiveness** | The soil is impacted with contaminants that were detected above RDWPC and ICDCC. No Action would not alleviate any current risks at the site. There would be no disturbance at the site or in the community associated with Alternative S1. | Excavation and disposal of designated soil would immediately decrease contaminant mass at the site. Remaining residual soil contamination could continue to act as a source of groundwater contamination at the Spartan site. | VOC soil concentrations would decrease rapidly upon startup of system. However, excessively high soil vapor concentrations and low oxygen concentrations may require the addition of dilution air to maintain SVE system operation. | Eliminating the highest hot spot soil contamination would reduce the need for processing dilution air through the SVE system. Immediate reduction in contaminant mass would be achieved through both excavation and extraction. |
| **6. Implementability** | There would be no associated construction for implementation of Alternative S1. Elevated contaminant concentrations would remain in the soil and potentially leach to groundwater. Therefore, Alternative S1 would not meet the RAOs of the AFS. | Implementation of this alternative would entail the use of conventional excavating equipment, such as backhoes and front-end loader. Although the planned excavations would be easily implemented, expanding the excavation areas beyond what is proposed would be more difficult. | Implementation of this alternative may utilize horizontal drilling technology or conventional trench excavation methods. Increased construction traffic may affect nearby residents during installation of the expanded SVE system. | Combined alternative is easily implemented and coincides with the recommended groundwater treatment alternatives. Will likely reduce SVE operation by 2 to 3 years. |
| **7. Cost (Estimated)** | There are no costs associated with the No Action alternative. | $600,000 - $987,000 (depending on the final soil volume removed) | $691,000 (assumes 5 years of off-site SVE-only system operation) | $891,000 - $1,278,000 (one year of SVE only operation) |
| **8. Support Agency Acceptance** | The U.S. EPA is the support agency for this project. The U.S. EPA will need to concur with any remedy before it can be implemented. Final acceptance will be determined after evaluating comments received from the public after the public comment period. | | | |
| **9. Community Acceptance** | Community acceptance of the recommended alternative will be evaluated after the public comment period | | | |

**Table 3**

**MAXIMUM ORGANIC GROUNDWATER CONTAMINANTS EXCEEDING THE PART 201 GENERIC RESIDENTIAL CLEANUP CRITERIA (GRCC)**
**Spartan Chemical Company Superfund Site**

| Contaminant | MDEQ GRCC | Maximum Concentration in Contaminated Groundwater, April 2003 |
|---|---|---|
| Acetone | 730 | 130,000 |
| Benzene | 5.0 | 1,800 |
| Bis(2-ethylhexyl)Phthalate | 6.0 | 11 |
| Bromodichloromethane | 100 | ** |
| 2-Butanone (MEK) | 13,000 | 62,000 |
| Butyl Benzyl Phthalate | *14* | 21 |
| Chlorobenzene | 100 | 130 |
| Chloroethane | 430 | 1,000 |
| Chloroform (CF) | 100 | ** |
| Chloromethane | 260 | ** |
| Cis-1,2-Dichloroethylene (c-DCE) | 70 | 11,000 |
| 1,1-Dichloroethane (DCA) | 880 | 1,200 |
| 1,1-Dichloroethylene | 7.0 | ** |
| 1,2-Dichloroethane | 5.0 | 1,400 |
| 1,2-Dichloropropane | 5.0 | 6.6 |
| Diethyl Ether | 10 | 26 |
| Di-N-Butyl Phthalate | *9.7* | 110 |
| Ethylbenzene | 74 | 12,000 |
| 2-Hexanone | 1,000 | ** |
| Methylene Chloride (MC) | 5.0 | 39,000 |
| 2-Methylnaphthalene | 260 | ** |
| 4-Methyl-2-Pentanone | 1,800 | 51,000 |
| 2-Methylphenol | *71* | 120 |
| Methyltertbutylether (MTBE) | 40 | ** |
| Naphthalene | *13* | 400 |
| N-Butylbenzene | 80 | ** |
| N-Propylbenzene | 80 | 270 |
| Pentachlorophenol | 1.0 | ** |
| Sec-Butylbenzene | 80 | ** |

**Table 3**

**MAXIMUM ORGANIC GROUNDWATER CONTAMINANTS EXCEEDING THE PART 201 GENERIC RESIDENTIAL CLEANUP CRITERIA (GRCC)**
**Spartan Chemical Company Superfund Site**

| Contaminant | MDEQ GRCC | Maximum Concentration in Contaminated Groundwater, April 2003 |
|---|---|---|
| Tetrahydrofuran | 95 | 3,300 |
| Tetrachloroethylene (PCE) | 5.0 | 1,300 |
| Toluene | 790 | 77,000 |
| Trans-1,2-Dichloroethylene (t-DCE) | 100 | ** |
| Trichloroethylene (TCE) | 5.0 | 6,800 |
| 1,1,1-Trichloroethane | 200 | 1,800 |
| 1,1,2-Trichloroethane | 5.0 | ** |
| 1,2,4-Trichlorobenzene | 70 | ** |
| 1,3,5-Trimethylbenzene | 72 | 860 |
| 1,2,4-Trimethylbenzene | 63 | 3,200 |
| Total Xylenes | 280 | 47,000 |
| Vinyl Chloride (VC) | 2.0 | 1,600 |

## Maximum Inorganic Groundwater Contaminants Exceeding RDWC

| Contaminant | MDEQ RDWC | Maximum Concentration in Contaminated Groundwater, April 2003 |
|---|---|---|
| Aluminum – Total | 50 | 2,100 |
| Arsenic – Total | 10 | 90 |
| Barium – Total | 2,000 | 3,300 |
| Chromium – Total | 100 | 1,500 |
| Iron – Total | 300 | 960,000 |
| Lead – Total | 4.0 | 24 |
| Manganese – Total | 50 | 16,000 |
| Nickel – Total | 100 | 220 |
| Vanadium – Total | 4.5 | 7.5 |
| Zinc – Total | 2,400 | 160,000 |

Notes:
All units are micrograms per liter (ug/L)
*Italicized* indicate that Groundwater Surface Water Interface Criteria are GRCC. All other GRCC values are RDWC.
**** These parameters were retained as contaminants of concern because of elevated analytical detection limits that were above RDWC.

# APPENDIX C
# Letter of Concurrence from the U.S. EPA

The U.S. EPA concurrence with this Record of Decision is provided by the signature of Richard C. Karl, Director, Superfund Division, Region 5, on page 3 of this Record of Decision.

# APPENDIX D
# Index to the Administrative Record

# Spartan Chemical Administrative Record

*Wyoming, Kent County, Michigan*

| Doc # | DocumentTitle | Author | Recipient | Document Date |
|---|---|---|---|---|
| 1 | Installation of Ground Water Observation Wells | STS Consultants | MDNR | 1/9/1981 |
| 2 | Hydrogeological Investigation | STS Consultants | MDNR | 12/1/1981 |
| 3 | Hydrogeological Investigation Proposed Work Plan | Prein & Newhof | MDNR | 6/22/1984 |
| 4 | Hydrogeological Study - Preliminary Remedial Action Master Plan | Prein & Newhof | MDNR | 10/1/1985 |
| 5 | Work Plan for Groundwater Purging and Treatment System | Prein & Newhof | MDNR | 12/10/1985 |
| 6 | Letter from EDI to Spartan Chemical | EDI Engineering & Science | Spartan Chemical | 6/3/1986 |
| 7 | Phase I Remedial Action Plan | EDI Engineering & Science | MDNR | 1/1/1987 |
| 8 | Work Plan on Demo of Treatability of Discharge at Wyoming POTW | EDI Engineering & Science | MDNR | 3/27/1987 |
| 9 | MDNR Review of Work Plan on Demo of Treatability of Discharge at Wyoming POTW | MDNR | EDI Engineering & Science | 3/27/1987 |
| 10 | Letter re: Demo of Treatability of Discharge at Wyoming POTW | EDI Engineering & Science | MDNR | 4/7/1987 |
| 11 | Demo on Treatability of Proposed Spartan Chemical Discharge | EDI Engineering & Science | MDNR | 5/6/1987 |
| 12 | Approval Letter Re: Discharge to POTW | MDNR | EDI Engineering & Science | 5/18/1987 |
| 13 | Letter from EDI to MDNR re: Purge Well 2 | EDI Engineering & Science | MDNR | 7/24/1987 |
| 14 | Letter from EDI to Litwack & Litwack re: Purge Well 2 | EDI Engineering & Science | Litwack & Litwack | 8/19/1988 |
| 15 | Letter from EDI to MDNR re: Purge Well 2 | EDI Engineering & Science | MDNR | 8/26/1988 |
| 16 | Letter from Litwack & Litwack to EDI re: Purge Well 2 | Litwack & Litwack | EDI Engineering & Science | 8/29/1988 |
| 17 | Groundwater Monitoring Program Work Plan | EDI Engineering & Science | MDNR | 10/28/1988 |
| 18 | Groundwater Monitoring Report | EDI Engineering & Science | MDNR | 2/2/1989 |
| 19 | Preliminary Health Assessment | MDPH/ATSDR | The Public | 3/1/1989 |
| 20 | Groundwater Monitoring Report | EDI Engineering & Science | MDNR | 4/21/1989 |
| 21 | Letter from EDI to MDNR re: Purge Well 2 | EDI Engineering & Science | MDNR | 9/12/1989 |
| 22 | Groundwater Monitoring Report | EDI Engineering & Science | MDNR | 11/14/1989 |
| 23 | Letter from EDI to Spartan Chemical re: Purge Well 2 | EDI Engineering & Science | Spartan Chemical | 11/22/1989 |
| 24 | Letter from Spartan Chemical to EDI re: Purge Well 2 | Spartan Chemical | EDI Engineering & Science | 3/1/1990 |
| 25 | Letter from WW Engineering & Science to Spartan Chemical re: Purge Well 2 | WW Engineering & Science | Spartan Chemical | 3/15/1990 |
| 26 | Groundwater Monitoring Report | WW Engineering & Science | MDNR | 11/19/1990 |
| 27 | Letter to the City of Wyoming re: Sanitary Service Agreement | WW Engineering & Science | City of Wyoming | 5/30/1991 |
| 28 | Groundwater Monitoring Report | WW Engineering & Science | MDNR | 6/18/1992 |
| 29 | Site Assessment Report | Ecology & Environment | EPA | 9/4/1992 |
| 30 | Final Remedial Investigation/Feasibility Study Summary Document | MDNR | The Public | 10/1/1992 |
| 31 | Groundwater Monitoring Report | WW Engineering & Science | MDNR | 11/4/1992 |
| 32 | Proposed Plan for Interim Remedial Actoin (Groundwater) | MDNR | The Public | 11/1/1992 |
| 33 | Public Notice for Interim Groundwater Cleanup Public Comment Period and for 12/17/92 Public Meeting | MDNR | The Public | 11/1/1992 |
| 34 | Public Meeting Transcript | Transcribed by O'Brien & Bails | MDNR | 11/17/1992 |
| 35 | Air Testing Results | Jim Bedford, MDPH | Spartan Chemical Files | 2/3/1993 |

# Spartan Chemical Administrative Record

*Wyoming, Kent County, Michigan*

| Doc # | DocumentTitle | Author | Recipient | Document Date |
|---|---|---|---|---|
| 36 | Interim Action Record of Decision for Groundwater with Responsiveness Summary | MDNR | EPA and the Public | 6/30/1993 |
| 37 | Groundwater Monitoring Report | WW Engineering & Science | MDNR | 6/7/1993 |
| 38 | Groundwater Monitoring Report | WW Engineering & Science | MDNR | 12/3/1993 |
| 39 | Field Sampling Plan (Groundwater only for 1994) | Eder Associates | MDNR | 3/16/1994 |
| 40 | Interim Groundwater Monitoring Program - QAPP | Eder Associates | MDNR | 3/16/1994 |
| 41 | RI/FS Work Plan | CCJM | MDNR | 8/1/1994 |
| 42 | RI/FS Work Plan (supplement to CCJM's Plan) | Malcolm Pirnie | MDNR | 8/26/1994 |
| 43 | RI/FS Data Package | CCJM | MDNR | 3/1/1995 |
| 44 | Explanation of Significant Differences Document | MDNR | EPA and the Public | 7/1/1995 |
| 45 | Work Plan Addendum for Phase II RI/FS | Malcolm Pirnie | MDEQ | 9/1/1995 |
| 46 | Quality Assurance Project Plan Addendum for Phase II RI/FS | Malcolm Pirnie | MDEQ | 9/1/1995 |
| 47 | RI Report Volumes I and II | Malcolm Pirnie | MDEQ | 10/1/1996 |
| 48 | Letter on Risk Assessment | Malcolm Pirnie | MDEQ | 12/12/1996 |
| 49 | Focused Feasibility Study Report | Malcolm Pirnie | MDEQ | 10/3/1997 |
| 50 | Proposed Plan for an Interim Action | MDEQ | The Public | 10/1/1997 |
| 51 | Supplemental Fact Sheet to the Proposed Plan for an Interim Action | MDEQ | The Public | 10/1/1997 |
| 52 | Letter on Risk Assessment | Malcolm Pirnie | MDEQ | 10/20/1997 |
| 53 | EPA Guidance: Presumptive Remedies: Site Characterization and Technology Selection for CERCLA Sites with Volatile Organic Compounds in Soils | EPA | various | 9/1/1993 |
| 54 | EPA Guidance: Presumptive Remedies: Policy and Procedures | EPA | various | 9/1/1993 |
| 55 | EPA Guidance: Feasibility Study Analysis for CERCLA Sites with Volatile Organic Compounds in Soils | EPA | various | 1/1/1993 |
| 56 | Interim Action Record of Decision with Responsiveness Summary | EPA & MDEQ | The Public | 4/9/1998 |
| 57 | Final Technical Memorandum Additional Remedial Investigation | DLZ | MDEQ | 12/31/2003 |
| 58 | Addendum to Feasibility Study | DLZ | MDEQ | 4/30/2004 |
| 59 | RI/FS Work Plans | DLZ | | |
| 60 | SVE Design | DLZ | | |
| 61 | Proposed Plan for Remedial Action for Groundwater | MDEQ | The Public | 7/7/2007 |
| 62 | 2006 Soil Gas, Geoprobe Study Results (logs, maps, tables) | WESTON | MDEQ | 6/6/2006 |
| 63 | Demolition and Asbestos Abatement Summary Report | WESTON | Kent County | 1/7/2007 |
| 64 | FFS Memorandum | WESTON | MDEQ | 3/1/2007 |
| 65 | Information Bulletin - Site Demolition Activities | WESTON | The Public | 8/14/2006 |