Work Plan for Additional Brownfield Redevelopment Related
Soil, Groundwater and Vapor Assessment Activities at the Former Amcast Facility
City of Cedarburg, Ozaukee County, Wisconsin

to include

Amcast North - N37W5684 Hamilton Road Site

BRRTS #02-46-583164 – Tax Key 13-051-005-000 NON SF ACTIVITY

Amcast Central – N39W5789 Hamilton Road Site

BRRTS #02-46-583162 – Tax Key 13-0505-21-09-000 NON SF ACTIVITY

Amcast South – Johnson Avenue Site

BRRTS #02-46-583163 – Tax Key 13-050-21-08-000 NON SF ACTIVITY

<u>Client</u>

Oliver Fiontar, LLC
N105W7585 Chatham Street
Cedarburg, WI 53012-3255

Drake Project Number
J16001

Date
April 18, 2019

DRAKE Consulting Group, LLC
118 Green Bay Road – Suite 4
Thiensville, WI 53092

DRAKE Consulting Group, LLC

April 18, 2017

Margaret Brunette
Wisconsin Department of Natural Resources
2300 N. Martin Luther King Drive
Milwaukee, WI

RE: Work Plan for the Former Amcast Site – Oliver Fiontar, LLC Brownfield Redevelopment Parcels in Cedarburg, Wisconsin: *Amcast North* - N37W5684 Hamilton Road Site: BRRTS #02-46-583164; Tax Key: 13-051-005-000 Non-SF Activity; *Amcast Central* – N39W5789 Hamilton Road Site: BRRTS #02-46-583162; Tax Key: 13-0505-21-09-000 Non-SF Activity; *Amcast South* – Johnson Avenue: BRRTS #02-46-583163; Tax Key: 13-050-21-08-000 Non-SF Activity. Drake Project No. J16001

Dear Ms. Brunette:

On behalf of Oliver Fiontar, LLC, the current owner of the three land parcels which comprise approximately 8.4 +/- acres of the Former Amcast Superfund National Priorities List (SF NPL) site (which consists of over 20 acres), Drake Consulting Group, LLC is pleased to submit the attached work plan to conduct additional soil, groundwater and vapor assessment activities relating to the proposed brownfield redevelopment of the above-referenced 8.4 +/- acre property and evaluate closure criteria requirements and/or remedial options at the planned Oliver Fiontar, LLC brownfield redevelopment site.

Oliver Fiontar, LLC and Drake understand that the proposed 8.4 +/- acre brownfield redevelopment site lies within the boundaries of the Former Amcast SF NPL site (BRRTS #02-46-000795; FID#246-003780) and as such have agreed to provide the EPA and/or its contractors and consultants with access to the proposed brownfield redevelopment site to conduct further assessment, remediation/cleanup and/or site closure activities.

Drake understands that the WDNR had previously reviewed and provided comments to the EPA (and its consultant CH2M) on an area-wide "Draft" Amcast Remedial Investigation in 2015 and had approved the "Superfund Final Remedial Investigation Report" on August 29, 2015. Drake also understands that the WDNR has since received and reviewed a copy of the "Remedial

Alternatives Screening Report" in 216 and the "Remedial Alternatives Evaluation Report" which was submitted to the EPA on May 17, 2017. We also understand that CH2M recently submitted to the EPA and WDNR a "draft" Feasibility Study in December 2018 that is currently under review by EPA and WDNR.

Thank you for receiving this work plan, and if you have any questions or need additional information, please call us at (262) 241-0005.

Respectfully,

DRAKE Consulting Group, LLC

Chelsea Corson
Senior Project Manager

Matthew Giovanelli, P.G.
Senior Project Manager

D.J. Burns
President/Project Director

WORK PLAN CONTENTS

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_ds	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

1.0 PROJECT SCOPE

The subject of this Work Plan for additional brownfield redevelopment related activities is soil and groundwater contamination associated with the Amcast Industrial and Amcast Automotive Sites located at N37W5684 and N39W5789 Hamilton Road and Johnson Avenue in Cedarburg, Wisconsin. The redevelopment site is separated into three parcels located north and south of Hamilton Road. The northern parcel (designated "Amcast North") is located at N37W5684 Hamilton Road and is situated northeast of Hamilton Road (tax identification number (TIN) 13051010500). The southern parcel is comprised of two parcels (designated "Amcast Central" and "Amcast South") situated south of the intersection of Hamilton Road and Johnson Avenue. Amcast Central is located at N39W5789 Hamilton Road (TIN: 1305052109000) while Amcast South is generally referred to as being located on Johnson Avenue (TIN: 130502108000).

The known environmental conditions at the redevelopment site are associated with contamination likely caused by the former Amcast Industrial Corporation. The subject property is currently owned by Oliver Fiontar, LLC and is currently vacant. Future plans for the site include the proposed demolition of several of the existing buildings, and redevelopment of the site to include mixed use planned development including commercial, retail, and residential components.

The redevelopment sites are located within a portion of the larger 20^{+} acre U.S. Environmental Protection Agency (EPA)-lead Amcast Industrial Corp. National Priorities List (NPL) Superfund (SF) Site (hereinafter referred to as the Amcast SF NPL site), which has been the subject of a prior Wisconsin Department of Natural Resources (WDNR)-approved Remedial Investigation (RI) report and is currently undergoing the evaluation and approval stage of the Remedial Alternatives Analysis process. Drake understands the EPA and the WDNR are in receipt of a "draft" Feasibility Study Report dated December 2018 which was prepared by CH2M (formerly CH2M Hill) and are currently reviewing the contents of this report. We understand the next steps associated with the Amcast SF NPL site will be to finalize the Feasibility Study Report, develop the proposed clean-up plan (selected remedial alternative), provide public notice of the proposed plan to clean up the site, respond to comments on the proposed plan and issue a Record of Decision that describes the remedy for the Amcast SF NPL site (currently scheduled to occur in March 2020). The WDNR has previously assigned an Environmental Repair Program (ERP) Bureau for Remediation and Redevelopment Tracking System number (BRRTS) for the entire 20^{+} acre project site as it relates to the Superfund activities associated with the site (BRRTS 02-46-000795).

The purpose of this Work Plan is to provide a summary of the results from previous site investigation activities conducted by others, present the planning, scope and responsibility elements of conducting the redevelopment activities at the site, provide the selection of a remedy to eliminate, reduce or control risks to protect public health, safety and welfare and the environment, and to meet the requirements of Chapters NR 700 to NR 726 as they relate to the redevelopment portion of the site.

This Work Plan contains references to data and reports that were reviewed by Drake; select portions of the investigative results were copied from the project files located on the USEPA's online database for the Amcast Industrial Corp. SF NPL site. The USEPA file information that is relevant to this Work Plan is listed in References section at the end of this document.

1.1 Site Description

The Amcast property is located in Section 35, Township 10 North, Range 21 East, in the City of Cedarburg, Ozaukee County, Wisconsin (Figure 1). The former industrial automotive plant is located in the southern portion of the City of Cedarburg with portions of the property located on the north and south sides of Hamilton Road and west of Cedar Creek. Figure 1-1[1] depicts the approximate location and current boundaries of the Amcast SF NPL site. The Amcast SF NPL Site includes the lands which have been historically referred to as the "Amcast North and South properties," the residential properties adjacent to the Amcast North property is referred to as "Residential Yards", the stormwater retention basin referred to as "Wilshire Pond," the "Quarry Pond" at Herman A. Zeunert Park and storm sewers in the vicinity of the site.

The property north of Hamilton Road (Amcast North) is the location of the most recent aluminum die-casting operations. The property consists of an approximate 4-acre parcel of land containing an approximate 144,000 square foot building, paved asphalt areas, and grassy corridors along the sides of the building. The former manufacturing plant building on the Amcast North parcel was built in 1963 and includes an approximate 40,000 square foot basement area. The majority of the site is covered by the building, parking areas and service drives. The buildings are currently vacant. Figure 1-2 depicts the general features of the Amcast North parcel.

[1] Figures 1-1 through 4-7 were prepared by CH2M and included in their April 2013 Remedial Investigation/Feasibility Study, May 2015 Remedial Investigation Report and their May 2017 Remedial Alternatives Evaluation Report which were prepared for the EPA under Contract No. EP-S6-06-01. The figures referenced throughout this report are designated using CH2M's figure reference numbers.

The parcels located south of Hamilton Road (Amcast Central and Amcast South) formerly contained the original foundry (now demolished) and consists of a combined approximate 4.4-acre parcel of land with a 2-story approximate 10,000 square foot commercial building located on the northwest corner of the Amcast Central parcel. The commercial building was built in 1953 and was used as corporate office space. A large Quonset style storage shed (approximately 5,000 square feet) and surrounding parking lots occupy the former location of the approximate 10,000 square foot Meta-Mold foundry building that was previously demolished. These buildings are currently vacant.

The Amcast South parcel does not have a postal address but adjoins the Amcast Central parcel at its northern boundary and abuts Johnson Avenue. The approximate 2-acre Amcast South parcel formerly housed a farmstead residence, barn and outbuildings that were razed several decades ago and the site is currently vacant. Within an area approximately 75-100 feet west of the eastern property boundary, demolition debris and rubble from the former Meta-Mold Foundry building (formerly located on the Amcast Central parcel) was reported to have been placed on the Amcast South parcel sometime between 1975 and 1980. The low-lying area formerly located on the Amcast South parcel (in the southeast corner) has been referred to in prior reports as the "former disposal area" and this area reportedly, "received material from foundry casting operations and material from the City of Cedarburg through the 1970s (Geraghty & Miller 1994)." Figure 1-3 depicts the general features of the Amcast Central and Amcast South parcels.

The Amcast North Property was previously zoned General Manufacturing District (M-2) and the Amcast South Property was previously zoned Limited Manufacturing District (M-l). The Amcast North Property currently has a zoning designation of RS-6 Residential and the Amcast South Property has a zoning designation of MUID Mixed Use Infill District. The surrounding area is a mixture of industrial, commercial and residential uses. The Amcast redevelopment site is bordered by single-family residential properties north, northeast and southeast adjacent to Amcast North and northwest adjacent to Amcast South. The Chicago-Milwaukee-St. Paul and Pacific Railroad right-of-way borders the Amcast North parcel along the northwestern portion of the site and along the eastern and southeastern portion of the Amcast Central and Amcast South parcel. The City of Cedarburg Department of Public Works is located south adjacent to the Amcast South parcel.

Wilshire Pond (Figure 1-4) is located southeast of Amcast North and the residential area. 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 Project Description

The three (3) parcels that comprise a portion of the Amcast Superfund site in Cedarburg were transferred from the City of Cedarburg to Oliver Fiontar, LLC's ownership effective September 17, 2018 via the recording of a Judgment, Deed, and Recorded Assignment which were filed by the Ozaukee County Register of Deeds office. The parcels acquired by Oliver Fiontar, LLC are part of the Amcast Industrial Corp. SF NPL Site being addressed by the EPA. The voluntary acquisition of these blighted parcels is related to the planned brownfield redevelopment of these parcels by Oliver Fiontar, LLC as part of a public-private partnership with the City of Cedarburg, City of Cedarburg Community Development Authority (CDA), and Ozaukee County.

On September 21, 2018, Drake Consulting Group, LLC (Drake) notified the WDNR that its client, Oliver Fiontar, LLC, had voluntarily acquired title to the three parcels of real estate in Cedarburg, Wisconsin. The notification also included a request that the Department assign two separate BRRTS numbers for parcels: the "Amcast North" property (TIN: 13051010500 located at N37W5684 Hamilton Road) and the "Amcast South" property (to be comprised of two parcels TIN: 130502109000 & 130502108000 located at N39W5789 Hamilton Road).

On October 17, 2018 Drake Consulting Group, LLC (Drake) submitted the first monthly progress report on behalf of Oliver Fiontar, LLC in accordance with the obligations under the Wis. Stat. 75.106 Agreement between the DNR and Oliver Fiontar, LLC dated August 2, 2018. Subsequent monthly progress reports were submitted on November 21, 2018, December 21, 2018, January 22, 2019, February 15, 2019 and March 15, 2019. The monthly progress reports document the redevelopment activities as they relate to the project site.

On March 6, 2019 the WDNR issued to Oliver Fiontar, LLC a “Responsible Party” (RP) letter with regard to the three parcels and issued three separate BRRTS numbers in association with each parcel: Amcast North was designated by the WDNR as “Amcast Industrial” with the BRRTS ID 02-46-583164 and a WDNR FID 246175820. Amcast Central and Amcast South were designated “Amcast Automotive” with the BRRTS IDs 02-46-583162 and 02-46-583163, respectively, and a WDNR FID 246003780.

This work plan for additional Brownfield redevelopment related activities is being submitted in accordance with Wis. Ad. Code Ch. NR 700.11 (bm) *Unless otherwise directed by the department, responsible parties shall submit a site investigation work plan meeting the requirements of s. NR 716.09 to the department within 60 days of receiving notification that a site investigation is required.* As such, through the submittal of this work plan from Drake, Oliver Fiontar, LLC intends to comply with the submittal of the work plan within the 60 day deadline from the March 6, 2019 issuance of the RP letter.

1.3 Work Plan Scope

This work plan has been prepared to permit Oliver Fiontar, LLC to conduct additional soil, groundwater and vapor assessment activities relating to their planned brownfield redevelopment of three parcels of land comprising approximately 8.4 acres of land lying within the over 20 acre former Amcast SF NPL site. The brownfield redevelopment area currently owned by Oliver Fiontar, LLC is comprised of three parcels identified in Figure 1A as Amcast North, Amcast Central and Amcast South areas.

This work plan includes a brief history of the project, a scope of work for additional post-Remedial Investigation/Feasibility Study (RI/FS) soil, groundwater and vapor assessment activities, a discussion of such assessment and investigation procedures and methods, and a schedule for the commencement of the planned activities.

As indicated previously, Oliver Fiontar, LLC acquired ownership of the three parcels of land comprising a portion of the Amcast SF NPL site on September 17, 2018. Drake anticipates that completion of the additional soil, groundwater and vapor assessment & evaluation activities outlined in the work plan will provide additional information so as to allow for the brownfield redevelopment of the site and to evaluate potentially applicable remedial options and/or closure criteria requirements.

The Amcast SF NPL site was previously assigned a Bureau for Remediation & Redevelopment Tracking System (BRRTS) number of #02-46-000795 and a Facility Identification number of #2460003780. Drake understands that this “open” Environmental Repair Program (ERP) site (comprised of over 20 acres) is an EPA-lead site and that the Superfund Final Remedial Investigation (RI) Report was approved by the DNR in 2015. Drake also understands that after completing the Superfund Final Remedial Investigation Report, the EPA’s consultant (CH2M) has since submitted a Remedial Alternatives Evaluation Report to the EPA and the DNR in May

2017 that outlines the various remedial alternatives under consideration for the Amcast SF NPL site. Oliver Fiontar, LLC and Drake understand that the proposed 8.4-acre brownfield redevelopment site lies within the boundaries of the Amcast SF NPL site and as such Oliver Fiontar, LLC has agreed to provide the EPA and/or its contractors and consultants with access to the Oliver Fiontar, LLC brownfield redevelopment site in order to allow them to conduct further assessment, remediation/cleanup and/or site closure related activities.

The planned brownfield redevelopment area is comprised of the lands owned by Oliver Fiontar, LLC and which are contained within the following three tax parcels:

Tax Parcel ID #13-051-01-0000 consisting of approximately 4.02 acres with a site address of N37W5684 Hamilton Road. The DNR has recently assigned BRRTS #02-46-583164 to this parcel. This parcel was generally referenced historically as the "Amcast North" area and will be referenced as the "Amcast North" parcel within this report.

Tax Parcel ID#13-050-21-09-000 consisting of approximately 2.40 acres with a site address of N39W5789 Hamilton Road. The DNR has recently assigned BRRTS #02-46-583162 to this parcel. This parcel was generally referenced historically as part of the "Amcast South" area but will now be referred to as the "Amcast Central" parcel within this report.

Tax Parcel ID #13-050-21-08-000 consisting of approximately 2.004 acres abutting Johnson Avenue with no designated site address. The DNR has recently assigned BRRTS #02-46-583163 to this parcel. This parcel was generally referenced historically as being part of the "Amcast South" area and will now be referred to as the "Amcast South" parcel.

For the purposes of this report and in an effort to accommodate the three BRRTS numbers issued to this redevelopment project, the above-referenced tax parcels will hereafter be referred to as the Amcast North, Amcast Central and Amcast South parcels as indicated above.

1.4 Amcast Industrial Corp. Site History

Prior to its developed use as part of an aluminum die casting foundry facility, the Amcast North, Amcast Central and Amcast South parcels were used primarily for residential/agricultural purposes. Available records indicate that the original foundry (the Meta-Mold Aluminum Company) may have commenced operations by 1937. The original foundry was located to the east of the currently existing corporate office building on the Amcast Central parcel. The existing corporate office building was constructed in the 1950's and replaced a residential structure (which was moved across the street to the west and is still in use). Dayton Malleable Iron, Inc. reportedly 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. Reports indicate that following the demolition of the Meta-Mold foundry sometime between 1975 and 1980, demolition debris and rubble from the former Meta-Mold Foundry building was placed in the southeastern portion of the Amcast South parcel. Available information indicates that the Amcast North parcel was first developed for foundry use after 1941 but prior to 1950. Subsequent major additions to the foundry on the Amcast North parcel occurred between 1963 and 1970 and again between 1970 and 1980.

Deposition of fill materials appears to have occurred on various parcels located along the northern edge of the Amcast North parcel during the period from 1963 through at least 1970, based on a review of aerial imagery. The Amcast South parcel was utilized primarily for residential/agricultural purposes through 1980 (with the exception of an approximate area approximately 75-100 feet west of the eastern property boundary, where demolition debris and rubble from the former Meta-Mold Foundry building were reported to have been placed sometime between 1975 and 1980 and which can be observed on aerial imagery from 1980). The low-lying area located on the Amcast South parcel has been referred to in some prior reports as the "former disposal area" and this area reportedly, "received material from foundry casting operations and material from the City of Cedarburg through the 1970s (Geraghty & Miller 1994)."

Known or suspected contaminants at, and in the vicinity of the Amcast site, include: volatile organic compounds (VOCs), polyaromatic hydrocarbons (PAHs), metals and polychlorinated biphenyls (PCBs). Within the immediate vicinity of the Amcast SF NPL site, polychlorinated biphenyl (PCB) use (or suspected use/storage or handling) was reported by others to have likely occurred historically in connection with the following properties:

N37W5684 Hamilton Rd. – Amcast Industrial Corp.
N39W5789 Hamilton Rd. – Amcast Industrial Corp.
N37W5663 Hamilton Rd. (Cedar Tool, Inc. Facility at the Hamilton Commercial Center)
W53N400 Park Lane – City of Cedarburg Water Recycling Center (WWTP)
W59N306-308 Johnson Avenue – City of Cedarburg Department of Public Works
N30 W5926 Lincoln Boulevard – Cedarburg Light & Water Utility

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 a 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).

In February 2003, Amcast Industrial Corporation signed an Administrative Order with USEPA to conduct the Remedial Investigation (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).

Current Status of the Facility
The Amcast facility is now closed, and the site is vacant. The buildings and structures remaining on the site are in the process of being redeveloped or razed as part of the brownfield redevelopment activities being conducted by Oliver Fiontar, LLC.

1.5 Amcast Industrial Corp. Project History

Numerous environmental studies, investigations and assessments have been performed at, or in the vicinity of the project site by the Amcast Industrial Corporation, the EPA and DNR. A large body of geologic, hydrogeologic, hydrologic, and chemical distribution information was developed during these activities.

Currently, the most comprehensive source of information regarding the previous investigations and assessments conducted at, and in the vicinity of, the former Amcast site is the "Final Remedial Investigation Report" dated May 1, 2015 which was prepared by CH2M for the EPA. It is Drake's understanding that both the DNR and the EPA have approved of the 1,905 page Final Remedial Investigation Report. Drake is also of the understanding that both the EPA and the DNR have received a copy of CH2M's most current report dated May 1, 2017 which is entitled, "Remedial Alternatives Evaluation Report."

The information from the previous environmental investigations and assessments is summarized below and was excerpted from prior reports prepared by CH2M for the EPA.

1990—E&K Hazardous Waste Services, Inc. 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 as DRO, and xylenes (E&K, Inc. 1991a).

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).

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.

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 ten 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 ten 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.

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 eight (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 nine (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 five 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 (ug/L). The investigation report (Geraghty & Miller 1994) included a recommendation for additional soil and groundwater investigation.

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.

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).

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. Foth & Van Dyke installed seven 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 six 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.

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.

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 ug/kg from a catch basin on the Amcast North property to 790,000 ug/kg from a sample collected from a storm sewer located on Amcast South.

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 ug/kg to 9,000 ug/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 ug/kg in a sample located at the southeastern bank of the pond to 52,000 ug/kg in the sample obtained at a location just downstream of the sewer discharge pipe that enters the area pond from the west.

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 ug/kg to 13,000 ug/kg.

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 ug/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 four 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—ten of the 12 storm sewer sediment samples contained PCB concentrations exceeding 1,000 ug/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 ug per 100 square centimeters.

2.0 PHYSICAL SITE SETTING

Information contained in this section was excerpted from a prior CH2M report prepared for the EPA and is believed by Drake to be generally accurate and representative of the Amcast SF NPL site conditions. Drake notes that these reports generally reference the Amcast North and Amcast South areas, but the newly designated Amcast Central parcel is located within the general boundaries of the Amcast South area and it is assumed that the Amcast Central parcel shares the general characteristics of the Amcast South area.

2.1 Local Demography and Land Use

The City of Cedarburg is located 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 (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), having previously been zoned industrial, 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 wastewater 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.

Land Surface Topography

The land surface elevations within the Amcast SF NPL site 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.

Meteorology

The Amcast SF NPL 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).

2.2 Site Geology & Hydrogeology

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

2.2.1 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).

2.2.2 Site-specific Geology

WGNHS information (WGNHS 1997) for the project area indicates that Amcast North and Amcast South 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.

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 in Appendix A of this report.

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.

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).

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).

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).

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.

2.3 Hydrogeology

2.3.1 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.

2.3.2 Site Hydrogeology

Groundwater is encountered within the unconsolidated aquifer at depths ranging between eight 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 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.

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 of the CH2M report from 2012.

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 4.31×10^{-4} centimeters per second. 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 2.08×10^{-2} centimeters per second.

2.4 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) in the vicinity of 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).

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. 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 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 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. 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. 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.

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.

2.5 Ecology

The Amcast Industrial Site is in a mixed-use urban area 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 (Poasp.).

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.

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 the 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.

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.

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).

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, 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.

2.6 Potential Receptors

The site and the surrounding City of Cedarburg are serviced by municipal sanitary and storm sewer. Water and electrical service to the area is provided by the Cedarburg Light & Water Utility. Additional underground utilities and lines in the area include natural gas, communications and private sewer lines.

Surface water in the vicinity of the site includes the quarry pond located to the southeast of the site and Wilshire pond and Cedar Creek which are located east of the site

3.0 NATURE & EXTENT OF CONTAMINATION

As the Department is aware, numerous prior investigations have been conducted to evaluate the impacts of the Amcast North and South operations on the surrounding environment. The information contained in the CH2M Hill 2015 Final Remedial Investigation Report is summarized below and provides a summary of 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 by CH2M on a sitewide basis.

As regards data screening and data presentation matters, CH2M indicated that 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 Levels (RSLs) for chemical contaminants at Superfund sites.
- 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 ug/kg. Therefore, 220 ug/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).

Due to the large amount of data collected over several years by several different consultants, special consideration was given by CH2M to how the data could be compared and presented most effectively. How the 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 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 (Figures 3-1 through 3-10) 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 CH2M by summing the detected values for certain individual PAH compounds.

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.

3.1 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.

Soil—PCBs

Surface Soil

Surface soil samples have been collected from 11 locations at Amcast North. PCBs were detected above the RSL in eight samples, with detected total PCB concentrations ranging from 33 ug/kg to 33,000 ug/kg (Figure 3-1). The highest concentrations were observed on the north side of the building (AMN-SO04: 33,000 ug/kg; AMN-SO07: 15,000 ug/kg) and on the southwest corner of the building (AMN-SO01: 12,000 ug/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 six samples and were detected below the RSL in seven samples. One sample (B-02) had a total PCB concentration (640 ug/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 ug/kg (Figure 3-1). The highest concentrations were detected in samples at FVSS-22 (24,000 ug/kg) and FVSS-23 (79,000 ug/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 ug/kg), are either at the non-detect level or below the RSL.

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 ug/kg. Of the 21 samples, PCBs were not detected in seven samples and were detected below the RSL in two 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 ug/kg) and at the adjacent FVSS-22 (24,000 ug/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 ug/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 ug/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 ug/kg; B-13: 280 ug/kg) that were located on the south and west sides of the building.

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 ug/kg.

The residential yards have elevated concentrations of PCBs greater than 1,000 ug/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 one 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.

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[2].

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 eight parts per million (ppm; equivalent to 8 mg/kg) (WDNR 2013).

Soil – PAHs

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 ug/kg to 5,090 ug/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

[2] Tables 3-1 through 3-8, 4-1, 4-2, 4-4 and 5-1 were prepared by CH2M and included in their May 2015 Final Remedial Investigation Report which was prepared for the EPA under Contract No. EP-S6-06-01. Please refer to CH2M's May 2015 Report for the associated table references.

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).

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 ug/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.

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.

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.

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.

Sediment

Seventeen sediment samples were collected from Wilshire Pond, with total PCB concentrations ranging from 1,300 ug/kg to 520,000 ug/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 ug/kg; FVSS-34: 150,000 ug/kg). The highest total PCB concentration detected in Basin B was at AMW-SD01 (51,400 ug/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 ug/kg to 9,700 ug/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.

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.

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.

3.2 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

Soil – PCBs

Surface Soil

Fifteen surface soil samples were collected from Amcast South, with total PCB concentrations ranging from nondetect to 11,000 ug/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.

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 ug/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 ug/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.

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 ug/kg was located in the 12 to 14-foot depth interval sample from AMS-SO01, along the eastern edge of the former disposal area.

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.

Soil – PAHs

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 ug/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.

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 ug/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.

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.

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.

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.

Zeunert Park/Quarry Pond

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.

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 ug/kg to 11,000,000 ug/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 ug/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).

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 ug/kg to 9,000 ug/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 ug/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.

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 ug/kg total PCBs, exceeding the PCB RSL of 220 ug/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 ug/kg and 270 ug/kg, respectively. The remaining surface soil samples in Zeunert Park had PCB concentrations below the RSL or did not have detectable levels of PCBs.

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 ug/kg
- FVMW-24/20-22 feet bgs = Aroclor 1260 at a concentration of 900 ug /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.

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 five of the eight 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 ug/L) at five of the eight 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 ug/kg and AMNSO010, 4 to 6-foot 13-ug/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 ug/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.

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 three of the six column feeder samples, with detected concentrations ranging from 2.7 to 4.3 mg/kg. PCBs were detected in eight of the ten 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 one of the five suspended feeder samples at a concentration of 6.3 mg/kg. PCBs were detected in one of the three 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).

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.

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 ug/kg to 19,000 ug/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 ug/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 ug/kg to 23,000,000 ug/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 ug/kg to 23,000,000 ug/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 ug/kg to 250,000 ug/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.

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.

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.

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.

Amcast South

At Amcast South, historical or recent samples from six of the ten 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.

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.

3.3 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.

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 five (5) to six (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 (3) 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.

Residential Yards

The residential yards have elevated concentrations of PCBs greater than 1,000 ug/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.

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.

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 six (6) of ten (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,which were detected at GMMW-4 located in the former disposal area. Bromodichloromethane at GMMW-1 was the only VOC compound detected at Amcast South concentration above its criteria. GMMW-1 is at the northwest corner of the site and the source for the bromodichloromethane is not known.

Storm Sewers

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 and eventually into the Wilshire Pond and Cedar Creek. Total PCB sample concentrations from storm sewers and catchment basins associated with Amcast North range in concentration from 65 ug/kg to 19,000 ug/kg. The highest sampled concentration was detected at CB-9 located on the northeast side of the Amcast North building.

Stormwater from Amcast South sewers combines at the south end of the parcel and flow under the railroad embankment, eventually discharging to Quarry Pond. Total PCB sample concentrations from sewer samples associated with Amcast South range in concentration from 135 ug/kg to 23,000,000 ug/kg. The samples with the highest concentrations on the Amcast South property are located on the north and south sides of the Quonset building and range from 90,000 ug/kg to 23,000,000 ug/kg. Concentrations decrease downstream from the Quonset building. Total PCB concentrations in samples collected from storm sewer locations in Zeunert Park range in concentration from 2,000 ug/kg to 250,000 ug/kg.

3.4 Summary of Fate and Transport Assessment

The 2015 Final RI Report prepared by CH2M discussed the environmental fate and transport of contaminants, both the general mechanisms that are applicable to individual contaminants and contaminant groups and the site-specific contaminants detected at the Amcast Industrial Site.

They wrote that the fate and transport of contaminants is important in understanding their current distribution at the site and for assessing the potential for exposure if no remedial action is taken. The information below provides a summary of CH2M's Fate and Transport analysis as contained within their Final RI Report. Additional information regarding CH2M's Fate and Transport Analysis as it related to their consideration of remedial alternatives for the Amcast SF NPL site is contained in their May 2017 Remedial Alternatives Evaluation Report.

General Physical and Chemical Properties

Mobility and persistence are terms used to describe the movement and partitioning of contaminants in the environment. Mobility is the potential for a contaminant to migrate through a medium. Persistence is a measure of how long a contaminant will remain in the environment. The principal properties that influence mobility and persistence include the following:

- Molecular weight
- Water solubility
- Specific gravity
- Vapor pressure
- Henry's law constant
- Octanol-water partitioning coefficient (K_{ow})
- Soil organic carbon/water partitioning coefficient (K_{oc})
- Distribution coefficient (K_d)

The definitions of the properties are included in Table 4-1. Typical values for site-related contaminants representative of each compound class at the Amcast Industrial Site are provided in Tables 4-2 and 4-3. The representative constituents for each chemical group were selected based on concentration, frequency of occurrence, migration potential, toxicity, and carcinogenic potential. Other environmental factors that might affect the mobility and persistence of contaminants include pH, concentration of other chemicals in the media, soil moisture, oxidation reduction potential (ORP), water chemistry, organic-matter content, and the presence and types of microorganisms in the subsurface.

General Fate and Transport Mechanisms

Fate and transport mechanisms are physical, chemical, and/or biological processes that affect the form and distribution of a chemical in the environment. The behavior of chemicals is controlled by both the properties of individual chemicals and site-specific characteristics. The following general processes can affect the fate and transport of contaminants at any site:

- **Volatilization—**Evaporation from a dissolved to a vapor phase in accordance with vapor pressure.

- **Wind Dispersion**—Contaminants in building materials or surface soil can be released to the atmosphere as airborne dust.
- **Sorption**—The physical adherence or bonding of chemical ions and molecules onto the surface of another phase (like soil). The conventional measure of sorption is the distribution coefficient of soil and geologic material for a specific chemical (K_d). Subsurface materials likely to sorb chemicals typically are clays and organic material.
- **Degradation**—The transformation of one chemical to another by such processes as hydrolysis, photolysis, or biodegradation, commonly expressed as a half-life that are based on the range of degradation rates for the most important processes operating within a particular medium.
- **Hydrolysis** is a substitution reaction in which an organic molecule reacts with water or a component ion of water and a halogen substituent (for example, chlorine) is replaced with a hydroxyl (OH^-) group.
- **Photolysis** is an abiotic process that can decompose organic compounds by exposure to light and the atmosphere or other radiant energy.
- **Biodegradation** occurs when microorganisms convert one chemical to another as part of their respiration process.
- **Metallic Transformation**—Occurs when metals are increased in valence state by oxidation or reduced in valence state by reduction. Transformation can be caused by ORP and pH changes and by microbial or nonmicrobial (abiotic) processe.
- **Bioaccumulation**—The process of chemicals adsorbing to and accumulating in plants and the organ tissue of animals.
- **Groundwater Transport**—Dissolved contaminants in groundwater move with the groundwater as determined by the horizontal and vertical gradient vectors within aquifer media. Dispersion, the process by which concentrations are reduced as a result of horizontal and vertical spreading within the saturated zone, will result in further reduction of contaminant concentrations. (Lateral dispersion of contaminants within the unsaturated zone is not significant because of the short distance to the groundwater table.)

If dissolved groundwater contaminants undergo chemical reactions while being transported through an aquifer, their migration rate and extent may be reduced (that is, retarded) relative to the average groundwater velocities. Such chemical reactions may include adsorption, and partitioning into soil organic matter. The ratio relating the average groundwater velocity to the contaminant plume it is carrying is referred to as the retardation coefficient, R. In order to estimate the retardation coefficient, both the properties of the specific contaminant and the characteristics of the aquifer system are considered

Fate and Transport of Site-Related Contaminants

Site-related impacts are represented by the following five main categories of chemicals that are present within the different media at the Amcast Industrial Site: PCBs, SVOCs/PAHs, SVOCs/non-PAHs, metals, and VOCs. The categories of compounds are discussed separately in the following subsections on the basis of behavior. It should be noted that the discussions of the fate of individual organic chemicals in the environment typically assume that the chemicals are "alone" in the environment and also that they are not present as a separate phase (such as a nonaqueous phase liquid).

Polychlorinated Biphenyls

PCBs are a class of chlorinated chemical compounds in which 2 to 10 chlorine atoms are attached to the biphenyl molecule (two connected benzene rings). There are 209 related substances (congeners) that are classified as PCBs. Mixtures of PCB congeners were sold under the trade name Aroclor. The Aroclors are identified by a four-digit numbering code in which the first two digits indicate the type of mixture (the number of carbons in the structure) and the last two indicate the approximate chlorine content by weight percent. The Aroclors detected at the Amcast Industrial Site include Aroclor 1242, 1248, 1254, and 1260, with Aroclor 1248 being the most frequently detected in soil and groundwater, and the only individual Aroclor detected in sediment samples. PCBs were not detected in surface water samples. Table 4-2 presents chemical and physical properties of some of the Aroclors.

The chemical, physical, and biological properties of PCBs depend to a large degree on the number of chlorine atoms attached to the biphenyl molecule and where they are attached (Mackay et al. 1992). In general, PCBs with fewer chlorine atoms are more soluble, more volatile, more amenable to chemical and biological degradation, less persistent in the environment, and will cause less potential harm to organisms than those PCBs with more chlorine atoms.

PCBs have relatively low vapor pressures, low water solubility, and high partitioning coefficients (K_{ow}). PCBs in soil are unlikely to leach to groundwater because of low water solubility and strong binding potential to soil. PCBs will leave the water column by partitioning onto solids (soil, sediments, and suspended particulates), and by volatilization at the air/water interface. Once bound, PCBs can be immobilized for relatively long periods with slow desorption providing continuous low-level exposure to the surrounding locality. PCBs sorb more easily onto solids composed primarily of organic matter and clay. The more highly chlorinated PCBs are less soluble in water, have higher distribution coefficients (K_ds) and a greater tendency to bind to solids. In contrast, the low molecular weight PCBs, which have a higher water solubility and lower K_ds, sorb to a lesser extent on solids and are more likely to remain in the water or to volatilize (see Table 4-2).

PCBs also leave the water column by concentrating in biota. PCBs are stored in the fatty tissues of animals that ingest contaminated soil, water, or sediment. Even at low exposure levels, the concentration of PCBs in fatty tissue can accumulate to a high level. PCBs that bioaccumulate in the fatty tissue of low-food-chain organisms are "magnified" when consumed by the animals at a higher level of the chain.

PCBs may be transported from soil and sediment to the atmosphere. PCBs with vapor pressures greater than 10^{-4} millimeters of mercury appear to exist in the atmosphere almost entirely in the vapor phase, while PCBs with vapor pressures between 10^{-7} and 10^{-4} milligrams of mercury (such as Aroclor 1254 and Aroclor 1260 in Table 4-2) exist in both the adsorbed and vapor phase. Volatilization from soil can be an important loss mechanism for these Aroclors. In addition to volatilization from soil, volatilization of PCBs from contaminated building materials may also be a transport mechanism occurring within the existing Amcast North building, or within building debris/waste material in the disposal area on Amcast South.

Photolysis of PCBs from surface soil may occur, and PCBs may also undergo base-catalyzed dechlorination, but neither process is likely to be a significant removal mechanism (ATSDR 2000).

The rate of PCB biodegradation in water also depends on both individual congener structure and environmental conditions. Highly chlorinated PCB congeners adsorb strongly to sediment and soil where they tend to persist with half-lives on the order of months to years. PCB congeners with three or fewer chlorine groups (Aroclors 1221 and 1232) are considered to be nonpersistent, whereas those with five or more chlorine groups (Aroclors 1248, 1254, and 1260) are not readily degraded and are considered to be persistent. Tetrachlorobiphenyls (major components in Aroclors 1016 and 1242) are intermediate in persistence. Thus, the addition of a PCB mixture to an aerobic environment results in a fractionating effect, whereby less chlorinated species biodegrade first and leave behind, for long-term buildup, the more highly chlorinated species (ATSDR 2000).

Biodegradation in the environment, although slow, occurs under both aerobic and anaerobic conditions and is the major degradation process for PCBs in soil. Aerobic biodegradation in soil, surface water, and sediments is limited to the less chlorinated congeners. Biodegradation of PCBs in aerobic soil is slow, especially in soils that have high organic carbon content. PCBs that remain firmly bound in soil and sediment may not be bioavailable to the degrading organisms at sufficient concentrations. In sediments, anaerobic microbial PCB degradation is primarily responsible for transformation, particularly of the more highly chlorinated congeners. PCBs biodegrade slowly in anaerobic environments through reductive dechlorination, resulting in the formation of less toxic mono- and dichlorobiphenyl congeners that are aerobically biodegradable. Optimal rates of PCB dechlorination usually occur in the concentration range of 100 to 1,000 parts per million (ppm) (wet weight). Below a certain threshold concentration (less than 50 ppm), the rate of dechlorination is often very slow or nonquantifiable. PCBs generally remain tightly bound in soil and sediment, and may not be bioavailable to the biodegrading organisms even at optimum concentration. Rates of dechlorination are fastest in methanogenic (the most reducing) environments (ATSDR 2000).

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).

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.

Solubility and volatility vary widely amongst the PAHs but they are generally low values in comparison to the other compound classes. 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 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).

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. 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.

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. 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 ug/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. 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.

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).

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. 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 ug/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.

3.5 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.

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.

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.

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.

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.

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.

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.

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.

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.

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).

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 ug/L versus the ES of 0.03 ug/L) and an exceedance of bromodichloromethane at GMMW-1 (1.1 ug/L versus the ES of 0.6 ug/L). The very low concentrations of the two constituents are not expected to cause mobile groundwater plumes downgradient of their detected well locations.

3.6 Summary of Human Health Risk Assessment

Impacts to Human Health and the Environment

Potential exposure to the site-related contamination for human and ecological receptors is evaluated in the excerpted portion of the CH2M RI report below:

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 information below provides a summary of the key components and findings of the HHRA.

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).

Exposure Evaluation

Potential current and future receptors were evaluated in the HHRA. 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.

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 (1×10^{-4}) to 1-in-1,000,000 (1×10^{-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.

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 1×10^{-4} or a target-organ-specific HI greater than 1.0). For each receptor group, when a potential site-related ELCR of 1×10^{-4} was exceeded for an environmental medium, the HHRA COPCs posing an individual ELCR greater than 1×10^{-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.

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.

3.7 Summary of Ecological Risk Assessment

Ecological Risk Assessment

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).

The following subsections 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.

Terrestrial Habitats

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.

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.

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.

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.

Aquatic Habitats

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.

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.

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.

4.0 ADDITIONAL SOIL, GROUNDWATER AND VAPOR ASSESSMENT ACTIVITIES

The proposed additional soil, groundwater and vapor assessment activities include the field, analytical, and documentation services considered necessary to comply with the regulatory requirements applicable to this site.

As indicated previously, the Amcast SF NPL site (which includes the Amcast North, Amcast Central and Amcast South parcels currently owned by Oliver Fiontar, LLC) has been the subject of considerable site investigation activities which culminated in the preparation of a Final Remedial Investigation Report in 2015 (which we understand that both the EPA and the DNR approved). At present, we understand that the EPA is working with CH2M to complete its review of the May 2017 Remedial Alternatives Evaluation Report.

Figures 1-1 through 4-1, 4-3, 4-6 and 4-7 were prepared by CH2M and included in their April 2013 Remedial Investigation/Feasibility Study, May 2015 Remedial Investigation Report and their May 2017 Remedial Alternatives Evaluation Report which were prepared for the EPA under Contract No. EP-S6-06-01. The figures referenced throughout this report and in the following section are designated using CH2M's figure reference numbers.

Figures 3-1 through 3-10 in Appendix A provide an illustration of the spatial distribution and concentration of contaminants identified during the prior site investigation activities of the Amcast SF NPL site. Figures 4-1, 4-3, 4-6 and 4-7 provide additional detailed information relating to the three parcels of land within the Amcast SF NPL site that Oliver Fiontar, LLC plans to conduct is brownfield redevelopment activities at.

The major findings of the prior investigative activities are summarized below as the information obtained during the completion of the site investigation activities will likely guide the future assessments that are anticipated to be conducted by Drake and the brownfield redevelopment activities that Oliver Fiontar, LLC plans to undertake.

The CH2M Final RI Report integrated results from previous investigations with new data to determine the nature and extent of contamination at the Amcast Industrial SF NPL 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.

4.1 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 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 4.31×10^{-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 2.08×10^{-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.

<u>4.2 Nature and Extent of Contamination</u>

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 ug/kg.
- Arsenic exceeds its RSL in surface and subsurface soil with concentrations ranging from 0.61 to5.3 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 ug /kg.

Wilshire Pond

- Total PCB concentrations range from 1,300 ug/kg to 520,000 ug/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 Central/Amcast South

- The highest concentrations of PCBs in soil at AmcastCentral/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 Central/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 ug/kg to 11,000,000 ug/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 ug/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 from2.5 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 ug/kg to 19,000 ug/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 ug/kg to 23,000,000 □g/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 ug/kg to 250,000 ug/kg.

Groundwater

- AMS-MW01 was the only site well that had detections of PCBs at a concentration exceeding the WDNR ES of 0.03 ug/L (Aroclor 1260: 1.5 ug/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 ug/L) was the only VOC detected above its MCL/ES (0.6 ug/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:

<u>Amcast South</u>

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

<u>Zeunert Park</u>

FVMW-23	manganese:722 ug/L
FVMW-24	manganese: 754 ug/L

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

4.3 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

4.4 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 1×10^{-4} to 1×10^{-6} or a non-carcinogenic 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 1×10^{-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 1×10^{-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
- 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 × 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—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
- Surface Water
  - 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

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(1,2,3c,d)pyrene
- Non-PAH SVOCs—bis(2ethylhexyl)phthalate; hexachloroethane; and PCP
- VOCs—1,1'biphenyl; 1,2,4trimethylbenzne; benzene; bromodichloromethane, chloroform ethylbenzene, and naphthalene

4.5 Ecological Health Risk Assessment

An ERA was conducted through Step 3A of the 8-step ERA process (USEPA 1997). The objective of the ER 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.

4.6 Additional Post-RI Assessment of Extent and Degree of Soil Contamination

In an effort to further refine the site model regarding the extent and degree of soil contamination provided in the Final RI Report prepared for the EPA in 2015 and the December 2018 "Draft" Feasibility Report prepared by CH2M, Drake has proposed conducting additional subsurface assessment activities in the areas of identified impacts at the Amcast North, Amcast Central and Amcast South parcels. Figures 4-1 and 4-3 provide an illustration of the impacted areas within the Amcast North, Amcast Central and Amcast South parcels. Figures 4-6 and 4-7 provide a depiction of the observed or suspected locations of storm sewer lines at these parcels.

The additional assessment is designed to permit Drake to further define the extent of the soil contamination observed in the soil borings and groundwater samples collected by others at the site, as well as to ascertain the current condition of the storm sewer lines so as to guide future work. The proposed scope of work includes the drilling and sampling of several hand auger borings and/or soil borings on the Amcast North, Amcast Central and Amcast South parcels.

Soil samples will be collected utilizing either a hand-sampling device, a direct push device, test-pit excavation equipment or a conventional truck-mounted drill rig. The samples will be analyzed on-site with a photoionization detector (PID), and evaluated for geological characteristics. Selected soil samples from each sample location boring will be retrieved for visual analysis and classification and select samples from these locations may be preserved for off-site laboratory analysis of VOCs, PAHs, RCRA metals and/or PCB analysis.

The proposed hand auger sampling associated with the Amcast North parcel will be performed within the general areas designated as Areas A, B, C, D, E and I by CH2M which are identified on Figure 4-1. Drake anticipates that approximately 6-10 hand auger borings will be advanced on the Amcast North parcel in order to further refine the conceptual site model. Additional hand auger sampling may occur in these areas if field observations indicate such additional sampling may be warranted.

The proposed hand auger sampling associated with the Amcast Central and Amcast South parcel will be performed within the general areas designated as Areas A, B, C, E, F and G by CH2M which are identified on Figure 4-3. Drake anticipates that approximately 8-12 hand auger borings will be advanced on the Amcast Central and Amcast South parcels in order to further refine the conceptual site model. Additional hand auger sampling may occur in these areas if field observations indicate such additional sampling may be warranted.

4.7 Additional Groundwater Monitoring & Evaluation

Prior investigation of the extent and degree of groundwater impacts in the vicinity of the site has been performed and historically reported by prior consultants, including the work performed by CH2M during their preparation of the 2015 Final RI Report for the Amcast SF NPL site and their December 2018 "Draft" Feasibility Report.

The most recent groundwater sampling of the existing on-site wells within the Amcast North, Amcast Central and Amcast South parcels was conducted by Drake on November 19, 2018. Drake's preliminary analysis of the November 2018 groundwater sampling results indicated no significant change in groundwater conditions has occurred at the Amcast North, Amcast Central and Amcast South parcels. Appendix B provides a summary of the November 2018 groundwater sampling data along with historical groundwater sampling results obtained by others at the site (Tables 1 through 5 – Amcast North; Tables 1 through 5 – Amcast Central and Amcast South).

Routine annual groundwater monitoring on an annual basis from the existing on-site groundwater monitoring well network is anticipated to provide sufficient information to further refine the site model and Drake will include the results and more detailed analysis of the groundwater sampling event it performed in 2018 in a future report. Drake anticipates collecting the next round of groundwater sampling in November 2019.

In the event that Drake considers it necessary to further evaluate the extent and degree of groundwater contamination associated with the Amcast North, Amcast Central or Amcast South sites, additional monitoring wells may be constructed and installed at the sites. Following installation, each monitoring well will be developed and surveyed, and groundwater samples will be collected and analyzed for select analytes. The direction and gradient of groundwater movement will be evaluated with the use of site surveying data and water level measurements obtained from the existing and any newly installed monitoring wells.

4.8 Evaluation & Assessment of Potential Vapor Impacts

Prior assessment of potential vapor impacts in the vicinity of the site has been performed and historically reported to the DNR and EPA by prior consultants, including work performed by CH2M for the EPA during their preparation of the RI/FS for the Amcast SF NPL site. Section 5 of the CH2M 2015 Final RI Report contains a description of the Human Health Risk Assessment (HHRA) that was conducted for contaminants of concern including PCBs, VOCs and PAHs.

As part of its work, Drake will conduct a review of the HHRA results and conduct an assessment of the vapor intrusion pathway as required by NR 716.11(5). The results and conclusions from the vapor assessment will be reported to the DNR whether or not vapor samples were taken.

5.0 SITE INVESTIGATION PROCEDURES

The procedures to be utilized during the post-RI/FS site assessment activities at the Former Amcast site are generally discussed in the following section.

5.1 Contractor and Laboratory Selection

Drake will assist with the selection of personnel and/or contractors as needed to provide and operate soil boring and well drilling equipment, construct monitoring wells, and provide laboratory analytical testing. Drake will establish the scope of work for each service and Drake will then schedule and coordinate the project with the selected contractors and laboratory.

5.2 Health and Safety Plan Preparation

Prior to the implementation of fieldwork, Drake will prepare a site-specific health and safety plan to comply with the requirements of the United States Occupational Safety and Health Administration (OSHA). The health and safety plan will apply to Drake staff members conducting fieldwork or providing project support at the site. A description of site characteristics, a hazards evaluation, safety requirements, and emergency procedures will be included in the plan. The health and safety plan will be available on-site during fieldwork operations.

5.3 Soil Boring Procedures

Public underground site utilities will be identified by Wisconsin Diggers Hotline prior to the commencement of subsurface work.

Soil samples will be collected utilizing either a hand-sampling device, a direct push device, test-pit excavation equipment or a conventional truck-mounted drill rig.

The selected contractor will collect continuous soil samples with a truck-mounted drill rig unit. Each soil sample will be collected within a split-spoon or other sampling device, and equipment decontamination procedures will be followed to prevent the transfer of contaminants by the equipment. Shallow soil sampling will be conducted by Drake personnel or selected contractors utilizing conventional equipment.

5.4 Drilling Procedures

If utilized, soil borings for monitoring well installation will be drilled by the selected contractor utilizing continuous-flight hollow-stem steel augers. Continuous soil samples will be collected during drilling operations. Equipment decontamination procedures will be followed to prevent the transfer of contaminants by the equipment.

5.5 Soil Sampling Procedures

Soil samples will be analyzed to identify the site's geologic conditions and to estimate the horizontal and vertical extent of the soil contamination. The selected contractors will assist Drake in collecting the samples at 2-foot or 4-foot vertical intervals utilizing sampling procedures designed to recover representative, relatively undisturbed samples. The equipment utilized to collect soil samples will be decontaminated before and after each sample recovery to prevent the transfer of contaminants by the sampling equipment. The recovered samples will be placed into appropriate containers for field and laboratory testing.

5.6 Soil Sample Screening and Classification

Drake will preliminarily evaluate soil samples in the field to identify indications of petroleum contamination. The samples will be screened with a PID following the WDNR "headspace" method. PID screening detects the presence of volatile organic vapors commonly emitted by VOCs, which are common constituents of petroleum fuels.

Following PID screening, the samples will be transported to Drake's facility. Drake will visually examine and classify the samples in general accordance with the Unified Soil Classification System (USCS). Each sample will also be evaluated to identify the presence of staining and odors indicative of contamination. The description and accompanying USCS classification for each sample will be presented on soil boring logs prepared by Drake. Drake will also prepare geologic cross section diagrams depicting the stratigraphy of the site.

Investigative wastes generated during the additional assessment activities will likely consist of contaminated soil and groundwater. Soils generated from the additional site assessment activities will be taken off site for bulk disposal.

5.7 Soil Sample Analytical Testing

Drake will submit selected soil samples to an independent WDNR-certified laboratory for analysis of selected analytes. A quality control trip blank will be included with the soil samples, and chain of custody documentation will be maintained for the samples. The selected analytes that may be included in the sampling plan are:

Analytical Parameter	Analytical Method
Volatile Organic Compounds (VOCs)	EPA Method 8021B
Poly-cyclic Aromatic Hydrocarbons (PAHs)	EPA Method 8270C
Resource Conservation and Recovery Act (RCRA) Metals	EPA Method 6010B/7471A
Polychlorinated Biphenyls (PCBs)	EPA Method 8082

Drake anticipates obtaining a minimum of one soil sample from each soil sample location for field-screening and/or for submission for laboratory analyses. A soil sample is anticipated to be collected from the upper four foot interval of each boring in order to evaluate direct contact parameters. An additional soil sample may be collected from above the groundwater interface if field screening and/or visual observations indicate the presence of volatile organic vapors at the direct contact interval to evaluate the potential for groundwater contamination.

Drake will compare the laboratory results to Wisconsin Administrative Code NR 720 generic RCLs and/or site-specific standards to evaluate the extent and degree of soil contamination.

5.8 Monitoring Well Construction

Drake does not anticipate installing additional monitoring wells at the site at this time. In the event that additional monitoring wells are elected to be installed, they will be installed in accordance with the procedures outlined in this section.

Monitoring wells will be utilized to compile data regarding hydrogeologic characteristics, evaluate groundwater quality, and evaluate natural attenuation factors. Drake will document well construction procedures and prepare WDNR monitoring well construction forms. Drake will also develop the wells in accordance with WDNR requirements and prepare WDNR monitoring well development forms.

An elevation survey will be completed utilizing conventional leveling methods to determine the ground surface, protective cover, and well casing elevations at each monitoring point. The depth to water in each monitoring well will be measured with an electronic water level probe, and the water table elevation will then be calculated. Drake will utilize the surveying and water level data to identify hydrogeologic characteristics and will prepare a diagram depicting water table elevations and the direction of groundwater flow for the site.

5.9 Groundwater Sampling and Analytical Testing

In the event that additional monitoring wells are installed at the site, they will be installed in accordance with the procedures outlined in this section.

Following development or purging, groundwater samples will be collected and submitted for field and laboratory testing from each monitoring well where sufficient water is present. The samples will be collected with disposable bailers and transferred to appropriate containers for laboratory analysis. A quality control trip blank will be included with the groundwater samples, and chain of custody documentation will also be maintained for the samples. The selected analytes that may be included in the sampling plan are:

Analytical Parameter	Analytical Method
Volatile Organic Compounds (VOCs)	EPA Method 8021B
Poly-cyclic Aromatic Hydrocarbons (PAHs)	EPA Method 8270C
Resource Conservation and Recovery Act (RCRA) Metals	EPA Method 6010B/7471A
Polychlorinated Biphenyls (PCBs)	EPA Method 8082

Drake will compare the laboratory results to standards set forth in Wisconsin Administrative Code NR 140 to evaluate groundwater quality at the site.

5.10 Vapor Assessment Activities

Sub-slab vapor sampling will be conducted in accordance with WDNR Pub. RR-800 and RR-986. Sub-slab vapor samples will be collected from unsaturated soil directly below a building using sample probes installed through the foundation using the water dam method described in WDNR Pub. RR-800. Sub-slab sample probes will installed through the foundation, with a pre-certified laboratory provided Summa canister connected to each probe. The canister will be fitted with a flow controller that limits vapor flow to no more than 200 ml/min (a 6-liter canister will fill in approximately 30-minutes at this flow rate).

Analytical Parameter	Analytical Method
Volatile Organic Compounds (VOCs)	EPA Method TO-15

6.0 POST-RI/FS ADDITIONAL ASSESSMENT SCHEDULE

6.1 Field Investigation

Following the submittal of this work plan with the required technical review fee, Drake will await receipt of DNR approval of the work plan prior to conducting the proposed activities. Per NR 716.11(2r), Oliver Fiontar, LLC anticipates initiating the activities outlined within the work plan within 60 days of receipt of the DNR approval. If additional phases of fieldwork are necessary to permit Drake to further refine the site model, they will be evaluated and implemented following the collection and analysis of data from the initial additional assessment field activity.

6.2 Report Preparation

Following the completion of all phases of fieldwork and the receipt of final laboratory analytical results, Drake will prepare a project report. The report will include a discussion of site characteristics, descriptions of the additional site assessment procedures, laboratory and field results, and a detailed analysis of the project results. Drake will also provide copies of diagrams, laboratory reports, and field forms in the report.

6.3 Post-RI/FS Redevelopment Site Remedial Action Evaluation

If remediation is considered to be warranted, Drake will consider and evaluate various potential alternatives to address soil, groundwater and/or vapor impacts, including non-active source control and natural attenuation monitoring for soil and groundwater remediation following the completion of the additional site assessment activities. Drake will evaluate the alternatives based on technical feasibility, the presence or absence of environmental factors, economic feasibility, timeframe, effectiveness, and regulatory acceptance.

7.0 CERTIFICATION STATEMENTS

Following are submittal certification statements required by Chapter NR 712 of the Wisconsin Administrative Code that apply to this document.

I, Matthew Giovanelli, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

WISCONSIN PROFESSIONAL GEOLOGIST
MATTHEW R. GIOVANELLI
G-490
WAUWATOSA
WIS

P.G., Senior Project Manager
Signature and title

April 18, 2019
Date

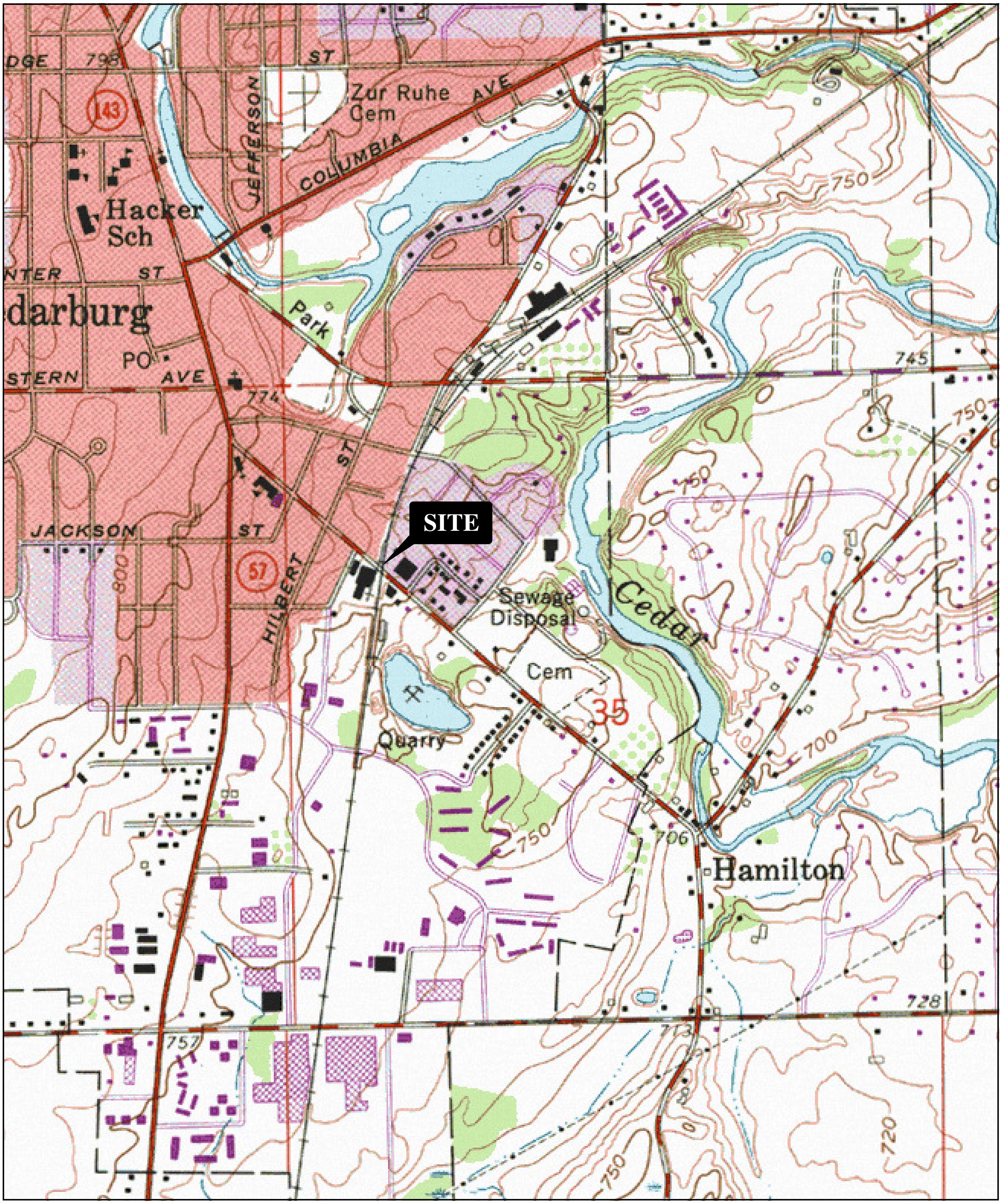
APPENDIX A

Figures – prepared by CH2M

CH2M *Final Remedial Investigation Report – May 2015*

CH2M *Final Remedial Alternatives Evaluation Report – May 2017*

Figures



Former Amcast Site
N37W5684 & N39W5789 Hamilton Road & Johnson Avenue
Cedarburg, Wisconsin

FIGURE 1 • Vicinity Diagram

Scale: 1"=1,000' • Contour Interval: 10'

Project Number: J16001	Date: 04/08/2019	By: CMC

DRAKE CONSULTING GROUP, LLC

Ozaukee County GIS

Amcast Industrial & Amcast Automotive

DISCLAIMER: Ozaukee County does not guarantee the accuracy of the material contained here in and is not responsible for any misuse or misrepresentation of this information or its derivatives.

FIGURE 1A

Ozaukee County
121 W Main St
P.O. Box 994
Port Washington WI 53074
262-284-9411

Print Date: 4/10/2019

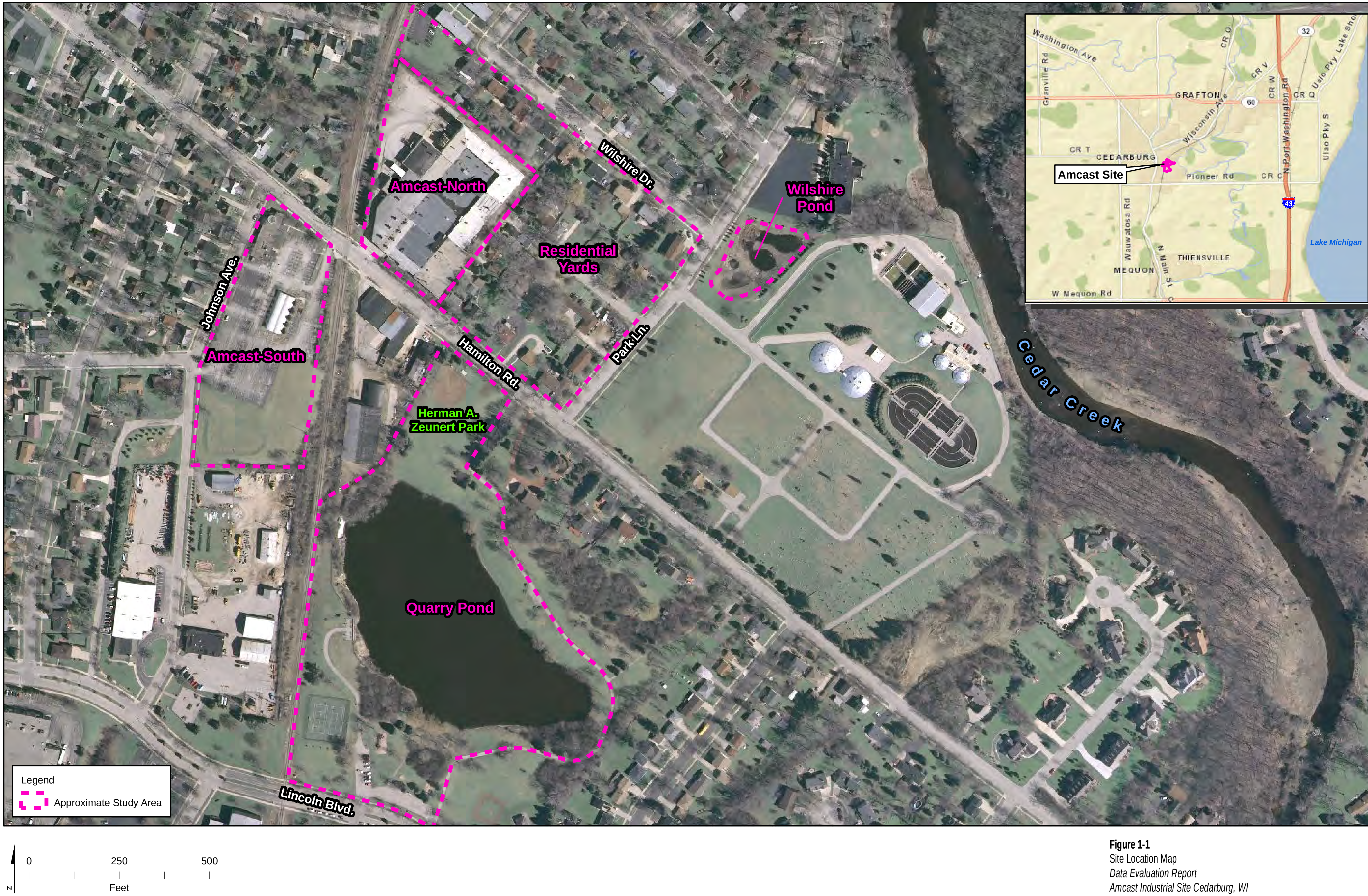


Figure 1-1
Site Location Map
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

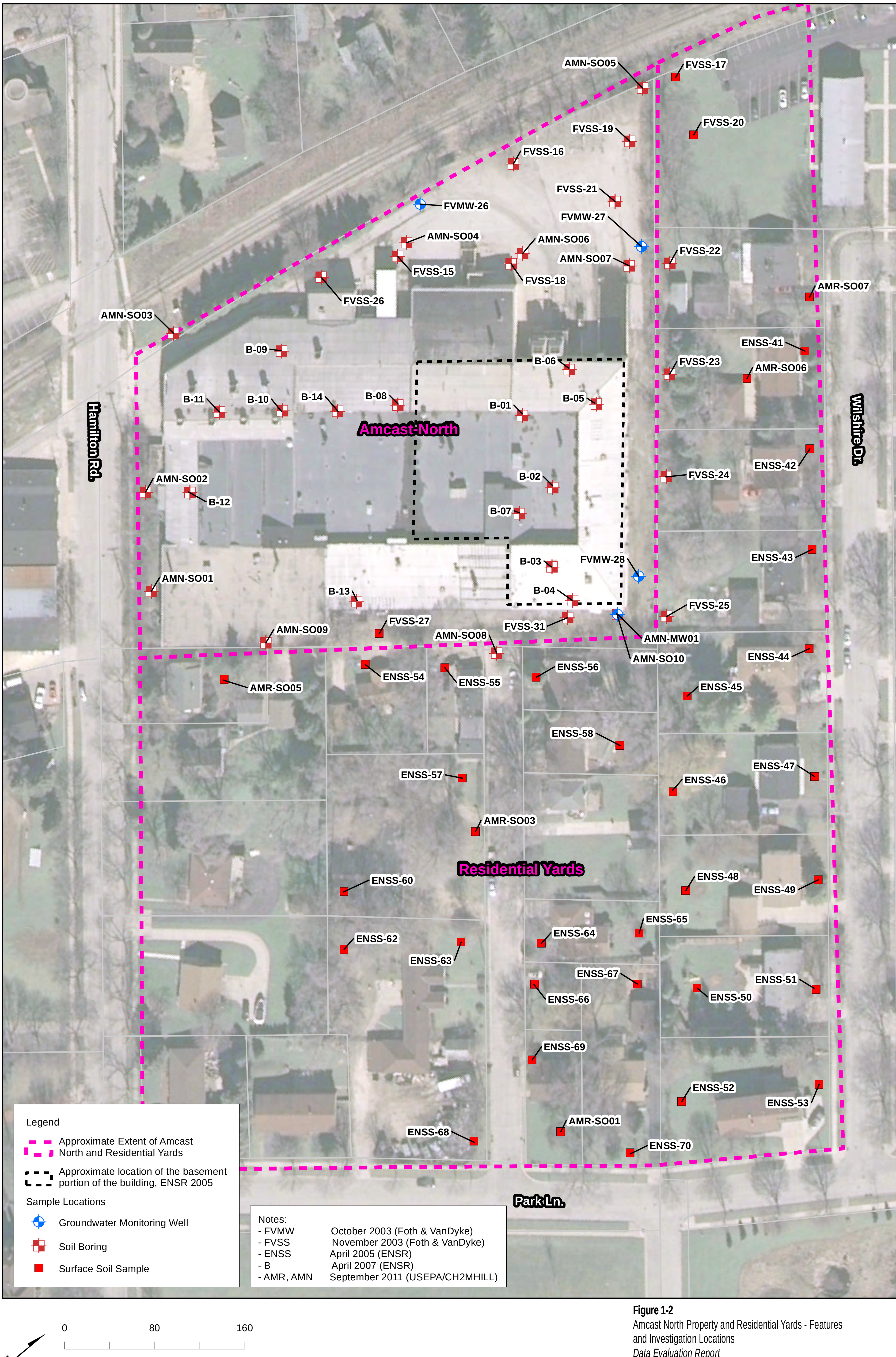


Figure 1-2
Amcast North Property and Residential Yards - Features and Investigation Locations
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 01-02 - AMCAST NORTH.MXD JHANSEN1 4/2/2013 4:07:28 PM

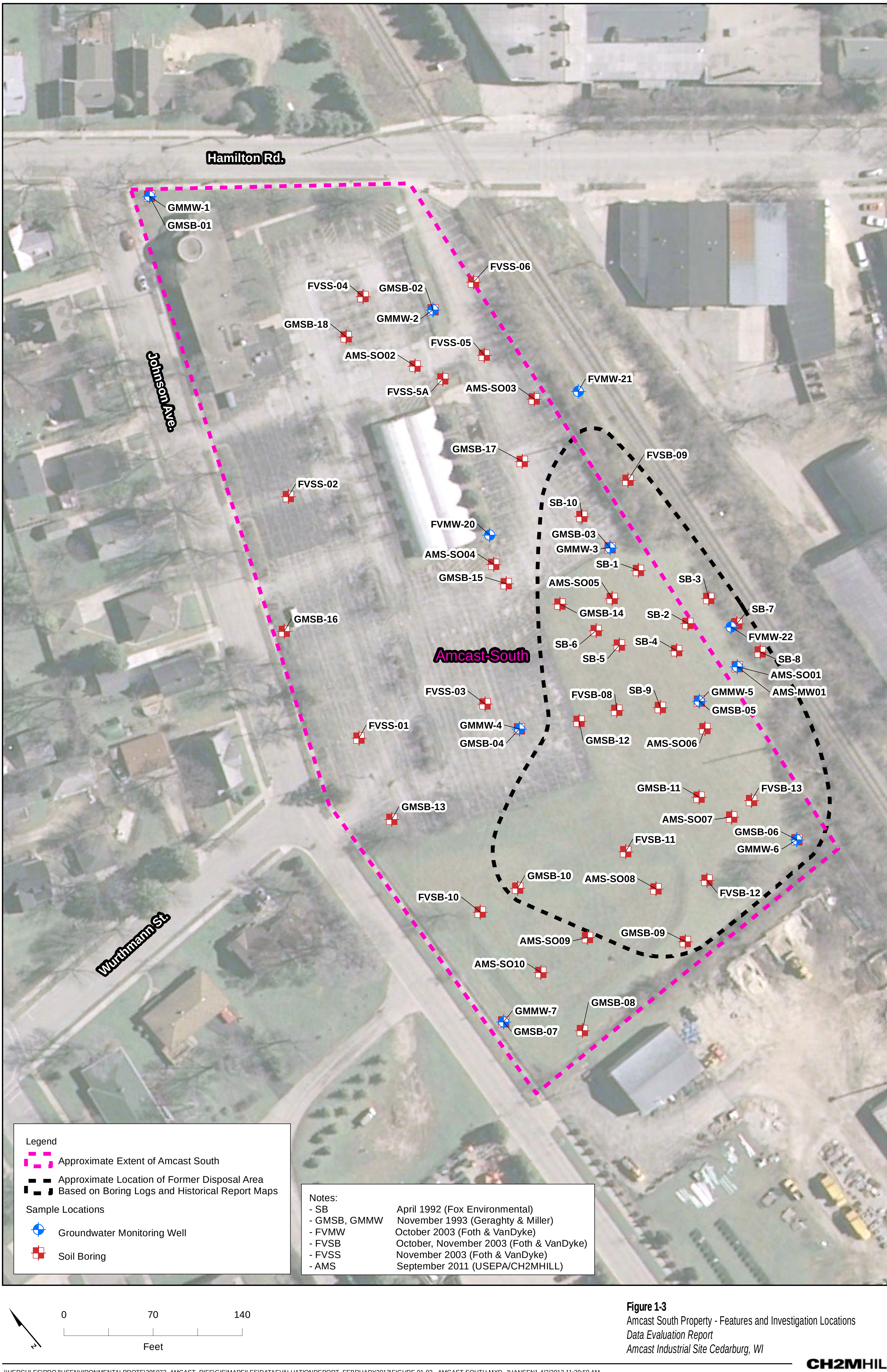
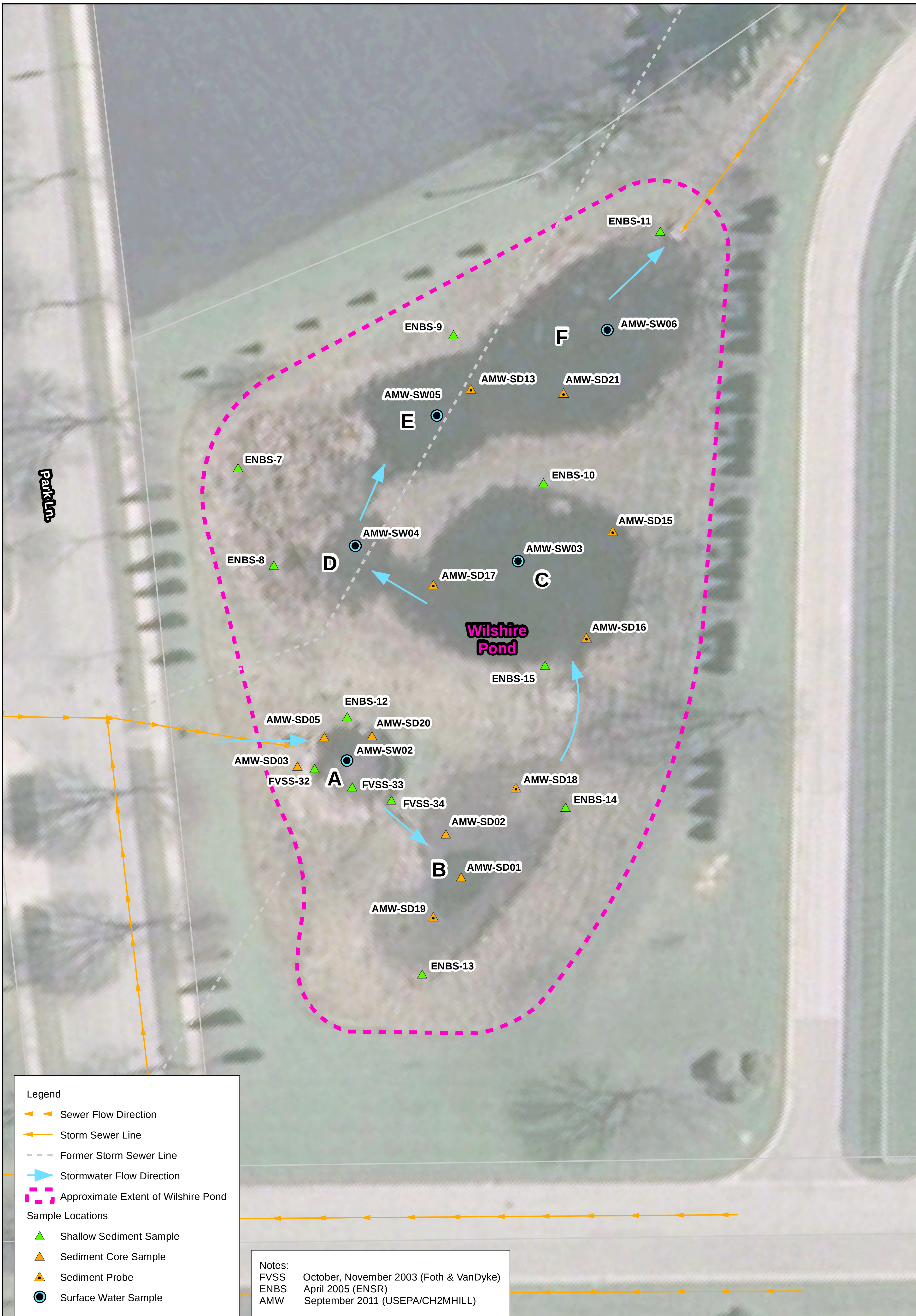


Figure 1-3
Amcast South Property - Features and Investigation Locations
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 01-03 - AMCAST SOUTH.MXD JHANSEN1 4/2/2013 11:29:50 AM



N

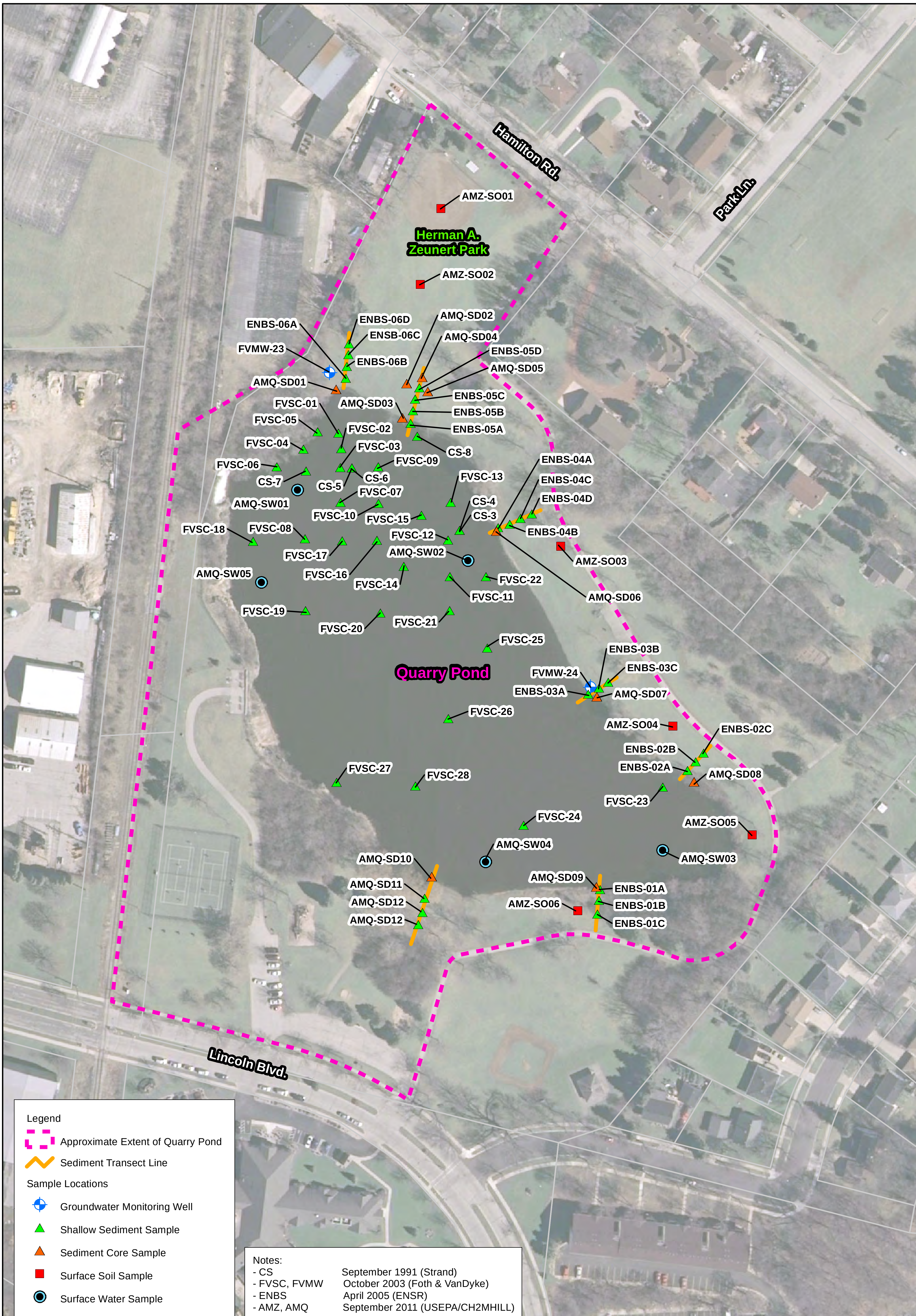
0 30 60

Feet

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

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 01-04 - WILSHIRE POND - FEATURES AND INVESTIGATION LOCATIONS.MXD JHANSEN1 4/2/2013 11:50:27 AM



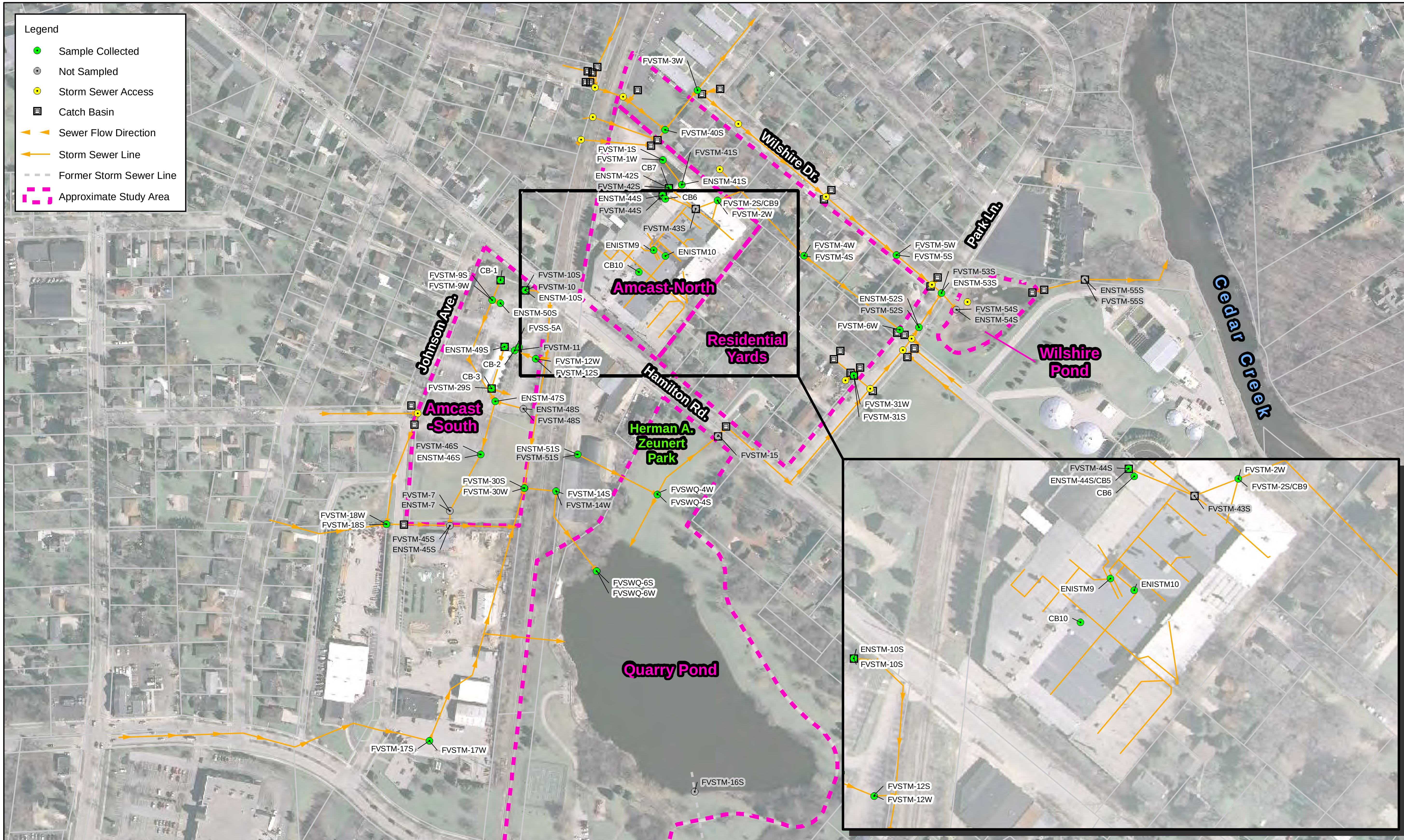
N

0 125 250

Feet

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

CH2MHILL



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
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

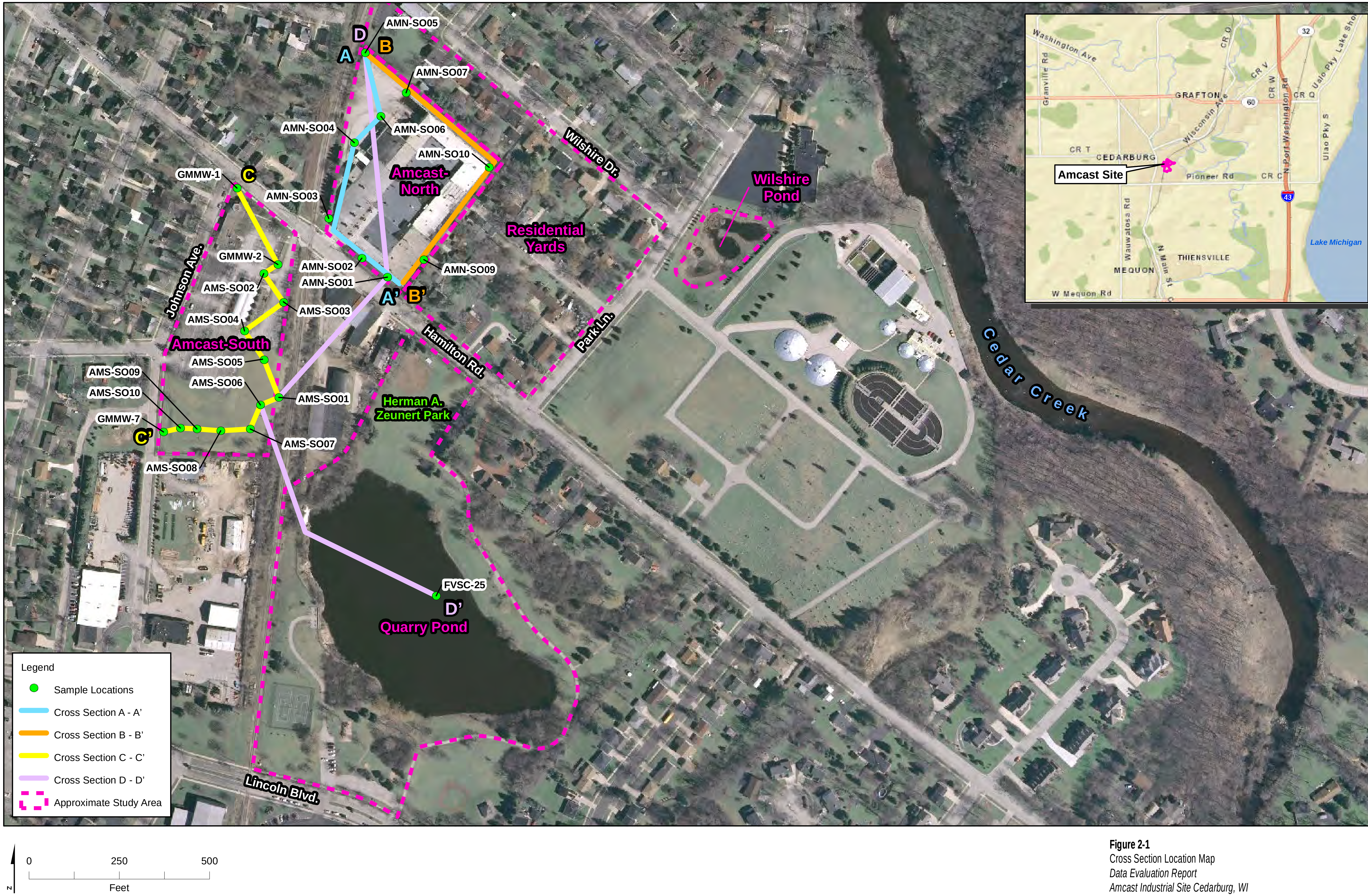
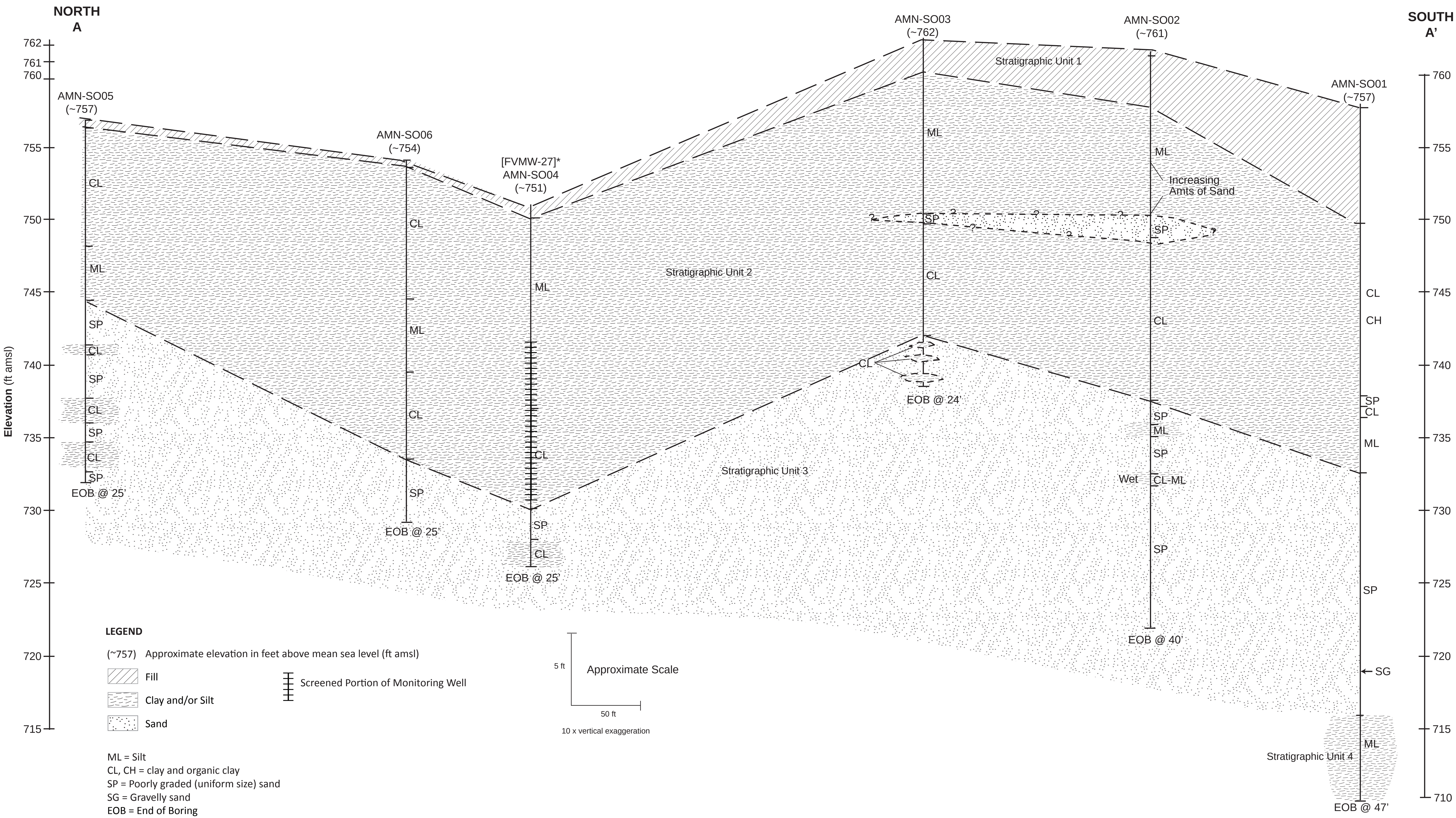


Figure 2-1
Cross Section Location Map
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL



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

CH2MHILL.

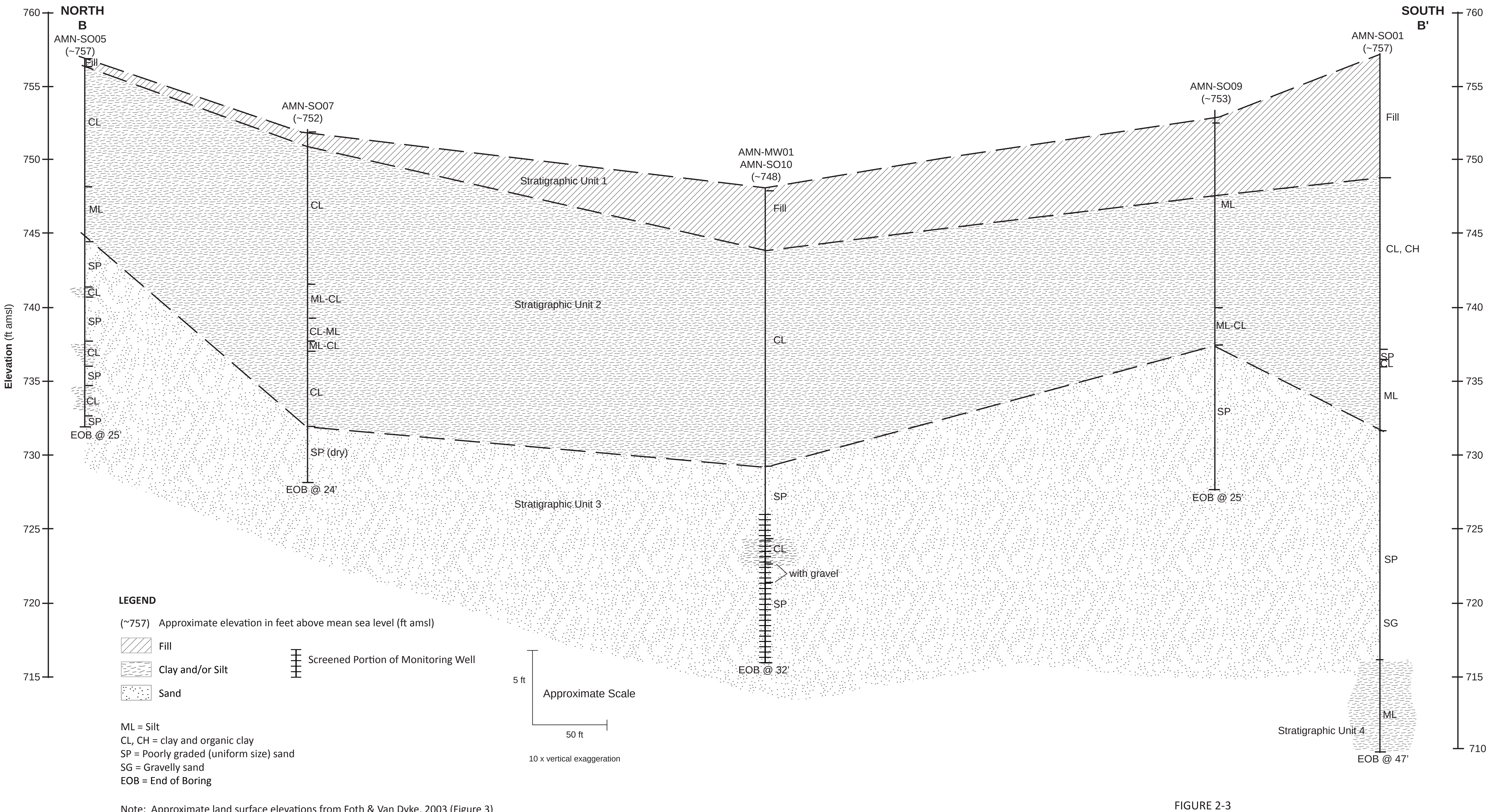


FIGURE 2-3
Cross-section B-B' Amcast North
Amcast Industrial Site
Cedarburg, WI

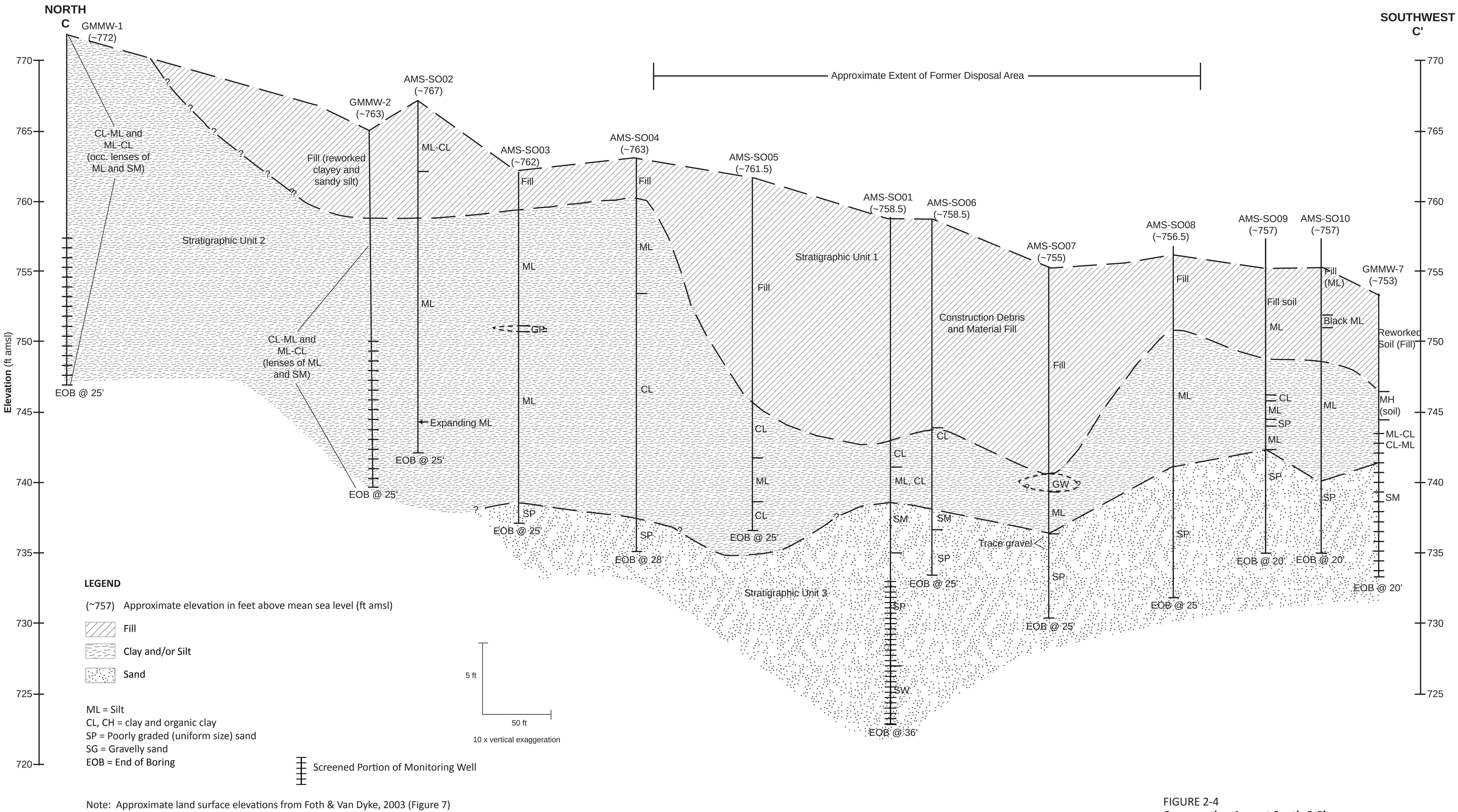
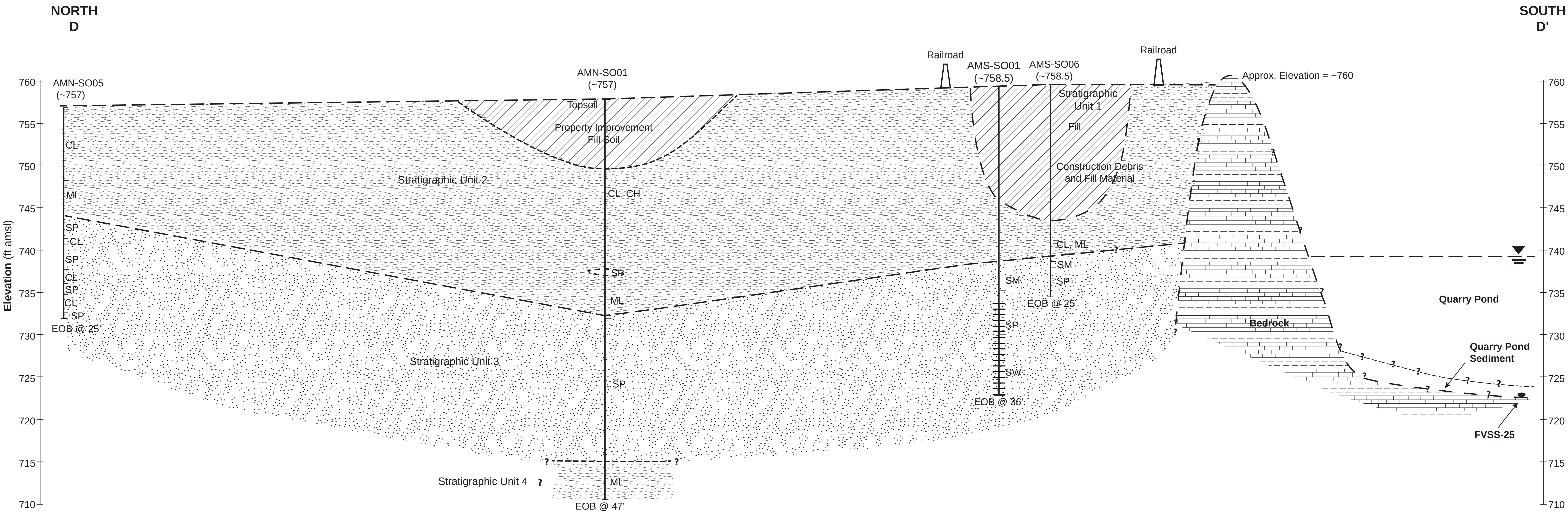


FIGURE 2-4
Cross-section Amcast South C-C'
Amcast Industrial Site
Cedarburg, WI



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

10 ft

100 ft

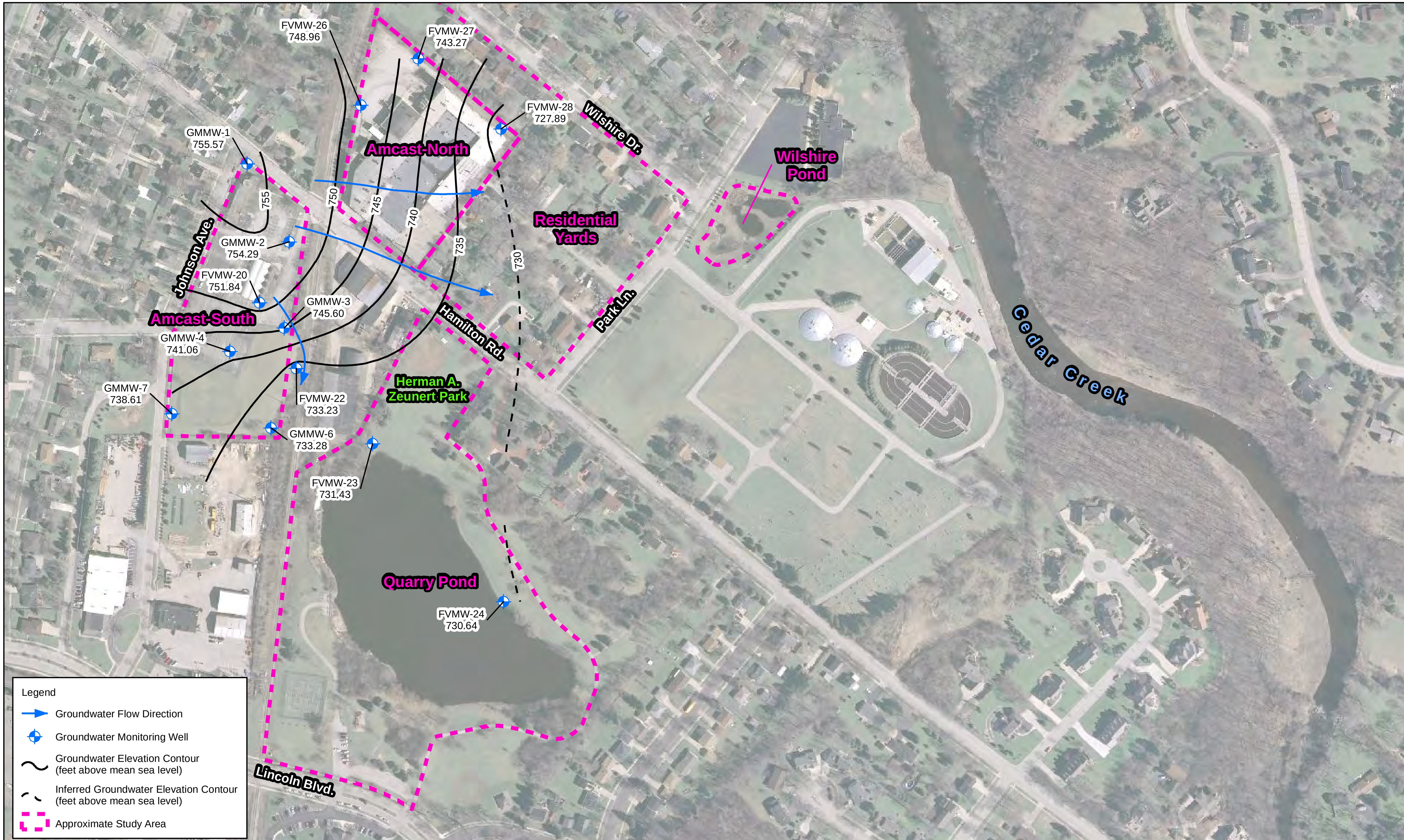
10 x vertical exaggeration

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

CH2MHILL.



N

0 250 500

Feet

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

CH2MHILL

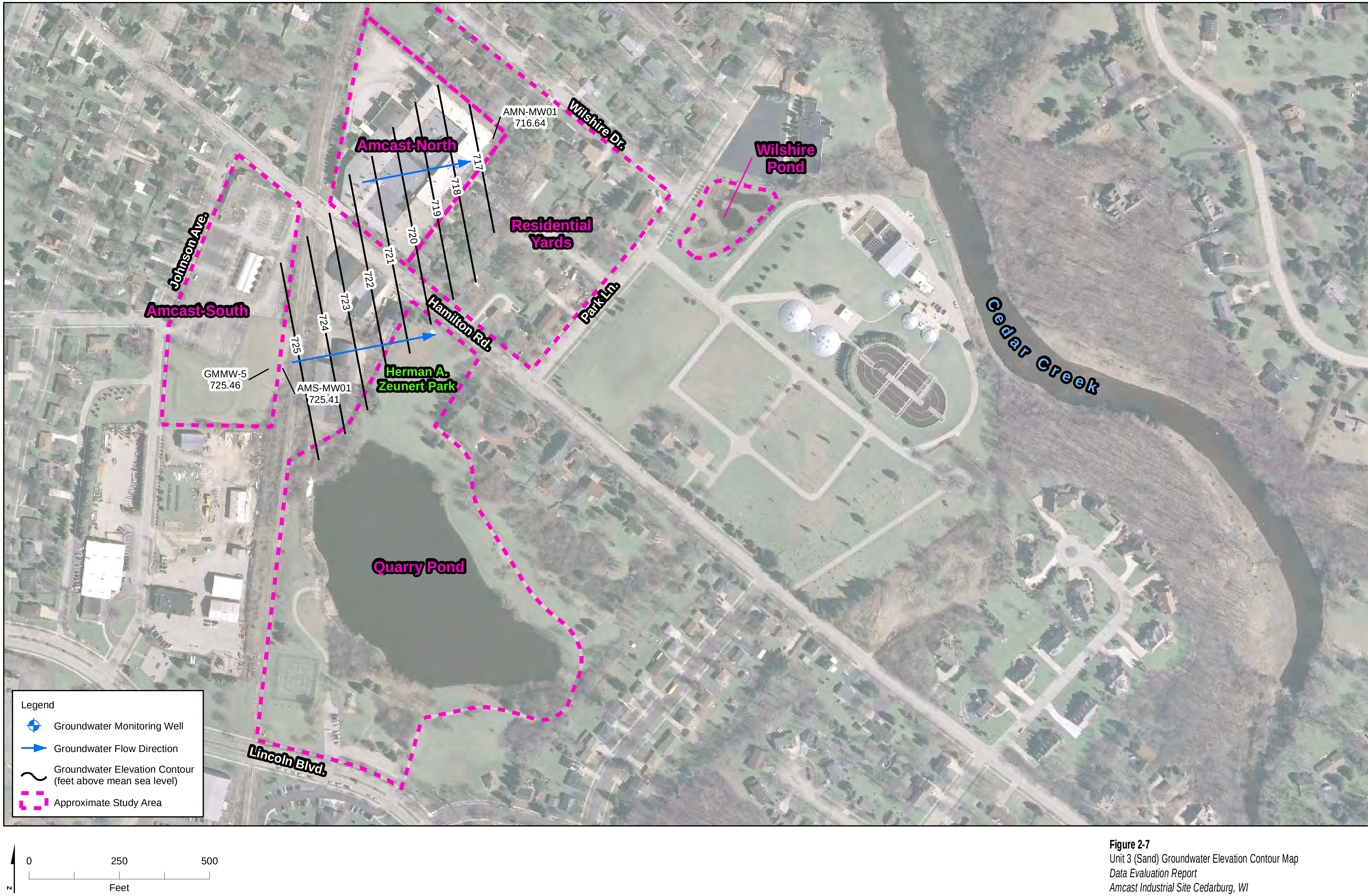
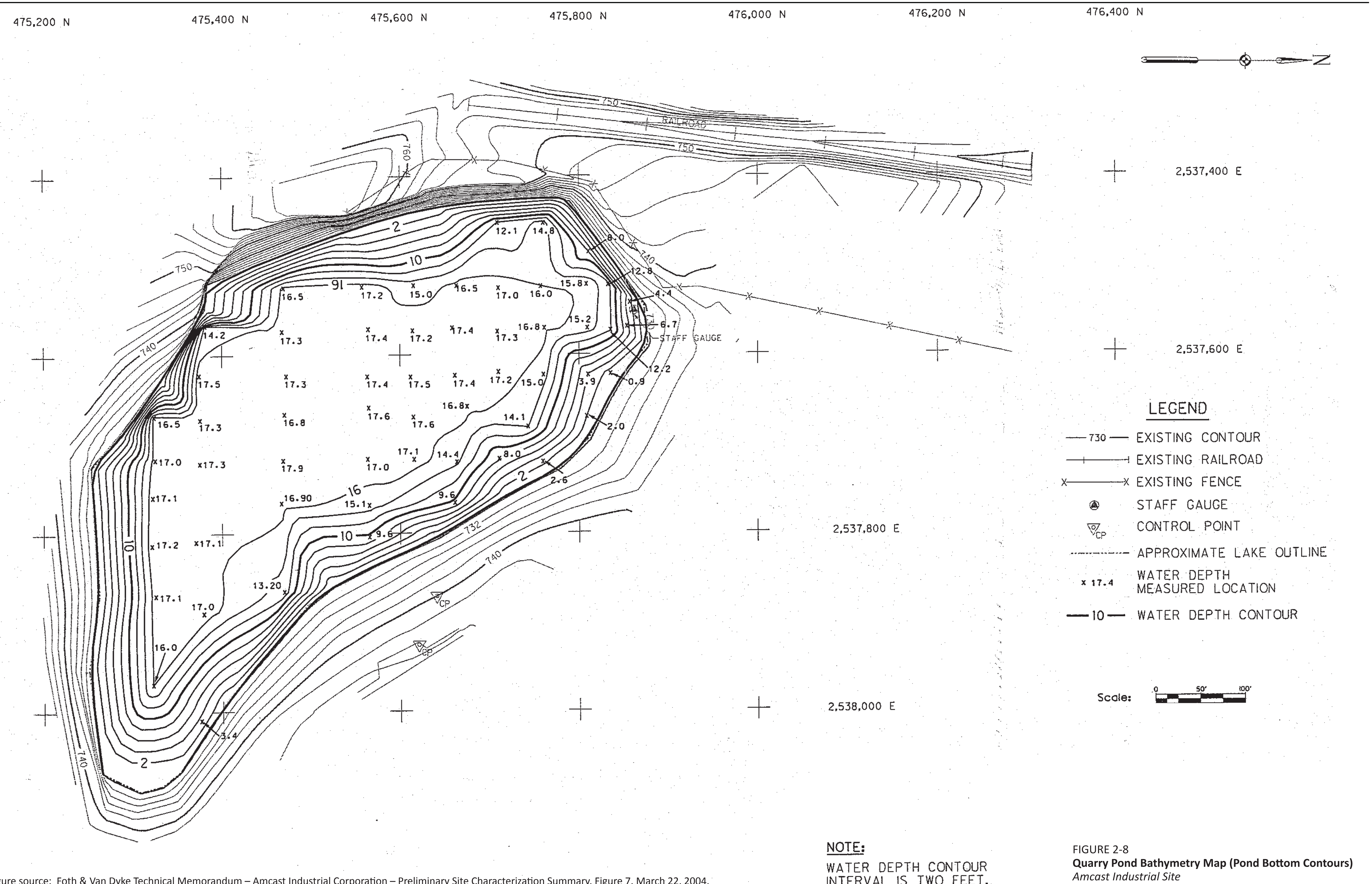


Figure 2-7
Unit 3 (Sand) Groundwater Elevation Contour Map
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 02-07 - UNIT 3 GROUNDWATER CONTOURS.MXD JHANSEN1 4/4/2013 2:57:08 PM



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

CH2MHILL.

ES102512233634MKE Fig2-8_QuarryPondBathymetryMap_v3.ai 04.02.13 jls

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

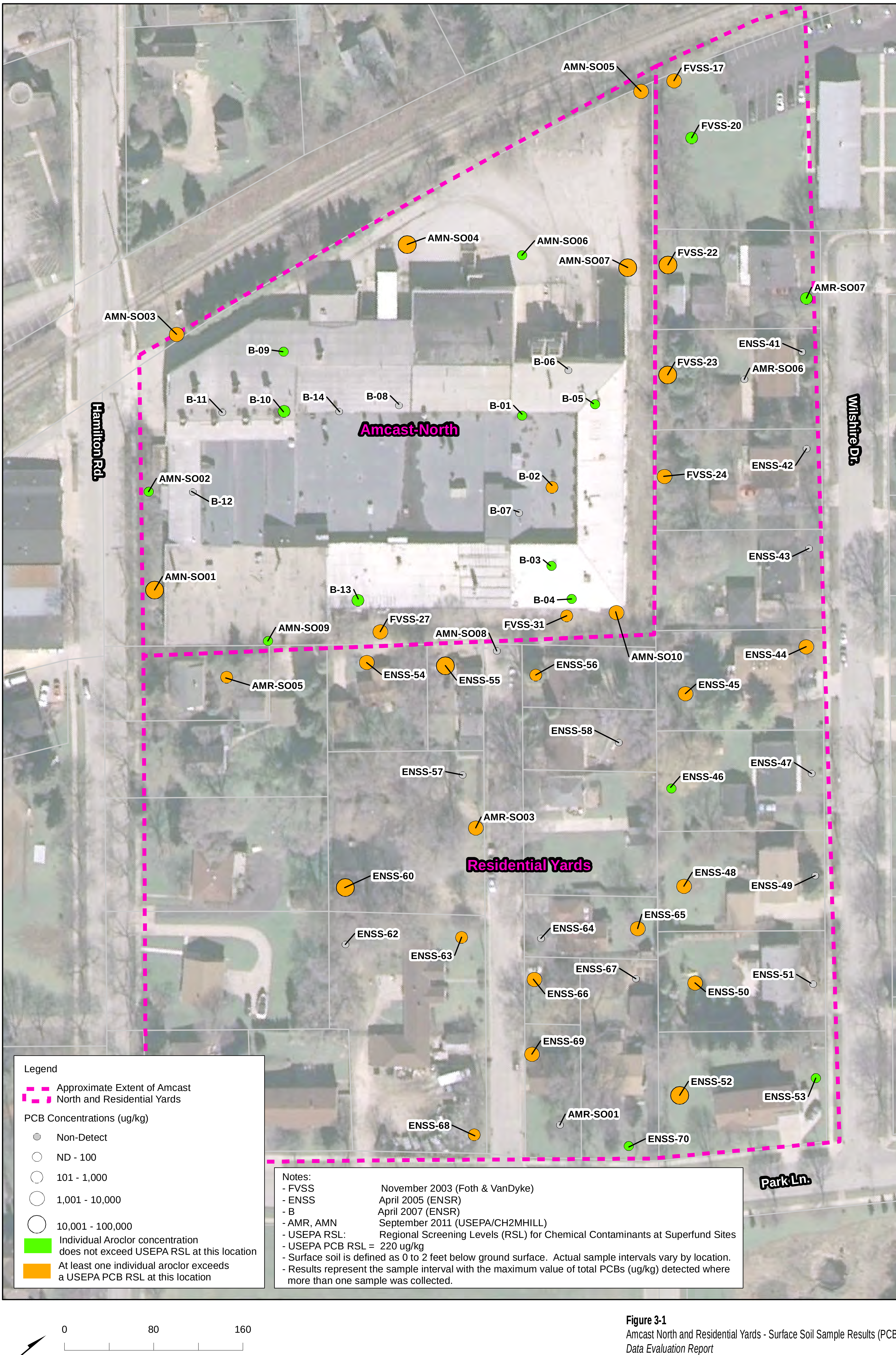


Figure 3-1
Amcast North and Residential Yards - Surface Soil Sample Results (PCBs)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-01 - SURFACE SOIL PCB - AMCAST NORTH.MXD JHANSEN1 4/3/2013 3:06:29 PM

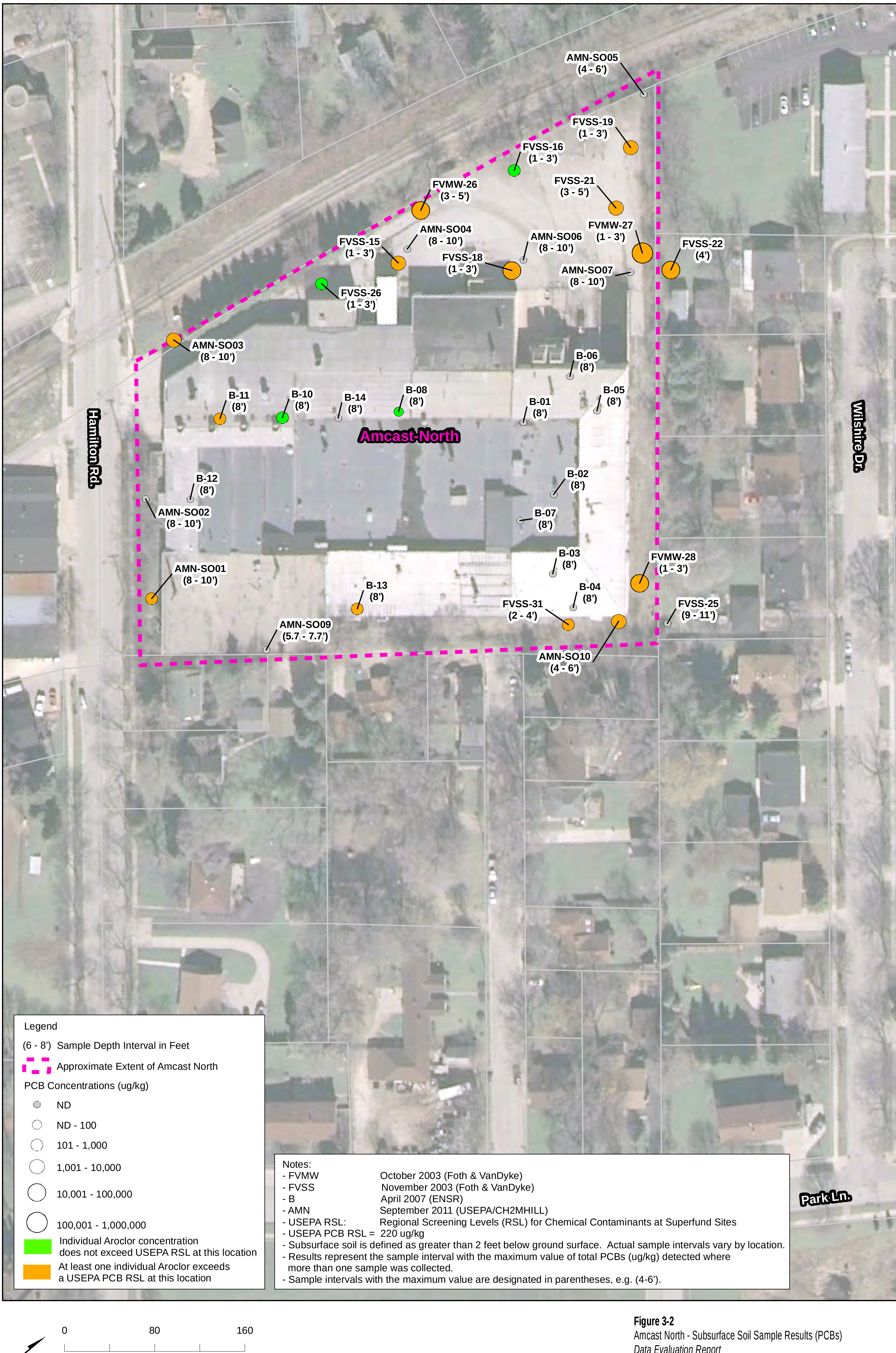


Figure 3-2
Amcast North - Subsurface Soil Sample Results (PCBs)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-02 - SUBSURFACE SOIL PCB - AMCAST NORTH.MXD JHANSEN1 4/3/2013 3:09:05 PM

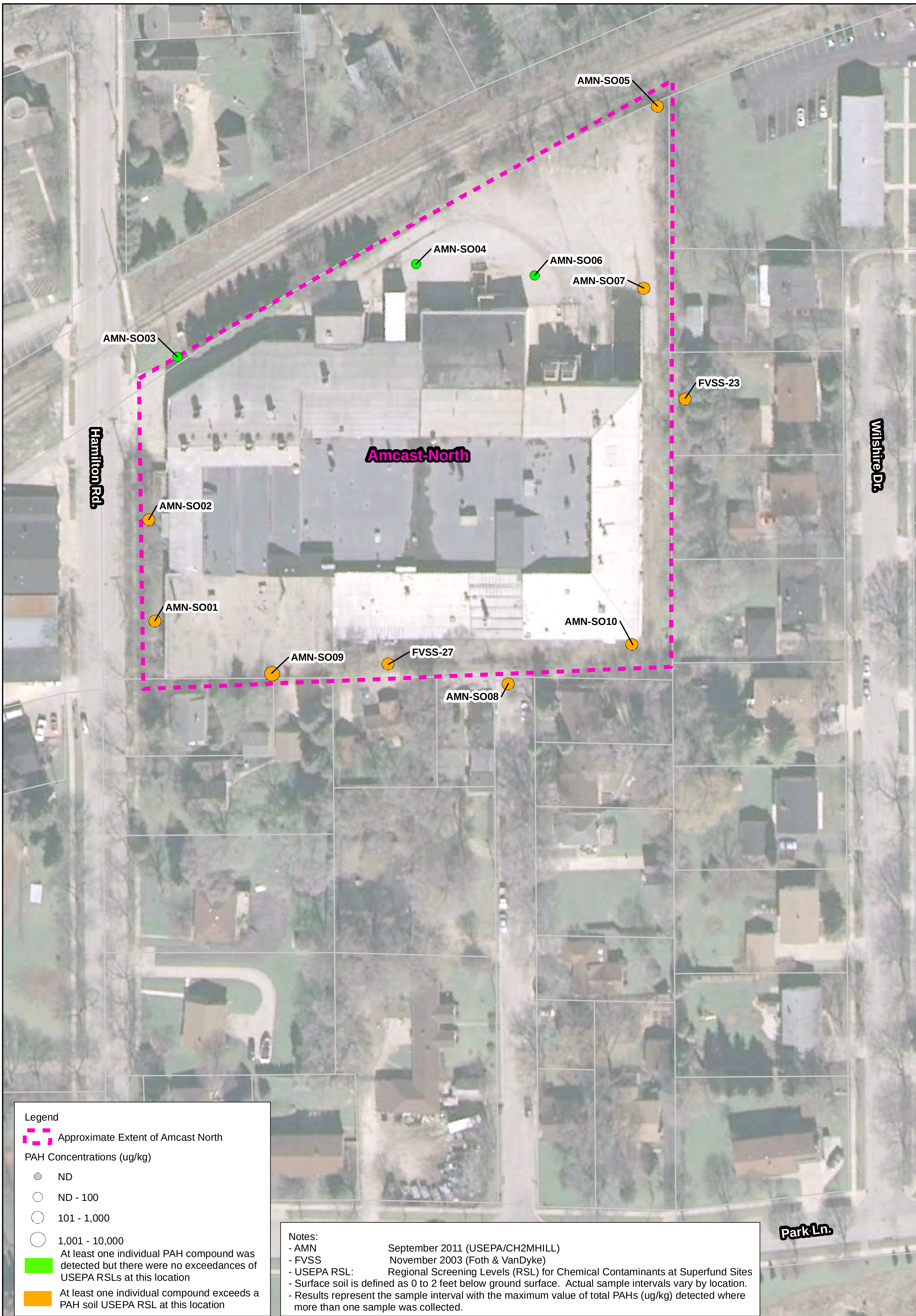
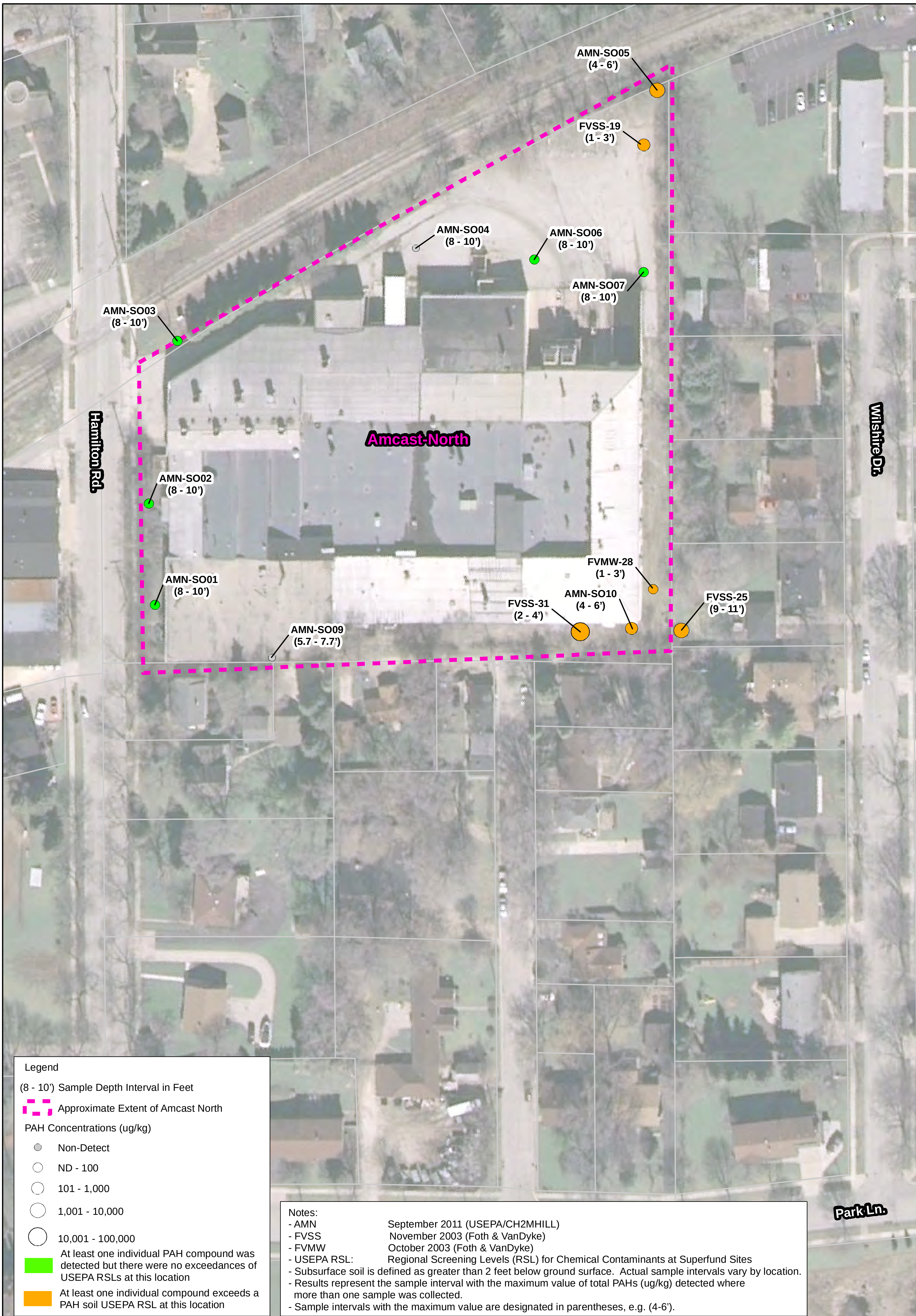


Figure 3-3
Amcast North - Surface Soil Sample Results (PAH)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-03 - SURFACE SOIL PAH - AMCAST NORTH.MXD JHANSEN1 4/3/2013 3:11:49 PM

CH2MHILL



N

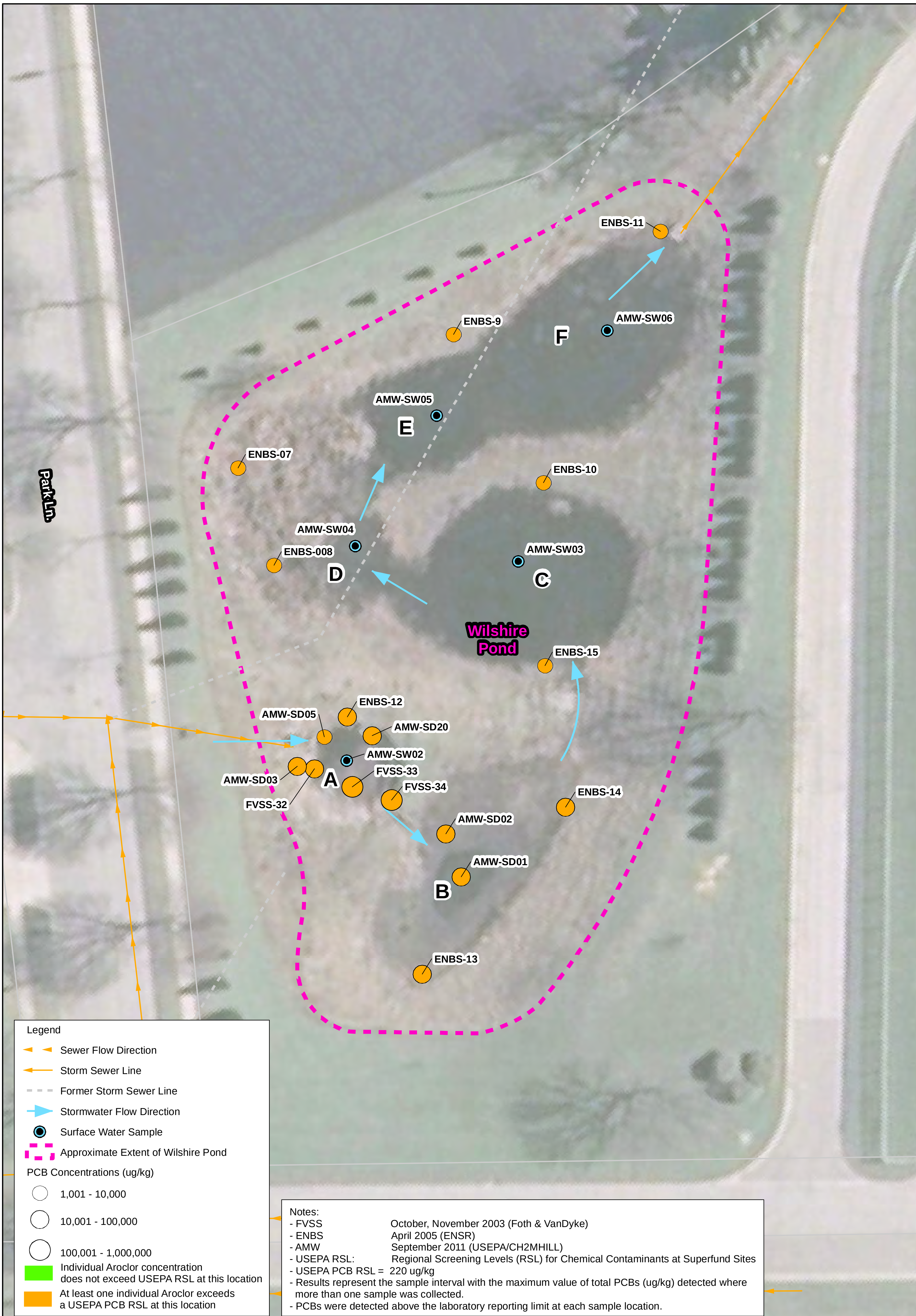
0 80 160

Feet

Figure 3-4
Amcast North - Subsurface Soil Sample Results (PAH)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-04 - SUBSURFACE SOIL PAH - AMCAST NORTH.MXD JHANSEN1 4/3/2013 3:14:38 PM



Notes:
- FVSS October, November 2003 (Foth & VanDyke)
- ENBS April 2005 (ENSR)
- AMW September 2011 (USEPA/CH2MHILL)
- USEPA RSL: Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites
- USEPA PCB RSL = 220 ug/kg
- Results represent the sample interval with the maximum value of total PCBs (ug/kg) detected where more than one sample was collected.
- PCBs were detected above the laboratory reporting limit at each sample location.

N

0 30 60

Feet

Figure 3-5
Wilshire Pond Sediment Sample Results (PCBs)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

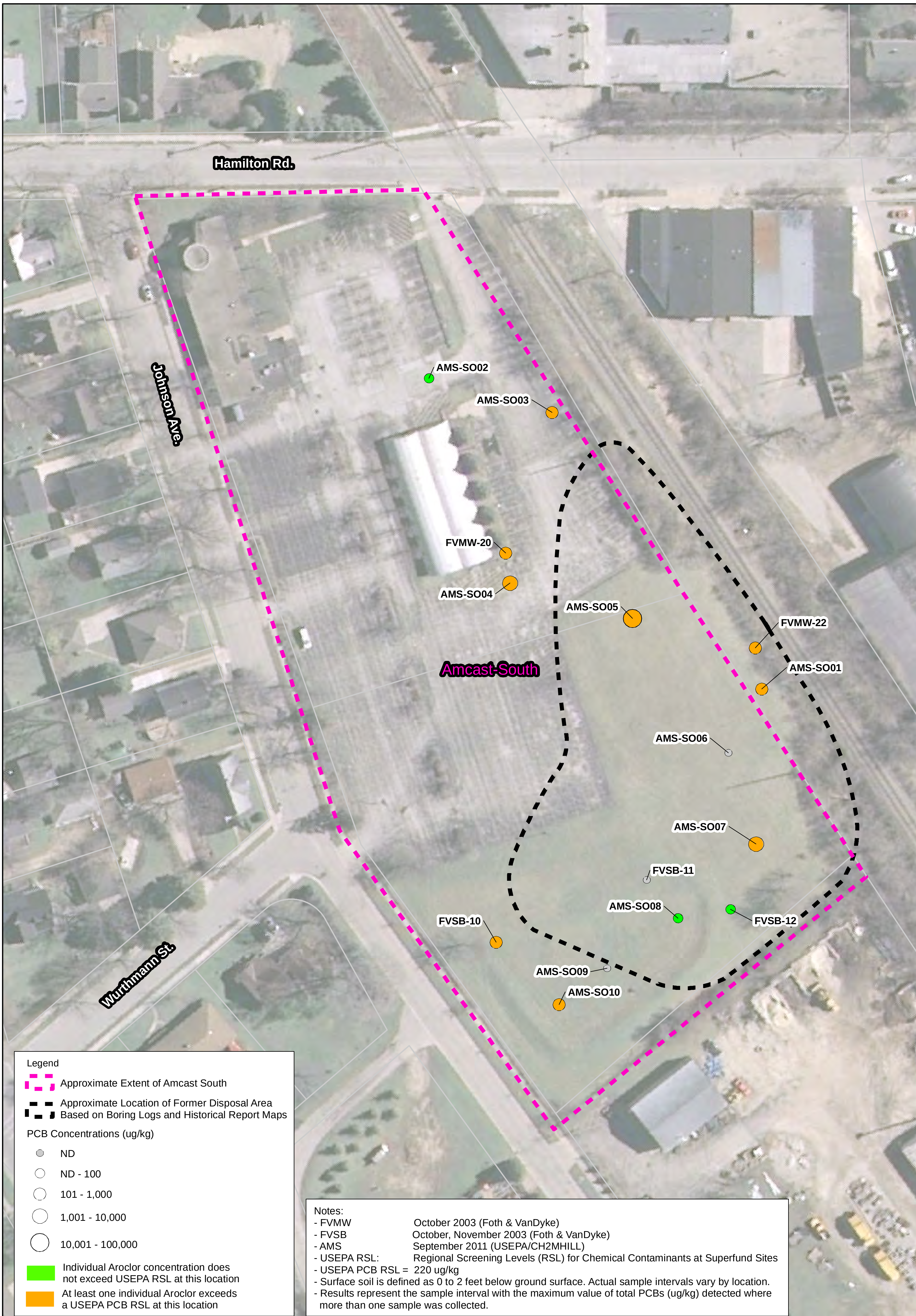
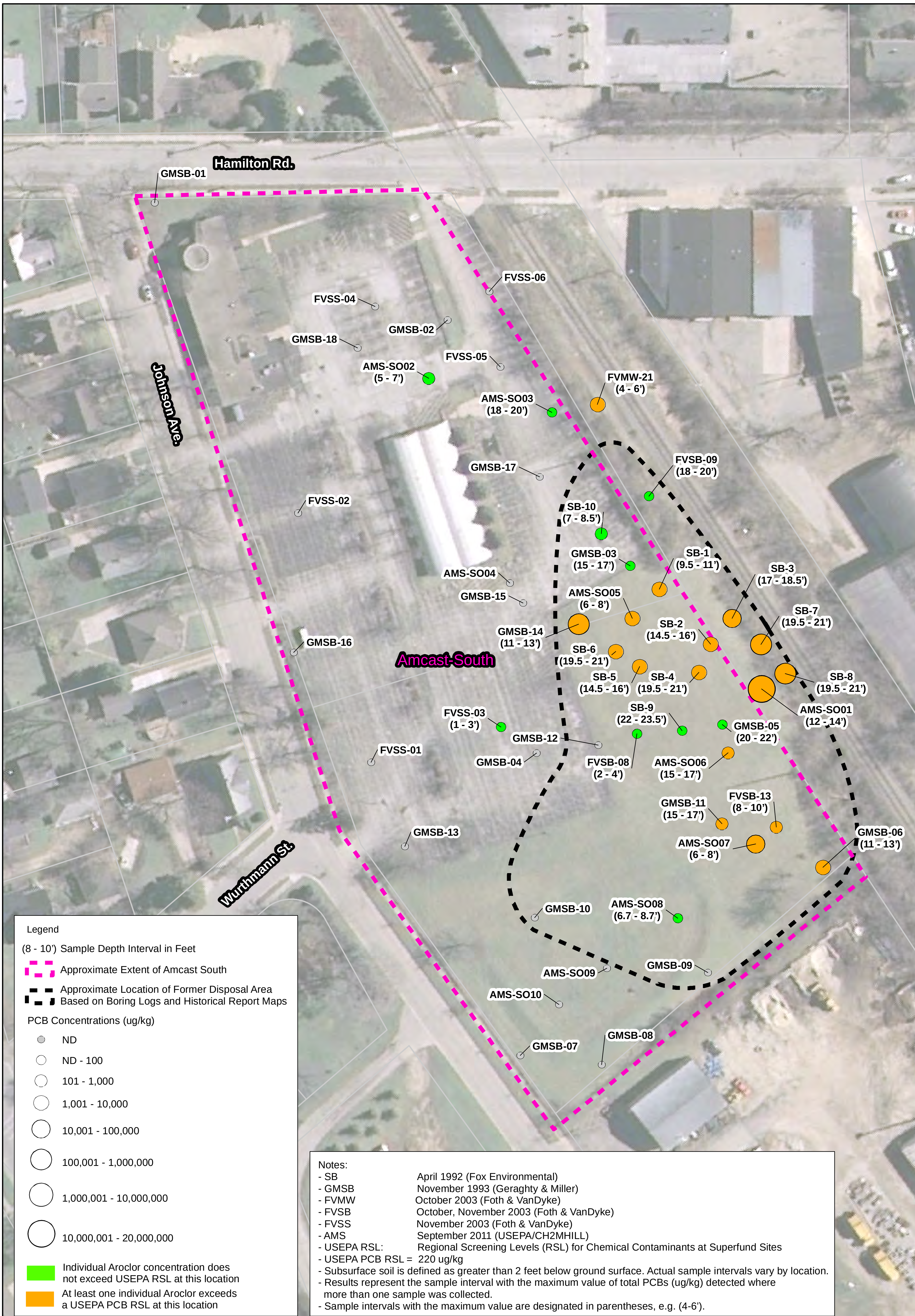


Figure 3-6
Amcast South - Surface Soil Sample Results (PCBs)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-06 - SURFACE SOIL PCB - AMCAST SOUTH.MXD JHANSEN1 4/3/2013 3:20:58 PM



Notes:
- SB April 1992 (Fox Environmental)
- GMSB November 1993 (Geraghty & Miller)
- FVMW October 2003 (Foth & VanDyke)
- FVSB October, November 2003 (Foth & VanDyke)
- FVSS November 2003 (Foth & VanDyke)
- AMS September 2011 (USEPA/CH2MHILL)
- USEPA RSL: Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites
- USEPA PCB RSL = 220 ug/kg
- Subsurface soil is defined as greater than 2 feet below ground surface. Actual sample intervals vary by location.
- Results represent the sample interval with the maximum value of total PCBs (ug/kg) detected where more than one sample was collected.
- Sample intervals with the maximum value are designated in parentheses, e.g. (4-6').

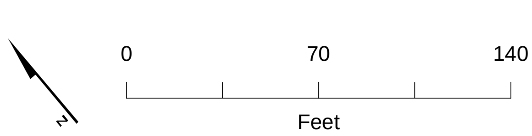


Figure 3-7
Amcast South - Subsurface Soil Sample Results (PCBs)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-07 - SUBSURFACE SOIL PCB - AMCAST SOUTH.MXD JHANSEN1 4/3/2013 3:22:30 PM

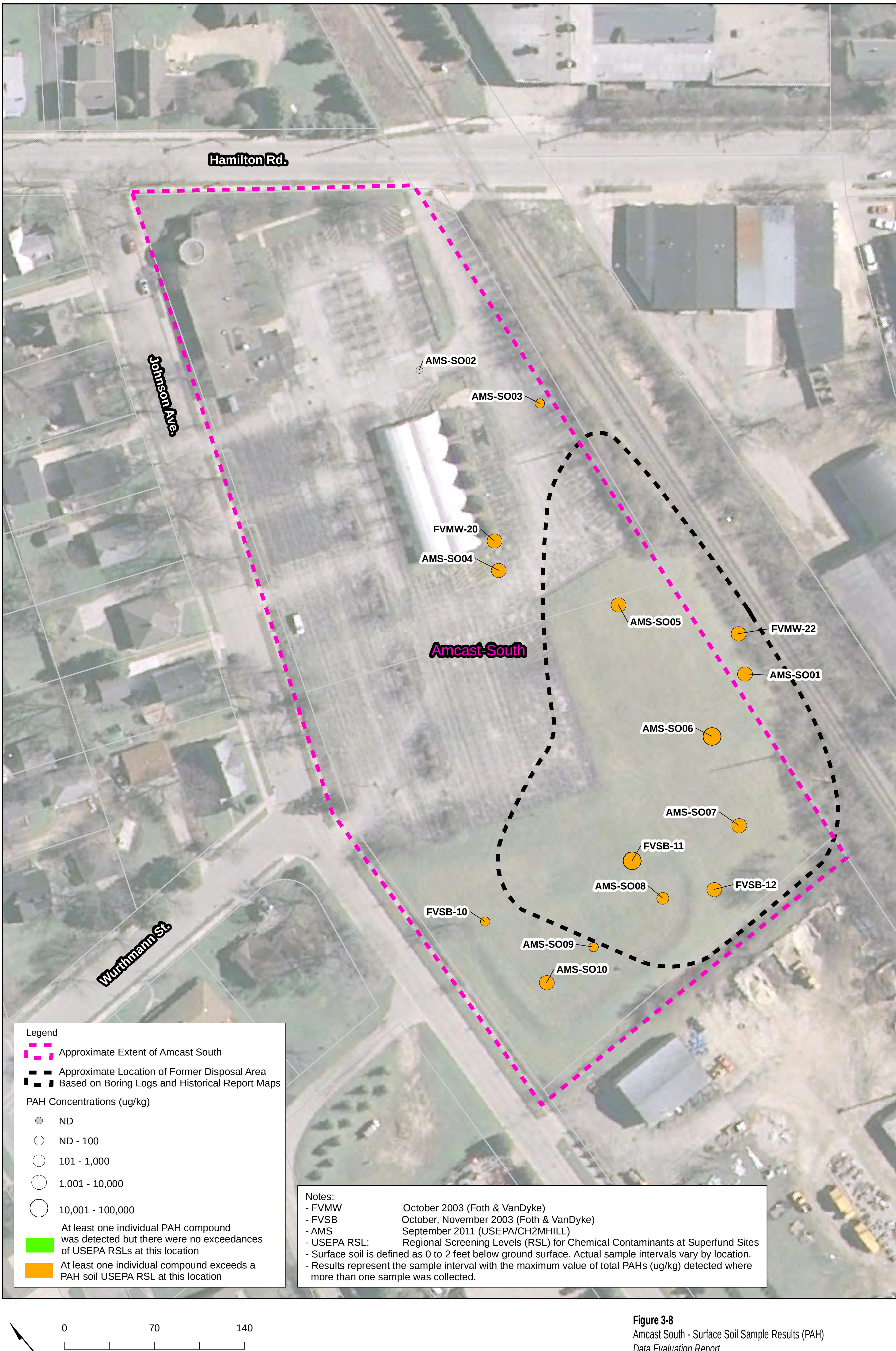


Figure 3-8
Amcast South - Surface Soil Sample Results (PAH)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

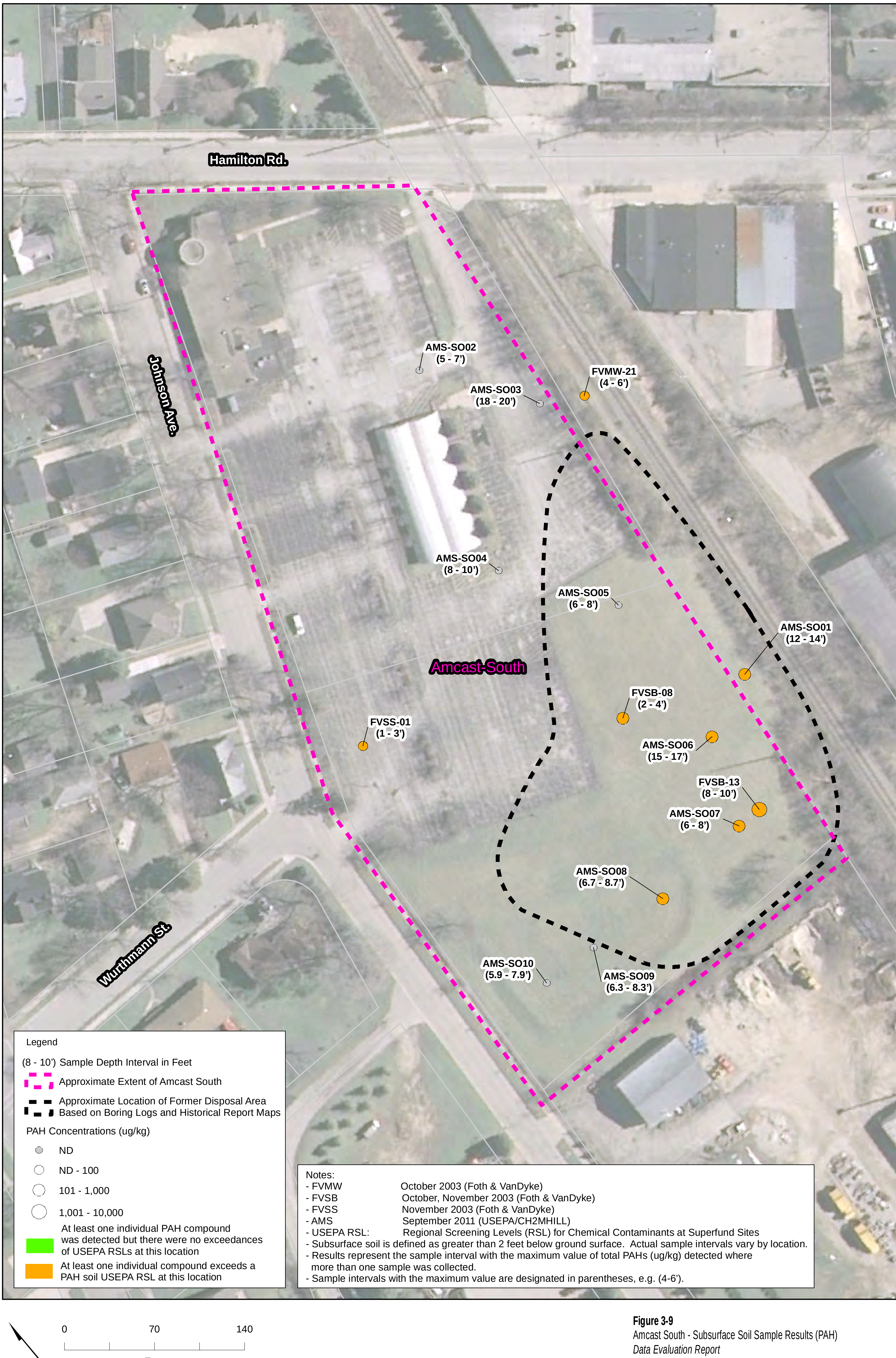
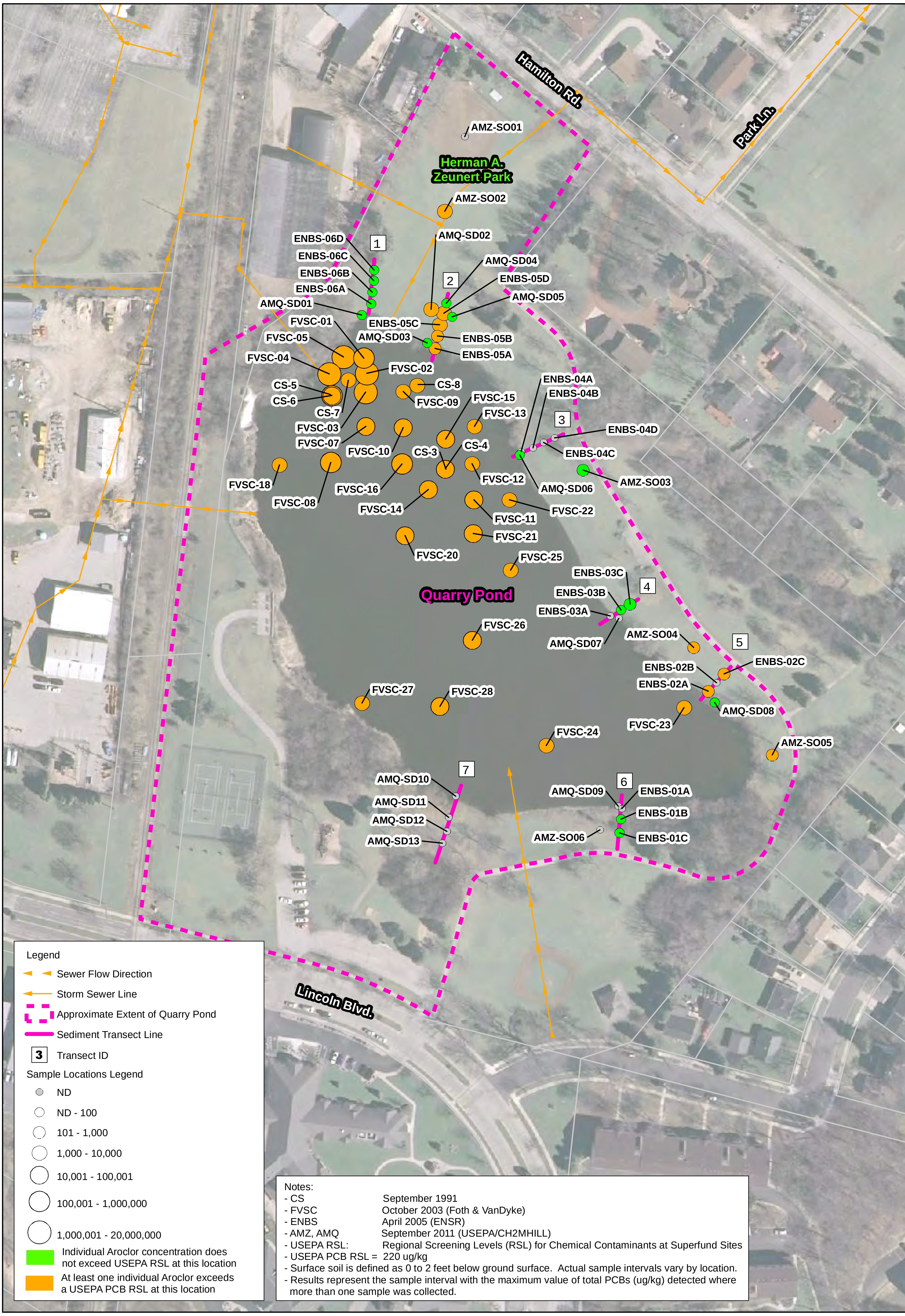


Figure 3-9
Amcast South - Subsurface Soil Sample Results (PAH)
Data Evaluation Report
Amcast Industrial Site Cedarburg, WI

CH2MHILL

\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-09 - SUBSURFACE SOIL PAH - AMCAST SOUTH.MXD JHANSEN1 4/3/2013 3:25:41 PM

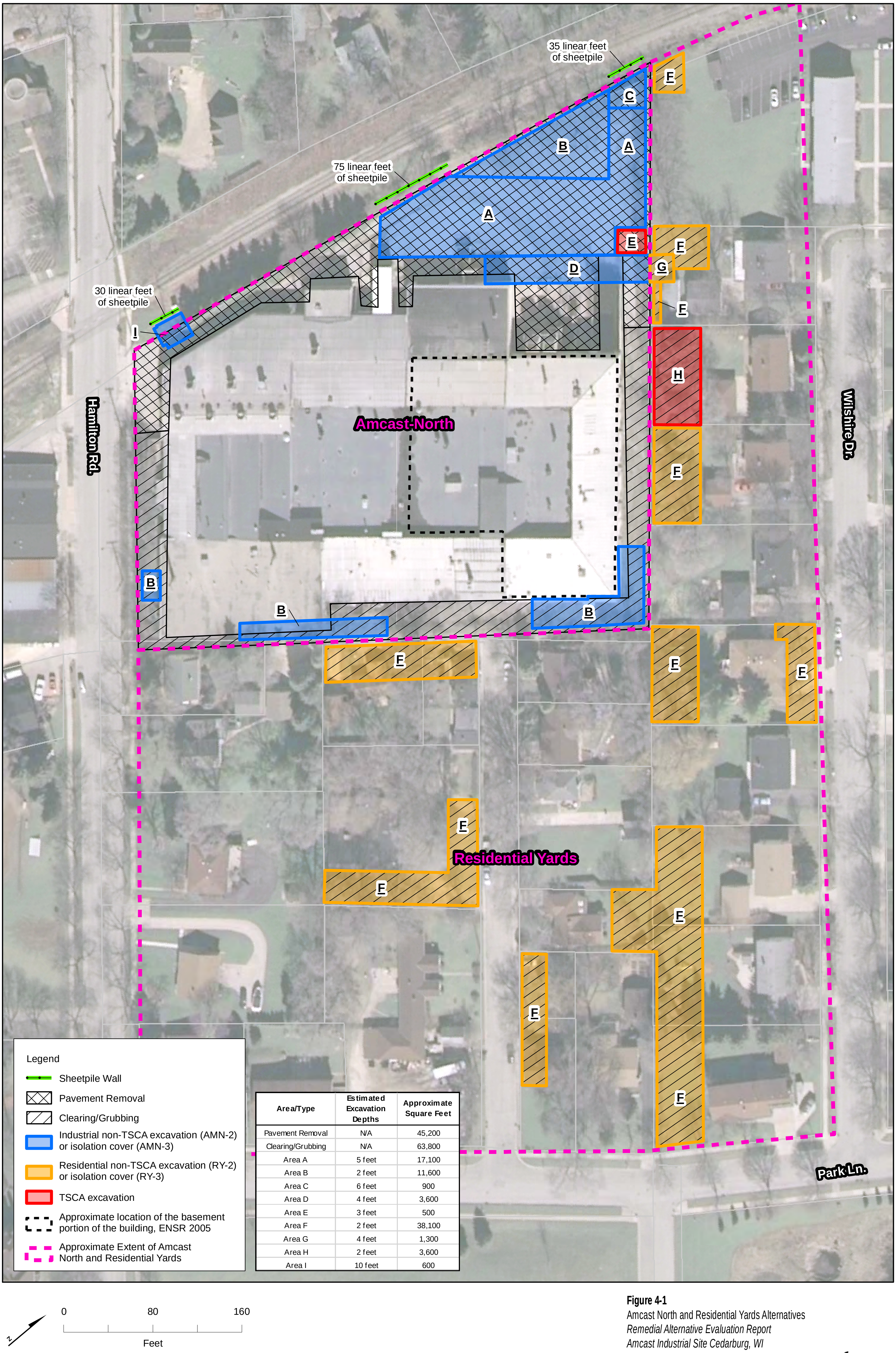


N
0 125 250
Feet

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

CH2MHILL

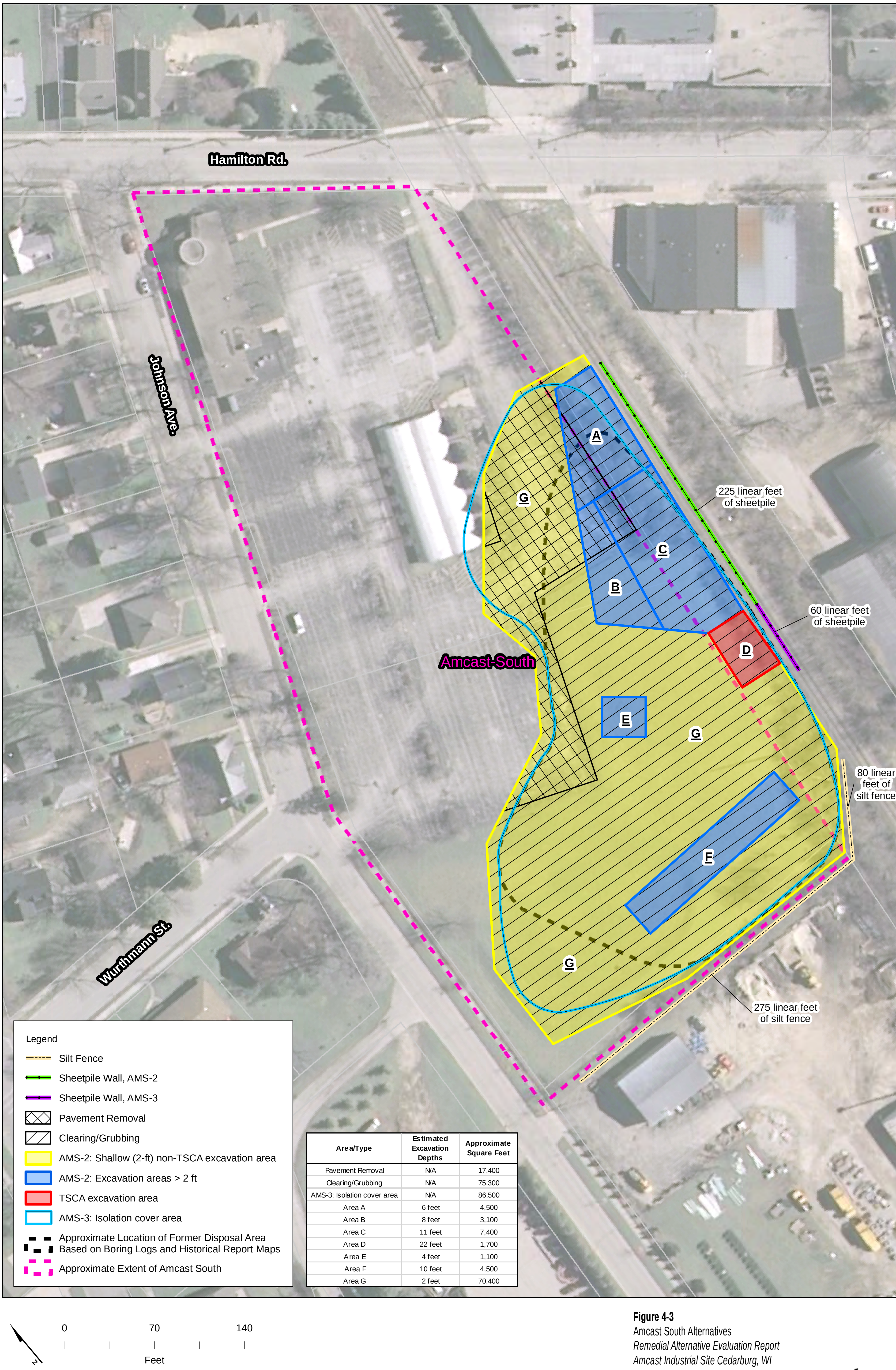
\\HERCULES\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\DATAEVALUATIONREPORT_FEBRUARY2013\FIGURE 03-10 - SURFACE SOIL AND SEDIMENT PCB - QUARRY POND.MXD JHANSEN1 4/3/2013 3:27:34 PM



Area/Type	Estimated Excavation Depths	Approximate Square Feet
Pavement Removal	N/A	45,200
Clearing/Grubbing	N/A	63,800
Area A	5 feet	17,100
Area B	2 feet	11,600
Area C	6 feet	900
Area D	4 feet	3,600
Area E	3 feet	500
Area F	2 feet	38,100
Area G	4 feet	1,300
Area H	2 feet	3,600
Area I	10 feet	600

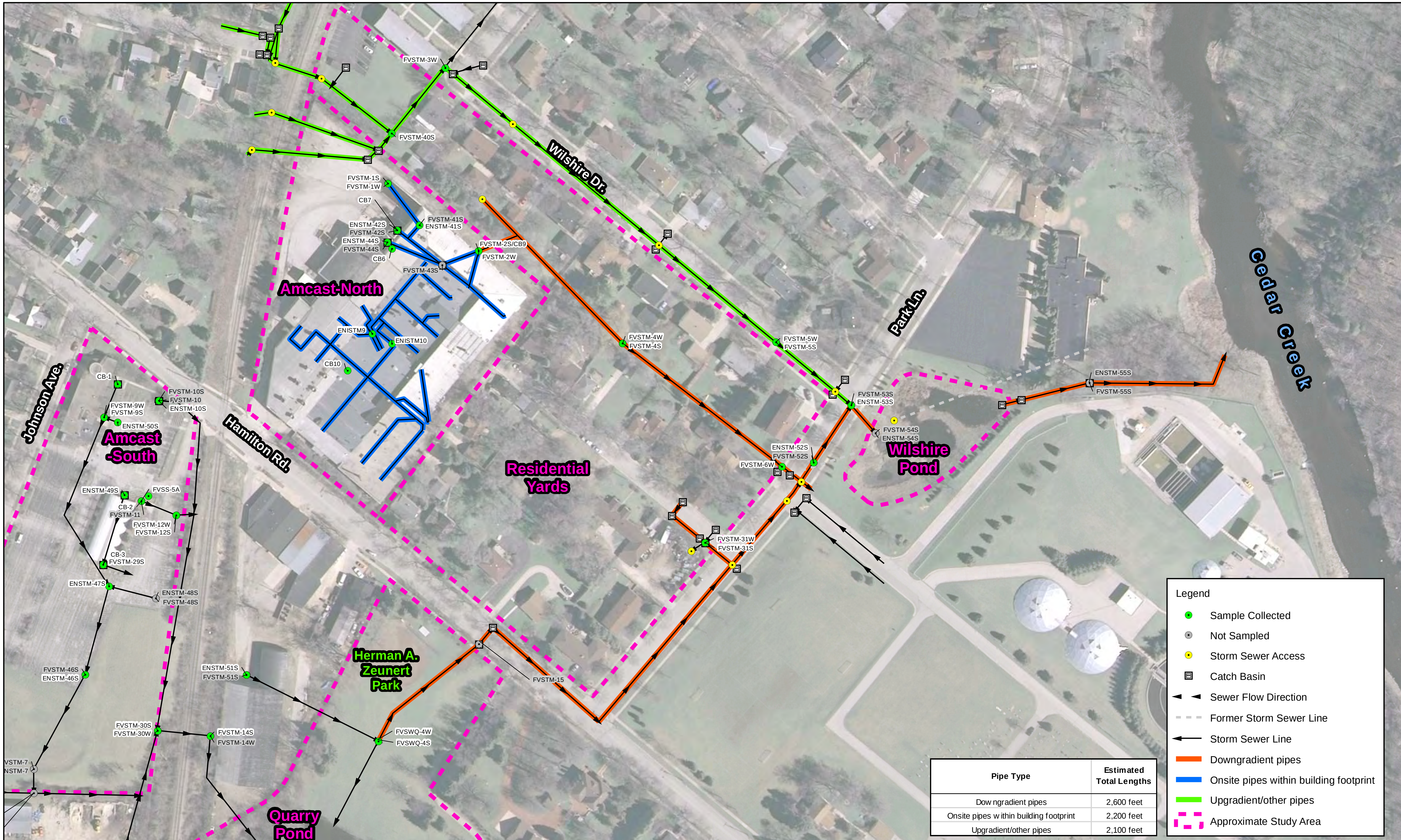
Figure 4-1
Amcast North and Residential Yards Alternatives
Remedial Alternative Evaluation Report
Amcast Industrial Site Cedarburg, WI

ch2m.



Area/Type	Estimated Excavation Depths	Approximate Square Feet
Pavement Removal	N/A	17,400
Clearing/Grubbing	N/A	75,300
AMS-3: Isolation cover area	N/A	86,500
Area A	6 feet	4,500
Area B	8 feet	3,100
Area C	11 feet	7,400
Area D	22 feet	1,700
Area E	4 feet	1,100
Area F	10 feet	4,500
Area G	2 feet	70,400

Figure 4-3
Amcast South Alternatives
Remedial Alternative Evaluation Report
Amcast Industrial Site Cedarburg, WI



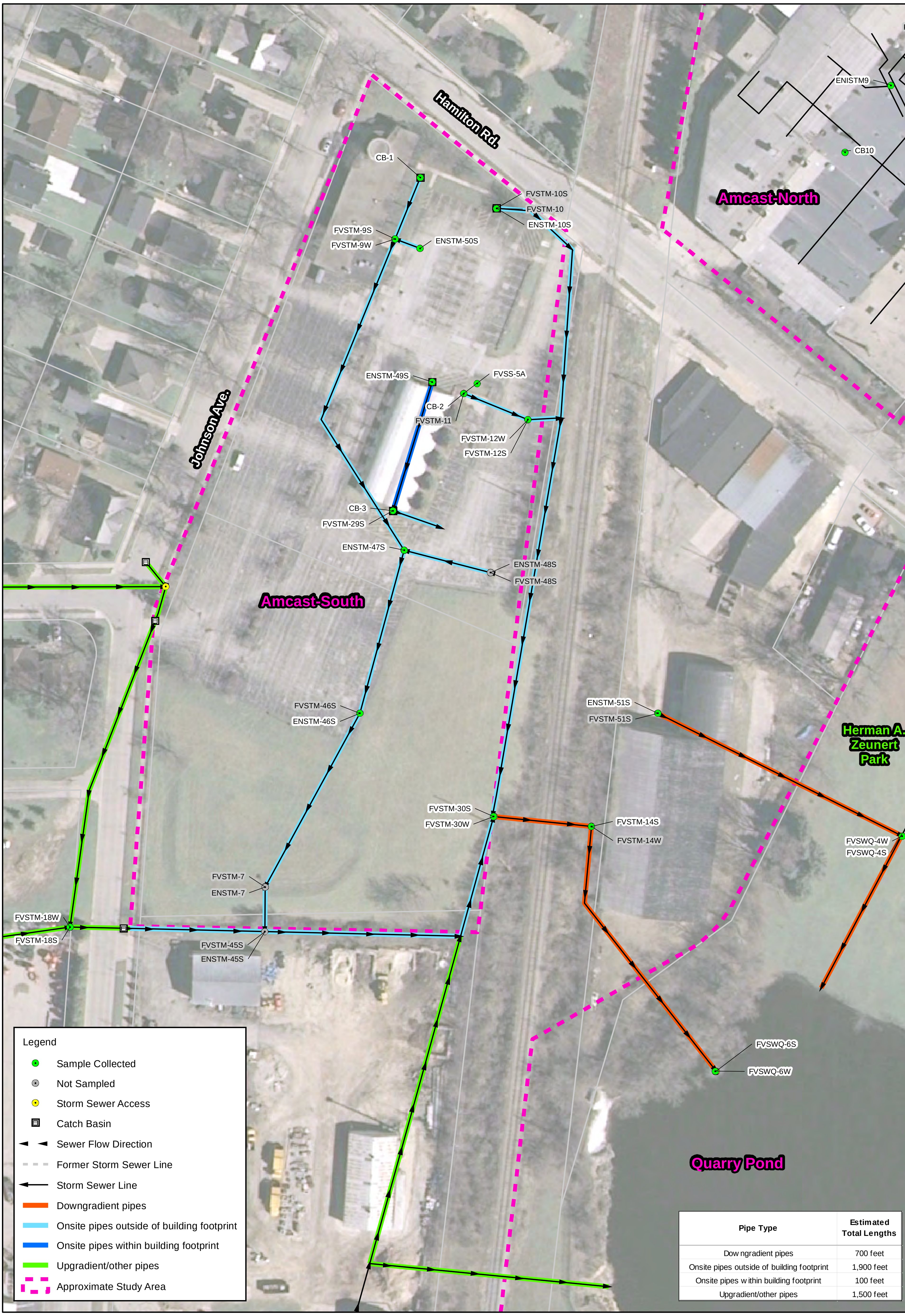
Pipe Type	Estimated Total Lengths
Downgradient pipes	2,600 feet
Onsite pipes within building footprint	2,200 feet
Upgradient/other pipes	2,100 feet

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 4-6
Amcast North Storm Sewer Alternatives
Remedial Alternative Evaluation Repor
Amcast Industrial Site Cedarburg, WI

ch2m

\\MKEFPP01\PROJ\USENVIRONMENTALPROTE\395072_AMCAST_RIFS\GIS\MAPFILES\2017\REMEDIAL_ALT_EVAL_REPORT_MARCH2017\FIGURE 04-06 - AMCAST NORTH STORM SEWER ALTS.MXD JHANSEN1 4/19/2017 2:36:11 PM



Pipe Type	Estimated Total Lengths
Downgradient pipes	700 feet
Onsite pipes outside of building footprint	1,900 feet
Onsite pipes within building footprint	100 feet
Upgradient/other pipes	1,500 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 4-7
Amcast south Storm Sewer Alternatives
Remedial Alternative Evaluation Report
Amcast Industrial Site Cedarburg, WI

APPENDIX B

Tables 1 – 5 Amcast North – Nov. 2018 and Historical Groundwater Analytical

Tables 1 – 5 Amcast Central/Amcast South – Nov. 2018 and Historical Groundwater Analytical

Tables – Referenced in Work Plan but not included. Refer to CH2M's *Final Remedial Investigation Report – May 2015*

3-1 Amcast North—Surface and Subsurface Soil—Metals Exceedances of USEPA RSL
3-2 Wilshire Pond Surface Water—Exceedances of NR 140 Enforcement Standards or USEPA Tapwater RSLs
3-3 Amcast South—Surface and Subsurface Soil—Metals Exceedances of USEPA RSL
3-4 Quarry Pond Surface Water—Exceedances of NR 140 Enforcement Standards or USEPA Tapwater RSLs
3-5 Historical Storm Sewer Sample Results—Detections of Total PCBs
3-6 Summary of Groundwater Concentrations Exceeding WDNR Enforcement Standards
3-7 Summary of PCB Concentrations Detected in Groundwater
3-8 Fish Tissue Analytical Results
4-1 Important Physical/Chemical and Environmental Fate Parameters
4-2 Chemical and Physical Properties of Some PCB Aroclors
4-3 Chemical and Physical Properties of Representative Chemicals
4-4 Conceptual Site Model - Potential Source Areas and Release/Transport Mechanisms
5-1 HHRA Chemicals of Potential Concern Based on Historical and Recent (2011) Analytical Data

Tables

Table 1

VOC - Groundwater Analytical Table

AMCAST NORTH- J16001

N39 W5789 Hamilton Road, Cedarburg WI

Monitoring Well ID	AMN-MW01		FVMW-26				FVMW-27				NR 140 Preventive Action Limit (PAL)	NR 140 Enforcement Standard (ES)
Sample Collection Date	09/23/11	11/19/18	12/02/03	04/10/07	09/21/11	11/19/18	12/03/03	04/10/07	09/21/11	11/19/18		
Volatile Organic Compounds (ug/L)												
1,1,1,2-Tetrachloroethane	-	<0.27	-	< 0.92	-	<0.27	-	<0.92	-	<0.27	*7*	**70**
1,1,1-Trichloroethane	0.5 U	<0.24	-	< 0.90	0.5 U	<0.24	-	<0.90	0.5 U	<0.24	*40*	**200**
1,1,2,2-Tetrachloroethane	0.5 U	<0.28	-	< 0.20	0.5 U	<0.28	-	<0.20	0.5 U	<0.28	*0.02*	**0.2**
1,1,2-Trichloroethane	0.5 U	<0.55	-	< 0.42	0.5 U	<0.55	-	<0.42	0.5 U	<0.55	*0.5*	**5**
1,1-Dichloroethane	0.5 U	<0.27	-	< 0.75	0.5 U	<0.27	-	<0.75	0.5 U	<0.27	*85*	**850**
1,1-Dichloroethene	0.5 U	<0.24	-	< 0.57	0.5 U	<0.24	-	<0.57	0.5 U	<0.24	*0.7*	**7**
1,1-Dichloropropene	-	<0.54	-	< 0.75	-	<0.54	-	<0.75	-	<0.54	NS	NS
1,2,3-Trichlorobenzene	0.5 U	<0.63	-	< 0.74	0.5 U	<0.63	-	<0.74	0.5 U	<0.63	NS	NS
1,2,3-Trichloropropane	-	<0.59	-	< 0.99	-	<0.59	-	<0.99	-	<0.59	*12*	**60**
1,2,4-Trichlorobenzene	0.5 U	<0.95	-	< 0.97	0.5 U	<0.95	-	<0.97	0.5 U	<0.95	*14*	**70**
1,2,4-Trimethylbenzene	-	<0.84	-	< 0.97	-	<0.84	-	<0.97	-	<0.84	*96*	**480**
1,2-Dibromo-3-chloropropane	-	<1.8	-	< 0.87	-	<1.8	-	<0.87	-	<1.8	*0.02*	**0.2**
1,2-Dibromoethane (EDB)	0.5 U	<0.83	-	< 0.56	0.5 U	<0.83	-	<0.56	0.5 U	<0.83	*0.005*	**0.05**
1,2-Dichlorobenzene	-	<0.71	-	< 0.83	-	<0.71	-	<0.83	-	<0.71	*60*	**600**
1,2-Dichloroethane	0.11 J	<0.28	-	< 0.36	0.5 U	<0.28	-	<0.36	0.5 U	<0.28	*0.5*	**5**
1,2-Dichloropropane	0.55	<0.28	-	< 0.46	0.5 U	<0.28	-	<0.46	0.5 U	<0.28	*0.5*	**5**
1,3,5-Trimethylbenzene	-	<0.87	-	< 0.83	-	<0.87	-	<0.83	-	<0.87	*96*	**480**
1,3-Dichlorobenzene	-	<0.63	-	< 0.87	-	<0.63	-	<0.87	-	<0.63	*120*	**600**
1,3-Dichloropropane	-	<0.83	-	< 0.61	-	<0.83	-	<0.61	-	<0.83	NS	NS
1,4-Dichlorobenzene	-	<0.94	-	< 0.95	-	<0.94	-	<0.95	-	<0.94	*15*	**75**
2,2-Dichloropropane	-	<2.3	-	< 0.62	-	<2.3	-	<0.62	-	<2.3	NS	NS
2-Chlorotoluene	-	<0.93	-	< 0.85	-	<0.93	-	<0.85	-	<0.93	NS	NS
4-Chlorotoluene	-	<0.76	-	< 0.74	-	<0.76	-	<0.74	-	<0.76	NS	NS
Benzene	0.5 U	<0.25	-	< 0.41	0.5 U	<0.25	-	<0.41	0.5 U	<0.25	*0.5*	**5**
Bromobenzene	-	<0.24	-	< 0.82	-	<0.24	-	<0.82	-	<0.24	NS	NS
Bromochloromethane	0.5 U	<0.36	-	< 0.97	0.5 U	<0.36	-	<0.97	0.5 U	<0.36	NS	NS
Bromodichloromethane	0.5 U	<0.36	-	< 0.56	0.5 U	<0.36	-	<0.56	0.5 U	<0.36	*0.06*	**0.6**
Bromoform	0.5 U	<4.0	-	< 0.94	0.5 U	<4.0	-	<0.94	0.5 U	<4.0	*0.44*	**4.4**
Bromomethane	0.5 U	<0.97	-	< 0.91	0.5 U	<0.97	-	<0.91	0.5 U	<0.97	*1*	**10**
Carbon tetrachloride	0.5 U	<0.17	-	< 0.49	0.5 U	<0.17	-	<0.49	0.5 U	<0.17	*0.5*	**5**
Chlorobenzene	0.5 U	<0.71	-	< 0.41	0.5 U	<0.71	-	<0.41	0.5 U	<0.71	*20*	**100**
Chloroethane	0.5 U	<1.3	-	<0.97	0.5 U	<1.3	-	<0.97	0.5 U	<1.3	*80*	**400**
Chloroform	0.5 U	<1.3	-	<0.37	0.5 U	<1.3	-	<0.37	0.5 U	<1.3	*0.6*	**6**
Chloromethane	0.5 U	<2.2	-	<0.24	0.5 U	<2.2	-	<0.24	0.5 U	<2.2	*3*	**30**
Dibromochloromethane	0.5 U	<2.6	-	<0.97	0.5 U	<2.6	-	<0.97	0.5 U	<2.6	*6*	**60**
Dibromomethane	-	<0.94	-	<0.60	-	<0.94	-	<0.60	-	<0.94	NS	NS
Dichlorodifluoromethane	0.5 U	<0.50	-	<0.99	0.5 U	<0.50	-	<0.99	0.5 U	<0.50	*200*	**1,000**
Diisopropyl ether	-	<1.9	-	<0.76	-	<1.9	-	<0.76	-	<1.9	NS	NS
Ethylbenzene	0.5 U	<0.22	0.98	<0.54	0.5 U	<0.22	0.67	<0.54	0.5 U	<0.22	*140*	**700**
Hexachloro-1,3-butadiene	5 U	<1.2	-	<0.67	5 U	<1.2	-	<0.67	5 U	<1.2	NS	NS
Isopropylbenzene (Cumene)	0.5 U	<0.39	-	<0.59	0.5 U	<0.39	-	<0.59	0.5 U	<0.39	NS	NS
Methyl-tert-butyl ether	0.5 U	<1.2	-	<0.61	0.5 U	<1.2	-	<0.61	0.5 U	<1.2	*12*	**60**
Methylene Chloride	0.5 U	<0.58	-	<0.43	0.5 U	<0.58	-	<0.43	0.5 U	<0.58	*0.5*	**5**
Naphthalene	-	<1.2	-	<0.74	-	<1.2	-	<0.74	-	<1.2	*10*	**100**
Styrene	0.5 U	<0.47	-	<0.86	0.5 U	<0.47	-	<0.86	0.5 U	<0.47	*10*	**100**
Tetrachloroethene	0.5 U	<0.33	-	<0.45	0.5 U	<0.33	-	<0.45	0.5 U	<0.33	*0.5*	**5**
Toluene	0.5 U	0.32 J	-	<0.67	0.5 U	<0.17	-	<0.67	0.5 U	<0.17	*160*	**800**
Trichloroethene	0.5 U	*2.1*	-	<0.48	0.5 U	<0.26	-	<0.48	0.5 U	<0.26	*0.5*	**5**
Trichlorofluoromethane	0.5 U	<0.21	-	<0.79	0.5 U	<0.21	-	<0.79	0.5 U	<0.21	*698*	**3,490**
Vinyl chloride	0.5 U	<0.17	-	<0.18	0.5 U	<0.17	-	<0.18	0.5 U	<0.17	*0.02*	**0.2**
cis-1,2-Dichloroethene	0.5 U	<0.27	-	<0.83	0.5 U	<0.27	-	<0.83	0.5 U	<0.27	*7*	**70**
cis-1,3-Dichloropropene	0.5 U	<3.6	-	<0.19	0.5 U	<3.6	-	<0.19	0.5 U	<3.6	*0.04*	**0.4**
Total Xylenes	1 U	<0.73	6	<2.63	1 U	<0.73	3.43	<2.63	1 U	<0.73	*400*	**2,000**
n-Butylbenzene	-	<0.71	-	-	-	<0.71	-			<0.71	NS	NS
n-Propylbenzene	-	<0.81	-	-	-	<0.81	-			<0.81	NS	NS
p-Isopropyltoluene	-	<0.80	-	<0.67	-	<0.80	-	<0.67	-	<0.80	NS	NS
sec-Butylbenzene	-	<0.85	-	<0.89	-	<0.85	-	<0.89	-	<0.85	NS	NS
tert-Butylbenzene	-	<0.30	-	<0.97	-	<0.30	-	<0.97	-	<0.30	NS	NS
trans-1,2-Dichloroethene	0.5 U	<1.1	-	<0.89	0.5 U	<1.1	-	<0.89	0.5 U	<1.1	*20*	**100**
2-Butanone	0.2 J	-	-	-	5 U	-	-	-	5 U	-	NS	NS
2-Hexanone	2.4 J	-	-	-	5 U	-	-	-	5 U	-	NS	NS
4-Methyl-2-Pentanone	5 U	-	-	-	5 U	-	-	-	5 U	-	NS	NS
Acetone	10 U	-	-	-	5 U	-	-	-	5 U	-	NS	NS
Carbon Disulfide	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
Chlorinated Fluorocarbon	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
Cyclohexane	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
Methyl Acetate	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
Methylcylohexane	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
trans-1,3-Dichloropropene	*0.13 J*	<4.4	-	<0.19	0.5 U	<4.4	-	<0.19	0.5 U	<4.4	*0.04*	**0.4**

Note:

ug/L - micrograms per liter (equivalent to parts per billion)

VOCs - Volatile Organic Compounds

ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140

PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140

Bold - concentration exceeds NR 140 ES

Italics - concentration exceeds NR 140 PAL

FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit

(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

NS - no established standard

< less than the specified detection limit

- sample either not analyzed for specific parameter or not reported for specific parameter

Table 2
PAH - Groundwater Analytical Table
AMCAST NORTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	AMN-MW01		FVMW-26			FVMW-27				NR 140 Preventive Action Limit (PAL)	NR 140 Enforcement Standard (ES)
Sample Collection Date	09/23/11	11/19/18	12/02/03	09/21/11	11/19/18	12/03/03	01/12/04	09/21/2011	11/19/18		
Polycyclic Aromatic Hydrocarbons (PAHs)											
1,2,4-Trichlorobenzene	0.5 U	<1.9	-	0.5 U	<1.9	-	-	0.5 U	<1.9	*14*	**70**
1,2-Dichlorobenzene	0.5 U	<1.8	-	0.5 U	<1.8	-	-	0.5 U	<1.8	*60*	**600**
1,3-Dichlorobenzene	0.5 U	<1.8	-	0.5 U	<1.8	-	-	0.5 U	<1.8	*120*	**600**
1,4-Dichlorobenzene	0.5 U	<1.8	-	0.5 U	<1.8	-	-	0.5 U	<1.8	*15*	**75**
2,2'-Oxybis(1-chloropropane)	5 U	<1.5	-	5 U	<1.5	-	-	5 U	<1.4	NS	NS
2,4,5-Trichlorophenol	5 U	<0.80	-	5 U	<0.80	-	-	5 U	<0.79	NS	NS
2,4,6-Trichlorophenol	5 U	<2.0	-	5 U	<2.0	-	-	5 U	<2.0	NS	NS
2,4-Dichlorophenol	5 U	<1.3	-	5 U	<1.3	-	-	5 U	<1.3	NS	NS
2,4-Dimethylphenol	5 U	<1.2	-	5 U	<1.2	-	-	5 U	<1.2	NS	NS
2,4-Dinitrophenol	10 U	<0.68	-	10 U	<0.68	-	-	10 U	<0.67	NS	NS
2,4-Dinitrotoluene	5 U	<0.75	-	5 U	<0.75	-	-	5 U	<0.75	*0.005*	**0.05**
2,6-Dinitrotoluene	5 U	<0.57	-	5 U	<0.57	-	-	5 U	<0.57	*0.005*	**0.05**
2-Chloronaphthalene	5 U	<1.6	-	5 U	<1.6	-	-	5 U	<1.6	NS	NS
2-Chlorophenol	5 U	<1.1	-	5 U	<1.1	-	-	5 U	<1.1	NS	NS
2-Methylnaphthalene	0.1 U	<1.4	-	0.1 U	<1.4	-	-	0.1 U	<1.4	NS	NS
2-Methylphenol(o-Cresol)	5 U	<0.83	-	5 U	<0.83	-	-	5 U	<0.82	NS	NS
2-Nitroaniline	10 U	<0.74	-	10 U	<0.74	-	-	10 U	<0.73	NS	NS
2-Nitrophenol	5 U	<1.1	-	5 U	<1.1	-	-	5 U	<1.1	NS	NS
3&4-Methylphenol(m&p Cresol)	5 U	<1.5	-	5 U	<1.5	-	-	5 U	<1.5	NS	NS
3,3'-Dichlorobenzidine	5 U	<0.86	-	5 U	<0.86	-	-	5 U	<0.85	NS	NS
3-Nitroaniline	10 U	<0.92	-	10 U	<0.92	-	-	10 U	<0.91	NS	NS
4,6-Dinitro-2-methylphenol	10 U	<0.62	-	10 U	<0.62	-	-	10 U	<0.62	NS	NS
4-Bromophenylphenyl ether	5 U	<1.9	-	5 U	<1.9	-	-	5 U	<1.9	NS	NS
4-Chloro-3-methylphenol	5 U	<1.6	-	5 U	<1.6	-	-	5 U	<1.6	NS	NS
4-Chloroaniline	5 U	<1.0	-	5 U	<1.0	-	-	5 U	<1.0	NS	NS
4-Chlorophenylphenyl ether	5 U	<0.78	-	5 U	<0.78	-	-	5 U	<0.77	NS	NS
4-Nitroaniline	10 U	<1.7	-	10 U	<1.7	-	-	10 U	<1.7	NS	NS
4-Nitrophenol	10 U	<1.0	-	10 U	<1.0	-	-	10 U	<0.99	NS	NS
Acenaphthene	0.1 U	<1.3	-	0.1 U	<1.3	-	-	0.1 U	<1.3	NS	NS
Acenaphthylene	0.1 U	<1.0	-	0.1 U	<1.0	-	-	0.1 U	<1.0	NS	NS
Anthracene	0.1 U	<1.7	-	0.1 U	<1.7	-	-	0.1 U	<1.7	*600*	**3,000**
Benzo(a)anthracene	0.1 U	<0.51	-	0.1 U	<0.51	-	-	0.1 U	<0.50	NS	NS
Benzo(a)pyrene	0.1 U	<1.8	-	0.1 U	<1.8	-	-	0.1 U	<1.8	*0.02*	**0.2**
Benzo(b)fluoranthene	0.1 U	<0.62	-	0.1 U	<0.62	-	-	0.1 U	<0.62	*0.02*	**0.2**
Benzo(g,h,i)perylene	0.1 U	<0.77	-	0.1 U	<0.77	-	-	0.1 U	<0.76	NS	NS
Benzo(k)fluoranthene	0.1 U	<0.95	-	0.1 U	<0.95	-	-	0.1 U	<0.95	NS	NS
Butylbenzylphthalate	5 U	<0.74	-	5 U	<0.74	-	-	5 U	<0.73	NS	NS
Carbazole	5 U	<0.71	-	5 U	<0.71	-	-	5 U	<0.71	NS	NS
Chrysene	0.1 U	<1.7	-	0.1 U	<1.7	-	-	0.1 U	<1.6	*0.02*	**0.2**
Di-n-butylphthalate	0.24 J	<2.4	-	5 U	<2.4	-	-	0.18 J	<2.4	NS	NS
Di-n-octylphthalate	5 U	<1.8	-	5 U	<1.8	-	-	5 U	<1.8	NS	NS
Dibenz(a,h)anthracene	0.1 U	<1.3	-	0.1 U	<1.3	-	-	0.1 U	<1.2	NS	NS
Dibenzofuran	5 U	<0.73	-	5 U	<0.73	-	-	5 U	<0.72	NS	NS
Diethylphthalate	5 U	<1.0	-	5 U	<1.0	-	-	5 U	<1.0	NS	NS
Dimethylphthalate	5 U	<1.8	-	5 U	<1.8	-	-	5 U	<1.8	NS	NS
Fluoranthene	0.1 U	<0.54	-	0.1 U	<0.54	-	-	0.1 U	<0.53	*80*	**400**
Fluorene	0.1 U	<0.71	-	0.1 U	<0.71	-	-	0.1 U	<0.71	*80*	**400**
Hexachloro-1,3-butadiene	5 U	<2.3	-	5 U	<2.3	-	-	5 U	<2.3	NS	NS
Hexachlorobenzene	5 U	<1.6	-	5 U	<1.6	-	-	5 U	<1.6	*0.1*	**1**
Hexachlorocyclopentadiene	5 U	<0.65	-	5 U	<0.65	-	-	5 U	<0.64	NS	NS
Hexachloroethane	5 U	<2.5	-	5 U	<2.5	-	-	5 U	<2.5	NS	NS
Indeno(1,2,3-cd)pyrene	0.1 U	<1.4	-	0.1 U	<1.4	-	-	0.1 U	<1.4	NS	NS
Isophorone	5U	<0.70	-	5 U	<0.70	-	-	5 U	<0.69	NS	NS
N-Nitroso-di-n-propylamine	5 U	<0.92	-	5 U	<0.92	-	-	5 U	<0.92	NS	NS
N-Nitrosodiphenylamine	5 U	<3.4	-	5 U	<3.4	-	-	5 U	<3.3	*0.7*	**7**
Naphthalene	0.1 U	<1.8	-	0.1 U	<1.8	-	-	0.1 U	<1.8	*10*	**100**
Nitrobenzene	5 U	<1.4	-	5 U	<1.4	-	-	5 U	<1.4	NS	NS
Pentachlorophenol	0.2 R	<1.4	-	0.08 J	<1.4	-	-	0.01 J	<1.4	*0.1*	**1**
Phenanthrene	0.1 U	<1.7	-	0.1 U	<1.7	-	-	0.1 U	<1.7	NS	NS
Phenol	5 U	<0.57	-	5 U	<0.57	-	-	5 U	<0.57	*400*	**2,000**
Pyrene	0.1 U	<1.3	-	0.1 U	<1.3	-	-	0.1 U	<1.3	*50*	**250**
bis(2-Chloroethoxy)methane	5 U	<0.95	-	5 U	<0.95	-	-	5 U	<0.94	NS	NS
bis(2-Chloroethyl) ether	5 U	<1.5	-	5 U	<1.5	-	-	5 U	<1.5	NS	NS
n-Propylbenzene	-	-	-	-	-	-	-	-	-	NS	NS
Acetophenone	5 U	-	-	5 U	-	-	-	5 U	-	NS	NS
Benzaidehyde	5 U	-	-	5 U	-	-	-	5 U	-	NS	NS
Caprolactam	5 U	-	-	5 U	-	-	-	5 U	-	NS	NS
Chlorophenpls	5 U	-	-	5 U	-	-	-	5 U	-	NS	NS
1,1 Biphenyl	5 U	-	-	5 U	-	-	-	5 U	-	NS	NS
1,2,4,5 tetrachlorobenzene	5 U	-	-	5 U	-	-	-	5 U	-	NS	NS
bis(2-Ethylhexyl)phthalate	25 U	<0.66	**7.3**	25 U	*1.4 J*	**260**	**120**	25 U	*1.3 J*	*0.6*	**6**

Note:

ug/L - micrograms per liter (equivalent to parts per billion)

PAHs - Polycyclic Aromatic Hydrocarbons

ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140

PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140

Bold - concentration exceeds NR 140 ES

Italics - concentration exceeds NR 140 PAL

FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit

(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

(R) - The data are unusable (the compound may or may not be present)

NS - no established standard

< less than the specified detection limit

\- sample either not analyzed for specific parameter or not reported for specific parameter

Table 3

RCRA Metals - Groundwater Analytical Table

AMCAST NORTH- J16001

N39 W5789 Hamilton Road, Cedarburg WI

Well ID	ANMW-01	FVMW-26	FVMW-27	**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	11/19/18	11/19/18	11/19/18		
Total Metals (ug/L)					
Arsenic, Total	*14.9 J*	<8.3	<8.3	*1*	**10**
Barium, Total	358	130	116	*400*	**2,000**
Cadmium, Total	*1.8 J*	<1.3	<1.3	*0.5*	**5**
Chromium, Total	**471**	<2.5	<2.5	*10*	**100**
Lead, Total	**35.5**	<5.9	<5.9	*1.5*	**15**
Mercury, Total	<0.084	<0.084	<0.084	*0.2*	**2**
Selenium, Total	<12.2	<12.2	<12.2	*10*	**50**
Silver, Total	<3.3	<3.3	<3.3	*10*	**50**

Well ID	ANMW-01	FVMW-26	FVMW-27	**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	11/19/18	11/19/18	11/19/18		
Dissolved Metals (ug/L)					
Arsenic, Dissolved	<8.3	<8.3	<8.3	*1*	**10**
Barium, Dissolved	83.1	94.9	112	*400*	**2,000**
Cadmium, Dissolved	<1.3	<1.3	<1.3	*0.5*	**5**
Chromium, Dissolved	**385**	<2.5	<2.5	*10*	**100**
Lead, Dissolved	<5.9	<5.9	<5.9	*1.5*	**15**
Selenium, Dissolved	<12.2	<12.2	<12.2	*10*	**50**
Silver, Dissolved	<3.3	<3.3	<3.3	*10*	**50**
Mercury, Dissolved	0.098 J	<0.084	<0.084	*0.2*	**2**

Note:

ug/L - micrograms per liter (equivalent to parts per billion)

ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140

PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140

Bold - concentration exceeds NR 140 ES

Italics - concentration exceeds NR 140 PAL

< less than the specified detection limit

FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

Table 3.b

Metals - Groundwater Analytical Table

AMCAST NORTH- J16001

N39 W5789 Hamilton Road, Cedarburg WI

Well ID	ANMW-01	FVMW-26			FVMW-27					**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	09/23/11	12/02/03	01/13/04	09/21/11	12/03/03	12/05/03	01/12/04	01/13/04	09/21/11		
UNKNOWN IF RESULTS ARE DISSOLVED OR TOTAL (ug/L)											
Aluminium	20 U	-	-	20 U	-	-	-	-	20 U	*40*	**200**
Antimony	2 U	-	-	2 U	-	-	-	-	2 U	*1.2*	**6**
Arsenic	*0.49 J*	*5.7*	-	*9.9*	*5.4*	-	*8.4*	-	**10**	*1*	**10**
Barium	140	-	-	75.3	-	-	-	-	127	*400*	**2,000**
Beryllium	1 U	-	-	1 U	-	-	-	-	1 U	*0.4*	**4**
Cadmium	1 U	*0.6*	-	1 U	*0.77*	-	-	-	1 U	*0.5*	**5**
Calcium	79,400	-	-	121,000	-	-	-	-	113,000	NS	NS
Chromium	**372**	*36*	9.9	1.8 J	*20*	1.4 (D)	*39*	1.6(D)	2.5	*10*	**100**
Cobalt	1.8	-	-	1 U	-	-	-	-	1 J	*8*	**40**
Copper	4.9 U	-	-	1.5 J	-	-	-	-	2.8	*130*	**1,300**
Iron	200 UJ	-	-	1,500	-	-	-	-	200 UJ	NS	NS
Lead, Total/Dissolved	1 U	**18**	*6.4/2.3(D)*	1 U	*12/2.3(D)*	-	**17**	-	1 U	*1.5*	**15**
Magnesium	107,000	-	-	58,900	-	-	-	-	59,400	NS	NS
Manganese	*77.7*	-	-	28.1 J	-	-	-	-	*73 J*	*60*	**300**
Mercury	0.2 U	-	-	0.2 U	-	-	-	-	0.2 U	*0.2*	**2**
Nickel	9.7	-	-	1.3	-	-	-	-	2.9	*20*	**100**
Potassium	149,000	-	-	5,000	-	-	-	-	14,600	NS	NS
Selenium	5 U	-	-	5 U	-	-	-	-	5 U	*10*	**50**
Silver	1 U	-	-	1 U	-	-	-	-	1 U	*10*	**50**
Sodium	286,000	-	-	39,200	-	-	-	-	33,200	NS	NS
Thallium	1 U	-	-	1 U	-	-	-	-	1 U	*0.4*	**2**
Vanadium	*17.6*	-	-	5 U	-	-	-	-	5 U	*6*	**30**
Zinc	3.5	-	-	1.4 J	-	-	-	-	577	NS	NS

Note:

ug/L - micrograms per liter (equivalent to parts per billion)

ES - enforcement standard, as established in Wisconsin Administrative Code Ch

PAL - preventive action limit, as established in Wisconsin Administrative Code C

Bold - concentration exceeds NR 140 ES

Italics - concentration exceeds NR 140 PAL

< less than the specified detection limit

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit

(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

NS - no established standard

\- sample either not analyzed for specific parameter or not reported for specific parameter

(D) - analytical report identified that this sample was dissolved

Results were reported without distinction of disssolved or total, as such the analysis is unknown unless otherwise noted

FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

Table 4
Polychlorinated biphenyls (PCBs) - Groundwater Analytical Table
AMCAST NORTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	AMNW-01		FVMW-26					FVMW-27					**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	09/23/11	11/19/18	12/02/03	01/13/04	04/10/07	09/21/11	11/19/18	12/03/03	01/12/04	04/10/07	09/21/11	11/19/18		
PCBs (ug/L)														
PCB-1016 (Aroclor 1016)	1 U	<0.24	-	-	<0.24	1 U	<0.24	-	-	<0.24	1 U	<0.24	NS	NS
PCB-1221 (Aroclor 1221)	1 U	<0.24	-	-	<0.24	1 U	<0.24	-	-	<0.24	1 U	<0.24	NS	NS
PCB-1232 (Aroclor 1232)	1 U	<0.24	-	-	<0.24	1 U	<0.24	-	-	<0.24	1 U	<0.24	NS	NS
PCB-1242 (Aroclor 1242)	1 U	<0.24	-	-	<0.24	1 U	<0.24	-	-	0.82	1 U	<0.24	NS	NS
PCB-1248 (Aroclor 1248)	1 U	<0.24	0 U	0 U	<0.24	1 U	<0.24	0 U	0.3	<0.24	1 U	0.37 J	NS	NS
PCB-1254 (Aroclor 1254)	1 U	<0.24	-	-	<0.24	1 U	<0.24	-	-	<0.24	1 U	<0.24	NS	NS
PCB-1260 (Aroclor 1260)	1 U	<0.24	-	-	<0.24	1 U	<0.24	-	-	<0.24	1 U	<0.24	NS	NS
PCB-1262 (Aroclor 1262)	1 U	-	-	-	-	1 U	-	-	-	-	1 U	-	NS	NS
PCB-1268 (Aroclor 1268)	1 U	-	-	-	-	1 U	-	-	-	-	1 U	-	NS	NS
PCB, Total	-	<0.24	-	-	<0.24	-	<0.24	-	**0.3**	**0.82**	-	**0.37 J**	*0.003*	**0.03**

Note:
ug/L - micrograms per liter (equivalent to parts per billion)
PCBs - Polychlorintated Biphenyls
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
NS - no established standard
< less than the specified detection limit
- sample either not analyzed for specific parameter or not reported for specific parameter

Table 5
NR 140 Exceedances - Groundwater Analytical Table
AMCAST NORTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Monitoring Well ID	**AMN-MW01**		**FVMW-26**				**FVMW-27**					**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	09/23/11	11/19/18	12/02/03	01/13/04	09/21/11	11/19/18	12/03/03	01/12/04	04/10/07	09/21/11	11/19/18		
Volatile Organic Compounds (ug/L)													
trans-1,3-Dichloropropene	*0.13 J*	-	-	-	-	-	-	-	-	-	-	*0.04*	**0.4**
Trichloroethene	-	*2.1*	-	-	-	-	-	-	-	-	-	*0.5*	**5**
Polycyclic Aromatic Hydrocarbons (PAHs)													
bis(2-Ethylhexyl)phthalate	-	-	**7.3**	-	-	*1.4 J*	**260**	**120**	**-**	**-**	*1.3 J*	*0.6*	**6**
Total Metals (ug/l)													
Arsenic	*0.49 J*	*14.9 J*	*5.7*	-	*9.9*	-	*5.4*	*8.4*	-	**10**	-	*1*	**10**
Cadmium	-	*1.8 J*	*0.6*	-	-	-	*0.77*	-	-	-	-	*0.5*	**5**
Chromium, Total (Dissolved)	**372**	**471 (385)**	*36*	-	-	-	*20*	*39*	-	-	-	*10*	**100**
Lead, Total (Dissolved)	-	**35.5**	**18**	*6.4 (2.3)*	*-*	-	*12 (2.3)*	**17**	-	-	-	*1.5*	**15**
Manganese	*77.7*	-	-	-	-	-	-	-	-	*73 J*	-	*60*	**300**
Vanadium	*17.6*	-	-	-	-	-	-	-	-	-	-	*6*	**30**
PCBs (ug/L)													
PCB, Total	-	-	-	-	-	-	-	**0.3**	**0.82**	**-**	**0.37 J**	*0.003*	**0.03**

Note:
ug/L - micrograms per liter (equivalent to parts per billion)
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
- sample either not analyzed for specific parameter or not reported for specific parameter

Table 1
VOC - Groundwater Analytical Table
AMCAST CENTRAL & SOUTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	AMSMW-01		GMMW-1						NR 140 Preventive Action Limit (PAL)	NR 140 Enforcement Standard (ES)
Sample Collection Date	09/22/11	11/19/18	11/18/93	12/03/03	01/12/04	04/10/07	09/20/11	11/19/18		
Volatile Organic Compounds (ug/L)										
1,1,1,2-Tetrachloroethane	-	<0.27	<5	-	-	<0.92	-	<0.27	*7*	**70**
1,1,1-Trichloroethane	0.5 U	<0.24	<5	-	-	<0.90	0.5 U	<0.24	*40*	**200**
1,1,2,2-Tetrachloroethane	0.5 U	<0.28	-	-	-	<0.20	0.5 U	<0.28	*0.02*	**0.2**
1,1,2-Trichloroethane	0.5 U	<0.55	<5	-	-	<0.42	0.5 U	<0.55	*0.5*	**5**
1,1-Dichloroethane	0.5 U	<0.27	<5	-	-	<0.75	0.5 U	<0.27	*85*	**850**
1,1-Dichloroethene	0.5 U	<0.24	<5	-	-	<0.57	0.5 U	<0.24	*0.7*	**7**
1,1-Dichloropropene	-	<0.54	-	-	-	<0.75	-	<0.54	NS	NS
1,2,3-Trichlorobenzene	0.5 U	<0.63	-	-	-	<0.74	0.5 U	<0.63	NS	NS
1,2,3-Trichloropropane	-	<0.59	-	-	-	<0.99	-	<0.59	*12*	**60**
1,2,4-Trichlorobenzene	0.5 U	<0.95	-	-	-	<0.97	0.5 U	<0.95	*14*	**70**
1,2,4-Trimethylbenzene	-	<0.84	-	-	-	<0.97	-	<0.84	*96*	**480**
1,2-Dibromo-3-chloropropane	-	<1.8	-	-	-	<0.87	-	<1.8	*0.02*	**0.2**
1,2-Dibromoethane (EDB)	0.5 U	<0.83	-	-	-	<0.56	0.5 U	<0.83	*0.005*	**0.05**
1,2-Dichlorobenzene	-	<0.71	-	-	-	<0.83	-	<0.71	*60*	**600**
1,2-Dichloroethane	0.5 U	<0.28	<5	-	-	<0.36	0.5 U	<0.28	*0.5*	**5**
1,2-Dichloropropane	0.5 U	<0.28	<5	-	-	<0.46	0.5 U	<0.28	*0.5*	**5**
1,3,5-Trimethylbenzene	-	<0.87	-	-	-	<0.83	-	<0.87	*96*	**480**
1,3-Dichlorobenzene	-	<0.63	-	-	-	<0.87	-	<0.63	*120*	**600**
1,3-Dichloropropane	-	<0.83	-	-	-	<0.61	-	<0.83	NS	NS
1,4-Dichlorobenzene	-	<0.94	-	-	-	<0.95	-	<0.94	*15*	**75**
2,2-Dichloropropane	-	<2.3	-	-	-	<0.62	-	<2.3	NS	NS
2-Chlorotoluene	-	<0.93	-	-	-	<0.85	-	<0.93	NS	NS
4-Chlorotoluene	-	<0.76	-	-	-	<0.74	-	<0.76	NS	NS
Benzene	0.5 U	<0.25	<5	-	-	<0.41	0.5 U	<0.25	*0.5*	**5**
Bromobenzene	-	<0.24	-	-	-	<0.82	-	<0.24	NS	NS
Bromochloromethane	0.5 U	<0.36	-	-	-	<0.97	0.5 U	<0.36	NS	NS
Bromodichloromethane	0.5 U	<0.36	<5	**1.4**	**1.2**	**1.4**	**1.1**	**0.61 J**	*0.06*	**0.6**
Bromoform	0.5 U	<4.0	<5	-	-	<0.94	0.5 U	<4.0	*0.44*	**4.4**
Bromomethane	0.5 U	<0.97	<10	-	-	<0.91	0.5 U	<0.97	*1*	**10**
Carbon tetrachloride	0.5 U	<0.17	<5	-	-	<0.49	0.5 U	<0.17	*0.5*	**5**
Chlorobenzene	0.5 U	<0.71	<5	-	-	<0.41	0.5 U	<0.71	NS	NS
Chloroethane	0.5 U	<1.3	<10	-	-	<0.97	0.5 U	<1.3	*80*	**400**
Chloroform	0.5 U	<1.3	<5	*1.1*	*1*	*1.7*	1.8 U	<1.3	*0.6*	**6**
Chloromethane	0.5 U	<2.2	<10	-	-	<0.24	0.5 U	<2.2	*3*	**30**
Dibromochloromethane	0.5 U	<2.6	<5	-	-	<0.81	0.5 U	<2.6	*6*	**60**
Dibromomethane	-	<0.94	-	-	-	<0.60	-	<0.94	NS	NS
Dichlorodifluoromethane	0.5 U	<0.50	-	-	-	<0.99	0.5 U	<0.50	*200*	**1000**
Diisopropyl ether	-	<1.9	-	-	-	<0.76	-	<1.9	NS	NS
Ethylbenzene	0.5 U	<0.22	<5	1.5	-	<0.54	0.5 U	<0.22	*140*	**700**
Hexachloro-1,3-butadiene	5 U	<1.2	-	-	-	<0.67	5 U	<1.2	NS	NS
Isopropylbenzene (Cumene)	0.5 U	<0.39	-	-	-	<0.59	0.5 U	<0.39	NS	NS
Methyl-tert-butyl ether	0.5 U	<1.2	-	-	-	<0.61	0.5 U	<1.2	*12*	**60**
Methylene Chloride	0.5 U	<0.58	<5	-	-	<0.43	0.5 U	<0.58	*0.5*	**5**
Naphthalene	-	<1.2	-	-	-	<0.74	-	7	*10*	**100**
Styrene	0.5 U	<0.47	<5	-	-	<0.86	0.5 U	<0.47	*10*	**100**
Tetrachloroethene	0.5 U	<0.33	<5	-	-	<0.45	0.5 U	<0.33	*0.5*	**5**
Toluene	0.5 U	0.26 J	<5	-	-	<0.67	0.5 U	<0.17	*160*	**800**
Trichloroethene	0.5 U	<0.26	<5	-	-	<0.48	0.1 J	<0.26	*0.5*	**5**
Trichlorofluoromethane	0.5 U	<0.21	-	-	-	<0.79	0.5 U	<0.21	*698*	**3490**
Vinyl chloride	0.5 U	<0.17	<10	-	-	<0.18	0.5 U	<0.17	*0.02*	**0.2**
cis-1,2-Dichloroethene	0.5 U	<0.27	<5	-	-	<0.83	0.5 U	<0.27	*7*	**70**
cis-1,3-Dichloropropene	0.5 U	<3.6	<5	-	-	<0.19	0.5 U	<3.6	*0.04*	**0.4**
Total Xylenes	1 U	<0.73	<5	9.6	-	2.63	1 U	<0.73	*400*	**2000**
p-Isopropyltoluene	-	<0.80	-	-	-	<0.67	-	<0.80	NS	NS
sec-Butylbenzene	-	<0.85	-	-	-	<0.89	-	<0.85	NS	NS
tert-Butylbenzene	-	<0.30	-	-	-	<0.97	-	<0.30	NS	NS
trans-1,2-Dichloroethene	0.5 U	<1.1	<5	-	-	<0.89	0.5 U	<1.1	*20*	**100**
2-Butanone	5 U	-	<50	-	-	-	5 U	-	NS	NS
2-Hexanone	5 U	-	<50	-	-	-	5 U	-	NS	NS
4-Methyl-2-Pentanone	5 U	-	<50	-	-	-	5 U	-	NS	NS
Acetone	10 U	-	<50	-	-	-	5 U	-	NS	NS
Carbon Disulfide	0.5 U	-	<50	-	-	-	0.5 U	-	NS	NS
Chlorinated Fluorocarbon	0.5 U	-	-	-	-	-	0.5 U	-	NS	NS
Cyclohexane	0.5 U	-	-	-	-	-	0.5 U	-	NS	NS
Methyl Acetate	0.5 U	-	-	-	-	-	0.5 U	-	NS	NS
Methylcyolohexane	0.5 U	-	-	-	-	-	0.5 U	-	NS	NS
trans-1,3-Dichloropropene	0.5 U	<4.4	<5	-	-	<0.19	0.5 U	<4.4	*0.04*	**0.4**

Note:
ug/L - micrograms per liter (equivalent to parts per billion)
VOCs - Volatile Organic Compounds
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
FVMW-22 and FVMW-22 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
NS - no established standard
< less than the specified detection limit
\- sample either not analyzed for specific parameter or not reported for specific parameter

Table 1
VOC - Groundwater Analytical Table
AMCAST SOUTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	GMMW-2						GMMW-3						**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	11/18/93	12/03/03	01/12/04	04/10/07	09/20/11	11/19/18	11/18/93	12/04/03	01/12/04	04/10/07	09/20/11	11/19/18		
Volatile Organic Compounds (ug/L)														
1,1,1,2-Tetrachloroethane	<5	-	-	<0.92	-	<0.27	<5	-	-	<0.92	-	<0.54	*7*	**70**
1,1,1-Trichloroethane	<5	-	-	<0.90	0.5 U	<0.24	<5	-	-	<0.90	0.5 U	<0.49	*40*	**200**
1,1,2,2-Tetrachloroethane	-	-	-	<0.20	0.5 U	<0.28	-	-	-	<0.20	0.5 U	<0.55	*0.02*	**0.2**
1,1,2-Trichloroethane	<5	-	-	<0.42	0.5 U	<0.55	<5	-	-	<0.42	0.5 U	<1.1	*0.5*	**5**
1,1-Dichloroethane	<5	-	-	<0.75	0.5 U	<0.27	<5	-	-	<0.75	0.5 U	<0.55	*85*	**850**
1,1-Dichloroethene	<5	-	-	<0.57	0.5 U	<0.24	<5	-	-	<0.57	0.5 U	<0.49	*0.7*	**7**
1,1-Dichloropropene	-	-	-	<0.75	-	<0.54	-	-	-	<0.75	-	<1.1	NS	NS
1,2,3-Trichlorobenzene	-	-	-	<0.74	0.5 U	<0.63	-	-	-	<0.74	0.5 U	<1.3	NS	NS
1,2,3-Trichloropropane	-	-	-	<0.99	-	<0.59	-	-	-	<0.99	-	<1.2	*12*	**60**
1,2,4-Trichlorobenzene	-	-	-	<0.97	0.5 U	<0.95	-	-	-	<0.97	0.5 U	<1.9	*14*	**70**
1,2,4-Trimethylbenzene	-	-	-	<0.97	-	<0.84	-	58	50	77	-	*114*	*96*	**480**
1,2-Dibromo-3-chloropropane	-	-	-	<0.87	-	<1.8	-	-	-	<0.87	-	<3.5	*0.02*	**0.2**
1,2-Dibromoethane (EDB)	-	-	-	<0.56	0.5 U	<0.83	-	-	-	<0.56	0.5 U	<1.7	*0.005*	**0.05**
1,2-Dichlorobenzene	-	-	-	<0.83	-	<0.71	-	-	-	<0.83	-	<1.4	*60*	**600**
1,2-Dichloroethane	<5	-	-	<0.36	0.5 U	<0.28	<5	-	-	<0.36	0.5 U	<0.56	*0.5*	**5**
1,2-Dichloropropane	<5	-	-	<0.46	0.5 U	<0.28	<5	-	-	<0.46	0.5 U	<0.57	*0.5*	**5**
1,3,5-Trimethylbenzene	-	-	-	<0.83	-	<0.87	-	-	-	<0.83	-	<1.7	*96*	**480**
1,3-Dichlorobenzene	-	-	-	<0.87	-	<0.63	-	-	-	<0.87	-	<1.3	*120*	**600**
1,3-Dichloropropane	-	-	-	<0.61	-	<0.83	-	-	-	<0.61	-	<1.7	NS	NS
1,4-Dichlorobenzene	-	-	-	<0.95	-	<0.94	-	-	-	<0.95	-	<1.9	*15*	**75**
2,2-Dichloropropane	-	-	-	<0.62	-	<2.3	-	-	-	<0.62	-	<4.5	NS	NS
2-Chlorotoluene	-	-	-	<0.85	-	<0.93	-	-	-	<0.85	-	<1.9	NS	NS
4-Chlorotoluene	-	-	-	<0.74	-	<0.76	-	-	-	<0.74	-	<1.5	NS	NS
Benzene	<5	-	-	<0.41	0.5 U	<0.25	<5	*3.8*	*3.7*	*1.2*	*1.4*	*0.56 J*	*0.5*	**5**
Bromobenzene	-	-	-	<0.82	-	<0.24	-	-	-	<0.82	-	<0.48	NS	NS
Bromochloromethane	-	-	-	<0.97	0.5 U	<0.36	-	-	-	<0.97	0.5 U	<0.72	NS	NS
Bromodichloromethane	<5	-	-	<0.56	**1.1**	<0.36	<5	-	-	*0.56*	**1.1**	<0.73	*0.06*	**0.6**
Bromoform	<5	-	-	<0.94	0.5 U	<4.0	<5	-	-	<0.94	0.5 U	<7.9	*0.44*	**4.4**
Bromomethane	<10	-	-	<0.91	0.5 U	<0.97	<10	-	-	<0.91	0.5 U	<1.9	*1*	**10**
Carbon tetrachloride	<5	-	-	<0.49	0.5 U	<0.17	<5	-	-	<0.49	0.5 U	<0.33	*0.5*	**5**
Chlorobenzene	<5	-	-	<0.41	0.5 U	<0.71	<5	-	-	<0.41	0.5 U	<1.4	NS	NS
Chloroethane	<10	-	-	<0.97	0.5 U	<1.3	<10	-	-	<0.97	0.5 U	<2.7	*80*	**400**
Chloroform	<5	-	-	<0.37	1.8 U	<1.3	<5	-	-	<0.37	1.8 U	<2.5	*0.6*	**6**
Chloromethane	<10	-	-	<0.24	0.5 U	<2.2	<10	-	-	<0.24	0.5 U	<4.4	*3*	**30**
Dibromochloromethane	<5	-	-	<0.81	0.5 U	<2.6	<5	-	-	<0.81	0.5 U	<5.2	*6*	**60**
Dibromomethane	-	-	-	<0.60	-	<0.94	-	-	-	<0.60	-	<1.9	NS	NS
Dichlorodifluoromethane	-	-	-	<0.99	0.5 U	<0.50	-	-	-	<0.99	0.5 U	<1	*200*	**1000**
Diisopropyl ether	-	-	-	<0.76	-	<1.9	-	-	-	<0.76	-	<3.8	NS	NS
Ethylbenzene	<5	4.4	-	<0.54	0.5 U	<0.22	<5	24	21	28	31	41.4	*140*	**700**
Hexachloro-1,3-butadiene	-	-	-	<0.67	5 U	<1.2	-	-	-	<0.67	5 U	<2.4	NS	NS
Isopropylbenzene (Cumene)	-	-	-	<0.59	0.5 U	<0.39	-	5.6	5.8	7	6.3	9.1 J	NS	NS
Methyl-tert-butyl ether	-	-	-	<0.61	0.5 U	<1.2	-	-	-	<0.61	0.5 U	<2.5	*12*	**60**
Methylene Chloride	<5	-	-	<0.43	0.5 U	<0.58	<5	-	-	<0.43	0.5 U	<1.2	*0.5*	**5**
Naphthalene	-	-	-	<0.74	-	<1.2	-	*14*	*12*	*49*	-	**184**	*10*	**100**
Styrene	<5	-	-	<0.86	0.5 U	<0.47	<5	-	-	<0.86	0.5 U	<0.93	*10*	**100**
Tetrachloroethene	<5	-	-	<0.45	0.5 U	<0.33	<5	-	-	<0.45	0.5 U	<0.65	*0.5*	**5**
Toluene	<5	-	-	<0.67	0.5 U	<0.17	<5	1.9	1.2	<0.67	0.67	<0.34	*160*	**800**
Trichloroethene	<5	-	-	<0.48	0.1 J	<0.26	<5	-	-	<0.48	0.1 J	<0.51	*0.5*	**5**
Trichlorofluoromethane	-	-	-	<0.79	0.5 U	<0.21	-	-	-	<0.79	0.5 U	<0.43	*698*	**3490**
Vinyl chloride	<10	-	-	<0.18	0.5 U	<0.17	<10	-	-	<0.18	0.5 U	<0.35	*0.02*	**0.2**
cis-1,2-Dichloroethene	<5	-	-	<0.83	0.5 U	<0.27	<5	-	-	<0.83	0.5 U	<0.54	*7*	**70**
cis-1,3-Dichloropropene	<5	-	-	<0.19	0.5 U	<3.6	<5	-	-	<0.19	0.5 U	<7.3	*0.04*	**0.4**
Total Xylenes	<5	29	3.3	2.63	1 U	<0.73	11	33	19.2	18.9	20.8	22.4	*400*	**2000**
p-Isopropyltoluene	-	-	-	<0.67	-	<0.80	-	-	-	3.7	-	1.8 J	NS	NS
sec-Butylbenzene	-	-	-	<0.89	-	<0.85	-	-	-	2.7	-	3.0 J	NS	NS
tert-Butylbenzene	-	-	-	<0.97	-	<0.30	-	-	-	<0.97	-	<0.61	NS	NS
trans-1,2-Dichloroethene	<5	-	-	<0.89	0.5 U	<1.1	<5	-	-	<0.89	0.5 U	<2.2	*20*	**100**
2-Butanone	<50	-	-	-	5 U	-	<50	-	-	-	5 U	-	NS	NS
2-Hexanone	<50	-	-	-	5 U	-	<50	-	-	-	5 U	-	NS	NS
4-Methyl-2-Pentanone	<50	-	-	-	5 U	-	<50	-	-	-	5 U	-	NS	NS
Acetone	<50	-	-	-	5 U	-	<50	-	-	-	2.4	-	NS	NS
Carbon Disulfide	<50	-	-	-	0.5 U	-	<50	-	-	-	0.5 U	-	NS	NS
Chlorinated Fluorocarbon	-	-	-	-	0.5 U	-	-	-	-	-	0.5 U	-	NS	NS
Cyclohexane	-	-	-	-	0.5 U	-	-	-	-	-	0.5 U	-	NS	NS
Methyl Acetate	-	-	-	-	0.5 U	-	-	-	-	-	0.5 U	-	NS	NS
Methylcylohexane	-	-	-	-	0.5 U	-	-	-	-	-	2.4	-	NS	NS
trans-1,3-Dichloropropene	<5	-	-	<0.19	0.5 U	<4.4	<5	-	-	<0.19	0.5 U	<8.7	*0.04*	**0.4**

Note:

ug/L - micrograms per liter (equivalent to parts per billion)
VOCs - Volatile Organic Compounds
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
FVMW-22 and FVMW-22 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
NS - no established standard
< less than the specified detection limit
\- sample either not analyzed for specific parameter or not reported for specific parameter

Table 1
VOC - Groundwater Analytical Table
AMCAST CENTRAL & AMCAST SOUTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	GMMW-4					GMMW-5				GMMW-6				NR 140 Preventive Action Limit (PAL)	NR 140 Enforcement Standard (ES)
Sample Collection Date	11/18/93	12/03/03	04/10/07	09/21/11	11/19/18	11/18/93	04/10/07	09/22/11	11/19/18	11/18/93	04/10/07	09/22/11	11/19/18		
Volatile Organic Compounds (ug/L)															
1,1,1,2-Tetrachloroethane	<5	-	<0.92	-	<0.27	<5	<0.92	-	<0.27	<5	<0.92	-	<0.27	*7*	**70**
1,1,1-Trichloroethane	<5	-	<0.90	0.5 U	<0.24	<5	<0.90	0.5 U	<0.24	<5	<0.90	0.5 U	<0.24	*40*	**200**
1,1,2,2-Tetrachloroethane	-	-	<0.20	0.5 U	<0.28	-	<0.20	0.5 U	<0.28	-	<0.20	0.5 U	<0.28	*0.02*	**0.2**
1,1,2-Trichloroethane	<5	-	<0.42	0.5 U	<0.55	<5	<0.42	0.5 U	<0.55	<5	<0.42	0.5 U	<0.55	*0.5*	**5**
1,1-Dichloroethane	<5	-	<0.75	0.5 U	<0.27	<5	<0.75	0.5 U	<0.27	<5	<0.75	0.5 U	<0.27	*85*	**850**
1,1-Dichloroethene	<5	-	<0.57	0.5 U	<0.24	<5	<0.57	0.5 U	<0.24	<5	<0.57	0.5 U	<0.24	*0.7*	**7**
1,1-Dichloropropene	-	-	<0.75	-	<0.54	-	<0.75	-	<0.54	-	<0.75	-	<0.54	NS	NS
1,2,3-Trichlorobenzene	-	-	<0.74	0.5 U	<0.63	-	<0.74	0.5 U	<0.63	-	<0.74	0.5 U	<0.63	NS	NS
1,2,3-Trichloropropane	-	-	<0.99	-	<0.59	-	<0.99	-	<0.59	-	<0.99	-	<0.59	*12*	**60**
1,2,4-Trichlorobenzene	-	-	<0.97	0.5 U	<0.95	-	<0.97	0.5 U	<0.95	-	<0.97	0.5 U	<0.95	*14*	**70**
1,2,4-Trimethylbenzene	-	-	<0.97	-	<0.84	-	<0.97	-	<0.84	-	<0.97	-	<0.84	*96*	**480**
1,2-Dibromo-3-chloropropane	-	-	<0.87	-	<1.8	-	<0.87	-	<1.8	-	<0.87	-	<1.8	*0.02*	**0.2**
1,2-Dibromoethane (EDB)	-	-	<0.56	0.5 U	<0.83	-	<0.56	0.5 U	<0.83	-	<0.56	0.5 U	<0.83	*0.005*	**0.05**
1,2-Dichlorobenzene	-	-	<0.83	-	<0.71	-	<0.83	-	<0.71	-	<0.83	-	<0.71	*60*	**600**
1,2-Dichloroethane	<5	-	<0.36	0.5 U	<0.28	<5	<0.36	0.5 U	<0.28	<5	<0.36	0.5 U	<0.28	*0.5*	**5**
1,2-Dichloropropane	<5	-	<0.46	0.5 U	<0.28	<5	<0.46	0.5 U	<0.28	<5	<0.46	0.5 U	<0.28	*0.5*	**5**
1,3,5-Trimethylbenzene	-	-	<0.83	-	<0.87	-	<0.83	-	<0.87	-	<0.83	-	<0.87	*96*	**480**
1,3-Dichlorobenzene	-	-	<0.87	-	<0.63	-	<0.87	-	<0.63	-	<0.87	-	<0.63	*120*	**600**
1,3-Dichloropropane	-	-	<0.61	-	<0.83	-	<0.61	-	<0.83	-	<0.61	-	<0.83	NS	NS
1,4-Dichlorobenzene	-	-	<0.95	-	<0.94	-	<0.95	-	<0.94	-	<0.95	-	<0.94	*15*	**75**
2,2-Dichloropropane	-	-	<0.62	-	<2.3	-	<0.62	-	<2.3	-	<0.62	-	<2.3	NS	NS
2-Chlorotoluene	-	-	<0.85	-	<0.93	-	<0.85	-	<0.93	-	<0.85	-	<0.93	NS	NS
4-Chlorotoluene	-	-	<0.74	-	<0.76	-	<0.74	-	<0.76	-	<0.74	-	<0.76	NS	NS
Benzene	<5	-	<0.41	0.5 U	<0.25	<5	<0.41	0.5 U	<0.25	<5	<0.41	0.5 U	<0.25	*0.5*	**5**
Bromobenzene	-	-	<0.82	-	<0.24	-	<0.82	-	<0.24	-	<0.82	-	<0.24	NS	NS
Bromochloromethane	-	-	<0.97	0.5 U	<0.36	-	<0.97	0.5 U	<0.36	-	<0.97	0.5 U	<0.36	NS	NS
Bromodichloromethane	<5	-	<0.56	**1.1**	<0.36	<5	<0.56	0.5 U	<0.36	<5	<0.56	0.5 U	<0.36	*0.06*	**0.6**
Bromoform	<5	-	<0.94	0.5 U	<4.0	<5	<0.94	0.5 U	<4.0	<5	<0.94	0.5 U	<4.0	*0.44*	**4.4**
Bromomethane	<10	-	<0.91	0.5 U	<0.97	<10	<0.91	0.5 U	<0.97	<10	<0.91	0.5 U	<0.97	*1*	**10**
Carbon tetrachloride	<5	-	<0.49	0.5 U	<0.17	<5	<0.49	0.5 U	<0.17	<5	<0.49	0.5 U	<0.17	*0.5*	**5**
Chlorobenzene	<5	-	<0.41	0.5 U	<0.71	<5	<0.41	0.5 U	<0.71	<5	<0.41	0.5 U	<0.71	NS	NS
Chloroethane	<10	-	<0.97	0.5 U	<1.3	<10	<0.97	0.5 U	<1.3	<10	<0.97	0.5 U	<1.3	*80*	**400**
Chloroform	<5	-	<0.37	1.8 U	<1.3	<5	<0.37	0.5 U	<1.3	<5	<0.37	0.5 U	<1.3	*0.6*	**6**
Chloromethane	<10	-	<0.24	0.5 U	<2.2	<10	<0.24	0.5 U	<2.2	<10	<0.24	0.5 U	<2.2	*3*	**30**
Dibromochloromethane	<5	-	<0.81	0.5 U	<2.6	<5	<0.81	0.5 U	<2.6	<5	<0.81	0.5 U	<2.6	*6*	**60**
Dibromomethane	-	-	<0.60	-	<0.94	-	<0.60	-	<0.94	-	<0.60	-	<0.94	NS	NS
Dichlorodifluoromethane	-	-	<0.99	0.5 U	<0.50	-	<0.99	0.5 U	<0.50	-	<0.99	0.5 U	<0.50	*200*	**1000**
Diisopropyl ether	-	-	<0.76	-	<1.9	-	<0.76	-	<1.9	-	<0.76	-	<1.9	NS	NS
Ethylbenzene	<5	3.1	<0.54	0.5 U	<0.22	<5	<0.54	0.5 U	<0.22	<5	<0.54	0.5 U	<0.22	*140*	**700**
Hexachloro-1,3-butadiene	-	-	<0.67	5 U	<1.2	-	<0.67	5 U	<1.2	-	<0.67	5 U	<1.2	NS	NS
Isopropylbenzene (Cumene)	-	-	<0.59	0.5 U	<0.39	-	<0.59	0.5 U	<0.39	-	<0.59	0.5 U	<0.39	NS	NS
Methyl-tert-butyl ether	-	-	<0.61	0.5 U	<1.2	-	<0.61	0.5 U	<1.2	-	<0.61	0.5 U	<1.2	*12*	**60**
Methylene Chloride	<5	-	<0.43	0.5 U	<0.58	<5	<0.43	0.5 U	<0.58	<5	<0.43	0.5 U	<0.58	*0.5*	**5**
Naphthalene	-	-	<0.74	-	<1.2	-	<0.74	-	<1.2	-	<0.74	-	<1.2	*10*	**100**
Styrene	<5	-	<0.86	0.5 U	<0.47	<5	<0.86	0.5 U	<0.47	<5	<0.86	0.5 U	<0.47	*10*	**100**
Tetrachloroethene	<5	-	<0.45	0.5 U	<0.33	<5	<0.45	0.5 U	<0.33	<5	<0.45	0.5 U	<0.33	*0.5*	**5**
Toluene	<5	-	<0.67	0.5 U	<0.17	<5	<0.67	0.5 U	<0.17	<5	<0.67	0.5 U	<0.17	*160*	**800**
Trichloroethene	<5	-	<0.48	0.1 J	<0.26	<5	<0.48	0.5 U	<0.26	<5	<0.48	0.5 U	<0.26	*0.5*	**5**
Trichlorofluoromethane	-	-	<0.79	0.5 U	<0.21	-	<0.79	0.5 U	<0.21	-	<0.79	0.5 U	<0.21	*698*	**3490**
Vinyl chloride	<10	-	<0.18	0.5 U	<0.17	<10	<0.18	0.5 U	<0.17	<10	<0.18	0.5 U	<0.17	*0.02*	**0.2**
cis-1,2-Dichloroethene	<5	-	<0.83	0.5 U	<0.27	<5	<0.83	0.5 U	<0.27	<5	<0.83	0.5 U	<0.27	*7*	**70**
cis-1,3-Dichloropropene	<5	-	<0.19	0.5 U	<3.6	<5	<0.19	0.5 U	<3.6	<5	<0.19	0.5 U	<3.6	*0.04*	**0.4**
Total Xylenes	<5	18.8	2.63	1 U	<0.73	<5	2.63	1 U	<0.73	<5	2.63	1 U	<0.73	*400*	**2000**
p-Isopropyltoluene	-	-	<0.67	-	<0.80	-	<0.67	-	<0.80	-	<0.67	-	<0.80	NS	NS
sec-Butylbenzene	-	-	<0.89	-	<0.85	-	<0.89	-	<0.85	-	<0.89	-	<0.85	NS	NS
tert-Butylbenzene	-	-	<0.97	-	<0.30	-	<0.97	-	<0.30	-	<0.97	-	<0.30	NS	NS
trans-1,2-Dichloroethene	<5	-	<0.89	0.5 U	<1.1	<5	<0.89	0.5 U	<1.1	<5	<0.89	0.5 U	<1.1	*20*	**100**
2-Butanone	<50	-	-	5 U	-	<50	-	5 U	-	<50	-	5 U	-	NS	NS
2-Hexanone	<50	-	-	5 U	-	<50	-	5 U	-	<50	-	5 U	-	NS	NS
4-Methyl-2-Pentanone	<50	-	-	5 U	-	<50	-	5 U	-	<50	-	5 U	-	NS	NS
Acetone	<50	-	-	10 U	-	<50	-	10 U	-	<50	-	5 U	-	NS	NS
Carbon Disulfide	<50	-	-	0.5 U	-	<50	-	0.5 U	-	<50	-	0.5 U	-	NS	NS
Chlorinated Fluorocarbon	-	-	-	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
Cyclohexane	-	-	-	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
Methyl Acetate	-	-	-	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
Methylcylohexane	-	-	-	0.5 U	-	-	-	0.5 U	-	-	-	0.5 U	-	NS	NS
trans-1,3-Dichloropropene	<5	-	<0.19	0.5 U	<4.4	<5	<0.19	0.5 U	<4.4	<5	<0.19	0.5 U	<4.4	*0.04*	**0.4**

Note:

ug/L - micrograms per liter (equivalent to parts per billion)
VOCs - Volatile Organic Compounds
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
FVMW-22 and FVMW-22 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
NS - no established standard
< less than the specified detection limit
- sample either not analyzed for specific parameter or not reported for specific parameter

Table 1
VOC - Groundwater Analytical Table
AMCAST CENTRAL & AMCAST SOUTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	**GMMW-7**					**FVMW-20**					**FVMW-21**	**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	11/18/93	12/03/03	04/10/07	09/21/11	11/19/18	12/02/03	01/13/04	04/10/07	09/20/11	11/19/18	04/10/07		
Volatile Organic Compounds (ug/L)													
1,1,1,2-Tetrachloroethane	<5	-	<0.92	-	<0.27	-	-	<0.92	-	<0.27	<0.92	*7*	**70**
1,1,1-Trichloroethane	<5	-	<0.90	0.5 U	<0.24	-	-	<0.90	0.5 U	<0.24	<0.90	*40*	**200**
1,1,2,2-Tetrachloroethane	-	-	<0.20	0.5 U	<0.28	-	-	<0.20	0.5 U	<0.28	<0.20	*0.02*	**0.2**
1,1,2-Trichloroethane	<5	-	<0.42	0.5 U	<0.55	-	-	<0.42	0.5 U	<0.55	<0.42	*0.5*	**5**
1,1-Dichloroethane	<5	-	<0.75	0.5 U	<0.27	-	-	<0.75	0.5 U	<0.27	<0.75	*85*	**850**
1,1-Dichloroethene	<5	-	<0.57	0.5 U	<0.24	-	-	<0.57	0.5 U	<0.24	<0.57	*0.7*	**7**
1,1-Dichloropropene	-	-	<0.75	-	<0.54	-	-	<0.75	-	<0.54	<0.75	NS	NS
1,2,3-Trichlorobenzene	-	-	<0.74	0.5 U	<0.63	-	-	<0.74	0.5 U	<0.63	<0.74	NS	NS
1,2,3-Trichloropropane	-	-	<0.99	-	<0.59	-	-	<0.99	-	<0.59	<0.99	*12*	**60**
1,2,4-Trichlorobenzene	-	-	<0.97	0.5 U	<0.95	-	-	<0.97	0.5 U	<0.95	<0.97	*14*	**70**
1,2,4-Trimethylbenzene	-	-	<0.97	-	<0.84	-	-	<0.97	-	<0.84	<0.97	*96*	**480**
1,2-Dibromo-3-chloropropane	-	-	<0.87	-	<1.8	-	-	<0.87	-	<1.8	<0.87	*0.02*	**0.2**
1,2-Dibromoethane (EDB)	-	-	<0.56	0.5 U	<0.83	-	-	<0.56	0.5 U	<0.83	<0.56	*0.005*	**0.05**
1,2-Dichlorobenzene	-	-	<0.83	-	<0.71	-	-	<0.83	-	<0.71	<0.83	*60*	**600**
1,2-Dichloroethane	<5	-	<0.36	0.5 U	<0.28	-	-	<0.36	0.5 U	<0.28	<0.36	*0.5*	**5**
1,2-Dichloropropane	<5	-	<0.46	0.5 U	<0.28	-	-	<0.46	0.5 U	<0.28	<0.46	*0.5*	**5**
1,3,5-Trimethylbenzene	-	-	<0.83	-	<0.87	-	-	<0.83	-	<0.87	<0.83	*96*	**480**
1,3-Dichlorobenzene	-	-	<0.87	-	<0.63	-	-	<0.87	-	<0.63	<0.87	*120*	**600**
1,3-Dichloropropane	-	-	<0.61	-	<0.83	-	-	<0.61	-	<0.83	<0.61	NS	NS
1,4-Dichlorobenzene	-	-	<0.95	-	<0.94	-	-	<0.95	-	<0.94	<0.95	*15*	**75**
2,2-Dichloropropane	-	-	<0.62	-	<2.3	-	-	<0.62	-	<2.3	<0.62	NS	NS
2-Chlorotoluene	-	-	<0.85	-	<0.93	-	-	<0.85	-	<0.93	<0.85	NS	NS
4-Chlorotoluene	-	-	<0.74	-	<0.76	-	-	<0.74	-	<0.76	<0.74	NS	NS
Benzene	<5	-	<0.41	0.5 U	<0.25	-	-	<0.41	0.5 U	<0.25	<0.41	*0.5*	**5**
Bromobenzene	-	-	<0.82	-	<0.24	-	-	<0.82	-	<0.24	<0.82	NS	NS
Bromochloromethane	-	-	<0.97	0.5 U	<0.36	-	-	<0.97	0.5 U	<0.36	<0.97	NS	NS
Bromodichloromethane	<5	-	<0.56	0.5 U	<0.36	-	-	0.56	0.5 U	<0.36	<0.56	*0.06*	**0.6**
Bromoform	<5	-	<0.94	0.5 U	<4.0	-	-	<0.94	0.5 U	<4.0	<0.94	*0.44*	**4.4**
Bromomethane	<10	-	<0.91	0.5 U	<0.97	-	-	<0.91	0.5 U	<0.97	<0.91	*1*	**10**
Carbon tetrachloride	<5	-	<0.49	0.5 U	<0.17	-	-	<0.49	0.5 U	<0.17	<0.49	*0.5*	**5**
Chlorobenzene	<5	-	<0.41	0.5 U	<0.71	-	-	<0.41	0.5 U	<0.71	<0.41	NS	NS
Chloroethane	<10	-	<0.97	0.5 U	<1.3	-	-	<0.97	0.5 U	<1.3	<0.97	*80*	**400**
Chloroform	<5	-	<0.37	0.5 U	<1.3	-	-	<0.37	0.5 U	<1.3	<0.37	*0.6*	**6**
Chloromethane	<10	-	<0.24	0.5 U	<2.2	-	-	<0.24	0.5 U	<2.2	<0.24	*3*	**30**
Dibromochloromethane	<5	-	<0.81	0.5 U	<2.6	-	-	<0.81	0.5 U	<2.6	<0.81	*6*	**60**
Dibromomethane	-	-	<0.60	-	<0.94	-	-	<0.60	-	<0.94	<0.60	NS	NS
Dichlorodifluoromethane	-	-	<0.99	0.5 U	<0.50	-	-	<0.99	0.5 U	<0.50	<0.99	*200*	**1000**
Diisopropyl ether	-	-	<0.76	-	<1.9	-	-	<0.76	-	<1.9	<0.76	NS	NS
Ethylbenzene	<5	-	<0.54	0.5 U	<0.22	-	-	<0.54	0.5 U	<0.22	<0.54	*140*	**700**
Hexachloro-1,3-butadiene	-	-	<0.67	5 U	<1.2	-	-	<0.67	5 U	<1.2	<0.67	NS	NS
Isopropylbenzene (Cumene)	-	-	<0.59	0.5 U	<0.39	-	-	<0.59	0.5 U	<0.39	<0.59	NS	NS
Methyl-tert-butyl ether	-	-	<0.61	0.5 U	<1.2	-	-	<0.61	0.5 U	<1.2	<0.61	*12*	**60**
Methylene Chloride	<5	-	<0.43	0.5 U	<0.58	-	-	<0.43	0.5 U	<0.58	<0.43	*0.5*	**5**
Naphthalene	-	-	<0.74	-	<1.2	-	-	<0.74	-	<1.2	<0.74	*10*	**100**
Styrene	<5	-	<0.86	0.5 U	<0.47	-	-	<0.86	0.5 U	<0.47	<0.86	*10*	**100**
Tetrachloroethene	<5	-	<0.45	0.5 U	<0.33	-	-	<0.45	0.5 U	<0.33	<0.45	*0.5*	**5**
Toluene	<5	-	<0.67	0.5 U	<0.17	-	-	<0.67	0.5 U	<0.17	<0.67	*160*	**800**
Trichloroethene	<5	-	<0.48	0.5 U	<0.26	*4.5*	*3.2*	*1.9*	*1.3*	*0.68 J*	<0.48	*0.5*	**5**
Trichlorofluoromethane	-	-	<0.79	0.5 U	<0.21	-	-	<0.79	0.5 U	<0.21	<0.79	*698*	**3490**
Vinyl chloride	<10	-	<0.18	0.5 U	<0.17	-	-	<0.18	0.5 U	<0.17	<0.18	*0.02*	**0.2**
cis-1,2-Dichloroethene	<5	-	<0.83	0.5 U	<0.27	-	-	<0.83	0.5 U	<0.27	<0.83	*7*	**70**
cis-1,3-Dichloropropene	<5	-	<0.19	0.5 U	<3.6	-	-	<0.19	0.5 U	<3.6	<0.19	*0.04*	**0.4**
Total Xylenes	<5	4.4	2.63	1 U	<0.73	-	-	2.63	1 U	<0.73	2.63	*400*	**2000**
p-Isopropyltoluene	-	-	<0.67	-	<0.80	-	-	<0.67	-	<0.80	<0.67	NS	NS
sec-Butylbenzene	-	-	<0.89	-	<0.85	-	-	<0.89	-	<0.85	<0.89	NS	NS
tert-Butylbenzene	-	-	<0.97	-	<0.30	-	-	<0.97	-	<0.30	<0.97	NS	NS
trans-1,2-Dichloroethene	<5	-	<0.89	0.5 U	<1.1	-	-	<0.89	0.5 U	<1.1	<0.89	*20*	**100**
2-Butanone	<50	-	-	5 U	-	-	-	-	5 U	-	-	NS	NS
2-Hexanone	<50	-	-	5 U	-	-	-	-	5 U	-	-	NS	NS
4-Methyl-2-Pentanone	<50	-	-	5 U	-	-	-	-	5 U	-	-	NS	NS
Acetone	<50	-	-	10 U	-	-	-	-	5 U	-	-	NS	NS
Carbon Disulfide	<50	-	-	0.5 U	-	-	-	-	0.5 U	-	-	NS	NS
Chlorinated Fluorocarbon	-	-	-	0.5 U	-	-	-	-	0.5 U	-	-	NS	NS
Cyclohexane	-	-	-	0.5 U	-	-	-	-	0.5 U	-	-	NS	NS
Methyl Acetate	-	-	-	0.5 U	-	-	-	-	0.5 U	-	-	NS	NS
Methylcylohexane	-	-	-	0.5 U	-	-	-	-	0.5 U	-	-	NS	NS
trans-1,3-Dichloropropene	<5	-	<0.19	0.5 U	<4.4	-	-	<0.19	0.5 U	<4.4	<0.19	*0.04*	**0.4**

Note:
ug/L - micrograms per liter (equivalent to parts per billion)
VOCs - Volatile Organic Compounds
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
FVMW-22 and FVMW-22 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
NS - no established standard
< less than the specified detection limit
\- sample either not analyzed for specific parameter or not reported for specific parameter

Table 2
PAH - Groundwater Analytical Table
AMCAST CENTRAL & AMCAST SOUTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	AMSMW-01		GMMW-1		GMMW-2		GMMW-3				GMMW-4				NR 140 Preventive Action Limit (PAL)	NR 140 Enforcement Standard (ES)
Sample Collection Date	09/22/11	11/19/18	09/20/11	11/19/18	09/20/11	11/19/18	12/04/03	01/12/04	09/20/11	11/19/18	12/03/03	01/12/04	09/21/11	11/19/18		
Polycyclic Aromatic Hydrocarbons (PAHs)																
1,2,4-Trichlorobenzene	0.5 U	<1.9	0.5 U	<1.9	0.5 U	<1.9	-	-	0.5 U	<19.2	-	-	0.5 U	<25.0	*14*	**70**
1,2-Dichlorobenzene	0.5 U	<1.8	0.5 U	<1.8	0.5 U	<1.8	-	-	0.5 U	<18.2	-	-	0.5 U	<23.7	*60*	**600**
1,3-Dichlorobenzene	0.5 U	<1.8	0.5 U	<1.8	0.5 U	<1.8	-	-	0.5 U	<17.8	-	-	0.5 U	<23.1	*120*	**600**
1,4-Dichlorobenzene	0.5 U	<1.8	0.5 U	<1.8	0.5 U	<1.8	-	-	0.5 U	<17.7	-	-	0.5 U	<23.0	*15*	**75**
2,2'-Oxybis(1-chloropropane)	5 U	<1.4	5 U	<1.4	5 U	<1.4	-	-	5 U	<14.4	-	-	5 U	<18.7	NS	NS
2,4,5-Trichlorophenol	5 U	<0.79	5 U	<0.79	5 U	<0.79	-	-	5 U	<7.9	-	-	5 U	<10.3	NS	NS
2,4,6-Trichlorophenol	5 U	<2.0	5 U	<2.0	5 U	<2.0	-	-	5 U	<19.9	-	-	5 U	<25.9	NS	NS
2,4-Dichlorophenol	5 U	<1.3	5 U	<1.3	5 U	<1.3	-	-	5 U	<12.9	-	-	5 U	<16.8	NS	NS
2,4-Dimethylphenol	5 U	<1.2	5 U	<1.2	5 U	<1.2	-	-	0.48 J	<11.9	-	-	5 U	<15.5	NS	NS
2,4-Dinitrophenol	10 U	<0.67	10 U	<0.67	10 U	<0.67	-	-	10 U	<6.7	-	-	10 U	<8.7	NS	NS
2,4-Dinitrotoluene	5 U	<0.75	5 U	<0.75	5 U	<0.75	-	-	5 U	<7.5	-	-	5 U	<9.7	*0.005*	**0.05**
2,6-Dinitrotoluene	5 U	<0.57	5 U	<0.57	5 U	<0.57	-	-	5 U	<5.7	-	-	5 U	<7.4	*0.005*	**0.05**
2-Chloronaphthalene	5 U	<1.6	5 U	<1.6	5 U	<1.6	-	-	5 U	<15.5	-	-	5 U	<20.2	NS	NS
2-Chlorophenol	5 U	<1.1	5 U	<1.1	5 U	<1.1	-	-	5 U	<10.9	-	-	5 U	<14.2	NS	NS
2-Methylnaphthalene	0.1 U	<1.4	0.1 U	<1.4	0.1 U	<1.4	-	-	2 U	185	-	-	0.1 U	<18.6	NS	NS
2-Methylphenol(o-Cresol)	5 U	<0.82	5 U	<0.82	5 U	<0.82	-	-	0.31 J	<8.2	-	-	5 U	<10.6	NS	NS
2-Nitroaniline	10 U	<0.73	10 U	<0.73	10 U	<0.73	-	-	10 U	<7.3	-	-	10 U	<9.5	NS	NS
2-Nitrophenol	5 U	<1.1	5 U	<1.1	5 U	<1.1	-	-	5 U	<11.0	-	-	5 U	<14.3	NS	NS
3&4-Methylphenol(m&p Cresol)	5 U	<1.5	5 U	<1.5	5 U	<1.5	-	-	5 U	<14.7	-	-	5 U	<19.2	NS	NS
3,3'-Dichlorobenzidine	5 U	<0.85	5 U	<0.85	5 U	<0.85	-	-	5 U	<8.5	-	-	5 U	<11.1	NS	NS
3-Nitroaniline	10 U	<0.91	10 U	<0.91	10 U	<0.91	-	-	10 U	<9.1	-	-	10 U	<11.9	NS	NS
4,6-Dinitro-2-methylphenol	10 U	<0.62	10 U	<0.62	10 U	<0.62	-	-	10 U	<6.2	-	-	10 U	<8.0	NS	NS
4-Bromophenylphenyl ether	5 U	<1.9	5 U	<1.9	5 U	<1.9	-	-	5 U	<18.6	-	-	5 U	<24.2	NS	NS
4-Chloro-3-methylphenol	5 U	<1.6	5 U	<1.6	5 U	<1.6	-	-	5 U	<15.9	-	-	5 U	<20.7	NS	NS
4-Chloroaniline	5 U	<1.0	5 U	<1.0	5 U	<1.0	-	-	5 U	<10.3	-	-	10 U	<13.5	NS	NS
4-Chlorophenylphenyl ether	5 U	<0.77	5 U	<0.77	5 U	<0.77	-	-	5 U	<7.7	-	-	5 U	<10.0	NS	NS
4-Nitroaniline	10 U	<1.7	10 U	<1.7	10 U	<1.7	-	-	10 U	<17.3	-	-	5 U	<22.5	NS	NS
4-Nitrophenol	10 U	<0.99	10 U	<0.99	10 U	<0.99	-	-	10 U	<9.9	-	-	10 U	<12.8	NS	NS
Acenaphthene	0.1 U	<1.3	0.1 U	<1.3	0.1 U	<1.3	9.3	12	4.6	21.9 J	-	-	0.1 U	<16.4	NS	NS
Acenaphthylene	0.1 U	<1.0	0.1 U	<1.0	0.1 U	<1.0	-	-	0.77 J	<10.0	-	-	0.1 U	<13.0	NS	NS
Anthracene	0.02 J	<1.7	0.1 U	<1.7	0.08 J	<1.7	-	-	0.31 J	<17.0	-	-	0.1 U	<22.1	*600*	**3,000**
Benzo(a)anthracene	0.1 U	<0.50	0.1 U	<0.50	0.1 U	<0.50	-	-	1 U	<5.0	12	8.5	0.07 J	86.2	NS	NS
Benzo(a)pyrene	0.1 U	<1.8	0.1 U	<1.8	0.1 U	<1.8	-	-	1 U	<17.8	**19**	**16**	*0.08 J*	**162**	*0.02*	**0.2**
Benzo(b)fluoranthene	0.1 U	<0.62	0.1 U	<0.62	0.1 U	<0.62	-	-	1 U	<6.2	**28**	**24**	*0.19*	**321**	*0.02*	**0.2**
Benzo(g,h,i)perylene	0.1 U	<0.76	0.1 U	<0.76	0.1 U	<0.76	-	-	1 U	<7.6	19	13	0.1 J	167	NS	NS
Benzo(k)fluoranthene	0.1 U	<0.95	0.1 U	<0.95	0.1 U	<0.95	-	-	1 U	<9.5	24	19	0.05 J	118	NS	NS
Butylbenzylphthalate	5 U	<0.73	5 U	<0.73	5 U	<0.73	-	-	5 U	<7.3	-	-	5 U	<9.5	NS	NS
Carbazole	5 U	<0.71	5 U	<0.71	5 U	<0.71	4.8	4.3	5.2	<7.1	3.1	2.3	5 U	18.1 J	NS	NS
Chrysene	0.1 U	<1.6	0.1 U	<1.6	0.1 U	<1.6	-	-	1 U	<16.4	**27**	**23**	*0.15*	**199**	*0.02*	**0.2**
Di-n-butylphthalate	0.47 J	<2.4	5 U	<2.4	0.15 J	<2.4	-	-	0.24 J	<24.2	-	-	5 U	<31.4	NS	NS
Di-n-octylphthalate	5 U	<1.8	5 U	<1.8	5 U	<1.8	-	-	5 U	<17.9	-	-	5 U	<23.2	NS	NS
Dibenz(a,h)anthracene	0.1 U	<1.2	0.1 U	<1.2	0.1 U	<1.2	-	-	1 U	<12.5	-	-	0.01 J	34.2 J	NS	NS
Dibenzofuran	5 U	<0.72	5 U	<0.72	5U	<0.72	5.4	7.1	3.4 J	12.0 J	-	-	5 U	<9.4	NS	NS
Diethylphthalate	5 U	<1.0	5 U	<1.0	5 U	<1.0	-	-	5 U	<10.2	-	-	5 U	<13.3	NS	NS
Dimethylphthalate	5 U	<1.8	5 U	<1.8	5 U	<1.8	-	-	5 U	<18.2	-	-	5 U	<23.7	NS	NS
Fluoranthene	0.1 U	<0.53	0.1 U	<0.53	0.1 U	<0.53	-	-	1 U	<5.3	50	43	0.29	**385**	*80*	**400**
Fluorene	0.1 U	<0.71	0.1 U	<0.71	0.1 U	<0.71	9.2	13	3.9	21.1 J	-	-	0.1 U	<9.2	*80*	**400**
Hexachloro-1,3-butadiene	5 U	<2.3	5 U	<2.3	5 U	<2.3	-	-	5 U	<23.2	-	-	5 U	<30.2	NS	NS
Hexachlorobenzene	5 U	<1.6	5 U	<1.6	5 U	<1.6	-	-	5 U	<16.0	-	-	5 U	<20.8	*0.1*	**1**
Hexachlorocyclopentadiene	5 U	<0.64	5 U	<0.64	5 U	<0.64	-	-	5 U	<6.4	-	-	5 U	<8.3	NS	NS
Hexachloroethane	5 U	<2.5	5 U	<2.5	5 U	<2.5	-	-	17	<25.1	-	-	5 U	<32.6	NS	NS
Indeno(1,2,3-cd)pyrene	0.1 U	<1.4	0.1 U	<1.4	0.1 U	<1.4	-	-	1 U	<14.1	21	17	0.12	184	NS	NS
Isophorone	5 U	<0.69	5 U	<0.69	5 U	<0.69	-	-	5 U	<6.9	-	-	5 U	<9.0	NS	NS
N-Nitroso-di-n-propylamine	5 U	<0.92	5 U	<0.92	5 U	<0.92	-	-	5 U	<9.2	-	-	5 U	<11.9	NS	NS
N-Nitrosodiphenylamine	5 U	<3.3	5 U	<3.3	5 U	<3.3	-	-	5 U	<33.3	-	-	5 U	<43.3	*0.7*	**7**
Naphthalene	0.1 U	<1.8	0.1 U	3.7 J	0.1 U	<1.8	*17*	*17*	*13 J*	**223**	-	-	0.1 U	<23.3	*10*	**100**
Nitrobenzene	5 U	<1.4	5 U	<1.4	5 U	<1.4	-	-	5 U	<13.7	-	-	5 U	<17.8	NS	NS
Pentachlorophenol	0.2 U	**3.6 J**	0.2 U	<1.4	0.02 J	<1.4	-	-	2 U	<13.5	-	-	0.02 J	<17.6	*0.1*	**1**
Phenanthrene	0.1 U	<1.7	0.1 U	<1.7	0.1 U	<1.7	-	15	2.9	<17.2	17	14	0.2 U	92.4	NS	NS
Phenol	5 U	<0.57	5 U	<0.57	5 U	<0.57	-	-	5 U	<5.7	-	-	5 U	<7.4	*400*	**2,000**
Pyrene	0.1 U	<1.3	0.1 U	<1.3	0.1 U	<1.3	-	-	1 U	<12.7	36	29	0.23	**308**	*50*	**250**
bis(2-Chloroethoxy)methane	5 U	<0.94	5 U	<0.94	5 U	<0.94	-	-	5 U	<9.4	-	-	5U	<12.2	NS	NS
bis(2-Chloroethyl) ether	5 U	<1.5	5 U	<1.5	5 U	<1.5	-	-	5 U	<14.9	-	-	5 U	<19.4	NS	NS
n-Propylbenzene	-	-	-	-	-	-	-	7.7	-	-	-	-	-	-	NS	NS
Acetophenone	5 U	-	5 U	-	5 U	-	9.3	12	5 U	-	-	-	5 U	-	NS	NS
Benzaidehyde	5 U	-	5 U	-	5 U	-	-	-	5 U	-	-	-	5 U	-	NS	NS
Caprolactam	0.28 J	-	5 U	-	0.25 J	-	-	-	5 U	-	-	-	0.38 J	-	NS	NS
Chlorophenpls	5 U	-	5 U	-	5 U	-	-	-	5 U	-	-	-	5 U	-	NS	NS
1,1 Biphenyl	5 U	-	5 U	-	5 U	-	-	-	5.4	-	-	-	5 U	-	NS	NS
1,2,4,5 tetrachlorobenzene	5 U	-	5 U	-	5 U	-	-	-	5 U	-	-	-	5 U	-	NS	NS
bis(2-Ethylhexyl)phthalate	25 U	<0.65	25 U	**12.6**	25 U	<0.65	**86**	**730**	25 U	**15 J**	**220**	**35**	25 U	<8.5	*0.6*	**6**

Note:

ug/L - micrograms per liter (equivalent to parts per billion)
PAHs - Polycyclic Aromatic Hydrocarbons
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
(R) - The data are unusable (the compound may or may not be present)
NS - no established standard
< less than the specified detection limit
- sample either not analyzed for specific parameter or not reported for specific parameter

FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

Table 2
PAH - Groundwater Analytical Table
AMCAST CENTRAL & AMCAST SOUTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	GMMW-5			GMMW-6		GMMW-7			FVMW-20		FVMW-21	NR 140 Preventive Action Limit (PAL)	NR 140 Enforcement Standard (ES)
Sample Collection Date	01/12/04	09/22/11	11/19/18	09/22/11	11/19/18	12/03/03	09/21/11	11/19/18	09/20/11	11/19/18	12/03/03		
Polycyclic Aromatic Hydrocarbons (PAHs)													
1,2,4-Trichlorobenzene	-	0.5 U	<1.9	0.5 U	<1.9	-	0.5 U	<1.9	0.5 U	<1.9	-	*14*	**70**
1,2-Dichlorobenzene	-	0.5 U	<1.8	0.5 U	<1.8	-	0.5 U	<1.8	0.5 U	<1.8	-	*60*	**600**
1,3-Dichlorobenzene	-	5.0 U	<1.8	0.5 U	<1.8	-	0.5 U	<1.8	0.5 U	<1.8	-	*120*	**600**
1,4-Dichlorobenzene	-	10.0 U	<1.8	0.5 U	<1.8	-	0.5 U	<1.8	0.5 U	<1.8	-	*15*	**75**
2,2'-Oxybis(1-chloropropane)	-	5 U	<1.4	5 U	<1.4	-	5 J	<1.4	5 U	<1.4	-	NS	NS
2,4,5-Trichlorophenol	-	5 U	<0.79	5 U	<0.79	-	5	<0.79	5 U	<0.79	-	NS	NS
2,4,6-Trichlorophenol	-	5 U	<2.0	5 U	<2.0	-	5 U	<2.0	5 U	<2.0	-	NS	NS
2,4-Dichlorophenol	-	5 U	<1.3	5 U	<1.3	-	5 U	<1.3	5 U	<1.3	-	NS	NS
2,4-Dimethylphenol	-	5 U	<1.2	5 U	<1.2	-	5 U	<1.2	5 U	<1.2	-	NS	NS
2,4-Dinitrophenol	-	10 U	<0.67	10 U	<0.67	-	10 U	<0.67	10 U	<0.67	-	NS	NS
2,4-Dinitrotoluene	-	5 U	<0.75	5 U	<0.75	-	5 U	<0.75	5 U	<0.75	-	*0.005*	**0.05**
2,6-Dinitrotoluene	-	5 U	<0.57	5 U	<0.57	-	5 U	<0.57	5 U	<0.57	-	*0.005*	**0.05**
2-Chloronaphthalene	-	5 U	<1.6	5 U	<1.6	-	5 U	<1.6	5 U	<1.6	-	NS	NS
2-Chlorophenol	-	5 U	<1.1	5 U	<1.1	-	5 U	<1.1	5 U	<1.1	-	NS	NS
2-Methylnaphthalene	-	0.1 U	<1.4	0.01 J	<1.4	-	0.10 U	<1.4	0.1 U	<1.4	-	NS	NS
2-Methylphenol(o-Cresol)	-	5 U	<0.82	5 U	<0.82	-	5 U	<0.82	5 U	<0.82	-	NS	NS
2-Nitroaniline	-	10 U	<0.73	10 U	<0.73	-	10 U	<0.73	10 U	<0.73	-	NS	NS
2-Nitrophenol	-	5 U	<1.1	5 U	<1.1	-	5 U	<1.1	5 U	<1.1	-	NS	NS
3&4-Methylphenol(m&p Cres	-	5 U	<1.5	5 U	<1.5	-	5 U	<1.5	5 U	<1.5	-	NS	NS
3,3'-Dichlorobenzidine	-	5 U	<0.85	5 U	<0.85	-	5 U	<0.85	5 U	<0.85	-	NS	NS
3-Nitroaniline	-	10 U	<0.91	10 U	<0.91	-	10 U	<0.91	10 U	<0.91	-	NS	NS
4,6-Dinitro-2-methylphenol	-	10 U	<0.62	10 U	<0.62	-	10 U	<0.62	10 U	<0.62	-	NS	NS
4-Bromophenylphenyl ether	-	5 U	<1.9	5 U	<1.9	-	5 U	<1.9	5 U	<1.9	-	NS	NS
4-Chloro-3-methylphenol	-	5 U	<1.6	5 U	<1.6	-	5 U	<1.6	5 U	<1.6	-	NS	NS
4-Chloroaniline	-	10 U	<1.0	5 U	<1.0	-	5 U	<1.0	5 U	<1.0	-	NS	NS
4-Chlorophenylphenyl ether	-	5 U	<0.77	5 U	<0.77	-	5 U	<0.77	5 U	<0.77	-	NS	NS
4-Nitroaniline	-	5 U	<1.7	10 U	<1.7	-	10 U	<1.7	10 U	<1.7	-	NS	NS
4-Nitrophenol	-	10 U	<0.99	10 U	<0.99	-	10 U	<0.99	10 U	<0.99	-	NS	NS
Acenaphthene	-	0.0 U	<1.3	0.1 U	<1.3	-	0.1 U	<1.3	0.1 U	<1.3	-	NS	NS
Acenaphthylene	-	0.1 U	<1.0	0.1 U	<1.0	-	0.1 U	<1.0	0.1 U	<1.0	-	NS	NS
Anthracene	-	0.0 U	<1.7	0.1 U	<1.7	-	0.1 U	<1.7	0.1 U	<1.7	-	*600*	**3,000**
Benzo(a)anthracene	-	0.10 J	<0.50	0.1 U	<0.50	-	0.1 U	<0.50	0.1 U	<0.50	-	NS	NS
Benzo(a)pyrene	-	0.10 J	<1.8	0.1 U	<1.8	-	0.1 U	<1.8	0.1 U	<1.8	-	*0.02*	**0.2**
Benzo(b)fluoranthene	-	0.1	<0.62	0.1 U	<0.62	-	0.1 U	<0.62	0.1 U	<0.62	-	*0.02*	**0.2**
Benzo(g,h,i)perylene	-	0.1 J	<0.76	0.1 U	<0.76	-	0.1 U	<0.76	0.1 U	<0.76	-	NS	NS
Benzo(k)fluoranthene	-	0.10 J	<0.95	0.1 U	<0.95	-	0.1 U	<0.95	0.1 U	<0.95	-	NS	NS
Butylbenzylphthalate	-	5 U	<0.73	5 U	<0.73	-	5 U	<0.73	5 U	<0.73	-	NS	NS
Carbazole	-	5 U	<0.71	5 U	<0.71	-	5 U	<0.71	5 U	<0.71	-	NS	NS
Chrysene	-	0.1	<1.6	0.1 U	<1.6	-	0.1 U	<1.6	0.1 U	<1.6	-	*0.02*	**0.2**
Di-n-butylphthalate	-	5 U	<2.4	0.22 J	<2.4	-	5 U	<2.4	5 U	<2.4	-	NS	NS
Di-n-octylphthalate	-	5 U	<1.8	5 U	<1.8	-	5 U	<1.8	5 U	<1.8	-	NS	NS
Dibenz(a,h)anthracene	-	0.10 J	<1.2	0.1 U	<1.2	-	0.1 U	<1.2	0.1 U	<1.2	-	NS	NS
Dibenzofuran	-	5 U	<0.72	5 U	<0.72	-	5 U	<0.72	5 U	<0.72	-	NS	NS
Diethylphthalate	-	5 U	<1.0	5 U	<1.0	-	5 U	<1.0	5 U	<1.0	-	NS	NS
Dimethylphthalate	-	5 U	<1.8	5 U	<1.8	-	5 U	<1.8	5 U	<1.8	-	NS	NS
Fluoranthene	-	0.03	<0.53	0.1 U	<0.53	-	0.1 U	<0.53	0.1 U	<0.53	-	*80*	**400**
Fluorene	-	0.1 U	<0.71	0.1 U	<0.71	-	0.1 U	<0.71	0.1 U	<0.71	-	*80*	**400**
Hexachloro-1,3-butadiene	-	5 U	<2.3	5 U	<2.3	-	5 U	<2.3	5 U	<2.3	-	NS	NS
Hexachlorobenzene	-	5 U	<1.6	5 U	<1.6	-	5 U	<1.6	5 U	<1.6	-	*0.1*	**1**
Hexachlorocyclopentadiene	-	5 U	<0.64	5 U	<0.64	-	5 U	<0.64	5 U	<0.64	-	NS	NS
Hexachloroethane	-	5 U	<2.5	5 U	<2.5	-	5 U	<2.5	5 U	<2.5	-	NS	NS
Indeno(1,2,3-cd)pyrene	-	0.1	<1.4	0.1 U	<1.4	-	0.1 U	<1.4	0.1 U	<1.4	-	NS	NS
Isophorone	-	5 U	<0.69	5 U	<0.69	-	5 U	<0.69	5 U	<0.69	-	NS	NS
N-Nitroso-di-n-propylamine	-	5 U	<0.92	5 U	<0.92	-	5 U	<0.92	5 U	<0.92	-	NS	NS
N-Nitrosodiphenylamine	-	5 U	<3.3	5 U	<3.3	-	5 U	<3.3	5 U	<3.3	-	*0.7*	**7**
Naphthalene	-	0.1 U	<1.8	0.01 J	<1.8	-	0.10 U	<1.8	0.1 U	<1.8	-	*10*	**100**
Nitrobenzene	-	5 U	<1.4	5 U	<1.4	-	5 U	<1.4	5 U	<1.4	-	NS	NS
Pentachlorophenol	-	0.02 J	<1.4	*0.18 J*	<1.4	-	0.20 U	<1.4	0.2 U	**3.9 J**	-	*0.1*	**1**
Phenanthrene	-	0.1 U	<1.7	0.1 U	<1.7	-	0.1 U	<1.7	0.1 U	<1.7	-	NS	NS
Phenol	-	5 U	<0.57	5 U	<0.57	-	5 U	<0.57	5 U	<0.57	-	*400*	**2,000**
Pyrene	-	0.02	<1.3	0.1 U	<1.3	-	0.1 U	<1.3	0.1 U	<1.3	-	*50*	**250**
bis(2-Chloroethoxy)methane	-	5U	<0.94	5 U	<0.94	-	5 U	<0.94	5 U	<0.94	-	NS	NS
bis(2-Chloroethyl) ether	-	5 U	<1.5	5 U	<1.5	-	5 U	<1.5	5 U	<1.5	-	NS	NS
n-Propylbenzene	-	-	-	-	-	-	-	-	-	-	-	NS	NS
Acetophenone	-	5 U	-	5 U	-	-	5 U	-	5 U	-	-	NS	NS
Benzaidehyde	-	5 U	-	5 U	-	-	5 U	-	5 U	-	-	NS	NS
Caprolactam	-	5 U	-	0.38 J	-	-	0.2 J	-	5 U	-	-	NS	NS
Chlorophenpls	-	5 U	-	5 U	-	-	5 U	-	5 U	-	-	NS	NS
1,1 Biphenyl	-	5 U	-	5 U	-	-	5 U	-	5 U	-	-	NS	NS
1,2,4,5 tetrachlorobenzene	-	5 U	-	5 U	-	-	5 U	-	5 U	-	-	NS	NS
bis(2-Ethylhexyl)phthalate	*5.1*	25 U	<0.65	25 U	*0.71 J*	**62**	25 U	<0.65	25 U	*2.1 J*	**33**	*0.6*	**6**

Note:

ug/L - micrograms per liter (equivalent to parts per billion)
PAHs - Polycyclic Aromatic Hydrocarbons
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
(R) - The data are unusable (the compound may or may not be present)
NS - no established standard
< less than the specified detection limit
\- sample either not analyzed for specific parameter or not reported for specific parameter
FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

Table 3

RCRA Metals - Groundwater Analytical Table

AMCAST CENTRAL & AMCAST SOUTH- J16001

N39 W5789 Hamilton Road, Cedarburg WI

Well ID	AMSW-01	GMMW-1	GMMW-2	GMMW-3	GMMW-4	GMMW-5	GMMW-6	GMMW-7	FVMW-20	**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	11/19/18	11/19/18	11/19/18	11/19/18	11/19/18	11/19/18	11/19/18	11/19/18	11/19/18		
Total Metals (ug/L)											
Arsenic, Total	**221**	<8.3	<8.3	*9.3 J*	**14.2 J**	**173**	<8.3	<8.3	<8.3	*1*	**10**
Barium, Total	*530*	*121*	75.8	113	219	300	178	214	131	*400*	**2,000**
Cadmium, Total	<1.3	<1.3	<1.3	<1.3	*1.4 J*	<1.3	<1.3	<1.3	<1.3	*0.5*	**5**
Chromium, Total	**123**	7.1 J	*17.8*	3.5 J	*64.3*	*81.9*	*14.6*	*20.7*	*17.1*	*10*	**100**
Lead, Total	**42.4**	<5.9	<5.9	<5.9	**90.2**	**25.6**	<5.9	<5.9	<5.9	*1.5*	**15**
Silver, Total	<12.2	<12.2	<12.2	<12.2	<12.2	<12.2	<12.2	<12.2	<12.2	*10*	**20**
Selenium, Total	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	<3.3	*10*	**50**
Mercury, Total	*1.3*	<0.084	<0.084	<0.084	0.093 J	0.084 J	<0.084	<0.084	<0.084	*0.2*	**2**

Well ID	AMSW-01	GMMW-1		GMMW-2		GMMW-3		GMMW-4		GMMW-5		GMMW-6		GMMW-7		FVMW-20	**NR 140 Preventive Action Limit (PAL)**	**NR 140 Enforcement Standard (ES)**
Sample Collection Date	11/19/18	11/18/93	11/19/18	11/18/93	11/19/18	11/18/93	11/19/18	11/18/93	11/19/18	11/18/93	11/19/18	11/18/93	11/19/18	11/18/93	11/19/18	11/19/18		
Dissolved Metals (ug/L)																		
Arsenic, Dissolved	<8.3	<10	<8.3	<10	<8.3	<10	8.7 J	<10	<8.3	<10	<8.3	<10	<8.3	<10	<8.3	<8.3	*1*	**10**
Barium, Dissolved	183	*600*	99.2	340	65.9	150	79.3	160	83.1	<120	108	<120	115	190	143	60.7	*400*	**2,000**
Cadmium, Dissolved	<1.3	<5	<1.3	<5	<1.3	<5	<1.3	<5	<1.3	<5	<1.3	<5	<1.3	<5	<1.3	<1.3	*0.5*	**5**
Chromium, Dissolved	<2.5	<10	3.1 J	<10	4.3 J	<10	<2.5	<10	<2.5	<10	<2.5	<10	<2.5	<10	<2.5	2.9 J	*10*	**100**
Lead, Dissolved	<5.9	<5	<5.9	<5	<5.9	<5	<5.9	<5	<5.9	<5	<5.9	<5	<5.9	<5	<5.9	<5.9	*1.5*	**15**
Silver, Dissolved	<12.2	<0.2	<12.2	<0.2	<12.2	<0.2	<12.2	<0.2	<12.2	<0.2	<12.2	<0.2	<12.2	<0.2	<12.2	<12.2	*10*	**50**
Selenium, Dissolved	<3.3	<10	<3.3	<10	<3.3	<10	<3.3	<10	<3.3	<10	<3.3	<10	<3.3	<10	<3.3	<3.3	*10*	**50**
Mercury, Dissolved	*0.94*	<10	<0.084	<10	<0.084	<10	<0.084	<10	*0.3*	<10	*0.26 J*	<10	<0.084	<10	<0.084	<0.084	*0.2*	**2**

Note:

ug/L - micrograms per liter (equivalent to parts per billion)

ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140

PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140

Bold - concentration exceeds NR 140 ES

Italics - concentration exceeds NR 140 PAL

< less than the specified detection limit

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit

FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

Table 3.b
Metals - Groundwater Analytical Table
AMCAST CENTRAL & AMCAST SOUTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	Sample Collection Date	Aluminium	Antimony	Arsenic	Barium	Beryllium	Cadmium	Calcium	Chromium	Cobalt	Copper	Iron	Lead (Total/ Dissolved)	Magnesium	Manganese	Mercury	Nickel	Potassium	Selenium	Silver	Sodium	Thallium	Vanadium	Zinc
AMSW-01	09/22/11	20 U	2 U	*3.3*	210	1 U	1 U	139,000	*17.2*	7.6	4.9 U	1,240	1 U	725,000	**1,120**	0.2 U	13.5	4,370 J	5 U	1 U	116,000	1 U	5.3	15.1
GMMW-1	12/03/03	-	-	-	-	-	-	-	*14*	-	-	-	*7*	-	-	-	-	-	-	-	-	-	-	-
	12/04/03	-	-	-	-	-	-	-	1.2(D)	-	-	-	*3.2(D)*	-	-	-	-	-	-	-	-	-	-	-
	01/12/04	-	-	-	-	-	-	-	6.8/1.5(D)	-	-	-	*5.7*	-	-	-	-	-	-	-	-	-	-	-
	09/20/11	20 U	2 U	*8.1*	64.7	1 U	1 U	67,300	3.6	1 U	2.8	200 UJ	1 U	26,300	1 UJ	0.2 U	2.2	5,000	5 U	1 U	255,000	1 U	5 U	2.3
GMMW-2	12/03/03	-	-	-	-	-	-	-	4.6	-	-	-	*6.2*	-	-	-	-	-	-	-	-	-	-	-
	12/05/03	-	-	-	-	-	-	-	6.2(D)	-	-	-	*2.3(D)*	-	-	-	-	-	-	-	-	-	-	-
	01/12/04	-	-	-	-	-	-	-	3.8/5.5(D)	-	-	-	*4.9/3.7(D)*	-	-	-	-	-	-	-	-	-	-	-
	09/20/11	20 U	2 U	*7.1*	161	1 U	1 U	124,000	6	1 U	4.2	200 UJ	1 U	53,600	1.6 J+	0.2 U	1.5	5,000 U	5 U	1 U	357,000	1 U	2.8 J	2.9
GMMW-3	12/04/03	-	-	**61/89(D)**	-	-	-	-	-	-	-	-	*2.6/2.1(D)*	-	-	-	-	-	-	-	-	-	-	-
	01/12/04	-	-	**28/10(D)**	-	-	-	-	1.2/1.1(D)	-	-	-	*2.7*	-	-	-	-	-	-	-	-	-	-	-
	09/20/11	20 U	2 U	**16.6**	89.8	1 U	1 U	21,100	2.8	1 U	1.7 J	1,120	1 U	203,000	11.5 J	0.2 U	2.2	20,000	5 U	1 U	292,000	1 U	5 U	2 U
GMMW-4	12/03/03	-	-	-	-	-	*0.97*	-	*48*	-	-	-	**74**	-	-	-	-	-	-	-	-	-	-	-
	12/04/03	-	-	-	-	-	-	-	1 (D)	-	-	-	*1.8(D)*	-	-	-	-	-	-	-	-	-	-	-
	01/12/04	-	-	*4.2*	-	-	*0.68*	-	*51*	-	-	-	**80/1.9(D)**	-	-	-	-	-	-	-	-	-	-	-
	09/21/11	20 U	2 U	**13.3**	121	1 U	1 U	129,000	2.2	3.6	2.7	785	1 U	109,000	**485 J**	0.2 U	7	5,000 U	5 U	1 U	220,000	1 U	5 U	1.6 J
GMMW-5	12/02/03	-	-	-	-	-	-	-	1.6/1.0(D)	-	-	-	*2.3/2.3(D)*	-	-	-	-	-	-	-	-	-	-	-
	01/12/04	-	-	-	-	-	-	-	2.1/1.3(D)	-	-	-	*1.6/3.8(D)*	-	-	-	-	-	-	-	-	-	-	-
	09/22/11	20 U	2 U	0.76 J	115	1 U	1 U	107,000	*17.9*	1 U	4.9 U	200 UJ	1 U	987,000	0.96 J	0.2 U	2.2	5,000 U	5 U	1 U	264,000	1 U	5.4	6.3
GMMW-6	09/22/11	20 U	2 U	1U	120	1 U	1 U	128,000	*11.5*	1 U	4.9 U	200 UJ	1 U	55,700	1.1	0.2 U	1.7	6,470	5 U	1 U	139,000	1 U	3.9 J	3.5
GMMW-7	12/03/03	-	-	-	-	-	-	-	1.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	12/05/03	-	-	-	-	-	-	-	1.1(D)	-	-	-	*1.8(D)*	-	-	-	-	-	-	-	-	-	-	-
	01/12/04	-	-	-	-	-	-	-	1.9/1.7(D)	-	-	-	*2.1/2.1(D)*	-	-	-	-	-	-	-	-	-	-	-
	09/21/11	20 U	2 U	*7.2*	119	1 U	1 U	135,000	1.7 J	1 U	2.4	200 UJ	1 U	54,400	1.7 J+	0.2 U	1.7	5,000 U	5 U	1 U	120,000	1 U	5 U	3.5
FVMW-20	12/02/03	-	-	-	-	-	-	-	5.9	-	-	-	*3.7*	-	-	-	-	-	-	-	-	-	-	-
	12/05/03	-	-	-	-	-	-	-	5.2(D)	-	-	-	*3.2*	-	-	-	-	-	-	-	-	-	-	-
	01/13/04	-	-	-	-	-	-	-	7.7/6.1(D)	-	-	-	*1.6*	-	-	-	-	-	-	-	-	-	-	-
	09/20/11	20 U	2 U	*8.7*	105	1 U	1 U	84,700	7.7	1 U	4.6	200	1 U	42,900	1 UJ	0.2 U	1.2	3,320	5 U	1 U	305,000	1 U	5 U	2.6
FVMW-21	12/03/03	-	-	-	-	-	-	-	*40*	-	-	-	*10*	-	-	-	-	-	-	-	-	-	-	-
	12/05/03	-	-	-	-	-	-	-	*46(D)*	-	-	-	*2 (D)*	-	-	-	-	-	-	-	-	-	-	-
	01/13/04	-	-	*7.2*	-	-	-	-	*70/35(D)*	-	-	-	**17/2.2(D)**	-	-	-	-	-	-	-	-	-	-	-
NR 140 Preventive Action Limit (PAL)		*40*	*1.2*	*1*	*400*	*0.4*	*0.5*	NS	*10*	*8*	*130*	NS	*1.5*	NS	*60*	*0.2*	*20*	NS	*10*	*10*	NS	*0.4*	*6*	NS
NR 140 Enforcement Standard (ES)		**200**	**6**	**10**	**2,000**	**4**	**5**	NS	**100**	**40**	**1,300**	NS	**15**	NS	**300**	**2**	**100**	NS	**50**	**50**	NS	**2**	**30**	NS

Note:
ug/L - micrograms per liter (equivalent to parts per billion)
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
< less than the specified detection limit
FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
NS - no established standard
\- sample either not analyzed for specific parameter or not reported for specific parameter
(D) - analytical report identified that this sample was dissolved
Results were reported without distinction of disssolved or total metals, as such the analysis is unknown unless otherwise noted

Table 4
Polychlorinated biphenyls (PCBs) - Groundwater Analytical Table
AMCAST CENTRAL & AMCAST SOUTH- J16001
N39 W5789 Hamilton Road, Cedarburg WI

Well ID	Sample Collection Date	PCB-1016 (Aroclor 1016)	PCB-1221 (Aroclor 1221)	PCB-1232 (Aroclor 1232)	PCB-1242 (Aroclor 1242)	PCB-1248 (Aroclor 1248)	PCB-1254 (Aroclor 1254)	PCB-1260 (Aroclor 1260)	PCB-1262 (Aroclor 1262)	PCB-1268 (Aroclor 1268)	**PCB, Total**
AMS-MW01	09/22/11	1 U	1 U	1 U	1 U	**1.5**	1 U	1 U	1 U	1 U	**1.5**
	11/19/18	<0.24	<0.24	<0.24	**2.8**	<0.24	<0.24	<0.24	-	-	**2.8**
GMMW-1	11/18/93	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-
	12/04/03	-	-	-	-	0 U	-	-	-	-	-
	01/12/04	-	-	-	-	0 U	-	-	-	-	-
	04/10/07	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-	-	<0.23
	09/20/11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	-
	11/19/18	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-	-	<0.24
GMMW-2	11/18/93	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-
	12/05/03	-	-	-	-	0 U	-	-	-	-	-
	01/12/04	-	-	-	-	0 U	-	-	-	-	-
	04/10/07	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-	-	<0.23
	09/20/11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	-
	11/19/18	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-	-	<0.24
GMMW-3	11/18/93	<1.0	<2.0	<1.0	<1.0	**2.3**	<1.0	<1.0	-	-	**2.3**
	12/04/03	-	-	-	-	0 U	-	-	-	-	-
	01/12/04	-	-	-	-	**1.6**	-	-	-	-	**1.6**
	04/10/07	<0.23	<0.23	<0.23	<0.23	**0.55**	<0.23	<0.23	-	-	**0.55**
	09/20/11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	-
	11/19/18	<0.24	<0.24	<0.24	<0.24	**5.5**	**2.7**	**0.61**	-	-	**8.81**
GMMW-4	11/18/93	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-
	12/03/03	-	-	-	-	0 U	-	-	-	-	-
	01/12/04	-	-	-	-	0 U	-	-	-	-	-
	04/10/07	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-	-	<0.23
	09/21/11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	-
	11/19/18	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-	-	<0.24
GMMW-5	11/18/93	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-
	12/02/03	-	-	-	-	0 U	-	-	-	-	-
	01/12/04	-	-	-	-	0 U	-	-	-	-	-
	04/10/07	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-	-	<0.23
	09/22/11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	-
	11/19/18	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-	-	<0.24
GMMW-6	11/18/93	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-
	04/10/07	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-	-	<0.23
	09/22/11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	-
	11/19/18	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-	-	<0.24
GMMW-7	11/18/93	<1.0	<2.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	-	-
	12/05/03	-	-	-	-	0 U	-	-	-	-	-
	01/12/04	-	-	-	-	0 U	-	-	-	-	-
	04/10/07	<0.23	<0.23	<0.23	**0.33**	<0.23	<0.23	<0.23	-	-	**0.33**
	09/21/11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	-
	11/19/18	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-	-	<0.24
FVMW-20	12/05/03	-	-	-	-	0 U	-	-	-	-	-
	01/13/04	-	-	-	-	0 U	-	-	-	-	-
	04/10/07	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	<0.23	-	-	<0.23
	09/20/11	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	-
	11/19/18	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	<0.24	-	-	<0.24
FVMW-21	12/05/03	-	-	-	-	0 U	-	-	-	-	-
	01/12/04	-	-	-	-	**0.3**	-	-	-	-	**0.3**
	04/10/07	<0.23	<0.23	<0.23	<0.23	**0.3**	<0.23	<0.23	-	-	**0.3**
NR 140 Preventive Action Limit (PAL)		NS	NS	NS	NS	NS	NS	NS	NS	NS	*0.003*
NR 140 Enforcement Standard (ES)		NS	NS	NS	NS	NS	NS	NS	NS	NS	**0.03**

Note:
ug/L - micrograms per liter (equivalent to parts per billion)
PCBs - Polychlorintated Biphenyls
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
FVMW-28 (not shown) well was observed to be "dry" during multiple sampling events - no groundwater samples have been recorded for this well

(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
(U) - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
NS - no established standard
< less than the specified detection limit
- sample either not analyzed for specific parameter or not reported for specific parameter

Table 5
NR 140 Exceedances - Groundwater Analytical Table
AMCAST CENTRAL & AMCAST SOUTH - J16001
N39 W5789 Hamilton Road, Cedarburg WI

Monitoring Well ID	AMSMW-1		GMMW-1						GMMW-2		GMMW-3						GMMW-4			
Sample Collection Date	09/22/11	11/19/18	11/18/93	12/03/03	01/12/04	04/10/07	09/20/11	11/19/18	09/20/11	11/19/18	11/18/93	12/04/03	01/12/04	04/10/07	09/20/11	11/19/18	12/03/03	01/12/04	09/21/11	11/19/18
Volatile Organic Compounds (ug/L)																				
Benzene	-	-	-	-	-	-	-	-	-	-	-	*3.8*	*3.7*	*1.2*	*1.4*	*0.56 J*	-	-	-	-
Bromodichloromethane	-	-	-	**1.4**	**1.2**	**1.4**	**1.1**	**0.61 J**	**1.1**	-	-	-	-	*0.56*	**1.1**	-	-	-	**1.1**	-
Chloroform	-	-	-	*1.1*	*1*	*1.7*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	*14*	*12*	*49*	-	**184**	-	-	-	-
1,2,4-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*114*	-	-	-	-
trans-1,3-Dichloropropene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)																				
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**19**	**16**	*0.08 J*	**162**
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**28**	**24**	*0.19*	**321**
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**27**	**23**	*0.15*	**199**
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pentachlorophenol	-	**3.6 J**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**308**
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	*17*	*17*	-	*13 J*	**223**	-	-	-	-
bis(2-Ethylhexyl)phthalate	-	-	-	-	-	-	-	**12.6**	-	-	-	**86**	**730**	-	-	**15 J**	**220**	**35**	-	-
Total Metals (ug/l)																				
Arsenic	*3.3*	**221**	-	-	-	-	*8.1*	-	*7.1*	-	-	**61/89(D)**	**28/10(D)**	-	**16.6**	*9.3 J*	-	*4.2*	**13.3**	**14.2 J**
Barium	-	*530*	*600*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.97*	*0.68*	-	*1.4 J*
Chromium, Total (Dissolved)	*17.2*	**123**	-	-	-	-	-	-	-	*17.8*	-	-	-	-	-	-	*48*	*51*	-	*64.3*
Lead, Total (Dissolved)	-	**42.4**	-	-	-	-	-	-	-	-	-	*2.6/2.1(D)*	*2.7*	-	-	-	**74**	**80/1.9(D)**	-	**90.2**
Mercury, Total (Dissolved)	-	*1.3 (0.94)*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.3*
Manganese	**1,120**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**485 J**	-
PCBs (ug/L)																				
PCB, Total	**1.5**	**2.8**	-	-	-	-	-	-	-	-	**2.3**	-	**1.6**	**0.55**	-	**8.81**	-	-	-	-

Monitoring Well ID	GMMW-5				GMMW-6		GMMW-7						FVMW-20						FVMW-21					NR 140 Preventive Action Limit (PAL)	NR 140 Enforcement Standard (ES)
Sample Collection Date	12/02/03	01/12/04	09/22/11	11/19/18	09/22/11	11/19/18	12/02/03	12/05/03	01/12/04	04/10/07	09/21/11	11/19/18	12/02/03	12/05/03	01/13/04	04/10/07	09/20/11	11/19/18	12/03/03	12/05/03	01/12/04	01/13/04	04/10/07		
Volatile Organic Compounds (ug/L)																									
Benzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.5*	**5**
Bromodichloromethane	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.06*	**0.6**
Chloroform	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.6*	**6**
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*10*	**100**
1,2,4-Trimethylbenzene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*96*	**480**
trans-1,3-Dichloropropene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.04*	**0.4**
Trichloroethene	-	-	-	-	-	-	-	-	-	-	-	-	*4.5*	-	*3.2*	*1.9*	*1.3*	*0.68 J*	-	-	-	-	-	*0.5*	**5**
Polycyclic Aromatic Hydrocarbons (PAHs)																									
Benzo(a)pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.02*	**0.2**
Benzo(b)fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.02*	**0.2**
Chrysene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.02*	**0.2**
Fluoranthene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*80*	**400**
Pentachlorophenol	-	-	-	-	*0.18 J*	-	-	-	-	-	-	-	-	-	-	-	-	**3.9 J**	-	-	-	-	-	*0.1*	**1**
Pyrene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*50*	**250**
Naphthalene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*10*	**100**
bis(2-Ethylhexyl)phthalate	-	*5.1*	-	-	*-*	*0.71 J*	**62**	-	-	-	-	-	-	-	-	-	-	*2.1 J*	-	-	-	-	-	*0.6*	**6**
Total Metals (ug/l)																									
Arsenic	-	-	-	**173**	-	-	-	-	-	-	*7.2*	-	-	-	-	-	*8.7*	-	-	-	-	*7.2*	-	*1*	**10**
Barium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*200*	**400**
Cadmium	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.5*	**5**
Chromium, Total (Dissolved)	-	-	*17.9*	*81.9*	*11.5*	*14.6*	-	-	-	-	-	*20.7*	-	-	-	-	-	*17.1*	*40*	*46(D)*	-	*70/35(D)*	-	*10*	**100**
Lead, Total (Dissolved)	*2.3/2.3(D)*	*1.6/3.8(D)*	-	**25.6**	-	-	-	*1.8(D)*	*2.1/2.1(D)*	-	-	-	*3.7*	*3.2*	*1.6*	-	-		*10*	*2 (D)*	-	**17/2.2(D)**	-	*1.5*	**15**
Mercury, Total (Dissolved)	-	-	-	*0.26 J*	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*0.2*	**2**
Manganese	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	*60*	**300**
PCBs (ug/L)																									
PCB, Total	-	-	-	-	-	-	-	-	-	**0.33**	-	-	-	-	-	-	-	-	-	-	**0.3**	-	**0.3**	*0.003*	**0.03**

Note:
ug/L - micrograms per liter (equivalent to parts per billion)
ES - enforcement standard, as established in Wisconsin Administrative Code Chapter NR 140
PAL - preventive action limit, as established in Wisconsin Administrative Code Chapter NR 140
Bold - concentration exceeds NR 140 ES
Italics - concentration exceeds NR 140 PAL
(J) - estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
\- sample either not analyzed for specific parameter or not reported for specific parameter

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