

Attachment 12

Groundwater and Surface Water Monitoring Programs

**GROUNDWATER AND SURFACE WATER
SAMPLING & ANALYSIS PLAN
EQ RESOURCE RECOVERY, INC.**

Revision 5.2, January 30, 2007

1.0 INTRODUCTION

The following sampling & analysis plan describes the standard protocol for the collection and analysis of ground water and surface water samples at EQ Resource Recovery, Inc. (EQRR). The monitoring activities described in this plan are required by the Operating License issued under Part 111 of Michigan Public Act 451 by the Michigan Department of Environmental Quality (MDEQ). This revision was prepared to incorporate constituents identified during Appendix IX analysis groundwater samples and to correct minor technical errors within the original revision. The previous revision was prepared to account for changes in site conditions brought about by the implementation of interim corrective measures along part of the east site boundary. Any deviations to the procedures and protocols contained herein must be approved in advance by MDEQ, and if permanent deviations, be incorporated into a revised plan to be reviewed and approved.

The monitoring program for EQRR consists of three components: site ground water quality monitoring, site ground water level monitoring, and surface water quality monitoring of the Trouton Drain. Groundwater quality is monitored in the saturated portion of a relatively thin layer of silty sand that is found at the ground surface to a depth of around 10 feet over the entire facility property except for part of the east site boundary where this unit was replaced with a clay dike keyed into the underlying clay. This area is shown on Figure 1 of this plan. No groundwater monitoring can be conducted in this area. The areas that will be monitored include locations where the sand unit is present and protected only by an asphalt barrier wall constructed to impede the flow of groundwater along the downgradient portions of the site. The groundwater level monitoring program serves as a means to determine flow directions and head levels at key points in the containment system that was installed to prevent on site groundwater from discharging into Trouton Drain. Surface water is monitored in Trouton Drain, a shallow storm drain that is the discharge area for any shallow groundwater flowing off site.

The sampling and field measurements are to be conducted by a trained Environmental Monitoring Technician or equivalent. The monitoring technician is responsible for performing these tasks in accordance with this sampling plan and in accordance with any applicable operating license conditions. The technician is also responsible for maintaining all required records and logs as outlined in Section 10 of this document.

2.0 SAMPLING LOCATIONS

Ground water samples will be collected from five monitoring wells (OW-107, MW-16, OW-22, OW-104 and OW-105) located outside of the asphalt based slurry wall along the east and south site boundary. Enhanced monitoring as identified within the operating permit will additionally be performed at monitoring wells (OW-11R, OW-9, and P-9) that are located on the inside the asphalt based slurry wall along the southeast and south site boundary. These areas are the natural downgradient direction at the site and the likely path of groundwater diverted by the clay dike. All eight of these wells are designated as sampling points on Table 1 and the locations of these wells are shown on Figure 1 Monitoring Well Location Map. The underdrain collection basin will also be sampled for the purpose of tracking the quality of groundwater collected inside the barrier wall.

To monitor the hydraulic conditions in the area of the barrier wall/under drain system, static water level measurements will be collected at the each of the wells, piezometers and manholes listed on Table 1. A description of how data from the wells will be utilized is included on the Table 1 (e.g. some wells are used only to construct water contour maps while others are used to assess gradients across the barrier wall). Well logs (if available) for the monitoring wells and piezometers are included in Appendix A.

Surface water samples will be collected from two permanent locations and one temporary location along Trouton Drain. For the permanent locations, the upstream location, SW-NE, is near the culvert where Trouton Drain passes beneath Van Born Road and the downstream location, SW-SE, is near MW-16 near the southeast corner of the site. These locations are also shown on the Figure 1. Temporarily, a third location, SW-TEMP located just south of the sediment trap at the downstream limit of the clay dike, will be monitored as well. EQRR will petition for removal of this location, if appropriate, when final corrective actions have been formulated.

3.0 SAMPLING FREQUENCY

Groundwater samples will be collected quarterly from the monitoring wells listed on Table 1 and semi-annually from the underdrain sump to monitor the composition of the ground water collected by the underdrain system. Surface water samples will be collected on approximately a quarterly basis as these samples must be collected within 24 hours subsequent to a 24 hour 0.5 inch precipitation event and when sufficient water is present within the drain to collect a sample. Therefore, the timing of sample collection may sometimes become skewed toward the wetter seasons of the year.

Static water levels at all of the wells, piezometers, and manholes listed on Table 1 are to be collected monthly. The data will be evaluated for the following: 1) evidence of outward gradients at any of barrier wall well pairs listed on Table 1, and 2) build-up of head in the area between the old asphalt barrier wall and the new clay dike. This gradient information will be used to assess the performance of the underdrain system and to evaluate the significance of any statistically significant increases found to occur in wells outside the wall. Water levels between the wall and the dike will be monitored to determine if there is a head build up in this area that would warrant head lowering measures.

4.0 MONITORING PARAMETERS

The list of ground water monitoring parameters to be analyzed in each sample is presented on Table 2. This list was developed from a detailed evaluation of on-site contamination. The list is updated by this revision to include 40 CFR Part 264 Appendix IX constituents identified during recent sampling events. During the eight quarters of background data collection, all primary, secondary and tertiary parameters will be analyzed. Following background, the frequency of monitoring for each parameter will be that shown on Table 2. The parameter list for the analysis of surface water samples is included on Table 3 and was developed in a similar fashion. Also, additional parameters from the primary and secondary ground water parameter list may be added to the surface water list if confirmed statistically significant concentrations of additional parameters are found in the ground water samples.

5.0 STATIC WATER LEVEL MEASUREMENTS AND WELL PURGING

During each water level survey, and prior to well purging during sampling, static water levels will be collected utilizing an electric water level indicator capable of 0.01 ft. precision. Measurements will be made from the surveyed part of the casing top, which is the north side of the casing top, and repeated several times to ensure that a reproducible water level is attained. The top of casings is surveyed relative to permanent USGS datum. Water levels will be measured to the nearest 0.01 ft. The probe and any submerged portion of the cable must be scrubbed with a detergent solution and then rinsed thoroughly with distilled water between each well. Measurements from all of the wells will be collected on the same day.

Well purging prior to sampling will be completed utilizing a disposable bailer. At least 3 well casing volumes of water will be removed prior to sampling, or the well will be purged dry. As all of the wells are 2-inch diameter wells, the volume to be removed can be estimated by the following equation:

$$\text{Volume Removed (gal)} = \text{Height of Water Column (ft)} * 0.5$$

The height of the water column is determined from the static water level and the total well depth. The volume purged will be recorded in a bucket of known volume. The purge water collected will be delivered to one of the manholes for the under drain. If the well purges dry, the recovery rate will be recorded to determine how long the well must recover before sampling. Samples will be collected within 1 day of purging, or sooner if recovery rates allow.

6.0 SAMPLING PROCEDURES

Ground water samples will be collected with disposable bailers composed of inert high-density polyethylene and equipped with a VOC sample delivery valve. This material has been shown to be suitable for collecting samples containing the parameters included in this program. A new bailer will be used to purge and sample each well and will be discarded after a single use. Samples will be delivered to the appropriate bottles as described on Table 4, which must be provided certified clean by the laboratory with appropriate preservatives. Samples to be analyzed for organic compounds (primary compounds) are collected first followed by metals (secondary parameters) and then

indicator parameters (tertiary parameters). In this way the most important samples are collected first in case the sample volume produced by the well is inadequate.

The sample collected for VOC analysis must be delivered to the sample vial while attempting to minimize turbulence to the sample. The vials must be filled to the top leaving no headspace. All sample bottles must be filled carefully with effort made to ensure no dirt or other foreign particulates end up in the sample. Samples collected will be immediately labeled and placed in an iced cooler. Samples to be analyzed for dissolved metals can be field filtered with a 0.45 µm in-line filter cartridge and preserved with a couple of drops of reagent grade HNO₃ to a pH of less than 2.

Surface water samples can be collected by direct access to the drain. To allow confirmation of an apparent impact to surface water, two sets of samples will be collected during each sampling event. The first set will be collected approximately 2 hours before the second. Only the first set must be analyzed and reported. However, if there is an apparent statistically significant increase, the second sample will be used for confirmation. Samples will be collected within the appropriate containers as described for the ground water samples.

7.0 FIELD MEASUREMENTS

Field measurements of pH, specific conductance, and temperature will be collected on both ground water and surface water samples using an YSI Model 3560 water quality monitoring system, or equivalent. A two-point calibration will be used for the pH meter. Measurements will be made on a small volume of sample collected in a clean plastic container. This sample will be discarded with the purge water after the measurements are completed. The instrument will be calibrated prior to each days sampling activities. The calibration step will be logged in the Equipment Inventory, Repair, and Calibration Log maintained by the Environmental Monitoring Technician.

8.0 ANALYTICAL PROCEDURES

The analytical procedures (referenced) and normally attainable detection limits for the ground water and surface water parameters are listed on Table 5. Some of these detection limits will not be attainable in the samples from the underdrain due to the required amount of sample dilution. The samples will be analyzed by Trimatrix Laboratories of Lansing, Michigan or another comparable lab. Holding times for the various parameters are included on Table 4.

9.0 QUALITY ASSURANCE/QUALITY CONTROL

Field QA/QC procedures will include the collection of blind duplicate samples and blanks. One blind duplicate sample will be collected annually for the groundwater program and for the surface water monitoring program. At least one trip blank will be maintained for each day of sampling (ground water or surface water) and field blanks for VOC's will be maintained for each sample collected. During each sampling event, the trip blank and one randomly selected field blank will be analyzed.

The laboratory QA/QC procedures are explained in detail in the Quality Assurance Manual for TRIMATRIX included as Appendix B. This manual describes the internal policies, guidelines and procedures of TRIMATRIX. This manual is not intended to describe the specific details of this particular monitoring program. Rather, this document is used as a guideline in evaluating TRIMATRIX's QA/QC and standard operating procedures to ensure that generally acceptable practices are employed.

10. RECORD KEEPING AND CHAIN OF CUSTODY CONTROL

Record keeping during sampling will be conducted at all times. Records will include notes taken in a field notebook, the standard chain of custody form, and the Equipment Inventory, Repair and Calibration Log. The field notebook shall contain, at a minimum, the following information:

1. The identity of all personnel involved in sample collection.

2. For each sample collected:
 - The sample location/well designation
 - The date and time each sample was collected
 - The static water level
 - Volume of water purged
 - Field measurements of pH, etc.
 - Visual observations of the condition of the sample

3. Any observations regarding the integrity of the monitoring or observation wells. Specifically, well assemblies should be inspected for damage to casings, locks, annular seals, and any evidence of tampering.

In the event that damage to a well is observed, a written report describing the damage and the necessary repairs must be submitted to the Site Manager or designee. With the exception of very minor repairs (e.g. replace a rusted lock, etc.) it may be necessary to notify MDEQ prior to making the repairs and in some cases obtain MDEQ approval prior to initiating the work.

The chain of custody form must be filled out to provide a complete record of the sample handling from the time of sample collection through the time of laboratory analysis. These forms are to accompany the samples to the laboratory. These forms must be filled out completely with sample information and must identify all persons who have been involved with the collection and shipping of the samples. If the samples change possession, both parties must sign and date the record at the time of the transfer. The lab keeps the original form and the sampler must obtain copies for EQRR files.

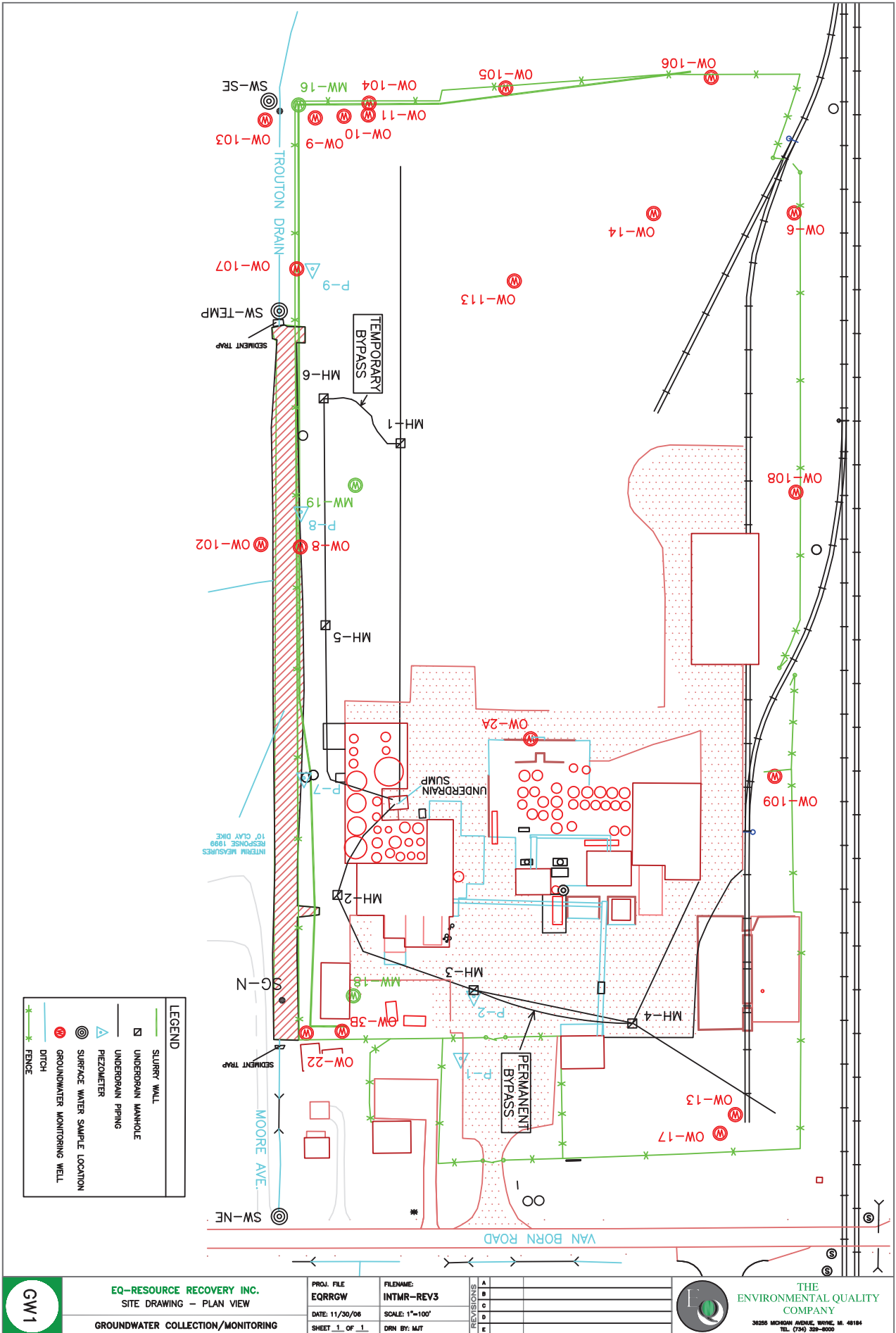
The Equipment Inventory, Repair and Calibration log must be maintained with the field monitoring equipment (e.g. pH meter, SWL meter, etc.) and should include the serial number of all equipment, a record of all equipment repairs or replacement, and a record of the calibrations performed.

11. DATA EVALUATION AND REPORTING REQUIREMENTS

The monitoring program for EQRR requires that reports be submitted to MDEQ on a timely basis for both background data evaluation and for routine monitoring. All groundwater quality analyses must be evaluated for evidence of statistically significant increases utilizing the statistical procedures outlined in Appendix C of this plan. In general, the following reporting requirements must be followed:

1. Quarterly ground water and surface water quality monitoring reports including analytical data and statistical analyses will be submitted to the Department within 60 days of the completion of each sampling event. However, if preliminary data from the laboratory suggests there may be organic contaminants within the waters of Trouton Drain, MDEQ will be notified of the results and apprised of any interim measures that EQRR elects to take to address the problem.
2. An annual report summarizing all monitoring activities must be submitted to the Department by March 1 of the following year.

Figure GW-1
Site Drawing – Plan View
Groundwater Collection/Monitoring



GW1

EQ-RESOURCE RECOVERY INC.
SITE DRAWING - PLAN VIEW
GROUNDWATER COLLECTION/MONITORING

PROJ. FILE
EQRRGW
DATE: 11/30/06
SHEET 1 OF 1

FILENAME:
INTMR-REV3
SCALE: 1"=100'
DRN BY: MJT



THE ENVIRONMENTAL QUALITY COMPANY
34255 HIGHWAY AVENUE, WILMINGTON, MICHIGAN 48184
TEL. (734) 328-8000

Tables

Table 1. Summary of Monitoring Well Information

Well I.D.	Date Installed	TOC	Depth (feet)	Paired with	Use
OW-2b	4/14/1982	668.19	9	---	SWL
OW-6	12/16/1975	666.90	7.3	---	SWL
OW-8		667.30		---	SWL
OW-9	1/16/1981	664.40	9	MW-16	SWL/HBM/GWQ
OW-10	1/16/1981	664.43	9	---	SWL
OW-11R	1/16/1981	664.26	9	OW-104	SWL/HBM/GWQ
OW-13	6/30/1982	666.89	8	---	---
OW-14	6/17/1983	667.66	7.5	---	SWL
OW-15R	11/1/1993	665.60	9	---	SWL
MW-16	***	664.19	***	OW-9	SWL/HBM/GWQ
OW-17	***	668.68	***	---	SWL
MW-18	4/26/1989	667.16	9	OW-22	SWL/HBM
MW-19	4/26/1989	669.78	11	---	SWL
OW-22		667.41		MW-18	SWL/HBM/GWQ
P-1	12/5/1990	664.99	7.9	---	SWL
P-2	12/5/1990	663.60	7.5	---	SWL
P-7		668.96		---	SWL
P-8		667.39		---	SWL
P-9		664.76		OW-107	SWL/HBM/GWQ
OW-102		664.38		---	---
OW-104	10/25/1994	664.00	8	OW-11R	SWL/HBM/GWQ
OW-105	10/25/1994	664.28	8	---	SWL/GWQ
OW-106	10/25/1994	665.56	9	---	SWL
OW-107	10/26/1994	663.38	8	P-9	SWL/HBM/GWQ
OW-108	9/6/1995	666.43	8	---	SWL
OW-109	9/6/1995	669.00	10	---	SWL
OW-113		664.20		---	SWL
MH-1	---	669.01	---	---	SWL
MH-2	---	664.14	---	---	SWL
MH-3	---	663.93	---	---	SWL
MH-4	---	664.73	---	---	SWL
MH-5	---	665.44	---	---	SWL
MH-6	---	668.61	---	---	SWL
Basin	---	666.26	---	---	---

SWL - Used to measure static water levels
 GWQ - Used to collect samples for groundwater quality monitoring
 HBM - Used to monitor performance of hydraulic barrier performance
 TBI - To be Installed
 *** no log available

Table 2. Groundwater Monitoring Parameters				
Primary Parameters	Quarterly	Annual	Secondary Parameters	Annual
Acetone	X		Arsenic	X
Benzene	X		* Antimony	X
Chlorobenzene	X		Barium	X
1,1-Dichloroethane	X		Cadmium	X
1,2-Dichloroethane	X		Cobalt	X
1,1-Dichloroethene	X		Chromium	X
Chloroethane	X		* Copper	X
1,2 Dichloroethene	X		Nickel	X
Ethylbenzene	X		Lead	X
Methylene Chloride	X		Vanadium	X
Tetrachloroethene	X		Selenium	X
Trichloroethene	X		Silver	X
1,1,1-Trichloroethane	X		Zinc	X
Toluene	X			
Total Xylenes	X		Tertiary Parameters	
Vinyl Chloride	X		Chloride	X
4-Methyl-2-Pentanone	X		Iron	X
2-Butanone (MEK)	X		Calcium	X
Isobutanol	X		Sulfate	X
* Benzyl Alcohol	X		Magnesium	X
* 2-Hexanone	X		Potassium	X
Benzoic Acid		X	Sodium	X
2,4-Dimethylphenol		X	Bicarbonate Alkalinity	X
Napthalene		X	Carbonate Alkalinity	X
2-Methylphenol		X	Phenolics	X
3&4 Methylphenol		X	Total Organic Carbon	X
Phenol		X	* Sulfide	X
o-toluidine		X		

* Constituents in bold type are updated per Appendix IX analysis of 1/11/2007 samples

Table 3. Surface Water Monitoring Parameters

Organic Parameters		
Acetone	1,2 Dichloroethene	Toluene
Benzene	Ethylbenzene	Total Xylenes
2-Butanone (MEK)	Methylene Chloride	Vinyl Chloride
1,1-Dichloroethane	Tetrachloroethene	Chloroethane
Isobutanol	4-Methyl-2-Pentanone	Napthalene
1,1-Dichloroethene	1,1,1-Trichloroethane	3&4 Methylphenol
Indicator Parameters		
Calcium	Sodium	Total Organic Carbon
Sulfate	Bicarbonate Alkalinity	Potassium
Chloride	Iron	

Table 4. Sample Preservation, Containerization and Holding Times

Constituent(s)	Volume (mL)	Preservation	Container	Holding Time
Chloride	100	none	plastic/glass	28 days
Sulfate	100	cool, 4 degrees C	plastic/glass	28 days
Alkalinity	100	cool, 4 degrees C	plastic/glass	14 days
Total Phenolics	1000	cool, 4 degrees C, H2SO4 pH<2	glass	28 days
Total Organic Carbon	100	cool, 4 degrees C, H2SO4 pH<2	glass	28 days
Dissolved Metals	200	filter 0.45 micron, pH <2 HNO3	plastic/glass	6 months
Volatile Organic Constituents	40 (2)	4 drops HCl, no headspace, cool	glass/teflon septa	14 days
Semi-volatile Organic Constituents	1000	cool, 4 degrees C	glass/teflon septa	7/40 days*

* 7days for extraction and 40 days for analysis

Table 5. Analytical Methods and Target Detection Limits

Constituent	Analytical Method	Target Detection Limit (mg/L)
Field Parameters		
pH	---	---
Specific Conductance	---	---
Temperature	---	---
Inorganic Parameters		
Chloride	4500/4110Cl	1.0
Iron	6010/7000	0.02
Calcium	6010/7000	0.2
Sulfate	4500/4110SO4	2.0
Magnesium	6010/7000	0.2
Potassium	6010/7000	0.2
Sodium	6010/7000	0.2
Bicarbonate Alkalinity	2320(B)	10.0
Carbonate Alkalinity	2320(B)	10.0
Phenolics	420	0.01
Total Organic Carbon	5310(C)	0.5
Sulfide	376.1	2.0
Antimony	6020(A)	0.001
Arsenic	6020(A)	0.001
Barium	6020(A)	0.02
Cadmium	6020(A)	0.0002
Chromium	6020(A)	0.02
Cobalt	6020(A)	0.001
Copper	6020(A)	0.001
Lead	6020(A)	0.001
Selenium	6020(A)	0.001
Silver	6020(A)	0.0005
Zinc	6020(A)	0.02
Organic Parameters		
Acetone	8260(B)	0.01
Benzene	8260(B)	0.001
Chlorobenzene	8260(B)	0.001
1,1-Dichloroethane	8260(B)	0.001
1,2-Dichloroethane	8260(B)	0.001
1,1-Dichloroethene	8260(B)	0.001
1,2 Dichloroethene	8260(B)	0.001
Ethylbenzene	8260(B)	0.001
Methylene Chloride	8260(B)	0.005
Tetrachloroethene	8260(B)	0.001
Trichloroethene	8260(B)	0.001
1,1,1-Trichloroethane	8260(B)	0.001
Toluene	8260(B)	0.001
Total Xylenes	8260(B)	0.003
Vinyl Chloride	8260(B)	0.005
4-Methyl-2-Pentanone (MIBK)	8260(B)	0.05
2-Butanone (MEK)	8260(B)	0.05
Isobutanol	8260(B)	1.0
2-Hexanone	8260(B)	0.025
3&4 Methylphenol	8270C	0.02
Napthalene	8270C	0.01
Benzoic Acid	8270C	0.05
2,4-Dimethylphenol	8270C	0.01
2-Methylphenol	8270C	0.01
Phenol	8270C	0.01
o-Toluidine	8270C	0.01
Benzyl Alcohol	8270C	0.005

Table 5
Rev 5.2

Appendix A
Monitoring Well Installation Logs

HECK CONSULTING SERVICES, INC.

"Ground Water Specialists"

4013 Dawn Avenue

East Lansing, Michigan 48823

(313) 382-8003

APPENDIX (3.)

SOIL BORING DATA

JOB NUMBER 416 DATE 12/16/75

OWNER Chemical Recovery Systems

LOCATION: State Michigan County Wayne Twp. Regulus

Section 5 T. 3 N.S.; R. 9 E.W.

Southeast corner of intersection between C & O Railroad and Van Born Road

MINERAL WELL PERMIT NUMBER: 500-752-132

AUGER: 4-inch 6-inch Profile Split-spoon

PLUGGING METHOD: Natural Materials
 Bentonite
 Cement

Geologist R. Hilty - G. Henry Field Ass't _____

BORING NUMBER 1 TOTAL DEPTH 10' S.W.L. (BGL) 2.43'

Sample Number	From to Feet	Lithologic Description
	0 - 2	Sand
	2 - 5	Clay
	5 - 10	Sand & Gravel
	10 -	Clay
		Ground Elevation = 110.27 ft (relative)

Piezometer: Screen 2' Pipe 8' Total Depth (BGL) 8.46'

JOB NUMBER 416 DATE 12/16/75 PAGE 2

BORING NUMBER 2 TOTAL DEPTH 11 S.W.L. (BGL) 2.11'

Sample Number	From to Feet	Lithologic Description
	0 - 11	Sand
	11 -	Clay
		Ground Elevation = 108.94 ft (relative)

Piezometer: Screen 2' Pipe 11' Total Depth (BGL) 10.56'

BORING NUMBER 3 TOTAL DEPTH 12 S.W.L. (BGL) 5.22

Sample Number	From to Feet	Lithologic Description
	0 - 12	Sand
	12 -	Clay
		Ground Elevation = 109.29 ft (relative)

Piezometer: Screen 2' Pipe 13' Total Depth (BGL) 11.86'

BORING NUMBER 4 TOTAL DEPTH 10' S.W.L. (BGL) 2.13'

Sample Number	From to Feet	Lithologic Description
	0 - 8	Sand
	8 - 10	Clay
		Ground Elevation: 103.99 ft (relative)

Piezometer: Screen 2' Pipe 8' Total Depth (BGL) 9.50

JOB NUMBER 416 DATE 12/15/75 PAGE 3

BORING NUMBER 5 TOTAL DEPTH 12' S.W.L. (BGL) 2.15'

Sample Number	From to Feet	Lithologic Description
	0 - 8	Sand
	8 - 12	Clay
		Ground Elevation = 106.35 ft (relative)

Piezometer: Screen 2' Pipe 8' Total Depth (BGL) 8.87'

BORING NUMBER 6 TOTAL DEPTH 10' S.W.L. (BGL) 0.71'

Sample Number	From to Feet	Lithologic Description
	0 - 10	Sand
	10 -	Clay
		Ground Elevation: 107.87 ft (relative)

Piezometer: Screen 2' Pipe 8' Total Depth (BGL) 7.27'

BORING NUMBER 7 TOTAL DEPTH 9' S.W.L. (BGL) 0

Sample Number	From to Feet	Lithologic Description
	0 - 8	Sand
	8 - 9	Clay
		Ground Elevation = 103.28 ft (relative)

Piezometer: Screen 2' Pipe 8' Total Depth (BGL) 8.40'

Figure B-4

JOB NUMBER 909

DATE February 7, 1990

PAGE 2

BORING NUMBER CW-4 West TOTAL DEPTH 15' S.W.L. (BGL)

Sample Number	From to Feet	Lithologic Description
	0 - 3	FILL: cement, clay & sand
1	3 - 13	SAND: fine w/silt, black-grey, strong odor, sat
	13 - 15	CLAY TILL: tight, grey, no sample
		Screened from 11-13'
		Sealed with bentonite

Piezometer: Screen 924-7 Pipe 14' Total Depth (BGL)

BORING NUMBER CW-4 South TOTAL DEPTH 10' S.W.L. (BGL)

Sample Number	From to Feet	Lithologic Description
1	0 - 2	SAND: high organics, silt, black, moist
2	2 - 8.5	SAND: med.-fn, strong odor, black, sat.
	8.5 - 10	CLAY TILL
		Screened from 6.5 - 8.5
		Sealed with bentonite

Piezometer: Screen 924-7 Pipe 10' Total Depth (BGL)

BORING NUMBER CW-3b TOTAL DEPTH 10' S.W.L. (BGL)

Sample Number	From to Feet	Lithologic Description
1	0 - 2	SANDY ORGANICS: grey, moist
2	2 - 8.5	SAND: fn.-silt, grey, strong odor, sat
3	8.5 - 10	CLAY TILL
		Screened from 6.5 - 8.5

Piezometer: Screen 924-7 Pipe 10' Total Depth (BGL)

KECK CONSULTING SERVICES, INC.

"Ground Water Specialists"

1099 Grand River

Williamston, Michigan 48898

(517) 655-4391

SOIL BORING DATA

JOB NUMBER 909 DATE 1/16/81

OWNER Chemical Recovery Systems, Inc.

LOCATION: State Michigan County Wayne Twp. Romulus

Section 5 T. 3 N. 30; R. 9 E. 1

MINERAL WELL PERMIT NUMBER: _____

AUGER: 4-inch 6-inch Profile Split-Spoon

LOGGING METHOD

- Natural Materials
- Bentonite
- Cement

Geologist J. Sheahan Field Ass't G. Ryan

BORING NUMBER OW-8 TOTAL DEPTH 11' S.W.L. (BGL) _____

Sample Number	From <u>0</u> to <u>11</u> Feet	Lithologic Description
	0 - 1	SAND; fine, yellow, moist
	1 - 4	SAND; fine, dk. gray, moist, slight odor
	4 - 5	SAND; very fine-fine, yellow, moist
	5 - 7	SAND; very fine-fine, gray, moist
	7 - 9	SAND; very fine-fine, gray, saturated
	9 - 11	CLAY; tight glacial till, w/angular small pebbles
		well screened 7 - 9 feet BGL
		grouted w/ 1/2 bag bentonite

KECK CONSULTING SERVICES, INC.

"Ground Water Specialists"

1099 Grand River

Williamston, Michigan 48895

(517) 655-4391

SOIL BORING DATA

JOB NUMBER 909 DATE 4/14/82

OWNER Chemical Recovery Systems, Inc.

LOCATION: State Michigan County Wayne Twp. Romulus
 Section 5 T. 3 N. XX; R. 9 E. XX

MINERAL WELL PERMIT NUMBER: _____

AUGER: 4-inch 6-inch Profile Split-Spoon

PLUGGING METHOD
 Natural Materials
 Bentonite
 Cement

Geologist J. Sheahan Field Ass't G. Ryan

BORING NUMBER CW-2 replacement TOTAL DEPTH 9.5' S.W.L. (BGL) _____

Sample Number	From <u>0</u> to <u>9.5</u> Feet	Lithologic Description
	0 - 1	TOPSOIL; dk., organic, very moist
	1 - 2.5	GRAVEL; fine w/fine sand, black, very moist
	2.5 - 5	SAND; fine w/silt, black, very moist
	5 - 7	SAND; fine w/silt, brown, saturated
	7 - 9	SAND; fine w/silt, gray, saturated
	9 - 9.5	CLAY FEEL; no sample
		grouted @ water table & surface w/1/2 bag bentonite each
		old CW-2 pulled - filled w/bentonite
		well screened 7 - 9 feet BGL



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well borings

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MEMBER

BORING NO. # 1 JOB NO. 14037 PROJECT CHEMICAL RECOVERY SYSTEMS, INC.

Ground Surface (Elev.) _____

Datum _____

CLIENT Ayres, Lewis, Norris & May, Inc. Location: Romulus, Michigan

Started 9 March 1988 Completed 9 March 1988

Driller B. Mancine, Sr.

ELEV.	DEPTH IN FEET	SAMPLE		STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_n	q_u
		TYPE	"N"						
				15"	Very Loose Moist Brown Sandy Topsoil-FILL		WATER ENCOUNTERED 15" AT COMPLETION 3'0"		
		LS	1	3'0"	Very Loose Wet Brown Extremely Fine Sand With Trace Of Pebbles & Vegetation-FILL		20.3	114	3
			2	4'6"	Plastic Moist Brown Sandy Clay With Trace Of Topsoil, Oil Soaked Clay, Silt, Weeds & Pebbles-FILL				
			3						
	5		5	8'0"	Medium Compact Wet Gray & Black Extremely Fine SAND		21.9	107	3
		LS	10						
			10						
			5						
	10	LS	5		Medium Compact Wet Gray Extremely Fine SAND With Occasional Pebbles		20.1	115	3
			6						
				12'0"					
			8		Stiff Moist Blue Sandy CLAY With Some Gravel & Pebbles				
	15	LS	12	15'0"			15.7	134	9330
			14						
					END OF BORING				
	20								
	25								
	30								

- "N" - Standard Penetration Resistance
- S.S. - 2" O.D. Split Spoon Sample
- L.S. - Sectional Liner Sample
- S.T. - Shelby Tube Sample
- B.S. - Bottle Sample
- H.S. - Hausel Sample
- W - H₂O% of dry weight
- γ_n - Natural Density lbs. cu. ft.
- q_u - Unconfined Compression lbs. sq. ft.
- W.L. - Water Level
- "H-N" - Hausel Penetration Resistance

Boring No. # 1 / 15

Figure B-14



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BORING NO. # 2 JOB NO. 14037 PROJECT CHEMICAL RECOVERY SYSTEMS, INC.
 Ground Surface (Elev.) _____
 Datum _____
 CLIENT Ayres, Lewis, Norris & May, Inc. Location Romulus, Michigan
 Started 9 March 1988 Completed 9 March 1988
 Driller B. Mancine, Sr.

ELEV.	DEPTH IN FEET	SAMPLE		STRATA CHANGE	SOIL CLASSIFICATION	W. L.	w	Y _n	q _u
		TYPE	"N"						
				10"	Loose Moist Brown & Black Fine Sand, Gravel, Wood Cinders & Pebbles-FILL				
		LS	2	2'6"	Loose Wet Brown & Black Topsoily Sand With Odor Of Possible Petroleum Or Gasoline-FILL				
			3	3'3"					
			8	4'0"					
			7	6'0"	Plastic Moist Brown Topsoily Clayey Sand With Small Trace Of Petroleum Odor-FILL				
		LS	12						
			21						
			12	Medium Compact Moist Brown Sandy TOPSOIL	Medium Compact Wet Brown Fine SAND	21.4	122	971	
		LS	16						
			21						
			15	13'0"	Compact Wet Brown, Gray, & Black Extremely Fine SAND				
		LS	23	15'0"	Extremely Stiff Moist Blue Sandy CLAY With Trace Of Pebbles				
			24		END OF BORING	14.5	136	10870	

WATER ENCOUNTERED 10"
AT COMPLETION 5'9"
AFTER
15.8 | 115 | 1650

- "N" - Standard Penetration Resistance
- S.S. - 2" O.D. Split Spoon Sample
- L.S. - Sectional Liner Sample
- S.T. - Shelby Tube Sample
- B.S. - Bottle Sample
- H.S. - Hausel Sample
- W - H₂O% of dry weight
- δ_n - Natural Density (lb. cu. ft.)
- q_u - Unconfined Compression (lb. sq. ft.)
- W.L. - Water Level
- "H-N" - Hausel Penetration Resistance

Boring No. # 2/1b

Figure B-15



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BORING NO. # 4 JOB NO. 14037 PROJECT CHEMICAL RECOVERY SYSTEMS, INC.

Ground Surface (Elev.) _____

Datum _____

CLIENT Ayres, Lewis, Norris & May, Inc. Location Romulus, Michigan

Started 9 March 1988 Completed 9 March 1988

Driller B. Mancine, Sr.

ELEV.	DEPTH IN FEET	SAMPLE TYPE	"N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	w	γ_n	q_u
					Loose Wet Black & Gray Fine Oil Soaked Sand & Weeds With Bits Of Debris & Light Petroleum Odor-FILL				
		LS	3	2'6"					
			1		Loose Moist Brown Fine SAND With Trace Of Vegetation & Petroleum Odor-Possible Fill				
			3	5'0"					
		LS	1		Loose Wet Brown & Gray Extremely Fine SAND				
			2	7'6"					
		LS	6		Medium Compact Wet Brown & Gray Fine To Extremely Fine SAND				
			8						
		LS	9						
				12'0"					
				13'0"	Compact Very Moist To Gray Extremely Fine SAND With Trace Of Silt & Blue Clay				
		LS	18						
			19	15'0"	Extremely Stiff Moist Blue Extremely Sandy CLAY With Large Lens Of Gray Fine Sand				
			23		END OF BORING				

WATER ENCOUNTERED 13" AT COMPLETION 4'9" AFTER

35.9	89	0
21.5	121	0
16.0	118	0
20.4	123	0

- "N" - Standard Penetration Resistance
- S.S. - 2" O.D. Split Spoon Sample
- L.S. - Sectional Liner Sample
- S.T. - Shelby Tube Sample
- B.S. - Bottle Sample
- H.S. - Hausel Sample
- W - H₂O% of dry weight
- δ_n - Natural Density-lbs. cu. ft.
- q_u - Unconfined Compression lbs. sq. ft.
- W.L. - Water Level
- "H-N" - Hausel Penetration Resistance

Boring No. # 4 / 15



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soil borings soil evaluation foundation investigation instrumentation

BORING NO. 6 JOB NO. 14037 PROJECT CHEMICAL RECOVERY SYSTEMS, INC.

Ground Surface (Elev.) _____

Datum _____

CLIENT Ayres, Lewis, Norris & May, Inc. Location Romulus, Michigan

Started 9 March 1988 Completed 9 March 1988

Driller B. Mancine, Sr.

ELEV.	DEPTH IN FEET	SAMPLE TYPE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	W	γ_n	c_u
			2 1/2"	Loose Wet Brown Fine Sand With Trace Of Pebbles, Gravel, Vegetation, & Topsoil-FILL		WATER ENCOUNTERED 2 1/2" AT COMPLETION 6'8" AFTER		
		LS	2'0"	Loose Moist To Wet Brown Extremely Fine SAND With Occasional Trace Of Vegetation-Possible Fill		18.5	117	0
		LS	6'0"	Loose Wet Black With Occasional Trace Of Gray Fine SAND With Petroleum Odor		22.4	120	0
		LS	8'0"	Medium Compact Wet Gray With Trace Of Brown Extremely Fine SAND With Petroleum Odor		20.8	123	0
		LS	11'6"	Medium Compact To Dense Wet Gray Fine SAND				
				Stiff Moist Blue Sandy CLAY With Trace Of Pebbles				
			15'0"	END OF BORING		14.3	120	6990

- "N" • Standard Penetration Resistance
- S.S. • 2" O.D. Split Spoon Sample
- L.S. • Sectional Liner Sample
- S.T. • Shelby Tube Sample
- B.S. • Bottle Sample
- H.S. • Hausel Sample
- W • H₂O% of dry weight
- γ_n • Natural Density-lbs. cu. ft.
- c_u • Unconfined Compression lbs. sq. ft.
- W.L. • Water Level
- "H-N" • Hausel Penetration Resistance

Boring No. 6/1b

Figure B-17



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BORING NO. # 7 JOB NO. 14037 PROJECT CHEMICAL RECOVERY SYSTEMS, INC.

Ground Surface (Elev.) _____

Datum _____

CLIENT Ayres, Lewis, Norris & May, Inc. Location: Romulus, Michigan

Started 11 March 1988 Completed 11 March 1988

Driller T. Byrnes

BOMBARDIER

ELEV.	DEPTH IN FEET	SAMPLE TYPE "N"	STRATA CHANGE	SOIL CLASSIFICATION	W. L.	w	γ_n	q_u
			6"	Soft Very Moist Brown Clayey SAND With Pebbles-Possible Fill		WATER ENCOUNTERED		
	2			Plastic To Firm Moist Brown & Dark Brown Varigated CLAY With Trace Of Vegetation & Occasional Pebble & Heavy Odor-Possible Fill		19.7	121	4170
	4	LS						
	5							
	6							
	6	LS						
	8		7'0"					
				END OF BORING				
	10	LS		Discontinued Because Of Contamination				
	15	LS						
	20							
	25							
	30							

"N" • Standard Penetration Resistance
S.S. • 2" O.Q. Split Spoon Sample
L.S. • Sectional Linear Sample
S.T. • Shelby Tube Sample
B.S. • Bottle Sample
H.S. • Hausel Sample

W • H₂O% of dry weight
 γ_n • Natural Density-lbs. cu. ft.
 q_u • Unconfined Compression lbs. sq. ft.
W.L. • Water Level
"H-N" • Hausel Penetration Resistance

Boring No. # 7/lb



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BORING NO. # 8 JOB NO. 14037 PROJECT CHEMICAL RECOVERY SYSTEMS, INC.

Ground Surface (Elev.) _____

Datum _____

CLIENT Ayres, Lewis, Norris & May, Inc. Location: Romulus, Michigan

Started 9 March 1988 Completed 9 March 1988

Driller B. Mancine, Sr.

ELEV.	DEPTH IN FEET	SAMPLE		STRATA CHANGE	SOIL CLASSIFICATION	W. L.	w	Y _n	q _u
		TYPE	"N"						
				18"	Loose Moist Brown Sandy TOPSOIL				
		LS	2						
			3	4'0"	Loose Very Moist Dark Brown Fine SAND With Trace Of Vegetation, Brown Fine Sand & Vegetation-Possible Fill		12.7	100	0
		LS	3						
	5		3	6'6"	Loose Wet Brown Extremely Fine SAND		20.5	114	0
		LS	6						
			6		Medium Compact Wet Brown To Gray Extremely Fine SAND				
	10	LS	13				19.2	118	0
			16						
			7	12'0"	Stiff Moist Blue Sandy CLAY With Trace Of Pebbles				
	15	LS	10						
			15	15'0"	END OF BORING		16.4	131	8150
	20								
	25								
	30								

"N" - Standard Penetration Resistance
 S.S. - 2" O.D. Split Spoon Sample
 L.S. - Sectional Liner Sample
 S.T. - Shelby Tube Sample
 B.S. - Bottle Sample
 H.S. - Hausel Sample

W - H₂O% of dry weight
 δ_n - Natural Density-lbs. cu. ft.
 q_u - Unconfined Compression lbs. sq. ft.
 W.L. - Water Level
 "H-N" - Hausel Penetration Resistance

Boring No. # 8 / 1b

Figure B-19

NTH Consultants, Ltd.

LOG OF TEST BORING NO OW-4A

Project Name MICHIGAN RECOVERY SYSTEMS, INC.

NTH Proj No. S0599 OW

Project Location ROMULUS TOWNSHIP, WAYNE COUNTY, MICHIGAN

Checked By R. K.

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. (FT)	SOIL TYPE	DEPTH (FT)	SAMPLE NO.	SOUNDS SANDS	STANDARD PENETRATION RESISTANCE (N)	MOISTURE CONTENT (PERCENT)	DENSITY (PCF)	SPT BLows
GROUND SURFACE ELEVATION: 66.7 FT								
66.0	TOPSOIL DARK BROWN SAND	1.0	S-1	2 2 5	7			
	MEDIUM COMPACT LIGHT BROWN SILTY SAND WITH TRACE OF CLAY	5.0	S-2	6 8 8	16			
65.5	MEDIUM COMPACT BLACK SILTY SAND WITH TRACE OF CLAY	8.0	S-3	6 7 5	12			
	VERY STIFF TO HARD GRAY SILTY CLAY WITH TRACE OF SAND AND TRACE OF GRAVEL	10.0	S-4	3 8 10	18			
65.0	END OF BORING	11.5	S-5	6 8 13	21			
64.5		15.0						
		20.0						

Total Depth : 11.5 FT
 Drilling Date : 12/04/90
 Inspector : C. ENDLER
 Contractor : G & D DRILLING COMPANY
 Caller : G. QUALLS

Plugging Procedure :
 OBSERVATION WELL NO. OW-4A INSTALLED IN THIS TEST BORING. SEE LOG OF OBSERVATION WELL INSTALLATION FOR DETAILS.

Water Level Observation :
 GROUNDWATER ENCOUNTERED AT 1.5' DURING DRILLING.

Drilling Method :
 MODIFIED DIEDRICH D-50 TRAILER-MOUNTED DRILLING RIG WITH A 3-3/4" INSIDE-DIAMETER, HOLLOW-STEM AUGER TO END OF BORING.

Figure B-23

NTH Consultants, Ltd.

OBSERVATION WELL NO. OW-4A

Project Name MICHIGAN RECOVERY SYSTEMS, INC.


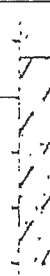
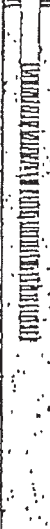
NTH Proj No SC593 OW

Project Location: ROMULUS TOWNSHIP, WAYNE COUNTY, MICHIGAN

Checked By: *P. Lee*

LOG OF OBSERVATION WELL

GROUNDWATER DATA

Generalized Subsurface Profile		Installation Schematic		Date	Ground-water Elev (ft)	Comments
ELEV. PRO- (FT)	GROUND SURFACE ELEVATION: 661.7	<input type="checkbox"/>	TOP OF WELL CASING ELEVATION: 664.11	12/05/90	659.00	
660	TOPSOIL SAND 1.0		BENTONITE PELLETS 2.0	12/06/90	658.93	
				12/11/90	658.78	
	LIGHT BROWN SILTY SAND 4.0		SILICA SAND	01/30/91	658.58	
655	BLACK SILTY SAND 8.0			03/19/91	658.58	
				04/18/91	658.36	
	GRAY SILTY CLAY 11.5			04/25/91	659.03	
650	END OF BORING		TIP ELEVATION: 651.7	05/02/91	658.58	
				05/09/91	658.46	
5-5				NOTES :		
				(1) FOR MORE DETAILED INFORMATION ON SUBSURFACE STRATA, SEE LOG OF TEST BORING OW-4A		
				(2) TOP OF CASING ELEVATION PROVIDED BY MICHIGAN RECOVERY SYSTEMS, INC. PERSONNEL		

Started: 12/04/90
 Completed: 12/04/90
 Inspector: C. ENDLER
 Driller: G. QUALLS
 Contractor: G & D DRILLING COMPANY
 Equipment: MODIFIED DIEDRICH D-50, TRAILER-MOUNTED
 Well Type: OBSERVATION

Casing Diameter: 2.0"
 Casing Length: 5.4'
 Casing Type: GALVANIZED STEEL
 Screen Diameter: 2.0"
 Screen Length: 5.0'
 Screen Mesh: 0.010"
 Screen Type: STAINLESS STEEL

NTH Consultants, Ltd.

LOG OF TEST BORING NO OW-8A

Project Name : MICHIGAN RECOVERY SYSTEMS, INC.

NTH Proj. No 90559 OW

Project Location : ROMULUS TOWNSHIP, WAYNE COUNTY, MICHIGAN

Checked By : *K. J.*

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. FT	DEPTH FT	GROUND SURFACE ELEVATION, 66.5 FT	SAMPLE NO.	ELEV. INCHES	PENETRATION RESISTANCE	WATER CONTENT		SOLIDS	LIQUID LIMIT	PLASTICITY INDEX
						WET	SHRUNK			
		GROUND SURFACE ELEVATION, 66.5 FT								
	0	TOPSOIL BROWN AND GRAY SILTY CLAY WITH LITTLE SAND	S-1	1 7						
	5	VERY LOOSE LIGHT BROWN SILTY SAND WITH TRACE OF CLAY, TRACE OF GRAVEL AND OCCASIONAL STREAKS OF BLACK SAND	S-2	2 2	4					
	5		S-3	2 1 3	4					
	7.5	MEDIUM COMPACT GRAY SILTY SAND WITH TRACE OF CLAY	BS-1							
	8.5		S-4	8 9 7	16					
	10	VERY STIFF TO HARD GRAY SILTY CLAY WITH TRACE OF SAND AND TRACE OF GRAVEL	S-5	8 12 15	27					
	11.5	END OF BORING								
	15									
	20									

Total Depth : 11.5 FT
 Drilling Date : 12/06/90
 Inspector : C. ENDLER
 Contractor : G & D DRILLING COMPANY
 Miller : G. QUALLS

Drilling Method :
 MODIFIED DIEDRICH D-50 TRAILER-MOUNTED DRILLING RIG WITH A 3-3/4" INSIDE-DIAMETER, HOLLOW-STEM AUGER TO END OF BORING.

Plugging Procedure :
 OBSERVATION WELL NO. OW-8A INSTALLED IN THIS TEST BORING. SEE LOG OF OBSERVATION WELL INSTALLATION FOR DETAILS.

Water Level Observation :
 GROUNDWATER ENCOUNTERED AT 5.5' DURING DRILLING.

Figure B-24

NTH Consultants, Ltd.

OBSERVATION WELL NO. OW-8A

Project Name : MICHIGAN RECOVERY SYSTEMS, INC.

NTH Proj. No 93589 OW

Project Location : ROMULUS TOWNSHIP, WAYNE COUNTY, MICHIGAN

Checked By *R. Lee*

LOG OF OBSERVATION WELL		GROUNDWATER DATA			
Generalized Subsurface Profile		Installation Schematic	Date	Ground-water Elev (ft)	Comments
ELEV PRO- GROUND SURFACE 1 FT FILE: ELEVATION: 664.5		TOP OF WELL CASING ELEVATION: 666.02	12/06/90	658.90	
	TOPSOIL SILTY CLAY 1.0	BENTONITE PELLETS	12/11/90	658.79	
			01/30/91	658.35	
			03/04/91	659.19	
			03/19/91	658.66	
			04/18/91	658.68	
			04/25/91	658.90	
			05/05/91	658.64	
			05/09/91	658.64	
660	VERY LOOSE SILTY SAND 7.5	SILICA SAND			
	MEDIUM COMPACT SILTY SAND 8.5				
655	SILTY CLAY 11.5				
	END OF BORING	TIP ELEVATION 656.0			
650					
645					

NOTES :
 (1) FOR MORE DETAILED INFORMATION ON SUBSURFACE STRATA, SEE LOG OF TEST BORING OW-2A
 (2) TOP OF CASING ELEVATION PROVIDED BY MICHIGAN RECOVERY SYSTEMS, INC PERSONNEL

Started: 12/06/90
 Completed: 12/06/90
 Inspector: C. ENDLER
 Driller: G. QUALLS
 Contractor: G & D DRILLING COMPANY
 Equipment: MODIFIED DIETRICH D-50, TRAILER-MOUNTED
 Well Type: OBSERVATION

Casing Diameter: 2.0"
 Casing Length: 5.0'
 Casing Type: GALVANIZED STEEL
 Screen Diameter: 2.0"
 Screen Length: 5.0'
 Screen Mesh: 0.010"
 Screen Type: STAINLESS STEEL

NTH Consultants, Ltd.

LOG OF TEST BORING NO. P-1

Project Name MICHIGAN RECOVERY SYSTEMS, INC.

NTH Proj No 90539 CW

Project Location ROMULUS TOWNSHIP, WAYNE COUNTY, MICHIGAN

Checked By *A. Lu*

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. (FT)	SOIL TYPE	DEPTH (FT)	SAMPLE TYPE NO	BLOWS/ SANDS	SPT PEN RESISTANCE (lb/in ²)	MOISTURE CONTENT (%)	UNIT WEIGHT (pcf)	CORRECTED SPT
564.0	FILL MEDIUM COMPACT BLACK SAND AND SANDY CLAY WITH GRAVEL BRICK FRAGMENTS AND ROOTS	0	S-1	8 20 7	27	-	-	-
552	MEDIUM COMPACT GRAY SILTY SAND WITH TRACE OF CLAY	8	S-2	5 8 10	18	-	-	-
545	VERY STIFF GRAY SILTY CLAY WITH TRACE OF SAND AND TRACE OF GRAVEL	10	S-3	8 9 12	21	-	-	-
545	END OF BORING	11.5	S-4	5 7 8	15	-	-	-
545		15	S-5	6 8 11	19	-	-	-
545		20						

Total Depth : 11.5 FT
 Drilling Date : 12/05/90
 Inspector : C. ENDLER
 Contractor : G & D DRILLING COMPANY
 Driller : G. QUALLS

Plugging Procedure :
 PIEZOMETER NO. P-1 INSTALLED IN THIS TEST BORING. SEE LOG OF PIEZOMETER INSTALLATION FOR DETAILS.

Water Level Observation :
 GROUNDWATER ENCOUNTERED AT 5.5' DURING DRILLING.

Drilling Method :
 MODIFIED DIEDRICH D-50 TRAILER-MOUNTED DRILLING RIG WITH A 3-3/4" INSIDE-DIAMETER, HOLLOW-STEM AUGER TO END OF BORING.

Figure B-25

LOG OF EXPLORATORY BORING

PROJECT NUMBER 220-2.1
 BY JB DATE 5/17/80

Page 2 of 2
 BORING NO. 24

SURFACE ELEV. 670.8

CLASSIFICATION DATA			FIELD DATA			Depth in Ft.	Ground Water Levels	Samples	DESCRIPTION
% Fines (No. 200)	Liquid Limit	Plasticity Index	Compressive Strength (TSF)	Penetration (Blows/Ft.)					
					45				
					50				
					55	▽			
					60				(SM) Gray silty very fine SAND wet, dense
					65				BOTTOM OF BORING

REMARKS: After completion of boring, bore hole was converted to a monitoring well with the installation of a 2" PVC casing to a depth of 52' 10". The bottom 5 feet of pipe was slotted at 3-inch intervals and the bottom 11 feet of annular space backfilled with pea gravel. A bentonite seal was placed above the gravel. The remainder of the



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LOG OF TEST BORING NO. P-1

Project Name: MICHIGAN RECOVERY SYSTEMS, INC.
 Project Location: ROMULUS TOWNSHIP, WAYNE COUNTY, MICHIGAN

NTH Proj No: 90559 CW
 Checked By: R. Lee

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. FT.	SOIL TYPE	GROUND SURFACE ELEVATION: 564.0 FT		DEPTH FT.	SAMPLE TYPE NO.	BLOWS/ SAND-25	SPT PEN RESISTANCE IN.	MOISTURE CONTENT PERCENT	SOLIDS DENSITY PCF	WATER BOUNDING
564.0	FILL	GROUND SURFACE ELEVATION: 564.0 FT								
		FILL MEDIUM COMPACT BLACK SAND AND SANDY CLAY WITH GRAVEL, BRICK FRAGMENTS AND ROOTS				S-1	8 20 7	27		
					30					
552		MEDIUM COMPACT GRAY SILTY SAND WITH TRACE OF CLAY			5	S-2	5 8 10	18		
					5					
		VERY STIFF GRAY SILTY CLAY WITH TRACE OF SAND AND TRACE OF GRAVEL			8	S-3	8 9 12	21		
					8					
549					10	S-4	5 7 8	15		
					10					
		END OF BORING			11.5	S-5	6 8 11	19		
					15					
					20					

Total Depth: 11.5 FT
 Drilling Date: 12/05/90
 Inspector: C. ENDLER
 Contractor: G & D DRILLING COMPANY
 Driller: G. QUALLS

Plugging Procedure:
 PIEZOMETER NO. P-1 INSTALLED IN THIS TEST BORING. SEE LOG OF PIEZOMETER INSTALLATION FOR DETAILS.

Water Level Observation:
 GROUNDWATER ENCOUNTERED AT 5.5' DURING DRILLING.

Drilling Method:
 SOILIED DIEDRICH D-50 TRAILER-MOUNTED DRILLING RIG WITH A 3-3/4" INSIDE-DIAMETER, HOLLOW-STEM AUGER TO END OF BORING.

Figure B-25

NTH Consultants, Ltd.

OBSERVATION WELL NO. OW-8A

Project Name : MICHIGAN RECOVERY SYSTEMS, INC.

NTH Proj. No 55595 OW

Project Location : ROMULUS TOWNSHIP, WAYNE COUNTY, MICHIGAN

Checked By *A. Lee*

LOG OF OBSERVATION WELL

GROUNDWATER DATA

Generalized Subsurface Profile		Installation Schematic		Date	Ground-water Elev. (ft)	Comments		
ELEV PRO- GROUND SURFACE (FT) FILE: ELEVATION: 664.5		TOP OF WELL CASING ELEVATION: 666.02		12/06/90	658.90			
TOPSOIL SILTY CLAY 1.0		BENTONITE PELLETS 2.0		12/11/90	658.79			
660 VERY LOOSE SILTY SAND 7.5	[Hatched Pattern]	[Vertical Line]	SILICA SAND	01/30/91	658.35			
				03/04/91	659.19			
				03/19/91	658.66			
				04/18/91	658.68			
				04/25/91	658.90			
				05/05/91	658.64			
MEDIUM COMPACT SILTY SAND 8.5				05/09/91	658.64			
655 SILTY CLAY 11.5				<p>NOTES :</p> <p>(1) FOR MORE DETAILED INFORMATION ON SUBSURFACE STRATA, SEE LOG OF TEST BORING OW-8A</p> <p>(2) TOP OF CASING ELEVATION PROVIDED BY MICHIGAN RECOVERY SYSTEMS, INC PERSONNEL</p>				
650 END OF BORING							11.5	
650								
645								
			TIP ELEVATION 656.0					

Started: 12/06/90
 Completed: 12/06/90
 Inspector: C. ENDLER
 Driller: G. QUALLS
 Contractor: G & D DRILLING COMPANY
 Equipment: MODIFIED DIETRICH D-50, TRAILER-MOUNTED
 Well Type: OBSERVATION

Casing Diameter: 2.0'
 Casing Length: 5.0'
 Casing Type: GALVANIZED STEEL
 Screen Diameter: 2.0'
 Screen Length: 5.0'
 Screen Mesh: 0.010"
 Screen Type: STAINLESS STEEL



PROJECT NO. 406-05015

PROJECT Soil Exploration

SURFACE ELEV 96.6+

DATE 2/29/80

LOCATION Rosulus, Michigan

Depth	Legend	SOIL DESCRIPTION	Penetration Blows per ft	Moisture %	Natural wt % CI	Org. Con wt % CI	Unit Comp Strength psf
0'9"		TOPSOIL with trace sand, black, moist					
1		Fine SAND, brown, wet, medium dense } some gravel	3				
2			5	22.7	121.1	98.7	-
3			8				
4			8				
5			13	21.1	125.0	103.2	-
6			19				
7			9				
8			12	21.1	127.4	105.2	-
9			15				
8'9"			Silty CLAY with few pebbles, blue, moist, very stiff	6			
10		8		16.3	135.4	116.4	-
11		13					(6000)
12							
13							
14							
15		6					
16		10		15.2	140.0	121.5	-
17		16					(7500)
18							
20'6"		End of Boring	6				
20			8	17.7	-	-	-
21			11				(4500)
22							
23							
24							
25							

TYPE OF SAMPLE
 D - DISTURBED
 U - UNDISTURBED
 L - LATEST LINEAR
 S - SPLIT SAMPLER

REMARKS:

GROUND WATER OBSERVATIONS
 GW ENCOUNTERED AT FT 9



JOB NO. 400-09015

PROJECT Soil Exploration

SURFACE ELEV. 100.2+ DATE 3-3-80

LOCATION Fenwick, Michigan

Depth	Legend	SOIL DESCRIPTION	Penetration Blow Count	Moisture %	Natural Wt. PCF	Org. Gra. Wt. PCF	UVC CL. 200/100 PSF
1							
10A UL	2	Fine SAND, brown, moist, medium dense Dense, wet	4				
	3		6	4.7	106.8	102.0	
	4		12				
10B UL	5		4				
	6		5	17.5	116.8	99.4	
	7		10				
10C UL	8		8				
	9		12	21.6	125.6	103.3	
	10		21				
10D UL	11		8				
	12	16	18.0	129.7	109.9		
	13	22					
	14						
	15	Silty CLAY with some pebbles, blue, moist, very stiff stiff	6				
10E UL	16		11	13.1	134.6	119.0	
	17		15				(9000)
	18						
	19						
10F UL	20		4				
	21		5	17.8	137.4	116.7	
	22		8				(4000)
	23						
	24						
	25						
		End of Boring					

TYPE OF SAMPLE
UNDISTURBED

REMARKS:

GROUND WATER OBSERVATIONS

Appendix C
Statistical Analysis Procedures

Appendix C Statistical Analysis Procedures

Background Statistics - Background statistics for the monitoring program were, or will be calculated from eight quarters of monitoring at each individual well at the facility. The backgrounds calculated are "intrawell" backgrounds based on data from each of the compliance wells at the site. Upon completion of background, the calculated background statistics will be submitted to MDEQ and become part of this monitoring plan.

Interim Statistics for Groundwater Quality Evaluation – Until background is completed, an interim statistical program will be used. For this program, the detection of any organic compound will be considered an apparent statistically significant increase that must be evaluated per license conditions.

Final Statistics for Ground Water Quality Evaluation - For the ground water quality monitoring program, EQRR uses either a combination Shewhart-Cusum control chart or a Non-Parametric Prediction Limit (NPPL) test for determining whether there is evidence of a statistically significant increase. The selection of the statistical method is based on degree of censorship. If the data are less than half BDL, then control charts are selected for that parameter. If the data are 50% or more BDL, then the NPPL test is used. During routine monitoring, statistics are conducted only on the primary parameters and secondary parameters. Tertiary parameters will be used to assist in evaluating apparent increases in primary and secondary parameters.

Control Charts - The combined Shewhart-CUSUM control chart is a powerful statistical technique appropriate for intrawell statistics. The Shewhart limit (U), or upper control limit will be set at 4.5, as recommended in the Interim Final Guidance for Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities (USEPA, 1989). The comparison statistic (Z) for each measured parameter is then calculated by:

$$Z = (x_b - x_m)/s_b$$

Where: x_b is the intrawell background mean

x_m is the measured concentration during detection monitoring

s_b is the standard deviation of the intrawell background

The value of Z is then simply compared to U (4.5) and if Z is greater than U then it is concluded that a statistically significant increase has occurred.

If a parameter exceeds the Shewhart limit, then, the well will be resampled in quadruplicate for the offending parameter. The mean of the quadruplicate analysis will be used to confirm whether the Shewhart limit is exceeded. If there is confirmation, then EQRR will conclude that there has been a statistically significant increase and report the results to the Department. If the increase is not confirmed, EQRR will resume normal routine monitoring and the unconfirmed measurement will be dropped from the control chart.

The CUSUM control chart will be constructed utilizing values of $k = 1$ and $h = 5$ as recommended by USEPA (1989). In the CUSUM procedure, the cumulative sum of the values for $Z - k$ are tabulated over time, each time a round of samples are analyzed. The value for Z is computed as described above. During each analysis subsequent to background, a value for $Z - k$ is computed and added to the previous total. As long as the cumulative total of $Z - k$ is a negative number; the cumulative sum (S) remains zero. As positive values accumulate, the value for S is compared to the selected value for h , in this case 5.0. If S is greater than h , then, a statistically significant event has occurred and resampling in quadruplicate will be initiated. The mean of the quadruplicate sample will then be used to determine whether this mean value would cause S to exceed h . If S exceeds h a second time, then, the increase is confirmed and appropriate measures will be taken as described above. If the increase is not confirmed, then, the mean of the quadruplicate replaces the result of the initial (unconfirmed) value within the CUSUM statistic.

Non-Parametric Prediction Limits - There are very limited alternatives for statistics for highly censored data. One method, which has been picking up support in RCRA programs, is a test based on non-parametric prediction limits. This approach defines an upper prediction limit and allows retesting as a means of controlling false positive rates. In the case of all BDL data, the upper prediction limit is merely the detection limit. In the case where there are some detectable values in the background, the upper prediction limit is defined as the maximum value measured during background. The number of retests allowed before concluding that there has been a confirmed statistically significant increase is a function of the number of wells and number of parameters and is designed to

control the facility-wide type II error rate at no more than 0.05 (or any other desired rate) per sampling event.

Surface Water Quality Evaluation - The statistical monitoring plan for surface water quality is designed to determine whether the surface water downstream of the facility is significantly degraded as compared to upstream surface water at the time of the sampling. To determine the statistical significance of differences in upstream versus downstream water quality, EQRR will use the sign test for inorganic parameters. For organics the test will simply be "is the compound present downstream and not upstream".

For the inorganic parameters, which will generally be present in detectable concentrations, the sign test will be performed at the 0.05 significance level to determine if the number of parameters that are present in the downstream samples in higher concentrations than the upstream sample is statistically significant. To perform the sign test, the downstream concentration of each inorganic monitoring parameter is compared to the upstream concentration for that sampling event. If the downstream concentration is higher, then, a "+" is assigned to that parameter; if the downstream concentration is lower, then, a "-" is assigned for that parameter; and if the concentrations are equal, then, a "0" is assigned for that parameter. The total number of "+" parameters and the total number of "-" parameters are then used with the binomial probability table shown as Table C-1 to determine if the number of "+" parameters is statistically significant. The table is entered at n, the total number of "+" and "-" parameters and the corresponding value for y is determined for the largest number for alpha that is than or equal to 0.05. This number y is the smallest number of "-" parameters that can be obtained without a statistically significant increase (e.g. if there are any less "-" parameters then there will be too many "+" parameters).

The detection of an organic parameter will be determined to be an apparent statistically significant increase if the parameter is detected downstream but not detected upstream. If an apparent statistically significant increase is indicated, it will be confirmed or refuted by the second sample collected during the sampling event. If it is not confirmed, the initial result will be considered an anomaly and routine monitoring will resume. If the results are repeated then EQRR will conclude that there has been a confirmed statistically significant increase, notify the Department, and attempt to determine the origin of the increase for the purpose of preventing future releases.