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Toxic and Hazardous Materials Agency

U.S. Military Reservation Milwaukee, Wisconsin

Final Field Sampling Plan Surface and Ground Water Investigation

February 1992

Prepared for:

U.S. Army Toxic and Hazardous Materials Agency
Aberdeen Proving Ground, Maryland 21010-5401

Prepared by:

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FINAL FIELD SAMPLING PLAN
FOR SURFACE AND GROUND WATER
INVESTIGATION AT THE
MILWAUKEE ARMY RESERVE CENTER (MIARC)
REPORT NO. CETHA-IR-CR-92007
DATA ITEM A004
CONTRACT NO. DAAA15-90-D-0019
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Submitted to:

United States Army Toxic and
Hazardous Materials Agency
Aberdeen Proving Ground, Maryland

Submitted by:

OHM Remediation Services Corp.
Pittsburgh, Pennsylvania
A Subsidiary of OHM Corporation

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1.0 INTRODUCTION

This Field Sampling Plan has been prepared by OHM Remediation Services Corp. (OHM), a wholly owned subsidiary of OHM Corporation, to support Task Order No. 004 of Contract No. DAAA15-90-D-0019 for the "Surface and Ground Water Investigation at the Milwaukee Army Reserve Center (MIARC)."

MIARC is located in eastern Wisconsin, approximately 5 miles from the western shore of Lake Michigan between North 48th and North 55th streets in the City of Milwaukee as shown in Figure 1-1. This property lies adjacent to, and directly north of, West Silver Spring Drive. The reserve center is comprised of several administrative/maintenance buildings located on approximately 60 acres with additional adjacent training areas. The complex includes military reserve buildings, a motor repair shop, paved roadways, parking areas, and sidewalks. The entire facility is fenced, however, public access is unrestricted in the northwest corner of the site.

Lincoln Creek bisects the western portion of the MIARC flowing southward across the study area. Surface water drainage across the site is directed to the south-southwest towards Lincoln Creek. Lincoln Creek originates approximately 2 miles northwest of the MIARC complex and discharges into the Milwaukee River, approximately 2-1/2 miles southeast of the study area.

This plan describes the technical specifications for the required monitoring well installation, ground water, surface water/sediment, and seep sampling and analyses to be conducted for this investigation. Findings from previous investigations conducted at the MIARC are summarized in Section 2.0. Section 3.0 presents the field program.

This plan is supported in part by the Quality Control Plan (Data Item A006, June 1990), and the Accident Prevention and Safety Plan (APSP) (Data Item A009, June 1990) prepared by E.C. Jordan for the "Site Investigation at the Manitowoc Army Reserve Center (MARC)."

2.0 REVIEW OF PREVIOUS INVESTIGATIONS

Previous studies/investigations at the MIARC focused on identifying any potential impacts to surface and ground water quality as a result of landfilling operations which occurred at the MIARC between 1957 and 1966. Prior land use information presented within the "Environmental Assessment and Finding of No Significant Impact Report" (Department of the Army, 1984) indicates that the Milwaukee Sanitation Department reportedly disposed of approximately 500,000 cubic yards of solid waste at the site. This included furniture, appliances, street sweepings, leaves, tin cans, bottles, ashes, cinder, and sewer pipe. No newspaper, garbage, industrial, or hazardous waste was accepted. During the landfilling operations, earth berms were constructed to minimize the flow of potential contaminants to Lincoln Creek. Seep and surface water samples from Lincoln Creek have not shown significant amounts of contamination to date.

As reported by the Department of the Army (1984), the Wisconsin Department of Natural Resources (WDNR) investigated leachate quality from a seepage point located along the landfill berm next to Lincoln Creek (i.e., reportedly 2,000 feet downstream of 55th and Douglas). According to the WDNR (letter to Cari Backes, July 27, 1983), the seepage discharge did not contain pollutant concentrations which would be detrimental to public health, wildlife, fish, or aquatic life. All parameters were less than the Wisconsin State Laboratory of Hygiene Detection Limits with the exception of iron. However, the iron appeared to be of the insoluble ferric form (FE+++), as evidenced by the red flocculant precipitate as Fe_2O_3. According to the WDNR, this form is considerably less toxic than soluble ferrous iron (Fe++). The insoluble ferric iron causes the most harm when present throughout the water column; this is unlikely considering the small seepage and dilution of the stream.

In 1984, Donahue was retained by the Corps of Engineers, Omaha District, to conduct evaluations at MIARC to determine the impact of the landfilling operation on nearby soil and ground water, and to install nine well nests in and around two landfilled areas. As reported in Donahue's Landfill Impact Evaluation (April 1985), ground water chemistry results contained very low organic matter content, and heavy metal concentrations were, in most cases, below detection limits. However in some cases, lead and mercury exceeded drinking water standards. Lead concentrations ranged from 0.03 to 0.13 mg/l with maximum concentrations in Wells 109A and 108A at 0.13 and 0.07 mg/l, respectively. Mercury concentrations ranged from 0.0005 to 0.0018 mg/l throughout Well Nests 101, 102, and 103 (i.e., Well 102B contained 0.0018 mg/l). A trip blank contained 0.0005 mg/l. The maximum contaminant levels (MCLs) for drinking water are 0.05 mg/l for lead and 0.002 mg/l for mercury. Iron was also found to be generally above detection limits and drinking water standards, 0.3 mg/l, with a maximum concentration of 2.47 mg/l in Well 101A. Other ground water chemistry results included generally higher values than would be expected for background water quality with respect to hardness, total dissolved solids, chloride, and sulfate particularly in Well Nest 101A/101B. As per Donahue, these higher-than-background values may have been attributable to the landfill. The high values were similar to analytical results of surface water samples from Lincoln Creek, both upstream and down stream of the landfill.

In 1987, Foth & Van Dyke and Associates, Inc., were retained by the Department of the Army, Fort McCoy, to conduct additional landfill sampling and analysis. Five rounds of ground water and surface water samples were collected from 15 monitoring points in the site vicinity, and were analyzed for selected organic and inorganic parameters. In addition, a landfill cap study was performed over the two landfilled areas. The investigation concluded that:

- The State of Wisconsin NR140 standards were exceeded as per Tables 2-1 and 2-2.

- Iron, sulfate, and vinyl chloride occurred at elevated levels in numerous wells both upgradient and downgradient of the landfilled areas.

- Specific conductivity, hardness, and alkalinity were highest in the northern wells (101A, 101B, 102A, and 102B) and in the southern wells (105A, 108A, and 108B).

- A seepage point sampled in September 1987 exceeded drinking water standards for iron, barium, mercury, lead, cadmium, and boron.

- The surface water quality of Lincoln Creek was assessed. The data indicated that water quality upstream of the landfill areas was similar to water quality downstream. The concentrations of all parameters tested, except for iron, were below drinking water standards.

- The landfill cap is inadequate with approximately 75 percent containing less than 2 feet of clay required by the WDNR.

- Water levels used to construct a water table contour map indicated that a water table high is located in the south central portion of the site in the vicinity of Well Nest OW-108B/P-108A. Flow from this area moves outward towards the north, east, and west. The landfill is the likely cause of this ground water mound.

3.0 FIELD PROGRAM

The field investigation for the MIARC site includes the following elements:

- o Geophysics
- o Drilling and monitoring well installation
- o Ground water sampling
- o Surface water/sediment sampling
- o Seep sampling.

The field program rationale and detailed descriptions of activities/procedures are presented in this section.

3.1 PROGRAM DESCRIPTION AND RATIONALE

The objectives of this field investigation are to locate the former Zautcke stone quarry from the 1930s and determine what, if any, chemical contamination is present within the former quarry area. In addition, the water and sediment quality of Lincoln Creek will be assessed to determine if there is a chemical loading impact on Lincoln Creek, and to identify potential contaminant source(s), if possible. In order to meet these objectives, the following field activities will be performed:

- o Conduct a geophysical survey to estimate the quarry boundaries and to clear potential drill sites within the quarry limits

- o Drill/install two new monitoring wells (i.e., a well nest) and sample the new wells as well as two existing wells

- o Assess chemical quality of water and sediment of Lincoln Creek by collecting and analyzing surface water/sediment, and seep samples along the creek, and by comparing surface water entering and leaving MIARC.

Monitoring well, surface water/sediment, and seep sampling locations are shown on Figure 3-1. As recommended by the WDNR, two monitoring wells are planned for installation in the center of the former stone quarry. One of the wells will be a piezometer-type monitoring well and both will be drilled and constructed according to State of Wisconsin and USATHAMA requirements. Where these requirements conflict, technical considerations justified the procedures discussed in Section 3.3.

In conjunction with existing data, the geotechnical and/or chemical data collected from the new wells will be used to:

- o Evaluate potential contamination, if any, within the quarry limits
- o Determine ground water flow direction
- o Provide subsurface soil profile information within the quarry
- o Provide information to identify potential ground water contaminant migration pathways.

In addition, results from the proposed surface water/sediment and seep sampling program will be compared to the ground water monitoring results.

Specific drilling and monitoring well installation procedures, surface water/sediment, and seep sampling procedures, and ground water sampling procedures are described in the following sections.

3.2 GEOPHYSICAL SURVEY

3.2.1 Magnetics Survey

Prior to the installation of two monitoring wells within the limits of the former stone quarry, OHM proposes to conduct a magnetics survey over the approximate location of the former quarry. This survey will be conducted to:

- o Better define the limits of the quarry. Assuming the quarry was filled with municipal trash prior to landfilling over the landfill site, larger magnitude magnetic anomalies should be evident within the limits of the quarry itself. Therefore, being able to locate the quarry and place two monitoring wells within the quarry is greatly enhanced.
- o Attempt to avoid drilling into large metallic objects during well installation. The wells will be located away from magnetic anomalies indicative of buried metal objects.

In OHM's original proposal, three geophysical techniques were to be used to identify the edges of the former stone quarry and to determine if any conductive leachate is originating from the stone quarry in order to better position the two monitoring wells. As mentioned in the proposal, the landfill is covered with a clay layer which would impede the ground penetrating radar (GPR) signal. In addition, the municipal trash within the landfill will also prevent the GPR signal from reaching the bedrock surface which appears to be approximately 30 feet below present ground surface. Since an old 1937 aerial photograph has identified the stone quarry in relation to the existing railroad tracks, positioning two monitoring wells in the center of the quarry will probably be possible without the use of geophysics. However, for ease of drilling, these locations should be free of subsurface metallic debris.

Based on a review of the aerial photograph which showed the stone quarry, the quarry excavation was approximately 250 feet in diameter. OHM proposes to conduct a magnetics gradiometer survey over a 350-foot-square area using a 10-foot data grid spacing shown on Figure 3-2. This would result in approximately 1,300 data points which will be entered into a field computer and contoured to indicate magnetic anomalies caused by subsurface metallic objects.

The magnetic survey will start by first locating the center of the former stone quarry based on the aerial photograph and other topographic maps. From this center location, a 350-foot-wide survey boundary will be established with the location being in the center. A transit, tape measure, and labeled pin flags will be used to mark the perimeter of the magnetic survey area and intermediate grid points. A grid system will be flagged within the limits of the area to provide accurate location while conducting the survey.

Magnetics data will be collected with an EDA OMNI IV/Plus proton precision magnetometer. The solid-state memory of this instrument has the capacity to store data from 2,500 locations. Each data location consists of a line number, position number, battery strength, sensor and decay strength, date, time, gradient reading, and total field reading. Each line within the survey area will be traversed and readings recorded on 10-foot intervals along each line. Upon completion of the survey, the data stored in the instrument's memory will be downloaded into the field computer where it will be processed and contoured. Based on these contours, a location free of detected subsurface metal will be selected (if existent) for the installation of the monitoring wells.

A detailed description of equipment operations, methodology, field procedures, and field results will be incorporated into the final report.

3.3 DRILLING AND MONITORING WELL INSTALLATION

The following paragraphs describe the general drilling and monitoring well installation techniques. Proposed well locations are shown on Figure 3-1.

3.3.1 Drilling Techniques

Hollow-stem augers with a 4-1/4-inch inside diameter (I.D.) will be used to advance borings. Hollow-stem augers are continuous-flight augers equipped with a hollow core that serves as a casing. During advancement, a removable center plug is placed in the bottom of this hollow core to prevent soil materials from entering the inside of the hollow-stem auger. Hollow-stem augers are advanced by a combination of rotation and downward pressure. The boring cuttings are compressed laterally and carried upward to the ground surface along the outside of the auger flights. When a desired depth is reached, the center plug is removed and a representative soil sample may be obtained by passing a split-spoon sampler through the inside of the hollow-stem auger and driving it out the bottom of the hollow-stem auger. The piezometer boring will be sampled at 2.5-foot intervals for geologic logging (split-spoon sample collection procedures are described in Section 3.3.2). If subsurface conditions preclude the use of hollow-stem augers, a wash rotary method will be utilized.

An OHM geologist/hydrogeologist will be present during the drilling of borings and well installation. The OHM representative will maintain drilling logs, collect appropriate samples, and be equipped as required by the USATHAMA Geotechnical Requirements (1987). Original monitoring well boring logs will be submitted to USATHAMA within three working days after the completion of each boring. An example field boring log form is presented in Appendix A.

Generally, the drilling will proceed as follows:

- Water for drilling and decontamination will be obtained from the USATHAMA-approved source (Village of Cleveland Water District). This source has been analyzed for all site-related contaminants and approved by USATHAMA.

- Bentonite and sand filter pack materials will be selected and submitted to USATHAMA for approval by the Contracting Officer's Representative (COR).

- Drilling will be conducted by Twin City Testing Corporation under subcontract to OHM.

- Drilling tools and rig(s) will be steam cleaned prior to being brought on site.

- o Prior to the first boring and between borings and well installations, drilling tools will be steam cleaned using the USATHAMA-approved water source.

- o Well materials will be cleaned prior to installation as described in the USATHAMA Geotechnical Requirements (1987) if not prepackaged.

Drill cuttings and drilling fluids will be inspected visually for discoloration or other indications of contamination and periodically screened with a photoionization detector (PID). The PID meter will be calibrated to 100 ppm isobutylene during each day of sampling activities. Drill cuttings will be placed in plastic sheeting and drilling fluids (if used) will be collected and stored in labeled drums on site as described in the Standard Operating Procedure contained in Appendix B.

Downhole drilling and sampling equipment will be cleaned by washing and steam cleaning prior to arrival on the MIARC site. In addition, the drilling equipment, sampling equipment, and monitoring well screen and riser material will be steam cleaned using water from the USATHAMA-approved water source after arrival on site. This cleaning will be conducted at a specific on-site location determined by USATHAMA. Well screens and risers will be covered with plastic after cleaning. At the completion of each monitoring well, drilling and sampling equipment will be steam cleaned to prevent cross contamination between borings. Fluids generated by decontamination of the drilling and sampling equipment will be collected and stored in labeled drums on site.

Required levels of personal protection will be used as described in the APSP.

3.3.2 Lithologic Determination and Subsurface Sampling

Soil samples from monitoring well borings will be obtained for geologic logging. The split-spoon sample will be retrieved from the boring and opened at rig-side. The OHM geologist/hydrogeologist will take charge of the sampling device as soon as it is withdrawn from the borehole and opened. The sampling device will be opened and screened with a PID. PID readings will be recorded on the Field Boring Log (see Appendix A). Ten percent of all samples will be analyzed for Atterberg limits and grain size distribution per USATHAMA's "Geotechnical Requirements for Drilling, Monitor Wells, Data Acquisition, and Reports," March 1987.

The following data will also be included on the Field Boring Logs:

- o Depths, recorded in feet and fractions thereof (tenths of feet)
- o Soil descriptions in accordance with the Unified Soil Classification System (USCS), prepared in the field by the OHM site geologist/hydrogeologist
- o Complete descriptions of soil samples; for split-spoon samples, the descriptions will include the following:
  - Classification
  - USCS symbol
  - Secondary components and estimated percentage
  - Color (using Munsell Soil Color Chart)
  - Plasticity
  - Consistency (cohesive soil) or density (noncohesive soil)
  - Moisture content
  - Texture/fabric/bedding
  - Depositional environment
- o Numerical, visual estimates of secondary soil constituents (if terms such as "trace," "some," or "several are used, their quantitative meanings will be defined in a general legend)
- o The length of sample recovered for each sampled interval for drive (split-spoon) samples
- o Blow counts, hammer weight, and length of fall for split-spoon samples
- o Depth to water, along with the method of determination, as first encountered during drilling (any distinct water-bearing zones below the first zone also will be noted)
- o A general description of drilling equipment used, including such information as rod size, auger type, pump type, drill rig manufacturer, and model

- o The drilling sequence
- o Special problems
- o Start and completion dates of borings
- o Lithologic contacts.

The boring log will be submitted directly from the field to the COR within three working days after completion of the boring. Only the original log will be submitted to the COR to fulfill this requirement.

3.3.3 Monitoring Well Installation

Two monitoring wells will be installed. The wells will be installed in accordance with USATHAMA Geotechnical Requirements (March 1987) and WDNR Ground Water Monitoring Well Requirements (January 1990). The OHM site geologist/ hydrogeologist will supervise the installation of the monitoring wells and will maintain detailed drilling logs and as-built monitoring well construction diagrams. The OHM hydrogeologist will immediately contact USATHAMA for authorization to proceed in situations which require a change in well design or installation methods. Any borings to be abandoned will be grouted in the presence of the OHM site geologist/hydrogeologist. Grout will be mixed to consist of 79 parts water, 20 parts cement, and 1 part bentonite by weight and will be installed by tremie pipe.

3.3.3.1 Well Installation Procedures

All well installations will begin within 48 hours of boring completion. Once begun, they will continue uninterrupted until completion. In all cases, the polyvinyl chloride (PVC) well screen and casing will be carefully steam cleaned (unless factory cleaned and sealed) with water from the approved source prior to installation in the hole. All screen and casing will be new, Schedule 40 PVC. Screens will have a solid bottom. A 5-foot screen will be placed at the bottom of the piezometer boring. A 15-foot section will be placed in the monitoring well boring so that 5 feet of screen is above the static water level and 10 feet of screen is below the static water level. The static water level will be measured in the existing monitoring wells and the piezometer. Typical piezometer and monitoring well completion diagrams are shown on Figures 3-3 and 3-4.

Solid Schedule 40 PVC riser casing will extend from the screen to approximately 2-1/2 feet above ground surface. Sand filter pack material will be installed by tremie pipe around the well screen and will extend 2 feet above the top of the screen. A 2-foot-thick seal consisting of bentonite pellets or a granular bentonite will be placed above the sand pack. Bentonite pellets will be used for the seal in the piezometer and granular bentonite will be used for the seal in the monitoring well. Cement-bentonite grout will be placed in the annular space above the bentonite seal.

The bentonite-cement grout will extend from the top of the bentonite seal to ground surface. Grouting will be completed as a continuous operation in the presence of the OHM site geologist/hydrogeologist. The grout will be pumped into the annular space under pressure using a tremie pipe placed above the top of the bentonite seal to ensure a continuous placement of the grout. The 5-foot minimum length protective casing will extend about 2-1/2 feet above ground surface and will be set in grout. Identification/protective posts, as required by Paragraph III.C.8 of the USATHAMA Geotechnical Requirements, will be installed around the well to prevent damage to the wells be vehicles. A concrete pad, 4 feet square and 4 inches thick, will be placed at each monitoring well.

The following materials will be used in well construction:

- o Casing will be flush-threaded PVC, Schedule 40, 2-inch (nominal) I.D. No PVC or glue solvents will be used. The well screen will be factory-slotted with a slot width of 0.010 inch. Well screen lengths will be 5 feet in the piezometer and 15 feet in the monitoring well. A vented PVC cap will be used to cover the well casing. This will allow equilibration of the water level in the well with the atmosphere.

- o Grout will be composed by weight of 20 parts Portland cement and up to 1 part bentonite with a maximum of 8 gallons of approved water per 94-pound bag of cement. These proportions may be modified with USATHAMA approval. Bentonite will be added after mixing the cement and water. Information concerning the bentonite will be submitted to USATHAMA for approval, as specified in Paragraph II.A.10.C of the geotechnical requirements.

- o Bentonite seals will consist of pellets or slurry, in accordance with WDNR requirements. Bentonite pellets or slurry used in the seal will be a commercially available product designed for well sealing purposes and will contain no additives. Material for bentonite seals are also subject to USATHAMA approval.

- Sand filter pack material around the well screen will be selected to be compatible with both the screen slot size and aquifer materials. Based on available geologic information, it is anticipated that a 30/40 sand with a uniformity coefficient of approximately 1.5 will be used.

- Prior to use, 1 quart of the proposed sand filter pack material will be submitted to USATHAMA for approval. The lithology, grain size distribution, and source of the material will be provided.

- A 4-inch protective iron casing will be installed around all wells. This casing will extend approximately 2-1/2 feet above ground surface and will be seated approximately 2-1/2 feet into the well seal grout. In accordance with the USATHAMA Geotechnical Requirements (Paragraph III.C.8), this casing will be closed with a lockable, hinged cap.

- A sketch of the well installation will accompany the boring log. It will show, by depth, the bottom of the boring, screen location, coupling location, sand filter pack material, seals, grout, cave-in, height of riser above ground surface, and details of the protective casing. The actual composition of the grout, seals, and sand filter pack material will be recorded on each sketch. As-built monitoring well construction diagrams will be submitted to USATHAMA within three working days of well completion.

- After the grout seal has set (approximately 24 hours), it will be checked for settlement. Additional grout (of approved composition) will be added to fill any depressions.

3.3.3.2 Well Development

After allowing at least 48 hours after grout placement, monitoring wells will be developed by pump-and-surge methods using a pump. This method will involve pumping at successively greater extraction rates, interspersed with on-off cycling of the pump to provide filter pack flushing. Development will involve pumping at least five volumes of standing water from the well casing and sand pack annulus and will be considered complete when the water exhibits stable specific conductivity readings and is free of fine sediment (to the fullest extent practical in accordance with the USATHAMA Geotechnical Requirements, Paragraph III.D.1-15).

No water will be added to the well during development. If well yields cannot sustain a reasonable flow rate, a bottom discharge bailer will be used for development. The outside of the pump and hose will be steam cleaned with approved water. If a submersible pump is used, the inside of the pump and hose will be cleaned by allowing approved water to run through the pump and hose prior to initial use and before development of the next well. If a bailer is used, the rope will be replaced between each well. Information on development of monitoring wells will be recorded and submitted to the COR within three working days after development. The following data will be recorded for development, as required in the USATHAMA Geotechnical Requirements (Paragraph III.D.14):

- Well designation
- Date of well installation
- Date of development
- Static water level before and 24 consecutive hours after development
- Quantity of water loss during drilling and fluid purging, if water is used
- Quantity of standing water in well and annulus (30 percent porosity assumed for calculation) prior to development
- Specific conductivity, temperature, and pH measurements taken and recorded at the start, twice during, and at the conclusion of development (calibration standards will be run prior to, during, and after each day's operation in the field)
- Depth from top of well casing to bottom of well
- Screen length
- Depth from top of well casing to top of sediment inside well, before and after development
- Physical character of removed water, including changes during development in clarity, color, particulates, and odor
- Types and size/capacity of pump and/or bailer used
- Description of surge technique, if used

- o Height of well casing above ground surface
- o Typical pumping rate during development
- o Estimate of recharge rate
- o Quantity of water removed and total time for removal.

A 1-pint sample of the last water obtained from the development process for each well will be retained and stored so as not to freeze, as required by USATHAMA. The cap and all internal components of the well casing above the water table will be rinsed with well water to remove all traces of soil, sediment, and cuttings. This washing will be conducted before and/or during development.

3.3.3.3 Surveying

The two new monitoring well locations, existing Wells OW-108B and OW-109B, surface water/sediment and seep sampling points will be surveyed by a professional land surveyor registered in the State of Wisconsin. The well survey will be conducted to establish the map coordinates within the Universal Transverse Mercator (UTM) or State Planar grid to within ±1.0 foot. Additionally, elevations for the natural ground surface at each sampling well and the top of the PVC casing will be determined to within ±0.01 foot and referenced to the National Geodetic Vertical Datum (NGVD) of 1929.

The survey will be completed to as near to the time of last well completion as possible, but no longer than 1 week after well installation. Survey field data (as corrected to include loop closure for survey accuracy) will be included within the informal project data submittals (Data Items A013-A015). Closure will be within the horizontal and vertical limits given above. These data will clearly list the coordinates (and system) and elevation (i.e., ground surface, top of well, and protective casings) as appropriate for all borings, wells, and reference marks. All permanent and semipermanent reference marks used for horizontal and vertical control (e.g., bench marks, caps, plates, chiseled cuts, and rail spikes) will be described in terms of name, character, and physical location.

All well drilling, installation, development, and surveying procedures/materials will be designed and conducted so that the well acceptance criteria listed in Paragraphs III.F.1-3 of the USATHAMA Geotechnical Requirements are satisfied. This will ensure that water well sampling tasks proceed in a timely manner following well installation.

3.3.3.4 Water Level Measurement

All water level measurements at monitoring wells will be obtained using an electronic water level meter. The water level will be measured to an accuracy of less than 0.05 foot. The probe end of the water level meter will be rinsed with deionized water and dried between monitoring wells.

At least two complete sets of static water level measurements for all monitoring wells installed for this site will be made over single, consecutive 10-hour periods.

3.4 SAMPLING PROCEDURES

Surface water/sediment, seep, and ground water sample collection procedures are discussed in the following sections.

3.4.1 Sediment Sampling Procedures

Two sediment samples will be collected from the locations shown on Figure 3-1. The sample numbers and locations are:

- SS-1 - The upstream reach of Lincoln Creek just downstream of the railroad bridge.
- SS-2 - The downstream reach of Lincoln Creek near the exit to the installation boundary and above the residential area.

The sediment samples will be analyzed for metals and anions, and other chemical parameters (excluding volatile organic compounds) as shown in Table 3-1.

Prior to collecting the sediment samples, the sampling equipment will be scrubbed and rinsed with clean water from the approved source. The sample will be collected with minimal disturbance. Clean, inert equipment (e.g., clean, disposable stainless steel spatulas) will be used to handle samples.

At the time of sediment sampling, the following data will be noted and recorded in the field notebook:

- Site number or location
- Date
- Time (24-hour system)
- Antecedent weather conditions

- o Pertinent observations (e.g., depth, color, and odor)
- o Signature of sampler and date.

The sediment sample will be carefully labeled so it can be identified by laboratory personnel. The sample label will include the project number, sample number, time and date, and sampler's initials. All samples will be identified immediately after collection with non-water-soluble ink on a standard preprinted label. Information concerning preservation methods and sample location also will be included on the label. The sediment samples will be stored and shipped in a cooler and will be kept at 4 degrees Celsius from time of sample collection until analysis.

3.4.2 Surface Water Sampling

Surface water samples will be collected from the two sediment sample locations (SS-1 and SS-2), and the seep sample location (SEEP-1) on Lincoln Creek as shown on Figure 3-1. The seep is located on the east bank of Lincoln Creek, approximately 170 feet north of the bridge to the easternmost landfill. The surface water and seep samples will be analyzed for metals, anions, and other chemical parameters (excluding volatile organic compounds) as shown in Table 3-1.

Each surface water sample will be collected in precleaned laboratory bottles. Sample management and chain-of-custody (COC) procedures will be identical to the procedures for ground water samples in the following section.

If adequate water is not available at the seep, a soil sample will be collected according to the sediment collection procedures described earlier, and will be analyzed for metals and anions.

3.4.3 Ground Water Sampling Procedures

This investigation will include two rounds of ground water sampling of the New Wells MW-201 and MW-202. Existing Wells OW-108B and OW-109B will be sampled during the first round of sampling of the new wells. The sampling rounds will be at least 30 days apart and the first round will be collected 14 days after completion of monitoring well development (to ensure that undisturbed ground water conditions are encountered and representative samples are obtained). Water levels of all wells shown on Figure 3-1 will be collected during both sampling rounds. The ground water samples will be analyzed for the chemical parameters as shown in Table 3-1.

Sampling equipment, including bailers, pumps, and tapes will be decontaminated prior to initial use and before each successive use. Discharge lines and ropes will be replaced for each well if used. Water used for decontaminating and rinsing field equipment will be distilled/deionized (DI) water or water from the USATHAMA-approved source, and in no instance will detergents, soaps, or solvents be used to clean equipment in the field. An equipment rinse blank will be included with each round of ground water samples and analyzed for the required parameters to ensure that adequate decontamination has been performed. This will be the QA/QC sample for each round of water sampling. Sampling equipment will be protected from ground surface contamination by the use of new, clean, plastic sheeting at each well. The sheets will be properly disposed of after use at each well.

The ground water sampling methodology is outlined in the following subsections. All information gathered during ground water sampling (e.g., pH, specific conductivity, purge volumes) will be recorded at the time of sampling on the Water Sample Field Collection Report (see Appendix A).

3.4.3.1 Pre-Purging Activities

- Check the well for proper identification and location.

- Measure and record the height of protective casing.

- After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using the PID. If readings above background are detected in the breathing zone, the sampler will utilize the appropriate safety equipment as described in the APSP (Jordan, 1990).

- Measure and record the distance between the top of the well and the top of the protective casing.

- Using the electronic water level meter, measure and record the static water level from the top of the well and the depth to the well bottom to the nearest 0.01 foot. Upon removing the water level meter, rinse it with water from the approved source or distilled water.

- o Calculate the amount of ground water contained in one well volume using the following formula (assuming a 2-inch I.D. monitoring well and a 6-inch-diameter borehole):

$$V = 7.48\pi[r^2(L_2 - L_1) + (R^2 - r^2)(L_2 - L_1)P]$$

where:

V = Volume in gallons

7.48 = Gallons of water per cubic foot

r = Radius of monitoring well (feet)

R = Radius of the sand pack (feet)

L_1 = Depth to water table from ground surface (feet)

L_2 = Total depth of well from ground water surface (feet)

P = Estimated porosity of sand pack (30 percent for bagged sand).

- o Record water-level information and pre-purging data on the Water Sample Field Collection Report.

Following the measurements and calculations, sampling will commence in the following sequence, utilizing the appropriate purging technique.

3.4.3.2 Purging and Sample Collection

- o Purging will be conducted with a bailer. The bailer will be cleaned prior to purging and a new nylon rope will be used on the bailer.

- o Purging is considered complete when five well volumes, as calculated in Section 3.4.3.1 (see Pre-Purging Activities), have been purged. For wells in low permeability locations, i.e., less than 1 gpm recharge, the well will be purged by a modified procedure approved by USATHAMA. For slow recharge wells, the well will be purged dry, allowed to recover, purged dry again, and the sample collected. A slow recharge well is defined as any well that requires four or more hours for recovery. Use of this procedure will also be coordinated with USATHAMA.

- o Record the in-situ parameters (e.g., pH, specific conductance, and temperature) on the Water Sample Field Collection Report.

- o After purging, lower a bailer to the bottom of the screened interval or midpoint of the static water level.

- o Collect the sample(s) in appropriate containers. Samples will be placed directly from the bailer into the appropriate containers. VOC sample containers will be filled with as little agitation as possible, and are completely filled so that no headspace or air bubbles exist in the vial.

- o Remove the bailer from the well and decontaminate by scrubbing and rinsing with water from the approved source.

- o Include an equipment blank containing DI water in both rounds of ground water samples.

- o Record sampling data on the Water Sample Field Collection Report.

- o Secure the well cap and lock.

It is anticipated that monitoring well purge water will also be collected and stored in labeled drums. If laboratory analyses indicate chemical concentrations below WDNR health-based criteria, the purged and development water will be discharged to the ground surface at the site.

The products of monitoring well sampling are as follows:

- o Ground water samples from each well

- o On-site measurements of conductivity, temperature, and pH

- o Depth to static water level at each well.

3.4.4 Sample Management/Chain-of-Custody

The environmental sample COC and management procedures to be used are described in the following subsections.

3.4.4.1 Chain-of-Custody

To assure that all environmental samples are accounted for at all times, OHM will follow USATHAMA CHAIN-OF-CUSTODY PROCEDURES (1987).

As the field sampling team collects each sample, the labels will be completed and affixed to each sample bottle. Clear plastic tape will be placed over each sample label to preserve the information on the label and protect it from alteration. Once the sample label is affixed to the sample bottle, appropriate field data records will be completed. Sampling personnel will initiate sample custody records in the field at the time samples are collected. This COC record will be used to document handling procedures, including sampling site, sample number, number and types of containers corresponding to each sampling site, and the person collecting and shipping the samples. Additionally, the COC record describes the sample and documents the COC including names of responsible individuals and dates and times of custody transfers.

3.4.4.2 Sample Staging/Shipping

The OHM hydrogeologist/geologist will oversee the collection of subsurface soil, surface water/sediment, and ground water samples. Samples will be collected, labeled, and COC-initiated as described above.

At the end of each day, samples from the MIARC site will be logged in, and associated data records and COC forms will be checked for completeness. After review, data record sheets will be initiated and dated. COC forms will be signed and dated.

Samples will be checked for integrity and lid closure to prevent leakage. Sample labels will be checked for completeness and integrity. Any leaking samples or other situations which may compromise sample data will be noted in the sample log and reported to the project manager and the COR.

Prior to shipment, sample bottles will be tightly packed to avoid breakage during shipment. Ice packs will be used to cool the samples during shipment to the USATHAMA-approved analytical laboratory. Samples will be shipped to Pace, Inc., the analytical laboratory via Federal Express; in no case will samples for analytical chemical analysis be allowed to remain in temporary storage at the sample staging area for more than 48 hours. The original COC form will be packaged in a Ziploc bag and will accompany the samples during shipment to the laboratory.

3.4.4.3 Sample Preparation and Establishment of Lots

Ground water, soil, and surface water/sediment samples will receive laboratory analysis will be prepared and established into lots according to USATHAMA QA requirements. The field sampling program and shipment of samples will be coordinated to ensure that minimum lot size requirements are met and that holding times are not exceeded.

Field QC samples will consist of one VOC equipment blank and trip blank per ground water sampling event. The equipment blank will consist of DI water contained in glass VOC bottles that was run across the sampling equipment after cleaning. The trip blank will consist of laboratory DI water prepared at the laboratory in glass VOC bottles which accompanies the sample bottle shipment from the laboratory to the site, and back to the laboratory. Analysis of the equipment blank for VOCs will indicate if sampling equipment has been properly cleaned. The analysis of the trip blank will indicate contamination within the shipping container especially if one of the sample bottles is broken during shipment.

3.4.4.4 Chemical Analyses Holding Times, Containers, and Preservation

Samples shipped to the subcontractor laboratory will be kept cold during shipment. Samples stored at the subcontractor laboratory will be stored at 4 degrees Celsius until analysis. The project manager will monitor the chemical analysis and sampling effort to assure compliance with holding time and preservation requirements. Any problems will be identified by the project manager to the task manager, and the appropriate corrective action will be instituted.

The cleaning procedures conducted by the laboratory for the containers are:

- Thoroughly wash container with hot detergent and water
- Triple rinse with tap water
- Triple rinse with DI water
- Air-dry
- Bake at 200 degrees Celsius for 2 hours
- Soak septa for several hours in methanol
- Bake at 100 degrees Celsius for 10 to 15 minutes.

3.5 SAFETY

All OHM's field activities will be conducted in accordance with the approved APSP (Data Item A009) for MARC. Adherence to the approved APSP will be enforced by the Health and Safety Office (HSO) or designee. who will be on-site during each site activity.

On-site OHM and subcontractor personnel will be appropriately trained, and will be currently enrolled in a Health Monitoring Program in compliance with health monitoring requirements per 29 CFR 1910.120.

TABLES

TABLE 2-1

WDNR ESTABLISHED PAL(1) and ES(2) FOR
VOCs DETECTED IN MONITORING WELLS(3)

VOC	PAL (ppb)	ES (ppb)	WELLS EXCEEDING PAL	WELLS EXCEEDING ES
Tetrachloroethylene	0.1	1.0	P-108B	None
Dichloromethane	15.0	150	None	None
Vinyl chloride	0.0015	0.015	OW-101B P-101A OW-102B P-102A P-105A	None

Notes:

(1)PAL - Preventive Action Limit.

(2)ES - Enforcement Standard.

(3)Reference: Landfill Sampling & Analysis Report, USARC (Foth & Van Dyke and Associates, Inc., February 1988).

TABLE 2-2

WDNR ESTABLISHED PAL(1) and ES(2)
FOR INORGANIC PARAMETERS ANALYZED(3)

PARAMETER	PAL (ppm)	ES (ppm)	EXCEEDANCE OF PAL	EXCEEDANCE OF ES
Chloride (Cl)	125	250	P-105A, P-101A, and P-102A	None
Nitrate-Nitrogen (NO_2 & NO_3-N)	2	10	None	None
Iron (Fe)	0.15	0.3	P-101A, P-102A, P-105A, OW-108B, OW-106B, P-108A, P-109A, OW-101B, OW-102B, and P-109A	None
Arsenic (As)	0.005	0.05	P-109A	None
Barium (Ba)	0.002	0.02	None	None
Cadmium (Cd)	0.001	0.01	P-109A	None
Lead (Pb)	0.005	0.05	None	None
Mercury (Hg)	0.0002	0.002	None	None
Chromium (Cr)	0.005	0.05	None	None
Sulfate (SO_4)	125	250	OW-101B, P-105, P-101A, OW-106B, OW-102B, OW-108B, P-102A, P-108A, OW-104B, P-109A, OW-111B	OW-111B

Notes:

(1)PAL - Preventive Action Limit.

(2)ES - Enforcement Standard.

(3)Reference: Landfill Sampling & Analysis Report, USARC (Foth & Van Dyke and Associates, Inc., February 1988).

TABLE 3-1

LIST OF CHEMICAL PARAMETERS FOR ANALYSIS

VOLATILE ORGANIC COMPOUNDS	METALS
Chloromethane	Aluminum
Bromomethane	Antimony
Vinyl Chloride	Arsenic
Chloroethane	Barium
Methylene Chloride	Beryllium
Acetone	Cadmium
Carbon Disulfide	Calcium
1,1-Dichloroethene	Chromium
1,1-Dichloroethane	Cobalt
1,2-Dichloroethene (total)	Copper
Chloroform	Iron
1,2-Dichloroethane	Lead
2-Butanone	Magnesium
1,1,1-Trichloroethane	Manganese
Carbon Tetrachloride	Mercury
Bromodichloromethane	Nickel
1,2-Dichloropropane	Potassium
cis-1,3-Dichloropropene	Selenium
Trichloroethene	Silver
Dibromochloromethane	Sodium
1,1,2-Trichloroethane	Thallium
Benzene	Vanadium
trans-1,3-Dichloropropene	Zinc
Bromoform	
4-Methyl-2-pentanone	ANIONS
2-Hexanone	
Tetrachloroethene	Bromide
Toluene	Chloride
1,1,2,2-Tetrachloroethane	Fluoride
Chlorobenzene	Nitrate as N
Ethyl Benzene	Nitrite as N
Styrene	Phosphate
Xylenes (total)	Sulfate

OTHER

Total Alkalinity as $CaCO_3$
Total Hardness as $CaCO_3$
COD
Ammonia as N

FIGURES

DRAWING NUMBER 11636-A1

APPROVED BY DWP 2-21-92

CHECKED BY 10-31-91

DRAWN BY A.C.Smith 9-10-91

OHM CORPORATION PITTSBURGH, PA

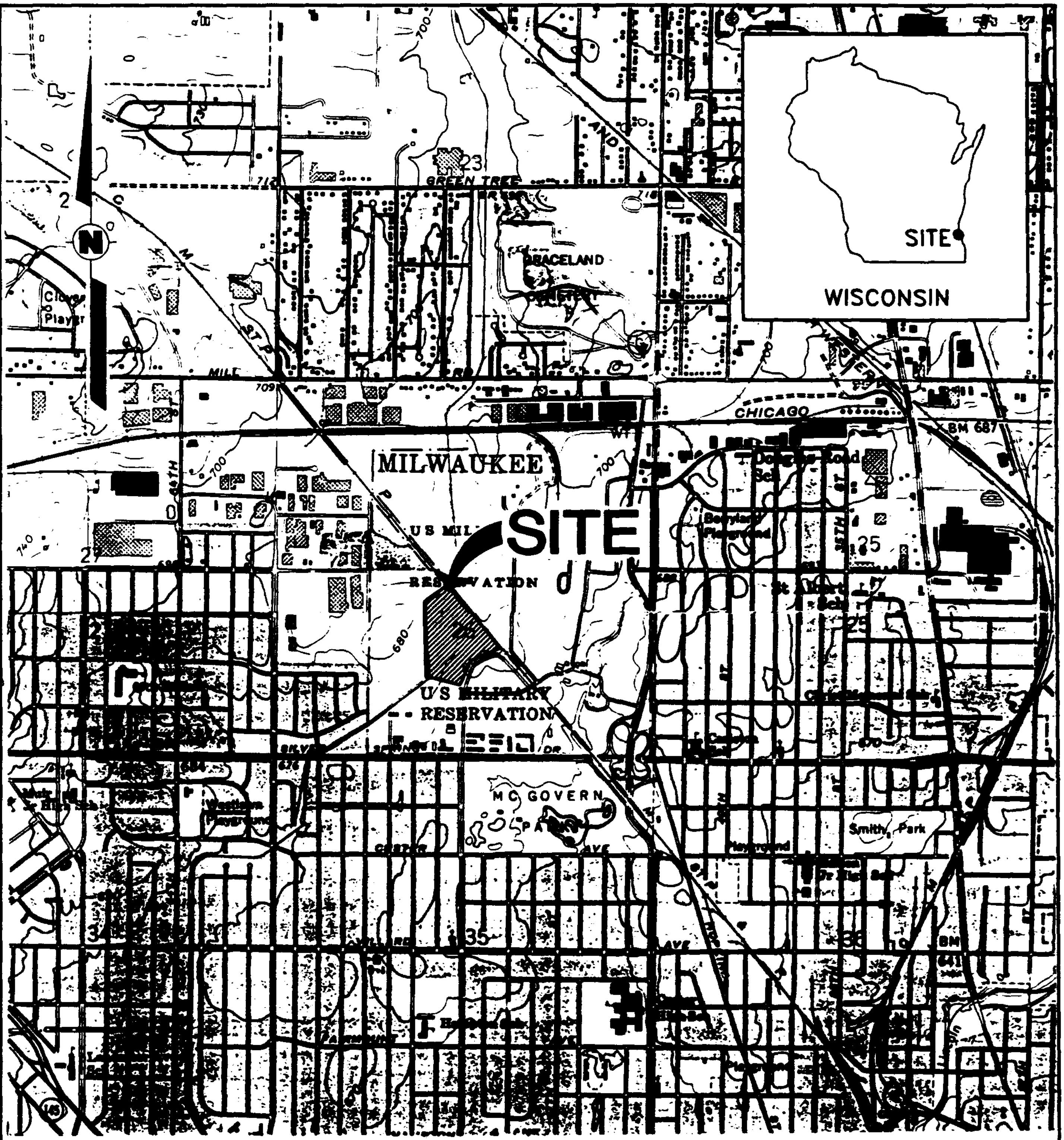


FIGURE 1–1

SITE LOCATION MAP

SURFACE AND GROUND WATER INVESTIGATION
U.S. MILITARY RESERVATION, MILWAUKEE, WISCONSIN

PREPARED FOR

USATHAMA
ABERDEEN PROVING GROUND, MARYLAND

SCALE

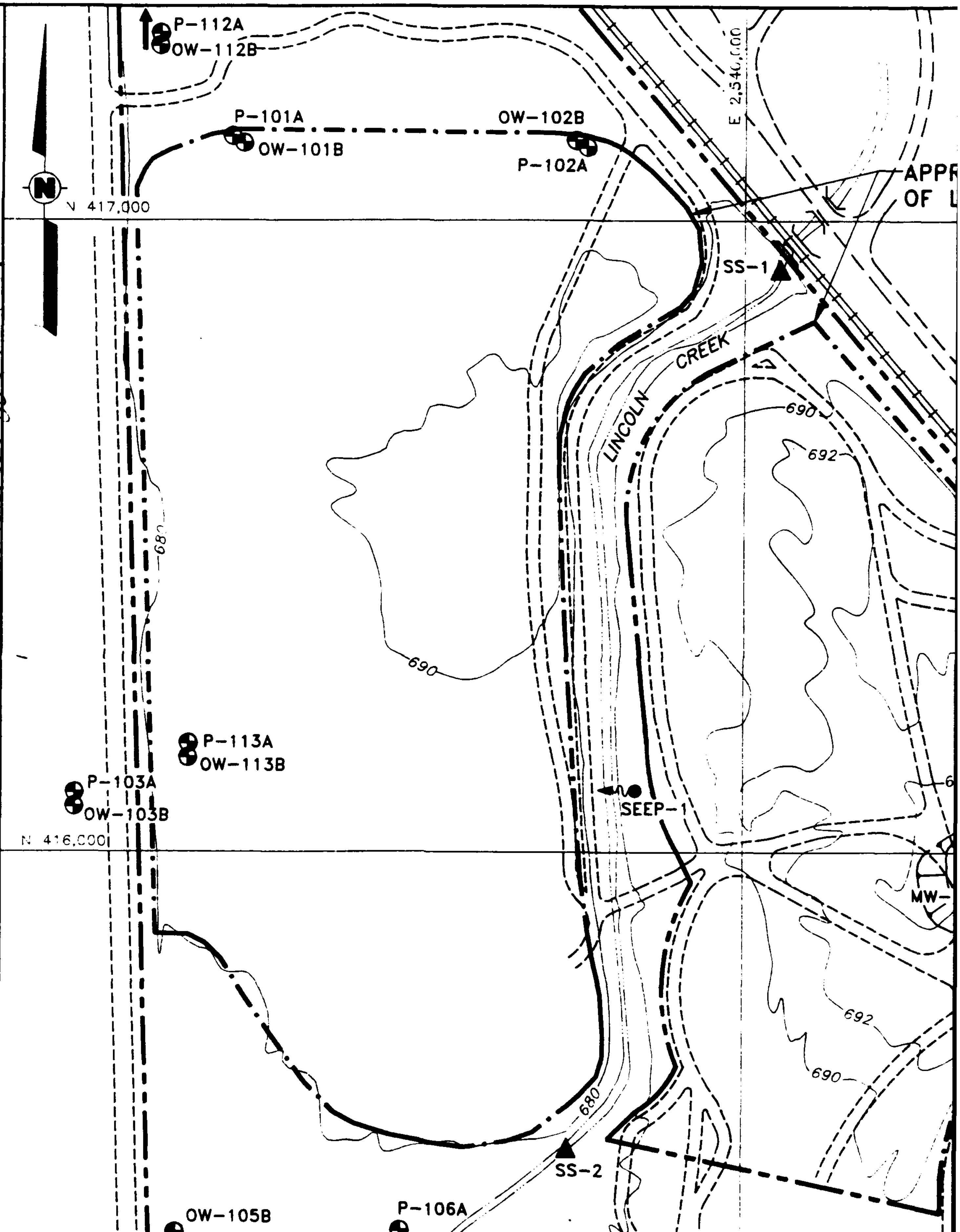
0 2000 4000 FEET

PLOT SCALE: 1" = 1"

REFERENCE:

U.S.G.S. 7.5 MIN QUADRANGLES OF THEINSVILLE AND MILWAUKEE, WISCONSIN; DATED: 1958, PHOTO-REVISED 1971 AND 1978, SCALE: 1:24000.

OHM Corporation

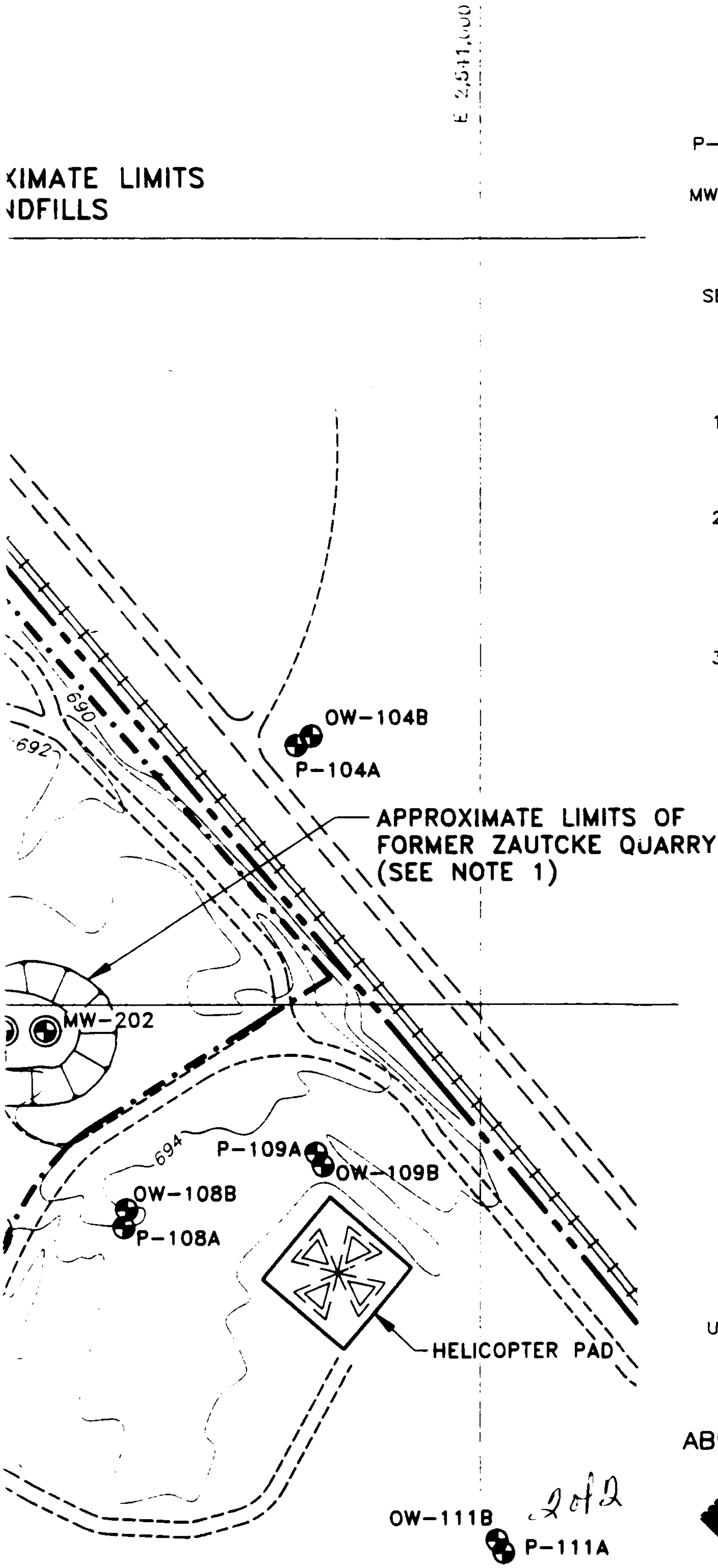


REFERENCE:
BASE MAP DIGITIZED FROM DRAWING NO. 47-018-1867 PREPARED BY FOTH & VAN DYKE, DATED: NOV. 5, 1987, SCALE: 1"= 100'

1 of 2

OHM CORPORATION PITTSBURGH, PA	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
	B.O'Connor 10-25-91	DWP 2-21-92	2-21-92	11636-B1

PLOT SCALE: 1" = 1"



LEGEND:

P-108A	EXISTING WELL LOCATION
MW-201	PROPOSED MONITORING WELL LOCATION
SS-1	PROPOSED SEDIMENT/SURFACE WATER SAMPLE LOCATION
SEEP-1	PROPOSED SEEP WATER AND SEDIMENT SAMPLE LOCATION

NOTES:

1. THE APPROXIMATE LIMITS OF THE FORMER ZAUTCKE QUARRY WERE ESTIMATED FROM A 1937 AERIAL PHOTOGRAPH, NO. WX-9-776 FROM THE WISCONSIN D.O.T.
2. THE PROPOSED DOWNSTREAM SEDIMENT AND SURFACE WATER SAMPLE LOCATION (SS-2) IS APPROXIMATELY WHERE LINCOLN CREEK EXITS THE INSTALLATION BOUNDARY BUT UPSTREAM OF RESIDENCES ALONG THE CREEK NEAR THE EXIT POINT.
3. ALL EXISTING WELLS WERE INSTALLED BY DONAHUE.

SCALE
0 200 400 FEET

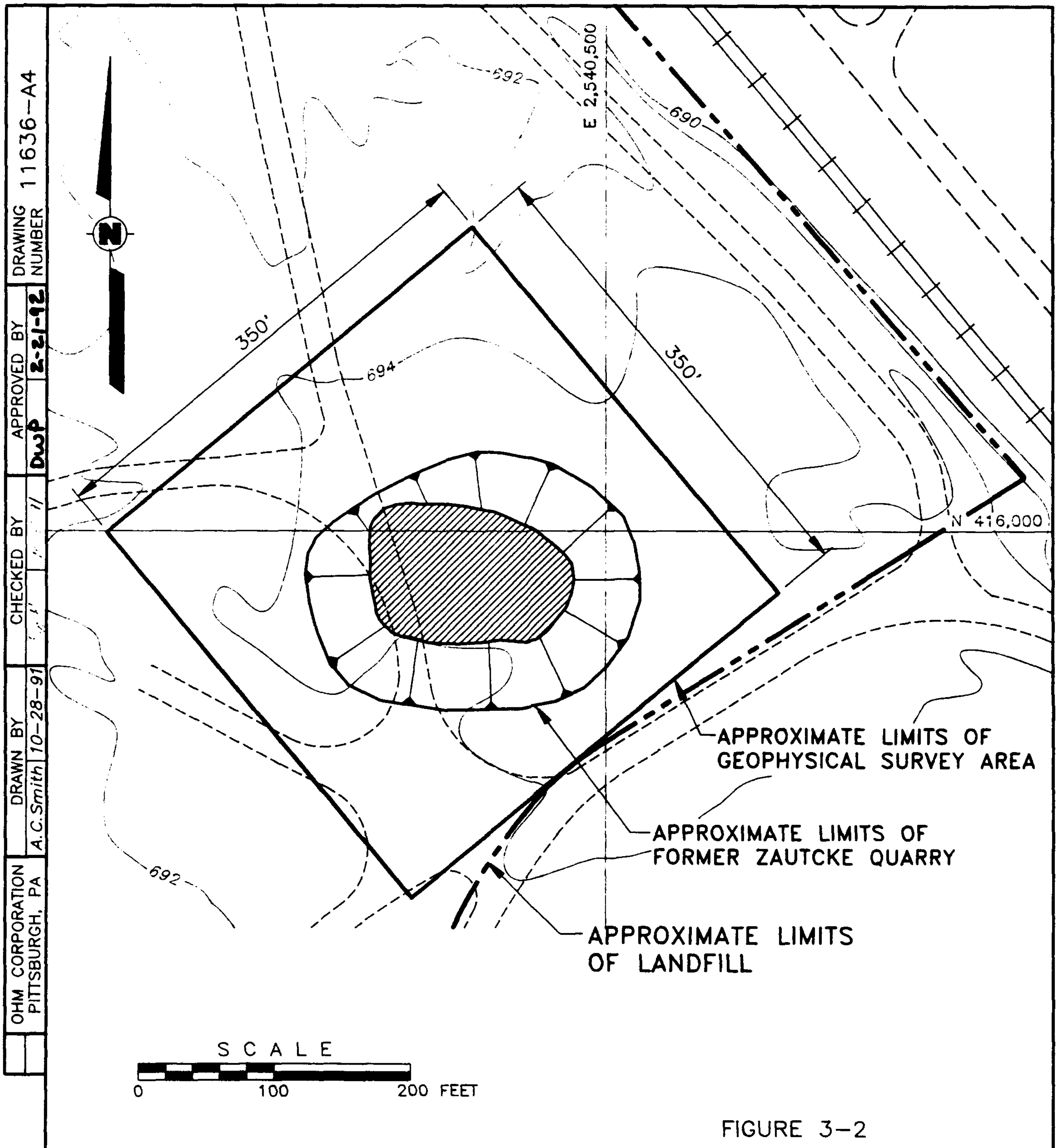
FIGURE 3-1

PROPOSED MONITORING WELLS AND SAMPLING LOCATIONS
SURFACE AND GROUND WATER INVESTIGATION
U.S. MILITARY RESERVATION, MILWAUKEE, WISCONSIN

PREPARED FOR

USATHAMA
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation



NOTES:

1. THE APPROXIMATE LIMITS OF THE FORMER ZAUTCKE QUARRY WERE ESTIMATED FROM A 1937 AERIAL PHOTOGRAPH, NO. WX-9-776 FROM THE WISCONSIN D.O.T.
2. THE APPROXIMATE LIMITS OF THE LANDFILL WHICH COVERED THE QUARRY WERE TAKEN FROM DRAWING NO. 47-018-1867 PREPARED BY FOTH & VAN DYKE.

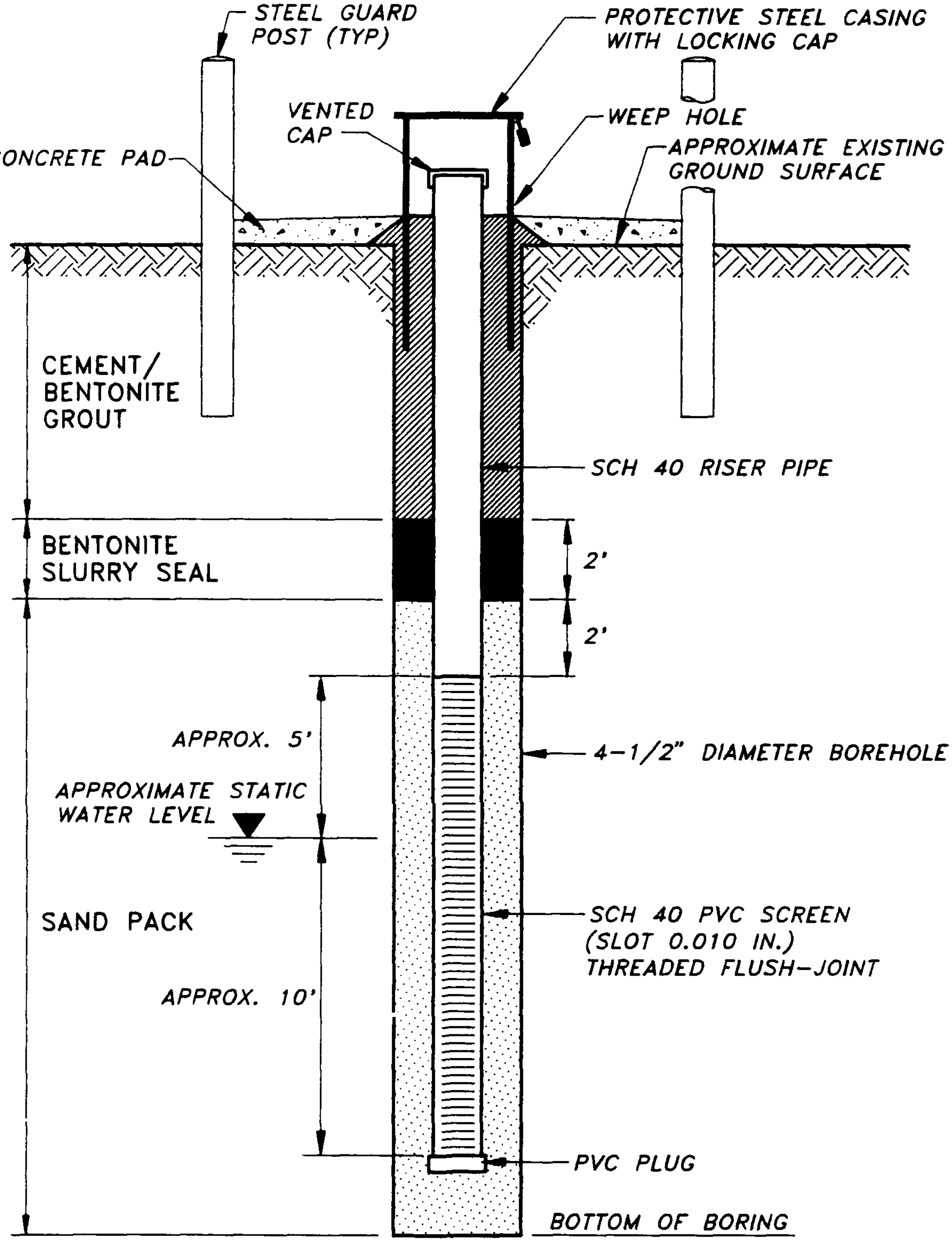
FIGURE 3-2

PROPOSED GEOPHYSICAL SURVEY AREA
SURFACE AND GROUND WATER INVESTIGATION
U.S. MILITARY RESERVATION, MILWAUKEE, WISCONSIN

PREPARED FOR

USATHAMA
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation



DRAWING NUMBER 11636-A3

APPROVED BY

CHECKED BY

DRAWN BY A.C.Smith 9-10-91

OHM CORPORATION PITTSBURGH, PA

PLOT SCALE: 1" = 1'

FIGURE 3-3

TYPICAL MONITORING WELL INSTALLATION DETAIL

SURFACE AND GROUND WATER INVESTIGATION
U.S MILITARY RESERVATION, MILWAUKEE, WISCONSIN

PREPARED FOR

USATHAMA
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

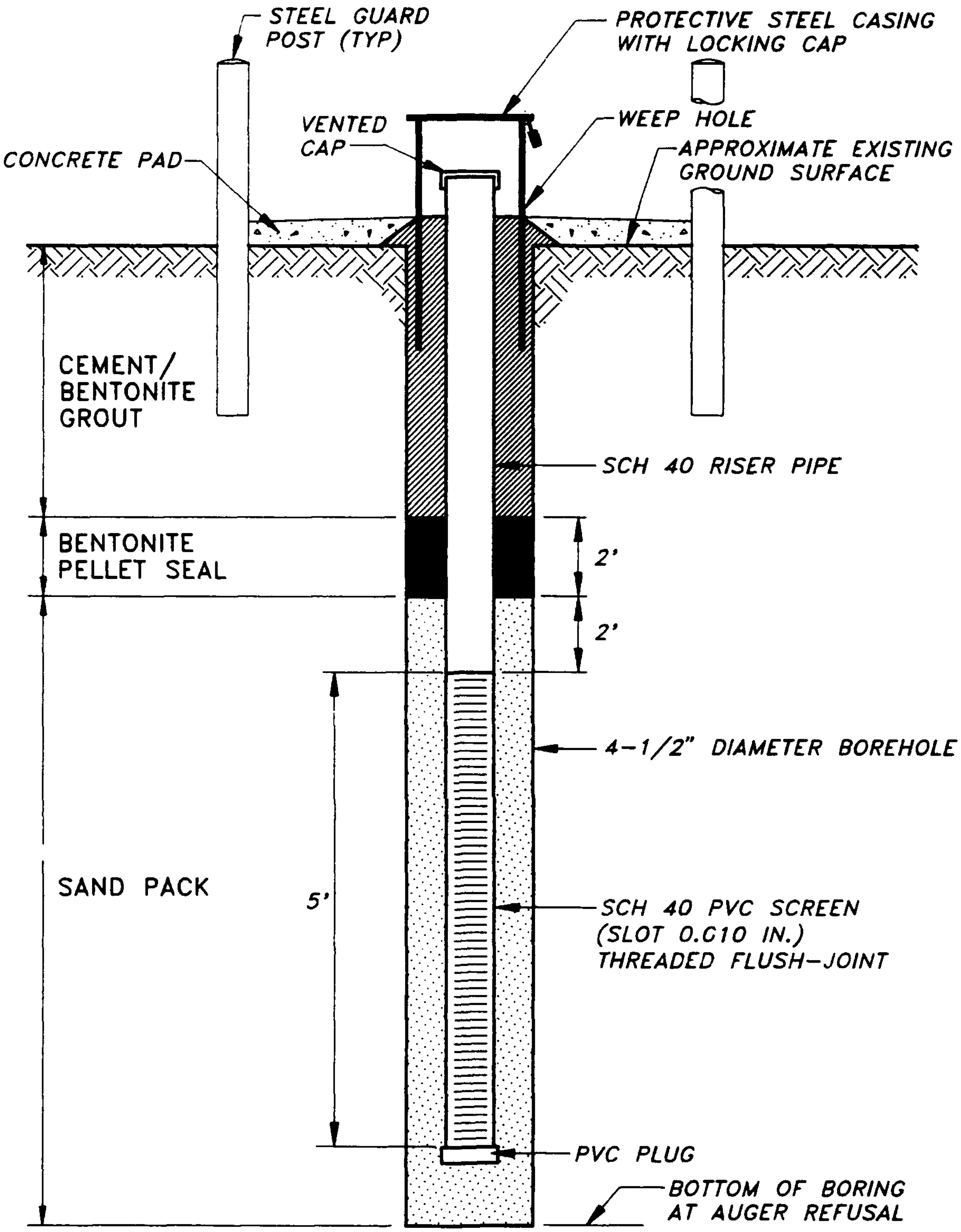


FIGURE 3-4

TYPICAL PIEZOMETER INSTALLATION DETAIL
SURFACE AND GROUND WATER INVESTIGATION
U.S. MILITARY RESERVATION, MILWAUKEE, WISCONSIN

PREPARED FOR

USATHAMA
ABERDEEN PROVING GROUND, MARYLAND

OHM Corporation

OHM CORPORATION PITTSBURGH, PA | DRAWN BY A.C.Smith 9-10-91 | CHECKED BY | APPROVED BY 2-21-92 | DRAWING NUMBER 11636-A2

PLOT SCALE: 1" = 1"

APPENDIX A

FIELD FORMS

State of Wisconsin
Department of Natural Resources

GROUNDWATER MONITORING WELL INFORMATION FORM

Chapter 144, Wis. State.
Form 4400-89

2-84

Facility Name	Facility ID Number	Date	Completed By (Name and Firm)

Well Name	Well ID Number DNR No	Well Location	N	S	E	W	Date Established	Well Casing		Elevations			Reference		Screen		Well Depth	Type of Well (✓)				
								Diam	Type	Top of Well Casing	Ground Surface	Screen Top	MSL (✓)	Site Datum (✓)	Length	Material		PIEZ	OW	PW	LYS	Other

Location Coordinates Are:

☐ Grid System

State Plane Coordinate
☐ Northern
☐ Central
Southern

Received In:

District: ______ Area: ______ Bureau: ______

By: ______

SMS Use:

File Maint. Completed ______ Date

Other: ______

HM Corporation

VISUAL CLASSIFICATION OF SOILS

Project Number ______________________
Project Name ______________________
Boring Number ______________________

Elevation ______________ Location ______________________ Page ______ of ______
Engineer/Geologist ______________ GWL: Depth ______ Date/Time ____/____ Date ______________
Drilling Co. ______________ Depth ______ Date/Time ____/____ Date Started ______________
Driller ______________ Casing Size/Depth: ____/____ Date Completed ______________
Drilling Method ______________________ Date Backfilled ______________

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS

otes: ____

F-204A 2/26/90

GENERAL NOTES AND LEGEND – BORINGS IN SOIL

GUIDE FOR SOIL DESCRIPTIONS:

1. SOIL DENSITY/CONSISTENCY
2. COLOR (INCL. DARK, LIGHT, MED.)
3. SECONDARY SOIL TYPE (SILTY, ETC.) 30–40% BY WEIGHT
4. PRIMARY SOIL TYPE (CLAY, ETC.)
5. DESCRIPTIVE TERMS, SUCH AS:
   - SOME (12–30% BY WEIGHT)
   - TRACE (5–12% BY WEIGHT)
   - LENS (≤ 1" IN THICKNESS)
   - LAYER (> 1" IN THICKNESS)
   - INTERBEDDED
   - SLICKENSIDED
   - POCKETS, ETC.
6. MOISTURE (DRY, MOIST, OR WET COMPARED TO OPTIMUM M/C)

SAMPLE TYPES

ST = SHELBY TUBE SAMPLE
P = PITCHER BARREL SAMPLE
PT = PISTON TUBE SAMPLE
S = SPLIT–SPOON SAMPLE

DENSITY OF GRANULAR SOILS

DENSITY	STANDARD PENETRATION RESISTANCE (1)
VERY LOOSE	0–4
LOOSE	5–10
MEDIUM DENSE	11–30
DENSE	31–50
VERY DENSE	OVER 50

MEASURED CONSISTENCY

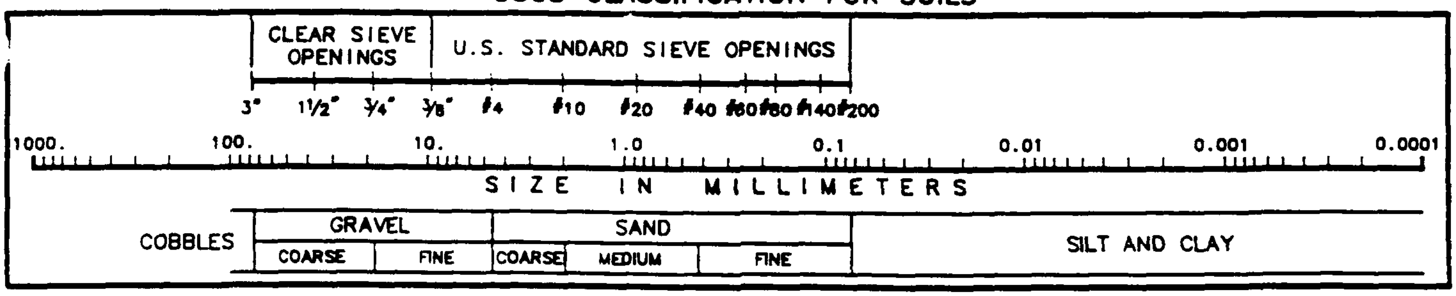
MEASURED CONSISTENCY= UNCONFINED COMPRESSIVE STRENGTH FROM POCKET PENETROMETER TEST; RESULTS OF TOR-VANE TESTS ARE IDENTIFIED AS SUCH ON THE LOGS.

(1) STANDARD PENETRATION RESISTANCE IS THE NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD 2–INCH O.D. SPLIT–SPOON SAMPLER 12 INCHES USING A 140–POUND HAMMER FALLING FREELY THROUGH 30 INCHES. THE SAMPLER IS DRIVEN 18 INCHES AND THE NUMBER OF BLOWS RECORDED FOR EACH 6–INCH INTERVAL. THE N–VALUE IS THE NUMBER OF BLOWS REQUIRED FOR THE LAST 12 INCHES.

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNCONFINED COMPRESSIVE STRENGTH (TONS PER SQUARE FOOT)	BLOW COUNTS	FIELD IDENTIFICATION
VERY SOFT	LESS THAN 0.25	0–2	EASILY PENETRATED SEVERAL INCHES WITH FIST
SOFT	0.25 TO 0.50	3–4	EASILY PENETRATED SEVERAL INCHES WITH THUMB
MEDIUM STIFF	0.50 TO 1.0	5–8	PENETRATED SEVERAL INCHES WITH THUMB UNDER MODERATE PRESSURE
STIFF	1.0 TO 2.0	9–15	READILY INDENTED WITH THUMB, BUT PENETRATED WITH GREAT EFFORT
VERY STIFF	2.0 TO 4.0	16–30	READILY INDENTED WITH THUMBNAIL
HARD	MORE THAN 4.0	OVER 30	INDENTED WITH DIFFICULTY WITH THUMBNAIL

USCS CLASSIFICATION FOR SOILS



COARSE–GRAINED SOILS

CLEAN GRAVELS (LITTLE OR NO FINES)	GW	WELL–GRADED GRAVELS, GRAVEL–SAND MIXTURES, LITTLE OR NO FINES
	GP	POORLY–GRADED GRAVELS GRAVEL–SAND MIXTURES, LITTLE OR NO FINES
GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	GM	SILTY GRAVELS, GRAVEL–SAND–SILT MIXTURES
	GC	CLAYEY GRAVELS, GRAVEL–SAND–CLAY MIXTURES
CLEAN SANDS (LITTLE OR NO FINES)	SW	WELL–GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
	SP	POORLY–GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	SM	SILTY SANDS, SAND–SILT MIXTURES
	SC	CLAYEY SANDS, SAND–CLAY MIXTURES

FINE–GRAINED/HIGHLY ORGANIC SOILS

SILTS AND CLAYS (LIQUID LIMIT LESS THAN 50)	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
SILTS AND CLAYS (LIQUID LIMIT GREATER THAN 50)	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS
	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

FOR USCS (UNIFIED SOIL CLASSIFICATION SYSTEM) CLASSIFICATIONS ON BORING LOGS, UPPER CASE LETTERS INDICATE LAB TEST CLASSIFICATION, LOWER CASE LETTERS INDICATE VISUAL FIELD CLASSIFICATION

OHM Corporation

SOIL SAMPLE FIELD COLLECTION REPORT

Project Number ____________

Project Name ____________

Site Location ____________

Collected By ____________ Date and Time Collected ____________

Sample Location ____________

SAMPLE(S) LOCATION SKETCH (use back side if necessary)

SAMPLE ID NUMBER	DEPTH OF SAMPLE	SOIL DESCRIPTION (color, composition, staining, odor, field measurements[1])

Sampling Method ____________

Composite Sample ? Y ☐ N ☐ Composite Sample ID Number ____________

Describe Compositing ____________

SAMPLE TYPES COLLECTED

TYPE[2]	VOLUME	PER SAMPLE ?	PER COMPOSITE ?
		Y ☐ N ☐	Y ☐ N ☐
		Y ☐ N ☐	Y ☐ N ☐
		Y ☐ N ☐	Y ☐ N ☐
		Y ☐ N ☐	Y ☐ N ☐

Number of Containers ____________

Date Received By Lab ____________ Laboratory ____________

Remarks: ____________

(1) For Example, Organic Vapor Analysis, Pocket Penetrometer, Etc.

(2) For Example, Metals, VOA, Organics, Etc.

F-116 2/28/90

OHM Corporation

WATER SAMPLE FIELD COLLECTION REPORT

Project Number ____________________
Project Name ____________________
Site Location ____________________

Sample ID Number ____________________ Date Collected ____________________
Sample Location ____________________ Time Collected ____________________
Diameter of Well ____________________ (in.) Collected By ____________________
Depth to Bottom of Well ____________________ (ft.) Casing Stick Up ____________________ (ft.)
Static Water Level ____________________ (ft.), Measured From (1) ____________________
Well Volumes Purged ____________________, Purging Method (2) ____________________
Type of Sample (3) ____________________, Sampling Method (4) ____________________
Depth of Sample ____________________ (ft.), Measured From (1) ____________________
Sample Collection Order ____________________

FIELD MEASUREMENTS

Water Temperature ____________________ pH ____________________
Specific Conductance ____________________ umho/cm at ____________________ (Temperature)
Other ____________________

METER CALIBRATION

pH STD	METER READING	SP. COND. STD	METER READING	______ /STD	METER READING

SAMPLE TYPES COLLECTED

TYPE (5)	VOLUME	FILTERED		PRESERVATION (6)	
______	______	Y ☐	N ☐	Y ______	N ☐
______	______	Y ☐	N ☐	Y ______	N ☐
______	______	Y ☐	N ☐	Y ______	N ☐
______	______	Y ☐	N ☐	Y ______	N ☐
______	______	Y ☐	N ☐	Y ______	N ☐

Number of Containers ____________________
Date Received by Lab ____________________ Laboratory ____________________
Remarks: ____________________

(1) T.O.C.=Top of Protective Casing; T.O.W.=Top of OF Well Casing; G.S.=Ground Surface
(2) Bailed, Pumped, Air Lift, Etc.
(3) Stream, Pond, Spring, Well, Seep, Supply, Etc.
(4) Bailer, Kemmerer, Grab, Pump, Etc.
(5) General Chem., Metal, VOA, Organics, Etc.
(6) HNO^3, NaOH, H^2SO^4, $Na^2O^3S^2$, Etc.

F-117A 3/2/90

OHM Corporation

REAL TIME AIR MONITORING LOG

Project Number ______________________

Project Name ______________________

Site Location ______________________

DATE	ANALYST	TIME	INSTRUMENT (MFG/MODEL/ SERIAL NO.)	CALIBRATION DATE & CPD.	COMPOUND MEASURED	SPAN SET OR SENS. CAL.	CONC. (UNITS)	LOCATION/ACTIVITY/COMMENTS

F-185 10/2/89

OHM Corporation

REAL TIME INSTRUMENT CALIBRATION LOG

Project Number ______________________

Project Name ______________________

Site Location ______________________

Instrument ______________________ Manufacturer ______________________ Instrument Serial No. ______________________

DATE/ TIME	TEMP.	BAR. PRESS.	% REL. HUMID.	GAS STD (NAME)	STD CONC (ppm)	ATTEN. SPAN SET/ SENS. CAL.	ZERO CHECK	METER READING (ppm)	COMMENTS	ANALYST SIGNATURE

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OHM Corporation

PROJECT NAME ____________________ PROJECT NO. ____________

SAMPLE LOCATION ____

BORING/WELL NO. ____________________ DATE ____________

DEPTH OF SAMPLE ____________________ TIME TAKEN ____________

COLLECTOR'S NAME ____

SAMPLE TYPE: ☐ GROUNDWATER ☐ SURFACE WATER

☐ SOIL ☐ SLUDGE/WASTE

PARAMETERS ____________________ PRESERVATIVE ____________

BOTTLE ______ OF ______ ☐ FILTERED ☐ NONFILTERED

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OHM Corporation

CHAIN OF CUSTODY RECORD

Project Number ______________________ Page ____ of ____

Project Name ______________________

Site Location ______________________

SAMPLE IDENTIFICATION	DATE	TIME	SAMPLE TYPE	SAMPLE LOCATION	VOLUME COLLECTED	NUMBER OF CONTAINERS							COMMENTS

RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):
RELINQUISHED BY (SIGNATURE):	DATE/TIME:	RECEIVED BY (SIGNATURE):	REMARKS:		

Distribution—Original accompanies shipment, copy to project files.

SAMPLE TYPE: W—WATER, S—SOLID, A—AIR, O—OTHER

LABORATORY:

NOTE: ALL SAMPLES ARE TO BE INSPECTED FOR PHYSICAL INTEGRITY UPON RECEIPT BY THE ANALYTICAL LABORATORY.

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APPENDIX B

STANDARD OPERATING PROCEDURES FOR CONTAINERIZATION, STORAGE, SAMPLING, AND DISPOSAL

APPENDIX B

STANDARD OPERATING PROCEDURES FOR CONTAINERIZATION, STORAGE, SAMPLING, AND DISPOSAL

The following Standard Operating Procedure (SOP) will be used by OHM during the Surface and Ground Water Investigation at the Milwaukee Army Reserve Center.

<u>CLASSIFYING/HANDLING SOIL CUTTINGS AND DECONTAMINATION LIQUIDS</u>

Possible contaminants in the soil cuttings/decontamination liquids/ground water are limited to metals, volatiles, and anionic compounds only.

<u>Screening</u>

- o Soils/decontamination liquids will be screened using a photoionization detector (PID); any materials exceeding 10 ppm will be containerized and further tested as described below.

- o PID instruments will be calibrated at least daily in accordance with manufacturer's directions.

- o PID readings will be obtained from a field headspace analysis procedure as described below:

  - Samples will be placed in glass containers, the container mouth will be covered with aluminum foil and capped.

  - Samples will be allowed to stabilize at a temperature of at least 20 degrees Celsius (68 degrees Fahrenheit) for at least 45 minutes.

  - The sample container lid will be removed, exposing the inner aluminum foil cover. The foil cover will be pierced with the PID probe to measure the total organic vapor concentration in the sample headspace.

  - For well borings, the sample will be composited from the split-spoon samples obtained for each 5-foot interval. Soils from the borings will be segregated in separate piles corresponding to each boring until PID analyses are obtained for classification.

- For decontamination liquids, at least one sample for PID evaluation will be collected from the containerization "pad" prior to any discharge being permitted from the "pad."

Material Handling

- o Soils/decontamination liquids exceeding 10 ppm PID readings will be containerized for further testing described below. Soils are to be in separate piles on plastic and then covered with plastic and secured. Decontamination liquids are to be consolidated in 55-gallon labeled drums if PID readings exceed 10 ppm.

- o Purged water will be pumped directly from the wells into 55-gallon, labeled, metal drums for temporary storage. Water from each well will be stored in separate drums.

- o Containerized material will be placed for temporary storage in a location to be assigned by the MIARC and the USATHAMA COR for MIARC.

Confirmatory Testing

- o Soil/decontamination liquid which failed the PID screening criteria will be sampled IAW USEPA methods (SW-846), and EPA's Target Compound List (TCL) for volatiles.

- o Soil which exceeds or meets WDNR's action levels for volatiles will be analyzed for the four hazardous waste characteristics (40 CFR 261, Subpart C):

  - TCLP
  - Ignitability
  - Corrosivity
  - Reactivity.

- o The ground water sample analyses will be used to characterize the drummed development and purged water from each well.

- o The ground water sample analyses for EPA's Target Analyte List metals and USATHAMA anions will be used to characterize the drill cuttings from each well which passed the PID screening.

- If analyses indicate ground water is "clean" according to WDNR, the development and purged water can be discharged to the local POTW with their approval, and drill cuttings which passed the PID screening can be deposited on site.

- If analyses indicate the drummed decontamination liquid is "clean" according to WDNR, the decontamination liquid can be discharged to the local POTW with their approval.

- If analyses indicate ground water/decontamination liquid is contaminated, the contamination levels will be reviewed by WDNR to determine type of ground water treatment required and the location for disposal. In this case, handling and disposal of all materials (i.e., drill cuttings, development and purged water, decontamination water) will need to be evaluated.

<u>Handling Containerized Materials</u>

- Any soils which fail any of the four test methodologies will be handled as RCRA hazardous wastes.

- OHM will arrange transportation and disposal of these materials according to RCRA, State, and Army regulations.

  Any soil container whose contents pass all of the four RCRA hazardous waste characteristic tests will be transported at the MIARC COR's direction to a sanitary landfill for disposal.

<u>Responsibilities</u>

- OHM will be responsible for providing material, labor, and equipment necessary to perform, and for performing, the requirements of the SOP, including:

  - All PID sampling and screening

  - Containerization and providing containers

  - Transportation of containerized materials on MIARC

  - Numbering and labeling samples and containers in a manner that will assure correlation of laboratory results with the corresponding container and well number, as appropriate

- Timely transmittal of analytical results (including PID results) to USATHAMA and MIARC within a maximum of 45 days from the date of sample collection

- The proper transportation and disposal of wastes generated and handled as described above.