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TECHNICAL MEMORANDUM
PHASE I EVALUATION OF THE VELSICOL SUPERFUND SITE SLURRY WALL VELSICOL CHEMICAL CORPORATION SITE ST. LOUIS, MI

Prepared for

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION
Constitution Hall
525 W. Allegan Street
Lansing, MI 48909

Prepared by

ROY F. WESTON, INC. OF MICHIGAN
300 River Place, Suite 2800
Detroit, MI 48207

May 2002

W.O. NO: 20083.500.001

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EXECUTIVE SUMMARY

INTRODUCTION

Roy F. Weston, Inc. of Michigan (WESTON®) has prepared this Phase I Technical Memorandum for the evaluation of the slurry wall at the former Velsicol Chemical Corporation (Velsicol) facility (Site), in St. Louis, Michigan in response to a request from the Michigan Department of Environmental Quality (MDEQ), Environmental Response Division (ERD), Superfund Section, under the Federal Level of Effort (LOE) contract between WESTON and the State (Contract No. 2012). The Phase I Activities were completed following the MDEQ and United States Environmental Protection Agency (EPA) approval of the document entitled, Work Plan for The Phase I Evaluation of the Velsicol Superfund Site Slurry Wall, dated January 2002.

This Phase I Technical Memorandum has been prepared to present the data collected during the Phase I activities; document any deviations in the execution of the scope from the procedures detailed in the Work Plan; present the findings and conclusions of the Phase I investigation; and provide recommendations concerning future Phase II work. WESTON anticipates incorporating the Phase I findings and expanding the evaluation of these data and Phase II data into a comprehensive Remedial Investigation and Feasibility Study (RI/FS) Report for the Site.

The primary objectives of the Phase I activities were to: locate the slurry wall; characterize soil and groundwater chemistry immediately inside and outside of the slurry wall area; complete an initial evaluation of the slurry wall and cap performance; and, provide recommendations for the Phase II investigations, as necessary.

SITE LOCATION AND HISTORY

The Site is located at 324 North Street, St. Louis, Gratiot County, Michigan. The property is situated near the center of Section 24, T12N, R3W. The Site encompasses approximately 52 acres, and is bordered on the west and north by the Pine River/St. Louis Reservoir, bordered by North Avenue and Watson Street to the east, and by Washington Avenue to the south.

The Site includes two Superfund Operable Units. Operable Unit 1 (OU-1) consists of the 52-acre former chemical plant manufacturing facility (**Figure 1**). Operable Unit 2 (OU-2) consists of contamination in the St. Louis Reservoir and Pine River.

The Site has been used for industrial operations since the mid 1800's and has been used at various times for a lumber mill, oil refinery, salt plant, and chemical plant. Michigan Chemical Corporation (MCC) purchased the Site in 1935 and operated a chemical manufacturing business until 1977 when MCC merged with Velsicol. MCC manufactured a wide variety of products at the Site from 1936 through 1977. These products included various salts, magnesium oxide, rare earth (radioactive) chemicals, fire retardants (polybrominated biphenyls [PBB], and pesticides (hexabromobenzene [HBB], 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane [DDT], and tris (2,3-Dibromopropyl) phosphate [TRIS]). The plant was closed in 1977 and decommissioning activities were initiated in 1978.

The remedy selected and implemented for OU-1 included construction of a 2-foot thick, low-permeability slurry wall around the 52-acre main plant facility and a 3-foot thick, low permeability clay cap over the Site. Under the Consent Judgment, Velsicol must maintain groundwater levels within the slurry wall and beneath the cap ("containment system") to a maximum allowable elevation. Velsicol completed construction of the containment system in 1984 and was required to reduce groundwater levels within the containment system to achieve compliance with the Consent Decree.

Studies completed since 1994 prompted the MDNR/MDEQ and EPA to take additional action to address apparent releases of Site contaminants of concern (COC) to OU-2, the Pine River. EPA completed a Time Critical Removal Action of contaminated sediments within the Pine River in 1999 and is currently undertaking addition remedial action to remove additional contaminated sediments from the Pine River and St. Louis Reservoir.

PHASE I SCOPE OF WORK

WESTON completed the following tasks under the Scope of Work (SOW) for the Phase I Investigation:

- Developed a Base Map for the Site based new aerial and land surveys;
- Compiled and cataloged over 4000 MEDQ Site documents into a database;
- Conducted a geophysical trial to locate slurry wall with non-intrusive methods;
- Completed thermal-infrared (T-IR) surveys to locate potential seeps to the Pine River;
- Completed a technical review of historic documents;
- Conducted sampling of the NAPL seep area;
- Located the slurry wall with soil borings;
- Identified residual contamination along the downgradient portion of the Site;
- Completed 40 vertical aquifer sampling (VAS) borings;
- Completed 14 soil borings in the slurry wall to assess the potential for breaches;
- Submitted 9 seep samples, 46 soil samples and 40 groundwater samples for laboratory analyses of: pesticides/polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), inorganics and the specialty chemicals: PBB; HBB; TRIS, and chlordane;
- Evaluated shallow groundwater chemistry inside and outside the slurry wall;
- Evaluated shallow groundwater flow conditions at the Site;
- Completed an initial review of slurry wall and cap performance;
- Compiled, reduced, evaluated and validated the data collected under this SOW; and
- Prepared this Technical Memorandum.

CONCLUSIONS

WESTON has made the following conclusions based on the findings of the Phase I activities, which included technical reviews of historic Site documents:

- The cap was not constructed with an adequate frost protection layer and is not graded properly. The durability testing of the slurry wall was inadequate and NAPL compatibility testing was not performed for containment system components.

- Large portions of the cap, and significant portions of the slurry wall and till samples analyzed as part of the 1997 Containment System Assessment Report failed to meet the project design criteria, particularly the hydraulic conductivity and grain size distribution requirements.

- The slurry wall was located by advancing soil borings until the wall was identified in soil sample cores. The slurry wall could not be located along the southwest corner of the Site near M-46, this is also the area where the PRPs could not locate the wall in past studies.

- Significant defects, including NAPL permeations and discontinuities ("windows" or "breeches") were identified in the slurry wall in the vicinity of the NAPL seep area.

- Several NAPL and groundwater seeps and areas of groundwater upwelling to the Pine River at the Site were identified. These occurrences suggest the Site containment system is not preventing off-site migration of contaminants to the Pine River.

- The NAPL seeps contain very high concentrations of pesticides, VOCs, SVOCs and metals. Contaminant concentrations were reported at levels more than 85,000 times greater than MDEQ Groundwater Surface Water Interface (GSI) criteria.

- The NAPL seeps were observed emanating from a sand channel feature exposed in the face of the riverbank, this sand channel has been incised into the underlying till layer.

- Evidence of residual contamination in borings located between the slurry wall and the Pine River across much of the downgradient portion of the Site at levels that exceed Part 201 criteria.

- Evidence of significant levels of contamination was found in samples collected form Site soil, sediment and groundwater.

- Soil contaminants of concern (COC) that exceed GSI criteria include: pesticides (4,4-DDT); VOCs (1,2-dichlorbenzene [1,2-DCB], chlorobenzene, and xylene); SVOCs (phenanthene); and, inorganics (chromium, cobalt, lead, mercury, selenium and silver).

- Groundwater COC that exceed Groundwater Surface Water (GSI) criteria include: Pesticides (4,4-DDT, dieldrin and gamma-BHC), VOCs (benzene, 1,2-dichloroethane [1,2-DCA], 1,2-DCB, 1,1,2,2-tetrachloroethane [1,1,2,2-TCA], chlorobenzene, chloroform, ethyl benzene, xylene, toluene, tetrachloroethene [PCE], trichloroethene [TCE], and vinyl chloride); SVOCs (1,2,4-trichlobenzene [1,2,4-TCB], 1,3-dichlorobenzene [1,3-DCB], 1,4-dichlorobenzne [1,4-DCB], 2-chlorophenol and bis(2ethylhexyl) phthalate); and, inorganics (chromium, cobalt, copper, lead, mercury, selenium, silver, thallium and vanadium).

- The shallow groundwater flow patterns and head differences across the slurry wall indicate the containment system has not eliminated the potential for off-site migration of impacted groundwater. In some areas the influence of the slurry wall is negligible to absent.

- The presence of a strong outward flow direction and hydraulic gradients along the downgradient portion of the Site as well as localized outward flow in the northeastern portion of the Site suggest that contaminated groundwater is flowing into the Pine River and potentially the residential properties adjacent to the upgradient portion of the Site.

- The migration of COCs to the Pine River will continue unless the NAPL seep is controlled and the outward hydraulic gradient is reversed.

- The cap and slurry wall components of the Site containment system are not functioning as intended and are no longer protective of human health and the environment.

RECOMMENDATIONS

WESTON has prepared a Draft Work Plan for Phase II Investigation activities. The objective of the Phase II investigation is to address data gaps discovered after completion of the Phase I activities and ultimately to collect additional information required to support a RI/FS report for OU-1.

WESTON recommends completion of the tasks described below to provide additional information in specific areas where data are insufficient. Ideally, these activities will provide the data necessary to develop a comprehensive understanding of the current conditions at the site. A comprehensive understanding of the current conditions is critical to the completion of a FS that evaluates appropriate and applicable remedial alternatives for the site.

The Phase II objectives should be achieved by completing the following tasks:

- Define the nature and extent of the NAPL source area immediately upgradient of the NAPL seep area.

- Evaluate effectiveness of the slurry wall by conducting dye studies, soil borings, continued monitoring of hydraulic heads inside and outside the wall and NAPL compatibility testing of slurry wall samples.

- Evaluate the effectiveness of the underlying till by conducting continuous soil borings through the till and testing till samples for Site COCs, hydraulic conductivity and NAPL compatibility.

- Evaluate the interaction between the shallow and lower aquifers and the Pine River by installing additional shallow and deep monitoring wells, and if necessary, intermediate wells within water bearing zones that may be located within the till, conducting aquifer slug tests, and gauging of the Pine River.

WESTON will submit a Final Phase II Work Plan that incorporates the comment provided by MDEQ and EPA during our Phase II kickoff meeting held at the Site on 16 May 2002. WESTON will submit an Amended Quality Assurance Project Plan (QAPP) that addresses the Phase II SOW particularly the procedures to be employed while drilling through the till.

WESTON will incorporate the Phase I and Phase II data and findings into the RI/FS report.

SECTION 1

INTRODUCTION

Roy F. Weston, Inc. of Michigan (WESTON®) has prepared this Phase I Technical Memorandum for the evaluation of the slurry wall at the former Velsicol Chemical Corporation (Velsicol) facility (Site), in St. Louis, Michigan in response to a request from the Michigan Department of Environmental Quality (MDEQ), Environmental Response Division (ERD), Superfund Section, under the Federal Level of Effort (LOE) contract between WESTON and the State (Contract No. 2012). The Phase I Activities were completed following the MDEQ and EPA approval of the document entitled, Work Plan for The Phase I Evaluation of the Velsicol Superfund Site Slurry Wall, dated January 2002.

This Phase I Technical Memorandum has been prepared to present the data collected during the Phase I activities; document any deviations in the execution of the scope from the procedures detailed in the Work Plan; present the findings and conclusions of the Phase I investigation; and provide recommendations concerning future Phase II work. WESTON anticipates incorporating the Phase I findings and expanding the evaluation of these data and Phase II data into a comprehensive Remedial Investigation (RI) Report for the Site.

1.1 Objective

The primary objective of the Phase I activities was to locate the slurry wall and characterize the soil and groundwater chemistry immediately inside and outside of the slurry wall area. The objectives of the Phase I investigation were achieved through completion of the following tasks:

- Organize MDEQ project files according to Superfund Section site file outline structure;
- Develop an accurate scaled base map for the Site;
- Locate and document the location of all or at least portions of the slurry wall;
- Identify and characterize seeps at the downgradient portion of the slurry wall;

- Identify the location of residual wastes located outside the slurry wall along the Pine River;
- Evaluate current groundwater elevations and flow conditions at the Site;
- Evaluate groundwater chemistry inside and outside the slurry wall;
- Complete an initial evaluation of the slurry wall and cap performance; and,
- Provide recommendations for the Phase II investigation, as necessary.

1.2 PROPERTY LOCATION

The Site is located at 324 North Street, St. Louis, Gratiot County, Michigan. The property is situated near the center of Section 24, T12N, R3W. The Site encompasses approximately 52 acres, and is bordered on the west and north by the Pine River/St. Louis Reservoir, bordered by North Avenue and Watson Street to the east, and by Washington Avenue to the south. The Site also includes a separate parcel located south of Washington Avenue across from the main plant parcel, which was formerly known as the "creamery warehouse".

The Site includes two Superfund Operable Units. Operable Unit 1 (OU-1) consists of the 52-acre plant site, which is the location of the former chemical plant manufacturing facility (**Figure 1**). Operable Unit 2 (OU-2) consists of contamination in the St. Louis Reservoir and Pine River.

1.3 SITE HISTORY

The Site has been used for industrial operations since the mid 1800's and has been used at various times for a lumber mill, oil refinery, salt plant, and chemical plant. Michigan Chemical Corporation (MCC) purchased the Site in 1935 and operated a chemical manufacturing business until 1977 when MCC merged with Velsicol. MCC manufactured a wide variety of products at the Site from 1936 through 1977. These products included various salts, magnesium oxide, rare earth (radioactive) chemicals, fire retardants (polybrominated biphenyls [PBB], and pesticides (hexabromobenzene [HBB], 1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane [DDT], and tris (2,3-Dibromopropyl) phosphate [TRIS]).

Former Site features included numerous manufacturing plant buildings, maintenance and warehouse buildings, offices and research and development laboratories, dozens of above ground storage tanks (ASTs), underground storage tanks (USTs), process piping, railroad sidings, lagoons and parking areas (**Figure 2**). While many of the raw materials for the chemical manufacturing were shipped to the Site via rail or truck, the Site also extracted brines from bedrock wells for use as process makeup water. Groundwater recovered during the OU-1 remedial actions was disposed of by deep well injection into the Velsicol deep well located across the Pine River from the Site.

The plant was closed in 1977 and decommissioning activities were initiated in 1978.

In 1982, a Consent Judgment was entered into by Velsicol, the EPA and the Michigan Department of Natural Resources (MDNR), under which Velsicol constructed and implemented the "Main Plant Site Containment Program and Golf Course Site Remedial Program." Between 1981 and 1984 and in accordance with the Consent Judgment, Velsicol submitted plans and specifications for the construction and installation of a containment system at the Plant Site for EPA and MDNR review and approval. During the development of these plans and specifications Velsicol conducted substantial field sampling and laboratory testing programs in accordance with the Consent Judgment in order to confirm that the construction specifications established for the components of the containment system would be met. The results of these sampling and laboratory programs were reviewed and approved by the EPA and MDNR as the design progressed.

The remedy selected and implemented for OU-1 consisted mainly of a 2-foot thick, low-permeability slurry wall around the 52-acre main plant facility and a 3-foot thick, low permeability clay cap over the Site. Under the Consent Judgment, Velsicol must maintain groundwater levels within the slurry wall and beneath the cap ("containment system") to a maximum allowable elevation. Velsicol completed construction of the containment system in 1984.

Construction of the containment system included: 1) the emplacement of a continuous containment wall along the entire boundary of the Plant Site that was reportedly keyed a minimum of 30 inches into the underlying clay till unit and which was to achieve a permeability

of 1 x 10^{-7} centimeters per second (cm/s); 2) construction of a clay cap 36 inches (18 inches in some areas) thick over the Site and compacted to achieve a permeability of 1 x 10^{-7} cm/s); and 3) maintenance of the water table elevation within the containment system to no greater than 724.13 feet above mean sea level (ft amsl), as calculated from the average water table elevations of 14 monitoring wells located on the Plant Site.

The 1982 Consent Judgment also provided for periodic testing of the containment wall for three years after its installation. During the implementation of the Plant Site closure program in 1983 and 1984, Velsicol was required to conduct a comprehensive Quality Assurance/Quality Control (QA/QC) sampling program to monitor the installation of the various components of the containment system to ensure that the construction specifications established within the Consent Judgment would be met. According to Velsicol, the QA/QC program demonstrated that the components of the containment system were installed according to the specifications set forth in the Consent Judgment. All of the tasks outlined within the Consent Judgment were completed by 1986 under State and Federal oversight. The former main plant portion of the Site (OU-1) was then subject to an Operation and Maintenance Program which was prepared by Velsicol and approved by the EPA, and which has been implemented since approval. According to Velsicol, subsequent periodic testing in the three years following construction of the containment system indicated the system was constructed as designed.

Water levels inside the containment system (slurry wall and cap) were maintained below the level set by the 1982 Consent Judgment until February 1993. In 1993 Velsicol had to remove 1.25 million gallons of water from the containment system to stay below the established level. In late 1994 Velsicol removed another 1.28 million gallons of groundwater from the system to maintain the level set in the Consent Judgment. Velsicol has not pumped water from the containment system since 1998 and lost the use of the Crumbaugh property deep injection well in which they had been disposing of the water.

Due to increasing water levels within the containment system in 1993, EPA and MDEQ became concerned about what effect, if any, the water levels may have upon the integrity of the containment system. In early 1995, Memphis Environmental Center, Inc. (MEC) agreed to conduct an assessment of the containment system to address the concerns of the EPA and

MDEQ. Field activities were conducted during the summer of 1996, with data collection activities continuing until April of 1997. The assessment addressed all three major elements of the containment system.

The State of Michigan collected fish samples in late 1994 and noted that the average concentration of total DDT in skin off carp filet samples more than doubled since the last collection in 1989. The average concentration of total DDT in 1989 was 10.5 parts per million (ppm); in 1994 tissue concentrations were 23.3 ppm. The State of Michigan collected fish again in 1995 and found an average total DDT concentration in skin off carp filet samples of 16.1 ppm. The elevated contaminant concentrations in fish tissue coupled with the increased water flux (possibly due to elevated rainfall) into the containment system caused concern that the containment system may have failed, increasing the loading of DDT into the Pine River.

Previous studies have revealed that Site soils are contaminated with PBB, HBB, TRIS, and other contaminants; groundwater is contaminated with vinyl chloride, toluene, chlorobenzene, DDT, and other contaminants; Pine River sediments are contaminated with PBB, HBB, and DDT; and elevated levels of PBB, DDT, and other contaminants are in fish.

Velsicol agreed to reassess the containment system to ensure that it was not a source of DDT into the Pine River. At the same time the EPA and the MDEQ reassessed sediment contamination in the Pine River and decided to reconsider the No Action decision made in 1982.

On 11 December 1997, Velsicol submitted a work plan entitled Work Plan Post-Closure Cap Maintenance, Former Michigan Chemical Plant Site, St. Louis, MI, in which Velsicol stated it would conduct maintenance of the clay cap during the summer of 1998 by recompacting areas of the clay cap. Velsicol decided to delay the work until the EPA completed the sediment removal project currently underway.

In 1997 Velsicol completed an assessment of the Site containment system. Velsicol's assessment of the clay cap included collection of samples from the upper portion of the cap and analyses for permeability, grain size, and Atterberg limits. Assessment of the containment wall consisted of installation of inclinometers inside and outside the slurry wall at seven locations, installation of settlement plates at seven locations inside the slurry wall, collection of samples at

nine locations for permeability analysis; installation of upper zone piezometers on the inside and outside of the wall at five locations; water level measurements and free product screening from all monitoring wells and piezometers; and a dye tracer study at the five locations where the piezometers were installed. Velsicol published a report entitled *Final Containment System Assessment Report, Former Michigan Chemical Plant Site, St. Louis, Michigan, 1 October 1997 (CSA Report)* detailing the containment system assessment and results.

The CSA Report concluded that the clay cap is leaking, probably because there is no frost protection layer on top of the cap. The CSA Report also concluded that 94% of the water that infiltrates the cap is discharged through the underlying clay till unit, rather than transmitted through the slurry wall. No obvious problems were documented in the report and Velsicol concluded that the containment system is working as designed.

On 8 June 1998 the EPA signed an Action Memorandum for a time-critical removal action (TCRA) at the Site. The removal action consisted of dredging/excavating sediments containing 3,000 ppm total DDT or greater (the hot spot), treating the sediments with a stabilizing/drying agent, and disposing the sediments off-site. The TCRA was completed in October 1999. Additional remedial actions have been undertaken since October 1999.

1.4 CURRENT CONDITIONS

The entire 52-acre, main plant parcel of the Site is now covered with shallow-rooted grass and, to restrict access, enclosed by a chain link fence. The Site topography consists of fairly flat to gentle rolling areas on the entire property. All former Site manufacturing features were demolished and buried on-site or removed. Velsicol is reportedly operating and maintaining the site in accordance with an approved operation and maintenance plan requiring weekly inspections for signs of deterioration, quarterly monitoring of gas vents, measurement of groundwater levels within the contained site, and slurry wall permeability testing.

The EPA is currently overseeing the remedial actions at the Site, which began in late 1999. Through December 2001, over 341,000 tons of stabilized sediments have been removed from the Pine River. The remedial action activities are scheduled to continue in 2002.

SECTION 2

SCOPE OF WORK

WESTON completed the Phase I Scope of Work outlined in the "*FINAL Work Plan for the Phase I Evaluation of the Velsicol Superfund Site Slurry Wall. Velsicol Chemical Corporation Site, St. Louis, MI*" (Work Plan) dated January 2002 and prepared by WESTON for the MDEQ. The Scope of Work activities were completed in accordance with the procedures and methodologies presented in Work Plan. The following section includes a discussion of the field activity methodologies and any changes from the original scope or deviations from the Work Plan.

2.1 HISTORIC DATA REVIEW

WESTON completed a review of selected historical data, activities, reports and supporting documents completed for the Site to assist in the development of the Phase I Work Plan and to facilitate evaluation of the Phase I data. WESTON reviewed historical aerial photos taken prior to, during and immediately after completion of the OU-1 Remedial Action. Historic photos for the following years were reviewed: 1992, 1980, 1975, 1970, 1963, 1956, 1950, and 1938. WESTON also reviewed relevant historic reports, site maps, facility maps and Sanborn maps during the review of MDEQ files, EPA files, and database searches

WESTON completed a thorough review of the 1997 MEC CSA Report detailing the containment system assessment and results.

2.2 FILE MANAGEMENT SUPPORT

WESTON provided MDEQ with a staff scientist who reviewed, compiled and organized the various existing MDEQ files for this Site in accordance with the ERD Superfund Section File Structure Outline. The WESTON staff scientist worked at the direction of the MDEQ Project Manager (PM) and complied information regarding each document reviewed into an electronic file and flagged historic data (i.e., groundwater elevations and analytical chemistry results) in a spreadsheet format provided by the MDEQ PM.

Beginning in September 2001, the files were sorted and categorized according to the predefined MDEQ Superfund Section file structure. Following categorization the files were logged into a Microsoft Access database. The database allowed for several fields to be entered in order to maintain a comprehensive list of what files were contained within the overall file. The following fields were keyed in: name of document, location within the Superfund Section file structure (including category and subcategory), who the document was sent to, who sent the document, the date of document origination, operable unit, and additional comments. With regards to the document name field, if a document was a letter, a memorandum, a message, a fax, or an email, this information was included in the document name field. The database incorporates four operable units, which include the following: the river (currently under EPA management), the plant (currently under MDEQ management), Breckenridge, and Total Petroleum. Breckenridge was a waste disposal site used by Michigan Chemical Company at one point in time. The Site has been the subject of several studies by the MDEQ and the National Radiation Commission (NRC), among other agencies. Several subcategories of the file structure were created when multiple documents were found to fit into the same category. If a document was placed in a subcategory this information is denoted in the comment's field.

Initially the files housed within the Superfund Section were categorized and filed according to the Superfund Section file structure. After WESTON had completed the sorting and categorizing the Superfund's files, the MDEQ Surface Water Quality Division (SWQD), the MDEQ Waste Management Division (WMD), and the MDEQ Rose Lake office were contacted. These organizations were contacted to determine what files each division/department had regarding the Site. The files from these organizations were sorted to determine if their files were not located within the MDEQ-ERD Superfund Section files. The files that were not located within the Superfund section files were photocopied, categorized, keyed into the database, and placed in the Superfund section files in the appropriate location.

Following categorization and database entry, the documents were filed into folders following the filing system defined by the MDEQ Superfund Section. During the filing process analytical data were pulled and set aside, including reports that contain analytical data and individual lab reports. The analytical data were entered into the database, but not filed with the other files.

2.3 TOPOGRAPHIC SURVEYS

WESTON conducted aerial and land surveys to develop an accurate base map of the existing Site topography, river configuration and anthropogenic features (i.e. monitoring wells, fence line, slurry wall alignment, etc.). Abrams Aerial Survey Corporation (Abrams) of Lansing, Michigan conducted the aerial survey on 2 November 2001. The services provided by Abrams included:

- a flyover of the Site; aerial photography of a scale of one inch equals 330 feet with 60% forward overlap;
- black and white film and a one inch equals 800 feet scale spot shot;
- color prints and enlargements;
- development of a topographic base map generated at a one inch equals 100 feet scale, with one foot contour intervals;
- and, a control survey with forward selected horizontal and vertical control points.

All aerial photographs were ortho-rectified and supplied in digital format. The topographic data was formatted for AutoCAD-14 software in DWG files that provided the topographic information for the base map. To complete the topographic map, WESTON subcontracted Wade-Trim of Bay City, Michigan to establish the required ground control after the flyover was completed. The ground control was used to tie the aerial photographic data to found points at the Site surface.

In addition to establishing the ground control for the aerial photography, the land survey crew conducted two mobilizations to collect on-site survey data. The first mobilization occurred on 3 and 4 December 2001 and included locating the existing fence line, wells, inclinometers, catch basins and manholes, locating two bench marks on bridges upgradient and downgradient of the site, and setting up a perimeter station grid at 100 foot intervals along the site fence line similar to one used during the slurry wall installation. The second mobilization occurred after the Phase I field activities were completed and was conducted on 27 and 28 February 2002. Tasks

completed during the second mobilization included locating the newly installed piezometer pairs, residual contamination soil borings, and slurry wall soil borings.

The land survey elevations were referenced to Mean Sea Level, specifically to the North American Vertical Datum (NAVD) of 1988 to an accuracy of 0.01 feet for monitoring wells and catch basins and 0.1feet for all other features. The horizontal locations were referenced to the Michigan State Plane Coordinate System NAD83, international feet - South (2113) zone. The horizontal locations were also supplied in latitude and longitude coordinates.

Figure 1, Current Site Conditions, presents the existing piezometer, monitoring well, and surface water measuring locations (including Phase I sample locations). **Table 1** presents the Monitoring Well & Piezometer Construction Summary, which includes the survey information for the Site monitoring wells and piezometers. **Appendix A** includes the raw survey data of existing Site monitoring points collected by WESTON in 2001 and through February 2002.

2.4 THERMAL INFRARED SURVEY

WESTON subcontracted a thermal infrared (T-IR) aerial survey for the Site. The objective of this survey was to obtain additional data to evaluate whether the slurry wall is leaking, discharging groundwater directly to the Pine River, or had historic point discharges to the Pine River. The T-IR survey was conducted by Davis Aviation of Kent, Ohio. Remote (i.e., aerial) T-IR sensing was used to evaluate varying radiant surface temperatures at the interface between Pine River and the Site boundary. A difference in the temperature of the Pine River and the groundwater would be evident in the T-IR images if a plume or plumes of groundwater are entering the Pine River surface water near the slurry wall interface. In order for the T-IR survey to identify potential seeps at the interface, a temperature difference between the surface water body and the groundwater must exist, and a significant flow flux must be occurring into the surface water body. The required flow needed is not quantifiable and depends on the site and environmental conditions at the time.

The T-IR scanner used was sensitive to 0.08 °C, therefore, only a minor temperature differential is required to identify an anomaly, any significant seeps should have been identified during the survey. This technique has been used to locate problems such as the discharge of thermal effluent,

vegetative stress, watershed delineation, leachate from disposal sites, and groundwater recharge via springs and seeps.

The T-IR image collection system was placed in a typical aerial survey plane and the flight line end points identified on digital United State Geological Survey (USGS) quad sheets, and geographic coordinates were extended for use in the aircraft global positioning system (GPS) navigation system for all flights. The image collection system that was used for this survey was the Mitsubishi IR-600 Thermal Imager. The instrument has a 512 x 512 pixel resolution and a detectable wavelength of approximately 2-6 μm.

2.5 GEOPHYSICAL TRIAL

The least intrusive method for locating the slurry wall and avoid damage to the existing clay cap was non-intrusive surface geophysical techniques. Due to varying Site conditions such as the clay cap, the metal fence surrounding the Site, and the location of the Pine River, WESTON conducted geophysical trials to evaluate electromagnetic (EM)-31, EM-38, Ground-Penetrating Radar (GPR) unit, and resistivity methods. In addition, the unit used to conduct the resistivity was also used to conduct Self Potential (SP) tests. The SP tests were used to evaluate whether it was viable to use geophysical methods to determine potential leaking of the slurry wall.

2.6 SEEP SAMPLING ACTIVITIES

During the Pine River sediment remedial action activities in October 2001, the EPA contractor observed dark colored seeps emanating from the bank of the Site. The seeps consisted of dark brown to black dense non-aqueous phase liquid (DNAPL), and emitted a very strong organic chemical odor. The MDEQ notified WESTON of this occurrence, and on 26 October 2001, WESTON observed and documented the conditions of the DNAPL seeps on the riverbank and river bottom with photographs, and field notes. WESTON also collected soil and water samples near the seeps for laboratory analyses. Nine samples were collected during this sampling event – two water samples and seven soil/sediment samples. **Figure 3** presents the locations of the nine samples that were collected in the river bottom as the area was dewatered for the sediment removal activities.

Appendix C contains photographs from the sampling event. The NAPL seeps were present in or adjacent to a buried channel of sand and gravel incised into the top of the till (near Station 67 + 00). This buried channel extended from the riverbank northeastward for over two hundred feet into the riverbed. WESTON observed NAPL discharging from the buried channel along the riverbank. The NAPL seeps appeared to migrate laterally through the buried channel and along the top of the till. WESTON also observed NAPL migrating vertically downward in some till fractures. The vertical and horizontal extent of the buried channel and NAPL has not been determined.

The two water samples were collected from water observed emanating from the riverbank (Sample 001) and riverbed (Sample 002). The water samples contained small quantities of free product or Non-Aqueous Phase Liquid (NAPL). The seven soil/sediment samples were collected from the river bank or river bottom at locations adjacent to the NAPL seeps or areas suspected to have been affected by NAPL staining.

The samples were sent to TriMatrix Laboratories, Inc. (TriMatrix) of Grand Rapids, Michigan – a MDEQ approved overflow laboratory for chemical analysis. The samples were analyzed for the following parameters:

- State of Michigan list of volatiles, using EPA Method 8260;
- State of Michigan list of semi-volatile organic compound (SVOCs), using EPA Method 8270;
- Polychlorinated biphenyls (PCBs), using EPA Method 8082;
- Pesticide List 1, using EPA Method 8081 (which included Polybrominated Biphenyl (PBB), A-Chlordane, G-Chlordane, and 2,4'-Dichlorodiphenyl Trichloroethane (DDT));
- Pesticide List 2, using EPA Method 8081 (which included technical Chlordane); and,
- Inorganics (Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn).

2.7 SLURRY WALL LOCATION ACTIVITIES

Prior to the start of Vertical Aquifer Sampling (VAS) and piezometer installation, residual contamination borings, and slurry wall borehole activities, the position of the slurry wall at each proposed borehole was located using a Geoprobe® 66DT rig. The Geoprobe drilling was completed by subcontractor Stearns Drilling, Inc. (Stearns) of Dutton, Michigan. The approximate location of the slurry wall was first determined by WESTON staff using diagrams, historic report information, and Site observations. The Geoprobe® was used to collect five-foot continuous samples at each boring location. Slurry wall location borings were five to 10 feet in depth. Approximately 80 borings were advanced to locate the slurry wall. The slurry wall was identified by the ease of pushing the Geoprobe® sampler through the material, as well as the visual identification of slurry wall material by a WESTON Geologist/Scientist. The slurry wall is composed of sandy soil with trace bentonite and is plastic, gray, moist and very soft (see **Appendix C** for photos of the slurry wall).

When the slurry wall was not encountered with the initial Geoprobe location, additional soil borings were completed approximately two feet away from the initial boring in accordance with the original Work Plan. This process was repeated perpendicular to the anticipated slurry wall alignment over a length of 20 to 25 feet perpendicular to the slurry wall, or until the slurry wall was located. Each boring was backfilled with Benseal™ bentonite granules prior to moving to the next soil boring. After the slurry wall was located, soil borings for soil and groundwater sampling and piezometer installation were offset far enough to ensure they would not breach the slurry wall. **Table 2** presents the horizontal location and vertical elevation survey data of the slurry wall soil borings.

2.8 RESIDUAL CONTAMINATION BORINGS

WESTON completed seven soil borings at five stations to evaluate the potential for residual contamination to exist beyond (i.e., downgradient) the slurry wall. The seven soil borings are identified as WSB-02-1 to WSB-02-7, and borehole logs for them are included in **Appendix D.** The borings were located between perimeter station 32+50 and 57+50 and were approximately 350 to 800 feet apart (see **Figure 1**). No additional residual contamination borings were located

east of WSB-01-02 and WSB-02-02 (station 32+50) as the VAS activities of exterior piezometer borings were providing the same information as to the soil and water conditions exterior to the wall. The residual contamination borings were advanced according to the procedures detailed in the Work Plan utilizing a Geoprobe® unit. Soil borings were advanced until the saturated zone was reached. See **Table 2** for total depths and coordinates of each boring. A water sample from each was then collected from the top of the saturated zone.

Where possible, the residual contamination borings were completed at locations equidistant between the slurry wall and the river. However, due to the steep grade of the riverbank, this was not possible at most locations. At these locations, the borings were located as close to the top of the riverbank as deemed safe by the drill rig operator. At two stations, one near 57+50 (WSB-02-1 and WSB-02-2) and one near 48+50 (WSB-02-4 and WSB-02-5), two borings were completed between the slurry wall and the riverbank.

At each residual contamination boring location except WSB-02-1, a groundwater sample was collected in accordance to the work plan and EPA Low-Flow sampling method. A groundwater sample was not collected at WSB-02-1 due to its close proximity to WSB-02-2. Borings WSB-02-1 and WSB-02-2 were sampled after the groundwater turbidity was no longer visible as the YSI flow through cell was not available.

2.9 VAS BORINGS AND PIEZOMETER INSTALLATIONS

VAS was performed at 32 boring locations to obtain groundwater samples for chemical analysis at various depths. Soil samples were also collected from these borings for chemical analysis. A track mounted Geoprobe® 66DT unit was used to collect samples and install the piezometers. Prior to conducting the interior or exterior borehole activities, the location of the slurry wall was determined as described in section 2.8. A pair of soil borings was then drilled exterior and interior of the slurry wall at 16 locations. The exterior locations were labeled as WPZ-01X through WPZ-16X and the interior locations were labeled as WPZ-01I through WPZ-16I (see **Figure 1**). Continuous soil sampling with the Geoprobe® unit was conducted at each exterior locations and logged in accordance to the Work Plan by a WESTON Geologist/ Scientist. Soil samples were collected at the bottom of each borehole to verify till was encountered. See

Table 1 for piezometer construction information and coordinates of each location. **Appendix D** contains the borehole logs and piezometer construction diagrams.

VAS was conducted at each of the exterior borings with the exception of WPZ-03X, WPZ-05X, and WPZ-13X. WPZ-03X and WPZ-13I did not yield enough water to allow for sampling, while WPZ-05X was not sampled due to its close proximity to residual soil boring WSB-02-6, which had already been sampled. In addition to the exterior borings, the following six interior locations were sampled for groundwater: WPZ-01I, WPZ-06I, WPZ-9I, WPZ-10I, WPZ-11I, and WPZ-14I.

All samples were collected using the EPA low-flow sampling method in accordance to the Work Plan. An adjustable length of screen between two to four feet was used. If the boring yielded enough water to sample a smaller screened interval was used. If the saturated zone was large enough, three samples were collected at different depths: at the top of the saturated zone, at an intermediate depth, and just above the till layer. For most borings, however, only one or two groundwater samples were collected because the thickness of the saturated zone was not as great as anticipated.

VAS borings WPZ-04X and WPZ-11X (25-30 ft) did not yield enough water to be sampled through the Geoprobe® rod and screen apparatus, per the Work Plan. These borings were subsequently sampled with a peristaltic pump in the same manner through the 1-inch PVC piezometer that was installed in each VAS boring.

After each VAS boring was sampled, a one-inch PVC piezometer was installed in the borings according to the Work Plan. The same boring used for VAS was used to install the piezometer. All of these piezometers were installed with a five-foot long 0.010-inch factory slotted PVC screen with the exception of WPZ-05X and WPZ-05I, where ten-foot long screens were installed. The longer screens were used to insure that these wells were not dry.

2.10 SLURRY WALL BORHOLE INVESTIGATION

The Phase I SOW was expanded to include the completion of additional soil borings directly through the slurry wall to further investigate the potential for direct migration of contaminants through the wall to the Pine River near WPZ-11 and the NAPL seep area (**Figure 3**). Fourteen direct push Geoprobe® borings spaced from 6-inches to 15 feet apart were drilled vertically through the entire depth of the slurry wall until the till was encountered. The purpose of these borings was to identify potential defects or breaches in the slurry wall and to investigate the configuration of the buried channel, the change in depth to the till layer, the continuity of the slurry wall, and the source of the seeps observed in 2001 during the river sediment dredging activities.

A WESTON Geologist/Scientist logged each boring, and noted evidence of possible slurry wall discontinuities and/or degradation of the slurry wall (**Appendix D** contains the borehole logs).

2.11 GROUNDWATER ELEVATION SURVEYS

WESTON collected four rounds of static groundwater elevations after the 16-piezometer pairs were installed at the Site. Groundwater elevations were collected on 1, 6, 13, and 19 March 2002. **Table 3** presents the results of the four rounds with depth to water measurements, corresponding groundwater elevations, and head height differences across the slurry wall (where applicable). Groundwater levels were measured in the newly installed piezometer pairs (i.e., WPZ-01X and I through WPZ-16X and I), along with the existing piezometer pairs (i.e.; CW6-EP and IP) and accessible existing monitoring wells. In addition, the elevation of the Pine River was measured using two permanent gauging points. The Pine River gauging point upstream of the Site is located at the M-46 Bridge, and the downstream gauging point is located at the Mill St. Bridge. **Figure 1** presents the locations of the new and existing monitoring points. Some of the existing piezometers or monitor wells were not sounded during one or more sampling rounds because they were inaccessible (i.e., locked), or a pink-dye was visible within the casing and not measured due to the potential to cross-contaminate other wells.

SECTION 3

RESULTS AND DISCUSSION

3.1 REVIEW OF 1997 CSA REPORT

In 1997 Velsicol retained MEC to complete an assessment of the Site containment system. MEC's assessment of the clay cap included collection of samples from the upper portion of the cap and analyses for permeability, grain size, and Atterberg limits. The MEC assessment of the containment wall consisted of installation of inclinometers inside and outside the slurry wall at seven locations, installation of settlement plates at seven locations inside the slurry wall, collection of samples at nine locations for permeability analysis; installation of upper zone piezometers on the inside and outside of the wall at five locations; water level measurements and free product screening from all monitoring wells and piezometers; and a dye tracer study at the five locations where the piezometers were installed. MEC submitted a report entitled *Final Containment System Assessment Report, Former Michigan Chemical Plant Site, St. Louis, Michigan, 1 October 1997 (CSA Report)* detailing the containment system assessment and results.

The CSA Report concluded that the clay cap is leaking, probably because there is no frost protection layer on top of the cap. The CSA Report also concluded that 94% of the water that infiltrates the cap is discharged through the underlying clay till unit, rather than transmitted through the slurry wall. No obvious problems were documented in the Velsicol report and it concluded that the containment system is working as designed.

WESTON completed a technical review of the CSA Report and found many of the MEC conclusions in the CSA report were not supported by the data provided. WESTON identified numerous concerns regarding the containment system design and construction.

WESTON identified several concerns with the dye tracer study conducted by MEC. The basis of the study design was not provided and therefore the validity and applicability of the results is suspect. The field methodology details of the study also were not provided. The duration of the study and location of dye injection points were not adequate to identify the breach at the NAPL

seep area. There is no analysis of the dye study travel times, flow paths, dispersion and flux rates.

WESTON identified several concerns with the Water Balance Evaluation included in the CSA Report. The main concern with the evaluation was that the MEC appeared to set up the model input parameters to ensure that the majority of system leakage occurred through the till by assuming that the slurry wall was functioning as designed. By making minor changes in the hydraulic conductivy inputs for the wall and till, the majority of the leakage can be shown to exit the system through the slurry wall. No sensitivity analyses were provided.

Limited NAPL screening was completed during and after the remedy construction. NAPL was noted in pre-construction boring logs and during construction but was apparently ignored by the PRPs. The PRPs used clear bailers only to screen for NAPL rather than interface probes or other field tests. The PRPs did not conduct NAPL compatibility testing on the slurry wall material or the underlying till. The PRPs did complete a limited durability study of slurry wall material, however, the tests were conducted with upgradient groundwater that was not significantly affected by Site COCs. Therefore, the utility of the durability tests is suspect.

Although the PRPs installed inclinometers and conducted settlement monitoring of the cap, they ignored significant movement (up to 5 inches displacement) reported for settlement markers. The PRPs dismissed observed displacements as the result of frost action and failed to acknowledge that frost action is detrimental to cap integrity.

WESTON found that the geotechnical testing evaluation of the cap and slurry wall demonstrated significant portions of these components failed pass the design specifications. Approximately 60% of cap samples failed to meet the 0.005 mm and percent passing No. 200 sieve criteria. Approximately 40 acres (78%) of the clay cap failed to meet the $1x10^{-7}$ cm/s hydraulic conductivity specification. Most cap samples (75%) failed to pass the $1x10^{-7}$ cm/s hydraulic conductivity criterion. A majority of cap samples (65%) were classified as a USCS "sand" and not "clay". In summary, over 80% of the cap samples failed to meet one or more design specifications. Less than 60% of the slurry wall samples passed $1x10^{-7}$ cm/s hydraulic

conductivity criterion. The average hydraulic conductivity of the clay till samples also failed to meet the $1x10^{-7}$ cm/s criterion.

Based on the concerns and deficiencies identified by WESTON in our review of the CSA Report, the MEC conclusion that *"the containment system components meet or exceed original specifications...and continues to be protective of human health and environment..."* is not supported by the available data, is incorrect and misleading. The data provided in the CSA Report clearly show the cap and slurry wall components due not meet the original design specifications and the remedy is not protective of the human health and the environment.

3.2 GEOPHYSICAL TRIAL

Appendix E contains the results of the geophysical field trial.

WESTON subcontracted the execution of the geophysical field trial to STS Consultants, Ltd. (STS) of Lansing, MI. The geophysical trial was conducted onsite 25 September 2001 at four transects where the approximate location of the slurry wall was known. All transects were conducted near piezometers and inclinometers that had been installed adjacent to the slurry wall (see **Figure 1, Appendix E**). The locations of the existing piezometers were used as an approximate guide to locate the slurry wall. Each geophysical method was used to attempt to locate the slurry wall. STS and WESTON evaluated the data gathered on-site as the trial was conducted. Significant interference from the perimeter fence, overlying clay cap, and apparent lack of an electrical resistivity differential between the slurry wall and surrounding native soil resulted in inconclusive or less than definitive profiles of the slurry wall location at all transects. None of the geophysical methods implemented could determine the location of the slurry wall to the level of accuracy and precision required for the proposed Phase I piezometer installations. Therefore, the geophysical trial was terminated and future attempts to locate the slurry wall with geophysical techniques were abandoned.

3.3 THERMAL INFRARED SURVEY

The results of the T-IR survey are included in **Appendix B**.

Two T-IR aerial surveys were conducted at the Site. The first occurred 3 January 2002 and was considered a reconnaissance flight to determine whether the approach, along with the existing site conditions would provide usable data. At the time of flight, ice conditions on the Pine River had just developed which interfered with the interpretation of the T-IR images. The ice on the River made some of the potential anomalies suspect due to other irregular features developed by the ice on the river. T-IR images reviewed at this time were placed in two categories – high potential anomalies and low potential anomalies. WESTON determined that a second T-IR flight would be conducted soon after the ice thawed completely from the river. The second T-IR aerial survey was conducted 10 April 2002. The Site conditions were good with no snow cover and no ice on the river, including the surface water impounded within the temporary sheet piling areas. The temperature difference between the Site groundwater and the Pine River water during the April event was not as significant as in January, which complicated or prevented the collection of useful data. In January the groundwater temperature ranged from 6 to 10 °C with the Pine River temperature approximately 3.6 to 4.2 °C. In April, the groundwater temperature was 7 to 8 °C, while the Pine River surface water ranged from to 7.3 to 14.4 °C. **Appendix B** contains a site map with the suspect areas noted and still images of the suspect areas from the two T-IR surveys.

Based on the images of the two T-IR surveys conducted, two localized groundwater seeps are present along the Site and Pine River interface. In addition, a large wide area of potential groundwater upwelling near the riverbank is present over approximately two-thirds of the riverbank along the west and north boundary of the Site. No linear source discharges (such as former pipe outfalls) were observed in the T-IR images other than the storm drain outfall near the M-46 bridge abutment. **Figure 1, Appendix B** presents the locations of suspect areas identified during the T-IR surveys. **Figure 2, Appendix B** presents the Annotation Guide that is printed with each T-IR image indicating date, local time, altitude, latitude and longitude, speed, and track. The following are descriptions of the suspect areas.

Groundwater Seeps

One groundwater seep (GS-1) was identified as a long, linear feature observed at the western portion of the Site, near Station 42+00. The groundwater seep appears in a low-lying area and

extends approximately 75 to 100 feet in length. The seep appears to flow along the low-lying area in a northerly direction until it reaches the Pine River. **Figure 3, Appendix B** presents T-IR image No. 53 and **Figure 4, Appendix B** presents T-IR image No. 52 which depict this linear groundwater seep. The feature appears white in these images indicating cooler water entering the warmer Pine River water. This groundwater seep corresponds with the "high potential" anomaly observed in the January 2002 T-IR Photo No. 21 **(Figure 5, Appendix B)**. This T-IR image indicates the potential of warmer groundwater entering the Pine River at the land and river boundary. At this time of the year, groundwater is warmer than surface water.

A "low potential" anomaly observed in the January 2002 T-IR photo No. 30 **(Figure 6, Appendix B)**. The T-IR image No. 30 indicates potential warmer groundwater entering the Pine River at the land and river boundary. This anomaly was identified as "low potential" because ice on the river obstructing the quality of the image. This anomaly was identified as potential groundwater seep GS-2.

In April 2002 the groundwater seep GS-2 is again present and is depicted as a subtle point where cooler groundwater is entering warmer river water. **Figure 7, Appendix G** presents T-IR photo identified as No. 54 (April 2002 T-IR Survey) confirming the interpretation of the second potential groundwater seep. The anomaly exhibits a strong signature similar to GS-1, but is smaller in size. The location of this potential seep corresponds with an area on the riverbank where a thin layer of concrete has been placed. It appears this concrete was placed in this area to stabilize the bank because significant erosion is occurring underneath the thin concrete pad. The location of GS-2 and concrete pad overlying the riverbank corresponds with the former Velsicol plant outfall No. 25. Outfall No. 25 is described in a historic document (National Pollutant Discharge System Application MI-070-0X5-2-710310) as an open ditch or yard drain.

Groundwater Upwellings

The April 2002 T-IR survey indicates signatures there are potential areas of groundwater upwelling in the Pine River along the western and northern boundaries of the Site. The signatures indicate cooler groundwater entering the warmer Pine River waters. The temperatures recorded for groundwater were approximately 7.1 to 7.9 °C and the Pine River water temperature ranged from 7.3 to 14.4 °C. **Figure 1, Appendix B** presents the areas where the potential

upwelling is occurring. These upwelling anomalies typify broad diffuse areas of groundwater discharge to the sediments of the Pine River as opposed to the localized, linear groundwater seeps also identified at the Site. These signatures are present along both the western and northern boundaries and **Figures 8, 9, 10, Appendix B** present snapshot images of these areas from the T-IR imaging video. (Note: that anomalies are more readily evident when viewing the T-IR videotape). This widespread area of groundwater upwelling into the bed of the Pine River would be expected for a "gaining" river under natural recharge conditions. However, the containment system at the Site would be expected to minimize or eliminate both upwellings and seeps along the reach of the river it borders. These anomalies suggest groundwater from within the containment system is leaking either through or around the slurry wall or through the underlying till or both.

Stormwater Discharge to Pine River – High Potential Anomaly

Figure 11, Appendix B presents T-IR Image No. 19 which was considered a "high potential" anomaly from the January 2002 T-IR Survey. The feature is a long linear, anomaly and indicates warmer conditions than the surrounding ground conditions. During a site visit after the January survey was conducted, this area was visually observed to be a drainage area. A concrete drain was found emerging from the ground surface and draining to a low area that ultimately discharges to the Pine River. After reviewing Site as-built drawings for the slurry wall containment system, WESTON determined that the water emanating from this pipe was most likely storm water drainage from Watson Street. During construction of the containment system, a storm water drainage system was installed between the residential homes on Watson and the former plant site. WESTON collected a water sample (SSD-01) from this pipe and there was no significant COCs detected.

The area of the Pine River that has been enclosed by the metal sheet piling which includes the area adjacent to WPZ-11 and the area that seeps were observed in 2000 and 2001 did not exhibit signatures or anomalies in the T-IR surveys. This area was suspected to show groundwater seeps or upwelling based on the historic observations. However, the difference between groundwater and Pine River surface water temperatures in the enclosed area was apparently very near or less than or near 0.08°C, which is the minimum resolution required for the T-IR camera. In addition,

the bottom of the river in this area is substantially deeper than the other areas along the Site boundary due to the dredging of the sediments that has recently occurred, which may mask the presence of the slightly colder groundwater that is potentially venting from the riverbed beneath deeper and cooler river water. The limited circulation of surface water in the enclosed area also may have confounded the T-IR results because the relatively stagnant surface water in this area would have more time to equilibrate with any groundwater upwellings or seeps.

T-IR Summary

In summary, the T-IR surveys indicate two potential groundwater seeps are emanating from the Site, both on the western edge of the Site. **Figure 1, Appendix B** presents the locations of these two seeps. These two locations could be interpreted as breaches in the slurry wall allowing groundwater to flow through the slurry wall. There is a broader signature along the western and northern boundary of the site indicating groundwater upwelling at the land and river interface. This signature can be interpreted as groundwater entering the river that has moved through or under the slurry wall.

3.4 SOIL BORING AND PIEZOMETER INSTALLATION

3.4.1 RESIDUAL CONTAMINATION SOIL BORINGS

Seven residual contamination soil borings were completed at the locations shown on **Figure 1**. The seven soil borings were identified as WSB-02-1 through WSB-02-7. Soil boring logs for these locations are provided in **Appendix D**. Field notes from the Phase I activities are provided in **Appendix F**.

The stratigraphy of the residual contamination borings (from top to bottom) consisted of zero to 17 inches of topsoil and/or limestone riprap, underlain by fill and/or native sediment which overlie a till deposit. The till was encountered at the following three locations: WSB-02-1, WSB-02-6, and WSB-02-7. The depths to till at these locations were 22.5, 16.6, and 18.5 feet below ground surface (bgs) (elevations: 704.5, 710.62, and 709.36 feet respectively). The till was classified as a clay (USCS: CL) and described as a gray silty clay, some sand, trace fine

gravel. The geotechnical results are included in **Appendix G**. Between the cap and till layers was various sediments deposits, including clay, sand, silt, and peat.

Air monitoring of the breathing zones and field screening of recovered soil samples was conducted with photo-ionization detector (PID) meters during completion of the residual contamination borings. None of the soil or water samples from the residual contamination soil borings had measurable responses to the PID. In addition, no visible evidence of contamination such as odors, staining or sheen was observed. Radiation monitoring was conducted with a model 19 microRmeter and none of the measurements exceeded background measurements.

WESTON collected groundwater samples at each residual contamination boring for laboratory analyses using a peristaltic pump. Prior to sampling the groundwater at soil borings WSB-02-3 through WSB-02-7, pH, conductivity, dissolved oxygen, oxidation reduction potential (ORP), and temperature of the groundwater were measured every minute while purging the well until the measurements stabilized (see **Table 4** for initial and final readings). Field parameters for WSB-02-5 appear to be erroneous due to an equipment failure.

The soil in these seven residual borings did not appear to be contaminated based on visual observations and field instrument measurements, however the analytical results from soil and water samples collected from these locations do indicate significant contamination. The analytical chemistry results from these sample locations are presented in Sections 3.6.2 and 3.6.3. In addition, several exterior VAS locations along the Pine River boundary did exhibit visual observations and field instrument measurements that indicated contamination outside the slurry wall.

3.4.2 VAS BORINGS AND PIEZOMETERS

VAS borings were completed at the 32 locations shown on **Figure 1**. These borings were installed as 16 pairs located inside and outside the slurry wall designated WPZ-01X/I through WPZ-16X/I.

The stratigraphy of the VAS borings consisted of three types of materials: clay cap and working platform, unconsolidated sediments above the till, and till. The clay cap and working platform

consisted of a sandy to silty non-plastic, dry, hard, yellowish to grayish brown clay. The depth to the bottom of the cap and working platform of the up-gradient interior and exterior borings, WPZ-01, WPZ-02, WPZ-03, WPZ-12, and WPZ-13, ranged from one to 2.8 feet bgs (elevation: 723.42 to 732.18 feet). The depth to the bottom of the cap and working platform of the down-gradient interior and exterior borings, WPZ-04 through WPZ-11, and WPZ-14 through WPZ-16, ranged from 6.2 to 10.8 feet bgs (elevation: 717 to 722.5 feet). The till was classified as a clay (USCS: CL) and described as gray, silty clay, some sand, trace fine gravel. The geotechnical results for these samples are included in **Appendix G**. The depth to the top of the till at the up-gradient borings ranged from seven to 12 feet bgs (elevation: 713.92 to 722.53 feet). The depth to the top of the till at the down-gradient borings ranged from 13 to 30.8 feet bgs (elevation: 697.64 to 717 feet). The unconsolidated sediments between the cap and till consisted of various sediments including clay, sand, silt, peat, wood, and fill material. The following are some key observations noted during piezometer boring installation:

- WPZ-04X contained black wood that had strong diesel like odors.
- WPZ-09X and WPZ-09I contained several inches of red stained wood fibers with a very strong chemical odor.
- WPZ-09X and WPZ-09I had a black unknown substance that was coarse, gritty cinder-like material. (This material was encountered in other borings and identified as black gravel).
- WPZ-07X contained an unknown white, very soft, non-granular, pasty substance with no odor (potentially magnesium oxide).

Evidence of contamination was observed at ten piezometer soil boring pairs. WPZ-04X, WPZ-06X through WPZ-11X, and WPZ-14X through and WPZ-16X had noticeable organic odors from the soil.

- WPZ-04X had a strong diesel odor,
- WPZ-07X had a petroleum like odor,

- WPZ-09X and WPZ-16X had a chemical odor, and
- WPZ-06X and WPZ-08X had a sulfur odor.

Evidence of staining and/or sheen was present in nine of these borings.

- WPZ-06X through WPZ-11X, WPZ-15X and WPZ-16X had black stained sand,
- WPZ-09X, WPZ-09I, WPZ-11X and WPZ-14X had sheen present, and
- WPZ-11X had greenish blue/silver sheen.

Air monitoring was conducted with a Multi-RAE PID and instrument responses above background at the following eight locations: WPZ-04X, WPZ-07X, WPZ-09I, WPZ-09X, WPZ-10X, WPZ-11X, WPZ-14X, and WPZ-16X. **Table 5** presents a summary of VOC field measurements. These readings indicated VOCs from 0.1 (WPZ-14X) to 43.8 ppm (WPZ-16X at 9 feet bgs).

Soil samples were collected for potential laboratory analysis generally at two-foot intervals between the cap and working platform layer and the saturated zone. Additional soil samples were collected for chemical analysis at the discretion of the WESTON geoscientist when impacted soil was observed. A discussion of the soil analytical results is presented in Section 3.6.2.

VAS was conducted at each of the exterior borings with the exception of WPZ-03X, WPZ-05X, and WPZ-13X. WPZ-03X and WPZ-13X did not yield sufficient water to allow groundwater sampling, while WPZ-05X was not sampled due to its close proximity to residual soil boring WSB02-6. In addition to the exterior borings, the following six interior locations were sampled for groundwater: WPZ-01I, WPZ-06I, WPZ-09I, WPZ-10I, WPZ-11I, WPZ-14I. VAS groundwater samples were collected using the EPA low-flow sampling method. Prior to sampling, pH, conductivity, dissolved oxygen, ORP, and temperature readings were measured and recorded every minute while purging until the measurements stabilized (see **Table 4** for initial and final field readings). The pH ranged from 5.92 to 8.84, conductivity ranged from 1201 to 7391 siemens, dissolved oxygen ranged from 1.6% to 93.9%, ORP ranged from –369 to

237, and temperature ranged from 5.59 to 11.1 °C. Observations of odors were recorded while sampling at the following nine locations: WPZ-4X, WPZ-6X, WPZ-8X, WPZ-9X, WPZ-10X, WPZ-10I, WPZ-10X, WPZ-11X, WPZ-11I, and WPZ-14X. Specifically, WPZ-4X had a strong diesel like odor and the water was black. A discussion of the groundwater analytical findings is presented in Section 3.6.3.

A one-inch polyvinyl chloride (PVC) piezometer was installed in each piezometer boring. Each piezometer was installed with a five-foot long, 0.010-inch factory slotted PVC screen with the exception of WPZ-05X and WPZ-05I which have a ten-foot long PVC screen (see **Appendix D** for well construction diagrams). The bottom of the screen was set at the top of the till layer or just beneath the top of the till.

WESTON recorded four rounds of groundwater level measurements on 1, 6, 13 and 19 March 2002 with the results discussed in Section 3.5. One round of measurements were taken using an interface meter to identify potential NAPL or DNAPL. During this measurement period, no NAPL or DNAPL were measured in the wells and piezometers.

See **Figures 4 through 9** for geological cross-sections and additional descriptions of Site stratigraphy.

3.4.3 SLURRY WALL BORINGS

A total of 14 slurry wall borings were installed at the locations shown on **Figure 3.**

The slurry wall investigation soil borings encountered sand from the ground surface to about one to two feet bgs. The constructed clay cap and working platform materials were observed beneath the sand to about six to seven feet bgs. The constructed cap and working platform material consisted of a sandy to silty non-plastic, dry, hard, gray clay. Beneath the cap materials each boring encountered the slurry wall. The slurry wall was characterized as a gray, fine to coarse sand with silty clay, trace fine to medium gravel (USCS: SC-SM). The geotechnical results are included in **Appendix G**. The slurry wall is plastic, moist, very soft and gray.

Of the 14 borings completed through the entire depth of the slurry wall, five borings encountered slurry wall that had no slurry wall degradation or defects. These five borings were WSW-02,

WSW-03, WSW-08, WSW-09, WSW-13 and were documented by photographs in **Appendix C**. At these five borings the till was encountered between 27.5 feet and 32.5 feet bgs (elevation: 701 feet to 696 feet). **Figure 5** presents cross-section A-A' which presents the soil borings in this area.

The other nine borings displayed evidence of potential slurry wall failure. These borings were WPZ-10S, WPZ-11S, WSW-01, WSW-04, WSW-05, WSW-06, WSW-07, WSW-10, WSW-11 (**Figure 5**). The till was encountered between 27 feet and 32.5 feet bgs (elevation: 701.5 feet to 696 feet) in these borings. At these nine borings a variety of sediments were observed between the slurry wall and the top of the till. Sediments observed included black stained gravels, sands with reddish to dark purple sheen, clays with a silver sheen, and black peat with wood fragments (**Appendix C**). Significant odors were noted at each of these borings along with elevated VOC levels recorded during air monitoring with PID meters. No significant amounts of free product were observed in these borings, however small amounts of potential free product were noted at WSW-04 in a sand layer at a depth of 26 feet bgs.

Black staining had permeated the slurry wall samples in borings WSW-05 and WSW-04 at 19 feet bgs. This staining was observed five to six feet below the water table in this area based on water level readings from nearby wells WPZ-11I and WPZ-11X. The thickness of this staining was about six to eight inches and significant organic odors were noted at both borings. The sediments in the vicinity of this staining had the same characteristics of the intact slurry wall. WSW-04 also exhibited four-inch seam of granular white material imbedded within the stained slurry wall sediment (see photographs included in **Appendix C**). Black staining of the slurry was also observed at WPZ-11S at 20 feet bgs. Wood fragments with black staining were also noted at this location. The thickness of the staining at this location was about six to eight inches and significant odors were noted. The stained sediments in this area had the same characteristics of the intact slurry wall except for the wood fragment. The wood appeared to be processed lumber.

Foreign materials were observed imbedded within the slurry wall materials of two borings: WPZ-10S and WSW-11. Details of these borings are provided below:

- At WPZ-10S a one-inch seam of black stained gravel with slurry wall material above and below was found at 25 feet bgs.

- At WSW-11 a layer of black peat, greenish-black clay, dark gray sand, and gray gravel surrounded by slurry wall material was observed between 24 and 25 feet bgs.

- Also at WSW-11 a two-inch seam of gray sand with slurry wall material above and below was found at 29 feet bgs.

- A small seam of odorous sand within the till was found at WPZ-10S as well. The two-inch seam of medium grain gray sand began at 29 feet bgs.

These defects suggest the integrity of the slurry wall has been compromised, however, there are several possible explanations for the apparent "windows" or "breaches" observed in the slurry wall including:

- The slurry wall may be intact, but the borehole may have deviated through the slurry wall at depth, giving the appearance of a gap.

- The slurry wall may not be consistently two feet wide for its entire depth. If so, a vertical borehole may breach the edge of the slurry wall, giving the appearance of a gap due to slurry wall thinning at depth. **Figure 6** presents cross-section B-B' which shows the potential thin areas.

- The slurry wall was designed to be keyed two feet into the till layer. If sediments sloughed into the key during construction rather than slurry wall materials, the boreholes could indicate a gap between the slurry wall and the till.

- It is also possible the slurry wall key was not completed at all and there is a gap between the slurry wall and the underlying till.

- Finally, it is also possible that significant windows in the slurry wall exist.

A channel like feature was discovered by EPA along the face of the riverbank at the NAPL seep area during the removal of sediments within the Pine River in October 2001. This channel was

deeper than the surrounding unconsolidated soils and appears to be incised into the till that underlies the Site. The slurry wall borings defined the profile of the channel. The channel is approximately 60-feet wide and is approximately seven feet deeper than the surrounding till sediments based on the top of till elevations. This channel is located within a broader valley like feature that exists in the till at the Site. DNAPL in this area could sink to the top surface of the till and would follow the sloping surface of the till and channel downward toward the river. These two features (the broad till surface dipping and channel) increase the potential for DNAPL and contaminants to migrate off-site into this area. This area also corresponds with former plant facilities where pesticides and DDT feed stock chemicals such as chlorobenzenes were used.

3.5 HYDROGEOLOGY

WESTON used groundwater elevation data from 1 March 2002 to create a Shallow Groundwater Flow Map presented as **Figure 10**. The large hill depicted in the southwest part of **Figure 10** was formed when demolition materials were deposited in this area during the plant decommissioning. This hill has created a groundwater mound effect that directs groundwater radially away from this topographic feature. Flow to the Pine River is present along the entire downgradient side of the Site bordering the Pine River. In general, the downgradient areas exhibit higher groundwater elevations inside the slurry wall and lower groundwater elevations immediately outside the slurry wall indicating an outward hydraulic gradient.

Figure 11 presents a profile of piezometer pair WPZ-15 that shows a typical outward hydraulic gradient example. Areas where the groundwater elevation in the internal piezometer are higher than the groundwater elevation in the exterior piezometer suggest that the slurry wall is inhibiting groundwater flow, but an outward hydraulic gradient exists. Along the upgradient side of the Site, the groundwater contours are 721 feet and greater, and typically show an inward gradient to the Site. **Figure 12** presents a profile of piezometer pair WPZ-03 that shows a typical example of an inward hydraulic gradient found over much of the upgradient portion of the Site.

Beyond the broad observations made regarding the upgradient and downgradient sides of the Site, the following are local smaller scale features noted concerning the shallow groundwater flow at the Site. An area of increased groundwater flow is evident near the NAPL seep area at

the northeast part of the Site adjacent to piezometer pairs WPZ-10 and WPZ–11. The head difference measured in piezometer pair WPZ-10 during from the four rounds of elevations collected ranges from between 1.38 feet to 1.52 feet suggesting conditions to those previously at piezometer pairs on the downgradient side of the Site (i.e., at WPZ-15). However, the head differences measured at the nearby piezometer pair WPZ-11 ranged from 0.25 feet to 0.30 feet, which is a significantly smaller head difference. **Figure 13**, Profile of Piezometer Pair WPZ-11, shows the smaller and nearly negligible horizontal hydraulic gradient observed there which suggests that slurry wall is having little effect on inhibiting the migration of groundwater at this point and may not significantly reduce the flow of impacted groundwater to the Pine River.

The groundwater flow direction is outward from the Site in the area of piezometer pair WPZ-01 and to the east. As stated above, typically the "upgradient" side of the Site exhibits an inward hydraulic gradient, however in the area adjacent to piezometer pair WPZ-01 and to the east, it appears that the groundwater flow may have changed direction after the installation of the slurry wall containment system. **Figure 14**, Profile of Piezometer Pair WPZ-01, indicates the outward horizontal hydraulic gradient, which is also negligible, suggesting that slurry wall has little influence on groundwater flow at this location. The outward hydraulic gradient in this area is significant in two ways: 1) this appears to be the only area where groundwater is moving offsite other than the border with the Pine River; and 2) the groundwater that is flowing offsite onto adjacent residential property could be contaminated.

An inward horizontal hydraulic gradient is present near the southeast corner of the Site, near piezometer pair WPZ-03, and may be an area of a potentially large influx of groundwater into the Site containment. The hydraulic heads in the piezometer pair WPZ-03 are significantly lower than the groundwater elevations of other upgradient monitor points. **Figure 12**, Profile of Piezometer Pair WPZ-03, depicts the inward horizontal hydraulic gradient present in this area. Site groundwater moves to the northwest in this area and than flows to the north and to the west toward the Pine River. The inward hydraulic gradient in this area may be the related to construction defects in the slurry wall. This area is located near a portion of the slurry wall failed and had to be reinstalled during construction.

The piezometer pair installation included identifying the location of the slurry wall with a soil boring, and then installing one piezometer inside the slurry wall and one on the outside of the wall. Locating the slurry wall with soil borings was successful at all locations, except for the piezometer pair WPZ-04. In attempting to locate the slurry wall near WPZ-04, material that appeared to be slurry wall was encountered, however the depths and thickness of the material were not consistent with what was observed at the other locations. Additional soil borings were attempted as described in the Work Plan to locate the slurry wall, however slurry wall material was not observed in the additional soil borings. Based on the observation of potential slurry wall material in the one soil boring along with the location of the slurry wall in other areas along the Site, an interior and exterior piezometer (WPZ-04I and WPZ-04X) were located and installed.

After further review of the containment system as-built drawings and the groundwater elevations of the two piezometers (WPZ-04I and WPZ-04X), which show negligible outward horizontal hydraulic gradient, it appears that WPZ-04I is located outside the slurry wall containment system. Velsicol also could not locate the slurry wall in the vicinity of the piezometer pair WPZ-04 during the 1996 investigation activities. Further investigation of this area will be conducted during Phase II to confirm the location of the slurry wall and evaluate hydraulic heads inside and outside of the wall near WPZ-04.

In summary, the shallow groundwater flow patterns and head differences across the slurry wall observed at the Site indicate that the slurry wall component of the containment system is influencing groundwater flow. However, this influence does not appear to have eliminated the potential for off-site migration of impacted groundwater. In fact, several of the piezometer pair comparisons suggest that in some areas the influence of the slurry wall is negligible to absent.

The presence of a strong outward flow direction and hydraulic gradients along the downgradient portion of the Site as well as localized outward flow in the northeastern portion of the Site suggest that potentially contaminated groundwater is flowing into the Pine River and potentially the residential properties adjacent to the upgradient portion of the Site.

3.6 ANALYTICAL CHEMISTRY DATA

Laboratory analytical reports for the Phase I samples are included in **Appendix H**.

In most cases, WESTON compared the analytical chemistry results of the Phase I samples to MDEQ Part 201 groundwater/surface water (GSI) criteria. The GSI criteria were used because they are often the most stringent and because of the proximity of the contaminants to the Pine River. Other Part 201 criteria (i.e., residual drinking water, or direct contact) were used for comparative purposes for some contaminants for which GSI criteria have not been established. Alternate criteria may be used for the Site during the RI risk assessment.

3.6.1 SEEP SAMPLES

A total of 9 seep samples (2 water and 7 soil) were collected from the Site on 26 October 2001. **Table 6** includes a summary of pesticides detected in the seep samples. The seep samples were analyzed by TriMatrix for Pesticides/PCBs, VOCs, SVOCs and TAL inorganics.

The following is a brief discussion of the seep sample analytical results. **Figure 3** presents a summary of select seep sample analytical data. The parameters presented in **Figure 3** were selected as representative of the VOC and pesticide contaminants detected in Site seep samples.

Pesticides/PCBs

Pesticides were detected in all of the seep samples collected. The pesticides 4,4-DDD, 4,4-DDE and 4,4-DDT were reported at concentrations that exceed one or more Part 201 criterion in both of the water samples and five of the seven soil samples. The highest pesticide concentrations reported were 21,000 mg/Kg of 2,4-DDT in seep soil sample 005 and 2,600 µg/L of 2,4-DDT in seep water sample 002. The most significant pesticide exceedances of GSI criteria were: 1,700 µg/L of 4,4-DDT in water sample 002; and, 14,000 mg/Kg of 4,4-DDT in soil sample 003. These concentrations are 85,000 and 30 times greater than their respective GSI criteria. Although 2,4-DDT concentrations in seep soil and water samples were even greater, there are no Part 201 criteria for this compound.

VOCs

Nine VOC compounds were detected in one or more seep samples the Site. **Table 6** presents a summary of VOCs compounds detected in the seep soils. The following VOC were detected VOCs at concentrations greater than GSI criteria: benzene; chlorobenzene, naphthalene,

1,4-dichlorobenzene; (1,4-DCB) 1,1,2,2-tetrachloroethane (1,1,2,2-TCA) and tetrachloroethane (PCE). Chlorobenzene concentrations exceeded GSI criteria in all of the seep samples. The maximum VOC detected was chlorobenzene at 93,000µg/L in water sample 001 to 6,900 mg/Kg in soil sample 001. The most significant GSI exceedance was for naphthalene detected at 85,000 µg/L in Water sample 001, which is approximately 6,500 times greater than the 13µg/L criterion.

Specialty Chemicals

The seep samples were not analyzed for the specialty chemicals, as TriMatirx had not yet developed laboratory methods for these compounds in October 2001.

SVOCs

Seven SVOCs were detected in the seep samples as presented in **Table 6**. The following SVOCs were reported at concentrations that exceed GSI criteria: 1,2,4-trichlorobenzene (1,2,4-TCB); 1,2-dichlorobenzene (1,2-DCB); 1,4-dichlorobenzene (1,4-DCB); 2,4,6-trichlorophenol (2,4,6-TCP). The most significant exceedances of GSI criteria were: 1,4-dichlorobenzene, detected at 140 µg/L in water sample 001 and 620 mg/Kg in soil sample 003. These concentrations are approximately 10 times greater than the GSI criterion for groundwater and 2,100 times the soil GSI criterion.

Inorganics

All of the seep samples contained one or more of the following COCs that exceed GSI criteria: arsenic; chromium; cobalt; selenium and vanadium. The most significant exceedance was for selenium, detected at 659 µg/L in water sample 001, which is approximately 130 times greater than the GSI criterion.

Soil Summary

In general, seep COCs that exceed GSI criteria include:

- Pesticides (DDD, DDE, DDT),

- VOCs (benzene, chlorobenzene, naphthalene, 1,4-DCB, 1,1,2,2-TCA and PCE),
- SVOCs (1,2,4-TCB, 1,2-DCB, 1,4-DCB, 2,4,6-TCP), and
- Inorganics (arsenic, chromium, cobalt, selenium and vanadium).

The highest COC concentrations were from seep samples collected near the center of the buried sand channel in the till. COC concentrations generally did not decrease with distance from the NAPL seep area. The most significant organic COCs include naphthalene, chlorobenzene, 2,4'-DDT, 4,4'-DDT, and 4,4'-DDE. The inorganics selenium, arsenic, cobalt, chromium and vanadium were also reported at levels that exceed GSI criteria.

3.6.2 SOIL SAMPLES

A total of 170 separate compounds that were analyzed for each of the 46 soil samples. **Table 7** presents the Summary of Soil Samples Collected. **Table 8** presents the complete list of parameters, tentative action limits, and quantitation limits. The SVOCs, inorganics, and pesticides/PCBs were analyzed through the EPA Contract Laboratory Program (CLP). The VOCs and Specialty Chemicals parameters were analyzed by TriMatrix.

The following is a brief discussion of the soil analytical results. **Figure 16** presents a summary of select soil analytical data. The parameters presented in **Figure 16** were selected as representative of the VOCs, SVOCs, pesticides and metals contaminants detected in Site soil samples.

Pesticides/PCBs

Pesticides compounds were detected in soils both inside and outside the containment system. **Table 9-A** presents a summary of detected pesticides and PCBs detected in soils during Phase I Activities. Only one PCB compound, Aroclor-1254, was detected – it was reported at one sample (WPZ-02E, 1-3 feet bgs) and the result (0.3 mg/Kg) was qualified.

The following is a list of pesticides and PCBs detected in soils during the Phase I sampling:

- 2,4'-DDT
- Beta-BHC

- 4,4'-DDD
- 4,4'-DDE
- 4,4'-DDT
- Alpha-BHC
- Dieldrin
- Endosulfan Sulfate
- Heptachlor Epoxide
- Aroclor-1254

No GSI criteria have been developed for these compounds as most have been designated by the MDEQ as "not likely to leach" under most soil conditions. However 4,4'-DDT concentrations in soil exceeded the MDEQ Part 201 direct contact criterion of 460 mg/Kg at WPZ-15X (7-9 feet) and WSB-02-1 (10-12 feet). Both of these exceedances are located on the downgradient portion of the Site in areas beyond the former DDT and pesticide production areas.

The maximum pesticide concentration detected in Site soils was 1200 mg/Kg of 4,4'-DDT in WPZ-15X, which is approximately 2.6 times greater than the direct contact criterion of 460 mg/Kg (no direct contact criterion has been established for 4,4'-DDT). In general the pesticide exceedances in Site soil were not nearly as widespread or significant as the pesticide exceedances in groundwater.

VOCs

Thirty-seven VOC compounds were detected in one or more soil samples collected from Site soil samples. **Table 9-B** presents a summary of VOCs compounds detected in Site soils. In general, the detected VOCs compounds have concentrations less than the MDEQ Part 201 GSI Criteria. However, only 1,2-dichlorbenzene, chlorobenzene, ethyl benzene and xylene were detected at concentrations, which exceed soil GSI criteria. GSI criteria were exceeded at the following locations: WPZ-07X; WPZ-09X; WPZ-10X; WPZ-11X; WSB-02-1; WSB-02-2; and SW-13. These exceedances are generally located along the northernmost downgradient portion of the Site from approximately Station 53+00 to Station 68+00.

The maximum VOC concentration detected was 1600 mg/Kg of chlorobenzene at WPZ-11X (19-20 feet bgs), which is approximately 1500 times greater than the GSI criterion of 0.94 kg/Kg.

Xylene was also detected at multiple locations above GSI criteria of 0.7 mg/Kg with the highest concentration measured at 17 mg/Kg at WPZ-07E.

Specialty Chemicals

All the specialty chemicals (PBB, HBB, TRIS, and gamma chlordane), along with 2,4-DDT were detected in one or more soil samples. HBB was detected in two soil samples collected at WSB-02-2 at concentrations of 0.0004 mg/Kg and 0.0007 mg/Kg. PBB was detected in multiple samples and locations with the highest concentration measured at WPZ-10E (2.6 mg/Kg). TRIS was detected at one sample location (WSB-02-3) with a qualified concentration of 0.023 mg/Kg. Alpha-chlordane was detected at two locations (WPZ-09E and WPZ-16E) at qualified concentrations of 0.190 mg/Kg and 0.0012 mg/Kg respectively. Gamma-chlordane was detected at multiple locations with the highest concentration of 0.020 mg/Kg at WPZ-02E. **Table 9-A** includes a summary of Specialty Chemical results. None of the specialty chemical concentrations in soil exceeded established MDEQ Part 201 generic cleanup criteria and screening levels.

SVOCs

Twenty-four SVOCs were detected in soils collected from outside the containment system. **Table 9-C** presents a summary of SVOCs detected in soil. In general, the SVOCs were detected at concentrations less than the MDEQ Part 201 GSI criteria. The only exception being the estimated concentration of phenanthrene detected at 2.7 mg/Kg in WPZ-04 at a depth of 10-12.

Inorganics

All soil samples were analyzed for the TAL list of inorganics. Soil concentrations of chromium, cobalt, mercury, selenium and silver were detected in the soil samples collected outside the containment system were reported at concentrations above MDEQ Part 201 GSI criteria. **Table 9-D** presents the soil inorganic results.

WESTON conservatively assumed that the total chromium concentrations detected in Site groundwater samples were comprised entirely of hexavalent chromium. Under this assumption, Site chromium concentrations would exceed the GSI criterion of 3.3 mg/Kg for hexavalent chromium in all soil samples submitted for laboratory analysis. The maximum total chromium concentration reported in Site soils was estimated at 97.9 mg/Kg at WPZ-15X (7-9 feet), which is nearly thirty times greater than the GSI criterion. The chromium concentrations were reported for total chromium and the concentrations of hexavalent chromium (if any) are unknown.

Therefore, analysis for hexavalent chromium must be conducted in the Phase II activities to determine whether any chromium exceedances actually exist.

Cobalt was reported in soil at concentrations that exceed the GSI criterion of 2 mg/kg at 35 of 45 samples submitted for laboratory analysis. The maximum cobalt concentration reported in Site soils was 20.9 mg/Kg at WPZ-11X (19-20 feet), which is approximately ten times greater than the GSI criterion.

Mercury was reported in soil at concentrations that exceed the GSI criterion of 0.1 mg/Kg at 17 of 45 samples submitted for laboratory analysis. The maximum mercury concentration reported in Site soils was 1.5 mg/Kg at WPZ-15X (7-9 feet), which is approximately 15 times greater than the GSI criterion.

Selenium was reported in soil at concentrations that exceed the GSI criterion of 0.4 mg/Kg at 14 of 45 samples submitted for laboratory analysis. The maximum selenium concentration reported in Site soils was 1.4 mg/Kg at WSB-02-2 (10-12 feet), which is approximately 3.5 times greater than the GSI criterion.

Silver was reported in soil at a concentration that exceeded the GSI criterion of 0.5 mg/Kg at one location (WPZ-11X [12-15 feet]). The maximum silver concentration reported in Site soils was 1.4 mg/Kg at WSB-02-2 (10-12 feet), which is approximately 3.5 times greater than the GSI criterion.

Lead was reported in Site soils at concentrations that exceeded the Statewide default background level of 21 mg/kg at 18 locations. The maximum lead concentration reported in Site soils was 367 mg/Kg at WPZ-11X (12-15 feet), which is approximately 17.5 times greater than the default background criterion.

Soil Summary

In general, soil COC that exceed GSI or direct contact criteria include:

- Pesticides (DDD, DDE, DDT),
- VOCs (1,2-DCB, chlorobenzene, chloroform, ethyl benzene and xylene),

- SVOCs (phenanthene), and
- Inorganics (chromium, cobalt, lead, mercury, selenium and silver).

These organic COCs were detected most frequently and at the highest concentrations in soil along the downgradient portion of the Site, particularly near the NAPL seep area. The most significant organic COCs include chlorobenzene, 2,4'-DDT, 4,4'-DDT, and 4,4'-DDE. The inorganic COC chromium was reported at levels that may exceed the hexavalent chromium GSI criterion in soil samples collected around the entire perimeter of the Site. The occurrence of chromium, cobalt and some of the other metals may not be related to the organic COC contamination, which appears to be limited to the downgradient portion of the Site.

3.6.3 GROUNDWATER SAMPLES

A total of 181 separate compounds were analyzed for each of the 40 groundwater samples. **Table 10** presents the Summary of Groundwater Samples Collected. **Table 8** presents the complete list of parameters, tentative action limits, and quantitation limits. The VOCs, SVOCs, inorganics, and pesticides/PCBs were analyzed through the EPA Contract Laboratory Program (CLP) and the Specialty Chemicals and Water Quality parameters were analyzed by TriMatrix.

The following is a brief discussion of the Phase I groundwater laboratory analytical results.

Pesticides/PCBs

Table 11-A presents a summary of pesticides detected in groundwater samples, and **Figure 17** presents a Summary of Select Groundwater Analytical Data and Total DDT in groundwater concentration contours.

The following is a summary of pesticides detected in the Phase I groundwater samples:

- 2,4'-DDT
- 4,4'-DDD
- 4,4'-DDE
- 4,4'-DDT
- Alpha-BHC
- Alpha-chlordane
- Beta-BHC
- Dieldrin
- Endosulfan I
- Endosulfan II
- Gamma-BHC
- Gamma-chlordane
- Heptachlor
- Heptachlor Epoxide

- Delta-BHC

Only three of these pesticides detected (4,4'-DDT, dieldrin and gamma-BHC) have established GSI criteria. These pesticides were detected at concentrations greater than ten times their GSI criteria. Groundwater samples from the following locations contained pesticides that exceeded GSI criteria: WPZ-06X; WPZ-06I; WPZ-09X; WPZ-09I; WPZ-10X; WPZ-10I; WPZ-11X; WPZ-11I; WPZ-15X; WSB-02-03; WSB-02-05; and WSB-02-06. These locations extend along the downgradient portion of the Site from the NAPL seep area and suspected slurry wall breach near piezometer pairs WPZ-10 and WPZ-11 (Station 66 + 75) to near WPZ-05 (Station 40+05).

In general, the pesticides concentrations were greatest near the NAPL seep area and the concentrations also tended to increase with depth in the upper aquifer. This area also corresponds with the location of the former DDT production facilities when the Site was in operation. The maximum pesticide concentration detected in water was 5,100 µg/l of 4,4'-DDT at WPZ-11I (28-30 feet bgs) which is 255,000 times above the MDEQ Part 201 GSI criterion of 0.02 µg/L. However, pesticides were also detected in significant levels to the west and east of this area. The pesticide compounds were detected in locations both inside and outside the slurry wall and external (i.e., between the slurry wall and the Pine River) indicating the potential for continued migration of impacts into the Pine River. Pesticides were generally not detected in the upgradient sample locations.

Only one PCB compound (decachlorobiphenyl) was detected in the Site groundwater samples. This compound was detected at one location (WPZ-10I) and at very low concentration (0.00796 µg/L), which is approximately 2.5 times less than the GSI criterion.

VOCs

Table 11-B presents a summary of VOCs detected in Phase I groundwater samples and **Figure 17** presents a Summary of Select Groundwater Analytical Data, including the VOCs benzene and chlorobenzene.

The following is a summary of the thirty VOCs detected in the Phase I groundwater samples:

- Isopropylbenzne
- Carbon disulfide

- Methylcyclohexane
- Trans-1,2-Dichloroethene
- 1,2-Dichlorobenzene(1,2-DCB)
- 1,1,1-Trichloroethane
- 1,1,2,2-Tetrachloroethane (1,1,2,2-TCA)
- 1,1,2-Trichloroethane
- 1,1-Dichloroethane
- 1,1-Dichloroethene
- 1,2-Dichloroethane
- 1,2-Dichloropropane
- 2-Hexanone
- 4-Methyl-2-pentanone
- Acetone
- Benzene
- Chlorobenzene
- Chloroethane
- Chloroform
- cis-1,2-Dichloroethene
- Ethylbenzene
- Methylene chloride
- Tetrachloroethene (PCE)
- Toluene
- trans-1,3-Dichloropropene
- Trichloroethene (TCE)
- Vinyl chloride
- Xylene (total)
- Cyclohexane

The following VOCs were reported at concentrations that exceed GSI criteria: 1,2-DCB; 1,1,2,2-TCA; 1,2-DCA; benzene; chlorobenzene; chloroform; ethyl benzene; PCE; toluene; TCE; and vinyl chloride. Groundwater samples from the following locations contained VOCs that exceeded GSI criteria: WPZ-04X; WPZ-06X; WPZ-06I; WPZ-09X; WPZ-09I; WPZ-10X; WPZ-10I; WPZ-11X; WPZ-11I; WPZ-14X; WPZ-15X; and WSB-02-02. As indicated in **Figure 17**, these locations extend along the nearly the entire downgradient portion of the Site from the NAPL seep area and suspected slurry wall breach near piezometer pairs WPZ-10 and WPZ-11(Station 66 + 75) to WPZ-04 (Station 33+20) near M-46.

Benzene and chlorobenzene were the two VOCs most often detected in Site groundwater. The highest concentrations of benzene and chlorobenzene were detected at WPZ-11I, WPZ-11X, and WPZ-06X. These compounds were detected in both the exterior and interior piezometer locations. The maximum benzene concentration was 2,600 µg/L at WPZ-06X (10-14 feet) which is 13-times greater than the GSI criterion of 200 µg/L. The maximum chlorobenzene of 150,000 µg/L was detected at WPZ-11X which is 3,191-times greater than the GSI criteria of 47 µg/L.

The VOC concentrations in groundwater were generally greatest near the NAPL seep area and the concentrations also tended to increase with depth in the upper aquifer. This area also corresponds with the location of the former DDT production facilities when the Site was in operation. Chlorobenzene is feedstock chemical for the production of DDT.

VOCs were detected in groundwater at locations both inside and outside the slurry wall indicating the potential for continued migration of impacts into the Pine River. VOCs were generally not detected in the upgradient groundwater sample locations.

Specialty Chemicals

One or more of the specialty chemicals PBB, TRIS, TRIS, and alpha and gamma chlordane and 2,4-DDT were detected in all but one (WPZ-12X) groundwater sample. HBB was not detected in Site groundwater samples.

PBB concentrations exceeded the MDEQ Part 201 residential drinking water criterion of 0.32 µg/L at five locations (WPZ-02X, WPZ-08X, WPZ-09X, WPZ-10X and WSB-02-6). The maximum PBB concentration in groundwater was 0.18 µg/L in WPZ-10X (23-25 feet) that is over 5 times the drinking water criterion. TRIS was only reported at two locations (WPZ-08X and WPZ-09X) at concentrations of 2.6 and 4.5 µg/L, respectively which exceeds the residential drinking water criterion of 0.71 µg/L by 6 times. Alpha and gamma chlordane were detected in six locations at concentrations that ranged from 0.046 to 1.1 µg/L, which are below the residential drinking water criterion of 2 µg/L.

The specialty chemical exceedances were generally located in the areas of the VOC and pesticide exceedances along the downgradient portion of the Site with the exception of PBB, which was detected at WPZ-02X near the upgradient boundary.

SVOCs

Table 11-C presents a summary of the SVOCs detected in groundwater. Seventeen SVOCs compounds were detected in groundwater samples collected.

The following is a list of SVOCs detected in the Phase I sampling:

- Caprolactam
- 1,1-Biphenyl, Dimethyl
- 1,2,4-Trichlorobenzene (1,2,4-TCB)
- 1,3-Dichlorobenzene (1,3-DCB)
- 1,4-Dichlorobenzne (1,4- DCB)
- 2,4,6-Trichlorophenol
- 4-Methylphenol
- Acetophenone
- bis(2-Ethylhexyl)phthalate (BIS)
- Di-N-Butyl phthalate
- D-N-Octyl phthalate
- Naphthalene

- 2,4-Dichlorophenol
- 2-Chlorophenol (2-CP)
- 2-Methylnaphthalene
- Phenanthrene
- Phenol

The following compounds were detected at concentrations which exceeded GSI criteria: 1,2,4-TCB; 1,3-DCB; 1,4-DCB; 2-CP and BIS at one or more of the following locations: WPZ-04X; WPZ-09X; WPZ-10X; WPZ-10I; WPZ-11X; WPZ-11I; WSB-02-3; and, WSB-02-7. The maximum SVOC concentration in groundwater was 1,4-DCB at 1300 µg/L in WPZ-11X (23-25 feet) that exceeded the GSI criterion of 13 µg/L by a factor of 100.

These SVOC exceedances compounds were reported both inside and outside the slurry wall. In general, the highest SVOCs concentrations were detected near piezometer pairs WPZ-11 and WPZ-10, and east and south to WPZ-06.

Inorganics

All groundwater samples were analyzed for the TAL list of inorganics. **Table 11-D** presents the groundwater inorganic results.

The following heavy metals were detected at concentrations that exceed GSI criteria: barium; cadmium; chromium; copper; lead; mercury; silver; thallium; and vanadium at one ore more of the following locations: WPZ-04X; WPZ-06X; WPZ-06I; WPZ-08X; WPZ-09X; WPZ-09I; WPZ-10X; WPZ-10I; WPZ-11X; WPZ-14X; WPZ-16X; and, WSB-02-6.

Total chromium levels were as high as 89.5 µg/L at WPZ-10I, which is approximately 8-times higher than the GSI criterion of 11 µg/L for hexavalent chromium. Lead levels were as high 2920 µg/L at WPZ-10I which is approximately 208-times higher than the GSI criterion of 14 µg/L. The maximum mercury concentration was 1.2 µg/l in WPZ-11I, which is over 900 times greater than the GSI criterion of 0.0013 µg/L. Vanadium levels were as high as 58.2 µg/L in WSB-02-6 which is approximately 5-times greater than the GSI criterion of 12 µg/L. Thallium and silver were reported at 4.5 and 5.2 µg/L respectively in location WPZ-11I only, which exceed the GSI criteria of 3.7 and 0.2 µg/L, respectively.

The maximum concentrations of the heavy metals exceedances described above were also generally reported near the NAPL seep area, and the exceedances persisted over much of the downgradient portion of the Site.

Other inorganics, particularly calcium (1,590,000 µg/L at WPZ-10X), sodium (1,400,000 µg/L at WPZ-9I), potassium (158,000 µg/L at WPZ-9X), and magnesium (556,000 µg/L at WPZ-06X) were reported at concentrations well above those expected for natural or "background" levels and are likely related to the inorganic brine processing conducted at the Site.

Laboratory Water Quality Parameters

The water quality parameter results are presented in **Table 11-E**.

BOD results ranged from less than 1 mg/L (WPZ-01I, WPZ-12X, WPZ-14I and the storm sewer sample SSD-01) to a maximum of 31 mg/L at WPZ-04X. COD concentrations ranged from 7.6 mg/L at WPZ-01X to 763 mg/L at WPZ-10X. TOC values ranged from 4.4 mg/L in WPZ-07X to a maximum of 33 mg/L in WPZ-04X. Oil and grease concentrations ranged from not detected (i.e., less than 5 mg/L) to 108 mg/L at WPZ-04X. WPZ-04X is located downgradient of former oil storage tanks and is adjacent to historic outfall No. 25. The maximum concentrations for these parameters were generally located at WPZ-04X, which is located at the southernmost downgradient portion of the Site near M-46.

Nitrogen as ammonia results ranged from 0.006 mg/L (WSB-02-5) to 12 mg/L at WPZ-10X and WPZ-9X. The residential drinking water criterion for ammonia is 10 mg/L was slightly exceeded at both WPZ-10X and WPZ-09X. Nitrogen as nitrate plus nitrite values ranged from less than < 0.01 mg/L (WPZ-08X, WPZ-10X, WPZ-11X, WPZ-16E and WSB-02-3) to 8 mg/L at WPZ-01X. The residential drinking criteria for nitrate and nitrite are 10 mg/L and 1 mg/L respectively and these may have been exceeded at SSD-01, WPZ-01X, WPZ-01I and WPZ-02X. Speciation of nitrite and nitrate will be required in Phase II to determine actual exceedances. TKN levels ranged from 0.3 mg/L (SSD-01) to 13 mg/L (WPZ-04X, WPZ-06X, WPZ-06I, and WPZ-9X).

TSS results ranged from to 4 mg/L at SSD-01 to a maximum of 7710 mg/L at WSB-02-6. TDS concentrations ranged from 292 mg/L (WPZ-01X) to 13,690 mg/L at WPZ-10X. The residential drinking water criterion for TDS is 500 mg/L, which was exceeded at Phase I groundwater sample locations except WPZ-01X and WSB-02-4. Chloride levels ranged from 7.1 mg/L (WPZ-01X) to 6,370 mg/L at WPZ-10X. The residential drinking water criterion for chloride is 250 mg/L, which was exceeded at Phase I groundwater sample locations except WPZ-01X, WPZ-01I, WPZ-02X, WSB-02-3, WSB-02-4 and WSB-02-5. Sulfate results ranged from 32 mg/L at WPZ-04X to 1,470 mg/L at WPZ-11X. The residential drinking water criterion for sulfate is 250 mg/L, which was exceeded at Phase I groundwater sample locations except WPZ-01X, WPZ-01I, WPZ-02X, WPZ-07X, WSB-02-4, WSB-02-5 and WSB-02-7.

Water quality parameter impacts and Part 201 criteria exceedances in most of the Phase I samples including downgradient and upgradient locations. Additional groundwater sampling rounds are conducted, the water quality parameter data will be evaluated over time, and trend analyses will be conducted for upgradient and downgradient locations and inside and outside containment system observations. The water quality parameters will be used to assess geochemical signatures that will be used to evaluate contaminant fate and transport mechanisms for the Site.

Field Water Quality Parameters

WESTON collected field measurements for pH, conductivity, dissolved oxygen (DO), ORP, and temperature prior to collecting VAS. The measured pH values ranged from 6.08 in WPZ-01X to 8.84 in WPZ-07X. A summary of these data is presented in **Table 4**.

DO values ranged from a minimum of 2.6% in WPZ-09X to 115.3% in WPZ-04X. ORP results ranged from a minimum of –341.2 at WPZ-06X to a maximum of 231.6 at WPZ-01X. Negative ORP readings were reported for all samples except WPZ-01X (8-10 feet) and WPZ-01I (9-11 feet) that is indicative of a reducing groundwater environment. These negative ORP values (and reducing conditions) are not consistent with the relatively high DO values reported. WESTON suspects the DO readings are erroneous and the result of instrument failure. The DO and ORP readings will be verified during the Phase II activities.

Temperature readings ranged from 4.94 °C at WPZ-08X to 11.01°C at WPZ-06X.

Groundwater Summary

In general, VOCs (benzene and chlorobenzene) and pesticides (2,4'-DDT, 4,4'-DDT, 4,4'-DDD) were detected in the most frequently, at the highest concentrations along the downgradient portion of the Site. Other VOCs and SVOCs were detected and were above MDEQ Part 201 criteria, however benzene, chlorobenzene, 2,4'-DDT, 4,4'-DDT, and 4,4'-DDD were reported at significantly higher levels than other organic compounds. Levels of lead and mercury significantly higher than their GSI criteria and the maximum concentrations were also located in the NAPL seep area. Levels of ammonia, chloride, sulfate, and TDS were also reported in excess of MDEQ Part 201 criteria.

SECTION 4

CONCLUSIONS AND RECOMMENDATIONS

4.1 CONCLUSIONS

The primary objective of the Phase I activities was to locate the slurry wall and characterize the soil and groundwater chemistry immediately inside and outside of the slurry wall area. The Phase I activities and results discussed previously provided the data from which these conclusions were drawn.

Location of Slurry Wall

Indirect geophysical methods failed to locate the slurry wall. However, WESTON was able to successfully locate the slurry wall using soil borings at 15 of 16 piezometer pair locations installed around the perimeter of the Site. At each of these 15 piezometer pairs the location of the wall was determined by completing Geoprobe soil borings in the vicinity of the suspected wall location. The slurry wall materials were readily distinguished from the native and fill materials based on its physical characteristics. WESTON could not locate the slurry wall in the vicinity of piezometer pair WPZ-04. The groundwater flow map created using shallow monitoring wells at the Site suggests that groundwater is exiting the containment system in this area. In addition, this is the same area where Velsicol could not locate the wall during previous post remedy construction studies. Generally, the slurry wall alignment is parallel to the riverbank and perimeter fence located along the downgradient portion of the Site.

WESTON completed 14 supplemental soil borings directly through the entire depth of the slurry wall in the vicinity of the NAPL seep area (Station 67+00). These borings were installed to evaluate potential defects or breeches in the wall and identify the top of the underlying till. WESTON observed evidence of potential defects in the wall in nine of the 14 borings installed with the slurry wall. These defects included: NAPL and black stained layers of sand, gravel or peat within the slurry wall samples, which are indicative of windows or breaches in the slurry wall.

Identification and Characterization of Seeps

WESTON identified and characterized several seeps at the Site. The first seeps were discovered by EPA and sampled by WESTON in October 2000 near the riverbank during the sediment removal operations. This area has been designated as the NAPL seep area. These seeps contained DNAPL discharges in addition to water contaminated with pesticides, VOCs, SVOCs and metals. The NAPL seeps were observed emanating from a sand channel feature exposed in the face of the riverbank, this sand channel has apparently been incised into the underlying till layer. The DNAPL observed at the NAPL seeps was similar to that found near piezometer pairs WPZ-10 and WPZ-11 which were located near the base of the buried sand channel along the slurry wall alignment.

Generally, the NAPL seep samples collected by WESTON exhibited the greatest concentrations of pesticides, VOCs, SVOCs, inorganics and water quality parameters of all of the samples collected during the Phase I investigation. The maximum chlorobenzene concentration in the seep samples was nearly 15,000 times greater than the GSI criterion. While the maximum 4,4-DDT concentration in the seep samples was more than 85,000 times greater than the GSI criterion. 2,4-DDT (which has no GSI criterion) was reported at concentrations that were even higher than 4,4-DDT. Based on the data currently available, the migration of COCs to the Pine River will continue unless the NAPL seep is controlled.

WESTON has identified other areas of potential groundwater seeps along the riverbank and upwellings within the Pine River using remote T-IR techniques. Two T-IR surveys were completed, one in January and the other in April 2002. The T-IR images identified two anomalies that likely represent groundwater seeps that have been designated GS-1 and GS-2. GS-1 is located near Station 42+00 while GS-1 is located near the former Outfall No. 25 An anomaly nearly 2000 feet long was noted in the Pine River along much of the downgradient portion of the Site. This anomaly has been interpreted by WESTON to represent areas of groundwater upwelling form the river sediments to the surface of the Pine River. All of these anomalies suggest that groundwater within the containment system is leaking either through or under the slurry wall. Groundwater samples collected in the vicinity of the seeps (both inside and outside the wall) and upwellings often contained pesticides, VOCs, SVOCs and inroganics at

concentrations that exceed GSI criteria and therefore the seeps may also contribute to the off-site migration of COCs to the Pine River.

An additional anomaly was identified during both T-IR surveys. This seep was confirmed to be a storm water drain located near the bridge abutment of M-46. Although very low levels of a few COCs were reported in the water sample collected from SSD-01, this discharge does not appear to be a source of significant source of contaminant migration from the Site.

Identification of Residual Wastes

WESTON identified the presence of contaminated soil at each of the 7 residual soil borings installed between the downgradient portion of the wall and the Pine River. Although samples from these borings appeared to be relatively "clean" in comparison to those found near the NAPL seep area, laboratory analyses confirmed elevated levels (in excess of GSI or other Part 201 criteria) of pesticides, VOCs, SVOCs and inorganics were present in each of the residual boring location. Based on the Phase I analytical results it appears that much of the soil and groundwater located between the slurry wall and the Pine River is contaminated at levels that exceed Part 201 criteria. It is unclear whether the COCs reported in the residual contamination borings are the result of past dumping of wastes along the river or direct contact of these soils with contaminated groundwater or seeps.

Evaluation of Groundwater Flow Conditions

WESTON evaluated shallow groundwater flow conditions by installing 16 piezometer pairs around the perimeter of the Site. The peizometer pairs were installed with wells located immediately inside and outside of the slurry wall. WESTON collected four rounds of groundwater elevations from each piezometer pair as well as the accessible existing monitoring wells. WESTON used these data to construct a shallow groundwater flow map for the Site.

In summary, the shallow groundwater flow patterns and head differences across the slurry wall observed at the Site indicate that the slurry wall component of the containment system is influencing groundwater flow. However, this influence suggests that flow off-site has been impeded and does not appear to have been eliminated. The potential for off-site migration of

impacted groundwater was confirmed. Moreover, several of the piezometer pair comparisons suggest that the influence of the slurry wall is negligible to absent.

The presence of a strong outward flow direction and hydraulic gradients along the downgradient portion of the Site as well as localized outward flow in the northeastern portion of the Site suggest that potentially contaminated groundwater is flowing into the Pine River and potentially the residential properties adjacent to the upgradient portion of the Site.

Soil and Groundwater COCs

WESTON evaluated the soil and groundwater chemistry by collecting 9 seep samples, 46 soil samples and 40 groundwater samples from within and outside of the Site containment system and submitting these samples for laboratory analysis of: pesticides (Method 8081), PCBs (Method 8082), VOCs (Method 8260), SVOCs (Method 8270), TAL inorganics and the following specialty chemicals: PBB; HBB; TRIS, chlordane and 2,4-DDT. The samples were analyzed by EPA CLP laboratories and Tri-Matrix and MDEQ approved overflow laboratory.

In general, soil contaminants of concern (COC) that exceed GSI or direct contact criteria include:

- Pesticides (DDD, DDE, DDT),
- VOCs (1,2-DCB, chlorobenzene, chloroform, ethyl benzene and xylene),
- SVOCs (phenanthene), and
- Inorganics (chromium, cobalt, lead, mercury, selenium and silver).

These organic COCs were detected most frequently and at the highest concentrations in soil along the downgradient portion of the Site, particularly near the NAPL seep area. The most significant organic COCs include chlorobenzene, 2,4'-DDT, 4,4'-DDT, and 4,4'-DDE. The inorganic COC chromium was reported at levels that may exceed the hexavalent chromium GSI criterion in soil samples collected around the entire perimeter of the Site. The occurrence of chromium, cobalt and some of the other metals may not be related to the organic COC contamination, which appears to be limited to the downgradient portion of the Site.

In general, groundwater COC that exceed GSI or residential drinking water criteria include:

- Pesticides (4.4-DDD, 4,4-DDE, 4,4-DDT, dieldrin and gamma-BHC),
- VOCs (benzene, 1,2-DCB, 1,1,2,2-TCA, chlorobenzene, chloroform, ethyl benzene, xylene, PCE, TCE, and vinyl chloride),
- SVOCs (1,2,4-TCB, 1,3-DCB, 1,4-DCB, 2-chlorophenol and 2-bis(ethylhexyl) phthalate), and
- Inorganics (chromium, cobalt, copper, lead, mercury, selenium, silver, thallium and vanadium).

The most significant groundwater COC exceedance was 5,100 µg/L of 4,4-DDT that is 255,000 times greater than the GSI criterion. VOCs (benzene and chlorobenzene) and pesticides (2,4'-DDT, 4,4'-DDT, 4,4'-DDD) were detected in groundwater the most frequently, at the highest concentrations along the downgradient portion of the Site near the NAPL seep area. Levels of lead and mercury in groundwater were significantly higher than their GSI criteria and the maximum concentrations were also located in the NAPL seep area. Levels of ammonia, chloride, sulfate, and TDS were also reported in excess of MDEQ Part 201 criteria.

Evaluation of Cap and Slurry Wall Performance

WESTON evaluated the performance of the cap and slurry wall by reviewing historic data and data collected during the Phase I activities. WESTON has concluded that the cap and slurry wall components of the Site containment system are not functioning as designed, do not meet the design specifications and are no longer protective of human health and the environment. This conclusion is based on the following findings:

- Large portions of the cap, and significant portions of the slurry wall and till samples failed to meet one or more design criterion, particularly the hydraulic conductivity and grain size distribution requirements.

- The cap was not constructed with an adequate frost protection layer and is not graded properly, the durability testing completed was inadequate and NAPL compatibility testing was not performed for containment system components.

- Borings installed within the slurry wall indicated numerous defects including NAPL staining layers within the slurry wall, and windows or breeches were likely present

- The results of the T-IR surveys and hydraulic heads within downgradient piezometer pairs confirmed groundwater seeps and upwellings into the river are occurring despite the existing of the slurry wall. The negligible head differences reported for some piezometer pairs suggest the slurry wall is not impeding groundwater flow in these areas.

4.2 RECOMMENDATIONS

WESTON has prepared a Draft Work Plan for Phase II Investigation activities. The objective of the Phase II investigation is to address data gaps discovered after completion of the Phase I activities and ultimately to collect additional information required to support a RI/FS report for OU-1 of the Site.

WESTON recommends completion of the tasks described below to provide additional information in specific areas where data are insufficient. Ideally, these activities will provide the data necessary to develop a comprehensive understanding of the current conditions at the site. A comprehensive understanding of the current conditions is critical to the completion of a FS that evaluates appropriate and applicable remedial alternatives for the site.

The Phase II objectives should be achieved by completing the following tasks:

- Define the nature and extent of the NAPL source area immediately upgradient of the NAPL seep area.

- Evaluate the effectiveness of the slurry wall by conducting dye studies, soil borings, continued monitoring of hydraulic heads inside and outside the wall and NAPL compatibility testing of slurry wall samples.

- Evaluate the effectiveness of the underlying till by conducting continuous soil borings through the till and testing till samples for Site COCs, hydraulic conductivity and NAPL compatibility.

- Evaluate the interaction between the shallow and lower aquifers and the Pine River by installing additional shallow and deep monitoring wells, and if necessary, intermediate wells within water bearing zones that may be located within the till, conducting aquifer stress tests, and gauging of the Pine River.

- Evaluate the nature and extent of Site COCs in the upper and lower aquifers by collecting and testing additional soil and water samples for pesticides, PCBs, SVOCs, VOCs and inorganics. Include testing for hexavalent chromium, dioxin, and poly brominated diphenyl ether (PBDE).

WESTON will submit a Final Phase II Work Plan that incorporates the comment provided by MDEQ and EPA during our Phase II kickoff meeting held at the Site on 16 May 2002. WESTON will submit an Amended Quality Assurance Project Plan (QAPP) that addresses the Phase II SOW particularly the procedures to be employed while drilling through the till.

WESTON will incorporate the Phase I and Phase II findings into the RI/FS report.

Table 1
Monitoring Well and Piezometer Construction Summary
Velsicol Superfund Site
St. Louis, Michigan

Well	Northing	Easting	Ground Elevation (ft)	Top of Casing Elevation (ft)	Total Depth from TOC (ft)	Screen Length (ft)	Depth to Top of Screen (ft bgs)	Depth to Bottom of Screen (ft bgs)*	Top of Screen Elevation (ft)	Bottom of Screen Elevation (ft)
WPZ-01X	696872.68	13057615.19	728.3	731.44	13.94	5	6.0	11.0	722.50	717.50
WPZ-01I	696887.05	13057614.3	730.0	732.84	13.92	5	6.5	11.5	723.92	718.92
WPZ-02X	696856.822	13057220.3	727.9	731.54	14.02	5	7.0	12.0	722.52	717.52
WPZ-02I	696855.52	13057202.81	730.2	733.23	16.57	5	9.0	14.0	721.66	716.66
WPZ-03X	695452.43	13056952.67	734.5	737.22	14.76	5	7.0	12.0	727.46	722.46
WPZ-03I	695468.86	13056952.03	735.0	738.09	14.41	5	7.0	12.0	728.68	723.68
WPZ-04X	695552.94	13056394.48	728.1	731.30	18.38	5	10.5	15.5	717.92	712.92
WPZ-04I	695565.41	13056408.04	728.6	731.85	17.94	5	10.0	15.0	718.91	713.91
WPZ-05X	696142.64	13056052.06	727.4	729.89	20.39	10	8.0	18.0	719.50	709.50
WPZ-05I	696142.19	13056060.41	729.0	731.38	20.58	10	8.5	18.5	720.80	710.80
WPZ-06X	696765.78	13056344.94	727.9	731.05	21.60	5	15.0	20.0	714.45	709.45
WPZ-06I	696759.29	13056353.6	728.3	731.43	22.98	5	15.0	20.0	713.45	708.45
WPZ-07X	697224.36	13056606.26	728.1	730.60	21.55	5	15.0	20.0	714.05	709.05
WPZ-07I	697223.99	13056612.83	728.5	730.91	18.88	5	12.0	17.0	717.03	712.03
WPZ-08X	697471.98	13057362.09	727.8	731.10	19.71	5	12.0	17.0	716.39	711.39
WPZ-08I	697463.53	13057362.7	728.5	731.48	19.66	5	12.0	17.0	716.82	711.82
WPZ-09X	697584.53	13057626.24	727.8	730.16	24.70	5	17.5	22.5	710.46	705.46
WPZ-09I	697574.64	13057622.51	728.8	731.21	27.40	5	17.5	22.5	708.81	703.81
WPZ-10X	697465.9	13057786.7	727.6	730.71	28.09	5	20.0	25.0	707.62	702.62
WPZ-10I	697462.06	13057777.71	728.9	732.02	27.43	5	20.5	25.5	709.59	704.59
WPZ-11X	697434.95	13057808.78	727.5	730.77	28.06[4]	5	25.0	30.0	702.53	697.53
WPZ-11I	697425.81	13057797.64	728.4	731.38	33.49	5	26.0	31.0	702.89	697.89
WPZ-12X	697076.47	13058064.09	724.4	727.00	12.63	5	5.5	10.5	719.37	714.37
WPZ-12I	697070.78	13058059.39	725.5	727.93	15.90	5	9.0	14.0	717.03	712.03
WPZ-13X	696437.96	13057217.75	727.2	729.61	8.48	5	2.0	7.0	726.13	721.13
WPZ-13I	696437.05	13057204.45	728.4	730.76	9.22	5	2.0	7.0	726.54	721.54
WPZ-14X	697395.35	13057046.13	727.4	729.88	21.44	5	14.5	19.5	713.44	708.44
WPZ-14I	697374.25	13057052.01	728.4	730.82	24.15	5	17.0	22.0	711.67	706.67
WPZ-15X	696922.89	13056531.52	728.1	731.09	18.96	5	11.5	16.5	717.13	712.13
WPZ-15I	696918.69	13056538.61	728.9	731.37	19.34	5	12.0	17.0	717.03	712.03
WPZ-16X	695816.99	13056192.62	727.6	730.58	14.69	5	8.5	13.5	720.89	715.89
WPZ-16I	695822.89	13056202.44	729.6	732.09	14.67	5	7.5	12.5	722.42	717.42

Notes:

Northing and Easting coordinates are Michigan State Plane NAD83, international feet

Elevation datum is NAVD88

Surveyed November 2001 and February 2002

NA[2] wells not measured-pink dye visible in wells

#[3] depth taken with interface probe on March 19, 2002

#[4] measured depth, well originally set at 30 ft

** depths obtained from original well logs (installed by WESTON and others)*

M-46 and Mill St. Bridge locations are benchmarks only, not wells

MDEQ and WESTON

Table 1
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CW6-EP	696875.9	13057652.86	728.6	731.44	22.14	15	5	20	724.30	709.30
CW6-IP	696886.86	13057651.6	729.7	732.43	21.11	15	5	20	726.32	711.32
CW19-EP	696115.63	13057058.93	731.1	733.96	16.71	8	5	13	725.25	717.25
CW19-IP	696116	13057048.9	732.2	735.13	16.65	8	5	13	726.48	718.48
CW31-EP	695454.72	13056630.37	731.1	733.77	NA[2]	10	8.5	18.5	722.61	712.61
CW31-IP	695469.26	13056627.87	731.9	734.69	NA[2]	9	6	15	725.89	716.89
CW51-EP	696739.47	13056331.42	728.5	731.30	18.54	10	6.5	16.5	722.76	712.76
CW51-IP	696736.19	13056340.01	728.5	730.79	19.40	10	7	17	721.39	711.39
CW60-EP	697387.31	13057005.67	726.2	728.89	20.99	10	9	19	717.90	707.90
CW60-IP	697361.6	13057019.4	727.5	729.75	15.76	10	4	14	723.99	713.99
GMW-1A	695507.13	13056567.57	731.5	734.47	17.12	10	3.7	13.7	727.77	717.77
GMW-1B	695586.64	13056562.56	735.2	738.17	18.27	13.9	3.9	17.8	731.3	717.35
GMW-1C	695512.93	13056539.27	731.4	733.45	16.38	6.5	7.3	13.8	724.1	717.62
GMW-1D	695463.4	13056580.96	731.1	733.45	81.8[3]	10	68	78	661.65	651.65
GMW-2	695882.67	13056904.45	738.6	741.74	23.65	-	-	-	-	718.09
GMW-3	695886.83	13056605.67	746.0	749.53	30.79	-	-	-	-	718.74
GMW-4A	696031.13	13056128.29	732.2	735.16	17.58	11.1	3.8	14.9	728.4	717.34
GMW-5A	696447.99	13056856.04	735.5	737.99	20.22	14	3.9	17.9	731.6	717.60
GMW-6	696534.95	13056560.59	730.4	734.23	15.38	-	-	-	-	718.85
GMW-7	696445.86	13056217.05	729.8	733.52	16.57	-	-	-	-	716.95
GMW-7D	696084.52	13056064.94	728.3	731.13	100.2[3,5]	10	95	105	640.93	630.93
GMW-8	696940.43	13056608.85	729.8	733.87	16.28	-	-	-	-	717.59
GMW-9	696925.8	13056932.24	730.4	734.05	15.38	-	-	-	-	718.67
GMW-10	697314.36	13057028.73	730.1	732.85	15.41	-	-	-	-	717.44
GMW-10D	697379.1	13056993.5	726.1	728.50	82.51	10	69	79	655.99	645.99
GMW-11	697002.26	13057217.39	731.6	733.98	14.05	-	-	-	-	719.93
GMW-12A	697412.21	13057357.74	728.7	731.01	13.75	7.1	3.8	10.9	724.9	717.80
GMW-13	697510.05	13057694.03	731.6	733.86	16.18	-	-	-	-	717.68
GMW-14	697167.16	13057587.78	731.8	735.46	18.33	-	-	-	-	717.13
GMW-14D	696874.39	13057665.92	728.3	730.65	79.51	10	70	80	661.14	651.14
GMW-15D	696153.95	13057059.11	731.4	734.13	73.20	10	60	70	670.93	660.93
GMW-16S	697981.59	13057870.66	727.2	730.61	27.99	10	16	26	712.62	702.62
GMW-16D	697979.17	13057879.45	727.1	730.03	91.22	10	79	89	648.81	638.81
River M-46 Bridge	695401	13056373	-	725.20	-	-	-	-	-	-
River Mill St Bridge	697466	13059010	-	728.37	-	-	-	-	-	-

Notes:

Northing and Easting coordinates are Michigan State Plane NAD83, international feet
Elevation datum is NAVD88
Surveyed November 2001 and February 2002
NA[2] wells not measured-pink dye visible in wells
#[3] depth taken with interface probe on March 19, 2002
#[5] measured depth, well originally set at 105 ft
** depths obtained from original well logs (installed by WESTON and others)*
M-46 and Mill St. Bridge locations are benchmarks only, not wells

MDEQ and WESTON

Table 3
Phase I
Groundwater Elevation Summary
Velsicol Superfund Site
St. Louis, Michigan

		March 1, 2002			March 6, 2002			March 13, 2002			March 19, 2002		
Well	Top of Casing Elevation (ft)	Depth to Water from TOC (ft)	Water Elevation (ft)	Head Difference (ft)	Depth to Water from TOC (ft)	Water Elevation (ft)	Head Difference (ft)	Depth to Water from TOC (ft)	Water Elevation (ft)	Head Difference (ft)	Depth to Water from TOC (ft)	Water Elevation (ft)	Head Difference (ft)
WPZ-01X	731.44	10.23	721.21		10.31	721.13		9.59	721.85		10.07	721.37	
WPZ-01I	732.84	11.19	721.65	0.44	11.09	721.75	0.62	10.85	721.99	0.14	10.88	721.96	0.59
WPZ-02X	731.54	8.97	722.57		9.06	722.48		8.51	723.03		8.98	722.56	
WPZ-02I	733.23	11.70	721.53	-1.04	11.61	721.62	-0.86	11.46	721.77	-1.26	11.49	721.74	-0.82
WPZ-03X	737.22	9.26	727.96		9.07	728.15		8.05	729.17		9.39	727.83	
WPZ-03I	738.09	12.34	725.75	-2.21	12.21	725.88	-2.27	11.92	726.17	-3.00	12.02	726.07	-1.76
WPZ-04X	731.3	12.86	718.44		13.16	718.14		12.58	718.72		12.82	718.48	
WPZ-04I	731.85	13.29	718.56	0.12	13.43	718.42	0.28	12.68	719.17	0.45	13.18	718.67	0.19
WPZ-05X	729.89	9.65	720.24		9.50	720.39		8.81	721.08		9.76	720.13	
WPZ-05I	731.38	9.35	722.03	1.79	9.21	722.17	1.78	9.01	722.37	1.29	9.06	722.32	2.19
WPZ-06X	731.05	12.21	718.84		12.51	718.54		12.25	718.80		12.19	718.86	
WPZ-06I	731.43	10.02	721.41	2.57	10.03	721.40	2.86	9.86	721.57	2.77	9.87	721.56	2.70
WPZ-07X	730.6	12.05	718.55		12.34	718.26		12.40	718.20		12.05	718.55	
WPZ-07I	730.91	9.52	721.39	2.84	9.33	721.58	3.32	9.03	721.88	3.68	9.15	721.76	3.21
WPZ-08X	731.1	11.65	719.45		11.75	719.35		11.34	719.76		11.62	719.48	
WPZ-08I	731.48	10.15	721.33	1.88	10.00	721.48	2.13	9.80	721.68	1.92	9.85	721.63	2.15
WPZ-09X	730.16	11.34	718.82		11.39	718.77		10.41	719.75		10.99	719.17	
WPZ-09I	731.21	9.75	721.46	2.64	9.68	721.53	2.76	9.51	721.70	1.95	9.53	721.68	2.51
WPZ-10X	730.71	12.34	718.37		12.61	718.10		11.84	718.87		12.11	718.60	
WPZ-10I	732.02	12.14	719.88	1.51	12.22	719.80	1.70	11.77	720.25	1.38	11.90	720.12	1.52
WPZ-11X	730.77	12.25	718.52		12.47	718.30		11.76	719.01		12.01	718.76	
WPZ-11I	731.38	12.61	718.77	0.25	12.81	718.57	0.27	12.12	719.26	0.25	12.32	719.06	0.30
WPZ-12X	727	8.34	718.66		8.57	718.43		7.85	719.15		8.18	718.82	
WPZ-12I	727.93	6.21	721.72	3.06	6.14	721.79	3.36	6.01	721.92	2.77	5.95	721.98	3.16
WPZ-13X	729.61	4.76	724.85		4.63	724.98		3.81	725.80		5.06	724.55	
WPZ-13I	730.76	8.52	722.24	-2.61	8.37	722.39	-2.59	8.04	722.72	-3.08	8.28	722.48	-2.07
WPZ-14X	729.88	10.52	719.36		10.72	719.16		10.61	719.27		10.47	719.41	
WPZ-14I	730.82	10.36	720.46	1.10	10.37	720.45	1.29	10.18	720.64	1.37	10.13	720.69	1.28
WPZ-15X	731.09	12.55	718.54		12.88	718.21		12.35	718.74		12.52	718.57	
WPZ-15I	731.37	9.58	721.79	3.25	9.48	721.89	3.68	9.29	722.08	3.34	9.34	722.03	3.46
WPZ-16X	730.58	10.75	719.83		11.33	719.25		10.67	719.91		11.03	719.55	
WPZ-16I	732.09	9.40	722.69	2.86	9.66	722.43	3.18	9.63	722.46	2.55	9.56	722.53	2.98

Notes:
Northing and Easting coordinates are Michigan State Plane NAD83, international feet
Elevation datum is NAVD88
NA[1] wells not measured during March 1, 2002 event
NA[2] wells not measured-pink dye visable in wells

MDEQ and WESTON

Table 2
Phase I
Soil Boring Summary
Velsicol Superfund Site
St. Louis, Michigan

	Boring	Northing	Easting	Ground Elevation (ft)	Total Depth (ft)
Residual Contamination Soil Borings	WSB02-01	697364.35	13056936.15	726.27	25
	WSB02-02	697373.50	13056932.81	725.28	15
	WSB02-03	697276.13	13056603.23	727.31	15
	WSB02-04	696858.70	13056466.43	726.35	10
	WSB02-05	696849.98	13056427.17	721.64	10
	WSB02-06	696144.50	13056051.86	727.22	20
	WSB02-07	695494.65	13056481.34	727.86	20
Slurry Wall Soil Borings	WPZ-01S	696879.97	13057614.19	729.00	10
	WPZ-02S	696856.10	13057210.97	729.29	5
	WPZ-03S	695462.34	13056951.39	734.92	10
	WPZ-04S	695556.82	13056399.60	728.51	10
	WPZ-05S	696144.54	13056055.46	728.33	5
	WPZ-06S	696763.03	13056348.85	728.14	15
	WPZ-07S	697225.27	13056607.97	728.21	10
	WPZ-08S	697468.35	13057363.10	728.06	15
	WPZ-09S	697580.33	13057623.05	728.44	15
	WPZ-10S	697465.18	13057782.52	728.73	30
	WPZ-11S	697433.16	13057805.26	728.22	35
	WPZ-12S	697075.15	13058061.27	724.94	10
	WPZ-13S	696437.51	13057210.64	727.87	10
	WPZ-14S	697391.30	13057045.67	727.64	10
	WPZ-15S	696922.18	13056535.12	728.80	15
	WPZ-16S	695818.75	13056197.70	728.82	15
	WSW-01	697449.31	13057792.99	728.63	33
	WSW-02	697418.86	13057814.86	728.70	35
	WSW-03	697406.80	13057823.12	728.91	30
	WSW-04	697395.03	13057832.00	728.91	33
	WSW-05	697382.98	13057840.58	728.68	30
	WSW-06	697370.53	13057847.52	728.64	30
	WSW-07	697357.54	13057855.45	728.54	30
	WSW-08	697341.82	13057860.95	729.36	30
	WSW-09	697328.01	13057865.35	729.52	30
	WSW-10	697423.73	13057811.00	728.74	35
	WSW-11	NA	NA	NA	35
	WSW-12P*	695543.29	13056399.55	727.11	10
	WSW-13	NA	NA	NA	35
	WSW-14	697469.09	13057364.38	728.13	23

Notes:

Northing and Easting coordinates are Michigan State Plane NAD83, international feet

Elevation datum is NAVD88

Surveyed February 2002

NA - WSW-11 and WSW-13 are located within one foot of WPZ-11S

Survey point WSW-12P is boring WSW-12Q

** Slurry wall was not found at this location*

MDEQ and WESTON

Table 3
Phase I
Groundwater Elevation Summary
Velsicol Superfund Site
St. Louis, Michigan

		March 1, 2002			March 6, 2002			March 13, 2002			March 19, 2002		
Well	Top of Casing Elevation (ft)	Depth to Water from TOC (ft)	Water Elevation (ft)	Head Difference (ft)	Depth to Water from TOC (ft)	Water Elevation (ft)	Head Difference (ft)	Depth to Water from TOC (ft)	Water Elevation (ft)	Head Difference (ft)	Depth to Water from TOC (ft)	Water Elevation (ft)	Head Difference (ft)
CW6-EP	731.44	10.39	721.05		NA[2]	NA[2]		NA[2]	NA[2]		NA[2]	NA[2]	
CW6-IP	732.43	10.77	721.66	0.61	NA[2]	NA[2]	-	NA[2]	NA[2]	-	NA[2]	NA[2]	-
CW19-EP	733.96	10.95	723.01		NA[2]	NA[2]		NA[2]	NA[2]		NA[2]	NA[2]	
CW19-IP	735.13	13.57	721.56	-1.45	NA[2]	NA[2]	-	NA[2]	NA[2]	-	NA[2]	NA[2]	-
CW31-EP	733.77	NA[2]	NA[2]		NA[2]	NA[2]		NA[2]	NA[2]		NA[2]	NA[2]	
CW31-IP	734.69	NA[2]	NA[2]	-	NA[2]	NA[2]	-	NA[2]	NA[2]	-	NA[2]	NA[2]	-
CW51-EP	731.3	12.81	718.49		NA[2]	NA[2]		NA[2]	NA[2]		NA[2]	NA[2]	
CW51-IP	730.79	9.12	721.67	3.18	NA[2]	NA[2]	-	NA[2]	NA[2]	-	NA[2]	NA[2]	-
CW60-EP	728.89	9.96	718.93		NA[2]	NA[2]		NA[2]	NA[2]		NA[2]	NA[2]	
CW60-IP	729.75	8.01	721.74	2.81	NA[2]	NA[2]	-	NA[2]	NA[2]	-	NA[2]	NA[2]	-
GMW-1A	734.47	11.09	723.38	-	10.86	723.61	-	10.57	723.90	-	10.70	723.77	-
GMW-1B	738.17	16.90	721.27	-	16.80	721.37	-	16.71	721.46	-	16.66	721.51	-
GMW-1C	733.45	12.61	720.84	-	12.48	720.97	-	12.20	721.25	-	12.40	721.05	-
GMW-1D	733.45	LOCKED	NA	-	LOCKED	NA	-	LOCKED	NA	-	35.72	697.73	-
GMW-2	741.74	20.09	721.65	-	20.02	721.72	-	19.82	721.92	-	19.78	721.96	-
GMW-3	749.53	NA[1]	NA[1]	-	27.49	722.04	-	27.29	722.24	-	27.32	722.21	-
GMW-4A	735.16	12.97	722.19	-	12.86	722.30	-	12.68	722.48	-	12.73	722.43	-
GMW-5A	737.99	16.58	721.41	-	16.38	721.61	-	14.82	723.17	-	15.45	722.54	-
GMW-6	734.23	NA[1]	NA[1]	-	12.16	722.07	-	12.07	722.16	-	12.02	722.21	-
GMW-7	733.52	11.51	722.01	-	11.42	722.10	-	11.26	722.26	-	11.22	722.30	-
GMW-7D	731.13	LOCKED	NA	-	LOCKED	NA	-	LOCKED	NA	-	28.35	702.78	-
GMW-8	733.87	12.17	721.70	-	12.06	721.81	-	11.88	721.99	-	11.90	721.97	-
GMW-9	734.05	12.43	721.62	-	12.30	721.75	-	12.09	721.96	-	12.17	721.88	-
GMW-10	732.85	11.06	721.79	-	10.96	721.89	-	10.76	722.09	-	10.79	722.06	-
GMW-10D	728.5	27.38	701.12	-	27.45	701.05	-	27.36	701.14	-	27.02	701.48	-
GMW-11	733.98	12.34	721.64	-	12.23	721.75	-	12.08	721.90	-	12.08	721.90	-
GMW-12A	731.01	9.23	721.78	-	9.12	721.89	-	8.93	722.08	-	8.94	722.07	-
GMW-13	733.86	12.19	721.67	-	12.14	721.72	-	11.99	721.87	-	11.95	721.91	-
GMW-14	735.46	13.77	721.69	-	13.70	721.76	-	13.58	721.88	-	13.49	721.97	-
GMW-14D	730.65	25.45	705.20	-	25.24	705.41	-	25.03	705.62	-	24.84	705.81	-
GMW-15D	734.13	39.94	694.19	-	39.25	694.88	-	36.83	697.30	-	38.39	695.74	-
GMW-16S	730.61	LOCKED	NA	-	11.10	719.51	-	10.00	720.61	-	10.34	720.27	-
GMW-16D	730.03	LOCKED	NA	-	28.75	701.28	-	28.56	701.47	-	28.00	702.03	-
River M-46 Bridge	725.2	6.66	718.54	-	7.04	718.16	-	6.68	718.52	-	6.52	718.68	-
River Mill St Bridge	728.37	9.94	718.43	-	10.94	717.43	-	10.20	718.17	-	9.92	718.45	-

Notes:
Northing and Easting coordinates are Michigan State Plane NAD83, international feet
Elevation datum is NAVD88
NA[1] wells not measured during March 1, 2002 event
NA[2] wells not measured-pink dye visable in wells

MDEQ and WESTON

I:\OMI\Shared\Velsicol-PineRiver\Table3 GW Elevation Summary

Table 4
Phase I
Summary of VAS Field Measurements
Velsicol Superfund Site
St. Louis, Michigan

Vertical Aquifer Sample Location	Interval (ft. bgs)	pH	Conductivity (uS)	Dissolved Oxygen (%)	ORP (mV)	Temperature (Celsius)
WPZ-1X initial	8-10	6.08	48	32.4	231.6	7.65
WPZ-1X final	8-10	6.58	531	23.7	202.1	7.85
WPZ-1X initial	9-11	6.94	662	22.5	-17.9	8.09
WPZ-1X final	9-11	6.80	670	13.1	-33.6	8.33
WPZ-1I initial	9-11	6.15	1211	62.2	212.0	5.59
WPZ-1I final	9-11	6.47	1203	13.5	120.1	6.86
WPZ-2X initial	9.5-12	6.32	927	55.4	-5.5	6.76
WPZ-2X final	9.5-12	6.23	896	15.6	-7.0	7.49
WPZ-4X	10-14	7.44	4408	115.3	-16.2	7.27
WPZ-6X initial	10-14	7.60	2836	75.4	-36.1	7.75
WPZ-6X final	10-14	7.88	3149	5.1	-341.2	8.75
WPZ-6X initial	18-20	7.55	5613	69.6	-198.1	10.36
WPZ-6X final	18-20	7.72	5673	5.9	-278.2	11.01
WPZ-6I initial	10-14	7.62	2976	47.6	-146.1	9.60
WPZ-6I final	10-14	7.54	3197	3.3	-217.1	9.01
WPZ-6I initial	18-20	7.18	6493	56.5	-119.2	8.41
WPZ-6I final	18-20	6.86	6320	3.4	-180.4	10.43
WPZ-7X initial	16-20	8.84	8.07	34.6	-180.0	8.84
WPZ-7X final	16-20	8.16	8.43	66.9	-77.0	8.16
WPZ-8X initial	10-12	7.66	3359	66.5	-132.4	4.94
WPZ-8X final	10-12	7.09	3429	93.9	-101.1	6.39
WPZ-8X initial	13-17	7.08	2935	56.6	-89.4	7.58
WPZ-8X final	13-17	6.89	3060	4.5	-115.7	8.98
WPZ-9X initial	9-13	7.70	4149	16.5	-64.0	5.88
WPZ-9X final	9-13	7.39	4339	6.1	-133.0	7.68
WPZ-9X initial	20.5-22.5	6.50	16689	10.8	-39.2	9.38
WPZ-9X final	20.5-22.5	6.57	16941	2.6	-58.0	10.69
WPZ-9I initial	10-14	6.81	7391	40.8	-91.0	7.17
WPZ-9I final	10-14	6.98	7312	20.7	-130.0	7.11
WPZ-9I initial	20.5-22.5	7.10	11062	44.7	-104.0	6.92
WPZ-9I final	20.5-22.5	6.81	13685	4.5	-160.0	8.65
WPZ-10X initial	9.5-13	7.13	2225	11.8	-72.9	7.02
WPZ-10X final	9.5-13	6.57	2002	4.0	-11.5	7.13
WPZ-10X initial	18-20	7.20	7359	24.2	-102.1	7.36
WPZ-10X final	18-20	6.12	5637	8.1	-34.5	10.16

**Notes:*
-Instument used: YSI 650 Multiparameter Display System and 6600 Sonde probe
-no water sample collected from WPZ-3X, WPZ-3I, and WPZ-13X
-no parameters were taken for WPZ-05X, WPZ-16X, WSB02-01, and WSB02-02.
-river temperature on 2/20/02 near WPZ-16 was 3.8, 3.6, 3.7, 3.8, and 4.2 (near run-off seep) degrees Celsius
-WPZ-4X went dry and then recharged to allow for water sample

Table 4
Phase I
Summary of VAS Field Measurements
Velsicol Superfund Site
St. Louis, Michigan

Vertical Aquifer Sample Location	Interval (ft. bgs)	pH	Conductivity (uS)	Dissolved Oxygen (%)	ORP (mV)	Temperature (Celsius)
WPZ-10X initial	23-25	6.21	19128	19.8	-65.4	10.19
WPZ-10X final	23-25	6.04	19070	7.3	-64.2	10.88
WPZ-10I initial	9.5-13	7.12	2742	47	-87.6	6.06
WPZ-10I final	9.5-13	6.69	2841	6.5	-84.4	7.88
WPZ-10I initial	23.5-25.5	6.52	4041	31.7	-73.6	9.51
WPZ-10I final	23.5-25.5	6.55	4080	6.6	-92.1	11.10
WPZ-11X initial	10-13	6.64	3307	20.8	19.3	5.46
WPZ-11X final	10-13	6.07	2500	2.7	2.5	7.21
WPZ-11X initial	23-25	6.02	7190	13.5	-36.8	8.70
WPZ-11X final	23-25	5.99	6825	2.4	-69.7	10.65
WPZ-11X initial	25-30	6.22	5092	6.8	-48.0	10.36
WPZ-11X final	25-30	5.92	4968	-3.3	-72.7	11.18
WPZ-11I initial	28-30	6.78	4634	25.5	-128.7	8.90
WPZ-11I final	28-30	6.17	4830	-1.3	-111.5	11.74
WPZ-12X initial	6.5-8.5	6.87	1969	25.3	8.2	6.39
WPZ-12X final	6.5-8.5	6.79	2039	41.3	19.8	6.55
WPZ-12X initial	8.5-10.5	6.99	2277	14.6	-128.0	7.11
WPZ-12X final	8.5-10.5	6.61	2326	4.2	-148.0	6.64
WPZ-14X initial	10-14	8.04	3684	3.6	-204.0	8.44
WPZ-14X final	10-14	7.85	3594	3.9	-119.0	7.94
WPZ-14X initial	17.5-19.5	7.13	4223	5.6	-101.0	10.40
WPZ-14X final	17.5-19.5	7.01	4222	1.6	-112.0	10.51
WPZ-14I initial	19-22	7.07	7140	2.5	-128.0	9.21
WPZ-14I final	19-22	6.83	8057	2.1	-112.0	10.17
WPZ-15X initial	14-16	7.00	3752	1.6	-182.0	8.97
WPZ-15X final	14-16	6.84	3917	3.1	-206.0	9.22
WSB02-03 initial	11-15	8.80	1257	108.8	16.1	6.20
WSB02-03 final	11-15	8.84	1333	109.0	-11.0	6.50
WSB02-04 initial	7-11	9.36	1232	47.9	235.5	6.88
WSB02-04 final	7-11	9.81	1201	20.2	236.7	7.14
WSB02-05 initial	4.5-6.5	13.49	747	51.9	227.0	4.02
WSB02-05 final	4.5-6.5	14.14	753	29.4	226.0	4.44
WSB02-06 initial	10-15	6.62	5796	16.2	-369.0	7.20
WSB02-06 final	10-15	6.46	6148	34.6	-202.0	7.98
WSB02-07 initial	11-15	7.20	9321	80.7	-55.0	8.68
WSB02-07 final	13-17	6.80	11170	32.5	-156.0	9.29

**Notes:*
-Instument used: YSI 650 Multiparameter Display System and 6600 Sonde probe
-no water sample collected from WPZ-3X, WPZ-3I, and WPZ-13X
-WPZ-4X went dry and then recharged to allow for water sample
-no parameters were taken for WPZ-05X, WPZ-16X, WSB02-01, and WSB02-02.
-river temperature on 2/20/02 near WPZ-16 was 3.8, 3.6, 3.7, 3.8, and 4.2 (near run-off seep) degrees Celsius

Table 5
Phase I
Summary of VOC Field Measurements
Velsicol Superfund Site
St. Louis, Michigan

Location	Date	Depth (ft bgs)	VOC Reading (ppm)
WPZ-04X	2/6/02	13	0.5
WPZ-07X	2/8/02	17	16.0
WPZ-09I	2/12/02	11	5.7
WPZ-09I	2/12/02	12	4.3
WPZ-09I	2/12/02	17	1.7
WPZ-09I	2/12/02	18	0.7
WPZ-09X	2/11/02	16	1.1
WPZ-09X	2/11/02	17	2.7
WPZ-09X	2/11/02	18	5.3
WPZ-09X	2/11/02	19	0.6
WPZ-10X	2/12/02	25	0.5
WPZ-11X	2/14/02	23	10.4
WPZ-11X	2/14/02	29	1.7
WPZ-14X	2/15/02	12	0.1
WPZ-14X	2/15/02	13	0.1
WPZ-16X	2/20/02	8	6.2
WPZ-16X	2/20/02	9	43.8
WPZ-16X	2/20/02	12	1.5
WPZ-16X	2/20/02	13	1.5
WPZ-16X	2/20/02	14	1.6
WPZ-11S	2/13/02	29	7.7
WSW-03	2/18/02	30	2.0
WSW-04	2/19/02	20	1.7
WSW-04	2/19/02	25	18
WSW-04	2/19/02	26.5	1.7
WSW-04	2/19/02	30	115
WSW-04	2/19/02	31	0.5
WSW-04	2/19/02	32.5	12.6
WSW-05	2/19/02	25	16.7
WSW-05	2/19/02	27.5	187.0
WSW-05	2/19/02	17.2	29.0
WSW-06	2/19/02	29	17.5
WSW-06	2/19/02	30	17.6

Notes:
Instument used: MultiRAE PLUS Multi-Gas Monitor with PID
No measurements collected between 2/20/02 and 2/22/02 due to heavy rain (WSW-09, WSW-10, WSW-11, WSW-13)

Table 10
Phase I
Summary of Groundwater Samples Collected
Velsicol Superfund Site
St. Louis, Michigan

#	LOCATION	DEPTH (FT)	DATE	TIME	CLP-ID	CASE #
1	WPZ-01I	9-11	2/4/02	11:25	EOSB2	30187
2	WPZ-01X	8-10	1/30/02	12:20	EOSA7	30176
3	WPZ-01X	9-11	1/30/02	14:45	EOSA8	30176
4	WPZ-02X	9-12	2/4/02	15:40	E0SC4	30187
5	WPZ-04X	10-14	2/6/02	14:20	EOSE5	30187
6	WPZ-06I	10-14	2/2/02	16:15	EOSF3	30187
7	WPZ-06I	18-20	2/8/02	10:00	EOSF4	30187
8	WPZ-06X	10-14	2/7/02	10:40	EOSE8	30187
9	WPZ-06X	18-20	2/7/02	14:20	EOSF0	30187
10	WPZ-07X	16-20	2/11/02	11:30	EOSG1	30210
11	WPZ-08X	10-12	2/11/02	12:00	EOSG3	30210
12	WPZ-08X	14-17	2/11/02	15:10	EOSG4	30210
13	WPZ-09I	10-14	2/12/02	15:10	EOSH4	30210
14	WPZ-09I	20-22	2/13/02	9:00	EOSH6	30210
15	WPZ-09X	20.5-22.5	2/12/02	11:50	EOSH2	30210
16	WPZ-09X	9-13	2/12/02	9:30	EOSG7	30210
17	WPZ-10I	23-25	2/13/02	11:10	EOSH9	30210
18	WPZ-10I	9-13	2/13/02	10:10	EOSH7	30210
19	WPZ-10X	16.5-20	2/12/02	12:45	E0SH3	30210
20	WPZ-10X	23-25	2/12/02	15:30	EOSH5	30210
21	WPZ-10X	9-13	2/12/02	10:55	EOSH1	30210
22	WPZ-11I	28-30	2/20/02	15:50	EOSL9	30229
23	WPZ-11X	10-13	2/14/02	10:15	EOSJ6	30210
24	WPZ-11X	23-25	2/14/02	12:10	EOSK2	30210
25	WPZ-11X	25-30	2/15/02	9:20	EOSK5	30210
26	WPZ-12X	6-8	2/13/02	15:15	EOSJ1	30210
27	WPZ-12X	8-10	2/14/02	8:15	EOSJ2	30210
28	WPZ-14I	19-22	2/19/02	9:00	EOSL2	30229
29	WPZ-14X	10-14	2/18/02	11:30	EOSK8	30229
30	WPZ-14X	17.5-19.5	2/18/02	14:45	EOSL0	30229
31	WPZ-15X	14-16	2/20/02	8:50	EOSL6	30229
32	WPZ-16X	10-13	2/20/02	16:00	EOSM0	30229
33	WSB-02	12-15	1/30/02	15:35	EOSB2	30187
34	WSB-03	12-15	2/4/02	13:30	EOSC1	30187
35	WSB-04	7-11	2/5/02	9:15	EOSC5	30187
36	WSB-05	4-11	2/5/02	11:30	EOSD0	30187
37	WSB-06	10-15	2/5/02	16:05	EOSD5	30187
38	WSB-07	13-17	2/6/02	14:00	EOSE4	30187
39	SSD-01	-	2/6/02	14:00	E0SE3	30187
40	SSD-01	-	2/6/02	14:00	EOSE3	30187

Table 6
Phase I
Seep Sample Analytical Data Summary
Velsicol Superfund Site
St. Louis, Michigan

Sample ID (Units) Date & Time Collected	Groundwater Surface Water Interface Criteria (Groundwater) (ug/L)	Surface Water Interface Protection Criteria (Industrial) (Soil) (mg/kg)	Most Stringent Part 201 Criteria (Groundwater) (ug/L)	Most Stringent Part 201Industrial & Commercial Criteria (Soil) (mg/kg)	Sample 001 Water (ug/L) 10/26/01 12:30	Sample 002 Water (ug/L) 10/26/01 13:15	Sample 001 Soil (mg/kg) 10/26/01 12:30	Sample 002 Soil (mg/kg) 10/26/01 13:15	Sample 003 Soil (mg/kg) 10/26/01 14:05	Sample 005 Soil (mg/kg) 10/26/01 13:50	Sample 006 Soil (mg/kg) 10/26/01 14:00	Sample 007 Soil (mg/kg) 10/26/01 13:30	Sample 008 Soil (mg/kg) 10/26/01 13:45
PESTICIDES													
4,4'-DDD	NA	NLL	9.1 [1]	540 [27]	460	420	2300	300	2900	3100	240	2.5	120
4,4'-DDE	NA	NLL	4.3 [1]	260 [27]	210	200	1200	190	1600	1300	160	1.7	110
4,4'-DDT	0.02 (M)	NLL	0.02 (M) [1]	460 [27]	1300	1700	8200	830	14000	12000	1100	6.8	140
2,4'-DDT	NA	NA	NA	NA	2400	2600	10000	1100	15000	21000	800	8.4	96
VOC's (8260)													
Benzene	200 (X)	4 (X)	5.0 (A) [1]	0.1 [21]	2100	1100	<74	20	<120	<12	<12	<0.28	<15
Chlorobenzene	47	0.94	47 [1]	0.94 [12]	93000	45000	6900	1900	14000	1600	1900	46	2600
1,2 - Dichlorobenzene	16	0.36	16 [1]	0.36 [12]	<1000	<500	<150	<36	<240	<23	<23	<0.56	<30
1,4 - Dichlorobenzene	13	0.29	13 [1]	0.29 [12]	<1000	<500	<150	<36	240	49	27	0.82	39
Naphthalene	13	0.87	13 [1]	0.87 [12]	85000	39000	<370	<91	<590	<59	<58	<1.4	<74
1,1,1,2-Tetrachloroethane	NA	NA	77 [1]	1.5 [21]	1400	1200	<150	<36	<240	<23	<23	<0.56	<30
1,1,2,2 - Tetrachloroethane	78 (X)	1.6 (X)	8.5 [1]	0.17 [21]	<1000	<500	<150	<36	<240	<23	<23	1.2	50
Tetrachloroethene	45 (X)	0.9 (X)	5.0 (A) [1]	0.10 [21]	<1000	<500	<74	<18	<120	<12	<12	5	<15
Trichloroethene	200 (X)	4 (X)	5.0 (A) [1]	0.10 [21]	<1000	<500	<74	<18	<120	<12	<12	0.44	<15
SVOC's (8270)													
Phenol	210	4.2	210 [1]	4.2 [12]	14	<5.0	<1.7	<0.33	<17	<0.83	<0.83	<0.33	<0.83
1,2,4 - Trichlorobenzene	30	1.8	30 [1]	1.8 [12]	20	9.0	17	2.4	170	21	6.9	<0.33	11
1,2 - Dichlorobenzene	16	0.36	16 [1]	0.36 [12]	25	10	9.2	0.91	<17	3.6	0.9	<0.33	1.1
1,4 - Dichlorobenzene	13	0.29	13 [1]	0.29 [12]	140	43	55	5.8	620	30	18	0.33	39
2,4,6-Trichlorophenol	4.4	0.33 (M)	4.4 [1]	0.33 (M) [12]	6	<4.0	<1.7	<0.33	<17	<0.83	<0.83	<0.33	<0.83
2-Chlorophenol	22	0.44	22 [1]	0.44 [12]	22	<5.0	<1.7	<0.33	<17	<0.83	<0.83	<0.33	<0.83
4-Methylphenol	71	1.4	71 [1]	1.4 [12]	56	<5.0	<1.7	<0.33	<17	<0.83	<0.83	<0.33	<0.83
METALS													
Aluminum	NA	NA	5.0 (V) [12]	1.0 [21]	740	90	3260	3060	1880	2780	1380	1220	289
Antimony	ID	ID	6.0 (V) [12]	0.5 (M) [21]	4.4	<2.0	<0.50	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50
Arsenic	150 (X)	70 (X)	50 (A) [12]	5.8 [10]	1400	53	3.5	2.7	2.0	3.6	4.4	13	1.6
Barium	1,900 (G,X)	(G,X)	2,000 (A) [12]	75 [10]	400	200	21	18	9.6	25	140	4.3	12
Beryllium	(G)	(G)	4.0 (A) [13]	51 [21]	<10	<10	<0.20	<0.20	<0.20	0.21	<0.20	<0.20	<0.20
Cadmium	2.5 (G,X)	(G,X)	5.0 (A) [12]	1.2 [10]	<2.0	0.081	0.1	<0.05	0.061	0.12	0.082	<0.05	<0.05
Calcium	NA	NA	NA	NA	52800	569	75700	69400	73200	71000	106000	74100	21100
Chromium	11	3.3	11 [1]	3.3 [12]	<10	<10	8.6	6.5	4.2	8.6	5.3	4.0	3.0
Cobalt	100	2.0	40 [1]	0.8 [21]	61	10	3.8	3	2.1	3.5	3.8	3.0	0.7
Copper	(G)	(G)	1,000 (E) [12]	32 [10]	78	21	5.6	4.4	5.9	4.6	1.7	1.1	22
Iron	NA	NA	300 (E) [12]	6.0 [21]	27900	<100	8170	7310	3690	7010	17400	14200	2500
Lead	14 (G,X)	(G,M,X)	4.0 (L) [12]	21 [10]	<25	<10	4.3	1.9	2.9	4.2	3.6	2.9	2.9
Magnesium	NA	NA	4.0 E+5	8000 [21]	727	138	22100	22400	15000	22900	22600	15000	303
Manganese	(G,X)	(G,X)	50 (E) [12]	1.0 [21]	2680	890	177	151	128	158	169	205	5.4
Mercury	1.3E-3 (Z)	0.1 (M)	1.3E-3 [1]	0.1 (M) [12]	<1.0	<0.2	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Nickel	(G)	(G)	100 (A) [12]	20 [10]	250	26	7.8	7.1	4.5	7.4	8.1	6.3	2.0
Potassium	NA	NA	NA	NA	45	23	784	723	402	639	254	279	123
Selenium	5	0.4	5.0 (A) [1]	0.4 [12]	659	59	1.5	1.5	1.5	1.4	1.3	1.7	1.1
Silver	0.2 (M)	0.50 (M)	0.2 (M) [1]	0.5 (M) [12]	<2.0	<2.0	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Sodium	NA	NA	1.2E+5 [1]	2500 [21]	2370	668	738	1160	2490	479	256	368	149
Thallium	3.7 (X)	4.2 (X)	2.0 (A) [12]	2.3 [21]	<10	<10	<0.5	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Vanadium	12	190	4.5 [1]	72 [21]	90	17	8.7	8.7	6.7	7.4	4.7	4.3	2.2
Zinc	(G)	(G)	2,400 [1]	47 [10]	136	<10	28	16	7.6	24	45	80	8.6

(A) Criterion is the State of Michigan Drinking Water Standard established pursuant to Section 5 of the Safe Drinking Water Act, Act No. 399 of the Public Acts of 1976

(E) Criterion is the aesthetic drinking water value

(G) GSI criterion is pH or water hardness dependent. (See MDEQ ERD Op Memo 18 footnotes for further explanation)

(L) Reserved

(M) Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

(V) Criterion is the aesthetic drinking water value

(X) The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

(Z) The current TDL for Mercury is 0.2ppb, however, a TDL of 5.0 E-4 using U.S. EPA Method 1631, will be required after September 30, 2000

Note: (G,X) denotes Surface Water Human Drinking Water Value Criteria. (See MDEQ ERD Op Memo 18.)

PART 201 Generic Cleanup Criteria of the Natural Resources & Environmental Protection Act, 1994 PA 451

1. Groundwater Residential and Industrial-Commercial - Residential & Commercial I Drinking Water Criteria

2. Groundwater Residential and Industrial Commercial - Industrial & Commercial II, III, & IV Drinking Water Criteria

3. Groundwater Residential and Industrial Commercial - Groundwater Surface Water Interface Criteria

10. Soil Industrial and Commercial II, III, IV - Statewide Default Background Levels

12. Soil Industrial & Commercial II, III, & IV - Groundwater Surface Water Interface Criteria

21. Soil Industrial and Commercial II, III, & IV - Residential Drinking Water Protection Criteria

27. Soil Industrial & Commercial II, III, & IV Direct Contact

Seep samples collected within dewatered portion of Pine River, Northeast portion of site, collected 10/26/01

NA - Criterion or value is not available or, as is the case for CSAT, not applicable

ID - Inadequate data to develop criterion

NLL - Hazardous substance is not likely to leach under most soil conditions

Shaded = Above GSI Criteria

Bold = Above Most Stringent Criteria

Table 7
Phase I
Summary of Soil Samples Collected
Velsicol Superfund Site
St. Louis, Michigan

#	LOCATION	DEPTH (FT)	DATE	TIME	CLP-ID	CASE #
1	WPZ-01X	2-4	1/30/02	11:50	EOSA6	30176
2	WPZ-01X	4-6	1/30/02	11:35	EOSA8	30176
3	WPZ-02X	1-3	2/4/02	14:30	EOSC2	30187
4	WPZ-02X	4-5	2/4/02	14:50	E0SC3	30187
5	WPZ-03X	3-4	2/5/02	9:30	EOSC7	30187
6	WPZ-03X	6-8	2/5/02	9:50	EOSC8	30187
7	WPZ-04X	10-12	2/6/02	10:15	EOSE0	30187
8	WPZ-04X	12-14	2/6/02	10:30	EOSE1	30187
9	WPZ-04X	8-10	2/6/02	9:50	EOSD9	30187
10	WPZ-06X	8-10	2/7/02	9:45	EOSE6	30187
11	WPZ-07X	10-12	2/8/02	11:00	EOSF7	30187
12	WPZ-07X	12-14	2/8/02	11:10	EOSF8	30187
13	WPZ-07X	14-15	2/8/02	11:20	EOSF9	30187
14	WPZ-07X	6-8	2/8/02	10:40	E0SF5	30187
15	WPZ-07X	8-10	2/8/02	10:50	EOSF6	30187
16	WPZ-08X	8.5-10	2/11/02	10:50	EOSG0	30210
17	WPZ-09X	13-15	2/11/02	17:20	E0SG5	30210
18	WPZ-10X	8-9	2/12/02	9:50	EOSH0	30210
19	WPZ-10X	9-10	2/12/02	10:00	EOSG9	30210
20	WPZ-11X	12-15	2/14/02	9:40	EOSJ7	30210
21	WPZ-11X	19-20	2/14/02	11:10	EOSK1	30210
22	WPZ-11X	8-9	2/14/02	8:45	EOSJ5	30210
23	WPZ-11X	9-10	2/14/02	9:15	EOSJ8	30210
24	WPZ-12X	4-5	2/13/02	15:10	EOSJ0	30210
25	WPZ-13X	4-5	2/14/02	15:30	EOSK3	30210
26	WPZ-14X	6-8	2/15/02	11:45	EOSK6	30210
27	WPZ-15X	7-9	2/19/02	15:10	EOSL4	30229
28	WPZ-16X	8-10	2/20/02	15:00	EOSL7	30229
29	WSB-01	10-12	1/30/02	11:30	EOSA3	30176
30	WSB-01	1-2	1/30/02	10:20	EOSA1	30176
31	WSB-01	15-17	1/30/02	11:35	EOSA4	30176
32	WSB-01	5-7	1/30/02	10:45	EOSA2	30176
33	WSB-02	10-12	1/30/02	15:00	EOSA9	30176
34	WSB-02	6-8	1/30/02	14:45	EOSB0	30176
35	WSB-03	1-3	2/4/02	12:00	EOSB9	30187
36	WSB-03	5-7	2/4/02	12:20	EOSC0	30187
37	WSB-04	6-8	2/4/02	17:00	EOSC6	30187
38	WSB-05	2-4	2/5/02	10:45	EOSC9	30187
39	WSB-06	10-12	2/5/02	15:40	EOSD3	30187
40	WSB-06	12-14	2/5/02	15:50	EOSD4	30187
41	WSB-06	8-10	2/5/02	15:30	E0SD2	30187
42	WSB-07	10-12	2/6/02	10:12	EOSD7	30187
43	WSB-07	12-13	2/6/02	10:20	EOSD8	30187
44	WSB-07	8-10	2/6/02	9:50	EOSD6	30187
45	SW-13	28-32	2/21/02	16:10	EOSM2	30229
46	SW-13	28-32	2/21/02	16:10	EOSM3	30229

Table 8
Parameter Action Limits and Laboratory Method Quantitation Limits
Velsicol Superfund Site
St. Louis, Michigan

ID	PARAMETER	PROJECT ACTION LIMIT WATER (ug/L)	PROJECT ACTION LIMIT SOIL (ug/kg)	QUANTITATION LIMITS WATER (ug/L)	QUANTITATION LIMITS SOIL (ug/kg)
	TCL VOC's				
1	Dichlorodifluoromethane	1700 [7]	95000 [7]	10	10
2	Chloromethane	260 [7]	5200 [11]	10	10
3	Vinyl Chloride	2.0 (A)	40 [7]	10	10
4	Bromomethane	10 [7]	200 [11]	10	10
5	Chloroethane	430 [7]	8600 [13]	10	10
6	Trichlorofluoromethane	2600 [7]	52000 [13]	10	10
7	1,1-Dichloroethene	7.0 (A) [1]	140 [7]	10	10
8	1,1,2-Trichloro-1,2,2-trifluoroethane	1.7 E+5 (S) [7]	5.5E+5 (C) [11]	10	10
9	Acetone	730 [7]	15000 [7]	10	10
10	Carbon Disulfide	800 [7]	16000 [13]	10	10
11	Methyl Acetate	NA	NA	10	10
12	Methylene Chloride	5.0 (A)	100 [7]	10	10
13	trans-1,2-Dichloroethene	100 (A) [7]	2000 [11]	10	10
14	Methyl tert-Butyl Ether	NA	NA	10	10
15	1,1-Dichloroethane	880 [7]	18000 [13]	10	10
16	cis-1,2-Dichloroethene	70 (A)	1400 [7]	10	10
17	2-Butanone	2200 [7]	44000 [7]	10	10
18	Chloroform	100 (A,W) [1]	2000 [11]	10	10
19	1,1,1-Trichloroethane	200 (A) [1]	4000 [11]	10	10
20	Cyclohexane			10	10
21	Carbon Tetrachloride	5.0 (A)	100 [1]	10	10
22	Benzene	5.0 (A)	100 [1]	10	10
23	1,2-Dichloroethane	880 [1]	100 [14]	10	10
24	Trichloroethene	5.0 (A) [1]	100 [21]	10	10
25	Methylcyclohexane	NA		10	10
26	1,2-Dichloropropane	5.0 (A)	100 [1]	10	10
27	Bromodichloromethane	100 (A,W) [1]	2000 [11]	10	10
28	cis-1,3-Dichloropropene	NA	NA	10	10
29	4-Methyl-2-pentanone	1800 [7]	36000 [7]	10	10
30	Toluene	140 [7]	2800 [13]	10	10
31	trans-1,3-Dichloropropene	NA	NA	10	10
32	1,1,2-Trichloroethane	5.0 (A)	100 [13]	10	10
33	Tetrachloroethene	5.0 (A)	100 [2]	10	10
34	2-Hexanone	1000	20000 [13]	10	10
35	Dibromochloromethane	100 (A,W) [1]	2000 (W) [11]	10	10
36	1,2-Dibromoethane	NA	NA	10	10
37	Chlorobenzene	47 [7]	940 [13]	10	10
38	Ethylbenzene	18 [7]	360 [13]	10	10
39	Xylenes (Total)	35 [7]	700 [13]	10	10
40	Styrene	80 [7]	2200 [7]	10	10
41	Bromoform	100 (A,W) [1]	2000 (W) [11]	10	10
42	Isopropylbenzene	800 [4]	91000 [13]	10	10
43	1,1,2,2-Tetrachloroethane	8.5 [7]	170 [11]	10	10
44	1,3 Dichlorobenzene	6.6	370 [11]	10	10
45	1,4-Dichlorobenzene	13 [7]	290 [13]	10	10
46	1,2-Dichlorobenzene	16 [7]	360 [13]	10	10
47	1,2-Dibromo-3-chloropropane	NA	NA	10	10
48	1,2,4-Trichlorobenzene	30 [7]	1800 [13]	10	10
	TCL SVOC's				
49	Benzaldehyde	NA	NA	10	330
50	Phenol	210 [3]	4200 [13]	10	330
51	bis-(2-Chloroethyl)ether	2.0 [7]	330 (M) [7]	10	330
52	2-Chlorophenol	22 [7]	440 [13]	10	330
53	2-Methylphenol	71 [7]	1400 [7]	10	330
54	2,2'-oxybis (1-Chloropropane)	NA	NA	10	330
55	Acetophenone	1500 [7]	30000 [7]	10	330
56	4-Methylphenol	71	14	10	330
57	N-Nitroso-di-n-propylamine	5.0 (M) [7]	330 (M) [7]	10	330
58	Hexachloroethane	6.7 (X) [7]	430 [13]	10	330
59	Nitrobenzene	3.4 [7]	330 (M) [7]	10	330
60	Isophorone	570 (X) [7]	11000 (X) [13]	10	330
61	2-Nitrophenol	NA	NA	10	330
62	2,4-Dimethylphenol	NA	NA	10	330
63	bis-(2-Chloroethoxy) methane	NA	NA	10	330
64	2,4-Dichlorophenol	NA	NA	10	330
65	Naphthalene	13	870 [13]	10	330
66	4-Chloroaniline	NA	NA	10	330
67	Hexachlorobutadiene	0.053 [7]	330 (M) [13]	10	330
68	Caprolactam	5800 [7]	1.2 E+5 [7]	10	330
69	4-Chloro-3-methylphenol	NA	NA	10	330
70	2-Methylnaphthalene		57000 [11]	10	330
71	Hexachlorocyclopentadiene	50 (A) [1]	3.2 E+5 [11]	10	330
72	2,4,6-Trichlorophenol	4.4 [4]	330 (M) [13]	25	830
73	2,4,5-Trichlorophenol	730	39000 [11]	10	330
74	1,1-Biphenyl	NA	NA	10	330
75	2-Chloronaphthalene	NA	NA	10	330
76	2-Nitroan+H46iline	NA	NA	25	830
77	Dimethylphthalate	NA	NA	10	330
78	2,6-Dinitrotoluene	NA	NA	10	330
79	Acenaphthylene	NA	NA	10	330
80	3-Nitroaniline	NA	NA	25	830
81	Acenaphthene	NA	NA	10	330
82	2,4-Dinitrophenol	NA	NA	25	830
83	4-Nitrophenol	NA	NA	25	830
84	Dibenzofuran	NA	NA	10	330
85	2,4-Dinitrotoluene	7.7 [7]	430	10	330
86	Diethylphthalate	NA	NA	10	330
87	Fluorene	12 [4]	5300 [13]	10	330
88	4-Chlorophenyl-phenylether	NA	NA	10	330
89	4-Nitroaniline	NA	NA	25	830
90	4,6-Dinitro-2-methylphenol	NA	NA	25	830
91	N-Nitrosodiphenylamine	270 [7]	5400 [7]	10	330
92	4-Bromophenyl-phenylether	NA	NA	10	330
93	Hexachlorobenzene	1.0 (A) [1]	1800 [11]	10	330
94	Atrazine	NA	NA	10	330
95	Pentachlorophenol	NA	NA	25	830
96	Phenanthrene	5.0 (M) [4]	2300 [13]	10	330
97	Anthracene	43 (S) [7]	47000 [7]	10	330
98	Carbazole	10 (M) [7]	1100 [13]	10	330
99	Di-n-butylphthalate	NA	NA	10	330
100	Fluoranthene	1.6 [7]	5500 [13]	10	330
101	Pyrene	140 (S) [7]	4.8 E+5 [7]	10	330
102	Butylbenzylphthalate	NA	NA	10	330
103	3,3'-Dichlorobenzidine	0.3 (M,X) [7]	2900 (M,X) [7]	10	330
104	Benzo(a)anthracene	2 [7]	29000 [7]	10	330
105	Chrysene	5.0 (M) [7]	2.0 E+6 [7]	10	330
106	bis-(2-Ethylhexyl)phthalate	NA	NA	10	330
107	Di-n-octylphthalate	NA	NA	10	330
108	Benzo(b)fluoranthene	2.0 (M) [4]	20000 [13]	10	330
109	Benzo(k)fluoranthene	5.0 (M) [4]	20000 [7]	10	330
110	Benzo(a)pyrene	5.0 (A,M) [1]	2000 [13]	10	330
111	Indeno(1,2,3-cd)pyrene	5.0 (M)	20000 [7]	10	330
112	Dibenz(a,h)anthracene	5.0 (M) [4]	2000 [13]	10	330
113	Benzo(g,h,i)perylene	5.0 (M) [4]	2.5E+6 [7]	10	330
	PESTICIDES/PCB's				
114	alpha-BHC	NA	NA	0.05	1.7
115	beta-BHC	NA	NA	0.05	1.7
116	delta-BHC	NA	NA	0.05	1.7
117	gamma-BHC (Lindane)	NA	NA	0.05	1.7
118	Heptachlor	0.4 (A) [1]	5600 [13]	0.05	1.7
119	Aldrin	0.098 [1]	1600 [14]	0.05	1.7
120	Heptachlor epoxide	0.2 (A) [1]	3100 [7]	0.05	1.7
121	Endosulfan I	17 [7]	1.4E+6 [7]	0.05	1.7
122	Dieldrin	0.02 (M) [7]	1100 [7]	0.10	3.3
123	4,4'-DDE	4.3 [7]	2.6E+5 [7]	0.10	3.3
124	Endrin	2.0 (A) [1]	65000 [7]	0.10	3.3
125	Endosulfan II	17 [7]	1.4E+6 [7]	0.10	3.3
126	4,4'-DDD	9.1 [7]	5.4E+5 [7]	0.10	3.3
127	Endosulfan sulfate	NA	NA	0.10	3.3
128	4,4'-DDT	0.2 (M) [7]	4.6E+5 [7]	0.10	3.3
129	Methoxychlor	40 (A) [1]	310000 [1]	0.50	17
130	Endrin ketone	NA	NA	0.10	3.3
131	Endrin aldehyde	NA	NA	0.10	3.3
132	alpha-Chlordane	2.0 (A) [1]	31000 [14]	0.05	1.7
133	gamma-Chlordane	2.0 (A) [1]	31000 [14]	0.05	1.7
134	Toxaphene	1.0 (M) [1]	860 [7]	5.0	170
135	Aroclor-1016	NA	NA	1.0	33
136	Aroclor-1221	NA	NA	2.0	67
137	Aroclor-1232	NA	NA	1.0	33
138	Aroclor-1242	NA	NA	1.0	33
139	Aroclor-1248	NA	NA	1.0	33
140	Aroclor-1254	NA	NA	1.0	33
141	Aroclor-1260	NA	NA	1.0	33
	SPECIALITY CHEMICALS				
142	Hexabromobenzene (HBB)	NA	NA	0.05	330
	Polybrominated Biphenyls				
143	(PBB)	0.032 [1]	1200 [4]	1.0	800
144	TRIS(2,3-Dibromo-1-Propyl) Phosphate (TRIS)	NA	NA	NA	NA
145	Chlordane, technical	2.0 (A) [1]	31000 [14]	0.05	25
146	2',4'-DDT	NA	NA	1.0	800

ID	PARAMETER	PROJECT ACTION LIMIT WATER (ug/L)	PROJECT ACTION LIMIT SOIL (ug/kg)	QUANTITATION LIMITS WATER (ug/L)	QUANTITATION LIMITS SOIL (ug/kg)
	TAL-INORGANICS				
147	Aluminum (Al)	5.0 (A) [7]	1000 [7]	200	40
148	Antimony (Sb)	6.0 (A) [7]	500 (M) [21]	60	12
149	Arsenic (As)	50 (A) [7]	5800 [15]	10	2
150	Barium (Ba)	2,000 (A) [12]	75000 [7]	200	40
151	Beryllium (Be)	4.0 (A) [7]	51000 [7]	5	1
152	Cadmium (Cd)	5.0 (A) [7]	1200 [6]	5	1
153	Calcium (Ca)	NA	NA	5000	1000
154	Chromium (Cr)	11 [1]	3300 [7]	10	2
155	Cobalt (Co)	40 [1]	800 [7]	50	10
156	Copper (Cu)	1,300 (E) [12]	32000 [6]	25	5
157	Iron (Fe)	300 (E) [12]	6000 [21]	100	20
158	Lead (Pb)	4.0 (L) [12]	21000 [16]	3	0.6
159	Magnesium (Mg)	4.0 E+5	8.0E+6 [21]	5000	1000
160	Manganese (Mn)	50 (E) [12]	1600 [21]	15	3
161	Mercury (Hg)	1.3 E-3 [7]	200 (M) [12]	0.2	0.04
162	Nickel (Ni)	100 (A) [7]	29000 [6]	40	8
163	Potassium (K)	NA	NA	5000	1000
164	Selenium (Se)	5.0 (A) [4]	400 [7]	5	1
165	Silver (Ag)	0.2 (M) [7]	500 (M) [7]	10	2
166	Sodium (Na)	2.E+5 [7]	2.5E+6 [20]	5000	1000
167	Thallium (Tl)	2.0 (A) [12]	2300 [21]	10	2
168	Vanadium (V)	4.5	72000 [21]	50	10
169	Zinc (Zn)	2,400 [7]	47000 [6]	20	4
170	Cyanide (Cn)	20 (M) [7]	400 (P) [11]	10	2
	WATER QUALITY				
171	Biological Oxygen Demand (BOD)	NA	NA	1000	NA
172	Chloride	1.25 E+5 (X) [7]	2.5E+6 (X) [13]	1000	NA
173	Sulfate	2.5E+5 (E) [7]	5.0 E+6 [13]	20000	NA
174	Total Suspended Solids (TSS)	NA	NA	1000	NA
175	Total Dissolved Solids (TDS)	5.0 E+5 (E) [7]	NA	2500	NA
176	Ammonia	NA	1.0E+7 (M) [20]	10	NA
177	Total Kjeldahl Nitrogen (TKN)	NA	NA	100	NA
178	Chemical Oxygen Demand (COD)	NA	NA	3000	NA
179	Nitrate + Nitrite	NA	NA	50	NA
180	Oil & Grease	NA	NA	5000	NA
181	Total Organic Carbon (TOC)	NA	NA	200	NA

(A) - Criterion is the State of Michigan Drinking Water Standard established pursuant to Section 5 of the Safe Drinking Water Act, Act No. 399 of the Public Acts of 1976

(M) - Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

(X) The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ, RRD Op Memo 18 Footnotes for further explanation)

(E) - Criterion of the aesthetic drinking water value, as required by Sec. 20120(1)(a)

(L) - Reserved

(S) - Criterion defaults to the chemical-specific water solubility limit

(W) - Criterion is the aesthetic drinking water value (secondary maximum contaminant level), as required by Sec. 20120(a)(5)

(W) - Concentrations of trihalomethanes in ground water must be added together to determine compliance with State of Michigan Drinking Water Standard of 100ug/L

NA - Criterion or value is not available or an MDEQ value for risk not applicable

PART 201 Generic Cleanup Criteria of the Natural Resources & Environmental Protection Act, 1994 PA 451

1 - Groundwater Residential and Industrial-Commercial - Residential & Commercial I Drinking Water Criteria

2 - Groundwater Residential and Industrial-Commercial - Industrial & Commercial II, III, & IV Drinking Water Criteria

3 - Groundwater Residential and Industrial-Commercial - Groundwater Surface Water Interface Criteria

4 - Soil Industrial and Commercial II, III, IV - Statewide Default Background Levels

5 - Soil Residential and Commercial I Drinking Water Protection Criteria

6 - Soil Industrial and Commercial II, III, & IV - Groundwater Surface Water Interface Criteria

7 - Soil Industrial and Commercial I Direct Contact Criteria

20 - Soil Industrial and Commercial II, III, & IV - Residential Drinking Water Protection Criteria

21 - Soil Industrial & Commercial II, III, & IV Direct Contact

Table 9-A
Phase I
Soil Analytical Data Summary (Detections only)
Pesticides, PCB's, and Specialty Chemicals
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-01X(2-4)	WPZ-01X(4-6)	WPZ-02X(1-3)	WPZ-02X(4-5)	WPZ-03X(3-4)	WPZ-04X(8-10)	WPZ-04X(10-12)	WPZ-06X(8-10)	WPZ-07X(6-8)	WPZ-07X(8-10)	WPZ-07X(10-12)	WPZ-07X(12-14)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		1/30/02	1/30/02	2/4/02	2/4/02	2/5/02	2/6/02	2/6/02	2/7/02	2/8/02	2//8/2	2/8/02	2/8/02
PESTICIDE/PCB		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
2,4'-DDT	-			0.93 J	0.52 J	0.0021 J			55	0.05 J	0.033 J	0.0085 J	
Hexabromobenzene	ID												
PBB(BP-6)	NLL			0.83 J	0.36 J	0.0032 J			-	0.012 J			
tris(2,3-Dibromopropyl)phosphate	NA												
4,4'-DDD	NLL		0.0035 J		0.39 J		0.11 J	0.012 J	15	0.013		0.25 D	0.0041 J
4,4'-DDE	NLL			1.1 D	0.93 D	0.0038 J	0.044		8.6	0.02	0.0028 J	0.067 D	
4,4'-DDT	NLL	0.018	0.044	3.2 D	3.1 D	0.014	0.027		56 D	0.0084 J	0.0084	0.088 D	0.0031 J
Alpha-BHC	-												
Alpha-chlordane	NLL												
Beta-BHC	-												
Dieldrin	NLL											0.0031 J	
Endosulfan Sulfate	NLL												
Gamma-Chlordane	NLL			0.02	0.019							0.0023 J	
Heptachlor Epoxide	NLL												
Aroclor-1254	NLL			0.3 J									

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451
D= The sample was diluted.
J The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample
NA = Criterion or value is not available or, as is the case for CSAT, not applicable
ID= Inadequate data to develop criterion
NLL = Hazardous substance is not likely to leach under most soil conditions.
Bolded and Boxed values exceed GSI criteria

Table 9-A
Phase I
Soil Analytical Data Summary (Detections only)
Pesticides, PCB's, and Specialty Chemicals
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location :	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-07X(14-15)	WPZ-08X(8-10)	WPZ-09X(13-15)	WPZ-10X(8-9)	WPZ-10X(9-10)	WPZ-11X(12-15)	WPZ-11X(19-20)	WPZ-11X(8-9)	WPZ-11X(9-10)	WPZ-12X(4-5)	WPZ-13X(4-5)	WPZ-14X(6-8)
Matrix :		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units :		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled :		2/8/02	2/11/02	2/11/02	2/12/02	2/12/02	2/14/02	2/14/02	2/14/02	2/14/02	2/13/02	2/14/02	2/15/02
PESTICIDE/PCB		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
2,4'-DDT	-		**0.06 J**	**3.5 J**	**14 J**	**0.76 J**	**670 J**	**370 J**	**67 J**	**18 J**	**0.088 J**		**0.048 J**
Hexabromobenzene	ID												
PBB(BP-6)	**NLL**			**0.52 J**	**2.6 J**						**0.079 J**		**0.024 J**
tris(2,3-Dibromopropyl)phosphate	NA												
4,4'-DDD	**NLL**		**0.068 J**	**21 D**		**0.014 J**	**54 J**	**95 J**		**0.69 J**	**0.51**	**0.037 D**	**0.082 D**
4,4'-DDE	NLL		0.15	38 D		0.058				1.7	2.1 D	0.27 D	0.19 D
4,4'-DDT	**NLL**	**0.0094**	**0.72 D**	**6.5 J**	**64 D**	**0.4 D**	**68 D**	**11 D**	**33 D**	**3.9 D**	**0.15 D**	**0.4**	**0.39 D**
Alpha-BHC	-					0.0013 J							
Alpha-chlordane	**NLL**			**0.19 J**									
Beta-BHC	-					0.012 J							
Dieldrin	**NLL**			**1.6 J**									
Endosulfan Sulfate	NLL		0.032 J										
Gamma-Chlordane	**NLL**		**0.014 J**									**0.002**	**0.0024 J**
Heptachlor Epoxide	NLL			1.2									
Aroclor-1254	**NLL**												

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451
D = The sample was diluted
J= The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample.
NA = Criterion or value is not available or, as is the case for CSAT, not applicable
ID= Inadequate data to develop criterion
NLL = Hazardous substance is not likely to leach under most soil conditions
Bolded and Boxed values exceed GSI criteria

Table 9-A
Phase I
Soil Analytical Data Summary (Detections only)
Pesticides, PCB's, and Specialty Chemicals
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-15X(7-9)	WPZ-16X(8-10)	WSB02-01(10-12)	WSB02-01(1-2)	WSB02-01(15-17)	WSB02-01(5-7)	WSB02-02(10-12)	WSB02-02(6-8)	WSB02-03(1-3)	WSB02-03(5-7)	WSB02-04(6-8)	WSB02-05(2-4)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/13/02	2/20/02	1/30/02	1/30/02	1/30/02	1/30/02	1/30/02	1/30/02	2/4/02	2/4/02	2/4/02	2/5/02
PESTICIDE/PCB		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
2,4'-DDT	-	**830 J**	**0.0076**	**22 J**	**0.028**	**6 J**	**0.041 J**	**0.001 J**		**0.04 J**	**39 J**	**0.23 J**	**3.7 J**
Hexabromobenzene	ID							0.0007 J					
PBB(BP-6)	**NLL**			**2 J**	**0.0018 J**	**0.26 J**	**0.0045 J**		**0.0036 J**	**0.0042 J**		**0.055 J**	**0.18 J**
tris(2,3-Dibromopropyl)phosphate	NA									0.023 J			
4,4'-DDD	**NLL**	110 J	0.041	49 J	0.17 J	17 J	0.57 J	0.44 J	0.026			0.86 D	0.45
4,4'-DDE	NLL	200 J	0.1		0.066		0.12	0.4	0.026	0.0075	31	0.92 D	3.6
4,4'-DDT	**NLL**	1200 D	0.59	660 D	1.5 D	240 D	4.1 D	3.3 D	0.033	0.022	310 D	0.71 D	21 D
Alpha-BHC	-												
Alpha-chlordane	**NLL**		**0.0012 J**										
Beta-BHC	-												
Dieldrin	**NLL**												
Endosulfan Sulfate	NLL												
Gamma-Chlordane	**NLL**		**0.0023 J**										
Heptachlor Epoxide	NLL												
Aroclor-1254	**NLL**												

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451
D= The sample was diluted.
J = The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample
NA = Criterion or value is not available or, as is the case for CSAT, not applicable
ID= Inadequate data to develop criterion
NLL = Hazardous substance is not likely to leach under most soil conditions
Bolded and Boxed values exceed GSI criteria

Table 9-A
Phase I
Soil Analytical Data Summary (Detections only)
Pesticides, PCB's, and Specialty Chemicals
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WSB02-06(8-10)	WSB02-06(10-12)	WSB02-07(8-10)	WSB02-07(10-12)	WSW-13(28-32)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/5/02	2/5/02	2/6/02	2/6/02	2/21/02
PESTICIDE/PCB		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
2,4'-DDT	-	0.0052 J	0.019 J	0.001 J	0.0009 J	3.9 J
Hexabromobenzene	ID					
PBB(BP-6)	NLL	0.088 J	0.24 J			
tris(2,3-Dibromopropyl)phosphate	NA					
4,4'-DDD	NLL	0.27 D	0.49 D	0.024		4.9 J
4,4'-DDE	NLL	0.21 D	0.20 D	0.032		2.1 J
4,4'-DDT	NLL	0.29 D	0.50 D	0.032		140 D
Alpha-BHC	-					
Alpha-chlordane	NLL					
Beta-BHC	-		0.0042 J			
Dieldrin	NLL					
Endosulfan Sulfate	NLL					
Gamma-Chlordane	NLL	0.006	0.0062 J			
Heptachlor Epoxide	NLL					
Aroclor-1254	NLL					

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451
D = The sample was diluted.
J= The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample
NA = Criterion or value is not available or, as is the case for CSAT, not applicable
ID= Inadequate data to develop criterion
NLL = Hazardous substance is not likely to leach under most soil conditions
Bolded and Boxed values exceed GSI criteria

Table 9-B
Phase I
Soil Analytical Data Summary (Detections only)
VOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-01X(4-6)	WPZ-02X(1-3)	WPZ-02X(4-5)	WPZ-03X(3-4)	WPZ-03X(6-8)	WPZ-04X(8-10)	WPZ-04X(10-12)	WPZ-04X(12-14)	WPZ-06X(8-10)	WPZ-07X(6-8)	WPZ-07X(8-10)	WPZ-07X(10-12)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		1/30/02	2/4/02	2/4/02	2/5/02	2/5/02	2/6/02	2/6/02	2/6/02	2/7/02	2/8/02	2/8/02	2/8/02
VOC's		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
1,2,3-Trichlorobenzene													
1,3,5-Trimethylbenzene	ID												1.3
1,2,4-Trimethylbenzene	ID						0.014 J	0.028 J					5.6
4-Isopropyltoluene	-								0.11				0.65
Bromobenzene	NA												
Iodomethane	-								0.20 J				
Isopropylbenzene	ID							0.039 J	0.098				0.87
Methyl Acetate	-			0.065 J	0.073 J		0.24 J	0.5 J					
Methyl(tert)butyl Ether	15{X}				0.018 J	0.024 J	0.018 J						
Methylcyclohexane	-							0.06 J	0.46 J				8.7
n-Butylbenzene	NA							0.25	0.41				
n-Propylbenzene	NA							0.085	0.21				1.6
sec-Butylbenzene	NA							0.064 J	0.16				0.57
1,2 Dichlorobenzene	0.36												
1,1,1-Trichloroethane	4												
1,1,2,2-Tetrachloroethane	1.6{X}												
1,1-Dichloroethane	ID												
1,2-Dichloroethane	7.2											0.011 J	
Acetone	34	0.64 J						0.27 J		0.4 J	0.41 J	0.34 J	
Benzene	4{X}				0.009 J	0.012 J	0.017 J			0.014 J			
Bromomethane	0.7									0.042	0.062 J	0.061 J	
Carbon disulfide	ID							0.018 J		0.16			
Carbon tetrachloride	0.9{X}												
Chlorobenzene	0.94	0.041 J							0.016 J	0.01 J	0.008 J		
Chloroethane	ID												
Chloroform	3.4												
Dichlorodifluoromethane	ID												
Ethylbenzene	0.36								0.12				**2.1**
Ethylene dibromide	0.02												
Methyl ethyl ketone	-			0.11 J	0.14 J	0.2 J	0.17 J			0.19 J	0.17 J		
Methylene chloride	19{X}							0.24 J					
o-Xylene	0.7												**0.86**
Tetrachloroethene	0.90{X}												
Toluene	2.8						0.011 J	0.014 J		0.012 J			0.059 J
Trichloroethene	4{X}		0.026 J	0.016 J				0.049 J					
Xylene (Total)	0.7							0.034 J		0.015 J			**17**
Cyclohexane	-								0.48 J				3.3

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D - The sample was diluted

J - The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample

NA - Criterion or value is not available or, as is the case for GSAL, not applicable

ID - Inadequate data to develop criterion

{X} The GSI criterion shown is not protective for surface water that is used as a drinking water source (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

Bolded and Boxed values exceed GSI criteria

Table 9-B
Phase I
Soil Analytical Data Summary (Detections only)
VOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-07X(12-14)	WPZ-07X(14-15)	WPZ-08X(8-10)	WPZ-09X(13-15)	WPZ-10X(8-9)	WPZ-10X(9-10)	WPZ-11X(12-15)	WPZ-11X(19-20)	WPZ-11X(8-9)	WPZ-11X(9-10)	WPZ-12X(4-5)	WPZ-13X(4-5)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/8/02	2/8/02	2/11/02	2/11/02	2/12/02	2/12/02	2/14/02	2/14/02	2/14/02	2/14/02	2/13/02	2/14/02
VOC's		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
1,2,3-Trichlorobenzene													
1,3,5 Trimethylbenzene	ID	0.38	0.027 J	0.025 J								0.022 J	
1,2,4-Trimethylbenzene	**ID**	**1.8**	**0.048 J**	**0.11**	**0.14 J**	**0.024 J**	**0.1**	**0.27 J**		**0.011 J**	**0.055 J**	**0.046 J**	
4 Isopropyltoluene	-	0.38	0.046 J	0.029 J									
Bromobenzene	**NA**			**0.031 J**									
Iodomethane	-												
Isopropylbenzene	**ID**	**0.34**		**0.044 J**			**0.047 J**				**0.032 J**		
Methyl Acetate	-												
Methyl(tert)butyl Ether	**15 {X}**												
Methylcyclohexane	-	1.1 J	0.14 J	0.28 J			0.17 J				0.15 J		
n-Butylbenzene	**NA**	**0.07 J**		**0.026 J**							**0.011 J**		
n-Propylbenzene	NA	0.46		0.072 J			0.063 J				0.03 J		
sec-Butylbenzene	**NA**	**0.051 J**		**0.019 J**							**0.012 J**		
1,2 Dichlorobenzene	**0.36**				**0.63**	0.013 J			**5 J**		0.013 J		
1,1,1-Trichloroethane	**4**						**0.068 J**				**0.074 J**		
1,1,2,2-Tetrachloroethane	1.6{X}						0.21				0.23		
1,1-Dichloroethane	**ID**						**0.037 J**				**0.018 J**		
1,2-Dichloroethane	7.2			0.064 J	0.19 J		0.13	0.31 J			0.07		
Acetone	**34**												**0.46 J**
Benzene	4{X}	0.025 J	0.1	0.83	0.5 J	0.014 J	0.23	0.62 J			0.048 J		
Bromomethane	**0.7**	**0.11 J**	**0.058 J**	**0.062 J**									
Carbon disulfide	*ID*		0.15										0.14
Carbon tetrachloride	**0.9{X}**			**0.087**									
Chlorobenzene	**0.94**	0.1 J	0.081	0.026 J	**66**	0.27	**1.2**	**78**	**1600**	0.16	0.48	0.095	
Chloroethane	**ID**						**0.1 J**				**0.059 J**		
Chloroform	3.4			0.039 J	0.14 J	0.082	**5.2**	0.2 J		0.1	**5.8**		
Dichlorodifluoromethane	**ID**												
Ethylbenzene	0.36	**1.8**	**0.44**	0.098			0.066 J				0.04 J		
Ethylene dibromide	**0.02**					**0.029 J**							
Methyl ethyl ketone	-												
Methylene chloride	**19{X}**										**0.1 J**		
o-Xylene	0.7	**1.1**	0.24	0.19			0.16				0.11		
Tetrachloroethene	**0.90{X}**			**0.036 J**		**0.017 J**	**0.13**				**0.28**		
Toluene	2.8	0.062 J	0.031 J	0.24		0.012 J	0.18	0.12 J		0.013 J	0.11		
Trichloroethene	**4{X}**						**0.22**				**0.78**		
Xylene (Total)	0.7	**2.8**	0.45	0.28			0.17				0.11 J		
Cyclohexane	**-**	**1.6**	**0.12 J**	**0.087 J**			**0.054 J**				**0.037 J**		

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D= The sample was diluted

J= The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample

NA- Criterion or value is not available or, as is the case for CSAT, not applicable

ID- Inadequate data to develop criterion

{X}- The GSI criterion shown is not protective for surface water that is used as a drinking water source (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

Bolded and Boxed values exceed GSI criteria

MDEQ and WESTON
Projects\20083.500.001.0010\PhaseITechMemo\Table 9-B soil VOC - XI

Table 9-B
Phase I
Soil Analytical Data Summary (Detections only)
VOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-14X(6-8)	WPZ-15X(7-9)	WPZ-16X(8-10)	WSB02-01(10-12)	WSB02-01(1-2)	WSB02-01(15-17)	WSB02-01(5-7)	WSB02-02(10-12)	WSB02-02(6-8)	WSB02-03(5-7)	WSB02-04(6-8)	WSB02-05(2-4)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/15/02	2/13/02	2/20/02	1/30/02	1/30/02	1/30/02	1/30/02	1/30/02	1/30/02	2/4/02	2/4/02	2/5/02
VOC's		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
1,2,3-Trichlorobenzene										**0.048 J**			
1,3,5-Trimethylbenzene	ID						0.015 J						
1,2,4-Trimethylbenzene	**ID**				**0.019 J**	**0.012 J**	**0.024 J**		**0.012 J**		**0.027 J**	**0.018 J**	
4-Isopropyltoluene	-												
Bromobenzene	**NA**				**0.023 J**		**0.028 J**						
Iodomethane	-			0.52									
Isopropylbenzene	**ID**												
Methyl Acetate	-						0.14 J		0.1 J	0.071 J	0.09 J	0.067 J	0.11 J
Methyl(tert)butyl Ether	**15{X}**												**0.012 J**
Methylcyclohexane	-	0.1 J	0.057 J		0.02 J		0.028 J				0.061 J	0.04 J	
n-Butylbenzene	**NA**						**0.022 J**						
n-Propylbenzene	NA												
sec-Butylbenzene	**NA**												
1,2-Dichlorobenzene	0.36				0.16		0.2	0.022 J				0.029 J	
1,1,1-Trichloroethane	**4**												
1,1,2,2 Tetrachloroethane	1.6{X}												
1,1-Dichloroethane	**ID**												
1,2-Dichloroethane	7.2		0.02 J						0.012 J				
Acetone	**34**	***0.4 J***				***0.59 J***	***0.66 J***	***0.65 J***	***0.64 J***				
Benzene	4{X}				0.1	0.014 J	0.096	0.031 J	0.052 J			0.08	0.025 J
Bromomethane	**0.7**												
Carbon disulfide	ID			0.27	0.026 J		0.062		0.17				
Carbon tetrachloride	**0.9{X}**												
Chlorobenzene	0.94	0.012 J	0.032 J		**20**	0.54	**18**	**3.2**	**1.5**	0.009 J	0.022 J		
Chloroethane	**ID**												
Chloroform	3.4	0.027 J			0.025 J		0.1						
Dichlorodifluoromethane	**ID**					**0.007[illegible]**							
Ethylbenzene	0.36												
Ethylene dibromide	**0.02**												
Methyl ethyl ketone	-					0.1 J						0.12 J	0.16 J
Methylene chloride	**19{X}**												
o Xylene	0.7	0.019 J	0.013 J				0.015 J				0.036 J		
Tetrachloroethene	**0.90{X}**				**0.03 J**		**0.027 J**						
Toluene	2.8	0.017 J	0.017 J		0.047 J	0.01 J	0.052 J	0.011 J	0.018 J		0.032 J	0.013 J	
Trichloroethene	**4{X}**				**0.049 J**		**0.058 J**						
Xylene (Total)	0.7	0.02 J			0.021 J		0.025 J				0.038 J		
Cyclohexane	**-**												

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D - The sample was diluted

J - The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

NA - Criterion or value is not available or, as is the case for CSAT, not applicable

ID - Inadequate data to develop criterion

{X} The GSI criterion shown is not protective for surface water that is used as a drinking water source (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

Bolded and Boxed values exceed GSI criteria

MDEQ and WESTON
Projects 20083 500 Phase I Tech Memo Table 9-B soil VOC XL

Table 9-B
Phase I
Soil Analytical Data Summary (Detections only)
VOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WSB02-06(8-10)	WSB02-06(10-12)	WSB02-06(12-14)	WSB02-07(8-10)	WSB02-07(10-12)	WSB02-07(12-13)	WSW-13(28-32)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/5/02	2/5/02	2/5/02	2/6/02	2/6/02	2/6/02	2/21/02
VOC's		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
1,2,3-Trichlorobenzene	[illegible]							
1,3,5-Trimethylbenzene	**ID**							
1,2,4-Trimethylbenzene	**ID**							
4-Isopropyltoluene	-							
Bromobenzene	**NA**	0.048 J		0.11				
Iodomethane	-		0.97 J					
Isopropylbenzene	**ID**							
Methyl Acetate	-	0.24 J		0.21 J	0.26 J	0.2 J	0.095 J	
Methyl(tert)butyl Ether	**15 {X}**		**0.019 J**	**0.019 J**	**0.028 J**	**0.017 J**		
Methylcyclohexane	-							
n-Butylbenzene	**NA**							
n Propylbenzene	**NA**							
sec-Butylbenzene	**NA**							
1,2-Dichlorobenzene	**0.36**							0.067 J
1,1,1-Trichloroethane	**4**							
1,1,2,2-Tetrachloroethane	**1.6{X}**							
1,1-Dichloroethane	**ID**							
1,2-Dichloroethane	**7.2**	0.014 J						0.18 J
Acetone	**34**							**1.9 J**
Benzene	**4{X}**	0.21	0.012 J	0.28	0.015 J	0.01 J	0.009 J	0.94
Bromomethane	[illegible]							
Carbon disulfide	**ID**	0.014 J		0.014 J				
Carbon tetrachloride	**0.9{X}**							
Chlorobenzene	**0.94**	0.18	0.094 J	0.25	0.018 J	0.027 J	0.14	**54**
Chloroethane	**ID**							
Chloroform	**3.4**							0.15 J
Dichlorodifluoromethane	**ID**							
Ethylbenzene	**0.36**							
Ethylene dibromide	**0.02**							
Methyl ethyl ketone	-	0.17 J	0.15 J	0.15 J	0.21 J	0.14 J	0.16 J	
Methylene chloride	**19{X}**							**0.18 J**
o-Xylene	**0.7**							
Tetrachloroethene	**0.90{X}**							
Toluene	**2.8**	0.02 J		0.018 J	0.012 J	0.01 J		0.14 J
Trichloroethene	**4{X}**							**0.12 J**
Xylene (Total)	**0.7**							
Cyclohexane	**-**							

CRITERIA Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D - The sample was diluted

J - The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

NA - Criterion or value is not available or, as is the case for CSAT, not applicable

ID- Inadequate data to develop criterion

{X} The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

Bolded and Boxed values exceed GSI criteria

Table 9-C
Phase I
Soil Analytical Data Summary (Detections only)
SVOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-02X(1-3)	WPZ-02X(4-5)	WPZ-03X(3-4)	WPZ-03X(6-8)	WPZ-04X(8-10)	WPZ-04X(10-12)	WPZ-06X(8-10)	WPZ-07X(6-8)	WPZ-07X(10-12)	WPZ-07X(14-15)	WPZ-08X(8-10)	WPZ-08X(8-10)	WPZ-09X(13-15)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/4/02	2/4/02	2/5/02	2/5/02	2/6/02	2/6/02	2/7/02	2/8/02	2/8/02	2/8/02	2/11/02	2/11/02	2/11/02
SVOC's		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
1,1-Biphenyl	-													
1,2,4-Trichlorobenzene	1.8							0.028 J						
1,3-Dichlorobenzene	1.1													
1,4-Dichlorobenzene	0.29											0.01		1.7
2,4,6-Trichlorophenol	0.33 (M)													
2,4-Dichlorophenol	0.38													
2-Methylnaphthalene	ID						2.1 J			0.45 J			0.38 J	
4-Methylphenol (P-Cresol)														
Benz(a)anthracene	NLL	0.11 J	0.084 J										0.23 J	
Benzo(a)pyrene	NLL	0.10 J	0.074 J					0.051 J					0.22 J	
Benzo(b)fluoranthene	NLL	0.090 J	0.087 J					0.062 J					0.21 J	
Benzo(g,h,i)perylene	NLL	0.067 J	0.047 J											
Benzo(k)fluoranthene	NLL	0.10 J	0.067 J					0.048 J						
bis(2-Ethylhexyl)phthalate	NLL	0.049 J	0.039 J	0.23	0.047 J			0.042 J						
Chrysene	NLL	0.11 J	0.094 J					0.046 J					0.32 J	
Di-N-Butyl phthalate	11										0.080 J			
Dibenz(a,h)anthracene	NLL													
Fluoranthene	5.5	0.20 J	0.17 J								0.045 J		0.40 J	
Hexachlorobenzene	ID							0.18 J						
Indeno(1,2,3-cd)pyrene	NLL	0.071 J	0.48 J											
Naphthalene	0.87			0.016 J	0.020 J	0.030 J			0.007 J			0.17 J	0.24 J	
Phenanthrene	2.3	0.075 J	0.10 J				2.7 J						0.39 J	
Phenol	4.2													
Pyrene	ID	0.170 J	0.15 J								0.077 J		0.45 J	

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D: The sample was diluted

J: The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

(M) = Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

NLL: Hazardous substance is not likely to leach under most soil conditions

Bolded and Boxed values exceed GSI criteria

Table 9-C
Phase I
Soil Analytical Data Summary (Detections only)
SVOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-09X(13-15)	WPZ-10X(8-9)	WPZ-10X(8-9)	WPZ-10X(9-10)	WPZ-11X(12-15)	WPZ-11X(19-20)	WPZ-11X(8-9)	WPZ-11X(9-10)	WPZ-12X(4-5)	WPZ-15X(7-9)	WPZ-15X(7-9)	WPZ-16X(8-10)	WSB02-01(10-12)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/11/02	2/12/02	2/12/02	2/12/02	2/14/02	2/14/02	2/14/02	2/14/02	2/13/02	2/13/02	2/13/02	2/20/02	1/30/02
SVOC's		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
1,1-Biphenyl	-													
1,2,4-Trichlorobenzene	1.8		0.022 J			0.024 J		0.011 J			0.017 J			
1,3-Dichlorobenzene	1.1					0.16 J								
1,4-Dichlorobenzene	0.29					2.2		0.016 J			0.034 J			0.44
2,4,6-Trichlorophenol	0.33 {M}													
2,4-Dichlorophenol	0.38													
2-Methylnaphthalene	ID	0.40 J		0.27 J					0.17 J					
4-Methylphenol (P-Cresol)														
Benz(a)anthracene	NLL									0.092 J		1.5 J		
Benzo(a)pyrene	NLL									0.11 J		1.6 J		
Benzo(b)fluoranthene	NLL									0.098 J		2.6 J		
Benzo(g,h,i)perylene	NLL									0.10 J		0.87 J		
Benzo(k)fluoranthene	NLL									0.081 J		1.5 J		
bis(2-Ethylhexyl)phthalate	NLL												0.14 J	
Chrysene	NLL	0.46 J								0.11 J		2.2 J		
Di-N-Butyl phthalate	11													
Dibenz(a,h)anthracene	NLL													
Fluoranthene	5.5	0.39 J								0.19 J		2.6 J		
Hexachlorobenzene	ID													
Indeno(1,2,3-cd)pyrene	NLL									0.081 J		1.0 J		
Naphthalene	0.87			0.23 J	0.14 J									
Phenanthrene	2.3	0.72 J								0.098 J		0.69 J		
Phenol	4.2						0.42 J							
Pyrene	ID	0.66 J								0.18 J		2.6 J		

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D: The sample was diluted

J: The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

{M} = Calculated criterion is below the analytical Target Detection Limit (TDL), therefore the criterion defaults to the TDL

NLL: Hazardous substance is not likely to leach under most soil conditions

Bolded and Boxed values exceed GSI criteria

Table 9-C
Phase I
Soil Analytical Data Summary (Detections only)
SVOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WSB02-01(10-12)	WSB02-01(15-17)	WSB02-01(15-17)	WSB02-01(5-7)	WSB02-02(10-12)	WSB02-03(1-3)	WSB02-03(5-7)	WSB02-04(6-8)	WSB02-05(2-4)	WSB02-06(8-10)	WSB02-06(10-12)	WSB02-06(12-14)	WSW-13(28-32)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		1/30/02	1/30/02	1/30/02	1/30/02	1/30/02	2/4/02	2/4/02	2/4/02	2/5/02	2/5/02	2/5/02	2/5/02	2/21/02
SVOC's		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
1,1-Biphenyl	-	**360 J**		**140 J**										
1,2,4-Trichlorobenzene	1.8													0.05 J
1,3-Dichlorobenzene	1.1													
1,4-Dichlorobenzene	0.29		0.53		0.043 J									0.00021 J
2,4,6-Trichlorophenol	0.33 {M}								0.059 J					
2,4-Dichlorophenol	0.38								0.21 J					
2-Methylnaphthalene	ID	0.12 J						0.091 J						
4-Methylphenol (P-Cresol)	-													0.14 J
Benz(a)anthracene	NLL							0.15 J	0.18 J	0.076 J				
Benzo(a)pyrene	NLL							0.15 J	0.18 J	0.074 J				
Benzo(b)fluoranthene	NLL							0.18 J	0.23 J	0.084 J				
Benzo(g,h,i)perylene	NLL							0.14 J	0.14 J	0.062 J				
Benzo(k)fluoranthene	NLL							0.15 J	0.17 J	0.073 J				
bis(2-Ethylhexyl)phthalate	NLL						0.063 J		0.053 J	0.059 J	0.047 J	0.074 J	0.060 J	0.27 J
Chrysene	NLL	0.12 J						0.18 J	0.22 J	0.092 J				
Di-N-Butyl phthalate	11													
Dibenz(a,h)anthracene	NLL								0.044					
Fluoranthene	5.5	0.13 J						0.23 J	0.41 J	0.160 J				
Hexachlorobenzene	ID													
Indeno(1,2,3-cd)pyrene	NLL							0.13 J	0.14 J	0.060 J				
Naphthalene	0.87					0.014 J			0.041 J	0.019 J	0.022 J		0.014 J	
Phenanthrene	2.3	0.21 J				0.056 J		0.081 J	0.20 J	0.12 J				
Phenol	4.2													
Pyrene	ID	0.15 J						0.22 J	0.34 J	0.15 J				

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D– The sample was diluted

J The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

{M} Calculated criterion is below the analytical Target Detection Limit ; TDL); therefore, the criterion defaults to the TDL

NLL Hazardous substance is not likely to leach under most soil conditions.

Bolded and Boxed values exceed GSI criteria

Table 9-D
Phase I
Soil Analytical Data Summary
Inorganics
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-01X(2-4)	WPZ-01X(4-6)	WPZ-02X(1-3)	WPZ-02X(4-5)	WPZ-03X(3-4)	WPZ-03X(6-8)	WPZ-04X(8-10)	WPZ-04X(10-12)	WPZ-04X(12-14)	WPZ-06X(8-10)	WPZ-07X(6-8)	WPZ-07X(8-10)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		1/30/02	1/30/02	2/4/02	2/4/02	2/5/02	2/5/02	2/6/02	2/6/02	2/6/02	2/7/02	2/8/02	2/8/2
METALS		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Aluminum	NA	2180	1750	3250	3080	4380	4410	6390	4160	11500	2990	3350	1890
Antimony	ID	<0.81	<0.94	<0.33	<0.31	<0.35	<0.34	<0.35	<0.4	<0.34	<0.33	<0.32	<0.32
Arsenic (As)	70	<0.81	<0.94	2 J	1.8 J	2.7 J	5.2 J	7 J	2.8 J	3.7 J	8.6 J	2.4	5.3 J
Barium	{G,X}	7.6	9.4	21.7	20.6	38	35.8	91.7	57.6	66.7	44.2	29.2	14
Beryllium	{G}	0.23 J	<0.23	0.14 J	0.15	0.23 J	0.25 J	0.38 J	0.27 J	0.59	0.31 J	0.21	0.04 J
Cadmium	{G,X}	<0.2	<0.23	0.07 J	<0.06	0.13 J	<0.07	0.3 J	0.14 J	0.13 J	0.4 J	<0.07	0.08 J
Calcium	-	362	12100	7250 J	20100 J	15200 J	8520 J	5690 J	30200 J	2180 J	29800 J	81200 J	73800 J
Chromium	3.3	4.2	4.4	6.2	6.2	7.7	8.5	12.5	8.9	19.8	6.9	9.4	5.2
Cobalt	2	1.4	1.2	2.2	1.9	3	4.5	6.5	3.2	7.9	2.1	3.1	2.3
Copper	{G}	1.4	5	9.8	13.6	6.5	11.3	31	12.3	12	28.7	9.2	8.2
Iron (Ferrous)	NA	3090	3500	6400 J	6800 J	8750 J	12100 J	13500 J	7200 J	15500 J	28800 J	7800	6640 J
Lead (Pb)	{G,M,X}	1.7 J	2.7	7.8	7.3	7.8	5.6	51.2	37.2	9.7	4.3	4.6	3.5
Magnesium	NA	555	1190	2980 J	4240 J	2240 J	5880 J	3760 J	9480 J	3390 J	5160 J	26100	14800 J
Manganese	{G,X}	48.7	49.4	126 J	92 J	314 J	176 J	223 J	127 J	108 J	300 J	183	177 J
Mercury	0.1	<0.05	<0.05	0.1 J	0.09 J	0.1 J	0.07	0.12 J	0.14 J	0.11 J	0.35	0.075 J	0.078 J
Nickel	{G}	3	3.9	5.8	5.7	6.7	11.9	14.1	7.6	17.7	16.7	9	5.5
Potassium	-	149	227	349 J	366 J	367 J	620 J	909 J	765 J	1460 J	313 J	877	406 J
Selenium	0.4	<0.81	<0.94	<0.41	<0.39	<0.44	<0.44	0.56	0.66	<0.44	0.44	<0.41	<0.4
Silver	0.5	<0.2	<0.23	<0.11	<0.1	<0.12	<0.12	0.19 J	<0.14	<0.12	<0.11	<0.11	<0.11
Sodium	NA	335 J	407	215 J	211 J	241 J	235 J	548 J	514 J	476 J	389 J	320	307
Thallium	4.2	<0.81	1.1	0.65 R	0.61 R	0.69 R	0.69 R	0.71 R	0.81 R	0.69 R	0.66 R	<0.65	<0.64
Vanadium	190	5.1	5.1	8.5	9.4	11.9	13.2	17.1	10.7	21.2	15.4	9.4	7.5
Zinc	{G}	7.6 J	12.1 J	21.8 J	22.1 J	23.2 J	22.5 J	153 J	54.7 J	35.9	92.3 J	18	18.4 J
Cyanide	0.4	<0.05	0.06 J	0.13	0.08	0.09	0.06	0.08	0.12	0.1	0.12	<0.043	<0.04

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D: The sample was diluted

J: The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

R: The data are unusable. (The compound may or may not be present)

{G}: GSI criterion is pH or water hardness dependent. (See MDEQ ERD Op Memo 18 footnotes for further explanation)

{M}: Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

{X}: The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 footnotes for further explanation)

NA: Criterion or value is not available or, as is the case for CSAT, not applicable

ID: Inadequate data to develop criterion

Bolded and Boxed values exceed GSI criteria

Table 9-D
Phase I
Soil Analytical Data Summary
Inorganics
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-07X(10-12)	WPZ-07X(12-14)	WPZ-07X(14-15)	WPZ-08X(8-10)	WPZ-09X(13-15)	WPZ-10X(8-9)	WPZ-10X(9-10)	WPZ-11X(12-15)	WPZ-11X(19-20)	WPZ-11X(8-9)	WPZ-11X(9-10)	WPZ-12X(4-5)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/8/02	2/8/02	2/8/02	2/11/02	2/11/02	2/12/02	2/12/02	2/14/02	2/14/02	2/14/02	2/14/02	2/13.02
METALS		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Aluminum	NA	4500	2700	5400	3760	5390	4270	1750	5810	4720	2160	2550	3460
Antimony	ID	<0.35	<0.55	<0.36	<2.1	<2.5	<2	<2.3	<3	<4	<1.9	<2.2	<2
Arsenic (As)	70	3.6	3.1	10	15.6	14.5	4.7	2	7.8	6.1	3	2.3	7
Barium	{G,X}	18	45	40	131	47.6	48.6	10.3	507	52.6	19.6	26	41.8
Beryllium	{G}	0.27	0.18	0.35	0.33	0.31	<0.22	<0.26	<0.33	<0.44	<0.21	<0.25	<0.22
Cadmium	{G,X}	<0.07	<0.11	1	<0.47	<0.56	<0.44	<0.52	<0.66	18.4	<0.43	<0.49	0.5
Calcium	-	83000	210000	6400	12300	3180	43200	5180	32600	42600	42100	5270	32700
Chromium	3.3	11	18	22	8.3	9.7	9.6	3.9	17	8.6	13.3	4.7	6.7
Cobalt	2	3.8	0.88	9.4	4.8	5.7	4	2.6	7.4	20.9	2.1	1.8	2
Copper	{G}	11	15	11	44.9	88.7	11.9	8.6	111	15.6	4.4	3.2	7.4
Iron (Ferrous)	NA	9400	4300	20000	17600	17400	10700	21700	11800	13000	6210	19100	6590
Lead (Pb)	{G,M,X}	7	170	18	102	329	27.3	15	367	30.6	13.7	9.6	22.8
Magnesium	NA	26000	87000	2000	3570	446	14500	1350	5230	6840	8370	268	4360
Manganese	{G,X}	190	210	1200	145	27.3	231	41.2	26.5	206	166	19.3	177
Mercury	0.1	0.09	0.16	0.07	0.17	0.23	0.16	<0.07	0.44	<0.11	0.06	<0.06	<0.06
Nickel	{G}	9.4	4.8	13	17.2	48.6	11.4	6.6	7.9	12.7	5.9	5.7	7.3
Potassium	-	780	430	510	429	275	653	218	704	843	252	270	328
Selenium	0.4	<0.45	<0.7	0.82	<0.94	1.2	<0.87	1.1	<1.3	2.8	<0.86	<0.99	<0.87
Silver	0.5	<0.12	<0.18	<0.12	<0.47	<0.56	<0.44	<0.52	2.2	<0.89	<0.43	<0.49	<0.43
Sodium	NA	530	1700	760	517	748	412	472	555	2280	368	404	284
Thallium	4.2	<0.71	<1.1	<0.72	3.2	2.7	1.9	3.9	3.5	<1.8	<0.86	3.8	1.4
Vanadium	190	12	5.5	37	13.1	6.7	11.5	6.1	12.8	12.9	7.6	6.6	8.8
Zinc	{G}	26	46	74	107	536	43.7	21.6	112	3940	26.5	25.2	176
Cyanide	0.4	<0.05	0.16	0.15	0.06	0.4	0.14	0.36	0.08	0.35	0.17	0.19	0.1

S: RITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 P.A 451

D: The sample was diluted.

J: The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

R: The data are unusable. (The compound may or may not be present)

{G}: GSI criterion is pH or water hardness dependent. (See MDEQ ERD Op Memo 18 footnotes for further explanation)

{M}: Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

{X}: The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

NA: Criterion or value is not available or, as is the case for CSAT, not applicable

ID: Inadequate data to develop criterion

Bolded and Boxed values exceed GSI criteria

Table 9-D
Phase I
Soil Analytical Data Summary
Inorganics
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WPZ-13X(4-5)	WPZ-14X(6-8)	WPZ-15X(7-9)	WPZ-16X(8-10)	WSB02-01(10-12)	WSB02-01(1-2)	WSB02-01(15-17)	WSB02-01(5-7)	WSB02-02(10-12)	WSB02-02(6-8)	WSB02-03(1-3)	WSB02-03(5-7)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOI	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/14/02	2/18/02	2/13/02	2/20/02	1/30/02	1/30/02	1/30/02	1/30/02	1/30/02	1/30/02	2/4/02	2/4/02
METALS		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Aluminum	**NA**	3200	1670	7750 J	6150 J	3250	4010	4410	6880	5950	8530	4880	2440
Antimony	ID	<2.1	<1.9	2.1 J	<0.74	<0.96	<0.87	<0.92	<1.2	<0.99	<0.92	<0.3	<0.31
Arsenic (As)	**70**	2.6	6.7	4.9	4.3	4.9	2.9	4.2	4.7	9	5.3	2.4 J	3.1 J
Barium	{G,X}	39.2	13.4	112	28.7	131	31.7	60	54.8	19.6	51.1	53.8	41
Beryllium	{G}	<0.23	<0.21	0.14 J	0.42 J	0.3	0.42 J	0.33 J	0.44 J	0.4 J	0.68 J	0.24 J	0.13 J
Cadmium	{G,X}	<0.46	<0.41	0.44	<0.1	0.24	<0.22	<0.23	<0.29	<0.25	<0.23	<0.13	0.23 J
Calcium	-	3290	53100	11700 J	6760	66800	86500	63100	74700	36600	34700	88700 J	5480 J
Chromium	3.3	5.3	6	97.9 J	12.8 J	8	8	10.9	13.1	13.1	14.7	10.4	8.6
Cobalt	2	1.8	2.4	3.8	7.5	4.3	3.7	4.9	6.2	4.9	6.5	5.1	2
Copper	{G}	13	11.2	165 J	7.4	36.6	8.7	22.4	13.3	34.3	20.9	10	55.1
Iron (Ferrous)	NA	5490	7820	20700 J	11300 J	9530	8460	9850	14000	17400	15100	9570 J	9550 J
Lead (Pb)	{G,M,X}	47.2	86.7	270 J	72 J	67 J	8.2 J	27	8.8 J	12.1 J	13.5	4.4	218
Magnesium	NA	1450	20300	3450	3940	21700	44200	21500	27400	38300	18100	31200 J	1960 J
Manganese	{G,X}	277	293	180 J	502	193	218	229	281	151	349	248 J	142 J
Mercury	0.1	<0.06	<0.05	1.5 J	<0.05	0.24	<0.05	0.08	<0.07	0.12	<0.06	0.08 J	0.46
Nickel	{G}	3.7	7.3	21.4	13.7	10.2	9.4	11.6	15	14.2	15.8	12.1	17.2
Potassium	-	147	306	284	1030	749	799	1050	1330	715	1200	1370 J	195 J
Selenium	0.4	<0.92	<0.82	0.66	<0.6	<0.96	<0.87	<0.92	<1.2	1.4 J	<0.92	<0.38	0.49
Silver	0.5	<0.46	<0.41	0.39	<0.26	<0.24	<0.22	<0.23	<0.29	<0.25	<0.23	<0.1	<0.1
Sodium	NA	300	404	527 J	575 J	572 J	568 J	564 J	753 J	653 J	556 J	329 J	340 J
Thallium	4.2	1.8	1.4	<1	<1	1.3	<0.87	<0.92	2	2.3	1.4	0.6 R	0.61 R
Vanadium	190	9.6	6.8	10.5	13.2	9.6	10.6	12.5	17.3	18.9	19.7	12.9	7.2
Zinc	{G}	35.9	27.1	293 J	27 J	93.5 J	23.8 J	57.5 J	38.1	50.1 J	36.4 J	21.2 J	107 J
Cyanide	0.4	0.13	0.14	0.12	<0.05	<0.06	<0.05	<0.06	<0.07	<0.06	<0.06	0.06	0.12

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D: The sample was diluted

J: The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample

R: The data are unusable. (The compound may or may not be present)

{G}: GSI criterion is pH or water hardness dependent. (See MDEQ ERD Op Memo 18 footnotes for further explanation)

M: Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

X: The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 footnotes for further explanation)

NA: Criterion or value is not available or, as is the case for CSAT, not applicable

ID: Inadequate data to develop criterion

Bolded and Boxed values exceed GSI criteria

Table 9-D
Phase I
Soil Analytical Data Summary
Inorganics
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (Industrial) (mg/kg)	WSB02-04(6-8)	WSB02-05(2-4)	WSB02-06(8-10)	WSB02-06(10-12)	WSB02-06(12-14)	WSB02-07(8-10)	WSB02-07(10-12)	WSB02-07(12-13)	WSW-13(28-32)
Matrix		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Units		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Date Sampled		2/4/02	2/5/02	2/5/02	2/5/02	2/5/02	2/6/02	2/6/02	2/6/02	2/21/02
METALS		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Aluminum	NA	2720	2630	5160	15000	4510	3740	10000	5900	4110 J
Antimony	ID	<0.33	<0.32	<0.32	<0.46	<0.33	<0.35	<0.35	<0.35	<0.72
Arsenic (As)	70	1.9 J	2.5 J	2.7 J	7.4 J	2.5 J	2.4 J	6 J	10.3 J	3.6 J
Barium	{G,X}	22.2	30.6	43.2	41	12.5	54.7	76.5	39.6	45
Beryllium	{G}	0.16 J	0.12 J	0.29 J	0.88	0.22 J	0.22	0.52 J	0.36	0.25 J
Cadmium	{G,X}	0.15 J	0.16 J	0.11 J	0.33 J	<0.07	0.12 J	0.12 J	<0.07	<0.09
Calcium	-	48200 J	3180 J	59200 J	2440 J	36400 J	37100 J	2290 J	2160 J	56900 J
Chromium	3.3	6.7	5	9.9	24.4	9.6	7.1	18.5	12	8.3 J
Cobalt	2	1.7	2	4.4	8.3	2.9	2.9	6.9	5.3	3.6
Copper	{G}	9	17.6	12.7	16.4	7.2	8.7	16.7	14.9	11.7 J
Iron (Ferrous)	NA	5220 J	6000 J	10900 J	24100 J	8340 J	8100 J	18500 J	15500 J	9810
Lead (Pb)	{G,M,X}	80.2	32.3	7.8	11.4	3.7	10.2	7.9	7.8	14.5 J
Magnesium	NA	3140 J	1550 J	18400 J	4280 J	13600 J	13000 J	3050 J	2570 J	21100
Manganese	{G,X}	95.8 J	128 J	272 J	181 J	123 J	172 J	137 J	127 J	220 J
Mercury	0.1	0.08 J	0.14 J	0.1	0.15 J	0.09 J	0.12 J	0.1 J	0.11 J	<0.06
Nickel	{G}	5	5.7	11.9	23.6	9.3	7.9	22.2	16.4	10.6
Potassium	-	270 J	241 J	1040 J	1490 J	746 J	764 J	1440 J	970 J	881
Selenium	0.4	<0.42	<0.4	<0.41	0.49	<0.42	<0.44	0.82	0.63	0.59
Silver	0.5	<0.11	<0.11	<0.11	<0.12	<0.11	<0.12	<0.12	<0.12	<0.25
Sodium	NA	306 J	260 J	335 J	507 J	419 J	348 J	335 J	382 J	635 J
Thallium	4.2	0.66 R	0.64 R	0.64 R	0.72 R	0.66 R	0.69 R	0.71 R	0.69 R	<1
Vanadium	190	7.2	8.6	12.7	29.4	10.4	11.3	21.6	16.2	10.6
Zinc	{G}	55 J	32.2 J	27.5 J	46.8 J	23.2 J	23.6 J	33.6 J	35 J	26.7 J
Cyanide	0.4	0.08	0.1	0.16	0.08	<0.05	0.17	0.15	<0.06	<0.05

1. CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451
D= The sample was diluted
J = The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample
R = The data are unusable. (The compound may or may not be present)
{G} GSI criterion is pH or water hardness dependent. (See MDEQ ERD Op Memo 28 footnotes for further explanation)
M: Calculated criterion is below the analytical Target Detection Limit (TDL), therefore the criterion defaults to the TDL
X: The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 28 footnotes for further explanation)
NA: Criterion or value is not available or, as is the case for CASRN, not applicable
ID: Inadequate data to develop criterion
Bolded and Boxed values exceed GSI criteria

Table 11-A
Phase I
Groundwater Analytical Data Summary (Detections only)
Pesticides, PCB's, and Specialty Chemicals
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	SSD-01	WPZ-01X(9-11)	WPZ-02X(9-12)	WPZ-06X(10-14)	WPZ-06X(18-20)	WPZ-06I(10-14)	WPZ-06I(18-20)	WPZ-07X(16-20)	WPZ-08X(10-12)	WPZ-08X(14-17)	WPZ-09X(20-22)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled		2/6/02	1/30/02	2/4/02	2/7/02	2/7/02	2/7/02	2/8/02	2/11/02	2/11/02	2/11/02	2/12/02
PESTICIDE/PCB		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
2,4'-DDT	NA	0.0023 J	0.0044 J	0.016 J	0.51 J	29 J	0.24 J	0.55 J	0.0024 J	0.027 J	0.069 J	0.12 J
PBB(BP-6)	IP			0.01							0.026	0.082
tris (2,3-Dibromopropyl) phosphate	NA									2.6 J	4.5 J	
4,4'-DDD	NA				0.93 J	26 DJ	0.11 J	0.17 J				
4,4'-DDE	NA				0.46 J	12						
4,4'-DDT	0.02 (M)				1.8 DJ	98 D	0.43 J					
Alpha-BHC	-				1.4 DJ		2 D					0.044 J
Alpha-chlordane	IP				0.079 J	1.1 J						
Beta-BHC	-				1.1 DJ		1 DJ					0.035 J
Decachlorobiphenyl	0.2											
Delta-BHC	-				1.9 J		2.2 D					
Dieldrin	0.02 (M)							2 DJ				
Endosulfan I	NA							0.13 J				
Endosulfan II	NA							0.061 J				
Gamma-BHC (Lindane)	0.027											
Gamma-Chlordane	IP				0.08 J	0.73 J						
Heptachlor	NA							0.15 J				
Heptachlor Epoxide	NA							0.14 J				

D: The sample was diluted

J: The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

IP: Development of generic GSI value in process

(M): Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

NA: Criterion or value is not available or, as is the case for CSAT, not applicable

ID: Inadequate data to develop criterion

Bolded & Boxed values exceed GSI criteria

Table 11-A
Phase I
Groundwater Analytical Data Summary (Detections only)
Pesticides, PCB's, and Specialty Chemicals
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	WPZ-09X(9-13)	WPZ-09I(10-14)	WPZ-09I(20-22)	WPZ-10X(16-20)	WPZ-10X(23-25)	WPZ-10X(9-13)	WPZ-10I(23-25)	WPZ-10I(9-13)	WPZ-11X(10-13)	WPZ-11X(23-25)	WPZ-11X(25-30)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled		2/12/02	2/12/02	2/16/02	2/12/02	2/12/02	2/12/02	2/12/02	2/13/02	2/13/02	2/14/02	2/15/02
PESTICIDE/PCB		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
2,4'-DDT	NA	0.34 J	0.1 J	0.18 J	14 J	5.3 J	10 J	40 J		240 J	490 J	37 J
PBB(BP-6)	IP	0.092	0.17	0.017		0.18 J						
tris (2,3-Dibromopropyl) phosphate	NA											
4,4'-DDD	NA	0.82 DJ	0.14	0.29	1.5 J	0.46		4.7 D	2.8 D	5.8 J	6.7 J	4.3 D
4,4'-DDE	NA	0.34										
4,4'-DDT	0.02 (M)	0.31 J	0.078 J	0.22 J	0.59 J	3.1 D	11 DJ	0.98 J		91 D	350 D	
Alpha-BHC		0.097	0.041 J	0.23	4.2 D	0.49	0.81 J	1.5	7.2 D			2.8 DJ
Alpha-chlordane	IP				0.058 J			0.046 J	0.028 J			0.058 J
Beta-BHC	-	0.24 J	0.058 J	0.1 J	1.4 D	0.21 J	0.94	1 DJ	3.1 D			2.4 D
Decachlorobiphenyl	0.2								0.00796			
Delta-BHC	-				0.11 J				0.24 J			0.15 J
Dieldrin	0.02 (M)	0.21 J							0.052 J			
Endosulfan I	NA											
Endosulfan II	NA											
Gamma-BHC (Lindane)	0.027			0.059 J	0.27 J			0.048 J				0.21 J
Gamma-Chlordane	IP	0.054 J										0.064 J
Heptachlor	NA											
Heptachlor Epoxide	NA											

D = The sample was diluted

J = The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

IP = Development of generic GSI value in process

(M) = Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

NA = Criterion or value is not available or, as is the case for USAF, not applicable

ID = Inadequate data to develop criterion

Bolded & Boxed values exceed GSI criteria

Table 11-B
Phase I
Groundwater Analytical Data Summary (Detections only)
VOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	SSD-01	WPZ-01X(8-10)	WPZ-01X(9-11)	WPZ-01I(9-11)	WPZ-02X(9-12)	WPZ-04X(10-14)	WPZ-06X(10-14)	WPZ-06X(18-20)	WPZ-06I(10-14)	WPZ-06I(18-20)	WPZ-07X(16-20)	WPZ-08X(10-12)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled		2/6/02	1/30/02	1/30/02	2/4/02	2/4/02	2/6/02	2/7/02	2/7/02	2/7/02	2/8/02	2/11/02	2/11/02
VOC's		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Isopropylbenzene	ID						14	1 J				1 J	
Methylcyclohexane	-						51	5 J		3 J			
trans-1,2-Dichloroethene	ID							2 J	1 J		2 J		
1,2 Dichlorobenzene	16							2 J	8 J	3 J	33		
1,1,1-Trichloroethane	200								5 J		3 J		
1,1,2,2 Tetrachloroethane	78 {X}												
1,1,2-Trichloroethane	330 {X}												
1,1-Dichloroethane	ID							5 J	16	3 J	22		1 J
1,1-Dichloroethene	65 {X}										2 J		
1,2-Dichloroethane	360 {X}								68		200 D		
1,2-Dichloropropane	290 {X}												
2 Hexanone	NA												
4-Methyl-2-pentanone	ID												
Acetone	1700											5 J	5 J
Benzene	200 {X}						22	2600 D	400 D	590 D	1400 D	15	11
Carbon disulfide	ID							1 J					
Chlorobenzene	47							270 D	620 D	540 D	1900 D	13	14
Chloroethane	ID										4 J		
Chloroform	170 {X}								1 J		5 J		
cis-1,2-Dichloroethene	*ID*								5 J		40		
Ethylbenzene	18						20	7 J	2 J	3 J	3 J	10	
Methylene chloride	940 {X}	3 J	1 J	1 J			2 J	2 J	4 J			1 J	
Tetrachloroethene	45 {X}						1 J				1 J		
Toluene	140						4 J	16	48	19	180		
trans-1,3-Dichloropropene	NA												
Trichloroethene	200 {X}			12	12	5 J			6 J		38		
Vinylchloride	15							7 J	12	4 J	52		
Xylene (Total)	35						12	14	6 J	2 J	11	10	
Cyclohexane	-						49	3 J	2 J	3 J	9 J	1 J	2 J

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D = The sample was diluted

J = The analyte was positively identified, the associated numerical value is an approximate concentration

NA = Criterion or value is not available or, as is the case for NA, not applicable

ID = Inadequate data to develop criterion

{X} = The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 28 Footnotes for further explanation.)

Bolded and Boxed values exceed GSI criteria

MDEQ and WESTON

Table 11-A
Phase I
Groundwater Analytical Data Summary (Detections only)
Pesticides, PCB's, and Specialty Chemicals
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	WPZ-11I(28-30)	WPZ-12X(8-10)	WPZ-15X(14-16)	WSB02-03(12-15)	WSB02-04(7-11)	WSB02-05(4-11)	WSB02-06(10-15)	WSB02-07(13-17)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled		2/20/02	2/14/02	2/20/02	2/4/02	2/5/02	2/5/02	2/5/02	2/6/02
PESTICIDE/PCB		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
2,4'-DDT	NA	4400 J		0.25 J	0.98 J	0.0063 J	0.051 J	0.03 J	0.012 J
PBB(BP-6)	IP							0.16 J	
tris (2,3-Dibromopropyl) phosphate	NA								
4,4'-DDD	NA	430 J			0.26 J			0.12 J	
4,4'-DDE	NA			0.24 J	0.4			0.05 J	
4,4'-DDT	0.02 (M)	5100 D		1.2	3.3 D		0.082 J	0.13 J	
Alpha-BHC	-		0.025 J			0.037 J			
Alpha-chlordane	IP								
Beta-BHC	-					0.027 J			
Decachlorobiphenyl	0.2								
Delta-BHC	-								
Dieldrin	0.02 (M)								
Endosulfan I	NA								
Endosulfan II	NA								
Gamma-BHC (Lindane)	0.027								
Gamma-Chlordane	IP								
Heptachlor	NA								
Heptachlor Epoxide	NA								

D= The sample was diluted

J= The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

IP= Development of generic GSI value in process

(M) Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL

NA= Criterion or value is not available or, as is the case for CSAT, not applicable

ID= Inadequate data to develop criterion

Bolded & Boxed values exceed GSI criteria

Table 11-B
Phase I
Groundwater Analytical Data Summary (Detections only)
VOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	WPZ-08X(14-17)	WPZ-09X(20-22)	WPZ-09X(9-13)	WPZ-09I(10-14)	WPZ-09I(20-22)	WPZ-10X(16-20)	WPZ-10X(23-25)	WPZ-10X(9-13)	WPZ-10I(23-25)	WPZ-10I(9-13)	WPZ-11X(10-13)	WPZ-11X(23-25)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled		2/11/02	2/12/02	2/12/02	2/12/02	2/16/02	2/12/02	2/12/02	2/12/02	2/12/02	2/13/02	2/13/02	2/14/02
VOC's		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Isopropylbenzene	ID												
Methylcyclohexane	-												
trans-1,2-Dichloroethene	ID		28	1 J		17 J	3 J			2 J	3 J		140 J
1,2-Dichlorobenzene	16		82 J	10 J		200 J	31		2 J	24 J	33 J	18	410 J
1,1,1-Trichloroethane	200						16		18			26	
1,1,2,2-Tetrachloroethane	78 {X}								78			56	1200 J
1,1,2-Trichloroethane	330 {X}						1 J						22 J
1,1-Dichloroethane	ID	4 J			2 J	4 J	14		2 J	4 J	5 J	3 J	37 J
1,1-Dichloroethene	65 {X}						2 J						
1,2-Dichloroethane	360 {X}				48	3 J	340 D		88		40 J	96	400 J
1,2 Dichloropropane	290 {X}						14		4 J			4 J	7 J
2 Hexanone	NA												
4-Methyl-2-pentanone	ID					15 J							
Acetone	1700		13 J			44 J	5 J		5 J	4 J		5 J	16 J
Benzene	200 {X}	32		200 J	110		1700 D	1500 D	91	540 D	840 D	150	1700 J
Carbon disulfide	ID									1 J		1 J	5 J
Chlorobenzene	47	20	130000 D	11000 D	4100 D	76000 D	15000 D	110000 D	790 D	3900 D	7800 D	3400 D	130000 D
Chloroethane	ID						53		14	74 J		32	29 J
Chloroform	170 {X}		2 J		6 J		380 D		250 D	2 J	8 J	440 D	36 J
cis-1,2-Dichloroethene	ID	3 J		3 J	34		15			90 J	27 J		430 J
Ethylbenzene	18		44	6 J	1 J	69 J	3 J				2 J		12 J
Methylene chloride	940 {X}					4 J			13	1 J			930 J
Tetrachloroethene	45 {X}		19			18 J	8 J		2 J			4 J	51 J
Toluene	140		52	4 J	1 J	93 J	11		1 J	4 J	6 J	5 J	560 J
trans-1,3-Dichloropropene	NA						3 J						
Trichloroethene	200 {X}		260 J	3 J	72	27 J	130		18	20 J	49 J	34	300 J
Vinylchloride	15	1 J	83 J	2 J							10 J		9 J
Xylene (Total)	35		7 J	6 J		30 J	11				5 J	1 J	22 J
Cyclohexane	-										2 J		

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D: The sample was diluted

J: The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample

NA: Criterion or value is not available or, as is the case for GSAT, not applicable

ID: Inadequate data to develop criterion

{X}: The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 Footnote for further explanation)

Bolded and Boxed values exceed GSI criteria

Table 11-C
Phase I
Groundwater Analytical Data Summary (Detections only)
SVOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	WPZ-04X(10-14)	WPZ-06X(10-14)	WPZ-06X(18-20)	WPZ-06I(10-14)	WPZ-06I(18-20)	WPZ 07X(16-20)	WPZ-09X(20-22)	WPZ-09X(9-13)	WPZ-09I(20-22)	WPZ-10X(16 20)	WPZ-10X(23-25)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Date Sampled		2/6/02	2/7/02	2/7/02	2/7/02	2/8/02	2/11/02	2/12/02	2/12/02	2/16/02	2/12/02	2/12/02
SVOCs		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Caprolactam	NA											
1,1-Biphenyl	-				6 J							
1,2,4-Trichlorobenzene	30								1 J	13		
1,3 Dichlorobenzene	38				1 J							
1,4-Dichlorobenzene	13		4 J	1 J	8 J	3 J			**30 J**		**38 J**	
2,4,6-Trichlorophenol	4.4											1 J
2,4-Dichlorophenol	19									1 J		3 J
2-Chlorophenol	22							27	19	**33 J**	**28**	**61**
2-Methylnaphthalene	ID	8 J			9 J							
4-Methylphenol (P-Cresol)	-							16	16	6 J	5 J	49
Acetophenone	NA											
bis(2-Ethylhexyl)phthalate	32	92		1 J			21	1 J	1 J			
Di-N-Butyl phthalate	9.7								1 J			
Di-N-Octyl phthalate	10											
Naphthalene	13									2 J		
Phenanthrene	5 [M]	7 J										
Phenol	210		9 J					10	10	20 J		33

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451
D- The sample was diluted
J- The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample
NA- Criterion or value is not available or, as is the case for CSAT, not applicable
ID- Inadequate data to develop criterion
[M] Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL
Bolded and Boxed values exceed GSI criteria

Table 11-C
Phase I
Groundwater Analytical Data Summary (Detections only)
SVOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	WPZ-10X(9-13)	WPZ-10I(23-25)	WPZ-10I(9-13)	WPZ-11X(10-13)	WPZ-11X(23-25)	WPZ-11X(25-30)	WPZ-11I(28-30)	WPZ-12X(6-8)	WPZ-15X(14-16)	WPZ-16X(10-13)	WSB02-03(12-15)	WSB02-07(13-17)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Date Sampled		2-12/02	2-12-02	2-13/02	2/13/02	2/14/02	2-15/02	2/20/02	2-13/02	2-20-02	2/20/02	2/4/02	2/6/02
SVOCs		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Caprolactam	**NA**							15		23			
1,1-Biphenyl	-			10	19 J			32					
1,2,4-Trichlorobenzene	**30**		2 J			24 J	**110 J**	16 J					
1,3 Dichlorobenzene	**38**			**41 J**									
1,4-Dichlorobenzene	**13**	3 J	**45 J**		**35**	**1300 J**		**130 J**					
2,4,6-Trichlorophenol	**4.4**												
2,4-Dichlorophenol	**19**												
2-Chlorophenol	**22**	10 J			8 J			13					
2-Methylnaphthalene	**ID**												
4-Methylphenol (P-Cresol)	-	2 J				250 D	190 D						
Acetophenone	**NA**	**0.5 J**								**2 J**			
bis(2-Ethylhexyl)phthalate	**32**		1 J	1 J	4 J	4 J	6 J		1 J	2 J		**36**	**90 D**
Di-N-Butyl phthalate	**9.7**												
Di-N-Octyl phthalate	**10**										1 J		
Naphthalene	**13**							2 J					
Phenanthrene	**5 {M}**												
Phenol	**210**	2 J			61	61	29	4 J					

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451
D - The sample was diluted
J - The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample
NA - Criterion or value is not available or, as is the case for CSAT, not applicable
ID- Inadequate data to develop criterion
{M} Calculated criterion is below the analytical Target Detection Limit (TDL), therefore, the criterion defaults to the TDL
Bolded and Boxed values exceed GSI criteria

Table 11-D
Phase I
Groundwater Analytical Data Summary
Inorganics
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	WPZ-08X(14-17)	WPZ-09X(20-22)	WPZ-09X(9-13)	WPZ-09I(10-14)	WPZ-09I(20-22)	WPZ-10X(16-20)	WPZ-10X(23-25)	WPZ-10X(9-13)	WPZ-10I(23-25)	WPZ-10I(9-13)	WPZ-11X(10-13)	WPZ-11X(23-25)	WPZ-11X(25-30)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled		2/11/02	2/12/02	2/12/02	2/12/02	2/13/02	2/12/02	2/12/02	2/12/02	2/13/02	2/13/02	2/14/02	2/14/02	2/15/02
Inorganics		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Aluminum	NA	798	7840	1770	15500	1770	3690	1750	1360	16700	3900	1080	6970	10500
Antimony	ID	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9
Arsenic (As)	150 {X}	<4	21.9	10.3	83.2	9.8	22.3	9.7	5.6	44.1	9	25.4	66.2	53.2
Barium	1900	49.7	643	80.2	462	43.7	223	188	47.2	443	52.9	134	733	551
Beryllium	{G}	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.4
Cadmium	2.5	<2	<2	<2	<2	<2	<2	<2	<2	3.6	<2	2.2	<2	6
Calcium	-	335000	824000	444000	525000	877000	657000	1590000	272000	442000	299000	291000	781000	734000
Chromium	11	2.2	36.5	4.2	34.9	3.2	13.4	13.2	5	89.5	8.5	5.1	56.3	39.1
Cobalt	100	1.9	8.3	1.7	13.3	3.1	6	3.2	29.3	26.1	10	16.1	43.5	76.9
Copper	{G}	5.4	54	16.9	182	30.4	108	24.1	10.8	219	22.8	64.8	73.5	67.6
Iron (Ferrous)	NA	9050	30300	10800	56400	22800	106000	90300	7160	67100	18600	19000	147000	127000
Lead (Pb)	14	5	49.9	188	1740	14.9	37.6	8.1	25.7	2920	290	145	150	141
Magnesium	NA	132000	204000	148000	212000	217000	114000	329000	61300	112000	88000	54900	188000	171000
Manganese	{G,X}	144	555	706	2160	963	1970	3650	891	2190	2480	608	2620	3010
Mercury	0.0013 {Z}	<0.1	<0.1	0.29	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.17	0.96	0.13	<0.1
Nickel	{G}	30.3	31.5	8	88.3	17.6	23.2	26.7	67.2	62.8	27.3	38.3	60.6	116
Potassium	-	34900	158000	31600	103000	96900	39100	97500	9020	42100	15600	8050	43900	39000
Selenium	5.0	<5	<5	<5	<5	<5	<5	<5	<5	5.8	<5	<5	<5	<5
Silver	0.2 {M}	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Sodium	NA	146000	1340000	235000	564000	1400000	145000	1160000	54100	156000	79700	59500	163000	117000
Thallium	3.7 {X}	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9	<9
Vanadium	12	<2	35.3	2.8	36.2	8.8	7.9	3.8	3.2	38.1	2.6	2.9	18.4	38.4
Zinc	{G}	6.6	94.5	65.1	328	21.8	352	199	377	1070	138	364	1490	3030
Cyanide	20 {M}	1.4	2	<1	2.2	2.8	1.5	1.9	1.4	1.9	2.4	<1	3.3	3.3

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act (1994 PA 451)

ID = The sample was diluted.

J = The analyte was positively identified; the associated numerical value is an approximate concentration of the analyte in the sample.

R = The data are unusable. (The compound may or may not be present.)

{G, GSI criterion is pH or water hardness dependent. (See MDEQ ERD Op Memo 18 footnotes for further explanation.)

{M} Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL.

{X} The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 footnotes for further explanation.)

{Z} The current TDL for Mercury is 0.2ppb; however, a TDL of 0.0013 using U.S. EPA Method 1631, will be required after September 30, 2006.

NA = Criterion or value is not available or not as is the case for GSI, not applicable.

ID: Inadequate data to develop criterion.

Bolded & Boxed values exceed GSI criteria

Table 11-E
Phase I
Groundwater Analytical Data Summary
Water Chemistry Parameters
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	SSD-01	WPZ-01X(8-10)	WPZ-01E(9-11)	WPZ-01I(9-11)	WPZ-02X-(9-12)	WPZ-04X(10-14)	WPZ-06X(10-14)	WPZ-06X(18-20)	WPZ-06I(10-14)	WPZ-06I(18-20)	WPZ-07X(16-20)	WPZ-08X(10-12)	WPZ-08X(14-17)
Matrix	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
Units	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
Date Sampled	2/6/02	1/30/02	1/30/02	2/4/02	2/4/02	2/6/02	2/7/02	2/7/02	2/7/02	2/8/02	2/11/02	2/11/02	2/11/02
WATER CHEMISTRY	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
BOD, 5 Day	<1	1.2	4.2	<1	1.3	31	29	29	9.1	<5	11	2	1.2
Carbon, Total Organic	4.7	4.8	7.7	6.1	8.5	33	18	14	16	34	4.4	11	10
HEM; Oil & Grease	<7.8	<5	<5	<5	<5	108	<5	<6.7	<5	<5	<5	<6.7	<5
Nitrogen, Ammonia	<0.01	<0.01	0.14	0.29	0.01	4.3	3	9.7	4.1	7.7	7.1	3.8	3.2
Nitrogen, Nitrate+Nitrite	1.1	7.2	7.5	8	1.8	0.02	0.03	0.02	0.01	0.02	0.01	0.02	<0.01
Nitrogen, Total Kjeldahl	0.3	0.36	0.65	0.62	0.68	13	4.1	13	5.2	13	7.4	4.2	3.8
Residue, Suspended (TSS)	4	38	37	38	131	1460	109	434	2290	303	89	266	6680
Residue,Dissolved @ 180° C (TDS)	650	292	406	836	552	2830	2080	3780	1170	3440	9700	2380	2110
Chemical oxygen demand	8.6	7.6	25	11	14	585	121	411	119	555	333	106	120
Chloride	131	7.1	24	32	44	302	595	1670	675	1890	5640	647	584
Sulfate	107	48	76	281	123	32	416	452	348	442	55	524	537

Table 11-E
Phase I
Groundwater Analytical Data Summary
Water Chemistry Parameters
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	WPZ-12X(8-10)	WPZ-14X(10-14)	WPZ-14X(17-19)	WPZ-14I(19-22)	WPZ-15X(14-16)	WPZ-16E(10-13)	WSB02-02(12-15)	WSB02-03(12-15)	WSB02-04(7-11)	WSB02-05(4-11)	WSB02-06(10-15)	WSB02-07(13-17)
Matrix	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
Units	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
Date Sampled	2/14/02	2/18/02	2/18/02	2/19/02	2/20/02	2/20/02	1/30/02	2/4/02	2/5/02	2/5/02	2/5/02	2/6/02
WATER CHEMISTRY	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
BOD, (5-Day)	<1	1.4	2.4	1	1.8	2.8	1.1	3.4	1.3	<1	3	1.2
Carbon, Total Organic	6	10	9.4	6.6	15	39	11	9.4	9.9	8.3	6.6	3.4
HEM; Oil & Grease	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Nitrogen, Ammonia	0.46	3.6	4.1	5.8	2.3	3	3.6	2.9	1.5	0.006	0.26	1.5
Nitrogen, Nitrate+Nitrite	0.07	0.01	0.01	0.02	0.02	<0.01	0.01	<0.01	0.03	0.28	0.01	0.01
Nitrogen, Total Kjeldahl	0.82	3.9	4.5	6.2	3.7	3.7	3.9	3.4	2.5	0.47	7	1.7
Residue, Suspended (TSS)	130	14	161	39	1490	5810	778	39	28	144	7710	288
Residue,Dissolved @ 180° C (TDS)	1630	2260	3090	4930	2700	1990	2450	922	790	494	4150	7170
Chemical oxygen demand	13	97	164	138	118	94	34	26	14	15	252	314
Chloride	349	259	984	2200	651	463	1010	25	39	51	1960	53
Sulfate	298	371	364	341	571	370	405	290	206	115	339	98

Table 11-B
Phase I
Groundwater Analytical Data Summary (Detections only)
VOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location :	Groundwater Surface Water Interface Protection Criteria (ug/l)	WPZ-11X(25-30)	WPZ-11I(28-30)	WPZ-12X(6-8)	WPZ-12X(8-10)	WPZ-14X(10-14)	WPZ-14X(17-19)	WPZ-14I(19-22)	WPZ-15X(14-16)	WPZ-16X(10-13)	WSB02-02(12-15)	WSB02-03(12-15)	WSB02-04(7-11)
Matrix :		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units :		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled :		2/15/02	2/20/02	2/13/02	2/14/02	2/18/02	2/18/02	2/19/02	2/20/02	2/20/02	1/30/02	2/4/02	2/5/02
VOC's		RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT	RESULT
Isopropylbenzene	ID												
Methylcyclohexane	-												
trans-1,2-Dichloroethene	ID	54 J	5 J		2 J	1 J	1 J			2 J			
1,2-Dichlorobenzene	16		**49 J**										
1,1,1-Trichloroethane	200	9 J	3 J										
1,1,2,2-Tetrachloroethane	78 {X}												
1,1,2-Trichloroethane	330 {X}	7 J											
1,1-Dichloroethane	ID	31 J	15 J			4 J	4 J	2 J	5 J		1 J		
1,1-Dichloroethene	65 {X}		2 J										
1,2-Dichloroethane	360 {X}		140 J										
1,2-Dichloropropane	290 {X}	6 J	5 J										
2-Hexanone	NA									61			
4-Methyl-2-pentanone	ID	6 J											
Acetone	1700	11 J	5 J				2 J			16 J			
Benzene	200 {X}	**2500 D**	**1200 D**	2 J	17	**470 D**	**510 D**	2 J	**440 D**	12	110	1 J	1 J
Carbon disulfide	ID	20 J	4 J			3 J	3 J						
Chlorobenzene	47	**150000 D**	**11000 J**		7 J	**48**	**54**	2 J	29	6 J	**2000 D**	1 J	1 J
Chloroethane	ID	33 J	78 J										
Chloroform	170 {X}	110 J	33 J										
cis-1,2-Dichloroethene	ID	130 J	42 J	1 J	7 J				110	3 J	25		
Ethylbenzene	18	17 J	3 J			2 J	2 J			2 J			
Methylene chloride	940 {X}		4 J			1 J					1 J		
Tetrachloroethene	45 {X}	72 J	2 J	2 J	6 J								
Toluene	140		31 J			2 J	2 J				4 J		
trans-1,3-Dichloropropene	NA												
Trichloroethene	200 {X}		180 J	2 J	6 J	1 J	1 J		1 J		2 J		
Vinylchloride	15		24 J		2 J			27	77		12		
Xylene (Total)	35	27 J	6 J			1 J	1 J			2 J			
Cyclohexane	-					1 J	1 J						

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D The sample was diluted

J= The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

NA- Criterion or value is not available or, as is the case for CSAT, not applicable.

ID Inadequate data to develop criterion

{X} The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

Bolded and Boxed values exceed GSI criteria

Table 11-B
Phase I
Groundwater Analytical Data Summary (Detections only)
VOC's
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	WSB02-06(10-15)	WSB02-07(13-17)
Matrix		Water	Water
Units		ug/l	ug/l
Date Sampled		2/5/02	2/6/02
VOC's		**RESULT**	**RESULT**
Isopropylbenzene	ID		
Methylcyclohexane	-		
trans-1,2-Dichloroethene	ID		
1,2-Dichlorobenzene	16		
1,1,1-Trichloroethane	200		
1,1,2,2-Tetrachloroethane	78 (X)		
1,1,2-Trichloroethane	330 (X)		
1,1-Dichloroethane	ID		
1,1-Dichloroethene	65 (X)		
1,2-Dichloroethane	360 (X)	16	
1,2-Dichloropropane	290 (X)		
2-Hexanone	NA		
4-Methyl-2-pentanone	ID		
Acetone	1700		
Benzene	200 (X)	10	
Carbon disulfide	ID		
Chlorobenzene	47	39	1 J
Chloroethane	ID	2 J	
Chloroform	170 (X)		
cis-1,2-Dichloroethene	ID		
Ethylbenzene	16		
Methylene chloride	940 (X)	2 J	2 J
Tetrachloroethene	45 (X)		
Toluene	140		
trans-1,3-Dichloropropene	NA		
Trichloroethene	200 (X)		
Vinylchloride	15		
Xylene (Total)	35		
Cyclohexane	-		

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Bolded and Boxed values exceed GSI criteria

Table 11-D
Phase I
Groundwater Analytical Data Summary
Inorganics
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	SSD-01	WPZ-01X(8-10)	WPZ-01X(9-11)	WPZ-01I(9-11)	WPZ-02X(9-12)	WPZ-04X(10-14)	WPZ-06X(10-14)	WPZ-0(Y(18-20)	WPZ-06I(10-14)	WPZ-06I(18-20)	WPZ-07X(16-20)	WPZ-08X(10-12)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled		2/6/02	1/30/02	1/30/02	2/4/02	2/4/02	2/6/02	2/7/02	2/7/02	2/7/02	2/8/02	2/11/02	2/11/02
Inorganics		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Aluminum	NA	85.3	667	503	526	1220	5030	2490	4860	10600	1620	129	862
Antimony	ID	2.8 J	<4	<4	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<1.5	<9	<9
Arsenic (As)	150 {X}	<1.7	<4	<4	2	2	56.6	32.8	38.2	30.9	45.6	10	9.1
Barium	1900	78.2	50.9	47	53.7	88.5	847	80.8	126	130	188	321	134
Beryllium	{G}	<0.3	<1	<1	<0.3	<0.3	<0.3	<0.3	<0.3	0.47 J	<0.3	<1	<1
Cadmium	2.5	<0.3	<1	<1	<0.3	<0.3	0.91	0.33 J	0.98 J	1.1 J	1.7	<2	<2
Calcium	-	134000	82400	91700	166000	142000	519000	116000	53000	143000	163000	1270000	363000
Chromium	11	0.9 J	1.4	1.8	<0.9	2.3 J	7	7.3 J	75.5 J	27.6 J	26.8 J	<2	<2
Cobalt	100	<2	<2	2.4	<2	<2	3.1	6.1	24.4	14.2	31.7	1	1.9
Copper	{G}	4.2 J	8.7	7.7	11.9	48.3	19.5	10.4 J	36.1	35.3	25.2	10	10.7
Iron (Ferrous)	NA	59.2	1150	1920	934	3390	33500	11100	28700	23600	55500	1520	18300
Lead (Pb)	14	<1.6	<2	<2	1.6 J	3.8 J	22.3	4.6 J	19.1 J	14.3 J	16 J	<3	19.8
Magnesium	NA	27200	18400	21600	55900	29700	86900	344000	556000	307000	534000	170000	99900
Manganese	{G,X}	<0.3	32	196	1780	171	2070	692	698	1180	1780	268	1010
Mercury	0.0013 {Z}	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	<0.1	0.26	0.22	0.23	<0.1	<0.1
Nickel	{G}	<1	<2	7.3	4.2 J	1.2 J	8.1	56.8	250	88.3	212	4.6	26.6
Potassium	-	9630	12600	11300	8150 J	14600 J	77500	36400 J	81600 J	47600 J	84500 J	152000	45200
Selenium	5.0	3.2	<4	<4	<1.9	<1.9	<1.9	<1.9	2.4	<1.9	<1.9	<5	<5
Silver	0.2 {M}	<0.5	<1	<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<2	<2
Sodium	NA	38800	2670	13100	16500	11600	233000	136000	344000	123000	347000	1090000	165000
Thallium	3.7 {X}	<3	<4	<4	<3	<3	<3	<3	<3	<3	<3	<9	<9
Vanadium	12	<1.7	1.2	1.8	<1.7	5	11.8	6	10.4	23.2	5	<2	<2
Zinc	{G}	<4.6	9.4 J	10.1 J	<4.6	29.3 J	47.2	21.2 J	147 J	60.5 J	79.8 J	<5	17.7
Cyanide	20 {M}	<0.8	<1	2 J	1.5	0.94	2.5	1.7	4	2	3.8	5.1	2.1

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D: The sample was diluted

J= The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

R= The data are unusable. (The compound may or may not be present)

{G} GSI criterion is pH or water hardness dependent. (See MDEQ ERD Op Memo 18 footnotes for further explanation)

{M} Calculated criterion is below the analytical Target Detection Limit (TDL), therefore, the criterion defaults to the TDL

{X} The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

{Z} The current TDL for Mercury is 0.2ppb, however, a TDL of 5.0 E-4 using U.S. EPA Method 1631, will be required after September 30, 2000

NA: Criterion or value is not available or, as is the case for CSAT, not applicable

ID: Inadequate data to develop criterion

Bolded & Boxed values exceed GSI criteria

Table 11-E
Phase I
Groundwater Analytical Data Summary
Water Chemistry Parameters
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	WPZ-09X(20-22)	WPZ-09X(9-13)	WPZ-09I(10-14)	WPZ-09I(20-22)	WPZ-10X(16-20)	WPZ-10X(23-25)	WPZ-10X(9-13)	WPZ-10I(23-25)	WPZ-10I(9-13)	WPZ-11X(10-13)	WPZ-11X(23-25)	WPZ-11X(25-30)	WPZ-11I(28-30)	WPZ-12X(6-8)
Matrix	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
Units	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L
Date Sampled	2/12/02	2/12/02	2/12/02	2/13/02	2/12/02	2/12/02	2/12/02	2/13/02	2/13/02	2/14/02	2/14/02	2/15/02	2/20/02	2/13/02
WATER CHEMISTRY	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
BOD, (5-Day)	2.9	9.7	7.6	9.7	29	67	2.8	9.7	9.7	6.1	60	93	23	9.7
Carbon, Total Organic	6.8	14	8.9	11	35	13	8.1	16	11	16	29	64	23	5.9
HEM; Oil & Grease	<5	<5	<5	<5	6.5	<5	10.4	<5	<5	7.2	<6.3	8.9	27.1	<5
Nitrogen, Ammonia	12	3.7	4.5	9.5	6.1	12	0.09	4.2	1.4	0.19	9	6.2	4.3	0.24
Nitrogen, Nitrate+Nitrite	0.02	0.01	0.02	0.01	<0.01	0.02	0.02	0.01	0.22	0.01	0.02	<0.01	0.06	0.09
Nitrogen, Total Kjeldahl	13	3.6	5	10	7.2	12	1.1	5.5	2.3	2.3	10	11	4.9	0.51
Residue, Suspended (TSS)	250	44	808	81	181	658	67	754	65	982	336	672	6300	7
Residue,Dissolved @ 180° C (TDS)	11200	2860	5180	9490	4830	13690	1360	3220	1890	2090	6400	4850	3920	1370
Chemical oxygen demand	333	81	163	326	294	763	70	109	68	56	643	400	143	15
Chloride	5210	784	1440	3710	1020	6370	249	776	370	260	1310	814	792	244
Sulfate	798	641	1280	1250	1370	845	367	511	504	543	1470	1470	914	276

Table 11-D
Phase I
Groundwater Analytical Data Summary
Inorganics
Velsicol Superfund Site
St. Louis, Michigan

Sampling Location	Groundwater Surface Water Interface Protection Criteria (ug/l)	WPZ-11I(28-30)	WPZ-12X(6-8)	WPZ-12X(8-10)	WPZ-14X(10-14)	WPZ-14X(17-19)	WPZ-14I(19-22)	WPZ-15X(14-16)	WPZ-16X(10-13)	WSB02-02(12-15)	WSB02-03(12-15)	WSB02-04(7-11)	WSB02-05(4-11)	WSB02-06(10-15)	WSB02-07(13-17)
Matrix		Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water
Units		ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
Date Sampled		2/20/02	2/13/02	2/14/02	2/18/02	2/18/02	2/19/02	2/20/02	2/20/02	1/30/02	2/4/02	2/5/02	2/5/02	2/5/02	2/6/02
Inorganics		**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**	**RESULT**
Aluminum	NA	3990	75.5	480	434	3100	702	2590	17600	359	287	439	747	26800	5280
Antimony	ID	3.6	<9	<9	<3.1	<3.1	<3.1	<3.1	<3.1	<4	<1.5	<1.5	<1.5	<1.5	2 J
Arsenic (As)	150 {X}	37.1	<4	<4	29.9	11.9	4.5	61.4	35.6	18.6	5.3	6.4	<1.7	46.6	18
Barium	1900	3190	127	143	86.3	129	303	120	216	114	19	48.8	21.5	366	484
Beryllium	{G}	0.21	<1	<1	<0.2	<0.2	<0.2	<0.2	1	<1	<0.3	<0.3	<0.3	1.4 J	<0.3
Cadmium	2.5	2	<2	<2	<0.4	<0.4	<0.4	<0.4	<0.4	<1	<0.3	0.35	<0.3	2.5	0.81 J
Calcium	-	599000	257000	293000	190000	338000	652000	294000	291000	287000	53000	167000	122000	814000	1450000
Chromium	11	60.1	<2	3.2	<1	15.4	<1	8.3	39.8	1.8	<0.9	<0.9	1.5 J	75.4 J	10.3 J
Cobalt	100	<1.3	1.7	3.3	<1.3	<1.3	<1.3	<1.3	10.9	<2	11	3.3	<2	39.3	5.9
Copper	{G}	195	9.9	15.8	2.6	23.1	3.8	24.3	47.2	1.9 J	2.5 J	4.2 J	11.7 J	63.3	16.9
Iron (Ferrous)	NA	64700	1000	2220	3690	10100	10000	33500	42100	8550	940	15500	1760	67100	16900
Lead (Pb)	14	513	<3	<3	<1.9	8.9	<1.9	11.8	24.1	<2	6 J	<1.6	2.4 J	35.3 J	7.4 J
Magnesium	NA	129000	55600	67100	212000	186000	131000	308000	237000	160000	154000	56200	32200	418000	473000
Manganese	{G,X}	2160	1170	1930	297	309	378	358	1350	314	155	1590	119	8830	1170
Mercury	0.0013 {Z}	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.16	<0.1
Nickel	{G}	35.8	4.8	7.2	36.3	45	77.7	46.8	43.5	40.3	2.1 J	11.4 J	1.9 J	171	16.9
Potassium	-	42900	15100	16700	60300	68400	117000	33900	40100	69500	26500 J	11900 J	5930	36400 J	25400 J
Selenium	5.0	<2.5	<5	<5	<2.5	<2.5	<2.5	<2.5	<2.5	<4	<1.9	<1.9	<1.9	<1.9	<1.9
Silver	0.2 {M}	5.2	<2	<2	<1.1	<1.1	<1.1	<1.1	<1.1	<1	<0.5	<0.5	<0.5	<0.5	<0.5
Sodium	NA	275000	64000	90400	177000	219000	493000	161000	191000	247000	34500	10300	9730	430000	432000
Thallium	3.7 {X}	4.5	<9	<9	<4.3	<4.3	<4.3	<4.3	<4.3	<4	<3	<3	<3	<3	<3
Vanadium	12	8.2	<2	<2	1.8	8.4	1.9	11.9	40.3	<1	<1.7	<1.7	1.9	58.2	10.9
Zinc	{G}	475	<5	358	<3.2	24.7	<3.2	70.4	86.2	<2	<4.6	44 J	22.3 J	197 J	27.3 J
Cyanide	20 {M}	<0.8	3.1	2.7	1.3	<0.8	<0.8	<0.8	<0.8	<1	<0.8	1.1	1.3	0.95	5.2

CRITERIA: Michigan Part 201 Generic Cleanup of the Natural Resources & Environmental Protection Act 1994 PA 451

D= The sample was diluted

J= The analyte was positively identified, the associated numerical value is an approximate concentration of the analyte in the sample

R = The data are unusable. (The compound may or may not be present)

{G} GSI criterion is pH or water hardness dependent. (See MDEQ ERD Op Memo 18 footnotes for further explanation)

{M} Calculated criterion is below the analytical Target Detection Limit (TDL), therefore, the criterion defaults to the TDL.

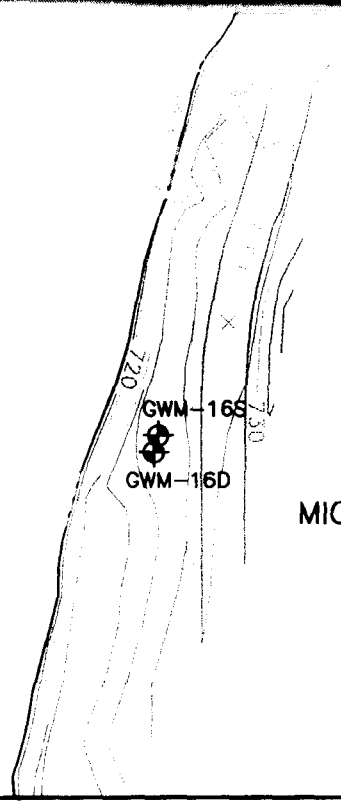
{X} The GSI criterion shown is not protective for surface water that is used as a drinking water source. (See MDEQ ERD Op Memo 18 Footnotes for further explanation)

{Z} The current TDL for Mercury is 0.2ppb, however, a TDL of 5.0 E-4 using U.S. EPA Method 1631, will be required after September 30, 2000.

NA: Criterion or value is not available or, as is the case for CSAT, not applicable.

ID: Inadequate data to develop criterion

Bolded & Boxed values exceed GSI criteria



DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

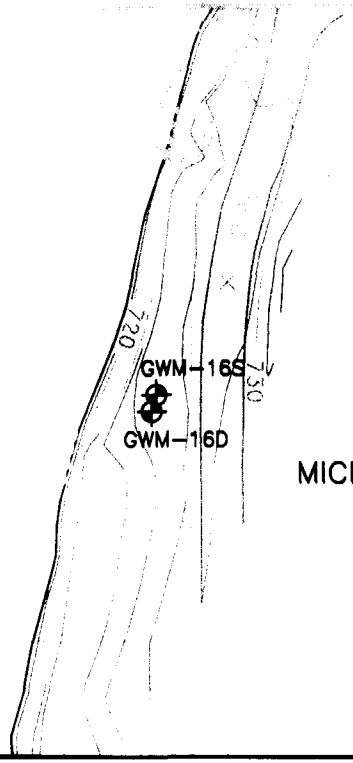
iver Place
uite 2800
Michigan
48207

EXISTING SITE CONDITIONS

VELSICOL SUPERFUND SITE

St. Louis, Michigan

SCALE:	DRAWN:	DATE:	DWG. NO.	
AS NOTED	D.C.H.	4/02	05302	FIGURE 1



MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

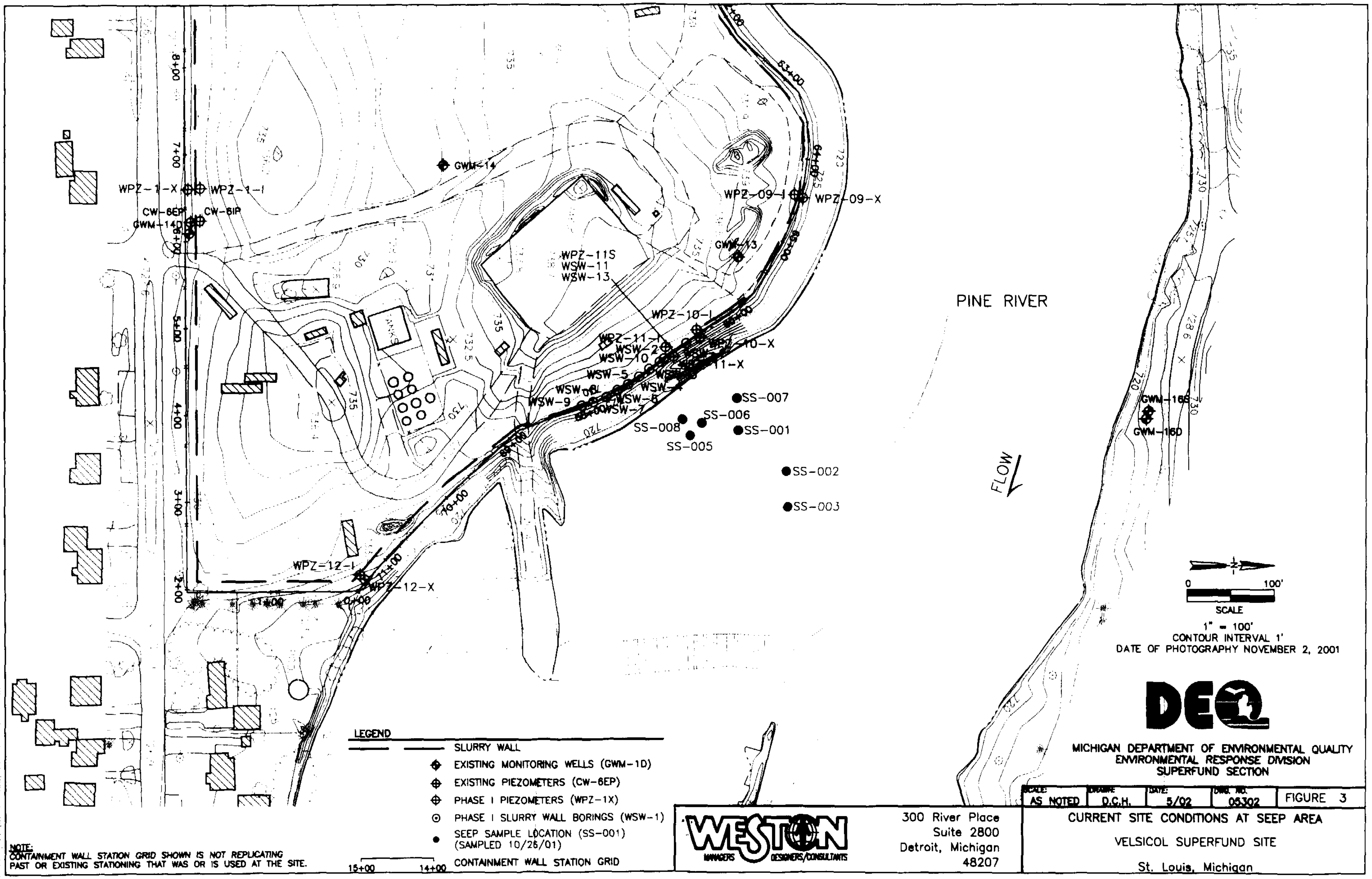
River Place
Suite 2800
, Michigan
48207

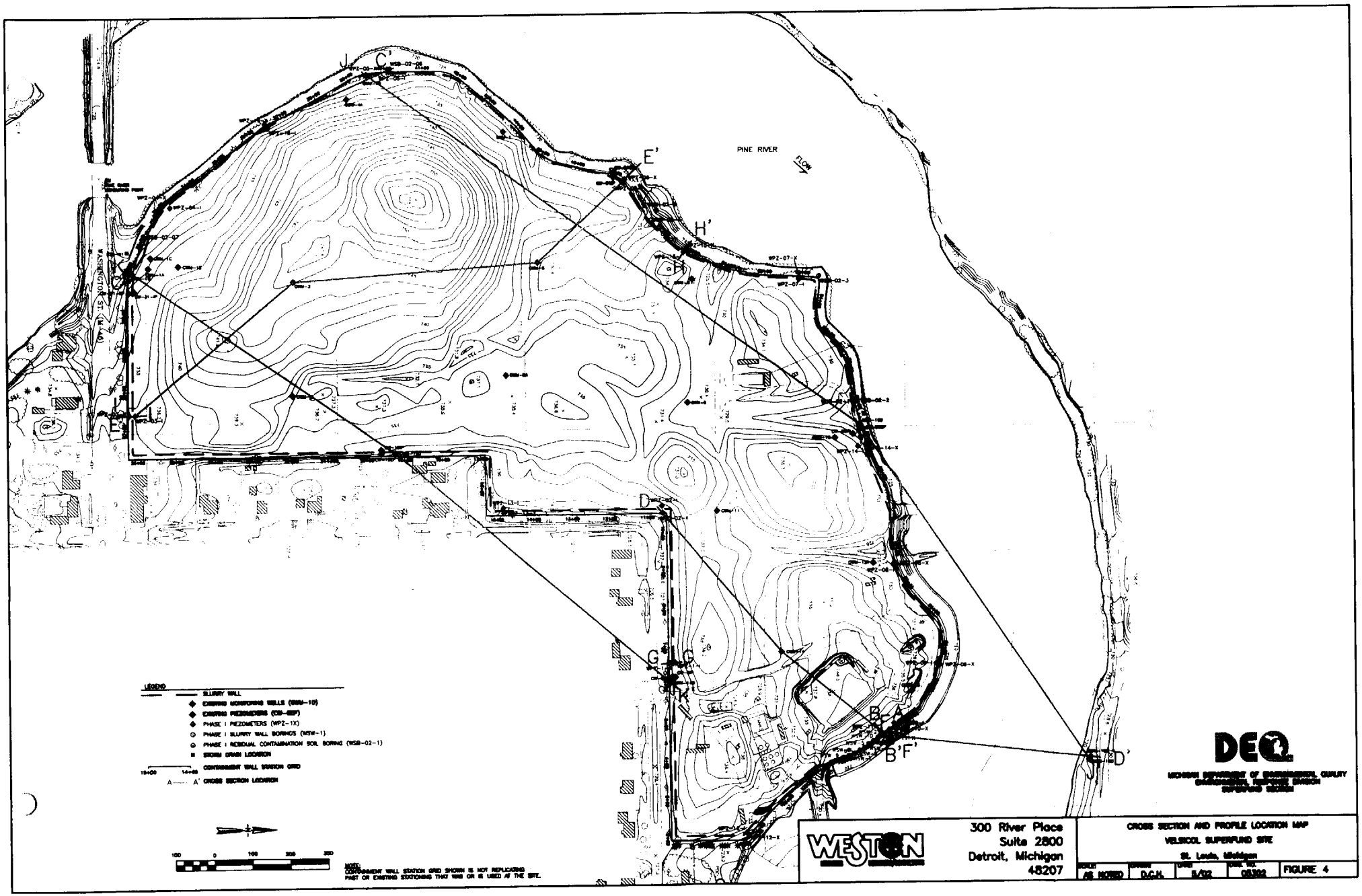
FORMER SITE CONDITIONS

VELSICOL SUPERFUND SITE

St. Louis, Michigan

SCALE:	DRAWN:	DATE:	DWG. NO.	
AS NOTED	D.C.H.	5/02	05302	FIGURE 2


PINE RIVER
FLOW
WPZ-1-X
WPZ-1-I
CW-6EP
CW-6IP
GWM-14D
GWM-14
WPZ-09-I
WPZ-09-X
GWM-13
WPZ-11S
WSW-11
WSW-13
WPZ-10-I
WPZ-10-X
WPZ-11-I
WSW-2
WSW-10
WSW-5
WSW-6
WSW-8
WSW-9
WSW-7
SS-007
SS-006
SS-001
SS-008
SS-005
SS-002
SS-003
GWM-16S
GWM-16D
WPZ-12-I
WPZ-12-X
TANKS
0 100'
SCALE
1" = 100'
CONTOUR INTERVAL 1'
DATE OF PHOTOGRAPHY NOVEMBER 2, 2001
DEQ
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION
LEGEND
SLURRY WALL
EXISTING MONITORING WELLS (GWM-1D)
EXISTING PIEZOMETERS (CW-6EP)
PHASE I PIEZOMETERS (WPZ-1X)
PHASE I SLURRY WALL BORINGS (WSW-1)
SEEP SAMPLE LOCATION (SS-001) (SAMPLED 10/26/01)
15+00 14+00 CONTAINMENT WALL STATION GRID
NOTE:
CONTAINMENT WALL STATION GRID SHOWN IS NOT REPLICATING PAST OR EXISTING STATIONING THAT WAS OR IS USED AT THE SITE.
WESTON
MANAGERS DESIGNERS/CONSULTANTS
300 River Place
Suite 2800
Detroit, Michigan
48207
SCALE: AS NOTED
DRAWN: D.C.H.
DATE: 5/02
DWG. NO. 05302
FIGURE 3
CURRENT SITE CONDITIONS AT SEEP AREA
VELSICOL SUPERFUND SITE
St. Louis, Michigan



DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

WESTON

300 River Place
Suite 2800
Detroit, Michigan
48207

CROSS SECTION AND PROFILE LOCATION MAP
VELSICOL SUPERFUND SITE
St. Louis, Michigan

DESIGNED	DRAWN	DATE	DWG. NO.	FIGURE 4
AR ROSSO	D.G.H.	5/02	05302	

695

FIGURE 5

Name: OMI\SHARED\Velsicol-PineRiver\XsectionAA'.DWG	Designed by: KAL	Drawn By: KAL	Checked by: JTB	Approved by: BJO

STON DESIGNERS/CONSULTANTS

Suite 2800
300 River Place
Detroit, Michigan
48207

GEOLOGIC CROSS SECTION A–A'
VELSICOL SUPERFUND SITE
ST. LOUIS, MICHIGAN

W.O.# 20083.500.001

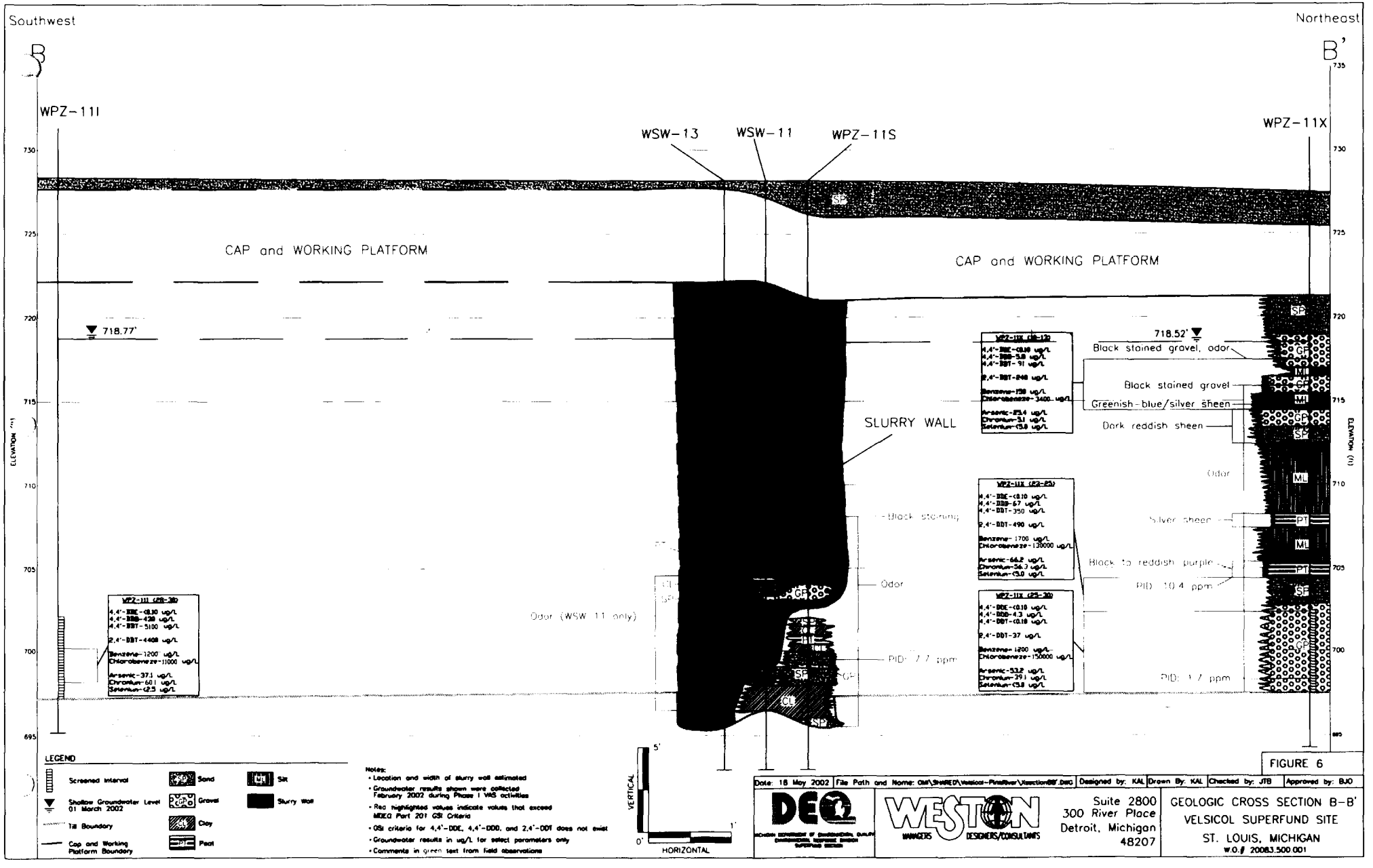


FIGURE 6

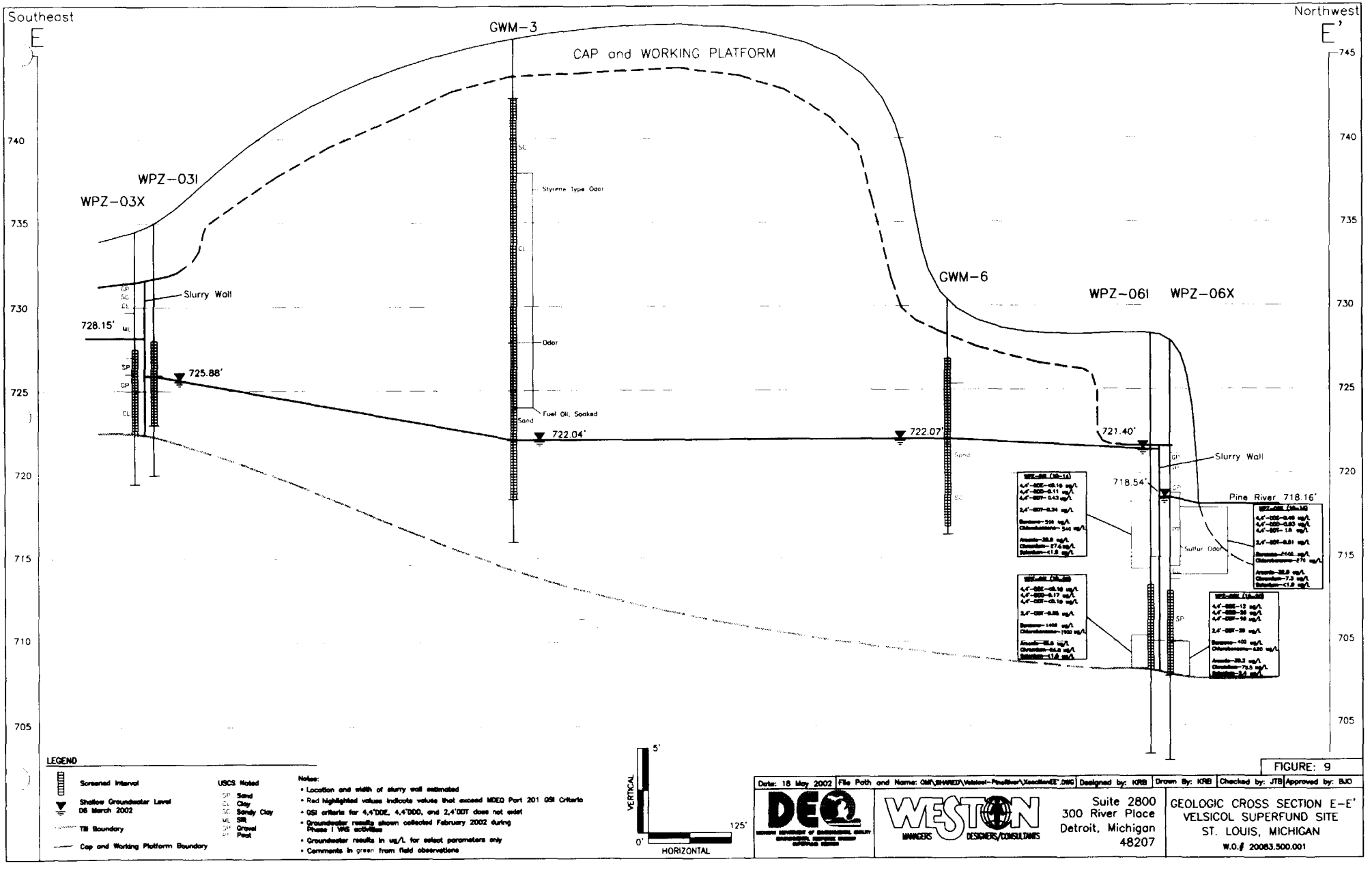
Date: 16 May 2002 | File Path and Name: C:\...\Velsicol-PineRiver\Xsection88'.DWG | Designed by: KAL | Drawn By: KAL | Checked by: JTB | Approved by: BJO

DEQ

WESTON MANAGERS DESIGNERS/CONSULTANTS

Suite 2800
300 River Place
Detroit, Michigan
48207

GEOLOGIC CROSS SECTION B-B'
VELSICOL SUPERFUND SITE
ST. LOUIS, MICHIGAN
W.O.# 20883.500.001

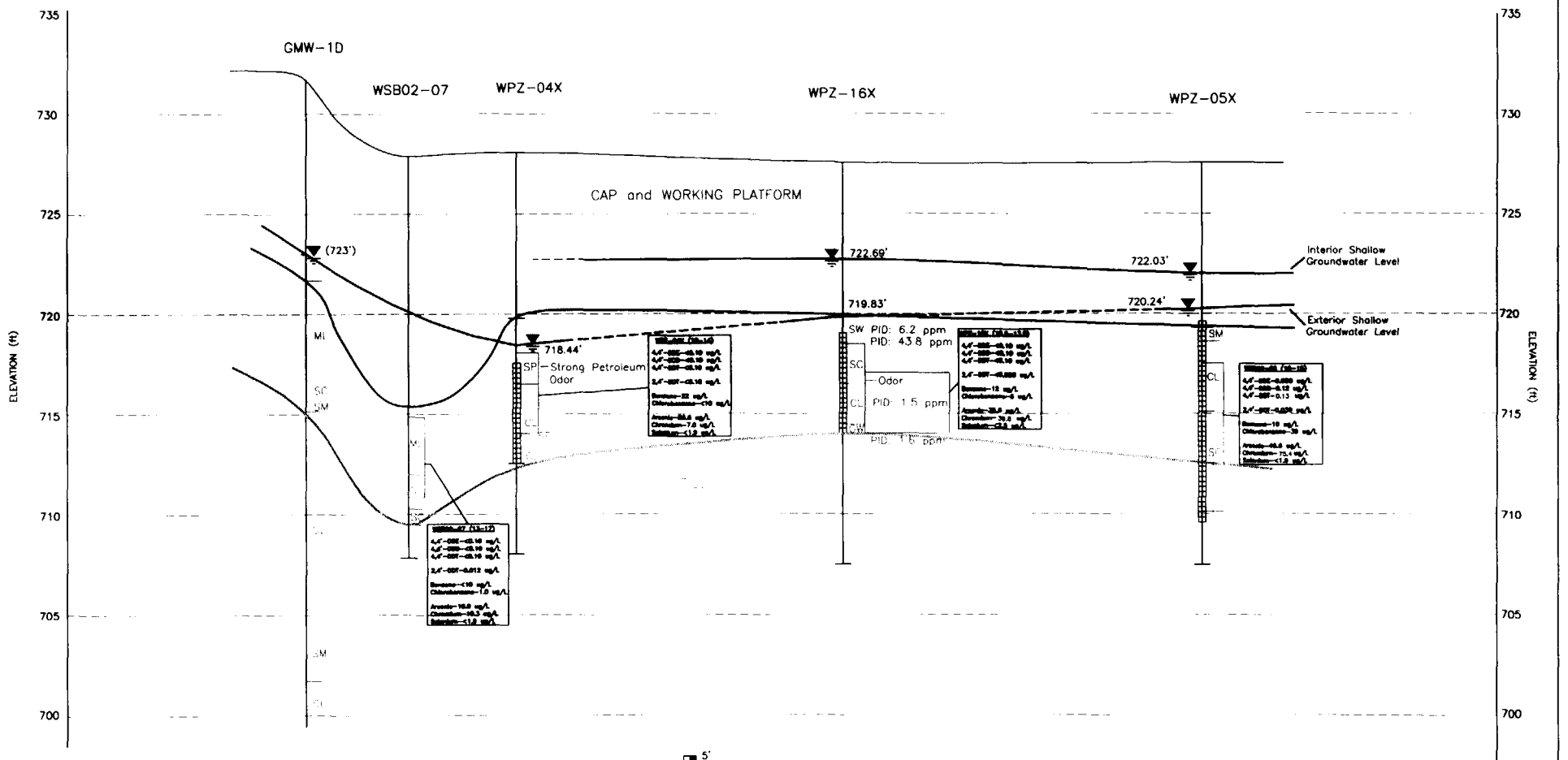

Southeast
E
Northwest
E'
GWM-3
CAP and WORKING PLATFORM
WPZ-03I
WPZ-03X
Slurry Wall
728.15'
725.88'
Styrene Type Odor
Odor
Fuel Oil, Soaked
722.04'
GWM-6
WPZ-06I
WPZ-06X
722.07'
721.40'
718.54'
Slurry Wall
Pine River 718.16'
Sulfur Odor
740
735
730
725
720
715
710
705
745
LEGEND
Screened Interval
Shallow Groundwater Level 08 March 2002
Till Boundary
Cap and Working Platform Boundary
USCS Noted
SP Sand
CL Clay
SC Sandy Clay
SR Silt
GP Gravel
PT Peat
Notes:
• Location and width of slurry wall estimated
• Red highlighted values indicate values that exceed MDEQ Part 201 GSI Criteria
• GSI criteria for 4,4'DDE, 4,4'DDD, and 2,4'DDT does not exist
• Groundwater results shown collected February 2002 during Phase I VAS activities
• Groundwater results in ug/L for select parameters only
• Comments in green from field observations
VERTICAL
5'
0'
125'
HORIZONTAL
Date: 18 May 2002
File Path and Name: GMI\SHARED\Velsicol-PineRiver\XsectionEE'.DWG
Designed by: KRB
Drawn By: KRB
Checked by: JTB
Approved by: BJO
DEQ
WESTON MANAGERS DESIGNERS/CONSULTANTS
Suite 2800
300 River Place
Detroit, Michigan
48207
GEOLOGIC CROSS SECTION E-E'
VELSICOL SUPERFUND SITE
ST. LOUIS, MICHIGAN
W.O.# 20083.500.001
FIGURE: 9

South

C

North

C'



LEGEND

- Screened Interval
- Shallow Groundwater Level 01 March 2002
- Till Boundary
- Cap and Working Platform Boundary

USCS Noted

- SP Sand – poorly graded
- SW Sand – well graded
- CL Clay
- SC Sandy Clay
- ML Silt
- SM Silty Sand
- GW Gravel

Note:

- Groundwater results shown were collected February 2002 during Phase I VAS activities
- Red highlighted values indicate values that exceeded MDEQ Part 201 GSI Criteria
- GSI criteria for 4,4' DDE, 4,4'DDD, and 2,4'DDT does not exist
- Groundwater results in ug/L for select parameters only
- Comments in green from field observations

VERTICAL 5' 0'

HORIZONTAL 75'

FIGURE 7

Date: 18 May 2002 | File Path and Name: C:\d\SHARED\Velsicol-PineRiver\XsectionCC'.DWG | Designed by: KRB | Drawn By: KRB | Checked by: JTB | Approved by: BJC

DEQ

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300 River Place
Detroit, Michigan
48207

GEOLOGIC CROSS SECTION C-C'
VELSICOL SUPERFUND SITE
ST. LOUIS, MICHIGAN
W.O.# 20083.500.001

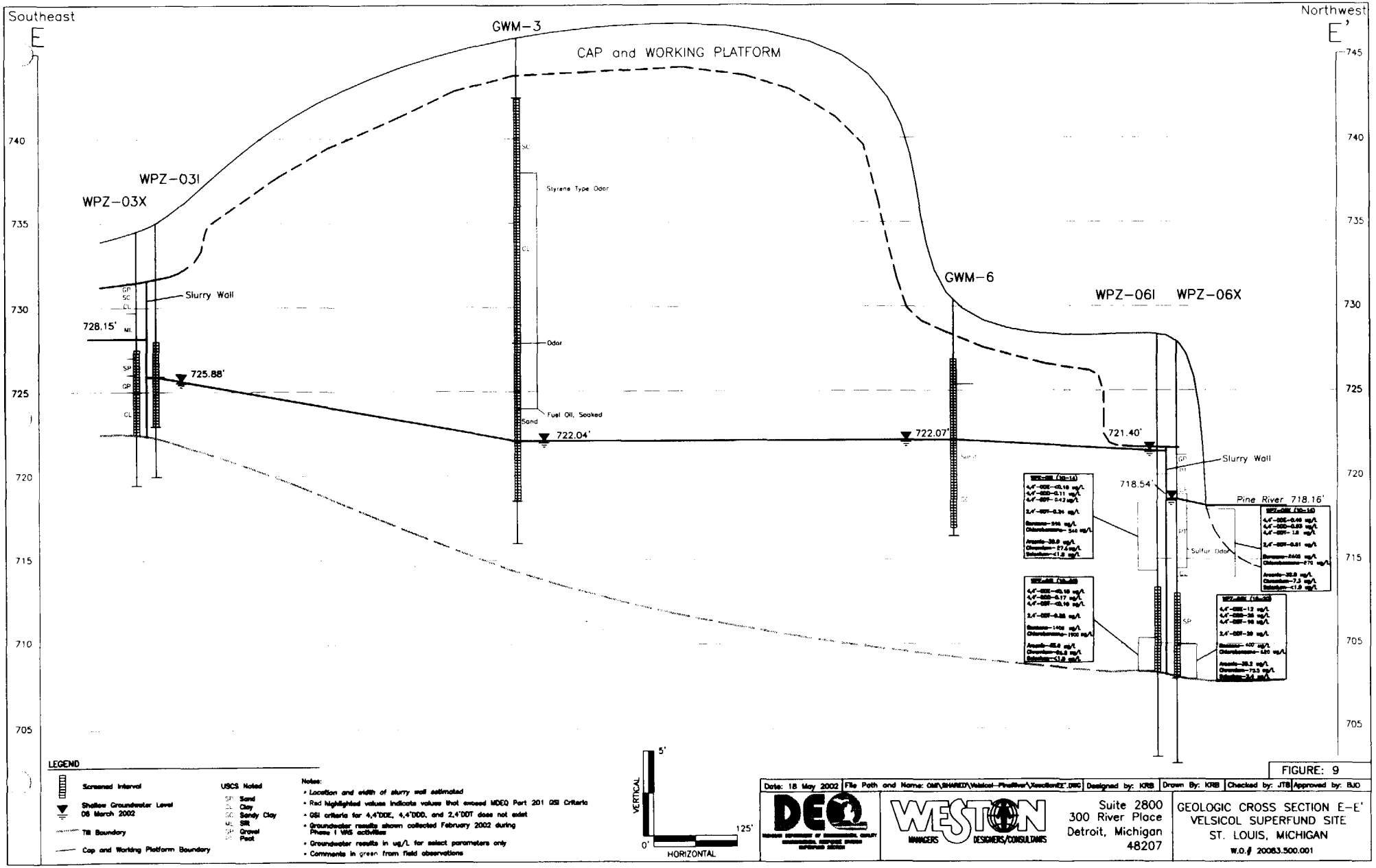


FIGURE: 9

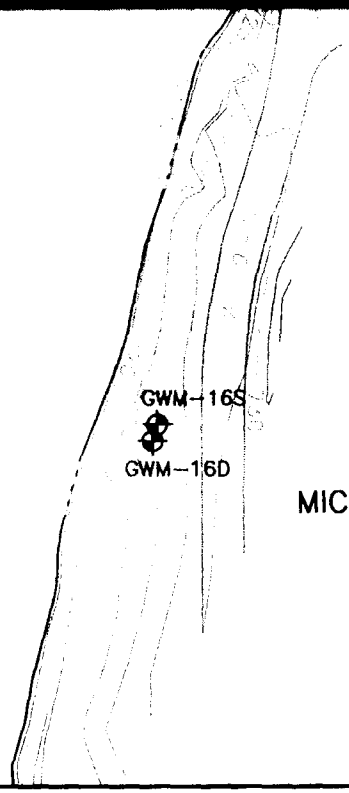
Date: 18 May 2002	File Path and Name: O:\all\SHARED\Velsicol-PineRiver\XsectionEE'.DWG	Designed by: KRB	Drawn By: KRB	Checked by: JTB	Approved by: BJO

DEQ

WESTON MANAGERS DESIGNERS/CONSULTANTS

Suite 2800
300 River Place
Detroit, Michigan
48207

GEOLOGIC CROSS SECTION E-E'
VELSICOL SUPERFUND SITE
ST. LOUIS, MICHIGAN
W.O.# 20083.500.001



DEQ

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

iver Place
uite 2800
, Michigan
48207

SHALLOW GROUNDWATER FLOW MAP

VELSICOL SUPERFUND SITE

St. Louis, Michigan

SCALE:	DRAWN:	DATE:	DWG. NO.	
AS NOTED	D.C.H.	5/02	05302	FIGURE 10

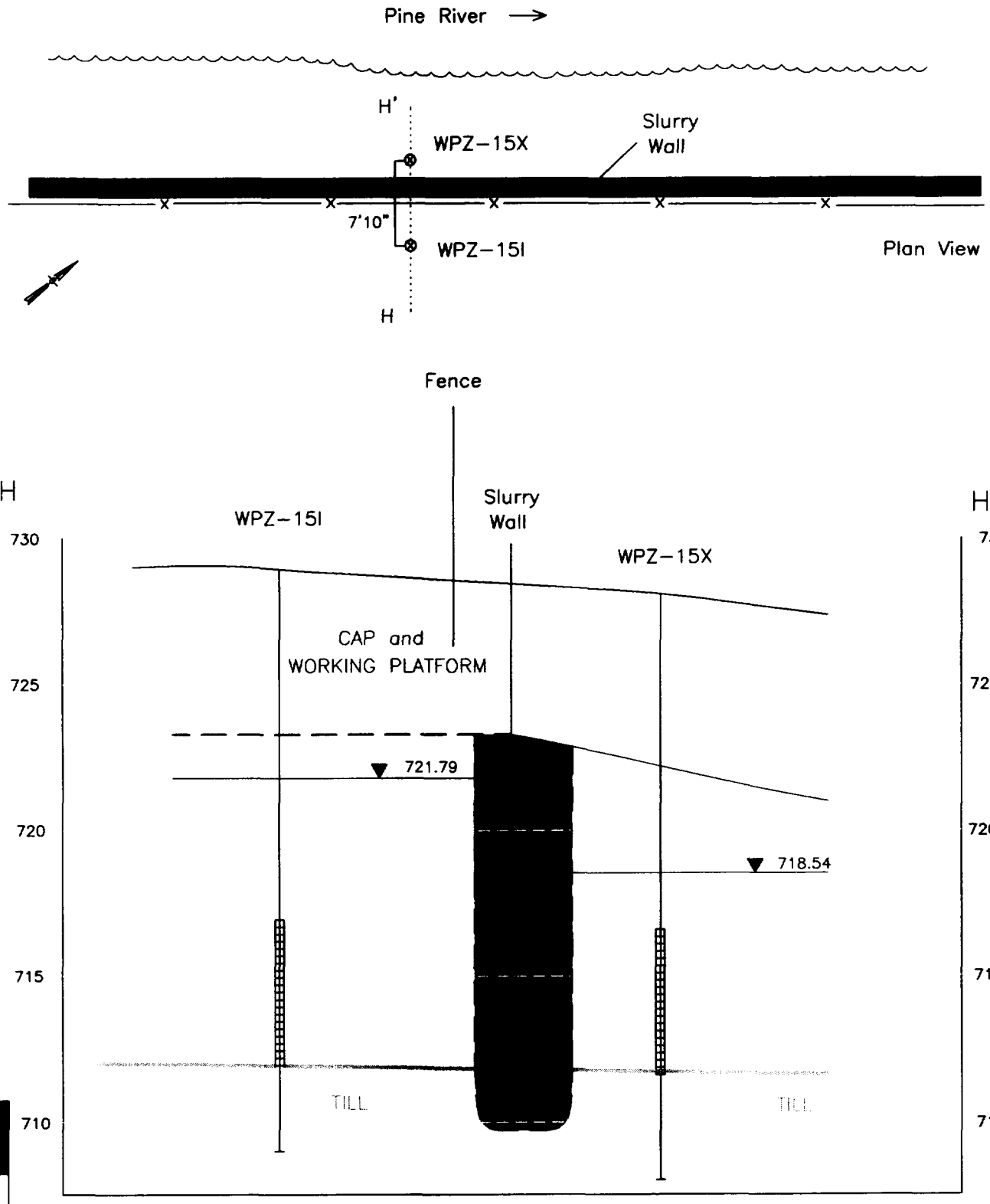


FIGURE 11

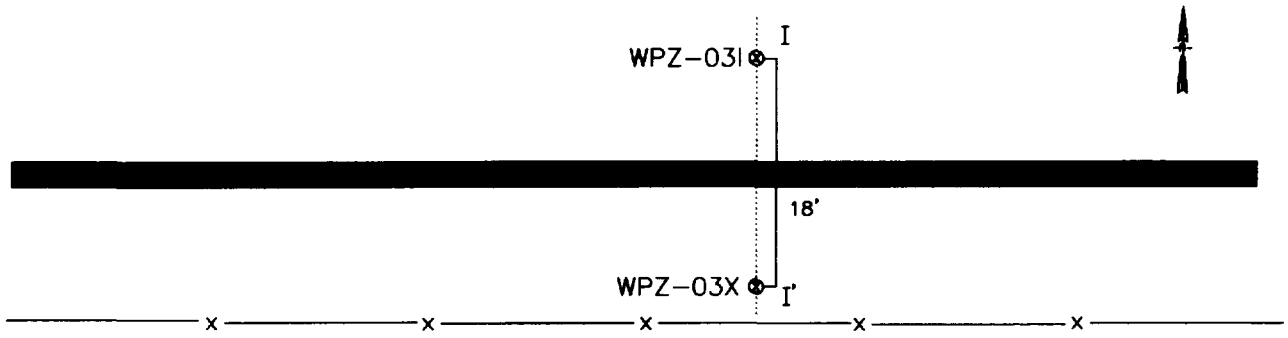
DEQ MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY ENVIRONMENTAL RESPONSE DIVISION SUPERFUND SECTION

WESTON MANAGERS DESIGNERS/CONSULTANTS

300 River Place
Suite 2800
Detroit, MI 48207

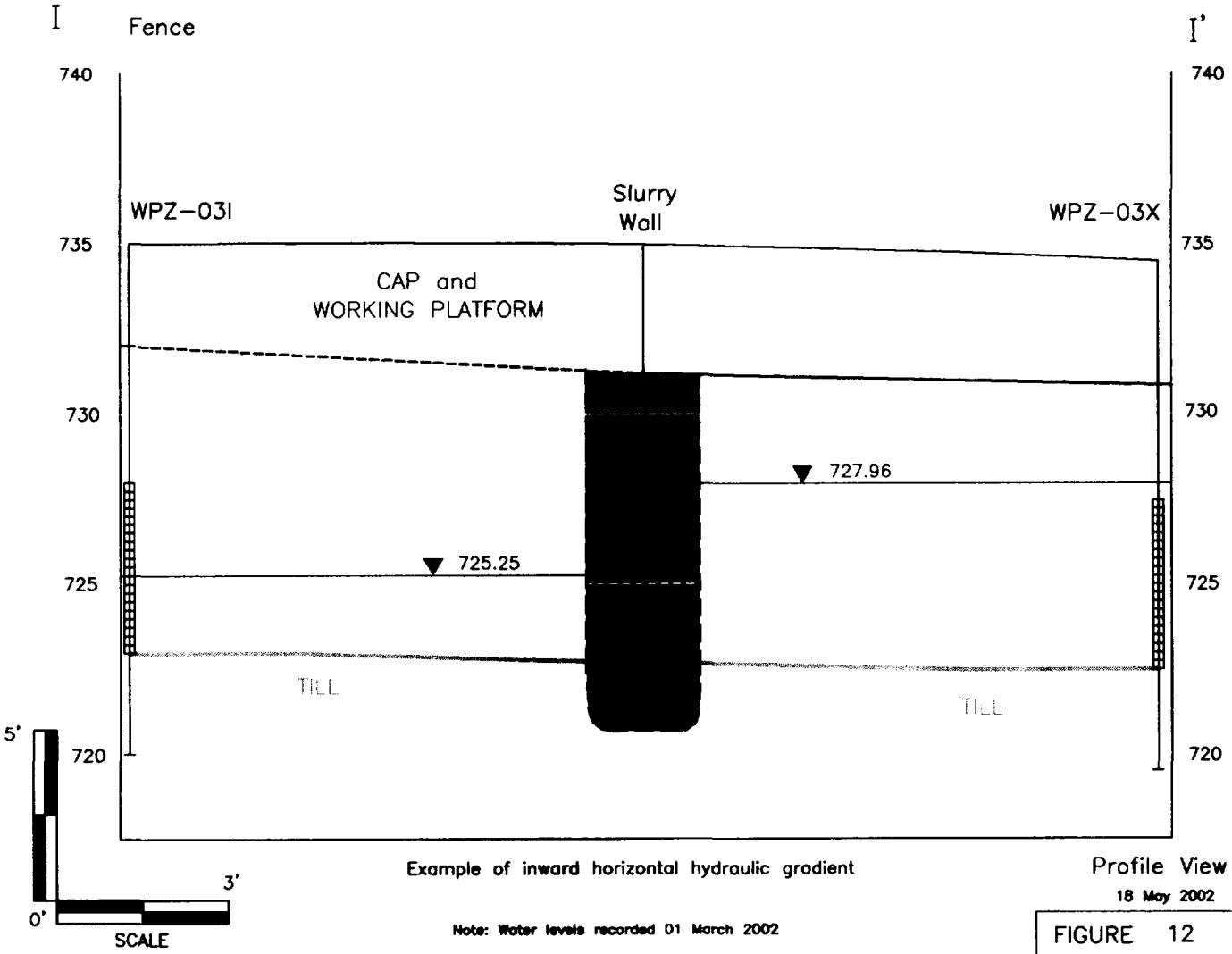
Profile of Piezometer Pair WPZ–15
Velsicol Superfund Site
St. Louis, MI
W.O.# 20083.500.001

D:\Velsicol-PineRiver\ProfileWPZ15.dwg
OMI\



Plan View

M-46



Example of inward horizontal hydraulic gradient

Profile View

18 May 2002

Note: Water levels recorded 01 March 2002

FIGURE 12

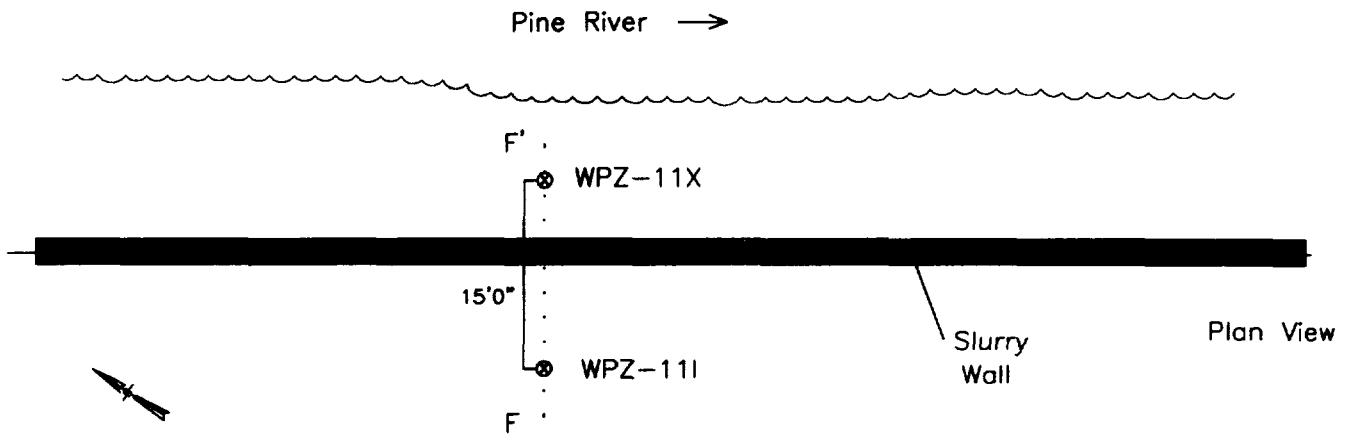
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

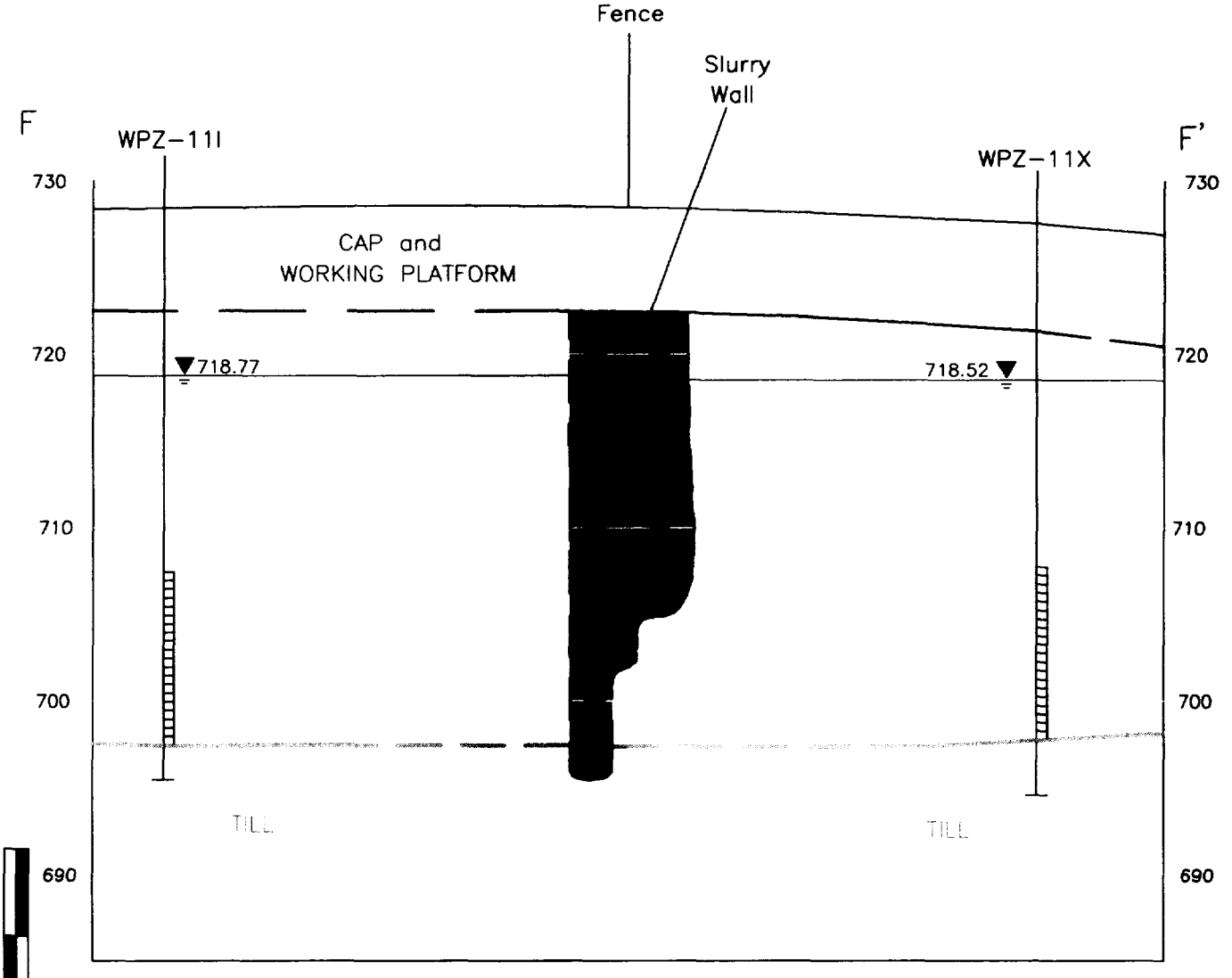
WESTON MANAGERS DESIGNERS/CONSULTANTS

300 River Place
Suite 2800
Detroit, MI 48207

Profile of Piezometer Pair WPZ-03
Velsicol Superfund Site
St. Louis, MI
W.O.# 20083.500.001

O:\M\SHARED\Velsicol-PineRiver\ProfileWPZ03.dwg





Example of negligible horizontal hydraulic gradient

Profile View
18 May 2002

Note: Water levels recorded 01 March 2002

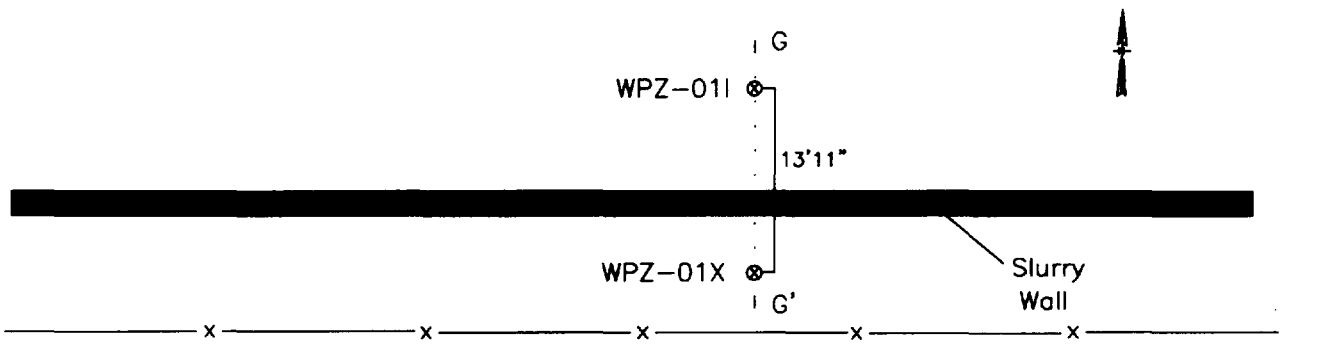
FIGURE 13

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

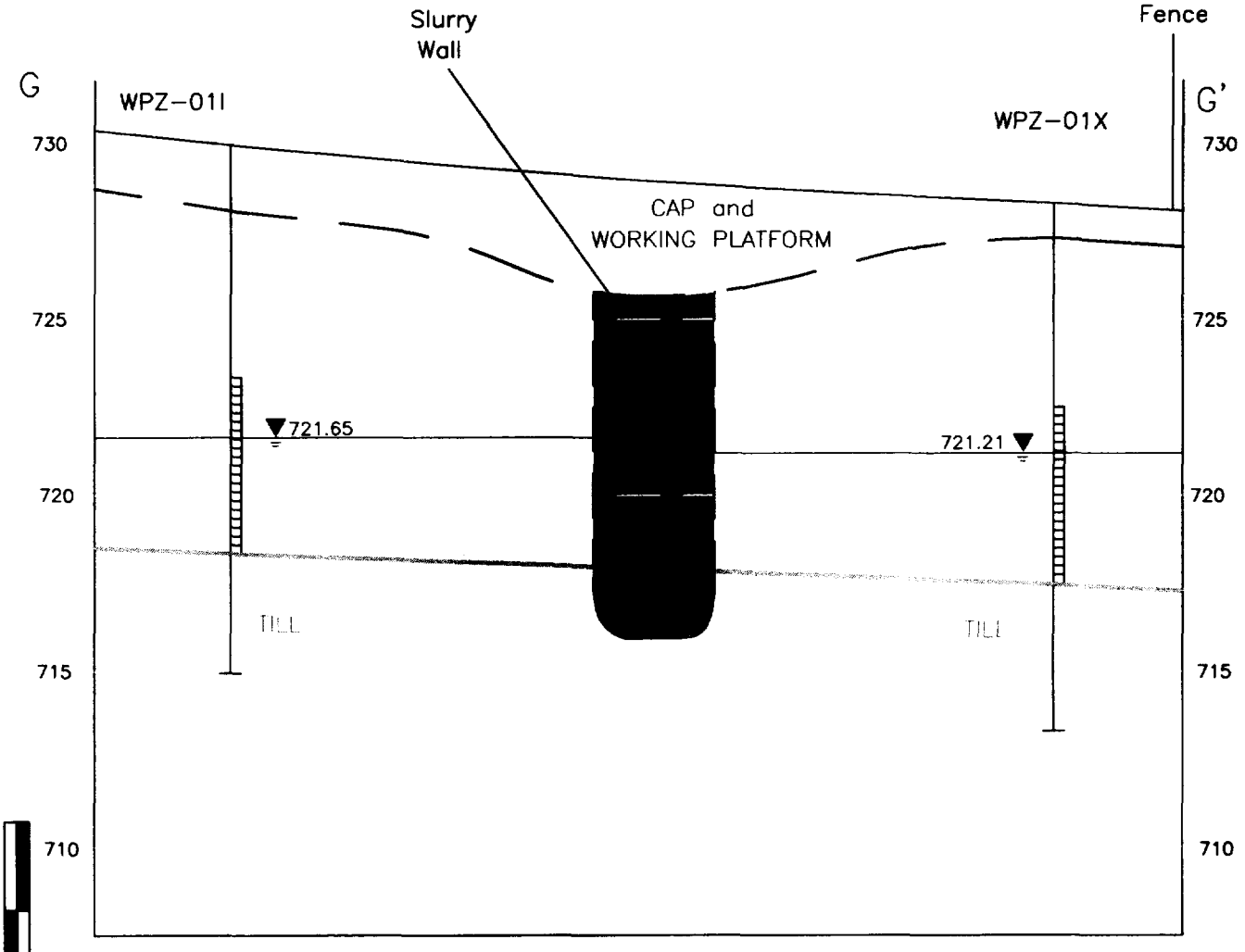
WESTON MANAGERS DESIGNERS/CONSULTANTS
Suite 2800
300 River Place
Detroit, MI 48207

Profile of Piezometer Pair WPZ-11
Velsicol Superfund Site
St. Louis, MI
W.O. # 20083.500.001

OMI\Sh...\Velsicol-PineRiver\ProfileWPZ11.dwg



North Street



Example of negligible horizontal hydraulic gradient

Profile View
18 May 2002

Note: Water levels recorded 01 March 2002

FIGURE 14

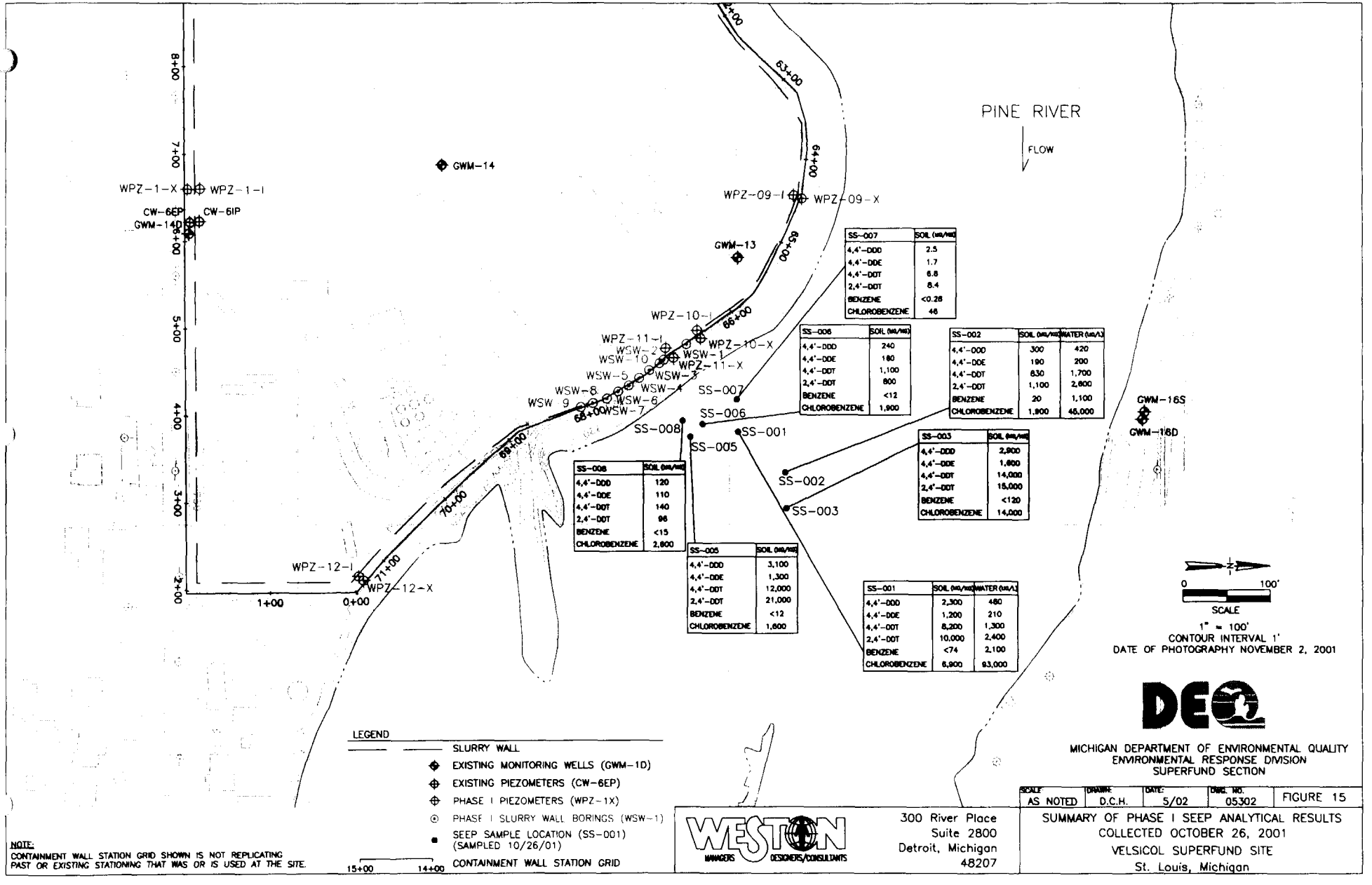
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

WESTON MANAGERS DESIGNERS/CONSULTANTS

Suite 2800
300 River Place
Detroit, MI 48207

Profile of Piezometer Pair WPZ-01
Velsicol Superfund Site
St. Louis, MI
W.O. # 20083.500.001

O:\I\SHARED\Velsicol-PineRiver\ProfileWPZ1.dwg



MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

SCALE:	DRAWN:	DATE:	DWG. NO.	
AS NOTED	D.C.H.	5/02	05302	FIGURE 15

WESTON MANAGERS DESIGNERS/CONSULTANTS
300 River Place
Suite 2800
Detroit, Michigan
48207

SUMMARY OF PHASE I SEEP ANALYTICAL RESULTS
COLLECTED OCTOBER 26, 2001
VELSICOL SUPERFUND SITE
St. Louis, Michigan

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION

(19-20)

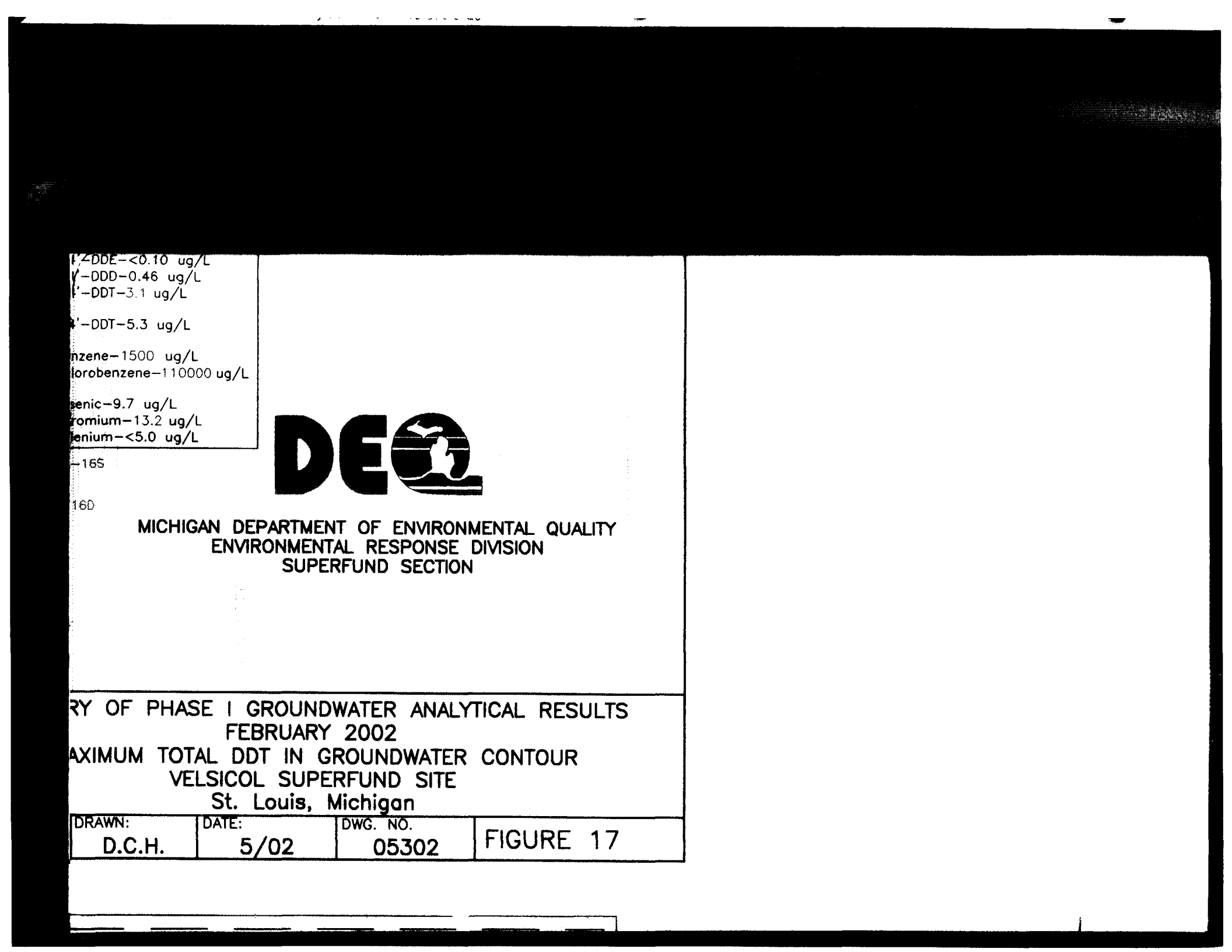
mg/kg
mg/kg
mg/kg

mg/kg

mg/kg
1600 mg/kg

OF PHASE I SOIL ANALYTICAL RESULTS
FEBRUARY 2002
VELSICOL SUPERFUND SITE
St. Louis, Michigan

	DATE:	DWG. NO.	
H.	5/02	05302	FIGURE 16


P,P'-DDE-<0.10 ug/L
P,P'-DDD-0.46 ug/L
P,P'-DDT-3.1 ug/L
O,P'-DDT-5.3 ug/L
nzene-1500 ug/L
lorobenzene-110000 ug/L
senic-9.7 ug/L
romium-13.2 ug/L
enium-<5.0 ug/L
-165
160
DEQ
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
ENVIRONMENTAL RESPONSE DIVISION
SUPERFUND SECTION
RY OF PHASE I GROUNDWATER ANALYTICAL RESULTS
FEBRUARY 2002
AXIMUM TOTAL DDT IN GROUNDWATER CONTOUR
VELSICOL SUPERFUND SITE
St. Louis, Michigan
DRAWN: D.C.H.
DATE: 5/02
DWG. NO. 05302
FIGURE 17