UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

September 29, 2015

REPLY TO THE ATTENTION OF:
SR-6J

Ms. Emily Jennings
Staff Geologist
CH2M Hill
135 South 84th Street, Suite 400
Milwaukee, WI 53214

RE: Approval of Amcast RI
Amcast Industrial Site, Cedarburg, Wisconsin

Dear Ms. Jennings:

The United States Environmental Protection Agency (EPA) reviewed the final Amcast Remedial Investigation (RI) sent via e-mail on May 15, 2015. EPA received the modified documents from CH2M Hill and the modifications were correctly incorporated into the RI, therefore EPA approves the Amcast RI.

Please submit three (3) CD copies to EPA and one (1) hard copy and two (2) CD copies to WDNR of the final Amcast RI. In addition, please make sure all the appendices are included in the final version. If you have any questions or would like to discuss things further, please contact me at 312-886-1999.

Sincerely,

Scott Hansen

Scott K. Hansen
Remedial Project Manager

cc: Margaret Brunette, WDNR

02-46-000795

TRANSMITTAL

TO: Wisconsin Department of Natural Resources
2300 N. Martin Luther King Jr. Dr.
Milwaukee, WI 53212

FROM: Emily Jennings
135 South 84th Street; Suite 400
Milwaukee, WI 53214

ATTN: Margaret Brunette

DATE: October 26, 2015

RE: Amcast Industrial Site
Final Remedial Investigation Report
WA No. 110-RICO-B5Kw/Contract No. EP-S5-06-01

We Are Sending You:

☒ Attached
☒ Documents
☐ Drawings
☐ Specifications
☐ Copies
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Method of Shipment:

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☐ Under separate cover via

| Quantity | Description |
|---|---|
| 1 | Final Remedial Investigation Report, Amcast Industrial Site, Cedarburg, Wisconsin |
| 2 | Final Remedial Investigation Report, Amcast Industrial Site, Cedarburg, Wisconsin (on CD-ROM) |
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# REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release
or Threatened Release of Hazardous Substances in Region 5

**FINAL REMEDIAL INVESTIGATION REPORT**

Amcast Industrial Site
Remedial Investigation/Feasibility Study
Cedarburg, Wisconsin



WA No. 110-RICO-B5KW/Contract No. EP-S5-06-01

May 2015

PREPARED FOR

U.S. Environmental Protection Agency

PREPARED BY

**CH2M HILL**
Critigen, LLC

FOR OFFICIAL USE ONLY

*Final Remedial Investigation Report*

# Amcast Industrial Site
# Cedarburg, Wisconsin

## Remedial Investigation/Feasibility Study

## WA No. 110-RICO-B5KW/Contract No. EP-S5-06-01

Prepared for

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

May 2015

CH2MHILL®

# Contents

**Appendixes (On Disk)**



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# Acronyms and Abbreviations

| | |
|---|---|
| amsl | above mean sea level |
| AST | aboveground storage tank |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| BERA | baseline ecological risk assessment |
| bgs | below ground surface |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| COC | contaminant of concern |
| COPC | contaminant of potential concern |
| CSM | conceptual site model |
| DEHP | bis(2-ethylhexyl) phthalate |
| DRO | diesel range organics |
| E&K, Inc. | E&K Hazardous Waste Services, Inc. |
| ELCR | excess lifetime cancer risk |
| ENSR | ENSR Corporation |
| EqP | equilibrium partitioning |
| ERA | ecological risk assessment |
| ES | enforcement standard |
| ESA | environmental site assessment |
| ESV | ecological screening value |
| °F | degrees Fahrenheit |
| GRO | gasoline range organics |
| HHRA | human health risk assessment |
| HI | hazard index |
| HMW | high molecular weight |
| HQ | hazard quotient |
| $K_d$ | distribution coefficient |
| $K_d$s | distribution coefficient |
| $K_{oc}$ | soil organic carbon/water partitioning coefficient |
| $K_{ow}$ | octanol-water partitioning coefficient |
| LMW | low molecular weight |
| LOAEL | lowest observed adverse effect level |
| MATC | maximum acceptable toxicant concentration |
| MCL | maximum contaminant level |

| | |
|---|---|
| μg/kg | micrograms per kilogram |
| μg/L | micrograms per liter |
| mg/kg | milligrams per kilogram |
| NR | Natural Resources |
| PAH | polynuclear aromatic hydrocarbons |
| PCB | polychlorinated biphenyl |
| PCP | pentachlorophenol |
| ppm | parts per million |
| QAPP | quality assurance project plan |
| ORP | oxidation reduction potential |
| R | retardation coefficient |
| RI | remedial investigation |
| RSL | Regional Screening Level |
| SERA | screening ecological risk assessment |
| Sigma | Sigma Environmental Services, Inc. |
| SL | screening level |
| SLC | screening level concentration |
| SVOC | semivolatile organic compound |
| TOC | total organic carbon |
| TPH | total petroleum organics |
| TRPH | total recoverable petroleum hydrocarbon |
| UCL | upper confidence limit |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| UST | underground storage tank |
| VISL | vapor intrusion screening level |
| VOC | volatile organic compound |
| WA | work assignment |
| WDNR | Wisconsin Department of Natural Resources |
| WGNHS | University of Wisconsin-Extension Geological and Natural History Survey |

SECTION 1

# Introduction

This report presents the results of the remedial investigation (RI) activities completed at the Amcast Industrial Site North and South facilities, the Zeunert Park/Quarry Pond, Wilshire Pond, and the adjacent residential neighborhood in Cedarburg, Wisconsin. The work was performed for the U.S. Environmental Protection Agency (USEPA) in accordance with the statement of work for Work Assignment (WA) No. 110-RICO-B5KW. The RI work was conducted consistent with the *Amcast Industrial Site Work Plan* (CH2M HILL 2009) and the *Remedial Investigation/Feasibility Study Amcast Industrial Site Quality Assurance Project Plan* (CH2M HILL 2011). The document is composed of the following sections:

- Section 1 provides a general site description, history and operations, previous investigations, data collection objectives, and an overview of the RI field activities.
- Section 2 describes the physical setting of the site, including the surrounding land use, meteorology, geology, hydrogeology, hydrology, and ecological characteristics.
- Section 3 summarizes the chemical setting, describing the nature and extent of contamination found in the sediment, soil, groundwater, surface water, and fish samples.
- Section 4 provides a summary of general physical and chemical fate and transport properties, along with properties for chemicals specifically detected at the Amcast Industrial Site.
- Section 5 is the draft human health risk assessment (HHRA) summary discussion.
- Section 6 is the summary of the findings of the draft ecological risk assessment (ERA), not yet reviewed by USEPA at the time of this interim draft RI report.
- Section 7 summarizes the findings of the remedial investigation.
- Section 8 provides the references cited in this document.
- Appendix A contains the technical memorandums summarizing the 2011 RI field activities (on CD).
- Appendix B contains data usability evaluations (on CD).
- Appendix C contains the summary analytical data tables (on CD).
- Appendix D contains the draft HHRA.
- Appendix E contains the draft ERA (Steps 1, 2, and 3A).

## 1.1 Site Description

The Amcast Industrial Site is in Section 35, Township 10 North, Range 21 East, in the city of Cedarburg, Ozaukee County, Wisconsin. The plant is located on the south side of Cedarburg at N39 W5789 Hamilton Road, with portions of the property located on the north and south sides of Hamilton Road (Figure 1-1) and west of Cedar Creek. The Amcast Industrial Site includes the Amcast North and South properties, the residential properties adjacent to Amcast North, the stormwater retention basin (referred to as Wilshire Pond), Quarry Pond at Herman A. Zeunert Park, and storm sewers. Individual portions of the Amcast Industrial Site are shown in Figures 1-2 through 1-6.

The property north of Hamilton Road (Amcast North; Figure 1-2) is the location of the most recent aluminum die-casting operations. The property is fenced and consists of the former manufacturing plant building, paved asphalt area, and grassy corridors along the sides of the building. Amcast North is bounded on the northwest by the railroad, on the southwest by Hamilton Road, and on the northeast and southeast by residential properties. The residential yards adjacent to Amcast North extend northeast to Wilshire Drive, southeast to Park Lane, and southwest to Hamilton Road (Figure 1-2). Wilshire Pond (Figure 1-4) is located southeast of Amcast North and the residential area.

The property south of Hamilton Road (Amcast South, Figure 1-3) is the location of the original foundry (now demolished) and includes an office building, Quonset storage building, an asphalt parking lot on the northern half of the property, and a former disposal area on the southern half of the property that contains buried waste. Amcast South is bounded on the north by Hamilton Road, on the east by the railroad, on the south by the City of Cedarburg Department of Public Works, and on the west by residential properties. Zeunert Park and the Quarry Pond are located across the railroad tracks and southeast of the former manufacturing operations at Amcast South (Figure 1-5).

The storm sewer system associated with the Amcast Industrial Site is shown in Figure 1-6. Storm sewers from the Amcast North property are in connection with the Wilshire Pond stormwater retention basin, which drains to Cedar Creek. Storm sewers from the Amcast South property are in connection with Quarry Pond at Zeunert Park.

# 1.2 History and Operations

## 1.2.1 Amcast South

The Amcast South property is the location of the former Meta-Mold Aluminum Company, an aluminum die-cast facility that began operating as early as 1937, as evidenced by the presence of the foundry building in a 1937 aerial photograph. Dayton Malleable Iron, Inc., acquired shares of the Meta-Mold Aluminum Company in 1955, which, in turn, became a division of Dayton Malleable in 1973. In 1993, Dayton Malleable changed its name to Amcast Industrial Corporation. The original foundry facility was located east of the present-day office building on Amcast South, and was demolished sometime between 1975 and 1980 based on aerial photography (Geraghty & Miller 1994).

Previous reports indicate that there were historically five aboveground storage tanks (ASTs) located to the south-southeast of the Quonset Building on Amcast South. The ASTs were reportedly used for the storage and distribution of fuel oil for heating the aluminum casting facilities on the Amcast South and North properties (Geraghty & Miller 1994). Based on historical aerial photographs, the ASTs were removed from the site between April 1980 and April 1985. Foth & Van Dyke (2003) suggest that only two ASTs were present onsite based on aerial photographs from 1967, 1970, 1975, and 1980.

A Phase I environmental site assessment (ESA) conducted by Sigma Environmental Services, Inc. (Sigma) in 2001 for the Amcast North and South properties reported that a 14,000-gallon underground storage tank (UST) was also located on Amcast South. The UST was reported to have been abandoned in place by filling with an inert material (sand/gravel/slurry). Personnel interviewed during the Phase I ESA could not identify the exact location of the UST.

Historical aerial photographs and the 1959 U.S. Geological Survey (USGS) topographic Cedarburg quadrangle indicate that the area on the southern half of the property was depressed in elevation by at least 5 to 10 feet from the surrounding land area (Sigma 2001) and was historically used for agriculture. The low-lying area, herein referred to as the former disposal area, received material from foundry casting operations and material from the City of Cedarburg through the 1970s (Geraghty & Miller 1994). The fill materials encountered during previous investigations were reported to include silt and sand with variable amounts of gravel, debris such as brick, metal, wood, concrete, slag, asphalt, a "white powdery substance," and visible staining and odors. The Phase I report prepared by Sigma described the placed material (from personnel interviews and notes) as including debris from previous site structures, general office and/or factory refuse (such as, paper and wood), and scrap metals. The disposal area may also have received spent oils such as hydraulic fluids. Spent hydraulic fluids were also reportedly applied to the former gravel parking lot for dust control. The parking lot is now paved with asphalt, and the site is vacant. The City of Cedarburg maintains the grassy areas during the growing season.

### 1.2.2 Amcast North

It is unknown when the manufacturing operations began at the Amcast North property; however, a portion of the manufacturing building is present on a 1963 aerial photograph. The manufacturing building was constructed in phases because the company required additional space. The northernmost addition to the manufacturing building included a partial basement (Figure 1-2) and was built in the 1970s (Sigma 2001).

Amcast Industrial Corporation was a former manufacturer of aluminum castings primarily for the automotive industry. The aluminum die casting process occurring at Amcast North in 2001 was reported to include the aluminum ingot being transported to the site and stored temporarily before being introduced into one of several heating furnaces. After melting, the aluminum was transferred into a holding furnace that metered aluminum into individuals dies. Once the die was complete, the material was cooled by air and/or water and transferred into an oven to be tempered. The part was then heat-treated, inspected, and shipped offsite for distribution to customers. Dies were reused by entering a blast booth that used plastic media to remove old coating from the die. The die was then heated and re-coated (Sigma 2001).

Three ASTs were reportedly present on the Amcast North property during 2001 (Sigma 2001). A propane AST was located adjacent to the railroad on the northwestern portion of Amcast North, and an AST containing liquid nitrogen was located near the partial basement. A 10,000-gallon AST was also reported at the southwestern portion of the northern facility that was used to collect contact, process, and other (oily) waters. The tank was emptied as needed and handled as a "nonhazardous special waste." Regulated wastewater was pumped from the facility and stored in the AST for disposal. Some of the drains and sumps in the manufacturing plant were also reportedly routed to this AST. No ASTs were observed on the site grounds during 2011 field activities.

The 2001 ESA also reported that Amcast Industrial Corporation had two bermed areas in the basement for storage of drummed liquid products. Glycol and water tanks associated with the aluminum casting process were stored in one bermed area, while petroleum and other liquid products were stored in a separate bermed area. The following chemicals were reportedly stored in secondary containment on the property in 2001: glycol and petroleum-based hydraulic fluids, petroleum-based die inspection fluid, oil- and vegetable-based cutting fluids, Stoddard Solvent, and mineral spirits and/or Naphtha. A detailed history of operations at the facility prior to 2001 is not available.

### 1.2.3 History of Polychlorinated Biphenyl Use and Detections

Previous reports summarizing the Wisconsin Department of Natural Resources (WDNR) records from 1990 indicated that specific products used onsite included Pydraul 312, Pydraul 312A, Pydraul 312C, and Amitron cutting fluid. A letter from Monsanto Company to Amcast Industrial Corporation's former legal counsel dated July 13, 1990, indicates sales of 23,000 pounds of polychlorinated biphenyl (PCB)-containing Pydraul 312 to the facility between 1966 and 1971. Pydraul 312 contained PCB Aroclor 1242 in a concentration of 47 to 48 percent. No sale of the material was documented after 1971.

Personnel interviewed for the Phase I ESA also indicated that PCB-based cutting fluids had historically been used onsite (Sigma 2001). Some of the material was reported to have been used to oil the roads on the property to reduce dust (Foth & Van Dyke 2003).

The summary of WDNR's project files regarding the PCB detections and the elimination of PCBs from the facility reported that in 1974, WDNR notified Amcast (Dayton Malleable, Inc.) that Aroclor 1248 was found in a storm sewer manhole (location not specified) on the Amcast Industrial Site. WDNR requested that Amcast (Dayton Malleable) discontinue use of PCB-containing oils and determine the path of hydraulic fluid to the storm sewer. Correspondence files indicated that efforts to remove PCB-containing oils from the machine system were completed by 1976, installation of an oil/water separator and floor drain modifications were completed by 1978, discharges to the storm sewer were eliminated by 1980, cooling water from the oil/water separator had been rerouted to discharge to the sanitary sewer by 1986, and effluent was within permitted limits per a 1986 compliance report. In addition, a letter from the City of

Cedarburg Light and Water Department to WDNR dated July 21, 1989, reported that transformers in Cedarburg had been refilled with non-PCB oils. A more detailed description of the WDNR project files reviewed by Foth & Van Dyke is presented in the *Preliminary Site Characterization Report* (Foth & Van Dyke 2004a).

Despite efforts to eliminate the presence and use of PCBs onsite, sample results from previous investigations indicate detectable levels of PCBs in storm sewers on the Amcast North and South properties. In addition, Sigma's 2001 ESA report noted records from the Wisconsin Spills database of cooling water and "contact water" (unspecified types or contents) spilled to surface waters and/or the storm sewer as reported to WDNR in 1998.

### 1.2.4 Recent Status of Operations

In February 2003, Amcast Industrial Corporation signed an Administrative Order with USEPA to conduct the RI. In April 2003, Amcast Industrial Corporation's consultant (Foth & Van Dyke) prepared and submitted an RI work plan to USEPA (Foth & Van Dyke 2003). The work plan was approved by USEPA on July 11, 2003. Some of the RI activities were completed in 2003 and 2004, before Amcast Industrial Corporation filed for bankruptcy under Chapter 11 in November 2004. Amcast Industrial Corporation operated until December 2005, when it filed for bankruptcy a second time under a Chapter 11 plan of liquidation. In April 2009, USEPA proposed the Amcast Industrial Site for the National Priorities List, and it was finalized as a National Priorities List site on September 23, 2009 (Federal Docket Management System Docket ID: EPA-HQ-SFUND-2009-0073). The facility is now closed, and the site is vacant. The building remaining on Amcast North is locked and boarded up, and is not being maintained, as evidenced by the large hole in the roof.

## 1.3 Previous Investigations

Amcast and WDNR have conducted multiple environmental investigations at and near the Amcast Industrial Site. A large body of geologic, hydrogeologic, hydrologic, and chemical distribution information was developed during the activities. The information from the previous environmental investigations is summarized in the following subsections.

### 1.3.1 1990—E&K Hazardous Waste Services, Inc., Hazardous Waste Services South Pond Investigation

E&K Hazardous Waste Services, Inc. (E&K, Inc.) completed an investigation of a former gravel parking area on the Amcast South property during November 1990. The following were the objectives of the investigation:

- Characterize the materials that were reportedly applied to the gravel parking area on Amcast South for dust control.
- Characterize the waste materials that were reportedly deposited in a suspected fill area (now referred to as the former disposal area) on Amcast South.

A total of three test pits were dug on the former Amcast South property east/southeast of the Quonset hut to a depth of 14 feet below ground surface (bgs). Two of the test pits were located in the former gravel parking lot, and one was located in the former disposal area.

Of the two pits located in the parking lot, both had approximately 2 feet of gravel at the surface, and one encountered a layer of blacktop beneath the gravel. A white powdery substance was encountered in one of the two test pits in the gravel parking lot. The substance was analyzed for asbestos, which was not detected; no additional analyses were run on the sample from this pit. The second pit that was located in the parking lot has a composite soil sample collected and analyzed for PCBs, benzene, ethylbenzene, toluene, and xylenes, total petroleum hydrocarbons (TPH) TPH gasoline range organics (GRO), TPH diesel range organics (DRO), and kerosene.

General debris, metal scrap, slag, wood, "hoses", and soil suspected to be contaminated with petroleum-based products (based on odor, visual staining, and field meter readings) was encountered in the test pit located in the former disposal area. Analysis of a composite soil sample from the test pit in the former disposal area indicated the presence of PCBs, TPH-GRO, TPH-DRO, and xylenes (E&K, Inc. 1991a).

### 1.3.2 1991—E&K, Inc., Hazardous Waste Services Quarry Pond Investigation

E&K, Inc., completed an investigation of the sediments in Quarry Pond during January 1991. The objective of the investigation was to characterize the sediments in Quarry Pond for possible PCB and TPH contamination.

Quarry Pond was separated into two areas during the investigation: Area No. 1 (west portion of the Quarry Pond) and Area No. 2 (east portion of Quarry Pond). A composite sample composed of sediment from six locations was submitted for PCB and TPH (infra-red method) analysis for each area of Quarry Pond. TPH and PCB Aroclor 1242 were detected in both composite samples (E&K, Inc. 1991b).

### 1.3.3 1991/1993—Strand Associates Inc/WDNR Source Investigation for PCBs in Cedar Creek

A 1992 Strand Associates Inc (Strand) report written on behalf of WDNR describes investigations associated with Cedar Creek that attempted to identify potential sources of PCBs in the Creek (Geraghty & Miller 1994). During the investigation, soil samples were collected at the Amcast North parking lot with resultant PCB detection of 1.27 milligrams per kilogram (mg/kg). Two samples collected at Amcast South had total PCBs of 4.2 mg/kg and 35mg/kg. WDNR personnel collected total PCB samples in 1993 from Amcast South beneath the parking lot (3.7 mg/kg), from an area adjacent to a stormwater catch basin on the south end of the Quonset building (0.9 mg/kg), and beneath the central parking lot west of the Quonset building (1.1 mg/kg). Target Compound List semivolatile organic compounds (SVOCs) detected in WDNR soil samples were reported at estimated concentrations below quantitation limits.

### 1.3.4 1992—Fox Environmental Services Inc. Investigation

Fox Environmental Services, Inc., completed an investigation for Amcast during 1992 to characterize the former disposal area on the Amcast South property for volatile organic compounds (VOCs), PCBs, and total recoverable petroleum hydrocarbon (TRPH) contamination (Geraghty & Miller 1994).

A total of 10 soil borings were completed ranging in depth between 16 and 26 feet. A minimum of two 1.5-foot soil sample intervals were collected from each soil boring for analysis. PCBs and TRPH were detected in at least one soil sample collected from each soil boring. Aroclor 1242 was the primary PCB detected. Concentrations of PCBs were detected at each of the 10 soil boring sample locations and ranged from between 0.034 mg/kg to 6.1 mg/kg in the former disposal area to between 0.721 mg/kg and 567 mg/kg on the railroad right-of-way east of the former disposal area. The primary VOCs detected were ethylbenzene, xylenes, and toluene, and methylene chloride.

### 1.3.5 1993—Geraghty & Miller Site Assessment

In 1993, Geraghty & Miller (1994) conducted a site assessment on the Amcast South property, in response to a request by WDNR. The following were the objectives:

- Investigate the nature and extent of VOCs, PCBs, and TRPH detected in the subsurface soils during previous investigations.
- Evaluate the potential of contaminants in subsurface soils to impact the groundwater.

A total of 18 soil borings were completed by Geraghty & Miller on the Amcast South property. Ten of the soil borings were completed in and around the former disposal area, while the remaining 8 borings were distributed over the rest of the property. Based on this investigation data, the thickness of the fill materials in the former disposal area is estimated to range between 9 feet in the southeast) and 16 feet thick in the western portion and to be generally comprised of the following: reworked soil (silt, sand with variable amounts of gravel); demolition debris such as brick, wood, metal, concrete, and asphalt; fine black sand; and some concrete-like material that was interpreted to be "refractory materials."

One soil sample was collected from the unsaturated zone of each soil boring based upon organic vapor readings and olfactory or visual characteristics (for example, staining) and analyzed for VOCs, TPH-DRO, and PCBs. In addition, three soil samples were submitted for SVOC analysis. VOCs were detected in two soil borings, and TPH-DRO was detected in four soil borings. Bis(2-ehtylhexyl) phthalate was the only SVOC detected in the three soil samples. PCBs were detected in 5 of the 18 soil borings as Aroclors 1242, 1248, and 1254 at concentrations that were "generally below the WDNR cleanup guideline of 5 ppm," except one soil boring (11- to 13-foot interval) where a concentration of total PCBs was recorded of 28 mg/kg. It should be noted that the WDNR soil cleanup standard has changed since 1993. Refer to the Wisconsin Administrative Code Natural Resources (NR) 720 for promulgated values.

Seven groundwater monitoring wells were installed on the Amcast South property as part of the site assessment. Groundwater samples collected from each of the wells were submitted for VOCs, TPH-DRO, PCBs, and dissolved inorganics analysis. VOCs, TPH-DRO, and PCBs were detected in the groundwater at one location where the total PCB concentration was 2.3 micrograms per liter (μg/L). The investigation report (Geraghty & Miller 1994) included a recommendation for additional soil and groundwater investigation.

### 1.3.6 2001—Sigma Environmental Services, Inc., Phase I ESA

Amcast Industrial Corporation retained Sigma to conduct an ESA in 2001 with the purpose of identifying any "recognized environmental conditions" (Recognized Environmental Conditions; ASTM E1527-00 terminology) for the property. The ESA comprises mainly environmental database searches to note the presence of potential tank or hazardous storage issues and reviews available historical tax records, maps, and photographs of the property.

### 1.3.7 2001—Former Cedar Creek/Hamilton Pond Floodplain Soil Remediation

In June 2001, Mercury Marine performed a removal action of floodplain soils and sediments that were exposed when the former Hamilton Dam failed in 1996. The sediment was previously submerged by impounded water known as the Hamilton Pond. This reach of Cedar Creek is located east of the Amcast Industrial Site. Per communication from Mercury Marine to USEPA (USEPA 2003a), the remediation reportedly included soil removal and clean-out of a stormwater sewer discharge pipe that drained from Wilshire Pond to the vicinity of Cedar Creek (Figures 1-4 and 1-6).

### 1.3.8 2003-2004—Foth and Van Dyke Preliminary Site Characterization

Foth & Van Dyke (2004a) conducted an investigation for Amcast Industrial, Inc., on the Amcast South and North properties, the residential properties surrounding Amcast North, and Quarry Pond and surrounding Zeunert Park from December 2003 to January 2004. The following were the objectives of the investigation:

- Investigate the nature and extent of soil contamination on the Amcast North and South facilities, and at the residential properties surrounding Amcast North and Amcast South.
- Characterize groundwater quality and the horizontal and vertical components of groundwater flow at the Amcast North and South properties.

The data collected by Foth & Van Dyke were incorporated into the project database and were evaluated along with the more recent data collected in 2011 by CH2M HILL. Foth & Van Dyke installed 7 groundwater monitoring wells to depths of approximately 20 to 25 feet, two at Amcast North (FVMW-26 and FVMW-27), three at Amcast South (FVMW-20, FVMW-21, and FVMW-22), and two in Zeunert Park (FVMW-23 and FVMW-24), and collected samples that were analyzed for PCBs, metals, VOCs, and SVOCs.

Foth & Van Dyke also collected 34 surface soil samples and installed 6 subsurface soil borings from which soil samples were collected for analysis of PCBs, metals, and SVOCs. Twenty-eight sediment samples were collected from Quarry Pond and analyzed for Aroclor 1248, total PCBs, and total organic carbon (TOC), along with three surface water samples analyzed for Aroclor 1248. Sixteen sediment samples were also collected from historical storm sewer catch basins and/or manholes and analyzed for total PCBs.

## 1.3.9 2005—ENSR Corporation Phase II Investigation

ENSR Corporation's (ENSR) scope of work required collection of sediment samples from Areas of Investigation identified in Foth & Van Dyke's Phase II Sampling Plan (Foth & Van Dyke 2004b). Sampling activities and results are summarized in the following subsections.

### 1.3.9.1 Amcast and City of Cedarburg Stormwater Sewer Sediment Sampling and Laboratory Analysis

Eleven sediment samples were collected from storm sewers located on Amcast North and South properties, and from the City of Cedarburg property south of Amcast South. PCB concentrations detected in the storm sewer sediment samples ranged from 640 micrograms per kilogram (μg/kg) from a catch basin on the Amcast North property to 790,000 μg/kg from a sample collected from a storm sewer located on Amcast South.

### 1.3.9.2 Quarry Pond Sediment Sampling and Laboratory Analysis

Twenty-one sediment samples were collected from the banks of the Quarry Pond and were obtained from the 0- to 6-inch interval. PCB concentrations detected in the samples ranged from 29 μg/kg to 9,000 μg/kg in a sample collected 30 feet from the bank of the pond along a northeastern transect extending away from the pond.

Nine sediment samples were collected from the banks of the City of Cedarburg Stormwater Detention Pond (renamed in later documents as "Wilshire Pond") from depths of 0 to 6 inches bgs. Detected PCB concentrations in the samples ranged from 1,300 μg/kg in a sample located at the southeastern bank of the pond to 52,000 μg/kg in the sample obtained at a location just downstream of the sewer discharge pipe that enters the area pond from the west.

### 1.3.9.3 Residential Yards near Amcast North—Surface Soil Sampling and Laboratory Analysis Results

Twenty-eight soil samples were collected from yards associated with private residences located southeast of the Amcast North property from a depth of between 0 and 6 inches bgs. PCBs were not detected in 11 of the samples, and detected concentrations ranged from 40 μg/kg to 13,000 μg/kg.

## 1.3.10 2007—ENSR Corporation Phase II Investigation

In 2007, ENSR conducted a Phase II investigation at the Amcast North and South properties and collected soil, sediment, and groundwater samples. In addition, wipe samples were collected from the interior of the foundry building on Amcast North.

Fourteen soil borings were completed to depths of 10 feet in the shallow subsurface beneath the Amcast Foundry Building (Amcast North), and two samples per boring were submitted for analysis of VOCs, PCBs, and DRO. PCB concentrations in soil were less than 1,000 μg/kg. One sample from a depth of 2 feet bgs contained DRO concentrations exceeding the Wisconsin Administrative Code NR 720 residual contaminant level for migration to groundwater (100 mg/kg). Migration to groundwater residual contaminant levels were also exceeded for cis-1,2-dichloroethene in two samples from each of two borings (four total samples).

Groundwater samples from 11 groundwater monitoring wells were analyzed for VOCs, PCBs, and DRO. PCB concentrations in groundwater samples exceeded the NR 140 Enforcement Standard (ES) for total PCBs in 4 of the 11 wells sampled. Concentrations of a few individual VOC compounds also exceeded NR 140 ES values (chloroform, benzene, naphthalene, and trichloroethene).

Twelve stormwater sediment samples were collected from exterior storm sewers at Amcast North and South and from Amcast North interior storm sewers/pump stations. Sediment was analyzed for PCBs—10 of the 12 storm sewer sediment samples contained PCB concentrations exceeding 1,000 μg/kg.

Forty wipe samples collected from floors and walls within the foundry building (Amcast North) were analyzed for PCBs. Thirty-five of the 40 samples exceeded the USEPA's World Trade Center screening value for indoor environmental assessment (USEPA 2003b) of 0.16 μg per 100 square centimeters.

## 1.4 Overview of the Remedial Investigation

The existing plans, reports, and data (in hard copy format) from the previous investigations were evaluated to develop the approach for completing the RI activities under this WA. The proposed investigation and sampling rationale were developed based on the stated objectives of the Foth & Van Dyke RI work plan, review of existing data and reports for data gaps, the current conceptual site model (CSM), and future land use goals as presented in the quality assurance project plan (QAPP) (CH2M HILL 2011).The QAPP also discusses specific sampling objectives, analytes, and approaches developed for each medium (sediment, soil, groundwater, surface water, and aquatic tissue). The data will be used to evaluate the impacts of Amcast Industrial Corporation's historical operations, to conduct the risk assessments, and to perform the feasibility study. The available environmental data from previous studies and CH2M HILL's investigation have been combined to evaluate the site conditions and the nature and extent of contamination.

The following are the objectives of the RI conducted under this WA:

- Refine the CSM for the nature and extent of contamination.
- Identify the fate of contaminants and their transport mechanisms.
- Characterize potential human health and/or ecological effects associated with site contaminants.
- Provide data to evaluate the potential site-related risks to human health and the environment.
- Conduct a flexible investigation to generate the minimum amount of data required for risk assessment and yet be sufficient to develop and evaluate potential remedial alternatives.

The summary of sample locations and rationale for the sediment, soil, groundwater, and fish tissue investigations are provided in Tables 1-1 through 1-4. The technical memorandums describing the 2011 field investigation and methods are provided in Appendix A.

SECTION 2

# Physical Site Setting

The physical site setting is described in Section 2 by summarizing demography, land use, topography, meteorology, geology, hydrogeology, surface water features, and ecology.

## 2.1 Local Demography and Land Use

The City of Cedarburg is within the Township of Cedarburg in southeastern Wisconsin, approximately 4.5 miles west of the western shore of Lake Michigan. The City consists of a 4.3-square-mile area and has a population of 11,412 people according to 2010 U.S. Census Bureau data (2012a; 2,362 people per square mile) with a 4.6 percent increase in population since 2000. The Town of Cedarburg is home to approximately 5,700 additional residents outside of the city limits.

Cedar Creek flows from north to south through the City along a meandering path, with the creek's location approximately 1,100 feet east of the Amcast Industrial Site. Land use along the creek varies and includes residential, parks, upland field/pastures and forest, and commercial uses (Arcadis 2012).

The Amcast Industrial Site is located along the southeastern portion of the City. Land use for the Amcast North and South properties and surrounding area consists of multiple zoning districts. The Amcast North property is zoned residential (City of Cedarburg 2012a) and is bounded on the northeast, southeast, and northwest by existing residences. The Canadian National Railroad line runs along the east side of Amcast South and along the west side of Amcast North and Zeunert Park/Quarry Pond (City of Cedarburg 2012). Farther east is an "I-1" zone (Institutional and Public Service District) that includes the Wilshire Pond and a municipal water treatment plant, and east of the parcel is Cedar Creek. Along the Creek's western boundary, between the Amcast Industrial Site and Cedar Creek, zoning is I1, B2 (Community Business), or C1 (Conservancy District).

The Amcast South property is located in a "mixed-use infill district" that is "intended to provide for a mixture of limited business and higher-density residential uses that are located adjacent to or within a primary residential area in a manner that is consistent with the City of Cedarburg Comprehensive Plan" (City of Cedarburg 2012). The South property is bounded on the west by existing residences, on the south by the City of Cedarburg's Department of Public Works offices and garages (I-1), and on the east by the railroad and a small manufacturer zoned as a "M-1" (Limited Manufacturing District). East of Amcast South across the railroad tracks is Zeunert Park and Quarry Pond, which are zoned as a park and recreation district (P-1). The P-1 area is surrounded by both residential- and industrial-zoned parcels.

The land use in Zeunert Park around Quarry Pond consists of park parcels on the north (baseball diamond), northeast, and southwest sides; private residences around the southeast; and a fenced private property around the northwest side. The southwest portion of the park includes a ballpark and play structures, and the northeast part of the park is green space. The park is located within city limits in a residential neighborhood. Quarry Pond basin is located in a residential neighborhood with no restrictions to access, and has been engineered with natural-style landscaping, including a convoluted perimeter, walkways, and marsh plants (Agency for Toxic Substances and Disease Registry [ATSDR] 2005). After detecting PCBs in fish collected from Quarry Pond in 1991, WDNR released a "do not eat" fish consumption advisory. "No Fishing" signs are present around Quarry Pond as observed during the 2011 field investigation; however, based on several community surveys, it is assumed that there may be current/future fishing in the pond.

## 2.2 Land Surface Topography

The land surface elevations range from a high of approximately 770 feet above mean sea level (amsl) near the northwestern portion of Amcast South to a low at the edge of Quarry pond (approximately 730 feet amsl) based on the 1994 USGS Cedarburg topographic quadrangle. The Amcast South property elevation decreases to approximately 760 feet amsl along its southern boundary (ground surface elevation for GMMW-5 is 758.12 feet amsl, Figure 1-3). The elevation range across Amcast North is approximately 760 to 750 feet amsl, and the downward slope continues across the residential area to the south and east, to a general elevation of approximately 730 feet amsl. Farther south and east, the elevation of Cedar Creek is approximately 700 to 710 feet amsl.

## 2.3 Meteorology

The Amcast Industrial Site and surrounding areas typically experience a continental climate, characterized by warm summers and moderate to cold winters. The average annual temperature (based on the West Bend, Wisconsin, weather station) is 46.1 degrees Fahrenheit (°F), and average annual precipitation is 32.8 inches (U.S. Climate Data 2012). The highest temperatures occur in July, with an average high temperature of 81°F, and an average low temperature of 60°F. The lowest temperatures occur in January with an average high of 26°F and an average low of 11°F. The maximum average precipitation occurs in June (3.60 inches). The minimum average precipitation occurs in January (1.5 inches).

## 2.4 Geology

Regional and site-specific geology is discussed in the following subsections.

### 2.4.1 Regional Geology

Unconsolidated Pleistocene-aged surface deposits overlie bedrock within Ozaukee County. The unconsolidated deposits range from 0 feet thick in areas where bedrock is present on the surface to 600 feet thick in buried bedrock valleys (Sigma 2001). The unconsolidated deposits consist of glacial sediments, alluvium (east of the site along Cedar Creek), and surface marsh deposits (University of Wisconsin-Extension Geological and Natural History Survey [WGNHS] 1997; 2005). Glacial material deposited in Ozaukee County during glacial periods includes diamicton (nonsorted or poorly sorted sediment with a wide range of grain size and a fine-grained matrix deposited directly beneath glacial ice or on ice margins by mudflows, landslides collapse off of glacial ice slopes), and landforms from interglacial and glacial periods, including end moraines, ground moraines, outwash plains, and ice-walled lake plains (WGNHS 1997).

The most recent ice advance into Ozaukee County produced massive end moraines that run more or less north-south from the Sheboygan County line to the Milwaukee County line, with moraines produced by the advance having a north-south orientation and characterized by low-relief hummocky topography (WGNHS 1997). Ice-marginal drainage flowing from north to south along several former ice-margin positions is marked by sand and gravel outwash or lake deposits between end-moraine diamicton.

Bedrock underlying the unconsolidated deposits ranges from Devonian to Precambrian age, and bedrock that is sedimentary in nature dips to the east (WGNHS 2005). The Silurian dolomite is the uppermost bedrock unit found in the county, except in areas along the Lake Michigan shoreline where it is overlain by Devonian bedrock. The Silurian dolomite is approximately 450 to 500 feet thick in the Cedarburg area, with the thickness of bedrock increasing towards Lake Michigan. The surface elevation of Silurian dolomite in Ozaukee County ranges from approximately 600 to 900 feet, and outcrops locally at the ground surface.

Underlying the dolomite is the Maquoketa Group Shale, approximately 150 feet thick in the Cedarburg area and acting as a confining layer to deeper bedrock units. Ordovician and Cambrian bedrock underlying the Maquoketa Group Shale consists primarily of sandstone and dolomite approximately 800 feet thick. The Lower Ordovician bedrock formations include the Prairie du Chien Group, the St. Peter sandstone, and the Galena-Platteville unit (undifferentiated Platteville and Decorah Formation and Galena Dolomite). The Cambrian formations are sandstones and include the Dresbach group (Mt. Simon, Eau Claire, and Galesville formations), the Franconia sandstones, and the Trempealeau Formation (Jordan sandstone and St. Lawrence Formation). Precambrian crystalline bedrock underlies sedimentary bedrock within the county (WGNHS 2005).

### 2.4.2 Site-specific Geology

WGNHS information (WGNHS 1997) for the project area indicates that Amcast North, Amcast South, Zeunert Park/Quarry Pond, Wilshire Pond, and the residences are situated within an area of glacial outwash material, very close to the margin, with a diamicton associated with end-moraine deposits. The outwash material is poorly graded, well-stratified gravel and sand—the diamicton is mostly unstratified clayey silt that is typically very uniform and compact—except for the upper few meters where sand lenses and other discontinuities are present in mudflow deposits that flowed off of the ice margin. Site-specific investigations indicate that unconsolidated soil deposits are present across most of the site, except where the bedrock outcrops north of Quarry Pond.

Available subsurface data collected both historically and in 2011 were used to establish stratigraphic units that describe the geologic conditions of the unconsolidated material at the site. The unit description provided herein supersedes previously-named units described in historical reports for various portions of the facility. Four different stratigraphic units are identified for the unconsolidated deposits. The locations for cross sections representing the generalized interpretation of the subsurface stratigraphy are shown in Figure 2-1, and the cross sections are provided as Figures 2-2 through 2-5.

#### 2.4.2.1 Stratigraphic Unit 1

The uppermost materials include two distinguishable fills found on portions of the site that were topographically lower in elevation prior to being filled in. The first fill type is soil fill material likely used for landscaping, contouring, and construction of the stormwater runoff catchment, and for bringing the former disposal area surface to grade with surrounding site features. The material consists of predominantly mottled, reworked clayey and sandy silts with occasional gravel inclusions (Geraghty & Miller 1994).
The second type is fill associated with the demolition of the original foundry encountered on the Amcast South property in the former disposal area (Figure 2-4). The disposal area fill extends to depths of up to 16 feet and typically consists of silt and sand with variable amounts of gravel and contains debris, including brick, metal filings, wood, concrete, and asphalt. Previous reports indicate the disposal area fill also contains a fine black sandy material that was thought to be casting sand and a concrete-like material thought to be a high-temperature refractory material (Geraghty & Miller 2004). The waste in the former disposal area increases from west to east/north where it was observed from 3 to 6 feet bgs at AMS-SO08 on the west side, 3 to 11.5 feet bgs on the east side at AMS-SO07, 0.5 to 14 feet bgs near the railroad tracks at AMS-SO01, and 2 to 21 feet bgs farther north at SB-3. In general, the waste appears to be confined to the grassy area and a small area beneath the asphalt on the southern portion of the property. Fill may also be present beneath the footprint of the former original foundry on Amcast South.

#### 2.4.2.2 Stratigraphic Unit 2

The native materials encountered either beneath fill material or in areas without any filled depressions, consist of clayey silts, silty clays, and sandy silts with discontinuous interbedded lenses of silt, sand, silty sand, and gravel. The unit is thickest in the northern and central portions of the site (Amcast North and northern portions of Amcast South) where it occurs at depths of up to 26 feet (Figure 2-5). Based on information from WGNHS (1997), characteristics of the unit indicate it is probably composed of fine-grained diamicton that was deposited on top of outwash deposits (Stratigraphic Unit 3). This unit may also contain a thin layer of organic rich clayey silt up to 5 feet thick in the east-central and southern portion of Amcast South property that may have been a buried soil horizon (Geraghty & Miller 1994).

#### 2.4.2.3 Stratigraphic Unit 3

The next, successively lower stratigraphic unit is a sand/silty sand unit that contains seams and lenses of clay, silt, sandy clay, and gravelly silty sand. Based on information from WGNHS (1997), characteristics of the unit indicate it is probably composed of glacial outwash deposits. In general, the top of the unit is encountered starting at an approximate elevation of between 730 and 745 feet amsl The lower boundary of the unit was only determined at soil boring location AMN-SO01 with a thickness of 15 feet and a bottom elevation of 714.5 feet amsl (Figure 2-4). The unit is at least 16 feet as encountered at AMN-SO02 (the bottom of the unit was not identified at this location).

#### 2.4.2.4 Possible Stratigraphic Unit 4

AMN-SO01 is the deepest soil boring onsite, and is the only soil boring that encounters another fine-grained layer (silt/clayey silt) beneath the Unit 3 sand; therefore, the horizontal and vertical extent of this potential, additional stratigraphic unit is unknown. The deeper silt/clay material was encountered at 42 feet bgs in AMN-SO01 (Figures 2-2, 2-3, and 2-5).

#### 2.4.2.5 Bedrock

Bedrock was not encountered in any of the soil borings conducted onsite; however, dolomitic bedrock outcrops on the north-northwestern shoreline of Quarry Pond at elevations ranging between approximately 750 and 760 feet amsl (Figure 5; Foth & Van Dyke 2004b). Bedrock was also found at or just a few inches bgs along the southern shoreline of Quarry Pond (at approximately 730 feet amsl). Bedrock was not encountered in any of the soil borings that extended deeper than 730 feet amsl on either the Amcast North or South properties, suggesting that the depth to bedrock is highly variable across the site. Borings AMN-SO01, AMN-SO02, AMN-SO10/AMN-MW01, AMS-MW01, and GMMW-5 extended deeper than 725 feet amsl, and AMN-SO01 extended to approximately 715 feet amsl without encountering bedrock.

## 2.5 Hydrogeology

### 2.5.1 Regional Hydrogeology

There are three major aquifer systems within Ozaukee County: the unconsolidated aquifer, the Niagara aquifer, and the sandstone aquifer (WGNHS 1980). The unconsolidated aquifer consists of the sand and gravel deposits, including outwash, alluvium, and glacial lake deposits and of any feature within diamicton deposits that yields enough water to a residential or other relatively low-use well. Groundwater flow directions within unconsolidated deposits are expected to be toward local rivers and streams that likely act as groundwater discharge areas.

The unconsolidated material directly overlies the Niagara aquifer, which is composed of Devonian and Silurian dolomite. The aquifer is generally unconfined, but may be locally confined if the overlying materials are clay (Foth & Van Dyke 2003). The Maquoketa shale, which underlies the Niagara aquifer, serves as an aquitard between the unconfined Niagara aquifer and the deeper, confined Ordovician-aged and Cambrian-aged sandstone and dolomite aquifer (WGNHS 1980). The deeper confined aquifer historically has a horizontal flow towards Lake Michigan to the east but localized variations are possible due to pumping of high-capacity wells.

### 2.5.2 Site Hydrogeology

Groundwater is encountered within the unconsolidated aquifer at depths ranging between 8 and 34 feet, depending on the ground surface elevation. Monitoring wells that are screened in the clayey silts and clays (Unit 2) are considered to be in a perched groundwater zone that is unable to yield sufficient water for residential or other use. Monitoring wells screened in the silty sand or sand material (Unit 3) underlying the silts and clays are considered to be part of the shallow unconsolidated groundwater aquifer. No monitoring wells onsite extend into the bedrock. Groundwater elevations are presented in Table 2-1 along with monitoring well location data. Groundwater elevation contour maps for the unconsolidated aquifer are presented in Figures 2-6 and 2-7 for Units 2 and 3, respectively.

In situ hydraulic conductivity testing of the unconsolidated materials was performed at 13 well locations during 2011 fieldwork. Hydraulic testing methods and results are provided in the Hydrogeologic Field Investigation Summary technical memorandum that is included in Appendix A (CH2M HILL 2012a). A summary of the results is presented in Table 2-2.

The potential direction of groundwater flow within the shallower clay unit (Unit 2) roughly coincides with the topography of the land surface, going southeast toward Quarry Pond. Unit 2 materials had a logarithmic-average hydraulic conductivity of $4.31 \times 10^{-4}$ centimeters per second (Table 2-2).

The potential direction of groundwater flow within the deeper sandy unit (Unit 3) appears to be to the east toward Cedar Creek. Unit 3 sand had a logarithmic-average hydraulic conductivity of $2.08 \times 10^{-2}$ centimeters per second (Table 2-2).

## 2.6 Surface Water Features

Much of the City of Cedarburg and the site itself are located just southeast of a southwest-northeast-trending topographic ridge (800-foot contour) on the USGS quadrangle (USGS 1994). Cedar Creek is approximately 1,000 feet east of the site. An old quarry that has since been filled with water (Quarry Pond) is situated south of Amcast North and South properties (Figure 2-1). The elevation of the ground surface (top of the unconsolidated materials) at the site ranges from between approximately 772 feet amsl in the northern portion of the Amcast North to approximately 730 feet amsl next to the water surface at Quarry Pond.

In addition to surface water drainage that occurs in general accordance with land surface topography, storm sewers emanating from Amcast South and/or North properties also evidently drain to low-lying topographic areas, specifically to Quarry Pond and Wilshire Pond, respectively (Figure 1-6).

### 2.6.1 Quarry Pond

The Quarry Pond is a former flooded rock quarry with water depths and sediment thicknesses as shown in Figures 2-8 and 2-9, respectively. The thickness of the water column in Quarry Pond as measured during a 2003 investigation (Foth & Van Dyke 2004b) ranges from 0 feet at the shoreline with a sharp drop off around the pond's edge to about 16 feet, and a deep point of 17.4 feet of water (Figure 2-8). Previous investigations indicated depths up to 22 feet (Strand 1992). The City of Cedarburg reportedly filled the east and south sides of the quarry during the 1970s with debris from reconstruction of Washington Avenue and to make it safe for use as a park pond (Strand 1992). The southwest portion of the quarry is comprised of a rock face that rises approximately 30 feet above the pond surface.

There are several storm sewer outfalls that discharge into Quarry Pond on the north, west, and south portions (Figure 1-6). The stormwater sewer discharge from the west originates along Lincoln Boulevard (community service/institutional zoning areas) and then into and through the City of Cedarburg's Department of Public Works parcel west of the pond. The discharge that enters the pond from the southern direction is apparently from residential and institutional zoning areas. The sewer pipe discharging into Quarry Pond from the northwest (Figure 1-6) conveys water from the Amcast South property, the City of Cedarburg Department of Public Works, and surrounding areas to the west.

The pipe entering the Quarry Pond on the north side is connected to a manhole in the center of the park (Figure 1-6). This sewer segment slopes to the south to apparently drain water to the Quarry Pond. From the manhole in the park, the pipe also extends northward toward Hamilton Road and slopes to drain water toward the road. A historical investigation report (Strand 1992) quotes City of Cedarburg personnel who indicated that the pond elevation fluctuates and reportedly rises during storm events to the elevation where it drains into Cedar Creek by way of the city storm sewer along Hamilton Road. However, at the time of RI fieldwork in 2011 it did not appear that there was any direct drainage out of Quarry Pond toward Hamilton Road. Foth & Van Dyke indicated during its October 2003 storm sewer investigation, that the outfall into Quarry Pond may have been broken when fill material was placed in around the pond (CH2M HILL 2003). Historical drawings and a CH2M HILL photograph showing the inside of the manhole, taken during oversight of the October 2003 Foth & Van Dyke site investigation, indicated that drainage also flows into this manhole from the property west of Zeunert Park (CH2M HILL 2003). The City of Cedarburg did not have historical storm sewer maps of this area in Zeunert Park (City of Cedarburg 2013a).

Foth & Van Dyke measured the sediment thickness in Quarry Pond during its 2003 site investigation. Quarry Pond sediment thickness was reported as ranging between 0.3 and 6.5 feet thick (Figure 2-9). The sediment thickness contour map is presented in Figure 2-9. The sediment deposits in Quarry Pond are thickest along the north-northeast side and in small pockets on the southeast and northwest sides. Sediment thicknesses at sample locations FVSC-01 and FVSC-02, located at the north end of Quarry Pond, were approximately 5 feet thick. The areas containing a relatively thicker sediment layer roughly correlate to where the bathymetric contours are more widely spaced as presented in Figure 2-8. Sediment deposits are thinnest in the interior portions of the pond. Sediment thicknesses at sample locations FVSC-20 and FVSC-26, located in the middle of Quarry Pond, were approximately 1 foot thick.

### 2.6.2 Wilshire Pond

Wilshire Pond is a shallow stormwater retention basin that receives stormwater from a storm sewer pipe entering from the west on Park Lane. The stormwater discharge is from Amcast North and the surrounding area (Figures 1-4 and 1-6). The Wilshire "Pond" is actually an amalgamation of depressed areas where effluent from a sewer pipe proceeds through a progression of basins until discharging through the outflow pipe on the east. Basin A receives the discharge from the storm drain on the west side of Wilshire Pond, then surface flow, assuming there is adequate water to cause flow out of Basin A, proceeds in order to Basins B, C, D, E, and F in sequence (estimated surface water flow direction arrows are also indicated in Figure 1-4). Basin F is the final spot within the pond prior to discharge through a storm sewer drain that extends in a northeast direction out of the pond, continuing through a wooded area toward a confluence with Cedar Creek (Figure 1-4). The outlet pipe was originally corrugated metal pipe, but was lined by the City of Cedarburg in 2011 (City of Cedarburg 2013b) because the invert of the pipe was in deteriorated condition.

Wilshire Pond sediment thickness was established during 2011 fieldwork as reported in the Soil and Sediment Field Investigation Summary Technical Memorandum (CH2M HILL 2012b; Appendix A). During 2011 fieldwork the water depth to the top of sediment was noted as ranging from no water ("0 feet" of water column) to a maximum of 1.5 feet of water. Sediment thickness in the pond was measured to range between 0.5 and 2.9 feet. The 2011 measurements are summarized in Table 2-3. It should be noted that the measurements were recorded during the month of September—measurements taken during alternate months or seasons may vary from those observed.

## 2.7 Ecology

### 2.7.1 Amcast North and South Properties

The Amcast Industrial Site is in a mixed-use urban area (see Section 2.1) that includes industrial, commercial, and residential properties. The urbanized land uses at the Amcast Industrial Site are mainly maintained lawns composed of a regularly mowed indeterminate grass species (Poa sp.). Overgrown/unmaintained areas typically contain common weeds, including common plantain (*Plantago major*), dandelion (*Taraxacum officinale*), canada thistle (*Cirsium arvense*), chicory (*Cichorium intybus*), common yarrow (*Achillea millefolium*), and white clover (*Trifolium repens*), among others. Deciduous and evergreen trees landscape residential and commercial plots.

The urbanized landscape offers a relatively low-quality habitat for flora and fauna. Typical species present in the areas include common birds (sparrows, finches, robins, crows, European starling, common grackle, blue jays, cardinals, hawks, etc.) and mammals (white-tailed deer, rodents, raccoons, and an occasional fox or coyote). The animal species may potentially pass through or use the area, and impacts to the species and their habitats are anticipated to be minor.

### 2.7.2 Quarry Pond

Quarry Pond was known to support a variety of fish species according to a 1991 assessment, including rainbow trout, pumpkinseed, bluegill, black bullhead, black crappie, yellow perch, smallmouth bass, walleye, northern pike, and white sucker (ATSDR 2005).

A biological survey of Quarry and Wilshire ponds was conducted in September 2011 to support human health and ecological risk assessments. Fish and tadpole tissue samples were collected to evaluate PCB concentrations, benthic macro invertebrate samples were collected for a preliminary assessment of community structure, and physical habitat and in situ water quality measurements were taken in support of the overall investigation. Species diversity was limited, with green sunfish and black bullhead as the dominant species. Ten black bullheads and six green sunfish were retained for fillet tissue analysis for PCBs.

Because little littoral vegetation is present around the perimeter of Quarry Pond, benthic macro invertebrates were collected from the quarry bottom at each of the water quality locations. Eleven organisms representing two taxa, and thus very little diversity, were collected from the pond. No organisms were present in deeper sample locations.

### 2.7.3 Wilshire Pond

Wilshire Pond is actually a series of small stormwater detention basins (Figure 1-4) of varying depths. Based upon water body characteristics (small size, shallow water depth) and 2011 field observations, the pond does not appear to support much of a fish population. The larger basins have very thick, silty bottoms that prevent extensive wading. Basin B was dry during the 2011 sampling event. Benthic macro invertebrates were sampled in each detention basin, except B. A more diverse benthic community was present in Wilshire than in Quarry Pond (11 taxa present, dominated by snails). Plenty of littoral vegetation was present around the perimeter of the pond. The soft sediment and heavy growth of small duckweed (*Lemna minor*) and broad-leaved cattail (*Typha latifolia*) made seining (a method to catch the fish) difficult. Species diversity was limited to green sunfish (*Lepomis cyanellus*) and golden shiner (*Notemigonus crysoleucas*). Other aquatic organisms such as frogs/tadpoles (unknown amphibian species) were also collected to obtain enough biomass for tissue analysis.

### 2.7.4 Cedar Creek

Cedar Creek lies east of the Amcast Industrial Site, east of additional industrial, business, and institutional land. Multiple investigations have historically been completed to examine Cedar Creek sediment and ecological species. Cedar Creek is classified by WDNR as a full fish and aquatic life stream, capable of supporting a diverse aquatic life community. The area of the creek that is situated east of the Amcast Industrial Site is mostly characterized by open fields that would support species similar to those described for the site itself and some zones of northern mesic forest and upland fields/pasture (Arcadis 2012).

### 2.7.5 Threatened and Endangered Species

There are no known occurrences of threatened or endangered species on or near the site. Based on information from the U.S. Fish and Wildlife Service (Appendix E), three federally-listed species, northern long-eared bat (*Myotis septentrionalis*), Hine's emerald dragonfly (*Somatochlora hineana*), and eastern prairie fringed orchid (*Platanthera leucophaea*) are known to occur in Ozaukee County. Based on habitat preferences and mapped critical habitats, none of these species are expected to occur on or near the site, including Zeunert Park, Quarry Pond, and Wilshire Pond.

SECTION 3

# Nature and Extent of Contamination

Several investigations have been conducted to evaluate the impacts of the Amcast North and South operations on the surrounding environment. The investigations were conducted to either address specific concerns (for example, the former disposal area) or were limited in scope and did not individually provide a comprehensive model of the nature and extent of contamination. In order to take advantage of the previous findings, a site-specific database was developed to allow for a comprehensive evaluation of the recent and historical site data.

Section 3.1 summarizes the methods used to compile the historical and recent analytical data and how that data were evaluated and presented in figures and tables within this report. The remaining subsections summarize the nature and extent of soil, sediment, surface water, and fish tissue contamination by area for Amcast North, residential yards, Wilshire Pond, Amcast South, and Zeunert Park/Quarry Pond, as applicable. The nature and extent of contamination in the storm sewers and groundwater are presented on a sitewide basis.

## 3.1 Data Screening and Presentation

### 3.1.1 Data Screening

For purposes of this RI report, analytical results were compared to screening criteria as a general means to evaluate constituent concentrations in soil, sediment, surface water, and groundwater. A more rigorous evaluation of analytical data against screening criteria to determine contaminants of concern was also performed as part of the HHRA and ERA (Appendixes D and E, respectively). The data to evaluate the nature and extent of contamination were compared to screening criteria by media as follows:

- Soil—USEPA Residential Soil Regional Screening Level (RSL).[1]
- Sediment—USEPA Residential Soil RSL.
- Surface Water—USEPA Tapwater RSL and WDNR Chapter NR 140 groundwater quality ES. Surface water was sampled from the Quarry and Wilshire Ponds. The water is not used as drinking water, and WDNR has issued a fish consumption advisory.
- Groundwater—USEPA maximum contaminant level (MCL) RSL and WDNR Chapter NR 140 groundwater quality ES.

The historical data for soil and sediment were typically reported as total PCBs, while the recent data were reported by individual Aroclor. The USEPA RSL table does not provide a screening level for total PCBs, but does for individual Aroclors. The lowest RSL value for any of the individual Aroclors detected at the site is 220 μg/kg. Therefore, 220 μg/kg was chosen as the most conservative screening level option for comparison to total PCB concentrations in soil and sediment. Additional information related to screening levels is presented in the QAPP (CH2M HILL 2011).

### 3.1.2 Data Presentation

Due to the large amount of data collected over several years by several different consultants, special consideration was given to how the data could be compared and presented most effectively. How specific components of the data sets were simplified for comparison purposes is summarized in the following paragraphs.

Historical and recent soil samples were grouped and evaluated as surface and subsurface soils. Surface soil is considered to be a sample that was collected within the 0- to 2-foot interval. Subsurface soil is considered to

[1] USEPA RSL = Regional Screening Levels (RSLs) for chemical contaminants at Superfund Sites

be a sample collected from an interval deeper than 2 feet. At some locations, more than one depth interval was sampled. For presentation purposes, the maximum concentration detected at an individual location is plotted on the constituent concentration figures to represent the most conservative scenario.

Recent PCB data were reported by individual Aroclor, and historical data were typically reported as total PCBs. In order to prepare the soil and sediment data sets for comparative evaluation and presentation, the detected values for individual Aroclors within a given sample (where individual Aroclors were analyzed) were summed to obtain a "total" detected PCB concentration for each sample.

Individual polynuclear aromatic hydrocarbons (PAHs) were the most frequently detected type of SVOC detected in soils. The other SVOCs detected in soil did not exceed their respective residential soil RSL values. Therefore, the data presentation for the SVOC nature and extent discussion focuses on PAH parameters. To simplify the data for presentation, total PAH values were presented by location and if at least one individual PAH compound was detected at a concentration above the respective RSL, the sample location was flagged as exceeding the RSL on the figure. Total PAH values were calculated by summing the detected values for the following individual PAH compounds:

- 2-methylnaphthalene
- acenaphthene
- acenaphthylene
- anthracene
- benzo(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- benzo(g,h,i)perylene
- benzo(k)fluoranthene
- chrysene
- dibenzo(a,h))anthracene
- fluoranthene
- fluorene
- ideno(1,2,3-cd)pyrene
- naphthalene
- phenanthrene
- pyrene

The nature and extent of PAH contamination in soil were based on a comparison of the detected concentrations to the respective USEPA Residential RSLs for the individual PAHs. To simplify the data presentation on a figure, if at least one of the individual PAH compounds was detected at concentrations above the respective RSL, the sampled location was flagged as exceeding the RSL.

## 3.2 Amcast North and Residential Yards

The data reported from previous investigations provide a relatively well-defined picture of soil contamination outside the building footprint. Therefore, a limited and focused soil investigation was conducted in 2011 to only collect samples from yards that were not sampled previously due to access issues.

Figures 3-1 and 3-2 present analytical results for soil samples collected for PCB analysis from the surface and subsurface soil, respectively. Figures 3-3 and 3-4 present analytical results for soil samples collected for PAH analysis from the surface and subsurface soil, respectively. A description of the activities and methods for the 2011 soil sampling is provided in the Soil and Sediment Investigation Summary Technical Memorandum provided in Appendix A (CH2M HILL 2012b). Details of historical investigations can be found in reports previously submitted by others. Soil samples on Amcast North were analyzed for PCBs, VOCs, SVOCs, metals, TOC, and percent solids depending on the available historical data and the data quality objectives for each sampling event.

### 3.2.1 Soil—PCBs

#### 3.2.1.1 Surface Soil

Surface soil samples have been collected from 11 locations at Amcast North. PCBs were detected above the RSL in 8 samples, with detected total PCB concentrations ranging from 33 μg/kg to 33,000 μg/kg (Figure 3-1). The highest concentrations were observed on the north side of the building (AMN-SO04: 33,000 μg/kg; AMN-SO07: 15,000 μg/kg) and on the southwest corner of the building (AMN-SO01: 12,000 μg/kg) along Hamilton Road.

In 2007, ENSR collected surface soil samples (within the upper 2 feet of soil) from 14 soil borings advanced through the Amcast North building's floor (Figure 3-1). Of the 14 surface soil samples, PCBs were not detected in 6 samples and were detected below the RSL in 7 samples. One sample (B-02) had a total PCB concentration (640 μg/kg) above the RSL. (Samples were not collected inside the building during the 2011 investigation due to the potential safety risks associated with the deteriorating building, including a collapsing roof).

Thirty-nine surface soil samples were collected from the residential yards adjacent to the Amcast North property. PCBs were detected above the RSL in 20 samples (18 properties), with concentrations ranging from nondetect to 79,000 μg/kg (Figure 3-1). The highest concentrations were detected in samples at FVSS-22 (24,000 μg/kg) and FVSS-23 (79,000 μg/kg), which are located near the fence along the northeastern edge of the former Amcast facility. Although PCB concentrations near the building were typically above the RSL, the remaining samples show a somewhat random distribution across the residential yards with respect to proximity to the site, roads, and the former drainage ditch that ran along the resident's yards on northeast side of the building down to Park Lane. However, the concentrations in samples collected along Wilshire Drive, with one exception (ENSS-44: 1,000 μg/kg), are either at the nondetect level or below the RSL.

#### 3.2.1.2 Subsurface Soil

Total PCBs concentrations for subsurface soil samples (more than 2 feet bgs) collected at Amcast North are shown in Figure 3-2.

Subsurface soil samples have been collected from 21 locations outside the former manufacturing building, with total PCB concentrations ranging from nondetect to 690,000 μg/kg. Of the 21 samples, PCBs were not detected in 7 samples and were detected below the RSL in 2 samples. Twelve samples had PCB concentrations above the RSL, with the highest total PCB concentrations detected north of the building at FVMW-27 (690,000 μg/kg) and at the adjacent FVSS-22 (24,000 μg/kg) located on the other side of the property fence. The highest concentrations are clustered on the northeast side of the site in the paved area and at one location near the southeast boundary (FVMW-28: 11,000 μg/kg).

Fourteen soil borings were completed by ENSR in 2007 inside the former facility building. Samples were collected at an approximate depth of 8 feet bgs, with concentrations ranging from nondetect to 567 μg/kg. The seven samples located beneath the approximate boundary of the building's basement did not have detectable levels of PCBs. Of the remaining seven samples, one sample was rejected, two were nondetect, two had detected concentrations lower than the PCB RSL, and two had detections that exceed the PCB RSL (B-11: 567 μg/kg; B-13: 280 μg/kg) that were located on the south and west sides of the building.

#### 3.2.1.3 PCB Soil Summary

Review of the surface and subsurface soil data from the Amcast North property indicates that the highest concentrations of PCBs are generally limited to the top 5 feet of soil and occur on the grounds surrounding the building (for example, grassy or asphalt paved areas). Based on the limited building investigation conducted in 2007, the PCB concentrations in the soil beneath the building are below 1,000 μg/kg.
The residential yards have elevated concentrations of PCBs greater than 1,000 μg/kg, which is the cleanup level for high-occupancy areas without further restrictions per USEPA 40 *Code of Federal Regulations* 761.61, in at least 1 sample on 18 parcels. Due to the spatial distribution of PCBs with concentrations above the RSL cleanup level and the varying concentrations of PCBs within a specific parcel, the residential yards will need to be evaluated for remediation in more detail on a parcel-by-parcel basis. In addition, due to access issues, one or more properties have not been characterized.

### 3.2.2 Soil—Metals

Thirty-eight surface or subsurface soil samples have been collected and analyzed for metals at the Amcast North property. The sample locations for surface and/or subsurface soil are presented in Figure 1-2, and sample depths and detected concentrations are listed in Table 3-1.

Arsenic was the only metal detected in samples at concentrations that exceed the RSL of 0.39 mg/kg, and concentrations ranged from 0.61 mg/kg to 5.3 mg/kg. At locations where two or more samples were collected, the arsenic concentrations are typically higher in the shallower soils.

Arsenic is a trace element commonly found in surface soils and has both natural and anthropogenic sources. Minerals such as glauconite, arsenopyrite, pyrite, and other sulfides contain arsenic and can weather in soils and release arsenic into the soil system. Arsenic-bearing minerals are commonly found in sedimentary rocks

(Stensvold 2012). Although the arsenic concentrations in site soils as shown in Table 3-1 exceed the RSL concentration, the detected concentrations fall within the range of baseline values (less than 1.1 mg/kg to 8.0 mg/kg) established by the USGS for glacially deposited soil within the Lake Michigan Lobe (Stensvold 2012). The WDNR has also concluded that the USGS data set is of sufficient scope and quality to establish a statewide soil background threshold value for arsenic that can be categorically accepted as "not exceeding background." The WDNR background threshold value for arsenic is 8 parts per million (ppm; equivalent to 8 mg/kg) (WDNR 2013).

### 3.2.3 Soil—PAHs

#### 3.2.3.1 Surface Soil

Twelve surface soil samples were collected at Amcast North and the residential area. The maximum value of total PAHs at each sampled surface soil location is presented in Figure 3-3, and at least one individual PAH compound was detected at each location with total PAH concentrations ranging from 26 µg/kg to 5,090 µg/kg. Three of the samples, collected near the northwestern boundary of the former facility building, had individual PAH concentrations below their respective RSLs. The remaining locations had concentrations of total PAH above the RSL and are distributed fairly evenly around the site perimeter. The highest total PAH concentration is at sample location AMN-SO09 in the southwest corner of the site (Figure 3-3).

#### 3.2.3.2 Subsurface Soil

Thirteen subsurface soil samples were collected at Amcast North, and the maximum value of total PAHs at each sampled subsurface soil location is presented in Figure 3-4. One residential subsurface soil sample was also analyzed (FVSS-25). Concentrations of total PAHs range from nondetect to 62,860 µg/kg, with concentrations above the screening level clustered at the southeast and northeast corners of the site. The highest detected concentration of total PAHs is located along the southeast boundary of the site at FVSS-31, and was collected from a depth of between 2 and 4 feet. With the exception of FVSS-25, samples collected at depths greater than 6 feet either did not have detectable concentrations of PAH compounds or the detected concentrations were below their respective RSLs.

#### 3.2.3.3 PAH Soil Summary

Review of the surface and subsurface soil data from the Amcast North property indicates that the highest concentrations of total PAHs are generally limited to the top 5 to 6 feet of soil and predominately occur on the northeast, southeast, and southwest corners of the property.

### 3.2.4 Soil—VOCs

Forty-seven soil samples were collected and analyzed at Amcast North for VOCs. Of the 47 samples (both surface and subsurface samples), none of the VOC concentrations were detected above their respective RSLs. The primary VOC compounds detected include toluene, cis-1,2-dichloroethene, and acetone.
The sample locations for surface and/or subsurface soil are presented in Figure 1-2, with sample depths and detected concentrations listed in Table 3-8.

## 3.3 Wilshire Pond

Two previous investigations were conducted that included collecting three samples near the storm sewer outfall in Basin A of Wilshire Pond in 2003 (Figure 3-5) and collecting nine bank sediment samples in the various basins to characterize the sediment in Wilshire Pond in 2005. An additional investigation was conducted in 2011 to characterize the sediment thickness of the basins, delineate the previously detected hotspot in Basin A, collect data to support the HHRA and ERA (for example, surface water samples), and collect data to refine the nature and extent of contamination and fill data gaps in the CSM.

Figure 3-5 presents stormwater flow direction, sample locations, and analytical results for sediment samples collected for PCB analysis. Surface water data are presented in Table 3-2. A description of the activities and methods for the 2011 sediment and surface water sampling is provided in the Soil and Sediment Investigation Summary Technical Memorandum provided in Appendix A (CH2M HILL 2012b). A description of the activities and methods for the 2011 fish tissue sampling is provided in the Field Sampling Summary, Aquatic Biological Investigation, Quarry and Wilshire Ponds technical memorandum (Appendix A; CH2M HILL 2012c). Details for historical investigations can be found in reports previously submitted by others.

### 3.3.1 Sediment

Seventeen sediment samples were collected from Wilshire Pond, with total PCB concentrations ranging from 1,300 μg/kg to 520,000 μg/kg (Figure 3-5). Each of the 17 samples contained total PCB concentrations above the RSL, with the highest concentrations occurring in Basin A near the present day stormwater inlet to the pond (FVSS-33: 520,000 μg/kg; FVSS-34: 150,000 μg/kg). The highest total PCB concentration detected in Basin B was at AMW-SD01 (51,400 μg/kg). PCB concentrations in Basins C through F, downstream of Basin B, are one to two orders of magnitude lower than PCB concentrations in Basins A and B, with concentrations ranging from 1,300 μg/kg to 9,700 μg/kg.

At locations where more than one sample was collected from different intervals (AMW-SD01, AMW-SD02, AMW-SD05, and AMW-SD20), the vertical distribution of PCB concentrations did not show a discernible trend. The samples collected from two depth intervals at two locations in Basin A (AMW-SD05 and AMW-SD20) contained similar PCB concentrations. Three sample intervals were collected from two locations in Basin B. In AMW-SD01, PCB concentrations increased with depth. In AMW-SD02, PCB concentrations decreased with depth.

### 3.3.2 Surface Water

Five surface water samples were collected from Wilshire Pond in 2011 at the locations indicated in Figures 1-4 and 3-5. Samples were analyzed for metals, PCBs, SVOCs, VOCs, and total suspended solids. Table 3-2 includes results for the parameters that exceed either the WDNR Chapter NR 140 groundwater quality ES or the USEPA Tapwater RSL. The surface water samples with concentrations above the ES are AMW-SW02 from Basin A, immediately downstream of the present-day pipe inlet (exceedances of aluminum and manganese) and AMW-SW05 in Basin E (exceedance of aluminum). PCBs were not detected in surface water samples.

### 3.3.3 Fish Tissue

Historical fish data are not available for Wilshire Pond, and based upon water body characteristics (for example, size and water depth), it was assumed that Wilshire Pond does not support a viable fish population from a human health exposure perspective. However, ecological exposures were potentially relevant, so a reconnaissance survey was conducted to determine if the pond supports a fish population that may serve as a prey base for piscivorous birds and mammals, or, if not, whether an alternative organism (for example, frogs/tadpoles) warranted sampling. Fish and aquatic organism tissue samples were collected in 2011 from the Wilshire Pond to support the ecological risk assessment. Fish species diversity was limited to green sunfish (*Lepomis cyanellus*) and golden shiner (*Notemigonus crysoleucas*). To obtain enough biomass for tissue analysis, other aquatic organisms (for example, tadpoles) were also collected.

Two suspended feeder samples were retained for analysis of PCBs and percent lipids, which included one whole-body sample (green sunfish) and one whole-body composite sample (one green sunfish and one golden shiner). PCBs were detected in both samples at concentrations of 17 to 29 mg/kg, respectively. Six composite samples of tadpoles of unknown species were also retained for analysis of PCBs and percent lipids. PCBs were detected in each sample, with concentrations ranging from 3.83 to 30 mg/kg. A detailed evaluation of the biological investigation will be presented in the human health and ecological risk assessments.

## 3.4 Amcast South

The data reported from previous investigations provide a relatively well-defined picture of soil contamination at the Amcast South property. Therefore, a limited and focused soil investigation was conducted in 2011 to collect data to support the human health risk assessment, to refine the nature and extent of contamination, and to fill data gaps in the CSM. Samples were collected for analysis of PCBs, VOCs, SVOCs, metals, TOC, and percent solids.

Figures 3-6 and 3-7 present total PCB analytical results for samples collected from surface and subsurface soil, respectively. Figures 3-8 and 3-9 present total PAH analytical results for samples collected from surface and subsurface soil, respectively. A description of the activities and methods for the 2011 soil sampling is provided in the Soil and Sediment Field Investigation Summary Technical Memorandum in Appendix A (CH2M HILL 2012b). Details for historical investigations can be found in reports previously submitted by others. Soil samples from Amcast South were analyzed for PCBs, VOCs, SVOCs, metals, TOC, and/or percent solids, depending on the historical data sets and the data quality objectives for each sampling event.

The locations of PAH and PCB concentrations on Amcast South that exceed standards are typically within the boundary of the former disposal area. In addition, subsurface soil borings with PAH or PCB detections are also located within the limits of the former disposal area (Figures 3-8 and 3-9). The following compounds were detected from locations within the former disposal area:

- PCBs:
  - Aroclor 1242
  - Aroclor 1248
  - Aroclor 1254
  - Aroclor 1260
- Metals:
  - Aluminum
  - Antimony
  - Arsenic
  - Barium
  - Beryllium
  - Cadmium
  - Chromium
  - Cobalt
  - Copper
  - Iron
  - Lead
  - Magnesium
  - Manganese
  - Mercury
  - Nickel
  - Potassium
  - Silver
  - Vanadium
  - Zinc
- VOCs:
  - 1,1,2,2-Tetrachloroethane
  - 1,2,4-Trimethylbenzene
  - 1,2-dichlorobenzene
  - 1,3,5-Trimethylbenzene
  - 1,3-Dichlorobenzene
  - 1,4-Dichlorobenzene
  - 2-Butanone
  - Acetone
  - Benzene
  - Carbon Disulfide
  - Chloroform
  - Cis-1,2-Dichloroethene
  - Cyclohexane
  - Ethylbenzene
  - Isopropylbenzene
  - Methylcyclohexane
  - Methylene chloride
  - n-Propylbenzene
  - p-Isopropyltoluene
  - s-Butylbenzene
  - Styrene
  - Toluene
  - Xylenes
- Non-PAH VOCs:
  - 1,1'-Biphenyl
  - 2,4-dimethylphenol
  - 4-methylphenol
  - Acetaphenone
  - Benzaldehyde
  - Caprolactam
  - Carbazole
  - Dibenzofuran
  - Diethyl Phthalate
  - p-Chloroaniline
  - Phenol
- PAHs
  - Acenaphthene
  - Acenaphthylene
  - Anthracene
  - Benzo(a)anthracene
  - Benzo(a)pyrene
  - Benzo(b)fluoranthene
  - Benzo(g,h,i)perylene
  - Benzo(k)fluoranthene
  - Chrysene
  - Dibenzo(a,h)anthracene
  - Fluoranthene
  - Fluorene
  - Indeno(1,2,3-cd)pyrene
  - 2-Methylnaphthalene
  - Naphthalene
  - Pyrene
  - Phenanthrene

## 3.4.1 Soil—PCBs

### 3.4.1.1 Surface Soil

Fifteen surface soil samples were collected from Amcast South, with total PCB concentrations ranging from nondetect to 11,000 μg/kg (Figure 3-6). The following are the results of the 15 surface soil samples from Amcast South:

- PCBs were not detected in samples from 3 locations.
- PCBs were detected at concentrations below the individual Aroclor RSL at 3 locations.
- Nine locations had total PCB concentrations that were above the RSL.

The highest total PCB concentration in surface soil is at AMS-S005, located in the northern portion of the former disposal area. Other locations with PCB concentrations above the RSL are in the parking lot areas adjacent to the Quonset building or in the grassy area at the south end of the site. Results for four samples from within the former disposal area had PCB concentrations below the RSL, or PCBs were not detected, which may be related to the topsoil that was placed during the final filling and seeding operations.

#### 3.4.1.2 Subsurface Soil

Subsurface soil samples (more than 2 feet bgs) were collected from various depth intervals at 49 locations (Figure 3-7). Total PCB concentrations ranged from nondetect to 15,000,000 µg/kg. Twenty-one of the 49 sampled locations did not have detectable levels of PCBs at the depth intervals sampled. The majority of the nondetect samples (grey-colored dot, Figure 3-7) were collected from locations outside of the former disposal area and/or along its perimeter. Eleven subsurface soil samples contained total PCB concentrations below the RSL. The samples were located both within and outside of the former disposal area's margin, at depths ranging between 2 and 23 feet bgs. The remaining 17 subsurface soil samples had concentrations reported above the PCB RSL.

The highest total PCB concentration of 15,000,000 µg/kg was in the 12- to 14-foot depth interval sample from AMS-SO01, along the eastern edge of the former disposal area. Staining and a "fuel-like" odor were noted on the boring log for that interval. The remaining sample with the elevated concentrations of PCBs (for example, SB-3, SB-7, SB-8, and GMSB-14) were also collected from borings along the eastern portion of the former disposal area at depths of between 11 and 21 feet.

#### 3.4.1.3 PCB Soil Summary

Review of the surface and subsurface soil PCB data from the Amcast South property indicates that the highest concentrations of PCBs are generally within the limits of the former disposal area, with concentrations increasing with depth to a maximum noted between 11 and 21 feet bgs The highest total PCB concentration in surface soil is at AMS-S005, located in the northern portion of the former disposal area. In subsurface soil, the highest total PCB concentration of 15,000,000 µg/kg was located in the 12- to 14-foot depth interval sample from AMS-SO01, along the eastern edge of the former disposal area.

### 3.4.2 Soil—Metals

Thirty-nine surface or subsurface soil samples have been collected and analyzed for metals from the Amcast South property. The locations of the surface and/or subsurface soil samples are listed in Table 3-3 along with sample depths and resultant detected arsenic and lead concentrations that exceed RSLs. Sample locations are presented in Figure 1-3.

Evaluation of the metals results indicates that arsenic is the metal most frequently detected at concentrations above its RSL (0.39 mg/kg). Although the arsenic concentrations exceed the RSL concentration, the detected concentrations fall within the range of baseline values (less than 1.0 mg/kg to 8.0 mg/kg) for glacially deposited soil within the Lake Michigan Lobe (Stensvold 2012), with the exception of AMS-SO04. An arsenic concentration of 8.2 mg/kg was reported for the sample from the 8- to 10-foot interval at AMS-SO04, only slightly exceeding the upper range from the USGS study, and is not considered to be indicative of historical activities at Amcast South.

There are two samples across two individually sampled depth intervals with concentrations of lead detected above the RSL (400 mg/kg) at one historical sample location (FSS-06 from November 2003, Figure 3-5). The lead concentration from the 1- to 3-foot interval was reported to be 1,200 mg/kg, and the 5- to 7- foot interval contained 430 mg/kg of lead. FSS-06 is located outside of the former disposal area boundaries, just west of the railroad tracks (Figure 3-7), and does not contain PCB or PAH concentrations exceeding standards. It is not apparent that the elevated lead concentrations are due to former activities associated with Amcast South.

### 3.4.3 Soil—PAHs

#### 3.4.3.1 Surface Soil

Fifteen surface soil samples were collected and analyzed for PAHs from the Amcast South property. Total PAH concentrations ranged from nondetect to 50,800 µg/kg. The maximum value of total PAHs of each surface soil location is presented in Figure 3-8. One of the 15 surface soil locations, AMS-SO02, located north of the Quonset building, did not have reportable levels of PAHs. The remaining 14 samples, which are located in the former disposal area and near the south end of the Quonset building, had at least one individual PAH detected at concentrations above their respective RSLs. The highest total PAH concentrations were reported in samples collected from locations AMN-SO06 and FVSB-11 within the former disposal area.

#### 3.4.3.2 Subsurface Soil

Fourteen subsurface soil samples were collected and analyzed for PAHs from the Amcast South property. Total PAH concentrations ranged from nondetect to 2,920 µg/kg. The maximum value of total PAHs at each sampled location is presented in Figure 3-9. Six of the 14 subsurface soil locations did not have reportable levels of PAHs and are situated outside of the boundary of the former disposal area, with the exception of AMS-SO05 (located at the northeast end of the former disposal area). At least one individual PAH was detected at a concentration above its respective RSL within the former disposal area and at FVMW-21 (located directly adjacent to the railroad tracks) and FVSS-01 (located west of the former disposal area). The highest detection of total PAHs in subsurface soil was located at FVSB-13 at a depth of between 8 and 10 feet.

#### 3.4.3.3 PAH Soil Summary

The areal distribution of PAHs in Amcast South surface and subsurface soil roughly correlates with the PCB distribution, but with the highest PAH concentrations being contained in surface soil.

### 3.4.4 Soil—VOCs

There were 115 surface and/or subsurface soil samples collected from 49 locations and analyzed for VOCs from Amcast South. None of the detected VOC concentrations for individual VOC compounds exceeds its respective RSL in any of the samples.

### 3.4.5 Amcast South Soil Summary

Descriptions about the items/debris observed in the former disposal area during drilling activities were consistent across various historical reports. The highest concentrations of PCBs were generally identified within the identified boundaries of the former disposal area, with some elevated surface soil concentrations adjacent to the Quonset building and west of the former disposal area. The spatial distribution of PAHs in surface and subsurface soils roughly correlates with the distribution of PCBs. One main difference is that PCB concentrations tend to increase in depth, with maximum concentrations observed between 11 and 21 feet bgs, whereas the highest concentrations of PAHs are found in surface soil. VOCs were not detected in soils, and RSL metals exceedances were limited to arsenic (naturally occurring) and lead.

## 3.5 Zeunert Park/Quarry Pond

A description of the activities and methods for the 2011 soil sampling is provided in the Soil and Sediment Investigation Technical Memorandum in Appendix A (CH2M HILL 2012b). Additional information for the surface water and fish tissue sampling is presented in the Field Sampling Summary, Aquatic Biological Investigation, Quarry and Wilshire Ponds Technical Memorandum (Appendix A; CH2M HILL 2012c). Details for historical investigations can be found in reports previously submitted by others. Samples collected from within Quarry Pond were analyzed for PCBs and TOC. Samples collected from Quarry Pond bank sediment and in Zeunert Park were analyzed for PCBs, TOC, and percent solids.

### 3.5.1 Quarry Pond Sediment

The data reported from previous investigations conducted in Quarry Pond provide a well-defined picture of PCB concentrations in Quarry Pond bottom sediments; therefore, an additional investigation was not conducted in 2011. Thirty-one sediment samples were historically collected from within Quarry Pond, with total PCB concentrations ranging from 1,300 µg/kg to 11,000,000 µg/kg. PCB data from sediment samples collected within Quarry Pond are summarized in Figure 3-10, where the maximum value of total PCBs detected at each location is presented.

The highest detected concentrations of PCBs are in the northern portion of the pond where the storm sewer discharge pipe, originating from the Amcast South property, empties into the pond. Concentrations decrease with distance from the outfall; however, the samples collected within the pond are greater than 1,000 µg/kg.

Evaluation of the PCBs concentrations versus sample depth indicate that the highest concentrations of PCBs, near the storm sewer outfall on the north side of the pond originating from the Amcast South property, were in samples from the intermediate depths, with less contaminated sediments sampled above and below the intermediate intervals. The PCB concentrations in the shallowest intervals in the area were two or three orders of magnitude lower than the intermediate sample intervals. Examples of this occurrence were observed in samples FVSC-01 to FVSC-05. The remaining samples throughout the pond generally had the highest PCB concentrations in the most shallow sample interval, which suggests that the new sediment entering the pond in the northern area is less contaminated than it was historically. The data suggest that the rate and distribution of deposition has decreased over time as evidenced by the presence of less contaminated shallow sediments on the north side in contrast to the absence of cleaner shallow deposits on the south side (Figure 3-10).

### 3.5.2 Quarry Pond Bank Sediment

An investigation was conducted in 2005 to characterize the PCB concentrations along the banks of Quarry Pond to determine if periodic flooding was depositing contaminated PCB sediment on the banks (ENSR 2005). To fill in data gaps identified from the 2005 investigation, a limited investigation was conducted during the 2011 RI investigation to define the extent of contamination on the banks with increasing distance from the pond. Sample locations and results are presented in Figure 3-10.

Samples collected from Transect No. 1, situated due north of the pond, had detectable levels of PCBs, but concentrations were below the PCB RSL. Samples collected from Transect No. 2 (ENBS-05A, B, C, D), adjacent to the north-northeast portion of the pond, had PCB concentrations above the RSL, with concentrations ranging from 830 µg/kg to 9,000 µg/kg. The area is lower in elevation than Transect 1 and more prone to flooding during periods of higher water.

Samples collected from Transect Nos. 3 and 4, completed along the eastern boundary of the pond, and from Transect Nos. 6 and 7 on the southern boundary, either did not contain detectable concentrations of PCBs or the detected concentrations were below the PCB RSL. However, soil Transect No. 5 (ENBS-02A, B, C) on the southeast boundary of the pond had sample concentrations above the PCB RSL, with concentrations ranging from nondetect to 470 µg/kg.

The sediment core samples collected adjacent to the transect lines either did not contain detectable levels of PCBs or the PCBs were detected at concentrations below the RSL.

### 3.5.3 Zeunert Park Surface Soil

Six surface soil samples were collected on the Zeunert Park grounds in 2011 to determine if PCBs were present in the surface soil. Sample AMZ-SO02 on the north side of the site detected a concentration of 2,000 µg/kg total PCBs, exceeding the PCB RSL of 220 µg/kg. On the southeast side of the site, adjacent to Transect No. 5, samples AMZ-SO04 and AMZ-SO05 had detections above the PCB RSL at concentrations of 260 µg/kg and 270 µg/kg, respectively. The remaining surface soil samples in Zeunert Park had PCB concentrations below the RSL or did not have detectable levels of PCBs.

### 3.5.4 Zeunert Park Subsurface Soil

Subsurface soil samples were collected by Foth & Van Dyke in October of 2003 while drilling monitoring wells (FVMW-23 and FVMW-24) on the eastern edge of Quarry Pond (Figure 1-5). PCBs were detected in two of the subsurface soil samples collected as follows:

- FVMW-23/14-16 feet bgs = Aroclor 1248 at a concentration of 77 µg/kg
- FVMW-24/20-22 feet bgs = Aroclor 1260 at a concentration of 900 µg /kg

PCBs were not detected in groundwater samples collected from monitoring well FVMW-23 in 2003 or 2004. Low concentrations of Aroclor 1248 and/or Aroclor 1260 were detected in samples collected from monitoring well FVMW-24 in 2003 and 2004. Monitoring well FVMW-24 is located in close proximity to the shoreline of Quarry Pond, which may be subject to flooding. PCBs were not detected in groundwater samples at either of the wells during the 2011 sampling event. See Section 3.7 for additional details.

### 3.5.5 Quarry Pond Surface Water

Eight surface water samples were collected in 2011 from Quarry Pond (Figure 1-5) and analyzed for metals, PCBs, SVOCs, VOCs, and total suspended solids. Three historical samples were also collected in 2003 and were analyzed for Aroclor 1248. PCBs were not detected in any of the surface water samples from the Quarry Pond.

Table 3-4 presents surface water sample results collected from Quarry Pond where at least one individual constituent concentration was detected above the ES or the USEPA Tapwater RSL. Arsenic was detected at concentrations above the tapwater RSL for 5 of the 8 samples collected in 2011. Similar to the arsenic in soil, the arsenic detected in Quarry Pond surface water is not thought to be associated with activities at the former Amcast South property.

Pentachlorophenol (PCP) was detected at concentrations above the NR 140 ES (1 µg/L) at 5 of the 8 samples in Quarry Pond surface water (Table 3-4, Figure 1-5). In addition, the total xylenes concentration measured at AMQ-SW01 was above the tapwater RSL. However, out of the 19 soil (surface or subsurface) samples collected on Amcast North that were analyzed for PCP, only two had detected concentrations at estimated values (AMN-SO008, 0- to 2-foot—12 µg/kg and AMNSO010, 4- to 6-foot—13 µg/kg). Of the 20 soil (surface or subsurface) samples collected on Amcast South that were analyzed for PCP, only one had detected concentrations at an estimated value (AMS-SO03, 0- to 2-foot—24 µg/kg). Based on the results of the soil and groundwater investigations, the concentrations of PCP detected in Quarry Pond surface water do not appear to be related to the former site operations.

### 3.5.6 Quarry Pond Fish Tissue

Fish tissue samples were collected in 2011 from Quarry Pond to support the human health and ecological risk assessments. Species of bottom feeders (black bullhead, white sucker) and water column predators (smallmouth bass) were targeted for tissue analysis.

The fish community structure and species diversity observed in Quarry Pond was limited to green sunfish (*Lepomis cyanellus*) and black bullhead (*Ameiurus melas*) as the dominant species. Water column predators were not present; therefore, the omnivorous green sunfish, a suspended feeder, was substituted for a water column predator. Ten black bullheads and six green sunfish were retained for fillet tissue analysis of PCBs and percent lipids to support a human health risk assessment. PCBs were detected in 3 of the 6 column feeder samples, with detected concentrations ranging from 2.7 to 4.3 mg/kg. PCBs were detected in 8 of the 10 bottom feeder samples, with detected concentrations ranging from 2.5 to 25 mg/kg.

Whole-body fish tissue samples of an appropriate size range for piscivorous wildlife (4 to 12 centimeters) were collected to support an ecological risk assessment. Five composite samples of a suspended feeder (green sunfish) and three samples of single individuals of bottom feeders (black bullhead) were retained for analysis of PCBs and percent lipids. PCBs were detected in 1 of the 5 suspended feeder samples at a concentration of 6.3 mg/kg. PCBs were detected in 1 of the 3 bottom feeder samples at a concentration of 5.2 mg/kg.

A detailed evaluation of the results from the biological investigation are also presented in the HHRA and ERA (Appendixes D and E).

### 3.5.7 Zeunert Park/Quarry Pond Summary

Distribution and concentrations of PCB-contaminated sediment in Quarry Pond suggest that the source of PCB contamination in the pond was from the Amcast South property and that input of PCB-contaminated sediment has significantly decreased over time. PCB contamination on the banks of Quarry Pond and in the Zeunert Park soil is coincident with the areas of the park that are more prone to flooding (north and southeast), which suggests that Quarry Pond sediment is likely the source of PCB contamination in the park, and that sediment particles suspended in the surface water were likely deposited on the shore during high-water/flooding events. A supplemental investigation may need to be conducted to delineate the nature and extent of contamination in Zeunert Park. Constituents detected in surface water above the WDNR ES or USEPA Tapwater RSL may not be site-related.

## 3.6 Storm Sewers

During several sampling events, sediment samples were collected from storm sewers and catch basins on the Amcast North/South properties or storm sewers and catch basins believed to be in connection with the Amcast sewerlines as indicated in Figure 1-6. In an effort to characterize flow direction and connectivity, dye testing, lamping, and visual inspections have been performed, as well as consultations with the City of Cedarburg, which provided current and historical as-built drawings and geographic information system files. Samples were collected in 2003, 2005, and 2007, although not at the same locations during each sampling event. The sample results are summarized in Table 3-5.

Total PCB sample concentrations from storm sewer locations, with the likely "origin area" being Amcast North, range in concentration from 65 µg/kg to 19,000 µg/kg. The stormwater from Amcast North is directed into one of two storm sewer mains that trend northwest-southeast along Wilshire Drive or through the residential yards. The storm sewers flow into the Wilshire Pond and eventually discharge to Cedar Creek. The storm sewers and catch basins within the Amcast North building are also connected to the sewerline that runs along the former drainage ditch. The hotspot sample at CB-9 (19,000 µg/kg) is located on the northeast side of the building and is connected to the storm sewer system in the building.

Total PCB sample concentrations from storm sewer locations, with the likely "origin area" being Amcast South, range in concentration from 135 µg/kg to 23,000,000 µg/kg. The stormwater in the lines at Amcast South coalesce at the south end of the site, flow under the railroad embankment, and discharge to Quarry Pond. The north and south sides of the Quonset building on the Amcast South property contain relatively higher total PCB concentrations in sewer sediment than the area farther away from the building. Concentrations of PCBs at FVSTM-11, ENSTM-49S, CB-3, FVSTM-29S, and ENSTM-47S range from 90,000 µg/kg to 23,000,000 µg/kg, with concentrations appearing to decrease downstream from the Quonset building.

Total PCB sample concentrations from storm sewer locations in Zeunert Park range from 2,000 µg/kg to 250,000 µg/kg. The flow of the storm sewer water at the Amcast South parcel is complex. A detailed summary of the storm sewer connectivity and flow paths was presented in Section 2.6, Surface Water Features.

## 3.7 Groundwater

The project database for groundwater sample results was compiled to contain both the historical and recent (2011) data sets. In 2011, existing groundwater monitoring wells associated with the former Amcast Site, including two new wells added that same year (one each at Amcast North and Amcast South), were sampled and analyzed for metals, PCBs, SVOCs, and VOCs. The locations of the sampled groundwater monitoring wells are shown in Figures 2-6 and 2-7.

### 3.7.1 Exceedance of the Maximum Contaminant Level/Enforcement Standard

Table 3-6 contains a summary of groundwater concentration detections, from both historical and recent data, where the USEPA's maximum contaminant level (MCL)/State of Wisconsin's ES criteria are exceeded.

#### 3.7.1.1 Amcast North

The three wells sampled at Amcast North have historically had concentrations of one or more compounds that exceed the MCL/ES, including chromium, lead, arsenic, bis(2-ethylhexyl)phthalate, and total PCBs. These include samples from shallow monitoring wells FVMW-26 and FVMW-27 screened in Unit 2 (clay and silt) and the newer AMN-MW01 screened in the (deeper) Unit 3 sands. In 2011, the only exceedances of MCL/ES at Amcast North were for chromium at well AMN-MW01 and arsenic at well FVMW-27.

#### 3.7.1.2 Amcast South

At Amcast South, historical or recent samples from 6 of the 10 wells contained concentrations that exceeded their respective MCL/ES for metals, VOCs, SVOCs, and PCBs. Bromodichloromethane in GMMW-1 was the only VOC compound detected in the three sampling events at concentrations exceeding the respective criteria. The source for the bromodichloromethane is not known. The only detection of this compound at the site was in GMMW-1, which is located in the northeast corner of the Amcast South property along Hamilton Road, upgradient of former Amcast South operations and cross gradient to former Amcast North operations.

Groundwater concentrations for lead, arsenic, and manganese exceed the MCLs/ESs at four of the six wells. Only arsenic in well GMMW-3 and lead in GMMW-4 are consistently detected (through multiple sample dates) at concentrations that exceed their respective standards.

Bis(2-ethylhexyl)phthalate exceedances are common amongst the Amcast South wells as shown in Table 3-6. Other SVOC/PAH constituents that have historically been detected above the MCL/ES include benzo(a)pyrene, benzo(b)fluoranthene, and chrysene, which were detected at GMMW-4 located in the former disposal area (Figure 1-3).

PCBs have been historically detected in samples from shallow monitoring wells FVMW-21 and GMMW-3 on Amcast South (Figure 1-3) that are screened in Unit 2 (clay and silt). During the 2011 monitoring event, PCBs (Aroclor 1248) were also detected at a concentration of 1.5 µg/L in AMS-MW01, which is screened in the (deeper) Unit 3 sands (Figure 2-7). The individual Aroclor concentration was above the PCB MCL/ES of 0.03 µg/L. PCBs were not detected in the other wells in 2011; however, FVMW-21 was not sampled because it is damaged. Recent and historical PCB detections in groundwater are listed in Table 3-7.

#### 3.7.1.3 Zeunert Park

There are two monitoring wells at the park, near the eastern edge of Quarry Pond, that are thought to be screened across or near the water table in the shallow (Unit 2) zone (soil boring logs are not available for these wells). FVMW-23 is situated directly adjacent to the northern end of Quarry Pond, with only one exceedance of a standard (manganese) in recent (2011) data; manganese concentrations do not exceed the standard at this well in any of the previous dates sampled (2003 and 2004).

FVMW-24, the well situated further south in the park and immediately adjacent to the eastern edge of the pond, has historical MCL/ES exceedances for PCBs. Review of recent sampling results found that concentrations for only two of the metals, arsenic and manganese, exceed the criteria.

## 3.8 Nature and Extent Summary

The findings of the field investigations relative to the nature and extent of contamination at the Amcast Industrial Site are described in the following subsections. PCBs (primarily Aroclor 1248) are the main contaminants in soil/sediment and/or surface water. There are also some detections of PAHs and metals above RSLs in soil/sediment samples. Individual VOC and non-PAH SVOC compounds were less frequently detected in soil/sediment, typically at concentrations lower than their respective RSLs. Historical groundwater detections of PCBs are very limited as to frequency and concentration.

### 3.8.1 Amcast North

Investigations at the Amcast North property have reported the detection of PCBs in the following areas: in stormwater; at former, apparent loading areas on the north side of the building and the southwest corner of the building; residential properties near the plant; and within the storm sewer system, including the stormwater retention area, referred to as Wilshire Pond. The highest concentrations of PCBs in soil at Amcast North are generally limited to the top 5 feet and occur on the grounds surrounding the building (for example, grassy or asphalt-paved areas). The only metal compound detected in Amcast North soil above an RSL concentration is arsenic, within the range of naturally occurring values. The highest concentrations of total PAHs at Amcast North are generally limited to the top 5 to 6 feet of soil and predominately occur on the northeast, southeast, and southwest corners of the property. None of the detected VOC concentrations in soil samples exceed its respective RSL for individual VOC compounds.

The three monitoring wells sampled at Amcast North have historically had groundwater concentrations of chromium, lead, arsenic, bis(2-ethylhexyl)phthalate, and total PCBs that exceed the MCL/ES. Arsenic has been shown to occur naturally in the soil in Southeast Wisconsin.

### 3.8.2 Residential Yards

The residential yards have elevated concentrations of PCBs greater than 1,000 µg/kg, which is the cleanup level for high-occupancy areas without further restrictions per USEPA 40 *Code of Federal Regulations* 761.61, in at least 1 sample on 18 parcels. Due to the spatial distribution of PCBs with concentrations above the RSL cleanup level, and the varying concentrations of PCBs within a specific parcel, the residential yards may need to be further evaluated on a parcel-by-parcel basis in regard to remediation. One or more properties were not characterized due to access issues.

### 3.8.3 Wilshire Pond

Each of the 17 sediment samples collected from Wilshire Pond contained total PCB concentrations above the soil RSL, with the highest concentrations occurring near the present day and former stormwater inlet to the pond. PCB concentrations in sediment samples collected farther "downstream" if these inlets are generally one to two orders of magnitude lower than those detected near the inlets. Similarly, surface water sample results within Wilshire Pond have higher concentrations immediately downstream of the present-day pipe inlet (exceedances of aluminum and manganese) and in one "downstream" location (exceedance of aluminum). PCBs were not detected in Wilshire Pond surface water samples. PCBs were detected in fish tissue samples within Wilshire Pond. A detailed evaluation of the biological investigation is presented in the ERA.

### 3.8.4 Amcast South

Investigations at the Amcast South property have detected the presence of PCBs in soils in the following locations: below the parking lot, the railroad right-of-way east of the parking lot, the fill and subsurface soils below the former disposal area, the storm sewer system, and the groundwater. The highest concentrations of PCBs at Amcast South are generally limited to the former disposal area at the south end of the site, with some elevated surface soil concentrations adjacent to the Quonset building and west of the former disposal area. The spatial distribution of PAHs in surface and subsurface soils roughly correlates with the distribution of PCBs, except that the highest concentrations of PAHs are found in surface soil, whereas the highest concentrations of PCBs are found at depth in the former disposal area. VOCs were not detected in soil samples at Amcast South, and RSL exceedances for metal constituents were limited to arsenic and lead.

Historical or recent groundwater from well samples at Amcast South contained concentrations that exceed their respective MCL/ES for metals, VOCs, SVOCs, and/or PCBs in 6 of 10 wells. Groundwater concentrations of metals detected above the MCL/ES include lead, arsenic, and manganese. PAH constituents detected above the MCL/ES in the Amcast South wells include benzo(a)pyrene, benzo(b)fluoranthene, and chrysene, Temperature is also an important factor controlling the rate of microbial dechlorination of PCBs. Temperatures in the range of 12 to 25 degrees Celsius support dechlorination, whereas dechlorination was not observed at temperatures greater than 37 degrees Celsius.

Biodegradation of PCBs in aerobic or anaerobic groundwater has not been studied, although PCBs have been reported in groundwater environments. In aerobic groundwater, less-chlorinated PCB congeners, which would be more likely to leach, presumably biodegrade based on studies in aerobic surface waters and soil. However, groundwater is also commonly anaerobic, and microbial degradation under low oxygen conditions proceeds for even the more highly chlorinated congeners (ATSDR 2000).

## 4.3.2 Semivolatile Organic Compounds

### 4.3.2.1 Polynuclear Aromatic Hydrocarbons

PAHs include a broad class of compounds ranging from low molecular weight (LMW) compounds such as benzo(a)anthracene, to high molecular weight (HMW) compounds such as dibenzo(a,h)anthracene. Benzo(a)pyrene was selected as the representative chemical for this PAH contaminant category because it was one of the most frequently detected compounds in soil. This compound was also conservatively selected to represent the PAH compound class because it is considered to be carcinogenic with relatively low soil and water screening criteria. In regard to groundwater and surface water, benzo(a)pyrene was detected three times in groundwater and once in surface water. There was no PAH analysis for pond sediment. Characteristics of benzo(a)pyrene are included in Table 4-3.

Solubility and volatility vary widely amongst the PAHs but they are generally low values in comparison to the other compound classes (Table 4-3). PAH constituents present in soils may be adsorbed to soil organic carbon. The LMW PAHs have higher water solubility values and are more likely to be released into groundwater than the higher molecular weight PAH compounds.

Benzo(a)pyrene has low water solubility (Table 4-3) and strong sorption to soil particles, and thus limited leaching potential. It also has low vapor pressure that results in low potential for the contaminant to migrate to the atmosphere.

Photolysis and biodegradation are two common attenuation mechanisms for PAHs. Although PAHs transform in the presence of light by photolysis, the transformation rates are highly variable among different PAHs. Photolysis may reduce concentrations of these chemicals in surface water or surface soils, but it is not relevant to subsurface soil. The ease of biodegradation of PAHs in soil is also extremely variable across the chemical class. Site-specific biodegradation estimates are difficult because of the many factors that affect the rate, including the availability of electron receptors, types of microorganisms present, the availability of nutrients, the presence of oxygen, and the chemical concentration (Federal Remediations Technology Roundtable 2002).

PAH degradation occurs more slowly in aquatic environments than in the atmosphere, and the cycling of PAHs in aquatic environments is poorly understood. In surface water, PAHs can evaporate, disperse into the water column, become incorporated into bottom sediments, concentrate in aquatic biota, or undergo chemical oxidation and biodegradation. The most important processes for the degradation of PAHs in aquatic systems are photo oxidation, chemical oxidation, and biological transformation by bacteria and animals. Most PAHs in aquatic environments are associated with particulate materials. Only about 33 percent are present in dissolved form. PAHs degrade most rapidly at higher concentrations, at elevated temperatures, at elevated oxygen levels, and at higher incidences of solar radiation. PAHs detected in groundwater may be associated with particulate matter with unfiltered samples.

Animals and microorganisms can metabolize PAHs to products that undergo complete degradation. PAHs in soil may be assimilated by plants, degraded by soil microorganisms, or accumulated to relatively high levels in the soils. Specific enzymes present in mammals metabolize PAHs, making them water soluble and available for excretion. Metabolic pathways detoxify PAHs, but some metabolic intermediates may be toxic, mutagenic, or carcinogenic to the host. Fish and most crustaceans possess the enzymes necessary for metabolism and excretion, but some mollusks and other invertebrates are unable to efficiently metabolize PAHs.

Literature values vary widely for half-life estimates for PAHs because of the numerous variables involved. Using conservative half-life estimates, PAHs show an increase in half-life associated with an increase in molecular weight. The half-life estimate for benzo(a)pyrene is from 57 to 2,117 days in soil or groundwater (Howard, et al. 1991).

#### 4.3.2.2 Non-PAH SVOC

Characteristics of bis(2-ethylhexyl) phthalate (DEHP) are provided to represent the non-PAH members of the SVOC compound class. DEHP is a colorless to slightly yellowish oily liquid, and a member of a group of compounds commonly referred to as the phthalate esters, whose predominant use is as plasticizers in flexible products made from polyvinyl chloride (ATSDR 2002). DEHP was selected as a representative compound for non-PAH SVOCs because it is a carcinogenic SVOC constituent whose characteristics are similar to other non-SVOC compounds detected at the site. DEHP was not detected in the 39 soil samples that were analyzed for DEHP from the Amcast Industrial Site. DEHP was, however, detected in 10 out of 24 groundwater samples (9 at concentrations exceeding the ES) collected in 2003 and 2004 data (no detections in 2011 data). DEHP was also analyzed but not detected in surface water samples from Wilshire Pond (5 samples) and Quarry Pond (5 samples). None of the sediment samples were analyzed for DEHP.

Volatilization from water or soil is not a dominant transport process for DEHP based on the low Henry's law constant (Table 4-3). It has been estimated that the evaporative half-life of DEHP from water would be about 15 years, and that only about 2 percent of DEHP loading of lakes and ponds would be volatilized.

When DEHP is released to soil or sediment, it adsorbs strongly and does not undergo significant photolysis, hydrolysis, or volatilization in soil or water. When released to groundwater, it dissolves slowly and is generally persistent in the subsurface.

Under aerobic (but not anaerobic) conditions, DEHP can be broken down by microorganisms to carbon dioxide and simpler chemicals. Biodegradation of DEHP occurs in the soil but at a slower rate than in water since adsorption onto the soil organic matter reduces the availability of DEHP for degradation. Anaerobic biodegradation of DEHP in sediments is reported to occur, but more slowly than under aerobic conditions.

Complexation of DEHP with fulvic acid, a compound associated with humic substances in water and soil, might increase solubilization and thus increase the mobility of DEHP in aquatic systems. The presence of common organic solvents such as alcohols and ketones might increase the solubility of relatively insoluble compounds such as DEHP, thereby increasing the amounts that might leach from the waste into subsoil and groundwater.

Bioconcentration of DEHP has been observed in invertebrates, fish, and terrestrial organisms. Residues of DEHP have been found in the organs of terrestrial animals such as rats, rabbits, dogs, cows, and humans, but accumulation of DEHP is minimized by metabolism. Biomagnification of DEHP in the food chain is not expected to occur. Uptake of DEHP from soil by plants has also been reported.

### 4.3.3 Volatile Organic Compounds

As a compound class, VOCs are relatively more soluble and more volatile than the other compound classes detected at the Amcast Industrial Site (Table 4-3). Of the 162 soil samples analyzed for VOCs at Amcast North and South portions of the site, none of the sample results for any of the individual VOCs detected exceeded their respective RSLs. Acetone, toluene, and cis-1,2-dichloroethene were the compounds that were detected in soil but at concentrations below RSLs. Detected VOC concentrations in groundwater also did not exceed their respective standards (the USEPA MCL/WDNR ES) with the exception of bromodichloromethane in GMMW-1 (Amcast North) at concentrations ranging from 1.1 to 1.4 μg/L. VOCs detected in groundwater (not exceeding RSLs) include the following: 1,2, 4-trimethyylbenzene; 1,2-dichloroethane; 1,2-dichloropropane; 2-butanone; 2-hexanone; benzene; bromodichloromethane; chloroform; ethylbenzene; isopropylbenzene;

methylcylohexane; n-propylbenzene; toluene; trans-1,3-dichloropropene; trichloroethene; and xylenes. Information on a subset of VOCs is provided in Table 4-3. Expanded information is provided on ethylbenzene as a representative VOC at Amcast Industrial Site.

The following is summarized from ATSDR 2010: Ethylbenzene is present in gasoline, automobile emissions, solvents, pesticides, printing ink, varnishes, coatings, and paints. Ethylbenzene is widely present at low concentrations in rural, suburban, and urban atmospheres, with the highest concentrations generally detected in areas of gasoline stations, tunnels, highways, and parking lots. Releases of ethylbenzene to surface soil can result in substantial losses to the atmosphere in addition to subsurface infiltration, depending upon site-specific conditions. Since it has a moderately high vapor pressure, ethylbenzene will evaporate fairly rapidly from dry soil. Vapor-phase transport will occur from subsurface releases (that is, from leaking USTs) and during migration through unsaturated soil pore spaces. Ethylbenzene is classified as having moderate mobility in soils. Sorption and retardation by soil organic carbon content will occur to a moderate extent, but sorption is not significant enough to completely prevent migration in most soils. Particularly in soils with low organic carbon content, ethylbenzene will tend to leach into groundwater. Mobility is also possible in aquifers that contain very little solid-phase organic matter.

The large vapor pressure and Henry's law constant of ethylbenzene suggests a moderate to strong tendency for ethylbenzene to partition into the atmosphere from either soil or water matrices, where it will exist predominantly in the vapor phase. Ethylbenzene dissolved in surface water, soil pore water, or groundwater will thus migrate into an available atmospheric compartment until its saturated vapor concentration is reached. Biodegradation in soil will also compete with transport processes such as volatilization and infiltration to groundwater. Because ethylbenzene migration is only moderately retarded by adsorption onto soil, leaching of the compound to an anaerobic environment (groundwater) is possible before biotransformation occurs in soil and may allow ethylbenzene to persist in an aquifer.

In surface water, transformations of ethylbenzene may occur through two primary processes—photo oxidation and biodegradation. Although ethylbenzene does not absorb light in the environmental ultraviolet spectrum, it is capable of undergoing photo oxidation in water through an indirect reaction with other light-absorbing molecules, a process known as sensitized photolysis, expected to occur in the presence of ubiquitous, naturally occurring humic material. Hydrolysis is not considered an important environmental fate process for ethylbenzene.

Biodegradation in aerobic surface water will compete with sensitized photolysis and transport processes such as volatilization. Ethylbenzene biodegradation by methanogenic and fermentative bacteria also appears to occur, but at significantly lower rates.

In comparison to chemicals such as PCBs, which are of great concern with respect to bioaccumulation, ethylbenzene does not significantly bioaccumulate in aquatic food chains.

### 4.3.4 Metals

Metals are naturally occurring, and their fate and transport in the environment is complicated by varying conditions of pH, organic content, and the concentrations of metal salts (Eisler 1988). They are also present in the environment in various valence states. Most metals entering natural waters are either hydrolyzed or precipitated as carbonates or hydroxides (Eisler 1993). Metals adsorb to iron, manganese, and aluminum oxyhydroxide or oxide coatings on soil.

The environmental fate of metals differs significantly from that of organic compounds. Metals in surface soil tend to be immobile. The contaminants are strongly sorbed to soil, relatively insoluble in water, and typically nonvolatile; however, metals can potentially be transported with eroded, moving with soil particles in surface runoff. Leaching of metals from soil with precipitation and subsequent downward transport/infiltration is typically unimportant for metals because of their low solubility in water.

Metals may undergo chemical transformations, but they do not degrade. Transformations include changes in oxidation state, precipitation with anions, adsorption, combination with organic liquids, or uptake by organisms. Valence state transformation, caused by oxidation or reduction processes, could have a significant effect on the mobility of an inorganic, either increasing or decreasing it.

If metals are present in dissolved groundwater, adsorption plays a key role in controlling their mobility. Natural organic matter that may be present in an environmental system can act as a complexing agent, keeping trace elements in solution that would otherwise adsorb to aquifer particles or precipitate.

The determination of site-specific soil/water distribution coefficient and retardation factors for inorganic constituents is complicated because inorganic constituents are affected by a number of variables, including pH, redox conditions, dissolved oxygen concentrations, iron oxide content, cation exchange capacity, and major ion chemistry, as well as the organic content of the aquifer materials. For this reason, single generic $K_d$ values cannot be assigned for individual metals in the same way as they are for individual organic constituents.

Under low pH conditions (pH less than 4), metals can be solubilized and migrate in soil and groundwater. At the more neutral pH (ranging from 6.61 to 7.41 during 2011 sampling) and oxidizing conditions (8 out of 12 field measured values) that were measured in the Amcast Site groundwater (CH2M HILL 2012a), metals are not expected to be particularly mobile or to form a dissolved groundwater "plume".

Metals generally have relatively higher $K_{oc}$ values and may bioaccumulate more readily. Biodegradation is not expected to occur with metals and other elements because of their elemental nature. The metal content of soil is assumed to have a default half-life of $10^8$ days unless site-specific information is presented showing that soil conditions will result in the loss of soil metal content (such as from leaching or weathering). Metals and other elements for which this soil half-life applies include arsenic and chromium(VI) (Cohen et al. 1994).

### 4.3.5 Manganese

At the Amcast Industrial Site, the only metal compounds detected at concentrations exceeding RSLs in surface or subsurface soil at Amcast North or Amcast South are arsenic (determined to be within the natural background concentration range for southeastern Wisconsin) and lead (two detections above standards in one historical soil boring on Amcast South—outside of the former disposal area). In the two surface water bodies, arsenic (likely natural as a result of natural soil concentrations), aluminum, and manganese are the only metal compounds detected above the NR 140 ES. Manganese has the highest concentration of metal compounds detected above the NR 140 ES in 2011 groundwater samples (Table 3-6). Manganese is ubiquitous in the environment, and human exposure arises from both natural and anthropogenic activities. It occurs naturally in more than 100 minerals with background levels in soil ranging from 40 to 900 mg/kg, and an estimated mean background concentration of 330 mg/kg (Barceloux 1999). It occurs naturally in surface water and groundwater with a median dissolved manganese concentration of 24 μg/L in samples from 286 U.S. rivers and streams (Smith et al. 1987).

There were two mechanisms involved in explaining the retention of manganese and other metals in the environment (Evans 1989). First, manganese ions and the charged surfaces of soil particles form manganese oxides, hydroxides, and oxyhydroxides through cation exchange reactions. The materials in turn form absorption sites for other metals. Second, manganese can be adsorbed to other oxides, hydroxides, and oxyhydroxides through ligand exchange reactions. When the soil solution becomes saturated, the manganese oxides, hydroxides, and oxyhydroxides can precipitate into a new mineral phase and act as a new surface onto which other substances can absorb.

Transport and partitioning of manganese in water is controlled by the solubility of the specific chemical form present, which in turn is determined by pH, Eh (oxidation-reduction potential), and the characteristics of the available anions. Manganese may exist in water in any of four oxidation states; however, Mn(II) predominates in most waters (pH of 4–7), but may become oxidized under alkaline conditions at pH greater than 8. The principal anion associated with Mn(II) in water is usually carbonate ($CO_3^{-2}$), and the concentration of manganese is limited by the relatively low solubility (65 milligrams per liter) of manganese carbonate. Under oxidizing conditions, the solubility of Mn(II) may be controlled by manganese oxide equilibria (Ponnamperuma et al. 1969), with manganese being converted to the Mn(II) or Mn(IV) oxidation states (Rai et al. 1986). In extremely reduced water, the fate of manganese tends to be controlled by formation of a poorly soluble sulfide. If the amount of dissolved oxygen is decreased in groundwater, Mn(IV) can reduce both chemically and bacterially into the Mn(II) form, which is water soluble and easily released into the groundwater (Jaudon et al. 1989). Oxidation-reduction conditions are not expected to change within site groundwater, but as groundwater discharges into the ponds or other ditches or tributaries, manganese will precipitate as it is oxidized.

Manganese compounds have negligible vapor pressures and therefore are unlikely to volatilize from the soil or groundwater to any extent. Manganese is a common trace metal and does not biodegrade.

## 4.4 Conceptual Site Model

The CSM is a summary of site conditions, including potential contaminated source areas and media, associated contaminants or contaminant types per media, and the most likely release/transport mechanisms for each medium. The information has been compiled for the Amcast Industrial Site and is presented in the following subsections.

### 4.4.1 Potential Contaminant Source Areas

An understanding of continuing source areas is critical to understanding how contaminants may continue to disperse into the environment if no action is taken. The identified source materials and/or affected areas include those listed in the first column in Table 4-4, which are based on the nature and extent of contamination observed at the site. The CSM is quite complex because of the separate, former operational areas at Amcast North and South and the former disposal area at Amcast South. The affected areas associated with the former Amcast North operations include the residential yards that are adjacent to Amcast North, Wilshire Pond, and the sewers that drain from Amcast North toward Wilshire pond. The potentially affected areas associated with the former Amcast South operations include the Quarry Pond, Zeunert Park, and the sewers that drain toward the Quarry Pond from Amcast South. Groundwater is considered on a sitewide basis.

### 4.4.2 Release and Transport Mechanisms

Potential routes of migration for contamination exist where chemicals can be released to the environment from existing source material that may include original sources or media that is now contaminated by original sources. The second column of information in Table 4-4 lists the potential release and transport mechanisms for each area/media on the site. In addition, a conceptual depiction of site features and associated, potential release and transport mechanisms is indicated in Figure 4-1.

The primary contaminant release and transport mechanisms from the Amcast Industrial Site summarized in the following subsections.

#### 4.4.2.1 Within Sewers

Movement of suspended or dissolved site compounds in water or sediment within storm sewers in a down-pipe/downstream direction toward Wilshire Pond or Quarry Pond. The PCBs in the sewer sediment tend to persist in the environment because they are slow to degrade through natural biologic or other processes. The PCBs will likely remain sorbed to sediment particles as opposed to becoming dissolved. As long as the PCB-contaminated sediment remains in the storm sewers they will act as a continuous source, moving down-pipe/downstream with stormwater, toward either Wilshire or Quarry Pond. Wilshire Pond has an outflow storm sewer that discharges toward Cedar Creek.

#### 4.4.2.2 Biological Uptake

Biological uptake by organisms of contaminated sediments in Wilshire Pond or Quarry Pond. Site-related contaminants such as PCBs can bioaccumulate in organisms.

#### 4.4.2.3 Surface Runoff from Contaminated Soil

Surface runoff of suspended or dissolved contaminants can occur from impacted soil to ditches, low-lying areas, or surface water bodies. The main contaminants in the surface soil (PCBs and PAHs), and subsurface soil (PCBs) tend to be persistent in the environment because they are slow to degrade. Transport of contaminants sorbed to soil particles in runoff will take precedence over dissolved contaminant transport because PCBs and PAHs have low solubility constants.

#### 4.4.2.4 Surface Runoff from Contaminated Sediment or Surface Water in Ponds

Surface runoff of suspended or dissolved contaminants may occur from Wilshire Pond or Quarry Pond to surrounding areas during high water events. Suspended contaminated sediment containing PCBs could be deposited adjacent to the ponds during high water events, with the sediment adding to the overall soil contamination. Dissolved site constituents such as metals (aluminum or manganese) are most likely to travel in surface runoff from Wilshire Pond; from Quarry Pond, the likely dissolved contaminant is PCP. The metals would likely either sorb to solid surfaces, once deposited, or combine with other constituents to form insoluble minerals. The PCP is more likely to remain in the dissolved phase due to its relatively high solubility.

#### 4.4.2.5 Infiltration to Groundwater from the Amcast South Former Disposal Area

Leaching of contaminants into groundwater may occur near the former disposal area on the Amcast South property. For the groundwater monitoring wells that are located near the former disposal area, the only wells with concentrations exceeding MCLs/ES in 2011 are GMMW-3, GMMW-4, and GMMW-7. Arsenic (identified in soil at natural/background concentrations) and manganese were the only constituents to exceed the criteria in 2011. Release and transport of contaminants associated with the disposal area are therefore considered to be of minimal importance.

#### 4.4.2.6 Infiltration to Groundwater from Soil

Leaching of contaminants into groundwater may occur after precipitation if there is infiltration through impacted zones. Dissolved contamination would migrate through contaminated soil, merge with the saturated zone groundwater, travel with groundwater flow, and potentially discharge to surface water bodies such as Wilshire Pond or Quarry Pond. Because surface and subsurface soil contaminants are chiefly PCBs and PAHs with limited dissolved mobility, this release and transport mechanism is of decreased importance.

#### 4.4.2.7 Dispersal of Site Contaminants into the Atmosphere by Volatilization or on Particulates

Building materials at Amcast North were not sampled/characterized in 2011 due to the deteriorated condition of the building, so the significance for this transport mechanism is not known. However, particulate transport is expected to be more important than volatilization because of the characteristics of likely building contaminants (PCBs, asbestos, and lead-based paint).

#### 4.4.2.8 Movement of Existing Groundwater Contaminants

Except for two groundwater concentrations detected in wells on Amcast South, the only metals constituents detected in the sitewide groundwater in 2011 at concentrations exceeding their respective MCL/ESs are chromium, arsenic, and manganese. As with metals, these contaminants are strongly sorbed to soil, relatively insoluble in water, and typically nonvolatile. Metals may undergo chemical transformations (oxidation state, precipitation with anions, adsorption, uptake by organisms, and precipitation in various mineral forms), but they do not degrade. Adsorption plays the key role in controlling their mobility. Migration of metals within groundwater is not expected to occur to an extensive degree.

The only exceedance of non-metallic groundwater standards at the Amcast Industrial Site in 2011 include an exceedance of total PCBs at AMS-MW01 (1.5 μg/L versus the ES of 0.03 μg/L) and an exceedance of bromodichloromethane at GMMW-1 (1.1 μg/L versus the ES of 0.6 μg/L). The very low concentrations of the two constituents are not expected to cause mobile groundwater plumes downgradient of their detected well locations.

### 4.4.3 Impacts to Human Health and the Environment

Potential exposure to the site-related contamination for human and ecological receptors is evaluated in Appendix D for human receptors (HHRA) and Appendix E (ERA) for ecological receptors. The documents are also summarized in Sections 5 and 6 of this RI report.

SECTION 5

# Human Health Risk Assessment

An HHRA was conducted to evaluate potential current and future health risks from exposure to soil, sediment, surface water, biota (fish), and groundwater. The complete HHRA is presented in Appendix D. Section 5 summarizes the key components and findings of the HHRA.

## 5.1 HHRA Chemicals of Potential Concern

Analytical results for soil (surface and subsurface), groundwater, surface water, sediment, and biota samples collected during various investigations from 1992 to 2011 were used in the HHRA. Soil analytes that were evaluated include metals, VOCs, SVOCs, and PCBs. Groundwater and surface water sample analytes evaluated include metals (total and dissolved), VOCs, SVOCs, and PCBs. PCB data for fish tissue samples and sediment samples were evaluated.

The soil data were divided into groupings based on their locations (Amcast North, Amcast South, Zeunert Park and Quarry Pond banks, residential yards, and Wilshire Pond banks) and then subdivided into the following specific exposure depths: (1) Amcast North, surface soil (0 to 2 feet bgs) and total soil (0 to 10 feet bgs); (2) Amcast South, surface soil (0 to 2 feet bgs) and total soil (0 to 10 feet bgs); (3) Offsite Residential Yards, surface soil (0 to 2 feet bgs); (4) Zeunert Park, surface soil (0 to 2 feet bgs) and non-submerged sediment collected from the banks of the Quarry Pond; and (5) Wilshire Pond, non-submerged sediment samples collected from the banks were evaluated as soil. Risk estimates and hazards associated with potential exposures in offsite residential yards were not calculated. Alternatively, PCB concentrations were compared to the soil clean-up level of 1 ppm for high-occupancy areas without further restrictions per USEPA 40 CFR 761.61. A total PCB concentration of 1 ppm will be used as the trigger for remedial action in the residential area.

Groundwater samples were collected from Amcast North, Amcast South, and the Quarry Pond; however, the groundwater samples were merged to create one sitewide groundwater grouping.

The sediment data set used in the HHRA consists of samples collected from the Quarry Pond and Wilshire Pond. Some sediment samples collected from residential properties, the Wilshire Pond banks, and the Quarry Pond banks were addressed as soil. In the HHRA, sediment samples were divided into the following two groupings: Quarry Pond and Wilshire Pond. The surface water data set to be used in the HHRA consists of samples collected from the Quarry Pond and Wilshire Pond. In the HHRA, surface water samples were divided into the following two groupings: Quarry Pond and Wilshire Pond.

Fish fillet samples collected from the Quarry Pond were used in the HHRA. Fish fillets were collected from bottom feeders (black bullhead) and suspended feeders (green sunfish). The fish fillet sample grouping consists of 10 bottom feeder fish samples and 6 suspended feeder fish samples.

HHRA chemicals of potential concern (COPCs) were identified for soil, surface water, sediment, groundwater and biota by comparing the maximum detected concentration of each chemical in a data grouping to its respective screening level (SL). If the maximum detected concentration exceeds its SL, it was retained as a COPC for the HHRA. Chemicals not detected in an exposure medium/data grouping were not selected as COPCs.

The SLs used in the HHRA are the USEPA RSLs for Chemical Contaminants at Superfund Sites (USEPA 2013b). Soil concentrations were compared to the soil RSLs. SLs for fish ingestion were calculated using the default exposure assumptions in the USEPA RSL Calculator for fish consumption (USEPA 2013c). Surface water and groundwater concentrations were compared in the HHRA against Wisconsin's Public Health Groundwater Quality Standards Preventive Action Limits presented in Wisconsin Administrative Code NR 140 in addition to the USEPA RSLs for the selection of COPCs. SLs for the groundwater-to-indoor air pathway (that is, vapor intrusion) were calculated using the USEPA Vapor Intrusion Screening Level (VISL) Calculator tool (USEPA 2013c). The HHRA COPCs identified for each environmental medium are listed by site area in Table 5-1.

## 5.2 Exposure Evaluation

Potential current and future receptors were evaluated in the HHRA. As noted in Section 3.1 of Appendix D and in the conceptual model parameters of potential human receptors (Appendix D, Figure 1 of Attachment B and Table 1 of Attachment A), current/future receptors evaluated in the HHRA consisted of onsite trespassers (adolescent [6 to 16 years old]), offsite residents (adult and child), offsite recreational users (adult and child), and offsite recreational anglers (adult and child). Onsite industrial workers, construction workers, and residents (adult and child) were identified as potential future receptors.

The following potential exposure pathways were quantified for potential current/future and future receptors identified at the Amcast Industrial Site.

- **Current Onsite Trespassers**—Adolescent (6 to 16 years old) trespassers who may contact onsite surface soil at Amcast North and Amcast South properties.
- **Current/Future Offsite Residents**—Adult and child residents who may contact surface soil in residential yards.
- **Current/Future Offsite Recreational Users**—Adult and child recreational users who may contact offsite soil at Zeunert Park, banks of the Quarry Pond and Wilshire Pond, and Quarry Pond and Wilshire Pond sediment and surface water.
- **Current/Future Offsite Recreational Anglers**—Adult and child anglers who may consume fish caught at Quarry Pond.
- **Future Onsite Residents**—Adult and child residents who may contact soil, groundwater, and indoor air (affected by potential vapor intrusion originating VOCs in groundwater), assuming that the site is developed for residential use in the future.
- **Future Onsite Industrial Workers**—Industrial workers who may contact soil, groundwater, and indoor air (affected by potential vapor intrusion originating from VOCs in groundwater), assuming that the site is developed as an industrial facility in the future.
- **Future Onsite Construction Workers**—Construction workers who may contact surface/subsurface soil during future site redevelopment/construction activities.

## 5.3 Risk Estimates

USEPA's target (acceptable) range for excess lifetime cancer risk (ELCR) associated with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites is 1-in-10,000 ($1 \times 10^{-4}$) to 1-in-1,000,000 ($1 \times 10^{-6}$). Similarly, the target (acceptable) noncancer hazard index (HI) is 1 or less per target organ. Risk estimates were calculated for potential receptors and exposure pathways using conservative assumptions for exposure factors and exposure point concentrations as detailed in Appendix D. The risk estimates are summarized in Tables 5-2 (current exposure scenarios), 5-3 (current/future exposure scenarios), and 5-4 (future exposure scenarios).

## 5.4 HHRA Chemicals of Concern

Chemicals of concern (COCs) were identified based on where the potential site-related ELCR or HI for a receptor group exceeded USEPA threshold values (a total ELCR greater than $1 \times 10^{-4}$ or a target-organ-specific HI greater than 1.0). For each receptor group, when a potential site-related ELCR of $1 \times 10^{-4}$ was exceeded for an environmental medium, the HHRA COPCs posing an individual ELCR greater than $1 \times 10^{-6}$ in that environmental medium were identified as HHRA COCs. When a potential site-related target organ HI exceeded 1 for an environmental medium, the COPCs posing a hazard quotient (HQ) greater than 0.1 for the target organ in that environmental medium were identified as COCs. The identified HHRA COCs are shown in Table 5-5.

# 5.5 HHRA Uncertainties

Uncertainties are present in the risk assessments because of the limitations of the available data and the need to make certain assumptions and extrapolations based on incomplete information. In addition, the use of various models carries with it some associated uncertainty as to how well the model reflects actual conditions. Since conservative assumptions were generally used, the uncertainties are more likely to result in an overestimation rather than an underestimation of the likelihood and magnitude of risks to human receptors. The uncertainties, and their potential impact on the HHRA, are discussed in Appendix D.

SECTION 6

# Ecological Risk Assessment

## 6.1 Introduction

A screening ecological risk assessment (SERA) and the first step (Step 3A) of the baseline ecological risk assessment (BERA) were conducted to evaluate whether site-related contaminants, present on the site and in surrounding areas connected to the site through complete transport pathways, represent a potential unacceptable risk to exposed ecological receptors. The assessment was performed in accordance with the *Ecological risk assessment guidance for Superfund: process for designing and conducting ecological risk assessments* (USEPA 1997). The outcome of the Step 3A will determine how the ERA process should proceed. The ERA consists of the SERA with the refined exposure assumptions (Step 3A) and is included as Appendix E.

The following subsections and Table 6-1 present the findings related to the identified COPCs for the various terrestrial and aquatic areas across the site and the associated potential estimated risks. Based on the findings, it is recommended that the ERA process continue beyond Step 3A for all areas with identified COPCs as discussed further below.

## 6.2 Terrestrial Habitats

### 6.2.1 Amcast North

Manganese, Aroclor-1248, and total PCBs were identified as final surface soil COPCs for direct exposures of lower trophic level receptors. The results of the terrestrial food web evaluation identified Aroclor-1248 and total PCBs as final COPCs. The potential risks were driven largely by short-tailed shrew exposures. Given the relatively poor habitat quality present in this area, the identified potential risks are likely of low ecological significance.

### 6.2.2 Residential Area

Aroclor-1248, Aroclor-1254, and total PCBs were identified as final COPCs in surface soil for direct exposures of lower trophic level receptors. However, potential risks to these receptors are relatively low. Based on a soil ecological screening value (ESV) for terrestrial plants of 8,000 μg/kg (including an uncertainty factor of 5), the maximum HQ in this area is 1.6; HQs based on 95 percent upper confidence limit (95% UCL) and mean concentrations would be 0.41 and 0.27, respectively. Given the relatively low habitat quality present in this area, it is likely that exposures and potential risks are low. The results of the terrestrial food web evaluation also identified Aroclor-1248, Aroclor-1254, and total PCBs as final COPCs. Potential risks were driven largely by short-tailed shrew exposures.

### 6.2.3 Amcast South

Copper, manganese, Aroclor-1248, Aroclor-1254, total PCBs, and HMW PAHs were identified as final surface soil COPCs for direct exposures of lower trophic level receptors. Copper exceeded ESVs in just one site surface soil sample but at a relatively high HQ (14.4), suggesting that there are spatially isolated areas in this portion of the site with relatively high concentrations of this metal. Similarly, HMW PAHs exceeded ESVs in 2 of 15 surface soil samples (but at maximum ratios exceeding 5), and mean HQs were less than one. Thus, PAH contamination at ecologically-relevant levels is likely to also be spatially limited.

The results of the terrestrial food web evaluation identified Aroclor-1248 and total PCBs as final COPCs. Potential risks were driven by short-tailed shrew exposures. However, HQs based on mean concentrations for this receptor were exceeded only for the maximum acceptable toxicant concentration (MATC) (HQs were about 1.50) and not for the lowest observed adverse effect level (LOAEL). Thus, potential risks are marginal for these two chemicals.

### 6.2.4 Zeunert Park

No chemicals were identified as final surface soil COPCs for direct exposures of lower trophic level receptors and risks are considered acceptable for this pathway. The results of the terrestrial food web evaluation identified Aroclor-1248 and total PCBs as final COPCs. Potential risks are driven by short-tailed shrew exposures. However, mean HQs for this receptor did not exceed one. Although potential risks are marginal for these two chemicals, additional assessments beyond Step 3A will be pursued for the COPCs.

## 6.3 Aquatic Habitats

### 6.3.1 Quarry Pond

No chemicals were identified as final surface water COPCs in Quarry Pond. Aroclor-1248 and total PCBs were identified as final COPCs in pond (basin) surface sediment. However, bank surface sediment samples did not exceed EqP-based ESVs and bank subsurface sediment samples generally would not exceed either SLC or EqP-based ESVs. Thus, potential risks related to bank surface sediments are relatively low and are not likely to be ecologically significant; no final COPCs were identified for bank surface sediments. The concentrations of Aroclor-1248 and total PCBs in pond (basin) surface sediment samples exceeded both SLC and EqP-based ESVs and the elevated concentrations extended into the subsurface sediments where the majority of samples would also exceed ESVs. Thus, risks related to pond (basin) surface sediments for Aroclor-1248 and total PCBs (the final COPCs for this medium) are relatively high and are likely to be ecologically significant.

Aroclor-1248 and total PCBs were identified as final COPCs in Quarry Pond fish tissue. However, HQs based on mean concentrations did not exceed one so potential risks on a population level are marginal. The limited food supply in the pond (based on the limited littoral zone and minimal benthic invertebrate community) and the seasonally low bottom dissolved oxygen concentrations in the deeper portions of the pond may be more limiting factors for fish populations than PCB contamination.

Similarly, Aroclor-1248 and total PCBs were identified as final COPCs for food web exposures in Quarry Pond. However, only the tree swallow had a LOAEL-based mean HQ exceeding one. Based on the qualitative benthic invertebrate sampling, there appears to be a limited food base for this receptor, which eats emergent flying insects. Thus, risks from food web exposures in Quarry Pond are marginal. Potential risks for species utilizing the pond banks (such as Canada geese) did not exceed acceptable risk thresholds. Thus, fish and aquatic food web pathway risks from PCB exposures are marginal and may not be ecologically significant given the relatively poor habitat conditions that currently exist.

### 6.3.2 Wilshire Pond

While there is some uncertainty due to the lack of dissolved metals data and the potential turbidity of some samples, potential risks from water column (surface water) exposures are relatively low and no final COPCs were identified for this medium.

Aroclor-1248 and total PCBs were identified as final COPCs in surface sediment. The concentrations of these chemicals in combined pond (basin) and bank samples exceeded both SLC and EqP-based ESVs. The elevated concentrations extended into the subsurface sediments of the basins where the majority of samples would also exceed ESVs. Thus, potential risks related to pond (basin) and bank surface sediment samples are relatively high and are likely to be ecologically significant.

Aroclor-1248 and total PCBs were identified as final COPCs in fish tissue and for food web exposures. Exceedances were of high enough magnitude to warrant the retention of these chemicals as final COPCs for these pathways, which constituted the highest potential ecological risks of those evaluated.

## 6.4 Uncertainties

Uncertainties are present in the risk assessments because of the limitations of the available data and the need to make certain assumptions and extrapolations based on incomplete information. In addition, the use of various models (for example, uptake and food web exposures) carries with it some associated uncertainty as to how well the model reflects actual conditions. Since conservative assumptions were generally used in the exposure and effects assessments, the uncertainties are more likely to result in an overestimation rather than an underestimation of the likelihood and magnitude of risks to ecological receptors. The uncertainties, and their potential impact on the ERA, are discussed in Appendix E.

SECTION 7
# Summary and Conclusions

The RI integrated results from previous investigations with new data to determine the nature and extent of contamination at the Amcast Industrial Site, assess the risk to potential receptors, and provide data to evaluate remedial alternatives. The site comprises several separate, but related areas—two former manufacturing areas, Amcast North and Amcast South; subsurface storm sewers that drained each of the areas toward respective ponds; two ponds and their associated sediment and organisms; and the groundwater present beneath the areas. There is a former manufacturing building still standing on Amcast North and a former (subsurface) disposal area at Amcast South. Storm sewers also drain Wilshire Pond in the direction of Cedar Creek.

RI data collected in 2011 included analytical results from surface and subsurface soil, surface water and sediment, fish tissue, and groundwater. Historical results were used to characterize contaminated sediment in the storm sewers. Two new monitoring wells were installed, one each at the Amcast North and Amcast South areas, respectively.

## 7.1 Physical Characteristics

The land surface topography across the various site areas ranges from a high of approximately 770 feet amsl near the northwestern portion of Amcast South to a low at the edge of Quarry pond (approximately 730 feet amsl), so land surface elevation decreases roughly from northwest to southeast across the site.
The subsurface materials in the vicinity of the site features, and immediately beneath them, include a compact and uniform clayey silt deposited during the last glacial period that sometimes includes sand lenses and other discontinuities. In addition, fill materials comprise the uppermost materials at Amcast South in association with the former disposal area. The former disposal area fill extends to depths of up to about 21 feet and contains silt, sand, gravel, brick, metal filings, wood, concrete, and asphalt with fill thickness ranging from about 0.5 foot to 21 feet. Underlying the fill (where the fill exists, otherwise this unit is at the surface) is a fine-grained diamicton (deposited beneath the final glaciers during the last ice age) consisting of clayey silts and silty clays with some interbeds of sand or gravel. Sometimes a thin layer of organic-rich clayey silt up to 5 feet thick is also encountered beneath the fill or clay/silt layer(s).

Below the clay/silt unit is a sand/silty sand unit that is reportedly composted of glacial outwash deposits that were noted to be 15 feet thick at AMN-SO01. Another fine-grained layer of silt/clayey silt was encountered below the outwash deposits in one boring during site investigation, although its deepest extent was not encountered. Below the unconsolidated units lies a dolomite bedrock that actually outcrops on the northwestern shoreline of Quarry Pond. Depth to bedrock is highly available across the various site areas.

Groundwater is encountered at depths ranging between 8 and 34 feet below ground, depending on the ground surface elevation. Monitoring wells that are screened in the shallow clay/silt are considered to be within a perched groundwater zone that is not able to yield sufficient water for residential or other use. The potential direction of groundwater flow within the shallow clay/silt unit roughly coincides with the topography of the land surface, sloping toward the southeast and Quarry Pond at a relatively slow rate (logarithmic-average hydraulic conductivity of $4.31 \times 10^{-4}$ centimeters per second). Monitoring wells screened in the deeper, sandy outwash material are considered to be part of a shallow unconsolidated groundwater aquifer with an apparent eastern flow direction at a relatively higher estimated flow rate (hydraulic conductivity of $2.08 \times 10^{-2}$ centimeters per second.

Surface water drainage occurs in the general direction that follows northwest to southeast topography. Quarry Pond (a former rock quarry) is situated south of Amcast North and South with an elevation of approximately 730 feet. In addition to overland flow the pond receives storm sewer discharge from adjacent commercial areas, including the City of Cedarburg Department of Public Works and the Amcast South property. Sediment thickness in the pond ranges from 1 to 5 feet thick. A 2011 biological assessment noted green sunfish and black bullhead as the dominant species in Quarry Pond.

Wilshire Pond is actually a shallow stormwater retention basin receiving stormwater from the neighborhood west of its location—emanating from Amcast North and surrounding areas. A stormwater discharge pipe extends in a northeast direction out of Wilshire Pond, continuing toward a confluence near Cedar Creek. Sediment thickness near Wilshire pond ranges from between 0.5 and 2.9 feet. Based on the small size of the pond and its shallow water depth, the pond does not appear to support much of a fish population, but snails and a heavy vegetation growth are present. Green sunfish and golden shiner are noted along with frogs/tadpoles of unknown species.

Cedar Creek flows north to south approximately 1,000 feet east of the site, and apparently receives stormwater from Wilshire Pond in addition to the typical surface runoff from zones immediately adjacent to the Creek. Cedar Creek is at a lower elevation than the Quarry Pond.

## 7.2 Nature and Extent of Contamination

The findings of the field investigation relative to the nature and extent of contamination at the Amcast Industrial Site included the following:

- Amcast North
  - The highest PCB concentrations are generally limited to the top 5 feet of soil on the grounds surrounding the existing building.
  - PCB concentrations in soil beneath the building are below 1,000 μg/kg.
  - Arsenic exceeds its RSL in surface and subsurface soil with concentrations ranging from 0.61 to 5.3 mg/kg, all lower than natural background concentrations according to the USGS and WDNR.
  - The highest concentrations of total PAHs that exceed individual RSLs are generally limited to the top 6 feet of soil and predominantly occur on the northeast, southeast, and southwest corners of the site.
  - None of the individual VOC compounds were detected above their respective RSLs in surface or subsurface soil.
  - Building materials were not sampled in 2011 due to the deteriorated/unsafe condition of the building.
- Residential Yards
  - At least one surface soil sample from each of the 18 residential parcels exceeds the concentration of 1,000 μg /kg.
- Wilshire Pond
  - Total PCB concentrations range from 1,300 μg/kg to 520,000 μg/kg in each of the 17 samples collected, and all samples exceed the individual congener RSL of 220.
  - PCBs were not detected in surface water samples.
  - Only aluminum and manganese exceed WDNR ES values in the water samples.
  - Total PCB concentrations ranged from 3.83 to 30 mg/kg in 8 organism samples.
- Amcast South
  - The highest concentrations of PCBs in soil at Amcast South generally occur within the limits of the former disposal area. Concentrations increase with depth to a maximum noted between 11 and 21 feet.
  - The distribution of PAHs in surface and subsurface soil roughly correlates with the PCB distribution, but the highest PAH concentrations are contained in surface soil versus at depth.

  - VOCs were not detected in soil samples.
  - Arsenic concentrations in soil and subsurface soil (1.2 mg/kg to 8.2 mg/kg) exceed the RSL but are naturally occurring according to USGS and WDNR.
  - Lead concentrations in soil at one location (FVSS-06; 1200 mg/kg from 1 to 3 feet, 430 mg/kg from 5 to 7 feet) exceed the RSL of 400 mg/kg; FVSS-06 is located outside of the former disposal area boundary, on the eastern boundary of Amcast South and west of the railroad tracks.
- Zeunert Park/Quarry Pond
  - The distribution and concentrations of PCB-contaminated sediment in the pond suggest the source is the Amcast South property by storm sewer discharge.
  - Total PCB concentrations range from 1,300 µg/kg to 11,000,000 µg/kg in 31 sediment samples, with the highest concentrations located in the northern portion of the pond where a storm sewer discharge pipe discharges that originates at Amcast South.
  - The highest PCB concentration interval within the sediment is at an intermediate depth, with less contaminated sediment above and below.
  - PCB contamination on the banks of Quarry Pond and in the Zeunert Park soil is coincident with park areas that are more prone to flooding (the northern boundary of the pond, and one spot on the southeastern edge, both at relatively low ground surface elevations), suggesting that pond sediment is the likely source of the "onshore" PCB contamination via deposition of sediment particles during high water events.
  - The highest total PCB concentration in surface soil was detected in sample AMZ-SO02 in the northern portion of the park (2,000 µg/kg), also thought to be due to high water events/sediment deposition from the pond.
  - PCBs were not detected in Quarry Pond surface water samples.
  - PCP was detected in 5 of 8 surface water samples at concentrations above the WDNR ES, but PCP concentrations are not believed to be related to former Amcast operations.
  - PCBs were detected in 13 of 24 organisms collected in the pond, ranging in concentration from 2.5 to 25 mg/kg.
- Storm Sewers
  - Storm sewers that connect Amcast North to Wilshire Pond eventually discharge to Cedar Creek. Total PCB sample concentrations in storm sewer sediment collected upslope from Wilshire Pond range in concentration from 65 µg/kg to 19,000 µg/kg, with the highest concentration detected immediately adjacent to the Amcast North building.
  - Storm sewer sediment samples collected from sewers that connect Amcast South and Quarry Pond have total PCB concentrations ranging from 135 µg/kg to 23,000,000 µg/kg. The highest concentrations were detected from sewer sediment samples on the north and south sides of the existing Quonset building on Amcast North, with concentrations decreasing in the downslope directions within the sewers.
  - Storm sewers located in Zeunert Park have total PCB sediment sample concentrations ranging from 2,000 µg/kg to 250,000 µg/kg.
- Groundwater
  - AMS-MW01 was the only site well that had detections of PCBs at a concentration exceeding the WDNR ES of 0.03 µg/L (Aroclor 1260: 1.5 µg/L) during the most recent (2011) monitoring event.

The well is located adjacent to and east of the former disposal area (Figure 2-7) on Amcast South and is screened from 30 to 40 feet bgs in the sand and gravel unit.

- Historical data (from 2003 and/or 2004) indicate PCB detections in 1 additional Amcast North well (FVMW-27) and 3 additional Amcast South wells (FVMW-21, GMMW-3, and GMMW-7), all of which are shallow wells screened in the upper clay/silt, and all of which had no PCB detections in 2011.
- Bromodichloromethane at GMMW-1 (1.1 µg/L) was the only VOC detected above its MCL/ES (0.6 µg/L) in 2011. GMMW-1 is located at the farthest northern corner of Amcast South, apparently upgradient former operations at Amcast South and cross gradient of former operations at Amcast North. The source of the contaminant is not known but is not thought to be related to former Amcast operations.
- There were no SVOC compounds detected above their individual MCL/ESs in 2011 groundwater data.
- The only metal compound concentrations that exceed an MCL/ES in 2011 data occurred at the following locations:

**Amcast South**

| | |
|---|---|
| AMS-MW01 | manganese: 1,120 µg/L versus MCL/ES of 300 µg/L |
| GMMW-3 | arsenic: 16.6 µg/L versus MCL/ES of 10 µg/L |
| GMMW-4 | arsenic: 13.3 µg/L, manganese 485 µg/L |

**Zeunert Park**

| | |
|---|---|
| FVMW-23 | manganese: 722 µg/L |
| FVMW-24 | manganese: 754 µg/L |

The arsenic concentrations in groundwater are likely a result of naturally elevated (background) concentrations in soil.

## 7.3 Contaminant Fate and Transport

The primary contaminant release and transport mechanisms from the Amcast Industrial Site, in decreasing order of importance based upon the current understanding of site conditions are as follows:

- PCB-contaminated sediment and water within storm sewers originating at Amcast North and Amcast South and discharging to Wilshire Pond and Quarry Pond, respectively
- PCB-contaminated sediment and water within the storm sewer originating at Wilshire Pond and discharging toward Cedar Creek
- Biological uptake of PCB-contaminated sediment by organisms in Wilshire and Quarry Ponds
- Surface runoff of suspended soil particles contaminated with PCBs and/or PAHs from surface soil at Amcast North, the residential properties adjacent to Amcast North, and Amcast South
- Surface runoff from PCB-contaminated sediment in ponds and subsequent deposition adjacent to the ponds during periods of high water elevation
- Surface runoff of dissolved metals from Wilshire Pond or PCP from Quarry Pond and subsequent dissolution or mineralization adjacent to the ponds during periods of high water elevation
- Infiltration/leaching through the former disposal area debris/contaminated soil at Amcast South with possible contaminant discharge into the groundwater
- Infiltration/leaching through PCB- and/or PAH-contaminated surface soil at residential properties, Amcast North, and Amcast South with possible discharge into the groundwater

- Dispersal of site contaminants from building materials (Amcast North) or contaminated surface soil into the atmosphere by volatilization or on particulates
- Movement of existing groundwater contaminants within the groundwater system with eventual discharge to Wilshire Pond or Quarry Pond

# 7.4 Human Health Risk Assessment

An HHRA was prepared using conservative assumptions and feasible exposure pathways that are based on both current and potential future site use conditions. Use of the conservative assumptions (consistent with a reasonable maximum exposure scenario) is intended to overstate rather than understate the potential risks. HHRA COPCs were identified for the various site media/area groupings by comparing the maximum detected concentration of each chemical in a media/data grouping to its respective SLs. If the maximum detected concentration exceeded its SL, it was retained as an HHRA COPC. Chemicals not detected in an exposure medium/data grouping were not selected as HHRA COPCs. HHRA SLs for various media included the following:

- Soil = USEPA RSLs for Chemical Contaminants at Superfund Sites (USEPA 2013b)
- Sediment = USEPA RSLs for Chemical Contaminants at Superfund Sites (USEPA 2013b)
- Fish ingestion = calculated using the default exposure assumptions in the USEPA RSL Calculator for fish consumption (USEPA 2013c).
- Surface water and groundwater = WDNR Preventive Action Limits and USEPA Tapwater RSLs
- Groundwater vapor pathway = calculated using the USEPA VISL Calculator tool (USEPA 2013a). The identified COPCs are listed by media/group in Table 5-1.

The HHRA was performed to evaluate potential exposure pathways and receptors, and to develop cumulative risk estimates for comparison with USEPA target risk reduction goals of ELCRs of $1 \times 10^{-4}$ to $1 \times 10^{-6}$ or a noncarcinogenic HI of 1.

Based on the current characterization data, the potential risks to human health are higher than USEPA target risk reduction objectives in different portions of the site. The estimated risks are based on the assumption that remedial actions are not conducted to address the existing soil and groundwater concentrations.

Current, potential exposure scenarios that exceed either the ELCR of $1 \times 10^{-6}$ or the HI of 1 at Amcast North or South include the following:

- Amcast North—Onsite Trespassers (adolescent)—Surface Soil
- Amcast South—Onsite Trespassers (adolescent)—Surface Soil

Offsite, current exposure scenarios that may remain unchanged for the future, and that are estimated to currently and in the future continue to exceed either the ELCR of $1 \times 10^{-6}$ or the HI of 1 include the following:

- Wilshire Pond (recreational use)
  - Bank Surface Soil—adult
  - Bank Surface Soil—child
  - Bank Surface Soil—adult + child combination
  - Surface Water—adult + child combination
  - Sediment—adult + child aggregate
- Zeunert Park
  - Surface Soil—adult + child combination
- Quarry Pond

- Surface Water—adult + child
- Sediment—adult
- Sediment—child
- Sediment—adult + child aggregate
- Recreational Angler—adult
- Recreational Angler—child

Future, potential exposure scenarios for the Amcast North and Amcast South properties that exceed either the ELCR of $1 \times 10^{-6}$ or the HI of 1 assuming a no action scenario include the following:

- Amcast North
  - Onsite Resident, Total Soil—Adult
  - Onsite Resident, Total Soil—Child
  - Onsite Resident, Total Soil—Adult + child aggregate
  - Onsite Resident, Groundwater—Adult
  - Onsite Resident, Groundwater—Child
  - Onsite Resident, Groundwater adult + child aggregate
  - Industrial Worker, Total Soil—Adult
  - Industrial Worker, Groundwater—Adult
  - Construction Worker, Total Soil—Adult
- Amcast South
  - Onsite Resident, Total Soil—Child
  - Onsite Resident, Total Soil—Adult + child aggregate
  - Onsite Resident, Groundwater—Adult
  - Onsite Resident, Groundwater—Child
  - Onsite, Resident, Groundwater adult + child aggregate
  - Industrial Worker, Total Soil—Adult
  - Industrial Worker, Groundwater—Adult
  - Onsite Construction Worker, Total Soil—Adult

HHRA COCs vary depending on media, but the inclusive list for all COCs covering all locations (onsite at Amcast North and South, offsite at Wilshire Pond, Zeunert Park, and Quarry Pond) and media (soil, surface water, sediment, groundwater, and fish fillets) are as follows:

- PCBs
- Metals—arsenic, chromium, iron, manganese, and lead
- Carcinogenic PAHs—benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; dibenzo(a,h)anthracene; and ideno(1,2,3-c,d)pyrene
- Non-PAH SVOCs—bis(2-ethylhexyl)phthalate; hexachloroethane; and PCP
- VOCs—1,1′-biphenyl; 1,2,4-trimethylbenzne; benzene; bromodichloromethane, chloroform ethylbenzene, and naphthalene

## 7.5 Ecological Risk Assessment

An ERA was conducted through Step 3A of the 8-step ERA process (USEPA 1997). The objective of the ERA was to evaluate whether site-related contaminants represent a potential unacceptable risk to exposed ecological receptors.

Conservative assumptions were generally used in the exposure and effects assessments, so uncertainties related to the limitations of the available data (requiring that certain assumptions and extrapolations be made), along with uptake and food web exposure model assumptions, are more likely to result in an overestimation rather than an underestimation of the likelihood and magnitude of risks to ecological receptors. Because ERA COPCs were identified for each of the terrestrial and aquatic areas evaluated in the ERA (Amcast North, Amcast South, Residential Area, Zeunert Park, Quarry Pond, and Wilshire Pond), it is recommended that the ERA process for these areas and COPCs continue beyond Step 3A of the ERA process.

PCBs (total PCBs and Aroclor-1248) were the ERA COPCs identified in aquatic habitats associated with the site (Quarry Pond basin sediment, fish tissue, and aquatic food webs; Wilshire Pond basin and bank sediment, fish tissue, and aquatic food webs). The fish tissue and aquatic food web exposures in Wilshire Pond constituted the highest potential ecological risks of those evaluated in the ERA.

PCBs (total PCBs, Aroclor-1248, and/or Aroclor-1254) were also the primary ERA COPCs in terrestrial habitats on and adjacent to the site (Amcast North surface soil and food web; Amcast South surface soil and food web; residential area surface soil and food web; Zeunert Park food web). There were no ERA COPCs identified for Zeunert Park surface soil. Manganese was also identified as an ERA COPC in Amcast North surface soil. Copper, manganese, and HMW PAHs (the sum total of benzo[a]anthracene; benzo[a]pyrene; benzo[b]fluoranthene; benzo[k]fluoranthene; benzo[g,h,i]perylene; chrysene; dibenzo[a,h]anthracene; indeno[1,2,3-cd]pyrene); and pyrene) were also identified as ERA COPCs for Amcast South surface soil.

SECTION 8
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# Tables

TABLE 1-1

**Summary of Sample Locations and Rationale for Sediment Investigation**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Overall Objective of Sampling | Media | General Location Description | Collection Method | Sample Depth (feet) | Analysis | Rationale for Sample Location Selection |
|---|---|---|---|---|---|---|
| Refine the conceptual site model for the nature and extent of contamination identified by previous investigations | Sediment | Quarry Pond | Sediment Core (hand push) | 0- to 6-inch interval composite<br>Interval above refusal<br>Mid-point (if total depth is greater than 1 foot) | PCBs<br>TOC<br>% solids | Execution of Phase 3 of RI (Foth & Van Dyke, 2004b).<br>Collection of data needed to assess the potential for human exposure to contaminated media via direct contact.<br>Collection of data necessary to complete the RI/FS and baseline risk assessment (BRA). |
| Fill data gaps | Sediment | Quarry Pond | Sediment Core (hand push or hand auger) | 0 to 6 inches | PCBs<br>TOC<br>% solids | Collect data to find the edge of the PCB hotspot in sediment adjacent to surface sediment transect ENBS-5C. |
| Fill data gaps | Sediment | Quarry Pond | Sediment Core (hand push or hand auger) | 0 to 6 inches<br>Interval above refusal, at location closest to shoreline<br>Mid-point interval, at location closest to shoreline (if total depth is greater than 1 foot) | PCBs<br>TOC<br>% solids | Collect data to find the edge of the PCB contamination along the south-southwest bank of the pond, perpendicular to the shoreline. |

TABLE 1-1

**Summary of Sample Locations and Rationale for Sediment Investigation**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Overall Objective of Sampling | Media | General Location Description | Collection Method | Sample Depth (feet) | Analysis | Rationale for Sample Location Selection |
|---|---|---|---|---|---|---|
| Fill data gaps | Sediment | Wilshire Pond | Sediment Probe (hand push) | Refusal | NA | To map the sediment bed and thickness in Wilshire Pond. |
| Refine the conceptual site model for the nature and extent of contamination identified by previous investigations | Sediment | Wilshire Pond | Sediment Core (hand push) | 0- to 6-inch interval composite<br>Interval above refusal<br>Mid-point (if total depth is greater than 1 foot) | PCBs<br>TOC<br>% solids | Execution of Phase 3 of RI (Foth & Van Dyke, 2004b).<br>Collection of data needed to assess the potential for human exposure to contaminated media via direct contact.<br>Collection of data necessary to complete the RI/FS and BRA. |
| Fill data gaps | Sediment | Wilshire Pond | Sediment Core (hand push) | 0- to 6-inch interval composite<br>Interval above refusal<br>Mid-point (if total depth is greater than 1 foot) | PCBs<br>TOC<br>% solids | To find the edge of the PCB hot spot (FVSS-33) at the end of the storm sewer outfall. |

Notes:

BRA = baseline risk assessment, NA = not available, PCB = polychlorinated biphenyl, RI = remedial investigation, TOC = total organic carbon

TABLE 1-2
**Summary of Sample Locations and Rationale for Soil Investigation**
*Amcast Industrial Site*
*Cedarburg, Wisconsin*

| Overall Objective of Sampling | Media | General Location Description | Collection Method | Sample Depth (feet) | Analysis | Rationale for Sample Location Selection |
|---|---|---|---|---|---|---|
| Refine the conceptual site model for the nature and extent of contamination identified by previous investigations and to fill data gaps | Shallow soil | Residential Yards | Stainless-steel spoon | 0 to 6 inches (below sod) | PCBs<br>TOC<br>% solids | Identify the extent of PCBs in the residential yards near the southeastern side of the facility along Hamilton Drive, in yards adjacent to the northeastern side of the facility, in one yard near the intersection of Park and Burr Lanes, and at two locations previously identified in the Amcast RI that were not sampled due to access agreements. |
| Fill data gaps | Surface soil | Zeunert Park/Quarry Pond | Stainless-steel spoon | 0 to 6 inches | PCBs<br>TOC<br>% solids | Determine if PCBs are present in the soil on the park grounds. |
| Refine the conceptual site model for the nature and extent of contamination identified by previous investigations and to fill data gaps | Shallow and subsurface soil | Amcast North Property | Hollow-stem auger | 0 to 2 feet<br>Most impacted interval<br>Boring depth approx. 25 feet | PCBs<br>VOCs<br>PAHs<br>Metals | Advance soil borings for well installation.<br>The final depth will be determined based on field observations.<br>Samples will be collected from 0 to 2 feet and the interval showing greatest signs of impact. |
| Refine the conceptual site model for the nature and extent of contamination identified by previous investigations | Shallow and subsurface soil | Amcast North Property | Direct-push methods | 0 to 2 feet<br>Most impacted interval<br>Boring depth approx. 10 feet | PCBs<br>VOCs<br>PAHs<br>Metals | To gain information necessary to complete the baseline risk assessment (BRA).<br>Samples will be collected from 0 to 2 feet and the interval showing greatest signs of impact |

TABLE 1-2

**Summary of Sample Locations and Rationale for Soil Investigation**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Overall Objective of Sampling | Media | General Location Description | Collection Method | Sample Depth (feet) | Analysis | Rationale for Sample Location Selection |
|---|---|---|---|---|---|---|
| Refine the conceptual site model for the nature and extent of contamination identified by previous investigations<br>Fill data gaps | Shallow and subsurface soil | Amcast South Property | Hollow-stem auger | 0 to 2 feet<br>Most impacted interval<br>Boring depth approx. 25 feet | PCBs<br>VOCs<br>PAHs<br>Metals | Advance soil borings for well installation.<br>The final depth will be determined based on field observations upon inspection of FVMW-28 well construction log (assume 25 feet).<br>Samples will be collected from 0 to 2 feet and the interval showing greatest signs of impact |
| Fill data gaps | Shallow and subsurface soil | Amcast South Property | Direct-push methods | 0 to 2 feet<br>Most impacted interval<br>Boring depth approx. 25 feet | PCBs<br>VOCs<br>PAHs<br>Metals | To gain information necessary to complete the BRA.<br>To characterize soil in the sedimentation basin at the south end of the site and the soil near hot spot FVSS-5A. |

Notes:

BRA = baseline risk assessment, NA = not available, PAH = polycyclic aromatic hydrocarbons, PCB = polychlorinated biphenyl, RI = remedial investigation, TOC = total organic carbon, and
VOC = volatile organic compound

TABLE 1-3
**Summary of Sample Locations and Rationale for Groundwater Investigation**
*Amcast Industrial Site*
*Cedarburg, Wisconsin*

| Overall Objective of Sampling | Monitoring Point | General Location Description | Collection Method | Sample Collection Depth (feet) | Analysis[a] | Rationale for Sampling Location Selection |
|---|---|---|---|---|---|---|
| Determine site-specific hydraulic gradients and groundwater velocities<br>Refine the conceptual site model for the nature and extent of contamination identified by previous investigations | Existing Monitoring Wells | Amcast North Property | Low flow sampling | 2 feet from bottom of well | PCBs<br>VOCs<br>PAHs<br>Metals<br>Field Analyses[c] | Show how water quality conditions relate to those identified by previous investigations. |
| Determine site-specific hydraulic gradients and groundwater velocities<br>Fill data gaps | New Monitoring Wells | Amcast North Property | Low flow sampling | 2 feet from bottom of well | PCBs<br>VOCs<br>PAHs<br>Metals<br>Field Analyses[c] | Determine groundwater flow direction and characterize conditions at the southwestern property boundary.<br>Install replacement well for FVMW-28 (dry) to determine groundwater flow direction and characterize conditions at the eastern property boundary. |
| Determine site-specific hydraulic gradients and groundwater velocities<br>Refine the conceptual site model for the nature and extent of contamination identified by previous investigations | Existing Monitoring Wells | Amcast South Property | Low flow sampling | 2 feet from bottom of well | PCBs<br>VOCs<br>PAHs<br>Metals<br>Field Analyses[c] | Show how water quality conditions relate to those identified by previous investigations. |
| Determine site-specific hydraulic gradients and groundwater velocities<br>Fill data gaps | New Monitoring Well | Amcast South Property | Low flow sampling | 2 feet from bottom of well | PCBs<br>VOCs<br>PAHs<br>Metals<br>Field Analyses[c] | Replacement well for FVMW-22 (dry), located near high PCB concentrations in deeper soil (approx. 19 to 21 feet), to determine groundwater flow direction and characterize conditions at the southeastern property boundary. |

TABLE 1-3

**Summary of Sample Locations and Rationale for Groundwater Investigation**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Overall Objective of Sampling | Monitoring Point | General Location Description | Collection Method | Sample Collection Depth (feet) | Analysis[a] | Rationale for Sampling Location Selection |
|---|---|---|---|---|---|---|
| Determine site-specific hydraulic gradients and groundwater velocities<br>Refine the conceptual site model for the nature and extent of contamination identified by previous investigations | Existing Monitoring Wells | Quarry Pond | Low flow sampling | 2 feet from bottom of well | PCBs<br>VOCs<br>PAHs<br>Metals<br>Field Analyses[c] | Show how water quality conditions relate to those identified by previous investigations. |

Notes:

[a]Field analyses includes water levels, temperature, pH, specific conductance, conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity. BRA = baseline risk assessment, PAH = polycyclic aromatic hydrocarbons, PCB = polychlorinated biphenyl, TOC = total organic carbon, and VOC = volatile organic compound

TABLE 1- 4

**Summary of Sample Locations and Rationale for Fish Tissue Investigation**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Overall Objective of Sampling | Media | General Location Description | Collection Method | Sample Depth (feet) | Analysis | Additional Comments | Rationale for Selection of Sampling Locations |
|---|---|---|---|---|---|---|---|
| Evaluate risk to human health from fish consumption | Fish tissue (fillets) | Quarry Pond | Boat-mounted electroshocking | Predatory (mid water column, approx. 8 feet below top of water)<br>Bottom feeder (near pond bottom; approx. 16 feet below top of water) | PCBs<br>% Lipids | Fish should be of a size above the legal size limit, if applicable.<br>Fish retained for samples should not vary in length by more than 10%.<br>Effort should be made to segregate species. | Execution of Phase 3 of RI (Foth & Van Dyke 2004b).<br>To determine if edible sized fish (or of legal limit size limit) in the Quarry Pond have concentrations of PCBs that could be of concern to human health. |

Notes:

PCBs = polychlorinated biphenyls, RI = remedial investigation

TABLE 2-1

**Monitoring Well Construction and Groundwater Elevation Data**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| | Well No. | Northing | Easting | Ground Elevation | Top of Casing Elevation (ft amsl) | September 2011 Depth to Water (ft) | September 2011 GW Elevation (ft amsl) |
|---|---|---|---|---|---|---|---|
| **Unit 2** | | | | | | | |
| Amcast North | FVMW-26 | 476852.80 | 2537524.05 | 757.13 | 756.66 | 7.7 | 748.96 |
| | FVMW-27 | 476979.17 | 2537679.19 | 751.33 | 750.78 | 7.51 | 743.27 |
| | FVMW-28 | 476788.90 | 2537901.86 | 747.40 | 746.98 | 19.09 | 727.89 |
| Amcast South | FVMW-20 | 476319.53 | 2537250.63 | 762.43 | 762.30 | 10.46 | 751.84 |
| | FVMW-22 | 476142.36 | 2537349.58 | 755.95 | 758.88 | 25.65 | 733.23 |
| | GMMW-1 | 476694.97 | 2537217.21 | 771.71 | 771.06 | 15.49 | 755.57 |
| | GMMW-2 | 476483.58 | 2537330.42 | 764.83 | 767.06 | 12.77 | 754.29 |
| | GMMW-3 | 476251.11 | 2537316.84 | 762.35 | 764.16 | 18.56 | 745.60 |
| | GMMW-4 | 476187.78 | 2537170.83 | 761.95 | 761.64 | 20.58 | 741.06 |
| | GMMW-6 | 475981.34 | 2537281.74 | 756.12 | 758.02 | 24.74 | 733.28 |
| | GMMW-7 | 476019.65 | 2537013.54 | 753.30 | 755.63 | 17.02 | 738.61 |
| Zeunert Park | FVMW-23 | 475939.08 | 2537555.37 | 736.84 | 739.44 | 8.01 | 731.43 |
| | FVMW-24 | 475512.35 | 2537909.25 | 735.56 | 735.15 | 4.51 | 730.64 |
| **Unit 3** | | | | | | | |
| Amcast North | AMN-MW01 | 476752.85 | 2537915.76 | 747.96 | 747.72 | 31.08 | 716.64 |
| Amcast South | AMS-MW01 | 476115.30 | 2537333.28 | 756.55 | 758.62 | 33.21 | 725.41 |
| | GMMW-5 | 476113.74 | 2537293.01 | 758.12 | 760.09 | 34.63 | 725.46 |

ft amsl – feet above mean sea level

TABLE 2-2

**Monitoring Well Hydraulic Test Result Summary**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Monitoring Well Location | Slug Test | Screened Geologic Unit[a] | Hydraulic Conductivity, K (cm/sec) | |
|---|---|---|---|---|
| **Amcast North** | | | **Unit 2** | **Unit 3** |
| AMN-MW01 | Rising | Unit 3 | -- | 6.26E-03 |
| FVMW-26 | Rising | Unit 2 | 8.92E-05 | -- |
| FVMW-27 | Rising | Unit 2 | 1.28E-04 | -- |
| **Amcast South** | | | | |
| AMS-MW01 | Rising | Unit 3 | -- | 7.82E-03 |
| FVMW-20 | Rising | Unit 2 | 2.74E-04 | -- |
| GMMW-1 | Rising | Unit 2 | 7.70E-05 | -- |
| GMMW-2 | Rising | Unit 2 | 2.40E-05 | -- |
| GMMW-3 | Rising | Unit 2 | 5.52E-03 | -- |
| GMMW-5 | Rising | Unit 3 | -- | 1.85E-01 |
| GMMW-6 | Rising | Unit 2 | 2.02E-03 | -- |
| GMMW-7 | Rising | Unit 2 | 6.01E-03 | -- |
| **Herman A. Zeunert Park** | | | | |
| FVMW-23 | Rising | Unit 2 | 1.92E-03 | -- |
| FVMW-24 | Rising | Unit 2 | 2.95E-04 | -- |
| **Logarithmic Average (cm/sec)** | | | 4.31E-04 | 2.08E-02 |
| **Max K (cm/sec)** | | | 6.01E-03 | 1.85E-01 |
| **Min K (cm/sec)** | | | 2.40E-05 | 6.26E-03 |

cm/sec - centimeters per second

[a] Unit 2 comprised of silts and clays with sand seams, Unit 3 comprised of sand

TABLE 2-3

**Wilshire Pond—Sediment Thickness**

*Amcast Industrial Site*

*Cedarburg Wisconsin*

| Sediment Core Location | Sediment Depth Data Collection Method | Water Depth (ft) | Sediment Probing Thickness (ft) |
|---|---|---|---|
| AMW-SD01 | Hand Core | 0.0 | 2.9 |
| AMW-SD02 | Hand Core | 0.0 | 1.8 |
| AMW-SD03 | Hand Core | 0.0 | 0.6 |
| AMW-SD05 | Hand Core | 1.5 | 0.6 |
| AMW-SD13 | Probe | 0.9 | 0.5 |
| AMW-SD15 | Probe | 0.5 | 1.4 |
| AMW-SD16 | Probe | 0.2 | 0.7 |
| AMW-SD17 | Probe | 0.5 | 0.6 |
| AMW-SD18 | Probe | 0.0 | 1.9 |
| AMW-SD19 | Probe | 0.0 | 2.8 |
| AMW-SD20 | Hand Core | 0.0 | 1.5 |
| AMW-SD21 | Probe | 1.1 | 1.7 |

TABLE 3-1
**Amcast North—Surface and Subsurface Soil—Metals Exceedances of USEPA RSL**
*Amcast Industrial Site*
*Cedarburg, Wisconsin*

| Sample Location ID | Sample Date | Start Depth (ft) | End Depth (ft) | Parameter | Result (mg/kg) | | Residential Soil RSL (mg/kg) |
|---|---|---|---|---|---|---|---|
| **Surface Soil** | | | | | | | |
| AMN-SO01 | 14-Sep-11 | 0 | 2 | Arsenic | 4.1 | | 0.39 |
| AMN-SO02 | 15-Sep-11 | 0 | 2 | Arsenic | 4.6 | | 0.39 |
| AMN-SO03 | 15-Sep-11 | 0 | 2 | Arsenic | 1.8 | | 0.39 |
| AMN-SO04 | 15-Sep-11 | 0 | 2 | Arsenic | 2.2 | | 0.39 |
| AMN-SO05 | 16-Sep-11 | 0 | 2 | Arsenic | 5.2 | | 0.39 |
| AMN-SO06 | 16-Sep-11 | 0 | 2 | Arsenic | 0.61 | J | 0.39 |
| AMN-SO07 | 16-Sep-11 | 0 | 2 | Arsenic | 1.6 | | 0.39 |
| AMN-SO08 | 15-Sep-11 | 0 | 2 | Arsenic | 3.2 | | 0.39 |
| AMN-SO09 | 15-Sep-11 | 0 | 2 | Arsenic | 5.3 | | 0.39 |
| AMN-SO10 | 14-Sep-11 | 0 | 2 | Arsenic | 3.1 | | 0.39 |
| FVSS-17 | 07-Nov-03 | 0 | 2 | Arsenic | 3.2 | | 0.39 |
| FVSS-20 | 07-Nov-03 | 0 | 2 | Arsenic | 2.8 | | 0.39 |
| FVSS-22 | 11-Nov-03 | 1 | 1.2 | Arsenic | 2.6 | | 0.39 |
| FVSS-27 | 05-Nov-03 | 1 | 1 | Arsenic | 2.7 | | 0.39 |
| **Subsurface Soil** | | | | | | | |
| AMN-SO01 | 14-Sep-11 | 8 | 10 | Arsenic | 2.1 | | 0.39 |
| AMN-SO02 | 15-Sep-11 | 8 | 10 | Arsenic | 0.62 | J | 0.39 |
| AMN-SO03 | 15-Sep-11 | 8 | 10 | Arsenic | 1.7 | | 0.39 |
| AMN-SO04 | 15-Sep-11 | 8 | 10 | Arsenic | 1.4 | | 0.39 |
| AMN-SO05 | 16-Sep-11 | 4 | 6 | Arsenic | 2.7 | | 0.39 |
| AMN-SO06 | 16-Sep-11 | 8 | 10 | Arsenic | 1.2 | | 0.39 |
| AMN-SO07 | 16-Sep-11 | 8 | 10 | Arsenic | 2.8 | | 0.39 |
| AMN-SO09 | 15-Sep-11 | 5.7 | 7.7 | Arsenic | 2.2 | | 0.39 |
| AMN-SO10 | 14-Sep-11 | 4 | 6 | Arsenic | 4.1 | | 0.39 |
| FVMW-26 | 28-Oct-03 | 1 | 3 | Arsenic | 1.3 | | 0.39 |
| FVMW-27 | 28-Oct-03 | 1 | 3 | Arsenic | 1.2 | | 0.39 |
| FVMW-28 | 29-Oct-03 | 1 | 3 | Arsenic | 1.9 | | 0.39 |
| FVSS-15 | 04-Nov-03 | 1 | 3 | Arsenic | 3.9 | | 0.39 |
| FVSS-16 | 04-Nov-03 | 1 | 3 | Arsenic | 1.9 | | 0.39 |
| FVSS-18 | 04-Nov-03 | 1 | 3 | Arsenic | 3 | | 0.39 |

TABLE 3-1

**Amcast North—Surface and Subsurface Soil—Metals Exceedances of USEPA RSL**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Sample Location ID | Sample Date | Start Depth (ft) | End Depth (ft) | Parameter | Result (mg/kg) | Residential Soil RSL (mg/kg) |
|---|---|---|---|---|---|---|
| FVSS-19 | 04-Nov-03 | 1 | 3 | Arsenic | 2.9 | 0.39 |
| FVSS-21 | 04-Nov-03 | 3 | 5 | Arsenic | 2.9 | 0.39 |
| FVSS-23 | 11-Nov-03 | 1.33 | 1.5 | Arsenic | 2.6 | 0.39 |
| FVSS-24 | 21-Nov-03 | 1.25 | 1.42 | Arsenic | 3 | 0.39 |
| FVSS-25 | 11-Nov-03 | 9 | 11 | Arsenic | 2.3 | 0.39 |
| FVSS-26 | 04-Nov-03 | 1 | 3 | Arsenic | 1.3 | 0.39 |
| FVSS-31 | 29-Oct-03 | 2 | 4 | Arsenic | 2.2 | 0.39 |

Notes:

Arsenic was the only metal detected above the USEPA Residential Soil RSL.

ft - feet

J = The associated value is an estimated quantity. This qualifier was appended when the data indicated the presence of a specific target analyte but was below the stated reporting (or quantitation) limit, and/or when quality control statistics alluded to an analytical bias.

mg/kg = milligrams per kilogram

USEPA RSL – Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites

TABLE 3-2

**Wilshire Pond—Surface Water—Exceedances of NR 140 Enforcement Standards or USEPA Tapwater RSLs**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Sample Location ID | Sample Date | Analyte Group | Parameter Description | ES (µg/L) | Tapwater RSL µg/L | Result* | | Result Unit |
|---|---|---|---|---|---|---|---|---|
| AMW-SW02 | 22-Sep-11 | Metals | Arsenic | 10 | 0.045 | **0.99** | J | µg/L |
| AMW-SW02 | 22-Sep-11 | Metals | Aluminum | 200 | 16000 | 212 | | µg/L |
| AMW-SW02 | 22-Sep-11 | Metals | Manganese | 300 | 320 | 301 | | µg/L |
| AMW-SW02 | 22-Sep-11 | SVOCs | Pentachlorophenol | 1 | 0.17 | **0.21** | J | µg/L |
| AMW-SW03 | 22-Sep-11 | Metals | Arsenic | 10 | 0.045 | **1.2** | | µg/L |
| AMW-SW04 | 22-Sep-11 | Metals | Arsenic | 10 | 0.045 | **1.4** | | µg/L |
| AMW-SW05 | 22-Sep-11 | Metals | Arsenic | 10 | 0.045 | **2.5** | | µg/L |
| AMW-SW05 | 22-Sep-11 | Metals | Aluminum | 200 | 16000 | 202 | | µg/L |
| AMW-SW05 | 22-Sep-11 | SVOCs | Benzo(a)pyrene | 0.2 | 0.0029 | **0.03** | J | µg/L |
| AMW-SW05 | 22-Sep-11 | SVOCs | Benzo(b)fluoranthene | 0.2 | 0.029 | **0.06** | J | µg/L |
| AMW-SW05 | 22-Sep-11 | SVOCs | Indeno(1,2,3-cd)pyrene | | 0.029 | **0.03** | J | µg/L |
| AMW-SW06 | 22-Sep-11 | Metals | Arsenic | 10 | 0.045 | **0.68** | J | µg/L |

Notes:

J = The associated value is an estimated quantity. This qualifier was appended when the data indicated the presence of a specific target analyte but was below the stated reporting (or quantitation) limit, and/or when quality control statistics alluded to an analytical bias.

ES = WDNR Enforcement Standard per NR140

SVOCs = semivolatile organic constituents

µg/L = micrograms per liter

USEPA RSL = Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites

*Results codes:

**Bolded Result** = exceeds USEPA Tapwater RSL

Shaded Text = exceeds WDNR NR140 Enforcement Standard

TABLE 3-3

**Amcast South—Surface and Subsurface Soil—Metals Exceedances of USEPA RSL**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Sample Location ID | Sample Date | Start Depth (ft) | End Depth (ft) | Parameter Description | Result (mg/kg) | Residential Soil USEPA RSL (mg/kg) |
|---|---|---|---|---|---|---|
| **Surface Soil** | | | | | | |
| AMS-SO01 | 13-Sep-11 | 0 | 2 | Arsenic | 1.2 | 0.39 |
| AMS-SO02 | 14-Sep-11 | 0 | 2 | Arsenic | 4.7 | 0.39 |
| AMS-SO03 | 14-Sep-11 | 0 | 2 | Arsenic | 4.6 | 0.39 |
| AMS-SO04 | 12-Sep-11 | 0 | 2 | Arsenic | 1.8 | 0.39 |
| AMS-SO05 | 12-Sep-11 | 0 | 2 | Arsenic | 2.7 | 0.39 |
| AMS-SO06 | 13-Sep-11 | 0 | 2 | Arsenic | 2.2 | 0.39 |
| AMS-SO07 | 13-Sep-11 | 0 | 2 | Arsenic | 3.1 | 0.39 |
| AMS-SO08 | 13-Sep-11 | 0 | 2 | Arsenic | 3.1 | 0.39 |
| AMS-SO09 | 13-Sep-11 | 0 | 2 | Arsenic | 2.5 | 0.39 |
| AMS-SO10 | 13-Sep-11 | 0 | 2 | Arsenic | 4.9 | 0.39 |
| FVMW-20 | 29-Oct-03 | 0 | 2 | Arsenic | 1.5 | 0.39 |
| FVMW-22 | 30-Oct-03 | 0 | 2 | Arsenic | 2.4 | 0.39 |
| FVSB-10 | 30-Oct-03 | 0 | 2 | Arsenic | 1.6 | 0.39 |
| FVSB-11 | 31-Oct-03 | 0 | 2 | Arsenic | 5.7 | 0.39 |
| FVSB-12 | 31-Oct-03 | 0 | 2 | Arsenic | 2.1 | 0.39 |
| **Subsurface Soil** | | | | | | |
| FVSS-01 | 03-Nov-03 | 1 | 3 | Arsenic | 3.4 | 0.39 |
| FVSS-01 | 03-Nov-03 | 5 | 7 | Arsenic | 1.3 | 0.39 |
| FVSS-02 | 04-Nov-03 | 3 | 5 | Arsenic | 5.3 | 0.39 |
| FVSS-03 | 03-Nov-03 | 1 | 3 | Arsenic | 2.8 | 0.39 |
| FVSS-04 | 04-Nov-03 | 1 | 3 | Arsenic | 3.5 | 0.39 |
| FVSS-05 | 03-Nov-03 | 1 | 3 | Arsenic | 3.1 | 0.39 |
| FVSS-06 | 05-Nov-03 | 1 | 3 | Lead | 1200 | 400 |

TABLE 3-3

**Amcast South—Surface and Subsurface Soil—Metals Exceedances of USEPA RSL**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Sample Location ID | Sample Date | Start Depth (ft) | End Depth (ft) | Parameter Description | Result (mg/kg) | | Residential Soil USEPA RSL (mg/kg) |
|---|---|---|---|---|---|---|---|
| FVSS-06 | 05-Nov-03 | 5 | 7 | Lead | 430 | | 400 |
| FVSS-06 | 05-Nov-03 | 5 | 7 | Arsenic | 8 | | 0.39 |
| FVSB-08 | 03-Nov-03 | 2 | 4 | Arsenic | 2.7 | | 0.39 |
| FVSB-08 | 03-Nov-03 | 18 | 20 | Arsenic | 4.7 | | 0.39 |
| FVSB-09 | 06-Nov-03 | 18 | 20 | Arsenic | 2.8 | | 0.39 |
| FVSB-09 | 06-Nov-03 | 24 | 26 | Arsenic | 2.9 | | 0.39 |
| FVSB-13 | 06-Nov-03 | 8 | 10 | Arsenic | 2.2 | | 0.39 |
| FVMW-21 | 29-Oct-03 | 4 | 6 | Arsenic | 1.6 | | 0.39 |
| AMS-SO01 | 13-Sep-11 | 12 | 14 | Arsenic | 4.2 | | 0.39 |
| AMS-SO02 | 14-Sep-11 | 5 | 7 | Arsenic | 2.5 | | 0.39 |
| AMS-SO03 | 14-Sep-11 | 18 | 20 | Arsenic | 1.3 | | 0.39 |
| AMS-SO04 | 12-Sep-11 | 8 | 10 | Arsenic | 8.2 | | 0.39 |
| AMS-SO05 | 12-Sep-11 | 6 | 8 | Arsenic | 0.83 | J | 0.39 |
| AMS-SO06 | 13-Sep-11 | 15 | 17 | Arsenic | 5.7 | | 0.39 |
| AMS-SO07 | 13-Sep-11 | 6 | 8 | Arsenic | 2.9 | | 0.39 |
| AMS-SO08 | 13-Sep-11 | 6.7 | 8.7 | Arsenic | 3.1 | | 0.39 |
| AMS-SO09 | 13-Sep-11 | 6.3 | 8.3 | Arsenic | 1.9 | | 0.39 |
| AMS-SO10 | 13-Sep-11 | 5.9 | 7.9 | Arsenic | 7.9 | | 0.39 |

Notes:

ft = feet

J = The associated value is an estimated quantity. This qualifier was appended when the data indicated the presence of a specific target analyte but was below the stated reporting (or quantitation) limit, and/or when quality control statistics alluded to an analytical bias.

mg/kg = milligrams per kilogram

USEPA RSL = Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites

TABLE 3-4

**Quarry Pond—Surface Water—Exceedances of NR 140 Enforcement Standards or USEPA Tapwater RSLs**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Sample Location ID | Sample Date | Analyte Group | Parameter Description | ES (µg/L) | Tapwater RSL µg/L | Result* | | Result Unit |
|---|---|---|---|---|---|---|---|---|
| AMQ-SW01 | 29-Sep-11 | Metals | Arsenic | 10 | 0.045 | **0.55** | J | µg/L |
| AMQ-SW01 | 29-Sep-11 | SVOCs | Pentachlorophenol | 1 | 0.17 | **3.1** | J | µg/L |
| AMQ-SW01 | 29-Sep-11 | VOCs | Xylenes, Total | 2000 | 190 | **425** | J | µg/L |
| AMQ-SW02 | 29-Sep-11 | Metals | Arsenic | 10 | 0.045 | **0.73** | J | µg/L |
| AMQ-SW02 | 29-Sep-11 | SVOCs | Pentachlorophenol | 1 | 0.17 | **1.1** | J | µg/L |
| AMQ-SW03 | 29-Sep-11 | Metals | Arsenic | 10 | 0.045 | **0.7** | J | µg/L |
| AMQ-SW03 | 29-Sep-11 | SVOCs | Pentachlorophenol | 1 | 0.17 | **1.5** | J | µg/L |
| AMQ-SW04 | 29-Sep-11 | Metals | Arsenic | 10 | 0.045 | **0.65** | J | µg/L |
| AMQ-SW04 | 29-Sep-11 | SVOCs | Pentachlorophenol | 1 | 0.17 | **1** | J | µg/L |
| AMQ-SW05 | 29-Sep-11 | Metals | Arsenic | 10 | 0.045 | **0.64** | J | µg/L |
| AMQ-SW05 | 29-Sep-11 | SVOCs | Pentachlorophenol | 1 | 0.17 | **1.2** | J | µg/L |

Notes:

J = The associated value is an estimated quantity. This qualifier was appended when the data indicated the presence of a specific target analyte but was below the stated reporting (or quantitation) limit, and/or when quality control statistics alluded to an analytical bias.

ES = WDNR Enforcement Standard per NR140

SVOCs = semivolatile organic constituents

µg/L = micrograms per liter

USEPA RSL = Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites

VOCs = volatile organic constituents

*Results codes:

**Bolded** Text = exceeds USEPA Tapwater RSL

Shaded Text = exceeds WDNR NR140 Enforcement Standard

TABLE 3-5

**Historical Storm Sewer Sample Results—Detections of Total PCBs**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Sample ID | Sample Date | Total PCB Concentration (μg/kg) | | Data source* |
|---|---|---|---|---|
| **Likely "Origin Area" = Amcast North; Exterior Storm Sewer Locations** | | | | |
| CB-05 | 4/9/2007 | 735 | | 1 |
| CB-07 | 4/9/2007 | 1,200 | | 1 |
| CB-09 | 4/9/2007 | 19,000 | | 1 |
| ENSTM-42S | 4/27/2005 | 640 | | 2 |
| ENSTM-44S | 4/27/2005 | 1,000 | | 2 |
| ENSTM-52S | 4/27/2005 | 9,000 | | 2 |
| ENSTM-53S | 4/27/2005 | 770 | | 2 |
| FVSTM-01S | 10/14/2003 | 3,000 | | 3 |
| FVSTM-02S | 10/14/2003 | 2,500 | | 3 |
| FVSTM-04S | 10/14/2003 | 2,000 | | 3 |
| FVSTM-05S | 10/14/2003 | 65 | | 3 |
| FVSTM-31S | 10/28/2003 | 8,800 | | 3 |
| FVSTM-40S | 10/29/2003 | 7,000 | | 3 |
| FVSWQ-04S | 10/15/2003 | 250,000 | | 3 |
| **Likely "Origin Area" = Amcast North; Interior Storm Sewer Locations** | | | | |
| CB-06 | 4/9/2007 | 3,900 | | 1 |
| CB-10 | 4/9/2007 | 4,300 | J | 1 |
| ENISTM-09 | 4/9/2007 | 3,000 | | 1 |
| ENISTM-10 | 4/9/2007 | 5,500 | J | 1 |
| ENSTM-41S | 4/27/2005 | 2,200 | | 2 |
| **Likely "Origin Area" = Amcast South; Exterior Storm Sewer Locations** | | | | |
| CB-01 | 4/9/2007 | 175 | | 1 |
| CB-02 | 4/9/2007 | 1,300 | | 1 |
| CB-03 | 4/9/2007 | 514,000 | | 1 |
| ENSTM-10S | 4/26/2005 | 2,900 | | 2 |
| ENSTM-10S | 4/9/2007 | 6,690 | | 1 |
| ENSTM-46S | 4/26/2005 | 23,000 | | 2 |
| ENSTM-47S | 4/26/2005 | 790,000 | | 2 |
| ENSTM-49S | 4/26/2005 | 66,000 | | 2 |
| ENSTM-49S | 4/9/2007 | 94,200 | | 1 |
| ENSTM-50S | 4/26/2005 | 1,900 | | 2 |

TABLE 3-5

**Historical Storm Sewer Sample Results—Detections of Total PCBs**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Sample ID | Sample Date | Total PCB Concentration (µg/kg) | Data source* |
|---|---|---|---|
| ENSTM-51S | 4/27/2005 | 690 | 2 |
| FVSS-05A | 11/5/2003 | 23,000,000 | 3 |
| FVSTM-09S | 10/28/2003 | 23,000 | 3 |
| FVSTM-12S | 10/28/2003 | 4,800 | 3 |
| FVSTM-14 | 10/13/2003 | 2,000 | 3 |
| FVSTM-17S | 10/16/2003 | 50 | 3 |
| FVSTM-18S | 10/14/2003 | 220 | 3 |
| FVSTM-29S | 10/13/2003 | 390,000 | 3 |
| FVSTM-30S | 10/16/2003 | 2,900 | 3 |
| FVSWQ-06S | 10/14/2003 | 8,900 | 3 |

* Historical Data Sources:

1 ENSR_Phase II Investigation_2007

2 TM_ENSR_Phase 2 Areas of Immediate Concern_June2005 - Table 1

3 F&VD_Preliminary Site Characterization Summary, Table 3

J = The associated value is an estimated quantity. This qualifier was appended when the data indicated the presence of a specific target analyte but was below the stated reporting (or quantitation) limit, and/or when quality control statistics alluded to an analytical bias.

µg/kg = micrograms per kilogram

USEPA RSL – Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites

TABLE 3-6
**Summary of Groundwater Concentrations Exceeding WDNR NR 140 Enforcement Standards**
*Amcast Industrial Site*
*Cedarburg, Wisconsin*

| Monitoring Well | Geologic Unit Assignment* | Sample Date | Analyte | Detected Concentration (µg/L) | WDNR ES (µg/L) |
|---|---|---|---|---|---|
| **Amcast North** | | | | | |
| AMN-MW01 | 3 | 9/23/2011 | Chromium | 372 | 100 |
| FVMW-26 | 2 | 12/2/2003 | Lead | 18 | 15 |
| | | | Bis(2-ethylhexyl)phthalate | 7.3 | 6 |
| FVMW-27 | 2 | 12/3/2003 | Bis(2-ethylhexyl)phthalate | 260 | 6 |
| | | 1/12/2004 | Lead | 17 | 15 |
| | | | Total PCB | 0.3 | 0.03 |
| | | | Bis(2-ethylhexyl)phthalate | 120 | 6 |
| | | 9/21/2011 | Arsenic | 10 | 10 |
| **Amcast South** | | | | | |
| AMS-MW01 | 3 | 9/22/2011 | Manganese | 1120 | 300 |
| | | | Total PCB | 1.5 | 0.03 |
| FVMW-21 | 2 | 12/3/2003 | Bis(2-ethylhexyl)phthalate | 33 | 6 |
| | | 1/12/2004 | Total PCB | 0.3 | 0.03 |
| | | | Lead | 17 | 15 |
| GMMW-1 | 2 | 12/3/2003 | Bromodichloromethane | 1.4 | 0.6 |
| | | 1/12/2004 | Bromodichloromethane | 1.2 | 0.6 |
| | | 9/20/2011 | Bromodichloromethane | 1.1 | 0.6 |
| GMMW-3 | 2 | 12/4/2003 | Arsenic | 89 | 10 |
| | | | Arsenic | 61 | 10 |
| | | | Bis(2-ethylhexyl)phthalate | 86 | 6 |
| | | 1/12/2004 | Arsenic | 10 | 10 |
| | | | Arsenic | 28 | 10 |
| | | | Total PCB | 1.6 | 0.03 |
| | | | Bis(2-ethylhexyl)phthalate | 730 | 6 |
| | | 9/20/2011 | Arsenic | 16.6 | 10 |
| GMMW-4 | 2 | 12/3/2003 | Lead | 74 | 15 |
| | | | Benzo(a)pyrene | 19 | 0.2 |
| | | | Benzo(b)fluoranthene | 28 | 0.2 |
| | | | Bis(2-ethylhexyl)phthalate | 220 | 6 |
| | | | Chrysene | 27 | 0.2 |
| | | 1/12/2004 | Lead | 80 | 15 |
| | | | Benzo(a)pyrene | 16 | 0.2 |

TABLE 3-6

**Summary of Groundwater Concentrations Exceeding WDNR NR 140 Enforcement Standards**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Monitoring Well | Geologic Unit Assignment* | Sample Date | Analyte | Detected Concentration (µg/L) | | WDNR ES (µg/L) |
|---|---|---|---|---|---|---|
| | | | Benzo(b)fluoranthene | 24 | | 0.2 |
| | | | Bis(2-ethylhexyl)phthalate | 35 | | 6 |
| | | | Chrysene | 23 | | 0.2 |
| | | 9/21/2011 | Arsenic | 13.3 | | 10 |
| | | | Manganese | 485 | J | 300 |
| GMMW-7 | 2 | 12/3/2003 | Bis(2-ethylhexyl)phthalate | 62 | | 6 |
| **Zeunert Park** | | | | | | |
| FVMW-23 | 2 | 9/20/2011 | Manganese | 722 | J | 300 |
| FVMW-24 | 2 | 12/4/2003 | Total PCB | 0.48 | | 0.03 |
| | | 1/13/2004 | Total PCB | 1.69 | | 0.03 |
| | | 9/20/2011 | Arsenic | 29.4 | | 10 |
| | | | Manganese | 754 | J | 300 |

Notes:

* Hydrogeologic unit assignments were made based on well depths, well construction logs (where available), and groundwater elevation data. Well construction logs were not available for FVMW series wells.

Unit 2 Silts and clays overlying Unit 3

Unit 3 Sands

ES = Enforcement Standard

J = detected value is an estimated concentration

µg/L = micrograms per liter

WDNR = Wisconsin Department of Natural Resources

TABLE 3-7

**Summary of PCB Concentrations Detected in Groundwater**

*Amcast Industrial Site*

*Cedarburg, Wisconsin*

| Monitoring Well | Geologic Unit Assignment* | Sample Date | Analyte | Concentration (µg/L) |
|---|---|---|---|---|
| **Amcast North** | | | | |
| FVMW-27 | 2 | 1/12/2004 | Aroclor-1248 | **0.3** |
| | | 1/12/2004 | Total PCB | **0.3** |
| **Amcast South** | | | | |
| AMS-MW01 | 3 | 9/22/2011 | Aroclor-1248 | **1.5** |
| FVMW-21 | 2 | 1/12/2004 | Aroclor-1248 | **0.3** |
| | | 1/12/2004 | Total PCB | **0.3** |
| GMMW-3 | 2 | 1/12/2004 | Aroclor-1248 | **1.6** |
| | | 1/12/2004 | Total PCB | **1.6** |
| **Zeunert Park** | | | | |
| FVMW-24 | 2 | 12/4/2003 | Aroclor-1260 | **0.48** |
| | | 12/4/2003 | Total PCB | **0.48** |
| | | 1/13/2004 | Aroclor-1248 | **0.29** |
| | | 1/13/2004 | Aroclor-1260 | **1.4** |
| | | 1/13/2004 | Total PCB | **1.69** |

Notes:

Enforcement Standard (ES) = 0.03 µg/L
Preventive Action Limit (PAL) = 0.003 µg/L
WDNR = Wisconsin Department of Natural Resources
µg/L = micrograms per liter
Unit 2 = Silts and clays overlying Unit 3
Unit 3 = Sand

* Hydrogeologic unit assignments were made based on well depths, well construction logs (where available), and groundwater elevation data. Well construction logs were not available for FVMW series wells.
**Bolded** text values exceed the WDNR PAL
Shaded text values exceed the WDNR ES = 0.03 µg/L

TABLE 3-8
**Fish Tissue Analvtical Results**
*Amcast Industrial Site*
*Cedarbura, Wisconsin*

| Purpose/Fish Type | Station ID | Sample ID | Chemical | Result (mg/kg) | |
|---|---|---|---|---|---|
| **Quarry Pond (September 26, 2011)** | | | | | |
| **HHRA** | | | | | |
| Fish Fillet (Bottom Feeders) | AMQ-FTBH-0101/01 | 11CG17-85 | Aroclor-1248 | 4.6 | J |
| | AMQ-FTBH-0102/01 | 11CG17-86 | Aroclor-1248 | ND | |
| | AMQ-FTBH-0103/01 | 11CG17-87 | Aroclor-1248 | 5.7 | J |
| | AMQ-FTBH-0104/01 | 11CG17-88 | Aroclor-1248 | ND | |
| | AMQ-FTBH-0105/01 | 11CG17-89 | Aroclor-1248 | 5.5 | J |
| | AMQ-FTBH-0106/01 | 11CG17-90 | Aroclor-1248 | 2.5 | J |
| | AMQ-FTBH-0107/01 | 11CG17-91 | Aroclor-1248 | 4.9 | J |
| | AMQ-FTBH-0108/01 | 11CG17-92 | Aroclor-1248 | 25 | |
| | AMQ-FTBH-0109/01 | 11CG17-93 | Aroclor-1248 | 4.5 | |
| | AMQ-FTBH-0110/01 | 11CG17-94 | Aroclor-1248 | 7.9 | J |
| Fish Fillet (Column Feeders) | AMQ-FTSH-0101/01 | 11CG17-95 | Aroclor-1248 | 2.7 | |
| | AMQ-FTSH-0102/01 | 11CG17-96 | Aroclor-1248 | 4.3 | J |
| | AMQ-FTSH-0103/01 | 11CG17-97 | Aroclor-1248 | ND | |
| | AMQ-FTSH-0104/01 | 11CG17-98 | Aroclor-1248 | ND | |
| | AMQ-FTSH-0105/01 | 11CG17-99 | Aroclor-1248 | 3 | J |
| | AMQ-FTSH-0106/01 | 11CG18-01 | Aroclor-1248 | ND | |
| **ERA** | | | | | |
| Whole Body (Bottom Feeders) | AMQ-FTBE-0101/01 | 11CG18-07 | Aroclor-1248 | ND | |
| | AMQ-FTBE-0102/01 | 11CG18-08 | Aroclor-1248 | 5.2 | |
| | AMQ-FTBE-0103/01 | 11CG18-09 | Aroclor-1248 | ND | |
| Whole Body Composite (Suspended Feeders) | AMQ-FTSE-0101/01 | 11CG18-02 | Aroclor-1248 | ND | |
| | AMQ-FTSE-0102/01 | 11CG18-03 | Aroclor-1248 | 6.3 | J |
| | AMQ-FTSE-0103/01 | 11CG18-04 | Aroclor-1248 | ND | |
| | AMQ-FTSE-0104/01 | 11CG18-05 | Aroclor-1248 | ND | |
| | AMQ-FTSE-0105/01 | 11CG18-06 | Aroclor-1248 | ND | |
| **Wilshire Pond (September 28, 2011)** | | | | | |
| **ERA** | | | | | |
| Whole Body Composite (Tadpoles) | AMW-FTE-0201/01 | 11CG18-12 | Aroclor-1016 | ND | |
| | AMW-FTE-0201/01 | 11CG18-12 | Aroclor-1260 | 0.033 | J |
| | AMW-FTE-0201/01 | 11CG18-12 | Aroclor-1248 | 3.8 | J |
| | AMW-FTE-0202/01 | 11CG18-13 | Aroclor-1016 | ND | |
| | AMW-FTE-0202/01 | 11CG18-13 | Aroclor-1260 | 0.033 | J |
| | AMW-FTE-0202/01 | 11CG18-13 | Aroclor-1248 | 12 | J |
| | AMW-FTE-0203/01 | 11CG18-14 | Aroclor-1016 | ND | |
| | AMW-FTE-0203/01 | 11CG18-14 | Aroclor-1260 | 0.033 | J |
| | AMW-FTE-0203/01 | 11CG18-14 | Aroclor-1248 | 30 | J |
| | AMW-FTE-0204/01 | 11CG18-15 | Aroclor-1016 | ND | |
| | AMW-FTE-0204/01 | 11CG18-15 | Aroclor-1260 | 0.029 | J |
| | AMW-FTE-0204/01 | 11CG18-15 | Aroclor-1248 | 7 | J |
| | AMW-FTE-0205/01 | 11CG18-16 | Aroclor-1260 | 2.8 | J |
| | AMW-FTE-0205/01 | 11CG18-16 | Aroclor-1016 | 3 | J |
| | AMW-FTE-0205/01 | 11CG18-16 | Aroclor-1248 | 13 | J |
| | AMW-FTE-0206/01 | 11CG18-17 | Aroclor-1260 | 1.5 | J |
| | AMW-FTE-0206/01 | 11CG18-17 | Aroclor-1016 | 2.2 | J |
| | AMW-FTE-0206/01 | 11CG18-17 | Aroclor-1248 | 8.7 | J |
| Whole Body (Suspended Feeders) | AMW-FTSE-0101/01 | 11CG18-10 | Aroclor-1016 | ND | |
| | AMW-FTSE-0101/01 | 11CG18-10 | Aroclor-1260 | 0.023 | J |
| | AMW-FTSE-0101/01 | 11CG18-10 | Aroclor-1248 | 17 | |
| Whole Body Composite (Suspended Feeders) | AMW-FTSE-0102/01 | 11CG18-11 | Aroclor-1016 | ND | |
| | AMW-FTSE-0102/01 | 11CG18-11 | Aroclor-1260 | 0.024 | J |
| | AMW-FTSE-0102/01 | 11CG18-11 | Aroclor-1248 | 29 | |

Notes:

HHRA = Human Health Risk Assessment

ERA = Ecological Risk Assessment

J = detected value is an estimated concentration

ND = Not Detected

TABLE 4-1
**Important Physical/Chemical and Environmental Fate Parameters**
*Amcast Industrial Site, Cedarburg, Wisconsin*

| Parameter | Definition |
|---|---|
| Molecular Weight | The molecular weight of a pure compound influences other physical characteristics of a compound. For example, organic compounds with higher molecular weights have a lower tendency to volatilize than those with lower molecular weights. |
| Water Solubility | Water solubility is the maximum mass of a compound that can dissolve in a specific volume of water at a specific pH, and temperature. Highly soluble compounds tend to be more mobile in groundwater, tend to leach from the soils, and are generally more biodegradable. In addition, the lower the solubility, the more likely the compound is to adsorb to soil. Aqueous concentrations in excess of the solubility may indicate sorption onto soil, the presence of solubilizing chemicals such as solvents, or the presence of a nonaqueous phase liquid. |
| Specific Gravity | Specific gravity and solubility of liquid compounds are among the primary physical properties that affect the transport of separate phase liquids in water. The density of relatively insoluble compound present as separate phase will determine whether it will sink or float in the saturated zone. |
| Vapor Pressure | Vapor pressure is a relative measure of volatility of a compound in its pure state. Compounds with relatively high vapor pressures readily volatilize from the liquid form. |
| Henry's Law Constant | Henry's Law Constant describes the distribution of a chemical between air and water at equilibrium. It is usually defined as the ratio of the spatial pressure of the compound in air, measured in atmospheres, to the mole fraction of the compound in a water solution. A high Henry's Law constant indicates a tendency of a compound to volatilize rather than remain in water.<br>$< 10^{-7}$ low volatility<br>$10^{-7}$ to $10^{-5}$ volatilize slowly<br>$> 10^{-5}$ volatilization is significant |
| $K_{ow}$ | The octanol-water partitioning coefficient, $K_{ow}$ is a function of a compound's water solubility and the capacity of the compound to sorb on organic material. The $K_{ow}$ is calculated experimentally by measuring the distribution of an organic chemical between octanol and water in contact with each other at equilibrium conditions. Compounds with high $K_{ow}$ tend to avoid the aqueous phase and may remain sorbed on soils longer. Compounds with high $K_{ow}$ also tend to bioaccumulate in the lipid tissues of animals. Compounds with low coefficients tend to move in the aqueous phase, do not have the propensity to bioaccumulate, and are considered mobile and transitory in the groundwater. |
| $K_{oc}$ | The soil organic carbon/water partitioning coefficient, $K_{oc}$ is indicative of a compound's water solubility and the sorptive capacity of the compound onto organic material at equilibrium. The higher the $K_{oc}$, the more likely a chemical is to bind to soil than to remain in water. The $K_{oc}$ is calculated experimentally and expressed as the ratio of the sorbed concentration versus the aqueous concentration. The following is a classification scheme for mobility of organic contaminants based on $K_{oc}$ (Dragun 1998):<br>< 50 very mobile<br>50 to 150 mobile<br>150 to 500 intermediate mobility<br>500 to 2,000 low mobility<br>> 2,000 immobile |
| $K_d$ | The distribution coefficient, $K_d$ is a soil-specific measure of the extent of chemical partitioning between the soil and the water. The extent of sorption can be reasonably calculated if the organic carbon content in the soil ($f_{oc}$) is known by using $K_d = K_{oc} \times f_{oc}$. The higher the $K_d$, the more likely a chemical is to bind to soil than to remain in water. |

TABLE 4-2

**Chemical and Physical Properties of Some PCB Aroclors**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| CAS No. | Aroclor (in order of increasing molecular weight) | Avg. Molecular Weight (g/mole) | Density | Water Solubility[a] (mg/L) | Vapor Pressure[b] (mm Hg) | Log $K_{ow}$ | $K_{oc}$ [c] (mL/g) | Henry's Law Constant[d] (atm-m$^3$/mol) |
|---|---|---|---|---|---|---|---|---|
| 11104-28-2 | 1221 | 200.7 | 1.18 | 0.59 @ 24°C | $6.7 \times 10^{-3}$ | 4.7 | $2.8 \times 10^{2}$ | $3.5 \times 10^{-3}$ |
| 11141-16-5 | 1232 | 232.2 | 1.26 | 0.45 | $4.06 \times 10^{-3}$ | 5.1 | $6.8 \times 10^{2}$ | $8.6 \times 10^{-4}$ [c] |
| 12674-11-2 | 1016 | 257.9 | 1.37 | 0.42 | $4 \times 10^{-4}$ | 5.6 | $5.4 \times 10^{4}$ | $2.9 \times 10^{-4}$ |
| 12672-29-6 | 1248[c] | 261 | 1.41 | 0.060 @ 24°C | $4.94 \times 10^{-4}$ | 6.1 | $4.4 \times 10^{5}$ | $5.6 \times 10^{-4}$ |
| 53469-21-9 | 1242 | 266.5 | 1.38 | 0.34 | $4.06 \times 10^{-4}$ | 5.6 | $5.1 \times 10^{3}$ | $5.2 \times 10^{-4}$ |
| 11097-69-1 | 1254 | 328 | 1.54 | 0.057 @ 24°C | $7.71 \times 10^{-5}$ | 6.5 | $4.1 \times 10^{5}$ | $2.0 \times 10^{-3}$ |
| 11096-82-5 | 1260 | 357.7 | 1.62 | 0.08 @ 24°C | $4.05 \times 10^{-5}$ | 5.8 | $2.6 \times 10^{6}$ | $4.6 \times 10^{-3}$ |
| 37324-23-5 | 1262 | 389 | 1.64 | 0.052 @ 24°C | No data | No data | No data | No data |
| 11100-14-4 | 1268 | 453 | 1.81 | 0.3 @ 24°C | No data | No data | No data | No data |

Notes:

All data were obtained from ATSDR's *Toxicological profile for Polychlorinated Biphenyls (PCBs)* (November 2000), unless otherwise indicated.

[a]Water Solubility in mg/L at 25°C, unless specified

[b]Vapor Pressure in mm Hg at 25°C

[c]Data from *Groundwater Chemicals Desk Reference* (Montgomery and Welkom, 1989)

[d]Henry's Law constant measured at 25°C

g/mole = grams per mole

mg/L = milligrams per liter

mm Hg = milligrams of mercury

mL/g – milliliters per gram

atm-m$^3$/mol = atmosphere per cubic meter per mol

TABLE 4-3

**Chemical and Physical Properties of Representative Chemicals**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| Chemical | Water Solubility[a] (mg/L) | Vapor Pressure[b] (mm Hg) | Molecular Weight (g/mole) | Log $K_{ow}$ | $K_{oc}$ (mL/g) | Henry's Law Constant[d] (atm-m$^3$/mol) |
|---|---|---|---|---|---|---|
| **PCBs** | **See Table 4-2** | | | | | |
| **Carcinogenic PAH** | | | | | | |
| Benzo(a)pyrene | 0.0016 | $5.5 \times 10^{-9}$ | 250 | 6.0 | $1.0 \times 10^{6}$[c] | $1.1 \times 10^{-6}$ |
| **Other SVOCs** | | | | | | |
| Bis (2-ethylhexyl)phthalate (DEHP)[f] | 0.041 | $1.0 \times 10^{-7}$ | 390.57 | 7.50 | $1.0 \times 10^{5}$[e] | $1.71 \times 10^{-5}$ |
| **VOCs** | | | | | | |
| Benzene | 1800 | 92[g] | 78 | 2.1 | 60-83[g] | $5.6 \times 10^{-3}$ |
| Ethylbenzene | 170 | 7.1[e] | 110 | 3.2 | $1.0 \times 10^{2}$[e] | $7.9 \times 10^{-3}$ |
| Bromodichloromethane | 3000 | 50[e] | 160 | 2.0 | 61.65[e] | $2.1 \times 10^{-3}$ |
| Chloroform | 8000 | 160[e] | 120 | 2.0 | 43.65[e] | $3.7 \times 19^{-3}$ |
| **Metals** | | | | | | |
| Arsenic | NP | NA | 75 | 0.68 | 760 | $7.7 \times 10^{-1}$ |
| Chromium (VI) | NP | NA | 52 | NP | 19 | NP |
| Manganese | NP | NA | 55 | 0.23 | 65 | NP |

Note:
All data were obtained from USEPA's Superfund Chemical Data Matrix (SCDM), January 2004 (available at http://www.epa.gov/superfund/sites/npl/hrsres/tools/scdm.htm), unless otherwise indicated.
[a]Water Solubility in mg/L at 25°C
[b]Vapor Pressure in mm Hg at 25°C
[c]Values from USEPA's *Supplemental Guidance for Developing Soil Screening levels for Superfund Sites* (December 2002), unless otherwise indicated
[d]Henry's Law constant measured at 25°C
[e]Data from the *Groundwater Chemicals Desk Reference* (Montgomery and Welkom 1989)
[f] ATSDR 2002. Toxicological Profile for Di(2-ethylhexyl) phthalate [DEHP]. September.
[g]ATSDR 2013. Toxicological Profile for Benzene. http://www.atsdr.cdc.gov/toxprofiles/tp.asp?id=40&tid=14
NA = Not Applicable
NP = Not Provided
g/mole = grams per mole
mg/L = milligrams per liter
mm HG = milligrams of mercury
mL/g – milliliters per gram
atm-m$^3$/mol =atmospheres per cubic meter per mol

TABLE 4-4

**Conceptual Site Model—Potential Source Areas and Release/Transport Mechanisms**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| Contaminant Source Areas | Potential Release/Transport Mechanisms |
|---|---|
| **Amcast North** | |
| AMN Building Materials - PCBs, potentially other hazardous components | Dispersal into air via particulates or vapors<br>Infiltration into surface soil/subsurface soil by sorption to particles<br>Infiltration into storm sewers beneath/adjacent to building |
| AMN Surface and Subsurface Soil - PCBs, CPAHs | Dispersal into air (surface soil) via particulates or vapors<br>Runoff in stormwater via particulates or solutes<br>Dissolution/desorption into groundwater |
| AMN Storm Sewer Sediment - PCBs | Particle or dissolved transport to Wilshire Pond |
| **Residences Adjacent to Amcast North** | |
| Residences' Surface Soil - PCBs | Dispersal into air via particulates or vapors<br>Runoff in stormwater via particulates or solutes<br>Infiltration into subsurface soil by sorption to particles |
| **Wilshire Pond** | |
| Wilshire Pond Sediment - PCBs | Dissolution into pond surface water<br>Infiltration into the groundwater<br>Bioaccumulation into organisms |
| Wilshire Pond Surface Water - Al, Mn, PCP, PAHs | Particle or dissolved transport via storm sewer to Cedar Creek<br>Runoff in stormwater via particulates or solutes during high water periods<br>Bioaccumulation of metals into organisms<br>Particle or dissolved transport via storm sewer during flooding periods to Cedar Creek |
| **Amcast South** | |
| AMS Former Disposal Area - contaminated debris/soil - PCBs, VOCs, PAHs, Non-PAH VOCs, metals | Dissolution/desorption into groundwater |
| AMS Surface and Subsurface Soil - PCBs, CPAHs | Dispersal into air (surface soil) via particulates or vapors<br>Runoff in stormwater via particulates or solutes<br>Dissolution/desorption into groundwater |
| AMS Storm Sewer Sediment - PCBs | Particle or dissolved transport to Quarry Pond (AMS) |

TABLE 4-4

**Conceptual Site Model—Potential Source Areas and Release/Transport Mechanisms**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| Contaminant Source Areas | Potential Release/Transport Mechanisms |
|---|---|
| **Quarry Pond** | |
| Quarry Pond Sediment - PCBs | Dissolution into pond surface water<br>Bioaccumulation into organisms<br>Infiltration into groundwater |
| Quarry Pond Surface Water - As, xylenes, PCP | Volatilization into the air<br>Runoff in stormwater via particulates or solutes during high water periods<br>Bioaccumulation of metals into organisms |
| Quarry Pond Fish Fillets - PCBs | Ingestion by humans |
| **Sitewide Groundwater** | |
| As, Mn, Pb, Cr, VOCs, DEHP, PAHs, PCBs | Downgradient transport with groundwater movement and discharge to ponds or streams, if present |

Notes:

Al = Aluminum

AMN = Amcast North

AMS = Amcast South

As = Arsenic

CPAH = carcinogenic polynuclear hydrocarbon

Cr = chromium

DEHP = bis (2-ethylhexyl)phthalate

Mn = Manganese

Pb = lead

PCBs = polychlorinated biphenyls

PCP = pentachlorophenol

VOCs = volatile organic compounds

TABLE 5-1

**HHRA Chemicals of Potential Concern Based on Historical and Recent (2011) Analytical Data**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| | PCBs | | | | | Metals | | | | | | | | | | | | PAHs | | | | | | | | | | Non-PAH SVOCs | | | VOCs | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Exposure Location/Media:** | **Aroclor 1242** | **Aroclor 1248** | **Aroclor 1254** | **Aroclor 1260** | **Total PCBs** | **Arsenic** | **Aluminum** | **Antimony** | **cadmium** | **chromium** | **cobalt** | **copper** | **iron** | **manganese** | **lead** | **vanadium** | **zinc** | **benzo(a)anthracene** | **benzo(a)pyrene** | **benzo(b)fluoranthene** | **benzo(k)fluoranthene** | **benzo(g,h,i)perylene** | **chrysene** | **dibenzo(a,h)anthracene** | **dibenzofuran** | **indeno(1,2,3-cd)pyrene)** | **pyrene** | **bis(2-ethylhexyl)phthalate** | **hexachloroethane** | **pentachlorophenol** | **1,1'-biphenyl** | **1,2-dichloropropane** | **1,2,4-trimethylbenzene** | **benzene** | **bromodichloromethane** | **chloroform** | **dibenzofuran** | **ethylbenzene** | **naphthalene** | **trichloroethylene** | **xylenes** |
| AMN Surface Soil | x | x | | | x | x | x | | | | x | | x | x | | | | x | x | x | | | | x | | x | | | | | | | | | | | | | | | |
| AMN Total Soil - Residential | x | x | | | x | x | x | | | | x | | x | x | | | | x | x | x | x | | | x | | x | | | | | | | | | | | | | | | |
| AMN Total Soil - Industrial and Commercial | | x | | | x | x | | | | | | | | | | | | x | x | x | | | | x | | x | | | | | | | | | | | | | | | |
| AMS Surface Soil | | x | x | | x | x | x | | x | | x | x | x | x | x | | | x | x | x | x | | | x | | x | | | | | | | | | | | | | | | |
| AMS Total Soil - Residential | x | x | x | | x | x | x | | x | | x | x | x | x | x | x | | x | x | x | x | | x | x | x | x | | | | | | | | | | | | | | | |
| AMS Total Soil - Industrial and Commercial | x | x | | | x | x | | | | | | | | | x | | | x | x | x | x | | | x | | x | | | | | | | | | | | | | | | |
| Offsite Residential Surface Soil | | | | | x | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wilshire Pond Bank Surface Soil | | x | | | x | x | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wilshire Pond Surface Water | | | | | | x | x | x | | x | x | | x | x | | | | | x | x | | | x | | | x | | | | x | | | | | | | | | | | |
| Wilshire Pond Sediment | | x | | | x | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Zeunert Park Surface Soil | | x | | x | x | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Quarry Pond Surface Water | | | | | | x | | | | x | | | | | | | | | | | | | | | | | | | | x | | | | | | | | | | | |
| Quarry Pond Sediment | | x | | | x | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Quarry Pond Fish Fillets | | x | | | x | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sitewide Groundwater - Potable | | x | | x | x | x | | | x | x | x | | x | x | x | x | x | x | x | x | x | x | x | x | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Sitewide Groundwater - Residential Vapor Intrusion | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | x | x | | | x | x | x | |
| Sitewide Groundwater - Industrial Vapor Intrusion | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | x | | | |

Notes:
AMN = Amcast North
AMS = Amcast South
HHRA = Human Health Risk Assessment
Surface soil = 0 to 2
Total Soil = 0 to 10 feet
Pond Bank Surface Soil = 0 to 2 feet near pond
Sediment = ingestion and dermal contact assumed

TABLE 5-2

**HHRA Current Exposure Scenarios and Estimated Risks for Amcast North and South**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| Exposure Scenario | Current ELCR | Target organ-specific HIs >1 |
|---|---|---|
| **Amcast North** | | |
| Onsite Trespassers (adolescent) - Surface Soil | $3 \times 10^{-5}$ | 2 |
| **Amcast South** | | |
| Onsite Trespassers (adolescent) - Surface Soil | $1 \times 10^{-5}$ | 0 |

Notes:
ELCR = Excess lifetime cancer risk
HHRA = Human Health Risk Assessment
HI = Hazard Index
Surface soil = 0 to 2 feet with ingestion, dermal contact, and inhalation assumed

TABLE 5-2

**HHRA Current Exposure Scenarios and Estimated Risks for Amcast North and South**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| Exposure Scenario | Current ELCR | Target organ-specific HIs >1 |
|---|---|---|
| **Amcast North** | | |
| Onsite Trespassers (adolescent) - Surface Soil | $3 \times 10^{-5}$ | 2 |
| **Amcast South** | | |
| Onsite Trespassers (adolescent) - Surface Soil | $1 \times 10^{-5}$ | 0 |

Notes:

ELCR = Excess lifetime cancer risk

HHRA = Human Health Risk Assessment

HI = Hazard Index

Surface soil = 0 to 2 feet with ingestion, dermal contact, and inhalation assumed

TABLE 5-3

**HHRA Current and Future Exposure Scenarios and Estimated Risks for Offsite Areas**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| Exposure Scenario | Current ELCR | Target organ-specific HIs >1 |
|---|---|---|
| **Wilshire Pond (recreational use)** | | |
| Bank Surface Soil - adult | | 2 |
| Bank Surface Soil - child | | 2 |
| Bank Surface Soil - adult + child combination | $1 \times 10^{-4}$ | |
| Surface Water - adult | | 0 |
| Surface Water - child | | 0 |
| Surface Water - adult + child combination | $2 \times 10^{-4}$ | |
| Sediment - adult | | 0 |
| Sediment - child | | 0 |
| Sediment - adult + child aggregate | $7 \times 10^{-6}$ | |
| **Zeunert Park** | | |
| Surface Soil - adult | | 0 |
| Surface Soil - child | | 0 |
| Surface Soil - adult + child combination | $1 \times 10^{-6}$ | |
| **Quarry Pond** | | |
| Surface Water - adult | | 0 |
| Surface Water - child | | 0 |
| Surface Water - adult + child | $3 \times 10^{-5}$ | |
| Sediment - adult | | 2 |
| Sediment - child | | 2 |
| Sediment - adult + child aggregate | $4 \times 10^{-4}$ | |
| Recreational Angler - adult | $3 \times 10^{-3}$ | 2 |
| Recreational Angler - child | $1 \times 10^{-3}$ | 2 |

Notes:

ELCR = Excess lifetime cancer risk

HHRA = Human Health Risk Assessment

HI = Hazard Index

Surface soil = 0 to 2 feet with ingestion, dermal contact, and inhalation assumed

Bank Surface Soil = 0 to 2 feet with ingestion, dermal contact, and inhalation assumed

Surface Water = ingestion and dermal contact assumed

Sediment = ingestion and dermal contact assumed

Recreational Angler - ingestion of fish fillets assumed

TABLE 5-4

**HHRA Future Exposure Scenarios and Estimated Risks for Amcast North and South**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| Exposure Scenario | Future ELCR | Target organ-specific HI's >1 |
|---|---|---|
| **Amcast North** | | |
| **Onsite Resident** | | |
| Total Soil - Adult | | 2 |
| Total Soil - Child | | 2 |
| Total Soil - Adult+child aggregate | $8 \times 10^{-4}$ | |
| Groundwater - adult | | 7 |
| Groundwater - child | | 10 |
| Groundwater adult + child aggregate | $3 \times 10^{-1}$ | |
| **Industrial Worker** | | |
| Total Soil - Adult | $2 \times 10^{-4}$ | 2 |
| Groundwater - adult | $9 \times 10^{-3}$ | 3 |
| **Onsite Construction Worker** | | |
| Total Soil - Adult | $2 \times 10^{-5}$ | 2 |
| **Amcast South** | | |
| **Onsite Resident** | | |
| Total Soil - Adult | | 0 |
| Total Soil - Child | | 2 |
| Total Soil - Adult+child aggregate | $4 \times 10^{-3}$ | |
| Groundwater - adult | | 7 |
| Groundwater - child | | 10 |
| Groundwater adult + child aggregate | $3 \times 10^{-1}$ | |
| **Industrial Worker** | | |
| Total Soil - Adult | $3 \times 10^{-4}$ | 0 |
| Groundwater - adult | $9 \times 10^{-3}$ | 3 |
| **Onsite Construction Worker** | | |
| Total Soil - Adult | $3 \times 10^{-5}$ | 2 |

Notes:
ELCR = Excess lifetime cancer risk
HHRA = Human Health Risk Assessment
HI = Hazard Index
Total soil = 0 to 10 feet with ingestion, dermal contact, and inhalation assumed
Groundwater = ingestion, dermal contact, and inhalation assumed
Surface Soil = 0 to 2 feet

TABLE 5-5

**HHRA Chemicals of Concern Based on Human Health Risk Assessment Estimates**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| | PCBs | Metals | | | | | PAHs | | | | | | | Non-PAH SVOCs | | | | VOCs | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Exposure Location/Media:** | **PCBs** | **Arsenic** | **chromium** | **iron** | **manganese** | **lead** | **benzo(a)anthracene** | **benzo(a)pyrene** | **benzo(b)fluoranthene** | **benzo(k)fluoranthene** | **chrysene** | **dibenzo(a,h)anthracene** | **indeno(1,2,3-c,d)pyrene)** | **bis(2-ethylhexyl)phthalate** | **hexachloroethane** | **pentachlorophenol** | **1,1'-biphenyl** | **1,2,4-trimethylbenzene** | **benzene** | **bromodichloromethane** | **chloroform** | **ethylbenzene** | **naphthalene** |
| AMN Surface Soil | x | | | | | | | | | | | | | | | | | | | | | | |
| AMN Total Soil | x | x | | | | | x | x | x | x | | x | x | | | | | | | | | | |
| AMS Surface Soil (none) | | | | | | | | | | | | | | | | | | | | | | | |
| AMS Total Soil | x | x | | | | | x | x | x | x | x | x | x | | | | | | | | | | |
| Wilshire Pond Bank Surface Soil | x | | | | | | | | | | | | | | | | | | | | | | |
| Wilshire Pond Surface Water (none) | | | | | | | | | | | | | | | | | | | | | | | |
| Wilshire Pond Sediment (none) | | | | | | | | | | | | | | | | | | | | | | | |
| Zeunert Park Surface soil (none) | | | | | | | | | | | | | | | | | | | | | | | |
| Quarry Pond Sediment | x | | | | | | | | | | | | | | | | | | | | | | |
| Quarry Pond Surface Water (none) | | | | | | | | | | | | | | | | | | | | | | | |
| Quarry Pond Fish Fillets | x | | | | | | | | | | | | | | | | | | | | | | |
| Sitewide Groundwater | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |

Notes:

HHRA = Human Health Risk Assessment

Surface soil = 0 to 2 feet with ingestion, dermal contact, and inhalation assumed

Bank Surface Soil = 0 to 2 feet with ingestion, dermal contact, and inhalation assumed

Surface Water = ingestion and dermal contact assumed

Sediment = ingestion and dermal contact assumed

TABLE 6-1

**ERA Chemicals of Potential Concern Based on Historical and Recent (2011) Analytical Data**

*Amcast Industrial Site, Cedarburg, Wisconsin*

| Exposure Location/Media | Aroclor 1248 | Aroclor 1254 | Total PCBs | Copper | Manganese | HMW PAHs |
|---|---|---|---|---|---|---|
| **Terrestrial Habitats** | | | | | | |
| Amcast North - Surface Soil | X | | X | | X | |
| Amcast North - Terrestrial Food Web | X | | X | | | |
| Residential Area - Surface Soil | X | X | X | | | |
| Residential Area - Terrestrial Food Web | X | X | X | | | |
| Amcast South - Surface Soil | X | X | X | X | X | X |
| Amcast South - Terrestrial Food Web | X | | X | | | |
| Zeunert Park - Surface Soil | | | No COPCs | | | |
| Zeunert Park - Terrestrial Food Web | X | | X | | | |
| **Aquatic Habitats** | | | | | | |
| Quarry Pond Surface Water | | | No COPCs | | | |
| Quarry Pond Basin Sediment | X | | X | | | |
| Quarry Pond Bank Sediment | | | No COPCs | | | |
| Quarry Pond Fish Tissue | X | | X | | | |
| Quarry Pond Food Web | X | | X | | | |
| Wilshire Pond Surface Water | | | No COPCs | | | |
| Wilshire Pond Sediment (Basin and Bank) | X | | X | | | |
| Wilshire Pond Fish Tissue | X | | X | | | |
| Wilshire Pond Food Web | X | | X | | | |

Notes:

ERA = Ecological Risk Assessment

Surface soil = 0 to 2 feet

HMW PAHs are the sum total of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene), and pyrene

# Figures

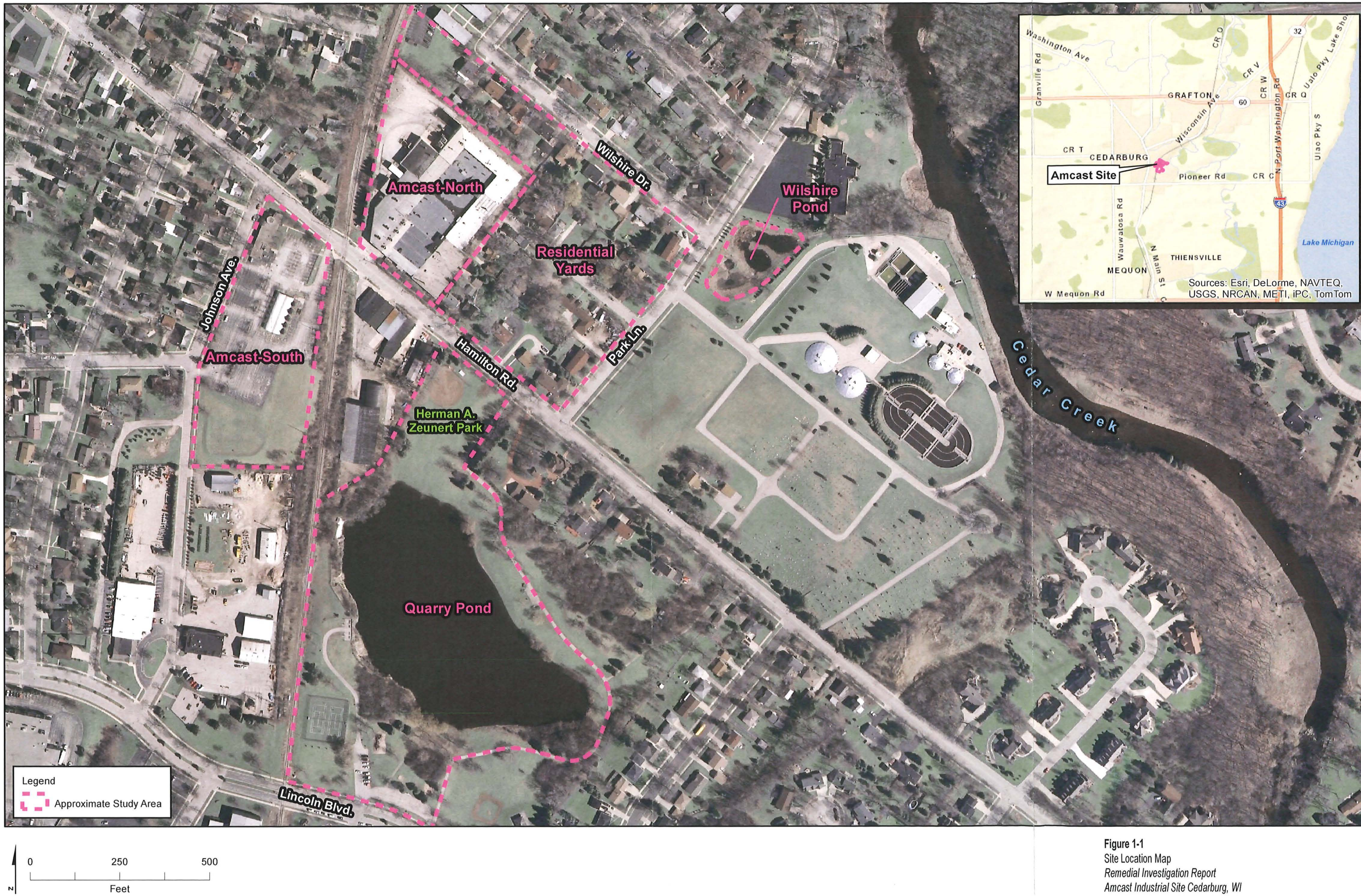
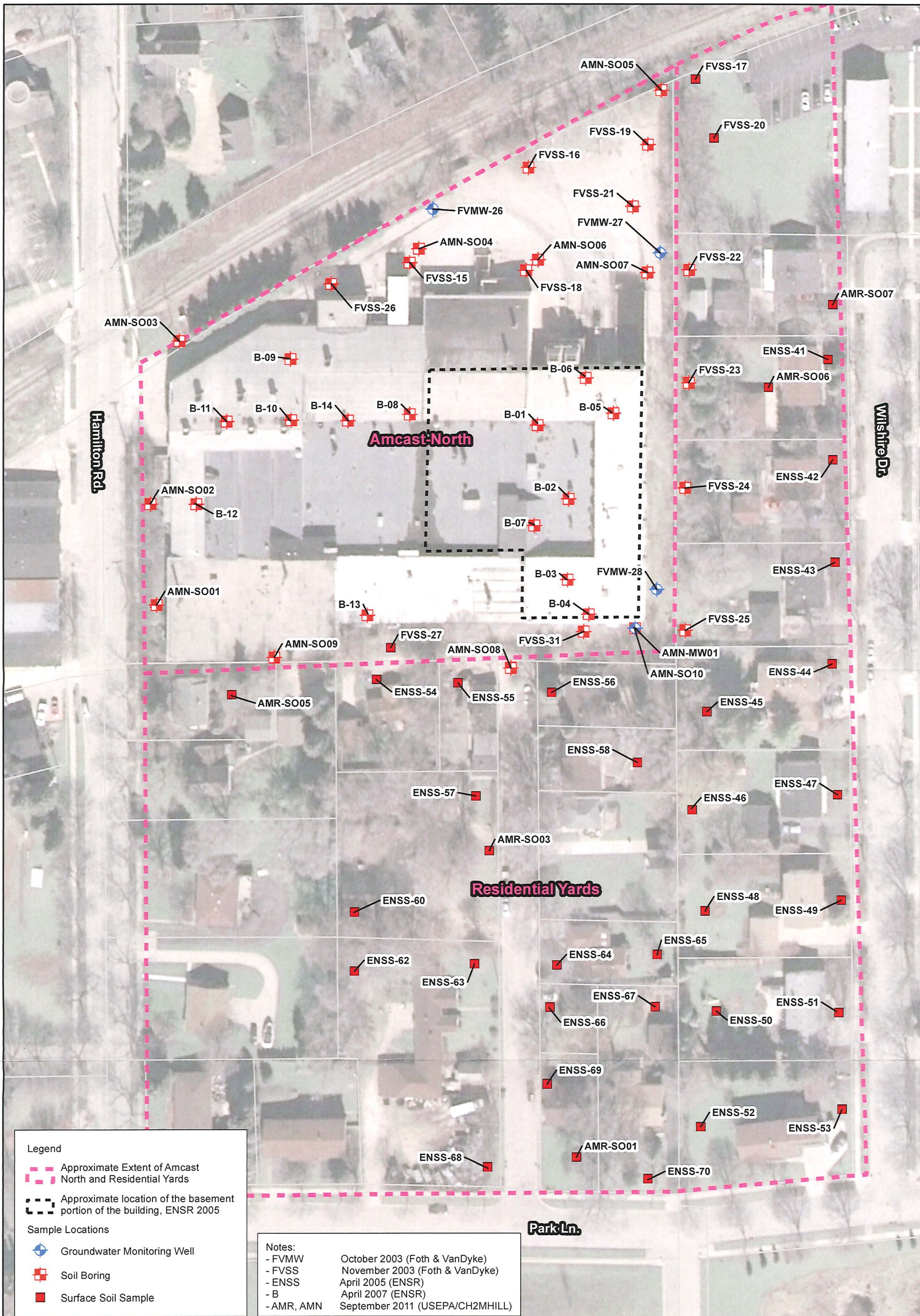



Figure 1-1
Site Location Map
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

CH2MHILL

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 01-01 - SITE LOCATION MAP.MXD JHANSEN1 5/12/2015 1:45:05 PM




0 80 160
Feet

**Figure 1-2**
Amcast North Property and Residential Yards - Features and Investigation Locations
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 01-02 - AMCAST NORTH.MXD JHANSEN1 5/12/2015 1:52:32 PM

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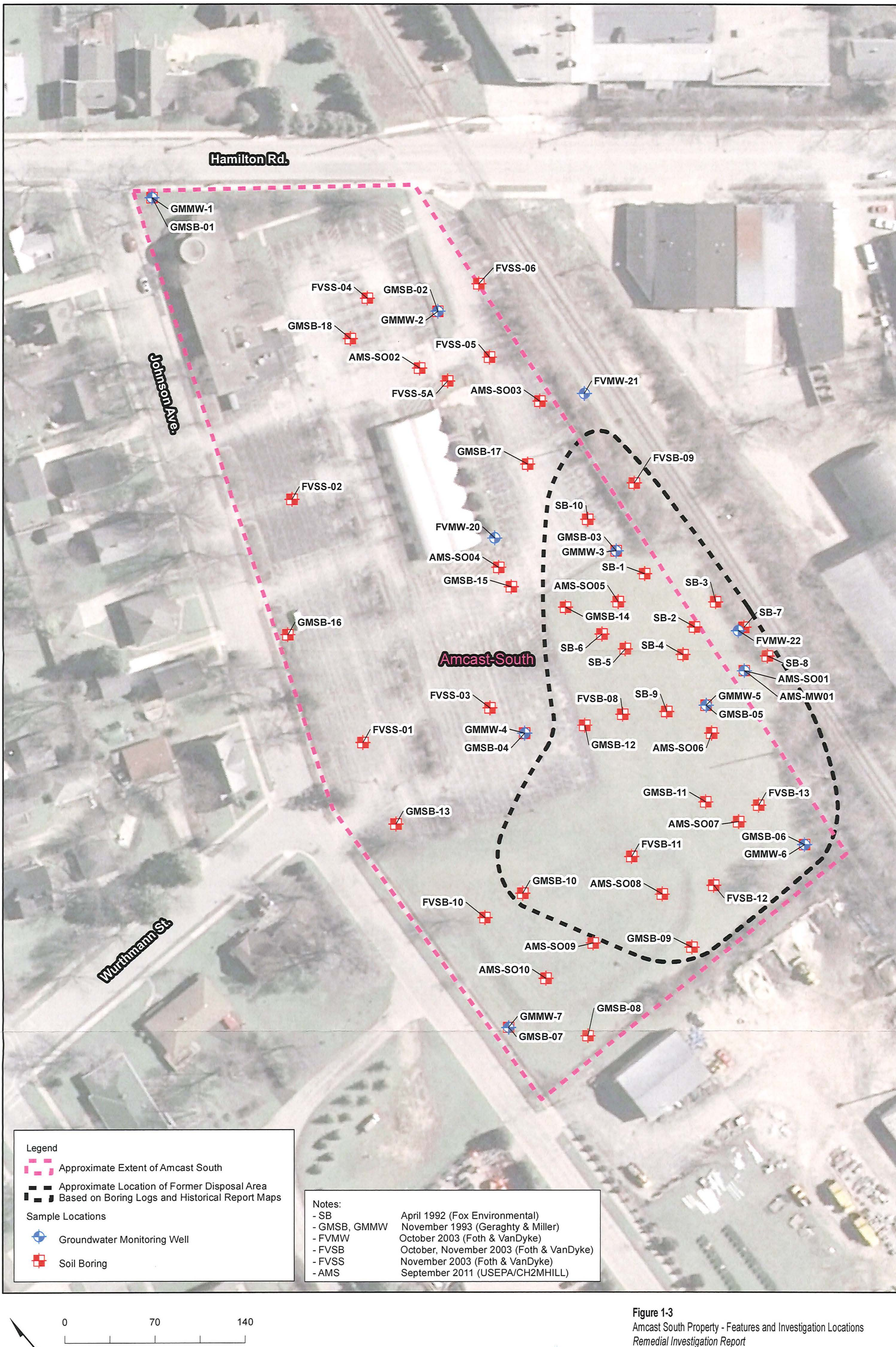


**Figure 1-3**
Amcast South Property - Features and Investigation Locations
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 01-03 - AMCAST SOUTH.MXD JHANSEN1 5/12/2015 2:01:14 PM

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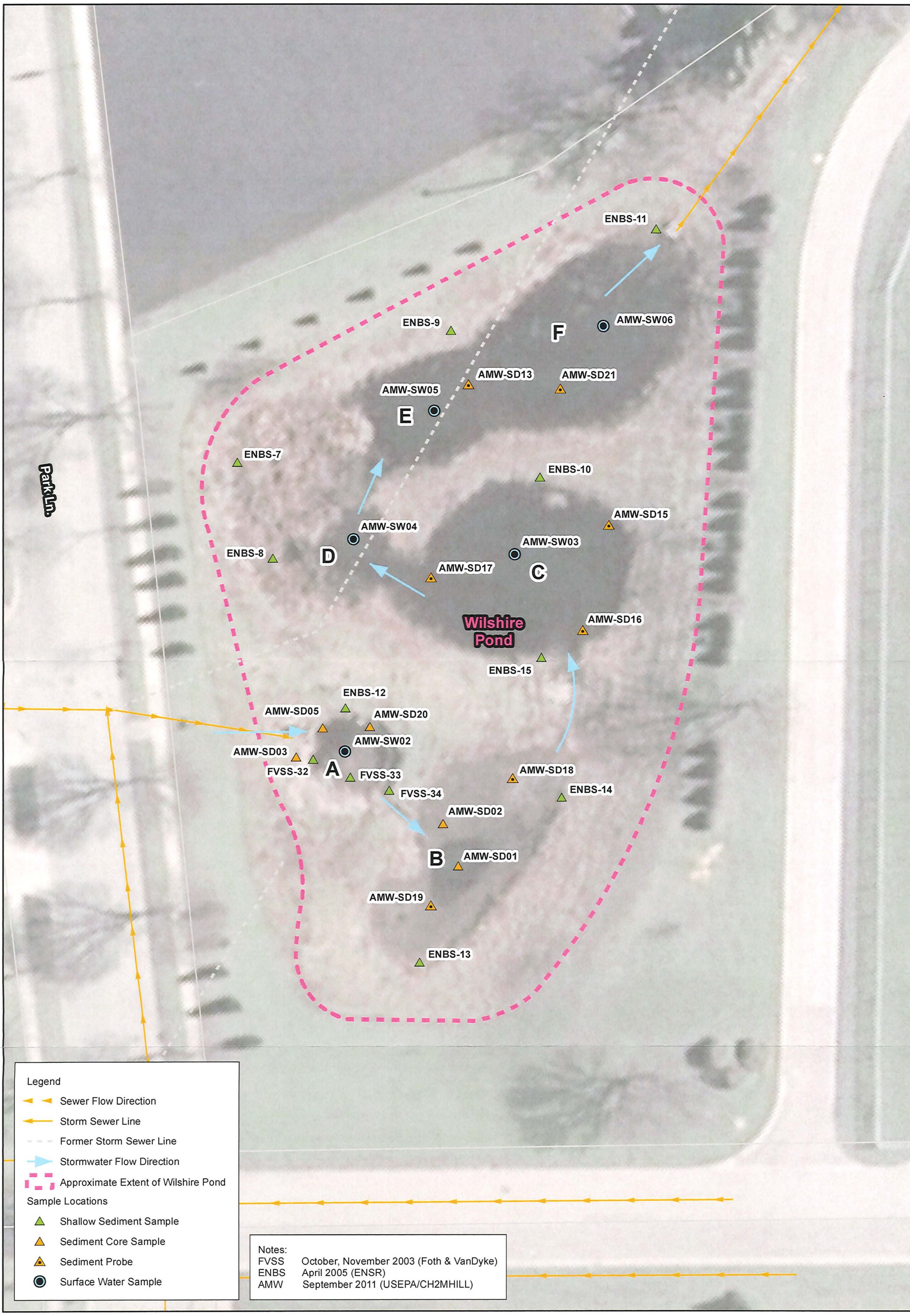


**Figure 1-4**
Wilshire Pond - Features and Investigation Locations
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

CH2MHILL

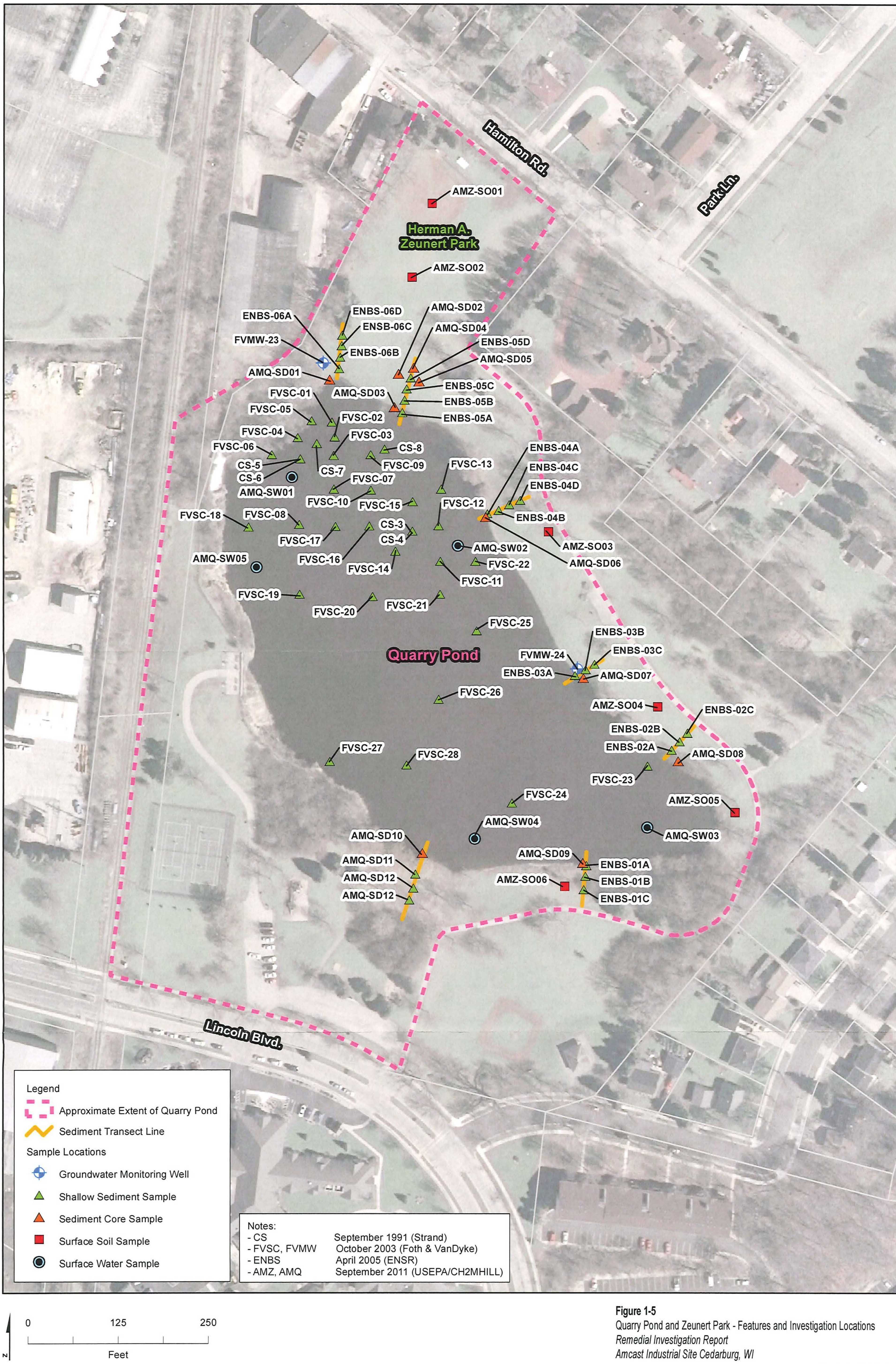


**Figure 1-5**
Quarry Pond and Zeunert Park - Features and Investigation Locations
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 01-05 - QUARRY POND.MXD JHANSEN1 5/12/2015 2:26:05 PM

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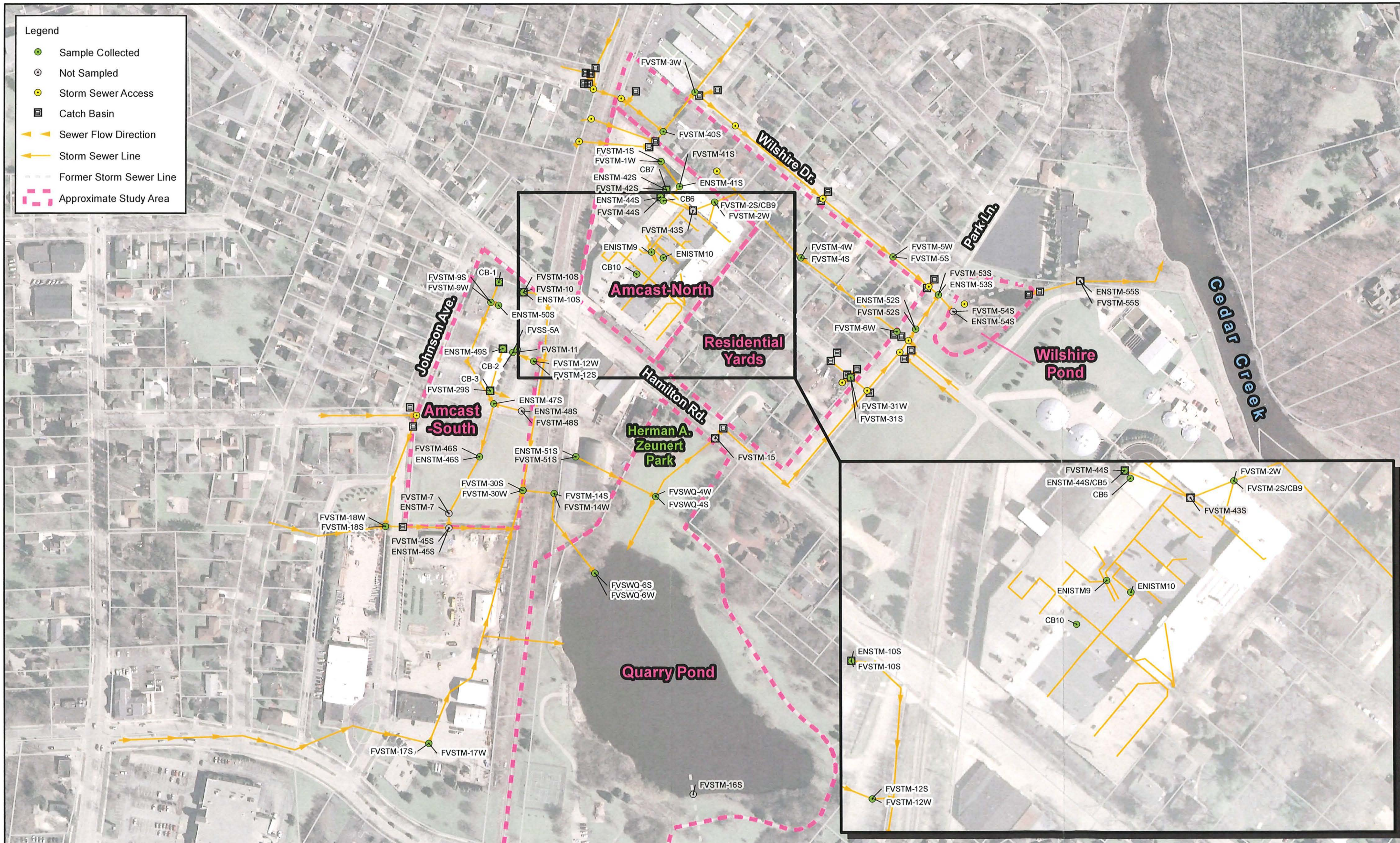


0 125 250
Feet

Notes: All locations and flow direction arrows are approximate, summarized from the following resources:
- City of Cedarburg 2010 Adobe Files
- Foth & Van Dyke, 2004.
- ENSR, 2005, 2007.

**Figure 1-6**
Storm Sewer Location Map
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

CH2MHILL

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 01-06 - STORM SEWER LOCATION MAP.MXD JHANSEN1 5/12/2015 2:50:42 PM


Figure 2-1
Cross Section Location Map
Remedial Investigation Report
*Amcast Industrial Site Cedarburg, WI*

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 02-01 - CROSS SECTION LOCATION MAP.MXD JHANSEN1 4/4/2013 9:19:37 AM

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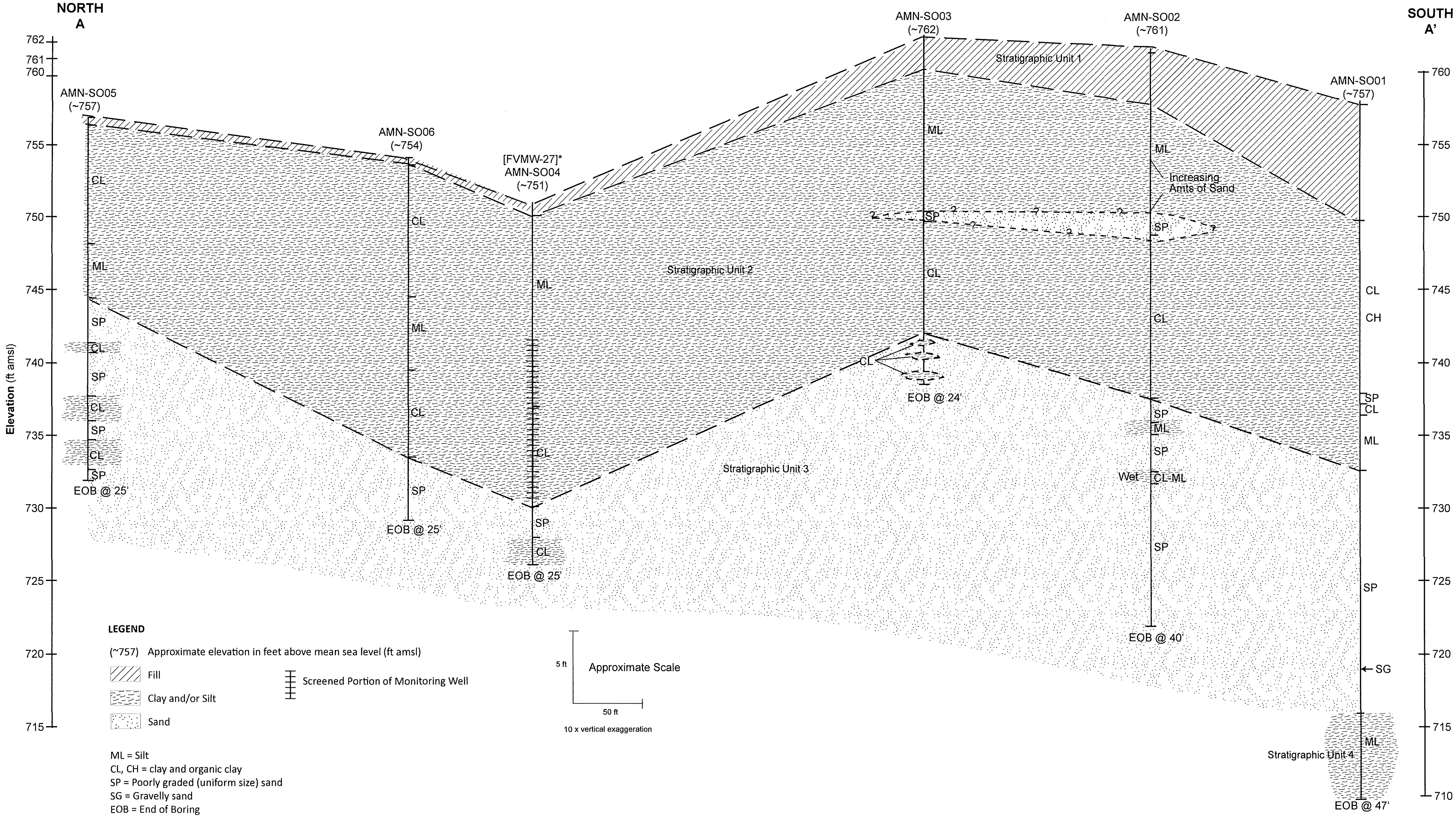


Note: Approximate land surface elevations from Foth & Van Dyke, 2003 (Figure 3)
* Stratigraphy based on boring log from AMN-SO04; screened interval of FVMW-27 inferred from measured total depth and Foth & Van Dyke, 2003.

FIGURE 2-2
**Cross-section A-A' Amcast North**
*Amcast Industrial Site*
*Cedarburg, WI*

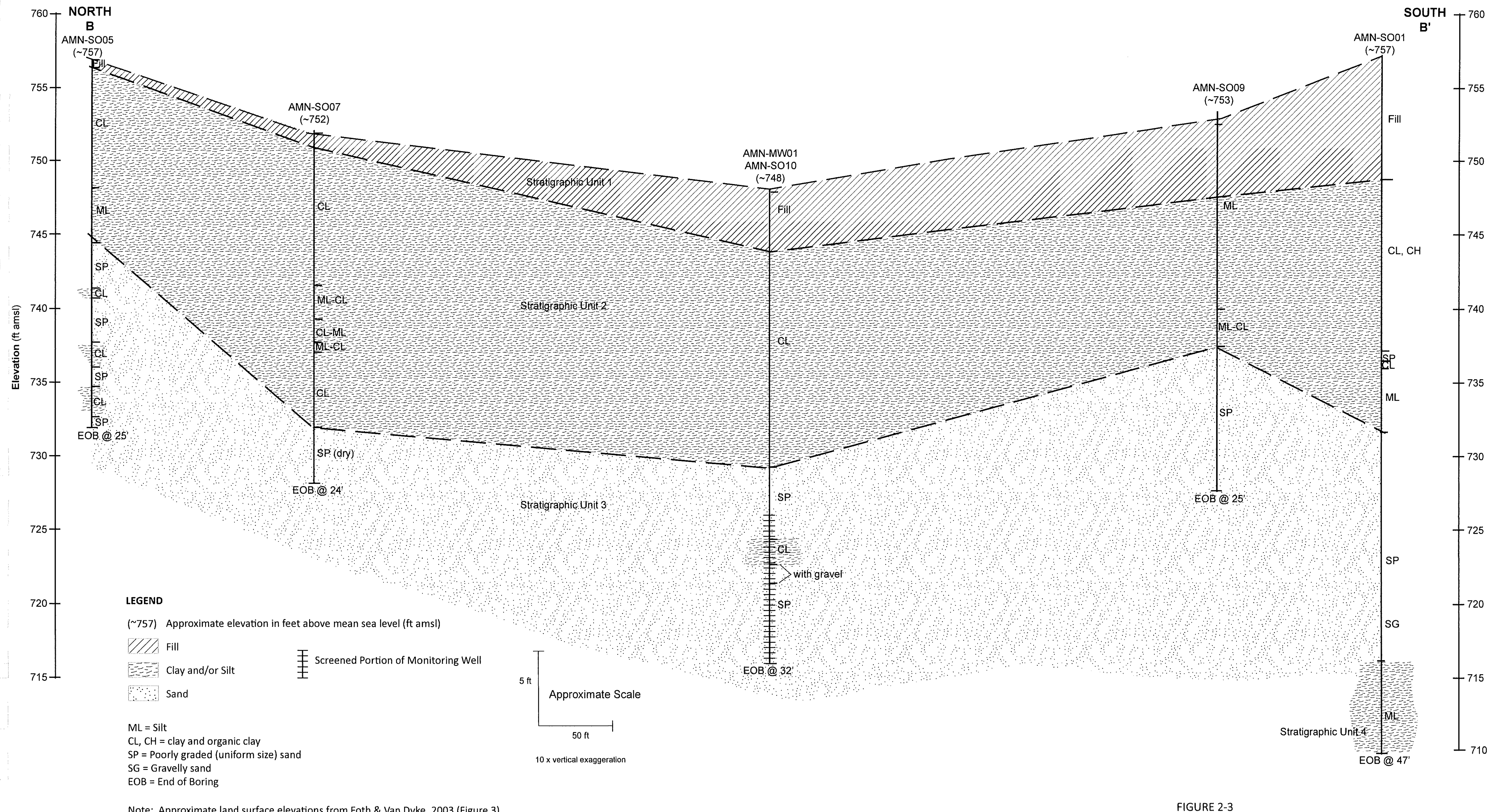


FIGURE 2-3
**Cross-section B-B' Amcast North**
*Amcast Industrial Site*
*Cedarburg, WI*

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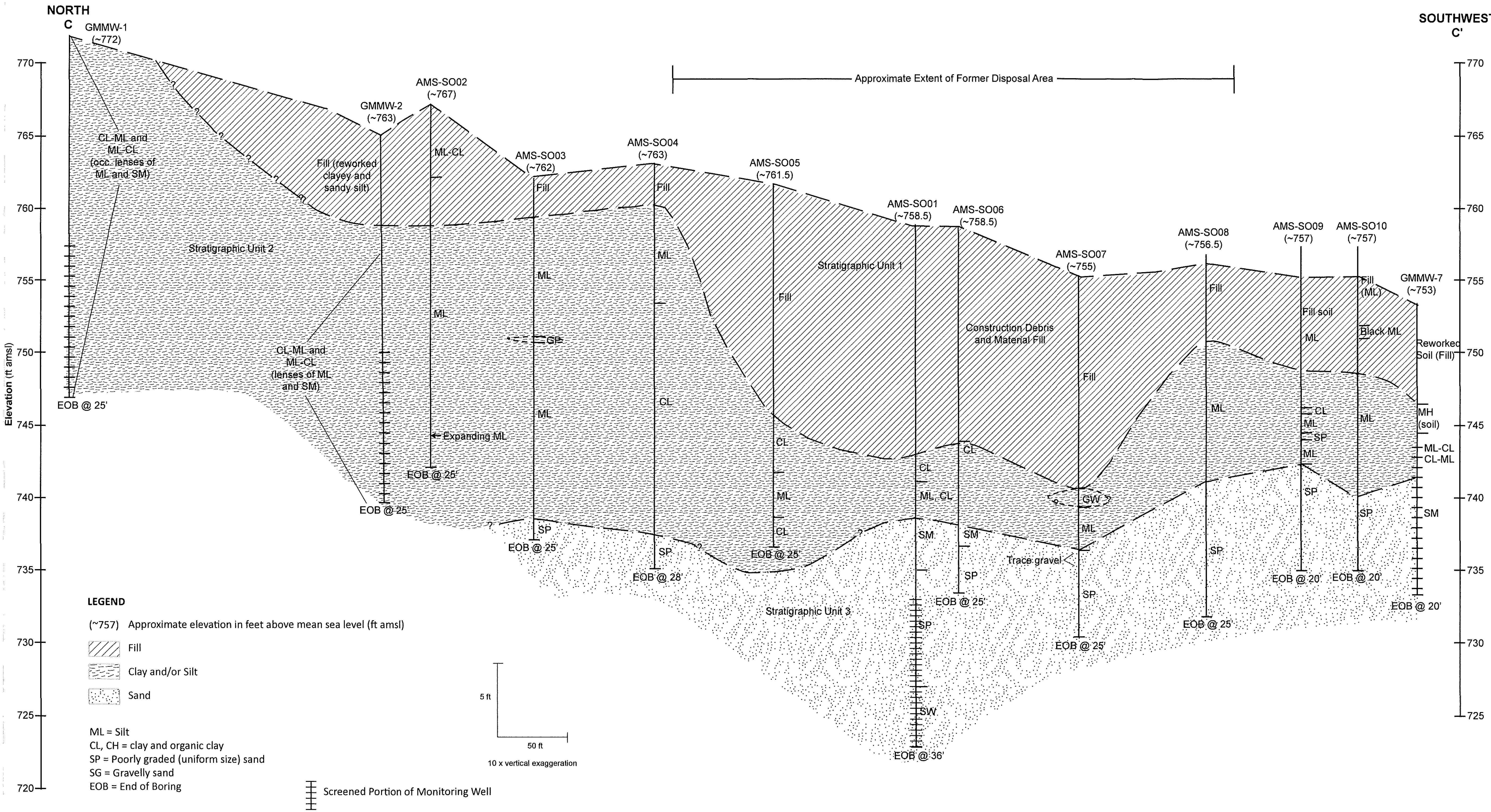
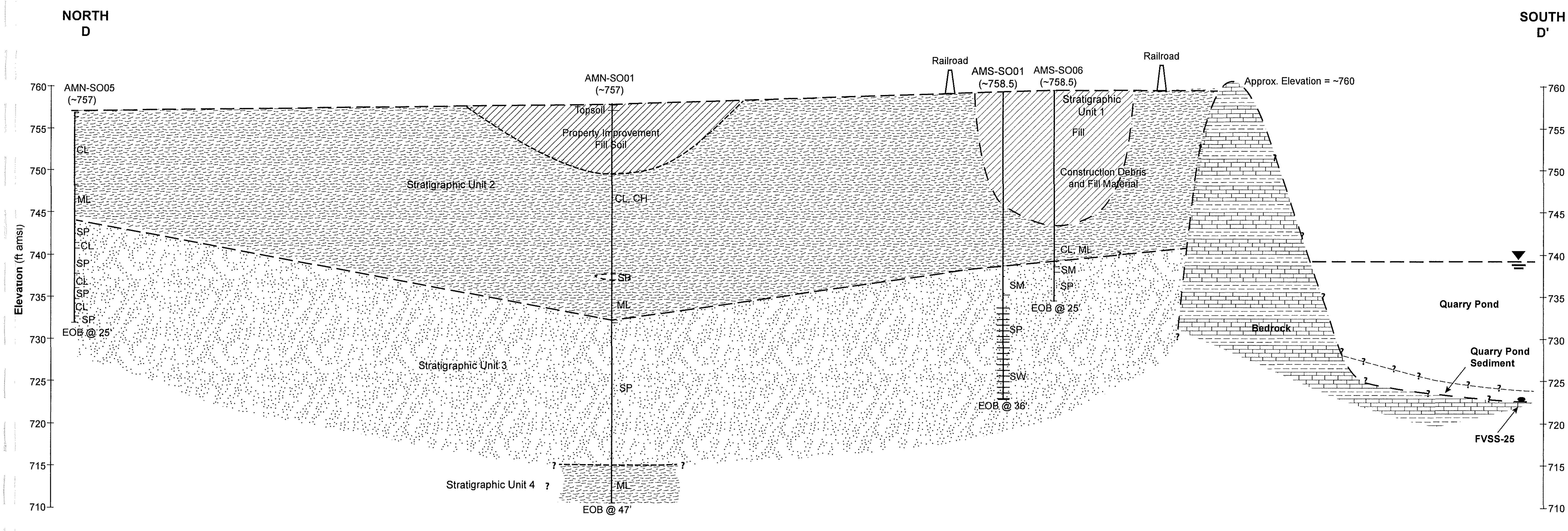
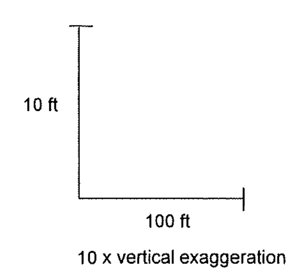



Note: Approximate land surface elevations from Foth & Van Dyke, 2003 (Figure 7)

FIGURE 2-4
**Cross-section Amcast South C-C'**
*Amcast Industrial Site*
*Cedarburg, WI*




**LEGEND**

(~757) Approximate elevation in feet above mean sea level (ft amsl)

Fill

Clay and Silt

Sand

Bedrock

Screened Portion of Monitoring Well

Approximate Water Surface

ML = Silt
CL, CH = clay and organic clay
SP = Poorly graded (uniform size) sand
SM = Silty sand
EOB = End of Boring

Note: Approximate land and water surface elevations from Foth & Van Dyke, 2003 (Figures 3 and 7) and Foth & Van Dyke, 2004 (Figures 6 and 7)

FIGURE 2-5
**Site Cross-section D-D'**
*Amcast Industrial Site*
*Cedarburg, WI*

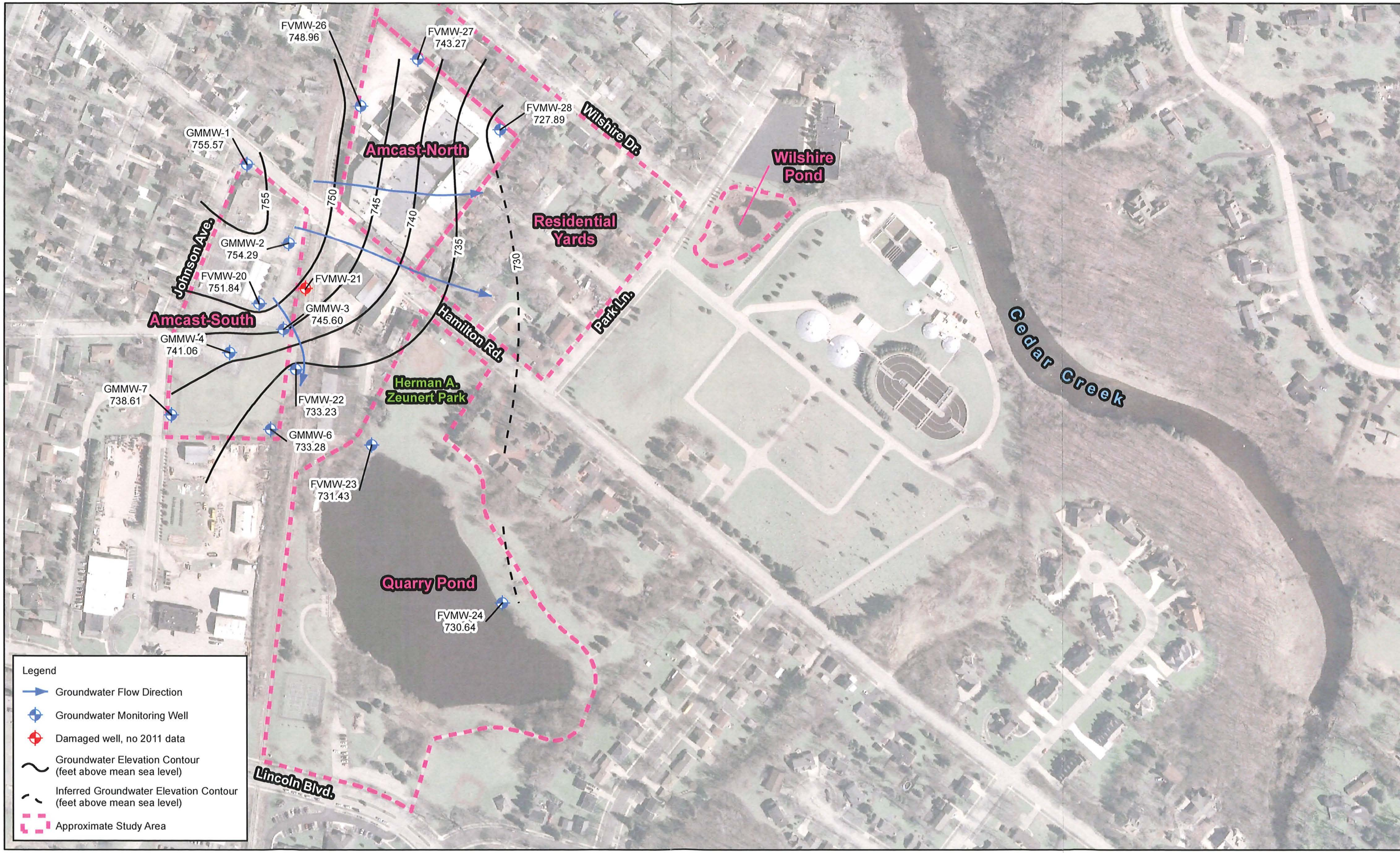



**Figure 2-6**
Unit 2 (Clay & Silt) Groundwater Elevation Contour Map
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 02-06 - UNIT 2 GROUNDWATER CONTOURS.MXD JHANSEN1 5/12/2015 3:21:39 PM

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**Figure 2-7**
Unit 3 (Sand) Groundwater Elevation Contour Map
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 02-07 - UNIT 3 GROUNDWATER CONTOURS.MXD JHANSEN1 5/12/2015 3:28:08 PM

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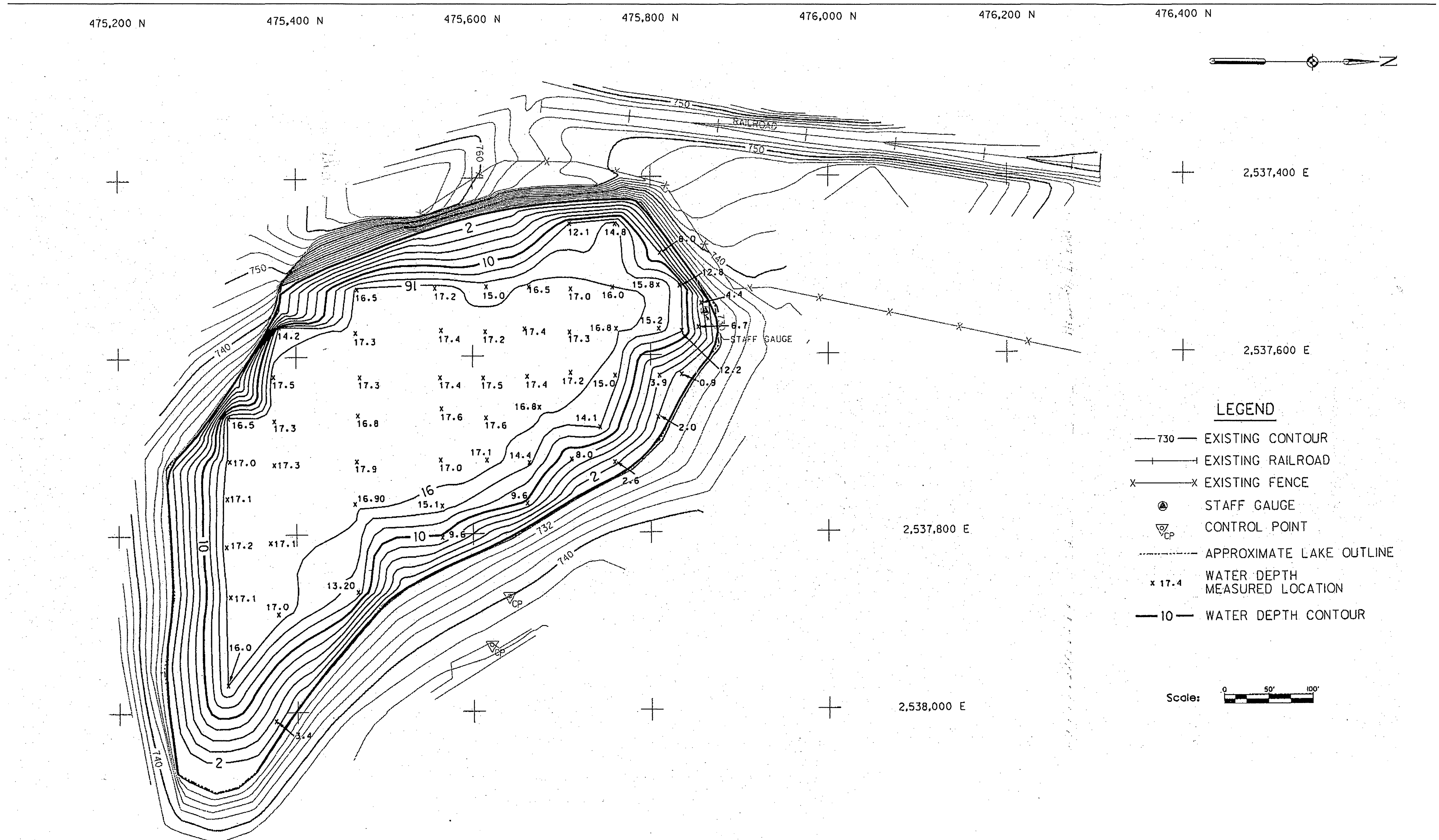


**NOTE:**
WATER DEPTH CONTOUR INTERVAL IS TWO FEET.

**Note:** Figure source: Foth & Van Dyke Technical Memorandum – Amcast Industrial Corporation – Preliminary Site Characterization Summary, Figure 7. March 22, 2004.

FIGURE 2-8
**Quarry Pond Bathymetry Map (Pond Bottom Contours)**
*Amcast Industrial Site*
*Cedarburg, WI*



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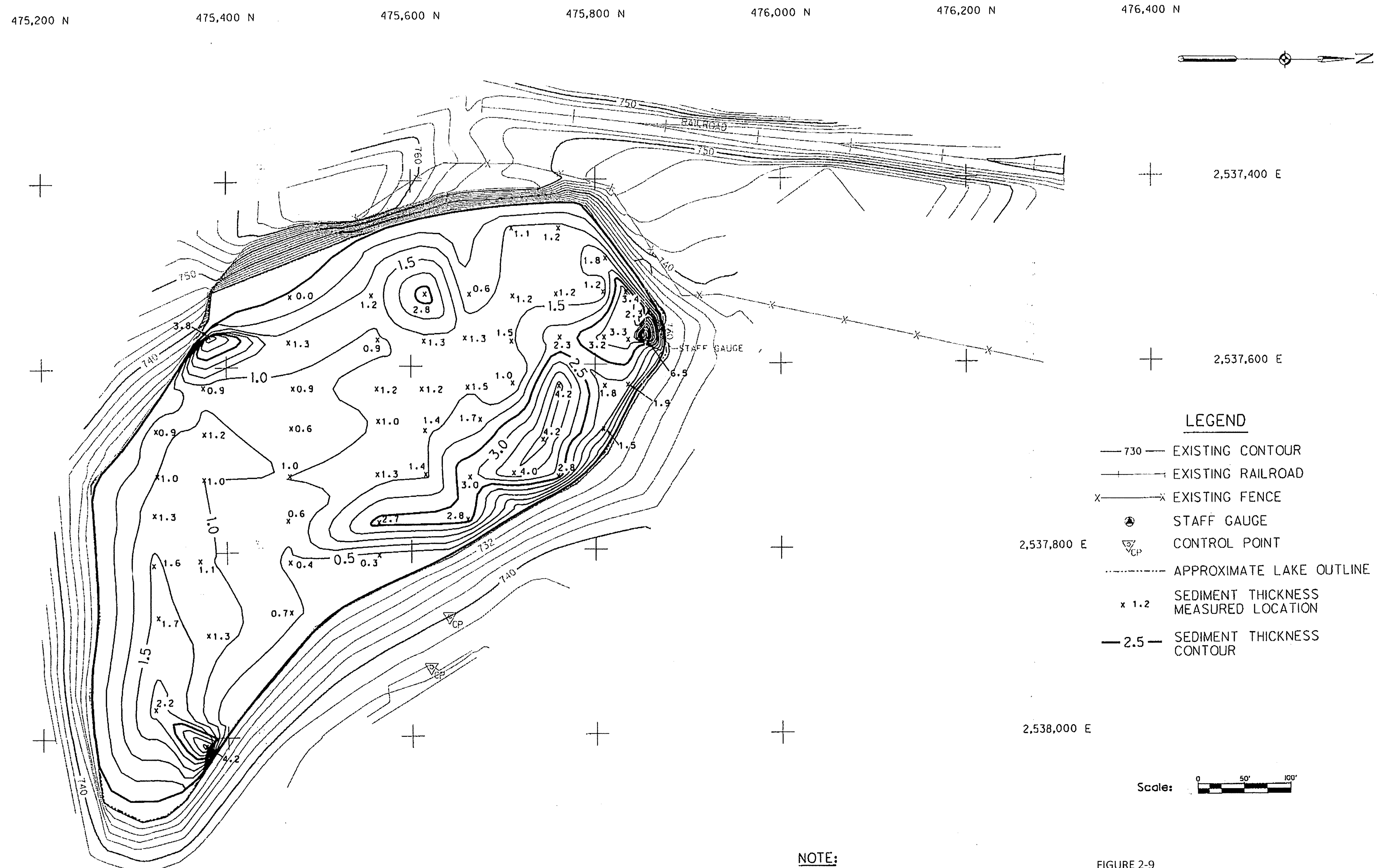


NOTE:
SEDIMENT THICKNESS CONTOUR INTERVAL IS 0.5 FEET.

**Note:** Figure source: Foth & Van Dyke Technical Memorandum – Amcast Industrial Corporation – Preliminary Site Characterization Summary, Figure 6. March 22, 2004.

FIGURE 2-9
**Quarry Pond Sediment Thickness Contour Map**
*Amcast Industrial Site*
*Cedarburg, WI*

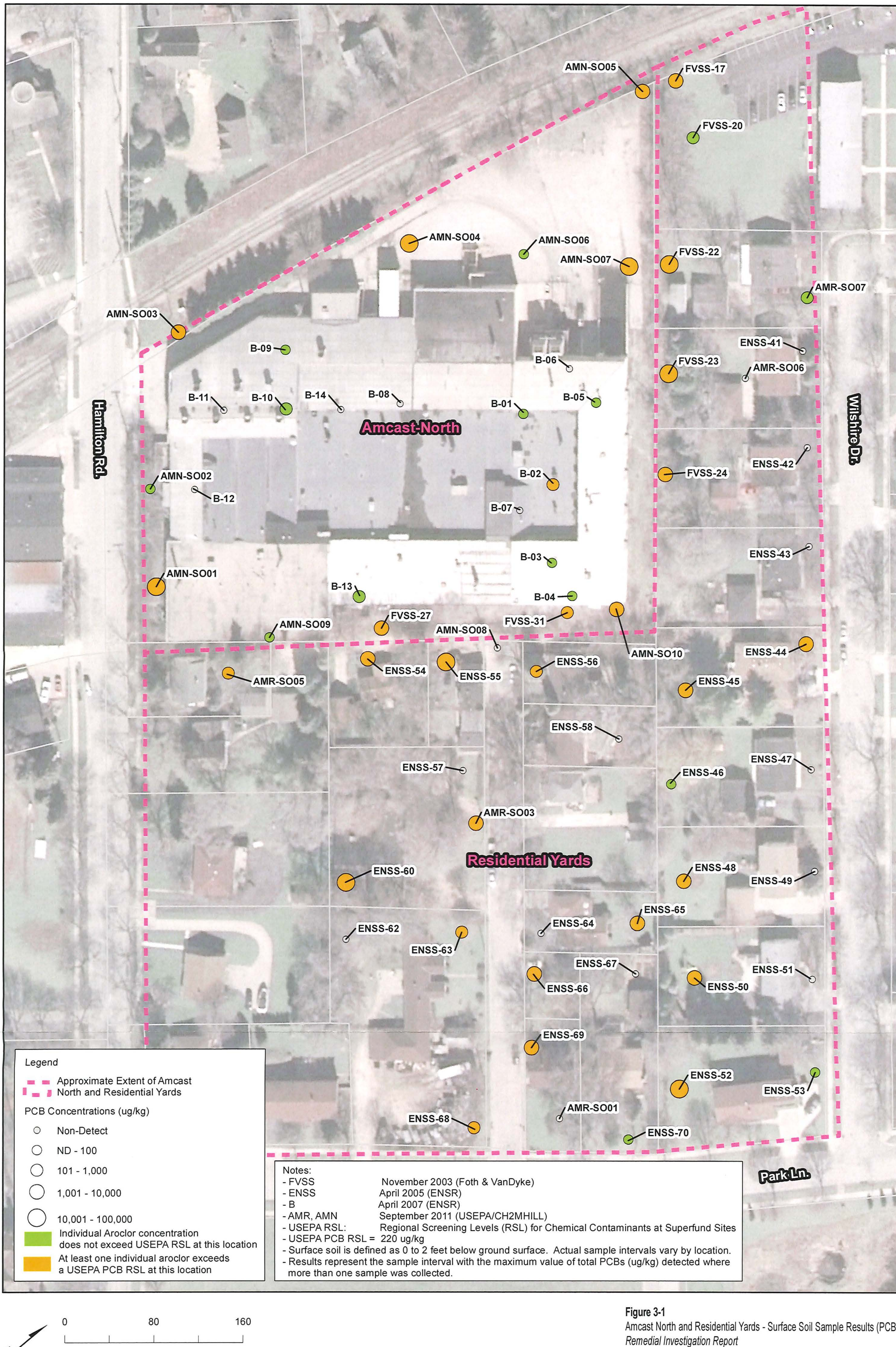


**Figure 3-1**
Amcast North and Residential Yards - Surface Soil Sample Results (PCBs)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 03-01 - SURFACE SOIL PCB - AMCAST NORTH.MXD JHANSEN1 5/12/2015 3:38:57 PM

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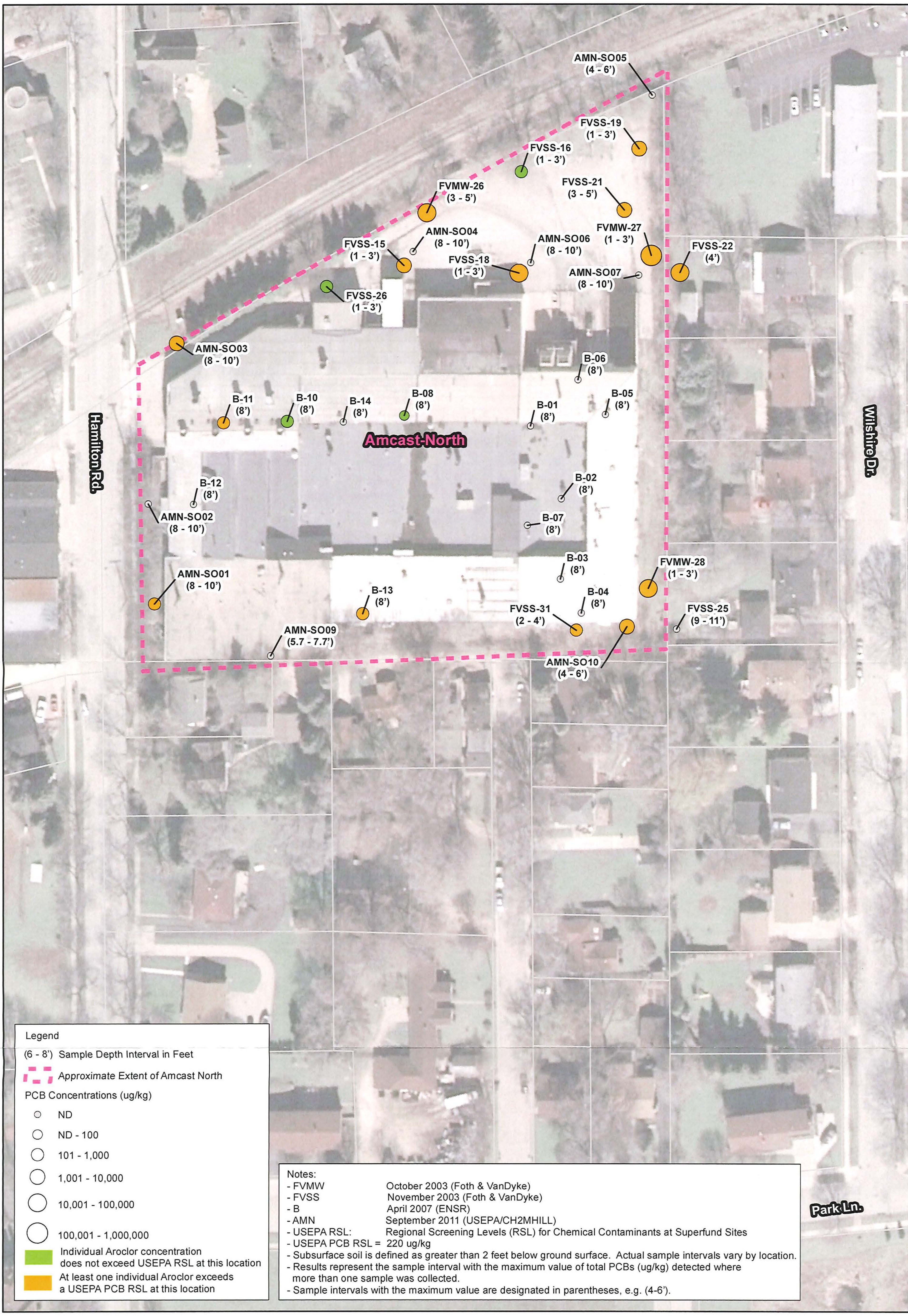


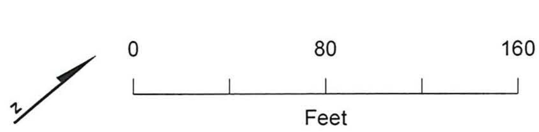


**Figure 3-2**
Amcast North - Subsurface Soil Sample Results (PCBs)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 03-02 - SUBSURFACE SOIL PCB - AMCAST NORTH.MXD JHANSEN1 5/12/2015 3:46:42 PM

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**Figure 3-3**
Amcast North - Surface Soil Sample Results (PAH)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 03-03 - SURFACE SOIL PAH - AMCAST NORTH.MXD JHANSEN1 5/12/2015 3:54:42 PM

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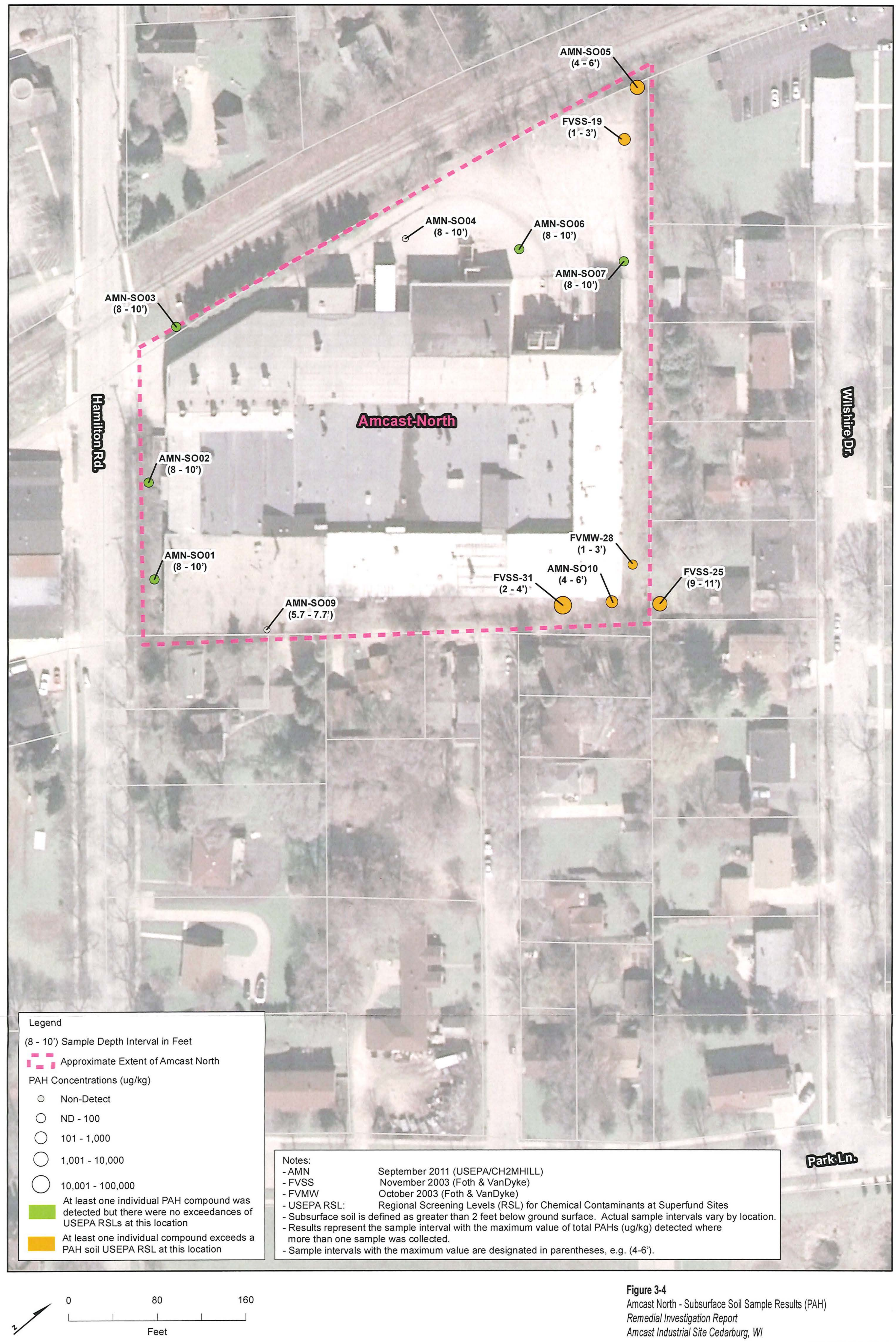


**Figure 3-4**
Amcast North - Subsurface Soil Sample Results (PAH)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

CH2MHILL

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-04 - SUBSURFACE SOIL PAH - AMCAST NORTH.MXD JHANSEN1 5/12/2015 4:04:31 PM

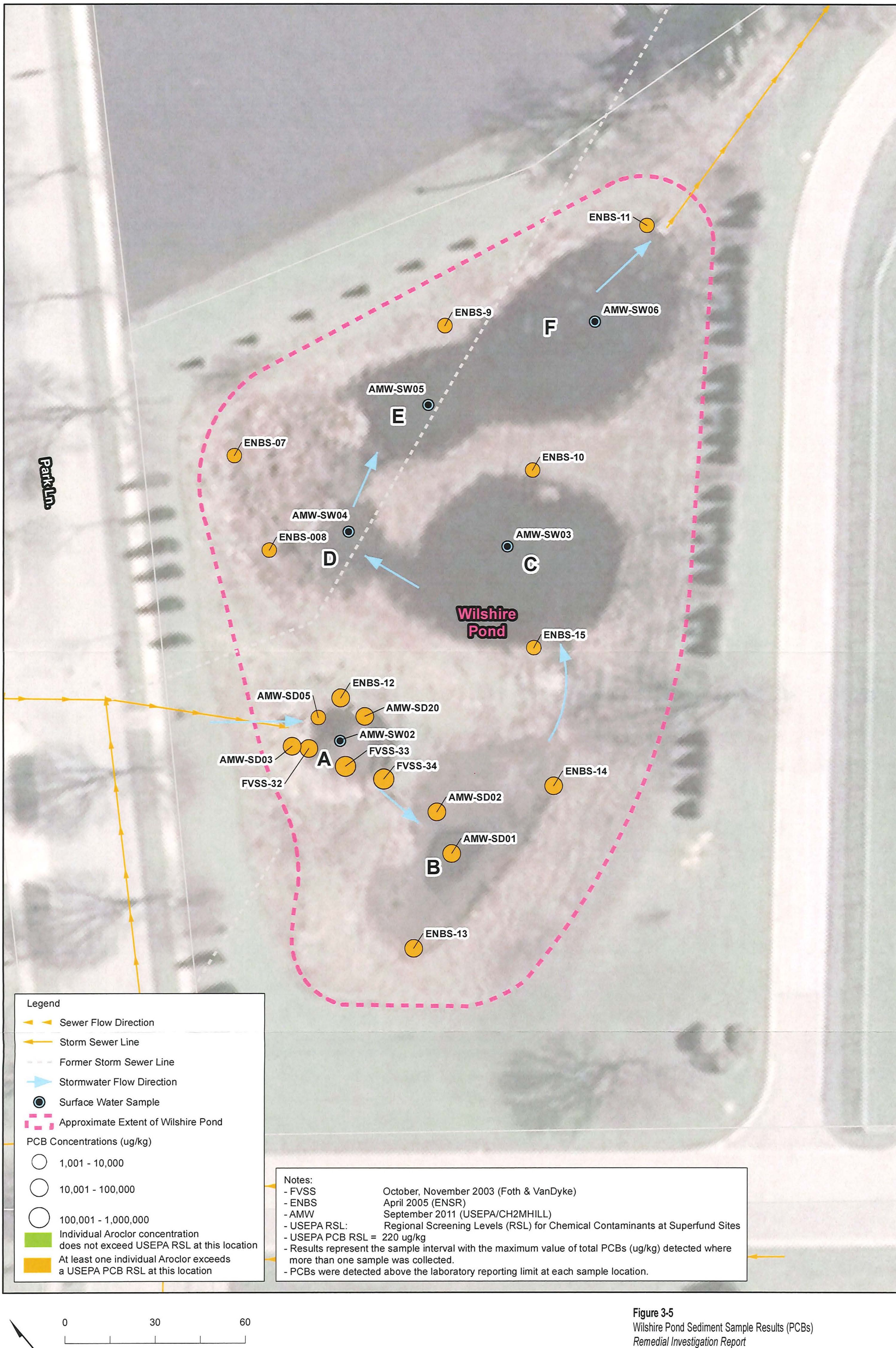


**Figure 3-5**
Wilshire Pond Sediment Sample Results (PCBs)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 03-05 - SEDIMENT PCB - WILSHIRE POND.MXD JHANSEN1 5/12/2015 4:09:13 PM

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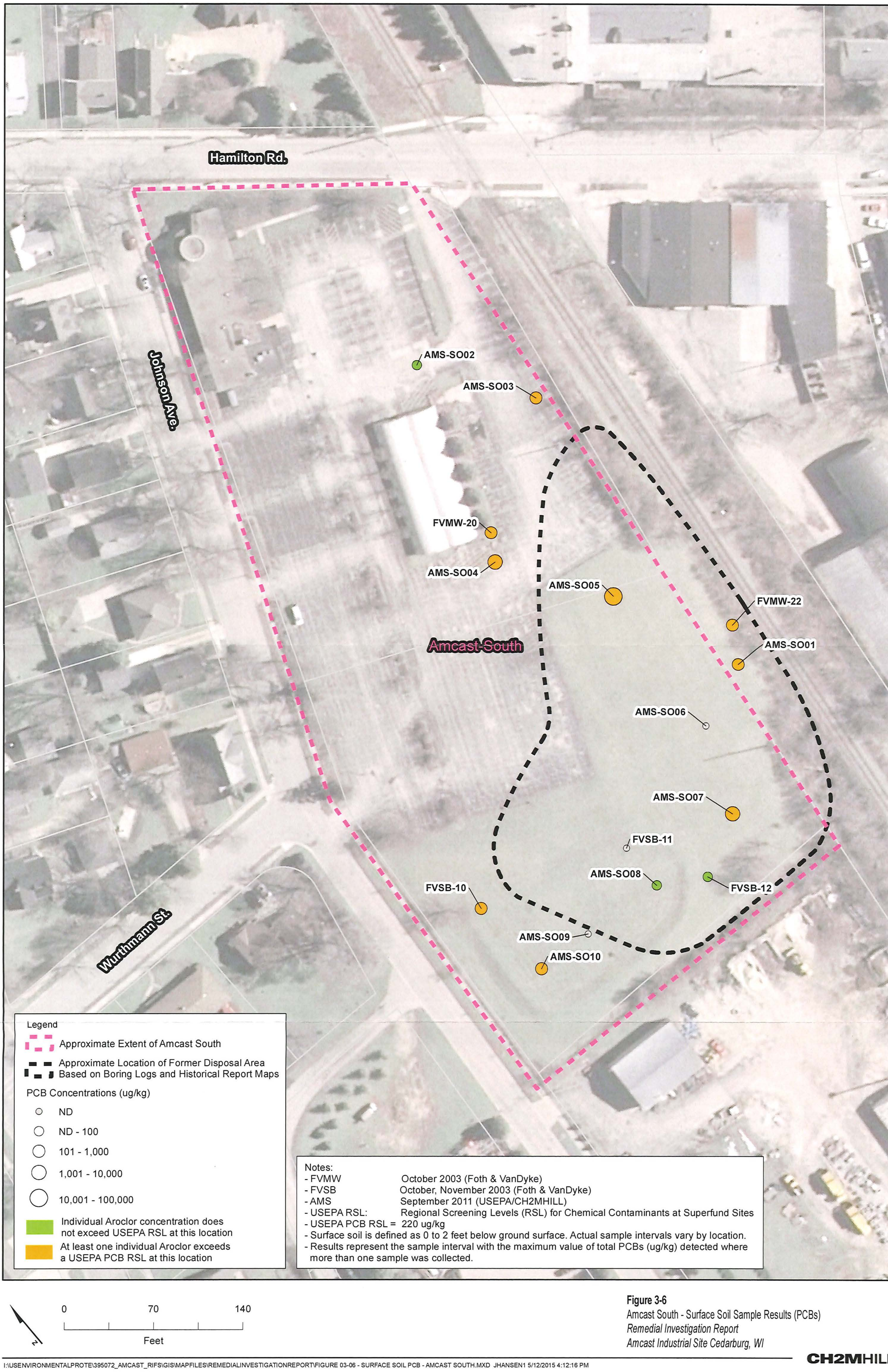
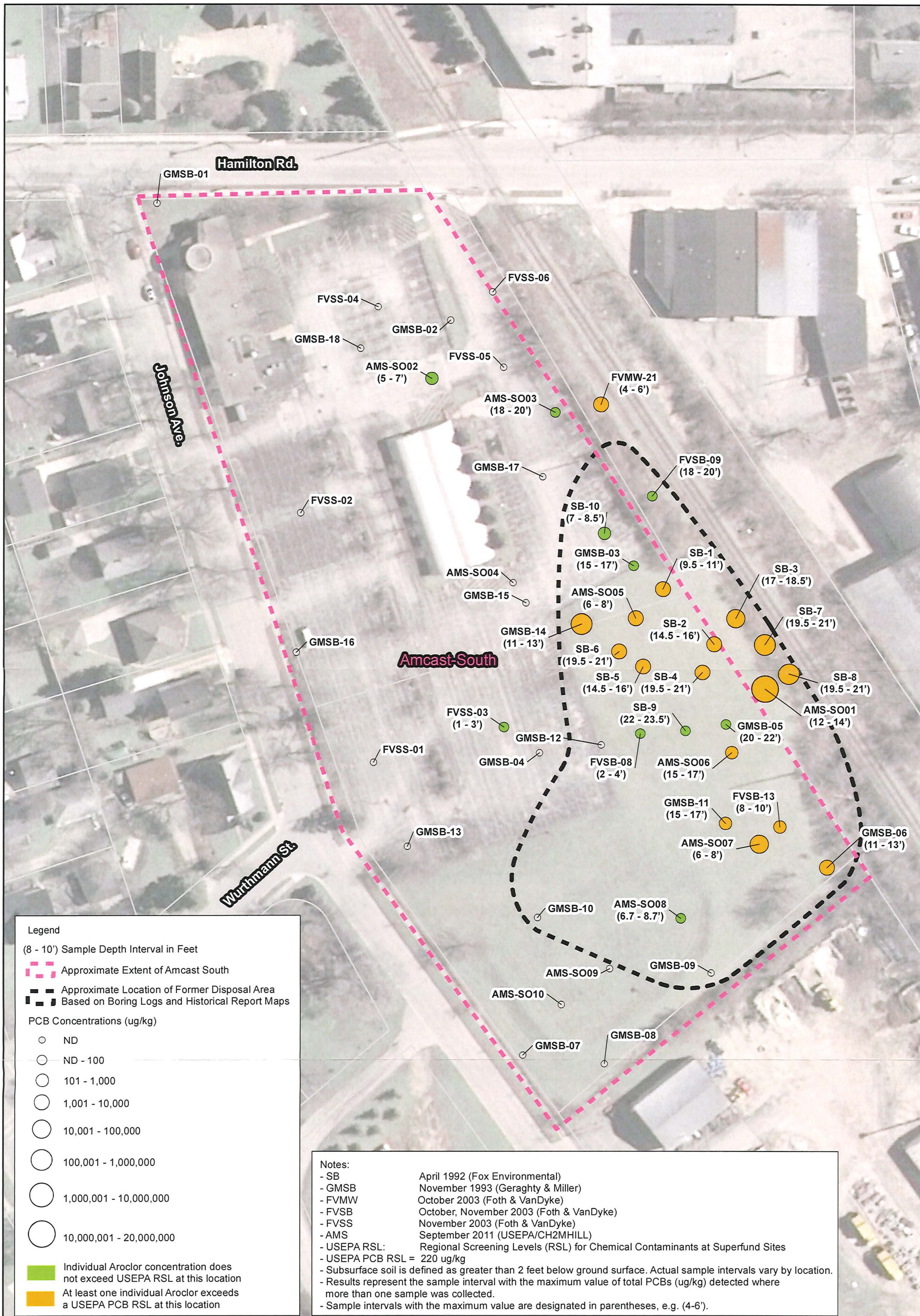



**Figure 3-6**
Amcast South - Surface Soil Sample Results (PCBs)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*




0 70 140
Feet

**Figure 3-7**
Amcast South - Subsurface Soil Sample Results (PCBs)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

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I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 03-07 - SUBSURFACE SOIL PCB - AMCAST SOUTH.MXD JHANSEN1 5/12/2015 4:14:40 PM

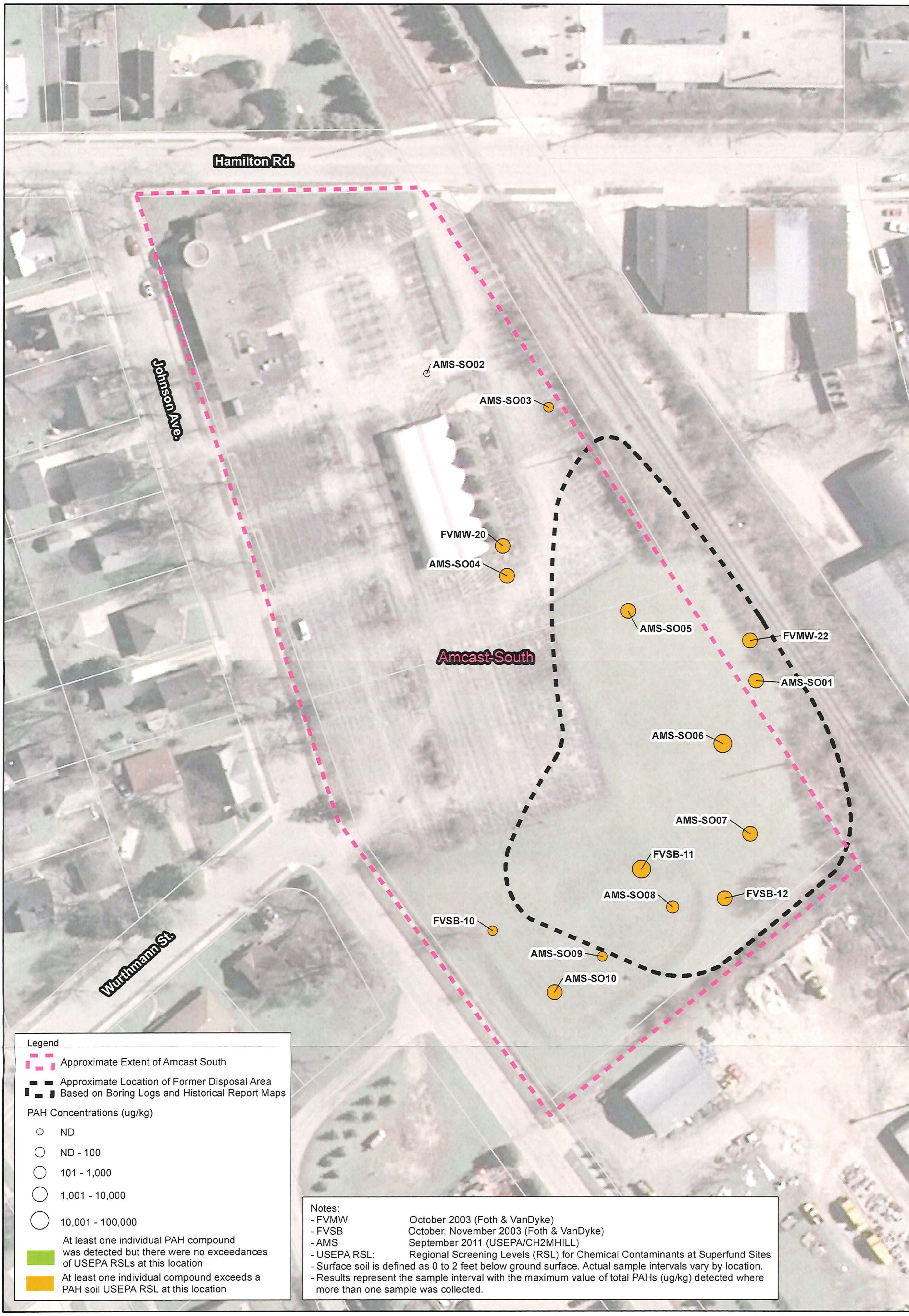


**Figure 3-8**
Amcast South - Surface Soil Sample Results (PAH)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 03-08 - SURFACE SOIL PAH - AMCAST SOUTH.MXD JHANSEN1 5/12/2015 4:18:35 PM

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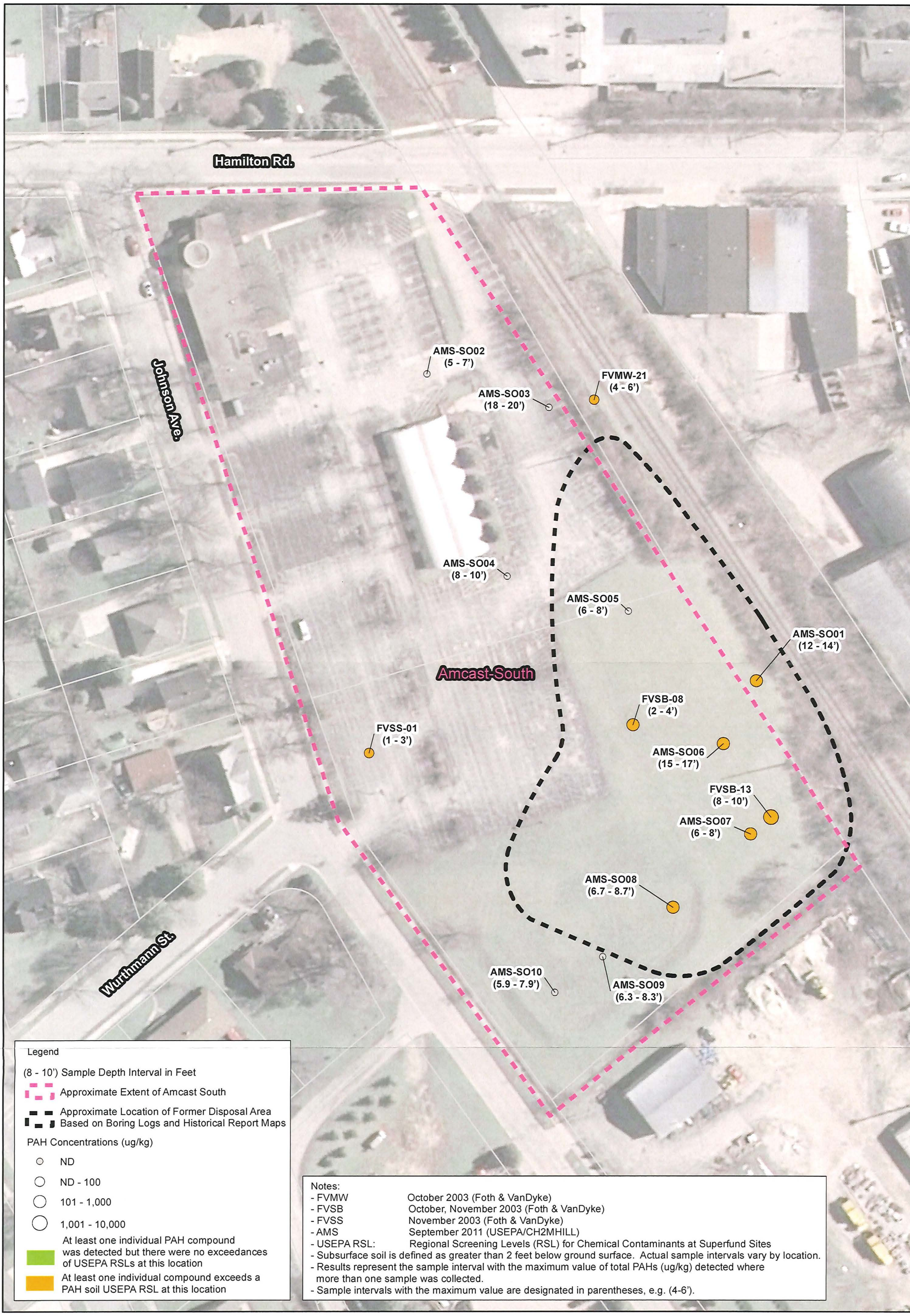


0 70 140

Feet

**Figure 3-9**

Amcast South - Subsurface Soil Sample Results (PAH)

*Remedial Investigation Report*

*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 03-09 - SUBSURFACE SOIL PAH - AMCAST SOUTH.MXD JHANSEN1 5/12/2015 4:23:01 PM

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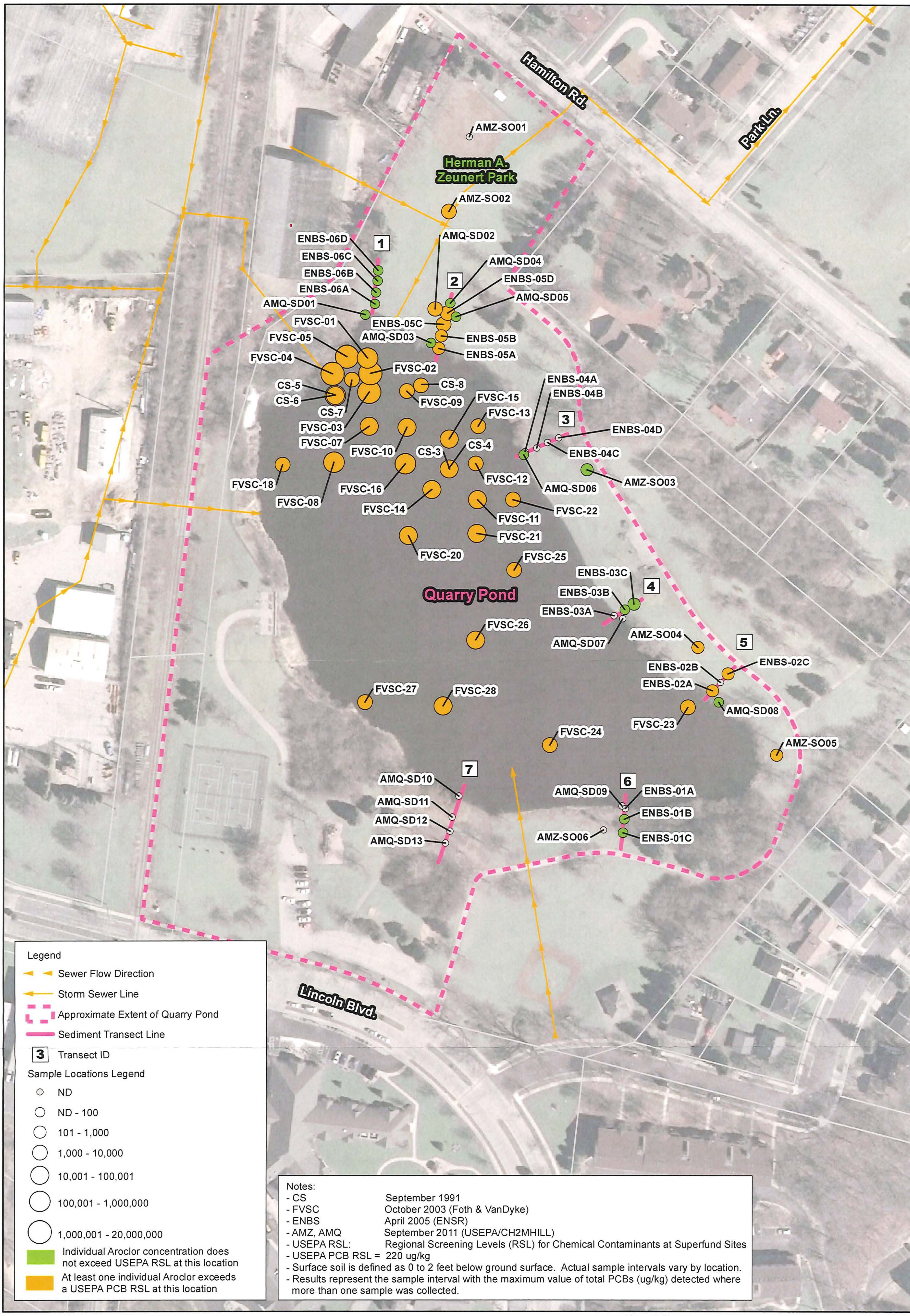


N
0 125 250
Feet

**Figure 3-10**
Quarry Pond and Zeunert Park Surface Soil and Sediment Sample Results (PCBs)
*Remedial Investigation Report*
*Amcast Industrial Site Cedarburg, WI*

I:\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\REMEDIALINVESTIGATIONREPORT\FIGURE 03-10 - SURFACE SOIL AND SEDIMENT PCB - QUARRY POND.MXD JHANSEN1 5/12/2015 4:27:21 PM

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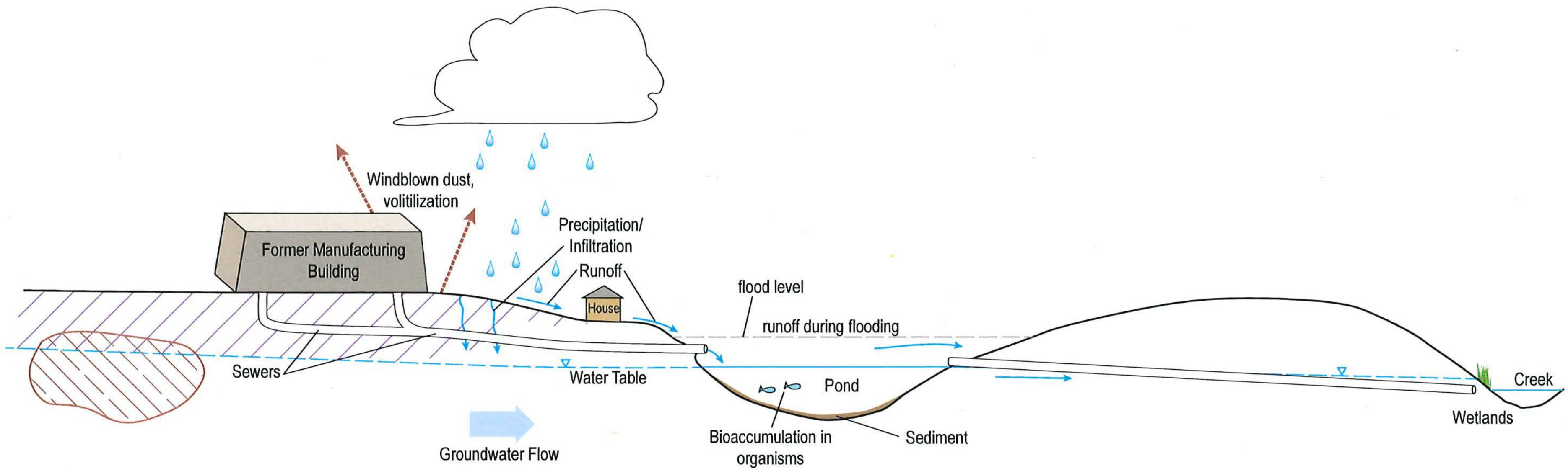


Not to scale

Contaminated soil

Contaminated Disposal Area

FIGURE 4-1
**Conceptual Depiction -**
**Release/Transport Mechanisms**
*Amcast Industrial Site, Cedarburg, WI*



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# Appendix A
# Investigation Technical Memorandums

# Appendix B
# Data Usability Evaluation

Included on CD

# Appendix C
# Laboratory Analytical Data Summary

Included on CD

# Appendix D
# Human Health Risk Assessment

Included on CD

# Appendix E
# Ecological Risk Assessment

Included on CD