Remedial Investigation/ Focused Feasibility Study

Willow Boulevard/A-Site Operable Unit

Volume 1 of 4

Allied Paper, Inc./Portage Creek/
Kalamazoo River Superfund Site
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1. Introduction

1.1 Scope of the Remedial Investigation/Focused Feasibility Study Report

This report presents the findings of the Willow Boulevard/A-Site Operable Unit (WB/A-OU) Remedial Investigation/Focused Feasibility Study (RI/FFS) conducted in accordance with the *Willow Boulevard/A-Site Operable Unit Remedial Investigation/Focused Feasibility Study Work Plan* (Work Plan) (Blasland & Bouck Engineers, P.C. [BBEPC], 1993b), approved by the Michigan Department of Environmental Quality (MDEQ). The work associated with the WB/A-OU RI/FFS was performed to satisfy, in part, investigation and reporting tasks specified in an Administrative Order by Consent (AOC), Final Order No. DFO-ERD-91-001, issued in 1991 by the Michigan Department of Natural Resources (MDNR) for the Allied Paper, Inc./Portage Creek/Kalamazoo River (API/PC/KR) Superfund Site (Site).

The AOC outlines, among other things, the preparation and performance of:

1. A Remedial Investigation (RI) to determine the nature and extent of contamination and any threat to the public health, welfare, or environment caused by the release or threatened release of hazardous substances, pollutants, or contaminants from the site.
2. A Feasibility Study (FS) to determine and evaluate alternatives for remedial action to prevent, mitigate, or otherwise respond to the threats identified.

The activities conducted under the AOC are intended to provide all information necessary for a Record of Decision (ROD), consistent with state and federal law, rules, policy, and guidance. This RI/FFS document was completed by the Michigan Department of Environmental Quality (MDEQ) as part of its responsibilities under the Revised Site-Specific Amendment to the Enforceable Agreement for State Enforcement Lead Sites in Michigan, under the Superfund Memorandum of Agreement with the United States Environmental Protection Agency (USEPA), dated January 9, 2002. The MDEQ intends for the analysis in this document to be consistent with the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) and the National Contingency Plan (NCP).

This report summarizes and incorporates by reference the contents, results, and findings presented in greater detail in documents and technical memoranda approved by the MDEQ (formerly the MDNR). Figure 1 presents a timeline that tracks the progression of major activities and the submission dates of some pertinent documents. Field data, analytical data, and quality assurance/quality control (QA/QC) information are reported in:

- *Description of the Current Situation* (DCS) (BBEPC, 1992). This document is designed to assist in the identification of specific areas of the WB/A-OU to be included in the RI and the nature of the RI/FFS activities for those areas. It is also intended to draw into focus the major issues involved in the assessment of remedial needs and alternatives. The seven-volume document includes 270 pages of narrative, 98 tables, and 60 figures. Four appendices provide land use figures, boring and well logs, National Wetlands Inventory (NWI) maps, and stiff diagrams. Sections 4.9 and 4.10 of the DCS present the conditions at the Willow Boulevard and A-Sites as they were in 1992, and Sections 5.7 and 5.8 of the DCS present previous surveys and actions at the site. Pertinent tables and figures from the DCS are included in Appendix A of this report.

- *Technical Memorandum 5 - Willow Boulevard/A-Site Operable Unit Results of the Air Investigation* (Blasland, Bouck & Lee, Inc. [BBL], 1994a). Approved by the MDNR in May 1994, this document is a record of air quality data collected during the RI. The two-volume memorandum includes 16 pages of narrative, 18 tables of data, and 43 figures. Appendices provide all field documentation, analytical data, QA/QC data review reports, and chain-of-custody records. Summaries of air investigations are presented in Sections 2.6 and 4.2.6, and pertinent tables and figures from *Technical Memorandum 5*, in Appendix B of this report.

- *Technical Memorandum 9 - Willow Boulevard/A-Site Operable Unit* (BBL, 1995b). Approved by the MDEQ in April 1995, this document is a record of data collected during the RI that characterizes soil, sediment, surface water, groundwater, and paper-making residuals (residuals). The five-volume memorandum includes 50 pages of narrative, 42 tables of data, and 26 figures. Appendices provide all field documentation, analytical data, QA/QC data review reports, and chain-of-custody records. This report contains summaries of the results of various site investigations in Sections 4.2, and pertinent tables and figures from *Technical Memorandum 9*, in Appendix C of this report.

- *Draft Addendum to Technical Memorandum 9 - Willow Boulevard/A-Site Operable Unit Additional Groundwater Sampling* (BBL, 1996). Submitted to the MDEQ in October 1996, this document is a record of the supplemental groundwater sampling and analyses performed in August 1995. The single-volume document includes 15 pages of narrative, nine tables of data, and four figures. Appendices provide all field documentation, analytical data, QA/QC data review reports, and chain-of-custody records. A summary of this information useful for purposes of preparing this report is included in Sections 2.2, 4.2.7, and Appendix D.

- *Removal Action Summary - Willow Boulevard/A-Site OU* (BBL, 2000). Submitted to the MDEQ on March 20, 2000, this document is a record of activities and sampling results of the interim response action (IRA) performed between November 1999 and April 2000 (note that this document was submitted prior to completion of IRA activities). The single-volume document includes eight pages of narrative, seven tables of data, and eight figures. Appendices provide analytical data for air, water, and soil samples collected, as well as dust monitoring and meteorological data. Readers should note the document title mistakenly uses the term "removal action;" the event was actually an interim response action. The report was not approved by the MDEQ (confirmation samples indicated some clean-up goals were not met) and any deficiencies should be met during remedial action for the river operable unit. However, summaries of activities, analytical data, and laboratory results are discussed in this RI/FFS.

- Letter reports submitted to the MDEQ on:
  - February 6, 1998 - reports results of soil samples near AMW-3A;
  - September 21, 1998 - reports subsequent AMW-3A sampling results; and
  - November 10, 2000 - reports results of samples collected from the Scott property.

Pertinent correspondence is included in Appendix F of this report.

This report also presents the results of a Focused Feasibility Study (FFS) conducted for the WB/A-OU. As required by the AOC, the purpose of the FFS is to develop and evaluate potential remedial alternatives.

This document includes revisions to accommodate the concerns of the USEPA, which reviewed multiple drafts of this RI/FFS, submitting comments through 2003.

1.2 OU Description and Background

The WB/A-OU is one of four land-based Operable Units (OUs) associated with the Site, and is also referred to as OU-2. The Site is contaminated with polychlorinated biphenyls (PCBs), the source of which is attributed to the recycling of wastepaper in local Georgia-Pacific and Allied Paper Company mills from the late 1950s to the early 1970s (BBEPC, 1992). Figure 2 and Aerial Photos 1 through 7 show a general site location for OU-2, located southeast of the intersection of Business I-94, and Highway M-96 (King Highway) in Kalamazoo Township, Michigan. The 32-acre WB/A-OU (Photo 1) is bordered by the Kalamazoo River to the north and northwest, Davis Creek to the east, and Willow Boulevard and the former Olmstead Creek to the south. There are several distinct areas associated with the WB/A-OU where specific investigations have been performed to

confirm remedial action is necessary which will be performed as part of the Remedial Action (RA) implemented for OU2. These areas are shown on Figure 3 and include:

- The area east of Davis Creek - approximately 3.5 acres, owned by Georgia-Pacific, across Davis Creek to the east of the A-Site;
- The AMW-3A area - south of the A-Site and west of Davis Creek, encompasses monitoring well AMW-3A and the surrounding area;
- Davis Creek;
- The drainageway - south of the Willow Boulevard Site;
- The former Olmstead Creek - separates the Willow Boulevard Site from the A-Site, continues along the south and southwestern sides of the A-Site; and
- The area south of the A-Site berm.

The area east of Davis Creek, the AMW-3A area, and Davis Creek are considered as ancillary components of the WB/A-OU. The drainageway is considered in conjunction with the Willow Boulevard Site, while the former Olmstead Creek and the area south of the A-Site berm are considered in conjunction with the A-Site.

1.2.1 Willow Boulevard Site

The Willow Boulevard Site (Figure 3) was acquired by Georgia-Pacific from the Kalamazoo Paper Company in 1967. The site received dewatered residuals excavated from the King Highway dewatering lagoons from the mid 1960s until disposal operations ceased in 1975. These residuals contained clay, paper fibers, and PCBs. From 1975 to 1981, the Willow Boulevard Site received an occasional load of residuals or cinders (Wilkins & Wheaton, 1981). The site was built without berms, and residuals were placed directly into the river and floodplain. In April 1987, Georgia-Pacific began implementation of an interim response program for the Willow Boulevard Site. To reduce further erosion of the riverbanks, geotextile, stone, and riprap were placed along the riverbank at points of rapid flow along the northeastern edge of the site. In addition, unvegetated areas were covered with crushed stone. Trees, which were believed to have contributed to erosion of the riverbank (Dell Engineering, 1988), were removed from the river channel. A draft closure plan for the site was submitted to the MDNR in 1990. As a temporary measure to stabilize the surface and reduce possible erosion of contaminated residual material into the river, a 6-inch layer of sand was spread over the site in 1999 and 2000 (Figures 12-A & 12-B). Portions of the interim cover were seeded to provide vegetative cover (Photo 2). Burrowing animals and erosion have taken a toll on these interim covering measures. Where the sand layer or

geotextile has been disturbed, residual waste is exposed at the surface and eroding into the Kalamazoo River (Photo 3).

1.2.2 A-Site

The A-Site (Figure 3) was originally a series of dewatering lagoons used by the Allied Paper Company's King Division Mill (Wilkins & Wheaton, 1981); hence, it is mostly surrounded by an earthen dike. Based on a review of historical aerial photographs (Aerial Photos 1 through 7), it appears that the A-Site lagoons were active between 1960 and 1967. The operations of the King Mill ceased in 1971, and in a 1974 aerial photograph, the lagoons appear to be inactive. The former King Mill was razed in 1978. A square manhole is located near the northern end of Riverside Avenue for access to the former piping system from the former King Mill to the A-Site. It is not known whether this piping system still remains (BBEPC, 1992).

Georgia-Pacific purchased the A-Site property in 1975 and used it to dispose of residuals excavated from the King Highway dewatering lagoons until 1977. From 1977 to 1987, the A-Site received dewatered residuals from the Georgia-Pacific filter presses. The A-Site ceased to be an active disposal area in April 1987, when the King Highway Landfill, a Type III Landfill, licensed pursuant to the former 1978 Public Act 641, Solid Waste Management Act, began operations (BBEPC, 1992). As an interim action at the WB/A OU, sheetpile was placed at the edge of the Kalamazoo River to improve stability (Photo 4). The interim action's sheetpile is not sealed, allowing groundwater to pass through seams and weep holes in the sheetpile (Photos 5, 6, & 7). Currently, some areas of the site are overgrown by volunteer grasses, shrubs, and small trees. On portions of the site, residual paper waste is exposed at the surface (Photos 8 & 9; Figures 12-A, 12-B, 12-C).

1.2.3 Ancillary Areas

Areas outside of the boundaries of the WB/A-OU were potentially impacted by site activities. Due to the nature and extent of PCB contamination in these areas, they are considered as ancillary areas, or in conjunction with, the WB/A-OU.

1.2.3.1 Area East of Davis Creek

Across Davis Creek to the east of the A-Site is a 3.5-acre shrub vegetated area partially bordered by a low earthen berm (Figure 3), forming a depression prone to flooding. Decant water from dewatering activity at the A-Site was discharged to this area. Georgia Pacific's records show no evidence that the area east of Davis Creek received residuals from the Georgia-Pacific Kalamazoo Mill (Swanson Environmental, 1990); however, a thin layer of residuals (generally less than 6 inches) was observed in this area (Photo 10) and historic aerial photographs (Aerial Photos 3, 4, and 5) indicate earth movement and possible construction of retention ponds.

RI investigations in 1993 confirmed that contaminated residuals are present in the top 6 inches of soil. This area is classified as semipermanently flooded (United States Fish and Wildlife Service, 1991; BBL 1995b); during much of the year, standing water is likely present and connected hydraulically to the Kalamazoo River (Photo 11). The figures in this document vary in their depiction of the area— it may be represented as flooded or as floodplain. Rather than being an inconsistency in the figures, it is simply an indication that the area is considered semipermanently flooded.

1.2.3.2 AMW-3A Area

Another ancillary area to the A-Site is the AMW-3A area, a 0.25 acre area located southeast of the WB/A-OU (Figure 3). The AMW-3A area lies west and immediately adjacent to Davis Creek, approximately 1,100 feet south of the Kalamazoo River, and 175 feet south of the A-Site at the eastern end of Carleton Avenue (See Figure 3.). To the west of the AMW-3A area is a residential neighborhood and to the east is Davis Creek. Previous investigations, further discussed in Sections 4.2.2.2 and 4.2.2.3, indicated soils in the AMW-3A area contain PCB in excess of residential cleanup criteria. In 2000, the fence line along the western side of the current AMW-3A area was relocated to the edge of the Georgia-Pacific property line to create a barrier between the Wright and Bloomfield residential properties and the Georgia-Pacific property.

1.2.3.3 Davis Creek

Davis Creek (Figure 3) originally ran along the southern edge of the area occupied by the A-Site, and its outlet was between the Willow Boulevard Site and the A-Site. In the early 1930s, the creek was diverted so that it ran a straight course from Carleton Avenue north to the Kalamazoo River. Within the creek's watershed are the Cork Street Landfill Superfund Site, the Lakeside Refining site, and American Cyanamid Company.

In response to frequent flooding of the Lakewood neighborhood, the Kalamazoo County Drain Commission installed flood-diversion piping in 1972 under the Kalamazoo County Fairgrounds, Lakewood Elementary School, and Lake Street. The piping consisted of two 95-inch by 67-inch corrugated metal arch pipes. The piping ended just north of the eastern end of Carleton Avenue, where flow rejoined Davis Creek. From this point, the creek flowed north to the Kalamazoo River (Hanney, 1991).

1.2.3.4 Area South of the A-Site Berm

As identified in Figure 3, the area south of the A-Site berm is a continuation of the A-Site with residuals extending into this area. This area is bounded by the A-Site berm to the north, Davis Creek to the east, residential properties to the south and the Willow Boulevard drainageway area to the west. Portions of the

former Olmstead Creek are located within this area and RI investigations in 1999 confirmed that contaminated residuals are present.

1.2.3.5 Former Olmstead Creek

The former Olmstead Creek (Figure 3) is an intermittent drainageway (Photo 12) that is located within the area south of the A-Site berm and continues on to form the separation between the Willow Boulevard and A-Site. The former Olmstead Creek discharges surface water drainage from portions of the A-Site and residential properties to the Kalamazoo River through a culvert that separates Willow Boulevard and A-Site. RI investigations in 1999 confirmed that PCB contamination exists in the creek sediments.

1.2.3.6 Willow Boulevard Drainageway

The Willow Boulevard drainageway (Figure 3) is a surface water runoff area from the Willow Boulevard site and surrounding areas. This area is bounded by the Willow Boulevard site to the north, the former Olmstead Creek to the east, Willow Boulevard to the south and the Kalamazoo River to the west. RI investigations in 1999 confirmed that contaminated residuals are present in this area.

1.2.4 Residential Areas

Due to its proximity to residential areas, the RI activities included neighboring residential areas, specifically the Lakewood neighborhood, which lies to the south and is separated from the site by Willow Boulevard (Figure 21 of the DCS, included in Appendix A). Particular attention was paid to the Wright, Bloomfield, Adkins, Wadsworth, and Scott properties either because of proximity of the WB/A-OU or due to owners' requests.

1.3 Objectives of the Remedial Investigation/Focused Feasibility Study

This report, in combination with the MDEQ-approved *Technical Memorandum 5* (BBL, 1994a) and *Technical Memorandum 9* (BBL, 1995b), *Draft Addendum to Technical Memorandum 9* (BBL, 1996), two letter reports describing additional investigation activities at the AMW-3A area, work plans describing additional investigation activities south of the A-Site berm and at residential properties, additional investigation efforts presented in this report, *Technical Memorandum 10* (CDM, 2002b), and the information contained in the Administrative Record for the KHL-OU3, was developed to fulfill the essential objective of the AOC. It is consistent with the National Oil and Hazardous Substances Contingency Plan (NCP), Part 201 of the Michigan Natural Resources and Environmental Protection Act (NREPA), 1994 Public Act 451, as amended, and other applicable state and federal guidance.

1.3.1 Objectives of the Remedial Investigation

The primary objective of the WB/A-OU RI (Sections 2 through 5 of this report) is to assess the nature and extent of PCB present in air, residuals, native soils, sediments, groundwater/leachate, and surface water as well as the potential threats to public health, welfare, or the environment caused by the release or threatened release of hazardous substances, pollutants, or regulated substances from the area. The source of the PCB appears to have been the recycling of wastepaper in the local Georgia-Pacific and Allied Paper Company mills from the late 1950s to the early 1970s (BBEPC, 1992). During this period, some wastepaper from offices and businesses included PCB-containing carbonless copy paper.

Corollary objectives of the RI include:

- Assessment of potential migration pathways;
- Evaluation of potential environmental and human exposure and risk;
- Screening for the presence of other constituents on the Contract Laboratory Program (CLP) Target Compound List (TCL) and Target Analyte List (TAL);
- Collection of data necessary to evaluate remedial alternatives;
- Characterization of OU-specific topography/drainage, geology/hydrogeology, meteorology, wetlands, biota, surrounding population, and land use;
- Evaluation of the geotechnical properties of the dikes and residuals; and
- Characterization of regional geologic/hydrologic features.

1.3.2 Objective of the Focused Feasibility Study

The primary objective of the WB/A-OU FFS (Sections 6 and 7 of this report) is to describe and compare cleanup remedies for the OU. As detailed in Section 6, the FFS process is streamlined through reference to the MDEQ-approved *King Highway Landfill Operable Unit 3 (KHL-OU3) Alternatives Array Document* (*AAD)* (BBL, 1994b) and *KHL-OU3 FFS* (BBL, 1994c).

Based on agreements between the MDEQ and the Kalamazoo River Study Group (KRSG) (Cornelius, 1998), a streamlined approach to this evaluation was adopted due to the similarities between this site and the KHL-OU3 (see Section 1.2). The development and screening of potential remedial alternatives for the WB/A-OU was based upon the *KHL-OU3 AAD* and the *KHL-OU3 FFS*, which presented a detailed screening of seven technology types and 60 process options.

The WB/A-OU Site is approximately one half mile from the KHL-OU3. The two OUs share many similarities, including:

- Each OU contains residuals produced using similar processes to recycle paper;
- Each OU is essentially a large-volume monofill of residuals with a similar range of PCB concentrations;
- PCB-containing residuals are present in areas contiguous to, but outside of, the assumed limits of the monofills;
- Each OU is located along the Kalamazoo River;
- A portion of each OU has a berm or sheetpile wall retaining system along the Kalamazoo River.

The WB/A-OU also has differences with respect to the KHL-OU3, including:

- A portion of KHL-OU3 (i.e., cells 1, 2, and 3) was an Act 641 licensed landfill - the WB/A-OU never had such a designation;
- At the WB/A-OU, residual materials were placed directly into the river and floodplain;
- The maximum PCB concentration detected at the WB/A-OU (330 parts per million [ppm]) is slightly higher than at the KHL-OU3 (310 ppm) and the average PCB concentration at the WB/A-OU (38 ppm) is also higher than at the KHL-OU3 (12 ppm);
- The WB/A-OU is in closer proximity to a residential area than the KHL-OU3;
- The berm (or rip-rap) construction of the Willow Boulevard site is different than the berm construction at KHL-OU3; and
- The depths to which the residuals exist at Willow Boulevard are greater than that of KHL-OU3.

Based on the knowledge gained from selecting a remedial alternative for KHL-OU3, three alternatives, presented in previous drafts of this report, were retained for the detailed analysis of alternatives in Section 7, along with a fourth alternative, which was developed and analyzed pursuant to MDEQ comments to the July 1999 draft of this RI/FFS. In 2002, Alternative 2 was broken into three subalternatives at the request of the USEPA. The net result is an FFS for the WB/A-OU that comprehensively and concisely evaluates four remedial alternatives in a manner that addresses the MDEQ concerns (von Gunten, 2000), includes the clarifications requested by USEPA (Boice, 1998; Hahnenberg, 1999; Short, 2001; 2002a; 2002b; 2002c; Cibulskis, 2003), and complies with the AOC, as well as applicable state and federal guidance.

While the AOC called for a preferred remedy to be identified in this RI/FFS, at the request of USEPA and with the concurrence of the parties to the AOC (Brown, 2003), remedy preference is left for the Record of Decision. It must be stressed that a remedy cannot actually be selected until important criteria, such as public acceptance, are carefully evaluated. The Proposed Plan, which will be created by the USEPA, will formally recommend a clean-up remedy and public input will be solicited. Upon evaluation of public comment, the analysis of likely remedial alternatives will conclude and a Record of Decision, also written by the USEPA, will set forth the clean-up remedy recommended for implementation.

1.4 Enforcement History

In December of 1990, the Michigan Department of Natural Resources and three respondents (HM Holdings, Inc., Georgia-Pacific Corporation, and Simpson Plainwell Paper Company) affiliated with the paper mills signed an Administrative Order of Consent (DFO-ERD-91-001), for the Allied Paper, Inc/Portage Creek/Kalamazoo River Superfund site. The AOC outlined Remedial Investigation activities to be performed by the respondents with State oversight. Investigation work on the site was initiated soon after a work plan was approved in 1993.

On January 21, 1997, the respondents submitted a first draft RI/FFS for this Operable Unit to MDEQ. The document (and a draft Proposed Plan) went through a series of revisions and continued to develop concurrent with ongoing technical discussions and collection of additional samples. Also, based on correspondence from USEPA during RI/FFS development (Boice, 1998), the MDEQ requested inclusion of a “removal alternative,” resulting in creation of an alternatives screening document, submitted by the respondents in October, 1998.

While RI/FFS progress continued, voluntary interim response actions were implemented between November 1999 and April 2000. On June 8, 2000, the MDEQ sent a letter to the respondents, detailing 125 remaining concerns (e.g. a need to include information pertaining to the latest sampling and interim response activities) with the 1999 iteration of the RI/FFS.

The respondents were directed to make specific changes to the document, include additional relevant data and discuss the site consistent with present-day conditions (MDEQ, September 26, 2000). Additional groundwater samples and more data from residential areas were collected. Upon review of the resulting submittal (March 2001), the respondents were informed that this latest version of the RI/FFS was still not adequate for approval. Supporting information, addressing 25 unresolved concerns, was required. On November 19, 2001 MDEQ

formally rejected the paper companies' RI/FFS and took over its revision in accordance with the provisions of the AOC.

2. OU Activities

This section presents a description of investigation activities and IRAs that were conducted at the WB/A-OU. Pre-remedial investigation activities, described in more detail in the DCS (BBEPC, 1992), were carried out between 1986 and 1990 and included:

- Surficial Residuals and Soils Investigation;
- Subsurface Residuals and Soils Investigation;
- Groundwater Investigation; and
- Air Monitoring.

Soil, sediment, dike material, residuals, surface water, groundwater/leachate, and air were evaluated by the installation of borings, cores, monitoring wells, piezometers, and air samplers and by sampling and analysis of each of these media at or near the OU. The investigative activities conducted at the WB/A-OU, as described in the MDEQ-approved *Work Plan* (BBEPC, 1993b); the *Work Plan Addendum* (BBL, 1995c), the *Field Sampling Plan* (BBEPC, 1993c), the *Quality Assurance Project Plan* (BBEPC, 1993d), plans for additional sampling of the AMW-3A area and modifications to that plan, the additional sampling plan for the drainageway area, and the residential soil sampling plan (Brown, 1998a; Brown 1998b; McGuire, 1998a; McGuire, 1998b; McGuire, 1999), included the following tasks:

- Residuals Characterization;
- Hydrogeological Investigation;
- Soil and Sediment Investigation;
- Geotechnical Investigation;
- Surface Water Investigation;
- Air Investigation; and
- Wetlands Assessment.

Areas investigated included the Willow Boulevard Site and the drainageway area associated with the Willow Boulevard Site, the A-Site and the areas associated with the A-Site (the area south of the A-Site berm and the former Olmstead Creek), the area east of Davis Creek, the AMW-3A area, Davis Creek, the Kalamazoo River, and nearby residential areas. Supporting field documentation for the investigation activities is included in the appendices of *Technical Memoranda 5* and *9*, and the *Draft Addendum to Technical Memorandum 9*. *Technical Memorandum 9* (BBL, 1995b) also discusses the results of sediment probing along the Kalamazoo River in the

vicinity of the WB/A-OU; the field documentation for these activities is provided in *Technical Memorandum 10 - Sediment Characterization and Geostatistical Pilot Stu*dy (CDM, 2002b).

In 1999, Georgia-Pacific conducted an IRA at the WB/A-OU, in accordance with the Residual Removal Work Plan outlined in a letter to MDEQ (McGuire, 1999). The IRA included excavating residuals from the river immediately adjacent to the Willow Boulevard Site (Figure 5) and from the confluence of the former Olmstead Creek and the Kalamazoo River (Figure 6), constructing berms along a portion of the river edge at the Willow Boulevard Site, placing a temporary sand cover over the regraded Willow Boulevard Site, and installing erosion protection measures. The banks of Davis Creek were also stabilized.

Willow Boulevard Site Activities

A variety of RI activities designed to characterize the Willow Boulevard Site were conducted between 1993 and 2000. Pre-RI activities that occurred between 1986 and 1988 are described in the DCS (BBEPC, 1992). The IRA described above was conducted between November 1999 and April 2000.

The following activities were conducted during the RI:

- Soil, residual, and sediment samples were collected July-August 1993, December 1999, and January 2000;
- Groundwater was sampled in October 1993, August 1995, and November 2000;
- Surface water was sampled in October 1993;
- Air monitoring was conducted from June to August 1993 and from November 1999 to March 2000; and
- A wetlands assessment was conducted using a desk-top approach with field verification in 1993.

Geotechnical sampling was not conducted during the RI at the Site. Since Dell Engineering gathered geotechnical data in 1988 and dikes did not extend around the site, additional sampling was not necessary.

A-Site Activities

A variety of RI activities designed to characterize the A-Site were conducted between 1993 and 2000, including:

- Soil, residual, and sediment samples were collected July-August 1993 and November-December 1999;
- An assessment of the geotechnical status was conducted in October 1993;
- Groundwater was sampled in October 1993, August 1995, and November and December 2000;
- Surface water was sampled in October 1993;
- Air monitoring was conducted from June to August 1993 and from November 1999 to March 2000; and

- A wetlands assessment was conducted using a desk-top approach with field verification in 1993.

Subsequent to RI activities, as a voluntary interim measure (with conditional MDEQ approval; Cornelius, 1998b), a sheetpile wall was installed at the A-Site along the length of the Kalamazoo River, extending approximately 150 feet up Davis Creek. This wall was installed to an elevation 2 feet above the site's 100-year flood elevation (top at 767 feet) to reduce the potential for residuals to be transported to the river in the possible event of failure of the existing dikes, and is intended to be left in place to complement future actions. However, remedial alternatives that either remove, or cut-off the existing sheet pile wall below the surface of the Kalamazoo River, are considered in this report.

A timeline illustrating the major activities carried out between 1985 and 2001 at the A-Site is presented in Figure 1.

2.1 Residuals Characterization and Response Activities

Residuals are defined as PCB-containing soils and sediments, visible gray paper residuals and associated clay, and visible gray paper residuals mixed with soil and/or sediment soils. Clay present in the paper residuals was a raw material in the paper making process and is different than the native clay soils deposited with glacial and fluvial actions in the Kalamazoo River basin.

The Residuals Characterization, as prescribed by the Work Plan (BBEPC, 1993b), consisted of drilling and sampling eight borings (five at the Willow Boulevard Site and three at the A-Site; WB-1 through WB-5 and AS-1 through AS-3) and 10 sediment cores (five near the Willow Boulevard Site and five near the A-Site; WRN-1 through WRN-5 and ARN-1 through ARN-5) within the investigation area of the WB/A-OU. Figure 4 presents the location of each boring and core. Continuous split-spoon samples at each of the eight boring locations were collected for visual classification. In addition, analytical (for PCB and Target Compound and Target Analyte Lists (TCL/TAL)) and geotechnical samples were collected at select intervals from these borings. Additional information regarding sampling is provided in Sections 2.2.1 and 2.2.2, results of analyses are provided in Section 4.

Additional soil and residuals sampling and analyses were conducted as part of the Hydrogeological Investigation (Section 2.2 of this report) and the Soil and Sediment Investigation (Section 2.3 of this report). In addition, assessing the extent and volume of residuals in the Kalamazoo River sediments immediately adjacent to the WB/A-OU included collecting cores near the OU during the river sediment probing survey, as reported in *Technical Memorandum 9* (BBL, 1995b) and *Technical Memorandum 10* (CDM, 2002b). The river sediment

probing survey included 10 river transects adjacent to the WB/A-OU, from which 77 cores were collected and visually characterized as part of the Kalamazoo River RI (*Technical Memorandum 10*; CDM, 2002b; KPT-5 through KPT-14; Figure 4). Additional details of the WB/A-OU Residuals Characterization activities and results are presented in Sections 2.1, 3.1, and 3.2 of *Technical Memorandum 9* (BBL, 1995b) and in *Technical Memorandum 10* (CDM, 2002b). Results are provided in Sections 4.2.1 and 4.2.2 of this report.

Locations of samples collected and descriptions of soil sample analyses performed are discussed throughout Section 2.1 and 2.3 of this report. Subsections are broken out by area of the WB/A-OU and the ancillary area. Note that soil sampling of residential property is addressed in Sections 2.3.2 and 2.3.4. Figure 4 presents site-wide information and identifies sample collection locations and piezometer locations at the WB/A-OU and associated areas. Additional details and results of the Geotechnical Investigation activities are presented in Sections 2.3.5 and 3.3 of *Technical Memorandum 9* (BBL, 1995b), and Sections 2.4 and 3.5 of this report.

2.1.1 Willow Boulevard Site

Remedial Investigation

In accordance with the Work Plan (BBEPC, 1993b), samples were collected from WB-1 through WB-5 (Figure 4). Surficial samples were submitted for PCB analyses; subsurface samples were submitted for PCB and TCL/TAL analyses. The surficial samples from WB-1, WB-2, and WB-3 were also analyzed for polychlorinated dibenzo-dioxins (PCDD) and polychlorinated dibenzo-furans (PCDF). Results of these analyses are discussed in Sections 4.2.1.1 and 4.2.3.1 of this report.

Five sediment cores (WRN-1 though WRN-5) were collected from the Willow Boulevard site and analyzed for PCB. Results of these analyses are discussed in Section 4.2.1.1 of this report.

Interim Response Activities

An area containing residuals, as determined by RI sampling, was excavated between November 1999 and April 2000 (Figure 5). It was agreed, during a February 7, 2000 conference call with the MDEQ and confirmed in a letter dated February 8, 2000, that any PCB-containing material remaining in the river adjacent to the Willow Boulevard Site will be addressed as part of the remedy for the Kalamazoo River (Brown, 2000). Analytical results of post-excavation samples are presented in Section 4.2.3.1 and in Appendix E of this report.

2.1.2 A-Site

Remedial Investigation

Five sediment cores (ARN-1 though ARN-5) were collected from the bank of the river at the A-Site and analyzed for PCB. Sample locations for A-Site samples are presented on Figure 4. Analytical results are presented in Section 4.2.1.2.

Samples were also collected from borings AS-1, AS-2, and AS-3 (Figure 4). Surficial samples were submitted for PCB analyses; subsurface samples were submitted for PCB and TCL/TAL analyses. The surficial samples from AS-1, AS-2, and AS-3 were also analyzed for polychlorinated dioxins (PCDD) and polychlorinated dibenzofurans (PCDF). Results are discussed in Sections 4.2.1.2 and 4.2.3.2 of this report.

Interim Response Activities

At the confluence of the former Olmstead Creek and the river, an area containing residuals, as determined by RI sampling, was excavated between November 1999 and April 2000 (Figure 6). It was agreed, during a February 7, 2000, conference call with the MDEQ and confirmed in a letter dated February 8, 2000, that any PCB-containing material remaining at the former Olmstead Creek confluence will be addressed as part of the remedy for the Kalamazoo River (Brown, 2000). Analytical results of post-excavation samples are presented in Section 4.2.3.1 and in Appendix E of this report.

2.2 Hydrogeologic Investigation Activities

Hydrogeological Investigation activities were conducted at the WB/A-OU in 1993, 1995, 1996, and 2000. The 1993 activities included a monitoring well inventory; monitoring well and piezometer installation, rehabilitation, and decommissioning; and groundwater/leachate sampling. Information included geologic descriptions, in-situ hydraulic conductivity test results, potentiometric surface elevations, and groundwater quality information. In 1993, groundwater samples were collected and analyzed for PCB and TCL/TAL parameters.

Monitoring wells were installed in two target zones: the upper-most five feet of saturated material immediately below the residuals or dikes (designated as an “A” well), and the saturated zone from five to 10 feet below the “A” well at each cluster (designated as the “B” well). As directed by the MDNR, saturated zones within the residuals (i.e., containing leachate) were also targeted for monitoring if the following conditions were encountered: (1) a zone at least three feet in thickness and at least two feet above the base of residuals (to be designated an “R” well); or (2) a perched saturated zone (designated as a “P” well). Four “P”-designated wells were installed at the WB/A-OU; no “R”-designated wells were installed. For details of well construction, see Section 2.2.2.1 in *Technical Memorandum 9* (BBL, 1995b). Figure 4 shows locations of all monitoring wells.

The 1995 activities included sampling of all existing monitoring wells, with analysis for PCB performed at a 0.2 micrograms per liter (μg/L) method detection limit, as directed by the MDEQ. The results of PCB analysis for unfiltered groundwater/leachate samples are discussed in Section 4.2.7.

On August 19, 1996, a 2-inch, double-cased well was installed at the Willow Boulevard Site to replace monitoring well WMW-3A. This well was replaced because of suspected cross-contamination from overlying residuals during installation in 1993. One groundwater sample was collected from the replacement well on August 30, 1996 and analyzed for PCB.

In November 2000, activities included an inspection of all existing monitoring wells, rehabilitation of the groundwater monitoring network (including the installation of river gages RG-1 and RG-2 [Figure 4]), and redevelopment and resampling of 23 groundwater monitoring wells. Nineteen of the wells (one at the Willow Boulevard Site and 18 at the A-Site) needed various degrees of rehabilitation. Rehabilitation included installing new temporary surface seals, cutting down well casings, and installing new well caps. Prior to sampling the 23 groundwater monitoring wells, the wells were redeveloped to remove fine material that had accumulated within the filter sand surrounding the well screen by surging and purging the wells with an inertia pump. After allowing the wells to equilibrate for a period of two weeks, the wells were resampled.

As stated, the primary objective of the WB/A-OU groundwater sampling and analysis was to assess the potential for PCB migration in groundwater beneath the OU. In addition to PCB, however, groundwater samples were also analyzed for the presence of TCL/TAL constituents. A summary of the concentrations of TCL compounds detected in groundwater samples is shown in Table 4-1 of *Technical Memorandum 9* (provided here in Appendix C), and a summary of TAL analytes detected in groundwater is shown in Table 4-2 of *Technical Memorandum 9* (BBL, 1995b) (provided here in Appendix C). A summary can be found in Section 4.2.1 of *Technical Memorandum 9* (BBL, 1995b).

2.2.1 Willow Boulevard Site

Pre-Remedial Investigation

Groundwater monitoring was conducted at the three on-site wells (WMW-1, WMW-2, and WMW-3; Figure 4) at the Willow Boulevard portion of the operable unit in February and March 1988. Results are discussed in Section 4.2.7.1.

In June 1990, groundwater samples from monitoring wells WMW-1 and WMW-3 (Figure 4) were analyzed for PCDD and PCDF homologues and 2,3,7,8-congeners. Results of these analyses are discussed in Section 4.2.7.1.

Remedial Investigation

After performing the monitoring well inventory in 1993, two wells (WMW-2 and WMW-3) were rehabilitated. Well WMW-4 was decommissioned and replaced with well WMW-4A. The replacement for the decommissioned well was installed with three other new wells (WMW-1A, WMW-3A, and WMW-4B). Locations of monitoring wells are presented on Figure 4. In October 1993 and August 1995, groundwater sampling was conducted at well clusters WMW-1/1A, WMW2, WMW-3/3A, and WMW-4A/4B. Results of these analyses are discussed in Section 4.2.7.1.

On August 19, 1996, a 2-inch, double-cased well was installed at the Willow Boulevard Site to replace monitoring well WMW-3A. This well was replaced because of suspected cross-contamination from overlying residuals during installation in 1993. One groundwater sample was collected from the replacement well (WMW-3AR) on August 30, 1996, and analyzed for PCB. Results are presented in Section 4.2.7.1 and included in Appendix F.

In November 2000, groundwater samples were collected from monitoring wells WMW-1, WMW-1A, WMW-2, WMW-3, WMW-3AR, WMW-4A, and WMW-4B (Figure 4). Results of the analyses performed on these samples are presented in Section 4.2.7.1 of this report.

2.2.2 A-Site

Pre-Remedial Investigation

Groundwater monitoring was conducted at five on-site wells (AMW-1 through AMW-5) (Figure 4) and was sampled at the A-Site between February 1988 and August 1990. The results are discussed in Section 4.2.7.2.

Remedial Investigation

Based on the monitoring well inventory in 1993, two damaged wells (AMW-1 and AMW-2) were rehabilitated and two wells needing decommissioning (AMW-9P and AMW-10B) were replaced. Fifteen additional wells (AMW-3A, AMW-6A, AMW-6B, AMW-6P, AMW-7A, AMW-7B, AMW-7P, AMW-10A, AMW-10B, AMW-10P, AMW-8A, AMW-8B, AMW-9-A, AMW-9B, and AMW-9P) and eight piezometers (P-1D, P-2D, P-3D, P-1RS, P-2RS, P-3RS, P-4WT, and P-5WT) were installed. Monitoring well and piezometer locations are shown on Figure 4. In October 1993 and August 1995, groundwater sampling was conducted at well

clusters AMW-1, AMW-2, AMW-4, AMW-5, AMW-6P/6A/6B, AMW-7P/7A/7B, AMW-8A/8B, AMW-9P/9A/9B, and AMW-10A/10B/10P. Analytical results are discussed in Section 4.2.7.2 of this report.

In November 2000, samples were collected from monitoring wells AMW-1, AMW-2, AMW-3/3A, AMW-4, AMW-5, AMW-6A/6B, AMW-7A/7B, AMW-8A/8B, AMW-9A/9B, and AMW-10A/10B. In December 2000, samples were again collected from AMW-3A, AMW-4, AMW-6A, AMW-8A, AMW-9A, and AMW-10A/10B. Results of the analyses on these samples are discussed in Section 4.2.7.2 of this report.

2.2.3 AMW-3A Area

Remedial Investigation

Groundwater samples were collected from AMW-3A (Figure 4) in October 1993 and August 1995, and the samples were analyzed for PCB. Results of these analyses are discussed in Section 4.2.7.3 of this report.

In November and December 2000, groundwater samples were collected from AMW-3A. Discussion of the results is presented in Section 4.2.7.3 of this report. Analytical results are presented in Appendix F.

2.3 Soil and Sediment Investigation Activities

The objective of the Soil and Sediment Investigation was to assess the nature and the vertical and horizontal extent of constituents in sediment and in surface and subsurface soil. Areas investigated included the Willow Boulevard Site, the A-Site, the area east of Davis Creek, the Kalamazoo River, Davis Creek, and nearby residential areas. At select boring locations (Figure 4) identified in *Technical Memorandum 9* (BBL, 1995b), samples of soil and sediment were collected and analyzed for TCL/TAL constituents.

2.3.1 WB/A-OU Surficial Soil and Sediment

Surficial soil samples were collected during pre-RI activities from locations GP-1, GP-2, 1 through 11, 1A through 22A, 12, 16, SB-1, SB-3, SB-6, SB-7, SB-8, A-1, A-3, A-7, A-11, B-8, B-14, C-3, C-5, C-9, C-13, and D-13. Pre-RI sampling locations are indicated on Figures 21 and 23 of the DCS, included here in Appendix A.

Surficial soil samples were collected during the RI from WB-1 through WB-3, AS-1 through AS-3, ARS-1 though ARS-3, FLA-SB-24, AMW-3A-1, AMW-3A-2, AMW-3A-3, AMW-6B, AMW-7B, AMW-8B, AMW-9B, AMW-10B, SB-3A-101 through SB-3A-107, SB-3A-201 through SB-3A-213, and EDC-1 through EDC-8.

Sediment samples were collected at sample location 15, WRN-1 through WRN-5, ARN-1 through ARN-5, OCU-SED, OCM-SED, OCD-SED, DCU-SED, DCM-SED, DCD-SED, and from river transects KPT-5 through KPT-14.

Results are discussed in Section 4.2.1.

2.3.1.1 Willow Boulevard Site

Pre-Remedial Investigation Activities

In December 1986, the MDNR discovered PCB in surficial samples taken from the bank of the Willow Boulevard Site (GP-1 and GP-2). More detailed investigations were conducted in 1987 and 1988 by Georgia-Pacific with MDNR on-site collecting split samples at the Willow Boulevard site. These investigations analyzed site materials for PCB, PCDDs, and PCDFs. Sampled locations include 1 through 11, and 1A through 22A. Locations are presented on Figure 21 of the DCS (BBEPC, 1992), provided here in Appendix A. Results are discussed in Section 4.2.1.1.

Remedial Investigation

Surficial soil samples were collected from borings WMW-3A and WMW-4B (Figure 4). Samples were analyzed for PCB. Results of these analyses are presented in Section 4.2.1.1.

In accordance with the Work Plan (BBEPC, 1993b), surficial samples were also collected from WB-1 through WB-5 (Figure 4). These samples were submitted for PCB analyses. Additionally, sample locations WB-1, WB-2, and WB-3 were analyzed for PCDD and PCDF. Results are discussed in Section 4.2.1.1 of this report.

Five sediment cores (WRN-1 though WRN-5) were collected and sampled for PCB from the Willow Boulevard site. Results of these analyses are discussed in Section 4.2.1.1 of this report.

From the four river transects immediately adjacent the Willow Boulevard Site that were probed (KPT-11 through KPT-14) (Figure 4), 31 cores were collected and visually characterized for residuals. Consistent with the findings of the Residuals Characterization (Section 2.1 of this Report) and the results of samples WRN-1 through WRN-5, these cores indicated the presence of residuals in the Kalamazoo River along a narrow band adjacent to the Willow Boulevard Site. Results are discussed in Section 4.2.1.1.

Interim Response Activities

During the IRA, conducted from November 1999 to April 2000, some of the residuals extending into the river west of the Willow Boulevard Site were excavated, and samples were collected to determine the remaining concentrations of PCB in the sediment underlying the backfill material that was placed. Results are discussed in 4.2.1.1 and presented in Figures 16 and 16A.

2.3.1.2 A-Site

Pre-Remedial Investigation

Surficial soil samples were collected in April 1987 from the east end of the A-Site. Samples were again collected in July 1990 by Georgia-Pacific, under the direction of the MDNR. Results are discussed in Section 4.2.1.2 of this report and in Tables 87 and 88 of the DCS (BBEPC, 1992), which is provided in Appendix A. Locations of surficial soil samples collected include 12, 16, SB-1, SB-3, SB-6, SB-7, and SB-8 and are presented on Figure 23 of the DCS (BBEPC, 1992; see Appendix A). Results are discussed in Section 4.2.1.2.

Remedial Investigation

Surficial samples were collected from borings AMW-6B, AMW-7B, AMW-8B, AMW-9B, and AMW-10B and analyzed for PCB. Locations are presented on Figure 4. Results are discussed in Section 4.2.1.2.

Investigations indicated that residuals extended beyond the southern berm of the A-Site. To assess the possible lateral and vertical extent of the residuals, a soil reconnaissance survey was conducted outward from the southern perimeter of A-Site. Surficial soil samples were collected from three locations in the area south of the A-Site berm (ARS-1 though ARS-3) (Figure 4). The area was probed with a shovel to determine if residuals were present, and if so, their continuity and spatial extent. Results are discussed in Section 4.2.1.2 of this report.

Samples were also collected from borings AS-1, AS-2, and AS-3 (Figure 4). The samples were submitted for PCB or TCL/TAL analyses. The surficial samples from AS-1, AS-2, and AS-3 were also analyzed for PCDD and PCDF. Results are discussed in Sections 4.2.1.2 and 4.2.3.2 of this report.

As determined in the February 17, 1999 Sampling Work Plan (McGuire, 1999), activities included the installation of 27 borings, with the collection of one surficial sample from soil boring FLA-SB-24 from the 0-to-2 foot interval (Sample W70338; see Figure 7) as a part of the effort to assess the extent of residuals south of the A-Site berm. Results are discussed in Section 4.2.1.2 of this report. Subsurface investigation activities associated with this investigation are discussed in Section 4.2.3.2.

Five sediment cores (ARN-1 though ARN-5) were collected from the bank of the river at the A-Site and analyzed for PCB (Figure 4). Analytical results are presented in Section 4.2.1.2.

From the six river transects immediately adjacent to the A-Site (KPT-5 through KPT-10) (Figure 4) that were probed, 46 cores were collected. Results are presented in Section 4.2.1.2.

Three sediment cores were collected from the former Olmstead Creek. As directed by the Work Plan, the sample locations (OCU-SED, OCM-SED, OCD-SED) (Figure 4) were selected such that one sample would be collected at an upstream location, one at a midstream location, and one downstream. Results of these analyses are discussed in Section 4.2.1.2 of this report.

Interim Response Activities

During the IRA, between November 1999 and April 2000, material from the confluence of former Olmstead Creek and the Kalamazoo River was excavated and then backfilled. Samples were collected to determine the remaining concentrations of PCB in the sediment underlying the backfill material. Results are discussed in Section 4.2.1.2 of this report and are shown in Figures 20 and 20A.

2.3.1.3 AMW-3A Area

Remedial Investigation

As part of the soil investigation, background soil samples were collected at AMW-3A. The borehole was placed upgradient of the OU, and the analytical results of the samples, in conjunction with background soil information obtained from the KHL-OU investigation, were to be used in the RI to estimate local background TAL analyte concentrations within the sand unit underlying the WB/A-OU. After review of the data, these sample locations did not satisfy MDNR's criteria for background samples; therefore, for the purpose of this report, it will be discussed here with the site soil data. For further discussion, see *Technical Memorandum 9* (BBL, 1995b).

During the RI, analytical results from the AMW-3A boring indicated that PCBs were present in an area considered background for the WB/A-OU. To confirm the results of the earlier RI activities, additional sampling was required in the area around monitoring well AMW-3A (defined as the AMW-3A area; Figure 3). These cores (AMW-3A-1, AMW-3A-2, and AMW-3A-3; Figure 8) were sectioned into 2-foot intervals as specified in the procedure outlined in a letter to the MDEQ in December 1997 (Brown, 1997b). This sectioning produced a surficial soil sample for PCB analyses from each of the cores (AMW-3A-1, AMW-3A-2, and AMW-3A-3). The results of this January 1998 investigation are discussed in Section 4.2.1.3 of this report.

The sampling plan for the second round of sampling in the AMW-3A area was submitted to the MDEQ in March 1998 (Brown 1998b). It prescribed the collection of samples from seven borings (SB-3A-101 through SB-3A-107; Figure 8) on property owned by Georgia-Pacific or Kalamazoo Township in a manner consistent with the original AMW-3A sampling plan. The results from samples collected during this phase of the investigation (July 1998) were submitted to the MDEQ in September 1998 (McGuire, 1998a). The results are presented in Section 4.2.1.3 of this report.

A third round of sampling activities in the AMW-3A area was conducted in March 1999 from soil borings SB-3A-201 to SB-3A-213 (Figure 8) (SB-3A-201, SB-3A-204, SB-3A-207, and SB-3A-209 through SB-3A-212 are discussed in the residential sampling in Sections 2.3.2.2 and 2.3.2.3). The results of this third round of sampling are discussed in Section 4.2.1.3 of this report.

2.3.1.4 Area East of Davis Creek

Pre-Remedial Investigation

In July 1990, Swanson Environmental collected soil samples from 11 locations in the area east of Davis Creek under the direction of the MDNR. Sample locations (A-1, A-3, A-7, A-11, B-8, B-14, C-3, C-5, C-9, C-13, and D-13) are shown on Figure 23 of the DCS; see Appendix A. Results are presented in Section 4.2.1.4.

Remedial Investigation

During RI activities, 16 soil samples were collected from the area east of Davis Creek (EDC-1 though EDC-8). Locations are presented on Figure 4. The area was probed with a shovel and hand auger to assess the presence and distribution of any grey, clayey soils which might be indicative of residuals. One sample at each location was collected from 0-to-6-inches below ground surface (bgs). A second sample from each location was collected from 6 inches bgs to the depth of groundwater (groundwater depth was generally 1 foot bgs). At one location (EDC-8), the second sample was collected in the interval from 1.5 to 2 feet bgs. Each sample was homogenized and analyzed for PCB. Results are discussed in Section 4.2.1.4 of this report.

2.3.1.5 Davis Creek

Remedial Investigation

Three sediment cores were collected from Davis Creek. As directed by the Work Plan (BBEPC, 1993b), the sample locations (DCU-SED, DCM-SED, DCD-SED) (Figure 4) were selected such that one sample would be collected at an upstream location, one at a midstream location, and one downstream (Figure 4). Results of these analyses are discussed in Section 4.2.1.5 of this report.

2.3.2 Residential Soils - Surficial

In order to assess the potential for residential exposure to PCB, soil samples were collected from residential properties adjacent the WB/A-OU. Soil samples were collected in July and August 1987 at 19 locations (Figure 21 of the DCS [BBEPC, 1992], presented here in Appendix A) in the neighboring Lakewood area. Results of the surficial soil sampling are presented in Table 81 of the DCS (BBEPC, 1992), which is included here in

Appendix A, and are also summarized in Section 4.2.2 of this report. Sample locations are presented in discussions of the specific sites in the sections below.

2.3.2.1 Residences South of the Willow Boulevard Site

Pre-RI

In July and August 1987, soil samples were collected from 19 locations in the neighboring Lakewood area. Sample locations are listed on Table 81 of the DCS and are shown on Figure 21 of the DCS (BBEPC, 1992) presented here in Appendix A. Results of this sampling activity are discussed in Section 4.2.2.1.

Remedial Investigation

During RI activities, in accordance with the Work Plan (BBEPC, 1993b), surficial soil samples were collected from three locations (WBAS-1 through WBAS-3) on residential properties adjacent to the WB/A-OU. The soil samples, taken from the locations to the south of the Willow Boulevard Site (Figure 4) were collected using a stainless steel hand auger, then homogenized and submitted for PCB analysis. Results are discussed in Section 4.2.2.1 of this report.

2.3.2.2 Residential Property Near the AMW-3A Area - Wright Property

Remedial Investigation

As part of the third round of AMW-3A area sampling, one sample was collected from each of three soil borings (SB-3A-201, SB-3A-204, and SB-3A-207) on the Wright property (Figure 9). Results are discussed in Section 4.2.2.2 of this report.

2.3.2.3 Residential Property Near the AMW-3A Area - Bloomfield Property

Remedial Investigation

As part of the third round of AMW-3A area sampling, one sample was collected from each of four borings on the Bloomfield property (SB-3A-209 though SB-3A-212). Two of these borings (SB-3A-210 and SB-3A-212) were installed along the boundary between the Bloomfield property and land owned by Georgia-Pacific adjacent to Davis Creek (Figure 9). Results are discussed in Section 4.2.2.3 of this report.

2.3.2.4 Residential Property South of the A-Site - Adkins Property

Remedial Investigation

In 1999, subsequent to RI activities and in response to the concerns of a local property owner (Adkins) over the possible breach of a potential former lagoon area south of the A-Site berm in the late 1960s, nine soil samples from nine soil borings (SB-ADKINS-1 through SB-ADKINS-9) (Figure 9) were collected on or near the Adkins property in accordance with a work plan outlined in a letter to the MDEQ (McGuire, 1999). The objective of

this plan was to delineate the extent of PCB-containing soils/residuals, if any, on the Adkins property. The locations of the borings are presented on Figure 9 and the results are discussed in Section 4.2.2.4 of this report.

2.3.2.5 Residential Property South of the A-Site - Wadsworth Property

Remedial Investigation

Wadsworth was another property owner who voiced concerns similar to those of Adkins. As a result, six surficial soil samples from three soil borings (B-1, B-2, and B-3) were collected from the Wadsworth property (Figure 9). Results of these samples are discussed in Section 4.2.2.5 of this report.

2.3.2.6 Residential Property South of the A-Site - Scott Property

Remedial Investigation

Scott was another property owner who voiced concerns similar to those voiced by Adkins. As a result, two surficial soil samples (from test pits TP-1 and TP-10) were collected from the Scott property (Figure 9). These results are discussed in Section 4.2.2.6 of this report.

2.3.3 WB/A-OU Subsurface Residuals and Soils

To gather analytical data regarding the presence of subsurface residuals, borings were drilled and sampled within the investigation area of the WB/A-OU (Figure 4). Continuous split-spoon samples were collected at each of the boring locations for visual classification. In addition, samples were collected at select intervals from these borings and analyzed for PCB and TCL/TAL analytes. Descriptions of analyses performed and locations of subsurface samples collected are discussed below. Subsections are broken out by area of the WB/A-OU and the ancillary areas. Results of these analyses are presented in Section 4.2.3 of this report.

The objective of the subsurface investigation was to assess the nature and the vertical and horizontal extent of the constituents in subsurface soil and residuals. Samples of soil were collected and analyzed for TCL/TAL constituents, in addition to PCB analysis. Boring locations included WB-1 though WB-5, WMW-1A, WMW-3A, WMW-4A, WMW-4B, and WBAS-1 through WBAS-3 from the Willow Boulevard Site; AS-1 through AS-3, AMW-6B, AMW-7B, AMW-8B, AMW-9B, AMW-10B, P1-D, P-2D, P-3D, P-4WT, P-5WT, ARS-1 through ARS-3 from the A-Site; AMW-3A, AMW-3A-1, AMW-3A-2, AMW-3A-2R, AMW-3A-3, SB-3A-101 through SB-3A-107, and SB-3A-201 through SB-3A-213 from the AMW-3A area; and EDC-1 though EDC-8 from the area east of Davis Creek (Figure 4).

2.3.3.1 Willow Boulevard Site

Pre-Remedial Investigation

In 1987 and 1988, MDNR and Georgia-Pacific collected subsurface samples to gauge PCB concentrations and distribution at depth. Sample data are discussed in Section 4.2.3.1. Sample locations include 1A through 22A and B-1 through B-3. Split samples were collected from 7A, 16A, and 21A. Locations are presented on Figure 21 of the DCS (BBEPC, 1992), presented here in Appendix A.

Remedial Investigation

Five borings (WB-1 through WB-5) (Figure 4) were installed at the Willow Boulevard Site. Samples were collected from these borings for PCB and TCL/TAL analyses. PCB and TCL/TAL analyses were also performed on samples collected at WMW-1A, WMW-3A, WMW-4A, and WMW-4B. Sample locations (Figure 4) are presented on Figures 15, 18, 21 through 23 of *Technical Memorandum 9* (BBL, 1995b) and are presented here in Appendix C. Results are presented in Section 4.2.3.1.

Additional sampling was conducted along the southern and western perimeter of the Willow Boulevard Site (eight soil samples [W70315 though W70322] from 59 borings [DWA-SB-1 though DWA-SB-59]) (Figure 7) to characterize the drainageway area of the site (McGuire, 1999). As prescribed in the February 17, 1999 Work Plan, four samples of residual material and four samples of underlying native materials were selected for analysis from the locations spread among the 19 transects performed to assess this area. The samples were collected from soil borings DWA-SB-14, DWA-SB-26, DWA-SB-38, and DWA-SB-51 (Figure 7). Results are discussed in Section 4.2.3.1.

Interim Response Activities

Sediment samples were collected at the base of the excavation adjacent to the Willow Boulevard Site by both BBL and the MDEQ. BBL samples include SV-5, SV-10, SV-12, SV-19, SV-23, SV-26, SV-29, SV-36, SV-40, SV-45, SV-50, SV-51, SV-53, SV-56, SV-57, SV-58, SV-60, and SV-65. MDEQ samples include WLF-1 through WLF-25, 26 through 33, and SS-34 through SS-65. Samples were analyzed for PCB. Results of these analyses are discussed in Section 4.2.3.1 and shown in Figures 16 and 16A.

2.3.3.2 A-Site

Pre-Remedial Investigation

Soil borings were drilled in July 1990 (SB-1 though SB-10, MW-4, and MW-5) to begin characterization of the nature and extent of residuals (Figure 23 of DCS [BBEPC, 1992], Appendix A). Results are discussed in Section 4.2.3.2.

Remedial Investigation

Three borings (AS-1 through AS-3) were installed at the A-Site. Samples were collected from these borings for PCB and TCL/TAL analyses. PCB analyses were also performed on samples from P1-D, P-2D, P-3D, P-4WT, and P-5WT. PCB and TCL/TAL analyses were performed on samples collected at AMW-3A and AMW-6B through AMW-10B. Sample locations are presented on Figure 4 of this report and on Figures 16, 19 through 21, and 24 of *Technical Memorandum 9* (BBL, 1995b), are presented here in Appendix C. Results are presented in Section 4.2.3.2.

RI activities included the collection of an additional 19 soil samples (W70323 through W70337 and W70339 through W70342), including one duplicate from 27 borings in March and April 1999 as a part of the effort to assess the extent of residuals south of the A-Site berm. As prescribed in the February 17, 1999 Work Plan, four samples of residual material and four samples of underlying native material were collected from soil borings FLA-SB-7, FLA-SB-12, FLA-SB-18, and FLA-SB-24 that were spatially located among the nine transects. Additionally, one sample was selected for analysis from the southernmost boring along each transect. These samples were collected from soil borings FLA-SB-1, FLA-SB-5, FLA-SB-8, FLA-SB-11, FLA-SB-13, FLA-SB-16, FLA-SB-19, FLA-SB-22, and FLA-SB-25 (Figure 7). Sample selection was based on visual observations and/or default sample acquisition at the interval just above the water table. Analytical results are discussed in Section 4.2.3.2 of this report.

Two additional samples (W70341 and W70342) were collected at soil borings DWA-FLA-SB-3 and DWA-FLA-SB-4, respectively, to access the suspect residual materials encountered at these borings (Figure 7). The results are discussed in Section 4.2.3.2 of this report and shown in Figures 20 and 20A.

2.3.3.3 AMW-3A Area

Remedial Investigation

As prescribed by the Work Plan (BBEPC, 1993b), two samples were collected from soil boring AMW-3A, one sample from each 6 to 8 and 10 to 12 feet bgs for PCB analyses as part of the RI activities. Results are presented in Table 3-11 of *Technical Memorandum 9* (BBL, 1995b) (included here in Appendix C) and summarized in Section 4.2.3.3. Sample locations are presented in Figure 8.

During the RI, analytical results from the AMW-3A boring indicated that PCBs were present in an area initially considered background for the OU. To confirm the results of the earlier RI activities, additional sampling was required in the area around monitoring well AMW-3A. Four cores (AMW-3A-1, AMW-3A-2, AMW-3A-2R,

and AMW-3A-3) (Figure 8) were sectioned into 2-foot intervals as specified in the Work Plan for additional sampling of AMW-3A (Brown, 1997b). This sectioning produced a total of 18 subsurface soil samples for PCB analyses. The results are discussed in Section 4.2.3.3 of this report.

The sampling plan for the second round of sampling in the AMW-3A area was submitted to the MDEQ in March 1998 (Brown, 1998b). It prescribed the collection of samples from seven borings (SB-3A-101 through SB-3A-107) (Figure 8) on property owned by Georgia-Pacific or Kalamazoo Township in a manner consistent with the original AMW-3A sampling plan. The results from samples collected during this phase of the investigation were submitted to the MDEQ in September 1998 (McGuire, 1998a). The results are discussed in Section 4.2.3.3 of this report.

A third round of sampling activities in the AMW-3A area was conducted in March 1999 from soil borings SB-3A-201 to SB-3A-213 (SB-3A-201, SB-3A-204, SB-3A-207, and SB-3A-209 through SB-3A-212 are discussed in the residential sampling in Section 2.3.4). Figure 8 shows the locations and the results are discussed in Section 4.2.3.3 of this report.

2.3.4 Residential Soils - Subsurface

In order to assess the potential for residential exposure to PCB, soil samples were collected from residential properties adjacent the WB/A-OU. Results of subsurface residential soil sampling are provided in Section 4.2.4 of this report. Sample locations are presented in discussions of the specific sites in the sections below.

2.3.4.1 Residential Property Near the AMW-3A Area - Wright Property

Remedial Investigation

As part of the third round of AMW-3A area sampling, 7 samples from 3 soil borings (SB-3A-201, SB-3A-204, and SB-3A-207) were collected on the Wright property (Figure 9). Results are discussed in Section 4.2.4.1.

2.3.4.2 Residential Property Near the AMW-3A Area - Bloomfield Property

Remedial Investigation

As part of the third round of AMW-3A area sampling, eight samples were collected from four borings on the Bloomfield property (SB-3A-209 though SB-3A-212). Two of these borings (SB-3A-210 and SB-3A-212) were installed along the boundary between the Bloomfield property and land owned by Georgia-Pacific adjacent to Davis Creek (Figure 9). Results are discussed in Section 4.2.4.2 of this report.

2.3.4.3 Residential Property South of the A-Site - Adkins Property

Remedial Investigation

In 1999, in response to the concerns of a local property owner (Adkins) over the possible breach of a potential former lagoon area south of the A-Site berm in the late 1960s, 37 subsurface soil samples (including four duplicates) from nine soil borings (SB-ADKINS-1 through SB-ADKINS-9) were collected on or near the Adkins property in accordance with a work plan outlined in a letter to the MDEQ (McGuire, 1999). The objective of this plan was to test for the presence and the extent of PCB-containing soils/residuals and, if present, delineate the extent, if any, on the Adkins property. The locations of the borings are presented on Figure 9 and the results are discussed in Section 4.2.4.3 of this report.

2.3.4.4 Residential Property South of the A-Site - Wadsworth Property

Remedial Investigation

Wadsworth was another property owner who voiced concerns similar to those of Adkins. As a result, three subsurface soil samples from two soil borings (B-1 and B-2) were collected from the Wadsworth property (Figure 9). Results of these samples are discussed in Section 4.2.4.4 of this report.

2.3.4.5 Residential Property South of the A-Site - Scott Property

Remedial Investigation

Scott was another property owner who voiced concerns similar to those voiced by Adkins. As a result, four subsurface soil samples from test pits TP-1, TP-12, TP-13, and TP-15 were collected from the Scott property (Figure 9). These results are discussed in Section 4.2.4.5 of this report.

2.4 Geotechnical Investigation

Geotechnical sampling and laboratory testing were conducted to assess the stability of the dikes at the A-Site and the shear strength and other characteristics of the residuals in the WB/A-OU. The Geotechnical Investigation included evaluating piezometer information and collecting disturbed and undisturbed samples of residuals and soil. Vane-shear tests were performed in select borings to aid in evaluating the shear strength of the residuals.

Geotechnical laboratory testing was performed on select residuals and soil samples. Laboratory tests included moisture content, organic carbon content, Atterberg Limits, specific gravity, unconsolidated-undrained (UU) tri-axial shear, one-dimensional consolidation, and gradation.

Additional details and results of the Geotechnical Investigation activities are presented in Sections 2.3.5 and 3.3 of *Technical Memorandum 9* (BBL, 1995b), Section 3.5, and Appendix C of this report.

2.4.1 Willow Boulevard Site

Remedial Investigation

Geotechnical sampling was not conducted as part of the RI at the Willow Boulevard Site because site-specific geotechnical data already exist (Dell Engineering, 1988) and dikes do not extend around the site. Results of Dell Engineering's analyses are discussed in Section 3.5.1 of this report.

2.4.2 A-Site

Remedial Investigation

Collection of relatively undisturbed samples of native soil and residuals was attempted following American Society for Testing and Materials (ASTM) D1587 procedures. Three Shelby tubes were recovered, including two of residuals (AMW-9A and AS-2) (Figure 4). The third tube, from GEO-2, was expected to contain peat from below the dikes, but instead contained sand, silt, and clay. Results are discussed in Section 3.5.2 of this report.

Field vane-shear testing was conducted in residuals at boring AMW-9A to aid in evaluating the shear strength of the residuals, according to ASTM D1873. This method takes into consideration disturbance of overlying materials, and requires that the vane-shear test be conducted at least 2.5 feet below the base of the borehole. Field vane-shear testing was also attempted at boring AMW-6P but was abandoned, as the residuals were too stiff to allow the vane to turn. Results from AMW-9A are discussed in Section 3.5.2 of this report.

Disturbed and undisturbed samples were selected for geotechnical laboratory testing. The geotechnical laboratory testing program included analysis of moisture content, organic content, Atterberg Limits, specific gravity, gradation, unconsolidated-undrained (UU) tri-axial shear, and one-dimensional consolidation. Table 2-4 of *Technical Memorandum 9* (BBL, 1995b) (provided in Appendix C) summarizes the samples selected for geotechnical testing.

2.5 Surface Water/Sediment

The Surface Water Investigation at the WB/A-OU consisted of collecting and analyzing three sediment cores and three surface water samples from Davis Creek, and one sediment core and one surface water sample from the former Olmstead Creek (in the area south of the A-Site berm) (Figure 4) for PCB. As directed by the Work Plan (BBEPC, 1993b), the sediment and surface water sample locations were selected such that one set (one sediment and one surface-water sample) was collected at an upstream location, one at a downstream location, and one at a midstream location in both Davis Creek and the former Olmstead Creek.

2.5.1 A-Site

Pre-Remedial Investigation

Swanson Environmental and MDNR collected split samples of surface water from the former Olmstead Creek in April 1987. Water from the former Olmstead Creek was collected and analyzed for PCB. Results are discussed in Section 4.2.5.1. Sample locations are shown on Figure 4 of this report.

Remedial Investigation

As prescribed in the Work Plan (BBEPC, 1993b), surface water samples were collected from three points on the creek: one point upstream, one point midstream, and one point downstream. Due to the intermittent nature of the water flow in the former Olmstead Creek, it was only possible to collect one surface water sample. That sample (OCD-SW) was collected at the confluence with the Kalamazoo River and analyzed for PCB. Results are discussed in Section 4.2.5.1; locations are shown on Figure 4 of this report.

2.5.2 Davis Creek

Pre-Remedial Investigation

Swanson Environmental and MDNR collected one split sample of surface water from Davis Creek in April 1987. Results are discussed in Section 4.2.5.2. The sample location is shown on Figure 23 of the DCS (BBEPC, 1992), presented here in Appendix A.

Remedial Investigation

As prescribed in the Work Plan (BBEPC, 1993b), surface water samples were collected from three points on the creek: one point upstream (DCU-SW), one point midstream (DCM-SW), and one point downstream (DCD-SW). These samples were collected and presented for PCB analysis. Locations are shown on Figure 4 and results are discussed in Section 4.2.5.2 of this report.

2.6 Air Monitoring

The air monitoring program conducted during the RI assessed potential emissions of PCB from the OU to ambient air during a period when such emissions would potentially be of concern. Five air samplers were placed at four separate locations around the perimeter of the OU (WB-1 through WB-5) (Figure 4). In addition, two co-located air samplers were placed in the city of Battle Creek (Figure 2.2 of *Technical Memorandum 5* [BBL, 1994a], presented here in Appendix B) to assess background PCB concentrations in a Michigan urban environment.

Concurrently, meteorological data for the OU were collected at the Kalamazoo County Fairgrounds Meteorological Station, located south of the OU. The station recorded ambient wind speed and direction, air temperature, and solar radiation levels.

Air monitoring was conducted as prescribed in the Work Plan (BBEPC, 1993b) and the Interim Response Activity Work Plan (McGuire, 1999) to monitor both vapor phase and particulate PCB concentration. Air monitoring was conducted between June and August 1993 when conditions favored worst-case emission and transport conditions in accordance with USEPA guidance (USEPA, 1988). Air monitoring was also conducted during the IRA to assess the potential for PCB vapor phase and particulate concentration to increase during remedial activities.

Remedial Investigation

Five air monitors (WB-1 through WB-5; Figure 4) were set up to assess the potential emissions of PCB from the WB/A-OU to ambient air along the perimeter of the site. The air monitoring program at the WB/A-OU was approved by the MDEQ on April 29, 1993 (Cornelius, 1993). The five locations were selected to accomplish two objectives (as stated in *Technical Memorandum 5* [BBL, 1994a]): identify the highest PCB concentrations expected for adjacent or nearest public access and residential locations, and provide data necessary to determine whether PCB are migrating from the OU via the air pathway. Air monitoring was conducted between June and August 1993, when conditions would favor worst-case emissions and transport. The action level was 0.02 $\mu g/m^3$; MDEQ's secondary screening risk level. A total of 101 samples were collected (each sample was analyzed in the vapor phase and the particulate phase). Figure 3-1 of *Technical Memorandum 5* (BBL, 1994a) provides a wind rose diagram of typical ambient meteorological conditions and is presented here in Appendix B. Results of the air monitoring program are discussed in Section 4.2.6 of this report.

Interim Response Activities

Air sampling was also conducted during the IRA (November 1999 through April 2000) to verify that PCB concentrations in ambient air did not exceed 0.02 $\mu g/m^3$. A total of 301 samples were collected and analyzed for vapor phase and particulate phase PCB levels in air. Results are presented in the *Removal Action Summary*, (BBL, 2000) and discussed in Section 4.2.6 of this report.

2.7 Wetlands Assessment

The wetlands assessment at the WB/A-OU was conducted by reviewing maps and other information followed by field verification as described in the Work Plan (BBEPC, 1993b). The National Wetlands Inventory (NWI) map (USFWS, 1991) and the United States Geological Survey topographic map (USGS, 1973) for the

Kalamazoo Quadrangle were reviewed prior to the field investigations. A field investigation was then carried out to verify vegetation, hydrology, and soil parameters in three areas near the WB/A-OU identified as wetlands. These parameters are standard wetland indicators according to the United States Army Corps of Engineers (USACE) *Wetlands Delineation Manual* (USACE, 1987).

Further details of the Wetlands Assessment are presented in Sections 2.5 and 3.4 of *Technical Memorandum 9* (BBL, 1995b), and in Section 3.8 of this report.

2.8 Summary of Samples Collected

Sample collection methods for samples collected during pre-RI activities, as presented in the DCS (BBEPC, 1992) and summarized throughout Section 2, are not known. These samples were collected by a variety of entities (i.e., MDNR, MDPH, Dell Engineering, Swanson Engineering, etc.) prior to approval of the *WB/A-OU Field Sampling Plan* (BBEPC, 1993c) and the *WB/A-OU Quality Assurance Project Plan* (BBEPC, 1993d). As prescribed by the *Review of Historical Data and Sampling Plan* (BBEPC, 1993a), attempts were made to review the quality of the historical data. The length of time between data collection and attempts at review, however, prohibited quality assurance and quality control of the data. As these data can not be verified, they should not be relied upon to provide critical information.

A total of 97 residuals/soil borings were installed during RI activities, yielding 99 residuals samples and 202 soil samples analyzed for PCB, 14 residuals and 18 soil samples analyzed for TCL/TAL constituents, and five residuals samples and one soil sample analyzed for PCDD/PCDF. In addition, 16 sediment cores and four surface water samples were analyzed for PCB, and four surface water samples from the Kalamazoo River were analyzed for TAL constituents and general water quality parameters. Twenty-eight monitoring wells were sampled for groundwater/leachate. A total of 85 groundwater samples and 8 leachate samples were collected at the WB/A-OU and analyzed for PCB and general water quality parameters. Of these, 26 groundwater samples and four leachate samples were analyzed for TCL/TAL constituents. Between June and August of 1993, perimeter and background air samplers collected air samples once every 6 days until 15 samples were collected. The two background air samplers at Battle Creek collected samples for 13 days, as there was difficulty in bringing electricity to the samplers for the first two days; no samples were collected on those two days. A total of 101 air samples were subsequently analyzed for PCB.

During the IRA, a total of 301 air samples were collected and analyzed for PCB, 21 soil samples were collected from the Kalamazoo River adjacent to the Willow Boulevard Site, and nine soil samples were collected from the confluence of the former Olmstead Creek and the Kalamazoo River.

2.9 Collection Methods

All RI and IRA samples were collected in the manner prescribed in the *Willow Boulevard/A-Site Operable Unit RI/FFS Field Sampling Plan* (FSP; BBEPC, 1993b) and were analyzed in accordance with the procedures described in the *Quality Assurance Project Plan* (QAPP; BBEPC, 1993c). Sample collection methodologies are presented in more detail in Section 2.3 of *Technical Memorandum 5* (BBL, 1994a), Section 2.6 of *Technical Memorandum 9* (BBL, 1995b), and Section 2 of the *Draft Addendum to Technical Memorandum 9* (BBL, 1996).

2.9.1 1993 Residuals/Soil/Sediment Sample Collection

Sampling locations are shown on Figure 4. The sampling scheme for PCB analysis at each of the residuals boring locations (displayed on Figure 4 of *Technical Memorandum 9* [BBL, 1995b] presented here in Appendix C) was as follows:

- One sample collected from 0 to 6 inches bgs as depicted as A1 on Figure 4 of *Technical Memorandum 9* (BBL, 1995b) presented here in Appendix C;
- One 2-foot sample interval selected within each 10-foot interval between 0.5 bgs and 6 feet above the residuals/native soil interface as depicted as A2 on Figure 4 of *Technical Memorandum 9* (BBL, 1995b) presented here in Appendix C; and
- Each 2-foot sample interval collected between 6 and 2 feet above the residuals/native soil interface as depicted as A3 on Figure 4 of *Technical Memorandum 9* (BBL, 1995b) presented here in Appendix C.

As directed by the MDNR, two samples from each of the borings were also analyzed for TCL/TAL constituents. These samples (see Figure 4 of *Technical Memorandum 9* [BBL, 1995b], presented in Appendix C) were collected as follows:

- The residuals sample 0 to 2 feet above the residuals/native soil interface as depicted as B on Figure 4 of *Technical Memorandum 9* (BBL, 1995b) presented here in Appendix C; and
- The native soil sample 0 to 2 feet below the residuals/native soil interface as depicted as B on Figure 4 of *Technical Memorandum 9* (BBL, 1995b) presented here in Appendix C.

In addition, six residuals samples from the WB/A-OU were analyzed for PCDD/PCDF. These surficial samples (0 to 6 inches bgs) were collected at borings WB-1, WB-2, AS-1, AS-2, and AS-3. Two of these samples, WB-1 and AS-2, were analyzed in duplicate.

At the shallow wells (designated A and P), one sample was collected every 5 feet to verify the stratigraphy.

Departures from the sampling scheme described above, which were either directed by or made in agreement with the MDNR in the field, are summarized in the following bullets:

- Samples selected for PCB analysis from boring WMW-1A and AMW-3A were obtained from the 0- to 2-foot interval below the water table. The TCL/TAL sample was taken from the 2- to 4-foot interval below the water table.
- Samples from the bottom 2 feet of the dike material in piezometer borings P-1D, P-2D, and P-3D were analyzed for PCB.
- Samples from the first 2 feet below the residuals/native soil interface in piezometer borings P-4WT and P-5WT were analyzed for PCB.
- No samples were taken for chemical analysis from the geotechnical borings (GEO-1, GEO-2, and G20-1) because of their single purpose for geotechnical analysis.
- The piezometers P-1RS, P-2RS, and P-3RS were installed by driving well points; therefore, no geotechnical or analytical samples were collected.

All 16 sediment cores collected at the WB/A-OU were analyzed for PCB. Samples WRN-1 through WRN-5 and ARN-1 through ARN-5 were collected from the 0- to 2-foot bgs interval. The sediment samples DCU-SED, DCM-SED, DCD-SED, OCU-SED, OCM-SED, and OCD-SED were collected from 0- to 6-inch bgs.

The borings completed east of Davis Creek (EDC-1 through EDC-8) were analyzed for PCB. Two soil samples were taken from each location. The first sample was from the 0- to 6-inch bgs interval. The second was from the 6-inch to 1-foot bgs or 1.5-foot to 2-foot bgs interval.

Reconnaissance borings ARS-1 through ARS-3 were collected and analyzed for PCB. Two soil samples were taken from each location. The first was from the 0- to 6-inch bgs interval. A second sample from the 0.5- to 2.0-foot bgs interval (except ARS-1, which was advanced to only 1-foot bgs) was collected and homogenized.

The residential soil borings WBAS-1 through WBAS-3 were sampled from the 0- to 6-inch bgs interval, and submitted for PCB analysis. Samples were identified based on location and depth, as well as by a six-digit numeric code. Each sample location was also surveyed to determine its position.

2.9.2 1993 Groundwater/Leachate Sampling

During the purging of the A and B wells, field measurements including pH, conductivity, and temperature were recorded (Table 2-3 in *Technical Memorandum 9* [BBL, 1995b], presented here in Appendix C). An initial set

of measurements was taken and then repeated after each well volume was purged from the well. Once these field parameters had stabilized (after a minimum of three well volumes had been removed), the groundwater samples were collected. The order for filling the sample containers with groundwater/leachate was as follows:

- Volatile organic compounds (VOCs);
- Total organic carbon (TOC);
- Semi-volatile organic compounds (SVOCs);
- PCB and pesticide compounds;
- TAL metals (unfiltered);
- TAL metals (filtered);
- Cyanide;
- Nitrate and chemical oxygen demand (COD); and
- Alkalinity, sulfate, chloride, carbonate, and bicarbonate.

Both filtered and unfiltered groundwater/leachate samples were collected for TAL analytes. The filtered sample was pumped through a 0.45-micron filter. Field parameters measured at the time of sample collection included temperature, pH, conductivity, dissolved oxygen, and turbidity. Samples were identified based on location and a six-digit numeric code. Table 2-6 of *Technical Memorandum 9* (BBL, 1995b), presented here in Appendix C, lists the samples from each well.

2.9.3 1993 Surface Water Sampling

Two river samples at RG-1 and RG-2 (Figure 4) were collected. The first was collected on October 11, 1993 prior to groundwater/leachate sampling, and the second on October 15, 1993 after completion of groundwater/leachate sampling. These samples were analyzed for inorganic constituents including: TAL, carbonate, bicarbonate, chloride, and sulfate. Field parameters measured at the time of sample collection included: temperature, pH, conductivity, dissolved oxygen, and turbidity. Table 2-6 *of Technical Memorandum 9* (BBL, 1995b), presented here in Appendix C, lists the samples from each location.

Four surface water samples were collected in Davis Creek and the former Olmstead Creek (DCU-SW, DCM-SW, DCD-SW, and OCD-SW; Figure 4). These samples were analyzed for PCB and total suspended solids (TSS). Table 2-6 of *Technical Memorandum 9* (BBL, 1995b; Appendix C) lists the samples from each location.

2.9.4 1993 Geotechnical Sampling

Geotechnical samples were also collected during the drilling of other borings. Samples were identified based on location and depth. Table 2-4 of *Technical Memorandum 9* (BBL, 1995b), presented here in Appendix C, lists the samples from each location. The geotechnical borings performed included GEO-1, GEO-2, and G20-1, all of which were located on the A-Site (Figure 4). GEO-1 and GEO-2 were sampled continuously with split-spoon samplers to a depth of 20 feet bgs (10 feet below the residuals/native soil interface). Each of these borings was continued as soil samples were collected at 5-foot intervals until an N-value of at least 50 (spoon refusal) was reached. In GEO-1, the spoon refusal was reached at 73 feet bgs, and in GEO-2 spoon refusal was reached at 72 feet bgs. G20-1 was sampled continuously with split-spoon samplers to a depth of 20 feet bgs (10 feet below the residuals/native soil interface) and continued at 5-foot intervals to a refusal depth of 32 feet bgs.

2.9.5 1993 Air Monitoring Program

The air sampling program of 1993 followed the USEPA Compendium Method TO-4, *Method for the Determination of Organochlorine Pesticides and Polychlorinated Biphenyls in Ambient Air*, (USEPA, 1988a). This method was summarized in the Field Sampling Plan (BBEPC, 1993c), and a brief description is provided here.

High-volume polyurethane foam (PUF) cartridge samplers (General Metal Works' Model GPS1) were used for this investigation. These samplers contain a timer, blower motor, flow control valve, flow meter, and a sampling head that contains a glass-fiber filter and PUF cartridge. During operation, the blower motor creates a vacuum that draws ambient air into the housing through the filter and PUF cartridge. Ambient air exits the unit through an exhaust hose. Method TO-4 prescribes a flow rate of 200 to 280 liters per minute (L/min). The method calls for a minimum acceptable air volume of 276 cubic meters (m^3) and a maximum of 420 m^3. The method also requires a minimum acceptable sampling time of 23 hours and a maximum time of 25 hours. Whatman 102 millimeter microquartz glass-fiber filters were used. The samplers were calibrated and installed on June 2, 1993 at the WB/A-OU (Figure 4) and at background Battle Creek sampling locations (Figure 2-2 *of Technical Memorandum 5* [BBL, 1994a], presented here in Appendix A).

Air samples were collected by each sampler once every six days following the USEPA National Particulate Matter Schedule (NPMS) time table defined by the USEPA (1983; 1987a). The time period for collection was midnight to midnight. Samples were collected on June 6, June 12, June 18, June 24, June 30, July 6, July 12, July 18, July 24, July 30, August 5, August 11, August 17, August 23, and August 29, 1993. Samples were not collected for either of the first two events at the Battle Creek locations due to a delay in bringing electrical power to the samplers.

After collection, each PUF cartridge and glass-fiber filter was repacked in its original foil or glass jar, sealed in labeled containers, placed within an ice chest, and transported within 24 hours of collection to Aquatec, Inc., following standard chain-of-custody procedures. Upon receipt, the samples were refrigerated at 4°C until extraction and analysis. The PUF cartridge and glass-fiber filter were analyzed separately, as required by the MDNR, to assess airborne particulate and volatile PCB concentrations. Filters and PUF cartridges were analyzed for PCB using USEPA SW-846 Method 8081.

2.9.6 1999 to 2000 Air Monitoring Program

The air sampling program of 1999 and 2000 (during the IRA) followed the USEPA Compendium Method TO-4, *Method for the Determination of Organochlorine Pesticides and Polychlorinated Biphenyls in Ambient Air* (USEPA, 1988a). This method was summarized in the FSP (BBEPC, 1993c), and a brief description is provided here.

High-volume (PUF) cartridge samplers (General Metal Works' Model GPS1) were used for this investigation as well. Three air monitors were installed at the WB/A-OU at the locations shown on Figure 2 of the *Removal Action Summary* (BBL, 2000), presented here in Appendix E.

Air samples were collected from each air sampler each day during the IRA. Samples were collected from November 30, 1999 to March 3, 2000.

After collection, each PUF cartridge and glass-fiber filter was repacked in its original foil or glass jar, sealed in labeled containers, placed within an ice chest, and transported within 24 hours of collection to KAR Laboratories, following standard chain-of-custody procedures. Upon receipt, the samples were refrigerated at 4°C until extraction and analysis. The PUF cartridge and glass-fiber filter were analyzed separately, as required by the MDNR, to assess airborne particulate and volatile PCB concentrations. Filters and PUF cartridges were analyzed for PCB using USEPA SW-846 Method 8081.

2.9.7 1995 Groundwater Sampling

Groundwater/leachate sampling was conducted on August 23, 24, 25, 28, 29, 30, and 31, 1995. All monitoring wells were sampled using a submersible pump. In accordance with the low-flow sampling protocols established in the FSP (BBEPC, 1993c) and *Work Plan Addendum* (BBL, 1995c) and after discussions with the MDNR, the purge rate did not exceed 500 milliliters per minute (ml/min). In addition, the sampling rate was consistent with the purging rate, and water levels were monitored during purging and sampling to avoid significant drawdown of the wells. Well volumes and volumes of water purged during sampling are presented in Table 2-1 of *Draft*

Addendum to Technical Memorandum 9 (BBL, 1996), presented here in Appendix D. The wells were not redeveloped prior to sampling.

General water quality parameter field measurements, including pH, specific conductivity, temperature, and turbidity, were recorded prior to purging, and then at regular intervals during the purging of the wells. When the field parameters were observed to have stabilized, unfiltered groundwater/leachate samples were collected and processed. A final set of field parameter measurements was obtained at the time of each sample collection.

2.9.8 2000 Groundwater Sampling

Groundwater sampling was conducted from November 15 to November 20, 2000 and from December 26 to 29, 2000. Monitoring wells were sampled using either a peristaltic pump or bladder pump. The wells were sampled using the ultra low-flow sampling technique with a purge rate not exceeding 100 ml/min. In addition, the sampling rate was consistent with the purging rate, and water levels were monitored during purging and sampling to avoid significant drawdown of the wells. Well volumes and volumes of water purged sampling are presented in Appendix G.

General water quality parameter field measurements including pH, specific conductivity, temperature, and turbidity were recorded prior to purging, and then at regular intervals during the purging of the wells. When the field parameters were observed to have stabilized, unfiltered groundwater/leachate samples were collected and processed. A final set of field parameter measurements was obtained at the time of each sample collection.

2.9.9 Residential Sampling

Residential sampling was conducted on March 23 and 24, 1999; May 2, 2000; and October 30, 2000. Sampling locations are shown on Figure 9 of this report. An MDEQ representative was present during residential sampling activities and the sample locations and depths were selected based on field observations and decisions made in the field with the MDEQ representative. Residential soil borings from the Wright property (SB-3A-201, SB-3A-204, and SB-3A-207), Bloomfield property (SB-3A-209 through SB-3A-212), Adkins property (SB-ADKINS-1 through SB-ADKINS-9), Wadsworth property (B-1 through B-3), and the Scott property (TP-1, TP-10, TP-12, TP-13, and TP-15) were collected and analyzed for PCB.

Sample locations from the Wright, Bloomfield, and Adkins properties were surveyed to determine their position. Sample locations from the Wadsworth and Scott properties were measured in the field and their approximate locations were recorded. Samples are identified based on location and depth.

2.10 QA/QC Review of Data

All data packages associated with the RI and interim response actions for the WB/A-OU including PCB residuals, soil, sediment, surface water, groundwater and air sample analysis were reviewed for quality assurance/quality control compliance with method guidelines and project specific requirements with the exception of the data for the samples collected from the Willow Boulevard Site drainageway area (DWA-SB-14, DWA-SB-26, DWA-SB-38, and DWA-SB-51 [Table 4-11]); the area south of the A-Site berm (FLA-SB-1, FLA-SB-5, FLA-SB-7, FLA-SB-8, FLA-SB-11, FLA-SB-12, FLA-SB-13, FLA-SB-16, FLA-SB-18, FLA-SB-19, FLA-SB-22, FLA-SB-24, FLA-SB-25, DWA/FLA-SB-3, and DWA/FLA-SB-4 [Table 4-5]); the Wadsworth property (B-1 through B-3 [Table 4-8D]); and the Scott property (TP-1, TP-10, TP-12, TP-13, and TP-15 [Table 4-8E]) which were not subjected to data review. Each data package was reviewed as outlined in the Quality Assurance Project Plan (QAPP). Specifically, included were evaluations of holding times, calibration requirements (initial and continuing), blank contamination, surrogate recovery, matrix spike and duplicate performance, laboratory control sample recovery and analyte identification, as applicable. The following summarizes the findings of the data review.

2.10.1 Sediment/Residual Sample PCB Data Quality Summary

Recovery for one surrogate was outside control limits in 41 samples. Since recoveries for the second surrogate were within control limits, no data were qualified based on the deviations. Recoveries for both surrogates were below control limits in four samples. All data for these samples were qualified as estimated with a potential low basis on the recoveries.

All matrix spike recoveries were within control limits. Recoveries for Aroclor 1242 were, however, below control limits in two matrix spike duplicates. Since the variable recoveries could be attributed to interference from Aroclor 1242 present in the unspiked samples, no data were qualified based on the deviations. All matrix spike blank recoveries were within control limits.

All field duplicate results were within USEPA Region 5 acceptance limits.

Aroclor 1268, which was identified as 1260, was detected in one of the rinse blanks. Aroclor 1260 was detected in two of the samples associated with the blank, but since the sample concentrations were greater than 5 times that found in the rinse blank and since the Aroclor patterns present in the samples resembled 1260 and not the 1268 found in the blank, no data were qualified based on the blank content.

Aroclor 1248 was detected in one method blank and in two of the associated samples. The concentration in one sample, W70123, was less than 5 times that found in the blank. Data for Aroclor 1248 in that sample was qualified as undetected. The concentration in the other sample, W70122, was greater than 5 times that found in the blank. Its presence in the sample was deemed site-related and no further action was taken.

2.10.2 Soil Sample PCB Data Quality Summary

Recovery for one surrogate was outside control limits in five samples. Since recoveries for the second surrogate were within control limits, no data were qualified based on the deviations. Recoveries for both surrogates were below control limits in four samples. The samples were subsequently re-extracted with acceptable surrogate recoveries. All data for these samples were reported from the re-extractions. Recoveries were below control limits for both surrogates in three samples. The samples were re-extracted with low recoveries for one surrogate in two samples and both surrogates in the remaining sample. All data for this sample qualified as estimated based on the recoveries.

Recovery for Aroclor 1242 was above control limits in one matrix spike. All other matrix spike and matrix spike duplicate recoveries were within control limits and since the variable recoveries could be attributed to interference from Aroclor 1242 present in the unspiked samples, no data were qualified based on the deviations. All matrix spike blank recoveries were within control limits.

Aroclor 1268, which was identified as 1260, was detected in one of the rinse blanks. Aroclor 1260 was detected in six of the associated samples, but since the sample concentrations were greater than 5 times that found in the rinse blank and since the Aroclor patterns present in the samples resembled 1260 and not the 1268 found in the blank, therefore its presence in the sample was deemed site related and no further action was taken. The presence of 1268 in the blank has been attributed to laboratory contamination and the associated sample data have not been affected.

Aroclor 1242 was detected in two method blanks and in one of the associated samples. Since the concentration of Aroclor 1242 in the sample was greater than 5 times that found in the blank, its presence in the sample was deemed site related and no further action was taken.

Aroclor 1248 was detected in one of the method blanks. Since no Aroclor 1248 was detected in the associated samples, no sample qualification was necessary based on the blank content.

2.10.3 Surface Water Sample PCB Data Quality Summary

Recovery for one surrogate was below control limits in three samples. Since recoveries for the second surrogate were within control limits, no data were qualified based on the deviations.

All matrix spike, matrix spike duplicate recoveries, and relative percent differences between recoveries were within control limits.

All field duplicate results were acceptable.

No target compounds were detected in the method blanks.

2.10.4 Groundwater Sample PCB Data Quality Summary

Recovery for one surrogate was below control limits in five samples. Since recoveries for the second surrogate were within control limits, no data were qualified based on the deviation

Recovery of Aroclor 1242 was slightly below control limits in one matrix spike. Since all other matrix spike and all matrix spikes duplicate recoveries and relative percent differences between recoveries were within control limits, no data were qualified based on the deviation. All matrix spike blank recoveries were within control limits.

All field duplicate results were acceptable.

No target compounds were detected in the method blanks.

2.10.5 Air Sample PCB Data Quality Summary

Recovery for one surrogate was below control limits in four samples. Since recoveries for the second surrogate were within control limits, no data were qualified based on the deviations.

Due to sampling constraints, no matrix spike analysis was performed. All matrix spike blank recoveries were, however, within control limits.

Aroclor 1232 was detected in three method blanks. Since no Aroclor 1232 was detected in the associated samples, the blank content had no impact on the reported data. Aroclor 1242 was detected in one method blank. Since all Aroclor 1242 detected in the associated samples was present at the concentrations exceeding 5 times that in the blank, the sample presence was deemed site-related and no further action was taken. Aroclor 1221

was detected in two method blanks. Aroclor 1221 was tentatively identified as present in the associated sample WP5P15. No Aroclor 1221 was detected in the remaining samples.

2.10.6 Residuals TCL/TAL Sample Data Quality Summary

VOCs

Recovery for one surrogate was below control limits in sample W70080. All data for the sample were qualified as estimated based on the deviation. All other surrogate recoveries were within control limits.

All matrix spike, matrix spike duplicate recoveries, and relative percent differences between recoveries were within control limits. All matrix spike blank recoveries were also within control limits.

Acetone was detected in one method blank. Since all acetone detected in the associated samples was present at concentrations greater than 10 times that in the method blank, the presence was deemed site-related and no further action was taken. Carbon tetrachloride was detected in a second method blank. Data for carbon tetrachloride in the associated sample W70041 was qualified as undetected based on the blank content.

SVOCs

Recovery for one surrogate was below control limits in samples W70056 and W0090. Since recoveries for the remaining surrogates were within control limits, no data were qualified based on the deviation. All other surrogate recoveries were within control limits. All matrix spike, matrix spike duplicate recoveries, and relative percent differences between recoveries were within control limits. All matrix spike blank recoveries were also within control limits. All field duplicate results were within acceptable limits.

Bis(2-ethylhexyl)phthalate was detected in several method blanks. Data for bis(2-ethylhexyl)phthalate was qualified as undetected in the associated samples W70073, W70108, W70019, W70029, W70030 and W70050 based on the blank's content. Since bis(2-ethylhexyl)phthalate was detected in sample W70049 at concentrations greater than 10 times that in the method blank, the presence was deemed site-related and no further action was taken.

Pesticide/PCB Analyses

Recovery for one surrogate was above control limits in samples W70029, W70140 and W70098. Since recoveries for the second surrogate was within control limits, no data were qualified based on the deviation. Recovery for one surrogate was less than 10 percent in sample W70131. Data for all positively identified compounds were qualified as estimated and all non-detect data were rejected based on the low recovery. All

other surrogate recoveries were within control limits. Matrix spike recoveries could not be accurately calculated due to interference from target compounds present in the unspiked samples.

No target compounds were detected in the method blanks.

Inorganic Analysis

Recoveries of antimony (55.3%), manganese (158.7%) and mercury (15.4%) were outside control limits in one matrix spike. All antimony and mercury data and all positive manganese data in the associated samples W70108, W70120, W70125, W70130, W70131, and W70140 were qualified as estimated based on the recoveries. Recoveries were outside acceptable control limits for antimony (54.3%), barium (70.9%), chromium (71.6%), copper (134.5%), lead (18.3%), mercury (62.6%), zinc (135.4%), cyanide (332.0%), and cyanide for the reanalysis (0%) in a second matrix spike. All antimony, barium, chromium, lead, and mercury data and all positive copper, zinc, and cyanide data in the associated samples W70019, W70029, W70030, W70041, W70048, and W70050 were qualified as estimated based on the recoveries. Cyanide data was rejected in the re-analysis of samples W70041 and W70048.

The results were outside acceptable control limits for calcium (56.2%), iron (93.2%), manganese (134.2%), and magnesium (150.0%) in one laboratory duplicate. All manganese and magnesium data in the associated samples W70108, W70120, W70125, W70130, W70131, and W70140 were qualified as estimated based on the results. Results were outside acceptable control limits for barium (54.9%), calcium (31.1%), lead (20.4%), and manganese (34.1%) in a second laboratory duplicate. No qualifiers were added to the associated samples based on the results.

With one exception, all calibration and preparation blanks were found to be acceptable with no target analytes detected above the contracted required detection limit (CRDL). Since the concentrations of all detected analytes in the samples associated with the non-compliant blank were in excess of 10 times that in the blank concentration, the presence was deemed site-related and no action was taken.

2.10.7 Soil TCL/TAL Sample Data Quality Summary

VOCs

All surrogate recoveries were within control limits and all matrix spike recoveries were within control limits. Matrix spike duplicate recoveries were, however, outside control limits in one matrix spike duplicate. No qualifiers were added to the data based on matrix spike performance alone. All field duplicates were within acceptable limits.

Acetone and methylene chloride were detected in several method blanks. Data for acetone were qualified as undetected in the associated samples W70146, W70041, W70114, W70121, and W70141 based on the blank content. Since acetone in samples W70126, W70132, W70133, W70081, W70091 and W70099 and methylene chloride in samples W70132 and W70133 were present at concentrations greater than 10 times that in the method blank, the presence was deemed site-related.

SVOCs

Recovery for one surrogate was below control limits in samples W70082, W70132 and W70068. Since recoveries for the remaining surrogates were within control limits, no data were qualified based on the deviation. All matrix spike, matrix spike duplicate recoveries, and relative percent differences between recoveries were within control limits. All field duplicate results were within acceptable limits.

Bis(2-ethylhexyl)phthalate was detected in several method blanks. Data for bis(2-ethylhexyl)phthalate was qualified as undetected in the associated samples W70068, W70082, W70101, and W700144 based on the blank content. Bis(2-ethylhexyl)phthalate was detected in sample W70033 was present at concentrations greater than 10 times that in the method blank, the presence was deemed site-related and no further action was taken.

Pesticide/PCB Analyses

Recovery for one surrogate was above control limits in samples W70031, W70032 and W70133. Since recoveries for the second surrogate were within control limits, no data were qualified based on the deviation. All other surrogate recoveries were within control limits.

All matrix spike, matrix spike duplicate recoveries, and relative percent differences between recoveries were within control limits.

All field duplicate results were within acceptable limits.

No target compounds were detected in the method blanks.

Inorganic Analysis

Recoveries were outside limits for antimony (45.2%), arsenic (52.4%), barium (73.7%), and lead (59.3%) in one matrix spike. All data for these analytes were qualified as estimated in the associated samples W70020, W70031, W70032, W70033, W70035, W70042 and W70049 based on the recoveries. Recoveries were outside acceptable control limits for antimony (64.6%), arsenic (141.9%), and manganese (63.5%) in a second matrix spike. All antimony and manganese data and all positive arsenic data in the associated samples W70057,

W70066, W70067, W70068, W70074, W70074, W70082, W70091, and W70099 were qualified as estimated based on the recoveries.

The results were outside acceptable control limits for barium (64.2%), copper (72.0%), iron (89.3%), lead (43.1%), manganese (126.2%), and magnesium (115.8%) in one laboratory duplicate. All manganese and magnesium data in the associated samples W70020, W70031, W70032, W70033, W70035, W70042 and W70049 were qualified as estimated based on the results. Results were outside acceptable control limits for barium (41.4%), calcium (33.1%), manganese (30.6%), and zinc (53.2%) in a second laboratory duplicate. No qualifiers were added to the associated samples based on the results. Results were outside acceptable control limits for aluminum (31.9%), calcium (103.0%), lead (96.1%), manganese (157.2%), magnesium (148.6%), and nickel (91.1%) in a third laboratory duplicate. All calcium, manganese, and magnesium data in the associated samples W70101, W70113, W70114, W70121, W70126, W70132, W70133, W70141 and W70144 were qualified as estimated based on the results.

Field duplicate results were within acceptable limits.

With one exception, all calibration and preparation blanks were found to be acceptable with no target analytes detected above the CRDL. Since the concentrations of all detected analytes in the samples associated with the non-compliant blank were in excess of 10 times that in the blank concentration, the presence was deemed site-related and no action was taken.

2.10.8 Groundwater/Leachate TCL/TAL Sample Data Quality Summary

VOCs

All surrogate recoveries were within control limits.

All matrix spike and matrix spike duplicate recoveries and relative percent differences between recoveries were within control limits.

No target compounds were detected in the method blanks. Carbon tetrachloride was detected in the trip blank, but not any of the associated samples.

SVOCs

Recoveries for two acid surrogates were above control limits in sample W74025. All positive acid fraction data were qualified as estimated based on the recoveries. All other surrogate recoveries were within control limits.

All matrix spike, matrix spike duplicate recoveries, and relative percent differences between recoveries were within control limits.

All field duplicate results were within acceptable limits.

Bis(2-ethylhexyl)phthalate was detected in several method blanks. Data for Bis(2-ethylhexyl)phthalate was qualified as undetected in the associated samples W74000 through W74022, W74024 and W7405 based on the blank content.

Pesticide/PCB Analyses

Recovery for one surrogate was above control limits in samples W74008, W74013, W74017, W74025, W74026 and W74028. Since recoveries for the second surrogate were within control limits, no data were qualified based on the deviation. All other surrogate recoveries were within control limits. Recoveries for both surrogates were below control limits in sample W74029. All data for this sample were qualified as estimated based on the recoveries.

All field duplicate results were within acceptable limits.

No target compounds were detected in the method blanks.

Inorganic Analysis

All matrix spike and matrix spike duplicate recoveries were within control limits, with the exception of arsenic, which had a recovery of 132.4 percent for the total analysis, and 152.2 percent for the dissolved analysis. All data for arsenic have been qualified as estimated based on the recoveries.

All laboratory duplicate results were within control limits.

All field duplicate results were within acceptable limits.

All laboratory control sample recoveries were within control limits.

All calibration and preparation blanks were found to be acceptable with no target analytes detected above the CRDL.

2.10.9 Surface Water TAL Data Quality Summary

Inorganic Analysis

All matrix spike recoveries were within control limits with the exception of arsenic (132.4%). All positive data for arsenic were qualified as estimated based on the recovery.

All laboratory duplicate results were within control limits.

All field duplicate results were within acceptable limits.

All laboratory control sample recoveries were within control limits.

All calibration and preparation blanks were found to be acceptable with no target analytes detected above the CRDL.

2.10.10 Soil and Residual PCDD/PCDF Data Quality Summary

All matrix spike and matrix spike duplicate recoveries were within control limits. Recoveries for 1,2,3,4,6,7,8-HpCDD and OCDD could not be calculated because they were saturated in the original unspiked sample, matrix spike and matrix spike duplicate.

All laboratory duplicate results were within control limits.

All field duplicate results were within acceptable limits.

Recoveries for two of the five surrogates in sample W70100 were below control limits. Poor recoveries were due to interference peaks present in the sample. All other surrogate recoveries were within control limits.

1,2,3,4,6,7,8,9-OCDD; 2,3,7,8-PeCDF; 2,3,4,7,8-PeCDF; 1,2,3,6,7,8-HxCDF; 2,3,4,6,7,8-HxCDF; and 1,2,3,4,6,7,8HpCDF were detected in one method blank. Data for these compounds have been qualified as undetected in the associated sample W70087.

2,3,4,6,7,8-HxCDF was detected in the two method blanks. Data for this compound have been qualified as undetected in the associated samples W70083 and W70115.

1,2,3,4,6,7,8-HpCDD; OCDD; 2,3,7,8-HxCDF; 1,2,3,4,6,7,8-HpCDF; and OCDF were detected in one method blank. These compounds, when present in the associated samples, were found at levels greater than five times

that found in the method blank. Their presence in the samples was, therefore, deemed site related and no further action was taken.

No target analytes were detected in the rinse blank.

3. Physical Characterization

This section summarizes the physical conditions observed at the WB/A-OU. This summary characterization was developed based on data generated during the RI and other investigations, including those conducted at the area south of the A-Site berm and the Willow Boulevard Site drainageway. The summary also incorporates changes to the physical character of the OU after completion of the interim response action. The following discussion of the physical setting of the study area includes descriptions of:

- OU-specific characteristics;
- Regional and OU-specific geologic and hydrogeologic characteristics;
- Geotechnical Investigation results;
- Topography and drainage;
- Meteorological conditions;
- Population and land use; and
- Results of the wetlands assessment.

3.1 OU-Specific Characteristics

The 32-acre WB/A-OU consists of two monofills: the Willow Boulevard Site and the A-Site (Figure 3). The Willow Boulevard Site occupies approximately 11 acres while the A-Site occupies approximately 22 acres. A fence exists around the southern and eastern limits of the site. Ancillary areas associated with the WB/A-OU include the AMW-3A area, the area east of Davis Creek, Davis Creek, Former Olmstead Creek, and the Willow Boulevard Drainageway area.

3.1.1 Willow Boulevard

The Willow Boulevard Site, which was built without berms, received dewatered residuals from the King Highway dewatering lagoons from the mid-1960s until 1975. From November 1999 through April 2000, Georgia-Pacific implemented interim response activities that included the removal of residuals from select areas along the western bank of the Kalamazoo River adjacent to the Willow Boulevard portion of the OU. Excavated materials were layered in the eastern area of the Willow Boulevard Site, and the entire Willow Boulevard Site was graded to promote positive drainage. The area was covered with 6 inches of sand. A portion of the river edge was backfilled to create a sand berm along the Kalamazoo River. Geotextile and riprap were then placed along the river edge to reduce erosion.

The residuals within the WB/A-OU extend into the drainageway south of the Willow Boulevard Site.

3.1.2 A-Site

The A-Site was originally a series of dewatering lagoons; hence, an earthen berm exists around the original perimeter of the A-Site. Supplemental characterization activities along the southern boundary of the OU (e.g., Geoprobe and test pit investigations) revealed that residuals migrated over the berm and extended in a southern direction toward the former Olmstead Creek confluence. Decant water from the dewatering lagoon at the A-Site was discharged to the area east of Davis Creek, and a low earthen berm is also located along a portion of this area (Swanson Environmental, 1990). In late 1998, as an interim measure, a sheetpile wall was installed along the length of the Kalamazoo River, extending approximately 150 feet up Davis Creek. This wall was installed to an elevation 2 feet above the site's 100-year flood elevation (top at 767 feet above mean sea level [amsl]) to reduce the potential for residuals to be transported to the river in the possible event of failure of the existing dikes, and was intended to be left in place to complement future actions. The elevation of the base of the sheetpile wall is approximately 737 feet amsl. However, remedial actions that either remove, or cut-off the sheet pile below the surface of the Kalamazoo River, are considered in this report.

The AMW-3A area lies west of Davis Creek approximately 1,100 feet south of the Kalamazoo River at the eastern end of Carleton Avenue. PCBs were detected in the AMW-3A area.

The area south of the A-Site berm is a continuation of the A-Site; residuals extend into this area. A chain-link fence exists along the property line between the WB/A-OU and the residences south of the A-Site. The property line, as shown on Figure 4, closely follows the channel of the former Olmstead Creek, which separates the Willow Boulevard Site from the A-Site and continues along the south and southwest boundaries of the A-Site to Davis Creek. Investigations at the residential properties south of the A-Site revealed that the residuals do not extend into these areas, including the Adkins, Scott, or Wadsworth properties. Flood-diversion piping installed in 1972 to control flooding of the Lakeside neighborhood drains the Kalamazoo County Fairgrounds and connects to Davis Creek near the AMW-3A Area.

The residences located nearest to the AMW-3A area are the Wright and Bloomfield properties. In 2000, the existing fence at the AMW-3A area was relocated to the property line, creating a barrier between the Wright and Bloomfield residential properties and the Georgia-Pacific property where PCB-containing materials are located.
The area east of Davis Creek, approximately 3.5 acres, is a low lying area with an earthen berm along portions of its perimeter. Upon investigation, it was determined that this area contains approximately 6 inches of residuals.

PCBs were detected in groundwater at the A-Site at the interior "A" wells during the 2000 groundwater sampling activities, possibly due to the transport of PCBs from the residuals into the groundwater. This could also be due to well construction, age, and/or frost heave, as these wells were screened in the saturated materials immediately below the residuals.

The IRA was conducted adjacent to the Willow Boulevard Site and the former Olmstead Creek from November 1999 to April 2000. Approximately 7,000 cubic yards (cy) of materials were removed from the area (6,700 cy from the river adjacent to the Willow Boulevard Site and 300 cy from Olmstead Creek) (Figures 5 and 6, respectively).

3.2 Regional Geology and Hydrogeology

The regional geology in the vicinity of the WB/A-OU consists of unconsolidated glacial deposits overlying consolidated bedrock formations. Figure 10 presents the regional surficial geology surrounding the WB/A-OU.

Groundwater within the Kalamazoo River Basin flows from topographic high areas to lowland discharge areas. High water table levels occur in the spring when groundwater recharge exceeds evapotranspiration and withdrawals. Low groundwater levels occur during the fall when less precipitation infiltrates the groundwater system. The Kalamazoo River acts as the principal hydrologic boundary and discharge area for groundwater in the county (Rheaume, 1990).

A more detailed description of the regional geology and hydrogeology is presented in Sections 2.2 and 2.4 of the DCS (BBEPC, 1992).

In accordance with the Work Plan (BBEPC, 1993a), an inventory of private, commercial, and industrial water wells was compiled for the area around the WB/A-OU. No wells were identified within ¼-mile of the WB/A-OU boundaries. Within ½-mile of the OU boundaries, 10 wells were identified: 6 of the 10 wells identified are north of the Kalamazoo River, which is a hydrologic barrier between the OU and the wells. The remaining four wells are east (three wells) and south (one well) of the OU, placing them hydrologically side-gradient or upgradient, respectively. The ¼- and ½-mile radius areas surrounding the WB/A-OU are presented on Figure 11, and well construction and usage details are presented in Table 3-1 of this report. The water well inventory results are presented in *Technical Memorandum 13 - Water Well Inventory* (BBL, 1995a).

3.3 OU-Specific Geology and Hydrogeology

The site-specific geologic and hydrogeologic conditions of the WB/A-OU were initially characterized based on the results of the investigation activities conducted in conjunction with the RI field programs completed in 1993

and 1995. Results of these activities are included in the MDEQ-approved *Technical Memorandum 9* (BBL, 1995b) and *Draft Addendum to Technical Memorandum 9* (BBL, 1996). Supplemental data regarding the subsurface geologic and hydrogeologic conditions at the WB/A-OU have been generated through additional field investigation activities associated with monitoring of the sheetpile wall and groundwater sampling in 2000. The discussion of the geologic and hydrogeologic conditions presented below has been revised since first reported in *Technical Memorandum 9* (BBL, 1995b) to illustrate the current understanding of the physical setting and groundwater flow conditions based on the supplemental site characterization.

The overburden materials observed in the immediate vicinity of the WB/A-OU consist of a sequence of residuals underlain by a discontinuous organic-rich peat unit, then fine to coarse sand and fine sand deposited as relatively permeable glacial outwash units. To illustrate the stratigraphic sequence observed at the WB/A-OU, four generalized geologic cross-sections have been generated along the alignments illustrated on Figure 12. The residuals were vertically continuous across both the Willow Boulevard Site and the A-Site. Cross-section A-A' shows the stratigraphic trends for both sites in the WB/A-OU from west to east (Figure 12A); cross-section B-B' shows the stratigraphy for the A-Site in a north-south direction (Figure 12B); cross-section C-C' shows the stratigraphy for the Willow Boulevard Site in a north-south direction (Figure 12B); and cross-section D-D' shows the stratigraphy for the A-Site in a north-south direction through the berm and sheetpile (Figure 12C). These four cross-sections illustrate the continuity of residuals across both sites.

Residuals at the Willow Boulevard Site were generally characterized as gray clay-rich material with "little" (10 to 20 percent) to "some" (20 to 35 percent) paper fibers. Clay materials present in the paper residuals were a raw material used in the paper making process. The residuals were generally homogeneous with little variation in color or texture. The shallower residuals were very compressible while the deeper residuals were less compressible. The residuals were damp at the surface at most locations, with moisture content increasing to moist with depth. No saturated zones within the residuals were observed at the Willow Boulevard Site.

The color and texture of residuals at the A-Site vary with depth. The upper half to two-thirds of residuals generally ranges from gray clay materials with little to some paper fibers to gray paper fiber with some clay. The deeper deposits contain materials with green, gray-green, brown, and dark green colors and a texture of paper fibers with some to "trace" (<10 percent) clay. The residuals were damp at the surface at most locations, with moisture content increasing to moist with depth. At well clusters on the A-Site, saturated zones within the residuals were encountered, necessitating the installation of shallow perched residuals wells (AMW-6P, AMW-

7P, AMW-9P, and AMW-10P) (Figure 12). The subsurface logs for all the borings and groundwater/leachate monitoring wells are included in Appendix H.

Based on a review of groundwater elevations collected on November 10, 2000 (summarized in Table 3-2 of this report), the water table exists at an elevation above the base of the residuals at the following monitoring well clusters: AMW-1, AMW-7, AMW-8, AMW-9, AMW-10, and WMW-3 (Figure 4). As presented on the geologic cross-sections A-A' and C-C' (Figures 12A and 12B, respectively), the interior and western portions of the Willow Boulevard Site contain residuals that have been shown to exist to 7 feet below the groundwater table. As presented on the geologic cross-section A-A', B-B', and D-D' (Figures 12A, 12B, and 12C, respectively), the interior of the A-Site also contains residuals that exist up to 4 feet below the groundwater table.

The native soil immediately below the residuals at the Willow Boulevard Site is either a dark brown organic peat or fine to coarse sands. Cross-section A-A' (Figure 12A) shows a brown fine to coarse sand directly beneath the residuals on the eastern side of the Willow Boulevard Site, which in turn, is underlain by a light brown fine sand layer. On the western side of the site, the residuals are underlain by peat followed by the light brown fine sand unit. Cross-section B-B'(Figure 12B) shows that the residuals in the vicinity of the central portion of the Willow Boulevard Site are underlain by a deposit of fine to coarse sand. The brown fine to coarse sand is underlain by the light brown fine sand unit.

The native soil immediately below the residuals at the A-Site is almost entirely peat (Figure 12A) with the exception of small southern and northern portions of the site, where the residuals are underlain by a light brown fine sand unit (Figure 12B). The peat is underlain by the fine sand unit in the northern and southern portions of the site and by a fine to coarse sand unit in the central portion of the site. The layer of peat formed historically along much of the floodplain of Kalamazoo River above the fluvial sands and glacial deposits. This peat/organic silt unit typically marks the transition between native deposits and overlying fill materials added throughout the operational history of this OU.

Two deeper borings (GEO-1 and GEO-2; Figures 12B and 12A, respectively) were advanced below the fine sand unit at the A-Site. Within GEO-1, the fine sand unit is underlain by an 18-foot thick medium to coarse sand and gravel unit. The sand and gravel unit was encountered at approximately 32 feet bgs. At approximately 50 feet bgs, this sand and gravel unit is underlain by dense silt to approximately 55 feet bgs followed by a 10-foot thick gravel layer. A second dense silt layer with a trace of shale fragments was encountered from 65 feet

bgs to the base of the boring at 72 feet bgs. Within GEO-2, the fine sand unit is underlain by sand and silt, fine sand, and a 23.5-foot thick medium to coarse sand and gravel unit. The coarse sand and gravel unit was encountered at approximately 41.5 feet bgs. At approximately 65 feet bgs, this sand and gravel unit is underlain by a dense silt layer to approximately 67 feet bgs, followed by a 1.5-foot thick fine sand layer. A second dense silt layer was encountered from 67.5 feet bgs to just below 71 feet bgs. Weathered shale bedrock was encountered below the second dense silt layer to the base of the boring at 73 feet bgs.

Hydraulic conductivity estimates, based on slug tests conducted on wells installed in the various subsurface units, range from 8.8E-2 to 1.7E-4 centimeters per second (cm/s). The berms at the A-Site were typically constructed directly over the peat unit near the Kalamazoo River. Over time, as wastewater from the paper-making operations was decanted, residuals settled out and accumulated behind these berms. As a result of clay content, residual deposits may have hydraulic conductivity values (based on studies of other paper waste sites) ranging from 4.2E-4 to 5.8E-8 cm/s (Maltby and Eppstein, 1996). The hydraulic conductivity estimates of WB/A residual material, based on slug tests conducted on wells installed within the residuals, range from 2.0E-3 to 1.7E-4. The more highly compressed and compacted residuals near the base of the deposits could be represented by the lower hydraulic conductivities. In comparison, the estimated hydraulic conductivity values determined for the native glacial materials range from 8.8E-2 to 4.3E-4 cm/s. It should be noted that while low conductivity values reflect some residuals in place at the OU, they cannot be applied to other areas of the river, where the residuals have mixed with native materials.

Potentiometric surface elevations and the in-situ hydraulic conductivity data were used to evaluate groundwater flow rates and directions. Water table contour maps for the WB/A-OU were generated based on water level data collected on October 11, 1993; August 30, 1995; and November 10, 2000. These contour maps are presented as Figures 13A, 13B, and 13C, respectively. The apparent general groundwater flow direction within the water table beneath the Willow Boulevard Site is from the south to the north; groundwater flow direction within the water table beneath the A-Site is generally from the southeast to the northwest with some deflection of groundwater toward the northwest in the direction of Davis Creek along the western edge of the A-Site. A comparison of the water table contour maps depicting pre-sheetpile installation (Figures 13A and 13B) and post-sheetpile installation (Figure 13C) water table elevation contours indicates that conditions remained generally consistent. As an interim action, the sheetpile wall was constructed with unsealed joints (and a drain behind the wall); it was not installed into a confining layer. There is, however, a concern that local groundwater flow paths near the sheetpile wall have been changed due to the construction of the sheetpile wall and drain. This concern

could be addressed in the future by work elements identified in a Hydrogeologic Monitoring Plan. Cross-section D-D' (Figure 12C) illustrates how the sheetpile wall was installed as a hanging wall into the sand unit.

The vertical groundwater flow gradients at well clusters WMW-1/1A, WMW-3/3AR, WMW-4A/4B, AMW-3/3A, AMW-6A/6B, AMW-7A/7B, AMW-8A/8B, AMW-9A/9B, and AMW-10A/10B were calculated using groundwater elevation data collected from October 8, 1993 to December 15, 1993; August 16, 1995 to August 30, 1995; and October 30, 2000 to November 18, 2000. The results of these calculations are presented in Table 3-3A, 3-3B, and 3-3C, respectively. The results indicate that, on average, a slight downward vertical gradient exists between shallow and deep wells at most of the well cluster locations. Slight upward vertical gradients were observed during one or more of the monitoring dates at the well cluster locations WMW-1, WMW-4, AMW-3, AMW-7, and AMW-8. Recent groundwater elevation data collected from the well clusters have consistently indicated downward vertical gradients. The downward vertical gradients at OU 2 are not expected to exist at any great depth in the shallow aquifer, as the downward vertical gradients are likely limited by the upward head associated with regional discharge/recharge to the river.

The average horizontal groundwater flow gradient at the A-Site was approximately 0.004 feet/feet between October 30, 2000 and November 18, 2000. The horizontal groundwater flow gradient for the A-Site was determined using monitoring wells AMW-4 and AMW-10A. The gradient was calculated by subtracting the groundwater elevation of the down gradient location AMW-4 (756.85 feet amsl for October 30, 2000) from the upgradient location AMW-10A (759.56 feet amsl for October 30, 2000), and finally dividing this value by the distance separating the two locations (530 feet). Based on these measurements, the horizontal groundwater flow gradient for this area was 0.005 feet/feet on October 30, 2000. This calculation was repeated for the seven measurements taken at the A-Site between October 30 and November 18, 2000; the calculated gradient values were averaged to 0.004 feet/feet. The same calculation was duplicated for the groundwater elevation data from the Willow Boulevard Site by using the downgradient location WMW-3AR and the upgradient location WMW-1A. The average horizontal groundwater flow gradient for the Willow Boulevard Site was calculated to be 0.005 for the seven measurements taken between October 30 and November 18, 2000.

3.4 Topography and Drainage

The topography of the A-Site is characterized by a hill with a gentle slope on the western portion and steeper slopes on the northern, eastern, and southern portions. The total relief across the A-Site is approximately 27 feet, with elevations ranging from approximately 760 feet amsl along the Kalamazoo River to approximately 787 feet amsl within the central portion of the A-Site.

The topography of the Willow Boulevard Site is characterized by a hummocky surface in the central portion of the site and the ground surface slopes down toward the shoreline of the Kalamazoo River. The total relief across the Willow Boulevard Site is approximately 16 feet, with elevations ranging from approximately 762 feet amsl along the Kalamazoo River to approximately 778 feet amsl near the center of the site. The 100-year floodplain elevation at the WB/A OU is 765.2 NGV Datum.

Relief across the area east of Davis Creek is 4 feet maximum, and most pronounced where low earthen berms exist. Elevations range from less than 760 feet amsl (to the northeast, northwest, and southwest) along the Kalamazoo River and Davis Creek to approximately 764 feet amsl at the eastern berm. Berms do not completely encircle the area; periodically, standing water (Figure 12-A) is in direct connection with the Kalamazoo River. Overall, the area is classified as semipermanently flooded (BBL, 1995b). The majority of the area is less than 1 foot above mean water level of the Kalamazoo River, the area drains directly to the river.

Drainage features near the WB/A-OU include the Kalamazoo River along the northern perimeter of the OU, Davis Creek along the eastern perimeter of the OU, the drainage way south of the Willow Boulevard Site, and the former Olmstead Creek along the southern and southwestern perimeter of the A-Site and between the A-Site and the Willow Boulevard Site.

3.5 Geotechnical Investigation Results

The geotechnical laboratory testing program included measuring moisture content, organic carbon content, Atterberg Limits, specific gravity, gradation, one-dimensional consolidation, and UU tri-axial shear. Field testing included in-situ vane-shear tests. The testing was performed in accordance with ASTM-approved methods. The laboratory program was conducted on samples from the A-Site only as the historical data for the Willow Boulevard Site can be used for preliminary analyses (Dell, 1988). Preliminary results of the Geotechnical Investigation are presented in Appendix I of *Technical Memorandum 9* (BBL, 1995b). Residuals stability, erosion control, and dike stability are further considered in Appendix H of this report.

3.5.1 Willow Boulevard

Geotechnical sampling was not conducted as part of the RI/FFS at the Willow Boulevard Site because site-specific geotechnical data already exist and dikes do not extend around the site. In 1988, Dell Engineering obtained three samples from the Willow Boulevard Site for laboratory testing. Their laboratory testing program focused on the compaction and permeability characteristics of the material. As-received permeabilities were about 2.5^{-8} cm/sec, and remolded permeabilities were about 8.0^{-7} cm/sec. The maximum dry density was 65.3 pounds per cubic foot (pcf) and the optimum moisture was 43 percent, with as-received moisture contents

ranging from 55 to 68 percent. The specific gravity of the residuals was 2.25. Atterberg Limits performed on the samples indicated that the residuals typically had liquid limits of about 65 to 68 percent and plastic limits of about 59 percent (Dell Engineering, 1988). The bulk sample appeared to have portions that were non-plastic. The Dell Engineering data indicate that the Willow Boulevard Site residuals typically have lower water content and higher specific gravity than the A-Site residuals. This indicates that the Willow Boulevard Site residuals are likely to be stronger and less compressible than the A-Site residuals.

3.5.2 A-Site

The parameters from the laboratory testing program were used for the dike stability analyses and for preliminary assessments of the residuals' stability and compressibility.

Field vane shear testing was conducted at A-Site boring AMW-9A at a depth of 12 to 14 feet bgs. The computed peak shear strength was 880 pounds per square foot (psf) and the remolded shear strength was 250 psf. The attempted vane shear test at A-Site boring AMW-6P (5 to 7 feet bgs) indicates the shear strength is greater than 600 psf. Attempts to conduct a test of higher strength capacity using the smaller vane were unsuccessful as the residuals resisted penetration by the vane.

In general, laboratory testing was performed on two types of material: residuals and dike material (consisting of sand, peats, and clays). The test results for each of these materials are discussed briefly below.

The residuals at the A-Site typically had consistently high organic content (27 to 70 percent by weight) and moisture content (47 to 199 percent by weight). The moisture content is expressed as a ratio of the weight of water in the sample to the dry weight of the soils. The high organic content of the residuals is principally related to the presence of organic paper fiber in these materials. The specific gravity results of the residuals at the A-Site were typically low, about 1.8 to 2.3, which is expected based on the high organic content. The Atterberg Limits were also high, with liquid limits of 0 to 169 percent and plastic limits of 72 to 84 percent. These Atterberg Limits and high organic content classify the residuals as OH (organic clay or silt) in the Unified Soil Classification System. A-Site residuals' dry densities were typically very low, 27 to 36 pcf, and the wet densities were also low, about 65 to 75 pcf.

A Shelby tube of cohesive soil from A-Site boring GEO-2 was tested for moisture content, Atterberg Limits, and gradation. The soil was found to be low-plasticity silty sand. A UU tri-axial shear test was performed, as there was insufficient material to perform a CIU tri-axial shear test, and the undrained shear strength was determined to be 3,484 psf, indicating a very stiff material.

At the A-Site, two consolidation tests were performed from two Shelby tubes of residuals; the materials were found to be moderately to highly compressible. A UU tri-axial shear test was performed on the Shelby tube sample from AMW-9A to evaluate the undrained shear strength. The undrained shear strength was found to be 330 psf at a strain of 11 percent. This shear strength was lower than the peak shear strength measured in the vane-shear testing about 2 feet above the Shelby tube sample depth. The difference could be due to disturbance during shipping or due to in-situ variations.

At the A-Site, four disturbed samples of native soil (appearing to contain organic matter) from borings GEO-1, G20-1, and P-1D at depths near the base of the dikes were tested for organic content and moisture content. The organic content results were low to moderately high with a range of 1.2 to 9.7 percent by weight. The moisture content results were also relatively low to moderately high with a range of 4 to 74 percent by weight. A sand sample from A-Site boring GEO-1 was tested for gradation and found to be fine sand with little silt and a trace of gravel.

3.6 Meteorological Conditions

3.6.1 Historical Conditions

Historical meteorological data for Kalamazoo County from 1851 to 1980 was examined to determine pertinent trends around the WB/A-OU. In winter, the average temperature was 28.7°F, and the average daily minimum temperature was 20.9°F. The lowest temperature on record for the area during the period of record was -16°F, which occurred in the city of Kalamazoo on February 10, 1885. In summer, the average temperature was 69.8°F, and the average daily maximum temperature was 81.3°F. The highest recorded temperature, which occurred on July 13, 1936, was 100°F. Table 1 in the DCS (BBEPC, 1992), presented in Appendix A, summarizes meteorological data for this period.

In Kalamazoo County, 58 percent of the average precipitation of 34.8 inches usually fell between April and September. Thunderstorms occurred about 37 days each year, generally in June and July. The heaviest 24-hour rainfall during the period of record was 5.6 inches, which occurred on May 11 and 12, 1914. The average seasonal snowfall was 73.1 inches. The average relative humidity at midday was 62 percent, with higher humidity at night and an average of 80 percent at dawn. The prevailing wind was from the southwest; the highest average wind speed occurred in January at 11.7 miles per hour (mph).

Allegan County's meteorological data are also summarized in Table 1 of the DCS (BBEPC, 1992), presented here in Appendix A, for the period 1851 to 1980. In winter, the average temperature was 27.9°F, and the average daily minimum temperature was 21°F. The lowest temperature on record was -20°F, which occurred in the city of Allegan on February 11, 1899. In summer, the average temperature was 67.8°F, and the average daily maximum temperature was 79.8°F. The highest recorded temperature, which occurred on July 13, 1936, was 104°F.

In Allegan County, 56 percent of the average precipitation of 35.6 inches usually fell between April and September. Thunderstorms occurred about 38 days each year. The heaviest 24-hour rainfall event during the period of record was 6.23 inches, which occurred on June 26, 1978. The average seasonal snowfall was 78.4 inches, with the greatest recorded snow depth at any one time measured at 42 inches on January 14, 1910. The average relative humidity at midday was 62 percent, with higher humidity at night and an average of 82 percent at dawn. The prevailing wind was from the west, and the average wind speed was highest in January at 11.5 mph.

3.6.2 Conditions from June through August, 1993

For the sampling period of June through August 1993, the vectors mean wind direction was east-southeast (Figure 3-1 of *Technical Memorandum 5* [BBL, 1994a], presented here in Appendix B). Wind rose diagrams summarizing the individual sampling rounds, including wind direction, vector means, and confidence intervals, are shown in Figures 3-2 to 3-16 of *Technical Memorandum 5* (BBL, 1994a) and presented here in Appendix B. The 24-hour average wind speed ranged from 2.3 mph (August 11, 1993) to 7.7 mph (July 30, 1993). Peak (one-hour average) winds of 13.4 mph occurred on July 6, 1993. Results of the OU-specific meteorological monitoring and air sampling are presented in *Technical Memorandum 5* (BBL, 1994a).

The 24-hour average temperatures ranged from 61.5°F to 77.1°F. The lowest temperature recorded for any one hour was 43.6°F, which occurred on June 6, 1993, and the highest temperature of 88.5°F occurred on August 23, 1993. The 24-hour average solar radiation ranged from 0.06 langleys/minute (June 30 and August 29, 1993) to 0.52 langleys/minute (July 12, 1993).

The 24-hour average relative humidity ranged from 56 percent (June 12 and August 29, 1993) to 79 percent August 11, 1993. Seven of the 15 days had recorded precipitation. The 24-hour average precipitation for those days ranged from 0.03 inches (June 18, 1993) to 0.26 inches (August 11, 1993). The greatest precipitation for any one hour period was 0.22 inches and occurred on August 11, 1993. Relative humidity and precipitation data are from the meteorological station located at the Allied Paper, Inc. OU (BBL, 1994b).

Summaries of the hourly wind speed and direction, ambient temperature, and other meteorological attributes obtained from the Kalamazoo County Fairgrounds Meteorological Station for the days on which samples were collected are presented in Table 3-1 of *Technical Memorandum 5* (BBL, 1994a). The daily temperature and barometric pressure readings are found on the Calibration and Comment Sheets for PUF Samplers (Appendix E of *Technical Memorandum 5* [BBL, 1994a]) and the field notes (Appendix H of *Technical Memorandum 5*, [BBL, 1994a]).

3.6.3 Conditions from November, 1999 through February 2000

For the sampling period of November 30, 1999 though February 29, 2000, the 24-hour average temperatures ranged from 10°F (January 27, 2000) to 5°F (December 3, 2000). The lowest temperature recorded for any one hour was -1°F, which occurred on January 27, 2000, and the highest temperature of 58°F occurred on December 5, 1999. The 24-hour average wind speed ranged from 2.4 mph (January 28, 2000) to 16.2 mph (December 20, 1999). Of the 92 days monitored during the IRA, 54 days recorded precipitation. The 24-hour average precipitation for those days ranged from trace (16 days) to .91 inches (December 2, 1999). The 24-hour average wind speed ranged from 2.4 mph (January 28, 2000) to 16.2 mph (December 20, 1999).

Complete meteorological data collected during the IRA from November 1999 to February 2000 are included in Appendix E of this report.

3.7 Population and Land Use

The WB/A-OU is located in Kalamazoo Township, which has a population of approximately 21,000. Land use in the general vicinity of the OU includes industrial, commercial, and residential properties. The WB/A-OU is currently an inactive disposal area. The A-Site is zoned for industrial use. When the area was zoned, the Willow Boulevard Site did not exist, and the area has never been zoned. After review of the past 40 years of industrial land use and consideration of similarities to the A-Site, if zoned today, the Willow Boulevard Site would appear to fall under the industrial category. The land adjacent to the WB/A-OU on the south is zoned as residential. Figure 14 presents the land use for the area surrounding the WB/A-OU.

Additional description of the physical setting is presented in Sections 4.9 and 4.10 of the DCS (BBEPC, 1992).

3.8 Wetlands Assessment

Four types of palustrine areas (wetlands) in the vicinity of the WB/A-OU as identified on the NWI map (USFWS, 1991), were reproduced on a larger scale, and included as Figure I-1 of *Technical Memorandum 9* (BBL, 1995b; Appendix C). The wetland types designated on the NWI map are generally consistent with the

results of field observations; however, the extent and configuration of the wetlands appear to have changed. The NWI-mapped wetland unit located in the Willow Boulevard Site is classified as palustrine unconsolidated bottom semi-permanently flooded (PUBFx) wetland (Area 1). A palustrine broad-leaved deciduous forest subject to seasonal flooding (PEO1C) wetland (Area 6) is present on the NWI map at the southern edge of the WB/A-OU and encompasses part of the former Olmstead Creek. Two palustrine wetland types in four areas are identified on the NWI map within the A-Site: PUBFx (Areas 3, 4, and 5) and palustrine emergent semi-permanently flooded (PEMFx) (Area 2). An additional PEMFx wetland is shown in the area east of Davis Creek (Area 7).

On-site wetland field investigations at the WB/A-OU were conducted to field-verify the wetlands identified on the NWI map for the area. Of these NWI areas, only Areas 6 and 7 were identified as wetlands during field investigations. No characteristic wetlands were found in Areas 1, 2, 3, 4, or 5. Areas 2, 3, 4, and 5 likely represented formerly ponded low areas at the A-Site. The area depicted as Area 1 (Figure 3 of *Technical Memorandum 9* [BBL, 1995b]; Appendix C) was not targeted for wetland field investigation because the area was not identified as a wetland at the time of the NWI mapping. However, wetland characteristics were apparent in Area 1 and noted during the wetlands assessment. Area 1 is located at the western edge of the Willow Boulevard Site. The approximate extent of wetland Area 1 is based on visual observations of vegetative cover. The approximate boundaries of other field-verified wetlands (i.e., Areas 2, 3, and 4) are also shown on Figure 3 of *Technical Memorandum 9* [BBL, 1995b]; Appendix C. NWI wetland areas 6 and 7 (Figure I-1 of *Technical Memorandum 9* [BBL, 1995b]; Appendix C) are shown as Areas 2 and 4 on Figure 3 (*Technical Memorandum 9* [BBL, 1995b]; Appendix C).

The observed extent of NWI-identified Area 6 wetland (Area 2; Figure 3 of *Technical Memorandum 9* [BBL, 1995b]; Appendix C) is consistent with the NWI map, while NWI Area 7 was observed in the field to be greater than mapped by NWI. An area south of the A-Site (Area 3; Figure 3 of *Technical Memorandum 9* [BBL, 1995b]; Appendix C), which includes a portion of the former Olmstead Creek channel, was identified in the field. This area was also not previously identified on the NWI map.

The WB/A-OU provides moderate quality habitat for terrestrial wildlife. Moderate quality habitat is generally considered supportive of common flora and fauna species typical of an area. Given that the “high quality” habitat designation is reserved for habitats such as those critical for threatened/endangered species, and no-to-low quality habitats are presumed equivalent to those providing the minimal requirements for common species

(e.g., disturbed areas such as parking lots, active industrial areas), the “moderate quality” designation is deemed appropriate for the WB/A-OU. There is high quality habitat adjacent to the site (Mehne, 1996, 2002).

Additional description of the WB/A-OU wetlands, biota, and habitat is presented in Sections 2.6 and 2.7 of the DCS (BBEPC, 1992) and Sections 2.5 and 3.4 of *Technical Memorandum 9* (BBL, 1995b).

Because land features may have changed since the last wetlands assessment was conducted, as a result of the interim response action or otherwise, the MDEQ will conduct a wetlands assessment of the entire WB/A-Site OU and ancillary areas, to update the existing wetland maps, in 2005.

4. Nature and Extent of Contamination

This section presents a summary of analytical results of RI and subsequent investigations, including volume estimates of the PCB contaminated material present at the WB/A-OU and ancillary areas and groundwater analytical results. Additional information regarding the nature and extent of contamination at the OU may be found in *Technical Memoranda 5* (BBL, 1994a) and *9* (BBL, 1995b), and *Draft Addendum to Technical Memorandum 9* (BBL, 1996). In addition to the results provided in this report, results of supplemental investigations are also reported in three letters (Brown, 1998a; McGuire, 1998b; and McGuire, 2000).

4.1 Volume Estimates

During the RI and subsequent investigations described in Section 2.1, 2.3, and 2.4, borings were taken and characterized to evaluate the vertical and horizontal extent of residuals. Volume estimates included here differ from those presented in the DCS (BBEPC, 1992) because additional data was collected during the RI, and different calculation methods were used. Field observations of gray clay materials containing paper fibers and the analytical data discussed in Section 4.2 were used to calculate volume estimates for the WB/A-OU. Analyses that detected PCB above detection limits prompted inclusion of those data in the volume estimate. Figure 15 shows the areas used to estimate volumes along with calculation results.

The table below summarizes the volume (including depth and area) of PCB-containing soil for each area of the site. PCBs are the constituent of concern and the volumes presented include the media of concern (i.e., surficial and subsurface soils, sediment, and residuals).

Estimated Areas and Volumes[1] of PCB-Containing Material

	Area	Maximum Depth (feet)	Estimated Volume (cy)
Willow Boulevard Site[2]	11 Acres	24	152,100
A-Site[2]	22 Acres	29	475,400
East of Davis Creek[2]	3.5 Acres	1	3,800
South of A-Site Berm[2]	2.5 Acres	6	2,900
AMW-3A[2]	Area Not Defined	12	100

1 Based on PCB concentrations above detection limits

2 Depth of residuals varies across the area.

4.1.1 Willow Boulevard Site

At the Willow Boulevard Site, residuals were found at the surface at the eastern end of the site to a depth of up to 21.5 feet bgs near the center of the site at WB-1. On the western end of the Willow Boulevard Site, in the

vicinity of WB-5, the residuals extended from the surface to 5.5 feet bgs. The estimated volume of residuals in the Willow Boulevard Site is 145,100 cy. During the interim response activities conducted between November 1999 and January 2000, an estimated 7,000 cy of residuals were removed from the Kalamazoo River to the west of Willow Boulevard Site and from the former Olmstead Creek. This removed material was layered with clean fill material and fly ash at the eastern end of Willow Boulevard Site. A six-inch sand layer covers the Willow Boulevard Site and portions of the river bank are covered with geotextile fabric for erosion control. Grass seed was sown in some areas to promote vegetative cover. However, burrowing animals and erosion continue to take a toll on the interim measures. Where the sand layer or geotextile has been disturbed, residual waste is exposed at the surface. The estimated volume of materials in Willow Boulevard Site, including the drainageway area and the materials removed from the river, is estimated at 152,100 cy. This volume estimate may be substantially different depending on the actual extent of contamination. The estimated area of the Willow Boulevard Site is 11 acres.

4.1.2 A-Site

At the A-Site, the residuals were observed from ground surface to 13.5 feet bgs on the western end of the site near the AMW-6 cluster. The residuals extended from the ground surface to 27 feet bgs at the eastern end of the site in the vicinity of the AMW-10 cluster. Small layers of residuals were observed below the dikes that contain the site on the northern and eastern boundaries. At boring locations P-1D and P-1RS, residuals with a thickness of 0.5 feet were observed with the dike fill and significantly above the water table. The area south of the A-Site berm contains an estimated 2,900 cy of residuals. The estimated volume of residuals in the A-Site, including the area south of the A-Site berm, is 478,300 cy. This volume estimate may be substantially different depending on the actual extent of contamination. The approximate area of the A-Site is 22 acres. Residual paper waste is visible at the surface in some areas of the site.

4.1.3 Area East of Davis Creek

As described in the DCS (BBEPC, 1992), a thin layer of residuals was observed in the area east of Davis Creek. Swanson Environmental (1990) reported that the thickness of the residuals was generally less than one foot. In an attempt to assess the possible lateral and vertical extent of residuals in the area, eight borings (EDC-1 to EDC-8) were collected. Five of the eight borings contained residuals from the ground surface to approximately 0.5 feet bgs. The area east of Davis Creek is estimated to be 3.5 acres in size. Based on these borings, the estimated volume of residuals in the area east of Davis Creek is 3,800 cy (Figure 15). This volume estimate may be substantially different depending on the actual extent of contamination.

4.2 Analytical Data

As described in Sections 1 and 2, investigation activities were conducted at the WB/A-OU between 1986 and 2000 as part of the pre-RI, RI, and IRA activities. Per request of the MDEQ, pre-RI data will be included in the summary below; however, it should be noted that the pre-RI data were not subjected to quality control procedures, as described in the *Quality Assurance/Quality Control Review of Historical Studies Data Plan* (BBEPC, 1993a).

An evaluation of the analytical data collected from the WB/A-OU in terms of TCL/TAL constituents detected, frequency of detection, and range of detected concentrations for each constituent is found in Sections 3.2 and 4 of *Technical Memoranda 5* (BBL, 1994a) and *9* (BBL, 1995b), and in the *Draft Addendum to Technical Memorandum 9* (BBL, 1996). Although PCB were presumed, with the agreement of the MDEQ, to be the essential issue at the WB/A-OU, samples of environmental media from various areas were analyzed for other organic and inorganic compounds (i.e., VOCs, SVOCs, pesticides/PCB, PCDDs, PCDFs, and inorganics). Below is a summary of the analytical data collected as part of the pre-RI, RI, and IRA activities.

The following subsections summarize the results of these investigations.

4.2.1 WB/A-OU Surficial Residuals, Soil, and Sediment

This section includes a summary of the analytical data collected from surficial residuals, soil, and sediment at the WB/A-OU as a part of the Pre-RI, RI, and IRA activities. Sample locations are shown on Figure 4. Table 4-1A presents a summary of the surficial (0 to 2 feet) PCB data collected as part of the pre-RI, RI, and IRA activities and lists the criteria that may be applicable. Results of residential property surficial sampling are discussed in Section 4.2.2.

4.2.1.1 Willow Boulevard Site

<u>Pre-Remedial Investigation</u>

In December 1986, the MDNR reported PCB concentrations of 44 and 47 mg/kg in two surficial sediment samples (GP-1 and GP-2) collected in June 1986 (Creal, 1986). The surficial soil sampling conducted by Georgia-Pacific in 1987 and 1988 (samples 1 through 11 and 1A through 22A) resulted in total PCB concentrations from not detected to 170 mg/kg. MDNR split samples of samples 1, 3, 4, 6, 8, 10, 7A, 16A, and 21A resulted in PCB concentrations ranging from not detected to 170 mg/kg. PCB sample data are included in Table 79 and PCDD/PCDF results are included in Table 84, both of the DCS (BBEPC, 1992); presented here in

Appendix A. Sample locations are shown on Figure 21 of the DCS (BBEPC, 1992), and included in Appendix A of this report.

Remedial Investigation

Total PCB concentrations in surficial residuals/soils samples collected at the Willow Boulevard Site during the RI from locations WMW-3A, WMW-4B, and WB-1 through WB-5 ranged from not detected to 270 mg/kg; Results are presented on Table 3-11 of *Technical Memorandum 9* (BBL, 1995b; included here with Appendix C). Results are summarized on Table 4-1A.

Summaries of surficial PCDD/PCDF concentrations from samples WB-1, WB-2, and WB-3 are presented on Table 4-2. Corresponding locations are presented on Figure 4.

Interim Response Activities

During the IRA conducted from November 1999 to April 2000, the sediment to the west of the Willow Boulevard Site was excavated and post-excavation confirmatory sampling was conducted. PCBs were detected in three of the sediment samples collected by BBL in accordance with *MDNR Guidance Document for Verification of Soil Remediation* (1994) adjacent to the Willow Boulevard Site (Figure 16); analyses of sediment samples collected by MDEQ (Figure 16A) showed elevated PCB concentrations in several samples, with a maximum concentration of 5.3 mg/kg. Tables 4-3 and 4-3A present the results, and Table 4-4 summarizes these results. While excavation activity occurred after these samples were collected, elevated concentrations of PCBs remain in Kalamazoo River sediment in the area of the IRA.

As discussed in Section 2.1.1, any PCB-containing material remaining in the river adjacent to the Willow Boulevard Site will be addressed as part of the remedy for the Kalamazoo River (Brown, 2000).

4.2.1.2 A-Site

Pre-Remedial Investigation

Surficial soil samples collected in April 1987 from the east end of the A-Site (samples 12 and 16) had PCB concentrations of not detected and 2 mg/kg, respectively (Table 87 and Figure 23 of the DCS [BBEPC, 1992], included here in Appendix A). PCBs were not detected in samples collected from the top two feet of soil borings drilled in July 1990 (SB-1, SB-3, SB-6, SB-7, and SB-8). These results are presented in Table 88 of the DCS (BBEPC, 1992) and are included here in Appendix A.

Remedial Investigation

PCB concentrations in surficial samples collected from the A-Site (AMW-6B, AMW-7B, AMW-8B, AMW-9B, and AMW-10B) ranged from not detected to 0.12 mg/kg. Results are presented in Table 4-1A.

Three samples were collected in the area south of the A-Site berm (ARS-1, ARS-2, and ARS-3) during the initial RI activities. The total PCB concentrations in these surficial samples ranged from not detected to 0.77 mg/kg.

Three samples were collected from AS-1, AS-2, and AS-3. Total PCB concentrations in these surficial samples ranged from not detected to 0.48 mg/kg. These results are presented in Table 3-11 *of Technical Memorandum 9* [BBL, 1995b], included with this report in Appendix C. Results of sampling for PCDD/PCDF are included on Table 4-2.

A surficial sample was collected from the area south of the A-Site berm in a subsequent round of sampling in 1999 from FLA-SB-24 (McGuire, 1999). This result was 14 mg/kg, as presented in Table 4-5. Analytical laboratory results for this sample are included in Appendix K.

Total PCB concentrations in the five sediment samples collected from north of the A-Site (ARN-1 through ARN-5) ranged from not detected to 0.14 mg/kg. Results are presented on Table 3-13 of *Technical Memorandum 9* (BBL, 1995b), presented here in Appendix C.

The three samples collected from the former Olmstead Creek (OCU-SED, OCM-SED, OCD-SED) had PCB concentrations of 9.94, 0.31 (7.6 duplicate), and 1.5 mg/kg, respectively. It should be noted that sample location OCD-SED was excavated as part of the IRA (see below). Results are presented on Table 3-13 of *Technical Memorandum 9* (BBL, 1995b), presented here in Appendix C. Sample locations are displayed on Figure 4. (The former Olmstead Creek is considered in conjunction with the A-Site.)

Interim Response Activities

A pre-excavation sample was collected at the confluence of the former Olmstead Creek and the river. This sample resulted in a PCB concentration of 4.0 mg/kg; MDEQ's sample resulted in a concentration of 25.1 mg/kg. These results are included in the datasheets of the *Removal Action Summary* (BBL, 2000) and are included in Appendix E. During the interim response activities conducted from November 1999 to April 2000, the confluence of the former Olmstead Creek and the river was excavated, and post-excavation confirmatory

sampling was conducted. Post-excavation samples collected at the former Olmstead Creek by BBL ranged from not detected to 0.75 mg/kg; MDEQ sample results ranged from not detected to 14 mg/kg. It should be noted that the 14 mg/kg collected from sample location SS-04 was a split sample of the BBL location SS-04 that resulted in a PCB concentration of 0.75 mg/kg. Tables 4-7 and 4-7A present the analytical results. Table 4-4 summarizes the results, and Figures 20 and 20A present the post-excavation sample locations and analyses results at the former Olmstead Creek for BBL and MDEQ, respectively.

As discussed in Section 2.1.1, any PCB-containing material remaining in the river adjacent to the Willow Boulevard Site will be addressed as part of the remedy for the Kalamazoo River (Brown, 2000).

4.2.1.3 AMW-3A Area

Remedial Investigation

Surficial soil samples were collected in the AMW-3A area during three rounds of sampling on property owned by Georgia-Pacific and Kalamazoo Township (Figure 18). The results of these sampling events were submitted through letters to the MDEQ (Brown, 1998a; McGuire, 1998a; McGuire, 1999). The PCB analytical results are presented in Tables 4-6A through 4-6C, respectively. Total surficial PCB concentrations in the AMW-3A area ranged from not detected to 5.9 mg/kg (Table 4-1A). In the January 1998 investigation, surficial PCB concentrations in three samples collected from AMW-3A-1, AMW-3A-2, and AMW-3A-3 ranged from 0.84 to 3.5 mg/kg (Table 4-6A).

In the July 1998 investigation, surficial PCB concentrations in seven samples collected from SB-3A-101 to SB-3A-107 ranged from not detected to 3.1 mg/kg (Table 4-6B). In the March 1999 investigation, surficial PCB concentrations in samples collected from SB-3A-202, SB-3A-203, SB-3A-205, SB-3A-206, SB-3A-208, and SB-3A-213 ranged from not detected to 5.9 mg/kg (Table 4-6C). However, the extent of surficial contamination on and adjacent to the Georgia-Pacific property in the AMW-3A area has not been defined; however this data gap should not impact the selection of alternatives.

4.2.1.4 Area East of Davis Creek

Pre-Remedial Investigation

In July 1990, soil samples were collected from 11 locations in the area east of Davis Creek (A-1, A-3, A-7, A-11, B-8, B-14, C-3, C-5, C-9, C-13, and D-13) (Figure 23 of the DCS [BBEPC, 1992], presented here in Appendix A). Samples were collected from the top six inches of soil at five locations (A-3, A-7, A-11, B-14, and C-9). The underlying sand, two feet below the surface, was also sampled. PCB concentrations ranged from

not detected to 5 mg/kg, as presented in Table 89 of the DCS (BBEPC, 1992), and included here in Appendix A. The triplicate analysis of sample B-14 indicated a PCB concentration of 80 mg/kg (MDNR, 1990).

Remedial Investigation

Total PCB concentrations in surficial samples collected from the area east of Davis Creek (EDC-1 through EDC-8) ranged from non-detect to 36 mg/kg. The extent of surficial contamination in the area east of Davis Creek has not been completely defined. Additional sampling will occur during remedial design and/or remedial action to fill this data gap; however the data gap should not impact the analysis of the remedial alternatives.

4.2.1.5 Davis Creek

Remedial Investigation

Total PCB concentrations in the three sediment samples collected from Davis Creek (DCU-SED, DCM-SED, and DCD-SED) were 0.12 mg/kg, 0.053 mg/kg, and 0.054 mg/kg, respectively. Results are presented in Table 3-13 of *Technical Memorandum 9* (BBL, 1995b), and included here in Appendix C; locations are displayed on Figure 4 of this report.

4.2.2 Residential Soils - Surficial

The MDEQ was present when the July and August 1987 soil samples were collected from 19 locations in the neighboring Lakewood area. These samples resulted in one sample with a detectable PCB concentration of 0.080 mg/kg (MDPH, 1987). This result was considered by the Michigan Department of Public Health (MDPH) to not pose a threat to public health (Chadzynski, 1987). Sample locations, shown on Figure 21 and Table 81 of the DCS (BBEPC, 1992), are presented here in Appendix A.

After the initial RI investigation, additional residential soil samples were collected on the Adkins, Wadsworth, and Scott properties south of the A-Site and on the Wright and Bloomfield properties in the AMW-3A area, as discussed in Section 2.3.2. The results of these additional investigations were submitted to the MDEQ in June 1999 (McGuire, 1999), and November 2000 (McGuire, 2000), and are summarized below.

The extent of PCBs in surficial residential soil has been sufficiently defined in the area south of the A-Site berm. Soil samples were collected from the Bloomfield, Wright, Adkins, Scott, and Wadsworth properties, and results of all samples were below the residential criteria of 4.0 mg/kg. PCB concentrations in samples collected from these residential properties ranged from not detected to an estimated 1.0 mg/kg. However, the extent of residual material has not been completely defined south of the Bloomfield Property (Lot 5) and must be addressed in remedial design and/or remedial action; however this should not impact the analysis of the remedial alternatives.

Three phases of investigations better defined the nature and extent of PCB-containing soils in residential areas south of the A-Site berm. SB-3A-201, SB-3A-204, and SB-3A-207, represent the Wright Property, and SB-3A-209 through SB-3A-212 represent the Bloomfield Property. Samples SB-ADKINS-1 through SB-ADKINS-9 represent the Adkins Property, samples B-1 through B-3 represent the Wadsworth Property, and samples TP-1, TP-10, TP-12, TP-13, and TP-15 represent the Scott Property. Sample locations are shown on Figure 21 and the analytical data are presented on Tables 4-8A through 4-8E.

4.2.2.1 Residences South of the Willow Boulevard Site

Pre-Remedial Investigation

PCBs were not detected during the soil sampling activities conducted in 1987 by the MDPH, now known as the Michigan Department of Community Health (MDCH) (Figure 21 of the DCS [BBEPC, 1992]; presented here in Appendix A).

Remedial Investigation

During RI activities, PCBs were not detected in the three surficial samples (0 to 6 inches) collected south of the Willow Boulevard Site (WBAS-1 through WBAS-3). Locations and results are presented on Figure 11 of *Technical Memorandum 9* (BBL, 1995b), presented here in Appendix C.

4.2.2.2 Residential Property Near the AMW-3A Area - Wright Property

Remedial Investigation

Sampling on or near the Wright property during the third round of additional sampling in the AMW-3A area involved the collection of one sample from each of the three soil borings: SB-3A-201, SB-3A-204, and SB-3A-207 (Table 4-8A and Figure 21). Only SB-3A-201, SB-3A-204, and SB-3A-207 are located on the Wright property. The three surficial samples collected from these three borings on the Wright Property resulted in non-detectable concentrations of PCB. The result of one sample taken from boring SB-3A-202 (Table 4-6C) was 4.4 mg/kg. This location was formerly within the Wright fence line, even though it is on Georgia-Pacific property. After the sampling activities were completed, the fence line was relocated and there is now a barrier between the Wright property and the sample location.

4.2.2.3 Residential Property Near the AMW-3A Area - Bloomfield Property

Remedial Investigation

Four borings were taken on the Bloomfield property as part of the third round of AMW-3A area sampling (SB-3A-209 through SB-3A-212). Two of these borings (SB-3A-210 and SB-3A-212) were taken along the boundary between the Bloomfield property and land owned by Georgia-Pacific adjacent to Davis Creek (Figure 21). As noted in Table 4-8B, PCBs were detected in two of the four surficial samples at estimated concentrations of 0.14 and 1.5 mg/kg, the latter quantified as Aroclor 1254. The two detected samples were at the Georgia-Pacific fence line; the two non-detects were within the Bloomfield property. All sample results are below the residential criterion of 4.0 mg/kg. PCB concentrations in the eight subsurface soil samples at the property were all reported as not detected (Table 4-8B).

4.2.2.4 Residential Property South of the A-Site - Adkins Property

Remedial Investigation

The results of the nine surficial samples collected from nine borings (none of which showed the presence of residuals) on or near the Adkins property are presented in Table 4-8C and Figure 21. PCBs were not detected in eight of the nine surficial soil samples collected on the property. Surficial samples were collected from soil borings SB-ADKINS-1 through SB-ADKINS 9. The one surficial detection (SB-ADKINS-7) was reported as an estimated 0.14 mg/kg and quantified as Aroclor 1260. No samples collected on or near the property had a PCB concentration that exceeded the residential criterion.

4.2.2.5 Residential Property South of the A-Site - Wadsworth Property

Remedial Investigation

Three borings were taken on the Wadsworth property at the request of the property owner (Figure 21). PCBs were not detected in the six surficial samples collected from borings B-1 through B-3 (Table 4-8D).

4.2.2.6 Residential Property South of the A-Site - Scott Property

Remedial Investigation

Fifteen test pits were dug at the Scott property (Figure 21) at the request of the property owner. Two surficial samples were collected from test pits TP-1 and TP-10 to determine the extent and nature of gray materials observed on the property. PCB concentrations in the two surficial samples at the property were both reported as not detected (Table 4-8E). There were no exceedances of the residential criterion.

4.2.3 WB/A-OU Subsurface Residuals/Native Soil

This section includes a summary of the PCB data collected from subsurface (greater than 2 feet bgs) soils and residuals as part of the pre-RI, RI, and IRA. Table 4-1B presents a summary of the subsurface PCB data collected as part of the pre-RI, RI, and IRA. As requested by the MDEQ, comparison of the 95% upper confidence limit (UCL) of the mean will be compared to the appropriate value (i.e., residential, industrial), used as a guidance value only.

Materials collected at P-1D and G20-1 from the dike at the northwest corner of the A-Site were characterized as residuals.

The depth/elevations at which residuals are present at the WB/A-OU are shown on the cross-sections included as Figures 12A, 12B, and 12C. As shown on Figures 12A and 12B, the residuals at the A-Site are a maximum of approximately 28 feet thick. The groundwater elevation relative to the elevation of residuals is also shown on Figures 12A, 12B, and 12C. Figures 12D, 12E, and 12 F are geologic cross sections, showing PCB concentration with depth.

4.2.3.1 Willow Boulevard Site

Pre-Remedial Investigation

The at-depth sampling conducted by MDNR and Georgia-Pacific during 1987 and 1988 found PCB concentrations ranging from not detected to 160 mg/kg (Figure 21 of the DCS [BBEPC, 1992], included here in Appendix A). Sample data are included in Table 79 of the DCS (BBEPC, 1992), presented with this report in Appendix A.

Remedial Investigation

Total PCB concentrations in subsurface residuals samples collected during the RI and subsequent investigations from the Willow Boulevard Site (including the drainageway area) ranged from not detected to an estimated 160 mg/kg (Table 4-1B). Results are presented in Table 3-11 of *Technical Memorandum 9* (BBL, 1995b; included here in Appendix C). Locations and results are presented on Figure 11 of *Technical Memorandum 9* (BBL, 1995b; included here in Appendix C). There is no apparent vertical gradient of the PCB concentrations in Willow Boulevard Site residuals. However, PCB concentrations at the base of the residuals were generally lower than those in the overlying residuals. Site investigations indicate that residuals are present at the Willow Boulevard Site to a depth of approximately 24 feet.

An investigation was conducted to characterize residuals along the southern and western boundaries of the WB/A-OU. Samples DWA-SB-14, DWA-SB-26, DWA-SB-38, and DWA-SB-51 represent the drainageway area of the Willow Boulevard Site. Total PCB concentrations in five of the eight subsurface native soil samples collected from the Willow Boulevard Site drainageway ranged from 0.39 to 30 mg/kg. Analytical data from this investigation are presented on Table 4-11 and shown on Figure 17.

Summaries of TCL compounds and TAL analytes detected in native soils are given in Tables 4-9 and 4-10, shown in Figures 15, 18, 22, and 23 of *Technical Memorandum 9* (BBL, 1995b), and presented here in Appendix C. Corresponding locations are presented on Figure 4 of this report. Mercury was detected in 12 of 15 subsurface samples; some results exceeded the GSI protective criterion for soil. In addition, cyanide, manganese, and zinc are also present in subsurface residuals and soils at levels that are higher than the GSI protective criteria for soil. The highest concentrations of mercury were detected in residual material. One analyte, lead, ranged from 8.1 to 1,100 mg/kg; of the nine samples analyzed for lead, one exceeded the industrial direct contact criterion of 900 mg/kg. Both mean and 95% UCL of the mean, however, did not exceed the industrial criterion.

Interim Response Activities

Sediment samples collected at the base of the excavation adjacent to the Willow Boulevard Site by BBL ranged from not detected to 0.73 mg/kg; MDEQ PCB results ranged from not detected to 2.7 mg/kg. Tables 4-3 and 4-3A present the analytical results, Table 4-4 summarizes the results, and Figures 16 and 16A present the post-excavation sample locations at the Willow Boulevard Site and the results obtained by BBL and MDEQ, respectively.

After completing both excavation and post-excavation sampling activities, test pits were dug at the area adjacent to the Willow Boulevard Site. A sample collected adjacent to the Willow Boulevard Site by BBL (sample SV-60) resulted in a PCB concentration of 0.99 mg/kg; MDEQ samples SS-59 through SS-62 resulted in PCB concentrations ranging from 2.0 to 5.3 mg/kg.

4.2.3.2 A-Site

Pre-Remedial Investigation

Soil borings drilled in July 1990 (SB-1 through SB-10, MW-4, and MW-5) resulted in PCB concentrations ranging from not detected to 15 mg/kg to a depth of 29 feet (Table 88 of the DCS [BBEPC, 1992], presented here in Appendix A).

Remedial Investigation

Total PCB concentrations in subsurface residuals collected from the A-Site ranged from not detected to 330 mg/kg Table 4-1B. PCB concentrations in A-Site residuals increased gradually with depth below the surface to a subsurface maximum (330 mg/kg at 22 to 24 feet bgs) within the residuals. From this peak level in PCB, concentrations tended to decrease to the base of the residuals (5.2 mg/kg at depths of up to 27 feet bgs). Results are presented in Table 3-11 of *Technical Memorandum 9* (BBL, 1995b) and included in Appendix C of this report. Previous site investigations (Swanson, 1990) indicated that residuals exist at the A-Site to a depth of 29 feet. Further investigations (BBEPC, 1992) indicated that the depth of residuals was 27 feet in the eastern half of the site and 15 feet in the western half, as presented in the DCS (BBEPC, 1992) and shown on Figures 12A and 12B.

Summaries of TCL compounds and TAL analytes detected in native soils are given in Tables 4-9 and 4-10 of this report and shown in Figures 16, 19, 22, and 24 of *Technical Memorandum 9* (BBL, 1995b), included here in Appendix C. Corresponding locations are presented on Figure 4 of this report. No TCL compounds or TAL analytes exceeded their respective industrial direct contact criterion. Mercury, however, detected in 10 of 17 samples, exceeded the generic cleanup criterion for protection of the groundwater surface water interface. The highest concentrations of mercury were detected in residual material.

An investigation was conducted to characterize residuals along the southern and western boundaries of the OU. Samples DWA/FLA-SB-3, DWA/FLA-SB-4, FLA-SB-1, FLA-SB-5, FLA-SB-7, FLA-SB-8, FLA-SB-11, FLA-SB-12, FLA-SB-13, FLA-SB-16, FLA-SB-18, FLA-SB-19, FLA-SB-22, FLA-SB-24, and FLA-SB-25 represent the area south of the A-Site berm. Nine out of 19 samples collected in the area south of the A-Site berm had PCB concentrations ranging from 0.36 to 37 mg/kg. All other samples were reported as not detected. Results are presented in Table 4-5 and on Figure 17 of this report.

4.2.3.3 AMW-3A Area

Remedial Investigation

Two samples were collected from the AMW-3A area at sample location AMW-3A (Figure 18), from 6 to 8 and 10 to 12 feet bgs, as part of RI activities. The PCB concentration in the 6 to 8 foot interval was estimated at 62 mg/kg and in the 10 to 12 foot interval the PCB concentration was 0.34 mg/kg (Table 3-11 of *Technical Memorandum 9* [BBL, 1995b]), presented here in Appendix C.

Total PCB concentrations in the 48 samples collected in the three rounds of RI sampling at the AMW-3A area ranged from not detected to an estimated 62 mg/kg (see Tables 4-6A, 4-6B, and 4-6C). The extent of subsurface contamination on the Georgia-Pacific property in the AMW-3A area has not been defined. This data gap can be addressed as part of the remedial action, but should not impact analysis of the remedial alternatives.

The area between the Wright and Bloomfield Properties along Carlton Avenue is considered residential. The residential criteria of 4 mg/kg was exceeded in four sample locations.

4.2.4 Residential Property Soils - Subsurface

4.2.4.1 Residential Property Near the AMW-3A Area - Wright Property

Remedial Investigation

Subsurface (> 2' bgs) samples collected on the Wright property during the third round of additional sampling in the AMW-3A area included seven samples from three soil borings (SB-3A-201, SB-3A-204, and SB-3A-207) as summarized in Table 4-8A and on Figure 21. PCBs were not detected in the any of those samples.

4.2.4.2 Residential Property Near the AMW-3A Area - Bloomfield Property

Remedial Investigation

Eight samples were taken from four borings on the Bloomfield property as part of the third round of AMW-3A area sampling (SB-3A-209 through SB-3A-212). Two of these borings (SB-3A-210 and SB-3A-212) were taken along the boundary between the Bloomfield property and land owned by Georgia-Pacific adjacent to Davis Creek (Figure 21). As noted in Table 4-8B, PCB concentrations in the eight subsurface soil samples at the property were all reported as not detected.

4.2.4.3 Residential Property South of the A-Site - Adkins Property

Remedial Investigation

The results of the 37 subsurface samples (including 4 duplicates) collected from nine borings (none of which showed the presence of residuals) on or near the Adkins property are presented in Table 4-8C and Figure 21. Of the 37 subsurface soil PCB samples, results ranged from not detected to 1.0 mg/kg.

4.2.4.4 Residential Property South of the A-Site - Wadsworth Property

Remedial Investigation

Three samples were collected from two borings (B-1 and B-2) on the Wadsworth property at the request of the property owner (Figure 21). An estimated PCB concentration of 0.12 mg/kg was identified in sample B-2 at 2

to 4 feet below ground surface (Table 4-8D). Results from the other two samples indicated non-detectable PCB concentrations.

4.2.4.5 Residential Property South of the A-Site - Scott Property

Remedial Investigation

Four subsurface soil samples were collected from TP-1, TP-12, TP-13, and TP-15. No PCBs were detected in any samples (Table 4-8F).

4.2.5 Surface Water

This section includes a summary of the surface water data collected as part of the Pre-RI and RI activities. Table 3-16 of *Technical Memorandum 9* (BBL, 1995b), included here in Appendix C, presents the analytical data and Table 4-12 of this report summarizes these results. Table 4-13 summarizes the detected TAL analyte concentrations in surface water. Table 4-14A summarizes the determination of hardness-dependent water quality values, consistent with Part 31 ,Water Resources Protection of the Natural Resources and Environmental Protection Act, 1994 of PA 451,.(Rule 57), For the purposes of point source discharges and venting groundwater, these values are designed to protect aquatic life.

4.2.5.1 A-Site

Pre-Remedial Investigation

Split samples of surface water were collected from the former Olmstead Creek by MDNR and Swanson in April 1987 (Table 91 of the DCS [BBEPC, 1992], presented here in Appendix A). PCBs were not detected in the surface water in the former Olmstead Creek (DCS; BBEPC, 1992).

Remedial Investigation

The total PCB concentration detected in the only surface water sample collected from Olmstead Creek (OCD-SW) (Figure 4) was an estimated 0.17 μg/L, [which exceeds the Water Quality Based Effluent Limit (0.000026 μg/L) of Act 451, Part 31, Rule 57(2)].

4.2.5.2 Davis Creek

Pre-Remedial Investigation

One split sample of surface water was collected by MDNR and Swanson in April 1987 (Table 91 of the DCS [BBEPC, 1992]). As reported in the DCS (BBEPC, 1992), PCBs were not detected in the surface water sample collected from Davis Creek.

Remedial Investigation

PCBs were not detected in the three surface water samples collected from Davis Creek (DCU-SW, DCM-SW, and DCD-SW) (Figure 4). Results are presented in Table 3-16 of *Technical Memorandum 9* (BBL, 1995b) and included in Appendix C.

4.2.6 Air Monitoring

This section includes a summary of the analytical data collected during the air monitoring program conducted as part of the RI and the IRA.

Remedial Investigation

Particulate-phase PCB were not detected on the glass-fiber filters used to collect air samples from the WB/A-OU and Battle Creek (Figure 4 of this report and Figure 2-2 of *Technical Memorandum 5* [BBL, 1994a], presented in Appendix B). The mean vapor-phase PCB concentrations at the OU air samplers ranged from 0.00049 micrograms per cubic meter ($\mu g/m^3$) to 0.0029 $\mu g/m^3$. Mean vapor-phase PCB concentrations at the two Battle Creek locations were 0.00026 $\mu g/m^3$ and 0.00041 $\mu g/m^3$. Vapor-phase PCB concentrations at the WB/A-OU were within acceptable limits established by the MDEQ's Secondary Risk Screening Level of 0.02 $\mu g/m^3$ for PCB, Part 55, Air Pollution Control of the Natural Resources and Environmental Protection Act, 1994 of PA 451, Rule 225(2). Results of the air investigation are presented in Tables 3-2 through 3-7 of *Technical Memorandum 5* (BBL, 1994a), included here in Appendix B.

Interim Response Activities

Air sampling was also conducted during the IRA from November 1999 to March 2000. A total of 301 air samples were collected and analyzed for PCB from the 3 air sampling locations shown on Figure 2 of the Remedial Action Summary (Appendix E). All results were below detectable levels during the extent of the interim response activities. These results are presented in the *Removal Action Summary, Willow Boulevard/A-Site-OU* (BBL, 2000b).

4.2.7 Groundwater

As presented in *Technical Memorandum 9* (BBL, 1995b), the MDEQ provided the following interpretation:

> Based on interpretation of the stiff diagrams for the OU, the residual mass and/or the residual leachate present in the residuals impacts the groundwater underlying the OU. The specific analytes denoted in the stiff diagrams include calcium, iron, bicarbonate, and sulfur.

Stiff diagrams and results of these analytes are presented in *Technical Memorandum 9* (BBL, 1995b) and are included here in Appendix C. Table 4-14 presents the summary of PCB concentrations and generic cleanup and GSI criteria.

This section includes a summary of the groundwater data collected as part of the pre-RI, RI, and the IRA.

Pre-RI (1988 to 1990) data are being presented; however, attempts to perform QC analyses of the data could not be completed as prescribed in the MDEQ-approved plan for the *QA/QC Review Historical Studies Data Plan* (BBEPC, 1993a). As presented in the DCS (BBEPC, 1992), the KSRG suspected that the pre-RI PCB detections were possibly an artifact of well construction. Given the inability to perform analytical quality control review, the potential that historical PCB detects are an artifact of well construction, and the fact these data are over ten years old, the groundwater data collected during the RI supersedes pre-RI groundwater data for characterizing conditions at the Site. Long-term groundwater monitoring, discussed in Section 6.2.2, is considered in most alternatives of the FS. Figure 22 shows PCB analytical results of groundwater samples collected between February 1988 and December 2000. Further evaluation of groundwater is necessary to demonstrate and/or to monitor compliance with applicable criteria. If long term groundwater monitoring data shows that PCB concentrations in groundwater exceed the applicable criteria at compliance well locations, the impacts to groundwater would need to be addressed.

Tables 4-15 and 4-15A summarize TCL and TAL data respectively and compare them to generic drinking water and groundwater surface water interface (GSI) criteria. To achieve compliance, groundwater venting to surface water (i.e. the Kalamazoo River) must be below generic GSI cleanup criteria, which is the current target detection limit (TDL) of 0.2 µg/L. TDLs may be revised by the MDEQ annually. If the TDL is changed, the groundwater criteria will also change accordingly.

4.2.7.1 Willow Boulevard Site

Pre-Remedial Investigation

Groundwater monitoring was conducted at the three on-site wells at the Willow Boulevard Site (MW-1, MW-2, and MW-3) in February and March 1988. The results of these analyses are presented in Table 82 of the DCS (BBEPC, 1992) and are presented here in Appendix A. The concentrations of total PCB ranged from non-detectable (at a detection limit of 0.025 mg/kg) to 1.4 µg/L, with an average concentration of 0.28 µg/L. A filtered groundwater sample from MW-3 contained a PCB concentration of 0.16 µg/L, and the unfiltered sample

had a PCB concentration of 1.4 μg/L. As reported in the DCS (BBEPC, 1992), the prevalent PCB Aroclor used for quantitation was Aroclor 1242.

In a sample collected from MW-1, the PCB concentration was 0.025 μg/L. After redevelopment, samples from MW-2 ranged from 0.04 to 0.056 μg/L PCB. Samples from MW-3, after redevelopment, ranged from 0.03 to 0.06 μg/L PCB.

In June 1990, groundwater samples from monitoring wells MW-1 and MW-3 were analyzed for PCDD and PCDF homologues and 2,3,7,8-congeners. These data are presented in Table 85 of the DCS (BBEPC, 1992) and are presented here in Appendix A. At MW-1, the total PCDF result was 0.00002 μg/L; the remainder of tests at MW-1 and all tests of MW-3 resulted in non-detects or returned results in test blanks, as well as sample media.

Remedial Investigation

PCBs were detected in one of five groundwater samples collected at the Willow Boulevard Site in October 1993. The sample taken at WMW-3A returned a PCB concentration of 1.5 μg/L, at a detection limit of 1 μg/L. Table 3-14 of *Technical Memorandum 9* (BBL, 1995b), included here in Appendix C, presents the results.

In August 1995, a 0.2 μg/L method detection limit was used, and PCBs were detected at 0.28 μg/L in a groundwater sample collected from monitoring well WMW-3A. Table 3-4 of the *Draft Addendum to Technical Memorandum 9* (BBL, 1995b), included here in Appendix D, presents the results.

BBL suspected that the PCB detected in the groundwater sample collected from monitoring well WMW-3A could be attributable to artifacts of well installation. To test this hypothesis, on August 19, 1996, a double-cased replacement well (WMW-3AR) was installed 21 feet from monitoring well WMW-3A. Monitoring well WMW-3AR has been sampled twice (August 30, 1996 and November 16, 2000) since installation. No PCB were detected in groundwater samples collected from monitoring well WMW-3AR in 1996 at the 0.2 μg/L reporting limit, and again in 2000 at the 0.051 μg/L reporting limit. These results support the hypothesis that the past detections of PCB at monitoring well WMW-3A may be an artifact of well construction.

Tables 4-1 and 4-2 and Figures 17, 20, and 25 of *Technical Memorandum 9* (BBL, 1995b), included here in Appendix C, summarize the concentrations of TCL compounds and TAL analytes detected in groundwater samples at this site. Cyanide, iron, manganese, and zinc were detected in groundwater samples at the Willow Boulevard site above generic GSI criteria (Tables 4-15 and 4-15A). These conditions may be due to their

presence in subsurface residuals and soils at levels that are higher than the generic GSI protective criteria (GSI PC) for soil.

In well WMW-2, zinc was present in a groundwater sample (and its duplicate) at a concentration of 2,200 μg/L. The Rule 57 acute toxicity value for aquatic life for zinc, as cited in the MDEQ's June 1997 comments on the RI/FFS, is 1,100 μg/L. Upon investigation, it was determined that the zinc levels in leachate samples were low across all four OUs (WB/A-OU, KHL-OU, Allied Paper, Inc. OU, and 12th Street Landfill-OU) (i.e., concentrations less than 63.2 μg/L). The groundwater samples with zinc concentrations exceeding the toxicity value are from old wells made with galvanized steel risers; none of the groundwater samples from the new wells have zinc levels even approaching the acute value. Corrosion of galvanized steel is known to bias groundwater sample results for zinc. It was concluded that the levels of zinc in groundwater samples in excess of the level determined to be acutely toxic to aquatic life is an artifact of well construction (Brown, 1997a). Still, because zinc levels in several subsurface soil samples are higher than GSI protective criteria, zinc is a contaminant of concern.

PCBs were not detected in the samples collected during the groundwater sampling conducted at the Willow Boulevard Site in November 2000. Tables 4-16 and 4-16A present the analytical results collected by BBL and the MDEQ, respectively. Analytical results of the 2000 groundwater sampling are included in Appendix L.

4.2.7.2 A-Site

Pre-Remedial Investigation

Groundwater was sampled at the five A-Site wells (MW-1 through MW-5) between February 1988 and August 1990, and the results are summarized in Table 90 of the DCS (BBEPC, 1992), presented here in Appendix A. Groundwater monitoring wells MW-2, MW-3, and MW-5 (Figure 4) had non-detectable concentrations of PCB (at a detection limit of 0.05 μg/L). Monitoring well MW-1, located in the northeast corner of the site, had PCB concentrations ranging from 0.59 to 3.2 μg/L (BBEPC, 1992). The initial sampling of MW-1 exhibited a PCB concentration of 22 μg/L. As reported in the DCS (BBEPC, 1992), it is suspected that the well became contaminated during installation. Monitoring well MW-4, which is located near MW-1, had a PCB concentration of 0.2 μg/L when sampled in 1990. Additional samples from MW-1 ranged from 0.2 μg/L to 0.8 μg/L. The results of the groundwater sampling conducted during the RI, described below, supersedes the pre-RI data due to the QC and well construction issues discussed in Section 4.2.7.

Remedial Investigation

PCBs were not detected in the groundwater samples collected at the A-Site in October 1993. Table 3-14 of *Technical Memorandum 9* (BBL, 1995b), included in Appendix C, presents the results.

PCBs were also not detected in the groundwater samples collected at the A-Site in August 1995. Table 3-4 of the *Draft Addendum to Technical Memorandum 9* (BBL, 1996), included in Appendix D, presents the results. Tables 4-1 and 4-2 and Figures 17, 20, and 25 of *Technical Memorandum 9* (BBL, 1995b), included in Appendix C, summarize the concentrations of TCL compounds and TAL analytes detected in groundwater samples along with residential groundwater (formerly Type B) and Generic Industrial (formerly Type C) Groundwater criteria. Mercury was detected in one groundwater sample (AMW-5) at a concentration of 0.22 ug/L; this concentration exceeded the generic GSI value of 0.0013 ug/L. Well AMW-5 is an existing well in the dike, screened in native materials. Though mercury was detected in 10 of 17 subsurface soil samples at the A-site (with the highest concentrations detected in residual material), it was not detected in any other groundwater or leachate samples collected from wells screened (approximately 6 inches) below the residuals or in the residuals at the WB/A-OU.

PCBs were detected in leachate wells AMW-6P and AMW-9P (Figure 4) at the A-Site. The extent of leachate was not determined as part of this evaluation. The leachate wells were installed within a perched saturated zone. Acetone, barium, 2-butanone, cyanide, di-n-butylphthalate, manganese, bis(2-ethylhexyl)phthalate (DEHP), 4-Mehylphenol, naphthalene, phenol, and vanadium were also detected in leachate samples at the A-site above generic GSI criteria (Tables 4-15 and 4-15A).

Barium, cyanide, manganese, mercury, and DEHP were also detected in groundwater samples at the A-site above generic GSI criteria (Tables 4-15 and 4-15A). These detections may be due to the presence of the analytes in subsurface residuals and soils at levels that are higher than the generic criteria GSI protective criteria for soil.

PCB concentrations ranged from not detected to an estimated 0.18 μg/L in samples collected from the A-Site during the November and December 2000 activities. Table 4-16 presents the results of these activities. Table 4-16A presents the results of the MDEQ split sampling of the November 2000 activity. MDEQ split samples collected from the same wells ranged from not detected to an estimated 0.11 μg/L. Split samples collected at six different wells (AMW-4, AMW-6A, AMW-8A, AMW-9A, AMW-10A, and AMW-10B) by MDEQ and BBL in November 2000 and sent to different laboratories, yielded a range of results. For example, the MDEQ sample

result from AMW-6A was non-detect, while the BBL sample yielded a result of 0.093 μg/L. The results for all of the 2000 groundwater sampling activities are presented in Tables 4-16 (BBL data) and 4-16A (MDEQ data). Analytical results of the 2000 groundwater sampling are included in Appendix G.

4.2.7.3 AMW-3A Area

Remedial Investigation

PCBs were not detected in the groundwater samples collected from AMW-3A during the October 1993 and August 1995 sampling activities. Table 3-14 of *Technical Memorandum 9* (BBL, 1995b), included in Appendix C, and Table 3-4 of the *Draft Addendum to Technical Memorandum 9* (BBL, 1996), included in Appendix D, present the results.

An estimated PCB concentration of 0.069 μg/L was detected during the November 2000 sampling activities, and a PCB concentration of 0.059 μg/L was detected during the December 2000 sampling activities. Table 4-16 presents the results of these activities. Analytical results of the 2000 groundwater sampling are included in Appendix L.

5. Fate and Transport

This section describes several key factors to be considered regarding the potential fate and transport of PCB at the WB/A-OU. The potential PCB transport pathways from the WB/A-OU include erosion of residuals/soils and sediment from surface runoff, transport within groundwater and air, and migration of groundwater through the banks/dikes.

5.1 Residuals/Soils Attenuation Capacity

The capacity of residuals/soils to attenuate PCB transport is related to the organic content of the material. The principal constituents of concern at the WB/A-OU are PCBs, which have a high affinity for organic matter. The residuals in which PCB have been identified at the WB/A-OU have organic contents ranging from approximately 27 percent to approximately 70 percent by weight. Table 5-1 summarizes the results of organic content analyses of selected samples at WB/A-OU. Detailed results can be found in *Technical Memorandum 9* (BBL, 1995b).

Values of organic carbon content of soils may be reported as total organic matter by multiplying the organic carbon content by the conventional "Van Bemmelen factor" of 1.724 (Allison, 1965). The use of this factor is based on the assumption that organic matter contains 58% carbon. Using the Van Bemmelen factor of 1.724 to convert the fraction of organic matter to total organic carbon (TOC), the approximate range of organic carbon content of the residuals is estimated to be between 16 and 40 percent TOC. Appendix M provides the derivation of this calculation.

5.2 Transport via Erosion of Residuals/Soils and Sediment

The soil and sediment PCB data generated during the RI and supplemental investigations indicated that PCB are present in surface residuals/soils and sediments. At the Willow Boulevard Site and drainageway, the area south of the A-Site, the area east of Davis Creek, and the AMW-3A area, a pathway exists for PCB transport via surface runoff since the surficial residuals/soils contain PCB. Suspension and migration of contaminated materials may be associated with surface water flow in Davis Creek, the former Olmstead Creek, and the Kalamazoo River, as well as with runoff from the Willow Boulevard, the area east of Davis Creek, the area south of the A-Site berm, and from the AMW-3A area. Off-site transport via erosion from the A-Site is limited by the perimeter dike and sheetpile wall at the A-Site. In addition, a potential erosion pathway exists at the A-Site for the residuals/soils outside of the dikes and sheetpile wall Due to the affinity of PCB for organic material as discussed in Section 5.1 (e.g., soil and sediment particles), transport via the erosion pathway would be primarily associated with the erosion of PCB-containing soil surfaces or stream sediments.

5.3 Fate and Transport Within Groundwater

The fate and transport of PCB in the environment is limited by their low water solubility. This generally limits aqueous phase concentrations to the low part per billion (ppb) range or less (Baker et al., 1986). In low permeability soils, such as those at the WB/A-OU, movement in leachate or groundwater is likely to be restricted. In general, the adsorption of PCB to soils and sediment increases with increasing organic content, decreasing particle size, and increasing congener chlorination (Lyman et al., 1982).

The groundwater quality data collected for the OU during the 1993 and 1995 field activities detected PCB in monitoring well WMW-3A. The results of additional investigation support the hypothesis that the past detections of PCB at monitoring well WMW-3A may be an artifact of well construction. Well construction details can be found in Appendix C of this report and the results of the groundwater sampling are summarized in Section 4.2.7 of this report.

PCBs were detected at the AMW-3A area and at AMW-4. The PCB detections at the AMW-3A area are thought not to be derived from the A-Site because the well location is approximately 400 feet upgradient of the A-Site. However, the monitoring well was installed in material containing PCB. Therefore, PCB detections at the AMW-3A well may be an artifact of well construction (BBEPC, 1992). The origin of the PCB-containing material is unknown, but appears to be limited in extent, as indicated by additional soil borings in the vicinity.

Results of the 2000 groundwater sampling activities at the A-Site indicate that PCB were detected in the groundwater wells located in the interior of the A-Site (AMW-6A, AMW-8A, AMW-9A, and AMW-10A). Development of a clear understanding of the nature and extent of groundwater contamination and the fate and transport of the contaminants has been complicated by the sample results. Split samples collected at six different wells (AMW-4, AMW-6A, AMW-8A, AMW-9A, AMW-10A, and AMW-10B) by MDEQ and BBL in November 2000 and sent to different laboratories, yielded a range of results. The results for all of the 2000 groundwater sampling activities are presented in Tables 4-16 (BBL data) and 4-16A (MDEQ data). Further evaluation of groundwater is necessary to demonstrate and/or to monitor compliance. If long-term monitoring data shows contaminants above applicable criteria, the impacts to groundwater would have to be addressed to prevent discharging to surface waters.

The following compounds and analytes were detected in the groundwater at the WB/A-OU: aldrin, arsenic, barium, benzene, beryllium, bis(2-ethylhexyl)phthalate, 2-butanone, calcium, chromium, copper, di-n-butylphthalate, iron, magnesium, manganese, mercury, 2-methylnaphthalene, 4-methylphenol, nickel, potassium, selenium, sodium, vanadium, and zinc (Tables 4-9 and 4-10). Barium, cyanide, manganese,

mercury, zinc, and bis(2-Ethylhexyl)phthalate were also detected in groundwater samples at the WB/A OU above generic criteria (Tables 4-15 and 4-15A). The generic GSI values are intended to ensure that unacceptable levels of contaminants are not discharged to surface waters. Background concentrations of these analytes have not been determined; the wells that were intended to serve as background wells were deemed to be not truly representative of background conditions.

Barium

The MDEQ (Alexander, 1997) also compared barium with Rule 57 and acute toxicity values, calculated based on groundwater flow data. While Barium concentrations at the WB/A-OU exceeded the Rule 57 value (1,470 ug/L), it did not exceed the acute toxicity value of 6,600 ug/L. Since that initial analysis, the MDEQ established procedures for calculating chronic toxicity values. For the purposes of point source discharges and venting groundwater, these values are designed to protect aquatic life over the long term. The hardness-dependent chronic value (and the new generic GSI value) calculated for barium is 1,159 ug/L. This value is exceeded in A-site groundwater and leachate. However, the current well network is not adequate to determine if this contaminant is venting to the river. The GSI protective criterion for soil (761 mg/kg) was exceeded at the A-Site, however, the mean soil value is less than the criterion. Additional wells, actually representing the GSI, are necessary to evaluate the significance of barium in groundwater.

Cyanide

Intended for the protection of aquatic life, the GSI criteria for cyanide (5.2 ug/L) is significantly lower than the value that would be allowed for drinking water (200 ug/L). The GSI criterion is exceeded in groundwater and leachate samples at Willow and the A-site, and the GSI protective criterion for soil (0.2 mg/kg) is also exceeded. At this point, it has not been established that cyanide is being released to the Kalamazoo River in unacceptable concentrations. Additional high-quality wells, placed closer to the river, are necessary to evaluate the significance of cyanide in groundwater.

Manganese

All groundwater samples at the Operable Unit were lower than the hardness-dependent GSI value for manganese (4,315 ug/L), indicating manganese concentrations are not acutely or chronically toxic to aquatic life. However, the industrial/commercial drinking water value (50 ug/L) is exceeded. Exceedences of this nature are not of concern if groundwater use on the property is formally restricted.

Mercury

Mercury was detected in one groundwater sample (from well AMW-5) out of the 27 sampled at the WB/A-OU; this concentration exceeded the generic GSI value. Well AMW-5 is an existing well in the dike, screened in native materials. Mercury was detected (as high as 2.1 mg/kg) in 10 of 17 subsurface soil samples at the A-site, at levels higher than the soil GSI protection criteria (0.1 mg/kg). However, mercury was not detected in any other groundwater or leachate samples collected from wells screened (approximately 6 inches) below the residuals or in the residuals at the WB/A-OU.

Zinc

Zinc was detected in two samples from wells at the Willow Boulevard Site above the generic GSI value, and was above the Rule 57 acute toxicity value (Alexander, 1997). Currently, the higher concentrations of zinc are thought to be well construction artifacts, but levels of zinc in the residuals and soil are present at levels above the GSI protective criteria could be contributing to levels in groundwater. Considering this, zinc cannot be eliminated as a contaminant of concern. The significance of zinc in groundwater can be further evaluated with the installation of new high-quality wells that are representative of the groundwater venting to the river.

Bis(2-ethylhexyl)phthalate (DEHP)

There was one detection of DEHP (49 ug/L), and this sample exceeded both the industrial drinking water value (6 ug/L) and the generic GSI value (32 ug/L). Because the compound was also detected in a quality control/quality assurance rinse blank, it is possible that this detection was an artifact of synthetic gloves or equipment being used by the sampling crew. However, DEHP is associated with the paper and pulp industry and remains a contaminant of potential concern. This issue could be resolved with additional sampling.

In the vicinity of Willow Boulevard, groundwater is clearly moving toward and discharging into the Kalamazoo River. The downward vertical gradients observed at the site are significant in that they demonstrate the existence of a groundwater transport pathway (and a contaminant transport pathway) from the residual/leachate-influenced groundwater directly beneath the residuals to the underlying aquifer and then to the river, where regional discharge is expected. Since the downward vertical gradients are likely limited by the upward head associated with the regional discharge system, the existence of site contaminants in the deeper portion of the aquifer would be dependent on nonaqueous transport mechanisms. The existing data set does not support the existence of contaminants deeper in the aquifer.

The analytes and compounds above, if venting to Davis Creek, Olmstead Creek, or the Kalamazoo River in concentrations higher than GSI criteria, could adversely affect aquatic life. As subsurface soil concentrations of many of these substances were above soil criteria protective of GSI, groundwater could be evaluated further as part of a hydrogeologic monitoring program. It is simply not possible at this point to conclude that contaminants in the groundwater are significantly higher than background levels or that contaminants are entering the Kalamazoo River in concentrations that would require remediation. As remedial actions may involve excavation, hauling, and capping activity, a reliable monitoring well network cannot be placed until remedial activities are well underway.

5.4 Leachate

PCBs were detected in two unfiltered leachate samples out of the four collected at the A-Site. PCBs were detected in samples collected from wells AMW-6P and AMW-9P. These "P" wells were installed in a perched saturated zone within the residuals which has the potential to impact the groundwater and surface water. This potential pathway could be evaluated as part of a hydrogeologic monitoring program. It is important to note that acetone, barium, 2-butanone, cyanide, di-n-butylphthalate, manganese, bis(2-Ethylhexyl)phthalate (DEHP), 4-Methylphenol, naphthalene, phenol, and vanadium were also detected in samples at the A-site above generic GSI criteria (Tables 4-15 and 4-15A).

5.5 Transport Within Air

As indicated by the WB/A-OU Air Investigation, presented in *Technical Memorandum 5* (BBL, 1994a), local differences were observed in ambient air concentrations of PCB. However, exposures to ambient air on an annual basis at the WB/A-OU were within the MDEQ's Secondary Risk Screening Level for PCB.

MDNR (Cornelius, 1994) provided the following interpretation of the results of the air monitoring program conducted from June to August 1993, as presented in *Technical Memorandum 5* (BBL, 1994a):

> The levels found during the three-month period were adjusted to an annual average concentration using a factor of three. This means that location WB-1, which has the highest concentrations, has an estimated annual concentration of 0.001 $\mu g/m^3$ total PCB (derived by 0.0029/3). The Air Quality Division of the MDEQ calculates an incremental cancer risk of 1 in a million for PCB at a concentration of 0.001 $\mu g/m^3$. This concentration with a 10-6 risk is designated the Initial Risk Screening Level (IRSL). Rule 230(5) of Act 348 of 1965, as amended (Air Pollution Act) requires that an entire site such as the Willow Boulevard/A-Site meet the Secondary Risk Screening Level (SRSL), which represents a risk of 1 in 100,000. The SRSL for PCB is 0.01 $\mu g/m^3$, a

concentration that is met by the estimated annual figure for location WB-1 of 0.001 $\mu g/m^3$. Since location WB-1 has the highest average concentration of all sample locations at this OU, the SRSL would not be exceeded by the estimated annual concentrations for all the other locations at this OU.

The sampling data show that while emissions are coming from the WB/A-OU, the levels are in compliance with rules of Act 348 of 1965, as amended. However, as shown for location WB-1, the estimated annual level is only ten times less than the SRSL under conditions where the site is not disturbed. Any activity that changes this undisturbed condition, such as remedial action proposed for this WB/A-OU, will need to have strict controls of all potential emission sources. This includes treatment process(es), movement of contaminated material, vehicular traffic and excavation. Given the proximity of residences to the OU, fugitive emissions during remedial actions shall be stringently controlled.

Remedial actions that disturb the waste material have a potential to increase emissions of PCB. As directed by the MDEQ, ambient air monitoring for PCB will be conducted during remedial actions in accordance with a plan approved by the Air Quality Division. Air emissions of PCB will be controlled during the remedial action.

Air monitoring was performed throughout the interim response activities conducted at the Willow Boulevard Site between November 1999 and March 2000. A total of 301 air samples were collected and analyzed for PCB, with all results below detectable levels during the extent of the interim response activities. The results of the sampling activities are included in Appendix B of the *Removal Action Summary, Willow Boulevard/A-Site OU* (BBL, 2000) included here in Appendix E. From this, it can be concluded that PCB transport within air is not a significant pathway.

6. Focused Feasibility Study

The purpose of this FFS is to develop and evaluate potential remedial alternatives for the WB/A-OU based on the results of the RI. The AOC requires that a FS be performed in accordance with Michigan Act 307 (superseded in June 1995 by Part 201 of the Natural Resources and Environmental Protection Act [NREPA]) and consistent with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Contingency Plan (NCP). Risks associated with PCBs in the Kalamazoo River and floodplain sediments will be addressed in a remedy for the river operable unit.

6.1 General

This FFS will be used to evaluate remedial alternatives that reduce or eliminate the risks to human health and the environment. To accelerate remedial action implementation at the various land-based operable units of the Site in a manner consistent with USEPA guidance, the MDEQ has indicated (August 8, 1996 meeting with the Kalamazoo River Study Group [KRSG]) that presumptive remedy approaches are appropriate. Specifically, the MDEQ and the KRSG have agreed in principle that containment (consolidation of waste and landfill capping) is an appropriate presumptive remedy for the landfill operable units. Due to the general similarities (outlined in Section 1.3.2) between the WB/A-OU and the KHL-OU3, for which the full feasibility study screening process was applied (BBL, 1994c), the screening process for the WB/A-OU has been streamlined and relies upon the detailed screening provided in the MDEQ-approved KHL-OU3 AAD (BBL, 1994b) and KHL-OU3 FFS (BBL, 1994c). Examples of how risks can be reduced are (1) addressing the potential migration of PCB via erosion (2) eliminating surface water transport of residuals/soils from the WB/A-OU and ancillary areas, and (3) bank stabilization measures that separate the residuals/soils from the river.

It should be noted that even though the MDEQ's Part 201 clean-up criteria table indicate that PCBs are 'not likely to leach', it is now clear that PCBs can be expected to become mobile in certain environments. Although this RI/FS is being completed using the presumptive remedy approach, there is concern that groundwater and leachate have not been fully evaluated. Without installing an adequate groundwater monitoring network in advance of remedial action (i.e., cap installation), demonstrating groundwater risk-reduction as a result of the remedy cannot be achieved. Furthermore, if long-term groundwater monitoring data indicate exceedances of GSI criteria in compliance wells, groundwater remedial action will be required.

Based upon the results obtained during the RI, related sampling activities and an evaluation of risks, remedial response objectives (RROs) were developed to define the goals of the remedial action and are presented in

Section 6.2.2. General response actions (GRAs), presented in Section 6.2.3, were developed from the RROs to identify generic technology types that could potentially be used to achieve the objectives. Using the GRAs, potential remedial technologies were identified and screened on the basis of technical implementability, and those that remained were used as the basis for the potential remedial alternatives.

The method for the screening of technologies and process options is outlined in Section 6.2.4

6.2 Development and Screening of Potential Remedial Alternatives

This section includes an evaluation of risks associated with the WB/A-OU and ancillary areas, and develops and screens potential remedial alternatives to address RROs and mitigate and/or eliminate the potential exposure pathways associated with air, residuals, soil, sediment, and groundwater. Risks associated with the Kalamazoo River and floodplain sediments outside this OU and ancillary areas will be addressed in a remedy for the river operable unit. The development of remedial alternatives was performed using the USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (USEPA, 1988b), the AOC, and the Michigan NREPA. The objective of this process was to develop remedial alternatives for a more detailed evaluation, as reported in Section 7. The evaluation consisted of the following steps:

- Identify and (based on GRAs) screen remedial technologies and process options to determine those that are technically feasible for implementation at the WB/A-OU;
- Assemble selected remedial technologies;
- Assemble remedial alternatives for detailed analysis (based on feasibility and criteria as specified in the AOC, consistent with the NCP); and
- Develop "Applicable" or "Relevant and Appropriate" Requirements (ARARs) for the assembled remedial alternatives (see Section 6.4).

According to USEPA guidance (USEPA, 1988b), technologies potentially applicable to remediation are evaluated in two steps. Initially, all potential remedial technologies were evaluated based on their technical implementability. Remedial technologies that have not been effective at full scale or that are not conducive to implementation at the WB/A-OU were eliminated from further consideration. The remaining remedial technologies were assembled into alternatives and subjected to a detailed evaluation, summarized in Section 7.

6.2.1 Evaluation of Site Risks

As a prelude to developing RROs for the protection of human health and the environment, potential risks associated with exposure pathways at the WB/A-OU were qualitatively assessed to determine which media, if any, need to be targeted for remediation and/or environmental controls. Potential exposure pathways, receptors and risks may vary throughout the WB/A-OU depending on geography, habitat, zoning, and reasonable future use. In accordance with USEPA guidance (USEPA, 1988b), RROs consist of medium-specific or site-specific goals for protecting human health and the environment.

The current understanding of human health and ecological risk associated exposure to residual paper waste, impacted soil or sediments, and the consumption of fish is based on the following documents:

- *Final (Revised) Human Health Risk Assessment* (HHRA) (CDM, 2003a). This assessment was performed by CDM on behalf of the MDEQ, and was formally approved by the USEPA.

- *Final (Revised) Baseline Ecological Risk Assessment* (BERA) (CDM, 2003). This assessment was performed by CDM on behalf of the MDEQ, and was formally approved by the USEPA.

- *Part 201, Environmental Remediation, of Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, and Part 201 Administrative Rules.* Rules R299.5744 through R299.5750 establish risk-based criteria, developed according to statutory provisions. They are based on standard risk assumptions, determined to characterize patterns of exposure associated with certain land uses. Only reasonable and relevant exposure pathways were used in development of the assumptions on which the criteria are based. They are used throughout Michigan to ensure contaminated sites are cleaned up to appropriate levels of safety.

The evaluation of risks in the site-wide HHRA concluded that the most significant exposure pathway is the consumption of fish from the river, which bioaccumulate PCBs from exposure to PCB contaminated material, surface water and prey. Recreational activities in the Kalamazoo River including swimming, boating, and wading do not pose unacceptable PCB-related health risks. The HHRA developed sediment concentrations that are protective for anglers consuming fish at ingestion rates specified for sport and subsistence anglers. For the development of these criteria, it was assumed that sediments are in-stream, or could become in-stream due to erosion or flooding. The criteria for persons consuming a combination of smallmouth bass and carp range from

0.04 mg/kg for the subsistence angler to 0.30 mg/kg for the central tendency sport angler. Because the MDEQ has a target detection limit of 0.33 mg/kg for PCBs, the cleanup criteria protective for people consuming fish defaults to the 0.33 mg/kg, unless MDEQ promulgates a lower TDL.

The protection of ecological receptors relative to PCB in sediment is based on reducing the potential risks associated with uptake of PCB by sensitive piscivorous consumers such as mink. The BERA developed a No Observable Adverse Effect Concentration (NOAEC) of 0.5 mg/kg to be protective of mink. For protection of terrestrial ecological receptors, PCB concentrations are compared to the NOAEC developed in the BERA of 5.9 mg/kg for carnivorous mammals, and 6.5 mg/kg for omnivorous songbirds.

Part 201 Generic Residential Criteria (4 mg/kg) and Generic Commercial II and Industrial Criteria (16 mg/kg) are developed based on land use scenarios, and are applicable at this OU in areas where the HHRA in-stream sediment criteria or BERA ecological criteria are not applicable.

The following subsections evaluate site risks with respect to air; surface soils, residuals and sediment; subsurface soils; surface water; subsurface soils; and groundwater/leachate.

6.2.1.1 Air

The protection of human health and the environment relative to PCB released from surface soil to air via particulate emissions and volatilization is based on reducing potential risks associated with exposure through inhalation. As presented in *Technical Memorandum 5* (BBL, 1994a) and consistent with air monitoring during interim response actions, vapor-phase PCB concentrations measured around the perimeter of the WB/A-OU do not pose a health risk and are below criteria (i.e., 0.01 $\mu g/m^3$) established by Part 55 of the NREPA. The primary source of the low levels of PCB in the air samples collected during the RI is believed to be the surficial residuals of the Willow Boulevard Site. The potential for remediation activities to increase emissions over the short term was evaluated during the RI conducted at the Willow Boulevard Site; the results indicate the vapor and particulate phase PCBs were within acceptable limits. Active remedial alternatives have the potential for PCB emissions and will be evaluated further in the design of remediation activities. Measures will be taken to maintain emissions below criteria established by Part 55 of the NREPA, as required.

6.2.1.2 Surface Soils, Residuals, and Sediment

Requirements for the protection of human health and the environment relative to surface soils, residuals, and floodplain sediment are based on risk levels associated with the potential for ingestion, dermal contact, inhalation of airborne releases, and erosion into aquatic habitat.

As referenced in Section 4 of this report, surficial residuals were observed at Willow Boulevard, A-site, and the Area East of Davis Creek. PCB concentrations in surficial soil and/or residuals sampled at those areas, as well as in the Willow Boulevard Drainageway Area, Area South of the A-Site Berm, Former Olmstead Creek, Davis Creek, and the AMW-3A Area, and the area south of AMW-3A area exceed the 0.33 mg/kg criteria, and, in cases, other ecological and land use criteria.

PCBs were not detected in surface soil samples collected from the residential area south of the Willow Boulevard Site during the RI, confirming results obtained in 1987 by the MDPH. Figure 21 and Table 81 of the DCS (BBEPC, 1992; Appendix A) show the MDPH sample locations and results of the residential sampling. All but one of the samples had non-detectable concentrations of PCB. One sample contained a total PCB concentration of 0.080 mg/kg and was considered by the MDPH as not posing a threat to public health (Chadzynski, 1987). Surficial soils associated with the Adkins, Wright, Bloomfield, Scott, and Wadsworth properties do not exceed the residential value 4.0 mg/kg (Figure 21), indicating that there is no unacceptable risk to those residents from PCB-containing material on these properties. PCBs have not been detected in the residential properties listed above at concentrations exceeding the residential criteria, and the extent of PCBs has sufficiently been defined for these properties. Because surficial soil collected from SB-3A-213, located near Lot 5 (Bloomfield residence) and adjacent to Davis Creek, had PCB concentrations (5.9 mg/kg) above residential criteria, additional characterization is necessary. PCBs in this general area as well as any PCBs in the area between Davis Creek and Lake Street (not within the ancillary “Area East of Davis Creek”), have the potential to impact the WB/A-Site OU, ancillary areas, and the Kalamazoo River, therefore, appropriate measures should be implemented.

6.2.1.3 Surface Water

The protection of human health and the environment relative to surface water is based on reducing risks associated with exposure through consumption of contaminated fish, incidental ingestion, and direct contact with surface water that has come in contact with PCB-containing residuals and/or sediment.

Michigan establishes surface water quality criteria to protect the quality of the surface water bodies of the state. The Kalamazoo River, upstream and in the vicinity of this operable unit, does not achieve the State’s surface water quality criteria for PCBs (0.00012 ug/L for wildlife, 0.000026 ug/L human cancer value for non-drinking

water) or the BERA's 0.00197 ug/L value; an unacceptable risk may be present. Historic data collected from surface waters at Davis Creek indicated PCB concentrations were at non-detectable levels.

The RI (Section 5.2; Photo 3) indicated a potential for surface water to suspend PCB-containing material when in contact with PCB-containing soils or sediment. Surface water may also erode exposed residuals and PCB contaminated material, thereby creating a potential for transport of PCB to aquatic habitat. The erosion of bank materials in the AMW-3A area, for example, could potentially expose subsurface PCB-containing soils for transport to the creeks and the river. Another potential pathway of PCB to surface water is through failure of the A-Site dike that could result in transport of PCB-containing residuals.

6.2.1.4 Subsurface Soils

The protection of human health and the environment relative to subsurface soils is based on reducing potential risks associated with (1) exposure through incidental ingestion and dermal contact, assuming activity at the site would bring subsurface soils to the surface; and, (2) transfer of contaminants from soils to water resources. The RI and subsequent investigations indicated that elevated PCB concentrations were detected in the subsurface soil samples from the WB/A-Site OU and all ancillary areas.

The reasonably anticipated future use of the WB/A-Site OU, following implementation of a presumptive remedy approach and assuming appropriate land use restrictions are implemented, will preclude direct contact with PCB contaminated subsurface soils by consolidating and capping this material. Under current conditions it is possible for PCB in subsurface soils to migrate to groundwater or surface water. Based on analytical data of groundwater samples collected from the WB/A-Site OU that show elevated concentrations of PCBs, the impacted subsurface soils pose an unacceptable risk to groundwater.

6.2.1.5 Groundwater/Leachate

The protection of human health and the environment relative to groundwater is based on reducing potential risks associated with exposure through ingestion, direct contact, and potential impact on biota. The Michigan groundwater surface water interface (GSI) criteria are established in accordance with Michigan statute and are designed to protect aquatic life by addressing the threat posed to the surface water bodies of the State by contaminated groundwater. Based on the results of sampling activities, there is potential for groundwater to exceed the default generic GSI criteria at the groundwater surface water interface (adjacent to the river), but the existing monitoring well network for WB/A-OU is insufficient to definitively determine whether groundwater/leachate poses an unacceptable risk to human health and the environment. These potential risks need to be further evaluated through a long-term hydrogeologic monitoring program, including installation of

additional monitoring/compliance wells, potential development of site-specific mixing zone-based criteria (which would replace the generic GSI criteria), and comparison to background conditions. If GSI criteria are exceeded at the compliance well locations, a groundwater remedy will be required.

Consistent with Part 201 of the NREPA, Rule 716 (R 299.5716), before a remedial action for the site is approved; a mixing zone determination can be requested from MDEQ. Criteria (reported as chronic criteria and acute criteria) established in the mixing zone determination, rather than generic GSI criteria, would then apply to the site. In a mixing zone determination, factors such as flow and assimilative capacity of the river, rate of groundwater discharge, and concentrations upgradient of the site are factored in to the criteria. Whole effluent toxicity testing could also be used to establish protective criteria. In a mixing zone determination, criteria for some analytes are likely to be less stringent than generic criteria, however, values for bioaccumulative chemicals of concern (such as PCB and mercury) are not likely to change from the generic values. A compliance area would be established, consisting of monitoring points close to the river, in areas where generic GSI criteria are exceeded or are expected to be exceeded. For each sampling event, the 95% UCL of monitoring points within the designated GSI compliance area would be calculated to see if chronic criteria are exceeded. No exceedances of acute criteria at individual monitoring points would be allowed. In the event that groundwater/leachate discharge exceeding chronic or acute criteria is predicted or has occurred, compliance monitoring plans may call for increased monitoring, evaluation of the severity of any exceedance, and evaluation of the need to implement further remedial actions.

Such a program could provide information to further assess whether transport of contaminants, via groundwater venting to surface water, is occurring. If so, the monitoring program could help determine if transport is significant enough to require action. Most of the alternatives in the FS consider groundwater monitoring and contingency planning as components of the remedial action. The possibility that a groundwater remedy might eventually be required to address risks (impacting total remediation cost) is also considered in the alternatives analysis in the FS. The extent of leachate that currently exists at the Willow Blvd./A-Site could also be determined during the design phase of the remedial action.

6.2.2 Remedial Response Objectives

Under the AOC, the purpose of the RROs is to establish site-specific objectives for the response consistent with applicable State and Federal regulations and guidance documents. RROs are medium-specific or operable unit-specific goals for protecting human health and the environment. They are based on the contaminant exposure pathways that need to be addressed as determined from results of the RI and evaluation of potential site risks. In

accordance with USEPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (1989) these RROs consider the contaminants, media of interest, exposure pathways and preliminary remediation goals that have been developed for the WB/A-Site OU.

The RROs are:

Air

- Prevent generation of airborne PCBs in excess of 0.01 $\mu g/m^3$ at the property boundary.

WB/A-Site OU and Ancillary Areas

- Sediment criteria (0.33 mg/kg) developed in the HHRA will apply to the sediments within waters of the state and all contiguous regulated wetlands. Clean-up criteria other than sediment clean-up criteria will be considered for areas within the regulated wetlands only if appropriate erosion control measures and subsequent additional response activities are employed and maintained to be protective of all relevant exposure pathways. In areas where the sediment criteria do not apply, the ecological terrestrial criteria of 5.9 mg/kg will apply to be protective of carnivorous mammals and omnivorous songbirds. Areas zoned for Residential Land Use must not exceed 4 mg/kg; whereas areas zoned for Commercial II or Industrial Use must not exceed 16 mg/kg.

Sediment in the Kalamazoo River:

- Remediation of Kalamazoo River bedded sediment is only indirectly an RRO for this remedial action, which essentially seeks to consolidate, contain, or remove PCB-contaminated wastes and prevent erosion of PCB-contaminated wastes into the Kalamazoo River. The Kalamazoo River bedded sediments will be directly addressed as part of the remedial action for the Kalamazoo River Operable Unit. MDEQ anticipates that the remedial action for the WB/A-Site OU will be consistent with any remedial action for the River.

Surface Water

- Prevent further degradation of the water quality of the Kalamazoo River, other in-stream areas (i.e., Davis Creek), and regulated wetlands, by preventing erosion or release of PCB-contaminated wastes or groundwater from the WB/A-Site OU and ancillary areas.

Groundwater and Leachate

- Ensure that use of groundwater at the WB/A-Site OU and ancillary areas is reliably restricted, and that groundwater with concentrations exceeding applicable criteria does not migrate to the Kalamazoo River, other in-stream areas, or regulated wetlands.
- Prevent the generation of PCB-contaminated leachate at the disposal areas. If leachate currently exists, or if the threat of leachate migration will exist subsequent to implementation of the remedy, then the RROs for this response action include the protection of the surface water quality of the Kalamazoo River, other instream areas and regulated wetlands by preventing the transportation of any such leachate.
- Prevent human ingestion of PCB-contaminated groundwater/leachate.
- Prevent transport of non-PCB contaminants, exceeding generic GSI or mixing zone-based criteria, via groundwater/leachate venting to surface water.
- Discharge to surface waters of the state must attain water quality criteria, consistent with Part 31 of the NREPA.

6.2.3 General Response Actions (GRAs)

GRAs are those actions that could be used to achieve the defined RROs. Such actions are generally identified based upon review and consideration of action-specific ARARs and remedial actions used, or considered for use, at similar sites. GRAs do not identify specific processes or materials to be used, but rather identify generic technology types that could be used individually or in combination. GRAs are medium-specific; for the WB/A-OU they apply to residuals, soil, sediment, groundwater/leachate, and air, with the understanding that a presumptive remedy approach will be used, as previously described in earlier sections of this report.

The following GRAs can be applied to RROs for residuals, soils, sediment, groundwater/leachate, and air at the WB/A-OU:

- *No Action*–consists of the implementation of no remedial actions;
- *Institutional Controls*–includes deed and access restrictions;
- *Containment/Control*–includes containment of residuals where they currently reside in disposal areas on-site and consolidation on-site of residuals that are currently in ancillary areas;
- *Water Treatment*–includes the use of activated carbon to reduce the volume, mobility, and toxicity of water;
- *Removal and Off-Site Disposal*–considers residuals excavation, stabilization, and transport off-site to appropriately permitted disposal facilities;

- *Removal, Consolidation, and Containment*–considers residuals excavation, stabilization, and consolidation on-site;
- *Groundwater Monitoring*–consists of implementing a long-term hydrogeologic monitoring program to assure that there is no significant migration of PCB or other contaminants from leachate or groundwater to the Kalamazoo River, the former Olmstead Creek, or Davis Creek. Actions would include installation of new monitoring wells and designating points of compliance at which GSI criteria (whether generic or mixing-zone based) would be enforced. If not compliant with GSI criteria, further action will be required.
- *Sediment Dewatering*–consists of a process that reduces water content of excavated materials or excavation areas; and
- *Air Monitoring*–considers the potential for an increase in PCB concentrations due to remedial activities.

6.2.4 Identification and Screening of Technologies

Based on the site-specific GRAs developed in Section 6.2.3, several potential technology types and process options associated with each GRA for residuals and soil are presented in Table 6-1. This screening step reduces the number of potential remedial options that will undergo further evaluation. Technology types and process options were evaluated for technical implementability. This entailed an assessment of whether a technology type or process option was applicable with respect to specific site conditions, whether implementation was feasible, and whether the technology has been fully developed for use. This analysis was based on site knowledge and experience, accrued experience at other PCB-containing waste sites, and published reports, such as pertinent USEPA documents. As indicated by the RI and as reflected in the RROs, PCBs are the constituent of concern and are therefore the focus of remedial response for the WB/A-OU.

Table 6-1 summarizes the identification and screening of potential remedial technologies addressing residuals, soils, sediment, and air, respectively. The first two columns of this table identify GRAs with several broad technology types under each GRA, and several associated process options. Process options were eliminated during the screening stage if they were determined to be not applicable, not sufficiently demonstrated at pilot scale or full scale, or if they were similar to other retained options. Several processes found potentially applicable were not retained upon further examination. The reasons for not retaining these processes are briefly described below. Note that process options retained following screening (indicated by shading in Table 6-1) served as the basis for developing the remedial alternatives discussed in Section 6.3.

Potentially Applicable Processes not Retained

- Biodegradation (C.I & E.II.) – PCB concentrations at OU-2 are too low for practical application, based on results from other sites where biodegradation has been tested or implemented.

- Immobilization (C.II & E.III.) – May not be effective due to characteristics of material. This process is more applicable in cases where contaminants of concern are metals.

- PCB Extraction (E.I.) – These various processes are generally not proven technologies for extraction of PCBs, have high associated costs, represent complex technologies, and produce a high volume of residual requiring disposal.

- Thermal Destruction (E.II.) – In general, these processes have not been found to be applicable or cost competitive with other feasible alternatives when treating soils having relatively low concentrations of PCBs.

6.3 Assembly of Potential Remedial Alternatives

Four potential remedial alternatives (RAs) were assembled for the WB/A-OU: no action; consolidation and containment of select materials (divided into conceptual subalternatives); removal and off-site disposal; and removal of residuals from Willow Boulevard Site and consolidation at the A-Site. Each potential alternative is described briefly below. A more detailed description, as well as a detailed analysis of each alternative, is provided in Section 7.

6.3.1 Alternative 1 - No Action

The no-action alternative is required under the NCP [40 CFR 300.430(e)(6)] and serves as a baseline to evaluate action-related RAs. This alternative would result in increased potential for PCB to migrate to the river over time; no action, such as failure to maintain fences at the site, would increase the chance of exposing trespassers and anglers to PCB-containing residuals.

6.3.2 Alternative 2 - Consolidation and Containment of Select Materials

Alternative 2 is not a stand alone remedy, as it would be coupled with subalternative 2A, 2B, or 2C. All options under Alternative 2 would involve the investigation and consolidation of residuals from the area south of A-Site berm, AMW-3A Area, former Olmstead Creek area, the area east of Davis Creek, with containment at the A-Site, as well as containment of residuals at the Willow Boulevard Site and drainageway. Under this alternative,

both the A-Site and Willow Boulevard Site would be capped with a cover system (with a flexible membrane liner (FML), as proposed by the PRPs). The isolation of PCB-containing residuals would reduce the potential for human and ecological exposure, and erosion control measures would reduce the migration of site materials into the Kalamazoo River, the former Olmstead Creek, Davis Creek, and regulated wetlands. In the area east of Davis Creek, the AMW-3A Area, and the area south of Lot 5, the extent of soils containing PCBs exceeding criteria would be better defined and addressed. For example, because SB-3A-213 showed 5.9 mg/kg PCB in the top 2 feet (near Davis Creek), additional characterization of soils south of Lot 5 is necessary to define the extent of material exceeding the sediment criteria and to confirm that residential criteria are attained, as appropriate. Adjacent residential properties (e.g. lots 38, 40, 41, 42, 43) would be assessed to ensure consolidation, containment, or removal at OU-2 does not reduce drainage capacity or increase the likelihood of flooding; backfilling and re-vegetation may be necessary. The piping system from King Mill, which transported paper waste to this OU, was not investigated in the RI and must be investigated and addressed in Remedial Design. Long-term maintenance and institutional controls would be applied.

A hydrogeologic monitoring program would be implemented, establishing points of compliance near the river and Davis Creek. Results would be compared to generic GSI criteria or mixing zone-based criteria, consistent with Part 201 of the NREPA, Rule 716(R 299.5716). Compliance with mixing zone-based GSI criteria that are based on chronic toxicity endpoints would be demonstrated statistically (i.e. 95% UCL of appropriate samples vs. criteria) and those that are based on acute toxicity on a point-by point basis.

In case groundwater compliance is not maintained, additional groundwater controls (such as shallow aquifer drains and sumps, contingent groundwater collection, or a treatment system) could be added to this alternative. If required, such additional controls would increase the cost of this alternative.

Quarterly groundwater samples would also be collected starting the first year of post-remediation monitoring activities, in accordance with an approved groundwater monitoring plan. The results of the monitoring would be reviewed periodically. After 5 years, the monitoring frequency could be modified, if approved by the MDEQ and USEPA.

6.3.2.1 Subalternative 2A – Consolidation/Containment of Select Materials and Install New Sheetpiling at Willow Boulevard

This is a specific option under Alternative 2 (includes all Alternative 2 tasks), but is distinct in specifying the installation of new sheetpiling adjacent to the Kalamazoo River along the perimeter of the Willow Boulevard

Site. The isolation of PCB-containing residuals would reduce the potential for human exposure. Sheetpiling, as an erosion control measure along the bank, would reduce the migration of contaminated materials into the Kalamazoo River, the former Olmstead Creek, and Davis Creek.

6.3.2.2 Subalternative 2B – Consolidation/Containment of Select Materials, Remove Existing Sheetpiling, Re-Grade/Stabilize Banks with a Setback along Entire OU

This option includes all tasks under Alternative 2, but calls for re-grading both the Willow and A-site area to establish a setback from the Kalamazoo River and Portage Creek. The existing sheetpiling at A-Site would be removed or cut off below the surface of the Kalamazoo River. Banks would be stabilized using techniques including, but not limited to, articulated concrete systems, geoweb materials, or revetment blankets. As described under Alternative 2, the isolation of PCB-containing residuals would reduce the potential for human exposure and migration of site materials into surface waters of the state. The setback and erosion control measures would allow new berms to be built, and reduce the habitat degradation posed by sheetpile by providing a buffer zone, while offering protection from flooding.

6.3.2.3 Subalternative 2C – Consolidation/Containment of Select Materials, Re-Grade/Stabilize Banks using Ecologically Friendly Options with Setback at Willow Boulevard

Option "C" includes all of the tasks under Alternative 2, but establishes a setback along the Kalamazoo River only at the Willow Boulevard Site; the sheetpile at the A-site would remain in place. Upon re-grading and capping, the bank would be reinforced using permanent but ecologically friendly means of bank stabilization. As in Alternative 2, the isolation of PCB-containing residuals would reduce the potential for human exposure. This option attempts to integrate the A-site's existing interim measures with ecologically friendly erosion control measures at the Willow site, reducing the impact (and habitat loss) of bank stabilization, while controlling costs. This alternative also attempts to be responsive to the community's desire to reduce the landfill footprint and have a component of the remedy address aesthetics and habitat issues.

6.3.3 Alternative 3 - Removal and Off-Site Disposal

Alternative 3 would involve the removal of PCB-containing residuals (approximately 634,200 cy) from the WB/A-OU and ancillary areas for disposal in an off-site landfill having the permission of the USEPA under the Toxic Substances Control Act (TSCA). This would be accomplished through the excavation, dewatering, and off-site disposal of residuals from the Willow Boulevard Site, A-Site, and the ancillary areas. Excavated residuals from these sites would be transported to and disposed of in an off-site landfill, thereby reducing or eliminating the need for on-site long-term monitoring or management. In the area east of Davis Creek, the

AMW-3A Area, and the area south of Lot 5, the extent of soils containing PCBs exceeding appropriate criteria would be better defined and addressed. For example, additional characterization of soils south of Lot 5 is necessary to ensure applicable criteria are attained. Adjacent residential properties (e.g. lots 38, 40, 41, 42, and 43) would be assessed to ensure excavation at OU-2 does not reduce drainage capacity or increase the likelihood of flooding; backfilling and re-vegetation may be necessary. The piping system from King Mill, which transported paper waste to this OU, was not investigated in the RI and must be investigated and addressed in Remedial Design as appropriate. Following the removal and disposal of residuals, these areas would be backfilled, graded, and restored to match the surrounding area.

6.3.4 Alternative 4 - Removal of Residuals from Willow Boulevard Site and Consolidation at the A-Site

Alternative 4 would involve the removal of PCB-containing residuals (approximately 158,800 cy) from the Willow Boulevard Site (including the drainageway area, south of the A-Site berm, and east of Davis Creek.) This would be accomplished through excavation, dewatering, and on-site consolidation of residuals onto A-Site. A-Site would be capped using a cover system (including a FML, as proposed by the PRPs). The removal and isolation of PCB-containing residuals would eliminate the potential for human exposure, while erosion control measures would prevent the migration of site materials into the surface waters of the Kalamazoo River, the former Olmstead Creek, and Davis Creek. In the area east of Davis Creek, the AMW-3A Area, and the area south of Lot 5, the extent of soils containing PCBs exceeding appropriate criteria would be defined and addressed. Adjacent residential properties (e.g. lots 38, 40, 41, 42, and 43) would be assessed to ensure excavation/consolidation at OU-2 does not reduce drainage capacity or increase the likelihood of flooding; backfilling and re-vegetation may be necessary. The piping system from King Mill would be investigated and addressed. Long-term maintenance and institutional controls would be applied.

A hydrogeologic monitoring program would be implemented, establishing points of compliance near the river. Results would be compared to generic GSI criteria or mixing zone-based criteria consistent with Part 201 of the NREPA, Rule 716 (R 299.5716) Compliance with mixing zone-based GSI criteria that are based on chronic toxicity endpoints could be demonstrated statistically (i.e. 95% UCL) and those that are based on acute toxicity on a point-by point basis.

In case groundwater compliance is not demonstrated, additional groundwater controls (such as shallow aquifer drains and sumps, contingent groundwater collection, or a treatment system) could be added to this alternative. If required, additional controls would increase the cost of this alternative.

Quarterly groundwater samples would be collected starting the first year of post-remediation monitoring activities, in accordance with an approved groundwater monitoring plan. The results of the monitoring will be reviewed periodically. After 5 years, the monitoring frequency could be modified, if approved by the MDEQ and USEPA.

6.4 Identification and Rationale for ARARs

CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), specifies that Superfund remedial actions must comply with the substantive requirements of federal and state environmental laws. Such requirements may be either "Applicable" or "Relevant and Appropriate" requirements, otherwise known as ARARs. In addition to ARARs, federal and state advisories and guidance documents exist that, although are not binding regulations, contain information "to be considered" (TBC). ARARs and TBCs are important in developing remedial objectives that comply with regulatory requirements or guidance (as appropriate). The identification of site-specific ARARs is based on specific constituents at a site, the various response actions proposed, and the general site characteristics. As such, ARARs are classified into three general categories:

Chemical-specific ARARs, which are specific to the type(s) of constituents, pollutants, or hazardous substances at a site. Chemical-specific ARARs include state and federal requirements that regulate contaminant levels in various media.

Action-specific ARARs, which are specific to the clean up activities being considered and are usually technology- or activity-based. Action-specific ARARs are regulatory requirements that define acceptable excavation, treatment, and disposal procedures.

Location-specific ARARs, which are specific to actions at the geographic location. Location-specific ARARs are requirements for contaminant concentrations or remedial activities resulting from a site's physical location. For example, federal and state ARARs exist for sites where remedial activities would impact wetlands, floodplains, or critical habitats. Because the Operable Unit is bordered by the Kalamazoo River, the most significant location-specific ARARs are those established for the protection of floodplains.

A list of potentially applicable federal and state ARARs and TBCs is summarized in Table 6-2, which also provides a regulatory citation and a brief description for each. The table also identifies whether the regulation applies to any portion of the anticipated work and, if so, whether it is a potential ARAR or TBC. The list of

ARARs/TBCs was developed based on appropriate guidance documents (USEPA, 1988b; USEPA 1989a) and professional judgment.

Similar to the RROs identified in Section 6.2.2, site conditions or other constraints may inhibit the ability to satisfy all ARARs. The ability to satisfy ARARs was evaluated in the detailed analysis in Section 7. Once a remedial alternative has been selected, additional ARARs may be identified that will need to be addressed, during the design and implementation phases.

7. Detailed Analysis of Alternatives

7.1 General

The detailed and comparative analyses of the four remedial alternatives described in Section 6.3 consist of the analysis and presentation of the relevant information needed to allow decision-makers to select a remedial alternative. The primary objectives of the detailed analysis are: (1) to further define alternatives described in Section 6.3; (2) to evaluate each of the alternatives against the evaluation criteria as specified in National Contingency Plan (NCP, 40 CFR Section 300.430 (e)9(iii)) and in *Guidance for Conducting Remedial Investigation and Feasibility Studies Under CERCLA* (USEPA, 1988b); and (3) to compare alternatives against each other to assess the relative performance of each alternative with respect to each evaluation criterion.

There are nine evaluation criteria contained in the USEPA guidance documents to address the CERCLA requirements as stated in the NCP. Assessments against two of the criteria relate directly to evaluation against regulatory requirements and are categorized as threshold criteria. Each alternative must meet these criteria, unless an ARAR waiver is granted. These two criteria are:

- **Overall Protection of Human Health and the Environment** - This criterion considers the overall benefits to human health and the environment as a result of implementation. These benefits include an alternative's protectiveness and ability to reduce potential for exposure and risk.

- **Compliance with ARARs** - The extent to which ARARs would be achieved by an alternative is considered.

The following five criteria are categorized as balancing criteria and represent the primary technical criteria upon which the detailed analysis is based:

- **Long-Term Effectiveness and Permanence** - This criterion considers the alternative in terms of risk remaining after its implementation and its ability to maintain reliable protection over time.

- **Reduction in Mobility, Toxicity, or Volume Through Treatment** - This criterion considers the ability of an alternative to reduce the mobility, toxicity, or volume through treatment of PCB-containing residuals at the OU.

- **Short-Term Effectiveness** - An alternative's short-term adverse impacts on human health or the environment due to construction and implementation are considered.

- **Implementability** - The technical and administrative feasibility of implementing an alternative, including the availability of services and materials required for implementation, is considered.

- **Cost** - This criterion considers short-term capital and operating costs, as well as long-term operation and maintenance (O&M) costs. Short-term capital and operating costs consist of direct and indirect costs. Direct costs include construction, equipment, transportation, disposal, analysis, treatment, and contingency costs, as appropriate. Indirect costs include engineering, legal, and permitting fees. For present worth (30-year) analysis of long-term O&M costs, a net interest rate of 7.0 percent was assumed.

The final two criteria will be evaluated following comments on the Proposed Plan and will be addressed in the ROD. These criteria, categorized as modifying criteria, are described below.

- **Community Acceptance** - Issues and concerns of the public are evaluated. Community acceptance is assessed after the Proposed Plan is released and the public has an opportunity to comment on the recommended remedy. This assessment is then embodied in the Responsiveness Summary section of the ROD.

- **Support Agency Acceptance** - This criterion considers issues and concerns the supporting environmental agency may have regarding an alternative, based on its review of the RI/FFS and Proposed Plan.

7.2 Analysis of Individual Alternatives

This subsection presents a detailed analysis of each potential remedial alternative based on effectiveness, implementability, and cost as defined by the nine criteria cited above. Quantities and associated costs are estimated to provide a basis for comparison between alternatives. Quantities and costs may change during the remedial design. Discussions of the alternatives include assumptions as to specific sizes of excavators, trucks, excavation sequences, anticipated production rates and activity durations. These assumptions are used to allow comparison of alternatives on an equivalent basis, and are not necessarily how a contractor would implement the work.

7.2.1 Alternative 1 - No Action

Development of a no-action alternative is required under the NCP. The no-action alternative provides a comparative baseline against which other alternatives can be evaluated. Under this alternative, no remedial action would be taken, and the PCB-containing soils and residuals would be left in place, without the implementation of any containment, removal, treatment, or other mitigating actions. This alternative does not

provide for the monitoring of soil and groundwater, and does not provide for any active or passive institutional controls to reduce the potential for exposure (e.g., physical barriers, deed restrictions), nor does it address the existing unacceptable human and ecological risks associated with this operable unit. Since no remedial action would be taken, the potential for transport of PCB to the Kalamazoo River via erosion and groundwater transport from the WB/A-OU would tend to increase over time. Also, the toppling of trees due to wind stress and erosion/undercutting of the banks/dikes by river flow could ultimately result in losses of PCB-containing residuals to the river. With the no-action alternative, the potential for exposing PCB-containing residuals would remain. No action would also adversely impact downstream remedial actions. Consistent with the recommendations of OSWER Directive 9285.6-08, *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (Feb. 12, 2002), control of source areas is crucial to the success of downstream actions.

Detailed analysis of the alternative follows.

Overall Protection of Human Health and the Environment

Under Alternative 1, the potential for transport of PCB-containing residuals to the Kalamazoo River via surface runoff would remain. Alternative 1 provides no increased protection over the current site conditions, provides absolutely no risk reduction, and would not be protective of human health and the environment.

Compliance with ARARs/TBCs

Alternative 1 would not be in compliance with state and federal ARARs.

Applicable ARARs/TBCs for this alternative are summarized in Table 6-2. Specific ARARs that would directly influence implementation of this alternative are discussed below.

- **Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended (Part 201).** This state ARAR provides for the identification, risk assessment, evaluation, and remediation of contaminated sites within the state. At sites of environmental contamination, this ARAR establishes generic cleanup criteria, and allows development of additional site-specific criteria to protect the environment, considering ecological risks (Section 20120(a)(17)). While Alternative 1 may meet applicable criteria in some areas of the WB/A-Site OU (i.e., Industrial Criteria on GP property that is zoned for industrial land use only), compliance with residential criteria (4 mg/kg) in adjacent residential areas requires further evaluation, and areas of the WB/A-Site and ancillary areas requiring HHRA in-stream sediment criteria, or BERA ecological criteria can not be met. Implementation of Alternative 1 would not reduce exposure and associated risk to acceptable levels and would not achieve a

degree of protectiveness appropriate for the property, as required in Part 201's Section 20120a and 20120b. The potential for exposure to PCB-containing residuals/soils would still exist as would the likely migration of PCB contaminated material. Alternative 1 could not satisfy the requirements for long-term monitoring, would not achieve the requirement to restrict future land use, and would not comply with Part 201 if there is transport (e.g. via venting groundwater) of PCB to surface water.

- **Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended (Part 115).** This state ARAR establishes the requirements for closure of a Part 115 permitted landfill. Although the WB/A-OU was not licensed under the NREPA, this act is considered an ARAR for the OU (siting requirements excluded). It requires separation between waste and surface water. Implementation of Alternative 1 would not meet the landfill closure criteria of this act.

- **Toxic Substances Control Act, 40 Code of Federal Regulations (CFR) 761 (TSCA.)**. TSCA is a federal cleanup statute with a PCB Remediation Waste Rule that provides cleanup and disposal options for PCB remediation waste. The no-action alternative would pose an unreasonable risk of injury to human health or to the environment, could not achieve the requirements of 40 CFR Section 761.61, and could not meet this ARAR.

Long-Term Effectiveness and Permanence

Alternative 1 would not be protective or reliable over time because of the potential for PCB migration due to erosion and transport by surface runoff. Unacceptable risks to human health and the environment would remain. This alternative would be less protective over time and the potential for bank/dike failure would increase.

Reduction in Mobility, Toxicity, or Volume Through Treatment

Alternative 1 provides no active remediation of residuals that would reduce the mobility, toxicity, or volume of PCB-containing residuals through treatment.

Short-Term Effectiveness

Alternative 1 would maintain current conditions and, as such, no short-term increase or decrease in exposure or associated potential risks would occur.

Implementability

Alternative 1 would not involve the implementation of any active remedial responses.

Cost

No cost would be associated with implementing Alternative 1.

Community Acceptance

Based on historic public comments on remedial alternatives for the landfill operable units, it is clear the community would find Alternative 1 unacceptable. Taking "no action" at the site would not reduce health risks to citizens and would not be consistent with the community's vision for the river corridor. Community acceptance can be completely evaluated upon receipt of public comment on the Proposed Plan.

Support Agency Acceptance

The support agency during creation of the Proposed Plan will be the MDEQ. Support agency acceptance would be evaluated upon receipt of public comment on the Proposed Plan. Because the MDEQ was the lead agency during creation of this RI/FFS, it is already able to indicate that, as support agency during remedy selection, it could not accept implementation of Alternative 1 because the alternative could not meet state ARARs or Remedial Response Objectives.

7.2.2 Alternative 2 (with 2A, 2B, or 2C) Consolidation and Containment of Select Materials

The primary objective of the alternative would be to consolidate the PCB containing material present at the WB/A-Site OU, including the ancillary areas; installation of a compliant landfill cap; and, implementation of a hydrogeologic monitoring plan and institutional controls, thereby protecting workers, anglers, trespassers, and ecological receptors from unacceptable risks associated with PCB-containing residuals, soils, sediments, or groundwater.

This would be accomplished through containment via capping following the consolidation of PCB-containing residuals, soils, or sediments (Figure 15) that are present in the WB/A-Site OU and ancillary areas. Following consolidation of these materials, a final cover system (including an FML, as proposed by the PRPs), would be constructed over both the Willow Boulevard Site and the A-Site. Figures 23a, 23b, and 23c present conceptual cross-sections of the proposed subalternative caps. Alternative 2 is not a stand-alone remedy, as it also requires erosion control measures (i.e., extension and protection of the cover system) along the perimeter of the WB/A-OU. Three options for erosion control are presented below in subalternatives 2A, 2B, or 2C, one of which must be added to Alternative 2. Activities described in this section would be included with those described in any of the subalternatives described. This alternative would provide protection of human health and the environment by preventing potential exposure and reducing the mobilization of residuals to the Kalamazoo River.

This alternative would entail the following tasks:

- Mobilization/demobilization;
- Preparation of the site (clearing and grubbing);
- Consolidation of residuals;
- Temporary stabilization of excavation area (i.e. berms, sheetpiling);
- Stabilization of river banks (described in subalternative 2A, 2B, or 2C below);
- Construction of the cover system; and
- Restoration of the area east of Davis Creek.

In addition, Alternative 2 would include long-term institutional controls, maintenance, and long-term monitoring. Long-term groundwater monitoring will consist of the following:

- Preparation of a groundwater monitoring plan;
- Installation of a groundwater monitoring network, including point of compliance wells;
- Scheduled collection of samples; and
- A contingency plan. In the event PCBs or other contaminants are detected above the appropriate criteria at the point of compliance wells, it may be necessary to increase monitoring frequency or possibly install, operate, and maintain groundwater control or treatment systems.

For the purposes of this Feasibility Study, it is assumed groundwater samples will be collected starting the first year of post-remediation monitoring activities, in accordance with an approved hydrogeologic monitoring plan. This assumption does not preclude implementation of groundwater monitoring sooner, as additional data collected immediately may maximize remedial design efficiency. Groundwater samples will be collected quarterly starting the first year of post-remediation monitoring activities. The results of the monitoring will be reviewed periodically. After 5 years, the monitoring frequency could be modified, if approved by the MDEQ and USEPA.

Detailed components of the alternative are described below.

On-Site Consolidation of Select Residuals

Based on findings of the WB/A-OU RI, approximately 7,000 cy of PCB-contaminated material from the Willow Boulevard Drainageway Area, approximately 3,800 cy of residuals in the area east of Davis Creek, approximately 2,900 cy of materials from the area south of the A-Site berm (including former Olmstead Creek), and approximately 100 cy of materials from the AMW-3A area, would be excavated and relocated to the A-Site.

All visible residuals, floodplain sediment and those materials that contain PCB in excess of 0.33 mg/kg would be excavated from in-stream areas and contiguous regulated wetlands and consolidated onto the A-Site. Post-removal confirmatory sampling would be performed in all excavated areas, and the areas would be backfilled to grade with clean soil (or restored in accordance with a MDEQ approved wetland restoration plan).

At the AMW-3A area, PCB-containing materials appear to be limited geographically, but the extent of contamination must be determined. PCB-containing material present in excess of the appropriate criteria would be removed and consolidated under the cap. Post-removal confirmatory sampling would be performed in all excavated areas, and the areas backfilled to grade with clean soil, protected against erosion as necessary, and vegetated. In addition, existing riprap, which was recently installed during a joint stream management program with the Friends of Davis Creek, will be evaluated for effectiveness.

Bank Stabilization and Erosion Control Measures

In order to further minimize the potential risks associated with PCB transport resulting from bank failure and/or erosion, bank stabilization and erosion control would be implemented as part of Alternative 2. Note that perimeter stabilization measures described here are conceptual in nature and are intended for use in developing cost/benefit estimates for comparison in this FFS document. Implementation of Alternative 2 will actually draw from the specific stabilization options described in the subalternatives 2A, 2B, or 2C. Although the general measures proposed here are considered protective, reliable, and cost-effective, final configurations would be developed and selected during remedial design based on remedial effectiveness, cost effectiveness, and compliance with the requirements of the NREPA (i.e. Part 115) and TSCA. At A-Site areas where sheetpile has not been installed, dike stabilization would entail either placement of additional sheet pile or limited excavation of dike soils to achieve a gentler and stable slope. A zone of rip-rap would be placed at the toe of the dike to provide erosion resistance.

Because an adequate dike does not exist along portions of the Willow Boulevard Site, a different approach to bank stabilization must be evaluated in the conceptual development of this alternative. Bank stabilization under this alternative could include any of the options outlined in Alternative 2A, 2B, or 2C. The alternative also includes constructing an earthen berm along the perimeter of the Willow Boulevard Site. This would provide a physical separation between adjacent residences and the OU and offer protection during extreme flow events. The areas of the cover system subject to erosion would be reinforced using techniques including, but not limited to, sheetpile, articulated concrete systems, geoweb materials, or revetment blankets.

Specific dike and bank stabilization options for Alternative 2 would be selected as part of the remedial design process. Some of the available options are explored in greater detail as Alternatives 2A, B and C, along with partial consolidation of materials.

Cover System

Following on-site consolidation of select residuals/soils/sediments, erosion control measures, and stabilization of the banks, the OU would be regraded and capped using a cover system that included an FML. Regrading design would focus on providing adequate slopes to achieve drainage.

As the parties responsible for implementing the remedy have proposed an FML as part of the cover system, that cover option is carried through this analysis. The FML would be supported by a 6-inch gas venting layer/soil cushion and protected by a minimum 24-inch soil layer (that would also serve as the drainage layer) and a minimum 6-inch topsoil layer (erosion layer capable of supporting native plant growth) (Figure 23). The protection layer will be designed to provide for lateral drainage of precipitation, minimize frost penetration into the cover system, and protect the FML from root penetration, ultraviolet light and other deleterious effects. A minimum slope of 4% would be required to avoid extensive maintenance to bring all areas up to the minimum required slope during the post-closure care period if the cap were to settle. The minimum and maximum slope requirements for this design are shown in Figure 23.

The interim earthen berm that exists along portions of the eastern, western, and the northern boundaries of the Willow Boulevard Site will be extended to complete the northern boundary. This earthen berm and installation of erosion control measures (such as sheetpiling) will complete the cap design for the Willow Boulevard Site.

To provide for the long-term effectiveness of the cover system, and as required by Part 201, Section 20120b, institutional controls would be established for the OU. Appropriate long-term controls would include deed

restrictions (e.g., restrictive covenant on land use), perimeter fencing (which already exists in some areas), posting every 200 feet to restrict access to the site, permanent monuments, and periodic inspections of the cover system (including maintenance as necessary).

Detailed analysis of the alternative follows.

Overall Protection of Human Health and the Environment

The containment alternative is considered an effective remedy for the WB/A-OU and ancillary areas; it would eliminate the potential for direct contact with residuals, reduce to acceptable levels risks to human and ecological receptors, and reduce PCB transport to the Kalamazoo River. This would be accomplished through residuals consolidation, bank stabilization, erosion control, cap placement, institutional controls, and long-term maintenance and monitoring. Stabilization and erosion control measures would minimize the potential for bank/dike failure and subsequent transport of PCB-containing residuals. Considering that PCBs would be left in place below the groundwater table, the potential for exceedences of applicable groundwater criteria exists. If venting groundwater exceeds criteria, the remedy would not be protective unless groundwater controls were implemented. Placement of a cap system that includes a FML would decrease infiltration, thereby providing further protectiveness by reducing the potential for PCB and other contaminants to leach into the groundwater. Alternative 2 has the potential to substantially reduce risk to human health and the environment and meet the RROs. Additional discussion of overall protection is provided under subalternative 2A, 2B, and 2C.

Compliance with ARARs

Applicable ARARs/TBCs for this alternative are summarized in Table 6-2. Some of the specific ARARs that directly influence implementation of this alternative are discussed below:

- **Part 201 of the NREPA**. This state ARAR provides for the identification, risk assessment, evaluation, and remediation of contaminated sites within the state. At sites of environmental contamination, this ARAR establishes generic cleanup criteria, and allows development of additional site-specific criteria to protect the environment (e.g. when considering ecological risks (Section 20120(a)(17)). The acceptable residential criteria (4 mg/kg PCB) are already attained in adjacent sampled residential areas, except for one small Kalamazoo Township-owned area in the vicinity at the end of Carlton Avenue (AMW-3A area), which it is expected can easily be addressed under this alternative. Implementation of Alternative 2 could achieve applicable criteria and the potential for exposure to PCB-containing residuals, soils, or sediments (and associated risks) that are contained would be greatly reduced.

Alternative 2 may not be in compliance with Part 201 if there is groundwater transport of contaminants to the surface water; however, the ARAR could be attained with implementation of compliance monitoring and a contingent groundwater remedy. The preliminary cost estimate for the Alternative 2 remedy and the three subalternatives for Alternative 2 are presented with and without contingent costs for a groundwater collection and treatment system. This ARAR is discussed further under subalternatives 2A, 2B, and 2C.

- **Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended (Part 31).** In accordance with the federal Water Pollution Control Act and the federal Clean Water Act, this state ARAR establishes state criteria for rivers, creeks, and floodplain areas, to protect aquatic life and human health. It also establishes water quality standards and monitoring requirements for discharge effluents including stormwater and venting groundwater, specifying standards for several water quality parameters, including PCB. Under Alternative 2, consolidation of PCB-contaminated sediments and soils combined with erosion control measures have the potential to achieve this ARAR. This ARAR must be attained if contaminated groundwater vents to the Kalamazoo River. Any remedial action that results in the unacceptable discharge of injurious substances to the Kalamazoo River will not be considered effective or complete under this ARAR. The portion of this requirement pertaining to floodplains (any excavation below the 100 year flood elevation) substantive requirements of a permit could be satisfied in implementation of this alternative.

- **Part 91, Soil Erosion and Sedimentation Control of the Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451, as amended (Part 91).** This ARAR pertains to soil erosion, sedimentation, and control of erosion and sedimentation. The ARAR requires that an "earth change" (excavation, filling, or grading) be designed, constructed, and completed in a manner that limits the exposed area of any disturbed land for the shortest possible period of time, as determined by the local enforcing agency. It also requires design of temporary or permanent control measures constructed for the conveyance of water around, through, or from the earth change area to limit the water flow to a nonerosive velocity. This ARAR requires installation and maintenance of temporary soil erosion and sedimentation control measures. The ARAR could be attained with controls such as those generally described in this alternative.

- **Part 115 of the NREPA.** This ARAR establishes the requirements for closure of an NREPA permitted landfill. Although the WB/A-OU was not licensed under the NREPA, this act is considered relevant and appropriate for the site because the OU is a solid waste disposal area. To be compliant with this

requirement, the cover system and landfill contents must be protected against a 100 year flood event. There must be physical separation between the waste and surface water, either literally or with engineered barriers. A leachate collection system may be required. Implementation of Alternative 2 could meet appropriate landfill closure criteria of this act.

- **Part 55, Air Pollution Control, of the NREPA (Part 55).** These are requirements regarding air emissions. Current PCB emissions are within acceptable limits. Since excavation of select residuals and disturbance of the surface of the Willow Boulevard Site and A-Site during construction could result in increased air emissions, some care would be necessary in final design and remedial action to assure that construction methods do not result in unacceptable emissions. As discussed in Section 5.5, air monitoring performed during the interim response measures conducted between November 1999 and March 2000 indicate that PCB transport via air should not be a factor during implementation of this remedial alternative. Nevertheless, a site-specific Health and Safety Plan would be developed to monitor emissions, prevent worker and community exposure, and confirm compliance with these ARARs.

- **TSCA.** This federal ARAR (specifically the PCB Remediation Waste Rule) applies to Alternative 2 because some material on site has PCB concentrations greater than 50 mg/kg. The materials may be managed under the PCB "Mega" rule (40 CFR 761 et seq.).

  The ARAR could be attained if the USEPA Superfund Division Director, in consultation with the TSCA program, reviews a written application and issues a written determination that the disposal method proposed (Alternative 2) will not pose an unreasonable risk of injury to health or the environment. Such a determination was recently made in a similar situation for the on-site consolidation and containment remedy selected in the ROD for the 12th Street Landfill-OU4 of the API/PC/KR Site.

  It is important to note that the chemical waste landfill requirements found in 40 CFR 761.75(b) do not apply to the WB/A-OU. Rather, the risk-based disposal method proposed under this alternative consists of waste consolidation, bank stabilization, erosion control, installation of a cover system, and implementation of a long-term monitoring program. Implementation of these containment elements results in the construction of an effective barrier to physically isolate PCB-containing materials from potential human or ecological contact. As long as the USEPA issues a written determination and the integrity of the containment system is maintained in perpetuity, the TSCA ARAR would be satisfied.

- **Rivers and Harbors Act of 1899 (33 USC 403).** The federal Rivers & Harbors Act prohibits unauthorized obstruction or alteration of the navigable capacity of waters of the United States (fill, cofferdams, bulkheads, etc.), except on plans recommended and authorized by the Army Corps of Engineers**.** CERCLA response actions, however, do not require a permit in which the Corps of Engineers typically gives authorization. On CERCLA remedial activities, authority has been deferred to USEPA (Edgar, 1985). The remedial action still must avoid unacceptable obstruction or alteration of the Kalamazoo River channel. This is possible with proper design and construction techniques.

Alternative 2 therefore has the potential to be in compliance with all state and federal ARARs and TBCs.

Long-Term Effectiveness and Permanence

Alternative 2 would involve the following long-term components: consolidation of residuals/soils/sediments on either the Willow Boulevard Site or A-Site; bank stabilization (under subalternatives 2A, 2B, and 2C); erosion control; capping with an FML; long-term groundwater monitoring of the WB/A-OU; the development of a hydrogeologic monitoring program that will include contingency plans identifying further remedial action in the event that the appropriate GSI criteria are not met at the points of compliance; and establishment of a vegetative cover. The process options associated with these components are proven and reliable technologies frequently used in both environmental remediation and general construction work. In the long term, the reliability of this alternative would be managed through inspection of the cap and bank stabilization measures, maintenance, and repair activities as necessary. In addition, it may be necessary to construct, maintain and operate a groundwater collection and treatment system if it is determined that PCBs are being transported off-site to surface water bodies by the groundwater. The details of these activities would be developed during remedial design and compiled into an Operation & Maintenance (O&M) manual for the site. Additional discussion of long term effectiveness and permanence is presented under subalternatives 2A, 2B, and 2C.

Reduction in Mobility, Toxicity, or Volume Through Treatment

Alternative 2 does not address the federal statutory preference for a remedy that employs treatment technologies that permanently and significantly reduce the mobility, toxicity, or volume of PCB-containing residuals through treatment. However, Alternative 2 would isolate residuals in place through consolidation of residuals/soils and placement of a cap (including an FML), thereby significantly reducing their mobility. There would be no reduction in the volume or toxicity of PCB-containing residuals under this alternative.

Short-Term Effectiveness

Alternative 2 provides an acceptable degree of short-term effectiveness. Because of residuals consolidation and cap construction activities, there is a potential short-term increase in PCB exposure to workers during implementation of this alternative. Potential off-site migration during remedial action also may increase over the short term due to potential dust-borne releases or incidental releases of the residuals to the river. However, compliance with proper health and safety procedures, surface management, and sediment control provisions developed as part of the remedial design would minimize the potential for worker and community exposure and the loss of PCB-containing residuals. It should be noted that air sampling conducted during the IRA excavation and consolidation activities resulted in no PCB detections in air emissions either in particulate or vapor phase. Additional discussion of short-term effectiveness is presented under subalternative 2A, 2B, and 2C.

Implementability

Implementation of Alternative 2 involves the following major components: work area isolation, removal and on-site consolidation of the residuals/soils/sediments, bank stabilization, erosion control, installation of groundwater monitoring network, capping, and long term operation and maintenance. In the event of GSI exceedances, Alternative 2 might involve the installation, operation and maintenance of groundwater control and treatment. These are proven technologies and are therefore considered technically feasible. No implementation problems are projected for Alternative 2. Additional discussion of implementability is provided under subalternative 2A, 2B, and 2C.

The services and materials necessary to implement this alternative would be readily available. Construction equipment would be obtained locally or transported to the OU from other areas, as appropriate. Discussions with local suppliers have indicated that sufficient quantities of capping materials are available. In addition, based on experience, qualified commercial contractors would be available locally to perform the work.

Alternative 2 could comply with the requirements of TSCA and Part 115, which are both ARARs for the WB/A-OU. In addition, the substantive requirements of other permits would be met for this alternative. Therefore, the alternative is considered administratively feasible.

Cost

Alternative 2 costs are associated with the following construction activities: mobilization/demobilization, work area isolation, site preparation, consolidation of select residuals/soils/sediments, sediment stockpile/stabilization (if necessary), water treatment, bank/dike construction and stabilization, erosion control, cap with FML,

vegetative cover, and health and safety. Costs are compiled and presented in the analysis of subalternatives 2A, 2B, and 2C.

Community Acceptance

Community acceptance is discussed under subalternatives 2A, 2B, and 2C.

Support Agency Acceptance

Support agency acceptance is discussed under subalternatives 2A, 2B, and 2C.

7.2.2.1 Subalternative 2A – Consolidation/Containment of Select Materials and Install New Sheetpiling at Willow Boulevard

Under this option, the objectives and means of achieving them as defined under Alternative 2 would be augmented with a 1,800 foot long sheetpile wall at Willow Boulevard, installed along the length of the river side of the site. Sheetpiling would extend at least 2 feet above the 100 year flood elevation. This would improve protection of human health and the environment by preventing exposure and reducing the potential mobilization of residuals to the Kalamazoo River.

This option would add the following task to those previously listed under Alternative 2:

- Installation of sheetpiling along Willow Boulevard as a bank stabilization/erosion control measure.

Alternative 2A also adds the following components to Alternative 2:

Bank Stabilization and Erosion Control Measures

At Willow Boulevard, because an adequate dike does not exist along the river bank, sheetpiling (to 2 feet above the 100 year flood elevation) would be installed along the Kalamazoo River. This will conceptually match what currently exists at the A-Site, providing a physical separation between the river and the OU. The sheetpile would offer protection against extreme flood events; it will also protect the existing bank from erosive forces of the river. Figure 23A presents a conceptual cross-section of the proposed remedial alternative bank stabilization measures.

Overall Protection of Human Health and the Environment

In addition to the protection otherwise offered by Alternative 2, a sheetpiling bank protection option would be an effective remedy for the WB/A-OU. Bank stabilization with sheetpiling and other erosion control measures would minimize the potential for bank failure and subsequent transport of PCB-containing residuals to Davis

Creek and the Kalamazoo River. This option would have a long-term effect on the riparian corridor, as the installation of sheetpiling would preclude establishment of bank habitat and would amount to a permanent barrier to wildlife migration between the aquatic and terrestrial environments. Alternative 2A has the potential to meet the RROs.

Compliance with ARARs

Beyond the ARAR issues already identified under Alternative 2, additional considerations under Alternative 2A are discussed below:

- **Part 201 of the NREPA**. Subalternative 2A would be in compliance with Part 201 only if there is no significant transport of contaminants to the surface water. If seepage between the seams of the sheetpile would serve to transport contaminants to the river, it may be necessary to seal the sheeting. Otherwise, the ARAR could be attained with implementation of monitoring and a contingent groundwater remedy. Costs for this Alternative have been developed both with and without contingent groundwater treatment.

- **Part 31 of the NREPA.** To achieve this ARAR, any discharge to surface water (including stormwater or from groundwater control mechanisms) would need to meet conditions established by a Substantative Requirements Document (SRD), issued by the MDEQ Water Division. Sheetpiling may change groundwater hydrology to the extent that groundwater control systems need to be installed. Demonstrating that venting groundwater does not exceed GSI criteria (and implementing containment contingency plans if criteria are not met) would be necessary to achieve this ARAR. Also, for excavation below the 100 year flood elevation, substantive portions of a permit are necessary.

- **Part 115 of the NREPA.** Implementation of Alternative 2A could meet appropriate landfill closure criteria of this act. If sheetpiling alone does not provide an adequate barrier between the waste and the river, construction of additional barrier components may be necessary.

Alternative 2A has the potential to be in compliance with all State and Federal ARARs.

Long-Term Effectiveness and Permanence

Alternative 2A adds the following component to those listed under Alternative 2: bank stabilization by installation of sheetpile. To ensure long term effectiveness, it may be necessary to seal sheetpile seams. The process options associated with component 2A are proven and reliable technologies frequently used in both environmental remediation and general construction work. In the long term, the reliability of this alternative

would be managed through inspection of the cap and bank stabilization measures, including sheetpile wall maintenance, and repair activities as necessary. The details of these activities would be developed during remedial design and compiled into an O&M manual for the site.

Reduction in Mobility, Toxicity, or Volume through Treatment

Alternative 2A does not reduce the mobility, toxicity, or volume of PCB-containing residuals through treatment. However, Alternative 2A would additionally isolate residuals in place through installation of sheetpiling, thereby reducing their mobility. There would be no reduction in the volume or toxicity of PCB-containing residuals under this alternative.

Short-Term Effectiveness

Alternative 2A provides an acceptable degree of short-term effectiveness, and involves no additional increase in PCB exposure beyond that already discussed under Alternative 2.

Implementability

No implementation problems are projected for Alternative 2A; installation of some sheetpiling has already been implemented at this OU. Experience at this OU also indicates sufficient quantities of sheetpiling materials are available. Qualified commercial contractors would be available locally to perform the work.

In addition, the substantive requirements of all ARARs are expected to be met for this alternative. Therefore, the alternative is considered administratively implementable.

Cost

Estimated capital costs associated with Alternative 2A is approximately $8.26 million, while the O&M cost is approximately $399,000 per year including costs associated with long-term groundwater monitoring, for a total O&M cost of approximately $4.95 million (based on a 30-year present worth analysis). The total project present worth cost for Alternative 2A is approximately $13.2 million. Costs for a contingency groundwater control and treatment system would increase the capital cost by $2.84 million and the annual O&M cost by $120,000. If groundwater collection infrastructure were placed prior to cap completion, there would be a substantial cost savings in the event that groundwater collection and treatment is required in the future. The total project present worth cost for Alternative 2A with groundwater treatment would be $17.54 million. Details of the cost estimate are provided in Table 7-1A.

Community Acceptance

Based on historic comments in public meetings and in communication with the MDEQ, the community has indicated serious reservations with placement of additional sheetpile. Community acceptance is anticipated to be minimal, as the footprint of the landfill is not reduced. Community acceptance will be completely evaluated upon receipt of public comment on the Proposed Plan.

Support Agency Acceptance

The support agency during creation of the Proposed Plan will be the MDEQ. Support agency acceptance will be established upon receipt of public comment on the Proposed Plan. Because the MDEQ was the lead agency during creation of this RI/FFS, it is able to indicate that, as support agency, it could accept implementation of Alternative 2A. This preliminary acceptance is based on the fact that the State previously supported a "consolidate and contain remedy" for this operable unit. Support would be contingent on an evaluation of the benefits of sealing sheetpile, and inclusion of a groundwater monitoring program to ensure GSI criteria are attained. This alternative provides a high degree of flood resistance, but would require operation and maintenance, and eventual replacement of sheetpile. It achieves risk reduction, but is not the most permanent. Support Agency acceptance will be evaluated formally upon receipt of comment on the Proposed Plan.

7.2.2.2 Subalternative 2B – Consolidation/Containment of Select Materials, Remove Existing Sheetpiling, Re-Grade/Stabilize Banks with a Horizontal Setback

Under this variation of Alternative 2, a horizontal setback would be established separating Willow Boulevard and A-Sites from both the Kalamazoo River and Davis Creek. This analysis assumes the setback would be 50 feet. The existing sheetpile wall at A-Site would be removed or cut off and erosion control measures would be implemented along the perimeter of WB/A-OU. This would provide protection of human health and the environment by preventing exposure and reducing the potential mobilization of residuals to the Kalamazoo River. Furthermore, creation of a set back from the river and use of low-profile bank stabilization methods (revetment blankets, geoweb material, articulated concrete system) would provide a more aesthetically pleasing river bank with more natural looking contours than a vertical sheetpile wall.

This subalternative would entail the following tasks, in addition to those listed under Alternative 2:

- Excavate a horizontal setback from the Kalamazoo River and Davis Creek;
- Stabilization of excavated areas and construction of new berms;
- Removal of the existing sheetpiling at the A-site or cutting it off below the waterline;

In addition to those described under Alternative 2, components of the Subalternative 2B are described below.

Bank Stabilization and Erosion Control Measures

At A-Site, the existing sheetpiling would be removed or cut off below the waterline and the bank area excavated to create a setback from the Kalamazoo River. At Willow Boulevard, because no sheetpiling exists, the existing bank would be excavated and a setback created along the Kalamazoo River. In order to further minimize the potential risks associated with PCB transport resulting from bank failure and/or erosion, new dikes and erosion control measures would be implemented as part of Subalternative 2B.

These activities would provide a physical separation between the river and the OU during extreme flow events, as well as protect the new berms from the erosive forces of the river. Figure 23B presents a conceptual cross-section of the proposed remedial alternative bank stabilization measures.

Overall Protection of Human Health and the Environment

In addition to the protectiveness described under Alternative 2, the consolidation/containment and setback alternative would be an effective remedy for the WB/A-OU and ancillary areas that would eliminate the potential for direct contact with residuals and reduce PCB transport to the Kalamazoo River. Excavation of the existing banks, their re-stabilization, and use of erosion control measures would reduce the potential for failure and subsequent transport of PCB-containing residuals to Davis Creek and the Kalamazoo River. Of critical importance to meeting this criterion is construction of the new bank to protect the landfill cover and contents from a 100 year flood event. Also, a barrier would be necessary to discourage people from accessing the site from the river side of the OU. Assuming the setback could achieve the required separation between waste and surface water and that erosion control would protect against a 100 year flood event, subalternative 2B has the potential to meet the RROs.

Compliance with ARARs

ARARs issues beyond those described in Alternative 2 are discussed below:

- **Part 201 of the NREPA**. Subalternative 2B would comply with Part 201 only if there is not significant transport of contaminants to the surface water. The ARAR could be attained with implementation of long term monitoring and a contingent groundwater remedy. Costs for this Subalternative have been developed both with and without groundwater treatment.

- **Part 31 of the NREPA.** Under Subalternative 2B, excavating a setback along the river would likely require water treatment. Substantive discharge requirements of Part 31 could be met by complying with a SRD, issued for the discharge. Ensuring that venting groundwater does not exceed GSI criteria (and implementing contingency plans if criteria are not met) could achieve this ARAR. Control of runoff/seepage during excavation near the river would also be required.

- **Part 91 of the NREPA**. This ARAR pertains to soil erosion, sedimentation, and control of erosion and sedimentation. The ARAR requires that an earth change be designed, constructed, and completed in a manner that limits the exposed area of any disturbed land for the shortest possible period of time as determined by the local enforcing agency. It also requires design of temporary or permanent control measures constructed for the conveyance of water around, through, or from the earth change area to limit the water flow to a nonerosive velocity. This ARAR requires installation and maintenance of temporary soil erosion and sedimentation control measures. The ARAR could be attained under this subalternative.

- **Part 115 of the NREPA.** A cover system would be built under this subalternative. Of critical importance in attaining this ARAR is the need to (1) keep the cover system from being inundated and compromised by flood events (2) ensuring flood events do not cause unacceptable infiltration of the waste, and (3) achieve an adequate degree of separation between waste and surface water. Implementation of Subalternative 2B could meet appropriate landfill closure criteria of this act, but it is likely that significant landfill engineering would be necessary to achieve the required separation and ensure cover integrity.

Subalternative 2B therefore has the potential to be in compliance with all state and federal ARARs.

Long-Term Effectiveness and Permanence

Subalternative 2B would involve the following components, in addition to those mentioned under Alternative 2: creation of a setback buffer, creation of a new bank with stabilization and erosion control. The process options associated with these components are proven and reliable technologies frequently used in both environmental remediation and general construction work. In the long term, the reliability of this subalternative would be managed through inspection of the cap and bank stabilization measures, maintenance, and repair activities as necessary. The details of these activities would be developed during remedial design and compiled into an O&M manual for the site.

Reduction in Mobility, Toxicity, or Volume through Treatment

Subalternative 2B does not address the federal statutory preference for a remedy that employs treatment technologies that permanently and significantly reduce the mobility, toxicity, or volume of PCB-containing residuals through treatment. However, Subalternative 2B would isolate residuals in place through consolidation of residuals/soils and placement of a cap (including a FML), thereby reducing their mobility. There would be no net reduction in the volume or toxicity of PCB-containing residuals under this subalternative.

Short-Term Effectiveness

Subalternative 2B provides a moderately acceptable degree of short-term effectiveness, due to the nature of excavating materials so close to the river to create the setback. Because of residuals consolidation and cap construction activities, there is a potential short-term increase in PCB exposure to workers during implementation of this subalternative. Potential off-site migration during remedial action also may increase over the short term due to dust-borne or other incidental releases of the residuals to the river. However, compliance with proper health and safety procedures, surface management, and sediment control provisions developed as part of the remedial design would minimize the potential for worker and community exposure and the loss of PCB-containing residuals. It should be noted that air sampling conducted during the IRA excavation and consolidation activities resulted in no PCB detections in air emissions either in particulate or vapor phase.

Implementability

Implementation of Subalternative 2B involves the following component, in addition to those described under Alternative 2: significant excavation of contaminated material adjacent to the river, thus decreasing implementability. In the event of GSI exceedances, Subalternative 2B might involve the installation, operation and maintenance of groundwater control and treatment. These are proven technologies and are therefore considered technically feasible. Some implementation problems are possible for Subalternative 2B.

The services and materials necessary to implement this subalternative would be readily available. Construction equipment would be obtained locally or transported to the OU from other areas. Qualified commercial contractors would be available locally to perform the work.

In addition, the substantive requirements of other permits could be met for this subalternative. Therefore, the subalternative is considered administratively implementable.

Cost

The horizontal setback distance of this subalternative would be established in remedial design. For the purposes of cost analysis, it is assumed the setback would be 50 feet. Given that assumption, estimated capital costs associated with Subalternative 2B is approximately $9.76 million, while the O&M cost is approximately $399,000 per year including costs associated with long-term groundwater monitoring, for a total O&M cost of approximately $4.95 million (based on a 30-year present worth analysis). The total project present worth cost for Subalternative 2B is approximately $12.66 million. Costs for a contingency groundwater control and treatment system would increase the capital cost by $2.84 million and the annual O&M cost by $120,000. If groundwater collection infrastructure were placed prior to cap completion, there could be a substantial cost savings in the event that groundwater collection and treatment is required in the future. The total project present worth for Subalternative 2B with groundwater treatment would be $16.99 million. Details of the cost estimate are provided in Table 7-1B.

Community Acceptance

As this subalternative slightly reduces the landfill footprint at the OU and eliminates sheetpile along the river, it moves toward achieving two commonly expressed community desires. MDEQ anticipates the community would be moderately accepting of Subalternative 2B. Sheet pile barriers have been, for the most part, frowned upon within the community, and a setback would probably be seen in a positive light. From the community standpoint, if this subalternative would include components consistent with their vision for a river walk or trail system, it would be likely be welcomed. Community acceptance will be more completely evaluated upon receipt of public comment on the Proposed Plan.

Support Agency Acceptance

It is likely the MDEQ would support this subalternative, contingent on the bank being engineered to provide a high degree of protection from the erosive and infiltration forces of the river, while not encouraging public contact with any potentially dangerous components of the remedy. This subalternative would significantly reduce site risks, but would require careful operation and maintenance to ensure the cover system is not compromised during rare flood events. Support Agency acceptance will be evaluated upon receipt of public comment on the Proposed Plan.

7.2.2.3 Subalternative 2C – Consolidation/Containment of Select Materials, Re-Grade/Stabilize Banks using Ecologically Friendly Options at Willow Boulevard

A setback and new dike, limited to the Willow Boulevard portion of the site would be installed along the Kalamazoo River and erosion control measures would be implemented along the remaining perimeter of the WB/A-OU. This would provide protection of human health and the environment by preventing exposure and reducing the potential mobilization of residuals to the Kalamazoo River.

In addition to tasks listed under Alternative 2, this subalternative would entail the following tasks:

- Creation of a setback at the Willow Boulevard portion of the OU;
- Stabilization of the excavation area;
- Construction of new berms;
- Bank stabilization using means engineered to provide habitat.

Components of the subalternative are described below.

Bank Stabilization and Erosion Control Measures

In order to further minimize the potential risks associated with PCB transport resulting from bank failure and/or erosion, bank stabilization and erosion control measures would be implemented as part of Subalternative 2C.

A-Site, AMW-3A, and the area south of the A-Site berm and in the Willow Boulevard drainageway areas would be managed in the same manner as described in Alternative 2. At Willow Boulevard, a horizontal setback would be excavated along the northern boundary and a new ecologically friendly (augmented with organic substrate and growing materials) dike would be installed along the Kalamazoo River. This would provide a physical separation between the river and the OU during extreme flow events, and protect the new berm from the erosive forces of the river. Figure 23A presents a conceptual cross-section of the proposed remedial alternative bank stabilization measures.

Analysis of the subalternative follows.

Overall Protection of Human Health and the Environment

The consolidation/containment and ecologically friendly dike alternative would be an effective remedy for the WB/A-OU and ancillary areas that would eliminate the potential for direct contact with residuals and reduce PCB transport to the Kalamazoo River. This would be accomplished through residuals consolidation, setback creation, new dike construction and stabilization, erosion control, cap placement, institutional controls, and

long-term maintenance and monitoring. Bank stabilization and erosion control measures could minimize the potential for bank failure and subsequent transport of PCB-containing residuals to Davis Creek and the Kalamazoo River. Of critical importance to meeting this criterion is construction of the new bank to achieve separation between surface water and waste and protect the landfill cover and contents from a 100 year flood event. This subalternative would achieve physical isolation of the PCB-containing residuals/soils outside the Willow Boulevard Site and A-Site, thereby eliminating the potential for direct contact with PCB in these areas. This subalternative would reduce long-term effect on riparian habitat, as there would be no new installation of sheetpiling; a more natural interface would be created between the aquatic and terrestrial ecotones. However, a barrier would be necessary to discourage people from accessing the site from the river side of the OU. Assuming the setback could achieve the required separation between waste and surface water and that erosion control would protect against a 100 year flood event, Subalternative 2C could meet the RROs.

Compliance with ARARs

Applicable ARARs/TBCs for this subalternative are summarized in Table 6-2. In addition to the ARARs already described under Alternative 2, the specific ARARs that directly influence implementation of this subalternative are discussed below:

- **Part 201 of the NREPA**. Subalternative 2C would comply with Part 201 only if there is not significant transport of contaminants to the surface water. The ARAR could be attained with implementation of long term monitoring and a contingent groundwater remedy. Costs for this Subalternative have been developed both with and without groundwater treatment.

- **Part 31 of NREPA.** Under Subalternative 2C, excavating a setback along the river would likely require water treatment and compliance with a substantive requirements document. With water treatment during construction of Subalternative 2C, consolidation of PCB-contaminated sediments and soils combined with the setback and erosion control measures have the potential to achieve this ARAR. Ensuring that venting groundwater does not exceed Rule 57 criteria (and implementing containment contingency plans if criteria are not met) could achieve this ARAR. Control of runoff/seepage during excavation near the river would also be required.

- **Part 91 of the NREPA**. This ARAR pertains to soil erosion, sedimentation, and control of erosion and sedimentation. The ARAR requires that an earth change be designed, constructed, and completed in a manner that limits the exposed area of any disturbed land for the shortest possible period of time as

determined by the local enforcing agency. It also requires design of temporary or permanent control measures constructed for the conveyance of water around, through, or from the earth change area to limit the water flow to a nonerosive velocity. This ARAR requires installation and maintenance of temporary soil erosion and sedimentation control measures. The ARAR could be attained under this subalternative.

- **Part 115 of the NREPA.** A cover system would be built under this subalternative. Of critical importance in attaining this ARAR is the need to (1) keep the cover system from being inundated and compromised by flood events (2) ensuring flood events do not cause unacceptable infiltration of the waste, and (3) achieve an adequate degree of separation between waste and surface water. Implementation of Subalternative 2B could provide the isolation of the waste from the surface water, but it is likely that significant landfill engineering would be necessary to achieve the required separation and ensure cover integrity.

Subalternative 2C has the potential to meet all ARARs.

Long-Term Effectiveness and Permanence

The process options associated with these components are proven and reliable technologies frequently used in both environmental remediation and general construction work. In the long term, the reliability of this subalternative would be managed through inspection of the cap and bank stabilization measures, maintenance, and repair activities as necessary. The details of these activities would be developed during remedial design and compiled into an O&M manual for the site.

Reduction in Mobility, Toxicity, or Volume through Treatment

Subalternative 2C does not address the federal statutory preference for a remedy that employs treatment technologies that permanently and significantly reduce the mobility, toxicity, or volume of PCB-containing residuals through treatment. However, Subalternative 2C would isolate residuals in place through consolidation of residuals/soils and placement of a cap (including a FML), thereby significantly reducing their mobility. There would be no reduction in the volume or toxicity of PCB-containing residuals under this subalternative.

Short-Term Effectiveness

Subalternative 2C provides a moderate degree of short-term effectiveness due to the nature of excavating materials so close to the river to create the setback. Because of residuals consolidation and cap construction activities, there is a potential short-term increase in PCB exposure to workers during implementation of this subalternative. Potential off-site migration during remedial action also may increase over the short term due to

potential dust-borne releases or incidental releases of the residuals to the river. However, compliance with proper health and safety procedures, surface management, and sediment control provisions developed as part of the remedial design would minimize the potential for worker and community exposure and the loss of PCB-containing residuals. It should be noted that air sampling conducted during the IRA excavation and consolidation activities resulted in no PCB detections in air emissions either in the particulate or vapor phase.

Implementability

Implementation of Subalternative 2C involves the following component, in addition to those described under Alternative 2: excavation of contaminated material adjacent to the river, thus impacting implementability. Due to the nature of excavating materials so close to the river to create the setback, implementability is reduced. In the event of GSI exceedances, Subalternative 2C might involve the installation, operation and maintenance of groundwater control and treatment. These are proven technologies and are therefore considered technically feasible. No implementation problems are projected for Subalternative 2C.

The services and materials necessary to implement this subalternative would be readily available. Construction equipment would be obtained locally or transported to the OU from other areas, as appropriate. Discussions with local suppliers have indicated that sufficient quantities of capping materials are available. In addition, based on experience, qualified commercial contractors would be available locally to perform the work.

Subalternative 2C could comply with the requirements of TSCA and Part 115, which are both ARARs for the WB/A-OU. In addition, the substantive requirements of other permits would be met for this subalternative. Therefore, the subalternative is considered administratively feasible.

Cost

For Willow Boulevard, the horizontal setback distance of this subalternative would be established in remedial design. For the purposes of cost analysis, it is assumed the setback would be 50 feet. Given that assumption, estimated capital costs associated with Subalternative 2C are approximately $7.37 million, while the O&M cost is approximately $399,000 per year including costs associated with long-term groundwater monitoring, for a total O&M cost of approximately $4.95 million (based on a 30-year present worth analysis). The total project present worth cost for Subalternative 2C is approximately $11.51million. Costs for a contingency groundwater control and treatment system would increase the capital cost by $2.84 million and the annual O&M cost by $120,000. If groundwater collection infrastructure were placed prior to cap completion, there would be a substantial cost savings in the event that groundwater collection and treatment is required in the future. The

total project present worth for Subalternative 2C with groundwater treatment would be $15.84 million. Details of the cost estimate are provided in Table 7-1C.

Community Acceptance

Based on historic public comments, it is anticipated that the community would find Subalternative 2C moderately acceptable and the most acceptable of the three options under Alternative 2. Attractive aspects of this subalternative are reduction of the landfill footprint at Willow and inclusion of ecologically friendly bank materials. Sheet pile barriers are unpopular within the community, and innovative bank engineering at approximately half of the site would probably be seen as an encouraging departure from the status quo. From the community standpoint, if this subalternative would include components consistent with their vision for a river walk or trail system, it would likely be welcomed. Community acceptance will be evaluated further upon receipt of public comment on this RI/FS and Proposed Plan.

Support Agency Acceptance

The state would likely approve this remedy, contingent on the bank being engineered to provide a high degree of protection from the erosive and infiltration forces of the river, that the sheetpile at the A-site be evaluated to determine if sealing joints are appropriate, and measures are implemented to prevent public contact with any potentially dangerous components of the remedy. The remedy would significantly reduce risk, although operation and maintenance would be required. Support Agency acceptance will be evaluated formally upon receipt of comment on the Proposed Plan.

7.2.3 Alternative 3 - Removal and Off-Site Disposal

The primary objective of this alternative would be to completely remove the PCB-containing residuals (approximately 634,200 cy) from the WB/A-OU and eliminate future risks of PCB migration or exposure at these sites. This would be accomplished through the excavation, dewatering, and off-site disposal of residuals from WB/A-Site OU and ancillary areas. The addition of a stabilizing agent (e. g., fly ash) would bring the total volume handled to approximately 762,200 cy.

This alternative would provide source control via removal of the residuals, thereby reducing or eliminating the need for long-term monitoring or management. Excavated residuals from these sites would be transported off site and disposed of in a landfill permitted to accept materials under the PCB “Mega Rule”. Following the removal and disposal of residuals, these areas would be backfilled, graded, and restored to match the surrounding area.

This alternative would entail the following tasks:

- Mobilize/demobilize;
- Prepare sites (clearing and grubbing);
- Excavate all residuals above the water table;
- Stabilize excavation area (berms, sheetpiling);
- Excavate residuals located below the original water table;
- Dewater and stabilize high-water residuals (from below water table);
- Transport and dispose of material in a permitted landfill;
- Test remaining soils and sediment for the presence of PCB;
- Backfill and regrade the site; and
- Restore affected areas.

Detailed descriptions of key components of the alternative are provided below.

Site Preparation

Following installation of erosion control measures (silt curtains, etc.) at the site and the removal of trees and brush (leaving the stumps), the work area isolation system (e.g., temporary sheetpile for removal purposes) would be installed along the river at the Willow Boulevard Site. The perimeter of the installed system would enclose the residuals at the Willow Boulevard Site (Figure 15). Sheetpiling has already been installed at the A-Site along the river and part of Davis Creek. Additional sheetpile would be installed adjacent to the OU along the rest of Davis Creek. The installed isolation system would serve to minimize the inflow of the river to the excavation area, as well as reduce the potential for site materials to migrate into the river.

Dry Excavation

Dry excavation activities in all removal areas would begin after completion of the site preparation actives noted above. The residuals would be excavated using a 4-cy excavator with materials placed into a 16-cy dump truck and moved to a staging area. The dry phase of the excavation would include all materials from the ground surface down to approximately 2 feet above the water table. The estimated volume of material that would be removed during the dry excavation phase is 542,200 cy.

Wet Excavation

Upon completing dry excavation at the site, preparation for wet excavation would begin. Due to the presence of a fine to coarse sand layer beneath the Willow Boulevard Site and the A-Site, the work area isolation system may not be an effective barrier to groundwater flow. The excavation of wet residuals would begin at the edge of the river. Continuous "strips" approximately 25 feet wide would be removed along the length of the shoreline. Upon completing each strip, the excavated area would be backfilled with clean material before the next strip of material is removed. If it is determined by the contractor that the working surface is not stable enough to support the excavation equipment, additional material (including gravel, clean fill, and sheetpiling) may need to be installed to stabilize the working surface during the wet excavation. The estimated volume of material to be removed during this phase is 92,000 cy.

Failure to stabilize the working surface through conventional means would require that the groundwater table be depressed at both the Willow Boulevard Site and the A-Site. Two conditions may arise during this second phase (wet excavation) that could complicate the excavation of residuals from below the groundwater table. First, unstable working surfaces may exist due to hydrodynamic pressures that could cause liquefaction at the base of the residuals. Second, excessive excavation seepage could be caused by upward groundwater gradients, as previously seen during excavation of sediments from the Kalamazoo River adjacent to the Willow Boulevard Site between November 1999 and January 2000. Alternately, pending regulatory agency approval, a process demonstration protocol and acceptance procedure would be developed. Once the treatment system has been initially demonstrated and accepted by the regulatory agencies, direct discharge would be allowed with compliance testing conducted at agreed to intervals. In the event that compliance testing showed that effluent limits were being exceeded, previously agreed to actions would be implemented to assure compliance.

All wet excavation would be implemented using the 4-cy excavator, and the amount of material to be removed would be based on visual characteristics.

Upon excavation, materials with PCB concentrations below the applicable criteria will be left in place; soil with PCB concentrations above the applicable criteria would be reexcavated.

Residuals Staging Area and Water Treatment System

A staging area (Figure 24) would be constructed in the area east of Davis Creek and south of the bridge, to facilitate the temporary storage of residuals, dewatering and stabilization of residuals, and loading of residuals for transport to an off-site landfill. Fencing to prevent the access of nonauthorized personnel will enclose this area.

Stabilization of the saturated residuals would take place within a 1/4-acre area lined with a flexible membrane liner. It is assumed that the saturated residuals would require a 1:1 mixing ratio with fly ash.

For the purpose of this FFS, it is assumed that the water treatment system for the discharge of the excavated material's dewatering process would use a sand filter to remove solids and several granular-activated carbon (GAC) units in parallel with another unit in series to remove PCB. The system would be redundant to facilitate backwashing of the sand filter, as well as to allow for the continued operation of the water treatment system in the event of system problems. Treated water will be stored and tested for PCB before discharge to the river.

The treatment of groundwater generated during the depression of the groundwater table (if needed) would require a water treatment system that could handle the 2,000 gpm pumping rate. In addition to the capacity of the treatment system, the treated groundwater would be required to be stored for two days to allow for testing prior to discharge. Based on the 2,000 gpm pumping rate, approximately 6 million gallons of treated groundwater would require storage. Alternately, pending regulatory agency approval, a process demonstration protocol and acceptance procedure would be developed. Once the treatment system has been initially demonstrated and accepted by the regulatory agencies, direct discharge would be allowed with compliance testing conducted at agreed to intervals. In the event that compliance testing showed that effluent limits were being exceeded, previously agreed to actions would be implemented to assure compliance.

Residuals Transportation and Disposal

Excavated materials would be transported to the staging area using 16-cy dump trucks. Transportation of materials to a licensed disposal facility (i.e. Great Lakes Waste, Inc.) permitted to accept waste under the "Mega Rule", would be accomplished using 48-cy gravel trains. The gravel trains would be loaded at the staging area.

Site Restoration

Upon completing the excavation, the work area isolation system, including the sheetpile present at the A-Site, would be removed and the remaining excavated areas would be backfilled with clean material and graded to mimic the conditions of the native floodplain prior to the placement of waste. This would include a minimum 6-inch layer of earthen material and vegetative cover to minimize erosion due to storm water flow and flood conditions.

The following detailed analysis evaluates the alternative with respect to the nine criteria introduced in Section 7.1.

Overall Protection of Human Health and the Environment

Alternative 3 is considered protective of human health and the environment by removing from the site and permanently disposing of PCB-containing materials in a permitted facility. This alternative could achieve the RROs and virtually eliminate risk through the removal and disposal of PCB-containing residuals.

Compliance with ARARs

Applicable ARARs/TBCs for this alternative are summarized in Table 6-2. Specific ARARs that directly influence implementing this alternative are discussed below.

- **U.S. Department of Transportation (USDOT) Placarding and Handling (40 CFR 171).** This ARAR regulates transportation and handling requirements for material containing PCB with concentrations greater than 20 mg/kg. This alternative involves the transport of up to approximately 762,200 cy (634,200 cy material plus stabilizing agent) of material with average concentrations over 20 mg/kg. The design and logistics of the transportation aspects of this alternative would be in compliance with this ARAR.

- **Clean Water Act, Federal Water Pollution Control Act.** This ARAR establishes federal criteria to protect aquatic life and human health, as well as monitoring requirements for discharging waste treatment effluent to U.S. waters. This alternative would involve treating water (from the dewatering) that is to be discharged back into the river and could comply with this ARAR.

- **Part 201 of the NREPA.** This state ARAR provides for the identification, risk assessment, evaluation, and remediation of contaminated sites within the state. At sites of environmental contamination, this ARAR establishes generic cleanup criteria, and allows development of additional site-specific criteria to protect the environment, considering ecological risks (Section 20120(a)(17)). Acceptable residential criteria (4 mg/kg PCB) are already attained in all adjacent residential areas sampled, except one small Kalamazoo Township-owned area at the end of Carlton Avenue (AMW-3A Area), which could easily be addressed under Alternative 3. On site, implementation of Alternative 3 could, at a minimum, achieve the applicable criteria.

- **Part 31 of the NREPA.** This ARAR establishes state standards to be used to ensure contaminants in rivers, creeks, and floodplain area, are protective of aquatic life and human health. This ARAR also establishes monitoring requirements and criteria for discharging waste treatment effluents. To meet this ARAR, all wastewater generated to implement this alternative requires treatment prior to discharge in accordance with a Substantive Requirements Document. This requirement would also apply to stormwater runoff.

- **Part 91 of the NREPA**. This ARAR pertains to soil erosion, sedimentation, and control of erosion and sedimentation. The ARAR requires that an earth change be designed, constructed, and completed in a manner that limits the exposed area of any disturbed land for the shortest possible period of time as determined by the county or local enforcing agency. It also requires design of temporary or permanent control measures constructed for the conveyance of water around, through, or from the earth change area to limit the water flow to a nonerosive velocity. This ARAR requires installation and maintenance of temporary soil erosion and sedimentation control measures. The ARAR could be attained under this alternative.

- **Part 55 of the NREPA.** This ARAR establishes criteria regarding air emissions in Michigan. At this OU PCB emissions previously have been at acceptable levels during excavation activities. Since excavating residuals and disturbing the surface of the site during construction could result in increased air emissions, some care would be necessary in final design and remedial action to assure that construction methods do not result in unacceptable emissions. As discussed in Section 5.5, air monitoring performed during the interim response measures conducted between November 1999 and March 2000 indicated that PCB transport via air should not be a factor during implementation of Alternative 3. A site-specific Health and Safety Plan would be developed to monitor emissions and to prevent worker exposure and confirm compliance with these ARARs.

- **TSCA** - This federal ARAR (PCB Remediation Waste Rule (40 CFR Section 761.61)) applies to Alternative 3 because PCB concentrations in some landfill waste materials are greater than 50 mg/kg. The ARAR could be attained if the USEPA Superfund Division Director, in consultation with the TSCA program, reviews a written application and issues a written determination that the disposal method proposed (Alternative 3) will not pose an unreasonable risk of injury to health or the environment.

  The risk-based disposal method proposed under Alternative 3 consists of waste removal (wet and dry excavation), sediment dewatering and stabilization, wastewater treatment, and transport and disposal of the waste in an off- site permitted landfill.

  Implementation of these excavation, stabilization, and disposal elements results in a remedy that would physically remove PCB-containing materials from potential human or ecological contact. As long as

USEPA issues a written determination that Alternative 3 does not pose an unreasonable risk of injury to health or the environment, the ARAR would be satisfied.

- **Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments Act of 1984 (HSWA).** This federal ARAR defines "solid waste" and "hazardous waste," setting forth handling and disposal requirements for each. A waste is defined as hazardous if it is specifically listed or exhibits the characteristics of being ignitable, corrosive, reactive, or toxic. The waste at this OU did not fail EP toxicity tests, and therefore is not characteristically toxic under RCRA, nor is it characteristically ignitable or reactive. Under an off-site disposal remedy, it would be appropriate to run periodic Toxicity Characteristic Leaching Procedure (TCLP) tests on the waste to confirm it is not characteristic hazardous waste, to which RCRA would apply. If portions of the waste are characteristic, they would be subject to full RCRA regulation. Overall, all transportation and disposal requirements under RCRA would need to be satisfied.

- **Rivers and Harbors Act of 1899 (33 USC 403).** The federal Rivers & Harbors Act prohibits unauthorized obstruction or alteration of the navigable capacity of waters of the United States (fill, cofferdams, bulkheads, etc.), except on plans recommended and authorized by the Army Corps of Engineers**.** CERCLA response actions, however, do not require a permit in which the Corps of Engineers typically gives authorization. On CERCLA remedial activities, authority has been deferred to USEPA (Edgar, 1985). The remedial action still must avoid unacceptable obstruction or alteration of the Kalamazoo River channel. This is possible with proper design and construction techniques.

Alternative 3 therefore has the potential to be in compliance with all state and federal ARARs.

Long-Term Effectiveness and Permanence

Alternative 3 would provide the most long-term protectiveness of human health and the environment. It would reduce the risks to workers, trespassers, anglers, and ecological receptors. Additionally, the potential migration of PCB via surface runoff or bank erosion would be eliminated as well. Through the removal of PCB-containing material, Alternative 3 would permanently reduce the potential for long-term effects such as human contact or off-site PCB migration.

Reduction in Mobility, Toxicity, or Volume Through Treatment

Alternative 3 would not result in reductions in mobility, toxicity, and volume of PCB through treatment. However, the volume of PCB-containing material at the WB/A-OU would be reduced through the excavation and off-site disposal of materials. The mobility of the material would be reduced through containment in a permitted landfill. The toxicity of the material would not be changed.

Short-Term Effectiveness

A degree of short term risk to workers and the community is involved with implementing this alternative because the associated work involves intrusive activities for handling and moving materials. These risks may be reduced by the use of engineering controls, safety procedures, and equipment; however, they can never be eliminated.

The excavation stage of this alternative would require a minimum of 605 days of excavation. The excavation of residuals at the A-Site would expose the residuals containing the highest PCB levels (0.77 mg/kg maximum at surface, 330 mg/kg maximum in the subsurface) and would increase the potential exposure risks from existing conditions to human receptors (primarily workers). Compliance with proper health and safety procedures, surface management, and sediment control provisions developed as part of the remedial design would minimize the potential for worker exposure and the uncontrolled release of PCB-containing materials, the potential for off-site migration via surface water runoff, dust-borne releases, and/or accidental releases of residuals to the river. Because of excavation and removal of residuals, Alternative 3 could significantly increase the potential for worker exposure to PCB-containing residuals, soils, or sediments. Potential exposure to nonworkers could increase through the potential for accidents during transportation to the landfill.

Implementability

Implementing Alternative 3 would involve excavating, dewatering, and transporting residuals to permitted landfills. These technologies have been applied successfully to other sites and are considered technically feasible. The materials and qualified commercial contractors are available nationally or locally to implement this alternative. Administratively, the disposal of residuals in a licensed disposal facility is possible.

Two conditions may arise during the wet excavation phase that may complicate the excavation of residuals from below the groundwater table. First, unstable working surfaces may exist due to hydrodynamic pressures that could cause liquefaction at the base of the residuals. Second, excessive excavation seepage might be caused by

upward groundwater gradients, as previously seen during excavation of sediments from the Kalamazoo River adjacent to the Willow Boulevard Site.

The saturated conditions created by seepage and upward groundwater gradients at the base of the residuals would make it very difficult to remediate. Under saturated conditions, the mechanism limiting the effectiveness of removal are the physical mixing of the PCB layer and the underlying layers by the mechanical action of both hydraulic and mechanical dredges. If mechanical excavation were attempted, it would be necessary to dewater liquefied residuals at the base of the excavated area. The water removed from the base of the residuals would require a water removal rate and treatment at a scale of approximately 2,000 gpm.

Although construction equipment for dredging and excavating the 92,000 cy of residuals that exist below the groundwater table is available locally and/or nationally, accessibility to the residuals would be difficult due to the anticipated lack of stable surfaces from which equipment could operate as seen in previous efforts at the work site (as described below). For the dredging and excavation to progress, extensive ground stabilization would be required in the form of dewatering cellular sheetpile structures backfilled with granular fill materials. Between November 1999 and January 2000, interim response activities were conducted to remove PCB-containing sediment from the Kalamazoo River adjacent to the Willow Boulevard Site. The vicinity of the Kalamazoo River and the constant inflow of groundwater into the excavation area complicated removal efforts. Similar conditions are expected to occur during excavation of the residuals in the vicinity of the groundwater table.

Cost

Alternative 3 costs are associated with the following construction activities: mobilizing/demobilizing, work area preparation, excavating residuals, stockpiling/stabilizing residuals, dewatering residuals, water treatment, transport and disposal of materials, site restoration, and health and safety. The estimated capital cost associated with Alternative 3 is approximately $46.14million. The transport and disposal of the excavated residuals accounts for approximately 42 percent of the total capital cost. If portions of the waste at the OU were found to be characteristically hazardous under RCRA, there would be an incremental cost associated with treatment prior to disposal. This is not likely, and is mentioned only to suggest that costs of this remedy could be higher. Details of the cost estimate are summarized in Table 7-2.

Community Acceptance

It is anticipated that the community would fully support Alternative 3, as it is consistent with their often-stated preferred alternative (complete removal of residual waste). Community acceptance will be further evaluated upon receipt of public comment to this RI/FS and the Proposed Plan.

Support Agency Acceptance

The State has gone on record (Zugger, 1989) indicating their first preference would be complete removal of PCB-contaminated materials from the floodplain. As this is clearly the most permanent remedy and would virtually eliminate risk associated with the OU. Minimal operation and maintenance would be required and only until vegetation became established. It is highly probable that the MDEQ would give full support if Alternative 3 were selected. Support Agency acceptance will be evaluated further upon receipt of comment on the Proposed Plan.

7.2.4 Alternative 4 - Removal of Residuals from Willow Boulevard Site and Consolidation at the A-Site

The primary objective of this alternative would be to remove the PCB-containing residuals (approximately 158,800 cy) from the WB/A-Site OU and ancillary areas to establish a barrier between PCB-containing residuals and the Kalamazoo River. This would greatly reduce potential risks of PCB transport, and protect workers, and trespassers (including anglers) from exposure with PCB-containing residuals, soils, or sediments. Following consolidation of materials, a final cover system, including an FML, would be constructed over the A-Site. In addition, the cover system would be constructed over the area south of the A-Site berm to protect against the potential for PCB-containing material transport to Davis Creek and the Kalamazoo River. Figure 23 presents a conceptual cross-section of the proposed cap. This alternative would provide source control via removal of the residuals, thereby reducing or eliminating the need for long-term monitoring or management at the Willow Boulevard Site and east of Davis Creek. Excavated residuals would be consolidated at the A-Site. Following the removal and disposal of residuals, the areas would be backfilled and/or graded and restored to mimic the native floodplain prior to placement of waste material.

A hydrogeologic monitoring program would be implemented, establishing points of compliance near the river. Results would be compared to generic GSI criteria or mixing zone-based criteria. In case groundwater criteria are not met, a contingent groundwater collection and treatment system is part of this alternative. It is assumed that groundwater samples will be collected starting the first year of post-remediation monitoring activities, in accordance with an approved groundwater monitoring plan. This assumption does not preclude implementation of groundwater monitoring sooner, as additional data may maximize remedial design efficiency. Groundwater

samples will be collected quarterly starting the first year of post-remediation monitoring activities. The results of the monitoring will be reviewed periodically. After 5 years, the monitoring frequency could be modified, if approved by the MDEQ and USEPA.

The alternative would entail the following tasks:

- Mobilization/demobilization;
- Preparation of the site (A-Site clearing and grubbing);
- Excavation of residuals above the water table;
- Stabilization of excavation area (berms, sheetpiling);
- Excavation of residuals located below the original water table;
- Dewatering and stabilizing high-water residuals (from below the water table);
- Transport and consolidate at the A-Site;
- Testing of remaining materials for the presence of PCB;
- Backfill and regrade the site;
- Cover system installation at A-Site (including south of A-Site berm); and
- Restore affected areas.

Detailed descriptions of key components of the alternative are provided below.

Site Preparation

The excavation and relocation of the residuals from the Willow Boulevard Site would include the establishment of erosion controls on land and sediment transport controls in the Kalamazoo River. A work area isolation system (e.g., sheetpiling) would be installed along the river at the Willow Boulevard Site; the perimeter of the installed system would enclose the residuals. The installed isolation system would serve to minimize the inflow of the Kalamazoo River to the excavation area as well as reduce the potential for site materials to migrate into the river.

Dry Excavation

Excavation activities at the Willow Boulevard Site would first include the excavation and removal of residuals that do not require dewatering. Since these residuals provide a barrier against the vertical flow of groundwater, this first phase of excavation would leave approximately two feet of residuals above the groundwater table in place. Residuals above and within the perimeter berm would be excavated to an elevation of 762 feet amsl. The

estimated volume of residuals removed would be 140,800 cy. The residuals would be excavated using a 4-cy excavator with materials placed into a 16-cy dump truck and moved to a staging area. Assuming a removal rate of 1,200 cy per day, it would require approximately 5 months to complete this phase of work.

Wet Excavation

The second excavation phase at the Willow Boulevard Site would commence at the conclusion of the initial excavation, and would include the removal of the two feet of residuals above the groundwater table and the residuals located below the groundwater table within the confines of the site. The estimated volume of residuals in this phase of excavation is 18,000 cy.

This second excavation phase would begin at the edge of the river. Continuous "strips" approximately 25 feet wide would be removed along the length of the shoreline. Upon completing each strip, the excavated area would be backfilled with clean material before removing the next strip of materials. If it is determined by the contractor that the working surface is not stable enough to support the excavation equipment, additional material (including gravel, clean fill, and sheetpiling) may need to be installed to stabilize the working surface during the excavation. Excavation would be implemented using the 4-cy excavator, and the amount of material to be removed would be based on visual characteristics, with only native material remaining. The estimated volume of material to be removed during this phase is 18,000 cy; assuming 600 cy removed per day, at least 1 month would be required to complete this phase. Conditions that could complicate excavation of residuals from below the groundwater table are discussed in the implementability analysis of this alternative.

Excavation activities at the area south of the A-Site berm will remove approximately 2,900 cy or that volume necessary to construct the drainage swale; excavation activities east of Davis Creek will remove approximately 3,800 cy. The visible residuals would be excavated using a 4-cy excavator with materials placed into a 16-cy dump truck and moved onto A-Site. Post-removal confirmatory sampling and analysis would be performed in the excavated area east of Davis Creek. The areas would be backfilled with clean material (to prevent ponding) and revegetated to prevent erosion.

Consolidation at A-Site

Residuals, being removed as part of Alternative 4, would be transported via dump truck to the A-Site, where they would be gravity dewatered (if necessary) mixed with fly ash at a 1:1 ratio for stabilization (if necessary), and graded over the site to provide adequate slopes to achieve drainage and meet Part 115 requirements. The water generated from the dewatering of the residuals would be contained, treated, and discharged into the

Kalamazoo River. The graded residuals would ultimately be contained beneath a cover system, including a FML, installed as part of the A-Site closure activities.

In the area south of the A-Site and in the Willow Boulevard drainageway area, residuals would be excavated, and consolidated on site below the cap. The excavated areas would be backfilled to grade with clean material. Upon completion of the removal of residuals and backfilling of all excavations, the cap would be extended and a drainage swale constructed. This engineered swale would be constructed with a geomembrane and stone to ensure proper drainage of the WB/A-OU. The backfilling of excavations and the construction of a drainage swale would eliminate the potential for exposure via direct contact or transport to the river via erosion of PCB remaining after excavation.

The low-permeability clay layer found in some landfill cover systems would be substituted by an infiltration layer consisting of a 30-mil FML at the WB/A-OU. The FML would be supported by a 6-inch gas-venting layer/soil cushion and protected by a minimum 24-inch soil layer (that would also serve as the drainage layer) and a minimum 6-inch topsoil layer (erosion layer capable of supporting native plant growth). The protection layer will be designed to provide for lateral drainage of precipitation, minimize frost penetration into the cover system, and protect the FML from root penetration, ultraviolet light and other deleterious effects. A minimum slope of 4% would be required to avoid extensive maintenance to bring all areas up to the minimum required slope during post-closure care period if the cap were to settle. The minimum and maximum slope requirements for this design are shown in Figure 23.

To provide for the long-term effectiveness of the cover system, and as required by Part 201, Section 20120b, institutional and erosion controls would be established for the OU, including the AMW-3A area. Appropriate long-term controls would include deed restrictions (e.g., restrictive covenant on land use), perimeter fencing, posting every 200 feet to restrict access to the site, and periodic inspections of the cover system (including maintenance as necessary).

In addition, long-term groundwater monitoring will be a component of the operation and maintenance of Alternative 4. Long-term groundwater monitoring will consist of the following:

- Preparation of a groundwater monitoring plan;
- Installation of a groundwater monitoring network, including point of compliance wells;
- Collection of scheduled sampling; and

- A contingency plan. In the event PCBs or other contaminants are detected above the appropriate GSI criteria at the point of compliance wells, it may be necessary to operate and maintain groundwater control or treatment systems.
- If the groundwater is found to be transporting PCB's or other contaminants off-site to adjacent water bodies, it may be necessary to construct, maintain and operate a groundwater collection and treatment system for the A-Site.

Site Restoration

Restoration activities would include backfilling excavated areas to establish grades similar in character to other areas along the Kalamazoo River in the vicinity of the Willow Boulevard Site (i.e., approximate elevation 760 feet amsl). Disturbed above-water areas would be revegetated with native plant species, with some subaqueous areas remaining as part of the river.

Presented below is a detailed analysis of the excavation and relocation alternative with respect to the nine criteria.

Overall Protection of Human Health and the Environment

Alternative 4 would be protective of human health and the environment by removing from the Willow Boulevard Site and consolidating PCB-containing materials at the A-Site. This would eliminate risk of exposure to PCB-containing materials at the Willow Boulevard Site, east of Davis Creek, and area south of the A-Site berm. This alternative will also eliminate the potential for direct contact with residuals and reduce PCB transport to the Kalamazoo River by construction of erosion control measures. This would be accomplished through consolidation, erosion control, cap placement, institutional controls, and long-term maintenance. Placement of a cap system that includes an FML would decrease infiltration, thereby reducing the potential for PCB to leach into the groundwater. This alternative would achieve the RROs and substantially reduce risk through the removal and containment of PCB-containing residuals and soils and the installation of a long-term groundwater monitoring network.

Compliance with ARARs

Applicable ARARs/TBCs for this alternative are summarized in Table 6-2. Specific ARARs that directly influence implementing this alternative are listed below.

- **Clean Water Act, Federal Water Pollution Control Act.** This ARAR establishes federal criteria to protect aquatic life and human health, as well as monitoring requirements for discharging waste treatment effluent to U.S. waters. This alternative would involve treating water (from the dewatering process) prior to discharge to the river. To comply with this ARAR, wastewater would require treatment and handling consistent with an SRD.

- **Part 201 of the NREPA.** This state ARAR provides for the identification, risk assessment, evaluation, and remediation of contaminated sites within the state. At sites of environmental contamination, this ARAR establishes generic cleanup criteria, and allows development of additional site-specific criteria to protect the environment, considering ecological risks (Section 20120(a)(17). Appropriate residential criteria (4 mg/kg PCB) are already attained in adjacent residential areas that were sampled, except in one small area at the end of Carlton Avenue; this area can be easily addressed under Alternative 4. On site, implementation of Alternative 4 would also achieve applicable cleanup criteria and reduce exposure and associated risk to acceptable levels. Alternative 4 might not comply with Part 201 if there is groundwater transport of contaminants to surface water; however, the ARAR could be attained with implementation of a contingent groundwater remedy. Costs were developed for this contingency for a groundwater collection and treatment system for the A-Site.

- **Part 31 of the NREPA.** This ARAR establishes state standards to be used to ensure contaminants in rivers, creeks, and floodplain area, are protective of aquatic life and human health. It also establishes water quality criteria and monitoring requirements for discharge effluents and venting groundwater, specifying standards for several water quality parameters, including PCB. To meet this ARAR, all wastewater generated to implement this alternative would require treatment prior to discharge in accordance with an SRD. Ensuring that venting groundwater does not exceed Rule 57 criteria (and implementing containment contingency plans if criteria are not met) could achieve this ARAR.

- **Part 91 of the NREPA**. This ARAR pertains to soil erosion, sedimentation, and control of erosion and sedimentation. The ARAR requires that an earth change be designed, constructed, and completed in a manner that limits the exposed area of any disturbed land for the shortest possible period of time as determined by the county or local enforcing agency. It also requires design of temporary or permanent control measures constructed for the conveyance of water around, through, or from the earth change area to limit the water flow to a nonerosive velocity. This ARAR requires installation and maintenance of

temporary soil erosion and sedimentation control measures. The ARAR could be attained under this alternative.

- **Part 115 of the NREPA.** This ARAR establishes the requirements for closure of a Part 115 permitted landfill. Although the WB/A-OU was not licensed under Act 451, this act is considered an ARAR for the site. Adequate physical separation between waste and surface water is required. Implementation of the alternative to consolidate the materials at the A-Site provides separation of the waste from direct contact with the surface water.

- **Part 55 of the NREPA.** This ARAR establishes regulations regarding air emissions. Current PCB emissions are within acceptable limits. Since excavation of select residuals and disturbance of the surface of the Willow Boulevard Site and A-Site during construction could result in increased air emissions, the final design would be structured to assure that construction methods do not result in unacceptable emissions. As discussed in Section 5.5, air monitoring performed during the IRA activities conducted between November 1999 and March 2000 concluded that PCB transport via air will not be a factor. A site-specific Health and Safety Plan would be developed to monitor emissions and prevent worker and community exposure.

- **TSCA.** This federal ARAR (PCB Remediation Waste Rule (40 CFR Section 761.61)) applies to Alternative 4 because PCB concentrations in landfill waste materials are equal to or greater than 50 mg/kg. The ARAR could be attained if the USEPA Superfund Division Director, in consultation with the TSCA program, reviews a written application and issues a written determination that the disposal method proposed (Alternative 4) will not pose an unreasonable risk of injury to health or the environment.

  The risk-based disposal method proposed under Alternative 4 consists of waste removal (wet and dry excavation), sediment dewatering and stabilization, wastewater treatment, and transport and disposal of the waste in the A-site portion of the site.

  Implementation of these excavation, stabilization, and disposal elements results in a remedy that would physically remove PCB-containing materials from potential human or ecological contact at the Willow Boulevard site and contain them at the A-site. As long as USEPA issues a written determination that Alternative 4 does not pose an unreasonable risk of injury to health or the environment, and the integrity of the A-site containment system is maintained in perpetuity, the ARAR would be satisfied.

- **Rivers and Harbors Act of 1899 (33 USC 403).** The federal Rivers & Harbors Act prohibits unauthorized obstruction or alteration of the navigable capacity of waters of the United States (fill, cofferdams, bulkheads, etc.), except on plans recommended and authorized by the Army Corps of Engineers**.** Remedial activities, which may require a permit to perform, must be conducted in such a way that they will avoid unacceptable obstruction or alteration of the Kalamazoo River channel.

Alternative 4 has the potential to meet at state and federal ARARs.

Long-Term Effectiveness and Permanence

Alternative 4 would provide long-term protectiveness, by greatly reducing the risks associated with human exposure. It would reduce the health risks to workers, trespassers, and anglers, and ecological receptors would reduce the potential migration of PCB via surface runoff or erosion. Through the removal of PCB-containing residuals from the Willow Boulevard Site, the area south of the A-Site berm, and east of Davis Creek, this alternative would permanently reduce the potential for long-term effects such as human contact or off-site PCB migration.

In the long term, the reliability of this alternative would be managed through cap inspection, maintenance, and repair activities as necessary, as well as a long-term groundwater monitoring at the perimeter of the WB/A-OU. The details of these activities would be developed during remedial design and compiled into a hydrogeologic monitoring program and O&M manual for the site.

Reduction in Mobility, Toxicity, or Volume Through Treatment

This alternative would not result in reductions in mobility, toxicity, or volume of PCB through treatment. While the volume of PCB-containing material at the Willow Boulevard Site and east of Davis Creek would be reduced, the material would be consolidated on the A-site, resulting in no net reduction of volume for the OU overall. The mobility of the material would be significantly reduced through containment at the A-Site under a cap (including an FML). Unless contingent groundwater treatment is necessary, the toxicity of the material (through treatment) would not be reduced.

Short-Term Effectiveness

The excavation stage of this alternative of 158,800 cy would require a minimum of 150 days of excavation (1,200 cy for dry excavation and 600 cy for wet excavation removed per day). Assuming 250 working days in 1 year, this phase of the project would last more than half a year. In the short term, excavation of residuals may

increase the potential exposure and releases to nearby receptors, such as site workers. Short-term protectiveness is also limited by the potential for PCB to migrate via airborne dust, surface water runoff, potential accidental releases from the dewatering/water treatment process, and residuals transport, despite the containment measures that will be in place. Other aspects of this remedial alternative that constrain its short-term effectiveness are the potential for increased air emissions and increased risk of accidental release during residuals handling.

Compliance with proper health and safety procedures and surface management and sediment control provisions developed as part of the remedial design would reduce the potential for worker and community exposure, the uncontrolled release of PCB-containing residuals, off-site migration via surface water runoff, dustborne releases, and/or accidental releases of residuals to the river.

Other aspects of this remedial alternative that constrain its short-term effectiveness are the potential for increased air emissions and increased risk of accidental release during residuals handling.

Implementability

Implementing Alternative 4 would involve excavation, dewatering, consolidation of residuals at A-Site, capping, long-term monitoring, and operation and maintenance of the containment system. In the event of GSI exceedances, Alternative 4 might involve the installation, operation and maintenance of groundwater control and treatment technologies. These technologies have been applied successfully to other sites and are considered technically feasible. Administratively, the disposal of residuals at A-Site is possible.

The services and materials necessary to implement this alternative are available locally or nationally. Discussions with local suppliers have indicated that sufficient quantities of capping materials are available. Qualified commercial contractors are available to perform the work, and construction equipment could be obtained and transported to the site.

The saturated conditions created by seepage and upward groundwater gradients at the base of the residuals would make it very difficult to remediate. Two conditions may arise during the second phase (wet excavation) that could complicate the excavation of residuals from below the groundwater table. First, unstable working surfaces may exist due to hydrodynamic pressures that could cause liquefaction at the base of the residuals. Second, excessive excavation seepage might be caused by upward groundwater gradients, as previously seen during excavation of sediments from the Kalamazoo River adjacent to the Willow Boulevard Site between November 1999 and January 2000. Under saturated conditions, the mechanism limiting the effectiveness of

removal are the physical mixing of the PCB layer and the underlying layers by the mechanical action of both hydraulic and mechanical dredges. Considering these two conditions, mechanical excavation activities may require dewatering of the excavation area. The dewatering may necessitate the daily storage and treatment of this water throughout this excavation phase if demonstration and acceptance of the water treatment system cannot be negotiated with the regulatory agencies.

Although construction equipment for dredging and excavating the 18,000 cy of residuals that exist below the groundwater table is available locally and/or nationally, accessibility to the residuals would be difficult due to the anticipated lack of stable surfaces from which equipment could operate as seen in previous efforts at the work site (as described below). For the dredging and excavation to progress, extensive ground stabilization may be required in the form of dewatering cellular sheetpile structures backfilled with granular fill materials.

Between November 1999 and January 2000, removal activities were conducted to remove PCB-containing sediment from the Kalamazoo River adjacent to the Willow Boulevard Site. Removal efforts were complicated by the vicinity of the Kalamazoo River and the constant inflow of groundwater into the excavation area. Similar conditions are expected to occur during excavation of the residuals in the vicinity of the groundwater table.

Although the disposal option is possible, the technical feasibility may be hindered. Even though capacity for the 158,800 cy of residuals on A-Site exists, the overall stability of the site during post-placement conditions would require a detailed technical evaluation. Stabilization measures may be necessary to accommodate the additional loading at the site (e.g., increase height and/or strength of existing sheetpile wall, berm stabilization).

Administratively, residuals at the Willow Boulevard Site could be excavated and relocated in accordance with applicable local, state, and federal rules and regulations.

Cost

The costs associated with Alternative 4 include the following construction activities: mobilizing/demobilizing, work area preparation, excavating residuals, dewatering residuals, stockpiling/stabilizing residuals, water treatment, transport and consolidation of materials, capping A-Site, vegetative cover, and site restoration. The capital cost associated with excavating residuals and disposing them at the A-Site is approximately $12.86 million. The annual estimated O&M cost for maintaining the site is approximately $236,000 per year. The 30-year present worth O&M cost is approximately $2.93 million. The total project present worth cost of Alternative 4 is approximately $15.78 million. Costs for a contingency groundwater control and treatment

system for the A-Site are estimated to be $2.13 million for capital cost, $93,000 for average annual O&M costs, an O&M present value of $1.67 million. The total additional project present worth of a groundwater treatment system if required is $3.8 million. If groundwater collection infrastructure were placed prior to cap completion, there would be a substantial cost savings in the event that groundwater collection and treatment is required in the future. Details of the cost estimate are summarized on Table 7-3.

Given that residuals would be fully removed from the Willow Boulevard Site under this remedial alternative, there would be no associated long-term O&M costs for the Willow Boulevard Site. O&M costs for the A-Site include implementation of a long-term groundwater monitoring network. A contingency groundwater treatment or collection system is also considered.

Community Acceptance

Based on verbal comments in various public meetings and written comments received from the public, it is anticipated that the community would be supportive of Alternative 4, as it significantly reduces the landfill footprint. There may be some opposition by immediate neighbors, as the A-site would be physically enlarged (i.e. the final landfill cover would be at a greater elevation). Community acceptance will be evaluated upon receipt of public comment on the Proposed Plan.

Support Agency Acceptance

It is anticipated that the State would be supportive of Alternative 4, contingent on evaluation of the sheetpile at the A-site to determine if sealing joints is appropriate and measures are implemented to prevent public contact with any potentially dangerous components of the remedy. This alternative would reduce risk, remove saturated paper residuals from the floodplain at the Willow portion of the OU, and have a fairly high degree of permanence. Support Agency acceptance will be formally evaluated upon receipt of comment on the Proposed Plan.

7.3 Comparative Analysis of Alternatives

The purpose of this subsection is to evaluate the relative performance of each alternative in relation to the criteria discussed in Section 7.1. The comparative analysis generally will focus on the differences between alternatives with respect to the primary balancing criteria since these factors play the major role in determining which options are cost-effective and which remedy utilizes permanent solutions and treatment to the maximum extent practicable. A discussion of the performance of the alternatives relative to each other according to the criteria is provided below

Overall Protection of Human Health and the Environment

Alternative 1 is the least protective of human health and the environment of all four alternatives. Alternative 1 provides no increased protection over the current conditions and would not be protective of human health and the environment over the long-term for foreseeable land uses. Isolating PCB-containing materials under the cap (Alternative 2 including options 2-A, B and C and Alternative 4) would be protective of human health and the environment by implementing bank stabilization erosion control measures, institutional controls, contingent groundwater treatment, and long-term maintenance to mitigate PCB migration. However, there is a chance that groundwater criteria would not be attained without additional remediation activity. Alternative 3, compared to the other three alternatives, would be most protective of human health and the environment by removal and off-site disposal of PCB-containing materials; groundwater monitoring (and contingent treatment), long-term maintenance, and bank stabilization and erosion control measures would not be required. With Alternative 3, there is no risk that after implementation, groundwater concentrations would exceed protective criteria – in fact it would be expected that the most stringent water quality criteria would be attained. Alternative 4 would be protective of human health and the environment (assuming there are no groundwater impacts) by implementing bank stabilization, erosion control measures, institutional controls, contingent groundwater treatment, and long-term maintenance to mitigate PCB migration at the A-Site. Alternative 4 would also be protective by removal and disposal of PCB-containing materials from the Willow Boulevard Site, south of the A-Site berm, and east of Davis Creek; therefore less river frontage and base area (i.e. smaller landfill "footprint") would require long-term maintenance, bank stabilization, or erosion control measures. Alternative 4 also has the benefit of removing, from the Willow Boulevard Site, saturated residuals lying up to 10 feet beneath the potentiometric surface of the water table.

Compliance with ARARs

Alternative 1 would not be compliant with Part 201, which establishes the cleanup criteria to be used while remediating a site. Alternative 1 would also not comply with the TSCA ARAR, as unreasonable risk of injury to human health and the environment would exist. Alternatives 2, 3, and 4 would comply with TSCA disposal regulations, if a formal determination were made by USEPA. Alternatives 2 and 4 might not be in compliance with Part 201 if there is groundwater transport of PCB to the surface water; contingent remedies are required to confirm ARAR compliance and ensure contaminated groundwater does not vent to the river. However, Alternatives 2 and 4 could be compliant provided appropriate groundwater collection and treatment systems were constructed. Otherwise, with proper design, implementation, and operational control, Alternative 2, 3, and 4 could be in compliance with all ARARs.

Long-Term Effectiveness and Permanence

A primary measure of the long-term effectiveness of an alternative is the magnitude of residual risk to human health and the environment after remediation. Alternative 1 would not be an effective or permanent alternative, because it does not reduce risk. With proper and effective operation and maintenance, Alternatives 2, 3, and 4 would provide long-term effectiveness by isolating or removing PCB-containing materials from the OU. Alternative 3 has the highest degree of long-term effectiveness and permanence because all materials containing PCB are excavated and removed from the site and placed in permitted landfill. Consistent with the site AOC, a preference is given to Alternative 3, as it minimizes the requirement for long-term management of residuals. Alternatives 2 and 4 (consolidation and containment) also have a high degree of effectiveness, but must rely on long-term management to prevent barrier degradations and ensure that potential exposure pathways are controlled. The magnitude of residual risk and exposures to human health and the environment is directly related to the adequacy and reliability of the cover system, long-term groundwater monitoring, groundwater contingency plans, and institutional controls.

Reduction in Mobility, Toxicity, or Volume Through Treatment

None of the alternatives (assuming groundwater treatment is not necessary) would reduce mobility, toxicity, or volume through treatment. Alternative 1 would achieve no reduction in mobility of contaminated residuals along the river bank or floodplain, no reduction whatsoever in toxicity, and no reduction in volume. Alternative 2 would reduce mobility by isolating residuals in place through consolidation of residuals/soils and placement of a cap (with an FML), but there is no net reduction of volume at the site. Alternative 2 does not eliminate the potential mobilization of contaminants to the groundwater surface water interface, as saturated residuals (beneath the surface of the water table) would remain at the Willow Boulevard Site. Some risk of contaminants moving to the river via venting groundwater would remain. Alternative 3 would greatly reduce the potential mobility of contaminated materials through containment in an off-site landfill. All saturated residuals (beneath the surface of the water table) would be placed in encapsulated landfill cells, specifically designed to retain contaminants. Alternative 3 would also reduce the volume of PCB-containing material at the WB/A-OU through excavation and off-site disposal of materials, but this volume would just be moved to another area. Alternative 4 provides no net reduction in volume since the PCB-containing material at the Willow Boulevard Site and ancillary areas would be consolidated at the A-Site. Alternative 4 would, however, reduce mobility through containment at A-Site under a cap (with an FML). Saturated residuals would be removed from the Willow Boulevard site and placed at the A-site above the water table. If a contingent groundwater treatment system were necessary (under Alternative 2 or 4), there would be some reduction in toxicity through treatment.

Short-Term Effectiveness

Alternative 1 does not involve concerns with effectiveness in the short term since no construction activities would be implemented. Alternative 2 has short-term effectiveness concerns because it involves excavating and moving residuals. Although the use of site controls and monitoring reduce the potential for short-term impacts, risks increase proportionally with increased handling of materials. Because Alternative 3 involves removal and transport of a large amount of material, it poses an incremental increased short term exposure risk and a possible further reduction in short term effectiveness. Alternative 4 also involves similar short term effectiveness concerns, but does not involve as much excavation, materials handling, or transportation as Alternative 3. These factors make Alternative 3 the least effective in the short term. Alternative 2 has the most short term effectiveness.

Implementability

Alternative 1 cannot truly be evaluated by this criterion; however, Alternatives 2, 3, and 4 are based upon proven technologies and are considered technically feasible. The services and material necessary to implement Alternatives 2 and 4 are available through local vendors or could be readily transported to the OU. The magnitude of Alternative 3 would require a substantial amount of equipment. The engineering, design, and administrative requirements increase with the complexity of the alternatives in the following order: Alternative 2, limited excavation, Alternative 4, extensive excavation, consolidation and containment of select materials; and Alternative 3, complete excavation, removal, and off-site disposal. The degree of difficulty in implementing these alternatives increases with the amount and type of material to be excavated and the distance to the selected disposal facility.

Excavation of residuals that exist above the groundwater table is expected to be fairly uncomplicated. However, excavating residuals from below the groundwater table may present a high degree of technical difficulty. Due to the magnitude of work required for Alternatives 3 and 4, Alternative 2 is considered more implementable.

Alternative Project Present Worth Costs

Alternative 1 has no associated capital or O&M costs. The range of total project present worth costs for Alternative 2 (including the subalternatives described) is approximately $11.6 million to $14.8 million if groundwater treatment is not required and $15.9 to $19.1 million if groundwater treatment is required. Alternative 3, although it has no O&M costs, has a project present worth cost of approximately $ 46.1 million The total project present worth cost for Alternative 4 is approximately $15.8 million if groundwater treatment is

not required and $19.6 million if groundwater treatment is required. A summary of costs is provided in Tables 7-1A, 7-1B, 7-1C, 7-2, 7-3 and 7.4.

Community Acceptance

Community acceptance of the various alternatives can be completely evaluated only upon review of public comment to the Proposed Plan. In lieu of actual public comment, a preliminary analysis of community acceptance is based on comments gleaned from several sources:

Summaries of previous public meetings (Moore, 1984; Geitka, 1984)

In 1984, potential remedies for the WB/A site were discussed at a public meeting. Members of the public expressed concern with venting groundwater. Another citizen specifically asked for removal of contaminated soils, especially those saturated with groundwater.

Kalamazoo Gazette article (1990)

One newspaper article summarized a public meeting on previous "consolidate and cap" proposals for this Operable Unit. According to the article, the public has historically indicated preferences for:

- an alternative that would reduce the size of the landfill footprint, as they considered capping a loss of community resource.
- remedies that remove PCBs from the site

Letter from the Chairman of the Kalamazoo County Board of Commissioners (Drenth, 1990).

This letter outlined concerns with a remedial action plan, previously proposed at Willow Boulevard. This board, elected by the public indicated:

- a containment plan appeared to be the best alternative presently available, but was considered an interim action.
- a preference for removal of the PCB contaminated soils and sediments where practical.
- a concern that groundwater could be a potential source of contamination to the Kalamazoo River.
- a desire to include, with the remedy, a stipulation that the Willow Boulevard Site be reviewed every three to five years to determine if technology has become available to allow removal of the PCBs.
- any economic redevelopment plan for the Kalamazoo River would be hindered until removal of PCBs is accomplished.

Transcripts of meetings on similar Operable Units (Great Lakes Shorthand Reporting, 1994)

In a public meeting on the Proposed Plan at the King Highway Landfill, several public comments were recorded.

- the Kalamazoo River Protection Association stated they were "not very supportive" of a consolidate and cap remedy. The citizen's group also indicated a desire for a remedy that did not preclude trails near the river.
- a representative of a neighborhood association clearly indicated a preference for alternatives that removed and disposed of materials off site
- one citizen called capping "the most realistic and probably the best approach."

The Responsiveness Summary attached to the King Highway Record of Decision *(MDEQ, 1998)*

The remedy selected for the King Highway Operable Unit was "consolidate and cap." Comments on the alternatives evaluated included:

- an unknown number of commenters and the Kalamazoo River Protection Association expressing preferences for alternatives involving removal and treatment.
- three commenters supported a cap and contain alternative, saying such things as it "is the lowest cost while protecting the environment"
- an unknown number of people supported a cap and contain remedy, but only with consideration of future treatment.
- two commenters stated that any cap and contain remedy should be compatible with future recreational use.

Kalamazoo River Area of Concern Public Advisory Council newsletter (PAC, 1998)

This publication stated the Council's position that consolidate and cap remedies are "far from an idea solution" and are "seen as a short-term solution." The PAC further stated that "future flooding or deterioration of containment structures and materials is clearly possible." They also stated that "on-going monitoring is essential."

Summary of Comments Received on the Draft RI/FS for the Kalamazoo River *(von Gunten, 2002)*

While the "consolidate and contain" alternatives in the River RI/FS were specific to cleanup of the river, the comments pertaining to containment might apply to the Operable Units, as well.

- 26 letters specifically supported the Kalamazoo River Protection Association preference that PCB-waste "must be disposed of in off-site landfills"; KRPA also stated no landfills should be allowed adjacent to the river.
- 405 respondents expressed desires consistent with removal, offering support for an alternative that would "use off-site approved landfills" No respondent spoke out against off-site disposal or in favor of on-site disposal facilities.
- 2 individuals expressed that "PCB contaminated material must be disposed of in an off-site licensed landfill or through a yet-to-be determined PCB decontamination technology.

The Responsiveness Summary attached to the 12th Street Landfill Record of Decision *(MDEQ, 2001)*

The remedy for the 12th Street Landfill is "consolidate and cap." Comments on the selected alternative include:

- Six individuals, the Kalamazoo River Protection Association, and the Michigan United Conservation Clubs indicated a preference for removing the landfill out of the 100 year floodplain.
- Three commenters and the Kalamazoo River Protection Association stated if the cap remedy were selected, containment walls or berms are needed at the landfill due to its proximity to the river. A bulkhead was suggested for support and erosion control
- Four commenters expressed a concern over reduced recreational use and aesthetics with the capping remedy.
- "Many commenters" stated support for the cap remedy because it prevents contaminants form migrating to the Kalamazoo River and Lake Michigan.
- One commenter and the KRPA suggested application of ecologically protective criteria for areas outside the landfill.

Letter from Michigan Environmental Council *(MEC, 2003)*

This letter requested that the Proposed Plan for the Willow/A-Site require "that existing steel wall and riprap materials (currently in the river) be removed and that the contamination be removed and placed at least 300 feet upland of the existing wall and that a natural wildlife green belt at least 200 feet in width be established to restore the biological and aesthetic feature for this stretch of the river for the benefit of wildlife and tourism."

As evidenced by the recent MEC letter, comments similar to those previously received are anticipated. It is expected that the public would enthusiastically support a removal alternative (Alternative 3). Support of capping (Alternatives 2 and 4) is likely to be limited and is anticipated to be increased if it (1) does not completely restrict beneficial use of the area (Alternative 2B, 2C, or 4); (2) reduces the size of the Landfill footprint (Alternative 2B, 2C, or 4) (3) uses risk-based criteria in ancillary areas (Alternatives 2 through 4) and (4) does not preclude future treatment of the waste. It is probable that community acceptance would rank in the following order:

- Alternative 3 - most acceptable, as it is consistent with the historic preferences
- Alternative 4 – moderately acceptable as it greatly reduces the landfill footprint and removes the Willow portion from the floodplain
- Alternative 2 and subalternatives – slightly acceptable. Due to limited footprint reduction and addition of engineered habitat, Alternative 2C is anticipated to be the public's preferred subalternative
- Alternative 1 - not acceptable

Support Agency Acceptance

Support Agency acceptance cannot be completely evaluated until receipt of public comment on the Proposed Plan. A preliminary analysis of State acceptance is provided here. It is based in part, on a review of historic site files.

The State's documented preference (Zugger, 1989) is an alternative that removes of all contaminated materials from the floodplain (Alternative 3). Upon reviewing "consolidate and cap" remedies, similar to those outlined in Alternatives 2 and 4, the State acknowledged that sheetpiling has a limited lifespan (and there is no underlying clay till to key into for complete encapsulation), but indicated consolidation, sheetpiling, and geomembrane capping is technically feasible. The review also concluded that with maintenance, monitoring, and replacement requirements, a "consolidate and cap remedy" would be protective of public health and the environment. The State indicated that if capping were implemented, periodic evaluation of the feasibility of on-site treatment would be necessary; further, if ever deemed feasible, on-site treatment would be required.

The State previously deemed a "consolidate and cap" remedy (Alternative 2) acceptable. It should be noted, however, that acceptance was conditional on resolution of a number of issues, including: (1) insuring sheetpiling

is sealed between piling sections and the cap and (2) evaluation of the installation of sheetpiling on the south side to further reduce groundwater infiltration through the site.

The State could not accept Alternative 1, as it would not comply with Part 201 of the NREPA. The options under Alternative 2 would likely be accepted, but with the conditions mentioned above. Alternative 3 would definitely be accepted, as it is the most protective and achieves the mandated preference (MCL 324.20118) for remedial alternatives that permanently and significantly reduce the volume, toxicity, or mobility of hazardous substances. It is likely Alternative 4 would also be accepted.

Pairwise Analysis of Alternatives

To assist in the relative evaluation of alternatives, a pairwise comparison was developed to compare each remedial alternative according to the nine evaluation categories specified by the NCP. A summary of this pairwise evaluation is presented in Table 7-4. For each remedial alternative pair, a three point scale was used for alternative ranking; three points if one remedial alternative was superior to another, two points if they were equal and one if the remedial alternative was inferior to the other. An example, for the evaluation category "Overall Protection of Human Health and the Environment", when remedial alternative 3 (Removal and Off-site Disposal) is compared to remedial alternative 1 (No Action), remedial alternative 3 would be given 3 points, as it is more protective to the human health and environment; remedial alternative 1 would be given 1 point, as it is not protective. The points for each remedial alternative were then summed by NCP evaluation categories. Using this evaluation tool alone, remedial alternative 2C (Consolidation/Containment of Selected materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard) was ranked highest.

A weighting factor was then applied to each of the nine NCP evaluation criteria, so components of criteria that are given weight according to their NCP criteria category. Items given a five multiplier were the two threshold criteria: overall protection of human health and the environment and compliance with ARARs. The Primary Balancing Criteria were given a three multiplier: long-term effectiveness and permanence, reduction of toxicity, mobility, or volume through treatment, short-term effectiveness, implementability, and cost. The two Modifying Criteria were given a one multiplier, and are State acceptance and community acceptance. The results of this weighted evaluation are also presented in Table 7-4. Using the weighted averages, the six remedial alternatives were ranked with the highest weighted sum score being ranked first and the lowest weighted sum being ranked seventh.

Using the weighted sum of the remedial alternatives evaluated under the NCP evaluation criteria, the highest ranked alternative is remedial alternative 2C. While this remedial alternative is similar to the selected and approved remedy for the KHL (OU3) and 12th Street Landfill (OU4), it has enhancements, that when pair evaluated, attempt to address community concerns and provides a better overall remedial alternative. These enhancements include a more ecologically friendly dike and protected river bank, a physical separation between the river high flow and the Operable Unit which will reduce potential damage during flood events, and a physical presence which will blend in better with the adjacent residential neighborhoods.

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TABLE 3-1

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF WATER WELLS WITHIN $^1/_2$ MILE OF THE OU

Well ID Number	Year Installed	Total Depth (ft)	Depth of Screen Interval (ft)	Reported Use
445	1968	55	52 - 55	Domestic
1279	1968	55	52 - 55	Domestic
1856	1987	37	NS	Domestic
1857	1968	55	52 - 55	Domestic
1938	1969	56	36 - 56	Industrial
1939	1972	50	40 - 50	NS
City of Kalamazoo Pumping Station #5				
2046	1951	98	NS	Public supply
2047	1953	100	NS	Public supply
2048	1966	120	NS	Public supply
2049	1966	120	NS	Public supply

Notes:
NS - Not specified in well records.
Data compiled from review of state and county well logs and other records.
No wells were reported as being within $^1/_4$ mile of the OU. See Figure 11 for approximate geographic location of each well.

TABLE 3-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

2000 GROUNDWATER/SURFACE WATER ELEVATIONS (ft amsl)

Well	Reference Elevation[1]	Measurement Date							
		10/30/2000	11/1/2000	11/3/2000	11/6/2000	11/8/2000	11/10/2000	11/18/2000	12/21/2000
Willow Boulevard Site									
WMW-1	763.78	758.23	758.30	NA[2]	NA[2]	NA[2]	NA[2]	NA[2]	755.98
WMW-1A	764.41	757.84	757.78	757.81	757.59	757.61	758.13	758.68	758.20
WMW-2	766.16	756.43	756.41	756.31	756.13	756.30	756.56	757.23	NA[3]
WMW-3	769.16	755.36	755.33	755.30	755.20	755.29	755.58	756.23	755.95
WMW-3A	771.19	756.27	756.22	756.13	755.97	756.16	756.52	757.17	756.74
WMW-3AR	770.60	755.85	755.81	755.72	755.57	755.76	756.11	756.75	756.36[4]
WMW-4A	774.54	756.32	756.28	756.17	755.96	756.03	756.15	757.16	756.84
WMW-4B[5]	774.61	756.11	756.05	756.01	755.87	755.99	756.29	756.99	756.61
A-Site									
AMW-1[5]	773.45	NA	757.03	756.97	757.01	756.98	757.26	757.73	757.42
AMW-2	772.37	756.06	756.05	756.03	755.90	755.96	756.25	756.71	756.42
AMW-3	769.06	759.62	759.59	759.56	759.54	759.59	760.01	759.99	759.74
AMW-3A[11]	765.54	NA	759.86	759.83	759.79	759.85	760.29	760.27	759.97[4]
AMW-4	772.42	756.85	756.82	756.77	756.70	756.77	757.07	757.50	757.29[4]
AMW-5[5]	775.13	NA	757.09	757.04	756.96	757.03	757.31	757.71	757.42
AMW-6A[11]	774.13	757.18	756.93	757.23	756.88	756.78	757.33	757.78	758.13
AMW-6B	773.99	756.19	756.20	756.17	756.06	756.11	756.36	756.93	756.61
AMW-6P	774.16	766.52	766.67	766.56	766.43	766.42	767.03	767.46	766.79
AMW-7A[5]	778.54	757.33	757.27	757.21	757.14	757.27	757.47	757.94	757.62
AMW-7B[5]	777.52	757.00	756.94	756.93	756.87	756.99	757.22	757.65	757.37
AMW-7P	779.51	769.07	769.24	769.20	769.10	769.14	769.25	770.56	770.70
AMW-8A[11]	783.36	757.50	757.48	757.41	757.37	757.40	757.66	758.11	757.85
AMW-8B[5]	782.82	757.37	757.34	757.25	757.23	757.34	757.54	757.97	757.70
AMW-9A[5]	783.67	758.45	758.37	758.31	758.29	758.31	758.65	759.09	NA[6]
AMW-9B[5]	783.95	758.42	758.33	758.28	758.25	758.27	758.60	759.08	758.64
AMW-9P[5]	783.48	774.61	774.28	773.89	774.23	773.98	773.92	774.12	773.99
AMW-10A[11]	787.57	759.72	759.07	758.97	759.27	758.92	759.87	759.82	760.57
AMW-10B[11]	787.99	758.59	758.56	758.48	758.43	758.46	758.92	759.23	758.71
AMW-10P	787.67	780.20	780.07	779.94	779.89	779.82	780.05	779.82	779.57

(See Notes on Page 2)

TABLE 3-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

2000 GROUNDWATER/SURFACE WATER ELEVATIONS (ft amsl)

Well	Reference Elevation[1]	Measurement Date							
		10/30/2000	11/1/2000	11/3/2000	11/6/2000	11/8/2000	11/10/2000	11/18/2000	12/21/2000
P-1D[5,7]	774.41	NA	NA	NA	NA	NA	NA	NA	763.37
P-1RS	769.93	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
P-2D	775.43	760.46	760.47	760.47	760.46	760.49	760.56	760.49	760.82
P-2RS	773.14	759.67	759.67	759.66	759.66	759.76	759.75	759.74	759.53
P-3D	772.37	760.73	760.72	760.72	760.75	760.75	760.82	760.76	760.71
P-3RS	771.24	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
P-4WT	762.19	757.79	757.75	757.68	757.61	757.65	758.07	758.35	758.09
P-5WT[8]	NA	NA	NA	NA	NA	NA	NA	NA	NA
Kalamazoo River Staff Gauges									
SG-1[9]	758.55	756.43	756.24	756.44	756.43	756.45	756.59	756.59	756.91[4]
SG-2[9]	757.97	755.35	755.16	755.35	755.10	755.38	755.63	755.63	NA[10]

Notes:

[1]Elevation of the top of the well's inner casing was used as reference.
[2]Well not fully recovered from development.
[3]Could not locate monitoring well.
[4]Measured on 12/26/00.
[5]Well reference elevation was resurveyed by Atwell-Hicks on 11/7/00.
[6]Monitoring well lock frozen.
[7]Well appears to have been damaged during site activities.
[8]Could not locate piezometer.
[9]River gauges were relocated and resurveyed by Atwell-Hicks on 11/7/00.
[10]River's surface was frozen at time of measurement.
[11]Well reference elevation was resurveyed by Blasland, Bouck & Lee, Inc. on 12/20/00.
amsl - Above mean sea level
NA - Measurement was not taken.

TABLE 3-3A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

1993 VERTICAL GROUNDWATER FLOW GRADIENTS

Well	Well Screen Midpoint[1]	October 8, 1993		October 11, 1993		December 15, 1993	
		Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]
Willow Boulevard Site							
WMW-1A		758.04		758.06		758.04	
WMW-1	6.0	758.02	3.3E-03	758.05	1.7E-03	758.01	5.0E-03
WMW-3A		756.51		756.54		756.49	
WMW-3	12.0	755.94	4.7E-02	755.96	4.8E-02	755.92	4.8E-02
WMW-4A		756.55		756.46		756.43	
WMW-4B	10.0	756.31	2.4E-02	756.34	1.2E-02	756.44	-1.0E-03
A-Site							
AMW-3A		759.85		759.92		759.92	
AMW-3	7.50	759.86	-1.3E-03	759.91	1.3E-03	759.94	-2.7E-03
AMW-6A		756.59		756.61		757.63	
AMW-6B	9.60	756.30	3.0E-02	756.33	2.9E-02	756.24	1.4E-01
AMW-7A		756.83		756.86		756.70	
AMW-7B	6.50	755.98	1.3E-01	757.02	-2.5E-02	756.93	-3.5E-02
AMW-8A		757.32		757.35		757.29	
AMW-8B	5.00	757.31	2.0E-03	757.37	-4.0E-03	757.27	4.0E-03
AMW-9A		758.46		758.49		758.42	
AMW-9B	11.00	758.41	4.5E-03	758.48	9.1E-04	758.38	3.6E-03
AMW-10A		759.46		759.62		759.51	
AMW-10B	10.00	758.72	7.4E-02	759.45	1.7E-02	758.78	7.3E-02

Notes:

[1]The distance of separation in feet of the midpoints of the screened intervals.

[2]Elevation in units of feet above mean sea level.

[3]A negative value indicates an upward vertical gradient, and a positive value indicates a downward vertica gradient.

NA - Not available

TABLE 3-3B

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

1995 VERTICAL GROUNDWATER FLOW GRADIENTS

Well	Well Screen Midpoint[1]	August 16, 1995		August 24, 1995		August 29, 1995		August 30, 1995	
		Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]
Willow Boulevard Site									
WMW-1A		NA		NA		757.00		756.97	
WMW-1	6.0	NA		NA		756.98	3.3E-03	756.95	3.3E-03
WMW-3A		NA		NA		755.57		755.40	
WMW-3	12.0	NA		NA		755.03	4.5E-02	753.84	1.3E-01
WMW-4A		NA		NA		755.44		755.36	
WMW-4B	10.0	NA		NA		755.39	5.0E-03	755.22	1.4E-02
A-Site									
AMW-3A		NA		NA		NA		759.56	
AMW-3	7.50	NA		NA		NA		759.58	-2.7E-03
AMW-6A		NA		756.21		755.57		755.32	
AMW-6B	9.60	NA		756.05	1.7E-02	755.42	1.6E-02	755.17	1.6E-02
AMW-7A		NA		NA		NA		755.88	
AMW-7B	6.50	NA		NA		NA		755.98	-1.5E-02
AMW-8A		NA		757.08		756.64		757.34	
AMW-8B	5.00	NA		757.04	8.0E-03	756.60	8.0E-03	756.40	1.9E-01
AMW-10A		766.10		760.96		759.96		757.33	
AMW-10B	10.00	758.29	7.8E-01	758.33	2.6E-01	758.15	1.8E-01	758.12	-7.9E-02

Notes:

[1]The distance of separation in feet of the midpoints of the screened intervals.

[2]Elevation in units of feet above mean sea level.

[3]A negative value indicates an upward vertical gradient, and a positive value indicates a downward vertical gradient.
A gradient was not calculated for AMW-9A/9B because an elevation could not be measured in AMW-9B due to a damaged protective casing.
NA - Not available

TABLE 3-3C

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

2000 VERTICAL GROUNDWATER FLOW GRADIENTS

Well	Well Screen Midpoint[1]	October 30, 2000		November 1, 2000		November 3, 2000		November 6, 2000	
		Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]
Willow Boulevard Site									
WMW-1A		757.84		757.78		757.81		757.59	
WMW-1	6.0	758.23	-6.5E-02	758.30	-8.7E-02	NA	NA	NA	NA
WMW-3AR		755.85		755.81		755.72		755.57	
WMW-3	9.5	755.36	5.2E-02	755.33	5.1E-02	755.30	4.4E-02	755.20	3.9E-02
WMW-4A		756.32		756.28		756.17		755.96	
WMW-4B	10.0	756.11	2.1E-02	756.05	2.3E-02	756.01	1.6E-02	755.87	9.0E-03
A-Site									
AMW-3A		NA		759.86		759.83		759.79	
AMW-3	7.50	759.62	NA	759.59	3.6E-02	759.56	3.6E-02	759.54	3.3E-02
AMW-6A		757.18		756.93		757.23		756.88	
AMW-6B	9.60	756.19	1.0E-01	756.20	7.6E-02	756.17	1.1E-01	756.06	8.5E-02
AMW-7A		757.33		757.27		757.21		757.14	
AMW-7B	6.50	757.00	5.1E-02	756.94	5.1E-02	756.93	4.3E-02	756.87	4.2E-02
AMW-8A		757.50		757.48		757.41		757.37	
AMW-8B	5.00	757.37	2.6E-02	757.34	2.8E-02	757.25	3.2E-02	757.23	2.8E-02
AMW-9A		758.45		758.37		758.31		758.29	
AMW-9B	11.00	758.42	2.7E-03	758.33	3.6E-03	758.28	2.7E-03	758.25	3.6E-03
AMW-10A		759.72		759.07		758.97		759.27	
AMW-10B	10.00	758.59	1.1E-01	758.56	5.1E-02	758.48	4.9E-02	758.43	8.4E-02

(See Notes on Page 2)

TABLE 3-3C

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

2000 VERTICAL GROUNDWATER FLOW GRADIENTS

Well	Well Screen Midpoint[1]	November 8, 2000		November 10, 2000		November 18, 2000		December 21, 2000	
		Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]	Water Level Elevation[2]	Vertical Gradient[3]
Willow Boulevard Site									
WMW-1A		757.61		758.13		758.68		758.20	
WMW-1	6.0	NA	NA	NA	NA	NA	NA	755.98	3.7E-01
WMW-3AR		755.76		756.11		756.75		756.36	
WMW-3	9.5	755.29	4.9E-02	755.58	5.6E-02	756.23	5.5E-02	755.95	4.3E-02
WMW-4A		756.03		756.15		757.16		756.84	
WMW-4B	10.0	755.99	4.0E-03	756.29	-1.4E-02	756.99	1.7E-02	756.61	2.3E-02
A-Site									
AMW-3A		759.85		760.29		760.27		759.97	
AMW-3	7.50	759.59	3.5E-02	760.01	3.7E-02	759.99	3.7E-02	759.74	3.1E-02
AMW-6A		756.78		757.33		757.78		758.13	
AMW-6B	9.60	756.11	7.0E-02	756.36	1.0E-01	756.93	8.9E-02	756.61	1.6E-01
AMW-7A		757.27		757.47		757.94		757.62	
AMW-7B	6.50	756.99	4.3E-02	757.22	3.8E-02	757.65	4.5E-02	757.37	3.8E-02
AMW-8A		757.40		757.66		758.11		757.85	
AMW-8B	5.00	757.34	1.2E-02	757.54	2.4E-02	757.97	2.8E-02	757.70	3.0E-02
AMW-9A		758.31		758.65		759.09		NA	
AMW-9B	11.00	758.27	3.6E-03	758.60	4.5E-03	759.08	9.1E-04	758.64	NA
AMW-10A		758.92		759.87		759.82		760.57	
AMW-10B	10.00	758.46	4.6E-02	758.92	9.5E-02	759.23	5.9E-02	758.71	1.9E-01

Notes:

[1]The distance of separation in feet of the midpoints of the screened intervals.

[2]Elevation in units of feet above mean sea level.

[3]A negative value indicates an upward vertical gradient, and a positive value indicates a downward vertical gradient.

NA - Not available

TABLE 4-1A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB CONCENTRATIONS AND CLEANUP CRITERIA SURFICIAL SAMPLES

Compound	Frequency of Detection	Range of Concentrations (mg/kg)	Arithmetic Mean[1] (mg/kg)	95% LCL[2] (mg/kg)	95% UCL[2] (mg/kg)	Act 451 Part 201 Generic Cleanup Criteria[3] Residential & Commercial I DCC Value (mg/kg)	Act 451 Part 201 Generic Cleanup Criteria[3] Industrial & Commercial II DCC Value (mg/kg)	Ecological Criteria[11] Piscivorous Consumers (mg/kg)	Ecological Criteria[11] Carnivorous Mammals (mg/kg)	Ecological Criteria11 Omnivorous Songbirds (mg/kg)	Human Health[12] Recommended Criteria (mg/kg)
Willow Boulevard Site[4]											
Total PCB	8 / 9	ND - 270	68	24	110	--	16[J] [7][5]	0.5	5.9	6.5	0.04 to 0.3
A-Site[6]											
Total PCB	13 / 17	ND - 14	1.8	ND	3.8	--	16[J]	0.5	5.9	6.5	0.04 to 0.3
AMW-3A Area[7]											
Total PCB	12 / 19	ND - 5.9	1.5	0.66	2.4	--	16[J]	0.5	5.9	6.5	0.04 to 0.3
Area East of Davis Creek[8]											
Total PCB	14 / 16	ND - 36	4.6	ND	9.5	4[J] [4][9]		0.5	5.9	6.5	0.04 to 0.3
Residential Areas[10]											
Total PCB	3 / 27	ND - 1.5	0.10	ND	0.21	4[J]	--	0.5	5.9	6.5	0.04 to 0.3

Notes:

(1) One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the arithmetic mean PCB concentration.
(2) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document Verification of Soil Remediation (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL. When the 95% UCL exceeded the maximum detected concentration, the maximum was used.
(3) From MDEQ, Part 201 Generic Criteria Tables, December 21, 2002. Generic values are presented here as default values. The number in brackets represents the number of sample detections exceeding the criterion.
(4) Includes results from borings WMW-3A (one duplicate), WMW-4B, WB-1, WB-2, WB-3 (two samples), WB-4, and WB-5 (2 samples [one duplicate]).
(5) Soil/residual samples which exceeded the criterion include samples from boring locations WMW-3A (one duplicate), WMW-4B, WB-3 (two samples), WB-4, and WB-5 (2 samples [one duplicate]).
(6) Includes results from borings AMW-6B, AMW-7B, AMW-8B, AMW-9B, AMW-10B, ARS-1 (two samples [one duplicate]), FLA-SB-24, OCU (one duplicate), OCM, ARS-2 (two samples), ARS-3 (two samples), AS-1, AS-2, and AS-3.
(7) Includes results from borings SB-3A-101, SB-3A-102, SB-3A-103, SB-3A-104, SB-3A-105, SB-3A-106 (two samples), SB-3A-107 (three samples), SB-3A-202, SB-3A-203, SB-3A-205, SB-3A-206 (one duplicate), SB-3A-208, SB-3A-213, AMW-3A-1, AMW-3A-2, and AMW-3A-3.
(8) Includes results from borings EDC-1 (two samples), EDC-2 (two samples), EDC-3 (two samples), EDC-4 (two samples), EDC-5 (two samples), EDC-6 (two samples), EDC-7 (two samples [one duplicate]), and EDC-8 (two samples).
(9) Soil/residual samples which exceeded the criterion include samples from boring locations EDC-1, EDC-4, EDC-5, and EDC-6.
(10) Includes results from borings WBAS-1, WBAS-2, WBAS-3, SB-3A-201, SB-3A-204, SB-3A-207, SB-3A-209, SB-3A-210, SB-3A-211, SB-3A-212, SB-ADKINS-1, SB-ADKINS-2, SB-ADKINS-3, SB-ADKINS-4, SB-ADKINS-5, SB-ADKINS-6, SB-ADKINS-7, SB-ADKINS-8, SB-ADKINS-9, B-1 (two samples), B-2 (two samples) B-3 (two samples), TP-1 and TP-10.
(11) From Final (Revised) Baseline Ecological Risk Assessment (CDM April 2003). Derived value for PCB in surface soil and floodplain sediment for protection of ecological receptors, specifically piscivorous consumers such as Mink, carnivorous mammals such as Red fox, and ominivorous songbirds such as American robin.
(12) From Final (Revised) Human Health Risk Assessment (CDM April 2003). Derived value for PCB in sediment for diet consisting of Bass/Carp; default to Part 201 MDL (0.33 mg/kg).
DCC - Direct contact criteria
ND - Not detected
-- Residential criteria are not applicable to industrial property (and vice versa).

Criterion Note:

(J) Hazardous substance may be present in several isomer forms. Isomer-specific concentrations are added together for comparison to criteria.

TABLE 4-1B

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB CONCENTRATIONS AND CLEANUP CRITERIA SUBSURFACE SAMPLES

Compound	Frequency of Detection	Range of Concentrations (mg/kg)	Arithmetic Mean[1] (mg/kg)	95% LCL[2] (mg/kg)	95% UCL[2] (mg/kg)	Act 451 Part 201 Generic Cleanup Criteria[3] Residential & Commercial I DCC Value (mg/kg)	Act 451 Part 201 Generic Cleanup Criteria[3] Industrial & Commercial II DCC Value (mg/kg)	Ecological Criteria[11] Piscivorous Consumers (mg/kg)	Ecological Criteria[11] Carnivorous Mammals (mg/kg)	Ecological Criteria11 Omnivorous Songbirds (mg/kg)	Human Health[12] Recommended Criteria (mg/kg)
Willow Boulevard Site[4]											
Total PCB	38 / 42	ND - 160	34	22	45	--	16[J] [25][5]	0.5	5.9	6.5	0.04 to 0.3
A-Site[6]											
Total PCB	58 / 73	ND - 330	32	18	46	--	16[J] [25][7]	0.5	5.9	6.5	0.04 to 0.3
AMW-3A Area[8]											
Total PCB	35 / 48	ND - 62	4.7	1.0	8.4	--	16[J] [3][9]	0.5	5.9	6.5	0.04 to 0.3
Residential Areas[10]											
Total PCB	6 / 55	ND - 1.0	0.073	0.036	0.11	4.0[J]	--	0.5	5.9	6.5	0.04 to 0.3

Notes:

(1) One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the arithmetic mean PCB concentration.

(2) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document Verification of Soil Remediation (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL.

(3) From MDEQ, Part 201 Generic Cleanup Criteria Tables, effective December 21, 2002. The number in brackets represents the number of sample detections exceeding the criterion.

(4) Includes results from borings WMW-1A (two samples), WMW-3A (six samples [two duplicates]), WMW-4A (two samples), WMW-4B (three samples), WB-1 (six samples), WB-2 (five samples), WB-3 (three samples [two duplicates]), WB-4 (four samples), WB-5 (three samples), DWA-SB-14 (two samples), DWA-SB-26 (two samples), DWA-SB-38 (two samples), and DWA-SB-51 (two samples).

(5) Soil/residual samples which exceeded the criterion include samples from boring locations WB-1 (five samples), WB-2 (one sample), WB-3 (two samples [one duplicate]), WB-4 (three samples), WB-5 (one sample), WMW-3A (five samples [one duplicate]), WMW-4A (one sample), WMW-4B (three samples), DWA-SB-14 (one sample), DWA-SB-26 (one sample), DWA-SB-38 (one sample), and DWA-SB-51 (one sample).

(6) Includes results from borings AMW-6B (five samples), AMW-7B (six samples [three duplicates]), AMW-8B (six samples), AMW-9B (six samples), AMW-10B (six samples), AS-1 (six samples), AS-2 (six samples), AS-3 (six samples), P-1D, P-2D, P-3D (one duplicate), P-4WT, P-5WT, ARS-1, ARS-2, ARS-3, FLA-SB-1, FLA-SB-5, FLA-SB-7 (two samples), FLA-SB-8, FLA-SB-11, FLA-SB-12 (two samples), FLA-SB-13, FLA-SB-16, FLA-SB-18 (two samples), FLA-SB-19, FLA-SB-22 (one duplicate), FLA-SB-24, FLA-SB-25, DWA/FLA-SB-3, and DWA/FLA-SB-4.

(7) Soil/residual samples which exceeded the criterion include samples from boring locations AMW-6B (two samples), AMW-7B (three samples [one duplicate]), AMW-8B (three samples), AMW-9B (three samples), AMW-10B (two samples), ARS-1 (four samples), ARS-2 (four samples), ARS-3 (one sample), FLA-SB-7 (one sample), FLA-SB-12 (one sample), and FLA-SB-18 (one sample).

(8) Includes results from borings SB-3A-101 (three samples), SB-3A-102 (two samples), SB-3A-103 (two samples), SB-3A-104 (four samples), SB-3A-105, SB-3A-202 (three samples), SB-3A-203 (four samples), SB-3A-205 (two samples), SB-3A-206 (two samples), SB-3A-208 (three samples), SB-3A-213 (two samples [one duplicate]), AMW-3A-1 (four samples), AMW-3A-2 (five samples), AMW-3A-2R (two samples), AMW-3A (two samples), and AMW-3A-3 (seven samples).

(9) Soil/residual samples which exceeded the criterion include samples from boring locations AMW-3A (one sample), AMW-3A-2 (one sample), and SB-3A-102 (one sample).

(10) Includes results from borings SB-3A-201 (three samples), SB-3A-204 (two samples), SB-3A-207 (two samples), SB-3A-209 (two samples), SB-3A-210 (two samples), SB-3A-211 (two samples), SB-3A-212 (two samples), SB-ADKINS-1 (three samples), SB-ADKINS-2 (four samples), SB-ADKINS-3 (four samples), SB-ADKINS-4 (four samples [two duplicates]), SB-ADKINS-5 (five samples), SB-ADKINS-6 (four samples [one duplicate]), SB-ADKINS-7 (three samples), SB-ADKINS-8 (three samples), SB-ADKINS-9 (three samples [one duplicate]), B-1 (two samples), B-2, TP-1, TP-12, TP-13, and TP-15.

(11) From Final (Revised) Baseline Ecological Risk Assessment (CDM April 2003). Derived value for PCB in surface soil and floodplain sediment for protection of ecological receptors, specifically piscivorous consumers such as Mink, carnivorous mammals such as Red fox, and ominivorous songbirds such as American robin.

(12) From Final (Revised) Human Health Risk Assessment (CDM April 2003). Derived value for PCB in sediment for diet consisting of Bass/Carp; default to Part 201 MDL (0.33 mg/kg).

DCC - Direct contact criteria

ND - Not detected

-- Residential criteria are not applicable to industrial property (and vice versa).

Criterion Note:

(J) Hazardous substance may be present in several isomer forms. Isomer-specific concentrations are added together for comparison to criteria.

TABLE 4-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCDD/PCDF CONCENTRATIONS AND CLEANUP CRITERIA SURFICIAL SAMPLES

Compound	TCDD Toxicity Equivalency Factor[1]	AS-1 W70092		AS-2 W70083 (DUP W70084)		Act 451 Part 201 Generic Cleanup Criteria[4]
		Sample Concentration (mg/kg)	TCDD Equivalent Concentration[2] (mg/kg)	Sample Concentration[3] (mg/kg)	TCDD Equivalent Concentration[2] (mg/kg)	Industrial & Commercial II DCC Value (mg/kg)
2,3,7,8-TCDD	1.0	1.3E-05	1.3E-05	ND	0.0E+00	
1,2,3,7,8-PeCDD	0.50	7.6E-06	3.8E-06	ND	0.0E+00	
1,2,3,4,7,8-HxCDD	0.10	3.5E-05	3.5E-06	3.3E-07	3.3E-08	
1,2,3,6,7,8-HxCDD	0.10	5.5E-04	5.5E-05	ND	0.0E+00	
1,2,3,7,8,9-HxCDD	0.10	1.3E-04	1.3E-05	ND	0.0E+00	
1,2,3,4,6,7,8-HpCDD	0.010	3.6E-02	3.6E-04	5.3E-05	5.3E-07	
1,2,3,4,6,7,8,9-OCDD	0.0010	1.8E-01	1.8E-04	6.7E-04	6.7E-07	
2,3,7,8-TCDF	0.10	1.5E-04	1.5E-05	3.3E-07	3.3E-08	
1,2,3,7,8-PeCDF	0.050	7.9E-05	3.9E-06	ND	0.0E+00	
2,3,4,7,8-PeCDF	0.50	7.2E-06	3.6E-06	ND	0.0E+00	
1,2,3,4,7,8-HxCDF	0.10	9.5E-05	9.5E-06	3.4E-07	3.4E-08	
1,2,3,6,7,8-HxCDF	0.10	2.2E-05	2.2E-06	ND	0.0E+00	
2,3,4,6,7,8-HxCDF	0.10	8.4E-05	8.4E-06	2.9E-07	2.9E-08	
1,2,3,7,8,9-HxCDF	0.10	ND	0.0E+00	6.5E-07	6.5E-08	
1,2,3,4,6,7,8-HpCDF	0.010	2.5E-03	2.5E-05	3.3E-06	3.3E-08	
1,2,3,4,7,8,9-HpCDF	0.010	1.9E-04	1.9E-06	8.8E-07	8.8E-09	
1,2,3,4,6,7,8,9-OCDF	0.0010	3.7E-02	3.7E-05	3.4E-05	3.4E-08	
Total TCDD - Equivalent Concentration			7.4E-04		1.5E-06	9.9E-04

Compound	TCDD Toxicity Equivalency Factor[1]	AS-3 W70100		WB-1 W70142 (DUP W70143)		Act 451 Part 201 Generic Cleanup Criteria[4]
		Sample Concentration (mg/kg)	TCDD Equivalent Concentration[2] (mg/kg)	Sample Concentration[3] (mg/kg)	TCDD Equivalent Concentration[2] (mg/kg)	Industrial & Commercial II DCC Value (mg/kg)
2,3,7,8-TCDD	1.0	6.0E-05	6.0E-05	2.4E-05	2.4E-05	
1,2,3,7,8-PeCDD	0.50	1.0E-05	5.1E-06	4.1E-06	2.0E-06	
1,2,3,4,7,8-HxCDD	0.10	1.3E-05	1.3E-06	7.9E-06	7.9E-07	
1,2,3,6,7,8-HxCDD	0.10	5.8E-04	5.8E-05	2.2E-04	2.2E-05	
1,2,3,7,8,9-HxCDD	0.10	1.4E-04	1.4E-05	8.4E-05	8.4E-06	
1,2,3,4,6,7,8-HpCDD	0.010	2.9E-02	2.9E-04	5.6E-03	5.6E-05	
1,2,3,4,6,7,8,9-OCDD	0.0010	2.5E-01	2.5E-04	5.4E-02	5.4E-05	
2,3,7,8-TCDF	0.10	6.5E-04	6.5E-05	2.7E-04	2.7E-05	
1,2,3,7,8-PeCDF	0.050	ND	0.0E+00	5.3E-06	2.6E-07	
2,3,4,7,8-PeCDF	0.50	1.3E-05	6.6E-06	1.1E-05	5.7E-06	
1,2,3,4,7,8-HxCDF	0.10	4.3E-05	4.3E-06	1.1E-05	1.1E-06	
1,2,3,6,7,8-HxCDF	0.10	1.0E-05	1.0E-06	3.0E-06	3.0E-07	
2,3,4,6,7,8-HxCDF	0.10	4.3E-05	4.3E-06	9.0E-06	9.0E-07	
1,2,3,7,8,9-HxCDF	0.10	ND	0.0E+00	ND	0.0E+00	
1,2,3,4,6,7,8-HpCDF	0.010	1.5E-03	1.5E-05	1.9E-04	1.9E-06	
1,2,3,4,7,8,9-HpCDF	0.010	6.6E-05	6.6E-07	2.0E-05	2.0E-07	
1,2,3,4,6,7,8,9-OCDF	0.0010	1.6E-02	1.6E-05	8.8E-04	8.8E-07	
Total TCDD - Equivalent Concentration			7.8E-04		2.0E-04	9.9E-04

(See notes on page 2)

TABLE 4-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCDD/PCDF CONCENTRATIONS AND CLEANUP CRITERIA SURFICIAL SAMPLES

Compound	TCDD Toxicity Equivalency Factor[1]	WB-2 W70115 Sample Concentration (mg/kg)	WB-2 W70115 TCDD Equivalent Concentration[2] (mg/kg)	WB-3 W70134 Sample Concentration (mg/kg)	WB-3 W70134 TCDD Equivalent Concentration[2] (mg/kg)	Act 451 Part 201 Generic Cleanup Criteria[4] Industrial & Commercial II DCC Value (mg/kg)
2,3,7,8-TCDD	1.0	1.5E-07	1.5E-07	5.2E-05	5.2E-05	
1,2,3,4,7,8-HxCDD	0.10	ND	0.0E+00	5.2E-05	5.2E-06	
1,2,3,6,7,8-HxCDD	0.10	1.4E-06	1.4E-07	4.1E-04	4.1E-05	
1,2,3,7,8,9-HxCDD	0.10	7.6E-07	7.6E-08	1.7E-04	1.7E-05	
1,2,3,4,6,7,8-HpCDD	0.010	8.7E-05	8.7E-07	4.4E-02	4.4E-04	
1,2,3,4,6,7,8,9-OCDD	0.0010	6.3E-04	6.3E-07	1.5E-01	1.5E-04	
2,3,7,8-TCDF	0.10	9.1E-07	9.1E-08	3.2E-04	3.2E-05	
1,2,3,7,8-PeCDF	0.050	ND	0.0E+00	ND	0.0E+00	
2,3,4,7,8-PeCDF	0.50	1.2E-07	6.0E-08	5.9E-05	3.0E-05	
1,2,3,4,7,8-HxCDF	0.10	ND	0.0E+00	5.4E-05	5.4E-06	
1,2,3,6,7,8-HxCDF	0.10	ND	0.0E+00	5.7E-05	5.7E-06	
2,3,4,6,7,8-HxCDF	0.10	ND	0.0E+00	1.2E-04	1.2E-05	
1,2,3,7,8,9-HxCDF	0.10	ND	0.0E+00	ND	0.0E+00	
1,2,3,4,6,7,8-HpCDF	0.010	3.1E-06	3.1E-08	6.6E-04	6.6E-06	
1,2,3,4,7,8,9-HpCDF	0.010	ND	0.0E+00	7.3E-05	7.3E-07	
1,2,3,4,6,7,8,9-OCDF	0.0010	8.3E-06	8.3E-09	2.2E-03	2.2E-06	
Total TCDD - Equivalent Concentration			2.0E-06		8.0E-04	9.9E-04

Notes:

(1) From USEPA, 1989a.

(2) Concentrations are the sample concentration multiplied by the appropriate TCDD toxicity equivalency factor. Samples reported as non-detect were given a value of zero.

(3) The sample result was averaged with the duplicate result to obtain a representative sample concentration. If one of the sample/duplicate pair was reported as non-detect, one-half the detection limit was used as a proxy concentration prior to averaging.

(4) From Part 201 Generic Cleanup Criteria Tables, effective December 21, 2002.

ND - Not detected

TABLE 4-3

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS BBL POST-EXCAVATION SAMPLES[1] ADJACENT TO THE WILLOW BOULEVARD SITE[2] (mg/kg)

Sample Location	SV-5	SV-10	SV-12	SV-19	SV-23	SV-26	SV-29	SV-36	SV-40	SV-45	SV-50
Sample ID	W70357	W70362	W70364	W70371	W70375	W70378	W70381	W70388	W70392	W70397	W70402
Date Sampled	12/9/1999	12/9/1999	12/9/1999	12/10/1999	12/10/1999	1/5/2000	12/17/1999	1/4/2000	1/4/2000	1/4/2000	1/7/2000
Aroclor 1242	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	0.73	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1254	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Total PCB	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	0.73	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)

Sample Location	SV-51	SV-53	SV-56	SV-57	SV-58	SV-60[3]	SV-65	SSS-2	SSS-6	SSS-8
Sample ID	W70403	W70405	W70408	W70409	W70410	W70412	W70417	W70419	W70423	W70425
Date Sampled	1/7/2000	1/7/2000	1/7/2000	1/7/2000	1/11/2000	1/11/2000	1/11/2000	1/13/2000	1/14/2000	1/18/2000
Aroclor 1242	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	0.56	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1254	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	0.43	0.53	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Total PCB	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	0.99	0.53	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)

Notes:

(1) Post-excavation soil samples were collected at the base of excavation, except for samples SSS-2, SSS-6, and SSS-8, which are surficial soil samples. Samples were collected from excavated areas north and west of the Willow Boulevard Site.

(2) Shows only the results for compounds detected above the quantitation limit.

(3) Sample was collected during test-pitting activities.

ND - Not detected

Note Explaining Data Qualifier:

U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-3A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MDEQ POST-EXCAVATION SAMPLES[1] ADJACENT TO THE WILLOW BOULEVARD SITE[2] (mg/kg)

Sample Location	WLF-1[3]	WLF-2[3]	WLF-3[3]	WLF-4[3]	WLF-5	WLF-6	WLF-7	WLF-8	WLF-9	WLF-10	WLF-11
Sample ID	AC08845	AC08846	AC08847	AC08848	AC08849	AC08850	AC08851	AC08852	AC08853	AC08854	AC08855
Date Sampled	12/8/1999	12/8/1999	12/8/1999	12/9/1999	12/9/1999	12/9/1999	12/9/1999	12/9/1999	12/9/1999	12/9/1999	12/9/1999
Aroclor 1242	ND(0.055)	0.60	ND(0.062)	0.080	ND(0.066)	0.26	0.66	2.4	0.27	0.16	0.20
Aroclor 1254	ND(0.055)	0.62	0.11	0.24	ND(0.066)	ND(0.083)	ND(0.058)	ND(0.18)	ND(0.058)	ND(0.062)	ND(0.061)
Aroclor 1260	ND(0.055)	ND(0.072)	ND(0.062)	ND(0.064)	ND(0.066)	ND(0.083)	ND(0.058)	ND(0.18)	ND(0.058)	ND(0.062)	ND(0.061)
Total PCB	ND(0.055)	1.2	0.11	0.32	ND(0.066)	0.26	0.66	2.4	0.27	0.16	0.20

Sample Location	WLF-12	WLF-13	WLF-14	WLF-15	WLF-18	WLF-19	WLF-20	WLF-21[3]	WLF-22[3]	WLF-23[3]	WLF-24
Sample ID	AC08856	AC08857	AC08858	AC08859	AC08860	AC08861	AC08862	AC08863	AC08864	AC08865	AC08866
Date Sampled	12/9/1999	12/10/1999	12/10/1999	12/10/1999	12/10/1999	12/10/1999	12/10/1999	12/10/1999	12/11/1999	12/11/1999	12/11/1999
Aroclor 1242	0.096	1.4	0.34	1.2	0.38	0.67	0.27	2.3	0.60	1.5	0.63
Aroclor 1254	ND(0.063)	0.62	0.22	0.60	0.26	0.34	0.17	1.5	0.54	ND(0.13)	ND(0.056)
Aroclor 1260	ND(0.063)	ND(0.13)	ND(0.062)	ND(0.14)	ND(0.061)	ND(0.062)	ND(0.064)	1.2	0.74	ND(0.13)	ND(0.056)
Total PCB	0.096	2.0	0.56	1.8	0.64	1.0	0.44	5.0	1.9	1.5	0.63

Sample Location	WLF-25[3]	26	27	28	29	30	31	32	33	SS-34	SS-35
Sample ID	AC08867	AC09027	AC09028	AC09029	AC09030	AC09031	AC09032	AC09033	AC09034	AD00071	AD00072
Date Sampled	12/11/1999	12/17/1999	12/17/1999	12/17/1999	12/17/1999	12/17/1999	12/17/1999	12/17/1999	12/17/1999	01/04/00	01/04/00
Aroclor 1242	0.50	ND(0.058)	ND(0.057)	ND(0.061)	ND(0.055)	ND(0.060)	ND(0.059)	ND(0.060)	ND(0.057)	ND(0.058)	ND(0.061)
Aroclor 1254	ND(0.058)	ND(0.058)	ND(0.057)	ND(0.061)	ND(0.055)	ND(0.060)	ND(0.059)	ND(0.060)	ND(0.057)	ND(0.058)	0.16
Aroclor 1260	ND(0.058)	ND(0.058)	ND(0.057)	ND(0.061)	ND(0.055)	ND(0.060)	ND(0.059)	ND(0.060)	ND(0.057)	ND(0.058)	ND(0.061)
Total PCB	0.50	ND(0.058)	ND(0.057)	ND(0.061)	ND(0.055)	ND(0.060)	ND(0.059)	ND(0.060)	ND(0.057)	ND(0.058)	0.16

Sample Location	SS-36	SS-37	SS-38	SS-39	SS-40	SS-41	SS-42	SS-43	SS-44	SS-45	SS-46
Sample ID	AD00073	AD00074	AD00075	AD00076	AD00077	AD00078	AD00079	AD00080	AD00081	AD00082	AD00083
Date Sampled	01/04/00	01/04/00	01/04/00	01/04/00	01/04/00	01/04/00	01/04/00	01/04/00	01/04/00	01/04/00	01/04/00
Aroclor 1242	0.16	1.2	1.5	ND(0.060)	ND(0.062)	ND(0.066)	0.18	ND(0.055)	ND(0.063)	ND(0.063)	ND(0.057)
Aroclor 1254	0.10	0.66	1.2	ND(0.060)	0.12	ND(0.066)	ND(0.065)	ND(0.055)	0.089	ND(0.063)	ND(0.057)
Aroclor 1260	ND(0.060)	ND(0.14)	ND(0.14)	ND(0.060)	ND(0.062)	ND(0.066)	0.24	ND(0.055)	ND(0.063)	ND(0.063)	ND(0.057)
Total PCB	0.26	1.9	2.7	ND(0.060)	0.12	ND(0.066)	0.42	ND(0.055)	0.089	ND(0.063)	ND(0.057)

Sample Location	SS-47	SS-48	SS-49	SS-50	SS-51	SS-52	SS-53	SS-54	SS-55	SS-56	SS-57
Sample ID	AD00146	AD00147	AD00148	AD00149	AD00150	AD00151	AD00152	AD00153	AD00154	AD00155	AD00156
Date Sampled	01/07/00	01/07/00	01/07/00	01/07/00	01/07/00	01/07/00	01/07/00	01/07/00	01/07/00	01/07/00	01/07/00
Aroclor 1242	ND(0.057)	ND(0.060)	0.15	ND(0.068)	0.17	ND(0.078)	ND(0.063)	ND(0.067)	ND(0.061)	ND(0.10)	ND(0.086)
Aroclor 1254	ND(0.057)	ND(0.060)	0.097	ND(0.068)	0.16	ND(0.078)	ND(0.063)	ND(0.067)	ND(0.061)	ND(0.10)	ND(0.086)
Aroclor 1260	ND(0.057)	ND(0.060)	ND(0.059)	ND(0.068)	ND(0.060)	ND(0.078)	ND(0.063)	ND(0.067)	ND(0.061)	ND(0.10)	ND(0.086)
Total PCB	ND(0.057)	ND(0.060)	0.25	ND(0.068)	0.33	ND(0.078)	ND(0.063)	ND(0.067)	ND(0.061)	ND(0.10)	ND(0.086)

See notes on page 2

TABLE 4-3A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MDEQ POST-EXCAVATION SAMPLES[1] ADJACENT TO THE WILLOW BOULEVARD SITE[2] (mg/kg)

Sample Location Sample ID Date Sampled	SS-58 AD00207 01/11/00	SS-59[4] AD00208 01/11/00	SS-60[4] AD00209 01/11/00	SS-61[4] AD00210 01/11/00	SS-62[4] AD00211 01/11/00	SS-63 AD00212 01/11/00	SS-64 AD00213 01/11/00	SS-65 AD00214 01/11/00	SSS-1 AD00430 01/13/00	SSS-2 AD00431 01/13/00	SSS-3 AD00432 01/13/00
Aroclor 1242	ND(0.077)	2.6	1.9	1.4	2.4	0.15	ND(0.056)	ND(0.097)	ND(0.058)	0.19	0.35
Aroclor 1254	ND(0.077)	2.6	1.7	0.63	2.9	ND(0.10)	0.081	2.1	ND(0.058)	0.11	0.15
Aroclor 1260	ND(0.077)	ND(0.37)	ND(0.30)	ND(0.19)	ND(0.44)	ND(0.10)	ND(0.056)	ND(0.097)	ND(0.058)	ND(0.058)	ND(0.055)
Total PCB	ND(0.077)	5.2	3.6	2.0	5.3	0.15	0.081	2.1	ND(0.058)	0.30	0.50

Sample Location Sample ID Date Sampled	SSS-4 AD00433 01/13/00	SSS-5 AD00434 01/13/00	SSS-6 AD00473 01/14/00	SSS-7 AD00474 01/14/00
Aroclor 1242	ND(0.061)	ND(0.058)	ND(0.055)	ND(0.10)
Aroclor 1254	0.063	ND(0.058)	0.064	ND(0.10)
Aroclor 1260	ND(0.061)	ND(0.058)	ND(0.055)	ND(0.10)
Total PCB	0.063	ND(0.058)	0.064	ND(0.10)

Notes:

(1) Post-excavation soil samples were collected by the MDEQ and analyzed by Northeast Analytical, Inc. Samples SSS-1 through SSS-7 are surficial soil samples.

(2) Shows only the results for compounds detected above the quantitation limit.

(3) Sample location was reexcavated.

(4) Sample collected during test-pitting activities.

ND - Not detected

TABLE 4-4

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB CONCENTRATIONS BBL AND MDEQ POST-EXCAVATION SAMPLES

Compound	Frequency of Detection	Range of Concentrations (mg/kg)	95% LCL[1] (mg/kg)	95% UCL[1] (mg/kg)
Surficial Samples				
Adjacent to the Willow Boulevard Site				
BBL Total PCB Results[2]	0 / 3	ND	NA	NA
MDEQ Total PCB Results[3]	4 / 7	ND - 0.50	ND	0.32
Subsurface Samples				
Adjacent to the Willow Boulevard Site				
BBL Total PCB Results[4]	2 / 17	ND - 0.73	NA	0.73 [6]
MDEQ Total PCB Results[5]	27 / 52	ND - 2.7	0.21	0.59
Former Olmstead Creek				
BBL Total PCB Results	2 / 9	ND - 0.75	NA	0.75 [6]
MDEQ Total PCB Results	3 / 9	ND - 14	ND	5.1

Notes:

(1) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document *Verification of Soil Remediation* (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL.

(2) Includes results from SSS-2, SSS-6, and SSS-8.

(3) Includes results from SSS-1 through SSS-7.

(4) Sample SV-60 was not included in the calculation of the 95% LCL and 95% UCL since it was collected during test pitting activities.

(5) Calculation of 95% LCL and 95% UCL excluded samples WLF-1 through WLF-4, WLF-21 through WLF-23, and WLF-25 due to reexcavation, and samples SS-59 through SS-62 since they were collected during test-pitting activities.

(6) Due to the small number of detects, the maximum value was used.

NA - Not Applicable

ND - Not detected

TABLE 4-5

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS SAMPLES FROM THE AREA SOUTH OF THE A-SITE BERM (mg/kg)

Sample Location	FLA-SB-1	FLA-SB-5	FLA-SB-7	FLA-SB-7	FLA-SB-8	FLA-SB-11	FLA-SB-12
Sample ID	W70323	W70324	W70325	W70326	W70327	W70328	W70329
Depth (ft bgs)	6.7 - 7.7	2.6 - 2.9	4.0 - 4.7	4.7 - 5.5	4.8 - 5.8	6.0 - 8.0	4.0 - 4.8
Media	Soil	Soil	Residuals	Soil	Soil	Soil	Residuals
Date Sampled	4/8/1999	4/8/1999	4/8/1999	4/8/1999	4/8/1999	4/8/1999	4/12/1999
Aroclor 1016	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1221	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1232	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1242	ND(0.33 U)	ND(0.33 U)	24	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	37
Aroclor 1248	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1254	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1260	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Total PCB	ND(0.33 U)	ND(0.33 U)	24	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	37

Sample Location	FLA-SB-12	FLA-SB-13	FLA-SB-16	FLA-SB-18	FLA-SB-18	FLA-SB-19	FLA-SB-22
Sample ID	W70330	W70331	W70332	W70333	W70334	W70335	W70336
Depth (ft bgs)	4.8 - 5.9	4.0 - 6.0	4.3 - 5.8	2.0 - 3.1	3.1 - 3.6	6.3 - 7.0	8.3 - 10.0
Media	Soil	Soil	Soil	Residuals	Soil	Soil	Soil
Date Sampled	4/12/1999	4/12/1999	4/12/1999	4/12/1999	4/12/1999	4/13/1999	4/13/1999
Aroclor 1016	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1221	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1232	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1242	ND(0.33 U)	0.36	ND(0.33 U)	25	6.0	ND(0.33 U)	ND(0.33 U)
Aroclor 1248	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1254	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1260	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Total PCB	ND(0.33 U)	0.36	ND(0.33 U)	25	6.0	ND(0.33 U)	ND(0.33 U)

Sample Location	FLA-SB-22 (DUP)	FLA-SB-24	FLA-SB-24	FLA-SB-25	DWA/FLA-SB-3	DWA/FLA-SB-4
Sample ID	W70337	W70338	W70339	W70340	W70341	W70342
Depth (ft bgs)	8.3 - 10.0	0.0 - 2.0	2.0 - 3.0	6.5 - 7.0	2.0 - 2.8	2.0 - 2.5
Media	Soil	Residuals	Soil	Soil	Residuals	Residuals
Date Sampled	4/13/1999	4/13/1999	4/13/1999	4/13/1999	4/14/1999	4/14/1999
Aroclor 1016	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1221	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1232	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1242	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1248	ND(0.33 U)	14	0.88	ND(0.33 U)	3.0	11
Aroclor 1254	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1260	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Total PCB	ND(0.33 U)	14	0.88	ND(0.33 U)	3.0	11

Notes:
bgs - Below ground surface
DUP - Duplicate sample
ND - Not detected

Note Explaining Data Qualifier:
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-6A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS JANUARY 1998 SAMPLES FROM THE AMW-3A AREA(mg/kg)

Sample Location Depth (ft bgs) Date Sampled	AMW3A-1 0.0 - 2.0 1/6/1998	AMW3A-1 2.0 - 4.0 1/6/1998	AMW3A-1 4.0 - 6.0 1/6/1998	AMW3A-1 7.5 - 8.0 1/6/1998	AMW3A-1 8.0 - 10.0 1/6/1998	AMW3A-2 0.0 - 2.0 1/6/1998	AMW3A-2 2.0 - 3.5 1/6/1998	AMW3A-2 3.5 - 4.0 1/6/1998	AMW3A-2 4.0 - 5.5 1/6/1998	AMW3A-2 5.5 - 6.0 1/6/1998	AMW3A-2 10.0 - 12.0 1/6/1998
Aroclor 1016	ND(0.096 U)	ND(0.092 U)	ND(0.19 U)	ND(0.48 U)	ND(0.46 U)	ND(0.37 U)	ND(0.099U)	ND(0.024 U)	ND(0.10 U)	ND(2.3 U)	ND(0.21 U)
Aroclor 1221	ND(0.096 U)	ND(0.092 U)	ND(0.19 U)	ND(0.48 U)	ND(0.46 U)	ND(0.37 U)	ND(0.099U)	ND(0.024 U)	ND(0.10 U)	ND(2.3 U)	ND(0.21 U)
Aroclor 1232	ND(0.096 U)	ND(0.092 U)	ND(0.19 U)	ND(0.48 U)	ND(0.46 U)	ND(0.37 U)	ND(0.099U)	ND(0.024 U)	ND(0.10 U)	ND(2.3 U)	ND(0.21 U)
Aroclor 1242	0.17	0.49	0.17 J	0.85	2.1	1.2	0.18	0.015 JN	0.51	17	1.8
Aroclor 1248	0.60	0.92	1.1	2.5	1.7	2.3	0.64	ND(0.024 U)	0.69	6.0	1.3
Aroclor 1254	0.071 J	ND(0.092 U)	0.11 J	ND(0.48 U)	ND(0.46 U)	ND(0.37 U)	0.056 J	ND(0.024 U)	ND(0.10 U)	ND(2.3 U)	ND(0.21 U)
Aroclor 1260	ND(0.096 U)	0.054 J	ND(0.19 U)	ND(0.48 U)	ND(0.46 U)	ND(0.37 U)	0.067 J	ND(0.024 U)	ND(0.10 U)	ND(2.3 U)	0.11 J
Total PCB	0.84 J	1.5 J	1.4 J	3.4	3.8	3.5	0.94 J	0.015 JN	1.2	23	3.2 J

Sample Location Depth (ft bgs) Date Sampled	AMW3A-2R 6.0 - 8.0 1/6/1998	AMW3A-2R 8.0 - 10.0 1/6/1998	AMW3A-3 0.0 - 2.0 1/6/1998	AMW3A-3 2.0 - 3.5 1/6/1998	AMW3A-3 3.5 - 4.0 1/6/1998	AMW3A-3 4.0 - 5.0 1/6/1998	AMW3A-3 5.0 - 5.5 1/6/1998	AMW3A-3 5.5 - 6.5 1/6/1998	AMW3A-3 6.5 - 7.5 1/6/1998	AMW3A-3 8.0 - 10.0 1/6/1998
Aroclor 1016	ND(0.47 U)	ND(0.43 U)	ND(0.39 U)	ND(0.20 U)	ND(0.50 U)	ND(0.21 U)	ND(0.23 U)	ND(0.23 U)	ND(0.41 U)	ND(0.021 U)
Aroclor 1221	ND(0.47 U)	ND(0.43 U)	ND(0.39 U)	ND(0.20 U)	ND(0.50 U)	ND(0.21 U)	ND(0.23 U)	ND(0.23 U)	ND(0.41 U)	ND(0.021 U)
Aroclor 1232	ND(0.47 U)	ND(0.43 U)	ND(0.39 U)	ND(0.20 U)	ND(0.50 U)	ND(0.21 U)	ND(0.23 U)	ND(0.23 U)	ND(0.41 U)	ND(0.021 U)
Aroclor 1242	2.3	3.6	0.52	0.59	ND(0.50 U)	0.81	0.63	2.1	0.75	0.086
Aroclor 1248	1.5	1.3	2.4	1.8	3.3	1.4	0.95	1.8	2.1	0.11
Aroclor 1254	ND(0.47 U)	ND(0.43 U)	ND(0.39 U)	ND(0.20 U)	0.35 J	0.19 J	0.16 J	ND(0.23 U)	ND(0.41 U)	ND(0.021 U)
Aroclor 1260	ND(0.47 U)	ND(0.43 U)	ND(0.39 U)	0.11 J	ND(0.50 U)	ND(0.21 U)	ND(0.23 U)	0.13 J	ND(0.41 U)	ND(0.021 U)
Total PCB	3.8	4.9	2.9	2.5 J	3.7 J	2.4 J	1.7 J	4.0 J	3.0	0.20

Notes:
bgs - Below ground surface
ND - Not detected

Notes Explaining Data Qualifiers:
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
JN - The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification. The associated numerical value is an estimated concentration only.
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-6B

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS JULY 1998 SAMPLES FROM THE AMW-3A AREA(mg/kg)

Sample Location	SB-3A-101	SB-3A-101	SB-3A-101	SB-3A-101	SB-3A-102	SB-3A-102	SB-3A-102	SB-3A-103	SB-3A-103	SB-3A-103	SB-3A-104
Sample ID	W70190	W70191	W70192	W70193	W70194	W70195	W70196	W70197	W70198	W70199	W70200
Depth (ft bgs)	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	0.0 - 2.0	2.0 - 3.5	3.5 - 5.5	0.0 - 2.0
Media	Residuals	Residuals	Soil	Soil	Residuals	Soil	Soil	Soil	Soil	Soil	Soil
Date Sampled	7/20/1998	7/20/1998	7/20/1998	7/20/1998	7/20/1998	7/20/1998	7/20/1998	7/20/1998	7/20/1998	7/20/1998	7/23/1998
Aroclor 1016	ND(0.54 U)	ND(0.17 U)	ND(0.068 U)	ND(0.086 U)	ND(0.22 U)	ND(3.2 U)	ND(0.18 U)	ND(0.060 U)	ND(0.059 U)	ND(0.058 U)	ND(0.17 U)
Aroclor 1221	ND(0.54 U)	ND(0.17 U)	ND(0.068 U)	ND(0.086 U)	ND(0.22 U)	ND(3.2 U)	ND(0.18 U)	ND(0.060 U)	ND(0.059 U)	ND(0.058 U)	ND(0.17 U)
Aroclor 1232	ND(0.54 U)	ND(0.17 U)	ND(0.068 U)	ND(0.086 U)	ND(0.22 U)	ND(3.2 U)	ND(0.18 U)	ND(0.060 U)	ND(0.059 U)	ND(0.058 U)	ND(0.17 U)
Aroclor 1242	ND(0.54 U)	ND(0.17 U)	ND(0.068 U)	ND(0.086 U)	ND(0.22 U)	61	0.86	0.39	0.087	0.039 J	0.28
Aroclor 1248	ND(0.54 U)	ND(0.17 U)	ND(0.068 U)	ND(0.086 U)	ND(0.22 U)	ND(3.2 U)	ND(0.18 U)	1.0	0.13	0.063	0.80
Aroclor 1254	3.1	1.1	0.36	ND(0.086 U)	3.1	ND(3.2 U)	0.098 J	0.063 J	ND(0.059 U)	ND(0.058 U)	ND(0.17 U)
Aroclor 1260	ND(0.54 U)	ND(0.17 U)	ND(0.068 U)	ND(0.086 U)	ND(0.22 U)	ND(3.2 U)	ND(0.18 U)	0.067 J	ND(0.059 U)	ND(0.058 U)	ND(0.17 U)
Total PCB	3.1	1.1	0.36	ND(0.086 U)	3.1	61	0.96 J	1.5 J	0.22	0.10 J	1.1

Sample Location	SB-3A-104	SB-3A-104	SB-3A-104	SB-3A-104	SB-3A-105	SB-3A-105	SB-3A-106	SB-3A-106	SB-3A-107	SB-3A-107	SB-3A-107
Sample ID	W70201	W70202	W70203	W70204	W70205	W70206	W70207	W70208	W70209	W70210	W70211
Depth (ft bgs)	2.0 - 2.5	2.5 - 3.0	3.0 - 4.0	4.0 - 6.0	0.0 - 2.0	2.0 - 4.0	0.0 - 1.0	1.0 - 3.0	0.0 - 0.50	0.50 - 1.0	1.0 - 3.0
Media	Soil	Residuals	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
Date Sampled	7/23/1998	7/23/1998	7/23/1998	7/23/1998	7/23/1998	7/23/1998	7/23/1998	7/23/1998	7/23/1998	7/23/1998	7/23/1998
Aroclor 1016	ND(0.066 U)	ND(1.3 U)	ND(1.7 U)	ND(0.060 U)	ND(0.057 U)	ND(0.056 U)	ND(0.054 U)	ND(0.053 U)	ND(0.056 U)	ND(0.053 U)	ND(0.058 U)
Aroclor 1221	ND(0.066 U)	ND(1.3 U)	ND(1.7 U)	ND(0.060 U)	ND(0.057 U)	ND(0.056 U)	ND(0.054 U)	ND(0.053 U)	ND(0.056 U)	ND(0.053 U)	ND(0.058 U)
Aroclor 1232	ND(0.066 U)	ND(1.3 U)	ND(1.7 U)	ND(0.060 U)	ND(0.057 U)	ND(0.056 U)	ND(0.054 U)	ND(0.053 U)	ND(0.056 U)	ND(0.053 U)	ND(0.058 U)
Aroclor 1242	0.14	5.3	15	0.052 J	ND(0.057 U)	ND(0.056 U)	ND(0.054 U)	ND(0.053 U)	ND(0.056 U)	ND(0.053 U)	ND(0.058 U)
Aroclor 1248	0.34	8.0	3.9	0.053 J	0.044 J	ND(0.056 U)	ND(0.054 U)	ND(0.053 U)	ND(0.056 U)	ND(0.053 U)	ND(0.058 U)
Aroclor 1254	0.042 J	ND(1.3 U)	ND(1.7 U)	ND(0.060 U)	ND(0.057 U)	ND(0.056 U)	ND(0.054 U)	ND(0.053 U)	ND(0.056 U)	ND(0.053 U)	ND(0.058 U)
Aroclor 1260	ND(0.066 U)	ND(1.3 U)	ND(1.7 U)	ND(0.060 U)	ND(0.057 U)	ND(0.056 U)	ND(0.054 U)	ND(0.053 U)	ND(0.056 U)	ND(0.053 U)	ND(0.058 U)
Total PCB	0.52 J	13	19	0.11 J	0.044 J	ND(0.056 U)	ND(0.054 U)	ND(0.053 U)	ND(0.056 U)	ND(0.053 U)	ND(0.058 U)

Notes:
bgs - Below ground surface
ND - Not detected

Notes Explaining Data Qualifiers:
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-6C

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MARCH 1999 SAMPLES FROM THE AMW-3A AREA (mg/kg)

Sample Location	SB-3A-202	SB-3A-202	SB-3A-202	SB-3A-202	SB-3A-203	SB-3A-203	SB-3A-203
Sample ID	W70270	W70271	W70272	W70273	W70274	W70275	W70276
Depth (ft bgs)	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0
Date Sampled	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999
Aroclor 1016	ND(0.63 U)	ND(0.062 U)	ND(0.086 U)	ND(0.059 U)	ND(0.19 U)	ND(0.30 U)	ND(0.12 U)
Aroclor 1221	ND(0.63 U)	ND(0.062 U)	ND(0.086 U)	ND(0.059 U)	ND(0.19 U)	ND(0.30 U)	ND(0.12 U)
Aroclor 1232	ND(0.63 U)	ND(0.062 U)	ND(0.086 U)	ND(0.059 U)	ND(0.19 U)	ND(0.30 U)	ND(0.12 U)
Aroclor 1242	ND(0.63 U)	ND(0.062 U)	ND(0.086 U)	ND(0.059 U)	ND(0.19 U)	ND(0.30 U)	ND(0.12 U)
Aroclor 1248	ND(0.63 U)	ND(0.062 U)	ND(0.086 U)	ND(0.059 U)	ND(0.19 U)	ND(0.30 U)	ND(0.12 U)
Aroclor 1254	4.4	0.29	ND(0.086 U)	ND(0.059 U)	1.7	1.7	0.91
Aroclor 1260	ND(0.63 U)	ND(0.062 U)	ND(0.086 U)	ND(0.059 U)	ND(0.19 U)	ND(0.30 U)	0.11 J
Total PCB	4.4	0.29	ND(0.086 U)	ND(0.059 U)	1.7	1.7	1.0 J

Sample Location	SB-3A-203	SB-3A-203	SB-3A-205	SB-3A-205	SB-3A-205	SB-3A-206	SB-3A-206 (DUP)
Sample ID	W70277	W70278	W70282	W70283	W70284	W70285	W70286
Depth (ft bgs)	6.2 - 6.6	6.6 - 7.8	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	0.0 - 2.0	0.0 - 2.0
Date Sampled	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999
Aroclor 1016	ND(0.086 U)	ND(0.062 U)	ND(0.060 U)	ND(0.059 U)	ND(0.059 U)	ND(0.060 U)	ND(0.058 U)
Aroclor 1221	ND(0.086 U)	ND(0.062 U)	ND(0.060 U)	ND(0.059 U)	ND(0.059 U)	ND(0.060 U)	ND(0.058 U)
Aroclor 1232	ND(0.086 U)	ND(0.062 U)	ND(0.060 U)	ND(0.059 U)	ND(0.059 U)	ND(0.060 U)	ND(0.058 U)
Aroclor 1242	ND(0.086 U)	ND(0.062 U)	ND(0.060 U)	ND(0.059 U)	ND(0.059 U)	ND(0.060 U)	ND(0.058 U)
Aroclor 1248	ND(0.086 U)	ND(0.062 U)	ND(0.060 U)	ND(0.059 U)	ND(0.059 U)	ND(0.060 U)	ND(0.058 U)
Aroclor 1254	ND(0.086 U)	ND(0.062 U)	0.61	0.046 J	ND(0.059 U)	ND(0.060 U)	ND(0.058 U)
Aroclor 1260	ND(0.086 U)	ND(0.062 U)	ND(0.060 U)	ND(0.059 U)	ND(0.059 U)	ND(0.060 U)	ND(0.074 U)
Total PCB	ND(0.086 U)	ND(0.062 U)	0.61	0.046 J	ND(0.059 U)	ND(0.060 U)	ND(0.074 U)

Sample Location	SB-3A-206	SB-3A-206	SB-3A-208	SB-3A-208	SB-3A-208	SB-3A-208	SB-3A-213
Sample ID	W70288	W70289	W70293	W70294	W70295	W70296	W70309
Depth (ft bgs)	2.0 - 4.0	4.0 - 6.0	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	0.0 - 2.0
Date Sampled	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999
Aroclor 1016	ND(0.054 U)	ND(0.055 U)	ND(0.056 U)	ND(0.052 U)	ND(0.053 U)	ND(0.058 U)	ND(1.1 U)
Aroclor 1221	ND(0.054 U)	ND(0.055 U)	ND(0.056 U)	ND(0.052 U)	ND(0.053 U)	ND(0.058 U)	ND(1.1 U)
Aroclor 1232	ND(0.054 U)	ND(0.055 U)	ND(0.056 U)	ND(0.052 U)	ND(0.053 U)	ND(0.058 U)	ND(1.1 U)
Aroclor 1242	ND(0.054 U)	ND(0.055 U)	ND(0.056 U)	ND(0.052 U)	ND(0.053 U)	ND(0.058 U)	ND(1.1 U)
Aroclor 1248	ND(0.054 U)	ND(0.055 U)	ND(0.056 U)	ND(0.052 U)	ND(0.053 U)	ND(0.058 U)	5.9
Aroclor 1254	ND(0.054 U)	ND(0.055 U)	ND(0.056 U)	ND(0.052 U)	ND(0.053 U)	ND(0.058 U)	ND(1.1 U)
Aroclor 1260	ND(0.054 U)	ND(0.055 U)	ND(0.056 U)	ND(0.052 U)	ND(0.053 U)	ND(0.058 U)	ND(1.1 U)
Total PCB	ND(0.054 U)	ND(0.055 U)	ND(0.056 U)	ND(0.052 U)	ND(0.053 U)	ND(0.058 U)	5.9

Sample Location	SB-3A-213	SB-3A-213 (DUP)	SB-3A-213
Sample ID	W70310	W70311	W70313
Depth (ft bgs)	2.0 - 4.0	2.0 - 4.0	4.0 - 6.0
Date Sampled	3/24/1999	3/24/1999	3/24/1999
Aroclor 1016	ND(0.056 U)	ND(0.056 U)	ND(0.056 U)
Aroclor 1221	ND(0.056 U)	ND(0.056 U)	ND(0.056 U)
Aroclor 1232	ND(0.056 U)	ND(0.056 U)	ND(0.056 U)
Aroclor 1242	ND(0.056 U)	ND(0.056 U)	ND(0.056 U)
Aroclor 1248	0.40	0.50	ND(0.056 U)
Aroclor 1254	ND(0.056 U)	ND(0.056 U)	ND(0.056 U)
Aroclor 1260	0.029 J	0.038 J	ND(0.056 U)
Total PCB	0.43 J	0.54 J	ND(0.056 U)

Notes:
bgs - Below ground surface
DUP - Duplicate sample
ND - Not detected

Notes Explaining Data Qualifiers:
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.

TABLE 4-7

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS BBL POST-EXCAVATION SAMPLES[1] FORMER OLMSTEAD CREEK[2] (mg/kg)

Sample Location	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10
Sample ID	W70344	W70345	W70346	W70347	W70348	W70349	W70350	W70351	W70352
Date Sampled	11/29/1999	11/29/1999	11/30/1999	11/30/1999	11/30/1999	11/30/1999	12/1/1999	12/1/1999	12/1/1999
Aroclor 1242	ND(0.33 U)	ND(0.33 U)	0.75	0.40	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Total PCB	ND(0.33 U)	ND(0.33 U)	0.75	0.40	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)

Notes:

(1) Post-excavation soil samples were collected at the base of excavation.

(2) Shows only the results for compounds detected above the quantitation limit.

ND - Not detected

Note Explaining Data Qualifier:

U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-7A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MDEQ POST-EXCAVATION SAMPLES[1] FORMER OLMSTEAD CREEK[2] (mg/kg)

Sample Location	SS-02	SS-03	SS-04	SS-05	SS-06	SS-07	SS-08	SS-09	SS-10
Sample ID	AC08538	AC08539	AC08540	AC08541	AC08542	AC08543	AC08544	AC08545	AC08546
Date Sampled	11/29/1999	11/29/1999	11/30/1999	11/30/1999	11/30/1999	11/30/1999	12/1/1999	12/1/1999	12/1/1999
Aroclor 1242	ND(0.12)	0.10	14	0.47	ND(0.057)	ND(0.054)	ND(0.055)	ND(0.057)	ND(0.059)
Total PCB	ND(0.12)	0.10	14	0.47	ND(0.057)	ND(0.054)	ND(0.055)	ND(0.057)	ND(0.059)

Notes:

(1) Post-excavation soil samples were collected by the MDEQ and analyzed at Northeast Analytical, Inc.

(2) Shows only the results for compounds detected above the quantitation limit.

ND - Not detected

TABLE 4-8A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MARCH 1999 SAMPLES FROM THE WRIGHT PROPERTY (mg/kg)

Sample Location	SB-3A-201	SB-3A-201	SB-3A-201	SB-3A-201	SB-3A-204	SB-3A-204	SB-3A-204
Sample ID	W70266	W70267	W70268	W70269	W70279	W70280	W70281
Depth (ft bgs)	0.0 - 2.0	2.0 - 4.0	4.0 - 4.7	4.7 - 6.0	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0
Date Sampled	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999
Aroclor 1016	ND(0.056 U)	ND(0.059 U)	ND(0.081 U)	ND(0.057 U)	ND(0.057 U)	ND(0.054 U)	ND(0.056 U)
Aroclor 1221	ND(0.056 U)	ND(0.059 U)	ND(0.081 U)	ND(0.057 U)	ND(0.057 U)	ND(0.054 U)	ND(0.056 U)
Aroclor 1232	ND(0.056 U)	ND(0.059 U)	ND(0.081 U)	ND(0.057 U)	ND(0.057 U)	ND(0.054 U)	ND(0.056 U)
Aroclor 1242	ND(0.056 U)	ND(0.059 U)	ND(0.081 U)	ND(0.057 U)	ND(0.057 U)	ND(0.054 U)	ND(0.056 U)
Aroclor 1248	ND(0.056 U)	ND(0.059 U)	ND(0.081 U)	ND(0.057 U)	ND(0.057 U)	ND(0.054 U)	ND(0.056 U)
Aroclor 1254	ND(0.056 U)	ND(0.059 U)	ND(0.081 U)	ND(0.057 U)	ND(0.057 U)	ND(0.054 U)	ND(0.056 U)
Aroclor 1260	ND(0.056 U)	ND(0.059 U)	ND(0.081 U)	ND(0.057 U)	ND(0.057 U)	ND(0.054 U)	ND(0.056 U)
Total PCB	ND(0.056 U)	ND(0.059 U)	ND(0.081 U)	ND(0.057 U)	ND(0.057 U)	ND(0.054 U)	ND(0.056 U)

Sample Location	SB-3A-207	SB-3A-207	SB-3A-207
Sample ID	W70290	W70291	W70292
Depth (ft bgs)	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0
Date Sampled	3/24/1999	3/24/1999	3/24/1999
Aroclor 1016	ND(0.057 U)	ND(0.058 U)	ND(0.054 U)
Aroclor 1221	ND(0.057 U)	ND(0.058 U)	ND(0.054 U)
Aroclor 1232	ND(0.057 U)	ND(0.058 U)	ND(0.054 U)
Aroclor 1242	ND(0.057 U)	ND(0.058 U)	ND(0.054 U)
Aroclor 1248	ND(0.057 U)	ND(0.058 U)	ND(0.054 U)
Aroclor 1254	ND(0.057 U)	ND(0.058 U)	ND(0.054 U)
Aroclor 1260	ND(0.057 U)	ND(0.058 U)	ND(0.054 U)
Total PCB	ND(0.057 U)	ND(0.058 U)	ND(0.054 U)

Notes:
bgs - Below ground surface
ND - Not detected

Notes Explaining Data Qualifiers:
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-8B

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MARCH 1999 SAMPLES FROM THE BLOOMFIELD PROPERTY (mg/kg)

Sample Location	SB-3A-209	SB-3A-209	SB-3A-209	SB-3A-210	SB-3A-210	SB-3A-210	SB-3A-211
Sample ID	W70297	W70298	W70299	W70300	W70301	W70302	W70303
Depth (ft bgs)	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	0.0 - 2.0
Date Sampled	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999
Aroclor 1016	ND(0.056 U)	ND(0.054 U)	ND(0.056 U)	ND(0.28 U)	ND(0.054 U)	ND(0.054 U)	ND(0.060 U)
Aroclor 1221	ND(0.056 U)	ND(0.054 U)	ND(0.056 U)	ND(0.28 U)	ND(0.054 U)	ND(0.054 U)	ND(0.060 U)
Aroclor 1232	ND(0.056 U)	ND(0.054 U)	ND(0.056 U)	ND(0.28 U)	ND(0.054 U)	ND(0.054 U)	ND(0.060 U)
Aroclor 1242	ND(0.056 U)	ND(0.054 U)	ND(0.056 U)	ND(0.28 U)	ND(0.054 U)	ND(0.054 U)	ND(0.060 U)
Aroclor 1248	ND(0.056 U)	ND(0.054 U)	ND(0.056 U)	ND(0.28 U)	ND(0.054 U)	ND(0.054 U)	ND(0.060 U)
Aroclor 1254	ND(0.056 U)	ND(0.054 U)	ND(0.056 U)	1.5	ND(0.054 U)	ND(0.054 U)	ND(0.060 U)
Aroclor 1260	ND(0.056 U)	ND(0.054 U)	ND(0.056 U)	ND(0.28 U)	ND(0.054 U)	ND(0.054 U)	ND(0.060 U)
Total PCB	ND(0.056 U)	ND(0.054 U)	ND(0.056 U)	1.5	ND(0.054 U)	ND(0.054 U)	ND(0.060 U)

Sample Location	SB-3A-211	SB-3A-211	SB-3A-212	SB-3A-212	SB-3A-212
Sample ID	W70304	W70305	W70306	W70307	W70308
Depth (ft bgs)	2.0 - 4.0	4.0 - 6.0	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0
Date Sampled	3/24/1999	3/24/1999	3/24/1999	3/24/1999	3/24/1999
Aroclor 1016	ND(0.054 U)	ND(0.056 U)	ND(0.050 UJ)	ND(0.054 U)	ND(0.056 U)
Aroclor 1221	ND(0.054 U)	ND(0.056 U)	ND(0.050 UJ)	ND(0.054 U)	ND(0.056 U)
Aroclor 1232	ND(0.054 U)	ND(0.056 U)	ND(0.050 UJ)	ND(0.054 U)	ND(0.056 U)
Aroclor 1242	ND(0.054 U)	ND(0.056 U)	ND(0.050 UJ)	ND(0.054 U)	ND(0.056 U)
Aroclor 1248	ND(0.054 U)	ND(0.056 U)	0.14 J	ND(0.054 U)	ND(0.056 U)
Aroclor 1254	ND(0.054 U)	ND(0.056 U)	ND(0.050 UJ)	ND(0.054 U)	ND(0.056 U)
Aroclor 1260	ND(0.054 U)	ND(0.056 U)	ND(0.050 UJ)	ND(0.054 U)	ND(0.056 U)
Total PCB	ND(0.054 U)	ND(0.056 U)	0.14 J	ND(0.054 U)	ND(0.056 U)

Notes:
bgs - Below ground surface
DUP - Duplicate sample
ND - Not detected

Notes Explaining Data Qualifiers:
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ - The compound was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

TABLE 4-8C

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MARCH 1999 SAMPLES FROM THE ADKINS PROPERTY AREA(mg/kg)

Sample Location	SB-ADKINS-1	SB-ADKINS-1	SB-ADKINS-1	SB-ADKINS-1	SB-ADKINS-2	SB-ADKINS-2	SB-ADKINS-2
Sample ID	W70216	W70217	W70218	W70219	W70220	W70221	W70222
Depth (ft bgs)	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	1.1 - 2.0	2.5 - 3.6	4.0 - 6.0
Date Sampled	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999
Aroclor 1016	ND(0.060 U)	ND(0.068 U)	ND(0.081 U)	ND(0.077 U)	ND(0.068 U)	ND(0.064 U)	ND(0.068 U)
Aroclor 1221	ND(0.060 U)	ND(0.068 U)	ND(0.081 U)	ND(0.077 U)	ND(0.068 U)	ND(0.064 U)	ND(0.068 U)
Aroclor 1232	ND(0.060 U)	ND(0.068 U)	ND(0.081 U)	ND(0.077 U)	ND(0.068 U)	ND(0.064 U)	ND(0.068 U)
Aroclor 1242	ND(0.060 U)	ND(0.068 U)	0.87 J	ND(0.077 U)	ND(0.068 U)	ND(0.064 U)	ND(0.068 U)
Aroclor 1248	ND(0.060 U)	ND(0.068 U)	ND(0.081 U)	0.048 J	ND(0.068 U)	ND(0.064 U)	ND(0.068 U)
Aroclor 1254	ND(0.060 U)	ND(0.068 U)	0.056 J	ND(0.077 U)	ND(0.068 U)	ND(0.064 U)	ND(0.068 U)
Aroclor 1260	ND(0.060 U)	ND(0.068 U)	0.075 J	ND(0.077 U)	ND(0.068 U)	ND(0.064 U)	ND(0.068 U)
Total PCB	ND(0.060 U)	ND(0.068 U)	1.0 J	0.048 J	ND(0.068 U)	ND(0.064 U)	ND(0.068 U)

Sample Location	SB-ADKINS-2	SB-ADKINS-2	SB-ADKINS-3	SB-ADKINS-3	SB-ADKINS-3	SB-ADKINS-3	SB-ADKINS-3
Sample ID	W70223	W70224	W70225	W70226	W70227	W70228	W70229
Depth (ft bgs)	6.0 - 8.0	8.0 - 10.0	0.40 - 2.0	2.0 - 3.5	4.0 - 6.0	6.0 - 6.8	6.8 - 8.0
Date Sampled	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999
Aroclor 1016	ND(0.089 U)	ND(0.057 U)	ND(0.072 U)	ND(0.072 U)	ND(0.11 U)	ND(0.11 U)	ND(0.057 U)
Aroclor 1221	ND(0.089 U)	ND(0.057 U)	ND(0.072 U)	ND(0.072 U)	ND(0.11 U)	ND(0.11 U)	ND(0.057 U)
Aroclor 1232	ND(0.089 U)	ND(0.057 U)	ND(0.072 U)	ND(0.072 U)	ND(0.11 U)	ND(0.11 U)	ND(0.057 U)
Aroclor 1242	ND(0.089 U)	ND(0.057 U)	ND(0.072 U)	ND(0.072 U)	ND(0.11 U)	ND(0.11 U)	ND(0.057 U)
Aroclor 1248	ND(0.089 U)	ND(0.057 U)	ND(0.072 U)	ND(0.072 U)	ND(0.11 U)	ND(0.11 U)	ND(0.057 U)
Aroclor 1254	ND(0.089 U)	ND(0.057 U)	ND(0.072 U)	ND(0.072 U)	ND(0.11 U)	ND(0.11 U)	ND(0.057 U)
Aroclor 1260	ND(0.089 U)	ND(0.057 U)	ND(0.072 U)	ND(0.072 U)	ND(0.11 U)	ND(0.11 U)	ND(0.057 U)
Total PCB	ND(0.089 U)	ND(0.057 U)	ND(0.072 U)	ND(0.072 U)	ND(0.11 U)	ND(0.11 U)	ND(0.057 U)

Sample Location	SB-ADKINS-4	SB-ADKINS-4	SB-ADKINS-4 (DUP)	SB-ADKINS-4	SB-ADKINS-4	SB-ADKINS-4	SB-ADKINS-4
Sample ID	W70230	W70231	W70232	W70234	W70235	W70236	W70237
Depth (ft bgs)	0.0 - 2.0	2.5 - 4.0	2.5 - 4.0	4.0 - 4.8	6.0 - 8.0	8.0 - 8.4	8.4 - 9.0
Date Sampled	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999
Aroclor 1016	ND(0.056 U)	ND(0.071 U)	ND(0.070 U)	ND(0.071 U)	ND(0.11 U)	ND(0.093 U)	ND(0.061 U)
Aroclor 1221	ND(0.056 U)	0.061 JN	ND(0.070 U)	ND(0.071 U)	ND(0.11 U)	ND(0.093 U)	ND(0.061 U)
Aroclor 1232	ND(0.056 U)	ND(0.071 U)	ND(0.070 U)	ND(0.071 U)	ND(0.11 U)	ND(0.093 U)	ND(0.061 U)
Aroclor 1242	ND(0.056 U)	ND(0.071 U)	ND(0.070 U)	ND(0.071 U)	ND(0.11 U)	ND(0.093 U)	ND(0.061 U)
Aroclor 1248	ND(0.056 U)	ND(0.071 U)	ND(0.070 U)	ND(0.071 U)	ND(0.11 U)	ND(0.093 U)	ND(0.061 U)
Aroclor 1254	ND(0.056 U)	ND(0.071 U)	ND(0.070 U)	ND(0.071 U)	ND(0.11 U)	ND(0.093 U)	ND(0.061 U)
Aroclor 1260	ND(0.056 U)	ND(0.071 U)	ND(0.070 U)	ND(0.071 U)	ND(0.11 U)	ND(0.093 U)	ND(0.061 U)
Total PCB	ND(0.056 U)	0.061 JN	ND(0.070 U)	ND(0.071 U)	ND(0.11 U)	ND(0.093 U)	ND(0.061 U)

Sample Location	SB-ADKINS-5	SB-ADKINS-5	SB-ADKINS-5	SB-ADKINS-5	SB-ADKINS-5	SB-ADKINS-5	SB-ADKINS-6
Sample ID	W70238	W70239	W70240	W70241	W70242	W70243	W70244
Depth (ft bgs)	0.0 - 2.0	3.4 - 3.8	4.0 - 6.0	6.0 - 8.0	9.6 - 10.0	10.0 - 12.0	0.0 - 2.0
Date Sampled	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999
Aroclor 1016	ND(0.054 U)	ND(0.063 U)	ND(0.072 U)	ND(0.10 U)	ND(0.061 U)	ND(0.057 U)	ND(0.055 U)
Aroclor 1221	ND(0.054 U)	ND(0.063 U)	ND(0.072 U)	ND(0.10 U)	ND(0.061 U)	ND(0.057 U)	ND(0.055 U)
Aroclor 1232	ND(0.054 U)	ND(0.063 U)	ND(0.072 U)	ND(0.10 U)	ND(0.061 U)	ND(0.057 U)	ND(0.055 U)
Aroclor 1242	ND(0.054 U)	ND(0.063 U)	ND(0.072 U)	ND(0.10 U)	ND(0.061 U)	ND(0.057 U)	ND(0.055 U)
Aroclor 1248	ND(0.054 U)	ND(0.063 U)	ND(0.072 U)	ND(0.10 U)	ND(0.061 U)	ND(0.057 U)	ND(0.055 U)
Aroclor 1254	ND(0.054 U)	ND(0.063 U)	ND(0.072 U)	ND(0.10 U)	ND(0.061 U)	ND(0.057 U)	ND(0.055 U)
Aroclor 1260	ND(0.054 U)	0.17 J	ND(0.072 U)	ND(0.10 U)	ND(0.061 U)	ND(0.057 U)	ND(0.055 U)
Total PCB	ND(0.054 U)	0.17 J	ND(0.072 U)	ND(0.10 U)	ND(0.061 U)	ND(0.057 U)	ND(0.055 U)

(See notes on page 2)

TABLE 4-8C

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MARCH 1999 SAMPLES FROM THE ADKINS PROPERTY AREA(mg/kg)

Sample Location	SB-ADKINS-6	SB-ADKINS-6 (DUP)	SB-ADKINS-6	SB-ADKINS-6	SB-ADKINS-6	SB-ADKINS-7	SB-ADKINS-7
Sample ID	W70245	W70246	W70248	W70249	W70250	W70251	W70252
Depth (ft bgs)	2.2 - 4.0	2.2 - 4.0	4.0 - 6.0	6.0 - 6.7	6.7 - 8.0	0.0 - 2.0	2.0 - 4.0
Date Sampled	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999
Aroclor 1016	ND(0.065 U)	ND(0.068 U)	ND(0.12 U)	ND(0.12 U)	ND(0.062 U)	ND(0.056 U)	ND(0.057 U)
Aroclor 1221	ND(0.065 U)	ND(0.068 U)	ND(0.12 U)	ND(0.12 U)	ND(0.062 U)	ND(0.056 U)	ND(0.057 U)
Aroclor 1232	ND(0.065 U)	ND(0.068 U)	ND(0.12 U)	ND(0.12 U)	ND(0.062 U)	ND(0.056 U)	ND(0.057 U)
Aroclor 1242	ND(0.065 U)	ND(0.068 U)	ND(0.12 U)	ND(0.12 U)	ND(0.062 U)	ND(0.056 U)	ND(0.057 U)
Aroclor 1248	ND(0.065 U)	ND(0.068 U)	ND(0.12 U)	ND(0.12 U)	ND(0.062 U)	ND(0.056 U)	ND(0.057 U)
Aroclor 1260	ND(0.065 U)	ND(0.068 U)	ND(0.12 U)	ND(0.12 U)	ND(0.062 U)	0.14 J	ND(0.057 U)
Total PCB	ND(0.065 U)	ND(0.068 U)	ND(0.12 U)	ND(0.12 U)	ND(0.062 U)	0.14 J	ND(0.057 U)

Sample Location	SB-ADKINS-7	SB-ADKINS-7	SB-ADKINS-8	SB-ADKINS-8	SB-ADKINS-8	SB-ADKINS-8	SB-ADKINS-9
Sample ID	W70253	W70254	W70255	W70256	W70257	W70258	W70259
Depth (ft bgs)	4.0 - 6.0	6.0 - 8.0	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	0.0 - 2.0
Date Sampled	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999	3/23/1999
Aroclor 1016	ND(0.057 U)	ND(0.058 U)	ND(0.057 U)	ND(0.065 U)	ND(0.16 U)	ND(0.065 U)	ND(0.058 U)
Aroclor 1221	ND(0.057 U)	ND(0.058 U)	ND(0.057 U)	ND(0.065 U)	ND(0.16 U)	ND(0.065 U)	ND(0.058 U)
Aroclor 1232	ND(0.057 U)	ND(0.058 U)	ND(0.057 U)	ND(0.065 U)	ND(0.16 U)	ND(0.065 U)	ND(0.058 U)
Aroclor 1242	ND(0.057 U)	ND(0.058 U)	ND(0.057 U)	ND(0.065 U)	ND(0.16 U)	ND(0.065 U)	ND(0.058 U)
Aroclor 1248	ND(0.057 U)	ND(0.058 U)	ND(0.057 U)	0.21	ND(0.16 U)	ND(0.065 U)	ND(0.058 U)
Aroclor 1254	ND(0.057 U)	ND(0.058 U)	ND(0.057 U)	0.033 J	ND(0.16 U)	ND(0.065 U)	ND(0.058 U)
Aroclor 1260	ND(0.057 U)	ND(0.058 U)	ND(0.057 U)	ND(0.065 U)	ND(0.16 U)	ND(0.065 U)	ND(0.058 U)
Total PCB	ND(0.057 U)	ND(0.058 U)	ND(0.057 U)	0.24 J	ND(0.16 U)	ND(0.065 U)	ND(0.058 U)

Sample Location	SB-ADKINS-9	SB-ADKINS-9	SB-ADKINS-9	SB-ADKINS-9 (DUP)
Sample ID	W70260	W70261	W70262	W70263
Depth (ft bgs)	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	6.0 - 8.0
Date Sampled	3/23/1999	3/23/1999	3/23/1999	3/23/1999
Aroclor 1016	ND(0.074 U)	ND(0.20 U)	ND(0.058 U)	ND(0.062 U)
Aroclor 1221	ND(0.074 U)	ND(0.20 U)	ND(0.058 U)	ND(0.062 U)
Aroclor 1232	ND(0.074 U)	ND(0.20 U)	ND(0.058 U)	ND(0.062 U)
Aroclor 1242	ND(0.074 U)	ND(0.20 U)	ND(0.058 U)	ND(0.062 U)
Aroclor 1248	ND(0.074 U)	ND(0.20 U)	ND(0.058 U)	ND(0.062 U)
Aroclor 1254	ND(0.074 U)	ND(0.20 U)	ND(0.058 U)	ND(0.062 U)
Aroclor 1260	ND(0.074 U)	ND(0.20 U)	ND(0.058 U)	ND(0.062 U)
Total PCB	ND(0.074 U)	ND(0.20 U)	ND(0.058 U)	ND(0.062 U)

Notes:
bgs - Below ground surface
DUP - Duplicate sample
ND - Not detected

Notes Explaining Data Qualifiers:
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
JN - The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification. The associated numerical value is an estimated concentration only.
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-8D

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MAY 2000 SAMPLES FROM THE WADSWORTH PROPERTY AREA (mg/kg)

Sample Location	B-1	B-1	B-1	B-1	B-2	B-2	B-2	B-3	B-3
Sample ID	W70426	W70427	W70428	W70429	W70430	W70431	W70432	W70433	W70434
Depth Interval (ft bgs)	0.0 - 0.5	0.5 - 2.0	2.0 - 4.0	4.0 - 5.0	0.0 - 0.5	0.5 - 2.0	2.0 - 4.0	0.0 - 0.5	0.5 - 1.0
Date Sampled	5/2/2000	5/2/2000	5/2/2000	5/2/2000	5/2/2000	5/2/2000	5/2/2000	5/2/2000	5/2/2000
Aroclor 1016	ND(0.061 U)	ND(0.089 U)	ND(0.18 U)	ND(0.088 U)	ND(0.054 U)	ND(0.052 U)	NA	ND(0.076 U)	ND(0.067 U)
Aroclor 1221	ND(0.061 U)	ND(0.089 U)	ND(0.18 U)	ND(0.088 U)	ND(0.054 U)	ND(0.052 U)	NA	ND(0.076 U)	ND(0.067 U)
Aroclor 1232	ND(0.061 U)	ND(0.089 U)	ND(0.18 U)	ND(0.088 U)	ND(0.054 U)	ND(0.052 U)	NA	ND(0.076 U)	ND(0.067 U)
Aroclor 1242	ND(0.061 U)	ND(0.089 U)	ND(0.18 U)	ND(0.088 U)	ND(0.054 U)	ND(0.052 U)	NA	ND(0.076 U)	ND(0.067 U)
Aroclor 1248	ND(0.061 U)	ND(0.089 U)	ND(0.18 U)	ND(0.088 U)	ND(0.054 U)	ND(0.052 U)	NA	ND(0.076 U)	ND(0.067 U)
Aroclor 1254	ND(0.061 U)	ND(0.089 U)	ND(0.18 U)	ND(0.088 U)	ND(0.054 U)	ND(0.052 U)	NA	ND(0.076 U)	ND(0.067 U)
Aroclor 1260	ND(0.061 U)	ND(0.089 U)	ND(0.18 U)	ND(0.088 U)	ND(0.054 U)	ND(0.052 U)	NA	ND(0.076 U)	ND(0.067 U)
Total PCB	ND(0.061 U)	ND(0.089 U)	ND(0.18 U)	ND(0.088 U)	ND(0.054 U)	ND(0.052 U)	0.12 JN	ND(0.076 U)	ND(0.067 U)

Notes:
bgs - Below ground surface
NA - Not available
ND - Not detected

Notes Explaining Data Qualifiers:
JN - The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification. The associated numerical value is an estimated concentration only.
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-8E

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS OCTOBER 2000 SAMPLES FROM THE SCOTT PROPERTY AREA (mg/kg)

Sample Location Depth (bgs) Date Sampled	TP-1 1.5 ft 10/30/2000	TP-1 2.5 ft 10/30/2000	TP-10 0.5 ft 10/30/2000	TP-12 3.0 ft 10/30/2000	TP-13 4.0 ft 10/30/2000	TP-15 3.5 ft 10/30/2000
Aroclor 1016	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1221	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1232	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1242	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1248	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1254	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1260	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Total PCB	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)

Notes:
bgs - Below ground surface
ND - Not detected

Note Explaining Data Qualifier:
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-9

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TCL COMPOUND CONCENTRATIONS AND SCREENING CRITERIA SUBSURFACE SAMPLES[1]

Compound	Frequency of Detection	Range of Concentrations (mg/kg)	Arithmetic Mean[2] (mg/kg)	95% LCL[3] (mg/kg)	95% UCL[3] (mg/kg)	Act 451 Part 201[4] Industrial & Commercial II DCC Value (mg/kg)
Willow Boulevard Site[b]						
VOCs						
Acetone	9 / 15	ND - 4.1	0.45	ND	1.0	73,000 [I]
Benzene	2 / 15	ND - 0.048	NA	NA	NA	400 [C,I]
2-Butanone	8 / 15	ND - 4.4	0.42	ND	1.0	27,000 [C, I, DD]
Carbon Disulfide	8 / 15	ND - 0.025	--	ND	0.025	280 [C, I, R, DD]
Carbon Tetrachloride	1 / 15	ND - 0.26	NA	NA	NA	390 [C]
Chlorobenzene	2 / 15	ND - 18	NA	NA	NA	260 [C, I]
Ethylbenzene	2 / 15	ND - 0.12	NA	NA	NA	140 [C, I]
Methylene Chloride	4 / 15	ND - 0.059	--	ND	0.059	2,300 [C]
Toluene	9 / 15	ND - 0.067	--	ND	0.067	250 [C, I]
Xylenes (total)	5 / 15	ND - 0.17	--	ND	0.17	150 [C, I]
SVOCs						
Acenaphthylene	3 / 15	ND - 0.082	--	ND	0.082	5,200
Anthracene	3 / 15	ND - 0.12	--	ND	0.12	730,000 [D]
Benzo(a)anthracene	3 / 15	ND - 0.67	--	ND	0.67	80 [Q]
Benzo(a)pyrene	3 / 15	ND - 0.82	--	ND	0.82	8 [Q]
Benzo(b)fluoranthene	3 / 15	ND - 0.78	--	ND	0.78	80 [Q]
Benzo(k)fluoranthene	3 / 15	ND - 0.98	--	ND	0.98	800 [Q]
bis(2-Ethylhexyl)phthalate	9 / 15	ND - 3.6	--	ND	3.6	10,000 [C]
Chrysene	3 / 15	ND - 0.81	--	ND	0.81	8,000 [Q]
1,2-Dichlorobenzene	1 / 15	ND - 1.0	NA	NA	NA	210 [C]
1,3-Dichlorobenzene	2 / 15	ND - 5.8	NA	NA	NA	170 [C]
1,4-Dichlorobenzene	2 / 15	ND - 15	NA	NA	NA	1,900
Fluoranthene	5 / 15	ND - 1.2	--	ND	1.2	130,000
Indeno(1,2,3-cd)pyrene	3 / 15	ND - 0.40	--	ND	0.40	80 [Q]
2-Methylnaphthalene	8 / 15	ND - 9.0	1.8	0.31	3.2	26,000
4-Methylphenol	4 / 15	ND - 19	3.0	ND	6.1	36,000 [J]
Naphthalene	4 / 15	ND - 1.0	--	ND	1.0	52,000
Pentachlorophenol	1 / 15	ND - 0.83	NA	NA	NA	320
Phenanthrene	4 / 15	ND - 0.38	--	ND	0.38	5,200
Pyrene	6 / 15	ND - 2.5	--	ND	2.5	84,000
1,2,4-Trichlorobenzene	1 / 15	ND - 5.4	NA	NA	NA	1,100 [C, DD]
Pesticides						
4,4'-DDD	1 / 15	ND - 0.0026	NA	NA	NA	400
4,4'-DDE[7]	5 / 14	ND - 0.15	0.044	0.012	0.077	190
4,4'-DDT[8]	2 / 10	ND - 0.10	NA	NA	NA	280

(See notes on page 3)

TABLE 4-9

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TCL COMPOUND CONCENTRATIONS AND SCREENING CRITERIA SUBSURFACE SAMPLES[1]

Compound	Frequency of Detection	Range of Concentrations (mg/kg)	Arithmetic Mean[2] (mg/kg)	95% LCL[3] (mg/kg)	95% UCL[3] (mg/kg)	Act 451 Part 201[4] Industrial & Commercial II DCC Value (mg/kg)
A-Site[9]						
VOCs						
Acetone	12 / 17	ND - 1.7	0.54	0.24	0.83	73,000 [I]
Benzene	12 / 17	ND - 0.065	--	ND	0.065	400 [C, I]
2-Butanone	13 / 17	ND - 0.83	0.35	0.12	0.58	27,000 [C, I, DD]
Carbon Disulfide	8 / 17	ND - 0.025	--	ND	0.025	280 [C, I, R, DD]
Chlorobenzene	1 / 17	ND - 0.0090	NA	NA	NA	260 [C, I]
Chloroform	4 / 17	ND - 0.060	--	ND	0.060	1,500 [C]
Ethylbenzene	6 / 17	ND - 0.045	--	ND	0.045	140 [C, I]
2-Hexanone	1 / 17	ND - 0.75	NA	NA	NA	2,500 [C]
4-Methyl-2-pentanone	1 / 17	ND - 0.054	NA	NA	NA	2,700 [C, I]
Methylene Chloride	6 / 17	ND - 0.16	--	ND	0.16	2,300 [C]
Tetrachloroethene	4 / 17	ND - 0.013	--	ND	0.013	88 [C]
Toluene	12 / 17	ND - 0.36	0.14	ND	0.31	250 [C, I]
Xylenes (total)	10 / 17	ND - 0.30	0.22	ND	0.30	150 [C, I]
SVOCs						
Butylbenzylphthalate	1 / 17	ND - 0.78	NA	NA	NA	310 [C]
Di-n-Butylphthalate	1 / 17	ND - 1.6	NA	NA	NA	760 [C]
2-Methylnaphthalene	10 / 17	ND - 22	5.5	1.3	9.6	26,000
4-Methylphenol	5 / 17	ND - 4.2	--	0.53	4.2	36,000 [J]
Naphthalene	6 / 17	ND - 10	5.4	1.1	10	52,000
Pentachlorophenol	1 / 17	ND - 1.5	NA	NA	NA	320
Phenanthrene	4 / 17	ND - 4.5	--	0.40	4.5	5,200
Pesticides						
Aldrin[10]	6 / 16	ND - 0.0055	--	< 0.0010	0.0055	4.3
4,4'-DDE[11]	4 / 14	ND - 0.70	0.10	ND	0.22	190
4,4'-DDT[12]	6 / 16	ND - 0.48	0.12	0.026	0.21	280
Delta-BHC[13]	1 / 14	ND - 0.094	NA	NA	NA	NC
Endrin Aldehyde	1 / 17	ND - 0.11	NA	NA	NA	NC
Gamma-Chlordane[14]	1 / 15	ND - 0.078	NA	NA	NA	150 [J]

Notes:

(1) Only shows results for compounds detected above the detection limit.

(2) One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the arithmetic mean PCB concentration.

(3) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document *Verification of Soil Remediation* (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL. When the 95% UCL exceeded the maximum detected concentration, the maximum was used.

(4) From MDEQ, Part 201 Generic Cleanup Criteria Tables, effective December 21, 2002.

TABLE 4-9

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TCL COMPOUND CONCENTRATIONS AND SCREENING CRITERIA SUBSURFACE SAMPLES[1]

Notes (continued):

(5) GSI Protection Criteria for Industrial and Commercial II Soil, Part 201 Generic Cleanup Criteria and Screening Levels, The number in brackets represents the number of sample detections exceeding the criterion.

(6) Includes results from borings WMW-1A, WMW-3A (two samples/two duplicates), WMW-4A (two samples), WB-1 (two samples), WB-2 (two samples), WB-3 (two samples/two duplicates), WB-4 (two samples), and WB-5 (two samples).

(7) 4,4'-DDE analysis for sample/duplicate collected at WMW-3A (18-20 ft depth interval) was rejected.

(8) 4,4'-DDT analysis for samples collected at WB-1 (20-22 ft depth interval), WB-3 (sample and duplicate at 4-6 ft depth interval), WB-4 (6-8 ft interval), WB-5 (4-6 ft interval), and WMW-4A (10-12 ft interval were rejected.

(9) Includes results from borings AMW-3A, AMW-6B (two samples), AMW-7B (two samples [two duplicates], AMW-8B (two samples), AMW-9B (two samples), AMW-10B (two samples), AS-1 (two samples), AS-2 (two samples), and AS-3 (two samples).

(10) Aldrin analysis for sample collected at AS-1 (20-22 ft depth interval) was rejected.

(11) 4,4'-DDE analysis for sample collected at AMW-6B (12-14 ft depth interval), AMW-7B (sample and duplicate at 20-22 ft depth interval), and AMW-9B (24-26 ft depth interval) were rejected.

(12) 4,4'-DDT analysis for the sample collected at AMW-9B (24-26 ft depth interval) was rejected.

(13) delta-BHC analysis for sample/duplicate collected at AMW-7B (20-22 ft depth interval), AMW-8B (24-24.5 ft depth interval), and AS-1 (18-20 ft depth interval) were rejected.

(14) gamma-Chlordane analysis for samples collected at AMW-8B (24-24.5 ft depth interval) and AS-1 (18-20 ft depth interval) were rejected.

DCC - Direct Contact Criteria.

NA - Calculation of the arithmetic mean and 95% LCL and UCL is not applicable due to small number of detected concentrations (n < 3).

NC - No criterion

ND - Not detected

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

-- - The calculated concentration was greater than the maximum detected concentration.

Criterion Notes:

(C) Value presented is a screening level based on the chemical-specific generic soil saturation concentration (Csat)since calculated risk-based criterion is greater than Csat

(D) Calculated criterion exceeds 100%, hence it is reduced to 100%.

(I) Hazardous substance may exhibit the characteristic of ignitability as defined in 40 CFR 261.21.

(J) Hazardous substance may be present in several isomer forms. Isomer-specific concentrations are added together for comparison to criteria.

(Q) Criteria for carcinogenic polycyclic aromatic hydrocarbons (PAHs) were developed using "relative potential potencies" (RPPs) to benzo(a)pyrene.

(R) Hazardous substance may exhibit the characteristic of reactivity as defined in 40 CFR 261.23.

(X) GSI criterion shown is not protective for surface water that is used as a drinking water source.

(DD) Hazardous substance causes developmental effects. Residential and Commercial I DCC are protective of both prena and postnatal exposure. Industrial and Commercial II, III and IV DCC are protective for a pregnant adult receptor.

(ID) Insufficient data to develop criterion.

Soil GSI PC (mg/kg) [5]
13
4 [X]
44
ID
0.9 [X]
0.94 [1]
0.36
19 [X]
2.8
5.6
4..4
ID
NLL
NLL
NLL
NLL
NLL
NLL
0.36 [1]
1.1 [1]
0.29 [2]
5.5
NLL
ID
1.4 [3]
0.87 [1]
(G,X)
5.3
ID
1.8 [1]
NLL
NLL
NLL

Soil GSI PC (mg/kg) [5]
13
4 [X]
44
ID
0.94
3.4 [X]
0.36
NC
ID
19 [X]
0.9 [X]
2.8
5.6
26 [X]
11
ID
1.4 [8]
0.87 [6]
(G,X)
5.3
NLL
NLL
NLL
NLL
NLL
NLL

the

atal

TABLE 4-10

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TAL ANALYTE CONCENTRATIONS AND SCREENING CRITERIA SUBSURFACE SAMPLES[1]

Analyte	Frequency of Detection	Range of Concentrations (mg/kg)	Arithmetic Mean[2] (mg/kg)	95% LCL[3] (mg/kg)	95% UCL[3] (mg/kg)	Act 451 Part 201[4] Ind.& Commercial II DCC Value (mg/kg)	Soil GSI PC (mg/kg) [5]	Default Background (mg/kg) [6]
Willow Boulevard Site[7]								
Aluminum	15 / 15	1,400 - 12,000	6,200	4,300	8,100	370,000 [B, AD]	NC	6,900 [11]
Antimony	2 / 15	ND - 15	NA	NA	NA	670	94	N/A
Arsenic	14 / 15	ND - 26	4.6	1.2	8.0	37 [B]	70	N/A
Barium	14 / 15	ND - 520	220	110	320	130,000	761	N/A
Beryllium	5 / 15	ND - 0.57	0.18	0.11	0.25	1,600	307	N/A
Cadmium	9 / 15	ND - 6.7	1.2	0.36	2.1	2,100 [B]	4 [2]	N/A
Calcium	15 / 15	13,000 - 92,000	34,000	24,000	44,000	NC	NC	NC
Chromium[8]	15 / 15	4.0 - 200	70	35	110	9,200	4.5E+06[14]	N/A
Cobalt	15 / 15	1.9 - 11	5.6	3.9	7.2	9,000	2	N/A
Copper	15 / 15	4.1 - 280	70	32	110	73,000	113	N/A
Cyanide[9,10]	9 / 13	ND - 20	2.7	ND	5.9	250 [P, R]	0.2	N/A
Iron	15 / 15	820 - 24,000	6,700	3,500	9,800	580,000 [B, D]	NC	12,000 [4]
Lead[11]	9 / 9	8.1 - 1,100	490	200	770	900 [1]	4,837	N/A
Magnesium	15 / 15	820 - 23,000	4,900	1,900	7,900	1,000,000 [B, D]	NC	NC
Manganese[12]	9 / 9	14 - 480	170	39	300	90,000 [B]	86 [5]	N/A
Mercury[13]	12 / 15	ND - 3.9	0.93	0.25	1.6	580	0.1	N/A
Nickel	15 / 15	3.5 - 27	8.5	5.1	12	150,000 [B]	117	N/A
Potassium	7 / 15	ND - 670	190	100	270	NC	NC	NC
Selenium	10 / 15	ND - 2.9	0.50	0.13	0.87	9,600 [B]	0.4	N/A
Silver	2 / 15	ND - 5.0	NA	NA	NA	9,000 [B]	0.5	N/A
Sodium	3 / 15	ND - 280	140	100	180	1,000,000 [D]	NC	NC
Vanadium	15 / 15	4.2 - 22	13	10	16	5,500	190	N/A
Zinc	15 / 15	20 - 620	200	100	300	630,000 [B, D]	255 [8]	N/A

(See notes on page 2)

TABLE 4-10

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TAL ANALYTE CONCENTRATIONS AND SCREENING CRITERIA SUBSURFACE SAMPLES[1]

Analyte	Frequency of Detection	Range of Concentrations (mg/kg)	Arithmetic Mean[2] (mg/kg)	95% LCL[3] (mg/kg)	95% UCL[3] (mg/kg)	Act 451 Part 201[4] Ind.& Commercial II DCC Value (mg/kg)	Soil GSI PC (mg/kg) [5]	Default Background (mg/kg) [6]
A-Site[14]								
Aluminum	17 / 17	1,100 - 22,000	6,600	3,900	9,200	370,000 [B, AD]	NC	6,900 [8]
Antimony	2 / 17	ND - 15	NA	NA	NA	670	94	N/A
Arsenic	16 / 17	ND - 36	7.2	2.3	12	37 [B]	70	N/A
Barium	17 / 17	13 - 1,300	280	100	460	130,000	761 [3]	N/A
Beryllium	5 / 17	ND - 0.36	0.19	0.14	0.24	1,600	307	N/A
Cadmium	1 / 17	ND - 0.66	NA	NA	NA	2,100 [B]	4	N/A
Calcium	17 / 17	7,300 - 93,000	30,000	18,000	42,000	NC	NC	NC
Chromium[8]	17 / 17	3.3 - 100	34	15	54	9,200	4.5E+06[15]	N/A
Cobalt	13 / 17	ND - 9.5	3.0	2.1	4.0	9,000	2	N/A
Copper	17 / 17	1.7 - 180	44	18	71	73,000	113	N/A
Cyanide[9]	13 / 17	ND - 120	13	ND	28	250 [P, R]	0.2	N/A
Iron	17 / 17	940 - 45,000	8,500	3,100	14,000	580,000 [B, D]	NC	12,000 [4]
Lead	17 / 17	0.92 - 680	180	52	310	900	4,837	N/A
Magnesium	17 / 17	540 - 18,000	4,700	2,100	7,400	1,000,000 [B, D]	NC	NC
Manganese	17 / 17	28 - 1,300	260	81	430	90,000 [B]	86 [9]	N/A
Mercury[13]	10 / 17	ND - 2.1	0.51	0.19	0.83	580	0.1	N/A
Nickel	15 / 17	ND - 10	4.9	3.6	6.1	150,000 [B]	117	N/A
Potassium	7 / 17	ND - 490	180	120	240	NC	NC	NC
Selenium	4 / 17	ND - 0.74	0.25	0.16	0.34	9,600 [B]	0.4	N/A
Sodium	5 / 17	ND - 310	160	130	200	1,000,000 [D]	NC	NC
Vanadium	17 / 17	5.7 - 21	12	10	15	5,500	190	N/A
Zinc	17 / 17	6.9 - 310	120	63	190	630,000 [B, D]	255 [1]	N/A

Notes:

(1) Only shows results for analytes detected above the detection limit.
(2) One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the arithmetic mean PCB concentration.
(3) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document Verification of Soil Remediation (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL. When the 95% UCL exceeded the maximum detected concentration, the maximum was used.
(4) From MDEQ, Operational Memorandum #18, Part 201 Generic Cleanup Criteria Tables, effective December 21, 2002. The number in brackets represents the number of sample detections exceeding the criterion.
(5) GSI Protection Criteria for Industrial and Commercial II Soil, Part 201 Generic Cleanup Criteria and Screening Levels, effective December 21, 2002. The number in brackets represents the number of sample detections exceeding the criterion.
(6) In the cases where there is no established Groundwater Surface Water interface protection criteria, the Statewide Default Background Levels have been included. The number in brackets represents the number of sample detections exceeding the criterion.
(7) Includes results from borings WMW-1A, WMW-3A (two samples [two duplicates]), WMW-4A (two samples), WB-1 (two samples), WB-2 (two samples), WB-3 (two samples [two duplicates]), WB-4 (two samples), and WB-5 (two samples).
(8) Chromium reported as total; cleanup criterion based on hexavalent-chromium.
(9) Cleanup criterion based on USEPA action level for releasable cyanide.
(10) Cyanide analysis for samples collected at WB-2 (16-18 ft depth interval) and WB-5 (6-8 ft depth interval) were rejected.

TABLE 4-10

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TAL ANALYTE CONCENTRATIONS AND SCREENING CRITERIA SUBSURFACE SAMPLES[1]

Notes (continued):

(11) Lead analysis for samples collected at WB-1 (22-24 ft depth interval), WB-2 (14-16 ft and 16-18 ft depth interval), WB-3 (sample and duplicate at 6-8 ft depth interval), WB-4 (8-10 ft depth interval), and WB-5 (6-8 ft depth interval) were rejected.

(12) Manganese analysis for samples collected at WB-1 (22-24 ft depth interval), WB-2 (14-16 ft and 16-18 ft depth interval), WB-3 (sample

(13) Cleanup criterion based on inorganic mercury.

(14) Includes results from borings AMW-3A, AMW-6B (two samples), AMW-7B (two samples [two duplicates]), AMW-8B (two samples), AMW-9B (two samples), AMW-10B (two samples), AS-1 (two samples), AS-2 (two samples), and AS-3 (two samples).

(15) Calculated Part 201 Generic Facility-Specific Soil GSI Protective Criteria (GSI PC) from Table 4-14A. Applies to trivalent cromium.

DCC - Direct Contact Criteria.

NA - Calculation of the arithmetic mean and 95% LCL and UCL is not applicable due to small number of detected concentrations (n < 3).

NC - No criterion

ND - Not detected

N/A - Not Applicable

Criterion Notes:

(B) Background, as defined in Rule 299.5701(c), may be substituted if higher than the calculated cleanup criteria. Background levels may not exceed criteria for all inorganic compounds.

(D) Calculated criterion exceeds 100%, hence it is reduced to 100%.

(P) Industrial and Commercial Direct Contact Criteria may not be protective of the potential for release of hydrogen cyanide gas.

(R) Hazardous substance may exhibit the characteristic of reactivity as defined in 40 CFR 261.23.

(DD) Hazardous substance causes developmental effects. Residential and Commercial I DCC are protective of both prenatal and postnatal

TABLE 4-11

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS SAMPLES FROM THE WILLOW BOULEVARD SITE DRAINAGEWAY (mg/kg)

Sample Location	DWA-SB-14	DWA-SB-14	DWA-SB-26	DWA-SB-26	DWA-SB-38	DWA-SB-38	DWA-SB-51	DWA-SB-51
Sample ID	W70315	W70316	W70317	W70318	W70319	W70320	W70321	W70322
Depth (ft bgs)	12.0 - 13.0	13.0 - 13.8	4.5 - 6.5	6.5 - 7.0	4.0 - 5.1	5.1 - 5.5	7.0 - 8.0	8.0 - 9.0
Media	Residuals	Soil	Residuals	Soil	Residuals	Soil	Residuals	Soil
Date Sampled	3/31/1999	3/31/1999	3/31/1999	3/31/1999	3/31/1999	3/31/1999	4/1/1999	4/1/1999
Aroclor 1016	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1221	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1232	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1242	23	ND(0.33 U)	ND(0.33 U)	25	ND(0.33 U)	22	23	0.39
Aroclor 1248	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Aroclor 1254	3.1	ND(0.33 U)	ND(0.33 U)	4.9	ND(0.33 U)	2.2	2.6	ND(0.33 U)
Aroclor 1260	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)	ND(0.33 U)
Total PCB	26	ND(0.33 U)	ND(0.33 U)	30	ND(0.33 U)	24	26	0.39

Notes:
bgs - Below ground surface
ND - Not detected

Note Explaining Data Qualifier:
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.

TABLE 4-12

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB CONCENTRATIONS AND SURFACE WATER CRITERIA

Compound	Frequency of Detection	Range of Concentrations (ug/L)	Act 451, Part 31, Rule 57[1] Wildlife Value (ug/L)	Act 451, Part 31, Rule 571 Human Cancer Value (ug/L)
Davis Creek[2]				
Total PCB	0 / 3	ND	1.2E-04	2.6E-05
Former Olmstead Creek[3]				
Total PCB	1 / 1	0.17	1.2E-04 [1]	2.6E-05 [1]

Notes:

(1) From MDEQ, Rule 57 Surface Water Quality Values, 7/23/03. The number in brackets represents the number of sample detections exceeding the criterion.

(2) Includes results from DCD, DCM, DCU (one duplicate).

(3) Includes results from OCD.

ND - Not detected

TABLE 4-13

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TAL ANALYTE CONCENTRATIONS AND SURFACE WATER CRITERIA[1]

Analyte	Frequency of Detection	Range of Concentrations (ug/L)	Arithmetic Mean[2] (ug/L)	95% LCL[3] (ug/L)	95% UCL[3] (ug/L)	Act 451, Part 31, Rule 57[4]			
						Human Non-Cancer Non-Drinking Water Value (ug/L)	FCV (ug/L)	AMV (ug/L)	FAV (ug/L)
Aluminum	2 / 4	ND - 98	NA	NA	NA	NC	NC	NC	NC
Arsenic	4 / 4	1.3 - 4.7	2.7	0.35	4.7	280	150	340	680
Barium	4 / 4	61 - 88	71	51	88	160,000	1,159 [5]	4,100[5]	8,200[5]
Calcium	4 / 4	85,000 - 93,000	88,000	82,000	93,000	NC	NA	NC	NC
Iron	4 / 4	360 - 820	580	280	820	NC	NA	NC	NC
Lead	4 / 4	ND - 3.0	1.7	0.21	3.0	190	27 [5]	300[5]	610[5]
Magnesium	4 / 4	23,000 - 24,000	23,000	22,000	24,000	NC	NC	NC	NC
Manganese	4 / 4	65 - 130	98	58	130	59,000	4,315 [5]	3,100[5]	6,100[5]
Potassium	4 / 4	2,000 - 3,100	2,400	1,800	3,000	NC	NC	NC	NC
Sodium	4 / 4	17,000 - 25,000	20,000	14,000	25,000	NC	NC	NC	NC
Zinc	3 / 4	ND - 13	8.3	0.41	13	22,000	257 [5]	300[5]	610[5]

Notes:

(1) Only shows results for analytes detected above the detection limit.
(2) One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the arithmetic mean PCB concentration.
(3) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document Verification of Soil Remediation (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL. When the 95% UCL exceeded the maximum detected concentration, the maximum was used
(4) From MDEQ, Rule 57 Surface Water Quality Values, 7/23/03.
(5) Criterion is pH or water hardness dependent. Calculated value presented per Table 4-13A.Includes results from RG-1 (two samples [one duplicate]) and RG-2 (two samples).

AMV - Aquatic maximum value
FAV - Final acute value
FCV - Final chronic value
NA - Calculation of the arithmetic mean and 95% LCL and UCL is not applicable due to small number of detected concentrations (n < 3).
NC - No criterion
ND - Not detected

TABLE 4-14

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB CONCENTRATIONS AND CLEANUP CRITERIA IN GROUNDWATER AND LEACHATE SAMPLES

Compound	Frequency of Detection	Range of Concentrations (ug/L)	Arithmetic Mean[1] (ug/L)	95% LCL[2] (ug/L)	95% UCL[2] (ug/L)	Act 451 Part 201 Generic Cleanup Criteria[3]	
						Industrial & Commercial II Drinking Water Value (ug/L)	GSI Value (ug/L)
Groundwater Sampling Results							
Willow Boulevard Site							
BBL Total PCB Results[4, 5]	2 / 21	ND - 1.5	NA	NA	NA	0.50 [A] [1]	0.20 [M] [2]
MDEQ Total PCB Results[6]	0 / 7	ND	NA	NA	NA	0.50 [A]	0.20 [M]
A-Site							
BBL Total PCB Results[7]	11 / 54	ND - 0.18	--	--	0.18	0.50 [A]	0.20 [M]
MDEQ Total PCB Results[8]	3 / 16	ND - 0.11	0.036	0.022	0.052	0.50 [A]	0.20 [M]
Leachate Sampling Results							
A-Site							
BBL Total PCB Results[9, 10]	4 / 8	ND - 1.4	0.67	0.28	1.1	0.50 [A] [2]	0.20 [M] [4]

Notes:

(1) One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the arithmetic mean PCB concentration.

(2) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document *Verification of Soil Remediation* (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL. When the 95% UCL exceeded the maximum detected concentration, the maximum was used.

(3) From MDEQ, Part 201 Generic Cleanup Criteria Tables, effective December 21, 2002. The number in brackets represents the number of sample detections exceeding the criterion.

(4) Includes results from monitoring wells WMW-1 (three samples), WMW-1A (three samples), WMW-2 (three samples [one duplicate]), WMW-3 (three samples [one duplicate]), WMW-3A (two samples), WMW-3AR (one sample [one duplicate]), WMW-4A (three samples), and WMW-4B (three samples).

(5) PCB detected within monitoring well WMW-3A can be attributed to the well construction.

(6) Includes results from monitoring wells WMW-1 (one sample), WMW-2 (one sample), WMW-3 (one sample [one duplicate]), WMW-3AR (one sample), WMW-4A (one sample), and WMW-4B (one sample).

(7) Includes results from monitoring wells AMW-1 (three samples [one duplicate]), AMW-2 (three samples), AMW-3 (three samples), AMW-3A (four samples), AMW-4 (four samples), AMW-5 (three samples), AMW-6A (four samples [one duplicate]), AMW-6B (three samples), AMW-7A (two samples [one sample was rejected]), AMW-7B (three samples), AMW-8A (four samples), AMW-8B (three samples), AMW-9A (four samples), AMW-9B (three samples [one duplicate]), AMW-10A (four samples [three duplicates]), and AMW-10B (four samples).

(8) Includes results from monitoring wells AMW-1 (one sample), AMW-2 (one sample), AMW-3 (one sample), AMW-3A (one sample), AMW-4 (one sample), AMW-5 (one sample), AMW-6A (one sample), AMW-6B (one sample), AMW-7A (one sample), AMW-7B (one sample), AMW-8A (one sample), AMW-8B ((one sample), AMW-9A (one sample), AMW-9B (one sample), AMW-10A (one sample [one duplicate]), and AMW-10B (one sample).

(9) Includes results from monitoring wells AMW-6P (two samples), AMW-7P (two samples), AMW-9P (two samples), and AMW-10P (two samples).

(10) PCB detections all occurred within leachate monitoring wells AMW-6P (two detections) and AMW-9P (two detections).

GSI - Groundwater/surface water interface

NA - Calculation of the arithmetic mean and 95% LCL and UCL is not applicable due to small number of detected concentrations (n < 3).

ND - Not detected

-- - The calculated concentration was greater than the maximum detected concentration.

Criterion Notes:

(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.

TABLE 4-14A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

CALCULATION OF HARDNESS DEPENDANT PART 201 GENERIC FACILITY-SPECIFIC GROUNDWATER SURFACE WATER INTERFACE (GSI) CRITERIA

Hazardous Substance	Hardness[1] in mg CaCO3/L	pH[2]	FCV Conversion Factor[3]	Final Chronic Value (FCV) (ug/Kg)	Wildlife Value (WV) (ug/Kg)	Surface Water Human Non-Drinking Water Value (HNDV) (ug/Kg)	GSI Criteria for Surface Water Not Protected for Drinking Water Use (ug/Kg)[4]
Barium	250	NA	NA	1,159	NA	160,000	1,159
Beryllium	250	NA	NA	24	NA	1,200	24
Cadmium	250	NA	0.870654075	4	NA	130	4
Chromium (III)	250	NA	0.86	157	NA	9,400	157
Copper	250	NA	0.96	20	NA	64,000	20
Lead	250	NA	0.65749793	27	NA	190	27
Manganese	250	NA	NA	4,315	NA	59,000	4,315
Nickel	250	NA	0.997	113	NA	210,000	113
Zinc	250	NA	0.986	257	NA	22,000	257
Pentachlorophenol	NA	8.14	NA	21	NA	3	3

Notes:

(1) Hardness of the Kalamazoo River is derived from the U.S. EPA STORET Database (River Street Bridge location). This value was used to determine the effluent limits for the Kalamazoo Waste Water Treatment Plant and the Auto Ion Superfund Site, both near the site.
(2) pH is derived from the USEPA STORET Database. Sample location is the River Street bridge.
(3) From MDEQ, July 2003. Mixing zone-based criteria may be developed in the future; generic values are presented as default values.
(4) For waters not protected as a source of drinking water, the value is the lesser of the FCV, WV, and HNDV

NA = Criterion or value is not available or not applicable.
AMV - Aquatic maximum value
FAV - Final acute value
FCV - Final chronic value

TABLE 4-14B

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

Calculation of Hardness Dependant Part 201 Generic Facility-Specific Soil GSI Protective Criteria (GSI PC)

Hazardous Substance	Calculated GSI Criteria	Soil-Water Distribution Coefficients (Kd) L/Kg	Henry's Law Constant (HLC) atm-m3/mol	Soil Organic Carbon-Water Partition Coefficient (Koc) L/Kg	Soil-Water Partition Value for GSI ug/Kg	20 X GSI ug/Kg	Soil GSI PC mg/kg[1]
Barium	1159	41	NA	NA	7.6E+5	23,188	761
Beryllium	24	790	NA	NA	3.1E+5	485	307
Cadmium	4	75	NA	NA	5.3E+3	88	5
Chromium (III)	157	1.8E+6	NA	NA	4.5E+9	3,139	4.5E+06
Copper	20	360	NA	NA	1.1E+5	392	113
Lead	27	11,000	NA	NA	4.8E+6	550	4,837
Manganese	4315	NA	NA	NA	NA	86,309	86
Nickel	113	65	NA	NA	1.2E+5	2,258	117
Zinc	257	62	NA	NA	2.5E+5	5,136	255
Pentachlorophenol	3	NA	2.44E-08	592	2.7E+4	56	27

Notes:

(1) The calculated GSI PC is the greater of the Soil-Water Partition value or 20 times the GSI, converted to ppm.

GSI - Groundwater/surface water interface

NA - Calculation is not applicable, since compound was not detected in any sample.

TABLE 4-15

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TCL COMPOUNDS CONCENTRATIONS AND CLEANUP CRITERIA IN GROUNDWATER AND LEACHATE SAMPLES[1]

Compound	Frequency of Detection	Range of Concentrations (ug/L)	Arithmetic Mean[2] (ug/L)	95% LCL[3] (ug/L)	95% UCL[3] (ug/L)	Act 451 Part 201 Generic Cleanup Criteria[4] Industrial & Commercial II Drinking Water Value (ug/L)	Act 451 Part 201 Generic Cleanup Criteria[4] GSI Value (ug/L)
Groundwater Sampling Results							
Willow Boulevard Site[5]							
VOCs							
Toluene	1 / 7	ND - 2.0	NA	NA	NA	790 [E, I]	140 [I]
SVOCs							
2-Methylnaphthalene	1 / 7	ND - 2.0	NA	NA	NA	750	ID
4-Methylphenol	2 / 7	ND - 13	NA	NA	NA	1,000 [J]	71 [J]
A-Site[6]							
VOCs							
Benzene	1 / 16	ND - 2.0	NA	NA	NA	5.0 [A, I]	200 [I, X]
2-Butanone	1 / 16	ND - 32	NA	NA	NA	38,000 [I]	2,200 [I]
Toluene	2 / 16	ND - 2.0	NA	NA	NA	790 [E, I]	140 [I]
SVOCs							
bis(2-Ethylhexyl)phthalate[7]	1 / 16	ND - 49	NA	NA	NA	6.0 [A] [1]	32 [1]
Di-n-Butylphthalate	1 / 16	ND - 2.0	NA	NA	NA	2,500	9.7
4-Methylphenol	9 / 16	ND - 44	8.8	2.5	15	1,000 [J]	71 [J]
Pesticides							
Aldrin	1 / 16	ND - 0.028	NA	NA	NA	0.40	0.01 [M, X] [1]
Leachate Sampling Results							
A-Site[8]							
VOCs							
Acetone	4 / 4	ND - 2,700	700	ND	2,700	2,100 [I] [1]	1,700 [1]
Benzene	1 / 4	ND - 2.0	NA	NA	NA	5.0 [A, I]	200 [I, X]
2-Butanone	3 / 4	ND - 5,600	1,400	ND	5,600	38,000 [I]	2,200 [I] [1]
Ethylbenzene	1 / 4	ND - 2.0	NA	NA	NA	74 [E, I]	18 [I]
2-Hexanone	1 / 4	ND - 68	NA	NA	NA	2,900	NC
4-Methyl-2-pentanone	1 / 4	ND - 40	NA	NA	NA	5,200 [I]	ID
Toluene	3 / 4	ND - 48	15	ND	48	790 [E, I]	140 [I]
Xylenes (total)	2 / 4	ND - 8.0	NA	NA	NA	280 [E, I]	35
SVOCs							
Di-n-Butylphthalate	1 / 4	ND - 14	NA	NA	NA	2,500	9.7 [1]
Diethylphthalate	1 / 4	ND - 150	NA	NA	NA	16,000	110 [1]
2,6-Dinitrotoluene	1 / 4	ND - 17	NA	NA	NA	NC	NC
2-Methylnaphthalene	1 / 4	ND - 7.0	NA	NA	NA	750	ID
4-Methylphenol	3 / 4	ND - 290	110	ND	290	1,000 [J]	71 [J] [1]
Naphthalene	2 / 4	ND - 210	NA	NA	NA	1,500	13 [2]
Phenol	3 / 4	ND - 880	240	ND	880	13,000	210 [1]

Notes:

(1) Only shows results for compounds detected above the detection limit.
(2) One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the arithmetic mean PCB concentration.
(3) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document Verification of Soil Soil Remediation (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL. When the 95% UCL exceeded the maximum detected concentration, the maximum was used.
(4) From MDEQ, Part 201 Generic Cleanup Criteria Tables, effective December 21, 2002. The number in brackets represents the number of sample detections exceeding the criterion.
(5) Includes results from monitoring wells WMW-1, WMW-1A, WMW-2 (one duplicate), WMW-3, WMW-3A, WMW-4A, and WMW-4B.
(6) Includes results from monitoring wells AMW-1, AMW-2, AMW-3, AMW-3A, AMW-4, AMW-5, AMW-6A (one duplicate), AMW-6B, AMW-7A (one duplicate), AMW-7B, AMW-8A, AMW-8B, AMW-9A, AMW-9B, AMW-10A, and AMW-10B.
(7) bis(2-Ethylhexyl)phthalate was also detected in the associated rinse blank.
(8) Includes results from monitoring wells AMW-6P, AMW-7P, AMW-9P, and AMW-10P.

TABLE 4-15

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TCL COMPOUNDS CONCENTRATIONS AND CLEANUP CRITERIA IN GROUNDWATER AND LEACHATE SAMPLES[1]

Notes (Continued):

GSI - Groundwater/surface water interface.
ID - Inadequate data to develop criterion.
NA - Calculation of the arithmetic mean and 95% LCL and UCL is not applicable due to small number of detected concentrations (n < 3).
NC - No criterion
ND - Not detected

Criterion Notes:

(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, as required by Sec. 20120(1)(5).
(I) Hazardous substance may exhibit the characteristic of ignitability as defined in 40 CFR 261.21.
(J) Hazardous substance may be present in several isomer forms. Isomer-specific concentrations are added together for comparison to criteria.
(M) Calculated criterion is below the analytical target detection limit, therfore the criterion defaults to the target detection limit
(X) The GSI criterion shown is not protective for surface water that is used as a drinking water source.

TABLE 4-15A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TAL ANALYTE CONCENTRATIONS AND CLEANUP CRITERIA IN GROUNDWATER AND LEACHATE SAMPLES[1]

Analyte	Frequency of Detection	Range of Concentrations (ug/L)	Arithmetic Mean[2] (ug/L)	95% LCL[3] (ug/L)	95% UCL[3] (ug/L)	Act 451 Part 201 Generic Cleanup Criteria[4] Industrial & Commercial II Drinking Water Value (ug/L)	GSI Value (ug/L)
Groundwater Sampling Results							
Willow Boulevard Site[5]							
Arsenic	6 / 7	ND - 19	5.5	ND	11	50 [A, B]	150 [B, X]
Barium	7 / 7	32 - 770	300	72	530	2,000 [A]	1,159 [G, X]
Calcium	7 / 7	110,000 - 270,000	190,000	130,000	240,000	NC	NC
Cyanide[6]	2 / 7	ND - 41	NA	NA	NA	200 [A, R]	5.2 [M, R] [2]
Iron	7 / 7	1,800 - 45,000	13,000	ND	27,000	300 [B, E] [7]	NC
Magnesium	7 / 7	23,000 - 85,000	49,000	27,000	70,000	1,100,000 [B]	NC
Manganese	7 / 7	670 - 1,900	1,100	710	1,600	50 [B, E] [7]	4,315 [B, G, X]
Potassium	7 / 7	1,500 - 8,400	4,800	2,400	7,300	NC	NC
Selenium	7 / 7	ND - 4.0	2.5	1.7	3.3	50 [A, B]	5.0 [B]
Sodium	7 / 7	30,000 - 53,000	38,000	29,000	48,000	350,000	NC
Vanadium	1 / 7	ND - 3.8	NA	NA	NA	62	12
Zinc	6 / 7	ND - 2,200	460	ND	1,200	5,000 [B, E]	257 [B, G] [2]
A-Site[7]							
Arsenic	13 / 16	ND - 95	13	0.071	27	50 [A, B] [2]	150 [B, X]
Barium	16 / 16	56 - 1,700	620	340	900	2,000 [A]	1,159 [G, X] [2]
Beryllium	2 / 16	ND - 0.40	NA	NA	NA	4.0 [A]	24 [G]
Calcium	16 / 16	86,000 - 250,000	170,000	150,000	190,000	NC	NC
Chromium(VI) [8]	4 / 16	ND - 5.5	1.8	1.3	2.4	100 [A]	11
Copper	1 / 16	ND - 3.8	NA	NA	NA	1,000 [E]	20 [G]
Cyanide[6]	9 / 16	ND - 22	11	7.9	14	200 [A, R]	5.2 [M, R] [9]
Iron	16 / 16	530 - 36,000	9,200	4,200	14,000	300 [B, E] [16]	NC
Magnesium	16 / 16	17,000 - 74,000	42,000	35,000	50,000	1,100,000 [B]	NC
Manganese	16 / 16	140 - 1,800	510	310	710	50 [B, E] [16]	4,315 [B, G, X]
Mercury[9]	1 / 16	ND - 0.22	NA	NA	NA	2.0 [A]	0.00050 [Z] [1]
Nickel	2 / 16	ND - 6.7	NA	NA	NA	100 [A, B]	113 [B, G]
Potassium	16 / 16	1,800 - 42,000	7,200	2,000	13,000	NC	NC
Selenium	11 / 16	ND - 4.6	1.7	1.1	2.4	50 [A, B]	5.0 [B]
Sodium	16 / 16	26,000 - 58,000	40,000	35,000	45,000	350,000	NC
Vanadium	4 / 16	ND - 4.0	2.1	1.7	2.6	62	12
Zinc	15 / 16	ND - 13	5.9	3.9	7.9	5,000 [B, E]	257 [B, G]

(See notes on page 2)

TABLE 4-15A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF TAL ANALYTE CONCENTRATIONS AND CLEANUP CRITERIA IN GROUNDWATER AND LEACHATE SAMPLES[1]

Analyte	Frequency of Detection	Range of Concentrations (ug/L)	Arithmetic Mean[2] (ug/L)	95% LCL[3] (ug/L)	95% UCL[3] (ug/L)	Act 451 Part 201 Generic Cleanup Criteria[4] Industrial & Commercial II Drinking Water Value (ug/L)	GSI Value (ug/L)
Leachate Sampling Results							
A-Site[10]							
Arsenic	4 / 4	3.2 - 19	8.4	ND	19	50 [A, B]	150 [B, X]
Barium	4 / 4	400 - 1,800	1,000	ND	1,800	2,000 [A]	1,159 [G, X]
Calcium	4 / 4	260,000 - 620,000	470,000	220,000	620,000	NC	NC
Chromium(VI) [8]	1 / 4	ND - 3.6	NA	NA	NA	100 [A]	11
Cobalt	1 / 4	ND - 16	NA	NA	NA	100	100
Cyanide[6]	4 / 4	20 - 130	69	ND	130	200 [A, R]	5.2 [M, R] [4]
Iron	4 / 4	8,600 - 59,000	35,000	650	59,000	300 [B, E] [4]	NC
Magnesium	4 / 4	140,000 - 190,000	160,000	130,000	190,000	1,100,000 [B]	NC
Manganese	4 / 4	720 - 2,500	1,500	330	2,500	50 [B, E] [4]	4,315 [B, G, X] [1]
Nickel	4 / 4	11 - 66	31	ND	66	100 [A, B]	113 [B, G]
Potassium	4 / 4	2,400 - 39,000	17,000	ND	39,000	NC	NC
Sodium	4 / 4	42,000 - 130,000	87,000	27,000	130,000	350,000	NC
Vanadium	2 / 4	ND - 71	NA	NA	NA	62 [1]	12 [1]
Zinc	4 / 4	3.9 - 19	8.8	ND	19	5,000 [B, E]	257 [B, G]

Notes:

(1) Only shows results for analytes detected above the detection limit.
(2) One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the arithmetic mean PCB concentration.
(3) 95% lower confidence limit (LCL) and 95% upper confidence limit (UCL) were calculated as outlined in the MDEQ Guidance Document *Verification of Soil Remediation* (MDEQ, 1994). One-half the detection limit was used as a proxy concentration for nondetects in the calculation of the UCL and LCL. When the 95% UCL exceeded the maximum detected concentration, the maximum was used.
(4) From MDEQ, Part 201 Generic Cleanup Criteria Tables, effective December 21, 2002. The number in brackets represents the number of sample detections exceeding the criterion.
(5) Includes results from monitoring wells WMW-1, WMW-1A, WMW-2 (one duplicate), WMW-3, WMW-3A, WMW-4A, and WMW-4B.
(6) Cleanup criterion based on USEPA action level for releasable cyanide.
(7) Includes results from monitoring wells AMW-1, AMW-2, AMW-3, AMW-3A, AMW-4, AMW-5, AMW-6A (one duplicate), AMW-6B, AMW-7A (one duplicate), AMW-7B, AMW-8A, AMW-8B, AMW-9A, AMW-9B, AMW-10A, and AMW-10B.
(8) Chromium reported as total; cleanup criterion based on hexavalent-chromium.
(9) Cleanup criterion based on inorganic mercury.
(10) Includes results from monitoring wells AMW-6P, AMW-7P, AMW-9P, and AMW-10P.

GSI - Groundwater/surface water interface
NA - Calculation of the 95% LCL and UCL is not applicable due to small number of detected concentrations (n < 3).
NC - No criterion
ND - Not detected

Criterion Notes:

(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.
(B) Background, as defined in Rule 299.5701(c), may be substituted if higher than the calculated cleanup criteria. Background levels may not exceed criteria for all inorganic compounds. The values shown are calculated criteria.
(E) Criterion is the aesthetic drinking water value, as required by Sec. 20120(1)(5).
(G) GSI Criterion is pH or water hardness dependent. The hardness value (250 mg CaCO3/L) was obtained from the EPA STORET Database
(M) Calculated criterion is below the analytical Target Detection Limit (TDL); therefore, the criterion defaults to the TDL.
(R) Hazardous substance may exhibit the characteristics of reactivity as defined in 40 CFR 261.23.
(X) The GSI criterion shown is not protective for surface water that is used as a drinking water source.
(Z) The TDL of 5.0 x e^{-4} using USEPA Method 1631 was required after 9/30/00.

TABLE 4-16

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS 2000 GROUNDWATER SAMPLING[1] (ug/L)

Sample Location	WMW-1	WMW-1A	WMW-2	WMW-3	WMW-3AR
Sample ID	W74109	W74110	W74089	W74095	W74096
Sample Date	11/19/2000	11/19/2000	11/15/2000	11/16/2000	11/16/2000
Aroclor 1232	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)
Aroclor 1242	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)
Aroclor 1254	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)
Total PCB	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)

Sample Location	WMW-3AR (DUP)	WMW-4A	WMW-4B	AMW-1	AMW-2
Sample ID	W74097	W74093	W74094	W74106	W74088
Sample Date	11/16/2000	11/16/2000	11/16/2000	11/20/2000	11/15/2000
Aroclor 1232	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)
Aroclor 1242	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)
Aroclor 1254	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)
Total PCB	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)

Sample Location	AMW-3	AMW-3A	AMW-3A	AMW-4	AMW-4
Sample ID	W74112	W74113	W74114	W74107	W74120
Sample Date	11/20/2000	11/20/2000	12/26/2000	11/20/2000	12/28/2000
Aroclor 1232	ND(0.051 U)	ND(0.051 U)	ND(0.052 U)	ND(0.051 U)	ND(0.053 U)
Aroclor 1242	ND(0.051 U)	0.069 JN	0.059	ND(0.051 U)	0.038 JN
Aroclor 1254	ND(0.051 U)	ND(0.051 U)	ND(0.052 U)	ND(0.051 U)	ND(0.053 U)
Total PCB	ND(0.051 U)	0.069 JN	0.059	ND(0.051 U)	0.038 JN

Sample Location	AMW-5	AMW-6A	AMW-6A	AMW-6B	AMW-7A
Sample ID	W74108	W74104	W74118	W74105	W74100
Sample Date	11/19/2000	11/19/2000	12/27/2000	11/19/2000	11/17/2000
Aroclor 1232	ND(0.051 U)	ND(0.051 U)	ND(0.052 U)	ND(0.051 U)	R
Aroclor 1242	ND(0.051 U)	0.066	0.049 JN	ND(0.051 U)	R
Aroclor 1254	ND(0.051 U)	0.027 J	ND(0.052 U)	ND(0.051 U)	R
Total PCB	ND(0.051 U)	0.093 J	0.049 JN	ND(0.051 U)	R

Sample Location	AMW-7B	AMW-8A	AMW-8A	AMW-8B	AMW-9A
Sample ID	W74101	W74102	W74121	W74103	W74098
Sample Date	11/17/2000	11/18/2000	12/29/2000	11/18/2000	11/17/2000
Aroclor 1232	ND(0.052 U)	0.11 JN	ND(0.051 U)	ND(0.051 U)	ND(0.052 U)
Aroclor 1242	ND(0.052 U)	ND(0.051 U)	0.039 J	ND(0.051 U)	ND(0.052 U)
Aroclor 1254	ND(0.052 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.052 U)
Total PCB	ND(0.052 U)	0.11 JN	0.039 J	ND(0.051 U)	ND(0.052 U)

TABLE 4-16

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS 2000 GROUNDWATER SAMPLING[1] (ug/L)

Sample Location Sample ID Sample Date	AMW-9A W74119 12/28/2000	AMW-9B W74099 11/17/2000	AMW-10A W74090 11/15/2000	AMW-10A (DUP) W74091 11/15/2000	AMW-10A W74115 12/27/2000
Aroclor 1232	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.052 U)
Aroclor 1242	0.18 JN	ND(0.051 U)	0.058	0.056	0.050 J
Aroclor 1254	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.051 U)	ND(0.052 U)
Total PCB	0.18 JN	ND(0.051 U)	0.058	0.056	0.050 J

Sample Location Sample ID Sample Date	AMW-10A (DUP) W74116 12/27/2000	AMW-10B W74092 11/15/2000	AMW-10B W74117 12/27/2000
Aroclor 1232	ND(0.055 U)	0.028 JN	ND(0.053 U)
Aroclor 1242	0.044 J	ND(0.051 U)	ND(0.053 U)
Aroclor 1254	ND(0.055 U)	ND(0.051 U)	ND(0.053 U)
Total PCB	0.044 J	0.028 JN	ND(0.053 U)

Notes:

(1) Shows only the results for compounds detected above the quantitation limit.

DUP - Duplicate sample
ND - Not detected
R - The sample results were rejected.
J - The compound was positively identified; however, the associated numerical value is an estimated concentration only.
JN - The analysis indicates the presence of a compound for which there is presumptive evidence to make a tentative identification. The associated numerical value is an estimated concentration only.
U - The compound was analyzed for but not detected. The associated value is the compound quantitation limit.
UJ - The compound was not detected above the reported sample quantitation limit. However, the reported limit is approximate and may or may not represent the actual limit of quantitation.

TABLE 4-16A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

SUMMARY OF PCB ANALYTICAL RESULTS MDEQ NOVEMBER 2000 GROUNDWATER SAMPLES[1] (ug/L)

Well	Sample ID	Sample Date	Total PCB
Willow Boulevard Site			
WMW-1	AD11665	11/20/2000	ND(0.050)
WMW-1A	AD11659	11/19/2000	ND(0.050)
WMW-2	AD11546	11/15/2000	ND(0.050)
WMW-3	AD11541	11/16/2000	ND(0.050)
WMW-3 (DUP)	AD11542	11/16/2000	ND(0.050)
WMW-3AR	AD11544	11/16/2000	ND(0.050)
WMW-4A	AD11551	11/16/2000	ND(0.050)
WMW-4B	AD11552	11/16/2000	ND(0.050)
A-Site			
AMW-1	AD11662	11/20/2000	ND(0.050)
AMW-2	AD11545	11/15/2000	ND(0.050)
AMW-3	AD11664	11/20/2000	ND(0.050)
AMW-3A	AD11663	11/20/2000	0.058 AD
AMW-4	AD11661	11/20/2000	0.11 AF
AMW-5	AD11658	11/19/2000	ND(0.050)
AMW-6A	AD11657	11/19/2000	ND(0.050)
AMW-6B	AD11656	11/19/2000	ND(0.050)
AMW-7A	AD11601	11/17/2000	ND(0.050)
AMW-7B	AD11602	11/17/2000	NA
AMW-8A	AD11655	11/18/2000	ND(0.050)
AMW-8B	AD11654	11/18/2000	ND(0.050)
AMW-9A	AD11600	11/17/2000	0.087 AD
AMW-9B	AD11599	11/17/2000	ND(0.050)
AMW-10A	AD11549	11/15/2000	ND(0.050)
AMW-10A (DUP)	AD11550	11/15/2000	ND(0.050)
AMW-10B	AD11547	11/15/2000	ND(0.050)

Notes:

(1) Groundwater samples were collected by the MDEQ and analyzed at Northeast Analytical, Inc.

DUP - Duplicate sample

NA - The sample was not analyzed.

ND - Not detected

Notes Explaining Data Qualifiers:

AD - Aroclor 1242 is being reported as the best Aroclor match. The sample exhibits an altered PCB pattern.

AF - Aroclor 1254 is being reported as the best Aroclor match. The sample exhibits an altered PCB pattern.

TABLE 5-1

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

ORGANIC CONTENT ANALYSIS RESULTS

Test Pit No.	P-5WT	P-5WT	P-5WT	P-5WT	AS-2	AS-2	AS-2	AS-2
Depth (ft)	0-2	4-6	8-10	16-18	4-6	10.4-10.5	14-16	16-18
Water Content	48.9	162	147	119	161	130	179	153
% Organic Content	27.4	50.2	41.4	35.8	58.7	50.2	56.3	70.3

TABLE 6-1

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

GENERAL RESPONSE ACTIONS AVAILABLE AND PRELIMINARY SCREENING OF PROCESS OPTIONS (shading denotes process options retained)

General Response Action/Technology Type	Process Option	Process Description	Preliminary Assessment
A. No Action/Monitoring with Institutional Controls			
	Monitoring	Periodic visual inspections and/or field sampling to track existing site conditions.	Not provided since it does not control off-site migration of residuals.
	Deed Restrictions	Constraints are placed on future use.	Not provided since it does not control off-site migration of residuals.
	Access Restrictions	Constraints are placed on access to the site.	Not provided since it does not control off-site migration of residuals.
B. In-Situ Containment/Control			
	Capping	Layers of materials (e.g., granular materials, clay, concrete, asphalt, synthetic materials, grout or cement filled geotextile, etc.) are placed to isolate and contain constituents.	Potentially applicable.
	Erosion Control	Prevention of erosion (and subsequent transport) of materials by velocity control measures, barrier mechanisms, or reimpondment of materials.	Potentially applicable.
	Hydraulic Containment	Use of physical barriers (e.g. slurry well, sheet piles, grout curtains) to prevent migration of groundwater	Not applicable since there are no significant groundwater impacts.
C. In-Situ Treatment			
I. Biodegradation	Natural	Degradation of organics using naturally occurring micro-organisms.	Potentially applicable.
	Enhanced	Degradation of organics assisted by nutrient addition, biological seeding, and/or environmental controls (i.e., aerobic/anaerobic).	Potentially applicable.
II. Immobilization	Solidification/Stabilization	Consists of chemically immobilizing media by injecting and mixing a stabilization/solidification agent into the residuals.	Potentially applicable; however, may not be effective or implementable based on the characteristics of the residuals.
	Vitrification	After removal and dewatering, solids are melted via electrical current, pyrolyzing PCB and incorporating remaining PCB and other constituents into glass-like monolith.	Full-scale operations have previously been suspended and continued operations are somewhat experimental.
III. Extraction	Soil Flushing	Continuous utilization of extraction and injection wells to remove, treat, and inject groundwater to flush constituents from soil.	Not practical due to the chemical and physical characteristics of PCB and residuals.

TABLE 6-1

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER
SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

GENERAL RESPONSE ACTIONS AVAILABLE AND PRELIMINARY SCREENING OF PROCESS OPTIONS
(shading denotes process options retained)

General Response Action/Technology Type	Process Option	Process Description	Preliminary Assessment
III. Extraction (Cont'd)	Vacuum Extraction	Apply vacuum to media to remove pore space air and volatile constituents. Can be used in conjunction with steam injection to facilitate removal of less volatile compounds.	Not practical due to site conditions and the chemical and physical characteristics of PCB and residuals.
IV. Other	Chemical Treatment	Use of chemical agents to change the nature of the constituents through oxidation, reduction, or neutralization.	Not practical due to site and PCB characteristics.
	Thermal Treatment	Heating of media with radio frequency waves to vaporize and thermally destroy constituents.	Process is still being developed for PCB applications.
D. Removal			
I. Excavation	Mechanical	Physical removal of waste constituents by typical excavation equipment under "dry" conditions.	Potentially applicable.
II. Groundwater Removal	Recovery Wells/Trenches	Collection of groundwater for subsequent treatment.	Not applicable since groundwater is not impacted by PCB.
E. Ex-Situ Treatment			
I. PCB Extraction	Vapor Extraction (DAVES)	Utilizes a low temperature fluidized bed to remove PCB from soil, sediment, or sludge.	Potentially applicable; however, less proven and more expensive than comparable alternative treatments.
	X*TRAX	Solids are heated in presence of nitrogen; organic constituents are extracted and collected.	Potentially applicable.
	Basic Extractive Sludge Treatment (BEST)	A solvent having temperature-dependent inverse miscibility in water is used to remove organic constituents from solids.	Process may be ineffective for residuals treatment.
	Low Energy Extraction Process (LEEP)	Acetone and kerosene are used as solvents to extract PCB from solids.	Limited field data and problems associated with residual acetone; not proven at pilot scale for PCB.
	Propane Extraction Process	Propane near critical conditions is used as a solvent to extract PCB and other organics from solids.	Potentially applicable.
	Furfural	Furfural, a solvent, is used to extract PCB from solids.	Process has been reported to be ineffective.

TABLE 6-1

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER
SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

GENERAL RESPONSE ACTIONS AVAILABLE AND PRELIMINARY SCREENING OF PROCESS OPTIONS
(shading denotes process options retained)

General Response Action/Technology Type	Process Option	Process Description	Preliminary Assessment
I. PCB Extraction (Cont'd)	Accurex Solvent Wash	A proprietary fluorocarbon-113 and methanol solvent is used to extract PCB from solids.	Process still being developed.
	Methanol Extraction	Methanol is used as a solvent to extract PCB from solids.	The process has not been proven to be technically feasible.
	Soilex Process	A kerosene and water mixture is used to extract PCB from solids.	This process has not been proven to be technically feasible.
	Soil Washing	Water and optional surfactants are used to "wash" PCB from solids.	Potentially applicable.
	Taciuk Process	Thermal extraction of PCB is accomplished using a four-stage rotary pyrolysis processor.	Potentially applicable.
II. PCB Destruction	Biodegradation	Degradation of organics using micro-organisms in an aerobic or anaerobic environment.	Potentially applicable.
	UV/Ozone/Ultrasonics	Ultrasonics are used to extract PCB from solids and the PCB are destroyed by subsequent UV/ozone treatment.	Difficult to implement due to complexity and excess water requirements.
	UV/Hydrogen/Ultrasonics	Ultrasonics are used to extract PCB from solids and the PCB are destroyed by subsequent UV/hydrogen treatment.	Difficult to implement due to complexity and excess water requirements.
	Ozonation	Ozone is used to decompose PCB in conjunction with ultraviolet radiation.	Destruction efficiency is reported to be too low for solid materials.
	ELI Ecologic International, Inc. Process	A gas-phase reduction reaction of hydrogen with PCB at elevated temperatures to produce hydrocarbon-rich gas product.	Process not tested at full-scale for PCB; may not be effective or implementable based on the characteristics of the residuals.
	THERMAL DESTRUCTION		
	a. On-site incineration	Media is thermally treated in a fluidized bed, rotary kiln, or infrared incinerator on site.	Potentially applicable.
	b. Off-site incineration	Media is thermally treated in an off-site TSCA permitted incinerator.	Potentially applicable.
	c. Radiant Energy (Photolysis)	UV light energy, combined with a reducing agent, is used to dechlorinate PCB.	Not proven to be effective for PCB.
	d. Pyrolysis	Use of high temperatures to decompose wastes in the presence of nitrogen.	Stringent particle size and water content restrictions.

TABLE 6-1

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER
SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

GENERAL RESPONSE ACTIONS AVAILABLE AND PRELIMINARY SCREENING OF PROCESS OPTIONS
(shading denotes process options retained)

General Response Action/Technology Type	Process Option	Process Description	Preliminary Assessment
II. PCB Destruction (Cont'd)	e. Plasma Arc	PCB are destroyed at very high temperatures.	Process still being developed for PCB treatment effectiveness.
	f. Electric Reactors	Pyrolysis of a waste stream by radiant heat in an electrically heated fluid wall reactor.	Process is still being developed.
	LOW TEMPERATURE THERMAL DESTRUCTION		
	a. Wet air oxidation	A proprietary process which uses special catalysts and relatively low temperature and high pressure to decompose PCB.	Destruction efficiency is reported to be low.
	b. Supercritical Water Oxidation	Temperature and pressure of supercritical water dissolve organics, which are then oxidized into carbon dioxide, water, and salts.	Not feasible at this site due to solids characteristics. Primarily a liquid phase treatment process.
	DECHLORINATION		
	a. Reduction	Various chemical agents (e.g., sodium borohydride, sulfur dioxide) are used to reduce constituents.	May not be effective for PCB.
	b. Sodium based reactions (NaPEG)	PCB are broken down into oxygenated organics, sodium chloride (salt), and biodegradable glycols.	Water destroys the reagent or interferes with its actions; thus, the process may require excessive drying of residuals.
	c. Potassium polyethylene glycoate based reactions (KPEG)	Involves the dehalogenation of PCB under mild conditions with potassium glycol reagent.	Potentially applicable.
	d. APEG-PLUS	Dehalogenation of PCB using an alkaline glycol reagent.	Potentially applicable.
	e. Electrochemical Dehalogenation	PCB are mixed with proprietary conducting medium. Electrical current is added to cause dechlorination.	Process is still being developed.
	f. Catalytic (low temperature) Dehalogenation	Proprietary nickel catalyst and other reagents dechlorinate PCB.	Process is still being developed.
III. PCB Immobilization	Solidification/Stabilization	Consists of physically or chemically immobilizing residuals by mixing the materials with a stabilization/solidification agent.	Potentially applicable.
	Vitrification	In-situ treatment in which solids are melted via electrical current, pyrolyzing PCB and incorporating remaining PCB and other constituents into glass-like monolith.	Full-scale operations have previously been suspended and continued operations are somewhat experimental.

TABLE 6-1

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

GENERAL RESPONSE ACTIONS AVAILABLE AND PRELIMINARY SCREENING OF PROCESS OPTIONS (shading denotes process options retained)

General Response Action/Technology Type	Process Option	Process Description	Preliminary Assessment
F. Disposal			
I. On-Site Disposal	Backfill	Place treated materials back into excavated areas.	Potentially applicable; however, less appropriate for untreated residuals.
	Confined upland disposal	Material placed in an engineered facility to prevent migration of constituents.	Potentially applicable.
II. Off-Site Disposal	TSCA Landfill	Disposal of solids at an existing TSCA permitted landfill facility.	Potentially applicable.
	Local TSCA Landfill	Construction of a new, local landfill for the disposal of solids.	Potentially applicable.
	Solid Waste Landfill	Disposal of solids (containing low levels of PCB) in an existing off-site permitted solid waste landfill.	Potentially applicable.
G. Treatment Residuals Management			
I. Off-Site Disposal	Solid Waste Landfill	Disposal of non-hazardous solid treatment residuals containing low levels of PCB in an existing off-site permitted solid waste landfill.	Potentially applicable for treated residuals.
	Confined upland disposal	Disposal of treatment residuals in a disposal facility.	Potentially applicable.
	Incineration	Disposal of treatment residuals via off-site incineration at a TSCA-permitted facility.	Potentially applicable; however, less appropriate for treated residuals.
II. Water Treatment and Discharge	Filtration	Used to reduce concentrations of suspended solids and hydrophobic organics in residual water.	Potentially applicable; commonly employed treatment technique.
	Gravity settling, oil & grease separation, and activated carbon	A system containing a settling basin, oil & grease separator, and activated carbon capable of treating residual water.	Potentially applicable; commonly employed treatment technique.
	Discharge to surface water	Discharge treated water directly to surface water.	Potentially applicable; commonly employed disposal technique.
	Discharge to municipal sewer system	Route treated liquid residuals to municipal sewer system.	Potentially applicable; however, may require sewer installation or truck transportation of treated liquid to the municipality due to lack of sewer availability

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs				
Clean Water Act (CWA)	40 CFR 131 EPA 440/5-86/001-Quality Criteria for Water - 1986	Recommended water quality criteria for protection of aquatic life and/or human health depending on designated water use. National Toxics Rule (NTR; 40 CFR 131.36) set forth water quality criteria for those states which had not adopted water quality criteria (including Michigan). The water quality criteria for total PCBs was updated on 11/9/99 to be 0.00017 ug/L for human health criteria. The 2002 updates to the NRWQC for total PCBs are: 0.000064 ug/L for human health, and 0.014 ug/L for the freshwater aquatic life criteria continuous concentration.	TBC	May be considered for surface water runoff discharging to the waterway from upland soils and for assessing water quality in the vicinity of the WB/A-OU.
	40 CFR 136	Guidelines establishing test procedures for the analysis of pollutants.	Applicable	Applicable for remedial alternatives that include excavation and dewatering of residuals, discharge to surface water, or water recovery/treatment. The procedure prescribed must be used.
	40 CFR 122	Establishes the National Pollutant Discharge Elimination System (NPDES) and sets criteria and standards.	Relevant and Appropriate	Appropriate for remedial alternatives involving discharge to surface water. Substantive requirements of a discharge permit must be attained.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs, continued				
Great Lakes Critical Programs Act of 1990 (Water Quality Guidance for the Great Lakes System)	33 U.S.C. 1258 and 1268 amended by P.L. 101-596, 104 Stat. 3000 et seq., 40 CFR 132	Creates Water Quality Guidance for the Great Lakes System that identifies minimum water quality standards, antidegradation policies, and implementation procedures to protect human health, aquatic life, and wildlife. Defines the Great Lakes System as “all the streams, rivers, lakes, and other bodies of water within the drainage basin of the Great Lakes within the United States.” Does not include numerical human health water quality criteria for PCBs in surface water. Water quality criteria for the protection of wildlife is set at 0.00012 ug/L for total PCBs in surface water.	TBC	May be considered for remedial alternatives which would include excavation and dewatering of residuals, and remedial alternatives which include groundwater recovery/treatment. May be considered for surface water runoff discharging to the waterway from upland soils.
Toxic Substances Control Act (TSCA)	40 CFR 761.61	PCB Remediation Waste Rule establishing risk-based disposal methods for PCB remediation waste.	Applicable	The site contains PCB remediation waste. A risk-based cleanup may be initiated if approved by EPA.
EPA 540/G-90/007	OSWER Directive 9355.4-01	Guidance on remedial actions for Superfund sites with PCB contamination. Advocates appropriate engineering and institutional controls for contaminated material that is managed in place long term	TBC	May be used as a guideline for handling PCB-containing residuals.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE CHEMICAL-SPECIFIC ARARs AND TBCs				
Michigan Public Act 451, Part 31 - Water Resources Protection	MCL 324.3109	Prohibits direct or indirect discharge of a substance that is injurious to public health, recreational use, or aquatic life. Establishes rules specifying standards for several water quality parameters.	Applicable	Any remedial action that results in the unacceptable discharge of injurious substances will not be considered effective or complete.
	MAC 323.1041-1116 (Part 4 Rules)	The State of Michigan's Part 4 Rules specify water quality standards which shall be met in all waters of the state. The rules require that all designated uses of the receiving water be protected, including indigenous aquatic life and wildlife.	TBC	These rules drive the need to reduce contaminant loading to the Kalamazoo River. Surface water quality standards may be used to assess surface water quality in the vicinity of the WB/A OU and as a means to gauge effectiveness of a remedial action.
	MAC 323.1201-1221 (Part 8 Rules)	In accordance with federal WPCA and CWA, establish chemical-specific water quality-based effluent limits (WQBELs) for point-source discharges.	Relevant and Appropriate	Part 201 requires that remedial actions comply with Part 31 and its promulgated rules. Criteria are applicable to venting groundwater, storm water, and discharge associated with implementing the remedial action.
	MAC 323.2101-2104, 2136-2140, 2142-2145, 2149, 2152-2155, 2160-2161, 2190 (Part 21 Rules)	Establishes a waste effluent discharge system compatible with NPDES.	Relevant and Appropriate	Substantive requirements of state discharge permits (including storm water permits) must be attained for remedial actions taking place on site.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE CHEMICAL-SPECIFIC ARARs AND TBCs, Continued				
Michigan Public Act 451, Part 201 - Environmental Response	MCL 324.20118(2) MCL 324.20120a MAC 299.5101-5117 MAC 299.5601 MAC 299.5705 MAC 299.5742	Establishes rules specifying site cleanup criteria. Requires that remedial action be consistent with cleanup criteria in promulgated rules. Generic and site-specific criteria deemed to meet the protectiveness requirement.	Applicable	By statute, the WB/A OU is a “facility.” Response activities conducted at the site must meet the appropriate state-established protective criteria. If these criteria are attained, the remedial action will be considered protective by MDEQ.
	MCL 324.20120a (15) MAC 299.5716	If a remedial action allows for venting groundwater, the discharge shall comply with Part 31. Allows for a mixing zone determination to set site-specific criteria.	Applicable	Applicable to any RA that allows venting groundwater. Consistent with promulgated rules, if GSI criteria are exceeded at compliance monitoring wells, additional action is required.
Michigan Public Act 451, Part 147- PCB Compounds.	MCL 324.14704 MAC 299.3317(2)	Establishes rules for disposal of PCB. Disposal requirements for PCB contaminated materials, which shall be disposed of at a licensed landfill approved for PCB disposal, unless approval for an alternative method of disposal is obtained from MDEQ.	Relevant and Appropriate	Appropriate due to presence of business generated PCB waste and because waste contains PCB concentrations greater than 100 ppm. PCBs are primarily regulated by the federal TSCA requirements, and this ARAR could be satisfied by MDEQ concurrence with a Record of Decision calling for disposal under TSCA.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
FEDERAL ACTION/LOCATION-SPECIFIC ARARs AND TBCs				
CWA	40 CFR 230	Guidelines to restore and maintain the chemical, physical, and biological integrity of waters of the United States by controlling discharge of fill material.	TBC	Guidelines may be followed for placement (or disposal) of fill into the river, floodplain, or wetland.
	40 CFR 232	Requirements for placement of fill	Relevant and Appropriate	Substantive requirements of Section 404 permit must be met.
	40 CFR 122 40 CFR 125	Establishes site-specific pollutant limitations and performance standards which are designed to protect surface water quality. Types of discharges regulated under the CWA include: discharge to surface water (including stormwater), indirect discharge to a POTW, and discharge of dredged or fill material into US waters.	Relevant and Appropriate	May be relevant and appropriate for remediation alternatives which treat and/or discharge water. Relevant and Appropriate for stormwater. Regarding stormwater regulations, the EPA Region V Construction General Permit outlines a set of provisions to follow. State standards that are more restrictive than federal criteria become the relevant and appropriate requirement, consistent with CERCLA 121(d).
Rivers & Harbors Act	33 USC 403 33 CFR 322 33 CFR 323	Prohibits unauthorized obstruction or alteration of any navigable waters (filling, cofferdams, piers, etc.)	Relevant and Appropriate	The river upstream of Calkins Dam is not considered navigable by the Army Corps of Engineers. However, substantive portions of CWA Section 404 permit must be met to ensure remedial activities avoid obstruction or inappropriate alteration the river channel.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
FEDERAL ACTION/LOCATION-SPECIFIC ARARs AND TBCs, Continued				
Executive Orders: 11990 - Protection of Wetlands 11988 - Floodplain management.	40 CFR 6.302 40 CFR 6, Appendix A; OSWER 9280.0-03	Requires federal agencies, where possible, to avoid or minimize adverse impacts of federal actions upon wetlands/floodplains. Calls for agencies to preserve and restore floodplains so that their natural and beneficial values can be realized.	Relevant and Appropriate	Executive orders affect any work conducted in floodplains or wetlands.
Resource Conservation and Recovery Act (RCRA)	40 CFR 257	Establishes the regulations regarding criteria for classification of solid waste disposal facilities and practices.	Applicable	ARAR if residuals are removed from the site.
	40 CFR 264.221 40 CFR 264.226 40 CFR 264.227 40 CFR 264.228	Establishes dike stabilization guidelines for surface impoundments containing hazardous materials.	TBC	WB/A-OU is not a RCRA surface impoundment, although dike stabilization criteria may still be considered when evaluating remedial alternatives.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
FEDERAL ACTION/LOCATION-SPECIFIC ARARs AND TBCs, Continued				
RCRA Subtitle D — Management of Solid Wastes	40 CFR 257 and 258; 42 U.S.C. 6901 et seq.	Establishes standards for the management and disposal of solid waste, including: 1) Facility or practices in floodplains will not restrict the flow of base flood, reduce the temporary water storage capacity of the floodplain, or otherwise result in a washout of solid waste; 2) Facility or practices shall not cause discharge of dredged or fill material into waters of the U.S; 3) Facility or practice shall not allow uncontrolled public access so as to expose the public to potential health and safety hazards; 4) Covers groundwater monitoring and corrective action requirements under Subpart E and closure and post closure care under Subpart F.	TBC	May be considered as it offers guidance on management of waste.
Clean Air Act (CAA)	40 CFR 52 42 U.S.C. 7401 et seq.;	Establishes requirements for constituent emission rates in accordance with National Ambient Air Quality Standards (NAAQS).	TBC	May be considered for remedial alternatives that include relocation of residuals. State criteria apply.
	40 CFR Part 50 42 U.S.C. 7401 et seq.;	Provides valuable guidelines with respect to minimizing the harmful effects of fugitive dust and airborne contaminants that result from excavation, construction, and other removal activities. Establishes primary and secondary ambient air quality standards for emissions of chemicals and particulate matter.	TBC	TBC for remedial alternatives that include excavation/removal of residual/soil.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
FEDERAL ACTION/LOCATION-SPECIFIC ARARs AND TBCs, Continued				
Water Quality Standards	40 CFR 264.226	State-specific ARARs for surface water quality.	Applicable	State-specific ARARs will govern where more stringent than federal ARARs.
USDOT Placarding and Handling	40 CFR 264.227	Transportation and handling requirements for materials containing PCB with concentrations of 20 mg/kg or more.	Applicable	This would apply if residuals are removed from the site.
Occupational Safety and Health Act—Hazardous Waste Operations and Emergency Response	29 CFR 1910.120	Establishes health and safety requirements for cleanup operations at sites on the National Priorities List	Applicable	Applies to any action alternative for protection of on-site workers.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE ACTION/LOCATION-SPECIFIC ARARs and TBCs				
Michigan Public Act 451, Part 303 - Wetland Protection	MAC 281.921-925	Establishes the rules regarding wetland uses.	Relevant and Appropriate	For certain remedial alternatives (especially east of Davis Creek), these regulations may limit potential work and/or storage areas.
Michigan Public Act 451, Part 201 - Environmental Response	MCL 324.20118(2) MCL 324.20120a MAC 299.5705	Requires that a remedial action shall provide for response activity that will satisfy cleanup criteria.	Applicable	The remedial action implemented must meet generic or site-specific cleanup criteria.
	MCL 324.20120a MAC 299.5708	If the target detection limit or background concentration is greater than the risk-based cleanup criteria, the target detection limit or background concentration shall be used instead of the risk-based cleanup criterion.	Applicable	Applicable to all environmental media and may be used to gauge the success of the remedial action.
	MCL 324.2017a MCL 324.20114	Requirements for owner of a facility, such as preventing exacerbation and exercising due care.	Applicable	Applicable to site if existing contamination is left in place or if there is a release of contaminants from the site.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE ACTION/LOCATION-SPECIFIC ARARs and TBCs, Continued				
Michigan Public Act 451, Part 201 - Environmental Response (Continued)	MCL 324.20116 MCL 324.20120a(16) MCL 324.20120b MAC 299.5524	Restrictions on transfer of real property designated as a facility. Requirement that if residential criteria are not met, land use restrictions must be provided. Actions required upon approval of remedial action plans.	Applicable	Due to existing contamination, property cannot be transferred without notification of land use restrictions that apply to the site. All actions leaving contamination in place must, with county register of deeds, record restrictions on activities that may interfere with the integrity of the remedial action and on activities that may result in unacceptable exposure.
	MCL 324.20118, et al. MAC 299.5532(11)	Required elements of remedial action plans (remedial design documents).	Relevant & Appropriate	Substantive requirements can be met in remedial design documents. For example, by including an aquifer monitoring plan and operation and maintenance plan. Such plans identify points of compliance for judging the effectiveness of the remedial action.
	MCL 324.20120c	Required action if contaminated soil is moved off-site or relocated within the site	Applicable	Material moved off site must be evaluated to determine if it is subject to Part 111. Required approval to move soil can be attained through MDEQ approval of a Remedial Design.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE ACTION/LOCATION-SPECIFIC ARARs and TBCs, Continued				
Michigan Public Act 451, Part 201 - Environmental Response (Continued)	MAC 299.5520 MAC 299.51003-51005	Objectives of response activities, determination (or nullification) that a response activity is complete.	Applicable	When the response action is complete, the entity initiating the action has the burden of demonstrating that the action meets all requirements.
	MAC 299.5522 MAC 299.51017	Liable parties must provide notice to the department and adjacent land owners in certain situations, such as if hazardous substances emanate beyond the property boundary.	Applicable	Applicable if there is a release (above criteria) from the site or if GSI criteria are exceeded during/after remedial action.
Michigan Public Act 451, Part 301 - Inland Lakes and Streams	MAC 281.951-965	Regulates dredging or filling of lake or stream bottoms.	Relevant and Appropriate	For remedial alternatives involving any fill in the river channel or streambeds, activities may be restricted by these regulations.
Michigan Public Act 451, Part 91 - Soil Erosion and Sediment Control	MCL 324.9112 MCL 324.9116 MAC 323.1701-1714	Requirements for owners of land undergoing an earth change. Establishes rules prescribing soil erosion and sedimentation control plans, procedures, and measures.	Relevant and Appropriate	For any remedial action involving an earth change, liable parties must implement and maintain soil erosion and sedimentation control measures. Substantive requirements of permit must be satisfied.
Michigan Public Act 451, Part 31 - Water Resources Protection	MCL 324.3112	Prohibition of discharge waste or waste effluent into surface water without approval of the State.	Applicable	Certain remedial alternatives may involve discharge of waters to the Kalamazoo River. Substantive requirements of a NPDES permit must be attained.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE ACTION/LOCATION-SPECIFIC ARARs and TBCs, Continued				
Michigan Public Act 451, Part 31 - Water Resources Protection (Continued)	MCL 324.3109a	Allows for mixing zone for discharge of venting groundwater.	TBC	For any remedial alternative where waste is left in place, the mixing zone criteria shall not be less protective than for point source discharges.
	MCL 324.3109b	Defines when Part 31 remedial obligations are satisfied.	TBC	For any remedial alternative meeting the requirements of Part 201, Part 31 requirements are satisfied.
	MCL 324.3108	Prohibits filling or grading of a floodplain, unless permitted by the state.	Applicable	For alternatives involving excavation below the 100 year flood elevation, Substantive requirements of a permit must be satisfied.
Michigan Public Act 451, Part 111-Hazardous Waste Management	MCL 324.11105 MAC 299.9101 -11107	Establishes requirements for hazardous waste generators, transporters, and treatment/storage/disposal facilities.	TBC	WB/A-OU is not a TSD facility or a generator although certain portions of the regulations may be useful as a means of determining proper methods of handling/ transportation. Response activities may generate waste residuals that may be classified as hazardous waste. Used for characterizing and identifying hazardous wastes and determining appropriate treatment and disposal.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE ACTION/LOCATION-SPECIFIC ARARs and TBCs, Continued				
Michigan Public Act 451, Part 115- Solid Waste Management	MCL 324 11501-11504 MCL 324.11507 MCL 324.11540 MAC 299.4101-4106a MAC 299.4301 (3)(d)	Establishes rules for methods of solid waste disposal and for design/operational standards for disposal areas. Describes where Type III Landfill standards apply.	Relevant and Appropriate	By statute, material at Willow boulevard is “solid waste” and the OU is a “disposal area.” By rule, the OU is a “Sanitary Landfill, Type III” to which Type III standards apply.
	MAC 299.4304	Type III final cover design to minimize erosion and infiltration to protect public health.	Relevant and Appropriate	Considering Type III standards apply to WB/A OU, cover design requirements must be met.
	MAC 299.4305 MAC 299.4307 MAC 299.4308	Landfill location restrictions and liner design standards.	Not applicable, relevant or appropriate	Not applicable because the WB/A OU is not a new disposal area. Location restrictions do not apply and neither
	MAC 299.4306	Water quality performance standards.	Relevant and Appropriate	The landfill design must ensure that all requirements for the protection of surface and groundwater under Part 31 (and rules) are met. For example, if the final cover is undermined by a 100 year flood event, this requirement would not be met. A design that keeps the final cover from being inundated is capable of limiting erosion and infiltration to the extent necessary to protect human health and the environment.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE ACTION/LOCATION-SPECIFIC ARARs and TBCs, Continued				
Michigan Public Act 451, Part 115- Solid Waste Management (Continued)	MAC 299.4310	For landfills that do not have a liner or a leachate collection system, The minimum required permanent clearance between waste and groundwater is 4 feet.	Relevant and Appropriate	The landfill does not currently have a liner or leachate collection system. The separation between waste and groundwater is applicable unless (1) a leachate collection system is installed (2) a gravity collection system is installed, or (3) a variance is approved by the MDEQ.
	MAC 299.4318	Type III landfill groundwater monitoring requirements.	Relevant and Appropriate	Substantive requirements must be met by any Remedial Action that leaves contaminants in place.
	MAC 299.4905-4908	Requirements of a hydrogeologic monitoring plan and monitoring network and associated sampling	Relevant and Appropriate	Substantive requirements must be met by documents submitted during Remedial Design and implemented through Remedial Action.
	MAC 299.4912	Requirements for natural soil barriers.	TBC	Natural soil barriers (or augments) may be evaluated by the specifications in this rule to help determine if the barriers are adequate to prevent lateral flow of groundwater or leachate into and out of the waste.
	MAC 299.4913 MAC 299.4915	Requirements for final cover materials.	Relevant and Appropriate	Covers must meet the specifications in the rules.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE ACTION/LOCATION-SPECIFIC ARARs and TBCs, Continued				
Michigan Public Act 451, Part 115- Solid Waste Management (Continued)	MAC 299.4916-4921	Construction Quality Control Program	Relevant and Appropriate	Substantive portions of construction quality control must be met in Remedial Design and Remedial Action.
Michigan Occupational Safety and Health Act, Act 154 of 1974	MAC 408.1001, et. seq. (Parts 1-49)	Establishes the rules for safety standards in the workplace.	Applicable	On-site remedial actions have the potential to expose workers to contaminants. Construction, excavation and other site actions may present potential health hazards to workers. Human labor could construct remedial systems and provide long-term maintenance on the systems. Such activities are governed by worker safety and health standards under this act and are applicable to all site actions and activities.
Michigan Public Act 451, Part 55 - Air Pollution Control	MAC 336.1101-2706	Establishes rules prohibiting the emission of air contaminants in quantities which cause injurious effects to human health, animal life, plant life or significant economic value, and/or property.	Applicable	Applicable for remedial alternatives that would generate air emissions (e.g., dust, during excavation, soil stabilization, or compaction). For certain remedial alternatives, air emissions must comply with substantive requirements of permits and monitoring would be required.

Table 6-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

COMPLIANCE WITH FEDERAL AND STATE ARARs AND TBCs

Regulation	Citation	Description	ARAR/TBC	Rationale
STATE ACTION/LOCATION-SPECIFIC ARARs and TBCs, Continued				
Michigan Public Act 300 of 1949, as amended. Michigan Vehicle Code	MCL 257.716, 257.722, et seq MAC 257.101, et seq	Rules governing the reduction of maximum axle loads during springtime frost periods	Applicable	Remedial action and construction may require heavy loads of equipment, fill dirt, contaminated media, etc. to be transported over roadways; however, this is not allowed during frost periods.

TABLE 7

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

PRELIMINARY COST ESTIMATE FOR ALL REMEDIAL ALTERNATIVES

Remedial Alternative	Description	Cost for Willow Boulevard Site	Cost for A-Site	Total Project Present Worth Cost	Cost for Groundwater Treatment (1)	Total Project Present Worth Cost w/ Groundwater Treatment (1)
1	No Action	$0	$0	$0	N/A	N/A
2A	Consolidation/Containment of Selected Materials and Install New Sheet Piling at Willow Boulevard	$6,050,000	$7,160,000	$17,540,000	$4,330,000	$17,540,000
2B	Consolidation/Containment of Selected Materials, Remove All Sheet Piling, Re-Grade/Stabilize Banks, 50' Setback	$4,530,000	$8,130,000	$12,660,000	$4,330,000	$16,990,000
2C	Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard	$4,360,000	$7,150,000	$11,510,000	$4,330,000	$15,840,000
3	Removal and Off-site Disposal as "Mega Rule" Waste	N/A	N/A	$46,140,000	N/A	N/A
4	Removal of Residuals from Willow Boulevard and Consolidation at A-Site	N/A	$15, 780,000	$15, 780,000	$3,800,000	$19,580,000

Note:

(1) Contingent present worth cost for implementation of a groundwater remedy if it is found that groundwater transport of PCB's is occuring to surface water.

TABLE 7-1A

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER
SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2A - WILLOW BOULEVARD SITE
Consolidation/Containment of Selected Materials and Install New Sheet Piling at Willow Boulevard

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost ($)**	**Comments**
	Direct Costs:					
1.	Mobilization/Demobilization	1	Lump Sum	2%	$0	2% Mob/Demob Included in 10% Indirect Costs below.
2.	Installation of Additional Groundwater Wells at Willow Boulevard	5	Each	$5,000	$25,000	Costs for installation of double-cased wells.
3.	Mechanical Excavation	5,000	Cubic Yard	$2.24	$11,200	Excavation of drainageway as necessary to construct cover system
4.	Sheet Piling					
	a. Excavation	2,000	Cubic Yard	$10.20	$20,400	Existing Bank adjacent to Kalamazoo River, placing spoils on-site
	b. Sheet Pile Installation	1,800	Linear Feet	$874	$1,573,200	Installation of sheetpile along Kalamazoo River
	c. Backfill	2,000	Cubic Yard	$12.75	$25,500	Backfill material between new sheet piling and residuals.
5.	Recontour Existing Grade	14,500	Cubic Yard	$1.52	$22,040	9 acres, 1 ft. thickness.
6.	Part 115 Type III Cap					Based on 7.6 acres.
	a. Filter Fabric	12,300	Square Yard	$1.84	$22,632	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	b. Gas Venting Layer	6,100	Cubic Yard	$13.96	$85,156	6-inch thickness. Sand, 6" lifts, on-site.
	c. Flexible Membrane Liner	12,300	Square Yard	$6.03	$74,169	Fabric Membrane Liner/Bentonite Liner.
	d. Drainage Layer	24,500	Cubic Yard	$13.96	$342,020	2-ft. thickness. Sand, 6" lifts, on-site.
	e. Filter Fabric	12,300	Square Yard	$2.81	$34,563	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	f. Topsoil Layer	6,100	Cubic Yard	$7.07	$43,127	6-inch thickness.
	g. Vegetative Cover	7.6	Acre	$14,572	$110,747	Restoration and creation of vegetative cover.
	h. Gas Vents	8	Each	$600	$4,800	One per acre, 8", HDPE Elbow construction.
7.	Stormwater Management System					
	a. Sedimentation Basin	1	Lump Sum	$15,000	$15,000	Approximately 0.5 acres.
	b. Pore Water Collection System	2,500	Linear Foot	$9.60	$24,000	Around perimeter of landfill, 6" diameter perforated PVC.
	c. Cover System Drainage Swales	1,500	Linear Foot	$9.72	$14,580	Grass-lined approximately 18" high with permanent erosion control mat.
	d. Ditches (grass-lined)	4,000	Linear Foot	$9.72	$38,880	Approximately 18" deep by 9' wide and overlain with permanent erosion control mat.
	e. Erosion control Mat	50,000	Square Foot	$0.65	$32,500	Assumed to be placed along upgradient access road side slopes and along the toe of the capped landfill side slopes.
	f. Ditches (rip-rap lined)	800	Linear Foot	$17.60	$14,080	Approximately 18-inches deep by 12-feet wide and underlain with non-woven geotextile.
	g. Downchutes	300	Linear Foot	$30.00	$9,000	Rip-rap filled reno mattress placed within a 12-foot wide channel and underlain with geomembrane.
	h. Culverts	400	Linear Feet	$15.40	$6,160	
				Subtotal, Direct Costs	$2,548,754	

See Notes on Page 6

TABLE 7-1A Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2A - A-SITE
Consolidation/Containment of Selected Materials and Install New Sheet Piling at Willow Boulevard

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost ($)**	**Comments**
	Indirect Construction Costs:					
1.	Add Div 01 (General Conditions) and General Contractor's OH+P% Allow 10%	1	Lump Sum	10%	$254,875	Adjusted by CDM Estimating Dept.
2.	State Sales Tax - Assume project is Tax exempt	1	Lump Sum			Submitted by CDM Estimating Dept.
3.	Allow for MBE/WBE/EED Requirements Allow 1/2 of 1% of direct costs.	1	Lump Sum	1/2 of 1%	$12,744	Adjusted by CDM Estimating Dept.
4.	Adjust labor costs due to Health and Safety Levels of Protection	I	Lump Sum	5%	$50,975	Adjusted by CDM Estimating Dept. Use EPA/COE Reference # 540-R-00-002 dated July 2000. Refer to Appendix B. Use 5% as adjustment Costs = (5%) ($2,548,754 * 40%)
5.	Adjust Project Costs due to Local Area Cost Factors	1	Lump Sum	1.076	$193, 705	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2000. Refer to Appendix B. Use Means 2002 Michigan Factor of 1.076.
			Subtotal, Indirect Construction Costs =		$512,299	
	Construction Cost Summary:					
			Subtotal,Direct and Indirect Construction Costs=		$3,061,053	
1.	Add Contingency at 30%	1	Lump Sum	30%	$918,316	
2.	Allow Engineering and Design Costs at 15%	1	Lump Sum	15%	$459, 158	
3.	Adjust Construction Cost Escalation to MPC	1	Lump Sum	4.5%	$137,747	Adjusted by CDM Estimating Dept, Allow 1.5 years at 3%/year or 4.5% escalation.
	Total, Capital Cost Estimate Remedial Alternative 2A-Willow Site			=	$4,576,274	
				Rounded to:	$4,580,000	
			Three Year Present Value (7):		$4,010,000	

See Notes on Page 6

TABLE 7-1A Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2A - A-SITE
Consolidation/Containment of Selected Materials and Install New Sheet Piling at Willow Boulevard

ANNUAL (POST-REMEDIAL SITE CONTROL)

	Item	Quantity	Units	Unit Cost ($)	Item Cost ($)	Comments
1.	Cap Maintenance	2	Event	$10,000	$20,000	Includes mowing and restoration of the site.
2.	Cap Repairs	61	Cubic Yard	$15	$915	Replace 1% of topsoil cover.
3.	Gas Monitoring	12	Lump Sum	$1,504	$18,048	One person, one 10-hour day/month
4.	Groundwater Monitoring	4	Lump Sum	$18,599	$74,396	Quarterly Sampling of groundwater monitoring system. 4 events/year, one 2-person crew, 40 crew hours/event, 10 samples for complete TC analysis

Subtotal:	$113,359
15% Engineering(5):	$17,004
30% Contingency(6):	$34,008
Total:	$164,371
30-Year Present Worth Cost (7):	$2,039,674
Rounded Total:	$2,040,000

Willow Boulevard Site Total Project Present Worth Cost:	$6,050,000

See Notes on Page 6

TABLE 7-1A Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2A - A-SITE
Consolidation/Containment of Selected Materials and Install New Sheet Piling at Willow Boulevard

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost($)**	**Comments**
	Direct Costs:					
1.	Mobilization/Demobilization	1	Lump Sum	2%	$0	2% Mob/Demob Included in 10% Indirect Costs below
2.	Site Preparation	17	Acre	$6,925	$117,725	Cost for clearing/chip trees (<12" diameter) and grubbing stumps
3.	Installation of Additional Groundwater Wells at A-Site	7	Each	$5,000	$35,000	Costs for installation of double-cased wells.
4.	Mechanical Excavation	6,700	Cubic Yard	$10.20	$68,340	Includes excavating residuals east of Davis Creek & south of A-site Berm as necessary to construct cover system and relocating to stabilization area.
5.	Confirmatory Sampling/Analysis	1	Lump Sum	$10,000	$10,000	In areas excavated as part of Item 4
5.	Bank Stabilization					
	a. Bank Regrading	5,000	Cubic Yard	$5.85	$29,250	Includes cost for regrading Bank to 4H:1V.
	b. Erosion Control	1,700	Cubic Yard	$70.00	$119,000	Includes cost for rip-rap (6- to 8-inch stone), geotextile, and vegetation.
6.	Recontour Existing Grade	16,800	Cubic Yard	$4.11	$69,048	20 Acres, varied thickness.
7.	Part 115 Type III Cap					Based on 19.6 acres.
	a. Filter Fabric	31,600	Square Yard	$1.84	$58,144	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	b. Gas Venting Layer	15,800	Cubic Yard	$13.96	$220,568	6-inch thickness. Sand, 6" lifts, on-site.
	c. Flexible Membrane Liner	31,600	Square Yard	$6.03	$190,548	Fabric Membrane Liner/Bentonite Liner
	d. Drainage Layer	63,000	Cubic Yard	$13.96	$879,480	2-ft. thickness. Sand, 6" lifts, on-site.
	e. Filter Fabric	31,600	Square Yard	$2.81	$88,796	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	f. Topsoil Layer	15,800	Cubic Yard	$7.07	$111,706	6-inch thickness.
	g. Vegetative Cover	19.6	Acre	$14,572	$285,611	Restoration and creation of vegetative cover.
	h. Gas Vents	20	Each	$600	$12,000	One per acre, 8", HDPE Elbow construction.
8.	Stormwater Management System					
	a. Sedimentation Basin	1	Lump Sum	$30,000	$30,000	Approximately 2 acres.
	b. Pore Water Collection System	4,000	Linear Foot	$9.60	$38,400	Around perimeter of landfill, 6" diameter perforated PVC.
	c. Cover System Drainage Swales	4,500	Linear Foot	$9.72	$43,740	Grass-lined approximately 18" high with permanent erosion control mat.
	d. Ditches (grass-lined)	10,000	Linear Foot	$9.72	$97,200	Approximately 18-inches deep by 9-feet wide and overlain with permanent erosion control mat.
	e. Erosion control Mat	80,000	Square Foot	$0.20	$16,000	Assumed to be placed along upgradient access road side slopes and along the toe of the capped landfill side slopes.
	f. Ditches (rip-rap lined)	800	Linear Foot	$17.60	$14,080	Approximately 18-inches deep by 12-feet wide and underlain with non-woven geotextile.
	g. Downchutes	600	Linear Foot	$30.00	$18,000	Rip-rap filled reno mattress placed within a 12-foot wide channel and underlain with geomembrane.
	h. Culverts	400	Linear Feet	$15.00	$6,000	
9.	Erosion Control at AMW-3A Area	1	Lump Sum	$5,000	$5,000	Installation of erosion control measures.
10.	Restoration of Area East of Davis Creek					
	a. Backfilling	3,800	Cubic Yard	$7.62	$28,956	Backfilling excavated area to pre-removal grade.
	b. Vegetative Cover	7	Acre	$14,572	$102,004	Restoration and creation of vegetative cover of excavated area
				Subtotal, Direct Costs:	$2,694,596	

See Notes on Page 6

TABLE 7-1A Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2A - A-SITE
Consolidation/Containment of Selected Materials and Install New Sheet Piling at Willow Boulevard

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost($)**	**Comments**
	Indirect Construction Costs:					
1.	Add Div 01 (General Conditions) and General Contractor's OH+P% Allow 10%	1	Lump Sum	10%	$269,460	Adjusted by CDM Estimating Dept.
2.	State Sales Tax-Assume project is tax exempt	1	Lump Sum			Submitted by CDM Estimating Dept.
3.	Allow for MBE/WBE/EEO Requirements Allow 1/2 of 1% of Direct Costs	1	Lump Sum	1/2 of 1%	$13,473	Adjusted by CDM Estimating Dept.
4.	Adjust Labor Costs due to Health and Safety Levels of Protection	1	Lump Sum	5%	$53,892	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2000. Refer to Appendix B. Use 5% as adjustment. Costs = (5%) ($2,694,596 * 40%)
5.	Adjust Project Costs due to Local Area Cost Factors	1	Lump Sum	1.076	$204,789	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2000. Refer to Appendix B. Use Means 2002 Michigan Factor of 1.076
				Subtotal, Indirect Construction Costs =	$541,614	
	Construction Cost Summary:					
				Subtotal, Direct and Indirect Construction Costs =	$3,236,210	
1.	Add Contingency at 30%	1	Lump Sum	30%	$970,863	
2.	Allow Engineernig and Design Costs at 15%	1	Lump Sum	15%	$485, 432	
3.	Adjust Construction Cost Escalation to MPC	1	Lump Sum	4.5%	$145,629	Adjusted by CDM Estimating Dept.Allow 1.5 years @ 3%/year of 4.5% Escalation
	Total, Capital Cost Estimate Remedial Alternative 2A- A-Site			=	$4,838,134	
				Rounded to	$4,850,000	
				Three Year Present Value (7):	$4,240,000	

See Notes on Page 6

TABLE 7-1A Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2A - WILLOW BOULEVARD SITE
Consolidation/Containment of Selected Materials and Install New Sheet Piling at Willow Boulevard

ANNUAL (POST-REMEDIAL SITE CONTROL)

	Item	Quantity	Units	Unit Cost ($)	Item Cost($)	Comments
1.	Cap Maintenance	2	Event	$24,000	$48,000	Includes mowing and restoration of the site.
2.	Cap Repairs	158	Cubic Yard	$15	$2,370	Replace 1% of topsoil cover.
3.	Gas Monitoring	12	Lump Sum	$1,504	$18,048	One person, one 10-hour day/month
4.	Groundwater Monitoring	4	Lump Sum	$23,299	$93,196	Quarterly Sampling of groundwater monitoring system. 4 events/year, one 2-person crew, 40 crew hours/event, 15 samples for complete TC analysis

Subtotal:	$161,614
15% Engineering(5):	$24,242
30% Contingency(6):	$48,484
Total:	$234,340
30-Year Present Worth Cost (7):	$2,907,929
Rounded Total:	$2,910,000

A-Site Total Project Present Worth Cost:	$7,150,000

TOTAL COST

WILLOW BOULEVARD SITE TOTAL PROJECT PRESENT WORTH COST:	$6,050,000
A-SITE TOTAL PROJECT PRESENT WORTH COST:	$7,160,000
GROUNDWATER TREATMENT TOTAL PRESENT WORTH COST (8):	$4,330,000
ALTERNATIVE 2A - TOTAL PROJECT PRESENT WORTH COST:	$17,540,000

Notes:

1. Unit cost shown includes material and labor costs unless otherwise noted.
2. Costs estimated based on similar project experience and R.S. Means Company 2001a; 2001b.
4. Cap repairs and maintenance will be implemented as necessary every year for a period of 30 years.
5. A 15% contingency is included to account for engineering fees. Contingency does not include legal fees and permit acquisition. Engineering Contingency developed based upon USEPA, 1987.
6. A 30% contingency is included provide for unexpected circumstances or variability in estimate areas, volumes, labor and material costs. Contingency allowance developed based upon USEPA, 1987.
7. 30-year present worth based on a 7.0 percent discount rate as published in USEPA, 1993c, and has been applied to Annual/O&M Costs
   Project fixed costs will be spread out over 3 years, with present worth based on a 7% discount rate as published in USEPA, 1993c, and has been applied to all other costs.
8. Refer to Table 7-1 for cost development.

TABLE 7-1B

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2B - WILLOW BOULEVARD SITE
Consolidation/Containment of Selected Materials, Remove All Sheet Piling, Re-Grade/Stabilize Banks, 50' Setback

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost ($)**	**Comments**
	Direct Costs:					
1.	Mobilization/Demobilization	1	Lump Sum	2%	$0	2% Mob/Demob Included in 10% Indirect Costs below.
2.	Installation of Additional Groundwater Wells at Willow Boulevard	5	Each	$5,000.00	$25,000	Costs for installation of double-cased wells.
3.	Mechanical Excavation	5,000	Cubic Yard	$2.24	$11,200	Costs for excavation of drainageway as necessary to construct cover system.
4.	Bank Stabilization					
	a. Bank Regrading	3,000	Cubic Yard	$5.85	$17,550	Includes regrading of Bank to 4H:1V slope.
	b. Earthen Berm	3,600	Cubic Yard	$12.75	$45,900	New engineered fill berm
	c. Erosion Control	1,800	Linear Feet	$70.00	$126,000	Includes rip-rap (6- to 8-inch stone), geotextile, and erosion control block.
	d. Water Treatment	1,000,000	gallons	$0.10	$100,000	Costs for treating (sand filtration/carbon adsorption) water infiltrating excavation (3 feet deep by 50 feet long) in the event that residual materials are found during the setback process, assumes 50,000 gpd, for 20 days.
5.	Recontour Existing Grade	93,236	Cubic Yard	$4.11	$383,200	To accommodate 5H:1V Slope
6.	Part 115 Type III Cap					Based on 7.6 acres.
	a. Filter Fabric	12,300	Square Yard	$1.84	$22,632	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	b. Gas Venting Layer	6,100	Cubic Yard	$13.96	$85,156	6-inch thickness. Sand, 6" lifts, on-site.
	c. Flexible Membrane Liner	12,300	Square Yard	$6.03	$74,169	Fabric Membrane Liner/Bentonite Liner.
	d. Drainage Layer	24,500	Cubic Yard	$13.96	$342,020	2-ft. thickness. Sand, 6" lifts, on-site.
	e. Filter Fabric	12,300	Square Yard	$2.81	$34,563	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	f. Topsoil Layer	6,100	Cubic Yard	$7.07	$43,127	6-inch thickness.
	g. Vegetative Cover	7.6	Acre	$14,572.00	$110,747	Restoration and creation of vegetative cover.
	h. Gas Vents	8	Each	$600.00	$4,800	One per acre, 8", HDPE Elbow construction.
7.	Stormwater Management System					
	a. Sedimentation Basin	1	Lump Sum	$15,000.00	$15,000	Approximately 0.5 acres.
	b. Pore Water Collection System	2,500	Linear Foot	$9.60	$24,000	Around perimeter of landfill, 6" diameter perforated PVC
	c. Cover System Drainage Swales	1,500	Linear Foot	$9.72	$14,580	Grass-lined approximately 18" high with permanent erosion control mat
	d. Ditches (grass-lined)	4,000	Linear Foot	$9.72	$38,880	Approximately 18-inches deep by 9-feet wide and overlain with permanent erosion control mat.
	e. Erosion control Mat	50,000	Square Foot	$0.65	$32,500	Assumed to be placed along upgradient access road side slopes and along the toe of the capped landfill side slopes.
	f. Ditches (rip-rap lined)	800	Linear Foot	$17.60	$14,080	Approximately 18-inches deep by 12-feet wide and underlain with non-woven geotextile.
	g. Downchutes	300	Linear Foot	$30.00	$9,000	Rip-rap filled reno mattress placed within a 12-foot wide channel and underlain with geomembrane.
	h. Culverts	400	Linear Feet	$15.40	$6,160	
				Subtotal, Direct Costs:	$1,580,264	

See Notes on Page 6

TABLE 7-1B Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2B - A-SITE
Consolidation/Containment of Selected Materials, Remove All Sheet Piling, Re-Grade/Stabilize Banks, 50' Setback

CAPITAL (DIRECT & INDIRECT)

	Item	Quantity	Units	Unit Cost ($)(1)	Item Cost ($)	Comments
	Indirect Construction Costs:					
1.	Add Div 01 (General Conditions) and (General Contractor's OH+P% Allow 10%	1	Lump Sum	10%	$158,026	Adjusted by CDM Estimating Dept.
2.	State Sales Tax -Assume project is tax exempt	1	Lump Sum			Submitted by CDM Estimating Dept.
3.	Allow for MBE/WBE EEO Requirements Allow 1/2 of 1% of Direct Costs	1	Lump Sum	1/2 of 1%	$7,901	Adjusted by CDM Estimating Dept.
4.	Adjust Labor Costs due to Health and Safety Levels of Protection	1	Lump Sum	5%	$31,605	Adjusted by CDM Estimating Dept. Use EPA/COE Reference # 540-R-00-002 dated July 2000. Refer to Appenidix B. Use 5% as adjustment. Costs = (5%) ($1,580,264 *40%)
5.	Adjust Project Costs due to Local Area Cost Factors	1	Lump Sum	1.076	$120,100	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2000. Refer to Appendix B. Use Means 2002 Michigan Factor of 1.076
				Subtotal, Indirect Construction Costs =	$317,632	
	Construction Cost Summary:					
				Subtotal, Direct and Indirect Construction Costs =	$1,897,896	
1.	Add Contingency at 30%	1	Lump Sum	30%	$569,369	
2.	Allow Engineering and Design Costs at 15%	1	Lump Sum	15%	$284,684	
3.	Adjust Construction Cost Escalation to MDC	1	Lump Sum	4.5%	$85,405	Adjusted by CDM Estimating Dept. Allow 1.5 years @ 3% or 4.5% Escalation.
	Total, Capital Cost Estimate Remedial Alternative 2B-Willow Site			=	$2,837,355	
				Rounded to	$2,840,000	
				Three Year Present Value (7):	$2,490,000	

See Notes on Page 6

TABLE 7-1B Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2B - A-SITE
Consolidation/Containment of Selected Materials, Remove All Sheet Piling, Re-Grade/Stabilize Banks, 50' Setback

ANNUAL (POST-REMEDIAL SITE CONTROL)

	Item	Quantity	Units	Unit Cost ($)	Item Cost ($)	Comments
1.	Cap Maintenance	2	Event	$10,000	$20,000	Includes mowing and restoration of the site.
2.	Cap Repairs	61	Cubic Yard	$15	$915	Replace 1% of topsoil cover.
3.	Gas Monitoring	12	Lump Sum	$1,504	$18,048	One person, one 10-hour day/month
4.	Groundwater Monitoring	4	Lump Sum	$18,599	$74,396	Quarterly Sampling of groundwater monitoring system. 4 events/year, one 2-person crew, 40 crew hours/event, 10 samples for complete TC analysis
				Subtotal:	$113,359	
				15% Engineering(5):	$17,004	
				30% Contingency(6):	$34,008	
				Total:	$164,371	
				30-Year Present Worth Cost (7):	$2,039,674	
				Rounded Total:	$2,040,000	
				Willow Boulevard Site Total Project Present Worth Cost:	$4,530,000	

See Notes on Page 6

TABLE 7-1B Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2B - A-SITE
Consolidation/Containment of Selected Materials, Remove All Sheet Piling, Re-Grade/Stabilize Banks, 50' Setback

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost($)**	**Comments**
	Direct Costs:					
1.	Mobilization/Demobilization	1	Lump Sum	2%	$0	2% Mob/Demob Included in 10% Indirect Costs Below
2.	Site Preparation	17	Acre	$6,925	$117,725	Cost for clearing/chip trees (<12" diameter) and grubbing stumps.
3.	Installation of Additional Groundwater Wells at A-Site	7	Each	$5,000	$35,000	Costs for installation of double-cased wells.
4.	Mechanical Excavation	6,700	Cubic Yard	$15	$100,500	Includes excavating residuals east of Davis Creek and south of A-site Bern as necessary to construct cover system and relocating to stabilization area.
5.	Confirmatory Sampling/Analysis	1	Lump Sum	$10,000	$10,000	In areas excavated as part of Item 4
5.	Remove Sheeting					
	Sheet Pile Removal	1,700	Linear Feet	$43.30	$73,610	Cost to cut steel sheeting at water level and disposing of 646 tons of steel Pulling all of existing sections out of the ground and disposing, $800/l.f.
6.	Recontour Existing Grade	180,427	Cubic Yard	$4.11	$741,555	To accommodate 5H:1V Slope
7.	Part 115 Type III Cap					Based on 19.6 acres.
	a. Filter Fabric	31,600	Square Yard	$1.84	$58,144	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	b. Gas Venting Layer	15,800	Cubic Yard	$13.96	$220,568	6-inch thickness. Sand, 6" lifts, on-site.
	c. Flexible Membrane Liner	31,600	Square Yard	$6.03	$190,548	Fabric Membrane Liner/Bentonite Liner.
	d. Drainage Layer	63,000	Cubic Yard	$13.96	$879,480	2-ft. thickness. Sand, 6" lifts, on-site.
	e. Filter Fabric	31,600	Square Yard	$2.81	$88,796	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	f. Topsoil Layer	15,800	Cubic Yard	$7.07	$111,706	6-inch thickness.
	g. Vegetative Cover	19.6	Acre	$14,572.00	$285,611	Restoration and creation of vegetative cover.
	h. Gas Vents	20	Each	$600.00	$12,000	One per acre, 8", HDPE Elbow construction.
8.	Stormwater Management System					
	a. Sedimentation Basin	1	Lump Sum	$30,000.00	$30,000	Approximately 2 acres.
	b. Pore Water Collection System	4,000	Linear Foot	$9.60	$38,400	Around perimeter of landfill, 6" diameter perforated PVC.
	c. Cover System Drainage Swales	4,500	Linear Foot	$9.72	$43,740	Grass-lined approximately 18" high with permanent erosion control mat.
	d. Ditches (grass-lined)	10,000	Linear Foot	$9.72	$97,200	Approximately 18-inches deep by 9-feet wide and overlain with permanent erosion control mat.
	e. Erosion control Mat	80,000	Square Foot	$0.20	$16,000	Assumed to be placed along upgradient access road side slopes and along the toe of the capped landfill side slopes.
	f. Ditches (rip-rap lined)	800	Linear Foot	$17.60	$14,080	Approximately 18-inches deep by 12-feet wide and underlain with non-woven geotextile.
	g. Downchutes	600	Linear Foot	$30.00	$18,000	Rip-rap filled reno mattress placed within a 12-foot wide channel and underlain with geomembrane.
	h. Culverts	400	Linear Feet	$15.00	$6,000	
9.	Erosion Control at AMW-3A Area	1	Lump Sum	$5,000.00	$5,000	Installation of erosion control measures.
10.	Restoration of Area East of Davis Creek					
	a. Backfilling	3,800	Cubic Yard	$7.62	$28,956	Backfilling excavated area to pre-removal grade.
	b. Vegetative Cover	7	Acre	$14,572.00	$102,004	Restoration and creation of vegetative cover of excavated area.
				Subtotal Direct Costs	$3,324,623	

See Notes on Page 6

TABLE 7-1B Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2B - A-SITE
Consolidation/Containment of Selected Materials, Remove All Sheet Piling, Re-Grade/Stabilize Banks, 50' Setback

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost($)**	**Comments**
	Indirect Construction Costs:					
1.	Add Div 01 (General Conditions) and General Contractor's OH+P% Allow 10%	1	Lump Sum	10%	$332,462	Adjusted by CDM Estimating Dept.
2.	State Sales Tax- Assume project is tax exempt.	1	Lump Sum			Submitted by CDM Estimating Dept.
3.	Allow for MBE/WBE/EEO Requirements Allow 1/2 of 1% of Direct Costs.	1	Lump Sum	1/2 of 1%	$16,623	Adjusted by CDM Estimating Dept.
4.	Adjust Labor Costs due to Health and Safety Levels of Protection	1	Lump Sum	5%	$66,492	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2000. Refer to Appendix B. Use 5% as Adjustment. Costs = (5%) ($3,324,624 * 40%)
5.	Adjust Project Cost due to Local Area Cost Factors	1	Lump Sum	1.076	$252,671	Adjusted by CDM Estimating Dept. Use EPA/COE Reference # 540-R-00-002 dated July 2000. Refer to Appendix B. Use Means 2002 Michigan Factor of 1.076
				Subtotal, Indirect Construction Costs =	$668,248	
	Construction Cost Summary:					
				Subtotal, Direct and Indirect Construction Costs =	$3, 992, 872	
1.	Add Contingency At 30%	1	Lump Sum	30%	$1,197, 862	
2.	Allow Engineering and Design Cost at 15%	1	Lump Sum	15%	$598, 931	
3.	Adjust Construction Cost Escalation To MDC	1	Lump Sum	4.5%	$179,679	Adjusted by CDM Estimating Dept. Allow 1.5 years at 3%/year or 4.5 Escalation
	Total, Capital Cost Estimate Remedial Alternative 2B - A-Site			=	$5,969,344	
				Rounded to	$5,970,000	
				Three Year Present Value (7):	$5,220,000	

See Notes on Page 6

TABLE 7-1B Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2B - A-SITE
Consolidation/Containment of Selected Materials, Remove All Sheet Piling, Re-Grade/Stabilize Banks, 50' Setback

ANNUAL (POST-REMEDIAL SITE CONTROL)

	Item	Quantity	Units	Unit Cost ($)	Item Cost($)	Comments
1.	Cap Maintenance	2	Event	$24,000	$48,000	Includes mowing and restoration of the site.
2.	Cap Repairs	158	Cubic Yard	$15	$2,370	Replace 1% of topsoil cover.
3.	Gas Monitoring	12	Lump Sum	$1,504	$18,048	One person, one 10-hour day/month
4.	Groundwater Monitoring	4	Lump Sum	$23,299	$93,196	Quarterly Sampling of groundwater monitoring system. 4 events/year, one 2-person crew, 40 crew hours/event, 15 samples for complete TC analysis

Subtotal:	$161,614
15% Engineering(5):	$24,242
30% Contingency(6):	$48,484
Total:	$234,340
30-Year Present Worth Cost (7):	$2,907,929
Rounded Total:	$2,910,000

A-Site Total Project Present Worth Cost:	$8,130,000

TOTAL COST

WILLOW BOULEVARD SITE TOTAL PROJECT PRESENT WORTH COST:	$4,530,000
A-SITE TOTAL PROJECT PRESENT WORTH COST:	$8,130,000
ALTERNATIVE 2B-TOTAL PROJECT PRESENT WORTH COST:	$12,660,000

TOTAL COST

WILLOW BOULEVARD SITE TOTAL PROJECT PRESENT WORTH COST:	$4,530,000
A-SITE TOTAL PROJECT PRESENT WORTH COST:	$8,130,000
Groundwater Treatment Total Present Worth Costs (8):	$4,330,000
ALTERNATIVE 2B-TOTAL PROJECT PRESENT WORTH COST:	$16,990,000

Notes:

1. Unit cost shown includes material and labor costs unless otherwise noted.
2. Costs estimated based on similar project experience and R.S. Means Company 2001a; 2001b.
4. Cap repairs and maintenance will be implemented as necessary every year for a period of 30 years.
5. A 15% contingency is included to account for engineering fees. Contingency does not include legal fees and permit acquisition. Engineering Contingency developed based upon USEPA, 1987.
6. A 30% contingency is included provide for unexpected circumstances or variability in estimate areas, volumes, labor and material costs. Contingency allowance developed based upon USEPA, 1987.
7. 30-year present worth based on a 7.0 percent discount rate as published in USEPA, 1993c, and has been applied to Annual/O&M Costs
   Project fixed costs will be spread out over 3 years, with present worth based on a 7% discount rate as published in USEPA, 1993c, and has been applied to all other costs
8. Refer to Table 7-1 for cost development

TABLE 7-1C

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2C - WILLOW BOULEVARD SITE
Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard, 50' Setback

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost ($)**	**Comments**
	Direct Costs:					
1.	Mobilization/Demobilization	1	Lump Sum	2%	$0	2% Mob/Demob Included in 10% Indirect Costs below.
2.	Installation of Additional Groundwater Wells at Willow Boulevard	5	Each	$5,000	$25,000	Costs for installation of double-cased wells.
3.	Mechanical Excavation	5,000	Cubic Yard	$2.24	$11,200	Costs for excavation of drainageway as necessary to construct cover system. Doubled standard excavation cost.
4.	Alternative Methods for Bank Stabilization					
	a. Bank Regrading Loam/Topsoil	3,000	Cubic Yard	$5.85	$17,550	Includes regrading of Bank to 4H:1V slope. Loam/Topsoil.
	b. Erosion Control	12,000	Square Yard	$5.65	$67,800	Nylon, 3 dimensional geomatrix, 9 mil thick.
	c. Eco-friendly planting	324,000	Square Feet	$0.50	$162,000	
	d. Water Treatment	1,000,000	gallons	$0.10	$100,000	Cost for treating (sand filtration/carbon adsorption) water infiltrating excavation (3 feet deep by 50 feet long) in the event that residual materials are found during the Setback process, assumes 50,000 gpd, for 20 days.
5.	Recontour Existing Grade	93,236	Cubic Yard	$4.11	$383,200	Re-Balance Site with 4 horizontal to 1 vertical slope
6.	Part 115 Type III Cap					Based on 7.6 acres.
	a. Filter Fabric	12,300	Square Yard	$1.84	$22,632	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	b. Gas Venting Layer	6,100	Cubic Yard	$13.96	$85,156	6-inch thickness. Sand, 6" lifts, on-site.
	c. Flexible Membrane Liner	12,300	Square Yard	$6.03	$74,169	Fabric Membrane Liner/Bentonite Liner.
	d. Drainage Layer	24,500	Cubic Yard	$13.96	$342,020	2-ft. thickness. Sand, 6" lifts, on-site.
	e. Filter Fabric	12,300	Square Yard	$2.81	$34,563	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	f. Topsoil Layer	6,100	Cubic Yard	$7.07	$43,127	6-inch thickness.
	g. Vegetative Cover	7.6	Acre	$14,572.00	$110,747	Restoration and creation of vegetative cover.
	h. Gas Vents	8	Each	$600.00	$4,800	One per acre, 8", HDPE Elbow construction.
7.	Stormwater Management System					
	a. Sedimentation Basin	1	Lump Sum	$15,000.00	$15,000	Approximately 0.5 acres.
	b. Pore Water Collection System	2,500	Linear Foot	$9.60	$24,000	Around perimeter of landfill, 6" diameter perforated PVC
	c. Cover System Drainage Swales	1,500	Linear Foot	$9.72	$14,580	Grass lined approximately 18" high with permanent erosion control mat
	d. Ditches (grass-lined)	4,000	Linear Foot	$9.72	$38,880	Approximately 18-inches deep by 9-feet wide and overlain with permanent erosion control mat.
	e. Erosion control Mat	50,000	Square Foot	$0.65	$32,500	Assumed to be placed along upgradient access road side slopes and along the toe of the capped landfill side slopes.
	f. Ditches (rip-rap lined)	800	Linear Foot	$17.60	$14,080	Approximately 18-inches deep by 12-feet wide and underlain with non-woven geotextile.
	g. Downchutes	300	Linear Foot	$30.00	$9,000	Rip-rap filled reno mattress placed within a 12-foot wide channel and underlain with geomembrane.
	h. Culverts	400	Linear Feet	$15.40	$6,160	
				Subtotal, Direct Costs:	$1,638,164	

See Notes on Page 6

TABLE 7-1C

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2C - WILLOW BOULEVARD SITE
Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard, 50' Setback

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost ($)**	**Comments**
	Indirect Construction Costs:					
1.	Add Div 01 (General Conditions) and General Contractor's OH+P % Allow 10%	1	Lump Sum	10%	$147,616	Adjusted by CDM Estimating Dept.
2.	State Sales Tax- Addume project is tax exempt	1	Lump Sum			Submitted by CDM Estimating Dept.
3.	Allow for MBE/WBE/EEO Requirements Allow 1/2 of 1% of Direct Costs.	1	Lump Sum	1/2 of 1%	$7,380	Adjusted by CDM Estimating Dept.
4.	Adjust Labor Costs due to Health and Safety Levels of Protection	1	Lump Sum	5%	$29, 523	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2000. Refer to Appendix B. Use 5% as adjustment. Costs = (5%) ($1,476, 164 *40%)
5.	Adjust Project Costs due to Local Area Cost Factors	1	Lump Sum	1.076	$112,188	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2000. Refer to Appendix B. Use Means 2002 Michigan Factor of 1%
				Subtotal, Indirect Construction Costs=	$296, 707	
	Construction Cost Summary:					
				Subtotal Direct, and Indirect Construction Costs =	$1,77,871	
1.	Add Contingency at 30%	1	Lump Sum	30%	$531,861	
2.	Allow Engineering and Design Costs at 15%	1	Lump Sum	15%	$265, 931	
3.	Adjust Construction Cost Escalation to MDC	1	Lump Sum	4.5%	$79, 779	Adjusted by CDM Estimating Dept. Allow 1.5 years @ 3%/year or 4.5% Escalation.
	Total, Capital Cost Estimate Remedial Alternative 2C- Willow Site			=	$2,650,442	
				Rounded to:	$2,650, 000	
				Three Year Present Value (7):	$2,320,000	

See Notes on Page 6

TABLE 7-1C Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2C - A-SITE
Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard, 50' Setback

	ANNUAL (POST-REMEDIAL SITE CONTROL)					
	Item	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost ($)**	**Comments**
1.	Cap Maintenance	2	Event	$10,000	$20,000	Includes mowing and restoration of the site.
2.	Cap Repairs	75	Cubic Yard	$15	$1,125	Replace 1% of topsoil cover.
3.	Gas Monitoring	12	Lump Sum	$1,504	$18,048	One person, one 10-hour day/month
4.	Groundwater Monitoring	4	Lump Sum	$18,599	$74,396	Quarterly Sampling of groundwater monitoring system. 4 events/year, one 2-person crew, 40 crew hours/event, 10 samples for complete TC analysis
				Subtotal:	$113,569	
				15% Engineering(5):	$17,035	
				30% Contingency(6):	$34,071	
				Total:	$164,675	
				30-Year Present Worth Cost (7):	$2,043,453	
				Rounded Total:	$2,040,000	
				Willow Boulevard Site Total Project Present Worth Cost:	$4,360,000	

See Notes on Page 6

TABLE 7-1C Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2C - A-SITE
Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard, 50' Setback

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost($)**	**Comments**
	Direct Costs:					
1.	Mobilization/Demobilization	1	Lump Sum	2%	$0	2% Mob/Demob Included in 10% Indirect Costs below
2.	Site Preparation	17	Acre	$6,925	$117,725	Cost for clearing and grubbing.
3.	Additional Groundwater Wells at A-Site	7	Each	$5,000	$35,000	Costs for installation of double-cased wells.
4.	Mechanical Excavation	6,700	Cubic Yard	$10	$68,340	Includes excavating residuals east of Davis Creek and south of A-site Bern as necessary to construct cover system and relocating to stabilization area.
5.	Confirmatory Sampling/Analysis	1	Lump Sum	$10,000	$10,000	In areas excavated as part of Item 4
4.	Alternative Methods for Bank Stabilization					
	a. Bank Regrading Loam/Topsoil	5,000	Cubic Yard	$5.85	$29,250	Includes regrading of Bank to 4H:1V slope. Loam/Topsoil.
	b. Erosion Control	1,700	Square Yard	$5.65	$9,605	Nylon, 3 dimensional geomatrix, 9 mil thick.
	c. Eco-friendly planting	100,000	Square Feet	$0.50	$50,000	
	d. Erosion Control	1,300	Linear Feet	$5.65	$7,345	Includes cost for rip-rap (6- to 8-inch stone), geotextile, and erosion control block.
5.	Recontour Existing Grade	16,800	Cubic Yard	$4.11	$69,048	Re-Balance Site with 5 horizontal to 1 vertical slope
6.	Part 115 Type III Cap					Based on 19.6 acres.
	a. Filter Fabric	31,600	Square Yard	$1.84	$58,144	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	b. Gas Venting Layer	15,800	Cubic Yard	$13.96	$220,568	6-inch thickness. Sand, 6" lifts, on-site.
	c. Flexible Membrane Liner	31,600	Square Yard	$6.03	$190,548	Fabric Membrane Liner/Bentonite Liner.
	d. Drainage Layer	63,000	Cubic Yard	$13.96	$879,480	2-ft. thickness. Sand, 6" lifts, on-site.
	e. Filter Fabric	31,600	Square Yard	$2.81	$88,796	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	f. Topsoil Layer	15,800	Cubic Yard	$7.07	$111,706	6-inch thickness.
	g. Vegetative Cover	19.6	Acre	$14,572	$285,611	Restoration and creation of vegetative cover.
	h. Gas Vents	20	Each	$600	$12,000	One per acre, 8", HDPE Elbow construction.
7.	Stormwater Management System					
	a. Sedimentation Basin	1	Lump Sum	$30,000	$30,000	Approximately 2 acres.
	b. Pore Water Collection System	4,000	Linear Foot	$9.60	$38,400	Around perimeter of landfill, 6" diameter perforated PVC
	c. Cover System Drainage Swales	4,500	Linear Foot	$9.72	$43,740	Grass-lined approximately 18-inches high with permanent erosion control mat.
	d. Ditches (grass-lined)	10,000	Linear Foot	$9.72	$97,200	Approximately 18-inches deep by 9-feet wide and overlain with permanent erosion control mat.
	e. Erosion control Mat	80,000	Square Foot	$0.20	$16,000	Assumed to be placed along upgradient access road side slopes and along the toe of the capped landfill side slopes.
	f. Ditches (rip-rap lined)	800	Linear Foot	$17.60	$14,080	Approximately 18-inches deep by 12-feet wide and underlain with non-woven geotextile.
	g. Downchutes	600	Linear Foot	$30.00	$18,000	Rip-rap filled reno mattress placed within a 12-foot wide channel and underlain with geomembrane.
	h. Culverts	400	Linear Feet	$15.00	$6,000	
8.	Erosion Control at AMW-3A Area	1	Lump Sum	5000	5000	Installation of erosion control measures.
9.	Restoration of Area East of Davis Creek					
	a. Backfilling	3,800	Cubic Yard	$7.62	$28,956	Backfilling excavated area to pre-removal grade.
	b. Vegetative Cover	7	Acre	$14,572	$102,004	Restoration and creation of vegetative cover of excavated area
				Subtotal, Direct Costs:	$2,642,546	

See Notes on Page 6

TABLE 7-1C Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2C - A-SITE
Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard, 50' Setback

CAPITAL (DIRECT & INDIRECT)

	Item	Quantity	Units	Unit Cost ($)(1)	Item Cost($)	Comments
	Indirect Construction Costs:					
1.	Add Div 01 (General Conditions) and General Contractor's OH+P% Allow 10%	1	Lump Sum	10%	$264,255	Adjusted by CDM Estimating Dept.
2.	State Sales Tax - Assume project is Tax exempt	1	Lump Sum			Submitted by CDM Estimating Dept.
3.	Allow for MBE/WBE/EEO Requirements Allow 1/2 of 1% of Direct Costs.	1	Lump Sum	1/2 of 1%	$13,213	Adjusted by CDM Estimating Dept.
4.	Adjust Labor Costs due to Health and Safety Levels of Protection	1	Lump Sum	5%	$132,127	Adjusted by CDM Estimating Dept. Use EPA/COE Reference # 540-R-00-002 dated July 2000. Refer to Appendix B. Use 5% as adjustment. Costs = (5%) (3,213,841*40%)
5.	Adjust Project Costs due to Local Area Cost Factors.	1	Lump Sum	1.076	$200,834	Adjusted by CDM Estimating Dept. Use EPA/COE Reference # 540-R-00-002 dated July 2000. Refer to Appendix B. Use Means 2002 Michigan Factor of 1.076.
				Subtotal, Indirect Construction Costs =	$610,428	
	Construction Cost Summary:					
				Subtotal, Direct, Indirect Construction Costs =	$3,252,974	
1.	Add Contingency at 30%	1	Lump Sum	30%	$975,892	
2.	Allow Engineering and Design Costs at 15%	1	Lump Sum	15%	$487,946	
3.	Adjust Construction Cost Escalation to MDC	1	Lump Sum	4.5%	$146,384	Adjusted by CDM Estimating Dept. Allow 1.5 years @ 3%/year or 4.5 Escalation.
	Total, Capital Cost Estimate Remedial Alternative 2C A-Site			=	$4,863,197	
				Rounded to	$4,860,000	
				Three Year Present Value (7):	$4,250,000	

ANNUAL (POST-REMEDIAL SITE CONTROL)

	Item	Quantity	Units	Unit Cost ($)	Item Cost($)	Comments
1.	Cap Maintenance	2	Event	$24,000	$48,000	Includes mowing and restoration of the site.
2.	Cap Repairs	180	Cubic Yard	$15	$2,700	Replace 1% of topsoil cover.
3.	Gas Monitoring	12	Lump Sum	$1,504	$18,048	Monitoring of the gas monitoring system.
4.	Groundwater Monitoring	4	Lump Sum	$23,299	$93,196	Quarterly Sampling of groundwater monitoring system. 4 events/year, one 2-person crew, 40 crew hours/event, 15 samples for complete TC analysis
				Subtotal:	$161,944	
				15% Engineering(5):	$24,292	
				30% Contingency(6):	$48,583	
				Total:	$234,819	
				30-Year Present Worth Cost (7):	$2,913,866	
				Rounded Total:	$2,910,000	
				A-Site Total Project Present Worth Cost:	$7,150,000	

See Notes on Page 6

TABLE 7-1C Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2C
Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard, 50' Setback

TOTAL COST	
WILLOW BOULEVARD SITE TOTAL PROJECT PRESENT WORTH COST:	$4,360,000
A-SITE TOTAL PROJECT PRESENT WORTH COST:	$7,150,000
ALTERNATIVE 2D-TOTAL PROJECT PRESENT WORTH COST:	$11,510,000

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 2C
Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard, 50' Setback
with Groundwater Treatment

TOTAL COST	
WILLOW BOULEVARD SITE TOTAL PROJECT PRESENT WORTH COST:	$4,360,000
A-SITE TOTAL PROJECT PRESENT WORTH COST:	$7,150,000
GROUNDWATER TREATMENT TOTAL PRESENT WORTH COST (8):	$4,330,000
ALTERNATIVE 2D-TOTAL PROJECT PRESENT WORTH COST:	$15,840,000

Notes:

1. Unit cost shown includes material and labor costs unless otherwise noted.
2. Costs estimated based on similar project experience and R.S. Means Company 2001a; 2001b.
4. Cap repairs and maintenance will be implemented as necessary every year for a period of 30 years.
5. A 15% contingency is included to account for engineering fees. Contingency does not include legal fees and permit acquisition. Engineering Contingency developed based upon USEPA, 1987.
6. A 30% contingency is included provide for unexpected circumstances or variability in estimate areas, volumes, labor and material costs. Contingency allowance developed based upon USEPA, 1987.
7. 30-year present worth based on a 7.0 percent discount rate as published in USEPA, 1993c, and has been applied to Annual/O&M Costs
   Project fixed costs will be spread out over 3 years, with present worth based on a 7% discount rate as published in USEPA, 1993c, and has been applied to all other costs.
8. Refer to Table 7-1 for cpst development.

TABLE 7-2

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

PRELIMINARY COST ESTIMATE REMEDIAL ALTERNATIVE 3 REMOVAL AND OFF-SITE DISPOSAL AS NON-TSCA WASTE

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1,2)**	**Item Cost ($)**	**Comments**
	Direct Costs:					
1.	Mobilization/Demobilization	1	Lump Sum	2%	$0	2% Mob/Demob Included in 10% Indirect Costs Below
2.	Site Preparation	34	Acres	$6,925	$235,450	Cost for clearing and grubbing.
3.	Work Area Isolation	26,000	Square Feet	$13.70	$356,200	Includes cost for driving sheet piling to allow for excavation adjacent to Kalamazoo River to isolate river flow around the project area, and extract sheeting upon project completion
4.	Mechanical Excavation/Dredge					
	a. Unsaturated	542,000	Cubic Yard	$7.50	$4,065,000	Cost is for excavation only, Handling/Staging is a separate line item
	b. Saturated	92,000	Cubic Yard	$20	$1,840,000	Costs include relocating saturated materials to stabilization area.
5.	Residuals Stabilization					
	a. Flexible Membrane Liner	1,200	Square Yard	$5.40	$6,480	Assumes 0.25-acre mixing area.
	b. Lime and mixing	92,000	Cubic Yard	$15	$1,380,000	Fly Ash (Class F), bulk delivered, mixing at 1:1, and equipment to mix.
6.	Handling/Staging of Residuals	726,000	Cubic Yard	$5	$3,630,000	
7.	Water Treatment	415,296,000	gallons	$0.01	$4,152,960	Costs for treatment (sand filtration and carbon adsorption) of water from residuals approximately 126,720,000 gallons of water from the Willow Boulevard Site (assumes 2,000 gpm for 44 days) and approximately 288,576,000 gallons of water from A-Site (assumes 1,200 gpm for 153 days).
8.	Residuals Transport and Disposal	726,000	Cubic Yard	$25	$18,150,000	Assumes material can be disposed of as non-TSCA, but regulated material.
9.	Confirmatory Sampling/Analysis	1	Lump Sum	$50,000	$50,000	In areas excavated as part of this remedial alternative
10.	Backfilling and Regrading	190,000	Cubic Yard	$7.62	$1,447,800	Assumes 30% of removed material.
11.	Restoration of Areas	34	Acres	$14,572	$495,448	Vegetation and landscaping for both areas.
				Subtotal, Direct Costs:	$35,809,338	
	Indirect Construction Costs:					
1.	Add Div 01 (General Conditions) and General Contractor's OH+P% Allow 10%	1	Lump Sum	10%	$1,765, 933	Adjusted by CDM Estimating Dept. Use 1070 (35, 809, 338 - 18, 150,000)
2.	State Sales Tax- Assume project is Tax Exempt	1	Lump Sum			Submitted by CDM Estimating Dept.
3.	Allow for MBE/WBE/EEO Requirements Allow 1/2 of 1% of Direct Costs	1	Lump Sum	1/2 of 1%	$88, 297	Adjusted by CDM Estimating Dept. Use (.005) (35,809,338 - 18,150,000)
4.	Adjust Labor Costs due to Health and Safety Levels of Protection	1	Lump Sum	5%	$353, 187	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2002. Refer to Appendix B. Use 5% as adjustment. Costs = (5%) ($17,659,338 * 40%)
5.	Adjust Project Costs due to Local Area Cost Factors	1	Lump Sum	1.076	$2,721,510	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2002. Refer to Appendix B. Use Means 2002 Michigan Factor of 1.076.
				Subtotal Indirect Construction Costs=	$4,928, 927	

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1,2)**	**Item Cost ($)**	**Comments**
	Construction Cost Summary:					
				Subtotal, Direct, Indirect Construction Costs=	$40,738, 265	
6.	Add Contingency at 30%	1	Lump Sum	30%	$6,776,480	Use 30% ($40,738,265 - $18,150,000)
7.	Allow Engineering and Design Costs at 15%	1	Lump Sum	15%	$3,388,240	Use 15% ($40, 738, 265 -$18,150,000)
8.	Adjust Construction Cost Escalation to MDC	1	Lump Sum	4.5%	$1,833,222	Adjusted by CDM Estimating Dept. Allow 1.5 years @ 3%/year or 4.5 Escalation
	Total, Capital Cost Estimate Remedial Alternative #3			=	$52,736,207	
				Rounded to	$52,740,000	
				Three Year Present Value (5):	$46,140,000	

Notes:

1. Unit cost shown includes material and labor costs unless otherwise noted.
2. Costs estimated based on similar project experience and R.S. Means Company 2001a; 2001b. A 15% contingency is included to account for engineering fees, and does not include legal fees or permit acquisition.
3. Engineering Contingency developed based upon USEPA, 1987. A 30% contingency is included to provide for unexpected circumstances or variability in estimate areas, volumes, labor and material costs.
4. Contingency allowance is included to provide for unexpected circumstances or variability in estimate areas, volumes, labor and material costs.
5. At the request of EPA, project fixed costs will be spread out over 3 years, with present worth based on a 7% discount rate as published in USEPA, 1993c, and has been applied to all costs

TABLE 7-3

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 4
REMOVAL OF RESIDUALS FROM WILLOW BOULEVARD SITE AND CONSOLIDATION AT THE A-SITE

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost ($)**	**Comments**
	Direct Costs:					
1.	Mobilization/Demobilization	1	Lump Sum	2%	$0	2% Mob/Demob Included in 10% Indirect Costs below
2.	A-Site Preparation	17	Acre	$6,925	$117,725	Cost for clearing/chip trees (<12" diameter) and grubbing stumps.
3.	Installation of Additional GW Wells at A-Site	7	Each	$5,000	$35,000	Costs for installation of double-cased wells.
4.	Temporary Sheetpiling Installation	1,800	Linear Foot	$305	$549,000	Temporary installation between Kalamazoo River and Willow Blvd. Site 15' deep, drive, extract & salvage.
5.	Erosion Control					
	a. Silt Curtain	300	Linear Foot	$15	$4,500	
	b. Silt Fencing	1,500	Linear Foot	$1	$1,500	Assume installation in difficult conditions.
6.	Recontour A-Site Existing Grade	16,800	Cubic Yard	$4.11	$69,048	20 acres, varied thickness.
7.	Mechanical Excavation/Dredge Willow Site					
	a. Unsaturated	134,100	Cubic Yard	$7.50	$1,005,750	Cost is for excavation only, staging is a separate line item.
	b. Saturated	18,000	Cubic Yard	$20.00	$360,000	Costs include relocating saturated materials to stabilization area.
8.	Water Treatment	126,720,000	gallons	$0.01	$1,267,200	Treating (sand filtration & carbon adsorption) water from residuals; est. 126,720,000 gallons (2,000 gpm for 44 days at $0.0216 per gallon). Modified by CDM to reflect $10/1000 gallons treated.
9.	Saturated Residuals Stabilization					
	a. Flexible Membrane Liner	1,200	Square Yard	$20.00	$24,000	Cost for 0.25 acre stabilization area.
	b. Fly Ash	18,000	Cubic Yard	$15	$270,000	Fly Ash (Class F), bulk delivered, mixing at 1:1, and equipment to mix.
10.	Relocation of Residuals	170,100	Cubic Yard	$2.27	$386,127	Relocation to cap area, 34 cy off-road dump.
11.	Residual Placement and Compaction at A-Site	170,100	Cubic Yard	$1.81	$307,881	Sheepsfoot roller 4 passes
12.	Part 115 Type III Cap Over A-Site					
	a. Filter Fabric	42,400	Square Yard	$1.84	$78,016	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	b. Gas Venting Layer	22,100	Cubic Yard	$13.96	$308,516	6-inch thickness. Sand, 6" lifts, on-site.
	c. Flexible Membrane Liner	42,400	Square Yard	$6.03	$255,672	Fabric Membrane Liner/Bentonite Liner.
	d. Drainage Layer	88,500	Cubic Yard	$13.96	$1,235,460	2-ft. thickness. Sand, 6" lifts, on-site.
	e. Filter Fabric	42,400	Square Yard	$2.81	$119,144	12 oz/sy Geotextile/Drainage Fabric (130 mil).
	f. Topsoil Layer	22,100	Cubic Yard	$7.07	$156,247	6-inch thickness.
	g. Vegetative Cover	23.0	Acre	$14,572	$335,156	Restoration and creation of vegetative cover.
	h. Gas Vents	24	Each	$600	$14,400	One per acre, 8", HDPE Elbow construction.
	i. Anchor Trench	4,607	Linear Feet	$3	$13,821	

TABLE 7-3, Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 4
REMOVAL OF RESIDUALS FROM WILLOW BOULEVARD SITE AND CONSOLIDATION AT THE A-SITE

	CAPITAL (DIRECT & INDIRECT), continued					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost ($)**	**Comments**
13.	Stormwater Management System					
	a. Sedimentation Basin	1	Lump Sum	$30,000	$30,000	Approximately 2 acres.
	b. Pore Water Collection System	4,000	Linear Foot	$9.60	$38,400	Around perimeter of landfill, 6" diameter perforated PVC
	c. Cover System Drainage Swales	6,300	Linear Foot	$9.72	$61,236	Grass-lined approximately 18" high with permanent erosion control mat
	d. Ditches (grass-lined)	11,000	Linear Foot	$9.72	$106,920	Approximately 18-inches deep by 9-feet wide and overlain with permanent erosion control mat.
	e. Erosion control Mat	120,000	Square Foot	$0.65	$78,000	Assumed to be placed along upgradient access road side slopes and along the toe of the capped landfill side slopes.
	f. Ditches (rip-rap lined)	1,000	Linear Foot	$17.60	$17,600	Approximately 18-inches deep by 12-feet wide and underlain with non-woven geotextile.
	g. Downchutes	800	Linear Foot	$30.00	$24,000	Rip-rap filled reno mattress placed within a 12-foot wide channel and underlain with geomembrane.
	h. Culverts	600	Linear Feet	$15.40	$9,240	
14.	Restoration of Willow Boulevard Excavation Area					
	a. Backfilling below groundwater table	18,000	Cubic Yard	$7.62	$137,160	Backfilling approximately 2 feet of material in the excavated area.
	b. Vegetative Cover	7	Acre	$14,572	$102,004	Restoration and creation of vegetative cover of excavated areas.
	c. New Riverbank Construction	1,800	Linear Feet	$35	$63,000	Restoration along bank of former Willow Boulevard Site.
15.	Site Restoration	1	Lump Sum	$50,000	$50,000	Off-cap disturbed area restoration.
16.	Additional Excavation					
	a. Temporary Access Road East of Davis Creek	1	Lump Sum	$100,000	$100,000	
	b. Residual Relocation East of Davis Creek	3,800	Cubic Yard	$2.27	$8,626	
	c. Excavation/Backfill East of Davis Creek	3,800	Cubic Yard	$15	$57,000	
	d. Residual Relocation South of A-Site	2,900	Cubic Yard	$2.27	$6,583	
	e. Excavation/Backfill South of A-Site	2,900	Cubic Yard	$15.00	$43,500	
	f. Water Treatment	1	Lump Sum	$50,000	$50,000	
	g. Confirmatory Sampling/Analysis	1	Lump Sum	$10,000	$10,000	In areas excavated as part of Item 16
				Subtotal Direct Costs	$7,907,432	

TABLE 7-3, Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 4
REMOVAL OF RESIDUALS FROM WILLOW BOULEVARD SITE AND CONSOLIDATION AT THE A-SITE

CAPITAL (DIRECT & INDIRECT), continued

	Item	Quantity	Units	Unit Cost ($)(1)	Item Cost ($)	Comments
	Indirect Costs:					
1.	Add Div 01 (General Conditions) and General Contractor's OH+P% -Allow 10%	1	Lump Sum	10%	$799,743	Adjusted by CDM Estimating Dept.
2.	State Sales Tax - Assume project is Tax exempt	1	Lump Sum			Submitted by CDM Estimating Dept.
3.	Allow for MBE/WBE/EEO Requirements. Allow for 1/2 of 1% of Direct Costs	1	Lump Sum	1/2 of 1%	$39,537	Adjustment by CDM Estimating Dept.
4.	Adjust Labor Costs due to Health and Safety Levels of Protection	1	Lump Sum	5%	$158,149	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002 dated July 2000. Refer to Appendix B. Use 5% as adjustment. Cost = (5%) ($9,377,384 * 40%)
5.	Adjust Project Costs due to Local Area Cost Factors	1	Lump Sum	1.076	$600,965	Adjusted by CDM Estimating Dept. Use EPA/COE Reference #540-R-00-002dated July 2000. Refer to Appendix B. Use Means 2002 Michigan Factor of 1.076
				Subtotal, Indirect Construction Costs =	$1,598,394	

	Construction Cost Summary:					
		Subtotal, Direct, and Indirect Construction Costs =			$9,505,826	
1.	Add Contingency at 30%	1	Lump Sum	30%	$2,851,748	
2.	Allow Engineering and Design Costs at 15%	1	Lump Sum	15%	$1,425,874	
3.	Adjust Construction Cost Escalation to MDC	1	Lump Sum	4.5%	$427,762	Adjusted by CDM Estimating Dept. Allow 1.5 years @ 3%/year or 4.5 Escalation.
	Total, Capital Cost Estimate, Remedial Alternative #4			=	$14,211,210	
				Rounded To	$14,210,000	
				Three Year Present Value (7):	$12,860,000	

ANNUAL MAINTENANCE (POST-REMEDIAL SITE CONTROL)

	Item	Quantity	Units	Unit Cost ($)	Item Cost($)	Comments
1.	Cap Maintenance	2	Event	$24,000	$48,000	Includes mowing and restoration of the site.
2.	Cap Repairs	221	Cubic Yard	$15	$3,315	Replace 1% of topsoil cover.
3.	Gas Monitoring	12	Lump Sum	$1,504	$18,048	One person, one 10-hour day/month
4.	Groundwater Monitoring	4	Lump Sum	$23,299	$93,196	Quarterly Sampling of groundwater monitoring system. 4 events/year, one 2-person crew, 40 crew hours/event, 10 samples for complete TC analysis
				Subtotal:	$162,559	
				15% Engineering:	$24,384	
				30% Contingency:	$48,768	
				Total:	$235,711	
				30-Year Present Worth Cost (7):	$2,924,932	
				Rounded Total:	$2,920,000	
				TOTAL PROJECT PRESENT WORTH COST:	$15, 780,000	

TABLE 7-3, Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 4
REMOVAL OF RESIDUALS FROM WILLOW BOULEVARD SITE AND CONSOLIDATION AT THE A-SITE
Groundwater Treatment Allowance (Cost by CDM)

	CAPITAL (DIRECT & INDIRECT)					
	Item	**Quantity**	**Units**	**Unit Cost ($)(1)**	**Item Cost ($)**	**Comments**
1.	Installation of 8 GW pumping wells	8	Each	$20,000	$160,000	Each well 80 gpm pumping well
2.	Piping to on-site GW Treament System					
	a. 4" diameter pipe	400	LF	$40	$16,000	
	b. 6" diameter pipe	1,400	LF	$60	$84,000	
3.	Treatment Facility		Lump Sum	$840,000	$840,000	640 gpm multimedia fileration followed by GAC Adsorption metal panel building
4.	Treatment Facilty Building Inc. Foundation	3,000	SF	$60	$180,000	
5.	Site Utilities		Lump Sum		$100,000	extend utilities to site
				Subtotal, Direct Costs =	$1,380,000	
	Indirect Construction Costs:					
1.	Add Div 01 (General Conditions) and General Contractor's OH+P % -Allow 10%	1	Lump Sum	10%	$138,000	
2.	State Sales Tax- Assume Project is Tax exempt	1	Lump Sum			
3.	Allow for MBE/WBE/EEO Requirements Allow 1/2 of 1% of direct costs	1	Lump Sum	1/2 of 1%	$6,900	
4.	Adjust Labor Costs due to Health and Safety Levels of Protection - Not Applicable	1	Lump Sum			
5.	Adjust Project Costs due to Local Area Cost Factors	1	Lump Sum	1.076	$104,880	
				Subtotal, Indirect Construction Costs =	$249,780	
				Subtotal Direct and Indirect Construction Costs=	$1,629, 780	
6.	Add Contigency at 30%	1	Lump Sum	30%	$488,934	
7.	Allow Engineering and Design Costs at 15%	1	Lump Sum	15%	$244,467	
8.	Adjust Construction Cost Escalation to MPC	1	Lump Sum	4.5%	$73, 340	
	Total, Capital Cost Estimate, Groundwater Treatment Allowance				2,436, 521	
				Rounded To	$2,440,000	
				Three Year Present Value:	$2,130,000	
	ANNUAL MAINTENANCE (POST-REMEDIAL SITE CONTROL)					
	Item	**Quantity**	**Units**	**Unit Cost ($)**	**Item Cost($)**	**Comments**
1.	Power and Utilities	1	Lump Sum	$42,000	$42,000	Annual Cost
2.	Parts and Supplies	1	Lump Sum	$8,000	$8,000	Carbon Replacement every 5 years
3.	Labor	1040	hrs.	$30	$31,000	Part-time coverage
4.	Compliance Monitoring	1	Lump Sum	$12,000	$12,000	24 sample/year
				Subtotal:	$93,000	
				30-Year Present Worth Cost (7):	$1,673,353	
				Rounded Total:	$1,670,000	
				TOTAL GROUNDWATER TREATMENT PRESENT WORTH:	$3,800,000	

TABLE 7-3, Continued

PRELIMINARY COST ESTIMATE
REMEDIAL ALTERNATIVE 4
REMOVAL OF RESIDUALS FROM WILLOW BOULEVARD SITE AND CONSOLIDATION AT THE A-SITE
WITH GROUNDWATER TREATMENT

	Item				Item Cost($)	Comments
1.	Removal of Residuals from Willow Boulevard Site and Consolidation On-site Total Project Present Worth:				$15, 780,000	
2.	Groundwater Treatment Total Project Present Worth:				$3, 800,000	
3.	Total Project Present Worth:				$19,580,000	

TABLE 7-4

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

WILLOW BOULEVARD/A-SITE OPERABLE UNIT REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY

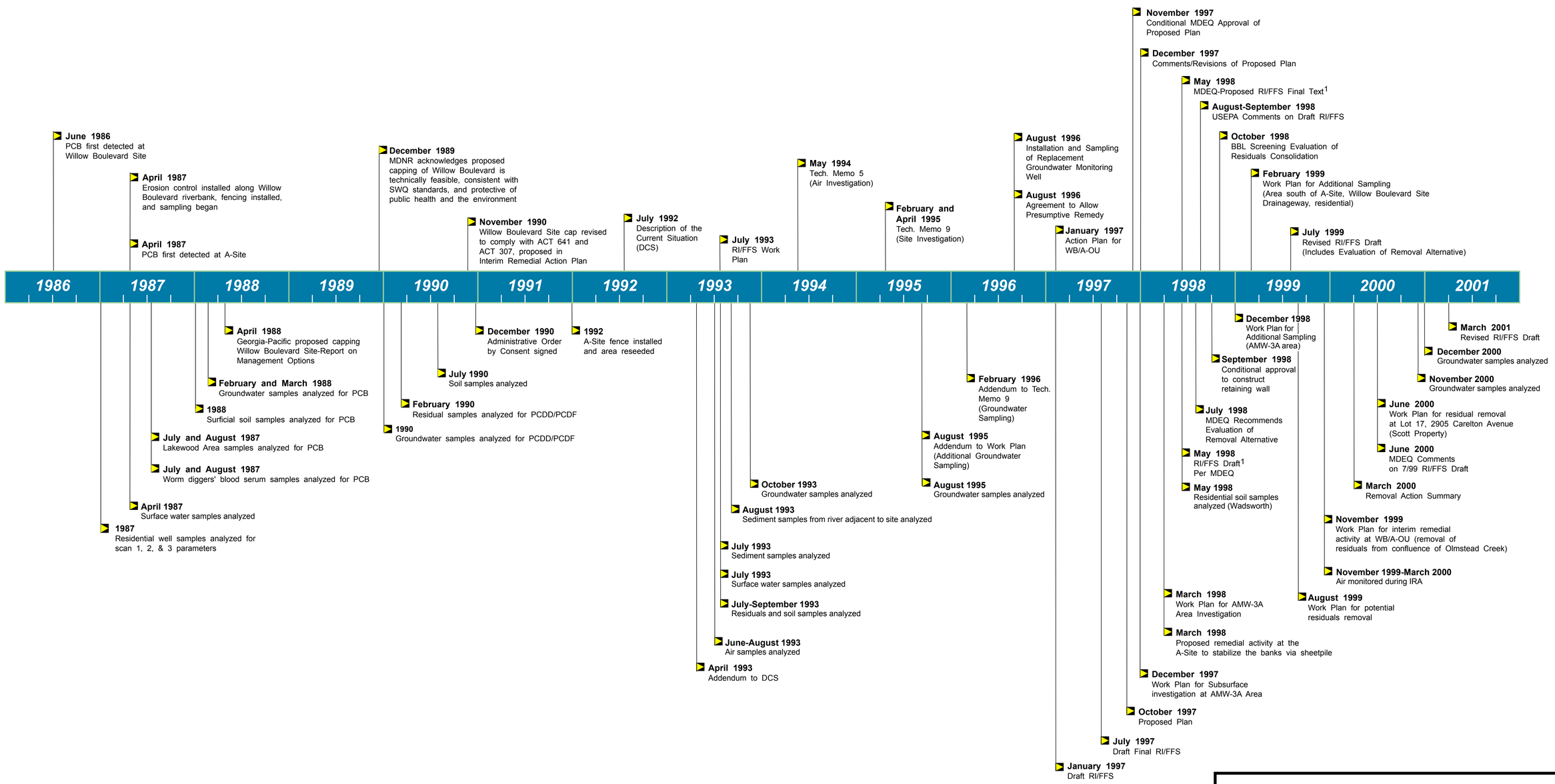
PAIRWISE COMPARISON OF ALTERNATIVES

Remedial Alternative	Description	SUM[1]	Weighted Sum[2]	Final Ranking
1	No Action	65	195	**6**
2A	Consolidation/Containment of Selected Materials and Install New Sheet Piling at Willow Boulevard	93	289	**2**
2B	Consolidation/Containment of Selected Materials, Remove All Sheet Piling, Re-Grade/Stabilize Banks, 50' Setback	91	275	**4**
2C	Consolidation/Containment of Selected Materials, Re-Grade/Stabilize Banks using Eco-Friendly Options at Willow Boulevard	101	297	**1**
3	Removal and Off-site Disposal as "Mega Rule" Waste	99	289	**2**
4	Removal of Residuals from Willow Boulevard and Consolidation at A-Site	91	275	**4**

Notes:

[1]Sum of pairwise comparison of each remedial alternative against the evaluation criteria as specified in National Contingency

[2]Pairwise sum multiplied by a weighting factor, so components of the evaluation criteria that are more important to protection of human health and the environment are given more weight. Items given a five multiplier were overall protection of human health and the environment and compliance with ARARs; items given a three multiplier were long-term effectiveness and permanence, reduction of toxicity, mobility, or volume, short-term effectiveness, implementability and cost; those given a one multiplier were State and community acceptance.



Note:

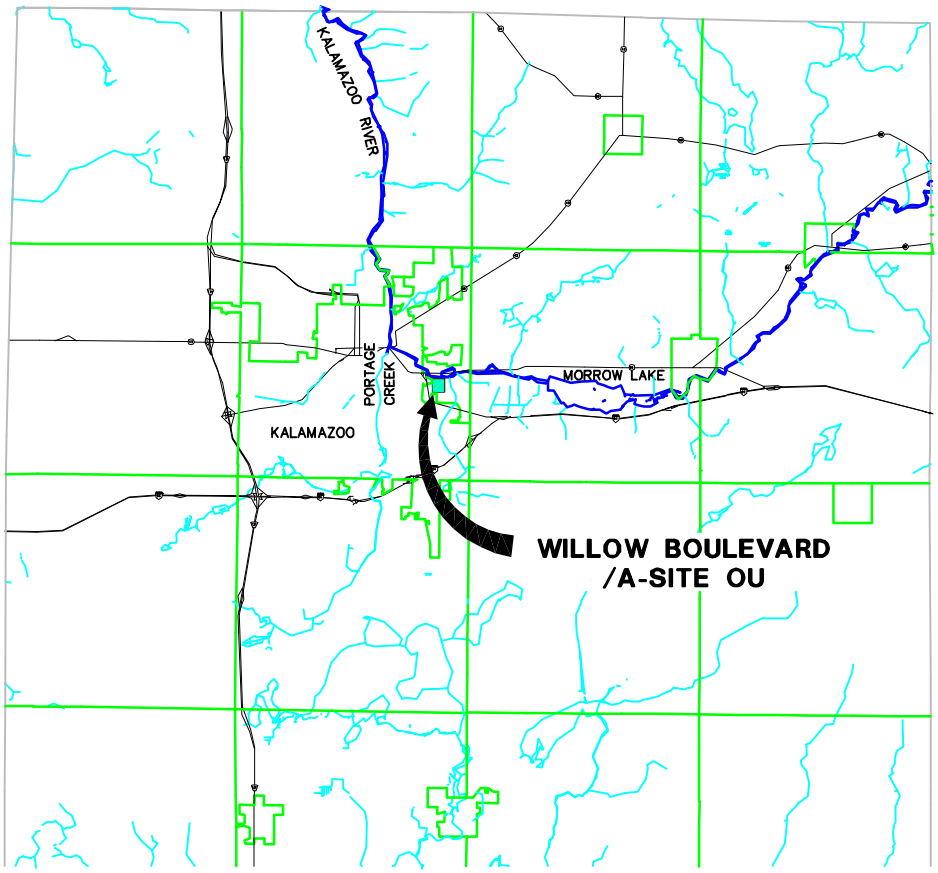
[1]Presumptive remedy and streamlined approach intact

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

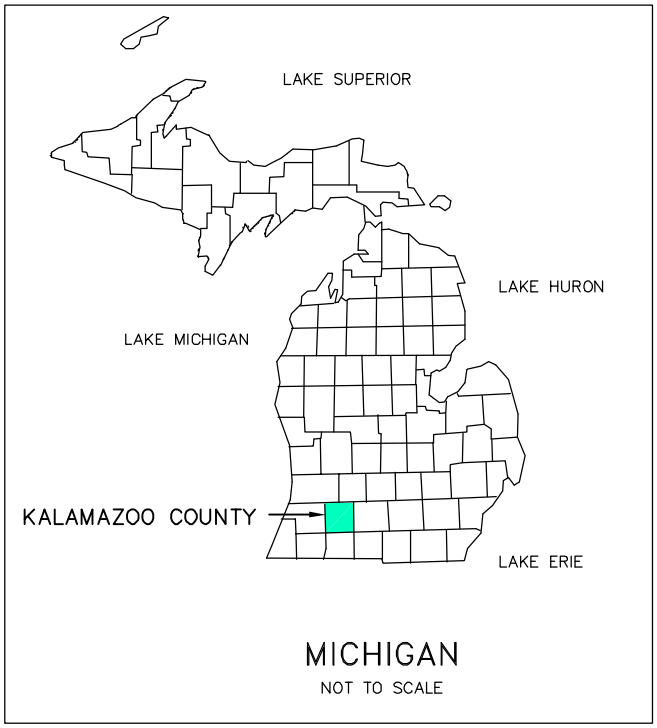
TIME LINE OF WILLOW BOULEVARD/ A-SITE ACTIVITIES AND DOCUMENT SUBMISSIONS

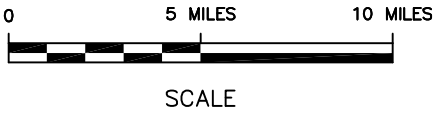
FIGURE
1

02/01 SYR-D54-DJH LBR
64581500/64581f02.cdr



KALAMAZOO COUNTY





NOTE:

KALAMAZOO COUNTY MAPPING OBTAINED FROM MICHIGAN RESOURCE INFORMATION SYSTEM.

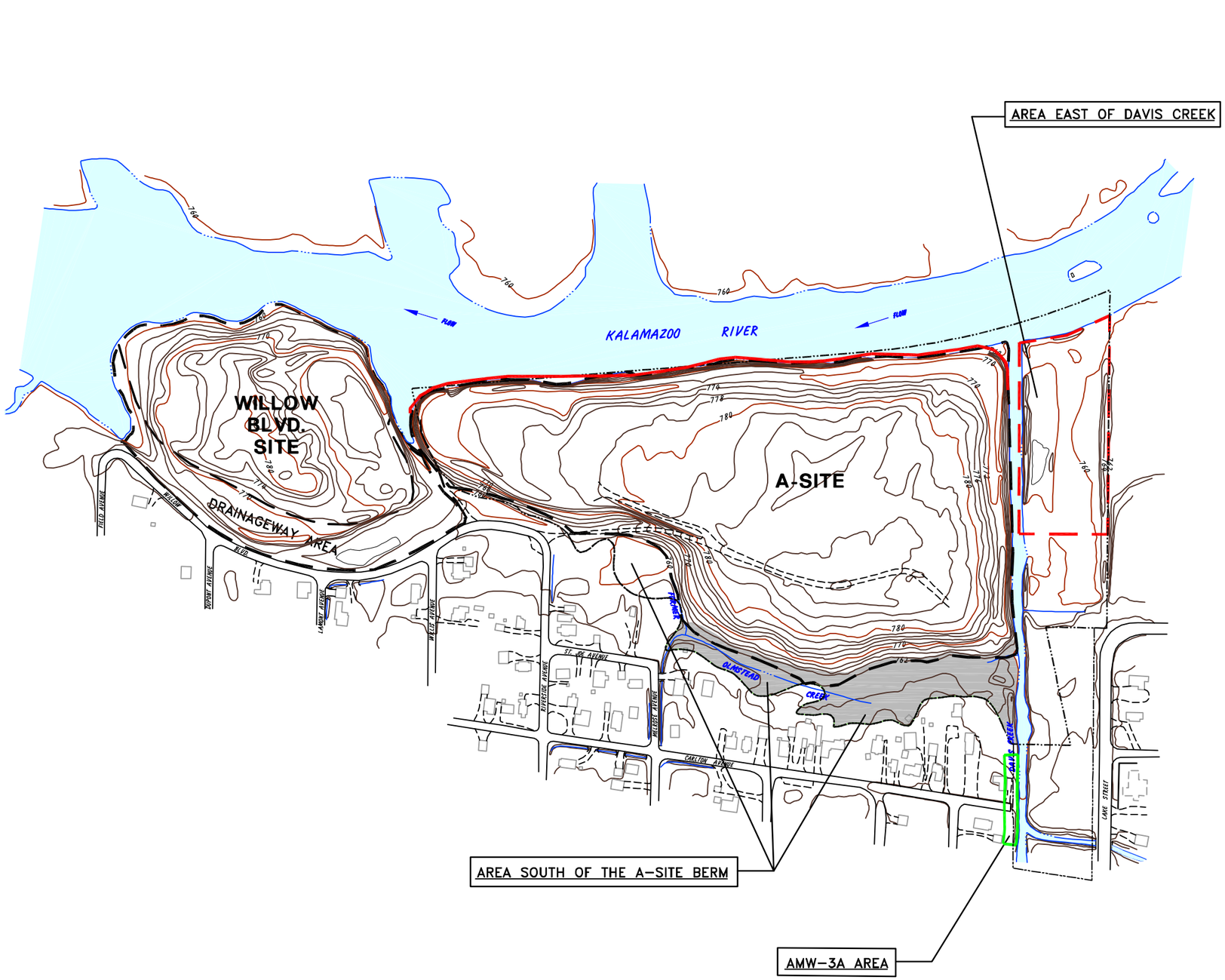
KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

LOCATION PLAN

FIGURE
2

P: DJA-G3-4
2/22/01 SYR-54-DJO JER GMS
64581640/64581G03.DWG



LEGEND

- 780 — ELEVATION CONTOUR (NGVD 1929)
- EDGE OF WATER OR DRAINAGE CHANNEL
- UNPAVED ROAD/TRAIL
- APPROXIMATE A-SITE BOUNDARY
- GEORGIA-PACIFIC PROPERTY BOUNDARY OUTSIDE OF A-SITE
- FORMER LAGOON AREA
- EXISTING SHEETPILE WALL

NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH AUGUST 1996. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BBL JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. ALL LOCATIONS ARE APPROXIMATE.

150' 0 300'

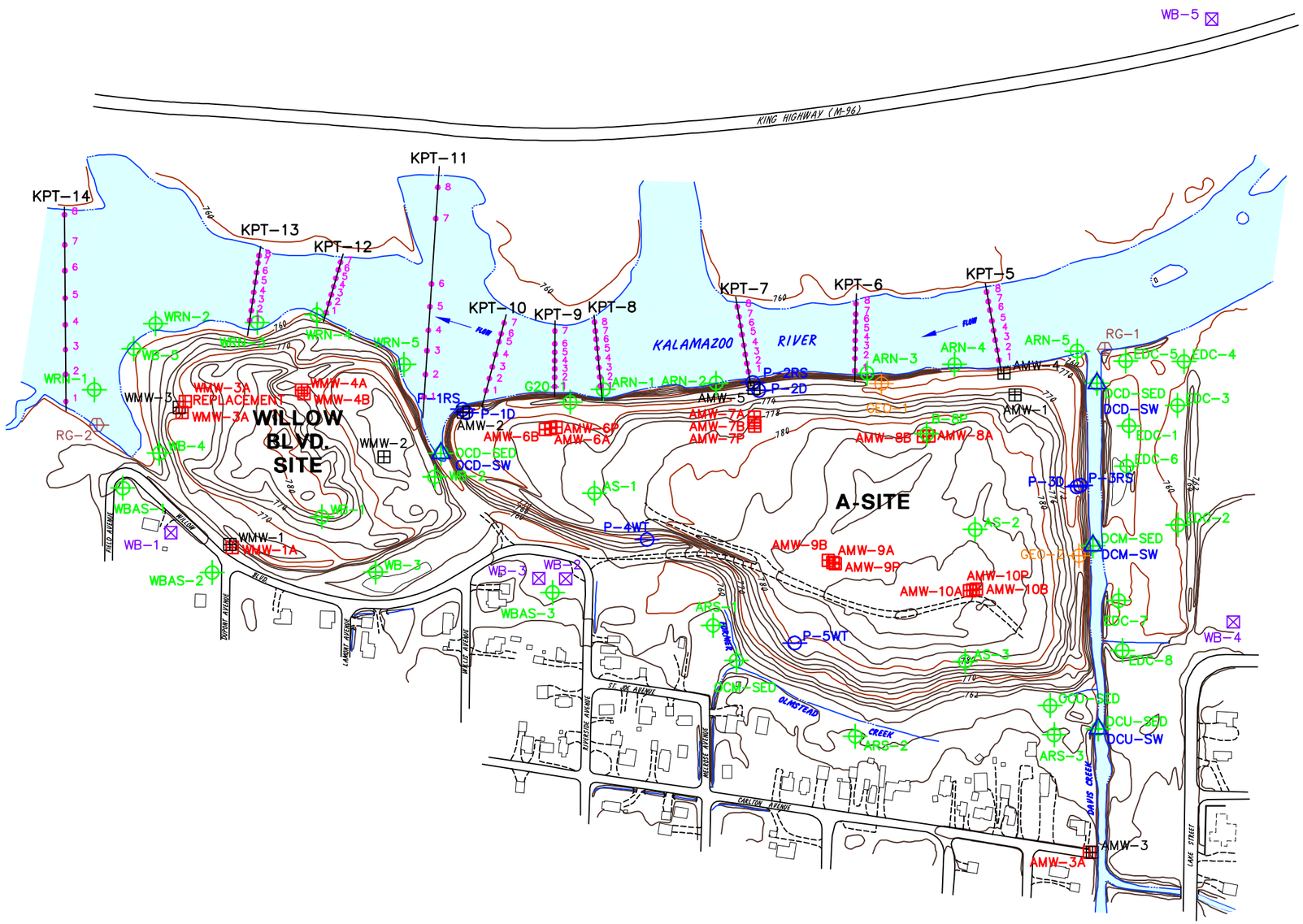
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

WILLOW BOULEVARD/A-SITE AND ANCILLARY AREAS

FIGURE 3

X: 64581X03
L:ON=*, OFF=*REF*, WBL*, *N-*, ON=WBL-SPL
P: FIG-2-3
2/23/01 SYR-54-RLP DJP GMS
64581640/64581G08.DWG



LEGEND

AMW-4	PRE-RI MONITORING WELL
WMW-1A	MONITORING WELL OR CLUSTER INSTALLED IN 1993
WMW-3A REPLACEMENT	REPLACEMENT MONITORING WELL INSTALLED IN 1996
WB-1	BORING INSTALLED IN 1993
GEO-1	GEOTECHNICAL BORING INSTALLED IN 1993
P-2D	PIEZOMETER INSTALLED IN 1993
DCD-SW	SURFACE WATER SAMPLE, 1993 INVESTIGATION
RG-1	RIVER GAUGE STATION INSTALLED IN 1993
WB-5	AIR SAMPLER INSTALLED IN 1993
780	ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	UNPAVED ROAD/TRAIL
KPT-5	SEDIMENT PROBING TRANSECT

150' 0 300'

SCALE

NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH AUGUST 1996. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BBL JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. ALL LOCATIONS ARE APPROXIMATE.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

SAMPLE LOCATIONS (PRE-RI TO 1996)

FIGURE 4

X: 64582X02
I: OFT=1*, WBL*, REF
P: FIG-2-3
2/22/01 SYR-54-RLP HSB DJP
64581500\64581G01.DWG

KALAMAZOO RIVER

SAND CONTAINMENT BERM

THIS AREA DID NOT CONTAIN RESIDUALS; HOWEVER, THE TOP FEW INCHES OF SEDIMENT WERE REMOVED.

NO SURFICAL RESIDUALS WERE OBSERVED IN THIS AREA.

THIS AREA WAS SCRAPED OF THE TOP FEW INCHES.

WILLOW BOULEVARD SITE

FIELD AVE.

WILLOW BLVD.

780

770

LEGEND

780	PRE REMOVAL ACTION ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	EDGE OF WATER DURING REMEDIAL ACTIVITIES
	APPROXIMATE AREA OF EXCAVATION ACTIVITIES
	APPROXIMATE AREA OF RE EXCAVATION

NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. EXCAVATION ACTIVITIES WERE CONDUCTED AS PART OF THE INTERIM REMEDIAL RESPONSE ACTIVITY CONDUCTED BETWEEN NOVEMBER 1999 AND JANUARY 2000.

0 60' 120'

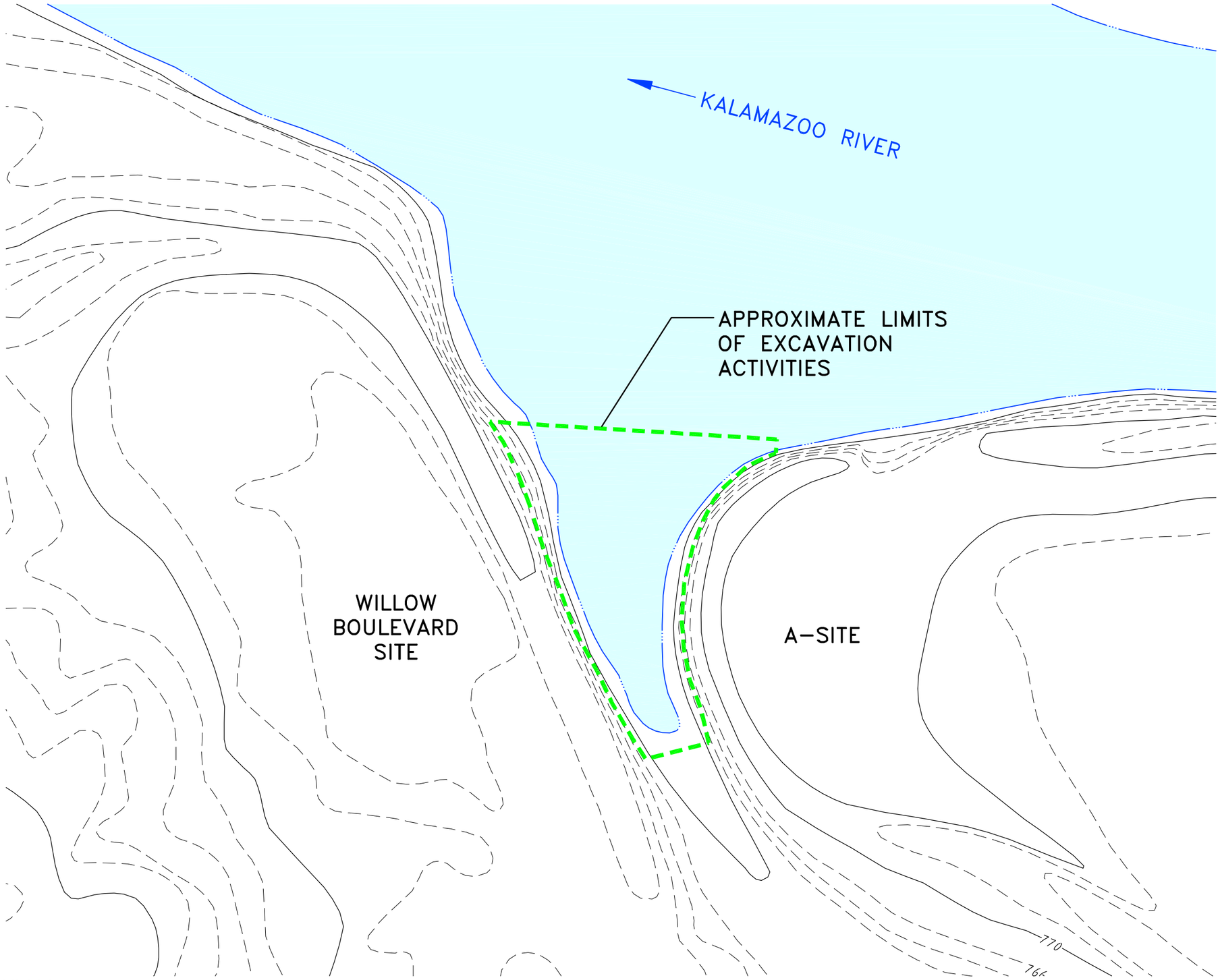
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

EXTENT OF EXCAVATION AT WILLOW BOULEVARD SITE

FIGURE 5

X: 64582X01.DWG
L: ON=*, OFF=*REF*
P: STD-BL.PCP
2/22/01 SYR-54-GMS JER DJP
64582500/64582B01.DWG



LEGEND

780 — PREREMOVAL ACTION ELEVATION CONTOUR (NGVD 1929)

EDGE OF WATER OR DRAINAGE CHANNEL

APPROXIMATE LOCATION OF EXCAVATION ACTIVITIES

NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.

2. EXCAVATION ACTIVITIES WERE CONDUCTED AS PART OF THE INTERIM REMEDIAL RESPONSE ACTIVITIES CONDUCTED BETWEEN NOVEMBER 1999 AND JANUARY 2000.

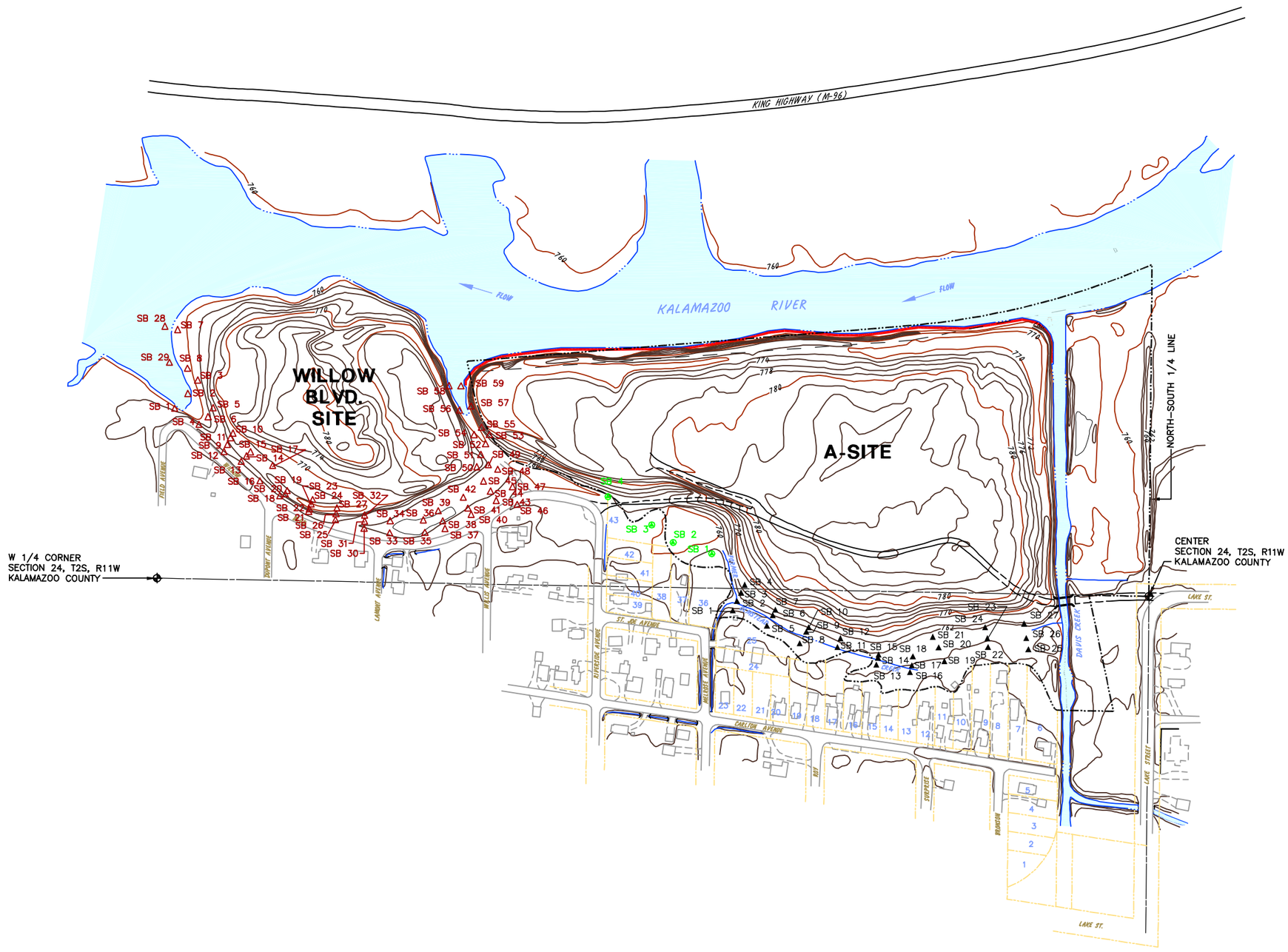
0 50' 100'
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

EXTENT OF EXCAVATION AT OLMSTEAD CREEK

FIGURE **6**

X: 64581X01.DWG
L: ON=*, OFF=*REF*
P: STD-PCP/BL.PCP
2/22/01 SYR-54-KLN JER DJP
64582500/64582B02.DWG



LEGEND

780	ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	UNPAVED ROAD/TRAIL
	APPROXIMATE A-SITE BOUNDARY
40	APPROXIMATE ADJACENT RESIDENTIAL PROPERTY LINES AND PARCEL NUMBER
	EXISTING SHEETPILE WALL
	BRIDGE
DWA-SB 50 △	WILLOW BLVD. SITE (DRAINAGEWAY AREA)
FLA-SB 25 ▲	AREA SOUTH OF THE A-SITE BERM
DWA/FLA-SB 1 ◎	EXISTING SOIL BORING BETWEEN DRAINAGEWAY AREA AND THE AREAS SOUTH OF THE A-SITE BERM

NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. SOIL BORINGS DWA-SB 1 THROUGH DWA-SB 9; FLA-1 THROUGH FLA-27; AND DWA/FLA-1 THROUGH DWA/FLA-4 SURVEYED BY ATWELL-HICKS INC. 5/06/99.
3. ALL PROPERTY LINES SHOWN WERE ADDED FROM A MAP BY ATWELL-HICKS, INC. ENTITLED TOPOGRAPHY SURVEY OF WILLOW BOULEVARD AREA, DATED 5/06/99.
4. ALL LOCATIONS ARE APPROXIMATE.
5. LOCATIONS DWA SB-46, SB-47, AND SB-58, CLA-SB-4 HAVE NOT BEEN SURVEYED.

150' 0 300'

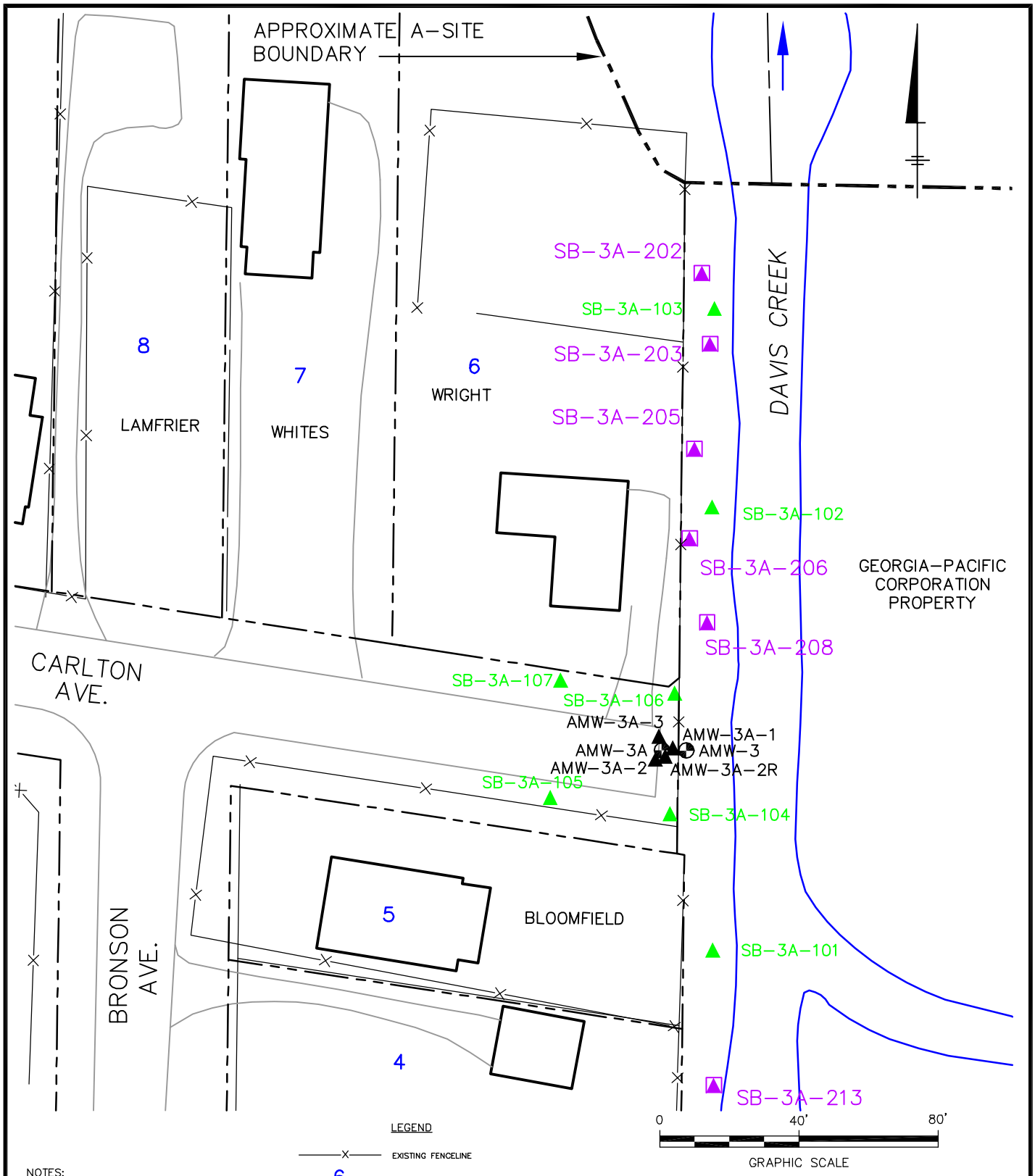
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

SUPPLEMENTAL SAMPLE LOCATIONS: WILLOW BLVD. SITE DRAINAGEWAY AREA AND THE AREA SOUTH OF THE A-SITE BERM

FIGURE
7

X: 64582X11.DWG
L: OFF=1*, WBL*, REF*
P: B01.PCP
2/22/01 SYR-54-RLP NES DJP
64581640/64581B05.DWG



LEGEND

—×—	EXISTING FENCELINE
6	PARCEL NUMBER
▲	SOIL BORING (3/99)
◐	EXISTING MONITORING WELL (1993)
▲	SOIL BORING (1/98)
▲	SOIL BORING (7/98)

NOTES:

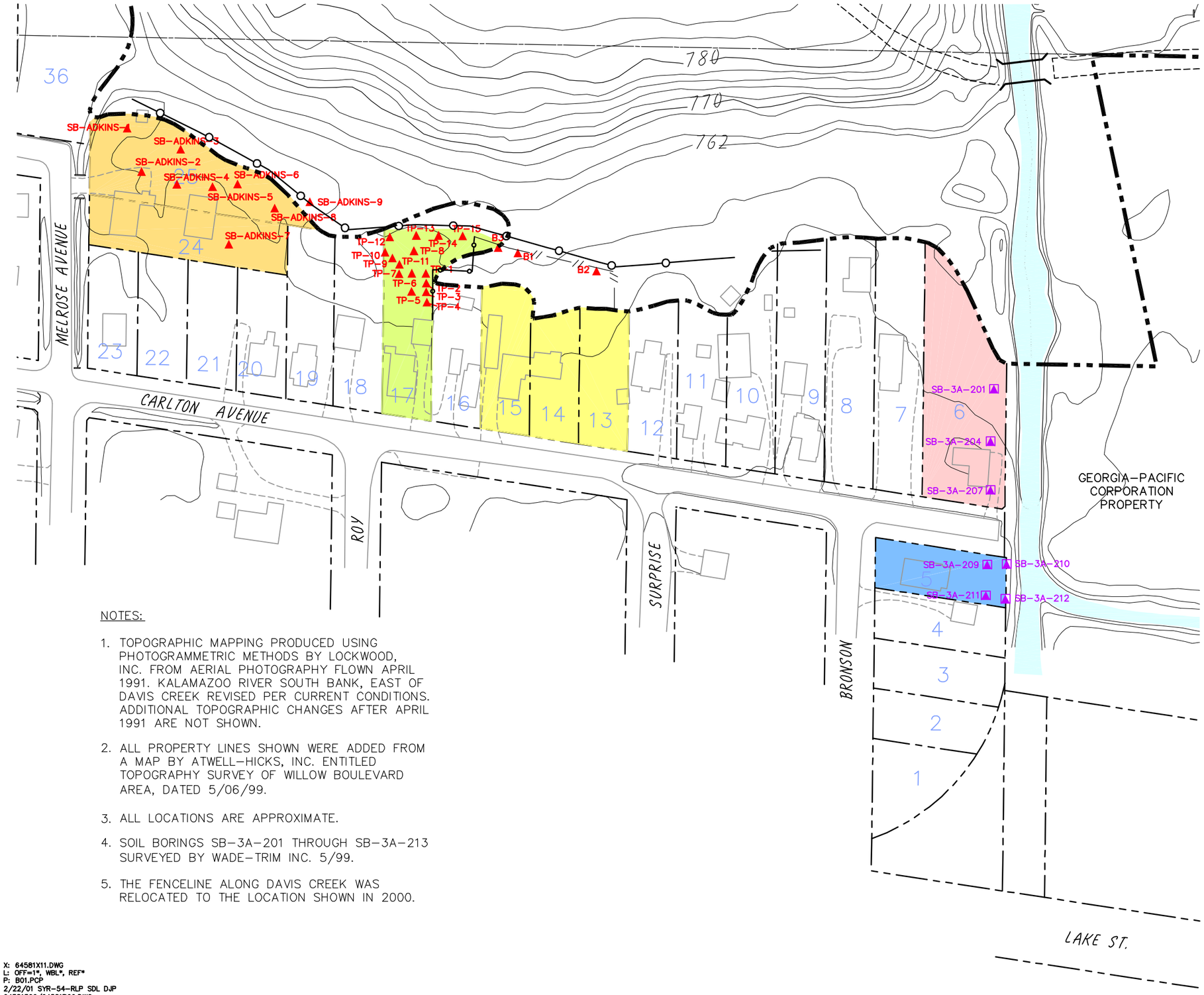
1. THE BASEMAP FOR THIS FIGURE WAS CREATED FROM PHOTOGRAMMATIC MAPPING PREPARED BY LOCKWOOD MAPPING, INC. DATED 4/91.
2. SOIL BORINGS SB-3A-201 THROUGH SB-3A-213 SURVEYED BY WADE-TRIM INC. 5/99.
3. ALL PROPERTY LINES SHOWN WERE ADDED FROM A MAP BY ATWELL-HICKS, INC. ENTITLED TOPOGRAPHY SURVEY OF WILLOW BOUELVARD AREA, DATED 5/06/99.
4. ALL LOCATIONS ARE APPROXIMATE.
5. THE FENCELINE ALONG DAVIS CREEK WAS REOCATED TO THE LOCATION SHOWN IN 2000.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

SAMPLE LOCATIONS
AMW-3A AREA

FIGURE
8

L: ON=* OFF=REF
P: STD-PCP/AP
2/23/01 SYR-5-GMS DJP GMS
64581500/64581B03.DWG



NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. ALL PROPERTY LINES SHOWN WERE ADDED FROM A MAP BY ATWELL-HICKS, INC. ENTITLED TOPOGRAPHY SURVEY OF WILLOW BOULEVARD AREA, DATED 5/06/99.
3. ALL LOCATIONS ARE APPROXIMATE.
4. SOIL BORINGS SB-3A-201 THROUGH SB-3A-213 SURVEYED BY WADE-TRIM INC. 5/99.
5. THE FENCELINE ALONG DAVIS CREEK WAS RELOCATED TO THE LOCATION SHOWN IN 2000.

LEGEND

780	ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	APPROXIMATE A-SITE BOUNDARY
40	APPROXIMATE ADJACENT RESIDENTIAL PROPERTY LINES AND PARCEL NUMBER
//	WOODEN FENCING
	CHAIN-LINK FENCING
B2	RESIDENTIAL SOIL BORING
SB-3A-201	SOIL BORING (3/99)
	WADSWORTH PROPERTY
	SCOTT PROPERTY
	ADKINS PROPERTY
	WRIGHT PROPERTY
	BLOOMFIELD PROPERTY

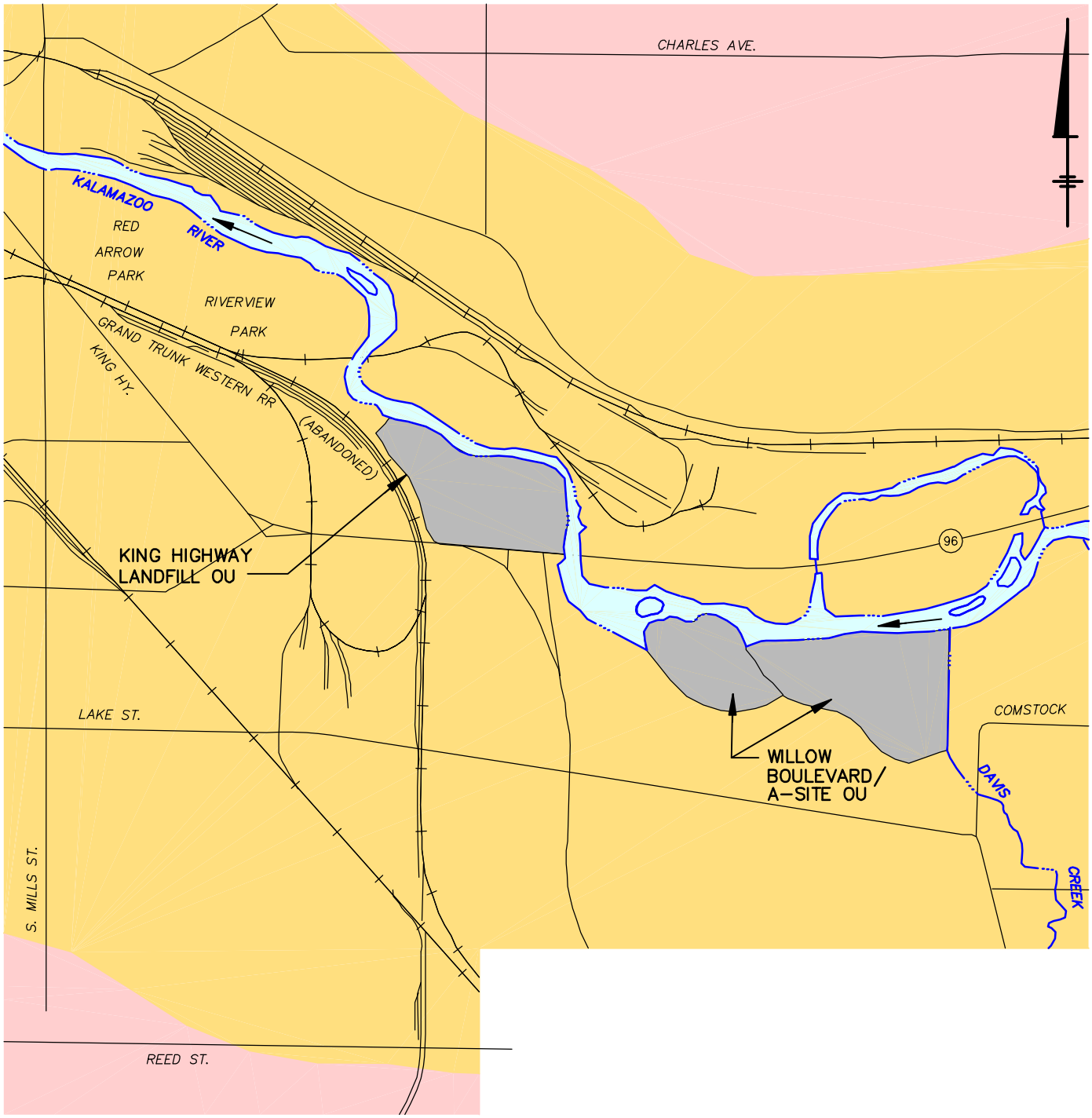
0 100' 200'
GRAPHIC SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

RESIDENTIAL SAMPLE LOCATIONS

FIGURE
9

X: 64581X11.DWG
L: OFF=1*, WBL*, REF*
P: B01.PCP
2/22/01 SYR-54-RLP SDL DJP
64581500/64581B06.DWG



1200' 0 1200'

SCALE

LEGEND:

GALESBURG-VICKSBURG OUTWASH PLAIN (APPROXIMATE)

DOWNCUT GLACIAL DRAINAGE CHANNEL (APPROXIMATE)

NOTES:

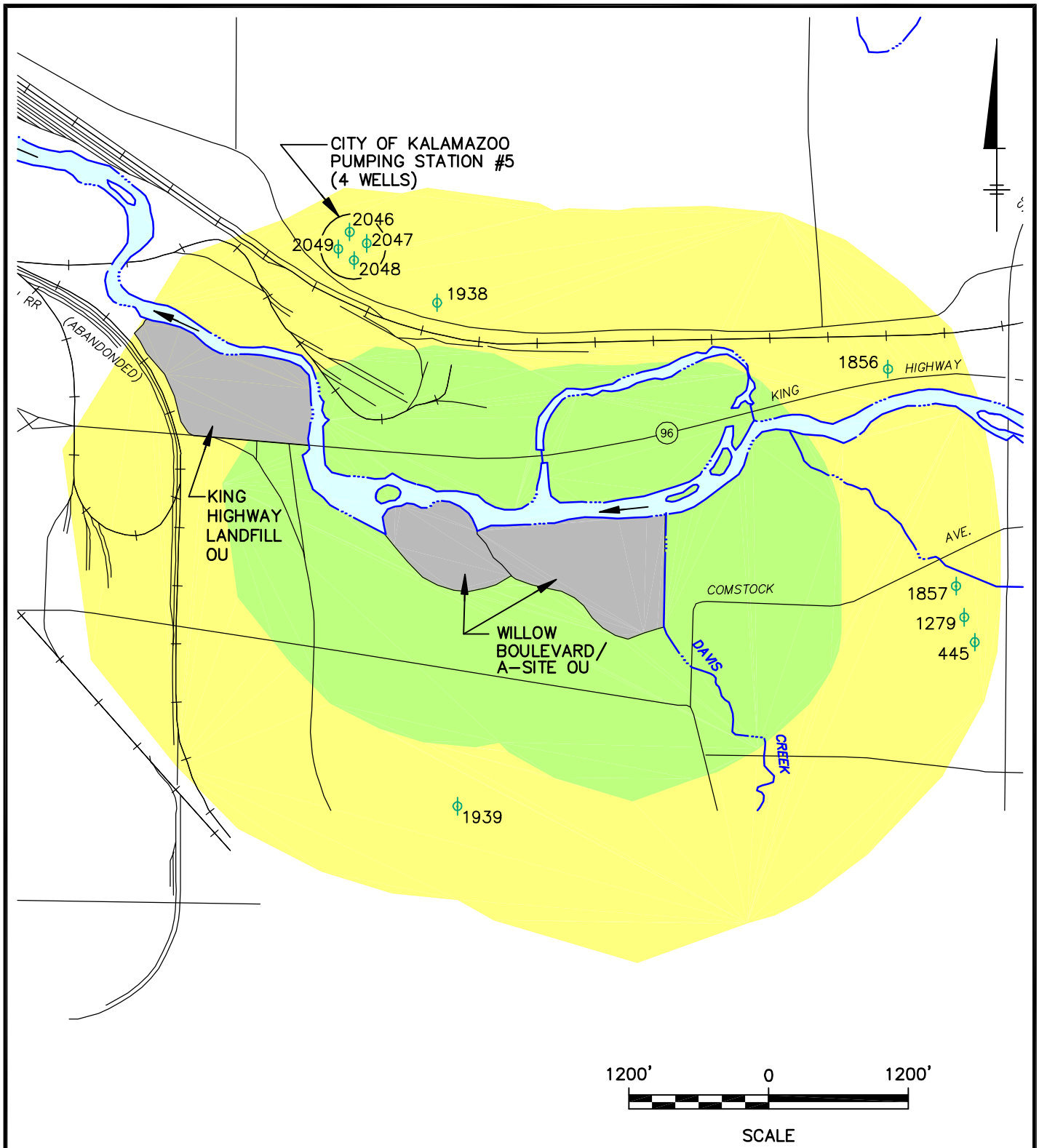
1. SURFICIAL GEOLOGY BASED ON RHEAUME, 1990.
2. BASE MAPPING PROVIDED BY MICHIGAN RESOURCE INFORMATION SYSTEM.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

REGIONAL SURFICIAL GEOLOGY

FIGURE 10



LEGEND:

1907 WELL LOCATION AND NUMBER

1/4 MILE OFFSET ZONE

1/2 MILE OFFSET ZONE

NOTES:

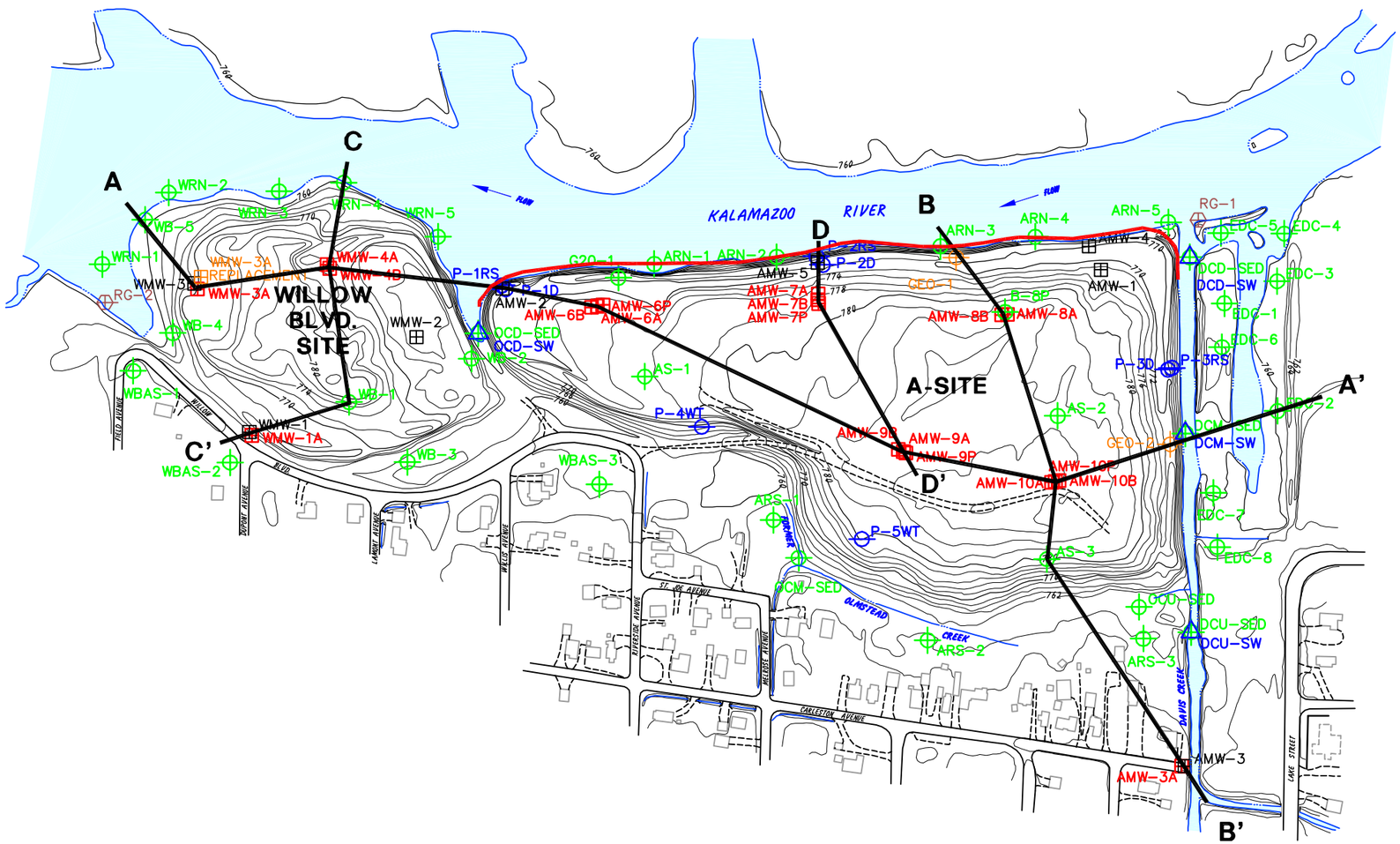
1. WELL LOCATIONS ARE UNSURVEYED, AND THEREFORE APPROXIMATE.
2. WELL LOCATIONS ARE DERIVED FROM WATER WELL LOGS SUBMITTED TO THE COUNTY OF KALAMAZOO DEPARTMENT OF PUBLIC HEALTH, AND MDNR GEOLOGICAL SURVEY DIVISION.
3. WELL NUMBERS CORRESPOND TO THE INVENTORY DATABASE COMPILED BY BLASLAND, BOUCK & LEE, INC. (1994).
4. BASE MAPPING PROVIDED BY MICHIGAN RESOURCE INFORMATION SYSTEM.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

WATER WELLS WITHIN 1/4 & 1/2 MILE OF THE OU

FIGURE
11



LEGEND

AMW-4	PRE-RI MONITORING WELL
WMW-3	MONITORING WELL OR CLUSTER INSTALLED IN 1993
WB-1	BORING INSTALLED IN 1993
GEO-1	GEOTECHNICAL BORING INSTALLED IN 1993
P-2D	PIEZOMETER INSTALLED IN 1993
SW-1	SURFACE WATER SAMPLE, INSTALLED IN 1993
RG-1	RIVER GAUGE STATION INSTALLED IN 1993
780	ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	UNPAVED ROAD/TRAIL
	EXISTING SHEETPILE WALL
A——A'	CROSS-SECTION LOCATION

150' 0 300'

SCALE

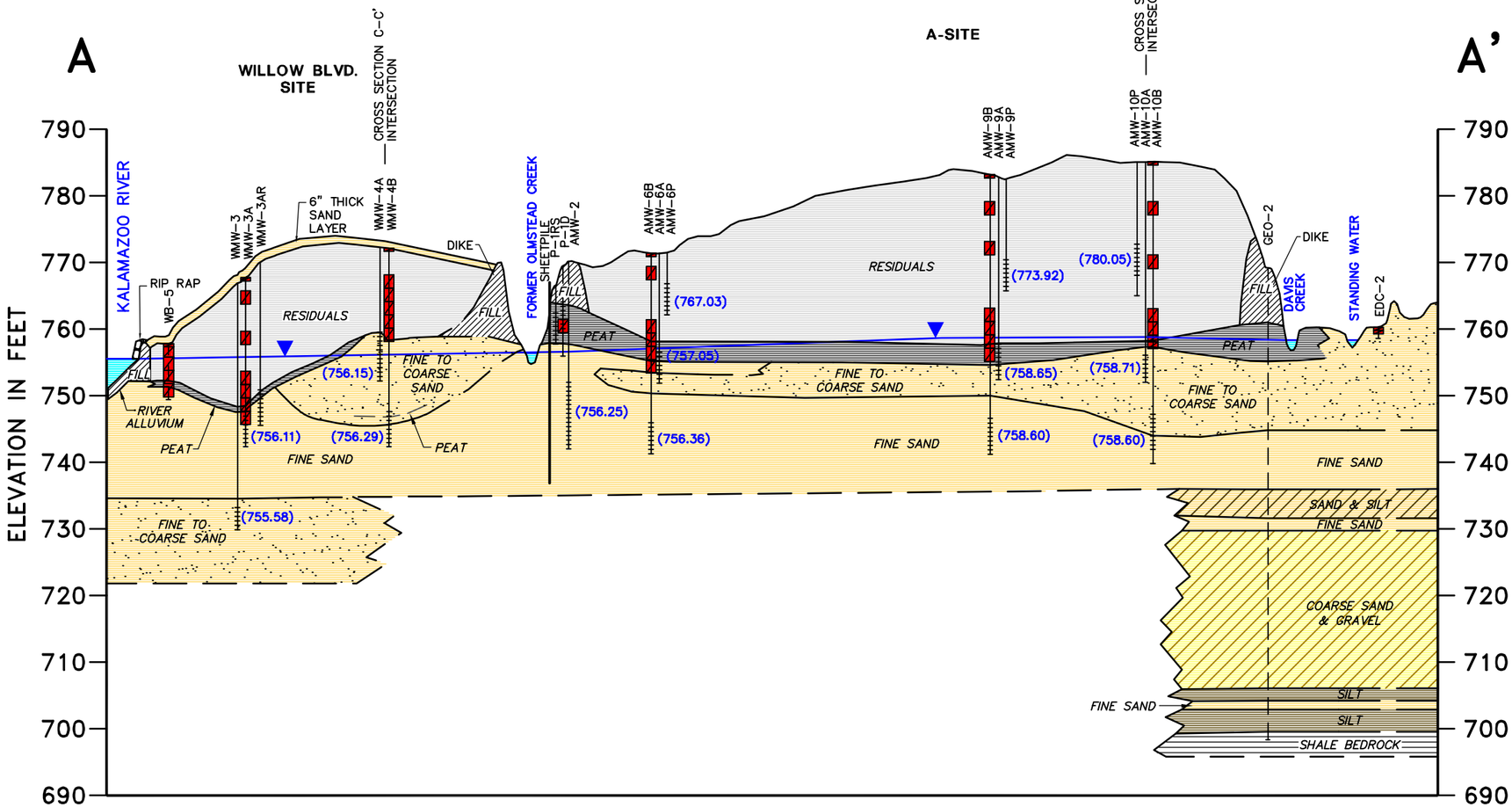
NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH AUGUST 1996. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BBL JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. SAMPLE RESULTS AS REPORTED BY AQUATEC, INC. 1995 AND 1996.

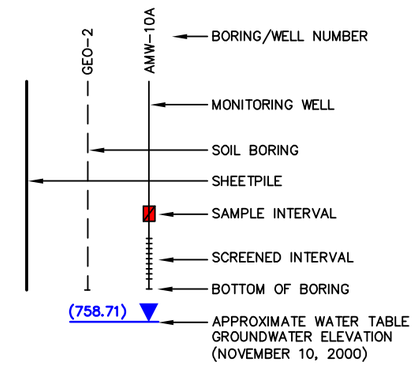
KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

GEOLOGIC CROSS-SECTION LOCATION MAP

FIGURE
12



LEGEND



- RESIDUALS
- FILL
- PEAT
- CLAY
- SILT
- SAND
- FINE TO COARSE SAND
- GRAVEL
- SHALE BEDROCK
- RIVER ALLUVIUM
- RIP RAP

NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH JANUARY 1994. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BLASLAND, BOUCK & LEE, INC. JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. SURFACE WATER ELEVATIONS BASED ON 12/15/93 MEASUREMENTS AND ARE APPROXIMATE.
4. GROUNDWATER ELEVATIONS BASED ON 11/10/00 MEASUREMENTS.

10' 0 10' 20'
VERTICAL SCALE:

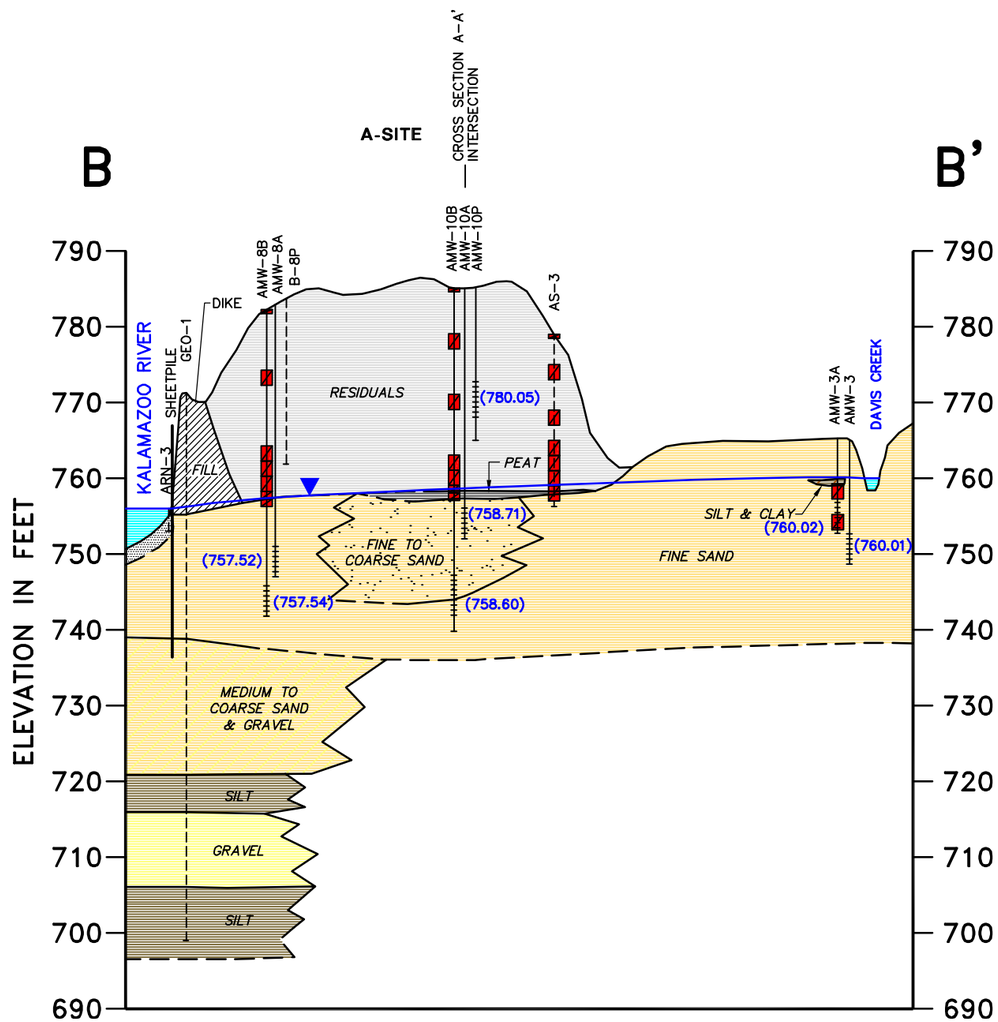
150' 0 150' 300'
HORIZONTAL SCALE:

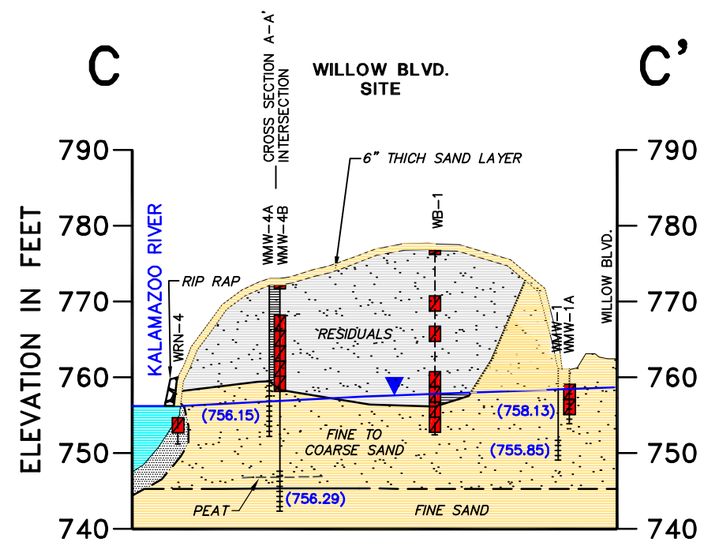
KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

GEOLOGIC CROSS-SECTION A-A'

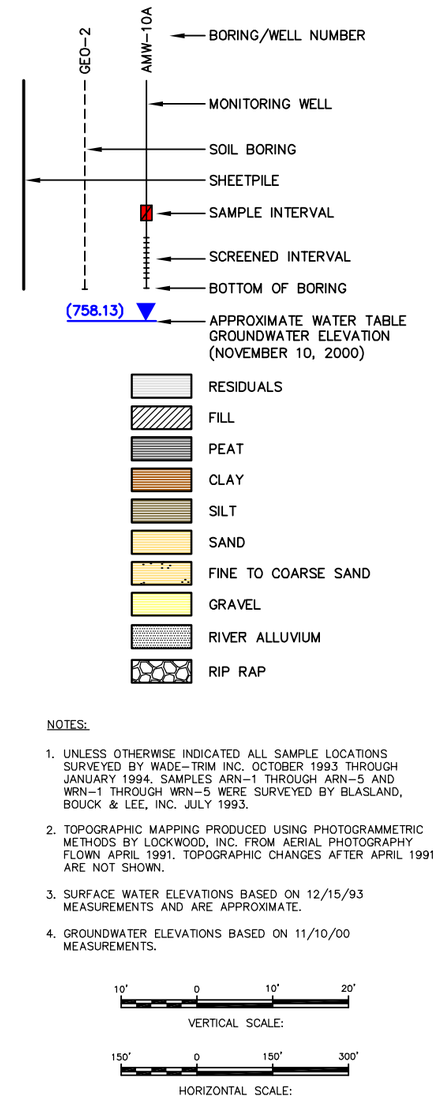
FIGURE
12A

P: BLX.PCP
2/22/01 SYR-54-DMW HSB DJP
64581500/64581CSA.DWG





LEGEND



NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH JANUARY 1994. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BLASLAND, BOUCK & LEE, INC. JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. SURFACE WATER ELEVATIONS BASED ON 12/15/93 MEASUREMENTS AND ARE APPROXIMATE.
4. GROUNDWATER ELEVATIONS BASED ON 11/10/00 MEASUREMENTS.

10' 0 10' 20'
VERTICAL SCALE:

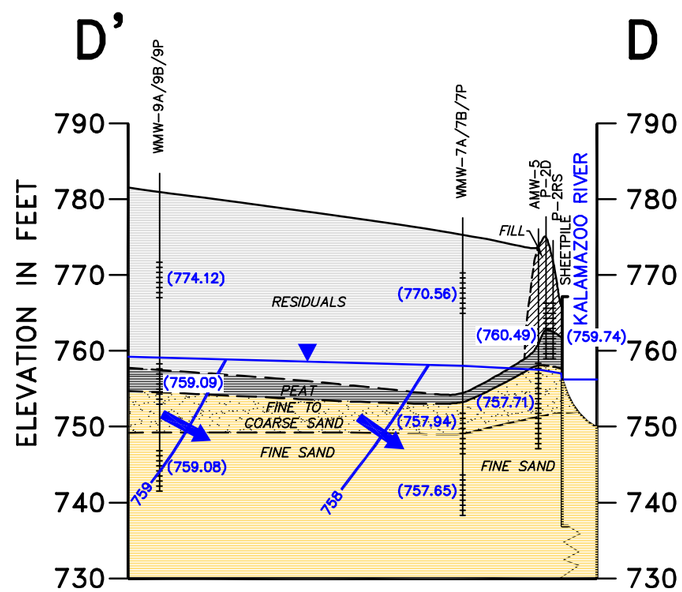
150' 0 150' 300'
HORIZONTAL SCALE:

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

GEOLOGIC CROSS-SECTIONS
B-B' AND C-C'

FIGURE
12B

P: BLX.PCP
2/22/01 SYR-54-DMW HSB DJP
64581500/64581CSB.DWG



LEGEND

- AMW-5 — BORING/WELL NUMBER
- MONITORING WELL
- SHEETPILE
- SCREENED INTERVAL
- BOTTOM OF BORING
- (759.08) — APPROXIMATE WATER TABLE GROUNDWATER ELEVATION (NOVEMBER 10, 2000)
- 758 — POTENTIOMETRIC ELEVATION CONTOUR LINE (FEET AMSL)
- FLOW DIRECTION
- RESIDUALS
- FILL
- PEAT
- FINE SAND
- FINE TO COARSE SAND

NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH JANUARY 1994. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BLASLAND, BOUCK & LEE, INC. JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. SURFACE WATER ELEVATIONS BASED ON 12/15/93 MEASUREMENTS AND ARE APPROXIMATE.
4. GROUNDWATER ELEVATIONS BASED ON 11/10/00 MEASUREMENTS.

10' 0 10' 20'
VERTICAL SCALE:

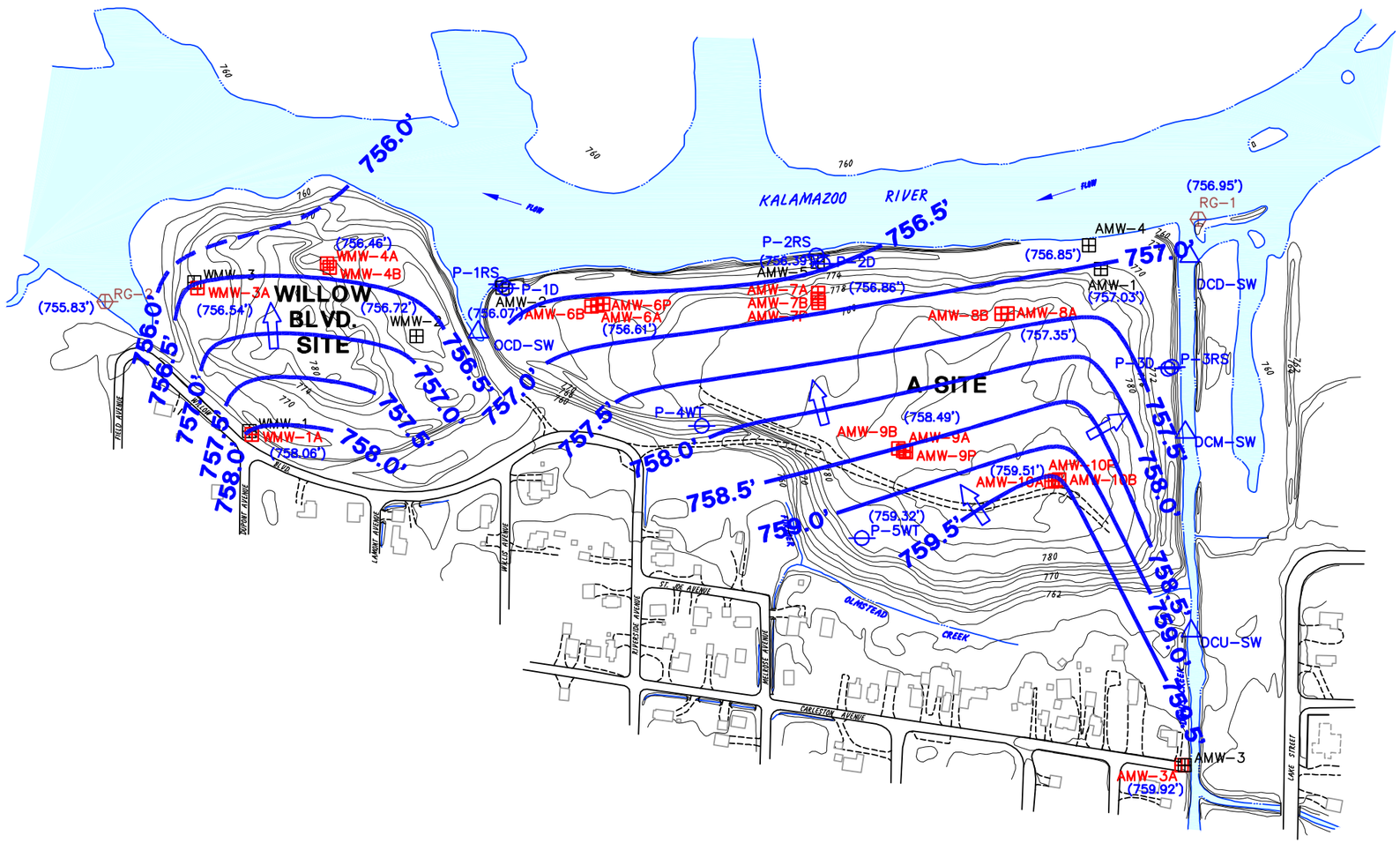
100' 0 100' 200'
HORIZONTAL SCALE:

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

GEOLOGIC CROSS-SECTIONS D-D'

FIGURE **12C**

P: BLX.PCP
2/22/01 SYR-54-DMW NES DJP
64581500/64581V01.DWG



LEGEND

AMW-4	PRE-RI MONITORING WELL
WMW-3	MONITORING WELL OR CLUSTER INSTALLED IN 1993
P-2D	PIEZOMETER INSTALLED IN 1993
SW-1	SURFACE WATER SAMPLE, INSTALLED IN 1993
RG-1	RIVER GAUGE STATION INSTALLED IN 1993
780	ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	UNPAVED ROAD/TRAIL
(759.51')	GROUNDWATER ELEVATION
759.0'	INTERPOLATED GROUNDWATER ELEVATION CONTOUR LINE
756.0'	EXTRAPOLATED GROUNDWATER ELEVATION CONTOUR LINE
	GROUNDWATER FLOW DIRECTION AS DERIVED PER OCTOBER 11, 1993

150' 0 300'

SCALE

NOTES:

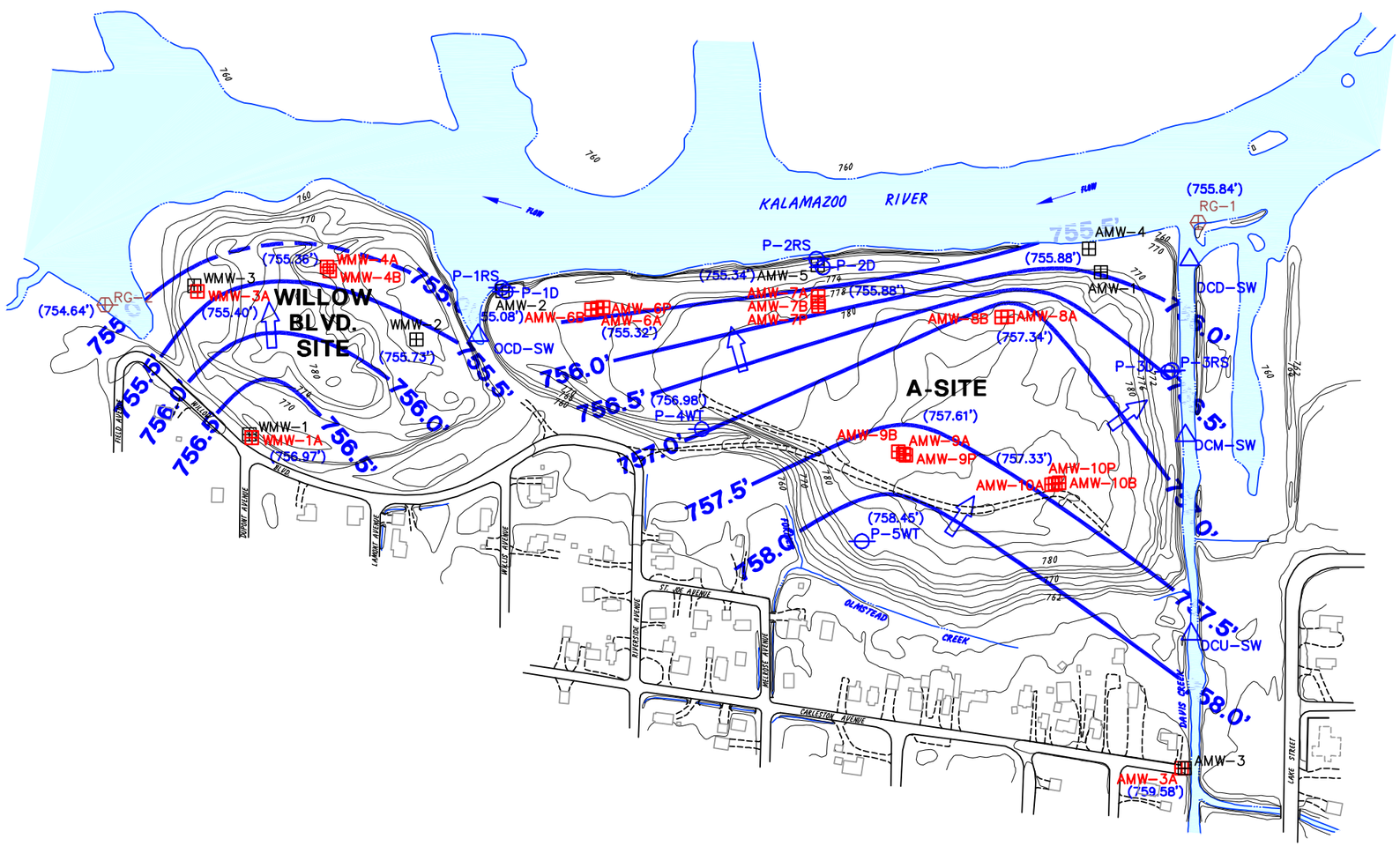
1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH JANUARY 1994. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BLASLAND, BOUCK & LEE, INC. JULY 1993
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

WATER TABLE CONTOUR MAP OCTOBER 11, 1993

FIGURE 13A

X: 64582X01.DWG
L: ON=*, OFF=*REF*
P: STD-BL.PCP
2/22/01 SYR-54-JER NES DJP
64582500/GEOLOGIC/64582BM2.DWG



LEGEND

AMW-4	PRE-RI MONITORING WELL
WMW-3	MONITORING WELL OR CLUSTER INSTALLED IN 1993
P-2D	PIEZOMETER INSTALLED IN 1993
SW-1	SURFACE WATER SAMPLE, INSTALLED IN 1993
RG-1	RIVER GAUGE STATION INSTALLED IN 1993
780	ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	UNPAVED ROAD/TRAIL
(755.73')	GROUNDWATER ELEVATION
756.0'	INTERPOLATED GROUNDWATER ELEVATION CONTOUR LINE
755.0'	EXTRAPOLATED GROUNDWATER ELEVATION CONTOUR LINE
	GROUNDWATER FLOW DIRECTION AS DERIVED PER AUGUST 30, 1995

150' 0 300'

SCALE

NOTES:

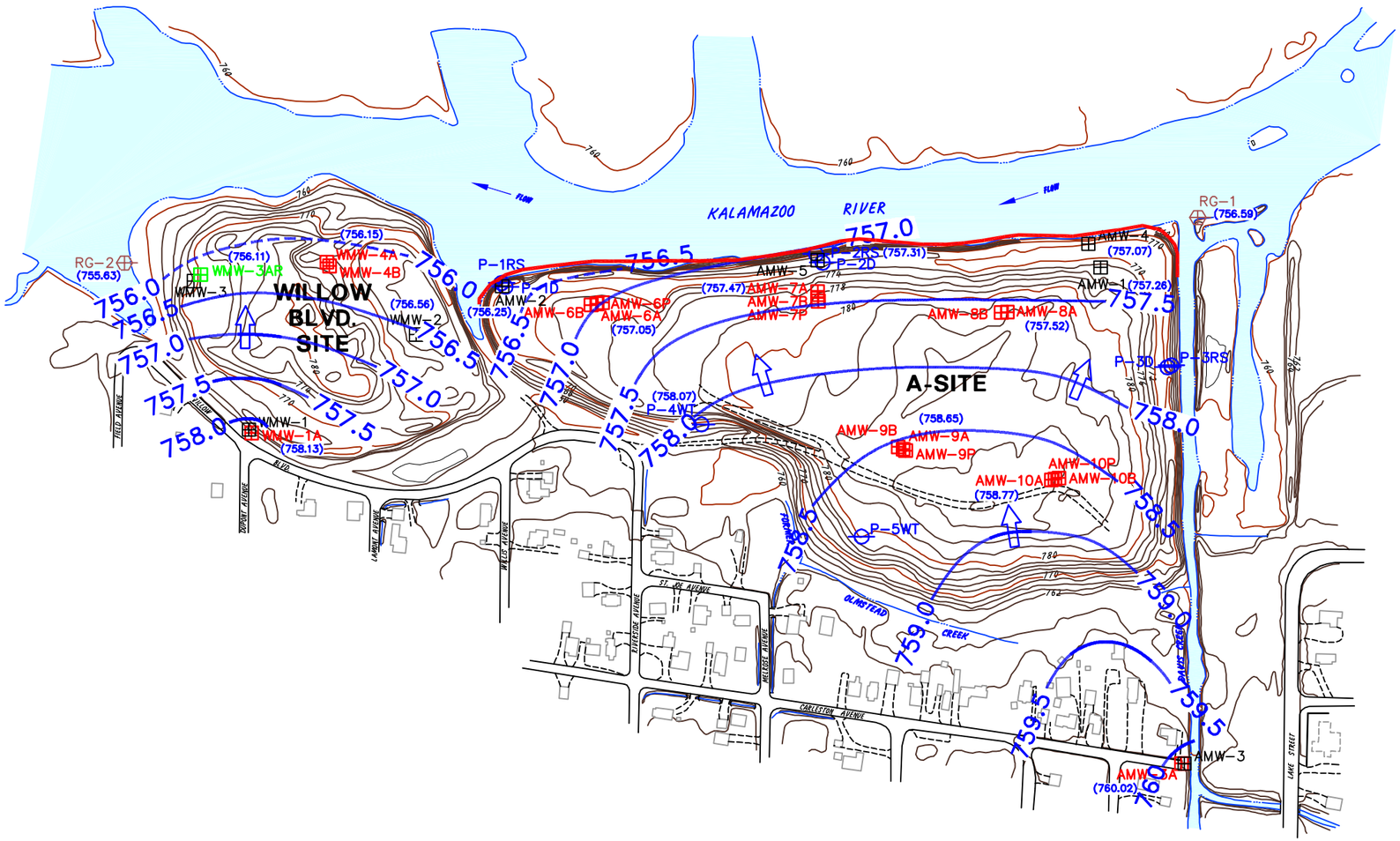
1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH JANUARY 1994. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BLASLAND, BOUCK & LEE, INC. JULY 1993
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

WATER TABLE CONTOUR MAP AUGUST 30, 1995

FIGURE **13B**

X: 64582X01.DWG
L: ON=*, OFF=*REF*
P: STD-BL.PCP
2/22/01 SYR-54-JER NES DJP
64582500/GEOLOGIC/64582BM3.DWG



LEGEND

AMW–4	PRE–RI MONITORING WELL
WMW–3	MONITORING WELL OR CLUSTER INSTALLED IN 1993
WMW–3AR	REPLACEMENT MONITORING WELL INSTALLED IN 1996
P–2D	PIEZOMETER INSTALLED IN 1993
RG–1	RIVER GAUGE STATION INSTALLED IN 1993
780	ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	UNPAVED ROAD/TRAIL
(755.73')	GROUNDWATER ELEVATION IN FEET (AMSL)
756.0'	INTERPOLATED GROUNDWATER ELEVATION CONTOUR LINE IN FEET (AMSL)
755.0'	EXTRAPOLATED GROUNDWATER ELEVATION CONTOUR LINE IN FEET (AMSL)
	GROUNDWATER FLOW DIRECTION AS DERIVED PER NOVEMBER 10, 2000
	EXISTING SHEETPILE WALL

NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE–TRIM INC. OCTOBER 1993 THROUGH AUGUST 1996. SAMPLES ARN–1 THROUGH ARN–5 AND WRN–1 THROUGH WRN–5 WERE SURVEYED BY BBL JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.

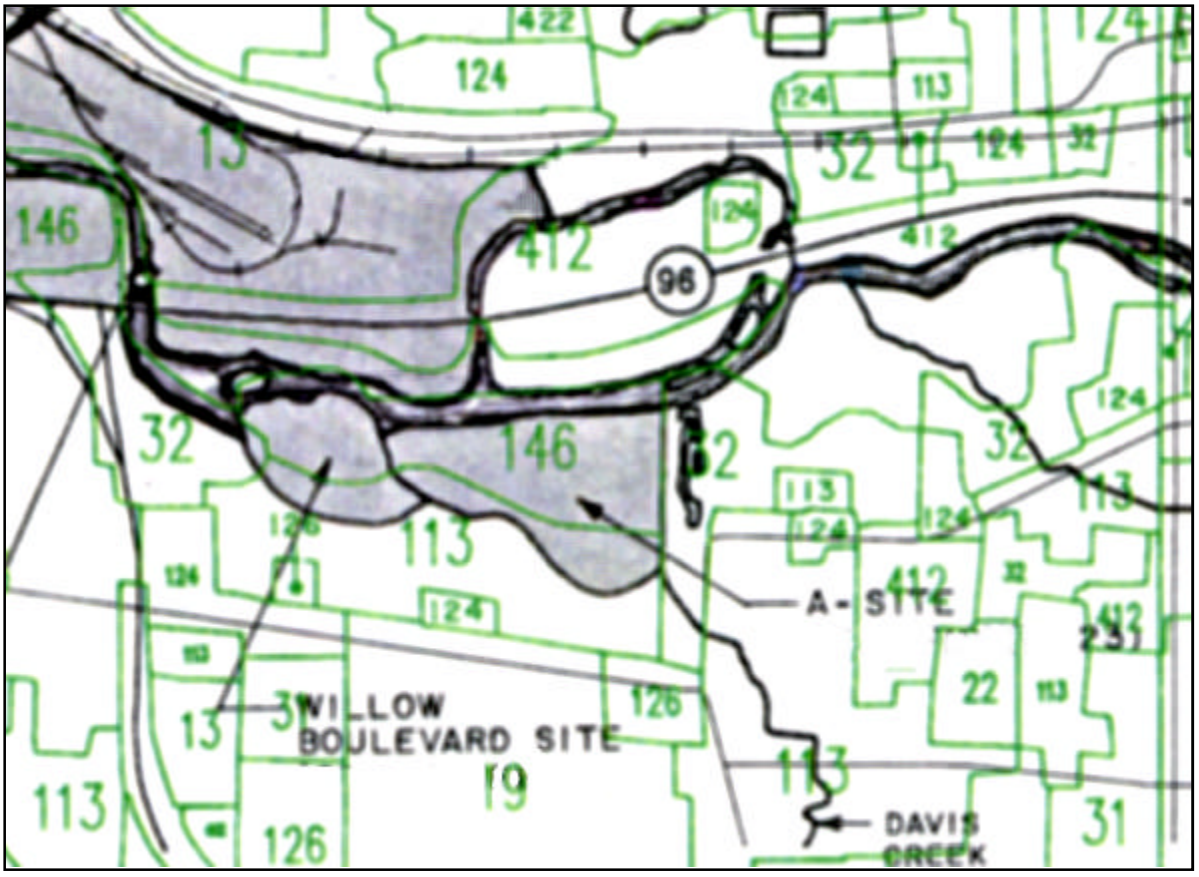
150' 0 300'
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A–SITE OU

WATER TABLE CONTOUR MAP NOVEMBER 10, 2000

FIGURE **13C**

X: NONE
L:ON=*,OFF=REF,WBL*,ON=WBL–SPL
P: FIG–4–B
2/22/01 54–RCB JER NES DJP
64582500/64582W01.DWG



LEGEND:

Urban

11	Residential
113	Single-Family Duplex
12	Commercial, Service, Institutional
124	Secondary Business/Strip Commercial
126	Institutional
13	Industrial
14	Transportation, Communications, Utilities
146	Utilities
19	Open Land and Other

Nonforested

31	Herbaceous
32	Shrub

Forested

412	Central Hardwood

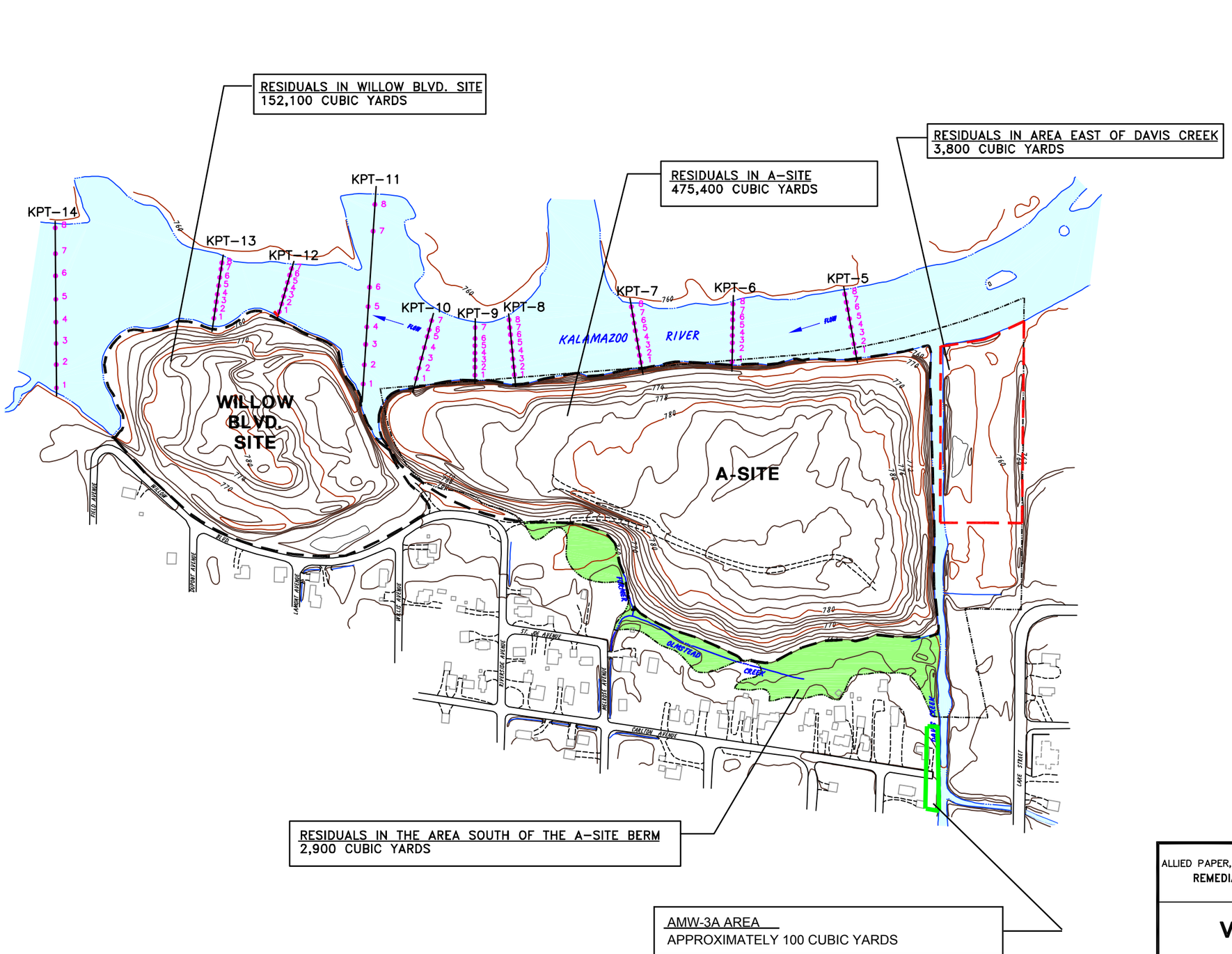
KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE

REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

LAND USE

FIGURE
14

02/01 SYR-D54-DJH LAS LBR
64581500/64581g03.CDR



LEGEND

- ELEVATION CONTOUR (NGVD 1929)
- EDGE OF WATER OR DRAINAGE CHANNEL
- UNPAVED ROAD/TRAIL
- APPROXIMATE A-SITE BOUNDARY
- KPT-5 SEDIMENT PROBING TRANSECT
- ASSUMED WILLOW BOULEVARD/ A-SITE OU BOUNDARY
- ASSUMED BOUNDARY FOR AREA EAST OF DAVIS CREEK VOLUME ESTIMATE
- AREA SOUTH OF THE A-SITE BERM

NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH AUGUST 1996. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BBL JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. ALL LOCATIONS ARE APPROXIMATE.
4. RESIDUALS VOLUME ESTIMATES ARE APPROXIMATE.

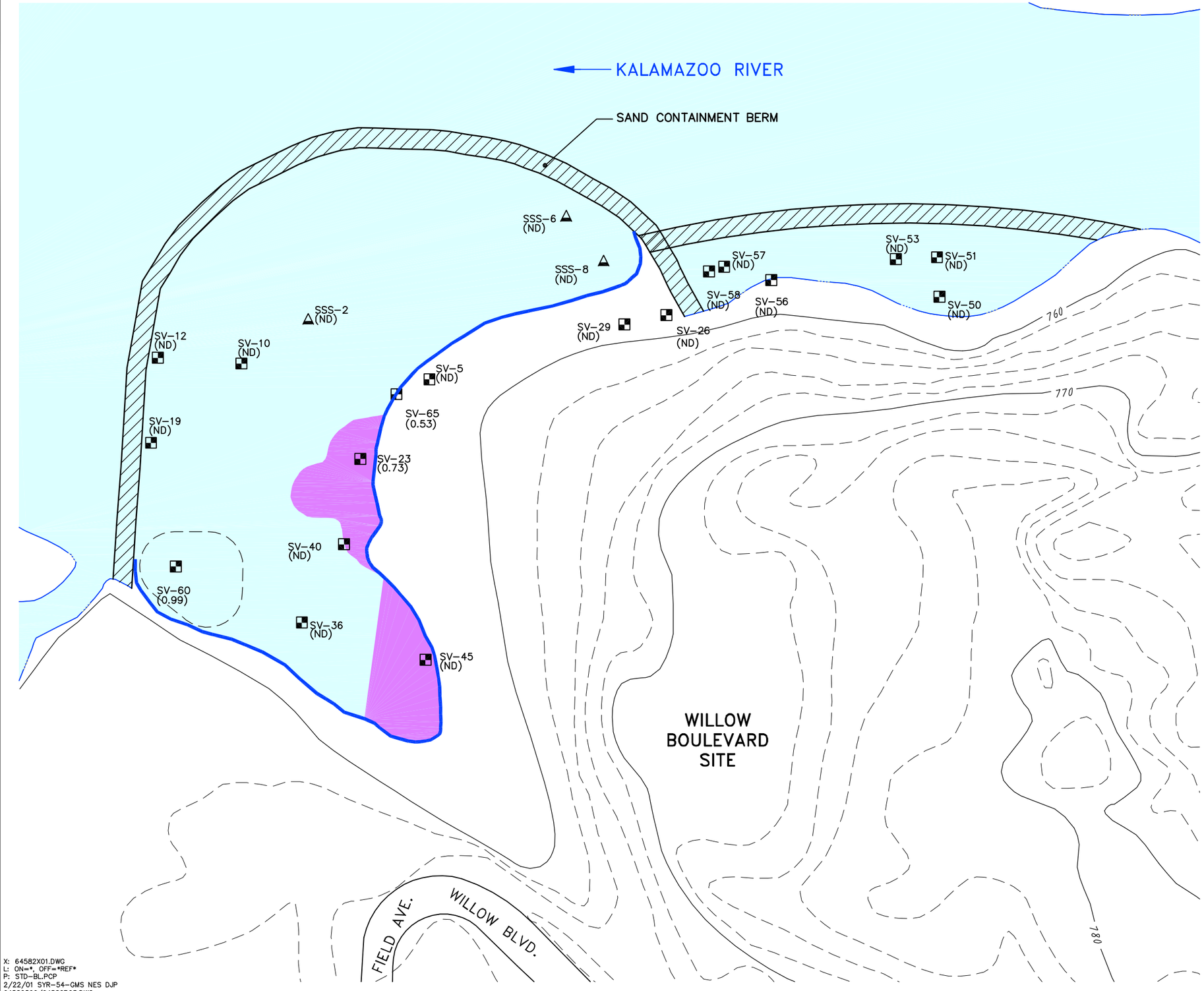
150' 0 300'
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

VOLUME ESTIMATES

FIGURE 15

X: 64581X03
P: FIG-2-3
L:ON=*,OFF=*REF*,WBL*,*N-*,ON=WBL-SPL
02/22/01 SYR- 54-RLP DCC SDL DJP
64581640/64581G01.DWG



LEGEND:

780	PRE-REMOVAL ACTION ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	EDGE OF WATER DURING REMEDIAL ACTIVITIES
SV-11	APPROXIMATE LOCATION OF POST-EXCAVATION SOIL SAMPLE
SSS-1	APPROXIMATE LOCATION OF POST-EXCAVATION SURFACE SOIL SAMPLE
(0.53)	PCB CONCENTRATION IN PARTS PER MILLION (ppm)
ND	NON-DETECT
	APPROXIMATE AREA OF RE-EXCAVATION

NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. SAMPLES WERE ANALYZED BASED ON A 25% RANDOM SAMPLING GRID.
4. AREAS IN OR NEAR SAMPLE LOCATIONS SV-1 THROUGH SV-4, SV-21 THROUGH SV-23, AND SV-25 WERE RE-EXCAVATED FOLLOWING SAMPLING OF THESE LOCATIONS.
5. SAMPLE LOCATION SV-60 WAS A DISCRETE SAMPLE CHOSEN BY THE MDEQ.
6. THE AREA SURROUNDING SAMPLE LOCATION SV-60 WAS SCRAPED OF THE TOP FEW INCHES AFTER POST-EXCAVATION SAMPLING WAS CONDUCTED. AS PRESENTED IN A FEBRUARY 8, 2000 (BROWN, 2000) ANY REMAINING PCB-CONTAINING MATERIALS IN THIS AREA WILL BE ADDRESSED AS PART OF THE KALAMAZOO RIVER.
7. DATA REFLECT TOTAL PCB DERIVED FROM THE SUM OF INDIVIDUAL AROCLORS. AROCLOR-SPECIFIC RESULTS AND THEIR QUALIFIERS CAN BE FOUND IN TABLE 4-16.

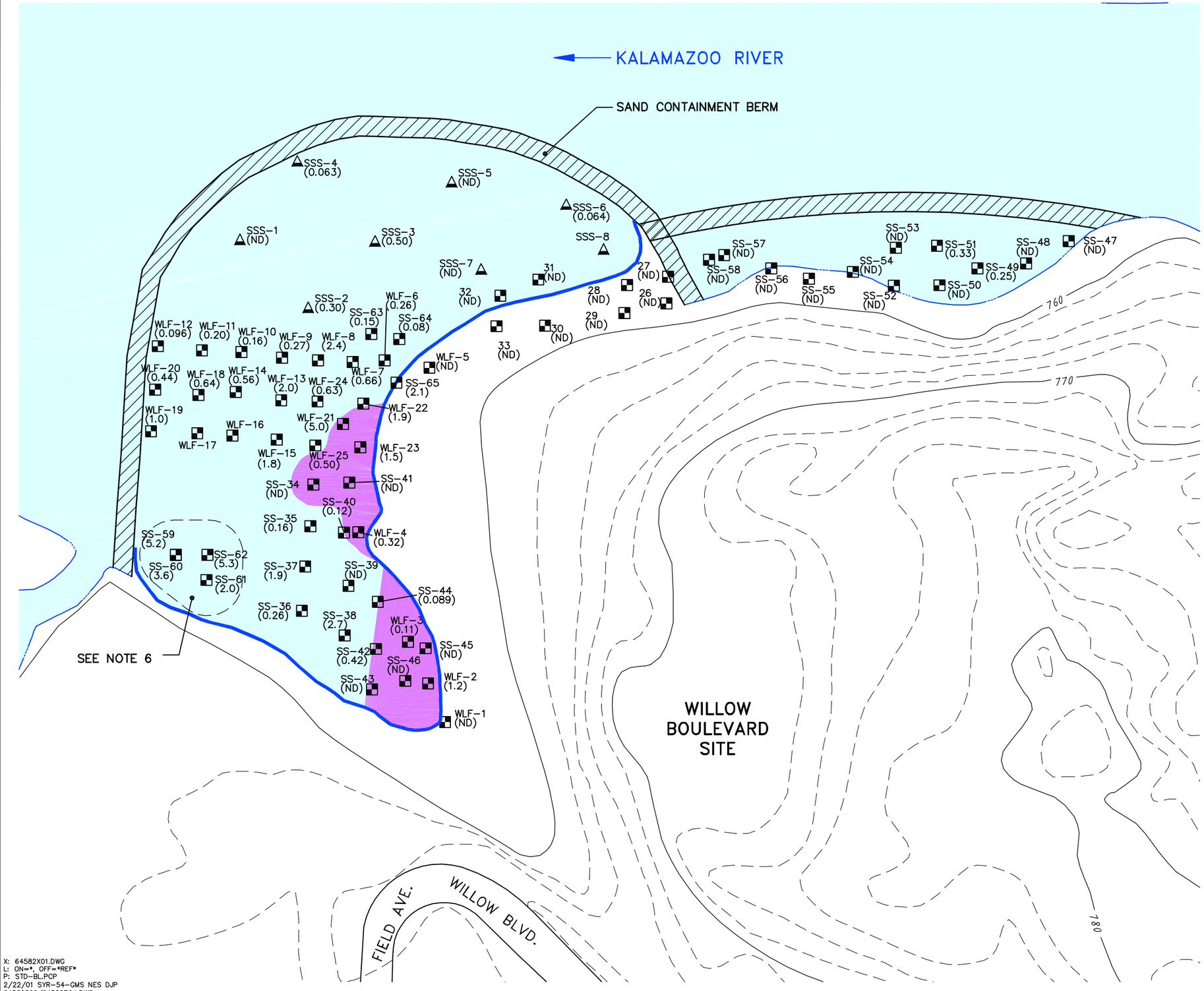
0 60' 120'
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

BBL POST-EXCAVATION SAMPLE LOCATIONS AND RESULTS

FIGURE 16

X: 64582X01.DWG
L: ON=*, OFF=*REF*
P: STD-BL.PCP
2/22/01 SYR-54-GMS NES DJP
64582500/64582B03.DWG



LEGEND:

780	PRE-REMOVAL ACTION ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	EDGE OF WATER DURING REMEDIAL ACTIVITIES
SV-11	APPROXIMATE LOCATION OF POST-EXCAVATION SOIL SAMPLE
SSS-1	APPROXIMATE LOCATION OF POST-EXCAVATION SURFACE SOIL SAMPLE
(0.53)	PCB CONCENTRATION IN PARTS PER MILLION (ppm)
(ND)	NON-DETECT
	APPROXIMATE AREA OF RE-EXCAVATION

NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. SOIL SAMPLE LOCATIONS WLF-16, WLF-17, AND SSS-8 WERE NOT SAMPLED.
4. AREAS IN OR NEAR SAMPLE LOCATIONS WLF-1 THROUGH WLF-4, WLF-21 THROUGH WLF-23, AND WLF-25 WERE REEXCAVATED FOLLOWING SAMPLING OF THESE LOCATIONS
5. SAMPLE LOCATIONS SS-59 THROUGH SS-62 WERE DISCRETE SAMPLES CHOSEN BY THE MDEQ.
6. THE AREA SURROUNDING SAMPLE LOCATIONS SS-59 THROUGH SS-62 WAS SCRAPED OF THE TOP FEW INCHES AFTER POST EXCAVATION SAMPLING WAS CONDUCTED. AS PRESENTED IN A FEBRUARY 8, 2000 LETTER (BROWN, 2000) ANY REMAINING PCB-CONTAINING MATERIALS IN THIS AREA WILL BE ADDRESSED AS PART OF THE KALAMAZOO RIVER
7. DATA REFLECT TOTAL PCB DERIVED FROM THE SUM OF INDIVIDUAL AROCLORS. AROCLOR-SPECIFIC RESULTS AND THEIR QUALIFIERS CAN BE FOUND IN TABLE 4-16A.

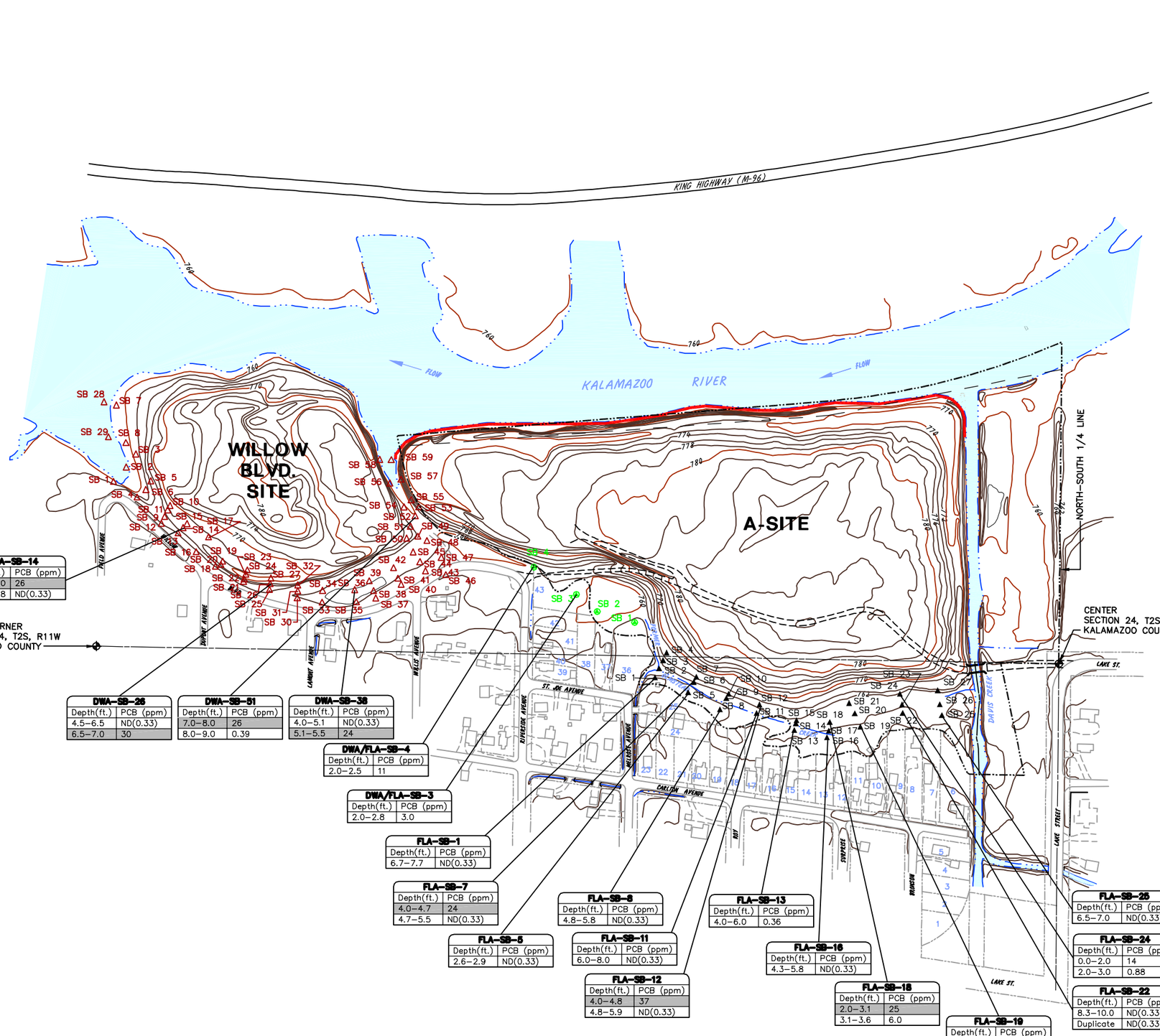
0 60' 120'
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

MDEQ POST-EXCAVATION SAMPLE LOCATIONS AND RESULTS

FIGURE **16A**

X: 64582X01.DWG
L: ON=*, OFF=*REF*
P: STD-BL.PCP
2/22/01 SYR-54-GMS NES DJP
64582500/64582B04.DWG



DWA-SB-14	
Depth(ft.)	PCB (ppm)
12.0–13.0	26
13.0–13.8	ND(0.33)

DWA-SB-26	
Depth(ft.)	PCB (ppm)
4.5–6.5	ND(0.33)
6.5–7.0	30

DWA-SB-51	
Depth(ft.)	PCB (ppm)
7.0–8.0	26
8.0–9.0	0.39

DWA-SB-38	
Depth(ft.)	PCB (ppm)
4.0–5.1	ND(0.33)
5.1–5.5	24

DWA/FLA-SB-4	
Depth(ft.)	PCB (ppm)
2.0–2.5	11

DWA/FLA-SB-3	
Depth(ft.)	PCB (ppm)
2.0–2.8	3.0

FLA-SB-1	
Depth(ft.)	PCB (ppm)
6.7–7.7	ND(0.33)

FLA-SB-7	
Depth(ft.)	PCB (ppm)
4.0–4.7	24
4.7–5.5	ND(0.33)

FLA-SB-5	
Depth(ft.)	PCB (ppm)
2.6–2.9	ND(0.33)

FLA-SB-8	
Depth(ft.)	PCB (ppm)
4.8–5.8	ND(0.33)

FLA-SB-11	
Depth(ft.)	PCB (ppm)
6.0–8.0	ND(0.33)

FLA-SB-12	
Depth(ft.)	PCB (ppm)
4.0–4.8	37
4.8–5.9	ND(0.33)

FLA-SB-13	
Depth(ft.)	PCB (ppm)
4.0–6.0	0.36

FLA-SB-16	
Depth(ft.)	PCB (ppm)
4.3–5.8	ND(0.33)

FLA-SB-18	
Depth(ft.)	PCB (ppm)
2.0–3.1	25
3.1–3.6	6.0

FLA-SB-19	
Depth(ft.)	PCB (ppm)
6.3–7.0	ND(0.33)

FLA-SB-25	
Depth(ft.)	PCB (ppm)
6.5–7.0	ND(0.33)

FLA-SB-24	
Depth(ft.)	PCB (ppm)
0.0–2.0	14
2.0–3.0	0.88

FLA-SB-22	
Depth(ft.)	PCB (ppm)
8.3–10.0	ND(0.33)
Duplicate	ND(0.33)

LEGEND

- 780 — ELEVATION CONTOUR (NGVD 1929)
- EDGE OF WATER OR DRAINAGE CHANNEL
- UNPAVED ROAD/TRAIL
- APPROXIMATE A-SITE BOUNDARY
- 40 — APPROXIMATE ADJACENT RESIDENTIAL PROPERTY LINES AND PARCEL NUMBER
- EXISTING SHEETPILE WALL
- BRIDGE
- DWA-SB 50 — WILLOW BLVD. SITE (DRAINAGEWAY AREA)
- FLA-SB 25 — AREA SOUTH OF THE A-SITE BERM
- DWA/FLA-SB 1 — EXISTING SOIL BORING BETWEEN DRAINAGEWAY AREA AND THE AREAS SOUTH OF THE A-SITE BERM

NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. SOIL BORINGS DWA–SB 1 THROUGH DWA–SB 9; FLA–1 THROUGH FLA–27; AND DWA/FLA–1 THROUGH DWA/FLA–4 SURVEYED BY ATWELL–HICKS INC. 5/06/99.
3. ALL PROPERTY LINES SHOWN WERE ADDED FROM A MAP BY ATWELL–HICKS, INC. ENTITLED TOPOGRAPHY SURVEY OF WILLOW BOULEVARD AREA, DATED 5/06/99.
4. ALL LOCATIONS ARE APPROXIMATE.
5. LOCATIONS DWA SB–46, SB–47, AND SB–58, FLA–SB–4 HAVE NOT BEEN SURVEYED.
6. DATA REFLECT TOTAL PCB DERIVED FROM THE SUM OF INDIVIDUAL AROCLORS. AROCLOR SPECIFIC RESULTS AND THEIR QUALIFIERS CAN BE FOUND IN TABLES 4–1 AND 4–2.

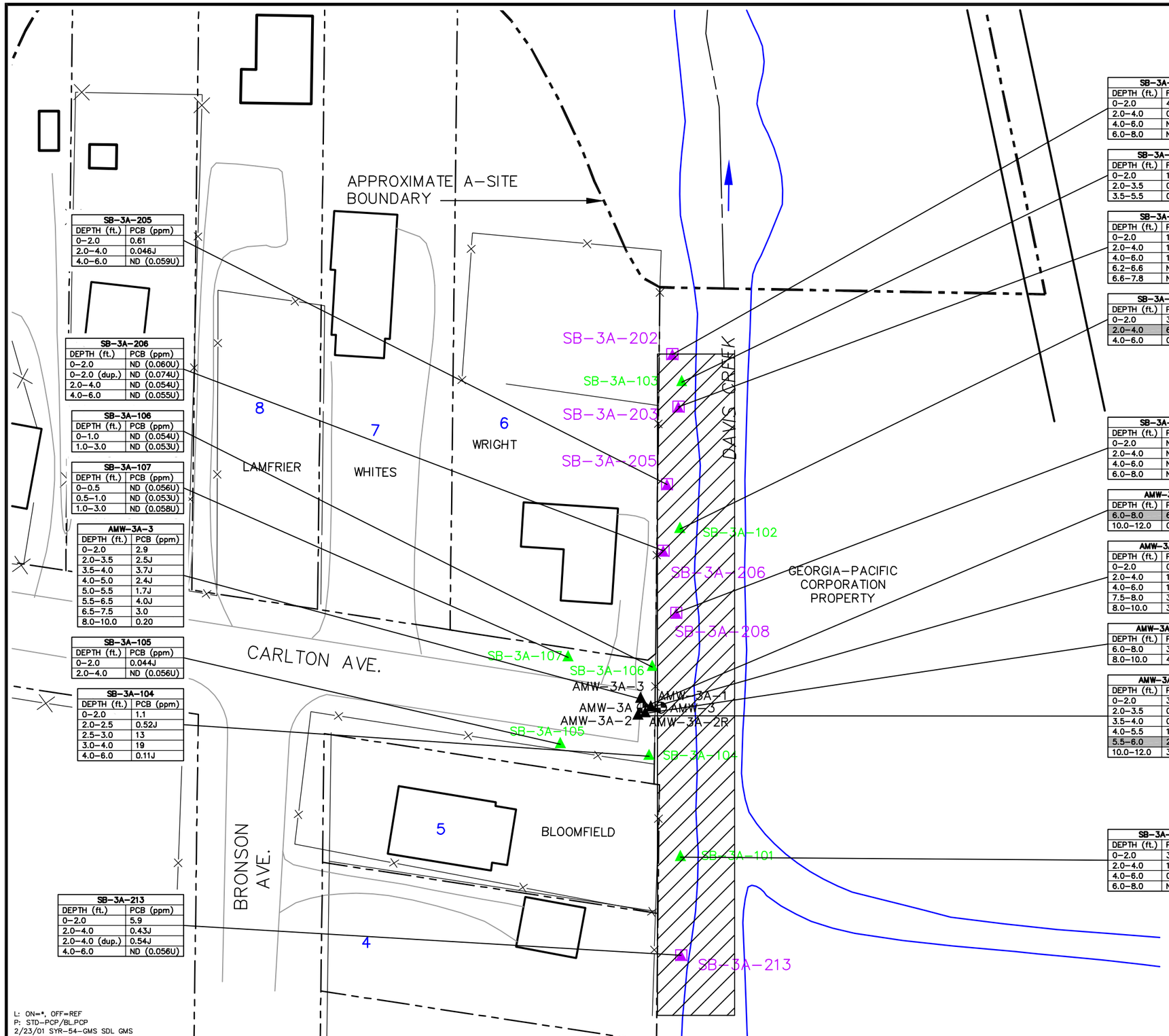
150' 0 300'
SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

TOTAL PCB CONCENTRATIONS: WILLOW BLVD. SITE DRAINAGEWAY AREA AND THE AREA SOUTH OF THE A-SITE BERM

FIGURE 17

X: 64582X11.DWG
L: ON=*, OFF=*REF*
P: B01.PCP
2/22/01 SYR-54-GMS NES DJP
64581500/64581B04.DWG



SB-3A-205	
DEPTH (ft.)	PCB (ppm)
0-2.0	0.61
2.0-4.0	0.046J
4.0-6.0	ND (0.059U)

SB-3A-206	
DEPTH (ft.)	PCB (ppm)
0-2.0	ND (0.060U)
0-2.0 (dup.)	ND (0.074U)
2.0-4.0	ND (0.054U)
4.0-6.0	ND (0.055U)

SB-3A-106	
DEPTH (ft.)	PCB (ppm)
0-1.0	ND (0.054U)
1.0-3.0	ND (0.053U)

SB-3A-107	
DEPTH (ft.)	PCB (ppm)
0-0.5	ND (0.056U)
0.5-1.0	ND (0.053U)
1.0-3.0	ND (0.058U)

AMW-3A-3	
DEPTH (ft.)	PCB (ppm)
0-2.0	2.9
2.0-3.5	2.5J
3.5-4.0	3.7J
4.0-5.0	2.4J
5.0-5.5	1.7J
5.5-6.5	4.0J
6.5-7.5	3.0
8.0-10.0	0.20

SB-3A-105	
DEPTH (ft.)	PCB (ppm)
0-2.0	0.044J
2.0-4.0	ND (0.056U)

SB-3A-104	
DEPTH (ft.)	PCB (ppm)
0-2.0	1.1
2.0-2.5	0.52J
2.5-3.0	13
3.0-4.0	19
4.0-6.0	0.11J

SB-3A-213	
DEPTH (ft.)	PCB (ppm)
0-2.0	5.9
2.0-4.0	0.43J
2.0-4.0 (dup.)	0.54J
4.0-6.0	ND (0.056U)

SB-3A-202	
DEPTH (ft.)	PCB (ppm)
0-2.0	4.4
2.0-4.0	0.29
4.0-6.0	ND (0.086U)
6.0-8.0	ND (0.059U)

SB-3A-103	
DEPTH (ft.)	PCB (ppm)
0-2.0	1.5J
2.0-3.5	0.22
3.5-5.5	0.10J

SB-3A-203	
DEPTH (ft.)	PCB (ppm)
0-2.0	1.7
2.0-4.0	1.7
4.0-6.0	1.0J
6.2-6.6	ND (0.086U)
6.6-7.8	ND (0.062U)

SB-3A-102	
DEPTH (ft.)	PCB (ppm)
0-2.0	3.1
2.0-4.0	61
4.0-6.0	0.96J

SB-3A-208	
DEPTH (ft.)	PCB (ppm)
0-2.0	ND (0.056U)
2.0-4.0	ND (0.052U)
4.0-6.0	ND (0.053U)
6.0-8.0	ND (0.058U)

AMW-3A	
DEPTH (ft.)	PCB (ppm)
6.0-8.0	62
10.0-12.0	0.34

AMW-3A-1	
DEPTH (ft.)	PCB (ppm)
0-2.0	0.84
2.0-4.0	1.5J
4.0-6.0	1.4J
7.5-8.0	3.4
8.0-10.0	3.8

AMW-3A-2R	
DEPTH (ft.)	PCB (ppm)
6.0-8.0	3.8
8.0-10.0	4.9

AMW-3A-2	
DEPTH (ft.)	PCB (ppm)
0-2.0	3.5
2.0-3.5	0.94J
3.5-4.0	0.015JN
4.0-5.5	1.2
5.5-6.0	23
10.0-12.0	3.2J

SB-3A-101	
DEPTH (ft.)	PCB (ppm)
0-2.0	3.1
2.0-4.0	1.1
4.0-6.0	0.36
6.0-8.0	ND (0.086U)

LEGEND:

- EXISTING FENCELINE
- 6 PARCEL NUMBER
- NEW SOIL BORING (3/99)
- EXISTING MONITORING WELL (1993)
- PREVIOUS SOIL BORING (1/98)
- PREVIOUS SOIL BORING (7/98)
- APPROXIMATE LOCATION OF EROSION PROTECTION

NOTES:

1. THE BASEMAP FOR THIS FIGURE WAS CREATED FROM PHOTOGRAMMATIC MAPPING PREPARED BY LOCKWOOD MAPPING, INC. DATED 4/91.
2. SOIL BORINGS SB-3A-201 THROUGH SB-3A-213 SURVEYED BY WADE-TRIM INC. 5/99.
3. ALL PROPERTY LINES SHOWN WERE ADDED FROM A MAP BY ATWELL-HICKS, INC. ENTITLED TOPOGRAPHY SURVEY OF WILLOW BOULEVARD AREA, DATED 5/06/99.
4. ALL LOCATIONS ARE APPROXIMATE.
5. DATA REFLECT TOTAL PCB DERIVED FROM THE SUM OF INDIVIDUAL AROCLORS. AROCLOR-SPECIFIC RESULTS AND THEIR QUALIFIERS CAN BE FOUND IN TABLES 4-3A, 4-3B, AND 4-3C.
6. THE FENCE LINE ALONG DAVIS CREEK WAS RELOCATED TO THE LOCATION SHOWN IN 2000.

0 40' 80'

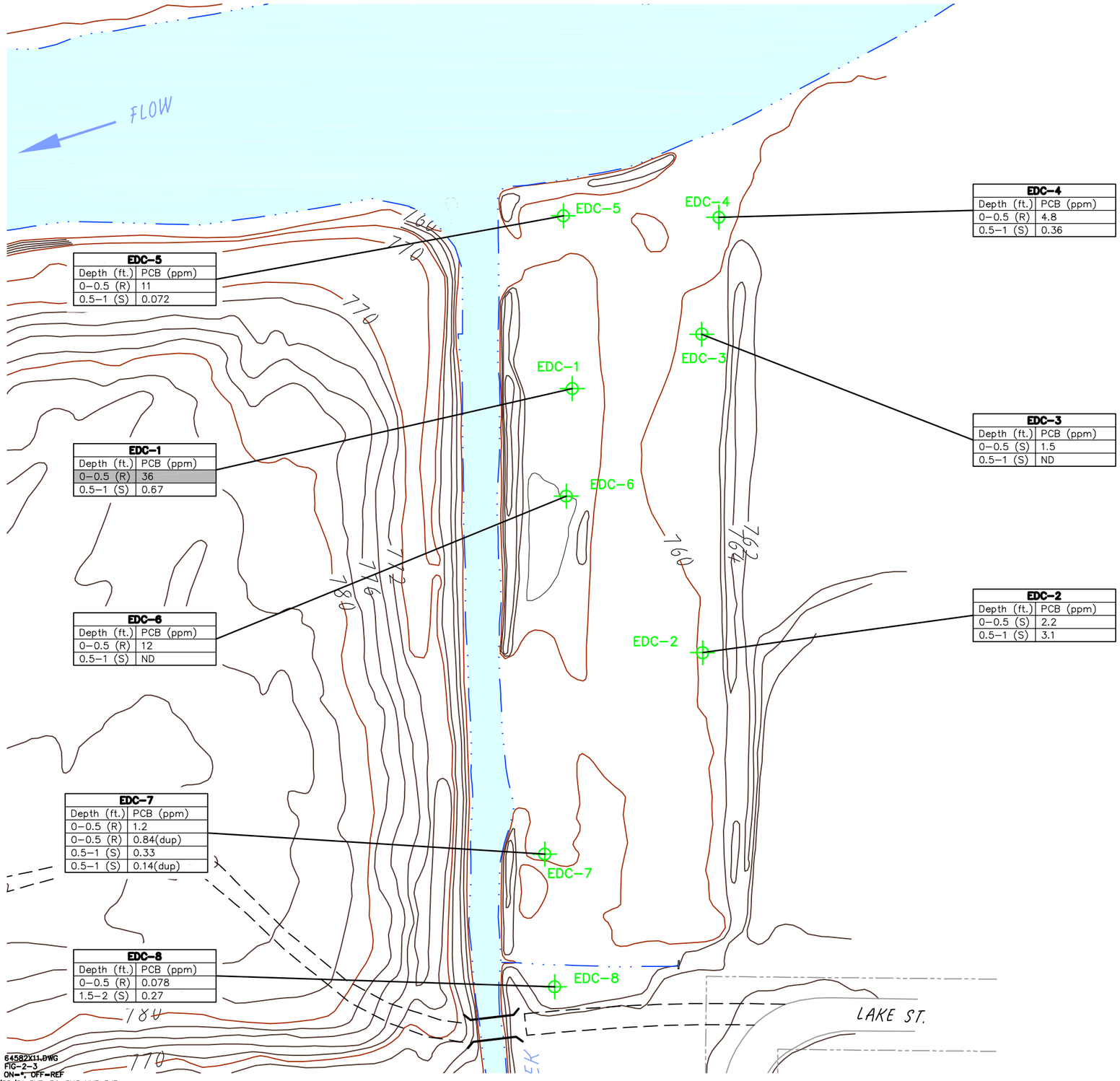
GRAPHIC SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

TOTAL PCB CONCENTRATIONS: AMW-3A AREA

FIGURE 18

L: ON=*, OFF=REF
P: STD-PCP/BL.PCP
2/23/01 SYR-54-GMS SDL GMS
64581500/64581B01.DWG



EDC-5	
Depth (ft.)	PCB (ppm)
0-0.5 (R)	11
0.5-1 (S)	0.072

EDC-4	
Depth (ft.)	PCB (ppm)
0-0.5 (R)	4.8
0.5-1 (S)	0.36

EDC-1	
Depth (ft.)	PCB (ppm)
0-0.5 (R)	36
0.5-1 (S)	0.67

EDC-3	
Depth (ft.)	PCB (ppm)
0-0.5 (S)	1.5
0.5-1 (S)	ND

EDC-6	
Depth (ft.)	PCB (ppm)
0-0.5 (R)	12
0.5-1 (S)	ND

EDC-2	
Depth (ft.)	PCB (ppm)
0-0.5 (S)	2.2
0.5-1 (S)	3.1

EDC-7	
Depth (ft.)	PCB (ppm)
0-0.5 (R)	1.2
0-0.5 (R)	0.84(dup)
0.5-1 (S)	0.33
0.5-1 (S)	0.14(dup)

EDC-8	
Depth (ft.)	PCB (ppm)
0-0.5 (R)	0.078
1.5-2 (S)	0.27

LEGEND

EDC-4 SAMPLE LOCATION

780 ELEVATION CONTOUR (NGVD 1929)

EDGE OF WATER OR DRAINAGE CHANNEL

UNPAVED ROAD/TRAIL

APPROXIMATE PROPERTY LINE

KEY:

ND NOT DETECTED
(S) SOIL SAMPLE
(R) RESIDUALS SAMPLE
(dup) DUPLICATE SAMPLE

NOTES:

1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH AUGUST 1996. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BBL JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. SAMPLE RESULTS AS REPORTED BY AQUATEC, INC. 1993, 1994.
4. DATA REFLECT TOTAL PCB DERIVED FROM THE SUM OF INDIVIDUAL AROCLORS. AROCLOR-SPECIFIC RESULTS AND THEIR QUALIFIERS CAN BE FOUND IN TABLE 3-11 OF TECHNICAL MEMORANDUM 9.
5. SAMPLES SHADED EXCEED THE CRITERIA.
6. ALL LOCATIONS ARE APPROXIMATE.

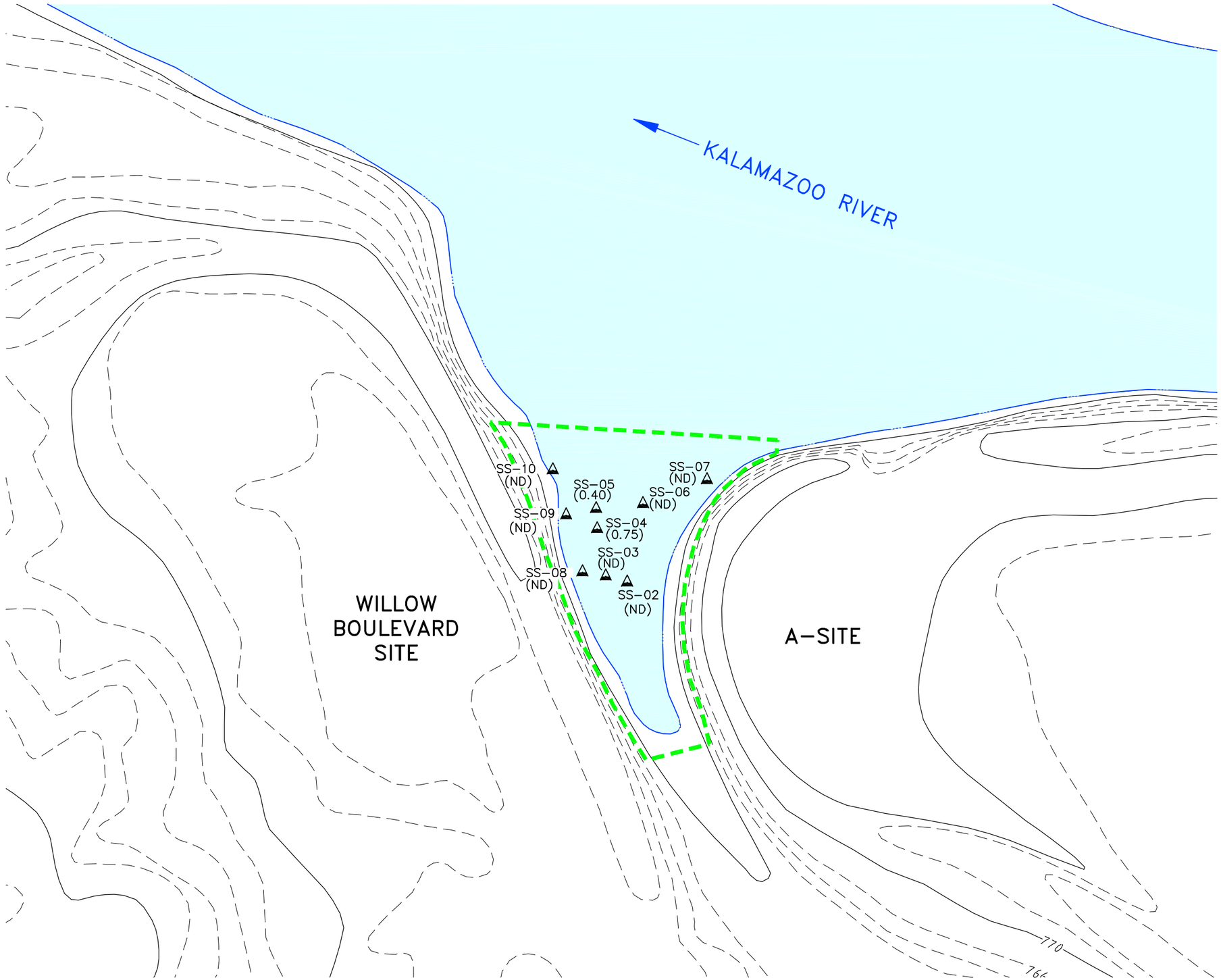
0 100' 200'
GRAPHIC SCALE

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

TOTAL PCB CONCENTRATIONS: AREA EAST OF DAVIS CREEK

FIGURE **19**

X: 64582X11.DWG
P: FIG-2-3
L: ON=*; OFF=REF
2/22/01 SYR-54-GMS KMD DJP
64581500/64581C05.DWG



LEGEND:

780	PRE-REMOVAL ACTION ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	APPROXIMATE LOCATION OF EXCAVATION ACTIVITIES
SS-06	APPROXIMATE LOCATION OF POST-EXCAVATION SOIL SAMPLE
(0.10)	PCB CONCENTRATION IN PARTS PER MILLION (ppm)
ND	NON-DETECT

NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. SAMPLE LOCATION SS-05 WAS INVESTIGATED ON 1/11/00; RESIDUALS WERE NOT ENCOUNTERED IN THIS AREA.
4. DATA REFLECT TOTAL PCB DERIVED FROM THE SUM OF INDIVIDUAL AROCLORS. AROCLOR-SPECIFIC RESULTS AND THEIR QUALIFIERS CAN BE FOUND IN TABLE 4-17.

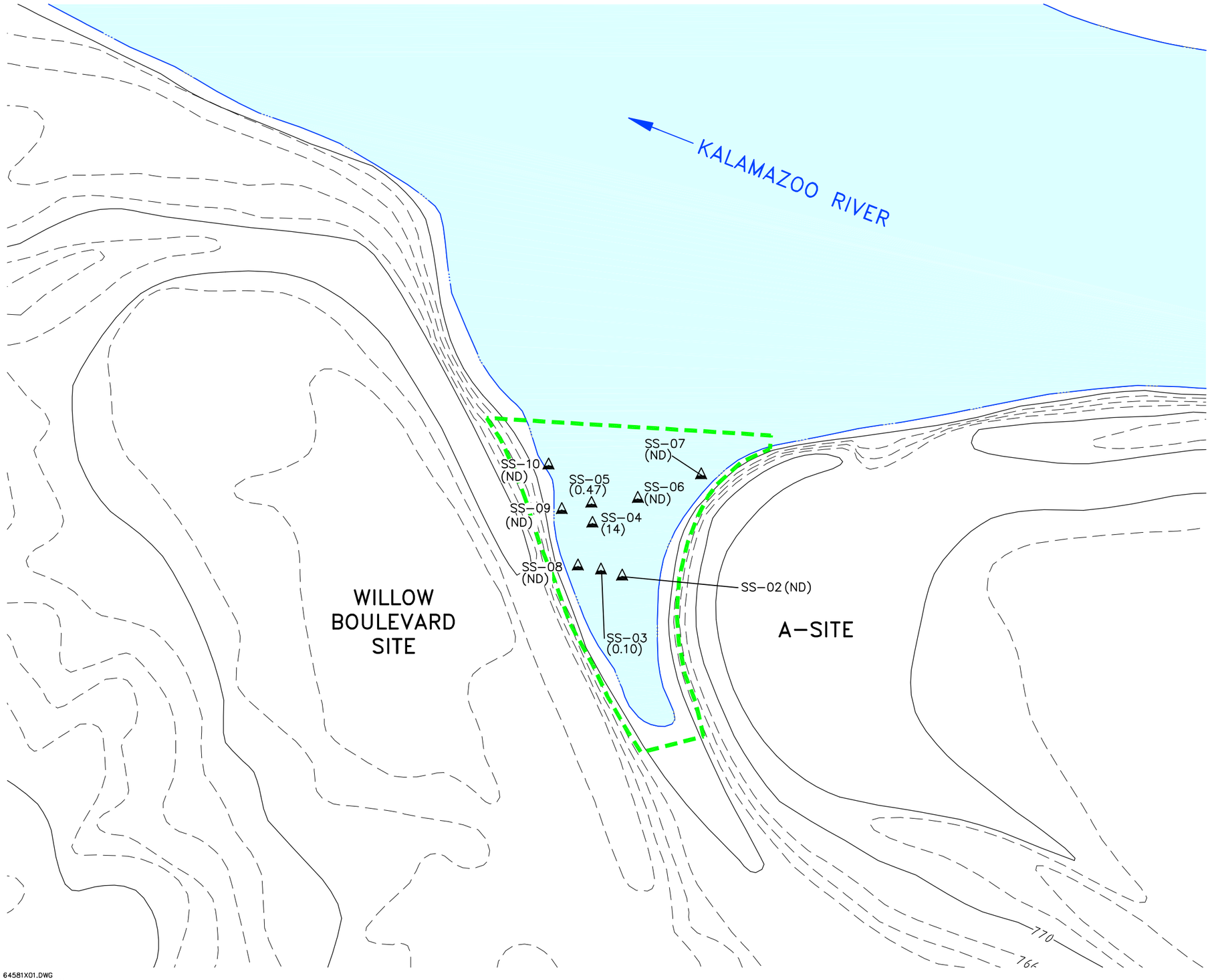
0 50' 100'

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

OLMSTEAD CREEK
BBL POST-EXCAVATION
SAMPLE LOCATIONS

FIGURE
20

X: 64581X01.DWG
L: ON=*, OFF=*REF*
P: STD-PCP/BL.PCP
2/22/01 SYR-54-GMS NES DJP
64582500/64582B05.DWG



LEGEND:

780	PRE-REMOVAL ACTION ELEVATION CONTOUR (NGVD 1929)
	EDGE OF WATER OR DRAINAGE CHANNEL
	APPROXIMATE LOCATION OF EXCAVATION ACTIVITIES
SS-06	APPROXIMATE LOCATION OF POST-EXCAVATION SOIL SAMPLE
(0.10)	PCB CONCENTRATION IN PARS PER MILLION (ppm)
ND	NON-DETECT

NOTES:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. ALL LOCATIONS ARE APPROXIMATE.
3. SAMPLE LOCATION SS-04 WAS INVESTIGATED ON 1/11/00; RESIDUALS WERE NOT ENCOUNTERED IN THIS AREA.
4. DATA REFLECT TOTAL PCB DERIVED FROM THE SUM OF INDIVIDUAL AROCLORS. AROCLOR-SPECIFIC RESULTS AND THEIR QUALIFIERS CAN BE FOUND IN TABLE 4-17A.

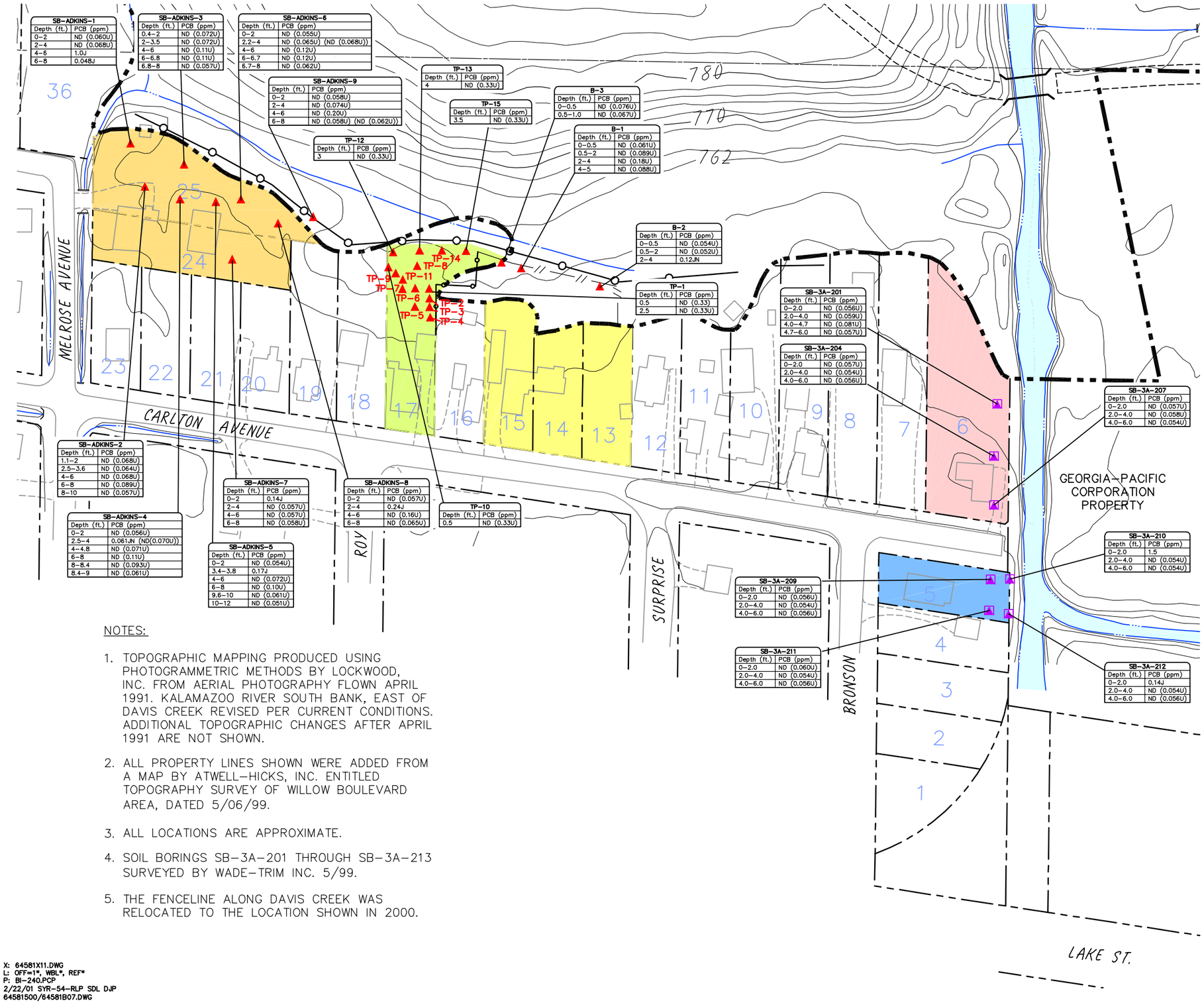
0 50' 100'

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

OLMSTEAD CREEK MDEQ POST-EXCAVATION SAMPLE LOCATIONS

FIGURE **20A**

X: 64581X01.DWG
L: ON=*, OFF=*REF*
P: STD-PCP/BL.PCP
2/22/01 SYR-54-GMS NES DJP
64582500/64582B06.DWG



SB-ADKINS-1	
Depth (ft.)	PCB (ppm)
0-2	ND (0.060U)
2-4	ND (0.068U)
4-6	1.0J
6-8	0.048J

SB-ADKINS-3	
Depth (ft.)	PCB (ppm)
0.4-2	ND (0.072U)
2-3.5	ND (0.072U)
4-6	ND (0.11U)
6-6.8	ND (0.11U)
6.8-8	ND (0.057U)

SB-ADKINS-6	
Depth (ft.)	PCB (ppm)
0-2	ND (0.055U)
2.2-4	ND (0.065U) (ND (0.068U))
4-6	ND (0.12U)
6-6.7	ND (0.12U)
6.7-8	ND (0.062U)

SB-ADKINS-9	
Depth (ft.)	PCB (ppm)
0-2	ND (0.058U)
2-4	ND (0.074U)
4-6	ND (0.20U)
6-8	ND (0.058U) (ND (0.062U))

TP-13	
Depth (ft.)	PCB (ppm)
4	ND (0.33U)

TP-15	
Depth (ft.)	PCB (ppm)
3.5	ND (0.33U)

TP-12	
Depth (ft.)	PCB (ppm)
3	ND (0.33U)

B-3	
Depth (ft.)	PCB (ppm)
0-0.5	ND (0.076U)
0.5-1.0	ND (0.067U)

B-1	
Depth (ft.)	PCB (ppm)
0-0.5	ND (0.061U)
0.5-2	ND (0.089U)
2-4	ND (0.18U)
4-5	ND (0.088U)

B-2	
Depth (ft.)	PCB (ppm)
0-0.5	ND (0.054U)
0.5-2	ND (0.052U)
2-4	0.12JN

TP-1	
Depth (ft.)	PCB (ppm)
0.5	ND (0.33)
2.5	ND (0.33U)

SB-3A-201	
Depth (ft.)	PCB (ppm)
0-2.0	ND (0.056U)
2.0-4.0	ND (0.059U)
4.0-4.7	ND (0.081U)
4.7-6.0	ND (0.057U)

SB-3A-204	
Depth (ft.)	PCB (ppm)
0-2.0	ND (0.057U)
2.0-4.0	ND (0.054U)
4.0-6.0	ND (0.056U)

SB-3A-207	
Depth (ft.)	PCB (ppm)
0-2.0	ND (0.057U)
2.0-4.0	ND (0.058U)
4.0-6.0	ND (0.054U)

SB-3A-210	
Depth (ft.)	PCB (ppm)
0-2.0	1.5
2.0-4.0	ND (0.054U)
4.0-6.0	ND (0.054U)

SB-3A-209	
Depth (ft.)	PCB (ppm)
0-2.0	ND (0.056U)
2.0-4.0	ND (0.054U)
4.0-6.0	ND (0.056U)

SB-3A-211	
Depth (ft.)	PCB (ppm)
0-2.0	ND (0.060U)
2.0-4.0	ND (0.054U)
4.0-6.0	ND (0.056U)

SB-3A-212	
Depth (ft.)	PCB (ppm)
0-2.0	0.14J
2.0-4.0	ND (0.054U)
4.0-6.0	ND (0.056U)

SB-ADKINS-2	
Depth (ft.)	PCB (ppm)
1.1-2	ND (0.068U)
2.5-3.6	ND (0.064U)
4-6	ND (0.068U)
6-8	ND (0.089U)
8-10	ND (0.057U)

SB-ADKINS-4	
Depth (ft.)	PCB (ppm)
0-2	ND (0.056U)
2.5-4	0.061JN (ND(0.070U))
4-4.8	ND (0.071U)
6-8	ND (0.11U)
8-8.4	ND (0.093U)
8.4-9	ND (0.061U)

SB-ADKINS-7	
Depth (ft.)	PCB (ppm)
0-2	0.14J
2-4	ND (0.057U)
4-6	ND (0.057U)
6-8	ND (0.058U)

SB-ADKINS-5	
Depth (ft.)	PCB (ppm)
0-2	ND (0.054U)
3.4-3.8	0.17J
4-6	ND (0.072U)
6-8	ND (0.10U)
9.6-10	ND (0.061U)
10-12	ND (0.051U)

SB-ADKINS-8	
Depth (ft.)	PCB (ppm)
0-2	ND (0.057U)
2-4	0.24J
4-6	ND (0.16U)
6-8	ND (0.065U)

TP-10	
Depth (ft.)	PCB (ppm)
0.5	ND (0.33U)

LEGEND

- 780 — ELEVATION CONTOUR (NGVD 1929)
- EDGE OF WATER OR DRAINAGE CHANNEL
- APPROXIMATE A-SITE BOUNDARY
- 40 — APPROXIMATE ADJACENT RESIDENTIAL PROPERTY LINES AND PARCEL NUMBER
- WOODEN FENCING
- CHAIN-LINK FENCING
- RESIDENTIAL SOIL BORING
- SOIL BORING (3/99)
- WADSWORTH PROPERTY
- SCOTT PROPERTY
- ADKINS PROPERTY
- WRIGHT PROPERTY
- BLOOMFIELD PROPERTY

0 100' 200'
GRAPHIC SCALE

NOTES:

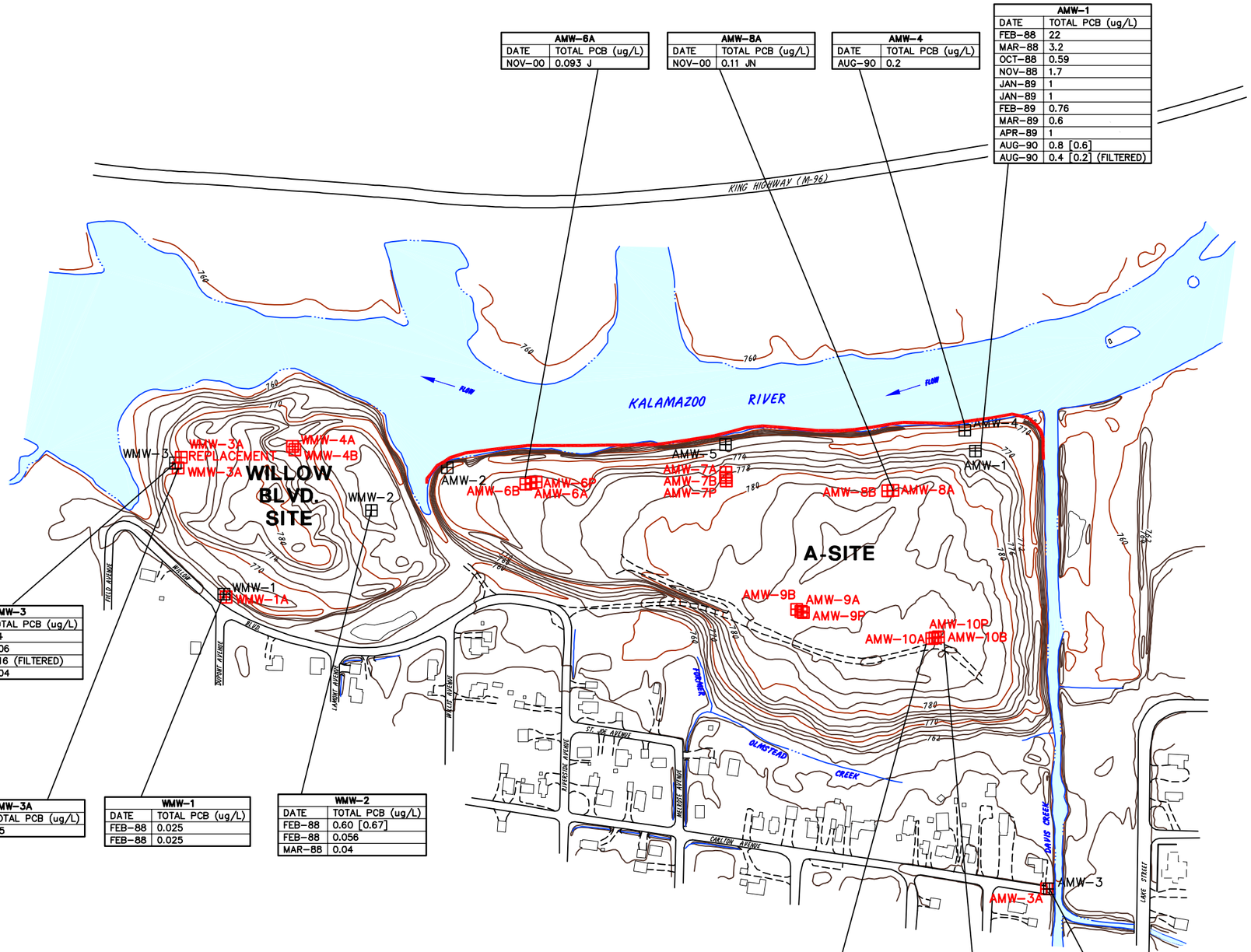
1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
2. ALL PROPERTY LINES SHOWN WERE ADDED FROM A MAP BY ATWELL-HICKS, INC. ENTITLED TOPOGRAPHY SURVEY OF WILLOW BOULEVARD AREA, DATED 5/06/99.
3. ALL LOCATIONS ARE APPROXIMATE.
4. SOIL BORINGS SB-3A-201 THROUGH SB-3A-213 SURVEYED BY WADE-TRIM INC. 5/99.
5. THE FENCELINE ALONG DAVIS CREEK WAS RELOCATED TO THE LOCATION SHOWN IN 2000.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

TOTAL PCB CONCENTRATIONS: RESIDENTIAL SAMPLE LOCATIONS

FIGURE **21**

X: 64581X11.DWG
L: OFF=1*, WBL*, REF*
P: BI-240.PCP
2/22/01 SYR-54-RLP SDL DJP
64581500/64581B07.DWG



AMW-6A	
DATE	TOTAL PCB (ug/L)
NOV-00	0.093 J

AMW-8A	
DATE	TOTAL PCB (ug/L)
NOV-00	0.11 JN

AMW-4	
DATE	TOTAL PCB (ug/L)
AUG-90	0.2

AMW-1	
DATE	TOTAL PCB (ug/L)
FEB-88	22
MAR-88	3.2
OCT-88	0.59
NOV-88	1.7
JAN-89	1
JAN-89	1
FEB-89	0.76
MAR-89	0.6
APR-89	1
AUG-90	0.8 [0.6]
AUG-90	0.4 [0.2] (FILTERED)

WMW-3	
DATE	TOTAL PCB (ug/L)
FEB-88	1.4
FEB-88	0.06
FEB-88	0.16 (FILTERED)
MAR-88	0.04

WMW-3A	
DATE	TOTAL PCB (ug/L)
OCT-93	1.5

WMW-1	
DATE	TOTAL PCB (ug/L)
FEB-88	0.025
FEB-88	0.025

WMW-2	
DATE	TOTAL PCB (ug/L)
FEB-88	0.60 [0.67]
FEB-88	0.056
MAR-88	0.04

AMW-10A	
DATE	TOTAL PCB (ug/L)
NOV-00	0.058 [0.056]

AMW-10B	
DATE	TOTAL PCB (ug/L)
NOV-00	0.028 JN

AMW-3A	
DATE	TOTAL PCB (ug/L)
NOV-00	0.069 JN

LEGEND

- AMW-4 — PRE-RI MONITORING WELL
- WMW-3 — MONITORING WELL OR CLUSTER INSTALLED IN 1993
- WMW-3A — REPLACEMENT MONITORING WELL INSTALLED IN 1996
- 780 — ELEVATION CONTOUR (NGVD 1929)
- EDGE OF WATER OR DRAINAGE CHANNEL
- UNPAVED ROAD/TRAIL
- SHEETPILE WALL

150' 0 300'
SCALE

NOTES:

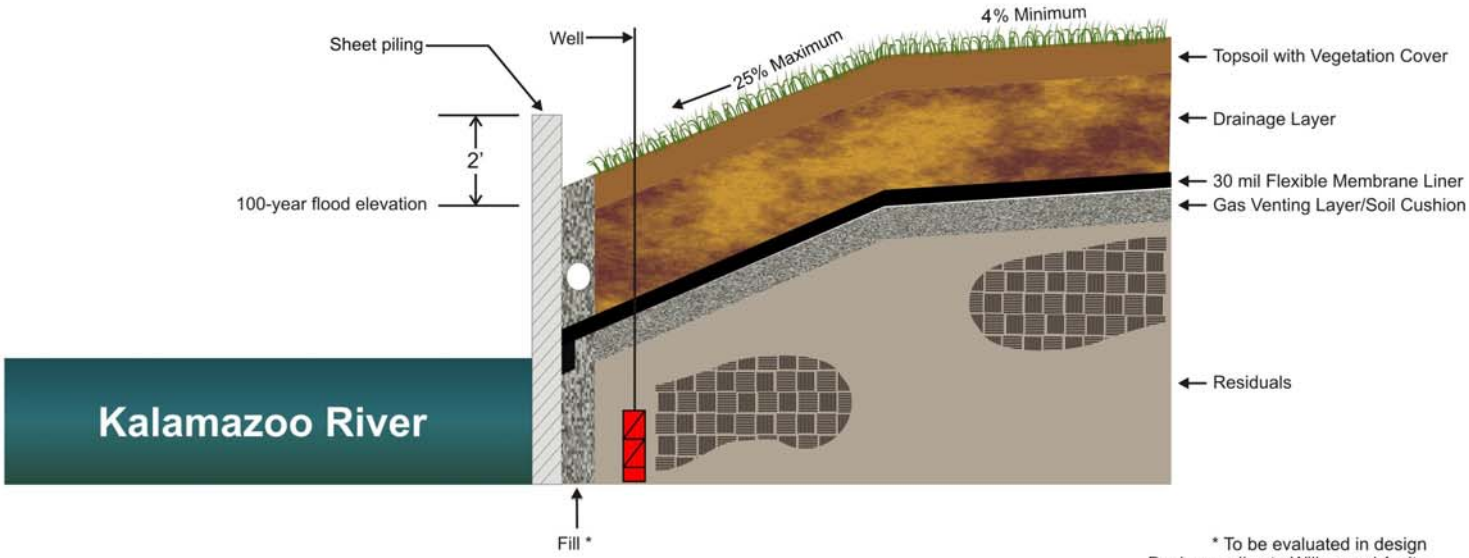
1. UNLESS OTHERWISE INDICATED ALL SAMPLE LOCATIONS SURVEYED BY WADE-TRIM INC. OCTOBER 1993 THROUGH AUGUST 1996. SAMPLES ARN-1 THROUGH ARN-5 AND WRN-1 THROUGH WRN-5 WERE SURVEYED BY BBL JULY 1993.
2. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.
3. ALL LOCATIONS ARE APPROXIMATE.
4. DATA REFLECT TOTAL PCB DERIVED FROM THE SUM OF INDIVIDUAL AROCLORS. AROCLOR SPECIFIC RESULTS AND THEIR QUALIFIERS CAN BE FOUND IN TABLE 4-13A; TABLE 3-14 IN TECHNICAL MEMORANDUM 9; AND TABLES 82 AND 90 IN THE DESCRIPTION OF THE CURRENT SITUATION.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

TOTAL PCB: GROUNDWATER DETECTIONS

FIGURE 22

X: 64582X02.DWG
L: ON=*, OFF=*REF*, N-PZ, N-RG, N-SB, N-SW
P: FIG-2-3
12/21/00 SYR-54-GMS JER
64581500/64581C04.DWG



* To be evaluated in design
Design applies to Willow and A-site

Sealing sheetpile with grout will be evaluated in design

Cross Section

NOT TO SCALE

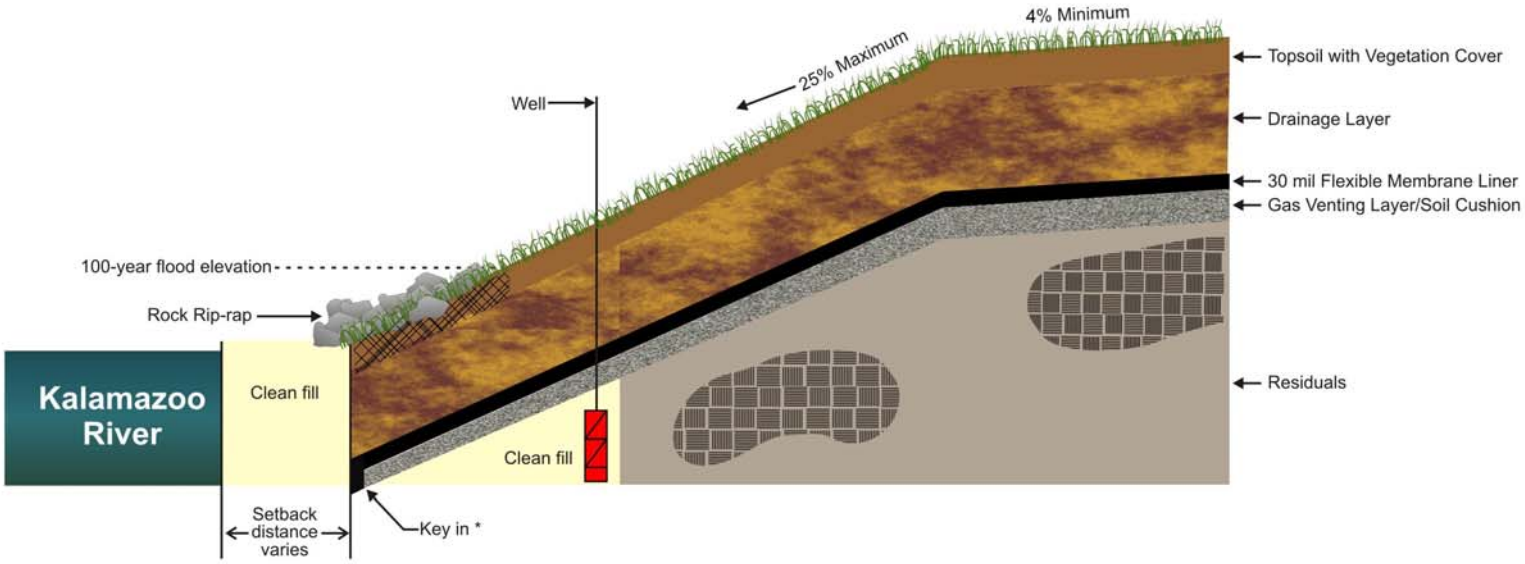
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

Alternative 2A Cross-Section

Consolidation with New Sheet Piling

FIGURE
23a

12/00 SYR-D54-DJH LAS
64581500/64581g01.CDR



* To be evaluated in design
Design applies to Willow and A-site

Cross Section

NOT TO SCALE

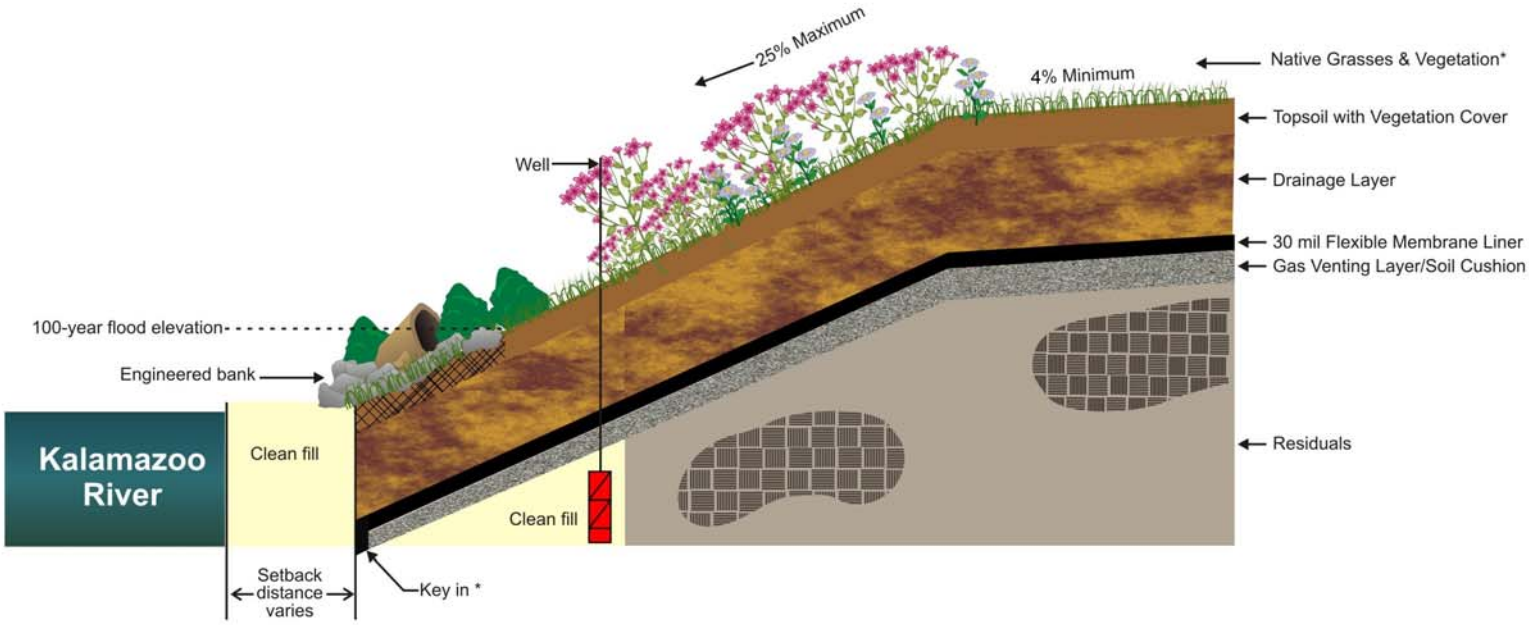
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

Alternative 2B Cross-Section

Consolidation/Containment with Setback

FIGURE 23b

12/00 SYR-D54-DJH LAS
64581500/64581g01.CDR



* To be evaluated in design
Design applies to Willow

Cross Section

NOT TO SCALE

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

Alternative 2C Cross-Section

Consolidation/Containment with Setback and Eco-friendly Options

FIGURE 23c

12/00 SYR-D54-DJH LAS
64581500/64581g01.CDR

LEGEND

POSSIBLE STAGING AREA
FOR ALTERNATIVE 3

0 100' 200'
SCALE

NOTE:

1. TOPOGRAPHIC MAPPING PRODUCED USING PHOTOGRAMMETRIC METHODS BY LOCKWOOD, INC. FROM AERIAL PHOTOGRAPHY FLOWN APRIL 1991. KALAMAZOO RIVER SOUTH BANK, EAST OF DAVIS CREEK REVISED PER CURRENT CONDITIONS. ADDITIONAL TOPOGRAPHIC CHANGES AFTER APRIL 1991 ARE NOT SHOWN.

KALAMAZOO RIVER STUDY GROUP
ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
REMEDIAL INVESTIGATION/FOCUSED FEASIBILITY STUDY
WILLOW BOULEVARD/A-SITE OU

POSSIBLE STAGING AREA

FIGURE
24

X: 64581X11.DWG
L:ON=*,OFF=REF,*518*,*FIELD*
P: STD/AP
02/22/01 54-RLP SDL DJP
64581640/64581G07.DWG

Photo 1: Aerial view of the Willow Boulevard/A-site, looking west (downstream). The bottom ¾ of the picture is the A-site. The interim sand cover on the Willow Blvd portion can be seen at the top of the photo. CDM, April, 2001

Photo 2: Looking north at the western edge of the Willow Blvd portion of the OU. The slope was vegetated to provide erosion control. The current placement of the fence allows passage of trespassers. CDM, 2001.

Photo 3: Black geofabric on the north bank of the Willow Blvd. portion of the OU. The fabric has parted, exposing gray paper waste. Residual material is visible in the river. CDM, 2001.

Photo 4: Sheetpile along northern edge of the A-site portion of the OU. CDM, 2001.

Photo 5: At the A-site, evidence of groundwater seepage through a sheetpile seam. (CDM, 2000).

Photo 6: A-site sheetpile. Moisture indicates groundwater seepage. (CDM, 2001).

Photo 7: Holes in sheetpile at A-site. Moisture indicates groundwater seepage (CDM, 2000).

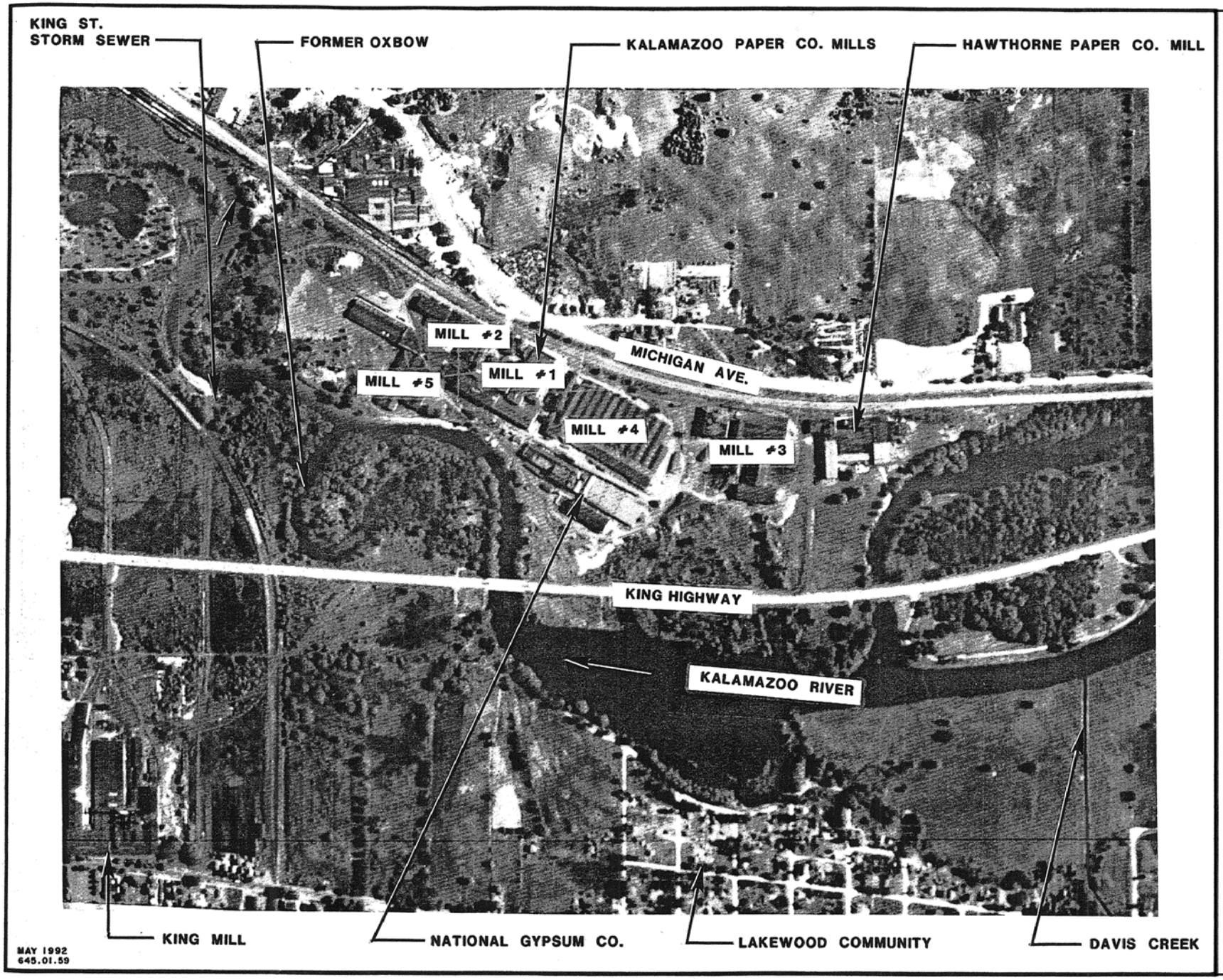
Photo 8: Paper residuals exposed at the surface of the A-site portion of the OU. (CDM, 2003).

Photo 9: Residuals exposed at the surface on east side of A-site. (CDM, 2003).

Photo 10: Residuals exposed at surface, Area East of Davis Creek (CDM 2001).

Photo 11: Area east of Davis Creek, partially inundated with 2 inches of water (CDM, July, 2003).

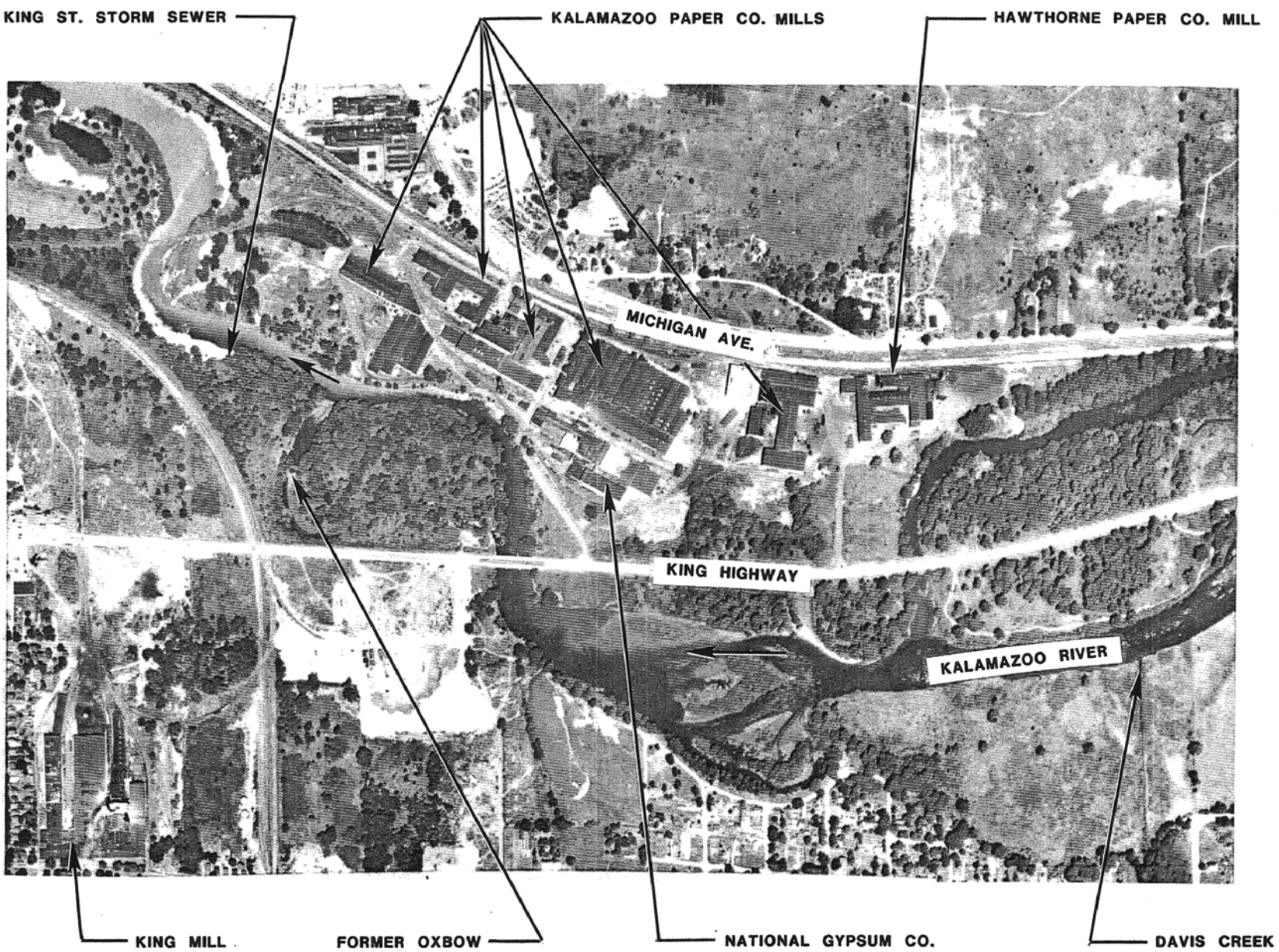
Photo 12: Former Olmstead Creek, inundated with surface water. (CDM, 2001).



AERIAL PHOTO # 1

ALLIED PAPER INC. / PORTAGE CREEK / KALAMAZOO RIVER SUPERFUND SITE

1938 AERIAL PHOTOGRAPH
FORMER KING MILL, GEORGIA-PACIFIC CORP.
KALAMAZOO MILL, KING HIGHWAY LANDFILL
WILLOW BOULEVARD SITE, A-SITE

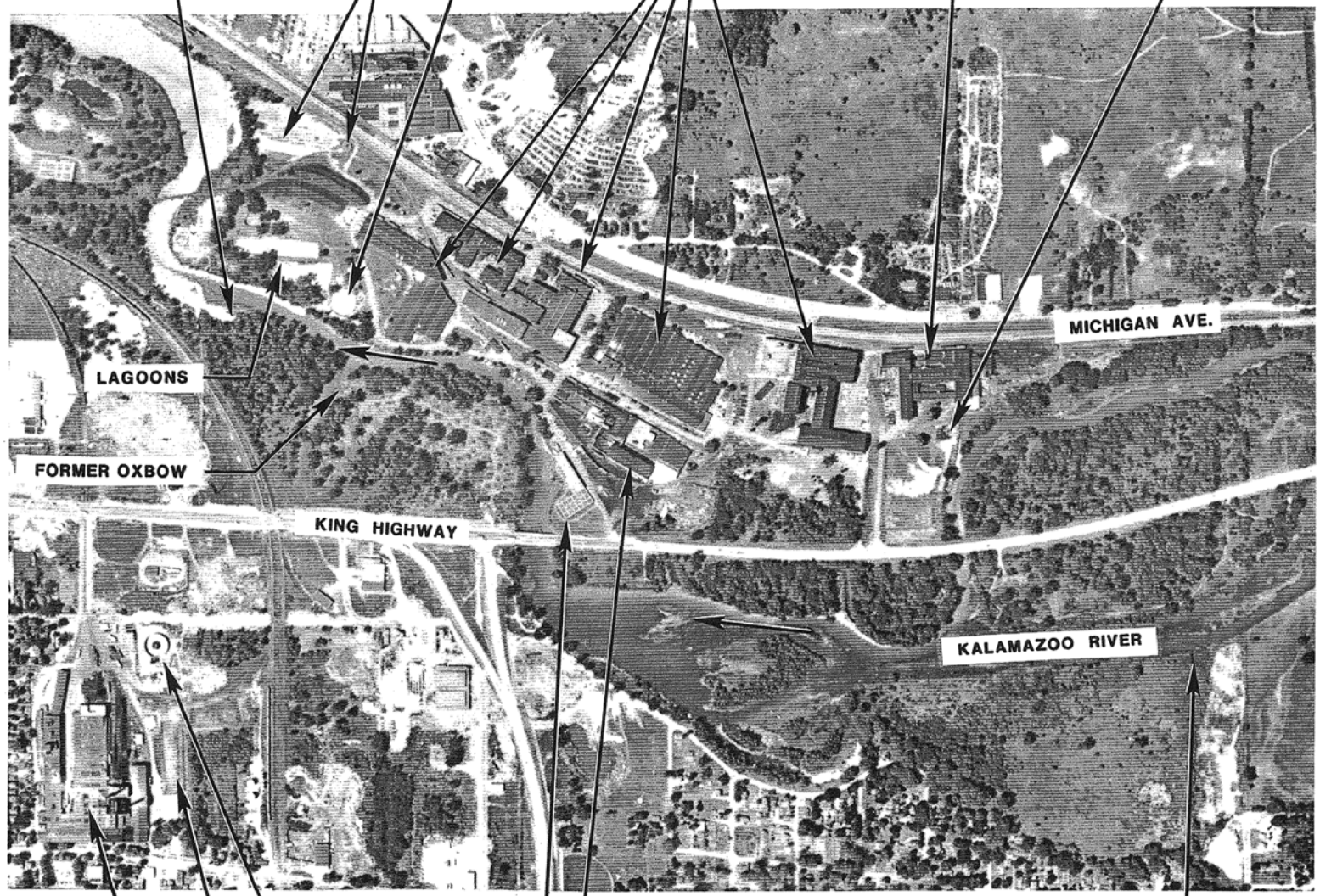


MAY 1992
645.01.59

AERIAL PHOTO #2

ALLIED PAPER INC. / PORTAGE CREEK / KALAMAZOO RIVER SUPERFUND SITE

1950 AERIAL PHOTOGRAPH
FORMER KING MILL, GEORGIA-PACIFIC CORP.
KALAMAZOO MILL, KING HIGHWAY LANDFILL
WILLOW BOULEVARD SITE, A-SITE



MAY 1992
645.01.59

AERIAL PHOTO # 3

ALLIED PAPER INC. / PORTAGE CREEK /
KALAMAZOO RIVER SUPERFUND SITE

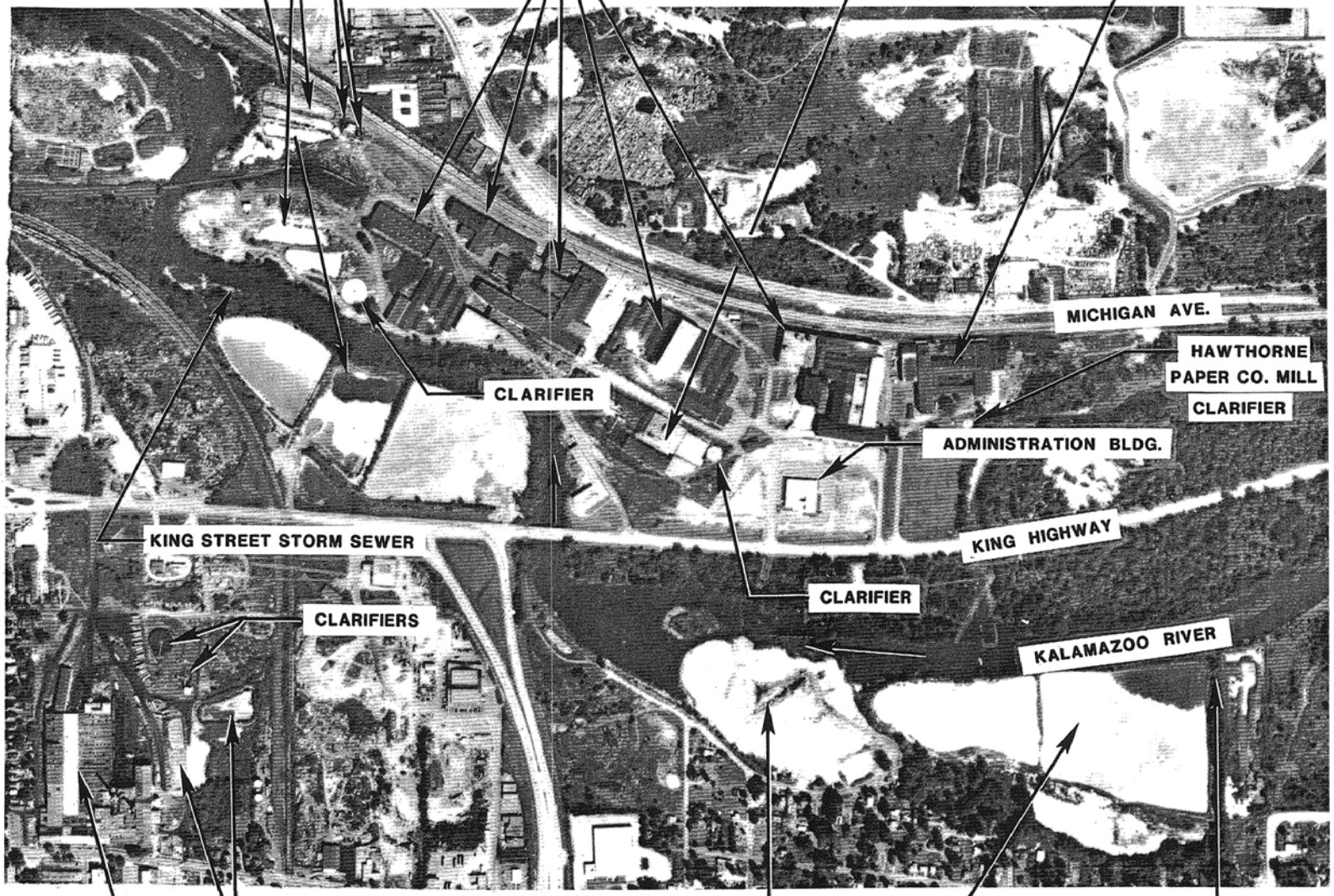
1955 AERIAL PHOTOGRAPH
FORMER KING MILL, GEORGIA–PACIFIC CORP.
KALAMAZOO MILL,KING HIGHWAY LANDFILL
WILLOW BOULEVARD SITE, A-SITE

MAY 1992
645.01.59

AERIAL PHOTO #4

ALLIED PAPER INC. / PORTAGE CREEK /
KALAMAZOO RIVER SUPERFUND SITE

1960 AERIAL PHOTOGRAPH
FORMER KING MILL, GEORGIA-PACIFIC CORP.
KALAMAZOO MILL, KING HIGHWAY LANDFILL
WILLOW BOULEVARD SITE, A-SITE

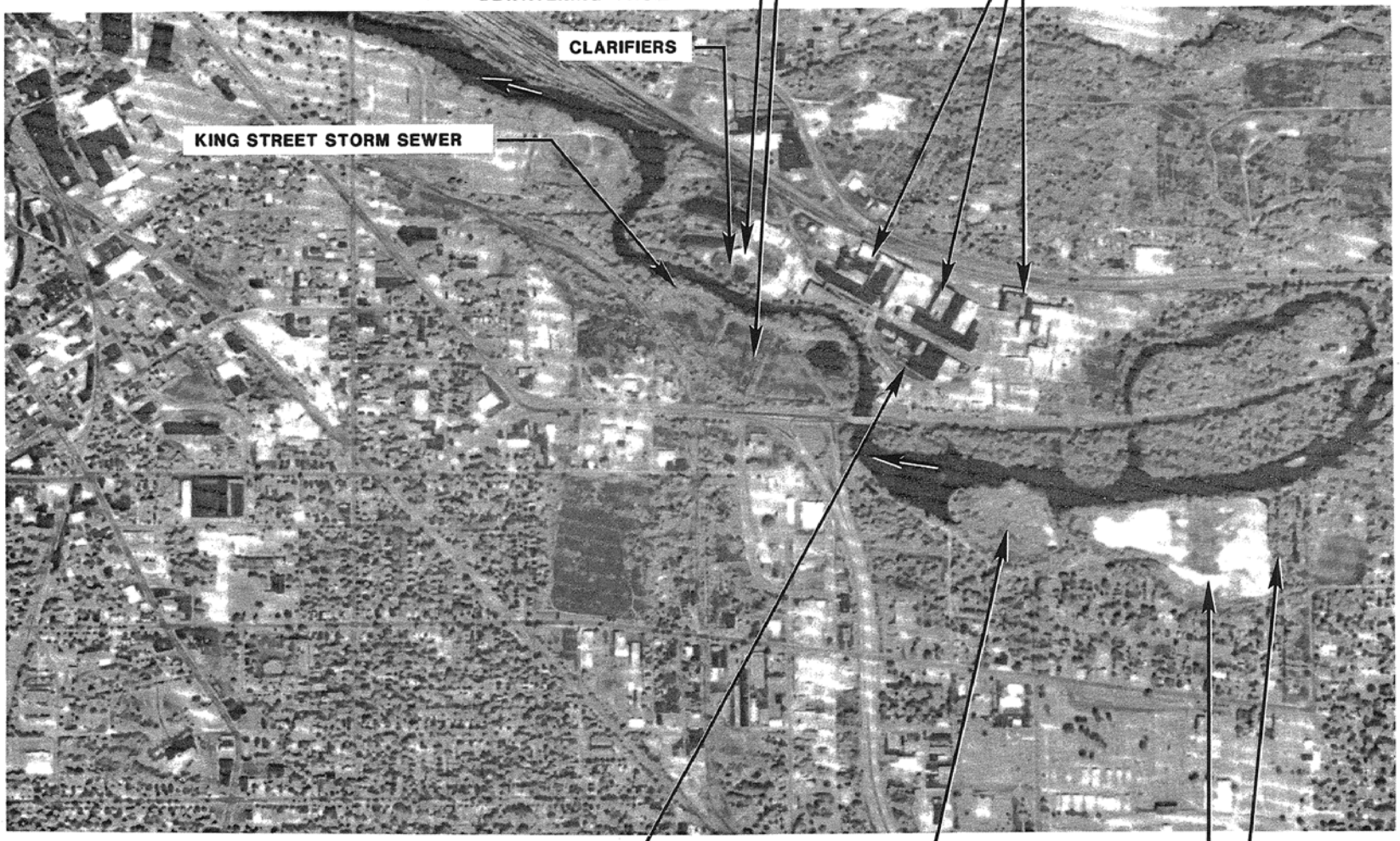


MAY 1992
645.01.59

AERIAL PHOTO # 5

ALLIED PAPER INC. / PORTAGE CREEK / KALAMAZOO RIVER SUPERFUND SITE

1967 AERIAL PHOTOGRAPH
FORMER KING MILL, GEORGIA-PACIFIC CORP.
KALAMAZOO MILL, KING HIGHWAY LANDFILL
WILLOW BOULEVARD SITE, A-SITE

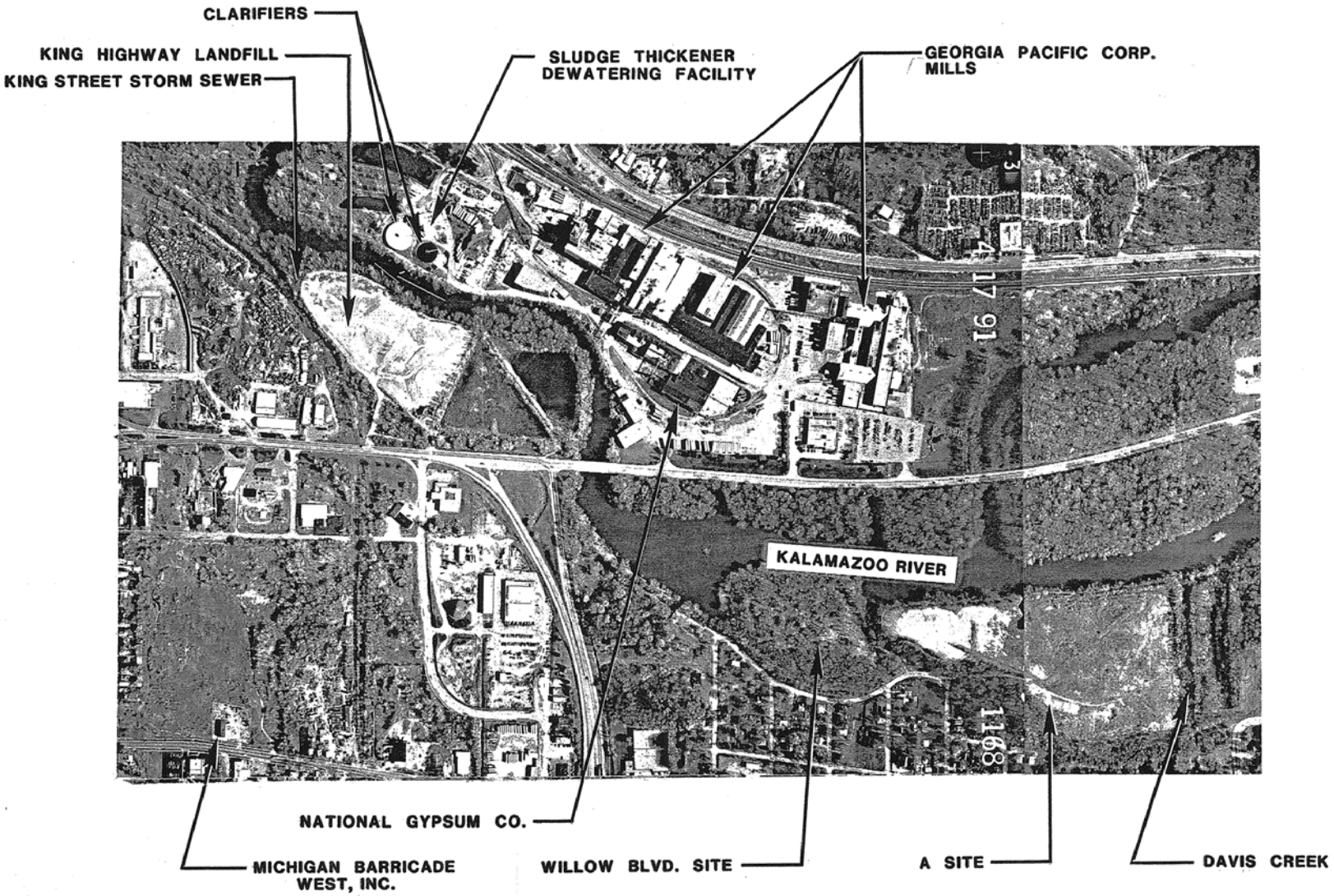


AERIAL PHOTO #6

ALLIED PAPER INC. / PORTAGE CREEK / KALAMAZOO RIVER SUPERFUND SITE

1986 AERIAL PHOTOGRAPH
FORMER KING MILL, GEORGIA-PACIFIC CORP.
KALAMAZOO MILL, KING HIGHWAY LANDFILL
WILLOW BOULEVARD SITE, A-SITE

MAY 1992
645.01.59



AERIAL PHOTO # 7

ALLIED PAPER INC. / PORTAGE CREEK / KALAMAZOO RIVER SUPERFUND SITE

1991 AERIAL PHOTOGRAPH
FORMER KING MILL, GEORGIA-PACIFIC CORP.
KALAMAZOO MILL, KING HIGHWAY LANDFILL
WILLOW BOULEVARD SITE, A-SITE

MAY 1992
645.01.59