Final Field Sampling Plan
Amcast Industrial Corporation

Cedarburg, Wisconsin
Scope I.D.: 02A010

Amcast Industrial Corporation

September 2003

Foth & Van Dyke
consultants · engineers · scientists

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September 4, 2003

Mr. Scott Hansen
EPA Remedial Project Manager
U.S. Environmental Protection Agency
Region 5 (SR-6J)
77 W. Jackson Blvd.
Chicago, IL 60604

Dear Mr. Hansen:

RE: Final - Field Sampling Plan - Amcast Industrial Corporation Site
Cedarburg, Wisconsin

On behalf of Amcast Industrial Corporation, Foth & Van Dyke is providing to U.S. EPA this "Final Field Sampling Plan" (FSP). The report has been prepared in accordance with the Administrative Order on Consent dated February 28, 2003 and U.S. Environmental Protection Agency guidance documents. The Final FSP addresses the U.S. EPA comment letter dated August 5, 2003.

If you have any questions concerning this report, please contact us at (920) 497-2500.

Sincerely,

Foth & Van Dyke and Associates, Inc.

Steve Laszewski

Stephen V. Donohue, P.H.
Senior Project Manager

Steven J. Laszewski, Ph.D.
Associate

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Final Field Sampling Plan
Amcast Industrial Corporation Site
Cedarburg, Wisconsin

Distribution

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Final Field Sampling Plan
Amcast Industrial Corporation
Cedarburg, Wisconsin

Scope ID: 02A010

Prepared for
Amcast Industrial Corporation

Prepared by
Foth & Van Dyke and Associates, Inc.

September 2003

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Cedarburg, Wisconsin

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List of Abbreviations, Acronyms, and Symbols

Amcast	Amcast Industrial Corporation, Inc.
AOC/SOW	Administrative Order on Consent and Statement of Work
AOI	Areas of Investigation
ASTM	American Society for Testing and Materials
DO	Dissolved Oxygen
DQOs	Data Quality Objectives
Foth & Van Dyke	Foth & Van Dyke and Associates, Inc.
FSP	Field Sampling Plan
PCB	Polychlorinated Biphenyls
PID	Photo Ionization Detection
RI	Remedial Investigation
SVOCs	Semi-Volatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedures
TOC	Total Organic Carbon
TSS	Total Suspended Solids
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WDNR	Wisconsin Department of Natural Resources
WWTP	Wastewater Treatment Plant

1. Site Background

Amcast Industrial Corporation, Inc, (Amcast) owns two parcels referred to as the Amcast North and Amcast South Properties at N39 W5789 Hamilton Road in Cedarburg, Wisconsin. The Amcast North Property includes the aluminum foundry. The Amcast South Property includes an office building, Quonset building, parking lot and sedimentation basin. Oils containing PCB's were used in the aluminum foundry between 1966 and 1971. An area south of the office building includes an approximate two-acre fill area which contains demolition rubble and industrial materials from the razing of a former plant previously located on the Amcast South Property.

Past investigations at the Amcast South Property have reported the presence of PCBs in soils below the parking lot, the railroad right-of-way east of the parking lot, the fill and subsoils below the fill area, and the shallow groundwater. Similarly, investigations at the Amcast North Property have reported the past occurrence of PCBs in stormwater, the loading dock area, the properties north of the plant, and the city of Cedarburg storm sewer system. Other studies have documented the occurrence of PCBs in the Quarry Pond located near the Amcast site. In February 2003, Amcast Industrial Corporation signed with the U.S. Environmental Protection Agency (U.S. EPA) an Administrative Order on Consent and Statement of Work (AOC/SOW) stipulating the investigative process required to render a decision on the need for remedial action to address potential environmental hazards associated with historical PCB usage at the site.

In April 2003, Amcast submitted to the U.S. EPA a Remedial Investigation (RI) Work Plan (Foth & Van Dyke 2003a) for this site. On May 8, 2003 U.S. EPA provided to Amcast, comments on the RI Work Plan. Amcast met with the U.S. EPA on June 5, 2003 to discuss the comments and the required changes to the RI Work Plan document. Amcast revised the RI Work Plan and submitted the final document on June 30, 2003. The RI Work Plan describes the investigative approach that Amcast will implement to assess PCB risks to human health and the environment.

2. Sampling Objectives

This Field Sampling Plan (FSP) is consistent with the investigative approach that is described in the RI Work Plan and the requirements of the February 2003 AOC/SOW. The FSP describes the specific investigative procedures and sampling requirements to assess the need for remedial action at the site. The specified sampling is designed to assess environmental risk posed by potential PCB migration pathways to receptors defined in Sections 3.2 and 3.3 of the RI Work Plan (Foth & Van Dyke, 2003a). This FSP is written so that the field sampling team will be able to easily understand what samples and field information needs to be gathered and documented.

The RI Work Plan described four Areas of Investigation (AOIs) at and around the Amcast site. These AOIs include:

- The Amcast North Property PCB impacted soils, residential properties, groundwater, storm sewers and old storm sewer outfall to Cedar Creek (AOI-1).
- The Amcast South Property PCB impacted soils and groundwater below the parking lot south and east of the Amcast office building and railroad right-of-way property east of the parking lot (AOI-2).
- The Amcast South Property PCB impacted fill soils, subsoils in the fill area, and groundwater (AOI-3).
- The Quarry Pond sediments and surrounding groundwater and storm sewers that service the Quarry Pond (AOI-4).

The sampling objectives for each of these AOIs are described below.

2.1 Sampling Objectives for AOI-1

The objective of the field sampling plan for AOI-1 is to:

- Characterize the degree and extent of contamination in soils at the Amcast North site that is related to historical PCB usage.
- Characterize the degree and extent of contamination in soils on residential properties immediately north of the Amcast North Property that is related to historical PCB usage.
- Characterize the degree and extent of possible contamination in groundwater at the Amcast North Property that is related to historical PCB usage.
- Verify through mapping and sampling of storm sewers that PCBs are no longer migrating from the Amcast site through the city of Cedarburg storm sewers.
- Characterize the potential presence of PCBs at the former storm sewer discharge to Cedar Creek.

- Characterize the groundwater flow and the hydraulic conductivity of the upper aquifer.

2.2 Sampling Objectives for AOI-2

The objective of the field sampling plan for AOI-2 is to:

- Characterize the degree and extent of contamination in shallow soils (i.e. upper 5-ft) beneath the parking lot and the railroad right-of-way property that is related to historical PCB usage.

- Characterize the degree and extent of contamination in groundwater that is related to historical PCB usage. A phased approach will be used to characterize the groundwater in the aquifers. The initial characterization will concentrate on characterizing the upper most aquifer. If contamination exceeding the Wis. Admin. Code NR 140 standards is found in the upper most aquifer then the lower aquifer and the vertical component of aquifer flow will be explored in a second phase of investigation.

(Note: The mapping of the storm sewers which service the Amcast South property is addressed in the sampling objectives of AOI-4 as part of the Quarry pond investigations.

2.3 Sampling Objectives for AOI-3

The objective of the field sampling plan for AIO-3 is to:

- Characterize the degree and extent of contamination in the impacted fill soils and native subsoil below the fill area related to historical PCB usage.

- Characterize the degree and extent of contamination in the groundwater beneath the fill area related to historical PCB usage. A phased approach will be used to characterize the groundwater in the aquifers. The initial characterization will concentrate on characterizing the upper most aquifer. If contamination exceeding the Wis. Admin. Code NR 140 standards is found in the upper most aquifer then the lower aquifer and the vertical component of aquifer flow will be explored in a second phase of investigation.

2.4 Sampling Objectives for AOI-4

The objective of the field sampling program for AOI-4 is to:

- Characterize the contaminated sediment thickness in the pond.

- Characterize the PCB concentrations and distribution (vertical and horizontal) within the pond sediments.

- Characterize water quality of the pond water.

- Characterize the hydraulic interaction that takes place between the Quarry Pond and underlying groundwater in the dolomite aquifer.
- Characterize potential PCB impacts to groundwater around the pond.
- Characterize the interconnection between storm sewers that service the Amcast South Property and the pond.
- Characterize the possible historical interconnection between storm sewers that service the Quarry Pond and Cedar Creek.

3. Sample Location and Frequency

3.1 AOI–1

The following is a general description of the scope of work for characterization of AOI-1. Figure 1 contains the approximate locations of the shallow soil boring locations, monitoring wells, and storm sewer samples for AOI-1 which are on and adjacent to the Amcast North Property. Figure 2 shows the locations of the shallow soil borings at the suspected former storm sewer outfall location and off-site storm sewer sampling locations for storm sewers that service the Amcast North Property.

3.1.1 AOI-1 Shallow Soil Sampling, Screening and Analysis

Shallow soils for the purpose of this investigation are defined as soils in the upper 5 ft of the soil profile. These may be undisturbed native soils or soils filled for site grading purposes. These soils will likely contain any PCB-related constituents, which were released during previous waste handling activities. The following bulleted items describe the shallow soil sampling methods and procedures. The referenced ASTM standards are listed in Appendix A-1.

- Soil borings on paved areas and areas accessible with a truck mounted drill rig will be advanced with continuous soil sample collection using a 3-inch Split Spoon sampler (ASTM D-1586) equipped with a membrane liner.

- Soil borings from inaccessible areas will be advanced with a stainless steel hand auger using techniques described in ASTM D-1452. Since these are shallow soil borings in predominantly fine-grained soils it is believed that in most locations the borings can be advanced with a hand auger. If borings can not be advanced to 5 feet with a hand auger as a contingency plan a portable power auger will be rented to advance the holes. Another available option is to complete the borings with a small ATV mounted Geoprobe ™ soil sampling rig. These contingency options for advancing the bore hole will be implemented only if necessitated by soil conditions.

- Shallow soil borings (refer to Figure 2) FVSS- 28 to FVSS-30 are located in the area where the former storm sewer outfall discharged. FVSS-32 to FVSS-34 are located in the existing storm water detention pond.

- The penetrated soil profile will be logged by a geologist, hydrogeologist or environmental technician in accordance with ASTM D-5434. The soils encountered will be classified in accordance with ASTM D-2488.

- For both split spoon sampled borings and hand auger borings, soils will be screened for:
  - Visual evidence of soil contamination (e.g., oil sheen, discoloration, etc.)
  - Olfactory observations
  - Screened with a Photo Ionization Detection (PID)

- Soil samples will be collected, containerized, and preserved according to Table 1 and Appendix A-2.

- A maximum of two soil samples from each boring at the Amcast North Property, residential properties to the north, the existing storm water detention pond and the location of the former discharge ditch to Cedar Creek, will be analyzed for some or all of the following parameters:
  - PCBs
  - Total Organic Carbon (TOC)
  - VOCs (except FVSS-28 through FVSS-30 and FVSS –32 through FVSS-34)
  - Semi-Volatile Organic Compounds (SVOCs) (except FVSS-28 through FVSS-30 and FVSS –32 through FVSS-34)
  - RCRA Metals (except FVSS-28 through FVSS-30 and FVSS –32 through FVSS-34)

  Note: FVSS-28, FVSS-29 and FVSS-30 are located in the area of the former outfall of the storm sewer that services the Amcast North property. As such the primary parameter of concern is PCB's since there is nothing in the historical record of the North property which indicates the presence of tanks for storing gas or fuel oil. As a result it is proposed to analyze for PCB's and TOC at this location. If, VOC's, SVOC's or metals contamination of regulatory significance is identified at the Amcast Industrial North site, sampling and analysis for the parameters will be conducted at the former outfall.

- A "magic marker" or paint stick will be used to mark a flagged lath that will be placed adjacent to a wooden hub pounded in close proximity to the soil boring location. Both the hub and the lath will be marked with the boring number. The location and elevation of the boring will be recorded later by the survey crew. The survey will include the Wisconsin State Plane Coordinates and ground surface elevation at each soil boring and well location.

The number of soil borings and samples to be tested for the selected parameters are summarized in Table 2. Soil boring and other sampling locations are shown on Figures 1 and 2. A maximum of two soil samples will be selected for laboratory analysis based on the results of the field screening listed above. A discreet soil samples from each core or sampling interval will be field screened and the soil above or below the sample exhibiting the appearance of the highest degree of contamination will be containerized for laboratory analysis. A second sample will be taken below the suspected contaminated sample to determine the approximate vertical extent of the contamination. If the field screening results show no signs of contamination then a sample will be taken directly below the topsoil or directly below the crushed aggregate base course if the sampling locations is over a paved area.

3.1.2 AOI-1 Characterization of the Groundwater Conditions

Groundwater characterization at AOI-1 will include monitoring groundwater quality, mapping the direction of groundwater flow, and measuring hydraulic conductivity of the upper aquifer.

The bulleted items which follow describe the number of wells, drilling methods, well construction materials, well development methods, the field methods for aquifer response testing, groundwater sampling methods, groundwater level measurement methods, etc. The referenced ASTM and WDNR standards are listed in Appendix A-1. The location of the groundwater monitoring wells proposed for AOI-1 are shown in Figure 1. The field investigation of the groundwater regime at AOI-1 will include the following:

- Construction of three groundwater surface monitoring wells. One well upgradient of the Amcast Plant and two wells down gradient. It is assumed that groundwater flows southwest to northeast toward Cedar Creek.

- Boreholes for wells will be drilled using hollow stem auger techniques (ASTM D 5784) when possible except in bedrock where mud rotary techniques (ASTM D 5783) will be used. The boreholes will be drilled to a depth of approximately 10-ft below the water table. If bedrock is encountered, we propose to drill down to the groundwater surface using mud-rotary techniques followed by drilling with clean water below the groundwater surface in the bedrock. This technique will eliminate any concerns regarding the introduction of drilling mud into any fractures in the bedrock.

- Well drilling and sampling will be completed in accordance with NR 141 and observed by an environmental technician supervised by a geologist licensed in the State of Wisconsin.

- Wells will be constructed in accordance with Wisconsin Administrative Code Chapter NR 141 requirements. The monitoring wells will be constructed with two inch inside diameter (2-inch ID) Schedule 40 PVC pipes and manufactured, 10 slot, PVC well screens.

- Well development will be completed in accordance with NR 141 which in general requires that the well be purged dry or a minimum of ten well volumes are removed from the well.

- Soil samples will be collected using a 3-inch Split Spoon Sampler (ASTM D-1586) equipped with a membrane liner. Soil samples will be collected continuously for the entire depth of the boring. A maximum of two soil samples from each monitoring well borehole will be analyzed for the parameters specified in Table 2.

- The following WDNR forms will be prepared and submitted for each well:
  - Groundwater monitoring inventory form- Form 3300-67
  - Monitoring well construction form – Form 4400-113A
  - Monitoring well development form – Form 3300-113B
  - Well/Drill hole abandonment form – From 3300-5B (for soil borings only)
  - Soil boring log information form- Form 4400-122

- Field aquifer testing will be conducted on the site wells a minimum of two weeks after well development. A rising or falling head field test will be completed using the Bouwer and Rice Methods (Bouwer (1989) and Bouwer & Rice, (1976)).

- Monitoring wells will be surveyed to Wisconsin State Plane coordinates. The elevation of the ground surface and the top of PVC pipe at each well will be surveyed. Each PVC pipe will be marked on the outside with an etched mark to show the location from which water level measurements should be taken. The location for measurement (i.e. north, south etc.) will be noted on the well construction report.

- Groundwater sampling will commence a minimum of two weeks after well development. Groundwater field sampling will be completed following the guidelines published by the WDNR (WDNR, 1996A and 1996B). Additional details concerning groundwater sampling are provided in the Sampling and Equipment Procedures contained in Appendix A.

- Groundwater samples from the Amcast North Property will be tested for:
  - PCBs
  - VOCs
  - SVOCs
  - Total and dissolved RCRA Metals (Note : Total RCRA metals are required for the risk assessment. Also if the total and dissolved metals analysis yields similar results for the first sampling event, the second round of analysis may be limited to analysis for dissolved parameters with the approval of the USEPA project manager.)

- Field parameters will include temperature, pH, conductivity, dissolved oxygen (DO), and redox potential (Eh).

- Two sampling rounds will be completed at a minimum of 30 days apart.

- Samples will be containerized and preserved according to the methods listed in Table 1

3.1.3 Mapping and Sampling of the AOI-1 Storm Sewers

The objective of this task is to determine that the existing storm sewer pipelines that service the Amcast North Property are no longer contributing PCB-related constituents to Cedar Creek. The city of Cedarburg maintains storm sewer maps that chart the existing storm sewer system. Mr. Robert Eichner, assistant city engineer believes that these maps contain accurate information for areas where the storm sewers were recently constructed, rebuilt or repaired, however, other areas are less accurate and in some cases data is speculative. Historical storm sewer maps at the courthouse will be reviewed as part of RI activities. Part of the fieldwork focus is to determine the storm sewer flow network that service the Amcast North Property.

Figure 2 shows the probable location of the existing off-site storm sewers for the Amcast North Property per the city of Cedarburg Storm Sewer System Map last updated April 14, 2001.

The following is a description of the scope of work proposed to characterize the storm sewers serving the Amcast North Property.

3.1.3.1 Characterize Storm Sewer Flow and Outfalls

Characterizing storm sewer flow direction and outfall location may include one or more of the following:

- Lamping of short storm sewer lines to determine flow direction, pipe condition, and if there are any sediments in the pipes. Lamping involves shinning a high intensity lamp from an access point such as a manhole or catch basin down the pipeline to another point where the sewer can be accessed.

- Dye testing consists of introducing a quantity of water treated with a highly visible and environmentally safe dye into the upstream end of a sewer line at a catch basin or manhole. Downstream outfalls or receiving water bodies are then observed for flow of the dye. This technique can be used to determine the storm sewer connection from the Amcast Properties to water bodies.

- Smoke testing may be conducted to confirm connection of Amcast North Property storm sewers to the down stream storm sewer system. Smoke testing consists of introducing an innocuous concentrated smoke into the storm sewer system with blowers to spread the smoke throughout the system. Any open connection to the system will become evident with smoke escape at that location.

- If the methods presented above are unsuccessful at defining the storm sewer flow, the lines in question can be televised. Televising a sewer line involves putting a camera down the sewer line and televising the sewer pipe condition. Televising the lines would locate connecting sewers, define pipe condition, and could locate areas of sediment deposits in the pipeline. Televising storm sewers would only be completed if the other methods outlined above are unsuccessful.

- The storm sewer locations, depths of manholes, catch basins, flow lines of pipes etc. will be surveyed and tied into to the existing city of Cedarburg or Amcast site maps so that the storm sewer flow direction, pipe size, pipe slope and storm sewer sample location can be portrayed.

Previously unknown storm sewer runs that are discovered will be characterized as follows:

- When located any manholes, catch basins, outfalls etc, will be marked by painting or flagging a lath and placing it adjacent to the storm sewer feature for future survey. Each new storm sewer line or feature will be surveyed so that it can be included on one of the site maps.

- The sediment in manholes, catch basins or pipes will be sampled and analyzed for the parameters listed in Table 2.

- Storm water will be sampled and analyzed for the parameters listed in Table 2.

- If possible or practicable the depth of the manholes will be measured.
- The size, type and condition of the storm sewer pipe will also be noted.

3.1.3.2 Storm Sewer Sampling and Analysis

The storm sewers will be sampled at selected locations shown on Figures 1 and 2 upon completion of the mapping of the various storm sewer lines as described above. The actual sampling locations may change based upon the results of the storm sewer survey described above. The sampling locations for AOI-1 storm sewers are designated FVSTM-1 through FVSTM-6. The locations and timing of the samples will be selected based on the following:

- Low flow conditions in the storm sewer system.
- Storm sewers that service the Amcast North Property.

Storm sewer sampling will include the following:

- Sampling of sediments and liquids where it is present at selected locations from catch basins and manholes.
- Authorization will be obtained from the city of Cedarburg to sample the sewers and manholes.
- Barricades, safety cones, and a blower for ventilation will be provided during manhole and catch basin sampling.
- Entering any manhole or catch basin will be completed in accordance with OSHA 1910.146 governing confined-space entry. A minimum two-man crew and safety (rescue) tripod will be used for manhole or catch basin entry. Personnel involved with confined space entry will be trained in accordance with OSHA 1910.146.
- Where present in storm sewer pipes, manholes or catch basins, sediment samples will be scraped from the manhole, catch basin or storm sewer pipe using a stainless steel spatula or spoon.
- Sediments will be initially placed in a stainless steel pan, then transferred to the appropriate sample jar.
- Sampling equipment will be decontaminated between sampling events.
- Containerizing and preserve the samples in accordance with the procedures in Table 1.
- Storm sewer sediments and liquids will be analyzed for the following:
  - PCBs
  - % solids (sediments only)

Figure 1 shows the proposed storm sewer sampling location on the Amcast North Property. Figure 2 shows the proposed storm sewer sampling locations of the storm sewers, which serve the residential properties to the North and the areas down stream of the Amcast North Property. The number of storm sewer sediment and liquid samples is summarized in Table 2.

Sewer sediment deposits that have sufficient volume will be considered for laboratory analysis by sieve and hydrometer (ASTM D-422). Per ASTM D 2217 for determining particle size of soil that would primarily be retained on the No. 10 sieve, 400 grams of soil is required. For soil with the majority of the particle size of the material passing the No. 10 sieve 115 grams is required for sandy soils and 65 grams for silt or clay soils is required.

3.2 AOI-2

The following is a general description of the scope of work for soil characterization in AOI- 2. Figure 3 shows the location of existing soil boring and groundwater monitoring wells along with the soil borings and monitoring wells proposed for AOI-2 and AOI-3. For the groundwater pathway, AOI-2 and AOI-3 will be described together since AOI-2 and AOI-3 are both on the Amcast South Property and are part of the same groundwater flow system. Details regarding the groundwater investigation for AOI-2 and AOI-3 are provided below in Section 3.3.2 of this FSP.

3.2.1 AOI-2 Shallow Soil Sampling, Screening and Analysis

For AOI-2, approximately six shallow soil borings (FVSS-1 through FVSS-6 in Figure 3) will be completed per the methodology described in Section 3.1.1. Up to two samples will be analyzed from each boring. In addition, two deeper borings for monitoring wells (FVMW-20 and FVMW-21 in Figure 3) will also be completed in the parking lot and railroad right-of-way. Up to two soil samples will be collected from each monitoring well borehole. The number of soil samples to be collected and the specified analytical parameters for all AOI-2 soil samples are summarized in Table 2. Samples will be containerized and preserved as specified in Table 1.

3.3 AOI-3

3.3.1 AOI-3 Fill Soil and Subsoil Investigation

As described in the RI Work Plan (Foth & Van Dyke, 2003a), extensive work has been completed to define the subsurface conditions in the filled area. Therefore, six soil borings and the soil boring for one groundwater surface monitoring well are proposed to provide additional information on the subsurface soil/fill conditions. The soil borings for AOI-3 are designated FVSB-8 through FVSB-13 in Figure 3. The boring for the groundwater surface monitoring well is labeled FVMW-22. The soil borings will be completed using the following procedures:

- The soil borings and borings for the groundwater surface monitoring well will be completed to a depth of 8-ft below the water table. Groundwater surface wells will be constructed with 10 foot screens positioned approximately 7 to 8 feet below the groundwater surface. This will allow the screened interval to intercept the groundwater during both high and low groundwater levels.

- Soil samples will be collected using a 3-in Split Spoon sampler (ASTM D-1586) equipped with a membrane liner. Soil samples will be collected continuously for the entire depth of the boring.

- Split spoon samples and drill cuttings will be field screened during drilling for:
  - Visual evidence of soil contamination (e.g., oil sheen, etc.)
  - Olfactory observations
  - Screened with a PID
  - Field screening results and any observations will be noted on the field logs and presented in a tabular form in the report.

Note that field screening will be completed immediately after the sample is removed from the spilt spoon sampler and prior to selection of the sample(s) for laboratory testing.

- Soil samples will be selected for laboratory testing based on the results of the field screening listed above. Selected samples will be containerized and preserved in accordance with Table 1 and Appendix A-2.

- The estimated number of soil samples proposed for laboratory analysis are included in Table 2. Up to two samples will be collected from each boring. It is anticipated that one sample will be collected from the soil horizon containing fill material and one sample from the native soil below fill material.

- The soil samples of fill soil, construction rubble or native soils will be analyzed for the following:
  - PCBs which includes analysis for percent solids
  - VOCs
  - TOC
  - SVOCs
  - RCRA Metals
  - Toxicity Characteristic Leaching Procedure (TCLP) on three fill samples, which based on field observation, appear most contaminated. TCLP testing is proposed for VOCs, SVOCs and RCRA metals on three soil samples from the borings/wells in the fill area.

The number of soil borings and samples to be tested for the selected parameters are summarized in Table 2. Soil boring and other sampling locations are shown on Figures 1 and 2. A maximum of two soil samples will be selected for laboratory analysis based on the results of the field screening listed above. A discreet soil samples from each core or sampling interval will be field screened and the soil above or below the sample exhibiting the appearance of the highest degree of contamination will be containerized for laboratory analysis. A second sample will be taken below the suspected contaminated sample to determine the approximate vertical extent of the contamination. If the field screening results show no signs of contamination then a sample will be taken directly below the topsoil or directly below the crushed aggregate base if the sampling locations is over a paved area.

3.3.2 Groundwater –AOI-3 and AOI-2

Groundwater characterization at AOI-3 and AOI-2 will include monitoring groundwater quality, measuring the direction of groundwater flow, and measuring the hydraulic conductivity of the upper aquifer.

Figure 3 shows the location of the three new groundwater monitoring wells proposed for the Amcast South Property (AOI-2 and AOI-3). The three groundwater surface wells proposed include FVMW-20, FVMW-21 and FVMW-22. The proposed wells will be constructed, developed and monitored as described in Section 3.1.2. Two rounds of groundwater samples will be collected from all wells at the Amcast South Site, including those installed by Geraghty & Miller (1994), and analyzed for the parameters listed in Table 2. The existing monitoring wells will be redeveloped prior to sampling.

A phased approach is proposed to characterize the groundwater flow at the Amcast South property. The initial phase will focus on determining if PCB related contaminants have migrated into the groundwater. PCB's have a high affinity for fine soil particles and the subsoils are predominately fine-grained soils. PCB's, if present, will likely be absorbed to the soils at the site. The PCB's are unlikely to migrate into or through the groundwater. If PCB's are detected in concentration which exceed the NR 140 groundwater standards in the groundwater surface wells, then a second phase of the investigation will be initiated. The second phase will consist of constructing two or three piezometers adjacent to existing groundwater surface wells. These piezometers will be constructed about 20 feet below the well screens of the adjacent groundwater surface wells. The piezometers will be used to determine the vertical characteristics of groundwater flow and to sample the aquifer at depth.

In addition, note that seven groundwater surface wells (i.e. GMMW-1 through GMMW-7) were installed during a previous investigation. These wells are all screened in the native soils below the construction rubble or the fill soils deposited on the Amcast South site. These additional monitoring points plus the monitoring wells proposed will provide the data necessary to determine if PCB's have impacted the upper most groundwater aquifer.

3.4 AOI-4

The Quarry Pond is accessible to the public and used for recreational purposes, therefore, exposure to PCB contaminated sediments by humans and biota will need to be evaluated. In accordance with the AOC/SOW, biota sampling will only occur if needed based on data from sediment and water quality samples. The characterization of the sediments and water quality of the Quarry Pond is also related to the characterization of the storm sewers serving the Amcast South Property. The storm sewers are being evaluated as a possible conduit for the transport of contaminated materials from the Amcast South Property to the Quarry Pond and beyond.

Sediment and other water sampling activities will likely be accomplished from a small boat. This FSP describes the methods proposed for sediment thickness measurements, sediment sampling, water column sampling, and topographic survey for pond bathymetry. The following is a description of the scope of work for the characterization of the Quarry Pond sediment and water quality in the pond.

3.4.1 Quarry Pond Bathymetry

A bathymetric survey of the Quarry Pond will be completed prior to initiation of any sediment or water quality sampling. The survey will record the water depth and bottom contours of the quarry pond. This survey will be accomplished using a poling or Sonar System.

The sediment thickness and determination of the water depths will be accomplished by probing the locations shown on Figure 4. Each probe location will be located using a Global Positioning Satellite (GPS) system to establish the horizontal and vertical locations of the sediment probes. Foth and Van Dyke employs a Timble Model 5700 GPS which has an approximate accuracy of +/- 0.02 foot horizontally and +/- 0.04 foot vertically. Sediment samples will be taken later in the investigation at locations identified as having adequate sediment thickness.

3.4.2 Quarry Pond Sediment Thickness

The sediments in the Quarry Pond will be poled on a grid pattern with a range pole equipped with a 1-inch square plastic tip and a steel shaft tip to determine the thickness of soft sediment. The sediment probing will be accomplished from a boat. The grid pattern probes will be supplemented with additional probes adjacent to the three storm sewer outfalls into the Quarry Pond and the area where the city of Cedarburg routinely dumped snow in the winter. Figure 4 shows the approximate location of the sediment probes proposed in the Quarry Pond. The sediment probes will be designated FVSP-1, FVSP-2, etc.

3.4.3 Quarry Pond Sediment Samples

The sediment sampling locations will be selected based on the sediment thickness determined in the sediment thickness survey discussed in Section 3.4.2 above. A soft sediment thickness isopach may be prepared which could be used to determine areas of the Quarry Pond where it is feasible to sample soft sediments. Sediments with sufficient thickness identified will be sampled for the entire depth of sediment. The upper 10 cm (4 inches) and then subsequent 15 cm (6 inches) sections of sediment will be containerized separately per the requirements specified in Table 1.

Figure 4 shows the location of sediment cores and PCB values in ppb as reported in prior investigations documented in the RI Work Plan (Foth & Van Dyke, 2003a). These data will be carried forward and used in the evaluation of the Quarry Pond sediments. Figure 4 also shows the location for the proposed sediment core locations. The locations are selected based on the following:

- Areas where PCB contaminated sediments were previously sampled.
- Areas where soft sediments were identified in previous investigations.
- Areas adjacent to the four storm sewer outfalls and the city of Cedarburg snow dumping area.
- Areas at the shoreline which may contain soft sediment.
- Locations throughout the Quarry Pond.

These locations will be reevaluated after the sediment thickness data is reviewed and the locations will be modified to sample areas, which have the greatest sediment present.

The sediment cores will be collected in accordance with the sampling procedures described in Appendix A. Sediment cores will be logged by an experienced scientist, geologist or technician working under the supervision of a geologist registered in the State of Wisconsin. All sediment core locations will be surveyed. The sediment samples will be containerized and preserved as described in accordance with Table 1. Sediment samples selected for analysis will be tested for the following as specified in Table 2:

- PCBs
- Percent solids
- Total Organic Carbon (TOC)

The total number of samples selected for analysis from each core will be determined based on field observation. Sediment samples, which recover a sufficient volume of sample, may be selected for soil laboratory testing for grain size and hydrometer analysis in accordance with ASTM D-422.

3.4.4 Quarry Pond Water Quality Samples

Figure 4 shows the location of the three water quality sample locations. Two of the water quality sample locations are in the vicinity of storm sewer outfalls into the Quarry pond. The other sample is located in the central part of the pond. Water quality samples shown on Figure 4 are designated FVSWQ-1 through FVSWQ-3.

Water quality sampling and analysis will include the following:

- At each sampling point, discreet water samples will be collected near the surface at the water column (Sample "A") and near the bottom of the water column (Sample "B").

- These discreet water samples will be tested in the field for pH, temperature, and specific conductivity.

- Discreet water samples collected will be analyzed for the following:
  - Total Suspended Solids (TSS)
  - PCB's

Appendix D of the QAPP contains the analytical and method detection limits that are listed in accordance with WDNR required method detection limits. The required container types and container volumes are listed in Table 1 of this FSP,

3.4.4.1 Quarry Pond Stormwater Water Quality

The water quality of the stormwater discharging into the Quarry Pond will also be assessed by taking samples from three of the storm sewers which discharge into the Quarry Pond and may also service the Amcast site. The location of these water quality samples are shown on Figure 4 and are designated FVSWQ-4 through FVSWQ-6. Samples will be taken during a low flow period after a rainfall event. Samples at the three locations will be analyzed for PCBs.

3.4.5 Quarry Pond Storm Sewer Mapping

As proposed for the North Amcast Property in Section 3.1.3, the city of Cedarburg storm sewer maps that chart the existing storm sewer system will be used as a guide for the investigation of storm sewers connected to the Quarry Pond. Part of the fieldwork focus is to determine, to the extent possible, the storm flow network that could have been a transport mechanism for PCBs to the Quarry Pond and potentially from the Quarry Pond to Cedar Creek.

Figure 5 shows the location of the existing and suspected storm sewers which service the Amcast South Property per the site topographic survey by Sundberg, Carlson and Associates, (1993). Figure 2 shows the storm sewers, which flow through the Amcast South Property from the west and the south, which are included in the sewer investigation. The storm sewers to the south and west of the Amcast South Property are being investigated to determine if PCB's could have originated from sources upstream of the Amcast South Property.

The scope of work proposed to characterize the piping, flow direction etc. for the storm sewers serving the Amcast South Property is the same as described in Section 3.1.3.1 of this FSP. Once the storm sewer system is mapped, final sample locations will be selected and sampling of the sediments and liquid in the storm sewers will proceed as described below. Figures 2 and 5 show the tentative locations of the storm sewer samples.

3.4.6 Quarry Pond Storm Sewer Sampling and Analysis

The storm sewers will be sampled at selected locations shown on Figures 2 and 5 upon completion of the mapping of the various storm sewer lines that service the Quarry Pond. The AOI-4 storm sewer sampling locations are designated FVSTM-7 through FVSTM-18. The actual locations may change based upon the results of the storm sewer survey described above in Section 3.4.5. The sampling of the storm sewers will be completed as described in Section 3.1.3.2. Table 2 summarizes the AOI-4 storm sewer sediment and liquid samples that will be collected and the proposed analytical parameters.

Samples will be containerized and preserved in accordance with Table 1.

3.4.7 Quarry Pond Groundwater Monitoring

The characterization of groundwater around the Quarry Pond will include monitoring groundwater quality, measuring the direction of groundwater flow, measuring the hydraulic conductivity of the aquifer and a determination of the relationship of groundwater to the water levels in the Quarry Pond.

The drilling methods, well construction materials, the field methods for aquifer response testing, well development, groundwater sampling, groundwater level measurement, etc., are described above in Section 3.1.2.

Figure 4 shows the location of the two groundwater surface monitoring wells labeled FVMW-23 and FVMW-24 that are proposed around the Quarry Pond. FVMW-23 is located between the Amcast South property and the Quarry Pond. FVMW-23 will be screened in the upper most groundwater surface which is likely in the bedrock aquifer. FVMW-23 will be constructed as a groundwater surface well with a 10 foot screen and a surface seal. The well screen will be placed 7 to 8 feet into the groundwater so that the screen intersects the groundwater surface during both high and low groundwater conditions. The total well depth will be approximately 15 to 20 feet depending on the depth at which the groundwater surface is encountered.

FVMW-24 as shown on Figure 4 is located near the southeast end of the Quarry Pond and as such is intend to intercept groundwater that maybe flowing from the pond. This well will be constructed similar to the FVMW-23 as described above.

Soil samples will be collected using a 3-inch Split Spoon Sampler (ASTM D-1586) equipped with a membrane liner. Soil samples will be collected continuously for the entire depth of the boring. One soil sample from each monitoring well borehole will be analyzed for the parameters specified in Table 2.

A staff gauge will be installed in the Quarry Pond. In addition, a rain gauge will also be installed at the site. The two monitoring wells at the Quarry Pond will be instrumented with data loggers to record groundwater levels on an hourly basis. The water level in the Quarry Pond and precipitation will be recorded on a daily basis. Two rounds of groundwater monitoring will be performed. The collected samples will be analyzed for PCBs and field parameters as specified in Table 2. Samples will be containerized and preserved as described in Table 1.

3.5 Mapping/Surveying of Site Features, Sampling Points, Monitoring Wells and the Quarry Pond

The WDNR files were reviewed for current mapping/survey information that could be used in the FSP. The sources listed below have base maps on which additional data points that are surveyed for the RI will be added. The mapping work proposed for incorporation into the subsequent investigations and reports and a description of the general use includes the following:

- Sundberg Carlson and Associates (1993), *Topographic Survey, Amcast Property, Cedarburg, Wisconsin.* This mapping includes a topographic survey of both the Amcast North and South Properties. This topographic map will be used to show the location of shallow soil sampling point, borings, monitoring wells, storm sewer sampling points, storm sewer catch basins, pipelines and manholes. This map has a coordinate system based on Wisconsin State Plane Coordinates and elevations based on mean sea level.
- Lockwood Mapping, Inc. (1997) completed an aerial topographic survey on March 1, 1997 for the Mercury Marine Corporation. This survey was used as a base map for Blasland, Bouck and Lee. Inc. (1998). The topographic survey information from this mapping may be used in two areas where recent topographic coverage is not available including but not limited to the following:

- Areas between the Amcast South Property and the Quarry Pond and the topography around the Quarry Pond. This topography may be merged with the Amcast South Property topography.

- Areas northwest of Park Lane and north of the Amcast plant and the area directly north of the Cedarburg Wastewater Treatment Plant (WWTP). More specifically the residential area north of the Amcast plant and the area north of the WWTP that was ditched prior to reconstructing of the storm sewer as it is today.

If this mapping is not available at the time of the field investigation the available mapping will be expanded to include the AOI's described in this FSP.

- City of Cedarburg utility maps, including storm sewer map, sanitary sewer map and water main maps. As stated earlier, these maps do not necessarily depict the precise condition of all utility locations. As a result, the critical location will be verified in field investigations.

3.6 Quality Control

Quality control analyses for the sampling will be conducted during the field investigations of AOI-1 through AOI-4 are summarized in Table 3. Both laboratory and field quality control samples are indicated.

4. Sample Designations

Other consultants and the WDNR have sampled and tested soil, sediment and groundwater from the Amcast North Property, Amcast South Property, the Quarry Pond and the city of Cedarburg storm sewers. The RI Work Plan (Foth & Van Dyke, 2003a) listed the data which is proposed to be brought forward and included in future evaluations of the listed properties. Samples collected during subsequent investigations are distinguished from past investigation by the prefix "*FV*" which refers to the sampling to be completed by Foth and Van Dyke and Associates, Inc. Samples are further identified by a description of the investigation method (e.g., SS for shallow soil boring) followed by the depth or sample number following the "*FV*". The following lists the designation of each investigation method followed by an example sample number.

FVSS - shallow soil boring number and depth (FVSS-1, 1'-2')
FVSB - soil boring number and depth (FVSB-10, 10'-12')
FVMW - groundwater monitoring well number (FVMW-20)
FVSP - sediment probe number and thickness (FVSP-1, 13")
FVSC - sediment core number and depth below sediment surface (FVSC-1, 0"–4")
FVWQ - surface water quality sample number and depth (FVWQ-1, 1'–1.5')
FVSTM - storm sewer sediment and liquid sample (FVSTM-1 (S = sediment, L = liquid))

5. Sampling Equipment and Procedures

The sampling equipment and procedures (including decontamination procedures) to be employed have been selected to meet the project data quality objectives (DQOs) and are detailed in Appendix A. DQOs are described more fully in the project's Quality Assurance Project Plan (Foth & Van Dyke, 2003b).

Appendix A of this FSP contains the following procedural descriptions:

A-1	Referenced ASTM Standards
A-2	Soil Sampling Procedures
A-3	Field Equipment Cleaning/Decontamination Procedures
A-4	Surface Water Sampling Procedures
A-5	Field Measurement for Water Quality Parameters
A-6	Vessel Operation and Station Positioning
A-7	Groundwater Sampling Procedures
A-8	Sediment Probing and Core Sampling Procedures
A-8A	Collecting Sediment Samples By Vibrocoring (ASCI Corporation)
A-9	Dissolved Oxygen and Redox Potential Testing

6. Sample Handling and Analysis

Each sample collected will be containerized, preserved and shipped for analysis in accordance with the requirements listed in Table 1. Details on these procedures are discussed in the QAPP.

Samples of the paperwork that will be used to track sample shipments (chain-of-custody forms) and other relevant forms are included in Appendix B.

7. Investigative Derived Waste Disposal Procedures

Investigative Derived Wastes (IDW) will be drummed or stored in a roll-off box on-site and disposed of at an appropriate landfill. The drilling contractor is responsible for a proper disposal of containerized soils. Any excess sediment from coring or storm sewer samples collected but not submitted for laboratory analysis will be containerized and properly disposed of.

Disposal equipment and debris such as health and safety equipment, plastic sheeting, sampling equipment, and other equipment and/or sampling debris that has come into contact with sediment/soil, will be collected in plastic bags during the sampling events and placed into appropriately labeled containers, and disposed in accordance with applicable rules and regulations.

Decontamination rinsate (e.g., tap and distilled water containing small amounts of cleaning solvent) will be containerized at each sampling location or group of locations. Upon completion of the field activities, the rinsate and other field-generated waste will be disposed of in accordance with applicable rules and regulations.

8. References

Blasland, Bouch and Lee Inc. 1998. Amcast/Mercury Marine Sediment Characterization Report, Cedar Creek, Cedarburg, Wisconsin.

Bouwer, H., 1989. The Bouwer and Rice Slug Test – An Update Groundwater. Volume 27, No. 3, 304-309.

Bouwer, H., and Rice, R.C., 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Partially Penetrating Wells. Water Resources Research 12:423-428.

Foth & Van Dyke, 2003a. Remedial Investigation Work Plan. Amcast Industrial Corporation Site, Cedarburg, Wisconsin.

Foth & Van Dyke, 2003b. Quality Assurance Project Plan, Remedial Investigation, Amcast Industrial Corporation Site, Cedarburg, Wisconsin. (to be provided)

Geraghty & Miller, Inc., May 1994. Site Assessment Report for the Amcast Industrial Corporation, Cedarburg, Wisconsin.

Lockwood Mapping, Inc., Rochester, NY, March 1997. Topographic Mapping Based on Aerial Photography Flown March 1, 1997 for Mercury Marine Corporation, Inc.

Sundberg, Carlson and Associates, May 1993. Topographic Survey, Amcast Property, Cedarburg, Wisconsin.

WDNR, 1996A. Groundwater Sampling Desk Reference, Wisconsin Department of Natural Resources, PUBL-DG-037-96, September 1996.

WDNR, 1996B. Groundwater Sampling Field Manual, Wisconsin Department of Natural Resources, PUBL-DG-038-96, September 1996.

Tables

Table 1

Analytical Methods, Sample Containers, Preservation, and Handling Procedures

Analytical Parameter	Analytical Method	Container[1]	Preservation and Handling	Maximum Holding Times[2]
		Groundwater/Surface Water/Liquids		
PCB – Aroclors	8082	(2)-1liter amber glass bottles with Teflon-lined lid	Cool (4° C)	7/40 days[a]
Total Suspended Solids (TSS)	160.2	1000-mL HDPE bottle	Cool (4° C)	7 days
Volatile Organic Compounds (VOCs)	8260	40-mL glass bottle with Teflon® lined septa	HCl pH <2 no headspace Cool (4° C)	14 days
SVOCs	8270	(2)-1 liter Amber glass bottle	Cool (4° C)	7 days
RCRA Metals	6010, 7470	500 ml Plastic bottle	HNO_3 pH <2 Cool (4° C)	180 days
		Soils [3]		
PCB – Aroclors	8082	9 oz glass jar with Teflon-lined lid	Cool (4° C)	14/40 days [a, b]
Moisture Content	D2216	non-corrodible airtight containers	3° - 30° C	Analyze as soon as practical
Toxicity Characteristic Leaching Procedure (TCLP)	1311	16 oz plastic,non-corrodible airtight containers/ (2) 60 ml glass jars (for volatiles)	Cool (4° C) no headspace	14 days
Total Organic Carbon Content (TOC)	9060	9 oz Wide-Mouth Glass or plastic jar	Cool (4° C)	28 days
VOCs	8260	2 oz glass jar w/20-35g of soil or stainless steel Encore sample	20 mils methanol Cool (4° C) Cool (4° C)	14 days 48 hours until extraction
SVOCs	8270	9 oz Amber glass jar	Cool (4° C)	7 days
RCRA Metals	6010, 7471 & 6020	9 oz wide-mouth glass (soil) or plastic jars	Cool (4° C)	180 days

Table 1 *(Continued)*

Analytical Parameter	Analytical Method	Container[1]	Preservation and Handling	Maximum Holding Times[2]
		Soft Sediment (Quarry Pond or Storm Sewers)[3]		
PCB – Aroclors	8082	250-mL glass jar with Teflon-lined lid	Cool (4° C)	14/40 days[a, b]
Total Organic Carbon Content (TOC)	9060	9 oz wide-mouth glass or plastic jar	Cool (4° C)	28 days

Prepared by: REM
Checked by: JSK

Notes:

[1] Double sample containers required when MS/MSD or duplicates are being analyzed.
[2] Unless otherwise specified, all holding times are measured from date of collection.
[3] Analysis for soils and sediments maybe combined and be taken from the same containers if appropriate
NS = Not specified
[a] Sample collection to extraction holding time/sample extraction to analysis holding time.
[b] If samples are frozen, the holding time is 1 year from sample collection to extraction.

Table 2

Proposed Soil Sampling and Laboratory Testing

AOI No./ Investigative Tool	No. of Sampling Sites[1]	Sample Designations	Total No. of Samples[1]	Analyses Required	Locations
AOI-1 /Shallow Soil Borings	13	FVSS-15 to FVSS-27 and FVSS-31	28	PCBs, %S TOC, VOCs, SVOCs and RCRA Metals[2]	Figure 1
AOI-1/Former Storm Sewer Outfall and Existing Retention Basin	3	FVSS-28 to FVSS-30 and FVSS-32 to FVSS-34	12	PCBs, %S and TOC	Figure 2
AOI- 1/Groundwater Monitoring Wells- Soil Samples	3	FVMW-26 to FVMW-28	3-6	PCBs, %S,TOC, VOCs, SVOCs and RCRA Metals[2]	Figure 1
AOI- 1/Groundwater Monitoring Wells-Groundwater Samples	3	FVMW-26 to FVMW-28	6[3]	PCBs, %S, VOCs, SVOCs and RCRA Metals[2]	Figure 1
AOI-1/ Storm sewer sediments and liquids	6	FVSTM-1 to FVSTM-6	6[4]	PCBs % S	Figures 1 and 2
AOI-2/ Shallow Soil Borings	6	FVSS-1 to FVSS-6	6-12	PCBs, %S, TOC, VOCs, SVOCs and RCRA Metals[2]	Figure 3
AOI-2/Groundwater Monitoring Well Soil Samples	2	FVMW-20 & FVMW-21	2-4	PCBs, %S, TOC, VOCs, SVOCs and RCRA Metals[2]	Figure 3
AOI-3 and AOI-2/Groundwater Monitoring wells-Groundwater Samples	10	GMMW-1[5], etc. and FVMW-20 etc.	20[3]	PCBs, %S, TOC, VOCs, SVOCs and RCRA Metals[2]	Figure 3
AOI-3/Fill and Native Subsoils (soil borings and wells)	7	FVSB-8 to FVSB-13, FVMW-22	7-14	PCBs, %S TOC, VOCs, TCLP[6] SVOCs and RCRA Metals[2]	Figure 3
AOI-4/ Sediment Thickness Probes	~55	FVSP-1, etc.	NA	NA	Figure 4
AOI-4/Sediment Cores	~30	FVSC-1, etc.	TBD	PCBs, TOC, % S	Figure 4
AOI-4/ Water Quality Samples	6	FVWQ-1 to FVWQ-6	9[7]	PCBs, %S and TSS (pond samples only)	Figure 4
AOI-4/Groundwater Monitoring Wells – Soil Samples	2	FVMW-23 and FVMW-24	2	PCBs, %S and TOC	Figure 4
AOI-4/Groundwater Monitoring Wells – Groundwater Samples	2	FVMW-23 and FVMW-24	4[3]	PCBs and %S	Figure 4
AOI-4/ Storm sewer sediments and liquids	12	FVSTM-7 to FVSTM-28	12	PCBs, % S	Figure 2 and 5

Table 2 *(Continued)*

[1] The actual number of samples will be determined durıng project implementation.
[2] RCRA metals – cadmium, chromium, lead, mercury, arsenic
[3] Two sampling rounds 30 days apart are proposed
[4] Up to 6 liquid samples will be collected from the storm sewers servicing the Amcast North Property. Up to 6 sediment samples will be collected from the storm sewers that service the Amcast North Property. Up to 12 sediment and/or liquid samples will be collected from storm sewers servicing the Quarry Pond.
[5] GMMW-1 etc. are reported in Geraghty and Miller, 1994
[6] TCLP testing is proposed for volatile and semi-volatile organic compounds and RCRA metals on three soil samples from the boring/wells in the waste fill area.
[7] Two samples will be collected at locations FVWQ-1 through FVWQ-3. One sample will be collected at FVWQ-4 through FVWQ-6.
TBD = To be determined
%S = percent solids

Prepared by: REM
Checked by: SVD1

Table 3

Quality Control Analyses
Amcast Field Sampling Plan

Parameters	Approx.[1] No. of Samples	Field QC Analyses						Laboratory QC Sample								Estimated Total
		Trip[3] Blank		Field/Rinsate Blank		Field Duplicate		Matrix Spike		Matrix Spike Dupl.		Lab Blank		Lab Duplicate		
		Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Groundwater/Surface Water																
PCBs - (Aroclor) Groundwater	TBD	NA	-	1/10	-	1/10	-	1/20	-	1/20	-	1/20	-	NA	-	TBD
VOCs-Groundwater	TBD	1/cooler	-	1/10	-	1/10	-	1/20	-	1/20	-	1/20	-	1/20	-	TBD
SVOCs – Groundwater	TBD	1/cooler	-	1/10	-	1/10	-	1/20	-	1/20	-	1/20	-	1/20		TBD
RCRA Metals Groundwater	TBD	NA	-	1/10	-	1/10	-	1/20	-	1/20	-	1/20	-	1/20	-	TBD
PCBs - (Aroclor) Surface Water and Storm Sewer	TBD	NA	-	1/10	-	1/10	-	1/20	-	1/20	-	1/20	-	NA	-	TBD
TSS-Surface Water	TBD	NA	-	1/10	-	1/10	-	1/20	-	1/20	-	1/20	-	NA	-	TBD
Shallow Soils/Fill Soils/Sediments																
PCBs (Aroclor)	TBD	NA	--	NA[2]	-	1/10	-	1/20	-	1/20	-	1/20	-	NA	-	TBD

Table 3 *(Continued)*

Parameters	Approx.[1] No. of Samples	Field QC Analyses						Laboratory QC Sample								Estimated Total
		Trip[3] Blank		Field/Rinsate Blank		Field Duplicate		Matrix Spike		Matrix Spike Dupl.		Lab Blank		Lab Duplicate		
		Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	Freq.	No.	
Total Organic Carbon Content (TOC)	TBD	NA	-	NA[2]	-	1/10	-	1/20	-	NA	-	1/20	-	1/20	-	TBD
VOCs	TBD	1/cooler	-	NA[2]	-	1/10	-	1/20	-	NA	-	NA	-	1/20	-	TBD
SVOCs	TBD	1/cooler	-	NA[2]	-	1/10	-	1/20	-	1/20	-	1/20	-	1/20	-	TBD
RCRA Metals	TBD	NA	-	NA[2]	-	1/10	-	1/20	-	1/20	-	1/20	-	1/20	-	TBD
TCLP	TBD	NA	-	NA[2]	-	1/10	-	1/20	-	NA	-	NA	-	1/20	-	TBD

[1] The actual number of samples collected and analyzed will be determined during project implementation.
[2] Dedicated sampling devices (core liners) will be used for these samples. If hand auger is used for soil samples, a rinsate blank will be collected at a rate of 1 blank/10 samples.
[3] The trip bland for soils is a methanol blank.
NA = Not analyzed
TBD = To be determined

Prepared by: REM
Checked by: JSK

Figures

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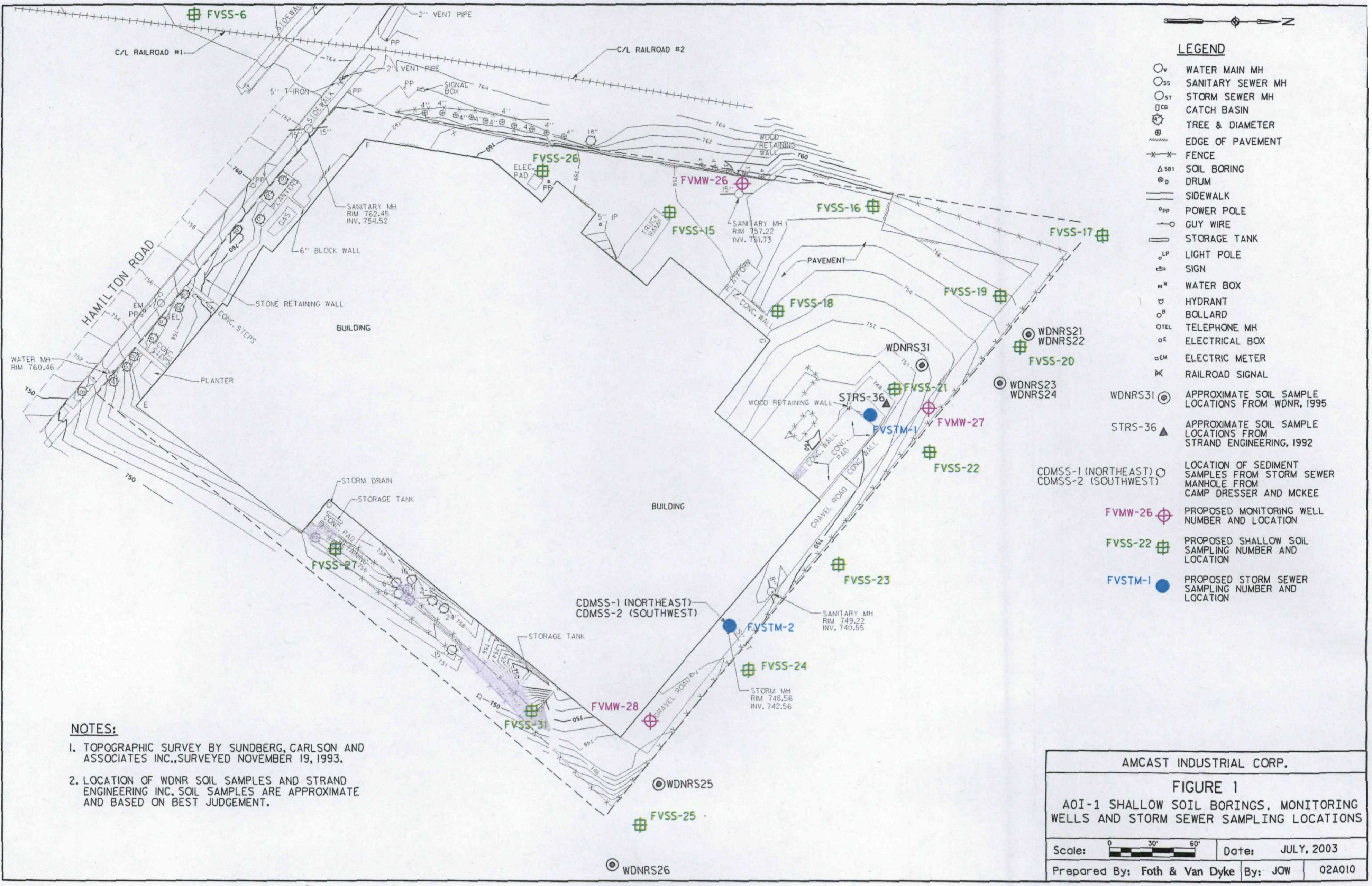


NOTES:

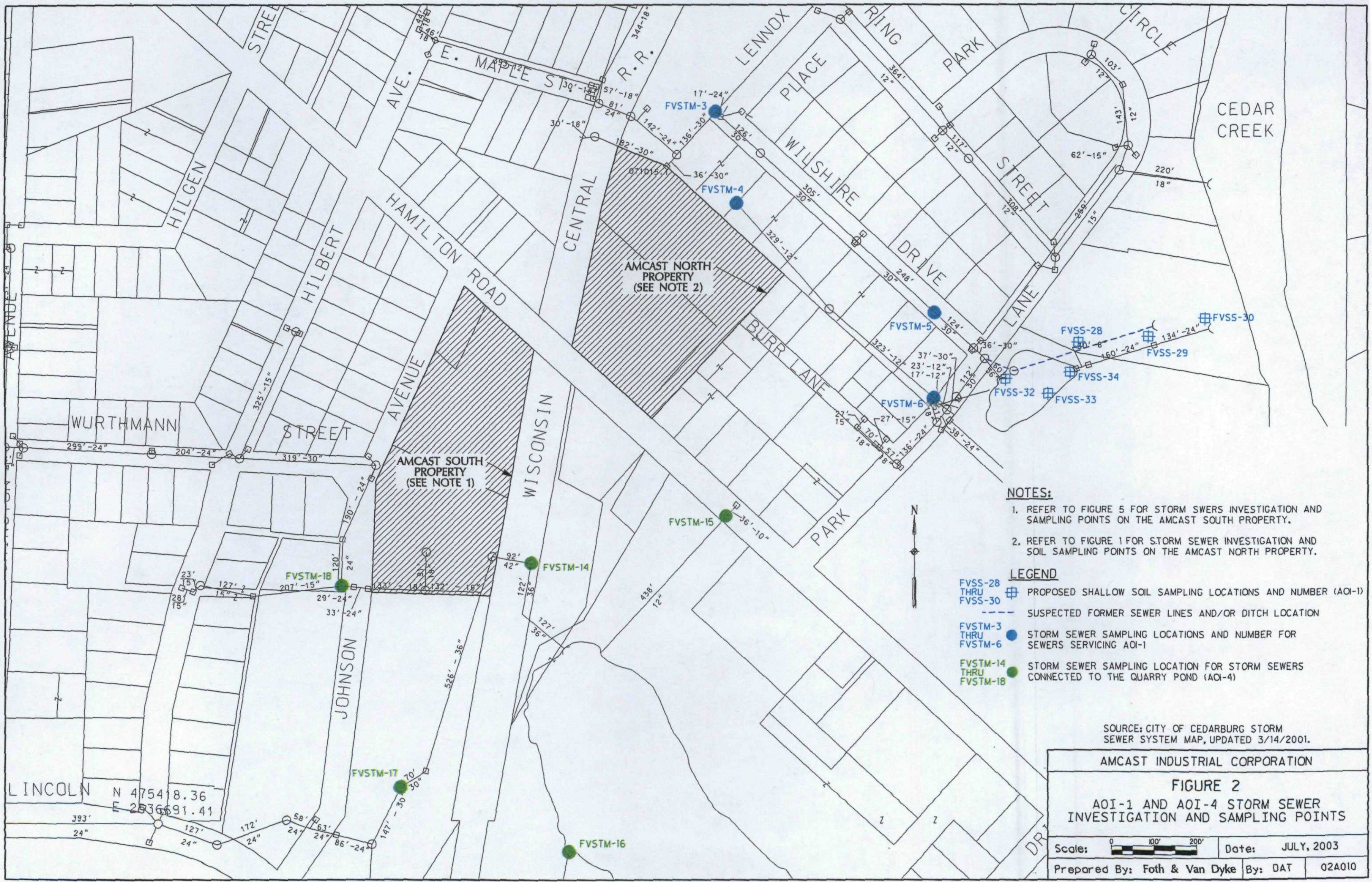
1. TOPOGRAPHIC SURVEY BY SUNDBERG, CARLSON AND ASSOCIATES INC., SURVEYED NOVEMBER 19, 1993.
2. LOCATION OF WDNR SOIL SAMPLES AND STRAND ENGINEERING INC. SOIL SAMPLES ARE APPROXIMATE AND BASED ON BEST JUDGEMENT.

AMCAST INDUSTRIAL CORP.

FIGURE 1

AOI-1 SHALLOW SOIL BORINGS. MONITORING
WELLS AND STORM SEWER SAMPLING LOCATIONS

Scale: 0 30' 60'
Date: JULY, 2003
Prepared By: Foth & Van Dyke
By: JOW
02A010



NOTES:

1. REFER TO FIGURE 5 FOR STORM SWERS INVESTIGATION AND SAMPLING POINTS ON THE AMCAST SOUTH PROPERTY.
2. REFER TO FIGURE 1 FOR STORM SEWER INVESTIGATION AND SOIL SAMPLING POINTS ON THE AMCAST NORTH PROPERTY.

LEGEND

FVSS-28 THRU FVSS-30 ⊞	PROPOSED SHALLOW SOIL SAMPLING LOCATIONS AND NUMBER (AOI-1)
----	SUSPECTED FORMER SEWER LINES AND/OR DITCH LOCATION
FVSTM-3 THRU FVSTM-6 ●	STORM SEWER SAMPLING LOCATIONS AND NUMBER FOR SEWERS SERVICING AOI-1
FVSTM-14 THRU FVSTM-18 ●	STORM SEWER SAMPLING LOCATION FOR STORM SEWERS CONNECTED TO THE QUARRY POND (AOI-4)

SOURCE: CITY OF CEDARBURG STORM SEWER SYSTEM MAP, UPDATED 3/14/2001.

AMCAST INDUSTRIAL CORPORATION

FIGURE 2

AOI-1 AND AOI-4 STORM SEWER INVESTIGATION AND SAMPLING POINTS

Scale: 0 100' 200'

Date: JULY, 2003

Prepared By: Foth & Van Dyke

By: DAT

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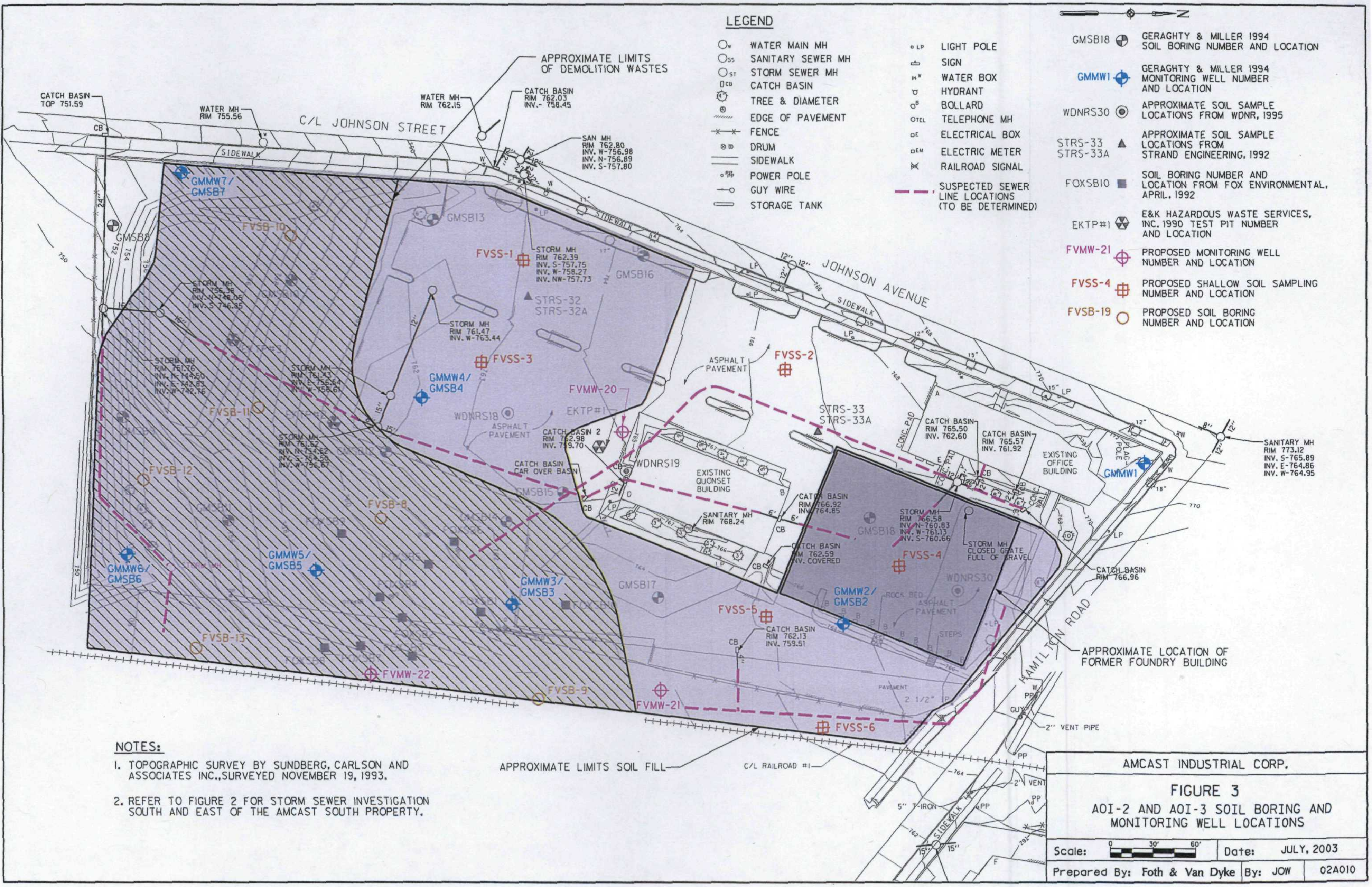


NOTES:

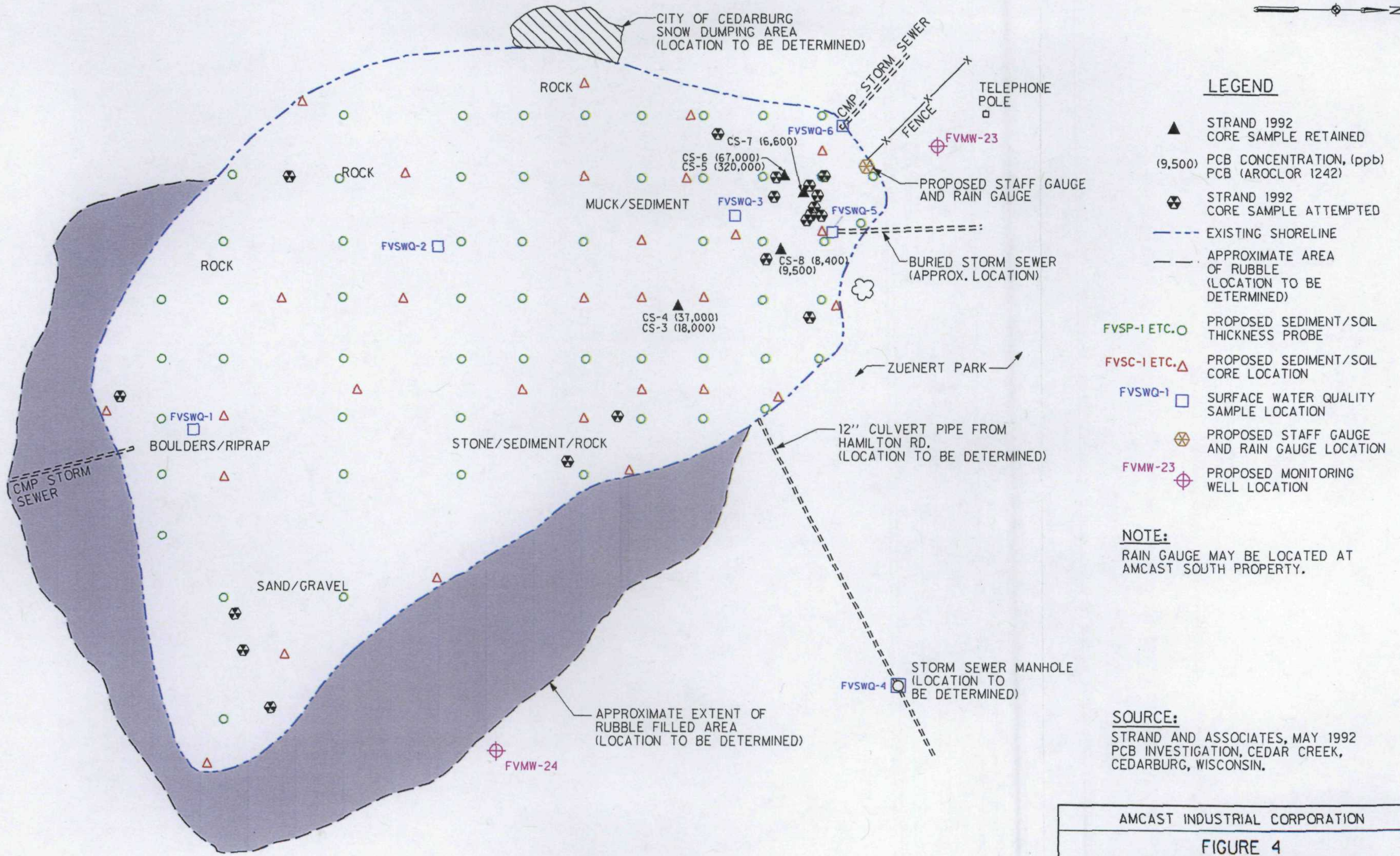
1. TOPOGRAPHIC SURVEY BY SUNDBERG, CARLSON AND ASSOCIATES INC., SURVEYED NOVEMBER 19, 1993.
2. REFER TO FIGURE 2 FOR STORM SEWER INVESTIGATION SOUTH AND EAST OF THE AMCAST SOUTH PROPERTY.

AMCAST INDUSTRIAL CORP.

FIGURE 3

AOI-2 AND AOI-3 SOIL BORING AND MONITORING WELL LOCATIONS

Scale: 0 30' 60'
Date: JULY, 2003
Prepared By: Foth & Van Dyke
By: JOW
02A010



NOTE:

RAIN GAUGE MAY BE LOCATED AT AMCAST SOUTH PROPERTY.

SOURCE:

STRAND AND ASSOCIATES, MAY 1992
PCB INVESTIGATION, CEDAR CREEK,
CEDARBURG, WISCONSIN.

AMCAST INDUSTRIAL CORPORATION

FIGURE 4

AOI-4 PROPOSED SEDIMENT PROBES, SEDIMENT CORES, WATER QUALITY SAMPLES, WELLS AND STAFF GAUGE LOCATIONS

Scale: 0 40' 80'		Date:	JULY, 2003
Prepared By: Foth & Van Dyke		By: JOW	02A010

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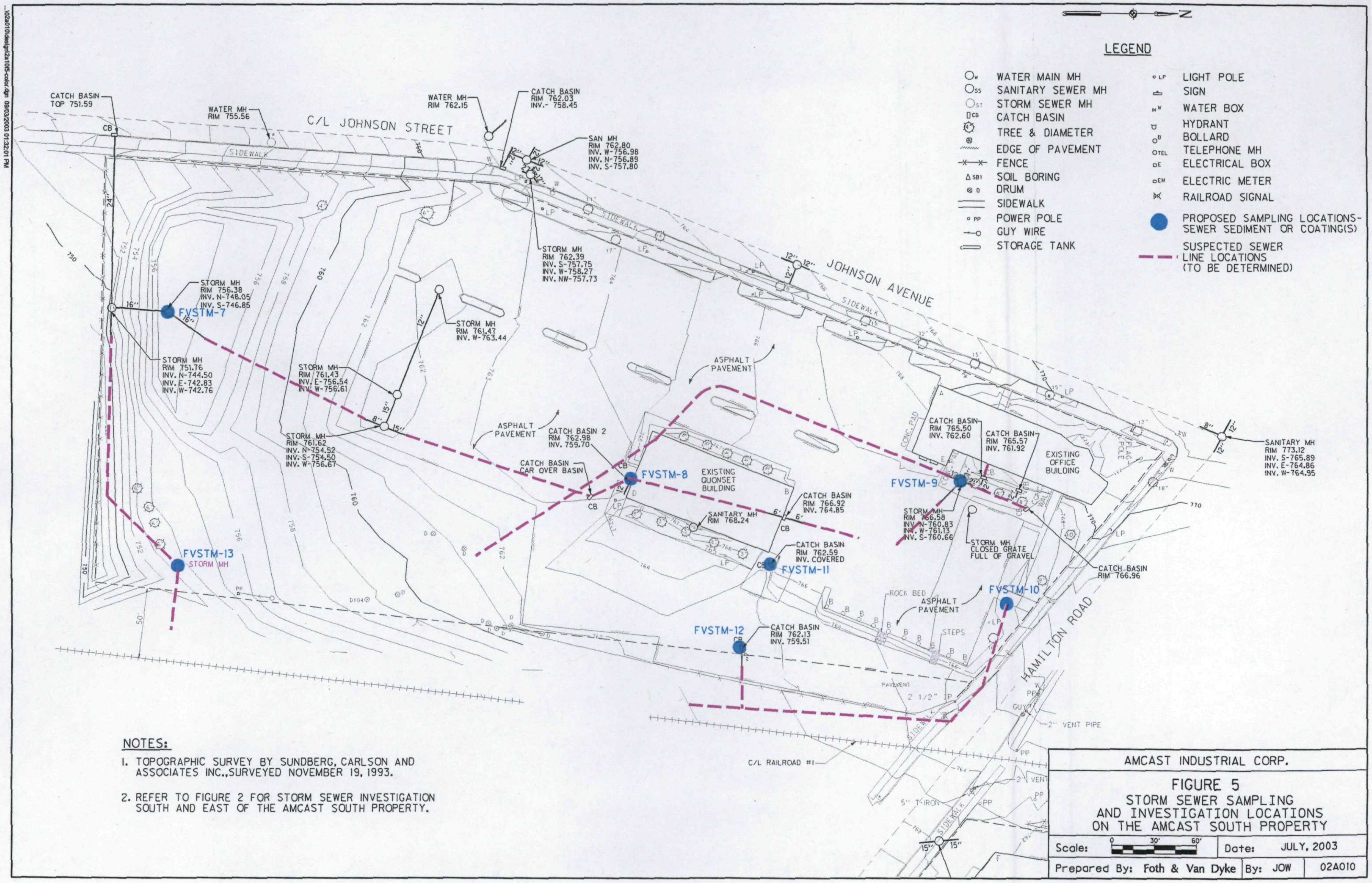

NOTES:

1. TOPOGRAPHIC SURVEY BY SUNDBERG, CARLSON AND ASSOCIATES INC., SURVEYED NOVEMBER 19, 1993.
2. REFER TO FIGURE 2 FOR STORM SEWER INVESTIGATION SOUTH AND EAST OF THE AMCAST SOUTH PROPERTY.

AMCAST INDUSTRIAL CORP.

FIGURE 5
STORM SEWER SAMPLING
AND INVESTIGATION LOCATIONS
ON THE AMCAST SOUTH PROPERTY

Scale: 0 30' 60'
Date: JULY, 2003
Prepared By: Foth & Van Dyke
By: JOW
02A010

Appendix A

Sampling Equipment and Procedures

A-1 Referenced ASTM and WDNR Standards
A-2 Soil Sampling Procedures
A-3 Field Equipment Cleaning/Decontamination Procedures
A-4 Water Column Sampling Procedures
A-5 Field Measurement for Water Quality Parameters
A-6 Vessel Operation and Station Positioning
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A-8A Collecting Sediment Samples by Vibrocoring (Submersible or Pole System) ASCI Corporation
A-9 Dissolved Oxygen and Redox Testing

Appendix A-1

Referenced ASTM and WDNR Standards

Referenced ASTM and Other Standards
(refer also to references section)

D-1452	Practice for Soil Investigation and Sampling by Auger Borings
D-1586	Test Methods for Penetration Tests and Split-Barrel Sampling of Soils
D-2487	Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
D-2488	Description and Identification of Soils (Visual-Manual Procedures)
D-5434	Guide for Field Logging of Subsurface Explorations of Soil and Rock
D-5783	Guide for Use of Direct Rotary Drilling with Water-Based Drilling Fluids for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices
D-5784	Guide for the Use of Hollow-Stem Auger for Geoenvironmental Exploration and the Installation of Subsurface Water-Quality Monitoring Devices
D-422	Test for Particle Size Analysis: Sieving/Hydrometer Method

Wisconsin Administrative Code Chapter NR 141, Groundwater Monitoring Well Requirements

Appendix A-2

Soil Sampling Procedures

Soil Sampling Procedures

I. Introduction

The general procedures to be used in the conduct of soil sampling at the project site are described below. The purpose of soil sampling is to collect representative samples of subsurface materials for physical and chemical characterization. Soil sampling will be conducted by continuous push, split-spoon, or grab sample collection. Soil sampling will be conducted by collecting a representative amount of material from the prescribed location at the project site

II. Materials

During soil sample collection activities, the following materials will be available as required:

- Personal protective equipment (as required by the Site Health and Safety Plan);
- Cleaning equipment;
- Decontamination equipment
- Soil sample collection receptacles (bags, jars, etc.) and appropriate labels
- Appropriate soil sample collection chain-of-custody documentation
- Portable field scale
- Book of Munsell soil color charts
- Pocket penetrometer (if required)
- Tape measure
- Transport container with ice
- Duct tape;
- Field forms and field drawings for recording and plotting soil sampling measurements;
- Field book
- Soil sampling devices such as:
  - Stainless steel hand augers
  - Split spoon samplers
  - Shelby tube samplers
  - Sediment coring devices
  - Stainless steel scoops

III. Procedures

The following list describes the procedures to be used when conducting soil sample collection.

1. Don personal protective equipment as required by the Site Health and Safety Plan.

2. Record the proposed sample location in the field notebook along with other appropriate information collected during the soil sample collection activity.

3. Describe and classify the soils in accordance with the approved Field Sampling Plan (FSP) and the Unified Soil Classification System (ASTM D-2487) using the visual-manual procedures described in ASTM D-2488.

4. Determine the appropriate sample collection interval (e.g., 0-6", 0-2-ft, etc.) to collect soils from in accordance with the FSP. (Note: Soil borings and monitoring wells shall be sampled continuously.)

5. Complete the field screening of the sample, including:
   - Screening with a PID as described in the FSP
   - Olfactory observations
   - Visual examination for soil contamination

   Note that both the drill cuttings and split spoon samples shall be field screened as described above. The field screening criteria listed above shall be used to select the soil samples for laboratory analysis. A discrete sample shall be field screened and a separate discrete sample containerized for laboratory analysis. Typically a sample from the most contaminated soil sampling interval will be collected for laboratory analysis.

6. Collect soil from the prescribed depth interval, weigh (if appropriate), add appropriate preservative (if required) and place into the appropriate sample container. (If a homogenization step is determined to be appropriate across the sample depth interval of interest, or for preparing composite samples, prepare the sample by homogenizing with disposable utensils in a clean disposable container following the homogenization procedures in the final paragraph of the "Core Processing" Procedures in Appendix A-8).

7. Secure and label the sample container with the sample identification, depth interval, type of analysis, and time and date of sample collection.

8. Place the sample receptacle in the appropriate transport container and log on the sample chain-of-custody.

9. Clean and decontaminate all sample collection equipment.

10. Verify the sample collection information documented on the chain-of-custody with the sample containers and field information (soil boring logs, field notebook).

Appendix A-3

Field Equipment Cleaning/Decontamination Procedures

Field Equipment Cleaning/Decontamination Procedures

I. Materials

- Health and safety equipment (as required in the Health and Safety Plan);
- Distilled water;
- Non-phosphate soap (Alconox® or equivalent);
- Tap water;
- Appropriate cleaning solvent (e.g., methanol or acetone);
- Rinse collection plastic containers;
- Knife;
- Brushes;
- Aluminum foil;
- Garbage bags;
- Spray bottles;
- Ziploc® type bags; and
- Plastic sheeting

II. Cleaning Procedures for Small Equipment and Sampling Devices

1. Follow health and safety procedures specified in the Health and Safety Plan.

2. Cleaning of reusable sampling equipment (e.g., scoops, mixing bowls, spatulas, etc.) will follow the decontamination procedures presented below:
    a. Wash all small equipment and sampling devices with non-phosphate detergent and distilled water;
    b. Rinse with distilled water;
    c. Rinse equipment with solvent (methanol or acetone);
    d. Rinse with distilled water; and
    e. Allow to air dry and wrap in aluminum foil.

3. Cleaning/decontamination will be conducted in plastic containers that will be transported to each sampling location.

4. These containers will also be used to collect all decontamination rinsate.

III. Cleaning Procedures for Large Equipment (if applicable)

1. Follow health and safety procedures specified in the Health and Safety Plan.

2. Cleaning of large sampling equipment will follow the decontamination procedures presented below:
    a. Wash all large sampling equipment with high-pressure steam cleaner or water wash using a brush as deemed necessary to remove any particles;
    b. Rinse with distilled water;
    c. Rinse with solvent;

    d. Rinse with distilled water; and
    e. Allow to air dry and wrap in aluminum foil.

3. Cleaning/decontamination will be conducted in plastic containers that will be transported to each sampling location.
4. These containers will also be used to collect all decontamination rinsate.

Cleaning of large sampling equipment such as auger flights, drill rods, and drill bits, etc., will only be required to following procedures III 1. and III 2a. Drilling rigs and associated large equipment will be cleaned prior to mobilizing to the site, after mobilizing to the site, between each bore hole on the site and prior to leaving the site.

Steam cleaning will be conducted on a decontamination pad lined with plastic sheeting, with decontaminated water collected in a lined sump and disposed of in accordance with applicable regulations.

Appendix A-4

Water Column Sampling Procedures

Water Column Sampling Procedures

I Introduction

The following procedure is applicable for collection of water column samples for analysis of PCBs.

II Materials/Equipment

Health and safety equipment as required by the health and safety plan;
Cleaning/decontamination equipment as required;
Sampling vessel(s);
Depth sounder
Kemmerer Water Sampler (or other appropriate water column grab sample);
Transport containers and packing, labeling, and shipping materials (coolers) with ice;
Sample containers and forms; and
Field notebook
Chest waders

III Procedures

Water column samples will be collected from a sampling vessel or by a sampling technician in waiters utilizing a grab sampler such as a Kemmerer Water Sampler. Samples will be taken at 0.2 and 0.8 of the total depth at the sampling location.

1. Identify sampling locations and appropriate sampling information in the field notebook.
2. Don health and safety equipment as prescribed in the project health and safety plan.
3. Clean the sampling equipment according to Appendix A-3.
4. Position the boat over the sampling location and maintain position as conditions require. In shallow water below storm sewer outlets and along the Quarry Pond Shore, it may be more efficient to sample the water wearing chest waiters.
5. Measure the total depth of the water column.
6. Grab and set the sampling device.
7. Slowly lower device to desired depth of 0.2 times the water depth
8. Let device equilibrate at depth for 1 minute.
9. Trip messenger to close sampling device.
10. Retrieve device and transfer sample into pre-cleaned sampling container.
11. Repeat procedure for 0.8 times the water depth.
12. Record required information on the appropriate forms and/or field notebook.
13. After each sampling container as been filled, take field measurements for pH, temperature, conductivity, and turbidity according to Appendix A-5.

IV Field Duplicates and Blanks

Field duplicates will be collected by taking water from the same grab samplel (if there is enough water) or by taking additional grab samples.

Appendix A-5

Field Measurement for Water Quality Parameters

Field Measurement of Water Quality Parameters

I. Introduction

Water quality parameters (e.g., turbidity, specific conductivity, pH, and temperature) are usually measured in the field. The temperature, pH, specific conductivity, and turbidity of surface water will be measured in-situ with a combination water quality meter.

II. Materials

The following materials, as required, shall be available during field measurement of water quality parameters:

- Personal protective equipment as required by the Health and Safety Plan (Min Level D);
- Cleaning equipment as required in Appendix A-3;
- Boat with minimum two anchors;
- Combination water quality meter and instruction booklet;
- Standard calibration solutions;
- Distilled/deionized water;
- Extra batteries for the meter; and
- Appropriate forms and field notebook.

III. Measurement of Temperature, pH, Conductivity and Turbidity

<u>Operating Range</u> (Cambridge Scientific Industries)

Conductance: 0-20 u/cm
0-200 u/cm
0-2000 u/cm
0-200000 u/cm

pH: 0-24 s.u.

Temperature: 0-160° F

<u>Accuracy</u>

Conductance: ± 2% Full scale @ 77° F

pH: ± -0.01 pH units @ 77° F

Temperature: ± 2° F

Calibration

Temperature and conductance are factory calibrated. However, conductance may be recalibrated if checked and found to be in need of such calibration. To recalibrate conductance, remove black plug revealing the adjustment potentiometer screw. Add standard solution to cup, discard and refill. Repeat until the digital display indicates the same value twice in a row. Adjust the potentiometer until the digital display indicates the known value of conductance. To increase the digital display reading, turn the adjustment potentiometer screw counterclockwise.

To standardize the pH electrode and meter, place the pH electrode in the 7.0 buffer bottle. Adjust the "zero" potentiometer on the face of the tester so that 7.00 is displayed. Then place the electrode in the 4.0 or 10.0 buffer bottle (depending on the expected pH of the actual measurement). Adjust the "slope" potentiometer on the face of the tester so that the display indicates the value of the buffer chosen.

Notes:

1. Rinse the electrode in distilled water between buffers.
2. When not in use, the cap should be kept on the electrode.
3. Moisten the cotton in the cap at lease once per week.
4. The carbon electrodes in the cup may be cleaned with a mild abrasive (400 grit or fine) on the end of the flat surface.
5. Wipe cup after every sample.

Operation

Rinse the inside of the sample cup with the liquid to be measured. Fill the sample cup at least 2/3 full.

Note:

The main body of the unit is not waterproof. Sample temperatures should be 160° F or below.

Slide the function switch to "temp" and push the "read" button. Adjust both temperature compensation knobs according to the displayed temperature. If the approximate conductance is known, slide the range selector to the proper range. Slide the function switch to "cond" and push the "read" button. Multiply the digital display reading by the factor indicated by the position of the range switch.

Note:

A three- or four-digit display, i.e., 1.00, must appear. If not, the range selector switch should be changed.

Slide the function switch to "pH". Insert the pH cable onto the tester. Place the pH electrode in the sample cup or in any other non-metallic container. Press the "read" button to display the pH value measured.

Note:

Always obtain conductivity reading before placing pH probe in the sample cup.

Maintenance

The instrument shall be maintained in accordance with the manufacturer's recommendations.

Appendix A-6

Vessel Operation and Station Positioning

Vessel Operation and Station Positioning

A variety of sampling vessels may be used, depending on the specific requirements. Vessels will be selected so that representative environmental samples can be collected efficiently and safely. To ensure that sampling is conducted appropriately and safely, any vessel will be operated by an experienced person, and a sufficient number of crew members will be onboard to conduct the required sampling activities in an efficient and safe manner.

A field team leader will be designated for each sampling event and will be onboard the sampling vessel during all sampling activities. In some cases, the field team leader may also be the vessel operator. The primary duties of the field team leader will be to supervise all sampling activities and ensure that the specifications of the QAPP/FSP are followed. If departures from the QAPP/FSP are required because of unforeseen circumstances, the field team leader will contact the field manager to obtain permission to incorporate changes prior to implementing any departures.

To meet the goals of the investigations, precise positioning of station locations is required. Both absolute accuracy (i.e., ability to define position) and repeatable accuracy (i.e., ability to return to a sampling station) are essential. Positioning for all sampling will be achieved using a servo driven total station or a differential GPS that is capable of locating stations with an absolute and repeatable accuracy of +/-1 meter.

To initially locate each station in the field, the sampling team will first estimate the position of the station relative to fixed shoreline objects, distance from shore, water depth and vegetation characteristics. Once a station has been located relative to such features, the appropriate positioning method will be used to determine the actual location of the station. If a station needs to be located again at a later date, its previous location will be reconfirmed by use of total station or differential GPS.

Appendix A-7

Groundwater Sampling Procedures

Appendix A-7

Groundwater Sampling Procedures

(Revised 9/25/03)

Groundwater Sampling Procedures

I. Introduction

The general procedures for sampling of groundwater monitoring wells are described below. Additional methods of groundwater sampling (if used) will be performed in accordance with WDNR guidance document: *PUBL-DG-038 96: Groundwater Sampling Field Manual, Wisconsin Department of Natural Resources, September, 1996.*

II. Materials

- Personal protective equipment as (as required by the Project Health and Safety Plan)
- Cleaning/decontamination equipment;
- Water level indicator;
- Submersible pump;
- Hydrolab-Minisonde^{TM};
- Field forms and field notebook;
- Appropriate sample collection containers and forms;
- Transport container with ice.

III. Procedures for Static Water Level Measurement

1. Document the Sampling Event

   a. Record all pertinent conditions regarding the sampling event including: time, date, weather, and atmospheric pressure recorded during the sampling event.

2. Measure the static water level

   a. Measure the static water level in the groundwater monitoring well prior to well purging, reading water level measurements to the nearest 0.01 foot by lowering the decontaminated probe or electrode into the well until the instrument indicates that you've reached the water column. Slowly raise and lower the probe or electrode in and out of the water column until you are satisfied that the instrument is providing a reliable water level reading. If necessary, adjust the instruments' sensitivity according to the manufacturer's instructions. Make the measurement from the point marked on the PVC well casing.

   b. Read the measurement on the cable or tape to the nearest 0.01 foot against the top of casing or reference elevation on the well. Record this measurement as the "depth to water" in the field notebook and/or on the appropriate field form.

3. Calculate Groundwater Elevation

   a. After obtaining depth to water measurements, subtract the "depth to water" from the "top of casing or reference elevation" and record this data as "groundwater elevation"

IV. Decontamination of Sampling Equipment

Acid rinse procedures described were derived from RCRA Groundwater Monitoring Technical Enforcement Guidance Document, 1986, United States Environmental Protection Agency.

1. Pump Decontamination

Prior to sampling at each well location, the Grundfos Redi-Flo2® submersible pump is decontaminated. A solution of Liquinox® and potable water is made and poured into a 5.5-ft length of schedule 40 polyvinyl chloride (PVC) pipe, capped at one end. The pump is lowered into the pipe and the Liquinox® solution pumped through the pump and tubing and recirculated into the pipe for three minutes. Distilled water is then recirculated through the pump. The PVC pipe is then rinsed with potable water until all the Liquinox® solution is removed. The PVC pipe is then rinsed once more with potable water. These potable water rinses are discarded into the "Decon Solution" drum.

The pump head is decontaminated with 0.1 Normal Hydrochloric Acid (0.1N HCl). The HCl rinse is collected into a dedicated high density polyethylene (HDPE) bucket labeled "Acid Rinse" and neutralized with sodium hydroxide (NaOH) to a pH greater than pH 5.

After the acid rinse, the pump-head is rinsed with Type II reagent grade deionized water over the "Acid Bucket". The pump is then submerged in the clean PVC pipe filled with reagent grade distilled water and the water is recirculated through the pump for three minutes. This water is then pumped into the 55-gallon drum labeled "Decon Solution."

2. Pump Tubing Decontamination

After pumping is completed at each well, the outside of the tubing is decontaminated. As the pump is lifted out of the well, the tubing, suspension cord, and controller cable are rinsed with a solution of Liquinox® and water. Following the Liquinox® wash, the tubing, cord, and cable are rinsed with steam distilled water.

3. Filter Apparatus Decontamination In-Line Filters Used

Before filtering a sample, each part of the filter apparatus that could potentially come into contact with the sample is decontaminated. The procedure includes disassembly of the apparatus, wash in an Liquinox® solution, rinse with steam distilled water, acid rinse, and final rinse with Type II reagent grade water.

4. Decontamination of Water Elevation Meter

The water level indicator is also decontaminated after each use. After the meter is reeled in, the cable is rinsed with a solution of Liquinox® and water. Special care is taken to rinse the meter's probe clean. Once the probe and cable are rinsed, the meter and probe are rinsed with steam distilled water.

5. Decontamination of pH and Conductivity probes

Between each sample point, the Corning Checkmate pH and conductance equipment is rinsed with steam distilled water using a dedicated spray bottle.

V. Well Purging

Prior to sampling a monitoring well, stabilized readings is taken at 5-gal intervals or until three volumes of water are purged from the monitoring well using the following procedures. First, a water level measurement is taken to determine the height of the water column. Then the volume of water in the well casing and sand pack was calculated (Appendix A). This volume is multiplied by three to determine the total volume of water to be purged from the well.

The pump is then lowered into the well (approximately 10 ft into the water column) and switched on. The pump is used to surge the well and mix the water column. In addition to the minimum of three well volumes, pH, temperature, and specific conductivity readings for the purge water also needed to be stable within 10%.

The pH meter and conductivity meter are calibrated daily according to the manufacturer's recommended procedures. The Corning Checkmate meter is calibrated using either pH 7 and pH 4 or pH 7 and pH 10 buffer solutions. The Corning Checkmate conductivity meter is calibrated with a 1440μS (micro siemen) standard solution. Each calibration is recorded in the pH/Conductivity Meter field log book. The calibrated instruments are then used to record the initial pH, temperature, and conductivity of the purge water. These parameters are then measured and recorded at intervals of 5-gals until stabilized or three well volumes are purged. Purging is stopped if the measurements are within 10% of the initial values. Otherwise, purging continued until these parameters stabilized. Once the well is stabilized, it is ready to be sampled.

VI. Well Sampling

Samples are collected through a submersible Whale® pump. Forty milliliter (ml) Volatile Organic Compound (VOC) vials are always collected first. Care is taken to minimize agitation of the VOC sample. The vial is then capped and turned over to make sure no air remained inside the vial. The remaining sample bottles are then filled and handled according to the Work Plan and laboratory requirements. Note that SVOC, VOC and PCB samples are not field filtered.

1. Field Filtering

In order to determine the concentration of dissolved chemical species, filtered samples are required. Approximately 1 liter of groundwater is field filtered at each well location. The filtering technique uses 0.45 micron disposable in-line filters.. The sample is then delivered directly into the sample bottle with the appropriate preservative for the particular analyte as provided by EnChem Inc. The sample containers are placed in a cooler with ice and the time of sample collection recorded on the appropriate sample chain-of-custody form When groundwater samples for total metals analysis are collected unfiltered samples are collected directly from the pump discharge tubing.

VII. QA/QC Sampling

Field duplicates will be collected by obtaining duplicate aliquots from groundwater monitoring wells as described in the project FSP and QAPP. Field blanks will accompany each batch of samples collected as described in the project FSP and QAPP. Trip blanks will be included with each batch of samples shipped to the applicable laboratories as required.

Appendix A-8

Sediment Probing and Core Sampling Procedures

Sediment Poling and Probing Procedures

I. Introduction

The general procedures to be used in the conduct of sediment probing in the river are described below. Sediment probing is performed to measure the thickness of soft sediment. Sediment probing will be conducted by advancing a sediment probe through the soft sediment materials of the bottom sediments until refusal.

II. Materials

During probing activities, the following materials will be available as required:

- Personal protective equipment (as required by the Site Health and Safety Plan);
- Cleaning equipment;
- Boat and/or chest waders;
- Calibrated sediment poling instrument (range pole fitted with a 1-ft by 1-ft square Plexiglas plate);
- Calibrated sediment probing instrument (range pole with pointed end);
- Duct tape;
- Field forms and field drawings for recording and plotting poling and probing measurements;
- Field book

III. Procedures

The following list describes the procedures to be used when conducting sediment poling and probing measurements.

1. Don personal protective equipment as required by the Site Health and Safety Plan.

2. Record the proposed sample location in the field notebook along with other appropriate information collected during poling and probing activities.

3. Position boat over the sampling location using a minimum of two points to secure the boat. Alternatively, chest waders may be donned by a sampling technician to access the sampling location.

4. Verify the horizontal location by confirming with global positioning system or other electronic positioning survey equipment.

5. At each location, lower the range pole with the 1-ft by 1-ft square plate to the point where the top of sediment is contacted.

6. Measure and record the depth of water to top of sediment.

7. Survey water elevation at the sampling location.

8. Retrieve the range pole with the square plate and replace the square plate tip with the sediment probe tip (or use a second range pole with a probe tip) and lower the probe tip to the measured top of sediment elevation.

9. Advance the rod into the sediment profile until vertical refusal.

10. Measure the depth of probe penetration relative to the top of sediment elevation and record the information in the field book or field form.

11. Reconfirm the location of the measurements collected and review all measurement data recorded on all forms to ensure accurate data collection.

12. Proceed to the next poling and probing location.

Sediment Core Sampling Procedures

I. Introduction

The two alternative procedures are proposed for obtaining sediment samples from the Quarry Pond. The alternatives are using Lexan ^{R} tubing for manual sampling of sediments or alternatively use Vibracoring technology. The sampling procedures for these two methods are provided below.

II. Materials- Lexan Tube Sampling

Lexan® tubing (minimum wall thickness of 1/8 inch) or core tubes with CAB liner tubes (minimum wall thickness of 3 mm) will be used to collect sediment cores. The core will be inserted with a straight, vertical entry into the sediments to secure a representative cross section sample.

During the sampling activities, the following materials will be available as required:

- Personal protective equipment (as required by the Site Health and Safety Plan);
- Cleaning equipment;
- Boat and/or chest waders;
- Sediment poling equipment (one range pole with a 1 ft by 1 ft square tip);
- Aluminum or stainless steel tray;
- Duct tape;
- Lexan® tubing with end caps or a core tube pipe with CAB liner with end caps;
- Stainless steel core driver;
- Brass push rod;
- Calibrated rod for sediment depth measurement;
- Hacksaw;
- Dremel tool (little circular saw);
- 6 ft rule or survey rod;
- Vacuum pump (for Lexan® tubing);
- Transport container with ice;
- Appropriate sample containers and forms; and
- Field notebook

III. Procedures for Lexan® Tube Sampling and the Core Tube with CAB Liner Tubes

1. Identify the proposed sample location in the field notebook along with other appropriate information collected during sediment sampling activities.

2. Don personal protective equipment as required by the Site Health and Safety Plan.

3. Position boat over the sampling location using a minimum of two points to secure the boat.

4. Decontaminate the inner surfaces of the tube or tube liner and all stainless steel sampling utensils following the procedures addressed in Appendix A-3.

5. At each sample location, lower the range pole with the 1-ft by 1-ft square tip until it just reaches the top of sediment. Measure the depth of water. Record the depth to the top of the sediment.

6. Replace the square tip on the range pole wit the sediment probe tip and lower to the top of sediment. Push the rod into the sediment until refusal vertically. Measure the depth of sediment.

7. Lower the sampling equipment (core) until the lower tip of the core is at the top of the sediment. Push the core tube 30 inches into the sediment or until refusal. If the core has not been pushed 30 inches, drive the tube or tube with liner several more inches, using a stainless steel core driver, and measure the distance. This procedure is performed to obtain a "plug" at the bottom of the core and prevent the loose sediment from escaping. Or vibracore or other similar sampling device may be used in areas where the sediment thickness is greater than 30 inches.

8. Slowly pull the tube or tube with liner from the sediment, twisting it slightly clockwise (if necessary) as it is removed.

9. Before the sediment core barrel is removed from the water, one of the samplers will temporarily cap the end with a flat instrument or by hand. The corer will be brought aboard the boat and the tip of the corer will be carefully removed while the sediment in the corer is held in place. The corer will be kept as upright (vertical) as possible to minimize disturbance of the top portion of the sediment.

10. After the core tip has been remove place a cap on the end of the CAB tube as soon as possible. While maintaining the corer in an upright position carefully remove the CAB tube from the core barrel keeping both the tube and corer as vertical as possible.

11. Keeping the tube or liner tube upright, wipe the bottom end dry and seal the cap with duct tape. Measure the length of sediment recovered and evaluate the integrity of the core. If the core is not suitably intact, repeat coring procedure adjacent to the first location attempted. Dispose of unsuitable cores by containerizing the core recovery as described in Section 7 of the FSP.

12. While still keeping the core upright, use a hacksaw or drill to make a horizontal cut or several drill holes in the tube or liner tube approximately one inch above the sediment.

13. Pour off liquid material at the top of the core and recap the cut end of the tube, seal the cap with duct tape, and mark this end as "TOP".

14. Wipe the tube or liner tube dry.

15. Place a completed sample label on the tube or liner tube.

16. Record the following information on both the tube or liner tube and on the cap:
    a. Sample number;

   b. Sampling date;
   c. Sampling time

17. Record sediment characteristics in the field log book.

18. Place the core sample upright in a container with ice.

19. Repeat the above procedures until all core samples are collected (for the sampling event or the sampling day).

20. Sediment cores will be extruded from the Lexan® tubing or removed from the liner tubes by slicing the tubes lengthwise using a Dremel tool onto an aluminum or stainless steel tray. Cores will be handled according to the type of analysis required:

21. The handsaw or spatulas used to section the core (see "Core Processing" below) should be cleaned between each cut.

22. Label all sample containers and record all appropriate information in the field notebook.

23. Handle, pack and ship the samples in accordance with the procedures in QAPP.

IV. Field Duplicates and Blanks

Field duplicates will be collected for sediment cores by replicating subsamples of a composited sample from a mixing bowl. Field blanks will be collected by rinsing deionized water into and over a decontaminated mixing bowl and spoon and collecting the rinse water in appropriate sample containers.

Note: The procedures described above may also be applied to individuals on foot (wading) performing poling and probing activities in areas inaccessible by boat.

V. Vibracoring Technology and Capbilities

The information which follows is from the Vibrcoring web site http://www.vibracoring.com

Vibracoring (or vibrocoring) is a technology and a technique for collecting core samples of underwater sediments and wetland soils. The vibrating mechanism of a vibracorer, sometimes call the "vibrahead", operates on hydraulic, pneumatic, mechanical or electrical power from an external source. The attached core tube is driven into sediment by the force of gravity, enhanced by vibration energy. When the insertion is completed, the vibracorer is turned off, and the tube is withdrawn with the aid of hoist equipment. A typical **vibracoring rig** is shown here.
A variety of **vibrahead types** have been developed. In general the frequency of vibrations is in the range of 3,000 to 11,000 vibrations per minute (VPM), and the amplitude of movement is on the order of a few millimeters (mm). The vibrations cause a thin layer of material to mobilize along the inner and outer tube wall, reducing friction and easing penetration into the substrate. The liquid spaces in the matrix allow sediment grains to be displaced by the vibrating tube. Vibracoring works best on unconsolidated, waterlogged, heterogeneous sediments and soils.

Silty sediments of mixed grain size are easiest to core. Vibracoring is less effective for relatively dry clays, packed sand or any consolidated (cemented) materials.

In a typical undisturbed sediment column the upper few inches may be a loose watery material that is easily resuspended by any nearby motion. This material will be **stirred up** by the vibracore tube (or other sampling devices) as it penetrates. In the deeper firmer layers of sediment, only a few millimeters adjacent to the tube wall are significantly disturbed by the low-amplitude vibrations and the movement of the tube. Within the "heart" of the core, **details of structure** such as layers and gas bubbles are normally still intact.

Once a core tube has fully penetrated the sediment and the vibrator is turned off, it must be withdrawn without loosing the sample. Helping to counteract suction at the lower end is a one-way **core catcher**, which collapses and (ideally) prevents sediment from slipping back out. Also, at the upper tube end is a one-way check valve, which seals and maintains suction inside the tube. If the tube was not fully submerged during coring, it contains (besides sediment and water) an elastic column of air, which should be replaced with water and the tube resealed before it is withdrawn.

For various reasons the length of a core sample never represents 100 per cent of the sediment column penetrated. First, the core catcher constricts the opening slightly, resulting in a little expansion and shortening of the core inside the tube. Secondly, sediments often contain biogenic gas bubbles which may be lost during coring and/or compressed during withdrawal. Thirdly, some of the plugging or rodding effect can occur, even in vibrocoring. Finally, some sediment loss can occur through the catcher, especially if sediments are very fluid or oily. In any case, core sample recoveries can be calculated as actual core length divided by the measured depth of penetration. Typically, core recoveries are 90% or more.

In the case of cores collected in metal tubes with plastic liners, the liner containing the sediment sample is usually removed from the bottom end after taking off the nose piece or cutter. Ideally this can be done without laying the tube down since the upper tube may contain a layer of water which -- when horizontal -- will mix with sediment and destroy some of the core's integrity. Unlined tubes are simpler to handle, especially if clear plastic tubes are used. First, the retrieved core tube is capped and taped securely at the bottom end while still vertical. In the clear tube, the sediment- water interface is visible, and a small hole can be drilled just above it to drain off the excess water. Then the tube is cut and capped at its upper end. At that stage the core can be laid down and transported without disturbing the contents greatly. Key information (station, date, time, length, etc.) can be written with a permanent marker on the top cap. The bottom end of the core still contains the catcher fastened inside it, and so is always recognizable.

Sealed cores prior to processing should always be maintained at original or lower temperatures to prevent expansion and leakage from the capped ends.

Vibrocoring is particularly well suited to sampling of contaminated sediments. Immediately after collection, the tube containing the intact core can be capped and taped. Although this minimizes the risk of exposure, sampling crews are advised to wear protective gear, including Tyvek suits, rubber gloves and boots, and safety glasses. Once the core tube is sealed, it can be transported and processed under controlled conditions ashore. Processing on board would not only contaminate the vessel, but would also slow down the sampling effort.

At the processing site, cores should be opened on a sheet of plastic film to contain leakage. Procedures should be set up for collecting sub-samples, decontaminating tools, and containing waste materials. The rinsed core tube halves can be disposed of as solid waste.

AScI Corporation (AScI) will be completing the coring at the Quarry Pond. Appendix A-8A contains *Collecting Sediment Samples by Vibrocoring (Submersible or Pole System)* which contains the standard operating procedures used by AScI on sediment coring projects.

Core Processing

Once the liner wall is cut through along opposite sides (top and bottom of the horizontal core), use a series of flat, thin blades of rectangular shape (and pre-cleaned) to cut the sediment core lengthwise into two half-cylinders, using a series of vertical cuts along the core's radial axis (Step 2, below). Use a clean blade for each cut. Vertical cutting in discrete steps, rather than "dragging" the blade through the core, ensures that the layered structure of the core is not obscured, and that contaminants are not spread across layers. Between each vertical cut, wash and scrub all adhering sediment off of the blade in a bucket of clean tap water. Note: it is usually not practical to decontaminate the blade fully after each cut, but any chance of contaminant carryover between zones can be minimized by cutting through the less oily parts of the core first. It helps if the blade is wet when cutting through oily silt or stiff clay sediments, which tend to adhere. A cleanly cut surface is best for documenting core structure.

Arrange the two half-cylinders of the core section side-by-side, with the cut surfaces facing up (Step 3, below). Extend a tape measure along beside them, starting at the original top end of the core. Photograph the core in color with a 35 mm camera. (160 watts (4, 4' bulbs) of fluorescent light, 200 speed film is suitable for good results.) Insure that the wet surface of the core does not reflect light directly into the camera lens. A polarizing filter helps to reduce reflectance off the wet core surface. Photograph the core section in overlapping frames; place a small label with core field ID number so that it appears in each frame. Advance the tape measure appropriately for any additional sections of the same core.

If a moveable light box is used, the tape measure is first positioned along the full length of the core. Overlap the fields of view at least one inch.

While the core section is still intact, record a general description of the core structure, noting zones of different color, texture, sediment type (silt, sand, clay, gravel, etc.) and apparent oiliness.

Collect each core interval, from the undisturbed core interior with a clean, stainless steel spoon or spatula. Place the sediment from an individual core interval into a clean stainless steel mixing bowl of appropriate size (bowls and spoons are pre-cleaned according to decontamination protocols). Mix the sediment with a clean stainless steel spoon thoroughly or until visually homogeneous. During this operation, remove any obviously "non-sediment" objects from the sample; bottle caps, broken glass, sticks, large rocks, etc. Place sediment sample in sample container.

Record all measurements and description on the "Sediment Core Collection and Processing Log" form attached.

Sediment Core Collection and Processing Log

Core Collection Date: _______ (Initials)

Time: _____________ Water Depth: (ft/in): ____________________ Sampling Personnel: _______

Station ID No. _____________ Core Penetration (in): ____________________ Courier Personnel: _______

Photo ID Nos.: _____________ Core Length (in): ____________________ Processing Personnel: ________

Station ID No.	Core Penetration (in)	Core Length (in)	Processing		Analyticals	
			Core Intervals* (in)	Descriptions	Core Intervals* (in)	Sample Numbe

*** From top of core**

Page ____ of _____

Appendix A-8A

Collecting Sediment Samples by Vibrocoring (Submersible or Pole System)
ASCI Corporation

COLLECTING SEDIMENT SAMPLES BY VIBROCORING (SUBMERSIBLE or POLE SYSTEM)

Standard Operating Procedure

V. Elliott Smith
AScI Corporation
Environmental Surveys

1.0 EQUIPMENT AND SUPPLIES

Either of two types of vibrocoring systems:

1. A mobile boat vibrocoring system consisting of: a 25 ft. aluminum pontoon boat with outboard motor and trailer, Rossfelder Model P-3 vibrocorer, 115/230 VAC, 3-phase generator, 15 ft. draw works with 1,500 lb. winch, 110 VAC, miscellaneous marine equipment and tools, as needed to operate the system. The original system uses aluminum 4-inch (1/8 in. wall) diameter core tubes up to 20 feet long. These may be lined with 3.75-inch (1/16 in. wall) diameter CAB (cellulose acetate butyrate) tubes. A stainless steel nose piece with core catcher is pop-riveted to the lower end of the core tube assembly. Alternatively, 4 in. x 3/32 CAB or 4 x 1/8 in. wall polycarbonate (Lexan) core tubes may be used with a riveted-in CAB core catcher. The vibrohead contains a ball check valve to help retain sediments during tube extraction.

2. a portable "pole" vibro-coring system per AScI design, consisting of: electric vibrator motor (12 V DC) and mounting plate with socket for attachment of 2" diameter extension poles; two, 12 V DC storage batteries with charger; core tube adapter and clamp with check valve and retrieval lines attached; 2-10 ft. extension poles, 6.5 ft. (2 meter) lengths of 2" diameter core tube (CAB or cellulose acetate butyrate] polymer) with CAB core catchers attached, 2" diameter PE (polyethylene) end caps; duct tape, marker pens, portable drill and ¼" bit; tube cutter tool; glass or polypropylene sample bottles; field crew of at least 2.

2.0 PROCEDURE

The following two sampling procedures apply to the submersible (S) and pole (**P**) vibrocoring systems. First:

- Locate the sampling station with an appropriate field positioning system that provides suitable accuracy (± 3 to 5 m).

- Triple anchor the boat (if any) to insure keeping it on station.

- Measure the water depth using appropriate means, such as a sounding line, marked pole or fathometer.

2.1 Collecting the Core

Submersible (S) Vibrocorer System:

S-1) Check for secure attachment of the vibro-head to the winch cable and the aluminum core tube/CAB liner assembly.

S-2) Using the winch and draw works, suspend and lower the vibrocorer slowly until the core tube contacts the bottom. A measuring tape attached to the top shackle of the vibrohead is used to calculate this when water depth and length of the core tube is known.

S-3) Begin vibration and continue penetration until the core tube is fully buried or refusal occurs. Be careful to maintain a taught cable to keep the core tube vertical. Turn off the vibration when penetration is completed.

S-4) Withdraw the core tube slowly by winch, using vibration only if extraction is difficult (as from clay). Raise the core tube until the lower end is accessible from on deck. Thereafter, keep the tube in a near vertical position to preserve core integrity.

S-5) Cap and tape the lower end. If a lined aluminum tube is used, remove the nose piece rivets, slide the liner out (downward) until the sediment/water interface is visible through the liner wall. Drill a small hole just above the interface to drain off all water above the sediment core. Carefully cut off (hacksaw) the liner at this hole, capping and taping it to seal the tube at both ends.

S-6) Label the upper end of the core with date, time and a unique station number. Transfer the core ashore as soon as possible to the processing location, protecting the core from sunlight, heat and physical disturbance as much as possible.

Pole (P) Vibrocorer System:

P-1) Check for secure attachment of the retrieval lines to the core tube mounting clamp.

P-2) Insert a 6.5 ft. length of 2" diameter CAB core tube (core catcher end down) into the mounting clamp and tighten the four wing nuts securely by hand. Make sure clamp is tightened evenly.

P-3) Choose an extension pole of appropriate length (water depth or longer) and insert it into the mounting plate socket; secure it using a 1/4" bolt and locknut.

P-4) Slip the flared lower end of the extension tube over the check-valve end of the core tube adapter, and hold it on byapplying upward tension on the retrieval lines. Lower the system vertically (CAB tubing first) into the water to the bottom. Press and vibrate tube into the sediment until it is inserted 6 ft., or until refusal occurs. Note insertion length by markings on extension pole.

P-5) Disengage the extension pole and stow on board sampling vessel.

P-6) Retrieve the core tube containing the sample by pulling on the two retrieval lines, either manually or by using a davit-mounted hand winch.

P-7) With tube and barrel held vertically in the boat, drill hole in tube just above the top of the sediment column to drain off water.

P-8) Cut off the tube just above the sediment surface and cap both ends.

P-9) Label the tube lengths with sample station ID codes with a permanent marker; make sure the upper ends are marked as such.

P-10) Stow core within a cooler or enclosed box with bag ice. Transport ashore for processing as soon as possible.

Appendix A-9

Dissolved Oxygen and Redox Testing

3. Dissolved Oxygen

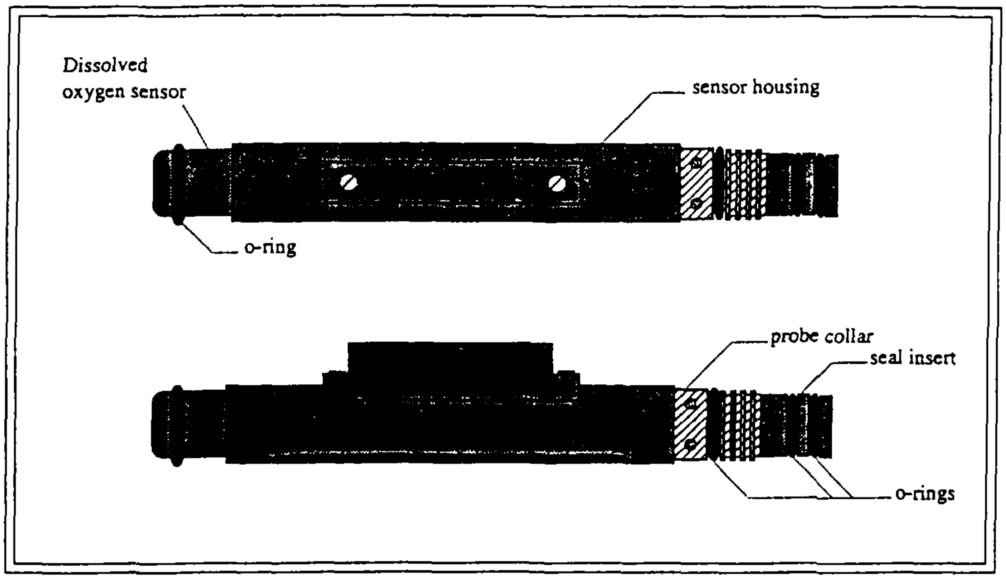


FIGURE 21: D.O. SENSOR (SIDE VIEWS)

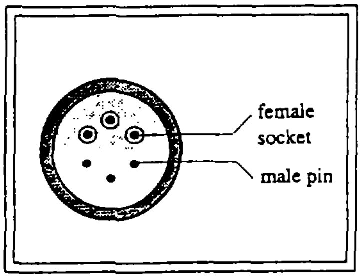


FIG. 22: D.O.SENSOR
(CONNECTOR END VIEW)

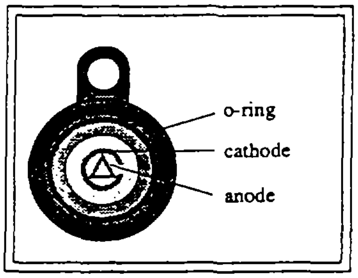


FIG. 23: D.O. SENSOR
(SENSOR END VIEW)

Maintenance

Dissolved oxygen (D.O.) sensor maintenance is usually required when calibration becomes impossible or when the membrane covering the cell becomes wrinkled, bubbled, torn, dirty, or otherwise damaged. Follow a regular schedule for membrane replacement.

What do I need to service the D.O. sensor?

- Hydrolab's MS/DS4 D.O. maintenance kit (Ref. No. 013430)
- Deionized water
- 1 pair of scissors or 1 pocket knife
- 1 lint-free cloth

Steps to follow

STEP 1: Remove the o-ring securing the membrane. Shake out the old electrolyte.

STEP 2: Rinse the sensor cavity with deionized water. Refill with fresh D.O. electrolyte (provided in the maintenance kit, or use 2M KCl) until a perceptible meniscus of electrolyte forms above the entire electrode surface of the sensor. To remove any bubbles trapped in the electrolyte, tap gently, on the side of the D.O. sensor.

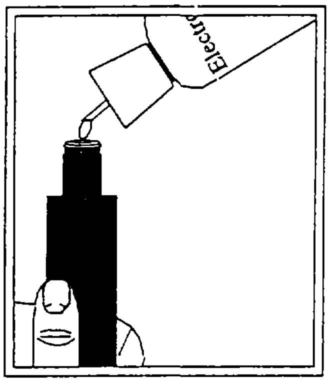
STEP 3: To replace the membrane, hold both ends of a new membrane with both hands between your thumbs and index fingers. Hold the membrane above the top and carefully drop the membrane over the top of the sensor.

STEP 4: Place the new o-ring over the gold cathode (use the old o-ring, if it is not damaged). Do not use any type of grease on the o-ring. Secure the membrane with the o-ring by pushing down with your thumbs on both sides of the o-ring. *Carefully* trim the excess membrane extending below the o-ring with the pair of scissors or the pocket knife.

STEP 5: Allow the membrane to soak overnight in tap water before calibration.

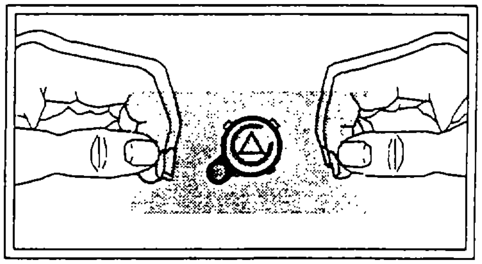
STEPS 2

FIGURE 24



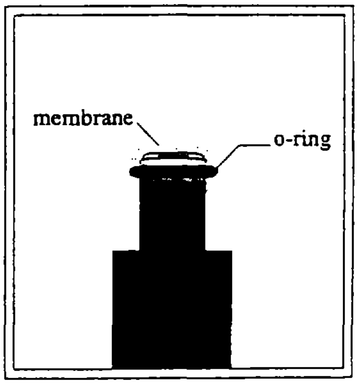
STEP 3

FIGURE 25



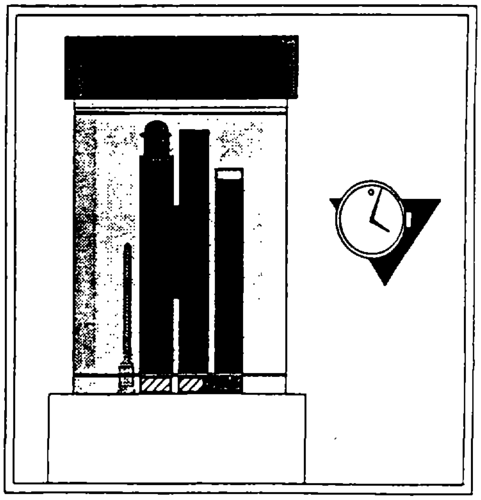
STEP 4

FIGURE 26



STEP 5

FIGURE 27



Calibration

The following procedure will calibrate D.O., % saturation, or mg/l.

Calibration can be performed in the DS4 calibration cup or MS cup, a bucket or large tub of water, or using the Winkler titration method. A membrane is installed on your multiprobe when it leaves the factory. Check if the membrane is properly installed (no wrinkles, tears, or bubbles). The Hydrolab membrane allows fast and accurate D.O. measurements.

If you have replaced the membrane, allow it to soak overnight in tap water before calibration.

What do I need to calibrate for dissolved oxygen readings?

- 1 lint-free cloth
- 1 DS4 calibration cup (see figure 30)
- 1 DS4 lid (see figure 28)
- 1 MS cup (see figure 31)
- 1 MS cap (see figure 29)

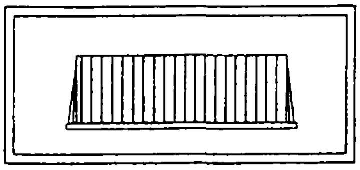


FIGURE 28: DATASONDE 4 LID

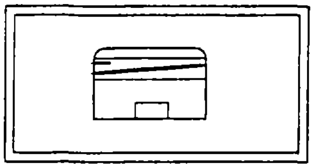


FIGURE 29: MINISONDE CAP

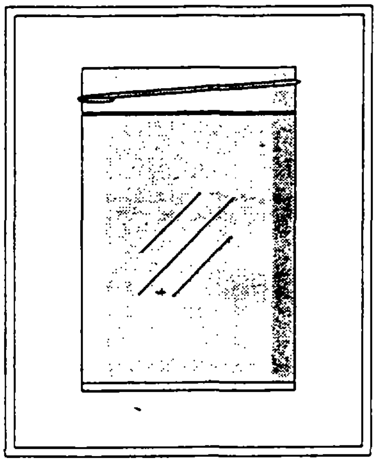


FIGURE 30: DATASONDE 4 CALIBRATION CUP (SIDE VIEW)

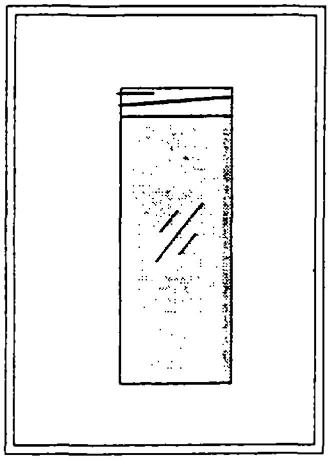


FIGURE 31: MINISONDE CUP (SIDE VIEW)

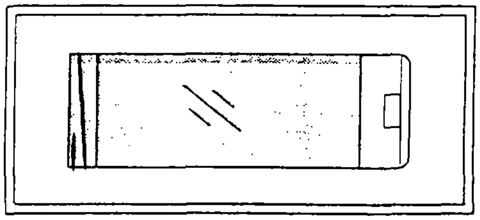


FIGURE 31: MINISONDE CALIBRATION AND STORAGE CAP AND CUP (Assembled)

Steps to follow

STEP 1: Secure your multiprobe to the work surface, sensors pointing toward the ceiling, and install the DS4 calibration or MS cup. Fill the DS4 calibration or MS cup with tap water (specific conductance less than 0.5 mS/cm) until the water is just level with the o-ring used to secure the D.O. membrane.

STEP 2: Carefully remove any water droplets from the D.O. membrane with the corner of the lint-free cloth.

STEP 3: Cover the DS4 calibration or MS cup with the inverted DS4 lid or MS cap. Allow a few minutes for D.O. readings to stabilize.

STEP 4: The sensor is ready for calibration once the readings on your display have stabilized. In the Main Menu, move the cursor with the arrow keys to `Calibrate` and press ENTER.

```
Id: n/a                    DataSonde 4 / MiniSonde                04/12/96
Serial No. 00000000          (C)1996, Hydrolab                    23:11:26

Main Menu:  Press -> or <- to move, ENTER to select...
   HL     Login      Setup      Calibrate      Files      Software
```

STEP 5: First, move the cursor to `Oxygen` and press ENTER.

```
Calibrate:
  Temp    Oxygen
```

STEP 6: Next, leave the cursor on `DO: %Sat` and press **ENTER**.

```
Calibrate: Oxygen:
  DO:%Sat   DO:mg/l   BP:mmHg
```

STEP 7: Then, type the barometric pressure in millimeters of Mercury (mmHg) at your site and press **ENTER**. Note that the last number typed will appear between brackets (`[760.0]` below).

```
Calibrate: Oxygen: DO:%Sat:
  Barometric pressure (mmHg):[760.0]  <<
```

To calibrate to a known D.O. concentration (for instance, a Winkler titration, or another D.O. instrument), follow the next steps:

NOTE:

- If you will be comparing your multiprobe readings with the Winkler titration results, make sure that the conductivity driver has been installed on your multiprobe. This will take care of the salinity compensation issue related to this specific calibration method.

STEP 1: Fill a bucket or large tub with deionized water. Immerse your instrument in the water. Allow time for the liquid to stabilize and reach room temperature. Stabilization may take several hours. Stirring the liquid may speed up the calibration process. Wait until the readings have completely stabilized (to ±0.5 %Sat within one hour).

STEP 2: Take a sample from the bucket or tub. Proceed with your Winkler titration.

STEP 3: In the Main Menu, move the cursor with the arrow keys to `Calibrate` and press **ENTER**.

```
Id: n/a                 DataSonde 4 / MiniSonde                04/12/96
Serial No. 00000000       (C)1996, Hydrolab                    23:11:26
---------------------------------------------------------------------
Main Menu:  Press -> or <- to move, ENTER to select...
  HL      Login      Setup      Calibrate      Files      Software
```

STEP 4: Then, move the cursor to `Oxygen`, and press **ENTER**.

```
Calibrate:
  Temp    Oxygen
```

STEP 5: Next, move the cursor to `DO:mg/l` and press **ENTER**.

```
Calibrate: Oxygen:
  DO:%Sat   DO:mg/l    BP:mmHG
```

STEP 6: Next, type the barometric pressure in mmHg at your site and press **ENTER**.

```
Calibrate: Oxygen: DO:mg/l:
  Barometric pressure (mmHg):[760.0]  <<
```

STEP 7: Finally, type the known concentration, or the value in mg/l produced by the Winkler titration, after `Standard: <<` and press **ENTER**.

```
Calibrate: Oxygen: DO:mg/l:
  Standard:[8.33]<<
```

Your D.O. sensor is now calibrated. Otherwise, repeat the procedure and refer to the "Quick calibration troubleshooting guidelines" (after depth calibration) and the "Troubleshooting" chapter.

NOTES:

- The standard barometric pressure is 760 mmHg at sea level. Call your local weather bureau or airport to find out the barometric pressure of your specific site. You can estimate this number using: BP = 760 - 2.5 (A/100), where A is your local altitude above sea level <u>in feet</u>. Also, if you are using the BP given by your local weather bureau, be aware that their numbers are corrected to sea level, and you must use BP', the uncorrected atmospheric pressure: BP' = BP - 2.5 (A/100).
- You can also use the built-in barometer in your Surveyor 4, carry a pocket barometer, or have one at your deployment site.

Appendix 1

DISSOLVED OXYGEN: SATURATION VALUES and SENSOR TYPES

A1.1 DO Saturation Values

Here is a listing of the dissolved oxygen saturation values used by Hydrolab water quality multiprobes when performing an air calibration of the DO system. The source of these values is an algorithm given in Measurement of Dissolved Oxygen, Hitchman, 1978. Included for comparison are saturation values from the 1971 and 1985 editions of Standard Methods for the Examination of Water and Wastewater. Each value is in milligrams per liter of zero chlorinity water, with first the temperature noted in degrees Centigrade.

	Hitchman	1985 SM	1971 SM
T°C	milligrams dissolved oxygen per liter water at one atmosphere		
0	14.57	14.621	14.6
1	14.17	14.216	14.2
2	13.79	13.829	13.8
3	13.43	13.460	13.5
4	13.08	13.107	13.1
5	12.74	12.770	12.8
6	12.42	12.447	12.5
7	12.11	12.139	12.2
8	11.81	11.843	11.9
9	11.53	11.559	11.6
10	11.26	11.288	11.3
11	10.99	11.027	11.1
12	10.74	10.777	10.8
13	10.50	10.537	10.6
14	10.27	10.306	10.4
15	10.05	10.084	10.2
16	9.83	9.870	10.0
17	9.63	9.665	9.7
18	9.43	9.467	9.5
19	9.24	9.276	9.4
20	9.06	9.092	9.2
21	8.88	8.915	9.0
22	8.71	8.743	8.8
23	8.55	8.578	8.7
24	8.39	8.418	8.5

(continued)

(continued)

T°C	Hitchman	1985 SM	1971 SM
	milligrams dissolved oxygen per liter water at one atmosphere		
25	8.24	8.263	8.4
26	8.09	8.113	8.2
27	7.95	7.968	8.1
28	7.81	7.827	7.9
29	7.68	7.691	7.8
30	7.55	7.559	7.6
31	7.42	7.430	7.5
32	7.30	7.305	7.4
33	7.18	7.183	7.3
34	7.07	7.065	7.2
35	6.95	6.950	7.1
36	6.84	6.837	7.0
37	6.73	6.727	6.9
38	6.63	6.620	6.8
39	6.52	6.515	6.7
40	6.42	6.412	6.6
41	6.32	6.312	6.5
42	6.22	6.213	6.4
43	6.13	6.116	6.3
44	6.03	6.021	6.2
45	5.94	5.927	6.1
46		5.835	6.0
47		5.744	5.9
48		5.654	5.8
49		5.565	5.7
50		5.477	5.6

Note that these values are for the standard atmospheric pressure of 760 mm Hg. Linear interpolation will provide a reasonable estimate for saturation values of non-whole number temperatures.

See Part Five of the Operating Manual for information on the effect of barometric pressure on DO calibration and readings.

STEP 13: Now, type the value of the slope buffer after `standard:` <<, followed by ENTER.

```
Calibrate: Ions-1: pH/Units:
Enter standard:[7.0](Slope buffer value)<<
```

Your pH sensor is now calibrated. Otherwise, repeat the procedure and refer to the "Quick calibration troubleshooting guidelines" (after depth calibration) and the "Troubleshooting" chapter.

6. Redox

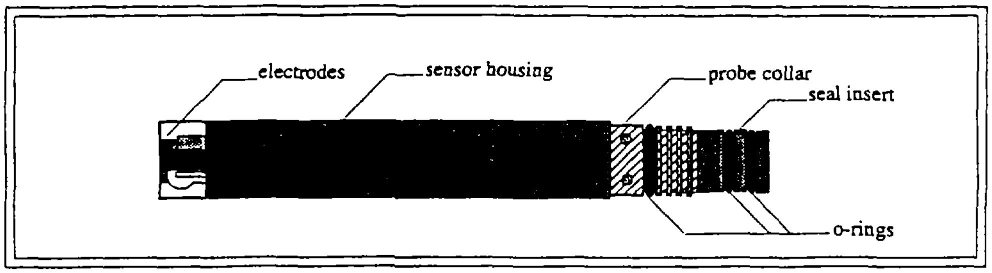


FIGURE 47: REDOX SENSOR (SIDE VIEW)*

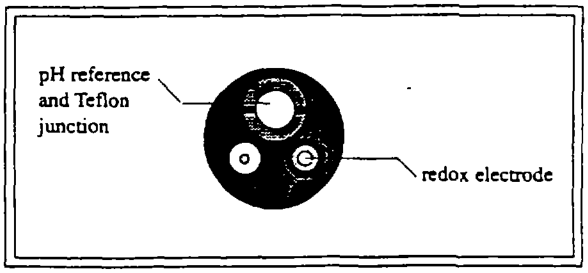


FIGURE 48: REDOX SENSOR (SENSOR END VIEW)

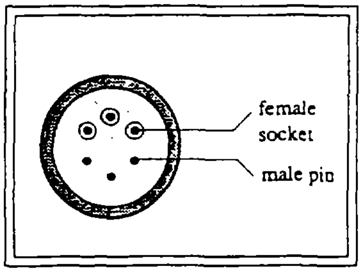


FIG. 49: REDOX SENSOR (CONNECTOR END VIEW)

NOTE:

* If you have chosen this sensor, your multiprobe may be equipped with either a pH sensor and a pH reference or a redox/ORP sensor, a pH sensor, and a pH reference electrode.

Maintenance

Generally, the redox sensor requires maintenance only when obviously coated with oil, sediment, or biological growth.

What do I need to service the redox sensor?

- Hydrolab's MS/DS4 pH maintenance kit (Ref. No. 013410)
- Deionized water
- Methanol
- Cotton balls, cotton swabs, or one very clean, soft, *nonabrasive* cloth
- 1 very mild abrasive, such as toothpaste, jeweler's rouge, or a fine polishing strip

Steps to follow

STEP 1: Wet a cotton ball or swab, or the very clean, soft, *nonabrasive* cloth with methanol. Carefully clean the redox electrode. This procedure will help remove any films on the platinum tip and restore the speed of response.

STEP 2: To remove discoloration on the platinum tip of the redox electrode, polish it with the very mild abrasive (e.g. jewelers rouge or a polishing strip). Rinse with deionized water. Be careful not to scratch the nearby pH glass electrode.

STEP 3: Soak the electrode overnight in tap water to allow the platinum surface to restabilize before calibration.

NOTE:

- ▸ As long as the platinum tip of the redox sensor and the reference electrode are kept properly serviced, you may not need to check the redox system calibration frequently.

Since the redox sensor uses the pH reference electrode, when servicing the redox sensor, we recommend that you also carry out the standard pH reference electrode maintenance procedure (see the pH maintenance and calibration section of this chapter for details).

Calibration

The redox calibration procedure is performed by completing the following steps.

What do I need to calibrate for redox readings?

- Deionized water
- Quinhydrone or another redox standard
- 4 and 7 pH buffers (for preparation of your redox standard)

Steps to follow

Redox standard preparation: Dissolve four grams of quinhydrone in 500 ml of 4.0 and 7.0 pH buffers. You can also use another redox standard.

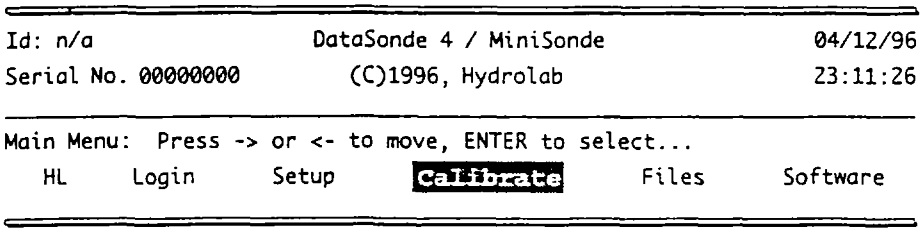
NOTE:

▸ Redox calibration solutions are also available from Hydrolab. The first solution is Zobell's solution (473 ml bottle, No. 013860) and is APHA-approved. The second one is Light's solution (473 ml bottle, No. 013870) and is APHA- and ASTM-approved.

STEP 1: Thoroughly rinse the sensors with deionized water. Discard the liquid. Repeat.

STEP 2: Rinse with a small amount of the redox standard. Discard the liquid. Then, fill the DS4 calibration cup or MS cup with this standard to a point above the D.O. cell. Allow time (1-3 minutes) for the standard to stabilize. <u>Note the temperature</u>.

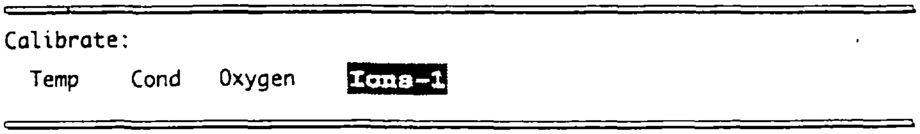
STEP 3: In the Main Menu, move the cursor with the arrow keys to `Calibrate` and press ENTER.



```
Id: n/a                    DataSonde 4 / MiniSonde                  04/12/96
Serial No. 00000000          (C)1996, Hydrolab                      23:11:26

Main Menu:  Press -> or <- to move, ENTER to select...
  HL     Login     Setup     Calibrate     Files     Software
```

STEP 4: First, move the cursor to `Ions-1` and press ENTER.



```
Calibrate:
  Temp    Cond    Oxygen    Ions-1
```

STEP 5: Next, move the cursor to `ORP:mV` and press ENTER.

```
Calibrate: Ions-1:
pH:Units ORP:mV NH4+:mg/l-N NH4Tot:mg/l-N NO3-:mg/l-N NH4+:mV NO3-:mV
```

STEP 6: Then, type the appropriate value from the table below or off the label of your redox standard after `Standard:[0.0]<<` and press ENTER.

```
Calibrate: Ions-1: ORP:mV:
Standard:[0.0](value)<<
```

TABLE 4: QUINHYDRONE REDOX VALUES

	20 °C or 68 °F or 293.15 K	25 °C or 77 °F or 298.15 K	30 °C or 86 °F or 303.15 K
pH buffer of 7	295 mV	285 mV	275 mV
pH buffer of 4	470 mV	462 mV	454 mV

* These redox values are reported based on the Normal Hydrogen Electrode (NHE) reference, and should only be used when you are calibrating your sensor with a Redox standard prepared with Quinhydrone.

STEP 7: Thoroughly rinse the sensors with deionized water. Repeat.

STEP 8: To check for linearity, rinse with a second redox standard. Discard the liquid. Then, fill the DS4 calibration cup or MS cup with this standard to a point just above the D.O. cell. Allow time (1-3 minutes) for the standard to stabilize. Note the temperature.

STEP 9: Verify that the value falls within 20 mV of the value in the table above or of the expected value for the redox standard that you are using.

NOTES:

- Select a standard value and temperature near that of your field samples.
- As long as the platinum tip of the redox sensor and the reference electrode are kept properly serviced, you may not need to check the redox system calibration frequently.

Your redox sensor is now calibrated. Otherwise, repeat the procedure and refer to the "Quick calibration troubleshooting guidelines" (after depth calibration) and the "Troubleshooting" chapter.

YSI 3682 Zobell Solution Instructions

DESCRIPTION

The YSI 3682 Zobell Solution is a reference solution that is used to verify the performance characteristics of redox potential cells such as the YSI 3540 ORP Electrode Assembly. This product is packaged in dry form and must be reconstituted before use. Each amber bottle contains 75% Potassium Chloride, 14% Potassium Ferrocyanide Trihydrate and 11% Potassium Ferricyanide by weight.

The reconstituted solution has a maximum shelf life of 6 months. The shelf life of an unopened bottle is 24 months; it should be stored below 40°C.

To reconstitute the solution, add 125 ±5 mL of deionized or distilled water. (125 mL typically fills the bottle to the bottom of the neck). The label should be marked to indicate the correct expiration date.

CALIBRATION

Pour Zobell Solution into a sample cup. (Suitable cups are provided in the YSI 3565 Sample Cup Pack). Clean and rinse the ORP electrode with deionized or distilled water followed by a rinse of 3682 solution before immersing it in the sample cup. Most pH meters that read in millivolts can be used to take redox potential readings.

Use this product with Ag/AgC1 or saturated calomel electrode systems. According to the U.S.G.S., the expected redox potential values for the Ag/AgC1 and saturated calomel electrode systems in Zobell reference solutions at 25°C are 231 ±10 mV and 185 ±10 mV respectively.

At 25°C, the reference voltage of the Ag/AgC1 and saturated calomel electrode systems in Zobell Solutions varies inversely with temperature according to the following equations. T is in °C.

$$E(Ag/AgC1) = 0.231 + 0.0013\,(25-T)\ \text{Volts}$$

$$E\ (\text{Calomel}) = 0.185 + 0.00164\,(25-T)\ \text{Volts}$$

The effects of temperature on oxidation-reduction reactions, which form the basis for redox potential measurements, are small but should be considered for temperatures higher or lower than 25°C. Redox potentials for Ag/AgC1 and saturated calomel electrode systems in Zobell reference solution are shown in the following table:

TEMP in °C	Ag/AgC1 (4M KC1) in millivolts	CALOMEL in millivolts
-5	270.0	234.2
0	263.5	226.0
5	257.0	217.8
10	250.5	209.6
15	244.0	201.4
20	237.5	193.2
25	231.0	185.0
30	224.5	176.8
35	218.0	168.6
40	211.5	160.4
45	205.0	152.2
50	198.5	144.0

The YSI 3682 Zobell Solution is not for food or drug use and can be harmful if swallowed. *It will react with acids to form harmful by-products, including hydrocyanide gas.* Dispose of this product in accordance with all Federal, Stat and Local Environmental Regulations and Laws concerning health and pollution.

REFERENCES

National Handbook of Recommended Methods for Water Data Acquisition, United States Geological Survey, Chapte 2.

"Studies on Redox Potential of Marine Sediments," *Bulleti of the American Association of Petroleum Geologists,* 30, 4 pp. 477-513, Tulsa, Okla.

Midgeley, Derek, *Potentiometric Water Analysis,* 1978.

National Handbook of Recommended Methods for Water Data Acquisition, United States Federal Interagency Work Group on Designation of Standards for Water Data Acquisition, 1972.

Yellow Springs Instrument Company, Engineering, Water Quality Group, *Design and Computation Book 1,* Zobell Calibrator Solution Weekly Chart.

Field Applications in Hydrogeology, Hydrogeology Group Department of Earth Sciences University of Waterloo, Ontario, Canada, 1981.

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Yellow Springs, Ohio 45387 USA•Phone 937-767-7241•800-765-4974•Fax 937-767-9353

ITEM # 061386 A35183D

Appendix B

Example Chain of Custody and Other Miscellaneous Sampling Forms

se Print Legibly)

pany Name: ______

ch or Location: ______

ct Contact: ______

hone: ______

ct Number: ______

ct Name: ______

ct State: ______

pled By (Print): ______

EN CHEM INC.

☐ 1241 Bellevue St., Suit
Green Bay, WI 54302
920-469-2436
FAX 920-469-8827

☐ 525 Science Drive
Madison, WI 53711
608-232-3300
FAX: 608-233-0502

CHAIN OF CUSTODY

75967

Page ______ of ______

P.O. # ______ Quote # ______

Mail Report To: ______

Company: ______

Address: ______

______

Invoice To: ______

Company: ______

Address: ______

______

Mail Invoice To: ______

*Preservation Codes

A=None B=HCL C=H2SO4 D=HNO3 E=EnCore F=Methanol G=NaOH
H = Sodium Bisulfate Solution I = Other

FILTERED? (YES/NO)

PRESERVATION (CODE)*

ANALYSES REQUESTED

TOTAL # OF BOTTLES SENT

a Package Options
se circle if requested)
ults Only
hem Level III (Subject to Surcharge)
hem Level IV (Subject to Surcharge)

Regulatory Program	Matrix Codes
UST RCRA SDWA NPDES CERCLA	W=Water S=Soil A=Air C=Charcoal B=Biota Sl=Sludge

BORATORY ID (Lab Use Only)	FIELD ID	COLLECTION DATE	COLLECTION TIME	MATRIX									CLIENT COMMENTS	LAB COMMENTS (Lab Use Only)

Turnaround Time Requested (TAT) - Prelim
TAT subject to approval/surcharge)
eeded: ______
ut Prelim Rush Results by (circle):
hone Fax E-Mail
#: ______
______
Address: ______

Samples on HOLD are subject to special pricing and release of liability

Relinquished By:	Date/Time:	Received By:	Date/Time:	En Chem Project No.
Relinquished By:	Date/Time:	Received By:	Date/Time:	Sample Receipt Temp.
Relinquished By:	Date/Time:	Received By:	Date/Time:	Sample Receipt pH (Wet/Metals)
Relinquished By:	Date/Time:	Received By:	Date/Time:	Cooler Custody Seal Present / Not Present
Relinquished By:	Date/Time:	Received By:	Date/Time:	Intact / Not Intact

EN CHEM INC

TYPE (CHECK) FILTERED ☐ UNFILTERED ☐

SAMPLE TYPE ____________________

SAMPLE POINT ____________________

DATE/TIME ____________________

COLLECTOR/COMMENTS ____________________

PRESERVATIVE ____________________

Foth ‹ /an Dyke
consultants · engineers · scientists

CHAIN OF ‹USTODY/ANALYSIS REQUEST FORM

No: 0571

ient Name: ______________________

ope ID: ______________________

mpling Location: ______________________

mpler: ______________________

Lab. Batch No.

ate	Time	Sample I.D./Description	No. of Bottles Bottle Size/Preservative						Total	*Sample Type	ANALYSIS REQUESTED										Remarks	Lab Use Only I.D. Number

MMENTS/SPECIAL INSTRUCTIONS:

*SAMPLE TYPE

S - Soil	SW - Surface Water	H - Hazardous Liquid
SE - Sediment	DW - Drinking Water	A - Air
SO - Solid	WW - Wastewater	O - Oil
	GW - Groundwater	X - Other ______

TO BE COMPLETED BY SAMPLER

Seal intact upon receipt by sampling co.: ☐ Yes ☐ No

Packed by: ______________________

Sealed for shipping by: ______________ Seal # ______

Results to: ______________________

____

____

Attention: ______________________

Billing address: ______________________

____

____

Phone: ______________ Fax: ______________

USTODY TRANSFERS

linquished by:	Date:	Time:	Received by:

eived for laboratory: ______________

SHIPPING DETAILS - TO BE COMPLETED BY LABORATORY

Seal intact upon receipt by laboratory ☐ Yes ☐ No

Method of shipment: ______________________

Contents temperature ______ °C rec'd on ice ☐ Yes ☐ No

Chain Of Custody - Geotechnical Samples

Foth & Van Dyke Scope ID: ____________________
Project Title: ____________________
Project Location/Site: ____________________

FVD Project Mgr.: ____________________
Date Samples Obtained: ____________________
Target Date/Required: ____________________

This area for Foth & Van Dyke use only.
Foth & Van Dyke file no. ____________________
Date received ____________________
Received by ____________________

Sample Information						Tests Requested (mark X in box)																		
Item I.D.	Boring No.	Sample No.	Type SS, ST or BULK	Depth - Below Surface - Lift Number	Classification (if known) or Comment	Natural Moisture Content	Unit Weight (Dry Density)	Strength, Penetrometer Value, TSF	Unconfined Compr. Strength—Split-Spoon Sample	Unconfined Compr. Strength—Shelby Tube (w/o S-S Curve)	Unconfined Compr. Strength—Shelby Tube (w/ S-S Curve)	Atterberg Limits (LL, PL and PI)	Dry Sieve	Washed Sieve	Combined Sieve & Hydrometer Analysis	Organic Content, LOI	Organic Content, Wet Method	pH	Specific Gravity	Moisture Density (proctor) Standard ASTM D-698	Moisture Density (proctor) Modified ASTM D-1557	Permeability Test Triaxial B.P. Sat. Method ASTM D-5084	Permeability Test Constant Head Method ASTM D-2434	Comments or Other Tests
1																								
2																								
3																								
4																								
5																								
6																								
7																								
8																								
9																								
10																								
11																								
12																								

Signature	Company	Date	Time	Carrier
Relinquished by				
Received by				
Relinquished by				
Received by				
Relinquished by				
Received by				

Remarks

Foth & Van Dyke
engineers · architects · scientists

White: Laboratory   Yellow: Sampler   Pink: Lab Coordinator/File

FORM CES018 (Rev. 6/96)