SIMON HYDRO-SEARCH

175 N. Corporate Drive
Suite 100
Brookfield, WI 53045

Telephone (414)792-1282
Facsimile (414)792-1310

WORK PLAN
FOR
REMEDIAL INVESTIGATION
MILWAUKEE PLATING COMPANY
MILWAUKEE, WISCONSIN

1/12/1994

January 12, 1994

Prepared For:

Milwaukee Plating Company
1434 N. 4th Street
Milwaukee, Wisconsin 53212

Prepared By:

Simon Hydro-Search
Brookfield Lakes Corporate Center XII
175 N. Corporate Drive, Suite 100
Brookfield, Wisconsin 53045

Project No.: 366115203

GERALD
LOUIS
DEMERS
E-21773
MILWAUKEE,
WIS.

Michael R. Noel, Sr. Vice-President
Manager, Milwaukee Operations

Gerald DeMers

Gerald DeMers, P.E.
Senior Engineer

SIMON
Environmental

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ACRONYMS

BETX	Benzene, Ethylbenzene, Toluene and Xylenes
DROs	Diesel Range Organics
ES	Enforcement Standard
GROs	Gasoline Range Organics
PID	Photoionization Detector
ppm	Parts Per Million
PVOCs	Petroleum Volatile Organic Compounds
QA/QC	Quality Assurance/Quality Control
U.S. EPA	United States Environmental Protection Agency
USCS	Unified Soil Classified System
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
WDNR	Wisconsin Department of Natural Resources

1.0 INTRODUCTION

1.1 Purpose

This work plan outlines the proposed scope of work to identify the horizontal extent of hydrocarbon impacts at Milwaukee Plating Company at 1434 N. 4th Street, Milwaukee, Wisconsin (Figure 1-1).

1.2 Introduction to Milwaukee Plating Facility

Milwaukee Plating provide zinc, copper, nickel, chrome, silver and tin plating on aluminum products. The facility is located in a building that was previously used by a sign company, Everbrite Electric, Inc., until 1964. The northern lot of the Milwaukee Plating Company was previously occupied by Kepec Paint Company which was destroyed by fire in the late 1960s.

1.3 Background

Milwaukee Plating Company contracted Simon Hydro-Search on November 9, 1989, to remove and abandon underground storage tanks (USTs) at their facility. Company personnel knew of two USTs on the property, which were used to store heating oil. A 3,000-gallon UST located on the southeast side of the site was removed and a 6,400-gallon UST on the east side of the building was abandoned-in-place due to its location under a loading dock (Figure 1-2). In addition, two 250-gallon USTs were located and removed north of the 6,400-gallon UST. Soil directly under the two 250-gallon USTs was tested and found to be free of impacts. Impacted soil was encountered in the vicinity of the 3,000-gallon UST and the 6,400-gallon UST. The UST closure activities were documented in the Simon Hydro-Search report dated May 15, 1990.

Beginning on November 30, 1990, a soil and ground-water investigation was conducted to determine the extent of impacts from hydrocarbons at the site. Five boreholes were installed in the public alleyways east and south of the Milwaukee Plating Company facility to determine the extent of soil impacts (Figure 1-3). Three of the boreholes were converted to ground-water monitor wells to evaluate ground-water quality and flow direction at the facility. In addition, a sixth borehole was installed in the northeast corner of the property to evaluate the background soil and ground-water quality.

Two additional monitor wells were installed in July, 1992 north of the site to aid in determining the direction of ground-water flow and upgradient water quality. The water-table surface at the site is shown on Figure 1-4.

In November, 1991, a UST was discovered below the basement of Milwaukee Plating Company. Based upon this discovery, a free product sample from existing monitor well MW-1 and a product sample from the UST was submitted to Global Geochemistry Corporation (GGC) to characterize the type, origin, and source of the products and to attempt to determine if the two products are source-related. Based upon their analysis of the UST product sample, GGC concluded that it consisted primarily of gasoline. Their analysis of the product sample from well MW-1 indicated that it is a mixture of gasoline and diesel fuel.

In May of 1992, an adjacent property owner, Central Control Alarm Corporation, threatened to file a lawsuit against Milwaukee Plating. This threat came about after Central Control discovered contamination on its property located across the public alley and directly east of Milwaukee Plating's facility. Central Control claimed that as a result of this contamination, it lost a potential purchase for its property. Soil and ground-water sampling and analysis results from their investigations are also shown on Figure 1-3, and summaries of soil and ground-water results are provided on Tables 1-2 and 1-3, respectively.

At the request of the Wisconsin Department of Natural Resources (WDNR), Milwaukee Plating has been removing free product from well MW-1 since September 13, 1993. Product is being removed by bailing. It was originally removed on a daily basis, but because of the small quantity removed, is now being bailed weekly.

In November 1993, the UST located below the basement floor at Milwaukee Plating was abandoned in-place. Holes due to corrosion were noted in the tank bottom. Soil samples collected from outside of the tank shell confirmed impacts by old, leaded gasoline. Soil sample results taken at the time of tank abandonment are provided on Table 1-1. It is noted that methyl-tertiary-butyl-ether (MTBE) was analyzed but not detected for soil samples collected from the abandoned UST. MTBE was detected in ground water in the monitor well DM-1. MTBE is present in unleaded gasoline, but was not used in leaded gasolines.

The existing ground-water monitor wells on-site exhibit impacts by petroleum related compounds. A summary of laboratory results for soil samples is provided on Table 1-2, and ground-water results are provided on Table 1-3. In addition to petroleum fuel compounds, chlorinated hydrocarbons have been detected in ground-water samples from borings GB-1 and GB-2 on Central Controls property, and in MW-3.

1.4 Scope of Work

The scope of work encompassed by this work plan includes the following:

- Install and develop four ground-water monitor wells.
- Sample and analyze soils collected during drilling.
- Test hydraulic conductivity and sample and analyze ground water from all existing and new monitor wells on-site.
- Evaluate remedial alternatives for the site.
- Report the results of the site investigation.

2.0 GEOLOGIC AND HYDROGEOLOGIC SETTING

2.1 Regional Conditions

Unconsolidated deposits in Milwaukee County are predominantly glacial drift of Pleistocene age and range in thickness from 0 to 450 feet. Surficial till deposits in the vicinity of the site are part of a ground moraine.

The uppermost bedrock surface underlying the glacial drift is the Silurian age Niagara Dolomite occurring at a depth of about 200 feet at the site. The principal geologic structure of the various bedrock units underlying and including the Niagara Dolomite is a monocline, where the bedrock dips gently to the east into the Michigan basin.

Surface elevations in the Milwaukee area range between 580 and 950 feet above mean sea level. Relief is generally minor except along the Lake Michigan shoreline where bluffs rise as much as 120 feet. Surface drainage is primarily to the Milwaukee and Menomonee River systems which flow into Lake Michigan.

The principal shallow aquifers in the Milwaukee area are Pleistocene sands and gravels and the Niagara Dolomite. Regional ground-water flow is to the east towards Lake Michigan.

2.2 Local Conditions

Boreholes have been drilled at the site as a result of previous investigations. Five boreholes have been converted to ground-water monitor wells (Figure 3-1). Boreholes ranged from 17 to 21 feet deep.

Boreholes B-6 through B-10 were installed on January 3 and 4, 1991 (Figure 2-2). Boreholes B-6 through B-8 were converted to ground-water monitor wells in accordance with state requirements. Borehole B-11 was installed on March 6, 1991 to a depth of 21 feet.

The public alleyway had been paved with 0.2 feet of asphalt, 0.5 feet of concrete and approximately 0.5 feet of crushed stone. Approximately 17 to 18 feet of fill material consisting of gravel, sand, silt, clay, and organic material was encountered in the boreholes. The native dark brown, hard clay till was encountered at a depth of 18 feet or greater depth below the ground surface.

Ground-water elevations were determined for the monitor wells at the site using the surveyed elevations of the PVC riser pipe and the measured depths to ground water for each well. Ground water was encountered at 11 to 13 feet in all the boreholes. Potentiometric contours were developed based on the ground-water elevations collected on January 8, 1991. The ground-water flow direction is perpendicular to the potentiometric contours. Figure 3-2 depicts the potentiometric contours and associated ground-water flow for the area. The flow direction is south to southeast based on the ground-water elevations collected on May 3, 1993.

3.0 FIELD INVESTIGATION PROCEDURES

3.1 Objectives

The objectives of this work plan are as follows:

- Determine the horizontal extent of ground-water impacts across the site.
- Attempt to identify the source area for chlorinated hydrocarbons present in the ground water.
- Calculate hydraulic conductivity values for the unconsolidated material using slug test data gathered from the monitor wells installed on the site.
- Use the horizontal gradient and hydraulic conductivity data to estimate ground-water flow velocities for the site.
- Based on the data gathered from the site investigation phase of the project, evaluate and select remedial alternatives for the site.
- Submit a report to the WDNR which includes the findings of the site investigation, the evaluation of remedial alternatives, and recommendations for the most practical method of remediation for the site.

3.2 Health and Safety Plan and Permits

The health and safety plan for the investigation is found in Appendix G. Diggers Hotline will be notified to clear the proposed drilling locations. A permit for drilling will also be obtained from the City of Milwaukee.

3.3 Drilling and Soil Sampling

Simon Hydro-Search proposes the installation of four monitor wells (flush-mounted) to evaluate ground-water conditions and monitor ground-water quality (Figure 3-1). To ensure the eligibility under PECFA of a portion of the investigative costs, three competitive drilling bids will be supplied to Milwaukee Plating for their direct subcontracting. Each borehole site will be drilled to a depth of approximately 20 feet (assuming 13 feet to ground water) using the hollow stem auger drilling and equipment decontamination procedures contained in Appendix C. Continuous split-spoon soil samples will be collected during drilling and field screened with a photoionization detector (PID) for VOCs using the procedures outline in Appendices B and D. One soil sample from above the water table will be collected from each borehole for laboratory analysis of VOCs, gasoline range organics (GRO), diesel range organics (DRO), polynuclear aromatic hydrocarbons (PAHs) and lead. One soil sample having the highest PID reading above background will also be analyzed from each borehole.

3.4 Well Installation and Development

Water-table monitor well construction, installation, and development procedures are contained in Appendix E. The 2-inch diameter PVC monitor wells will be installed in accordance with Chapter NR141 of the Wisconsin Administrative Code. A 20-foot borehole depth will allow a 10-foot screen to be installed. After each well is developed, an in-situ hydraulic conductivity test will be performed using the bail/recovery method.

Purge water from well development and sampling will be containerized and stored on-site. Purge water is expected to be discharged to the sanitary sewer after laboratory results indicate that it is not impacted.

3.5 Ground-Water Sampling and Analysis

Ground-water sampling procedures are found in Appendix F. Ground water obtained from each new and existing monitor well will be analyzed for VOCs, PAHs, oil and grease, and total suspended solids. To ensure the eligibility under PECFA of a portion of the investigative costs, three competitive laboratory bids will be supplied to Milwaukee Plating for their direct subcontracting.

In accordance with WDNR requirements, the following quality assurance samples will also be prepared and submitted for analysis. One duplicate ground-water sample will be collected and analyzed for every 10 (or fewer) investigative ground-water samples. The duplicate sample will be analyzed for the same parameters as the investigative ground-water samples. In addition, one trip blank sample will be analyzed for VOCs for each batch of samples.

3.6 Surveying

Monitor well locations and elevations will be surveyed by a licensed surveyor after they have been installed. Three bids will be requested for surveying work.

4.0 REPORT PREPARATION

All data collected during this investigation will be included in the report along with a description of the geology, the direction and rate of ground-water flow, and the nature and extent of any soil and ground-water impacts. Remedial alternatives will be evaluated, and the most appropriate method recommended.

5.0 WORK SCHEDULE

Simon Hydro-Search will begin this investigation at the site within 15 days of acceptance of this work plan by the WDNR. Written notification from the WDNR to proceed may be necessary prior to initiating site work. The estimated time to complete four monitor wells, perform hydraulic conductivity tests and sample ground water from each well is 4 days. The soil and ground-water analytical results should be received from the laboratory 4 weeks after the end of field activities. Data analysis and report preparation are expected to take an additional five weeks.

6.0 REFERENCES

Hydro-Search, Inc., Soil and Ground-Water Investigations, Milwaukee Plating Company, November 21, 1991.

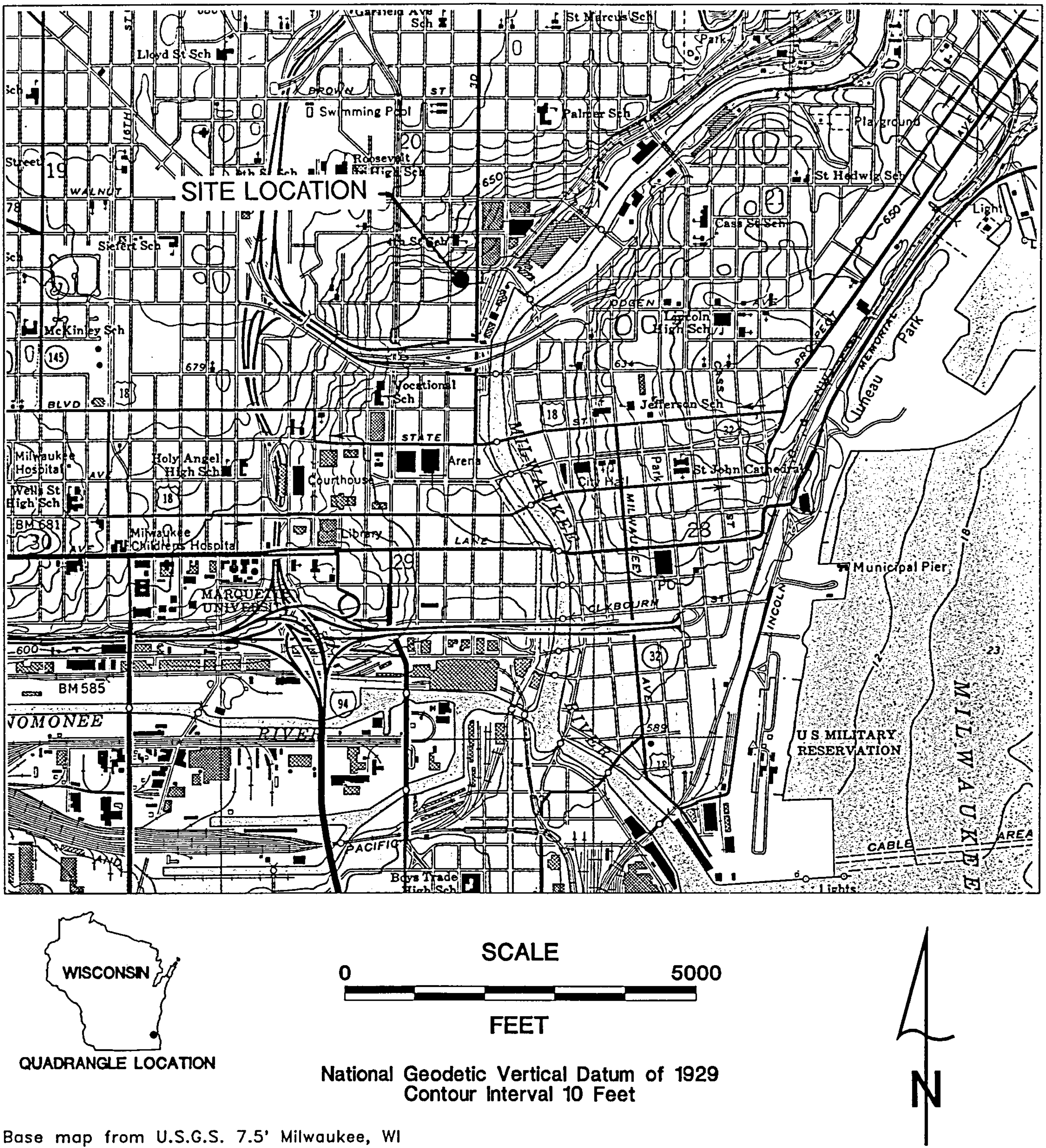
Hydro-Search, Inc., Underground Storage Tank Closures and Remediation, Milwaukee Plating Company, May 15, 1990.

Wisconsin Department of Natural Resources, February, 1987, Ground-Water Sampling Procedures Guidelines, Publication PUBL WP-153-87, WDNR, Madison, Wisconsin,.

Wisconsin Department of Natural Resources, June, 1991, Groundwater Monitoring Well Requirements, Chapter NR141 of the Wisconsin Administrative Code.

Wisconsin Department of Natural Resources, January, 1992, Groundwater Quality, Chapter NR140 of the Wisconsin Administrative Code.

FIGURES



National Geodetic Vertical Datum of 1929
Contour Interval 10 Feet

Base map from U.S.G.S. 7.5' Milwaukee, WI
topographic quadrangle map, photorevised 1971

SIMON HYDRO-SEARCH

Brookfield Lakes Corporate Center XII
175 N. Corporate Drive, Suite 100
Brookfield, Wisconsin 53045

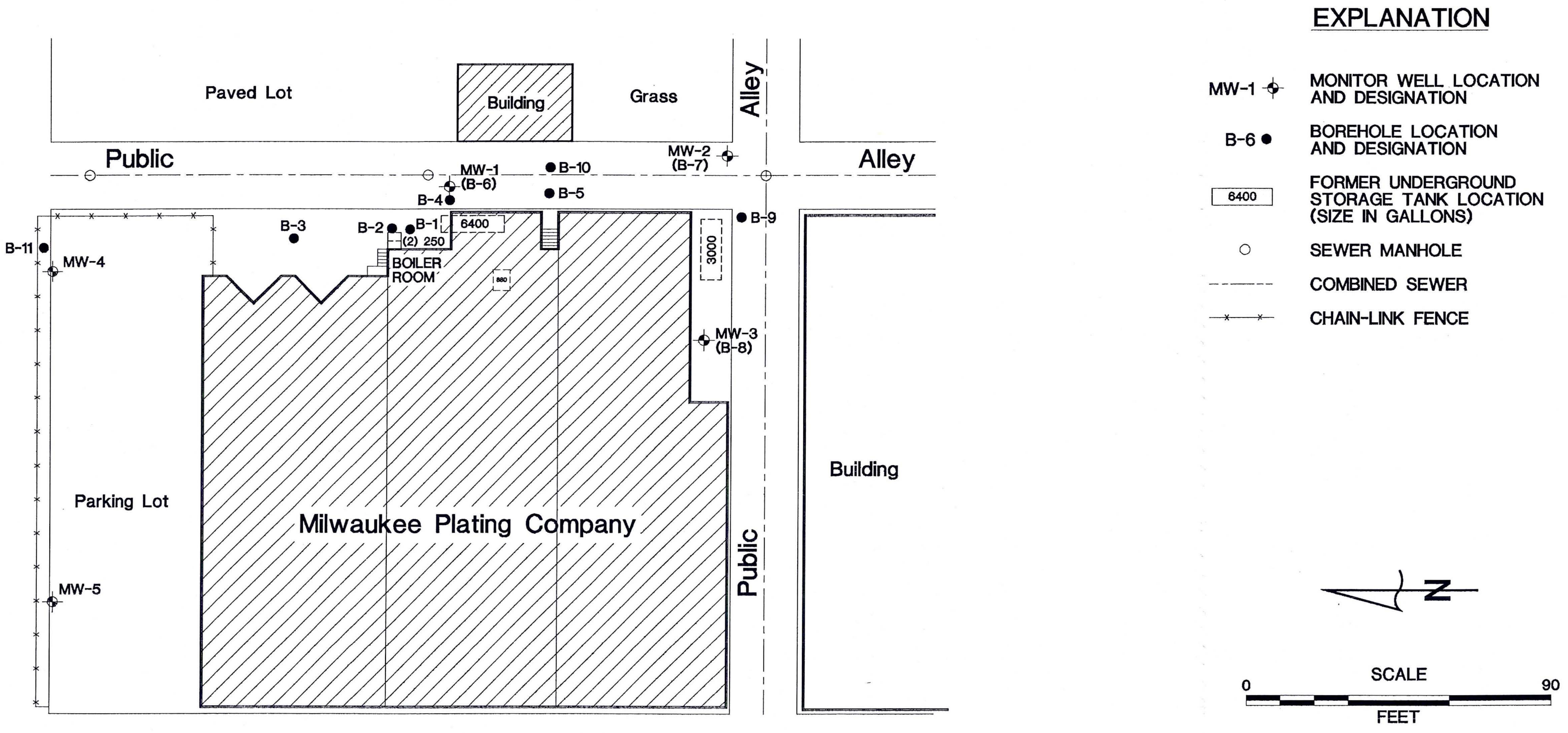
Dsgn. by: JG	Chk. by: GLD	Apprv. by: DLM

PROJECT: 366115203	DATE: 01/11/94

MILWAUKEE PLATING
MILWAUKEE, WISCONSIN

SITE LOCATION and LOCAL TOPOGRAPHY

DRAWING: 1520	FIGURE: 1-1



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Brookfield Lakes Corporate Center XII
175 N. Corporate Drive, Suite 100
Brookfield, Wisconsin 53045

Dsgn. by: RK	Chk. by: GLD	Apprv. by: DLM
PROJECT: 366115203	DATE: 12/29/93	

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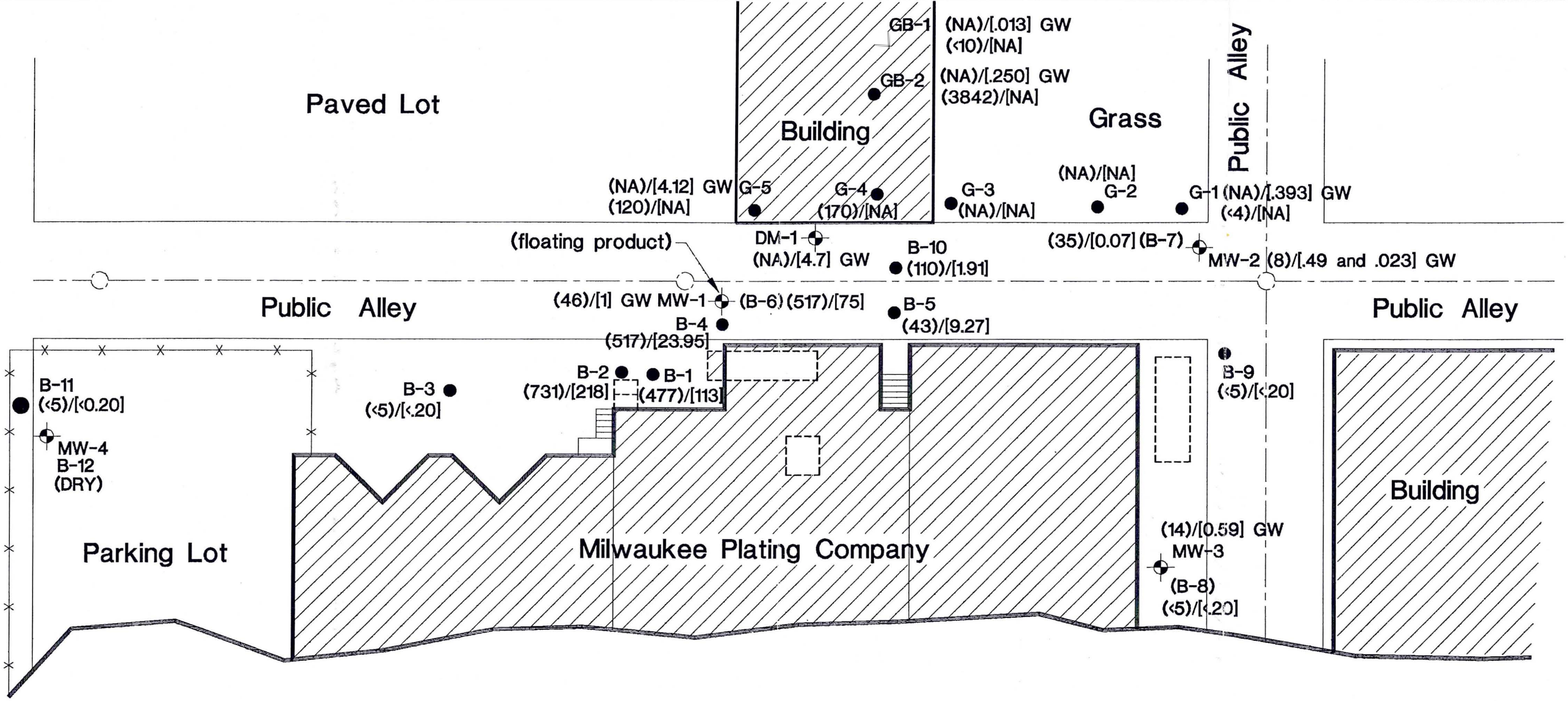
SITE LAYOUT

DRAWING:	1520-b2	FIGURE:	1-2



EXPLANATION

MW-1 ⊕ (46)/[1] GW	MONITOR WELL LOCATION, DESIGNATION, AND GROUND WATER TPH (ppm) AND BETX [ppm] ANALYTICAL RESULTS
B-6 ● (46)/[1]	BOREHOLE LOCATION, DESIGNATION, AND SOIL TPH (ppm) AND BETX [ppm] ANALYTICAL RESULTS
┌---┐	FORMER UNDERGROUND STORAGE TANK LOCATION
G-1,GB-1 ●	SOIL BORINGS INSTALLED BY GILES ENGEERING
DM-1 ⊕	MONITOR WELL INSTALLED BY DAMES AND MOORE
NA	NOT ANALYZED
○	SEWER MANHOLE
— - — - —	COMBINED SEWER
—x—x—	CHAIN-LINK FENCE

N

SCALE

0 45

Feet

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Brookfield Lakes Corporate Center XII
175 N. Corporate Drive, Suite 100
Brookfield, Wisconsin 53045

Dsgn. by: PAS
Chk. by: GLD
Apprv. by: DLM
PROJECT: 366E12433
DATE: 01/11/94

MILWAUKEE PLATING CO.
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SOIL AND GROUNDWATER ANALYTICAL RESULTS

DRAWING: 1243-5
FIGURE: 1-3

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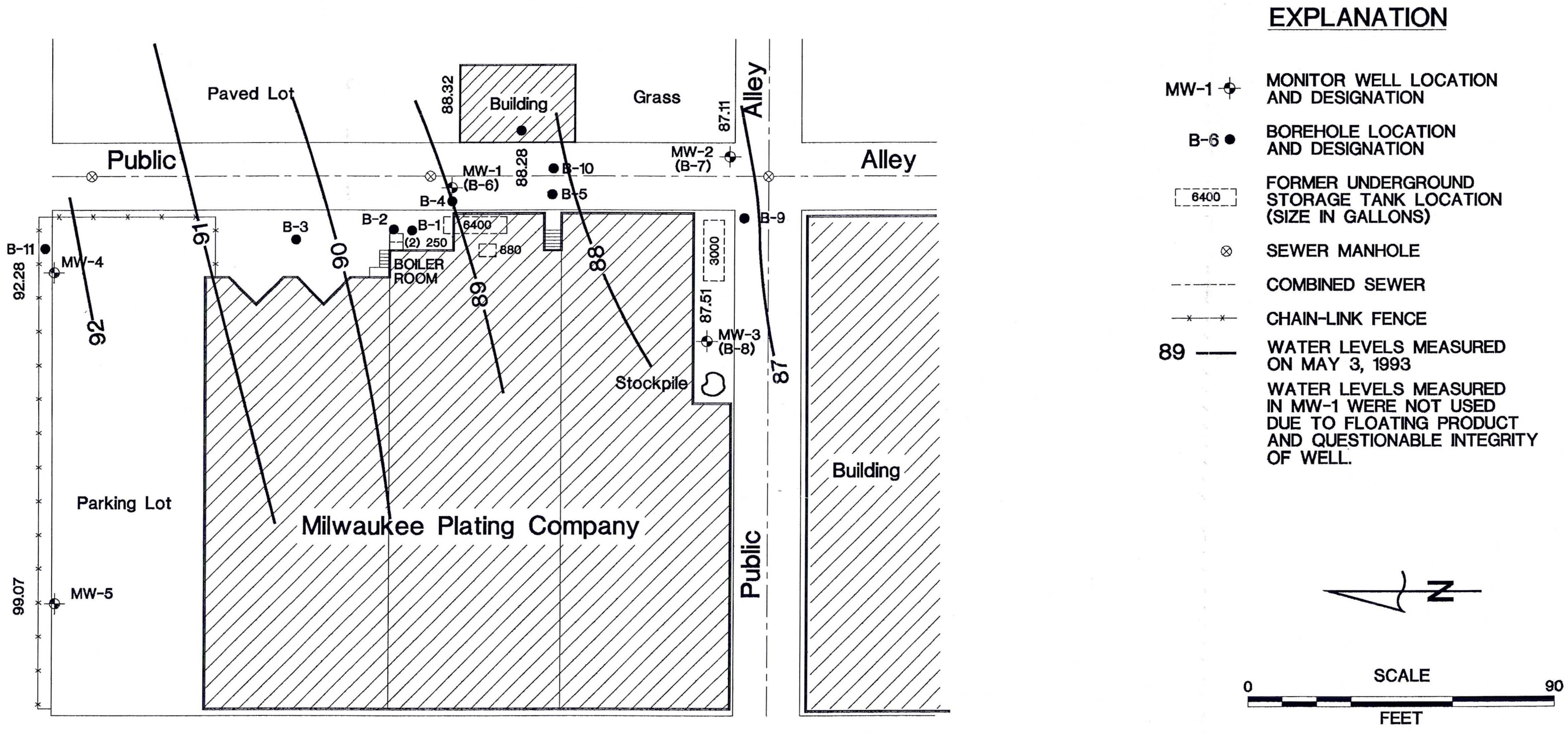

EXPLANATION

MW-1 ⌖	MONITOR WELL LOCATION AND DESIGNATION
B-6 ●	BOREHOLE LOCATION AND DESIGNATION
6400	FORMER UNDERGROUND STORAGE TANK LOCATION (SIZE IN GALLONS)
⊗	SEWER MANHOLE
– – – –	COMBINED SEWER
–×–×–	CHAIN-LINK FENCE
89 ——	WATER LEVELS MEASURED ON MAY 3, 1993

WATER LEVELS MEASURED IN MW-1 WERE NOT USED DUE TO FLOATING PRODUCT AND QUESTIONABLE INTEGRITY OF WELL.

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Brookfield Lakes Corporate Center XII
175 N. Corporate Drive, Suite 100
Brookfield, Wisconsin 53045

Dsgn. by: RAS	Chk. by: GLD	Apprv. by: DLM
PROJECT: 366115203	DATE: 01//06/94	

MILWAUKEE PLATING CO.
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WATER TABLE SURFACE

DRAWING:	1243-a1	FIGURE:	1-4

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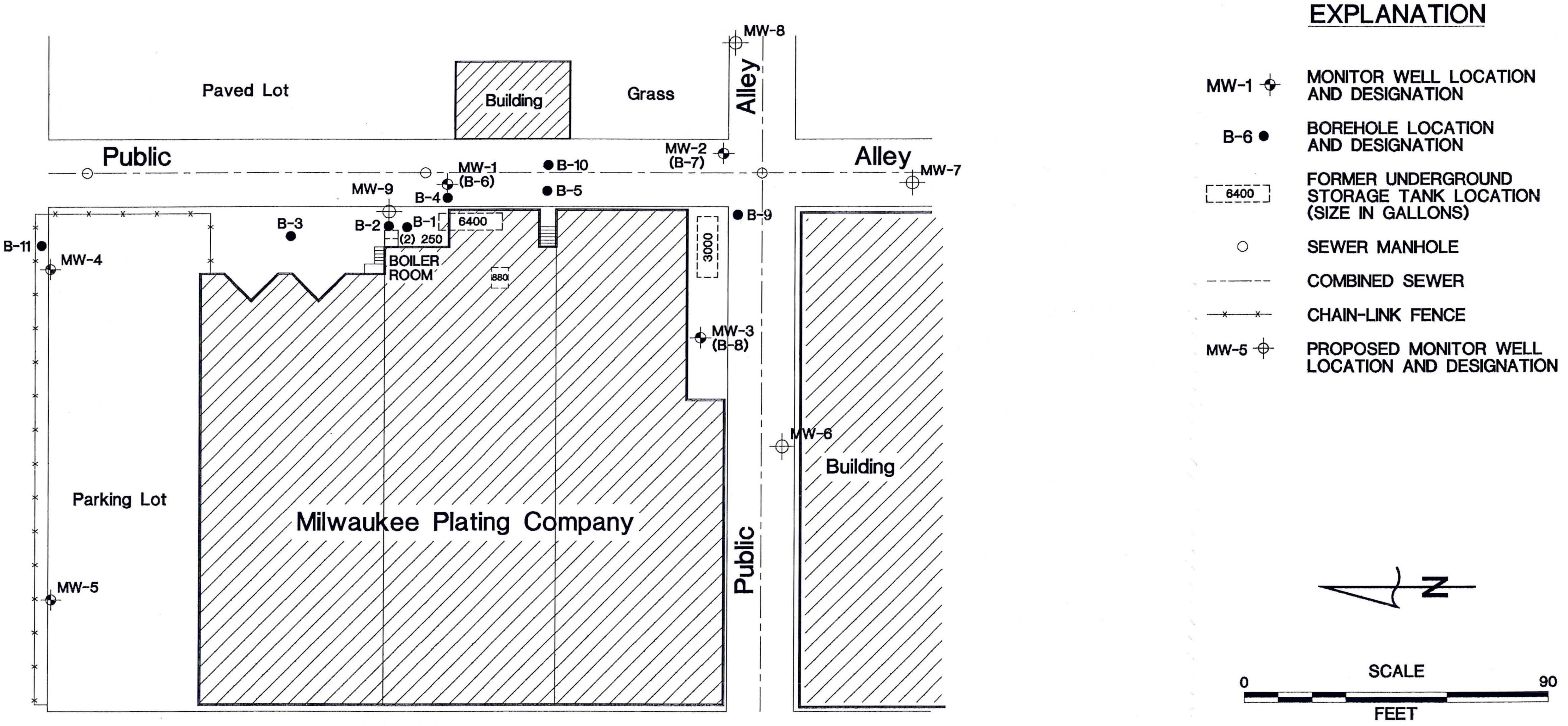

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Brookfield Lakes Corporate Center XII
175 N. Corporate Drive, Suite 100
Brookfield, Wisconsin 53045

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PROJECT: 366115203	DATE: 12/29/93	

MILWAUKEE PLATING CO.
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PROPOSED BOREHOLE LOCATIONS

DRAWING: 1520-b1 FIGURE: 3-1

TABLES

Table 1-1. Soil Sampling Results

COMPOUND	SOIL CONCENTRATION (mg/kg)			
	WEST WALL	EAST WALL	NORTH WALL	WEST FLOOR
Benzene	0.32	<0.50	<0.50	7.7
n-Butylbenzene	1.1	2.0	5.7	2.4
sec-Butylbenzene	<0.10	<0.50	0.51	0.19
Ethylbenzene	0.34	0.76	1.4	5.6
Isopropylbenzene	<0.10	<0.50	0.32	0.68
p-Isopropyltoluene	0.42	<0.50	0.28	<0.10
Naphthalene	0.85	1.5	1.9	0.97
n-propylbenzene	1.2	1.4	1.5	1.9
Toluene	0.32	0.38	0.11	13
1,2,4-Trimethylbenzene	0.98	2.1	93	90
1,3,5-Trimethylbenzene	2.3	1.5	3.7	3.1
Xylenes	1.1	2.4	4.5	26
TOTAL VOCs:	8.93	12.04	112.92	151.54
Gasoline Range Organics	<5.0	170	260	110
Diesel Range Organics	6.6	380	190	27
Lead	41	58	42	40

Table 1-2 Soil Sampling Results

SIMON HYDRO-SEARCH RESULTS													
Parameter	B-1 12/89	3000 Gal. UST 12/89	B-2 2/90	B-3 2/90	B-4 2/90	B-5 2/90	B-6 (MW-1) 1/91	B-7 (MW-2) 1/91	B-8 (MW-3) 1/91	B-9 1/91	B-10 1/91	B-11 3/91	B-12 (MW-4) 7/92	B-13 (MW-5) 7/92
Benzene	5.73	0.19	1.8	<.05	11.02	6.45	0.29	.07	<.05	<.05	0.43	<0.5	--	--
Ethylbenzene	24.64	3.40	48.75	<.05	11.05	0.36	0.26	<.05	<.05	<.05	0.21	<0.5	--	--
Toluene	6.46	1.59	0.47	<.05	3.38	0.66	0.05	<.05	<.05	<.05	0.27	<0.5	--	--
Xylenes	76.42	15.16	167	<.05	50	1.80	0.56	<.05	<.05	<.05	1.0	<0.5	--	--
TPH	477	2,926	731	<5	517	43	46	35	<5	<5	110	<5	--	--
GRO	--	--	--	--	--	--	--	--	--	--	--	--	ND	ND
DRO	--	--	--	--	--	--	--	--	--	--	--	--	18	6

CENTRAL CONTROLS RESULTS						
Parameter	G-1 9/91	G-4 9/91	G-5 9/91	GB-1 10/91	GB-2 10/91	DM-1* 4/93
TPH	<4	170	120	<10	3842	--
DRO	--	--	--	--	--	14.6
GRO	--	--	--	--	--	<10.0

All results in parts per million

*Petroleum VOCs were also anlyzed for sample DM-1; none were detected

-- = Not Analyzed

[redacted] [redacted]

Table 1-3 Ground-Water Monitoring Sampling Results

DM-1

Parameter	Simon Hydro-Search						Dames & Moore	Giles			
	MW-1 1/91	MW-2 1/91	MW-2 3/91	MW-3 1/91	MW-3 7/92	MW-5 7/92	4/93	B-1 9/91	B-5 9/91	GB1 10/91	GB2 10/91
Benzene	4800	450	3	570	250	<1	3970	320	2600	13	250
Ethylbenzene	840	12	<1	3.5	<1	<1	154	16	430	<5	<10
Methyl-t-butyl-ether	--	--	--	--	--	--	9.68	<1	<50	--	--
Toluene	360	19	8	10	1	<1	71.3	6.2	110	<5	<10
1,2,4 Trimethylbenzene	--	--	--	--	--	--	57.5	36	400	--	--
1,3,5 Trimethylbenzene	--	--	--	--	--	--	194	11	50	--	--
Xylenes	--	10	12	4.8	<1	<1	552	51.4	980	<5	<10
Chloroform	2800	<1	<1	--	<1	<1	--	2.7	170	--	--
Vinyl Chloride	--	<10	<10	--	140	<1	--	22	<250	--	--
cis-1,2 Dichloroethene	--	--	--	--	540	<1	--	5.6	<50	--	--
trans 1,2 Dichloroethene	--	<1	<1	--	19	<1	--	--	--	--	--
Methylene Chloride	--	<1	<1	--	<1	<1	--	8.8	360	--	--
Isopropylbenzene	--	--	--	--	<1	<1	--	7.2	<50	--	--
N-propylbenzene	--	--	--	--	<1	<1	--	6.7	160	--	--
2,2 Dichlorpropane	--	--	--	--	260	<1	--	<1	<50	--	--
Trichloroethene	--	<1	<1	--	14	<1	--	<1	<50	--	--
N-Butylbenzene	--	--	--	--	<1	<1	--	2.7	120	--	--
Naphthalene	--	--	--	--	<1	<1	--	2.9	<50	--	--
DRO	--	--	--	--	<.1	<.1	.609	--	--	--	--
GRO	--	--	--	--	0.6	<.1	10.6	--	--	--	--
TPH	110	8	14	--	--	--	--	--	--	--	--

Note: Floating product was observed in MW-1 on 3/91 and 7/92 and a product sheen was observed on MW-2 on 7/92
All detects are μg/ℓ except for DRO, GRO, and TPH which are mg/ℓ.
-- Not analyzed

APPENDIX A

PHOTOIONIZATION DETECTOR CALIBRATION, OPERATION AND MAINTENANCE PROCEDURES

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50000 EQUIPMENT CALIBRATION, OPERATION AND MAINTENANCE

1.0 Purpose

Parameters which would be likely to change with time prior to delivery to the laboratory are generally measured in the field. Because of the potential for temporal differences in measured values, laboratory measurements of these parameters, although potentially more precise, would be less accurate than measurements collected in the field. In addition, field measurements can serve as an initial screening tool to evaluate relative degree of contamination of samples. Sample contamination concentration information is also useful in determining packaging and shipping requirements.

Field measurements are typically performed for the following parameters: (1) total volatile organic vapors in soil and water samples, (2) fluid pH, (3) fluid specific conductance, and (4) fluid temperature. Simon Hydro-Search field equipment to be used for the above parameters include one or more of the following:

- ENMET CGS-10M Portable Gas Detector
- HNU photoionization detector model PI-101,
- digital pH meter,
- YSI S-C-T meter Model 33, and
- Glass thermometer.

The calibration and maintenance history, as appropriate, of all equipment used to make measurements at waste sites should be recorded on a Field/Laboratory Equipment Calibration Form (attachment).

In some cases, use of this sheet may not be appropriate. For instance, the field pH meter is calibrated with each use in the field, and a note of this calibration should be recorded in the field notebook. In general, however, equipment must be calibrated prior to each site visit, or on a regular schedule as specified in the manufacturer's equipment operating procedure.

EQUIPMENT CALIBRATION FORM

Equipment Make/Model/MSI I.D. Number ______________________________

DATE	TIME	CALIBRATION MEDIA	RESULTS	COMMENTS

50200 HNU PID

1.0 Purpose

The HNu is a portable, nonspecific vapor/gas detector employing the principle of photoionization to detect a variety of volatile compounds. HNu readings are routinely performed during borehole installations in areas of known or suspected contamination and as part of soil surveys to help define extent of contamination. The instrument is also frequently used to monitor ambient air for health and safety purposes.

2.0 Overview of Operation

The HNu contains an ultraviolet (UV) light source within its sensor chamber. Air is drawn into the chamber with the aid of a small fan. If the ionization potential (IP) of any molecule present in the air is equal to or lower than the energy of the UV light source, ionization will take place causing a deflection in the meter. Response time is approximately 90 percent at three seconds. The meter reading is expressed in parts per million (ppm) as benzene, therefore, a direct interpretation of meter readings as ppm may be erroneous equivalents. Compounds other than benzene may produce instrument responses with higher or lower sensitivity relative to benzene.

The HNu is used as a field screening and semi-quantitative field measurement device to monitor photoionizable VOCs in air. Field screening of potential soil or ground water contamination is accomplished by performing a headspace analysis on air in contact with a sample within an enclosed container. The form used for recording PID readings is attached.

Limitations to the use of the HNu include the following:

- The HNu does not identify the compounds being detected; (i.e., provides reading of total organic vapors)
- If the IP of a compound is greater than the UV light source, the instrument will not detect that compound. Simon Hydro-Search generally uses 10.2 eV and 11.7 eV lamps as a UV light source;
- The HNu does not detect methane gas;
- During cold weather condensation may form on the UV light source window, producing erroneous meter response;
- Instrument readings can be affected by humidity, power lines and portable transmitters such as two-way radios;
- Concentrations are measured relative to benzene. Therefore, actual contaminant concentrations in the air sample cannot be quantified, unless the contaminant occurs as a single compound whose sensitivity is known relative to benzene. While the instrument scale reads zero to 2,000 ppm, response is linear (to benzene) only from zero to about 600 ppm. Concentrations greater than 600 ppm may be "read" at a higher or lower level than the true value; and
- Wind speeds greater than three miles an hour may affect fan speed and meter readings, depending on the position of the probe relative to the wind direction.

3.0 Calibration Procedure

Prior to use, the battery should be tested by turning the function knob to "BATT" and confirming needle deflection to the green zone of the meter scale.

The instrument should be zeroed by rotating the zero potentiometer knob when the function switch is in the "Stand-by" position. Instrument function will be verified by placing the probe near an organic point source, such as a magic marker, and noting meter deflection. HNu calibration gas canisters equipped with a regulator will be used to calibrate the instrument on a daily basis prior to field use. The calibration procedure is as follows:

1) Connect a sampling hose with a tee connection to the regulator outlet on the calibration gas cylinder and end of the tee to the sampling probe of the HNu;

2) Open the regulator valve full;

3) Take a reading; and

4) Adjust the span potentiometer to produce the concentration listed on the gas cylinder. This procedure shall be followed only until the span potentiometer reaches the following limits:

Probe	Initial Span Pot Setting	Maximum Acceptable Span Pot Setting
9.5 eV	5.0	1.0
10.2 eV	9.8	8.5
11.7 eV	5.0	2.0

5) If these limits are exceeded, the instrument must be returned for maintenance and recalibration.

6) Calibration results will be documented each day on the equipment calibration log. This documentation includes recording the following:

   a. Date inspected;
   b. Person who calibrated the instrument;
   c. The instrument ID number;
   d. The results of the calibration (ppm, probe eV, span potentiometer setting);
   e. Identification of the calibration gas (source, type, concentration pressure); and
   f. HNu model serial number.

4.0 Measurement Procedure

Semi-quantitative measurements of total VOCs in soil and ground water can be determined using an HNu PID by monitoring the headspace within a sample jar. The procedure to be used for measuring sample headspace is as follows:

1) Record the background ambient air concentration on the field PID form. Typical background values are zero to 3.0 ppm or higher depending on the measurement location. Locations with ambient PID readings greater than 3.0 ppm should not be utilized for field screening measurements.

2) Half-fill a clean 16 oz. glass Mason jar with the sample to be analyzed. Quickly cover the top with two sheets of clean aluminum foil and apply a screw cap to tightly seal the jar.

3) Allow headspace development of VOCs for at least ten minutes in ambient temperatures greater than 55°F. Vigorously shake or swirl the jar for 15 seconds both at the beginning and end of the headspace development period. Where ambient temperatures are below 55°F, headspace development should occur within a heated vehicle or building.

4) Subsequent to headspace development, quickly puncture foil seal with the HNu sampling probe to a point about one-half of the headspace depth. Exercise care to avoid uptake of water droplets or soil particles.

5) Record the maximum meter response observed within 15 seconds on the field PID data form as the jar headspace concentration. Maximum response should occur between two and five seconds. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case notation should be made of the suspected cause of the erratic reading. Record sample identification information.

6) All HNu readings for soil will be followed by the symbol "d" (dry), "m" (moist) or "w" (wet) to aid in data interpretation. The symbol "w" will be used when there is substantial accumulation of water droplets in the bag or jar to the extent that readings are probably being affected by the humidity. Erratic meter response may occur at high organic vapor concentrations or conditions of elevated headspace moisture, in which case headspace data should be discounted.

5.0 Quality Assurance

5.1 Replicates

If sufficient sample is available, headspace analysis of samples should be performed in duplicate. True duplicate samples of soil are not possible to collect due to matrix heterogeneity however to minimize the matrix effects, duplicate samples for VOCs should be collected by dividing the sample in half perpendicular to any noted bedding or layering. This is performed to include all layers of the sample in both replicates as one layer may be more permeable thereby concentrating contaminants within one area of the sample. If duplicate samples are collected, the headspace screening data from both jar samples should be recorded and compared. Generally, replicate values should be consistent to plus or minus 20 percent. Duplicate samples should be screened on one out of every ten samples collected.

5.2 Blanks

Blank samples will be measured to determine if any contamination is being introduced as part of the measurement procedure. One PID blank sample will be performed for each 11 samples measured, inclusive of duplicates, which represents one jar for each case of Mason jars used. The measurement procedure for field PID blanks is given below:

Water

Distilled water should be substituted for sample water, and the same headspace measurement procedure as outlined in Section 4.0 should be followed.

Soil

The headspace measurement procedure outlined in Section 4.0 should be followed, but no sample should be placed in the Mason jar, as no universal soil blank has been accepted. A headspace reading of the jar should be taken after the jar has been opened, resealed, and allowed to sit for ten minutes.

6.0 Data Recording

PID data should be recorded in the field notebook and clearly marked "PID reading (ppm)." The data should also be recorded on applicable field forms, such as PID data forms, soil borehole logs, and water quality sampling and analysis forms. In addition to data records, maintenance records and calibration records will be generated and maintained on appropriate forms or in the site field notebook. Records of the instrument user, dates of uses, instrument identification number, and project identification should also be maintained.

Site: ______________________

Project No: ______________________

Date: __________ __________

Personnel: ______________________

Meter No: ______________________

Probe eV: ______________________

FIELD PID DATA FORM

Sample Number	Sample Media (1)	Location/ Depth	Moisture (2)	Time Sample Collected	Time Sample Analyzed	Volatilization Period Air Temp (C)	PID Readings (ppm)		Comments
							Background	Peak Response	

(1)
SO - Soil
SD - Sediment
GW - Ground Water
SW - Surface Water
WS - Waste (Solid)
WL - Waste (Liquid)

(2)
D - Dry
M - Moist
W - Wet
S - Saturated

[redacted]

APPENDIX B

HOLLOW STEM AUGER DRILLING
AND
EQUIPMENT DECONTAMINATION

70100 HOLLOW STEM AUGER DRILLING

1.0 Purpose

This procedure describes geologic conditions under which hollow stem auger drilling is appropriate. To ensure consistency throughout the project, it also summarizes procedures for soil sample collection, soil classification, and the preparation of soil logs.

2.0 Methodology

The hollow stem auger technique will be used for drilling in unconsolidated materials whenever possible. The hollow stem auger technique is the preferred method, because it causes minimal disturbance to the geologic formation, and can be used without the introduction of drilling fluids. However, hollow stem auger techniques may become impracticable if dense gravels or boulders are encountered during drilling, or if drilling depth exceeds 80-100 feet. The diameter of the augers will depend on the diameter of the well casing and the need for temporary or permanent steel casing. A minimum of 1.33 inches larger diameter is required between the well screen and the hollow stem auger ID through which the well is set, in order to avoid bridging of the sand pack material. If casing is called for, casing diameters will be at least 1.33 inches greater in diameter than the ID of the well casing.

3.0 Sample Collection and Description

Unless otherwise specified, soil samples will be collected continuously, in advance of the drill bit using standard split-barrel sampling techniques (ASTM Method D 1586-84). Each sample will be visually classified by a Simon Hydro-Search geologist in accordance with ASTM Method D 2488-84, using the Unified Soil Classification System (USCS). Descriptions will be recorded on Simon Hydro-Search Soil Borehole Log forms, or on

WDNR Soil Boring Log Information Form 4400-122 (included). The descriptions will include applicable information pertaining to soil type, organic material content, grain size distribution, gradation, plasticity, mottling, color (using Munsell notation), odor, moisture content, consistency, density, grain shape and lithology, soil structure, layering, jointing, lenses, fractures, void space, unconfined compressive strength, photoionizable constituent content, genetic origin, and group symbol.

If laboratory sampling of soils is proposed, a portion of each split-spoon sample will be placed in a laboratory-quality glass jar with a teflon-lined cap immediately after sample recovery. The soil sample will then be cooled to approximately 4°C., pending final selection of the depth interval to be used for laboratory analysis. Soil will completely fill the jar to minimize volatile compound loss to headspace. The jar will be tagged with the project number, borehole identification, sample depth, interval, date, time, sample type (grab or composite), and sampler. A second portion of each split-spoon sample may be placed in a glass jar for PID head space screening.

OIL B

TE NAME AND LOCATION:	DRILLING METHOD: SAMPLE METHOD:	BORING NO. SHEET OF
	WATER LEVEL | | | | TIME | | | | DATE | | | | CASING DEPTH | | | |	DRILLING START | FINISH TIME | TIME DATE | DATE

ATUM: msl ELEVATION:

DRILL RIG: | SURFACE CONDITIONS:

NGLE: Vertical BEARING ---

AMPLE HAMMER TORQUE FT.-LBS

(ELEVATION)	BLOWS/ 6 IN. ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING	TEST RESULTS: WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPEC. GRAVITY	PID (ppm) OTHER TESTS

DRILLING CONTR

LOGGED BY

DATE

State of Wisconsin
Department of Natural Resources

Route To:
___ Solid Waste
___ Emergency Response
___ Wastewater
___ Haz. Waste
___ Underground Tanks
___ Water Resources
___ Other ______________

SOIL BORING LOG INFORMATI
Form: 4400-122 7/

Page ___ of ___

.ity/Project Name	License/Permit/Monitoring Number	Boring Number

Boring Drilled by (Firm name and name of crew chief)	Date Drilling Started ___/___/___ M M D D Y Y	Date Drilling Completed ___/___/___ M M D D Y Y	Drilling Method

DNR Facility Well No.	WI Unique Well No.	Common Well Name	Final Static Water Level _______ Feet MSL	Surface Elevation _______ Feet MSL	Borehole Diameter _______ inches

Boring Location
State Plane ______________ N, ______________ E S/C/N
_____ ¼ of _____ ¼ of Section _____ T_____N, R_____ E or W

Lat ___ ___ ___
Long ___ ___ ___

Local Grid Location (if applicable)
_______ Feet N or S
_______ Feet E or W

County	DNR County Code _____ _____	Civil Town/City/or Village

SAMPLE										SOIL PROPERTIES							
NUMBER	LENGTH RECOVERED (in)	BLOW COUNTS	DEPTH (ft.)	SOIL/ROCK DESCRIPTION AND GEOLOGIC ORIGIN FOR EACH MAJOR UNIT	USCS	GRAPHIC LOG	WELL DIAGRAM	PID/FID	STANDARD PENETRATION	MOISTURE CONTENT	LIQUID LIMIT	PLASTIC LIMIT	P 200	RQD/COMMENTS

I hereby certify that the information on this form is true and correct to the best of my knowledge.

Signature	Firm HYDRO-SEARCH, INC. 175 N. Corporate Dr., #100, Brookfield, WI 53045

Th. form is authorized by Chapters 144.147 AND 162, Wis. Stats. Completion of this report is mandatory. Penalties; Forfeit not less than $10 nor more than $5,000 for each violation. Fined not less than $10 or more than $100 or imprisoned not less than 30 days, or both, for each violation. Each day of continued violation is a separate offense, pursuant to ss 144.99 and 162.06, Wis. Stats.

70101 BOREHOLE AND EXCAVATION CLEARANCE

Appropriate borehole clearance procedures must be taken prior to any excavation greater than 1.0 foot in depth. These procedures apply to excavations undertaken using a drilling rig, a backhoe, hand augers, or any other intrusive excavating equipment. Following these procedures is extremely important for the safety of the working crew and the potential company liability should damage occur to subsurface equipment.

These are three steps in obtaining authorization for excavating. The first step in obtaining excavation clearance is location of the proposed boreholes. If possible, visit the site and review the proposed boring locations in the field with someone from the site who is knowledgeable about the site. If drilling equipment or backhoes are to be used, note the location of overhead power lines. Typical regulations require a 25-foot separation between overhead power lines and excavation equipment. Locate the site storm sewer manholes and any utility access boxes. Make a note of the directions they probably run and keep the excavation locations at least 5 feet away from these utilities. Flag or mask the proposed excavation areas and tell the site contact, if present, the number and location of the marked areas. Leave a location map with the site contact showing the proposed excavation areas so they can refer to the map and assist, if necessary, utilities which will be contacted to locate the excavation areas.

The second step in obtaining borehole clearance is calling an underground utilities locating service. These services operate under different names in each state and have the ability to notify several utilities of your excavation plans. A list of the locating services for several states is presented below:

Illinois (JULIE)	1-800-892-0123
Iowa (ONE CALL))	1-800-292-8989
Michigan (Miss Dig)	1-800-482-7171

Minnesota (Underground Alert)	1-800-252-1166
Ohio (OUPS)	1-800-362-2764
Dallas, Texas	1-214-998-4102
Wisconsin (Diggers Hotline)	1-800-242-8511

Locating services need certain information about the proposed excavation, including the excavation address, county, specific excavation locations, a site contact, and other information. Complete the Utilities Clearance Form (attached) before calling the locating service and include information from the conversation on the form. This form should be completed and included in the project file as proof of HSI's investigation of underground utilities should some conflict arise during excavation.

When calling the locating service, the specific excavation location can either be located using general instructions (i.e., an entire parking lot) or specifically (i.e., the southeast and northeast corner of the parking lot). It is often advisable to give the general location so if a decision to move the excavation is made in the field, the location of the utilities has already been marked. The excavation locations could also be marked using point or flags prior to calling the locating service. If specific locations are provided, request that a 10 to 20 foot radius around the flagged areas be marked for utility clearance so some flexibility is available regarding slight movement of the excavation area.

The locating service will typically specify a start date (approximately 3 to 5 working days after you call) after which your site will have been legally cleared for excavation. Note on the utilities clearance form the names of the utilities that the locating service will contact, the ticket identification number, and the other specific information.

Line locating services frequently do not include municipal water supply or sewer lines on their list of contacted utilities. If appropriate, contact these departments and have them review the proposed excavation areas.

The third step in obtaining borehole clearance is getting the client to authorize the excavation by completing the HSI Borehole Location Approval Form (attached). If the site is active, talk to the site manager or a knowledgeable site contact regarding the presence of on-site private utilities which may be in conflict with the excavation area. These utilities may include, but are not limited to, water, electricity, gas, former underground storage tanks, sewer, pipelines, cable, or telephone. Ask if any drawings are available showing the location of private utilities in the areas of interest. Walk to each proposed excavation area with the site contact and get the person to accept the location for excavation. Have the site contact sign the HSI Boring Location Approval Form. HSI must have signature authorization on this form before excavation can commence. If the client refuses to sign the form, call the project manager. Do <u>NOT</u> begin an excavation without signature authorization on the HSI Boring Location Approval Form.

If the site is inactive or abandoned, mail a map showing the proposed excavation areas and the boring location approval form to the client for signature. Tell the site owner that the areas have been cleared for excavation by the utilities locating service and tell them which utilities have been covered. HSI must have this form signed before excavation can commence.

After receiving authorization for excavation from the line locating service and having the boring location approval form authorized, make a final on-site review of the visible site utilities. Locate the storm sewer, water, electricity, gas, overhead power lines, or other utilities and try to identify if there could be an interference with the excavation. Only after completion of these procedures should excavation commence.

After excavation has begun, be aware of encountering any unusual objects during the excavation. If drilling is being performed, very hard objects resulting in auger or split-spoon sampler refusal encountered with the top 10 feet of penetration may be pipes, tanks, or other manmade structures. Care should be taken when unexpected hard structures are encountered and at shallow depths. If considered necessary, the excavation should be halted and a site manager or the site contact should be contacted before a decision is made to drill through the obstruction.

UTILITIES CLEARANCE FORM

Job Name ____________________ Job Number ____________________

Site Address ____________________ County ____________________

____________________ Date ____________________

Person Completing Form ____________________

Locating Service Called ____________________ Phone # ____________________

Date Called ____________________ Date Utilities Cleared ____________________

Ticket Number ____________________

UTILITIES CONTACTED	YES	NO	COMPANY NAME
Electricity			
Gas			
Pipeline(s)			
Cable(s)			
Telephone(s)			
Water			
Sewer			
Other:			
Other:			

Near Overhead Lines? __________

Marking instructions provided to locating service ____________________

____

Marking distance requested around each site? __________

Excavation area staked? __________

Name of site contact referenced for locating? ____________________

Follow-up actions: ____

____

____

BORING LOCATION APPROVAL

I, ______________________________, have assisted in staking the location of boring/well number ___________ at the _____________________ site. I hereby certify that drilling operations at the proposed location will not, to the best of my knowledge, encounter any buried utilities, pipelines, or other man-made structures.

Signed: ___________________________

Date: ___________________________

85000 EQUIPMENT DECONTAMINATION

1.0 Purpose

Decontamination is required to prevent cross-contamination within a site or between sites. The level of decontamination procedures required will vary depending upon the level of contamination encountered on a site. This procedure is meant to ensure that equipment used at the site does not bring contaminants to the site, or remove contaminants from the site.

2.0 Mobilization

Drill rigs, support vehicles, and associated drilling tools and equipment will be steam cleaned on-site, prior to commencement of drilling, to minimize the potential for cross contamination. All drilling equipment will be unloaded from the drill rig and the storage compartments, and steam cleaned. Storage compartments will also be steam cleaned where appropriate. Cleaned tools will be returned to the storage compartments. Augers, drill stem, bits, and other downhole equipment will be stored on plastic and covered in an area designated by Simon Hydro-Search. The storage area will be clean, easily accessible, and away from most daily site activity.

3.0 Drilling Operations

All downhole drilling equipment and associated tools will be steam-cleaned between boreholes. In addition, excess soil on the drill rig will be removed by steam cleaning between boreholes, as appropriate. Pipe racks will be used to elevate the augers and drilling rod during steam cleaning. In addition, the bed of the truck used to transport the augers or drill rods from the decontamination staging area to the drilling site will also be steam cleaned where appropriate. After transport to the drilling site, augers and drilling rods will be stored on additional pipe racks and covered with clean visqueen sheeting until used.

All downhole sampling equipment will be cleaned between samples by:

1. scrubbing with potable water to remove soil particles,
2. washing with a non-phosphate detergent, and
3. rinsing with potable water.

Soil sampling equipment such as scoops, stainless steel bowls, etc. will also be decontaminated between samples using the above method. In some instances, depending on the contaminants and the sampling tools, this procedure will be followed by an isopropyl rinse and a distilled water rinse.

Equipment decontamination will be supervised by a Simon Hydro-Search hydrogeologist or geologist.

4.0 Ground-Water Sampling

In general, dedicated sampling equipment, such as QED™ pumps which are not removed from the well following installation, will be used wherever possible to eliminate the need for decontamination and the potential for cross contamination between sampling points. Bailers will be stored within the well, suspended from the PVC well cap, above the water surface. Bailers will be rinsed with distilled water prior to each use. Dedicated bailers will be used for sampling of all permanent well installations. Decontamination procedures will be employed on other ground-water sampling and filtering equipment and on probes used for water level and product measurements, and for purging and sampling during packer tests. The equipment will be washed with the non-phosphate detergent and rinsed with distilled water after each use and wiped dry with clean paper towels.

5.0 Decontamination Staging Area

Decontamination will be performed in a staging area, to be determined through coordination with client and, if necessary, regulatory personnel prior to mobilization.

6.0 Demobilization

Drill rigs, support vehicles, and associated drilling tools and equipment will be steam cleaned on-site upon completion of drilling activities, prior to final demobilization to ensure that no contaminants are carried off-site by the drilling contractor.

APPENDIX C

SOIL SAMPLING AND ANALYSIS

80100 GENERAL SHALLOW SOIL SAMPLING PROCEDURES

1.0 Purpose

The procedures listed in this section are established to guarantee sample representativeness and integrity.

2.0 Soil Sample Types

Unless otherwise specified, all samples obtained will be discrete grab samples which are representative of the material under consideration. Composite samples are only obtained when it has been demonstrated that the data generated will provide useful information on site conditions.

Each grab sample container is filled to 75 to 100 percent by volume, depending upon the analytical parameter(s). For parameters which may decrease due to volatilization loss, every attempt will be made to fill the jar 100 percent by volume.

Subsamples may be required when separate analytical tests will be performed on the same sample obtained, or duplicates will be sent to various labs. Subsampling is accomplished by dividing the initial grab sample into separate samples. If subsampling is required, the sample is split in the field. For saturated samples, the sample is split using techniques to ensure that each subsample is representative of the material being sampled. Samples should be divided by cutting perpendicular to any layering to ensure representative samples. Upon laboratory receipt of the samples, they may be further subdivided to allow for separate analytical determination.

Surface soil sampling is undertaken to determine the type, degree, and extent of soil contamination resulting from previous disposal practices. Fully saturated soils located below the water table may have impacts caused by migration of impacted ground water, and, thus, may not be representative of soil contamination resulting from on-site disposal practices.

Depending upon the type of contamination, soils immediately above the water table may also be impacted by volatilization loss from impacted ground water. Procedures for sampling ground water are presented in Section 8000. Soil materials which are submerged or exist beneath standing water, such as ponds or streams, are considered sediments. Specific procedures for obtaining sediment samples are described in Standard Operating Procedure 80600.

Soils may have variable characteristics depending upon their texture, structure, and moisture content. The selection of optimum sampling techniques and equipment to be used for soils will be dependent on the condition of the soil and the amount of material required for analysis. Surface samples are generally easy to obtain using hand equipment, as described below. When a more detailed description of the shallow soil conditions are desired, excavation of test pits may be required, as described in Standard Operating Procedure 80300.

3.0 General Sampling Equipment and Techniques

Surface soil samples may be obtained using a number of manual devices such as shovels and trowels. These instruments may be used to obtain soil samples at depths of up to six feet, or in road cuts or backhoe pits. Sampling equipment must be relatively inert, easily operated, and easily cleaned.

Collected soil samples are transferred to laboratory-prepared containers with a minimum of handling. Specific sample container and preservation requirements are discussed in Standard Operating Procedure 40600.

4.0 Surface and Shallow Depth Soil Sampling Procedures

4.1 Trowel

Trowels consist of scooped stainless steel or galvanized steel blades four to eight inches long and two to three inches wide, attached to a handle. Trowels may be used for obtaining surface soil or sediment samples to a depth of a few inches. Trowels may also be used to obtain subsurface soil samples from profiles exposed in test pits. Trowels are generally only practical when sample volumes of one pint or less will be obtained.

4.2 Shovels

Shovels are used when larger quantities of materials than those practically attainable using trowels are required. Shovels are also used when subsurface samples at depths of up to six feet are to be obtained by hand excavation. Standard steel shovels may be used for excavation; stainless steel or polypropylene implements should be used for sampling.

4.3 Core Sampler

Core samplers are cylindrical steel implements with diameters of one-half to three inches. Hand-operated core samplers can be used to obtain samples at depths of up to four feet in non-compacted materials. Extension rods are used to reach depths of greater than one foot. The sampler is pushed into the soil at 45° to 60° from the horizontal and rotated when desired depth is reached. The core itself is generally six to 18 inches in length. The core is then removed and sample placed into appropriate container.

4.4 Hand Auger

Auger samplers are comprised or sharpened spiral blades attached to a hardened metal central shaft. The diameters of hand augers are generally in the range of one to one and one-half inches and are used to obtain samples in materials through which hand core samplers cannot be used. Hand augers are more appropriate than core samplers for sampling in soils with stone or gravel content or high bulk densities.

Hand augers can be used to obtain disturbed soil samples at depths of up to three feet. Large diameter augers (greater than three inches), used in conjunction with portable gasoline powered engines, can be used to obtain disturbed samples at depths of up to about six feet. If necessary, topsoil may be excavated with a shovel to below the existing subsoil levels, with the thickness of topsoil noted.

The hand auger is screwed into the soil at an angle of 45° to 60° from the horizontal. When the entire auger blade has penetrated soil, the auger is pulled from the material, and the sample is removed. This procedure is repeated until the desired depth is reached. The auger is removed by lifting straight up without turning (if possible).

4.5 Bucket Augers

Bucket augers are generally comprised of two cutting blades attached to a three-to four-inch diameter core four to six inches long. The bucket is attached to a hard metal shaft generally four to five feet in length with a perpendicular handle attached for rotating the bucket.

Bucket augers are used to obtain disturbed samples at depths of up to four feet. Bucket augers can be utilized in stony or dense materials in which use of hand operated core or screw augers are not practical. Bucket augers with closed blades are utilized in single grain materials or saturated materials which cannot generally be retrieved in core samplers.

The bucket auger is rotated while exerting downward pressure until the bucket is full. The bucket is then removed from the boring and the sample is transferred to the appropriate container. This procedure is repeated until the appropriate depth is attained.

80400 SUBSURFACE SOIL SAMPLING

1.0 General

The objective of subsurface sampling is to obtain soil from known depths in order to evaluate site characteristics, detect the presence of any contaminants and to evaluate the potential for pollutant migration. In the following section, the equipment and techniques used to collect subsurface soil samples are described.

2.0 Borehole Drilling

Subsurface soil samples from boreholes can be obtained at specified depths or continuously. Several techniques can be utilized for advancing borings including wash boring, auger boring, or rotary drilling.

3.0 Soil Sampling

The boring techniques utilized to excavate a borehole result in considerable disturbance of soil and do not allow for accurate determination of the depth from which soil materials have been excavated. Therefore split spoon, thin wall tubes or other sampling techniques must be used in conjunction with boring operations to obtain soil samples.

Subsurface samples may be obtained at predetermined depths, at every change in lithology or continuously. Continuous sampling provides the most accurate record of subsurface conditions for interpretive purposes.

3.1 Split Spoons

Split spoons are devices used to obtain subsurface samples of up to 2.5 feet in length within hollow stem auger flights, cased borings, and mudded holes. The 1.75 to 2.5 inch ID split spoon samplers are advanced into the undisturbed material beneath the bottom of the casing or borehole by use of weighted hammer and drill rod. The relationship between hammer weight, drop and blows required to advance the split spoon in 6-inch increments is an indication of density or consistency of subsurface soils. After the split spoon has been driven the prescribed depth, it should be removed carefully to avoid loss of soil materials. In non-cohesive or saturated soils a "catcher" should be used to help retain the sample.

Following removal of the split spoon from the casing, it should be detached from the drill rod and opened to allow for visual classification of the sample. When less then a 10-inch sample has been obtained, a second cleaned sampler should be obtained. The first sample collected, if any, should be retained unless greater sample recovery is obtained during the subsequent sampling attempts. The entire sample (except the top several inches of possibly "disturbed" material) should be retained.

Once an adequate sample is collected, the sample should be inspected, described, placed in wide mouth jars, labeled, and stored for transportation to the laboratory, if appropriate.

If volatile organic analyses are to be performed, VOA vials should be filled immediately from the split spoon before jarring. Subsamples for the specific chemical analyses shall be taken as soon as possible as required.

3.2 Thin Wall Tubes

Thin wall tubes (shelby tubes) are hollow pipes which are pressed into the soil without rotation to obtain core samples of relatively undisturbed soils. Thin wall tube samplers are generally 1.875 inches ID, 2 inches OD and 2 to 3 feet long, but may be of any size convenient for sampling. The thin wall tube has a sharp cutting edge and a positive inside clearance.

Thin wall tube samplers may be pushed into soils inside hollow stem auger flights, wash bore casings or uncased boreholes. The tubes are pushed into the soil without rotation until the desired depth is attained or to refusal. If the sample tubes can not be advanced by pushing, it may be necessary to drive the tube into the soil, without rotation, using hammers and drill rods. The tubes are generally allowed to remain in the boring for 10 to 15 minutes to allow buildup of skin friction prior to removal. The sampler is then rotated to shear the sample from the soil below and carefully removed from the borehole.

Following removal of the tube sampler from the drilling equipment, the sampler is inspected to ensure that an adequate length of sample has been obtained. This sampling procedure shall be repeated until an adequate soil core is obtained provided that the material being sampled is of a nature which would permit retention in the sampler.

Upon successful retrieval of a soil core it shall be described and recorded in the log book and any disturbed soil shall be removed from each end of the tube. Samples for volatile organic analysis must be extracted from the soil sample as soon after the sampler is withdrawn as possible. During transport to the sampling station, the tube should be capped with a non-reactive material. For other parameters, the shelby tube should be sealed by pouring three 1/4 inch layers of paraffin in each end, allowing the wax to solidify between each layer.

Plastic caps should be taped over the ends of the cylinder. The tube shall then be labeled. Care should be taken in handling to label the top and bottom of the tube and the depth interval. Tubes should be stored top-up in an upright position.

120100 SOIL SAMPLE DESCRIPTION

1.0 Purpose

A soil log is maintained for all soil sampling operations as a record of visual descriptions made in the field. The log will be completed by a geologist supervising the soil sampling operations.

2.0 Content

The log will contain a detailed description of the soil encountered as per ASTM method D2488-84. The descriptions will include applicable information pertaining to soil type, organic material content, grain size distribution, gradation, plasticity, mottling, color (using Munsell notation), odor (when respirators are not necessary), moisture content, consistency, density, grain shape and lithology, soil structure, horizonation, layering, jointing, photoionizable constituent content, geologic origin, and group symbol. Soil descriptions will be recorded on standard Simon Hydro-Search borehole log forms (attached) or such forms as specified by the state agency in which the work is being performed (Note: Some states also require other methods for soil description. An example of this is the Indiana Department of Environmental Management which requires soil descriptions in accordance with the USDA classification system. Check state specific regulations!).

SOIL BOREHOLE LOG

SITE NAME AND LOCATION:

DRILLING METHOD:

SAMPLE METHOD:

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

BORING NO.

SHEET OF

DRILLING	
START	FINISH
TIME	TIME
DATE	DATE

DATUM: msl ELEVATION:

DRILL RIG:

ANGLE: Vertical BEARING ---

SAMPLE HAMMER TORQUE FT.-LBS

SURFACE CONDITIONS:

								TEST RESULTS				
TH (ELEVATION)	BLOWS/ 6 IN. ON SAMPLER (RECOVERY)	SYMBOL	SAMPLE NUMBER AND DESCRIPTION OF MATERIAL	SAMPLER AND BIT	CASING TYPE	BLOWS/FOOT ON CASING		WATER CONTENT %	LIQUID LIMIT %	PLASTIC LIMIT %	SPEC. GRAVITY	PID (ppm) OTHER TESTS

DRILLING CONTR

LOGGED BY

DATE

APPENDIX D

WATER-TABLE WELL CONSTRUCTION, INSTALLATION, AND DEVELOPMENT

75100 WATER TABLE WELLS

1.0 Purpose

Water table wells will be installed to determine: 1) the water table elevations at given times and the fluctuation of the water table over time, 2) the presence or absence of light non-aqueous phase liquids on the water surface, and 3) the presence or absence of specific contaminant compounds in the upper ground-water zone. Water table, well construction and installation procedures are presented below.

2.0 Construction Materials

Typical water table well construction is depicted on Figure 1. All site water table wells less than 100 feet deep which do not penetrate bedrock will be constructed of new 2-inch inner diameter (ID) PVC which meets the standards set forth in NR141.07. A contingency will made to substitute 2-inch ID 316 stainless steel for PVC if highly impacted ground water zones are encountered. "Highly impacted" refers to wells in which PID readings of >50 units above background are measured on samples collected from the completion zone, *and* in which there is evidence of the presence of non-aqueous phase contaminants. This would include both direct evidence such as the visible presence of an oily liquid with an iridescent sheen on samples, or indirect evidence such as nearby wells completed in the same stratigraphic which contain LNAPLs or DNAPLs.

All joints will be flush-threaded. The screens will be 10 feet long, with slot size determined according to NR141.09. A vented cap will cover the top of the PVC or stainless steel well casing. A protective casing consisting of an 8-foot length of metal casing with a lockable cap will also be included. The ID of the protective casing will be a minimum of 2 inches larger than the ID of the well casing, per NR141. Well casings, couplings and screens will be steamed cleaned and sealed in plastic prior to use or will remain sealed in factory plastic until use. The well casings, and screens will be visually inspected for defects per NR141.07 (4) and defective material will not be used.

Well packing and sealing material will adhere to specifications set forth in NR141.11, and NR141.13. A 2-foot thick filter pack seal comprised of a clean fine-grained sand will be placed above the filter pack material, and a 2-foot thick granular bentonite seal will be placed above the filter pack seal, if required, per NR141.13. The remaining annular space will be sealed with one of the following materials:

1) Bentonite - cement grout,

2) Granular bentonite slurry,

3) Bentonite sand slurry,

4) Neat cement grout, if Schedule 80 PVC or stainless steel well casing is used, or

5) Bentonite pellets or granular bentonite provided the well depths meet the requirements in NR141.13(2)3.

When a slurry is used for the annular space sealant it will be installed using a tremie pipe, following the procedures in NR141.10.

3.0 Installation

Drilling methods are discussed in procedure 70000. The borehole will be flushed, if necessary, using drilling rod or tremie pipe inserted to the bottom of the borehole to circulate clean water. The borehole will be flushed until water free of drill cuttings and drilling fluid flows from the top of the borehole. The total depth of the borehole will then be measured using a tape measure or measuring rod.

Figure 1 shows typical water table monitoring well construction specifications. The well casing will extend at least 20 inches above the ground surface. The amount of packing and sealing materials required will be calculated prior to installation based on the diameter of the borehole less the casing diameter, and the linear footage of packing or sealing materials required. Filter pack material for water table wells is required to extend from 6 inches below the bottom of the well screen to 2 feet above the top of the screen. The well screen and casing will then be inserted through the center of the borehole by personnel wearing clean gloves. Filter pack material will then be installed in the annular space between the well and the borehole walls to 2 feet above the top of the well screen. A tape measure or measuring rod will be used to ensure the pack material is installed evenly and over the proper depth interval. If the packing material bridges, it will tamped into place.

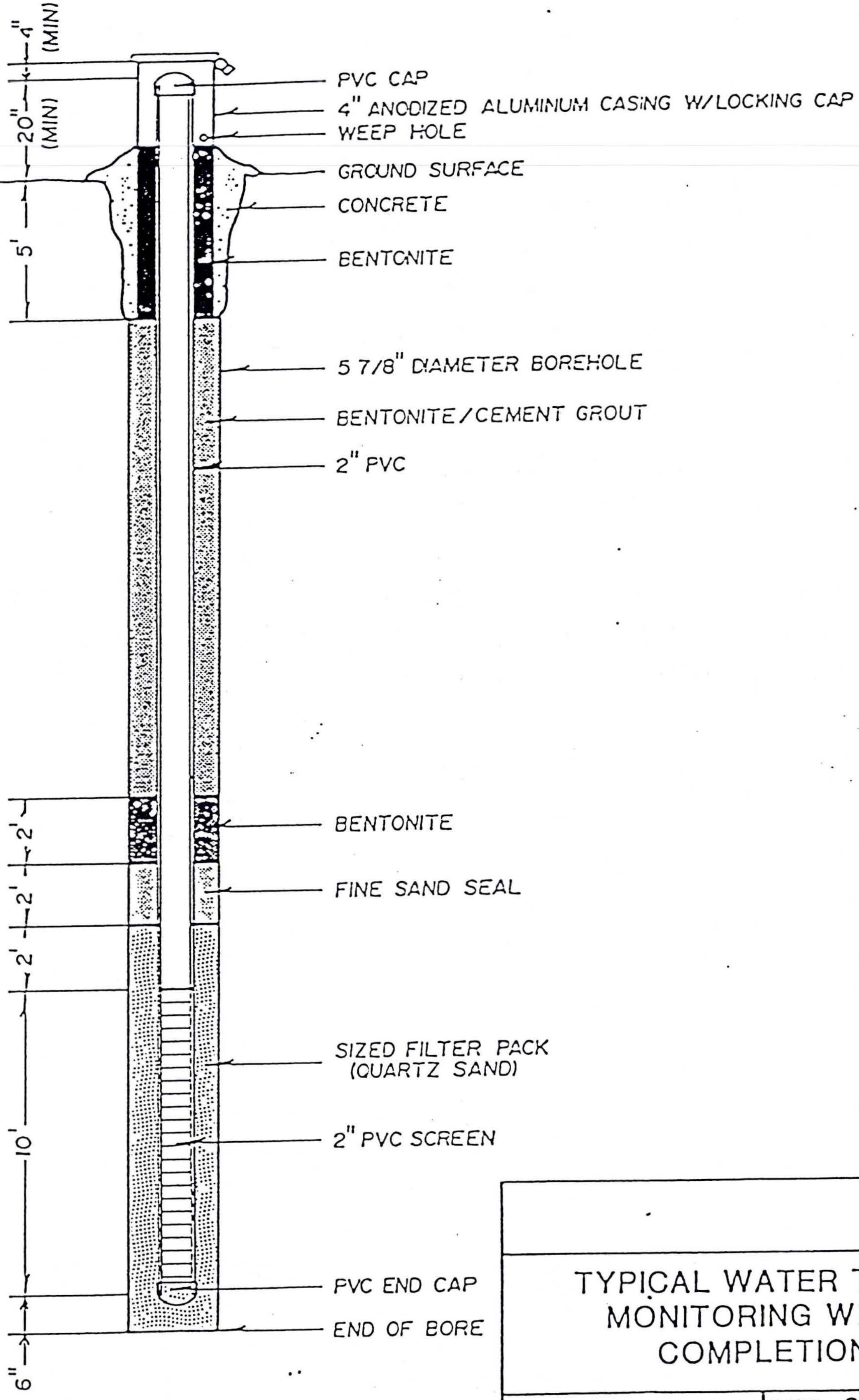
A 2-foot thick filter pack seal comprised of clean, fine-grained sand will be placed above the filter pack material, and 2-foot thick granular bentonite seal will be placed above the filter pack seal, per NR141.13. The depth interval for the fine sand and bentonite seals will be similarly measured and, if necessary, the seal will be tamped into place.

If a grout or slurry is used as an annular space seal, it will be tremied into place, according to specifications in NR141.10. If bentonite granules or pellets are used, they will be poured freely down the borehole per NR141.13(2)(b). If a slurry or grout annular space seal is used, the protective casing will not be installed until a minimum 12-hour waiting period has elapsed and any grout or slurry settlement has been topped off, per NR141.13(2)(b)3.

The protective casing will be centered over the well casing prior to installing the ground surface seal. The protective casing will extend from at least 5 feet below the ground surface to at least 2 feet above the ground surface, and will be placed such that the well casing is no more than 4 inches below the top of the protective casing, unless dedicated pumping equipment is to be installed, in which case a minimum of 6 inches will be left between the well casing and the protective casing to allow room for installation of pumping equipment. The ground surface seal will then be installed between the borehole wall and the protective casings.

If bentonite is used as a ground surface seal, it will extend from 5 feet below the ground surface to 1 foot below the ground surface, and topsoil will be placed in the remaining annular space and sloped away from the protective casing. If concrete is used as the ground surface seal, it will extend from 5 feet below the ground surface to above the ground surface, and will be finished to slope away from the protective casing (Figure 1). All new wells will have concrete ground surface seals. The annular space between the well casing and the protective casing will be filled to the top of the surface seal with bentonite pellets. A 1/4-inch diameter hole will be drilled through the protective casing to allow water which may collect between the casings to drain out.

The calculated and actual amounts of each type of material used to construct the monitoring well will be recorded. Well construction data will be recorded per proposed NR141.23 requirements on a WDNR Well Construction Diagram #4400-113A and a WDNR Well Information Form #4400-89. Forms #4400-89 and #4400-113A will be submitted to WDNR within 60 days after installation per Chapter 144, Wisconsin Statutes, and NR141.23.



TYPICAL WATER TABLE MONITORING WELL COMPLETION

PROJECT:	DATE: 04/27/90

Hydro-Search, Inc.
HYDROLOGISTS·GEOLOGISTS·ENGINEERS
RENO DENVER MILWAUKEE

FIGURE 1

70700 WELL DEVELOPMENT

1.0 Purpose

After a minimum waiting period following installation, all new monitor wells will be developed to ensure they adequately reflect aquifer conditions and ground-water quality.

2.0 Methodology

Wells and monitor wells will be developed using either a pump or a bailer or a combination of the two to remove the effects of drilling and installation operations. If a monitor well can be purged dry, development will consist of slowly purging the well dry to limit agitation. Development is complete when ten well volumes have been removed, or sediment-free water is produced. If a monitor well cannot be purged dry, it will be developed by alternately surging and purging the well for a minimum of 30 minutes and then pumping or bailing until ten well volumes are removed or until sediment free water is produced. The well volume is calculated as follows:

$$(\mathrm{II}(\frac{D_1}{2})^2 H_1) + (\mathrm{II}\, n H_2(\frac{D_3}{2})^2 - (\frac{D_2}{2})^2))$$

where:

II = 3.14159
D_1 = inner diameter of well casing (ft.)
D_2 = outer diameter of well casing (ft.)
D_3 = borehole diameter (ft.)
H_1 = height of water column in well casing (ft.)
H_2 = length of filter pack or height of water column, whichever is less (ft.)
n = porosity of filter pack

Periodic measurements and observations of field parameters including temperature, specific conductance, pH, visual appearance and odor will be made and recorded on a Simon Hydro-Search Well Development/Purge Summary Form (included) as each well is developed. In addition, time expended in development, volume of water removed, and any sedimentation present in the bottom of each well before and after development will be noted on WDNR Form 4400-113B (included). Water level measurements will be obtained prior to and following development, and following water level stabilization. The purge water will be properly drummed, labelled, and stored on site. Simon Hydro-Search will supply the drums and recommend appropriate methods for disposal of the purge water.

SIMON HYDRO-SEARCH

WELL DEVELOPMENT/PURGE SUMMARY

Well ___ ________

PROJECT: ____________
PROJECT #: ____________
LOCATION: ____________
PERSONNEL: ____________

WELL COORDINATES: ____________
PVC RISER ELEVATION: ____________
GROUND LEVEL ELEVATION: ____________
CONSTRUCTED WELL DEPTH: ____________
WELL CASING INSIDE DIAMETER: ____________

INSTRUMENTS
TEMPERATURE: ____________
CONDUCTIVITY: ____________
pH METER: ____________
WATER LEVEL PROBE: ____________
OTHER: ____________

Date	Time	Method	Water Level* (ft.msl)	Measured Well Depth* (ft.msl)	Volume Purged** (gallons)	Appearance	pH (s.u.)	T (C)	Elec. Cond. (umhos/cm)		Comments
						Color / Odor / Clarity			Measured	at 25C	

* Record both initial and final measurements when using as Well Development Summary.
** Purge four borehole volumes, if possible, prior to sampling.

S of Wisconsin
Department of Natural Resources

MONITORING WELL DEVELOPMENT

Form 4400-113B Rev. 4-90

Route to: Solid Waste ☐ Haz. Waste ☐ Wastewater ☐
Env. Response & Repair ☐ Underground Tanks ☐ Other ☐ ________

F y/Project Name	County Name	Well Name	
F ity License, Permit or Monitoring Number _ _ _ _ _ _ _ _	County Code _ _	Wis. Unique Well Number _ _ _ _ _ _	DNR Well Number _ _ _ _ _ _

1. an this well be purged dry? ☐ Yes ☐ No

2. Well development method

surged with bailer and bailed	☐	4 1
surged with bailer and pumped	☐	6 1
surged with block and bailed	☐	4 2
surged with block and pumped	☐	6 2
surged with block, bailed and pumped	☐	7 0
compressed air	☐	2 0
bailed only	☐	1 0
pumped only	☐	5 1
pumped slowly	☐	5 0
Other ____________	☐	▨

3. Time spent developing well ____ min.

4. epth of well (from top of well casisng) ___ . _ ft.

5. Inside diameter of well __ . __ in.

6. lume of water in filter pack and well casing ___ . _ gal.

7. lume of water removed from well ___ . _ gal.

3. lume of water added (if any) ___ . _ gal.

9. Source of water added ____________

10. alysis performed on water added? ☐ Yes ☐ No (If yes, attach results)

		Before Development	After Development
11. Depth to Water (from top of well casing)		a. ___ . __ ft.	___ . __ ft.
	Date	b. __/__/__ m m d d y y	__/__/__ m m d d y y
	Time	c. __ : __ ☐ a.m. ☐ p.m.	__ : __ ☐ a.m. ☐ p.m.
12. Sediment in well bottom		__ . _ inches	__ . _ inches
13. Water clarity		Clear ☐ 1 0 Turbid ☐ 1 5 (Describe)	Clear ☐ 2 0 Turbid ☐ 2 5 (Describe)

Fill in if drilling fluids were used and well is at solid waste facility:

14. Total suspended solids	____ . _ mg/l	____ . _ mg/l
15. COD	____ . _ mg/l	____ . _ mg/l

16 dditional comments on development:

Vell developed by: Person's Name and Firm

I hereby certify that the above information is true and correct to the best of my knowledge.

Signature: ____________

Print Initials: _ _ _

Firm: ____________

N ____________

Fir ____________

: Shaded areas are for DNR use only. See instructions for more information including a list of county codes.

APPENDIX E

GROUND-WATER SAMPLING AND ANALYSIS

91000 GROUND-WATER SAMPLING

1.0 Purpose

This manual contains detailed procedures for sampling ground water. Following these procedures will provide samples of ground water that are as representative as possible, the subsequent analysis of which will provide analytical data that is of the highest quality and fully defensible. This manual is not only intended to be used in training personnel involved in sampling, but as a reference to the proper procedures to be followed even by experienced samplers.

The objective of a ground-water monitoring program is to determine to what extent contaminants from a site are impacting the ground water. Federal, state, and local regulatory bodies have established criteria that must be met for clean up standards.

This manual provides the procedures necessary to carry out the first and most critical element in a ground-water monitoring program--the sampling. Other elements of a ground-water monitoring program can be found in the site specific Work Plan, or Quality Assurance Project Plan (QAPP), whichever is applicable.

Field forms are used to document each sampling event. Copies of all forms must be maintained in the project files. The required forms are discussed in Work Plan or the Data Management Plan.

2.0 Preliminary Procedures

Prior to any sampling at a site, a number of preliminary tasks must be accomplished. These preliminary procedures may be done infrequently; but if done properly the first time, can insure that the subsequent sampling events are carried out smoothly and cost effectively.

3.0 Coordination with the Analytical Laboratory

For a scheduled sampling event, the analytical laboratory should be notified a minimum of one week prior to sampling. Sample bottles and shuttles are typically sent via courier, which requires approximately 7 days for delivery. For rapid response projects, designated by the Project Manager, shuttles and bottles can be sent express (overnight) or delivered by the lab. To minimize the need for express shipments, a limited amount of sample bottles and supplies may be stored at local labs, or at the site if storage space is available. However, short notice of a project tends to increase project costs. As much notice as possible should be given on any project.

The information described in the following paragraphs is to be defined with the laboratory or other supplier in placing an order for sample bottles.

3.1 Number of Samples and Matrix

The number of samples to be collected and analyzed including field and trip blanks, sample types and matrices (i.e., water, soil, etc.) are to be defined. It is important to identify samples which may have a complex matrix or potential interferences, such as high sulfide or chloride concentrations. These samples may require special cleanup procedures prior to analysis. The number, size, and type of sample bottles required should be determined in conjunction with the analytical laboratory prior to ordering sample bottles and preservatives.

3.2 Sample Point IDs

Sample point designations must be standardized to avoid confusion. Sample point designations are to be alpha-numeric characters. For samples which are field duplicates, the appropriate source code with the ID code is to be used.

3.3 Sampling Date(s)/Schedule

Specific dates for sample collection are to be scheduled as soon as possible. Anticipated dates for sample shuttle arrival at the laboratory(s) are identified so the laboratory manager may schedule work and reserve laboratory capacity for the project.

3.4 Turnaround

Standard turnaround times for analytical results should be within 28 days from receipt of sample by the laboratory. Exception to this may be required for unusual detection limits, odd matrices, or special compounds. Express or emergency turnaround, when required, must be identified.

3.5 Parameters to be Analyzed/Reporting Requirements

The parameters to be analyzed are to be listed by sample on the Chain-of-Custody form. Special detection limits or methodologies required must be defined under special instructions. In all cases, the Chain-of-Custody form will identify the specific U.S. EPA approved method of analysis to be performed on each sample.

3.6 Special Comments

Special instructions must also be noted. For example:

1. For rapid response projects, frozen ice packs may be received with delivery of the shuttles to the site. This must be specified;

2. Special packing requirements should be noted, e.g., bottles required for splits;

3. Special report requirements (i.e., state reporting forms, distribution of results to an attorney).

4. Known interferences or known high levels of a compound from a specified sample point should be identified so that special analytical procedures can be undertaken. For example, petroleum hydrocarbon samples should identify, if known, the type of hydrocarbon present (i.e. gasoline, fuel oil #2 etc).

5. Sample filtering procedures which are to be used in the field should be noted on the form.

4.0 Pre-Sampling Procedures

Once the wells have been located and the order placed, preplanning must be done to reduce the chance of errors and/or delays. These pre-sampling procedures include the procurement and calibration of equipment, checking sample shuttle, filling out field form, and purging the well. Each of these procedures is addressed in the following paragraphs. It is suggested that preparation for a sample event begin at least one day before the event is to take place to ensure time to accomplish all of the procedures and to leave time to correct any problems that arise.

4.1 Organizing Equipment and Materials

All equipment necessary for a sampling event should be cleaned, checked, and, if necessary, calibrated prior to going into the field. As much preparation as possible should be done ahead of time since neither the facilities nor the material required for equipment cleaning and calibration may be available at the site.

The following is a check list of equipment that may be required for a sampling event. In any case, it is a good place to start in preparing and assembling the required equipment for a sampling event.

EQUIPMENT LIST/CHECK-LIST

___ 1)

Bailers:	PVC	Stainless	Teflon
3/4"	___	___	___
1-1/2"	___	___	___
3"	___	___	___

___ 2) Dedicated pump equipment (two sets minimum):
- Hose
- Compressor
- Depth Indicator

___ 3) Pumps

___ 4) Spare parts for wells:
- ___pump
- ___hose
- ___rope (nylon braided)
- ___bailers (see above)

___ 5) Dedicated pump maintenance kit

___ 6) Field Meters:
- ___pH and extra electrode ___calibrated
- ___specific conductivity ___calibrated
- ___temperature ___calibrated
- ___batteries for meters

___ 7) Site map with well locations

___ 8) Keys for wells and gates

___ 9) Personal Protective Equipment

___ 10) Distilled Water

___ 11) Chain-of-Custody Forms, Custody Seals, if applicable, and Field Parameter Forms
___ 12) Sample shuttles and/or other packing material such as ziplock bags, bubble wrap and vermiculite
___ 13) Sample bottles
___ 14) Extra bottles including pre-filtration bottles
___ 15) Ice or ice packs
___ 16) Preservative kit,
___ 17) Pipe wrenches and tool chest
___ 18) Weighted tape
___ 19) Tape measure
___ 20) Large plastic bags (to provide clean work area)
___ 21) Watch with second hand
___ 22) Bailer retriever
___ 23) Calibrated 5 gallon bucket
___ 24) Filtering equipment
___ 25) Hand soap--to preserve sample integrity
___ 26) Disposable Latex or PVC gloves (without powder)
___ 27) Paper towels
___ 28) Tape
___ 29) Calculator
___ 30) Camera
___ 31) Conversion Chart
___ 32) Markers and pens
___ 33) Vinyl notebook with clipboard
___ 34) Required filtration list
___ 35) Field meter log books for calibration
___ 36) pH buffers - 4, 7, 10
___ 37) Specific conductivity standards

___ 38) Extension cord (if required)
___ 39) Air source and regulator (if required)
___ 40) Clean vehicle (inside and out)
___ 41) Gasoline and oil - for pump or generator if required.
Do not store near sampling equipment!

4.2 Bailers

Dedicated PVC bailers are preferable when monitoring for organics, and are appropriate for sampling all required RCRA parameters. Teflon or stainless steel bailers are the second choice. Non-dedicated bailers must be washed with a phosphate-free detergent and triple-rinsed with distilled water between wells. Dedicated bailers require no rinsing unless they are visibly contaminated by LNAPLs, in which case they should be completely decontaminated before use.

4.3 Pumps

The selection of pumps should be geared to the nature of the parameters. There are several advantages and disadvantages to each type of pump. Use of suction lift pumps may result in degassing and loss of volatile components. Portable submersible pumps are not suitable when sampling for organics if lubricants are used in the pump. Gas stripping of volatile compounds may occur with air-lift samplers and are generally not suited for pH sensitive parameters such as metals. Well Wizards or similar brands (air actuated, peristaltic pumps, constructed of PVC, stainless steel, or teflon), therefore, are the preferable equipment when pumps are needed.

When non-dedicated pumps are used, stringent cleaning procedures must be followed between sites. Before purging wells at the next site, sufficient amounts of distilled water must be flushed through the pump and tubing.

The cleaning procedures should be performed in a clean room/laboratory environment. The non-dedicated pump should be placed in a standpipe (PVC or stainless steel) filled with distilled water. (NOTE: A continual supply of distilled water must be added to the standpipe.)

Initial specific conductance and amount of distilled water used should be accurately measured and recorded in the field notebook. Pump and tubing should continue to be flushed until the specific conductance of the discharged distilled water is within ±10 (um/cm at 25°C) of the initial measurement. Once this is achieved, the pumps and tubing should be properly stored and will be ready for use at the next site.

Decon procedures at the sample locations are equally important. To ensure the integrity of the non-dedicated pump between wells, a minimum of 3-gallons of distilled water should be used to thoroughly flush the pump and tubing before and after use in the well.

4.4 Shuttles and Sample Bottles

The sampler will be responsible for checking all sample bottles and shuttles as soon as they are received, and for preparing ice packs prior to the sampling event. They are to notify the laboratory immediately as to any problems or questions. If the sample shuttles are not shipped to the office, (i.e. the samples shuttles are shipped to the site, local laboratory, or subcontract samplers), coordination with the site is necessary to confirm arrival of the shuttles and to arrange the checking of equipment and supplies.

The Simon Hydro-Search staff person conducting the sampling should ask that the laboratory or bottle supplier notify the sampler as to delivery arrangements and correct content of all containers.

The Chain-of-Custody forms should be included with the sample shuttle and should be carefully examined. The Chain-of-Custody form must be filled out and returned with the samples.

If sample bottles are received in a shuttle, note the arrangement of the bottles and ice packs prior to removing equipment from the shuttle in order to re-pack them. Shuttles are packed for economy of space and often, unless special attention is given, it may be difficult to fit everything back into them.

An inventory of the bottles and their condition must be taken. A bottle list as well as analyses required and preservation requirements are noted on the Chain-of-Custody form in the "Sample Bottle" section. Each sample bottle is to be labelled with the Simon Hydro-Search project number.

Properly cleaned, new sample bottles must be used. The type of bottle will vary depending on the analysis required. For samples requiring preservatives, pre-measured amounts of preservatives should be included with the bottles or contained in the bottle prior to mobilization. Each bottle must be labeled to identify the preservatives which are required. Preservatives must not be introduced into bottles which do not require them. A list of sample bottles (type and size) and preservatives required for each analysis is attached.

Each shuttle which includes bottles for volatile organic analysis must also include the same volume of trip blanks as the investigative sample (usually three 40 ml vials filled with reagent free water). Each vial must be checked to ensure that the blank has no air bubbles. On occasion, due to pressure and temperature changes, small bubbles will appear in the blank. Condition of the blanks as well as any relevant information concerning condition of the shuttle should be noted on the Chain-of-Custody form.

For field blank analyses, the shuttle must include the bottles for preparing field blanks. Deionized water, used by the sampling team in the field, will be used for these samples.

Ice packs must be contained within the shuttle to help maintain the temperature as required by U.S. EPA protocol. The sampling period must be planned so that there will be adequate time to allow freezing of the ice packs. Usually a 24-hour period is required to assure that the ice pack will be frozen solid.

4.5 Equipment Storage

After all shuttles, containers, and equipment are checked or packed, they must be stored prior to the sampling event in a designated, contaminant free area.

On occasion, not all bottles and containers will be used (i.e., the well was dry and no sample was obtained). Unused shuttles and/or bottles should be returned to the laboratory they came from, if applicable, at the completion of the sampling event. The laboratory must be notified regarding the return of unused shuttles.

4.6 Calibration and Use of Meters

Field measurements along with proper documentation are integral parts of the monitoring program. Before the actual trip to the field, all equipment must be checked for possible malfunctions and cleaned.

Prior to use in the field, all meters must be calibrated by the sampling team to ensure proper working order and to render integrity to the measured values. Calibration procedures provided by the manufacturer are to be followed.

Calibration of the pH meter should be made with pH 7 and pH 10 buffers, and a pH 4 buffer as a check, or with pH 7 and pH 4 buffers, and a pH 10 buffer as a check, depending on the average expected pH values of the samples. Please note the actual pH of your buffers at the temperature used for calibration. (A chart for this is usually provided on the buffer container.) You may need to calibrate the 7 buffer to 6.95 or 7.03 or some point in between, depending on the temperature of your buffers. The measured value for the check buffer must be within the recalibration limits listed at the bottom of the page. If not, the meter must be recalibrated.

Calibration of the specific conductivity meter should be made with a standard of approximately the same conductivity as those expected at the site, and should be measured at (or converted to) 25°C. At least one additional standard must also be checked. This standard should be of the same conductivity as the original standard, but should be cooled below room temperature (refrigerated). In checking the conductivity of this cooled standard, a verification will also be made of the automatic temperature compensation of the meter (or conversion calculation). The calibration check limit for this second standard should be within ±1% of the expected value. An additional (third) standard may also be used (if desired). In this case, a standard of higher or lower conductivity than the original standard should be used. The calibration check limit for this third standard should be within ±5% of the expected value.

When rechecking the calibration of the field meters, the pH reading must be within ±0.1 pH unit of the expected value (i.e., pH 4 buffer, calibrated to within pH 3.90-4.10). The specific conductivity value must be within ±5% of the expected value (i.e., 1,413 μmhos/cm standard, calibrated to within 1,342-1,484). If the recheck of the calibration of the instrument does not fall within these limits, the instrument must be recalibrated. The calibration of the field instruments must be checked every 4 hours and at the end of the day. If the calibration check is not within the limits listed above, the meter must be recalibrated.

The specific conductance of the deionized (DI) water being used in the field is measured and recorded each morning. The daily conductivity values are placed in the log book of the meter which is used (field or laboratory). If the specific conductance of the DI water is greater than 50 μmhos/cm at 25°C, the project manager should be contacted immediately. The DI water should not be used. DI water should then be obtained from an alternative source (local laboratory, etc.) until the problem can be corrected.

Thermometers will be checked before each sampling event for accuracy against a National Bureau of Standards (NBS) calibrated thermometer, and recorded in the field meter log.

5.0 Field Records

Improper documentation or inadequate information regarding the circumstances of collection and/or subsequent disposition of the samples (i.e., Chain-of-Custody) may render any resulting data useless. Proper Chain-of-Custody documentation is crucial as part of the QA/QC program. Comprehensive, consistent, and accurate documentation of field tests, measurements, and field observations is also extremely important.

Two forms must be filled out by the sampler during a sampling event. A Chain-of-Custody form and Well Purge form are maintained for each sample. The original Chain-of-Custody must be sent with the samples to the laboratory. Under no circumstances will samples be analyzed without these forms. These forms must be completed with ink only. Pencils/felt-tip pens should not be used. Appropriate forms may include consultants' forms, state forms, and/or federal forms. Copies of all completed forms are to be maintained in the Project Master File for easy reference. Analytical data must also be maintained in the project files.

5.1 Chain-of-Custody Form

In order to maintain the integrity of the samples, strict Chain-of-Custody procedures are necessary to ensure that tampering with the samples has not occurred.

From the time the sample bottles leave the laboratory until the issuing of the analytical laboratory results, the samples and/or sample containers must be in the custody of assigned Simon Hydro-Search personnel. Chain-of-Custody is discussed in more detail in the site specific Work Plans or the QAPP. Failure to complete the Chain-of-Custody form will render the data useless.

5.2 Well Purge Form

The Well Purge form contains information regarding site and well conditions, sampling and purging procedures used, and field measurements. The Well Purge form must be filled out by the sample collector for each sample point and placed in the project master file.

Sample Point

The sample point ID are contained on the Chain-of-Custody form for the sample. All sample point ID's must be identical to the codes in the Chain-of-Custody form.

Purging Information

This section should be completed if the sample points are wells. All wells must be purged prior to sampling. The date and time the well was purged, the elapsed time for purging, the volume of water in the casing (gallons), and the volume purged (number of gallons) must be documented.

The field sampling and analysis form must document the purging data and indicate if the well was dry and if a sample was or was not collected.

Sampling Information

The types and materials of construction of equipment used for collection is to be documented. If Well Wizard or similar pumps are used, the tubing material must be documented. If a code number does not correspond to the actual material, then a written description must be provided.

Field Measurements

For ground-water sampling events, the ground-water elevation (depth to ground water adjusted to msl), temperature, pH, and specific conductance at 25°C are to be determined. Additional parameters, e.g., color, odor, and turbidity, may also be required. Space is provided for these additional parameters. The units and values of these measurements are to be noted. The site-specific sampling plan may require additional field parameters which should also be noted.

Field Comments

The section on field comments should include field observations such as:

- Condition of the well and dedicated equipment
- Weather condition--wind direction and speed, upwind activities, rain, snow, temperature, cloud cover, barometric pressure (where required per regulatory requirements), etc.

- Sample appearance - odor, color, turbidity

Odor:	Rotten eggs, earthy, strong, moderate, slight, metallic
Color:	True "color" is the color after the turbidity has been removed. The color observed after sampling is an "apparent color", influenced by sediment in the sample. True color may be caused by metallic ions, humus, peat, industrial chemicals. Hold the sample up to the light and describe the color as well as possible. Observations may include: no color (clear), brown, gray, yellow etc.
Turbidity:	None--sample is clear.
Trace:	Sediment only slightly clouds or colors the sample. Sediment does not accumulate at bottom of bottle.
Moderate:	Definite cloudiness/color. Sediment accumulates at bottom of sample bottle.
High:	Muddy appearance.

- Reference point for well measurements.

- Well ID where field blank is prepared.

- All calculations for purge volumes and temperature conversions, as well as if well was purged dry, or an explanation when less than 4 casing volumes are removed.

- Duplicate field measurement results.

- Other conditions, such as sample splits with regulatory agencies, potential safety or health hazards (i.e., fire ants, dry well etc.).

  NOTE: When samples are split with regulatory agencies, note the condition of the bottles, preservatives used, etc., by the agency on the summary sheet.

6.0 Well Observations and Measurements

It is very important during each sampling event that various observations concerning the condition of the well be made. Also required are specific measurements during a sampling event such as purge volume, water level, and depth of well. These observations and measurements are all documented on the well purge form.

6.1 Observe Maintenance Conditions at Well

The conditions of the well and its surrounding area are observed and recorded on the Well Purge form upon arrival at the well location. The following information should be noted:

- The presence and condition of the well's identification sign.

- Was the well recently painted?

- Is the well locked and does the key work?

- Well integrity.

- Physical surroundings (high weeds, standing water, cleanliness, activities nearby).
- Condition of dedicated pump or dedicated bailer?
- Obstructions or kinks in well casing?
- Condition of cement footing--cracked, raised?
- Water in annular space?
- Grease around top of well on threaded caps?
- Weather conditions: include wind direction for volatiles and note if sampling was performed downwind.
- Evidence of contamination: animal or insect parts in well, etc.
- Well guard post's condition.

6.2 Measurements to Determine Purge Volume

The elevation of the ground water at each monitoring well is determined for each sampling event. Measurement of the static water level is taken prior to well purging and sample withdrawal. The elevation of the ground water is then determined by the following equation:

Ground-Water Elevation (msl) =
Elevation at top of casing (ft msl) - Depth to water (ft)

Note: All well measurements must be made from the point at which the elevation was measured (i.e., top of well casing). This point must be noted in the comments section of the well purge form.

Static Water Level Measurements

If wells have not been equipped with dedicated systems which contain static head sensors to measure depth, a water level or slope indicator (or similar device), is used to determine the static level of water in the well, as well as the total depth of the well. Water level indicators with lead weights should not be used.

A slope indicator works on a conductivity principle -- an alarm sounds and a red light is illuminated when the probe comes in contact with the water. The cable is permanently marked in increments of 0.02 foot (0-150 feet). To measure the static water level with a slope indicator, the procedure below should be followed:

1) Rinse the slope indicator cable off with distilled water. Shake all excess water.

2) Switch the sensitivity dial to high. Depress the red button. The red light should be illuminated and a buzzing should be heard. This will ensure that the meter is working.

3) Slowly unreel the cable in the well until the buzzing sound can be heard and the illuminated red light on the meter is observed.

4) Slowly raise and lower the cable to a point when the buzzer and light (together) just begin. This indicates the static water level.

5) Using the thumb and an index finger, mark this position on the cable--using as a reference point, the point at which the elevation has been measured.

6) Record the measurement to the nearest 0.01 feet on the field parameter form.

7) Rinse the slope indicator off with distilled water after reeling the cable back onto the spool.

8) Shake off all excess water.

Depth of Well Measurements

This measurement is required. Wells with dedicated pumps installed are exempt from this measurement. The depth of well, when not measured, should be obtained from the Well Construction Log and noted on the Well Purge form and also noted in the comments section, "from Well Construction Log."

Use of slope indicator for measuring the depth of the well is not as accurate as the water level measurement, as the bottom is determined entirely by "feel". This measurement should be reported to the nearest 0.1 foot and is used to calculate the volume of water in the casing for purging operations.

1) After a recording of the static water level, unreel the cable or tape, until it hits the bottom of the well.

2) Slowly pull up the slack until slight tension is felt on the cable.

3) Slowly raise up and down until a feel for the bottom is obtained.

4) Using as a reference point the point at which the elevation has been measured, mark the cable using a finger, and measure as for the water level.

5) Reel the cable back on the spool, rinse with distilled water, and shake off all excess water.

6) Record measurement on Field Parameter form.

6.3 Detection of Immiscible Layers

If a light or dense immiscible layer is encountered or suspected to be encountered in a well, the well will be tested for the presence of immiscible layers using an interface probe. The interface probe will be lowered into the well to the static fluid level as determined by the probe. The interface probe will then be slowly lowered into the fluid to complete an electrical connection. The probe indicates an organic compound by one type of tone or light, and water by a different tone or light. The interface probe is slowly lowered to the base of the well or piezometer to determine if a dense immiscible phase is present, and to determine the total well depth. By measuring the length of cable in the well at each interface, the thickness and elevation of each layer can be determined.

6.4 Additional Field Measurements

At this time, stick-up and casing size are measured and recorded on the Well Purge form. Additional sampling and purging information, as listed on this form, should also be recorded (i.e., sampler type, material, etc.)

7.0 Purging the Well

7.1 General

Monitoring wells should be pumped or bailed prior to sample withdrawal to safeguard against collecting non-representative stagnant water in a sample. As a general rule, pump or bail a minimum volume of 4 times the volume of water standing in the well (for moderate to high yield formations) and at least one casing volume for low yield formations (those with slow recharge). Well purging should be sufficient to ensure that water which is representative of the ground water has entered the well.

If a monitoring well is a very low yield well, bail the volume of water standing in the well and allow the well to recharge for 24 hours. If there is insufficient water for sampling any parameter, then the well is considered dry for the sampling event. If the volume of water available is insufficient for filling all of the sample containers, portions of the sample are to be collected (unless otherwise specified by the regulatory agency or the Project Manager). In all of these situations, notify the Project Manager immediately.

NOTE: Clay till wells may be allowed to recharge for three (3) days, or as otherwise specified by the Site Specific Sampling Plan.

7.2 Calculating Purge Volume

To determine the volume of water to be purged, calculate:

h = # of feet in water column = total well depth (ft)* - depth to water (ft)
1 Casing Volume = $\pi r^2 h = \pi (1/2 \text{ well ID})^2 h^*$
Purge volume = 4 casing volumes
* From the Well ID chart, or as measured.

NOTE: Purge volume calculation must be made in equivalent units, so if feet of water is used for h, well diameter must be converted to feet (i.e., 2" ID well = 1" radius = 0.083' radius; therefore r^2 for 2" ID well = 0.0069', and for each 1-foot of water in a well $\pi r^2(1) = 0.022\ ft^3\ (7.48\ gal/ft^3) = 0.16\ gal$).

Example:

FIELD MEASUREMENTS

Well Elevation (ft/msl)	48.56	Well Depth (ft)	27.0*
Depth to Ground Water	3.63		
Ground-Water Elevation (ft/msl)	44.93	*From Well Construction Log	

FIELD COMMENTS

2" well casing
h = 27.0 - 3.63 = 23.37 feet of water in column
1 well volume = $\pi\{(1/2 \times 2\ in.)\ (1\ ft/12\ in.)]^2\ (23.37\ ft.)\ (7.48\ gal/ft^3)$
= 3.8 or approximately 4 gallons
Purge volume = 4 well volumes = 16 gallons

The recovery time may be noted on the Well Purge form in the "other" section. This should initially be determined during development of a newly installed well.

7.3 Purging the Well

After necessary field measurements are made and the volume of water to be purged is determined, the purging process is begun.

The single most important objective while purging a well is minimizing contamination. Equipment should never touch the ground or any other possible contamination sources. For example, a fiber drum lined with a new plastic bag may be used to collect the rope in when using a bailer. Purged water should be discarded away from the well footing or in the manner described in the site specific work plan. This will prevent the possibility of contamination due to the formation of mud.

To measure the volume of water being removed from the well, a calibrated 5-gallon bucket or a known volume container may be used to collect water.

Procedure Using Bailers

When using a bailer for purging, the largest available bailer that will fit into the well should be used in order to minimize purge time.

Nylon rope, preferably braided, is to be used. It is imperative that new rope be utilized. In addition, the rope should be of adequate length and strength--thicker rope is easier to grip. The rope should be fastened to the well cap. Where this is not possible, the rope should be secured to a large spool to prevent loss of the rope and bailer in the well.

If a non-dedicated bailer is used, the bailer must be washed with a non-phosphate detergent and triple rinsed inside and out with distilled water before purging. Additionally, the people handling the bailer should wash their hands before purging the well. Disposable PVC or latex powderless gloves <u>must</u> be worn (the powder contains phthalates which can contaminate samples). New gloves should be used at each well or possibly changed more frequently (e.g., dirty, torn, etc.). The rope should be tied onto the bailer securely and checked with each bail during the purging process.

The purging of the well is accomplished by a repetitive lowering, raising, and dumping of the bailer.

1) Slowly lower the bailer into the well until the bailer contacts the water.
2) Allow the bailer to fill with water. The bailer will "gulp" when it is full and increased tension will be felt on the rope.
3) Pull the bailer out of the well while coiling the rope and dropping it in the plastic bag lined fiber drum.
4) Pour out the water from the bailer, into a calibrated bucket, and observe water characteristics.
5) Repeat the process until the appropriate volume of water has been purged from the well.

Suggested precautions while purging a well:

1) Lower the bailer slowly into the well;
    - so as to prevent contamination from rust or the sediment which may accumulate around the top of the well casing.
    - to minimize the upwelling of bottom sediment.
    - to minimize the possibility of the bailer becoming lodged in the well due to a kink in the well casing.
    - to minimize the chance of the rope becoming untied from the bailer.
2) Never allow the bailer to come in contact with any surface other than your gloves and the inside of the well.

3) Always be conscious of possible contamination sources (i.e., grease on well cap, etc.).

Procedure Using Non-Dedicated Pumps

Non-dedicated pumps are most often used for purging when large volumes of water must be removed from the well prior to sampling. The best, and most commonly used pumps are submersible, centrifugal pumps.

All of the equipment must be thoroughly washed using a non-phosphate detergent and rinsed with tap water followed by a distilled water rinse and air dried before using. The samplers should wash their hands before purging the well. Disposable PVC or latex powderless gloves <u>must</u> be worn. New gloves should be used at each well or possibly changed more frequently (e.g., dirty, torn, etc.).

Purging of the well basically involves the correct placement of the pump and turning it on.

1) Slowly lower the equipment (pump, hose, rope) into the well. All of the equipment must be lowered simultaneously to prevent possible jamming of the equipment in the well.

2) Place the pump well below the static water level head, (above the well screen in piezometers) as damage to the pump may occur if the pump is run dry for even a few seconds.

3) Turn on the pump. Purge the required volume of water.

4) Turn pump off.

5) Remove equipment from the well when purging is complete. All equipment must be removed simultaneously to prevent possible jamming of the equipment in the well.

6) Decontaminate all equipment before reusing, per the procedure for cleaning discussed above.

Dedicated Pump Procedure

Dedicated pumps involve the connection of the dedicated pump to its power source and turning it on. Electrical power sources (where possible) are preferred in order to minimize possible contamination sources.

8.0 Sampling the Well

Ground-water samples should be collected in the shortest possible time while maintaining sampling integrity.

Field Measurements

At a minimum, three field measurements must be conducted on each sample point after purging: pH, specific conductivity, and temperature. A separate bottle or beaker should be used for these measurements. These bottles may be reused, if thoroughly rinsed with distilled water before use. A phosphate detergent wash followed by a distilled water rinse may be required if the sampled waters are significantly contaminated. All results must be recorded on the Field Parameter form, noting units to three (3) significant figures.

(All pH meters must be able to provide a reading to the hundredths place [i.e., 7.14]).

When field measurements appear to be in error, all data must be discarded, new sample taken, and all new measurements made. Errors should be crossed out with one line, initialed, and the reason for the error noted. Instruments which appear to have erroneous readings should be recalibrated.

Duplicate field measurements must be taken for 1 out of every 10 samples, or at least once per day. The duplicate field measurements are recorded on the Well Purge form in the comments section.

If the values obtained are not within the normal ranges, notify the Project Manager immediately. Do not discard this sample, as regulatory requirements specify that analysis be performed on it. Additional samples may be requested by the Project Manager to ascertain the cause of abnormal readings.

For RCRA sampling, pH and conductivity measurements must be done in quadruplicate. Four measurements are to be made from one sample container. Between measurements, the instrument should be turned off, rinsed, and dried.

8.1 When Not to Sample

During a sampling event, all wells must be sampled, except in the following cases:

- Well has been destroyed or otherwise rendered useless (i.e., casing broken off or severely bent so as to preclude sampling).
- Well is dry (i.e., no water can be pumped within 24 hours of purging, or bailed without dropping the bailer all the way to the silt at the bottom of the well to obtain a partial bailer full of water, unless regulatory requirements

dictate awaiting a longer recharge time or as specified by the Project Manager).

- Well is new and has not been properly developed (pH and specific conductivity must be stabilized).
- The Project Manager states that the sampling should not be done.

8.2 Sampling

The method to be used for sampling is usually the same as that used for purging, unless otherwise specified by the Project Manager.

Procedures for sampling include the same steps as those for purging with the exception that the water removed from the well is placed in the sample bottles rather than being discharged.

8.3 Filling Sample Bottles

Sample bottles should be filled directly from the bailer or pump with a minimal amount of air contact. Volatile organics bottles should be headspace-free and are never field-filtered. Samples which require field filtration should be filtered in-line, if possible. Where in-line filtration is not available, laboratory-quality pre-filtration bottles should be used to collect samples. This is to assure that no sediment will be introduced into the filtered sample which could cause possible analytical errors. Pre-filtration bottles must be laboratory quality. Plastic containers should be used for inorganic parameters only.

When filling the sample bottles, these important procedures and precautions must be followed:

1) Bottle caps should be removed carefully so that the inside of the cap is not touched. Caps should never be put on the ground. Caps for VOA vials contain a teflon lined septum. The teflon side of the septum must be facing the sample to prevent contamination of the sample through the septum.

Sample bottles and pre-filtration bottles must be laboratory-quality.

2) The sample bottles should be filled with a minimal amount of air contact, and without allowing the sampling equipment or personnel to contact the inside of the bottles. Tubing or hoses from pumps must not be placed into the sample bottles.

3) Samples which are to be filtered and preserved, should be placed in pre-filtration bottles and filled completely full to allow for any loss of water from sediment during filtering. Once filtered, sufficient space should be available in the sample bottles for the addition of required preservatives. The bottle caps should then be replaced tightly.

4) Samples which are not to be filtered and which have preservatives in the bottles when received should be completely filled with the sample with as little overflow as possible and bottle caps replaced tightly. If required preservatives have not been received in the bottles, the bottles should be filled with adequate space available in the bottles for the preservative to be added.

5) VOA vials must be filled so that they are "headspace free" (i.e., no air bubbles in the sample bottle). These sample bottles, therefore, need to be over-filled (water tension will maintain a convex water surface in the bottle). The caps for these bottles should be replaced gently, so as to eliminate any air bubbles in the sample. These bottles must then be checked, by inverting the bottles

and snapping them sharply with a finger. If any air bubbles appear, open the bottle, add more water, and repeat this process until all air bubbles are absent. Do not empty the bottle and refill.

6) All sample bottles, once filtered, filled, and preserved as required, must be placed into a refrigerator or cooler with ice until ready to be shipped. Samples must be shipped to the laboratory no longer than 24 hours after they are collected. Therefore, allow time a the end of the day to get the collected samples to the courier. Other samples which have shorter holding times or which are on short-turn around time should be shipped or delivered to the laboratory at the end of the sampling day.

7) Never place VOA vials in direct contact with ice packs as they may cause the sample to freeze and break the vial.

8) Sample bottles, caps, or septums which fall on the ground before filling should be thoroughly rinsed with sample water before being used.

8.4 Blanks

Field and trip blanks are used as control or external QA/QC samples to detect contamination that may be introduced in the field (either atmospheric or from sampling equipment), in transit to or from the sampling site, or in the bottle preparation, sample log-in, or sample storage sites within the laboratory. The blanks will also reflect any contamination that may occur during the analytical process.

Trip blanks are samples of reagent free water which are prepared in a controlled environment prior to field mobilization. Trip blanks must be used for samples intended for VOC analysis and are analyzed for VOCs only. Trip blanks remain with the sample bottles while in transit to the site, during sampling, and during the return trip to the laboratory. At no time during these procedures are they opened. Upon return to the laboratory, they are analyzed as if they were another sample, receiving the same QA/QC procedures as ordinary field samples. If these samples are accidentally opened, note that on the Chain-of-Custody form and if extra trip blanks are available, discard the opened vial.

Field blanks are used to determine if decontamination procedures are being carried out properly and there is no "carryover" from one aqueous sample to another. When sample bottles are filled directly and do not come in contact with sampling or filtering apparatus, field blanks are not required.

Field blanks are prepared in the field (at the sampling site) using empty bottles and distilled water used for cleaning sampling equipment. Procedures may vary from site to site. Check with the Project Manager prior to sampling, and note on the Well Purge form if procedures other than those listed below are followed. The well at which the field blank is prepared must be noted in the comments section of the Well Purge form.

For <u>non-dedicated sampling equipment</u>, the deionized water is purged into the sampling device (e.g., bailer) after it has been cleaned in preparation for the next sample point. If the parameter of the field blank would normally be filtered, this water should then be placed into a pre-filtration bottle and then filtered. This water, or the unfiltered water, should then be placed into the field blank bottles and the proper preservative added if required.

For new <u>dedicated sampling equipment</u> such as dedicated bailers, the deionized water is purged into the sampling device, transferred to the field blank bottles, and the proper preservative added if required. This is done prior to sampling to ascertain if the sampling device was clean to begin with. Field blanks will be analyzed for all parameters that the field samples are analyzed for.

Field and trip blanks are used to detect contamination which may have been introduced during field and analytical steps and to assess the performance of the analytical procedures. Field and trip blanks are required as part of the QA/QC procedures for the overall sampling and analytical program. One field blank is required for every ten samples and one trip blank is required for each sample shipment cooler or shuttle containing aqueous or gas samples for VOC analysis.

8.5 Duplicate Samples

The sampling personnel are responsible for submitting one duplicate sample for every ten or fewer samples collected for each matrix. Duplicate samples will be collected at the same time and in the same manner as the normal investigative samples.

8.6 Filtration

State guidelines may vary regarding filtration of samples in the field. However, samples which must be filtered should be filtered through a 0.45 micron membrane pressure filter as described in the following pages.

Standard Procedures Not Requiring Field Filtering

- Alkalinity
- Turbidity
- Total Suspended Solids TSS
- Total Solids
- Volatile Organics, VOA's
- Cyanide
- PCBs and Pesticides
- Semi-volatiles
- Total Organic Halogen, TOX

- Total Heavy Metals
- Any Other Parameters Listed as Total (excluding TOC) refers to unfiltered samples (If it does not say Total, assume Dissolved)
- Coliform
- pH
- Specific Conductance
- Oil and Grease

Site-specific requirements must be noted on the Water Quality Sampling and Analysis form. Filtering is used in order to sample the ions and compounds that are dissolved in solution in the ground water. Monitoring wells are not as fully developed as drinking water wells and often contain silts and sediment that need to be removed by filtration. If the water is not filtered, the ions and compounds that are naturally present in, or absorbed on, the suspended particles may be released when samples are preserved and analyzed. This would result in false data for the constituents that actually are present in dissolved phase in the ground water only.

Filtration and preservation of ground-water samples is an integral part of the monitoring program. Improper techniques during this process can affect the integrity of the sample. Therefore, all possible precautions should be taken to ensure that no contamination sources are introduced during filtration or preservation.

NOTES:

- Filtering should be performed immediately upon collection of the samples. Filtration should be done in the field. Where this is not possible, it should be completed as soon as possible after the sample has been taken and should be done under the most sanitary conditions available.

- Any sample which is suspected or known to contain high contamination levels (as identified by the Project Manager), are to be filtered last to minimize the potential for possible cross-contamination.

- Surface water, private wells, and leachate samples are never filtered.

- Pre-filtration bottles are <u>not</u> to be reused. The use of pre-filtration bottles and bottle type (glass, plastic) must be noted on the Water Quality Sampling and Analysis form.

<u>Filtration Equipment and Procedures</u>

Following is a list of equipment/requirements necessary for properly filtering and preserving ground-water samples:

- 0.45 micron disposable in line filters
- Distilled water
- Pre-filtration bottles
- Peristaltic pump, if well is not equipped with dedicated pump
- Misc. supplies (paper towels, tools, markers, etc,)
- Parameter checklist as listed on the Chain-of-Custody form to ensure that there is a proper pre-filtration bottle for each analysis or series of analyses that is required for that particular sample
- Knowledge of which samples are to be filtered for each sample point
- Proper use of preservatives (type and amount)

Following is a step by step procedure for filtering and preserving a typical monitoring well sample:

1) Filters and pre-filtration bottles are dedicated to the sample point and should arrive at the site ready for use requiring no decontamination. The peristaltic pump hose may be dedicated or may be decontaminated between locations depending on site conditions.

2) Position the new bottle under the outlet valve of the disposable filter.

3) Place inlet end of the peristaltic pump hose into the full pre-filtration bottle. Pump the water from the pre-filtration bottle through the filter via the hose. A minimum of three (3) pump cycles of water must be allowed to pass through the filter before obtaining a sample.

4) When the sample bottle is full, turn the pump off.

5) Add the proper preservative, which is attached to the bottle or the filtered sample (as stated on the Chain-of-Custody form) and recap the bottle. Invert the bottle several times to mix the sample.

6) Record the necessary information on the Field Parameter form and Chain-of-Custody form after every filter change.

7) Between samples, disassemble the peristaltic pump and its hose and wash the hose with non-phosphate detergent and thoroughly rinse (a minimum of 3 times) with distilled water. Air dry.

8) Reassemble the filter apparatus and repeat steps 1 through 8 for the next sample.

It is imperative that the proper filtration and preservation techniques be strictly followed. This precise care is necessary since many parameters are measured in the 0-10 ppb range.

9.0 Sample Preservation, Storage and Shipment

For samples designated for CRL/CLP analysis, appropriate U.S. EPA protocol will be followed for sample preservation, storage, and shipment. The following sections serve as general guidelines to be followed for all samples.

9.1 Sample Preservation

Samples are to be preserved, if necessary, immediately after filtering or immediately after sample collection if not filtered. VOCs which require zero headspace (no air bubbles trapped in the sample) may have preservative included in the sample bottle prior to mobilization. During filling, do not allow this bottle to overflow any more than necessary to eliminate headspace.

Pre-measured amounts of preserving reagents should be added to the sample bottle after the bottle has been filled unless a pre-measured amount has been added to the sample bottle prior to sampling. Bottles must not be overfilled (with the exception of VOCs), and should be inverted (once capped) to mix the preservative and sample. Bottle lids must not be placed on the ground or interchanged between sample bottles. Empty preservative ampules should be returned to the shuttle with the sample bottles.

A listing of preservatives, by analysis, are included as an attachment to this SOP.

Temperature Control

Sample temperature should be maintained at 4°C from the time the sample is taken until they arrive at the laboratory. Samples should be maintained in temperature regulated refrigerators, in coolers, or shuttles containing frozen ice packs. Provisions must be made beforehand for facilities to freeze the ice packs. The recommended method is to bring coolers and ice and/or dry ice to the site.

9.2 Sample Packing and Storage

Checking Sample Codes and Numbers

The sampler must record the sample code (well ID#) in the appropriate blanks of the Chain-of-Custody, Water Quality Sampling and Analysis, and Well Purge forms, as necessary. These codes should be double checked prior to sealing the sample shuttle. In addition, Simon Hydro-Search project numbers, if assigned, must be indicated on all bottles and forms, including those from the laboratory.

ALL BOTTLES AND CORRESPONDING CHAIN-OF-CUSTODY AND FIELD PARAMETER FORMS MUST HAVE THE SAME SAMPLE POINT ID NUMBER AND SIMON HYDRO-SEARCH PROJECT NUMBER.

All bottles filled from the same sample point at the same time must have identical sample codes and sample numbers unless used for duplicate analysis, in which case a different number will be used. Bottle tags should be double checked for consistency. Samples which are split with regulatory agencies should also be checked for consistent sample point ID numbers and for other methods of identification if used by the agency.

Sample Packing

After collection of the sample and addition of the preservatives (when applicable), the bottles are sealed, tagged, and then placed into the shuttle. The frozen ice packs are then placed into the shuttle. The Chain-of-Custody form must be completed and placed into a zip-locked plastic bag and taped to the inside lid of the cooler/shuttle.

All bottles should be wiped clean prior to placement in the sample shuttle or cooler. VOA bottles should never be placed directly on the ice packs. The shuttle or cooler must be maintained as clean as possible to minimize the potential for contamination. All bottle caps should be checked to ensure they are tight and that they do not become loose upon inserting them into the shuttle. Sample tags should be taped only if they are loose.

The shipment of samples necessitates the use of containers and packing material designed to prevent breakage and spills. Tight packing materials are provided around each sample bottle. The shuttles must never be shipped without the ice packs. The packing material should be absorbent (vermiculite) and the packed cooler/shuttle should be sealed such that tampering would be evident. These will provide for Chain-of-Custody procedures.

There are three important reminders for packing the coolers/shuttles:

1) Glass should not be packed in contact with glass. Ice packs or packing sleeves should be between these bottles.
2) It may not be necessary to freeze, or freeze completely, all of the ice packs. In very cold weather for example, the ice packs should be unfrozen or slushy.
3) If the ice packs appear to be leaking, they should be sealed in a zip-lock bag.

Sample Storage

Samples should be stored at 4°C in an enclosed cooler or darkened refrigerator prior to shipment to the laboratory for analysis. Samples should be shipped daily to the laboratory, if possible, to ensure proper temperature control and to avoid exceeding holding times for samples.

9.3 Sample Shipment

Transportation Arrangements

A member of the sampling team must be designated to arrange sample pickup and transportation to the laboratory. Sampling schedules should avoid shipment of samples to the local laboratory on a Friday if at all possible, as holding times may be exceeded over a weekend. Delivery requested on the weekend must be noted on the shipping/packing label for the courier.

Samples should be shipped by overnight courier. When contacting the courier for sample transport, provide information as to the shuttle contents. Alert the courier as to potential problems of freezing of samples in the winter and of melting of ice packs in the summer and note this on the shipping/packing label. The courier must take extra steps to minimize exposure of the shuttles to temperature extremes. The shuttle must be received at the laboratory within 48 hours or less of the time the frozen ice packs were placed into the shuttle. Documentation is required for verification of the time lags.

Laboratory Sample Receipt

The laboratory will receive and log-in samples and continue to maintain the Chain-of-Custody procedures until the analyses are completed and reported.

Each laboratory, upon receipt of any sample, will record the following information on the Sample Receipt Log:

- Presence/absence of custody seal (s);
- Condition of custody seal (intact, broken);
- Presence/absence of Chain-of-Custody forms;
- Presence/absence of air bills and/or bills of lading documentation for shipment of samples.
- Condition of samples (intact, broken, obvious movement during shipment, bubbles in VOA samples or trip blanks, OK, etc.);
- Presence/absence of sample point ID numbers, where applicable, job numbers on bottles, Chain-of-Custody forms and Field Parameter forms;
- Notation of discrepancies between numbers on bottles received and those listed on the Chain-of-Custody form;
- Temperature measurement of shuttle;
- Description of preservation procedures; and
- Any problems encountered that might affect analysis.

The laboratory will contact the sampler and/or Project Manager to resolve any deficiencies. It is essential to respond quickly since analyses could be delayed beyond the allowable holding time. Complete documentation and detailed filing procedures are utilized at the sites in order to resolve these problems quickly. Sample results may be delayed by incomplete shipments which do not include all paper work. <u>All Chain-of-Custody Forms must accompany samples</u>.

If all samples recorded on the Chain-of-Custody form were received by the laboratory and there are no problems observed with the sample shipment, laboratory personnel will sign the Chain-of-Custody form in the "received for laboratory by" box with the date and time. If problems are noted, these will be recorded on the Chain-of-Custody form under

Laboratory Observations, and detailed on the sample receipt log in addition to the normal sign-in procedures.

The following sample information is also documented on the sample log:

- date received;
- sample matrix;
- sample volume; and
- Client sample ID with appropriate order information.

Laboratory personnel will provide feedback on the condition of the samples, field information and completeness of paperwork.

9.4 Resampling

Resampling of wells between regularly scheduled sampling events should be kept to a minimum. The decision to resample, based on the analytical results, should always be reviewed with the Project Manager. However, in cases where well samples are received broken, samples are missing, etc., the wells should generally be resampled as soon as possible.

APPENDIX F

HEALTH AND SAFETY PLAN

FORM SHP-3

SIMON HYDRO SEARCH, INC.
SMALL SITE
HEALTH AND SAFETY PLAN

1.0 General Information

Site/Location: Milwaukee Plating Company   Project #: 366115203

Plan Prepared by: Gerald DeMers   Date: January 7, 1994

Plan Reviewed by: Steven E. Carlson   Date: January 7, 1994

Activity(ies): Drilling; soil sampling; monitor well installation; and monitor well development, hydraulic testing, and sampling.

Dates of work:

Simon Hydro-Search personnel:	Signature
Gerald DeMers, Project Manager	

Description of Site: (include map if possible) Site is located at 1434 N. 4th Street, Milwaukee, Wisconsin. Site is an active metal plating facility. Drilling will occur in adjoining public alley.

Types of hazardous material: Gasoline fuel oil and possible chlorinated solvents contaminated soil and/or ground water.

Major safety/health hazards: (contamination, equipment, fire etc.) Routine drilling hazards, in particular, subsurface and overhead utilities. Traffic hazards during the day period when site is used for business.

* Safety coordinator/emergency coordinator

** Designated First-Aid provider

2.0 Safety Plan

Protective Equipment/Instruments

Hard hat:	X	Boots:	X	Glasses (type):	Safety
Suits:		Respirator:			
HNu:	X	CGI:		Other:	

Safety equipment/instructions: Wear hard hat and boots at all times within work area while drill rig is present. During drilling, monitor breathing space in work area with HNu PID. Keep clear of overhead lines. Note any overhead obstructions and survey potential subsurface hazards before drilling. Following instructions for safety and instrumentation as outlined in Attachment SHP-3C.

Decontamination Methods: Wash/rinse contaminated clothes, boots, etc. on-site. Wet-wipe dirt and contamination from equipment and instruments.

3.0 EMERGENCY PLANNING

Phone #'s

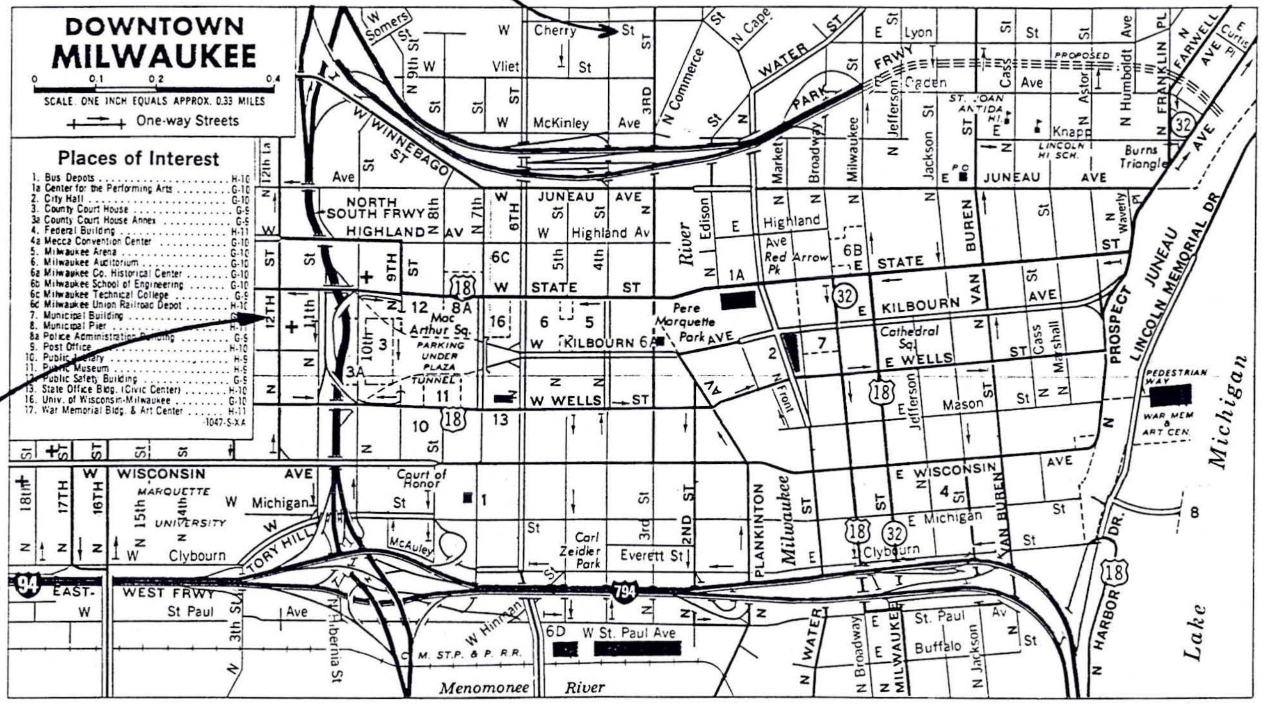
Hospital: (414) 283-6666 Sinai Samaritan Medical Center.
Fire Dept: 911
Police: 911
HSI: (414) 792-1282
Contractors: To be determined

Note: Map of area is attached.

Resources:

Nearest phone: In main office - west side of building.
Water: In building.
Electric: In building.
Other:

MILWAUKEE PLATING COMPANY



SINAI SAMARITAN MEDICAL CENTER

(EAST CAMPUS)

945 N. 12 st.

SAFETY PLAN COMPLIANCE AGREEMENT

I, ______________________________ (print name), have received a copy of the Site Health and Safety Plan for the __________________ project for __________________ ___ sites. I have read the plan, understand it and agree to comply with all of its provisions. I understand that I could be prohibited from working on the project for violating any of the safety requirements specified in the plan.

Signed:

___________________________ (Signature)

__________________ (Date)

Firm: ___________________________

HEALTH AND SAFETY GUIDELINES
for
FIELD ACTIVITIES INVOLVING PETROLEUM DISTILLATE PRODUCTS

1.0 PURPOSE

This operating procedure establishes minimum procedures for protecting personnel against the hazardous properties of motor oil and petroleum distillate fuels during the performance of field work including known and suspected releases of such materials. The procedure was developed to enable health and safety personnel and project managers to quickly prepare and issue site safety plans for investigations of such releases.

Whenever this procedure is used, Form SHP-3 and SHP-3A and B must be completed and attached. Together, the completed form and this operating procedure shall comprise a site safety plan. Safety procedures for drilling, trenching, and other construction operations should be attached as necessary.

2.0 APPLICABILITY

This procedure is applicable to field investigations involving the substances listed below and involving one or more of the activities listed below.

2.1 Substances

Motor Oil (used and unused)
Leaded and Unleaded Gasoline
No. 1 Fuel Oil (kerosene, JP-1)
No. 1-D Fuel Oil (light diesel)
No. 2 Fuel Oil (home heating oil)

No. 2-D Fuel Oil (medium diesel)
No. 4 Fuel Oil (residual fuel oil)
No. 5 Fuel Oil (residual fuel oil)
No. 6 Fuel Oil (Bunker C fuel oil)
JP-3, 4, & 5 (Jet fuel)
Gasohol

2.2 Activities

Collection of samples of subsurface soil with aid of truck-mounted drill rig, hand-held power auger, or hand auger.

Construction, completion, and testing of ground-water monitoring wells.

Collection of ground-water samples from new and existing wells.

Observing removal of underground fuel pipes and storage tanks.

Small scale removals of contaminated soils.

This procedure must not be used for confined space entry (including trench entry) or for installing or operating pilot and full-scale fuel recovery systems.

No safety plan is needed for non-intrusive geophysical surveys, reconnaissance surveys, and collection of surface soil, surface water, and biota.

3.0 HAZARD EVALUATION/RISK ANALYSIS

Motor oil and petroleum distillate fuels are mixtures of aliphatic and aromatic hydrocarbons. The predominant classes of compounds in motor oil, gasoline, kerosene, and jet fuels are the paraffins (e.g., hexane, octane), naphthenes (e.g., cyclohexane), and aromatics (e.g., benzene, toluene). Gasoline contains about 80 percent paraffins, 6 percent naphthenes, and 14 percent aromatics. Kerosene and jet fuels contain 42-48 percent paraffins, 36-68 percent naphthenes, and 16-20 percent aromatics. Diesel fuels and heating oils contain less than 10 percent paraffins, 14-23 percent naphthenes, and 68-78 percent non-volatile aromatics. These heavier fuels contain almost no volatile aromatic compounds. Chemicals may be added to automotive and aviation fuels to improve their burning properties. Examples are tetraethyl-lead and ethylene dibromide.

3.1 Flammability

Crude oil and petroleum distillate fuels possess two intrinsic hazardous properties, namely, flammability and toxicity. The flammable property of the oil and fuels presents a far greater hazard to field personnel than toxicity. Being flammable, the vapors of volatile components of crude oil and the fuels can also be explosive when confined.

The lower explosive limits (LEL) of the fuels listed in Section 2.1 range from 0.6 percent for JP-5 to 1.4 percent for gasoline. Flash points range from -36°F for gasoline to greater than 150°F for No. 6 fuel oil. JP-5 has a flashpoint of 140°F. Although it has a lower LEL than gasoline, it can be considered less hazardous because its vapors must be heated to a higher temperature to ignite.

Crude oil and petroleum distillate fuels will not burn in the liquid form; only the vapors will burn and only if the vapor concentration is between the upper and lower explosive limits, sufficient oxygen is present, and an ignition source is present. If these conditions occur in a confined area, an explosion may result.

The probability of fire and explosion can be minimized by eliminating any one of the three factors needed to produce combustion. Two of the factors -- ignition source and vapor concentration -- can be controlled in many cases. Ignition can be controlled by prohibiting open fires and smoking on site, installing spark arrestors on drill rig engines, and turning the engines off when LELs are approached. Vapor concentrations can be reduced by using fans. In fuel tanks, vapor concentrations in the head space can be reduced by introducing dry ice (solid carbon dioxide) into the tank; the carbon dioxide gas will displace the combustible vapors and oxygen.

3.2 Toxicity

Crude oil and petroleum distillate fuels exhibit relatively low acute inhalation and dermal toxicity. Concentrations of 160 to 270 ppm gasoline vapor have been reported to cause eye, nose, and throat irritation after several hours of exposure. Levels of 500 to 900 ppm can cause irritation and dizziness in one hour, and 2000 ppm produced mild anesthesia in 30 minutes. Most fuels, particularly gasoline, kerosene, and jet fuels, are capable of causing skin irritation after several hours contact with the skin.

Some of the additives to gasoline, such as ethylene dichloride, ethylene dibromide, and tetraethyl and tetramethyl lead, are highly toxic; however, they are present in low concentrations and their contribution to the overall toxicity of gasoline and other fuels is negligible in most instances.

3.3 Exposure Limits

OSHA has developed permissible workplace exposure limits of 300 ppm for gasoline. It has also established permissible exposure limits for individual components, such as benzene. ACGIH has established a permissible exposure limit of 300 ppm for gasoline. The limit took into consideration the average concentration of benzene in gasoline (1 percent) as well as its common additives. There are no exposure limits established for other petroleum fuels.

3.4 Physical Hazards

Various physical hazards may be associated with the activities outlined in Section 2.2. These include, but are not limited to, drill rig operational hazards, excavating and heavy equipment, excessive noise, heat and cold stress, underground and aboveground utilities, and fires. The anticipated hazards for this project are included in the General Information section of the site safety plan. Recommended safety practices are discussed in specific attachments to this plan.

4.0 HEALTH AND SAFETY

4.1 Personnel Clearance

4.1.1 Medical Surveillance

Personnel on-site must be certified by a physician as being physically fit to wear respiratory protective devices and to perform their assigned field work. This should be conducted through a medical surveillance program meeting the requirements of 29CFR1910.120 (f).

4.1.2 Training Requirements

All personnel exposed to site health and safety hazards must be certified as having successfully completed, as a minimum, an off-site training course meeting requirements of 29CFR1910.120 (e) for field personnel. Supervisory and refresher training must have been completed, as necessary, for applicable site personnel.

4.2 Site-Specific Safety Briefing

Before field work begins, all field personnel, including subcontractor employees, must be briefed on their work assignments and safety procedures contained in this document. Each must be provided with a copy of this document and submit a signed safety compliance agreement before commencing work. Individuals refusing to sign the agreement will be prohibited from working on the site.

4.3 Personnel Protective Equipment

4.3.1 Recommended Equipment

- NIOSH-approved full- or half-face respirator with organic vapor cartridges
- Saranex- or polyethylene-coated Tyvek coveralls
- Splash-proof safety goggles or glasses with full side shields
- Nitrile or neoprene gloves
- Neoprene or butyl boots, calf-length with steel toe and shank
- Hardhat

4.3.2 Equipment Usage

Chemical-resistant safety boots must be worn during the performance of work where surface soil is obviously contaminated with oil or fuel, when product quantities of oil or fuel are likely to be encountered, and within 10 feet of operating heavy equipment.

Respirators must be worn whenever total airborne hydrocarbon levels in the breathing zone of field personnel reach or exceed a 15-minute average of 25 ppm. If total airborne hydrocarbons in the breathing zone exceed 100 ppm, work must be suspended, personnel directed to move a safe distance from the source, and the DHS or designee consulted.

Chemical resistant gloves must be worn whenever soil or water known or suspected of containing petroleum hydrocarbons is collected or otherwise handled.

Chemical resistant coveralls must be worn whenever product quantities of fuel are actually encountered and when oil- or fuel-saturated soil is handled.

Safety glasses must be worn when working within 10 feet of any operating heavy equipment (e.g., drill rig, backhoe). Splash-proof goggles or face shields must be worn whenever product quantities of oil or fuel are encountered.

Hardhats must be worn when working with or in the vicinity of an operating drill rig, backhoe, or other heavy equipment.

Operators of some facilities, such as refineries, often require all personnel working within facility boundaries to wear certain specified safety equipment. Such requirements shall be strictly observed by Simon Hydro-Search personnel and its subcontractors.

5.0 ENVIRONMENTAL MONITORING

5.1 Required Equipment

- Organic vapor meter with flame- or photoionization detector
- Combustible gas meter

5.2 Monitoring Requirements and Guidelines

Vapor monitoring shall be performed as often as necessary and whenever necessary to protect field personnel from hazardous vapors. Monitoring must be performed by individuals trained in the use and care of the monitoring equipment.

During drilling operations, vapor emissions from boreholes must be measured whenever the auger is removed from the boring and whenever flights are added or removed from hollow-stem augers. This requirement does not apply to borings less than five feet deep and borings of any depth made to install monitoring wells in uncontaminated soils. Measurements should be made initially with an organic vapor meter, followed with a combustible gas meter if vapor levels exceed the highest concentration measurable with the organic vapor meter.

Initially, measurements shall be made about 12 inches from the borehole, both upwind and downwind positions. If the total hydrocarbon concentrations exceed the respirator use action level (See Section 4.3.2), measurements must be made in the breathing zone of the individual(s) working closest to the borehole. Decisions regarding respiratory protection should be made using vapor concentrations in the breathing zone.

If total organic vapor concentrations within 12 inches of the borehole exceed the capacity of the organic vapor meter, a combustible gas meter (CGM) must be used to determine if explosive conditions exist. Operations must be suspended, the drill rig motor shut down, and corrective action taken if combustible gas concentrations reach 25 percent of LEL within a 12-inch radius of the borehole or 10 percent of LEL at a distance greater than 24 inches from the borehole. This procedure must also be followed whenever the organic vapor meter goes offscale at its highest range and no CGM is available. If corrective action cannot be taken, field personnel and all other individuals in the vicinity of the borehole must be directed to move to a safe area and the local fire department and facility management must be alerted.

Instruments used on-site must be maintained and calibrated in accordance with manufacturers requirements. Instrument manuals with calibration instructions shall be taken to each site with the instrument.

6.0 AREA CONTROL/WORK ZONES

Access to hazardous and potential hazardous areas of spill sites must be controlled to reduce the probability of occurrence of physical injury and chemical exposure of field personnel, visitors, and the public. A hazardous or potentially hazardous area includes any area where (1) field personnel are required to wear respirators, (2) borings are being drilled with powered augers, and (3) excavating operations with heavy equipment are being performed.

The boundaries of hazardous and potentially hazardous areas must be identified by cordons, barricades, or emergency traffic cones or posts, depending on conditions. If such areas are left unattended, signs warning of danger and forbidding entry must be placed around the perimeter if the areas are accessible to the public. Trenches and other large holes must be guarded with wooded or metal barricades spaced no further than 20 feet apart and connected with yellow or yellow and black nylon tape not less than 3/4-inch wide. The barricades must be placed no less than two feet from the edge of the excavation or hole.

Entry to hazardous areas shall be limited to individuals who must work in those areas. Unofficial visitors must not be permitted to enter hazardous area while work in those areas is in progress. Official visitors should be discouraged from entering hazardous areas, but may be allowed to enter only if they agree to abide by the provisions of this document, follow orders issued by the site safety officer, and are informed of the potential dangers that could be encountered in the areas.

7.0 DECONTAMINATION

Recommended decontamination procedures for personnel and equipment is as follows.

7.1 Personnel

Gasoline, kerosene, jet fuel, heating oil, gasohol, and diesel oil should be removed from skin using a mild detergent and water. Hot water is more effective than cold. Liquid dishwashing detergent is more effective than hand soap. Motor oil and the heavier fuel oils (No. 4-6) can be removed with dishwashing detergent and hot water also; however, if weathered to an asphaltic condition, mechanic's waterless hand cleaner is recommended for initial cleaning followed by detergent and water.

7.2 Equipment

Gloves, respirators, hardhats, boots and goggles should be cleaned as described under personnel; however, if boots do not become clean after washing with detergent and water, wash them with a strong solution of trisodium phosphate and hot water.

Sampling equipment, augers, vehicle undercarriages, and tires should be steam cleaned. The steam cleaner is a convenient source of hot water for personnel and protective equipment cleaning.

8.0 SMOKING

Smoking and open flames are strictly prohibited at sites under investigation.

9.0 PREPARATION OF TANKS

The procedures to be used by the firm responsible for tank removal/transport must agree with procedures recommended by the American Petroleum Institute. If the firm's procedures, especially those addressing removal/inactivation of flammable vapors, disagree substantially with API's procedures, the PM must be notified immediately (by telephone if possible). In turn, the PM shall inform the client that Simon Hydro-Search personnel will not report to the site during tank removal/transport operations unless proper procedures are used. If the firm responsible for tank removal/transport is under subcontract to Simon Hydro-Search, it must be required to follow API procedures.

10.0 EMERGENCY RESPONSE

The following summarizes standard procedures to be followed in the event of an emergency. All responses must be coordinated through the designated on-site project manager. First-aid may only be administered by a certified first-aid provider (see Form HSP-3, General Information).

Fire: Stop work, shut off equipment, and evacuate to safe distance (Simon Hydro-Search vehicle should be kept at a reasonable distance from work area to prevent endangerment from fire). Contact fire department, then Simon Hydro-Search. Keep at a safe distance until emergency services arrive. No fire fighting beyond incipient fires will be attempted!

Injury/Illness: Perform first aid, if possible, and call EMS. Do not move if broken bones are suspected unless life is endangered. If person is safe to move (minor cuts, burns, etc.), transport person to hospital. If serious, arrange for rescue squad.

Overexposure: Remove employee (only if there is no danger to rescue) from exposure source to location of fresh air. Contact rescue squad/ambulance as necessary. Do not continue work until source of contamination is found, identified, and controlled. Contact Simon Hydro-Search office for technical assistance.

Hazardous Materials Accident: Stop equipment and work. Relocate to safe distance. To the extent possible, determine nature of incident (utility, gas, pipe, etc.). Contact Simon Hydro-Search offices for instructions. Do not attempt equipment backout from utility strike without guidance of utility company.

11.0 ACCIDENT REPORTING

Form AI-1 must be completed and delivered to the Director of Health Sciences for each accident or incident involving Simon Hydro-Search personnel. Near misses must be reported on form AI-2. These forms are available from the office Health and Safety Coordinator.

SIMON HYDRO-SEARCH
SITE STANDARD SAFETY
OPERATING PROCEDURES

To prevent injuries and health effects, the following safe work practices are to be followed with dealing with known or unknown site hazards. These practices establish a pattern of general precautions and measures for reducing the risks associated with response operations. This list is not inclusive and shall be amended as necessary.

1. Eating, drinking, chewing gum, or tobacco, taking medications, and smoking are prohibited in the contaminated or potentially contaminated area, or where the possibility for the transfer of contamination exists.

2. Upon leaving contaminated or suspected contaminated areas, the hands and face must be thoroughly washed. A thorough shower and washing must be taken should excessive body contamination occur.

3. Avoid contact with potentially contaminated substances. Do not walk thorugh puddles, pools, mud, etc. Avoid, whenever possible, kneeling on the ground, leaning or sitting on drums, equipment, or ground. Do not place monitoring equipment on potentially contaminated surface.

4. No beard or facial hair which interferes with satisfactory qualitative respirator fit test may be worn.

5. Be familiar, knowledgeable, and adhere to all instructions in the Site Health and Safety Plan. As a minimum, a safety meeting will be held at the start of each project to discuss this plan. Additional meetings will be held, as necessary to address new or continuing safety and health concerns.

6. Be aware of the location of all emergency phone numbers.

SITE STANDARD SAFETY OPERATING PROCEDURES (Cont.)

7. All personnel going on-site shall be briefed on the anticipated hazards, equipment requirements, safety practices, emergency procedures, and communication methods.

8. Entrance and exit routes should be planned, and emergency escape routes delineated.

9. Unfamiliar operations should be rehearsed prior to implementation.

10. Whenever respiratory protective equipment is in use, the buddy system must be used. Buddies should prearrange hand signals or other means of emergency communication in case of lack of radios or radio breakdown.

11. Visual contact must be maintained between pairs on-site with the team members remaining in close proximity in order to assist each other in case of emergencies.

12. The number of personnel and equipment in the contaminated area will be minimized consistent with site operations.

13. Appropriate work areas should be established for support, contamination, reduction, and exclusion areas.

14. Establish appropriate decontamination procedures for leaving the site.

15. Report all injuries or illnesses, unsafe conditions, practices or equipment immediately to the site safety coordinator.

SITE STANDARD SAFETY OPERATING PROCEDURES (Cont.)

16. A portion of the site "field book" will be maintained as a project safety log. The project safety log will be used to record the names, entry and exit dates, and time of all Simon Hydro-Search and subcontractor personnel, and of project site visitors; air quality and personal exposure monitoring data; and other information related to safety matters. All accidents, illnesses or other incidents shall be reported immediately to the Operations Manager and to the Simon Hydro-Search Health and Safety Officer.