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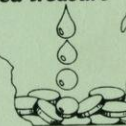
Wisconsin Groundwater Management Practice Monitoring Project No. 27

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Wisconsin Department of Natural Resources

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ENVIRONMENTAL INVESTIGATION
OF THE
CITY OF TWO RIVERS LANDFILLS
MANITOWOC COUNTY, WISCONSIN

June, 1986

Prepared For:

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REC'D DNR
JUL -7 1986
GREEN BAY

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1.0 EXECUTIVE SUMMARY

This report contains the results of an environmental investigation at the City of Two Rivers' North and South Landfills in Manitowoc County, Wisconsin. The main purposes of this investigation were to characterize the hydrogeologic setting and provide preliminary information on the extent of organic contamination.

The work conducted for this project included (1) drilling 17 boreholes, (2) installing and developing seven ground-water monitoring wells, and (3) screening soil and ground-water samples for organic vapors.

The findings indicate that the site is underlain by a low permeability silty, clayey till that is interbedded with sand units. Ground-water flow in the shallow interconnected sand units is west towards the East Twin River. Ground-water within the deep sand is confined by the overlying till and also flows west towards the river.

Organic vapors were detected during drilling and in soil and ground-water samples. Most detections of organic vapors occurred up and downgradient of the South Landfill.

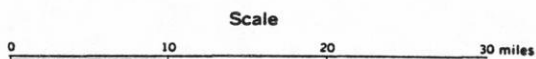
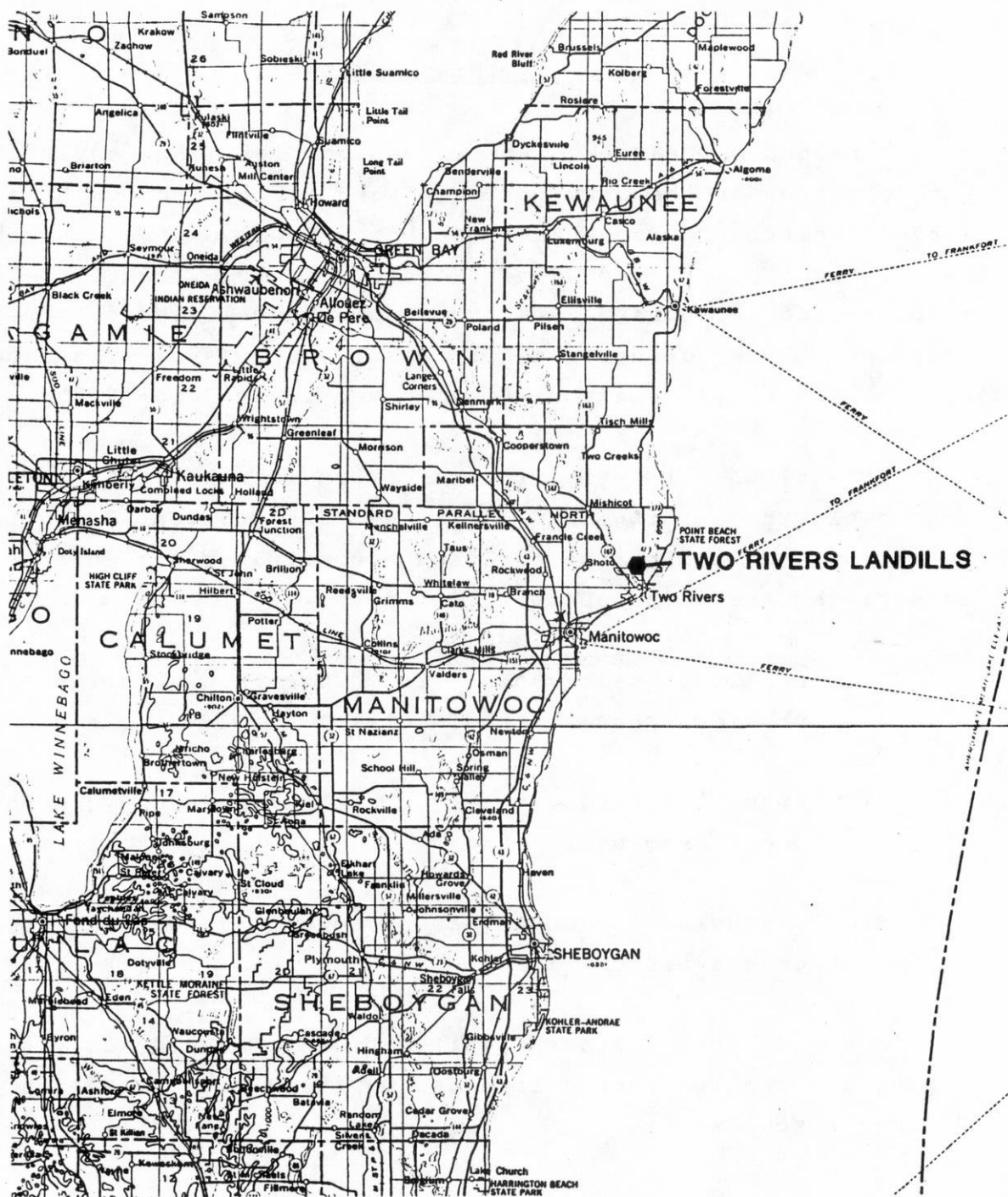
2.0 INTRODUCTION

This report presents the results of an environmental investigation of the City of Two Rivers North and South Landfill sites located in northeast Manitowoc County, Wisconsin (Figure 1). The City of Two Rivers operated the landfills which, according to Wisconsin Department of Natural Resources records, accepted unknown quantities of hazardous waste. The landfills were closed by placement of final cover in the mid-1970's.

The objectives of this investigation were to characterize the hydrogeologic setting and assess the extent of organic contamination within the soil and ground-water. To address these objectives, the scope of work included:

- 1) drilling test holes to determine stratigraphy and physical properties of soils,
- 2) installing and developing shallow and deep ground-water monitoring wells, and
- 3) measuring organic vapor concentration of soil and ground-water samples.

This scope of work and the specifications of field activities and report preparation were delineated by the Wisconsin Department of Natural Resources.



Contour Interval 200 feet
Datum is mean sea level

LEGEND

- State capital
- County seat
- City, village, or place
- ✈ Scheduled service airport
- Built-up area shown for cities over 10,000 population
- County boundary
- Interstate highway
- U.S. highway
- State highway
- Other principal roads

Two Rivers Landfills

SITE LOCATION MAP

PROJECT 148E06103

DATE 6/23/86

REVISIONS



Hydro-Search, Inc.
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3.0 METHODS OF INVESTIGATION

3.1 Soil Borings

The original boring program established by DNR for the North and South Landfill sites consisted of eight boreholes. However, because of subsurface conditions related to buried refuse and/or organic vapors detected during drilling, a total of 17 boreholes were drilled at the locations shown in Figure 2. Seven of the boreholes were completed as ground-water monitoring wells. The remaining ten boreholes were properly abandoned.

All boreholes were drilled using an Acker AD2 with an 8-inch hollow stem auger. To prevent cross-contamination, all downhole drilling equipment was pressure cleaned before use. The deepest borehole at each of the nested sites was sampled at five-foot intervals with a split barrel sampler in accordance with ASTM method 1586-84. In addition, four Shelby tube samples were taken of representative soil layers for laboratory permeability testing.

A geologic log was prepared by analyzing split-spoon soil samples and drilling indications. After field inspections, representative sample sections were stored in plastic bags for subsequent analysis and material property testing. A total of eight samples were analyzed for grain size distribution. Finalized borehole logs which describe and identify soils are presented in Appendix A. These logs include a description of lithology, grain size, sorting, color (Munsell color charts), consistency and strength (Pocket penetrometer), water occurrence, and blow count. Results of material property tests are compiled in Appendix B.

In accordance with the safety plan (Appendix C), a Gastech NP-204 natural gas indicator was used to quantify combustible gas concentration during drilling. In addition, organic vapors were

monitored using a HNu model PL101 with a 10.2 ev probe and a span setting of 5.0. Measurements of gas and organic vapors were collected at the mouth of the uppermost section of hollow stem auger prior to retrieval of soil samples. The results of these efforts are presented in Appendices A and D.

To provide preliminary information on the presence of organic contamination, all soil samples obtained during drilling were screened for organic vapors. The results of this effort are compiled in Appendix D.

Several boreholes were initiated on the South Landfill which subsequently had to be abandoned. Reasons for abandonment were 1) detection of organic vapors while drilling background wells, and 2) presence of buried refuse at other locations. A total of ten boreholes ranging in depth from 3 to 30 feet were abandoned in this process. Shallow holes (less than 5 feet deep) were backfilled with cuttings; deeper holes were backfilled using a cement grout.

3.2 Monitoring Well Installation and Development

Monitoring wells were completed in three of the boreholes at the North Landfill and four of the boreholes at the South Landfill. The locations and depths were specified by DNR and the installation of each conformed with specifications presented in DNR's Guideline for Monitoring Well Installation.

The wells were constructed of 2-inch ID, schedule 40, threaded flush-joint PVC pipe. Depending on depth and geology, a 5- or 10-foot section of 0.010 inch mill slotted PVC was used for the screen. The bottom of each well was closed with a screw cap and the top with a slip cap. Washed silica sand was placed in the annulus to a depth of 2 to 3 feet above the top of the screen. In some instances, natural sand cave-in was used. A 3- to 5-foot

seal of quarter-inch volclay bentonite pellets was installed on top of the sand pack. Thick bentonite slurry was used to backfill the annulus to a depth 2 to 3 feet from the surface. A 5-foot long, 4-inch ID locking steel protective casing was placed over the PVC riser. The remaining annulus was filled with cement and a small conical cement pad was built up around the protective casing to shed surface-water away from the well. Appendix E presents the well construction summaries.

Following installation, the wells were developed. All wells except DNR-6 were developed by bailing more than three well volumes, and observing the conductance and pH of the water. Bailing was performed using teflon and PVC bailers. All down-well equipment was thoroughly rinsed with distilled deionized water before and after bailing. Daily readings of pH, temperature, specific conductance and water level were obtained at each well. All wells except DNR-6 exhibited stabilized field water chemistry values prior to sampling. Well DNR-6 could not be extensively developed due to the very low initial inflow of water to this well. Appendices F and G present the well development summaries and the water level data, respectively.

3.3 GROUND-WATER SAMPLING

The wells were sampled using a three-foot, 1.66 inch ID teflon point source bailer attached to a downrigger using stainless steel cable. All downhole equipment was thoroughly rinsed with distilled deionized water before and after sampling. All bottles, except for metals, were filled directly; samples for metals were filtered in the field using a #24 glass prefilter and a 0.45 micron membrane filter set in a backflushing filter holder. Water level measurements, as well as pH, temperature and specific conductance readings, were taken at each well, except at the leachate riser. These field-measured water quality results are presented in Appendix H. All water samples were screened for

organic vapors, the results of which are presented in Appendix D.
All water samples were transferred to DNR for analysis.

4.0 FINDINGS

4.1 Geology

Six cross-sections were developed using information obtained in this investigation and from previously existing borehole data. North-South sections through the landfill areas are presented in Figures 3 through 5 and east-west sections in Figures 6 through 8. Locations of the sections with respect to the landfills are shown in Figure 9. Because the cross-sections were developed primarily from existing data which do not allow till identification, the legend was based on texture and not stratigraphy. The lithologic divisions used in the cross-sections are 1) solid waste and surface fill, 2) sand and silty sand, 3) peat, 4) clayey silt and sandy silt, and 5) silty clay.

In general, the cross-sections indicate the geology consists primarily of a silty clayey till interbedded with sand units. Based on regional information (Mickelson, et al, 1984), the tills are of the Kewaunee Formation which, in the area, is comprised of the Two Rivers, Valders Haven, and Ozaukee members in descending order. These tills are described as silty units with the upper Two Rivers and Valders members being slightly sandy and the lower Haven and Ozaukee members being slightly clayey. Differentiation of the tills is based primarily on clay mineralogy because the members appear very similar in color and texture.

A surficial sand unit occurs across the southern half of the investigated area. The unit averages approximately 5 to 10 feet thick and reaches a maximum thickness of 20 feet near the northwest corner of the South Landfill at borings No. 10 and B-40.

A deep sand unit is present along the western edge of the investigated area (Figure 5). The top of this deep sand occurs at

an elevation of about 560 feet msl or 40 to 60 feet deep. It is not certain if this unit is interconnected with the deep sand encountered at DNR-1 (located at the northeast corner of the North Landfill). Grain size analyses of this deep sand indicate that it is well sorted averaging 86 percent sand, 11 percent silt, and 3 percent clay.

Between the surficial and deep sand, discontinuous sand units are present. One unit occurs near the southeast corner of the South Landfill (Figure 8) and the other near the southwest corner of the North Landfill (Figure 7). The units are approximately 10 feet thick and occur at a depth of approximately 20 to 30 feet. Towards the west, both of these units outcrop or are interconnected with the surficial sand.

4.2 Hydrogeology

Water levels were obtained from shallow and deep monitor wells at the landfill sites on June 19, 1986. Based on these measurements, a water table map (Figure 10) and a potentiometric map of the deep sand (Figure 11) were developed.

In general, both maps indicate that shallow and deep ground-water flow is west towards the East Twin River. The horizontal gradients of the water table and potentiometric surfaces are 0.035 and 0.012 respectively. Vertical gradients are downward and range between 0.63 and 0.34.

Monitor well DNR-10 was completed in a sand unit between the surficial and deep sands. Water level elevation in this well occurs between the elevation of the water table and potentiometric surfaces and was, therefore, not included in either of the contour maps.

Based on laboratory tests, the permeability of the silty clayey till ranges between 2×10^{-8} to 2×10^{-7} cm/sec. Although

permeabilities were not run on the sand units, they are presumed to be much higher (i.e., in the range of 10^{-3} to 10^{-4} cm/sec).

4.3 Organic Vapor Concentrations

The results of the organic vapor screening are presented in plan view in Figure 12 and are tabulated in Appendix D. Organic vapor concentrations shown are highest values recorded. Measurements were obtained through the hollow stem auger during drilling, and of the soil and water samples collected as part of this program.

In general, most detections of organic vapors occurred around the South Landfill. The highest value recorded in the hollow stem auger was 10 ppm at borehole DNR-8F. Only one soil sample had detectable organic vapors with a value of 0.3 ppm at DNR-10B. The head space of three water samples had detectable levels of organic vapors : 3.8 ppm at DNR-8, 0.7 ppm at DNR-7, and 0.2 ppm at DNR-5. (It should be noted that measurements at DNR-8 and DNR-7 were made by DNR personnel and with a different HNu instrument.) A value of 5 ppm was recorded for the sample taken at the leachate riser west of the North Landfill.

REFERENCES

- Mickelson, D. M., Clayton, L., Baker, R. W., Mode, W. N., and Schneider, A. F., 1984. Pleistocene Stratigraphic Units of Wisconsin. Wisconsin Geological and Natural History Survey, Miscellaneous Paper, 84-1.
- Warzyn Engineering and Service Company, Inc., 1975: Log of Soil Borings, Two Rivers Sanitary Landfill. Report to: City of Two Rivers, Wisconsin.
- Wisconsin DNR, Bureau of Solid Waste Management, 1985. Guidelines for Monitoring Well Installation. Wisconsin Department of Natural Resources, Madison, Wisconsin.

APPENDIX A
BOREHOLE LOGS

HSI BOREHOLE LOG

ABBREVIATIONS AND SYMBOLS

Column Headings

DEPTH: Borehole depth in feet below grade.

SAMPLE: Type of soil sampling methods.

N VAL: N Value (Standard Penetration Resistance). Sum of the number of blow counts required for the second and third six inches of split spoon penetration.

% CH4: Percent combustible gas by volume using a GASTECH Model NP-204 standardized with methane.

HNu Soil/

HNu Air: Concentration in part per million (ppm) volatile organic components using a HNu Model PL-101 with a 10.2 ev probe and a span of 5.0.

Miscellaneous Abbreviations

penetration: penetrometer reading, values in pound per square inch

SS: Standard (18 inch) split spoon

SH: Standard (3 inch ID) Shelby tube

TD: Total depth (feet)

OD: Outside diameter (inch)

ID: Inside diameter (inch)

ft. msl: Feet above mean sea level

ND: Not detected

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-6Location: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 2+00N, 13+90W						DRILLER: Pittsburgh Testing		<u>START</u> DATE: 6/2/86		<u>END</u> 6/2/86	
GROUND ELEV.: 600.9 ft. msl						RIG: Acker AD2		TIME: 1120		1330	
TOTAL DEPTH: 45 feet						BIT(S): Hollow Stem Auger		COMPLETED AS: Monitoring well installed			
BOREHOLE DIAM.: 8 inches OD						FLUID:					
D E P T H ft.	S A M P L E	N V A L	% C H 4	H N u S O I L ppm	H N u A I R ppm	MATERIAL DESCRIPTIONS AND COMMENTS					
						0-1.0': Top soil, silty sand					
0						1.0'-4.0': Clayey sand, coarse, well rounded, some gravel, brown (10YR 3/4), unconsolidated, wet, oxidized					
5	SS	6	ND	ND	ND	4.0-5.5': Oxidized sand as above, penetration: 1-0.5					
10	SS	4	ND	ND	ND	6.0-9.0': Organic rich clayey sand, some gravel, black, soft, plastic					
15	SS	4	ND	ND	ND	9.0-10.0': Sand as above, light brown (10YR 4/3), well sorted, oxidized, penetration: 0; 10-10.5': organic silty clay, black, moist					
20	SH		ND	ND	ND	11.0': Clay, calcareous, pale gray (10YR 6/4), well sorted, plastic, penetration: 0.5, moist.					
25	SS	8	ND	ND	ND	21.0': Clayey silt, pinkish gray (7.5YR 6/2), calcareous, moist, brittle, penetration: 1.0					
30	SS	8	ND	ND	ND	24.0-25.5': Silty clay, trace of gravel, light brown (10YR 4/2), very uniform, moist, plastic, penetration: 0.25-0.6					
35	SS	8	ND	ND	ND	29.0-30.5': Silty clay, as above, siltier towards 30.5', moist, brittle along silt lenses (thin, penetration: 0.25-1					
40	SS	13	ND	ND	ND	34.0-35.5': Silty clay, light brown (7.5YR 4/2), trace of sand, uniform, 2" silt layer at 35', moist, plastic, penetration: 0.25-1					

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-6Location: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 2+00N, 13+90W						DRILLER: Pittsburgh Testing		START DATE: 6/2/86		END 6/2/86	
GROUND ELEV.: 600.9 ft. msl						RIG: Acker AD2		TIME: 1120		1330	
TOTAL DEPTH: 45 feet						BIT(S): Hollow Stem Auger		COMPLETED AS: Monitoring well installed			
BOREHOLE DIAM.: 8 inches OD						FLUID:					
D E P T H ft.	S A M P L E	N V A L	% C H 4	HNu S O I L ppm	HNu A I R ppm	MATERIAL DESCRIPTIONS AND COMMENTS					
45						37.0-41.0': Sand, silty, fine to medium grained, well rounded, light gray (10YR 5/2), unconsolidated TD: 45 feet					

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-7Location: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 8+95S, 16+95W	DRILLER: Pittsburgh Testing	START	END
GROUND ELEV.: 613.4 ft. msl	RIG: Acker AD2	DATE: 6/13/86	6/13/86
TOTAL DEPTH: 22 feet	BIT(S): Hollow Stem Auger	TIME: 0730	0920
BOREHOLE DIAM.: 8 inches OD	FLUID:	COMPLETED AS: Monitoring well installed	

D E P T H ft.	S A M P L E	N V A L	% C H 4	HNu S O I L ppm	HNu A I R ppm	MATERIAL DESCRIPTIONS AND COMMENTS
0						See Borehole Log of DNR-80
5						
10						
15						
20						TD 22 feet

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-8Location: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 8+90S, 16+65W						DRILLER: Pittsburgh Testing		START DATE: 6/11/86		END 6/13/86	
GROUND ELEV.: 613.4 ft. msl						RIG: Acker AD2		TIME: 1035		1420	
TOTAL DEPTH: 65 feet						BIT(S): Hollow Stem Auger		COMPLETED AS: Monitoring well			
BOREHOLE DIAM.: 8 inches OD						FLUID:					
D E P T H ft.	S A M P L E	N V A L	% C H 4	H N u S O I L ppm	H N u A I R ppm	MATERIAL DESCRIPTIONS AND COMMENTS					
0						2-4' of black fill					
			0.1	1.4	0.1	See Borehole Log of DNR-8G					
10			ND	ND	0.3						
			ND	ND	ND						
20			ND	ND	ND						
			ND	ND	0.1						
30			ND		ND						
			ND		0.3						
40			ND		0.8						
			ND		1.0						
50			ND		0.3						
			ND		0.8						
60			ND		0.4	60': Hit Sand					
			ND		0.4						
70						TD: 68 feet					

Borehole ID : ONR-8D

Logged by: Thomas P. Van Biersel

HYDROLOGISTS-GEOLOGISTS-ENGINEERS

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-8FLocation: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 6+20S, 15+70W						DRILLER: Pittsburgh Testing		START DATE: 6/6/86		END 6/6/86	
GROUND ELEV.: 612.9 ft. msl						RIG: Acker AD2		TIME: 1317		1322	
TOTAL DEPTH: 5 feet						BIT(S): Hollow Stem Auger		COMPLETED AS: Filled with cuttings			
BOREHOLE DIAM.: 8 inches OD						FLUID:					
D E P T H ft.	S A M P L E	N V A L	% C H 4	HNu S O I L ppm	HNu A I R ppm	MATERIAL DESCRIPTIONS AND COMMENTS					
					0.8	0-5.0': Fill with garbage (wood, glass, metal, etc.), strong odor of hydrocarbon, HNu reading in the boring of 10 ppm and 0.8 ppm 3' above ground. TD: 5 feet					
0											
5					10						

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-8GLocation: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 8+75S, 15+70W						DRILLER: Pittsburgh Testing		START DATE: 6/7/86		END 6/13/86	
GROUND ELEV.: 613.3 ft. msl						RIG: Acker AD2		TIME: 1435		1600	
TOTAL DEPTH: 65 feet						BIT(S): Hollow Stem Auger		COMPLETED AS: Neatly grouted			
BOREHOLE DIAM.: 8 inches OD						FLUID:					
D E P T H ft.	S A M P L E	N U A L	% C H 4	H N u S O I L P D M	H N u A I R P D M	MATERIAL DESCRIPTIONS AND COMMENTS					
0						0-3.0':	Sand, find grained, light brown, (10YR 7/4), unconsolidated.				
	SS	8	>10	ND	ND	3.0-4.0':	Sandy silt, gray (10YR 6/1)				
10	SS	12	ND	ND	0.4-0.5	4.0-5.5':	Sand, fine grained, trace of silt and clay, well sorted, uniform, wet, unconsolidated, light brown (10YR 7/4)				
	SS	11	ND	ND	0.8						
20	SS	16	0.2	ND	4.0	8.0':	Organic rich layer of sand				
	SS	9	ND	ND	3.4	9.0-10.0':	Fine sand, trace of silt, greenish gray (5YR 5/2), wet, soft; 10-10.5': silty clay, trace of gravel, light brown (10YR 5/2), stiff, penetration: 3.5-4.0				
30	SS	22	ND	ND	5.4						
	SS	11	ND	ND	5.5	14.0-15.5':	Silty sand, fine, interbedded with silty clay layer, wet, uniform (clayey at top, silty at bottom)				
40	SS	14	ND	ND	7.0						
	SH		ND	ND	ND	19.0-20.5':	Interbedded clay and silt as above; silt is sandy, clayey, calcareous, uniform, light brown (10YR 5/2), penetration: 6.75; clay is silty, calcareous, trace of gravel, gray (10YR 4/1), penetration: 1.75, wet, stiff				
50	SS	3	ND	ND	ND						
	SS	78	ND	ND	ND	24.0-25.5':	Buried root horizon, clayey silt, calcareous, black (5YR 5/1), underlain by grey (10YR /1) calcareous silt				
60	SS	27	ND	ND	ND						
						29.0-30.5':	Sandy, clayey silt, uniform, brown (7.5 YR 5/2), stiff, penetration: 2.75, wet				
70											

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-10Location: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 12+40S, 4+30W	DRILLER: Pittsburgh Testing	START DATE: 6/6/86	END 6/7/86
GROUND ELEV.: 638.8 ft. msl	RIG: Acker AD2	TIME: 1940	1030
TOTAL DEPTH: 34.5 feet	BIT(S): Hollow Stem Auger	COMPLETED AS: Monitor-	
BOREHOLE DIAM.: 8 inches OD	FLUID:	ing well installed	

D E P T H ft.	S A M P L E	N V A L	% C H 4	H N u S O I L ppm	H N u A I R ppm	MATERIAL DESCRIPTIONS AND COMMENTS
0						See Borehole Log of DNR-9 and DNR-10C
10						TD: 34.5 feet
20						TD: 34.5 feet
30						TD: 34.5 feet
40						TD: 34.5 feet
50						TD: 34.5 feet

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-10ALocation: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 11+50S, 5+50W						DRILLER: Pittsburgh Testing		START DATE: 6/4/86		END 6/4/86	
GROUND ELEV.: 635.1 ft. msl						RIG: Acker AD2		TIME: 0750		1202	
TOTAL DEPTH: 35 feet						BIT(S): Hollow Stem Auger		COMPLETED AS: Neatly tremie grouted			
BOREHOLE DIAM.: 8 inches OD						FLUID:					
D E P T H ft.	S A M P L E	N V A L	% C H 4	H N u S O I L ppm	H N u A I R ppm	MATERIAL DESCRIPTIONS AND COMMENTS					
0						0-4.0':	Silty sand, fine, oxidized, light brown (10YR 5/4), calcareous, wet, soft, silt at 4'				
5	SS	10	ND	ND	ND	4.0-5.5':	Silt, light brown (10YR 5/4 to 10YR 4/4), calcareous, wet, brittle, penetration: 0.5-1.1				
10	SS	13	ND	ND	ND	5.5-9.0':	Silt as above.				
15	SS	13	ND	ND	ND	9.0-10.0':	Silt, gray (10YR 5/2), calcareous, wet, soft, penetration: 0.5; 10-10.5': clay, silty, calcareous, reddish brown (5YR 5/3), hard, penetration: 2-3.5				
20	SH		ND	ND	0.4-0.6	14.0-15.5':	Clay, silty, calcareous, brown (10YR 4/3), trace of gravel, uniform, hard, moist, penetration: 2				
25	SS	11	ND	ND	0.2-1.2	20.5':	Clay, silty, brown (10YR 4/4), as above				
30	SS	10	ND		0-0.6	24.0-25.5':	Clay, silty, trace of coarse sand, calcareous, reddish brown (5YR 5/3), very uniform, moist, plastic, penetration: 0.5-0.75				
35	SS					29.0-30.5':	Clay, silty, calcareous, trace of coarse sand and gravel, brown (10YR 4/3), moist, plastic, penetration: 1.25-1.5				

Logged by: Thomas P. Van Biersel

HYDROLOGISTS-GEOLOGISTS-ENGINEERS

BOREHOLE LOGProject: Two Rivers Landfills (148E06103)Borehole ID : DNR-10CLocation: Two Rivers, WisconsinLogged by: Thomas P. Van Biersel

LOCATION: 13+10S, 0+70W						DRILLER: Pittsburgh Testing		<u>START</u>		<u>END</u>	
GROUND ELEV.: 649.9 ft. msl						RIG: Acker AD2		DATE: 6/6/86		6/6/86	
TOTAL DEPTH: 55 feet						BIT(S): Hollow Stem Auger		TIME: 1400		1956	
BOREHOLE DIAM.: 8 inches OD						FLUID:		COMPLETED AS: Neatly tremie grouted			
D E P T H ft.	S A M P L E	N V A L	% C H 4	H N u S O I L ppm	H N u A I R ppm	MATERIAL DESCRIPTIONS AND COMMENTS					
0						0-20.0': See Borehole Log of DNR-9					
10			ND		1.2						
			ND		0.8	17.0': Clayey silt, light gray, wet					
20		15	ND		2.3	19.0-20.0': Clayey silt to silty clay, calcareous, brown (10YR 5/4), hard, wet, penetration: 2.0;					
			0.1	ND	0.8-0.6	20.0-20.3': sand, silty, calcareous, gray (10YR 6/2); 20.3-20.5': clayey silt, calcareous, gray (10YR 5/2), plastic					
30						22.0-25.0': light gray sand					
40			ND	ND	1.5	25.0-40.0': Interbedded clayey sand silt, light gray, and light gray clayey silty sand, saturated					
			ND	ND	0.4	43.0': Reddish gray, silty clay, calcareous, very uniform, wet					
50						45.0-50.0': Light brown, silty clay, calcareous, uniform, wet, plastic					
60						50.0-55.0': Light gray silt					

APPENDIX B
MATERIAL PROPERTY TESTS

MATERIAL PROPERTY TESTING								
Borehole	Depth (ft.)	Sample Type	Unified Soil Class*	Grain Size				Hydraulic Conductivity cm/s
				Gravel %	Sand %	Silt %	Clay %	
DNR-3	4.5-6.0	SS	CL	1	18	30	52	
DNR-6	9.5-10.5	SS	SM	2	77	20	3	
DNR-6	19-20.5	SH	ML	1	14	49	36	4.39×10^{-8}
DNR-6	40	SS	SM	0	86	13	1	
DNR-8G	14.0-15.5	SS	ML	<1	24	58	18	
DNR-8G	44-45.5	SH	CL	0	3	16	81	4.40×10^{-8}
DNR-8G	59-60.5	SS	SP-SM	0	87	9	4	
DNR-10A	19-20.5	SH						2.22×10^{-8}
DNR-10B	4-5.2	SH	SC-SM	10	52	23	25	2.16×10^{-7}

* ASTM D-2487-83

Notes: SS : Split Spoon
SH : Shelby

Wisconsin

TESTING LABORATORIES



Testing and Inspection of:

Soils
Concrete
Asphalt
Geotechnical Reports
Soil Borings
Rock Coring

RECEIVED JUN 25 1986

June 24, 1986

Hydro-Search, Inc.
Suite 101
210 Regency Court
Waukesha, Wisconsin 53186

Attention: Thomas VanBiersel

Re: Laboratory Soil Testing
Two Rivers L.F.
Client's No. 148E06103
(L-8612)

Gentlemen:

Submitted herewith are the results of laboratory tests performed on the soil samples delivered to our laboratory by the client. Grain size analyses were performed on eight (8) samples, as designated. One (1) permeability test has been completed and the result relayed to the client by phone. Three (3) permeability tests are in progress.

The grain size distribution curve sheets are attached hereto. It should be noted that the textural soil classification on the curve sheets are approximate only, since the Atterberg limits were not determined.

The unused portions of the soil samples will be retained in our laboratory for a period of 30 days, and will then be discarded. If other arrangements are desired, please notify our office.

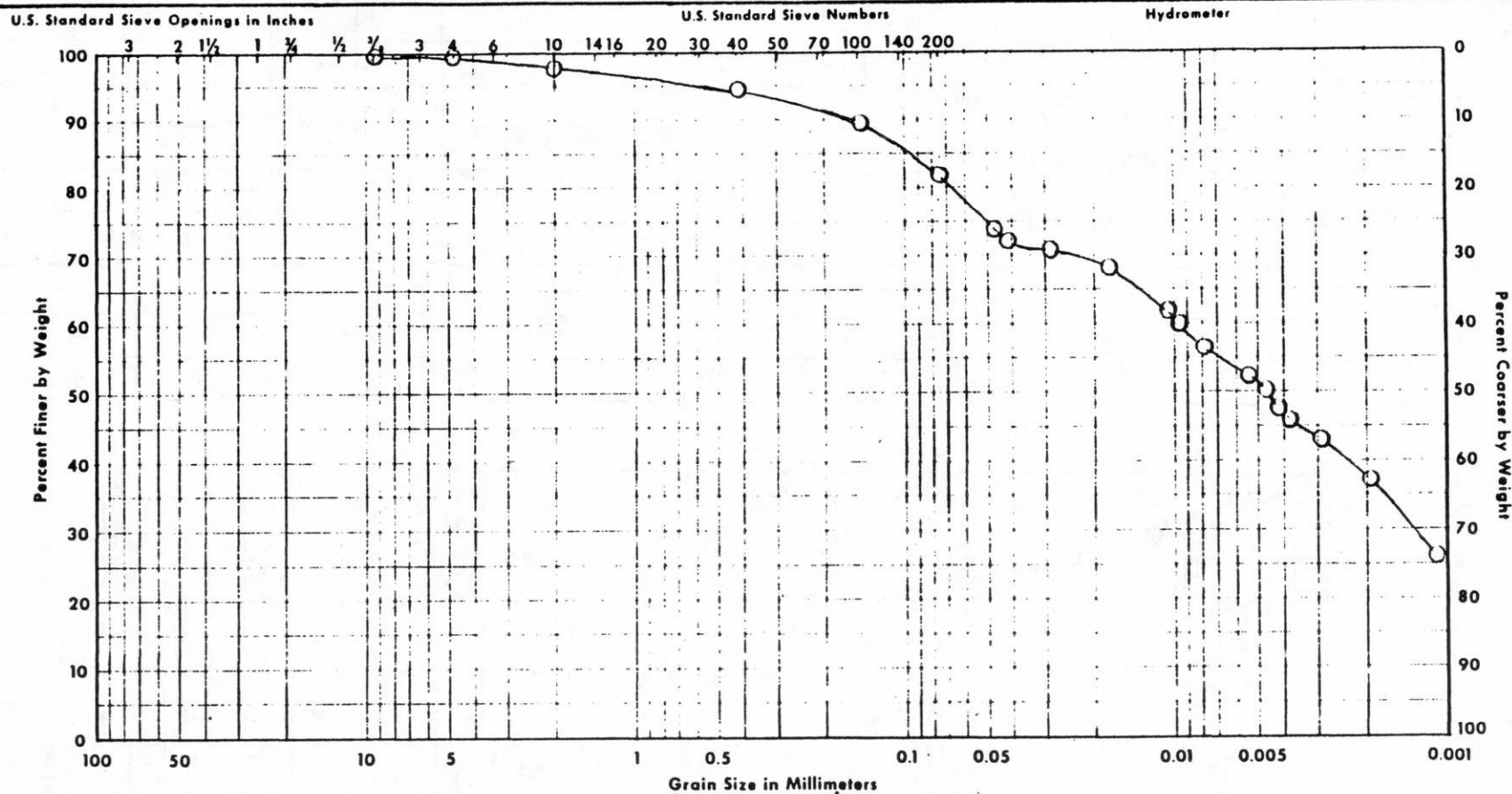
If there are any questions regarding these data, please contact our office. We appreciate the opportunity to be of service to you.

Very truly yours,

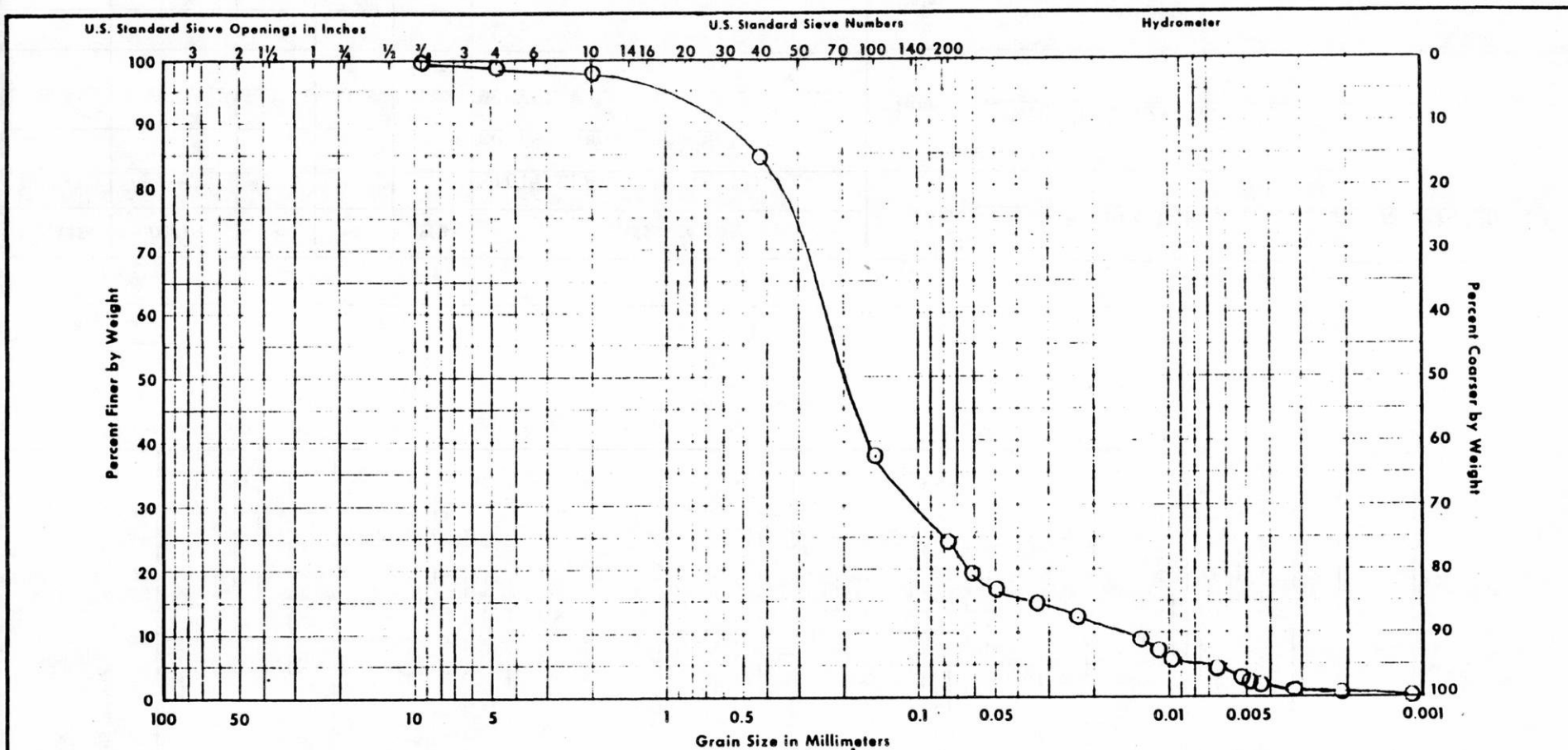
Allan F. Huseth, P.E.

AFH/jlt

Copies (3) Client



GRAIN SIZE ANALYSIS



UNIFIED	GRAVEL		SAND		SILT OR CLAY	
AASHO	GRAVEL		COARSE	FINE	SILT	CLAY

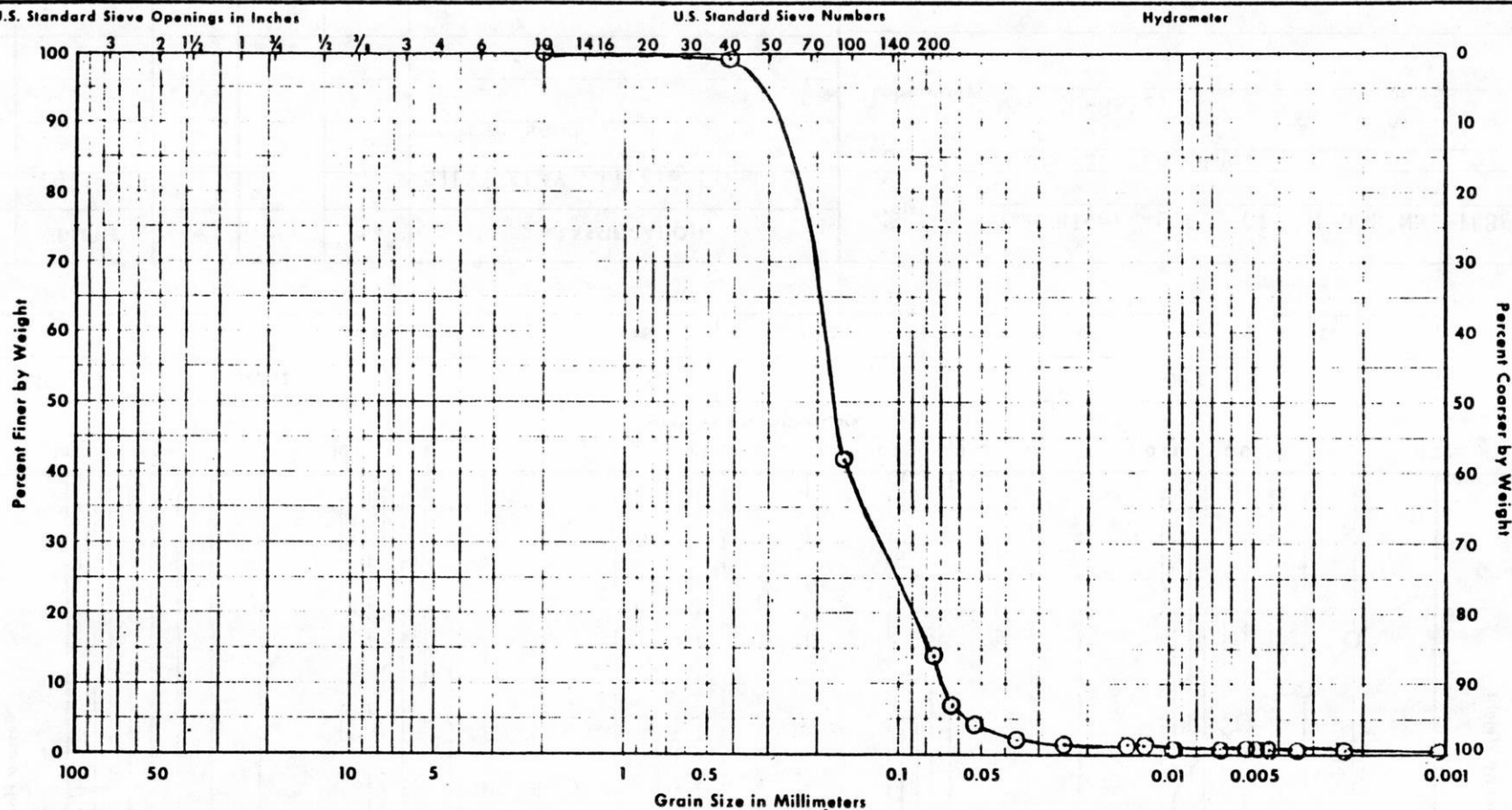
NUMBER	DEPTH	w	w _L	w _p	CLASSIFICATION
DNR-6	9 1/2' - 10 1/2'				SILTY FINE TO COARSE SAND, trace fine gravel

Project: Two Rivers L.F., Client Job No. 148E06103

For: Hydro-Search, Inc.

Laboratory: WTL (L-8612)

Date: June 23, 1986



UNIFIED	GRAVEL		SAND		SILT OR CLAY	
AASHTO	GRAVEL		COARSE	FINE	SILT	CLAY

NUMBER	DEPTH	w	w _L	w _P	CLASSIFICATION
DNR-6	40'				FINE SAND, trace medium sand, trace silt

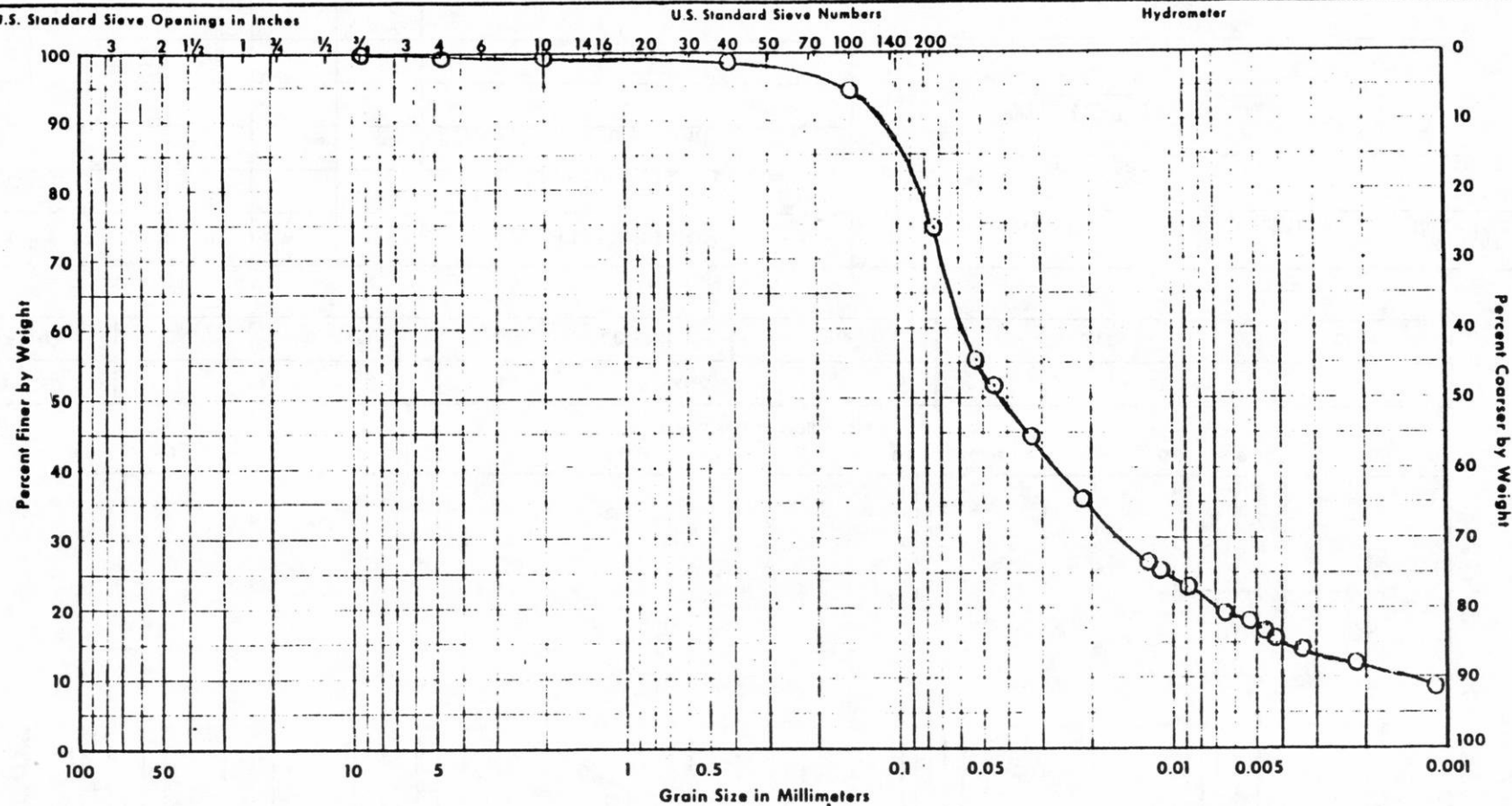
Project: Two Rivers L.F., Client Job No. 148E06103

For: Hydro-Search, Inc.

Laboratory: WTL (L-8612)

Date: June 23, 1986

GRAIN SIZE ANALYSIS



UNIFIED	GRAVEL		SAND		SILT OR CLAY	
AASHO	GRAVEL		COARSE	FINE	SILT	CLAY

NUMBER	DEPTH	w	w _L	w _p	CLASSIFICATION
DNR-8G	14'-15½'				VERY SILTY CLAY, some fine to coarse sand, trace fine gravel

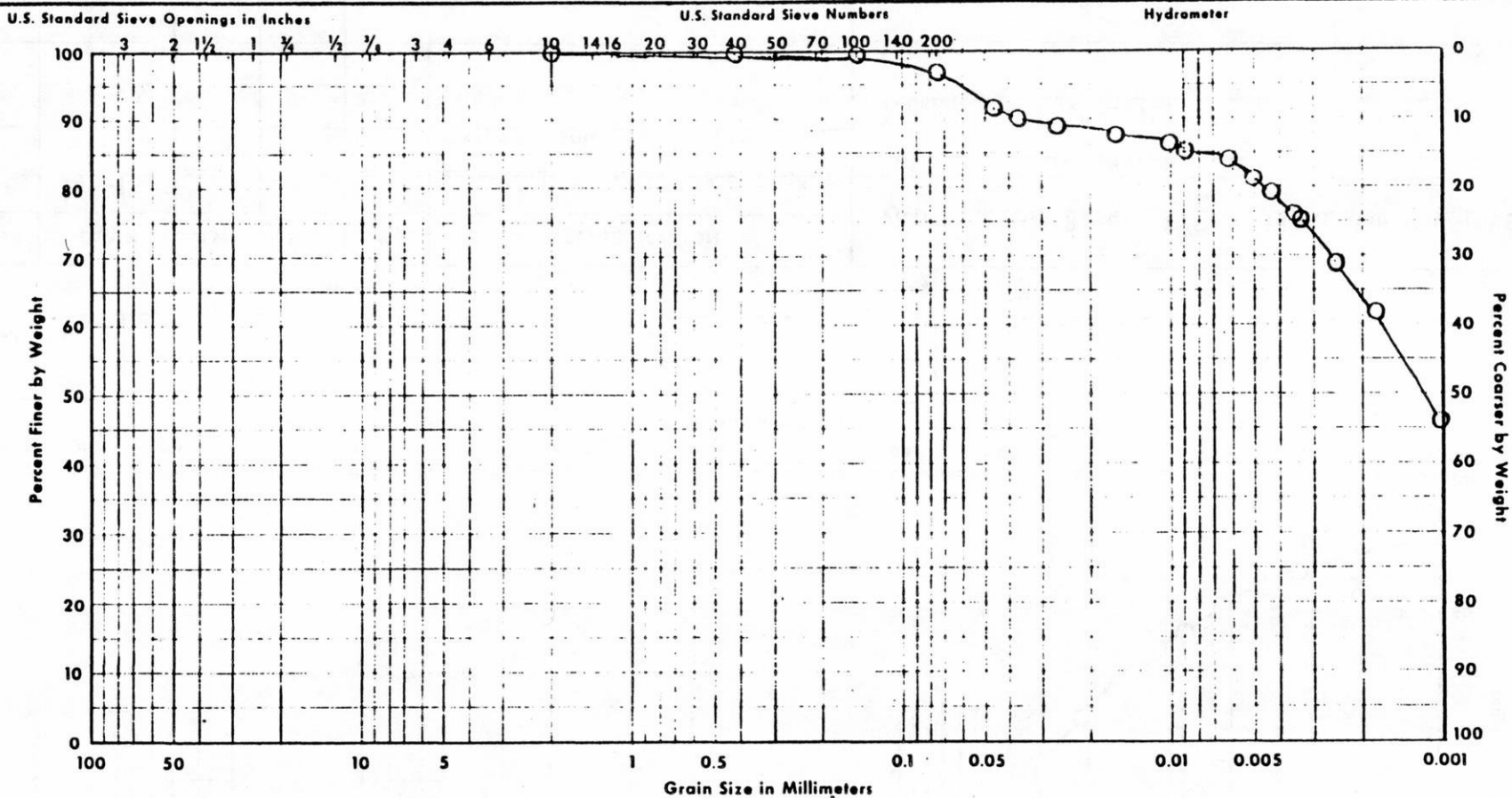
Project: Two Rivers L.F., Client Job No. 148E06103

For: Hydro-Search, Inc.

Laboratory: WTL (L-8612)

Date: June 23, 1986

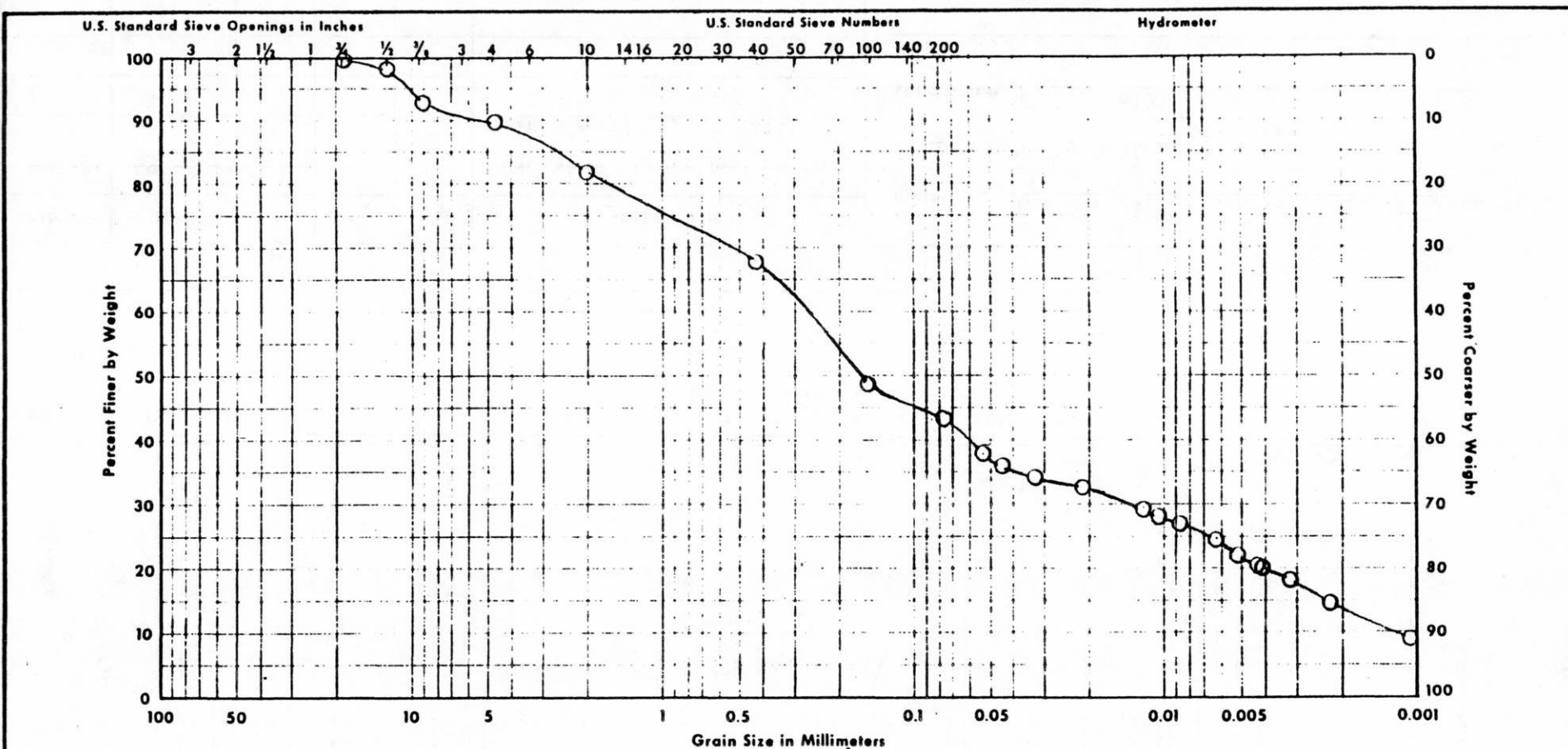
GRAIN SIZE ANALYSIS



UNIFIED	GRAVEL		SAND		SILT OR CLAY	
AASHO	GRAVEL		COARSE	FINE	SILT	CLAY

NUMBER	DEPTH	w	w _L	w _P	CLASSIFICATION	Project: Two Rivers L.F., Client Job No. 148E06103
DNR-8G	44'-45 1/2'				CLAY, little silt, trace fine to medium sand	For: Hydro-Search, Inc.
						Laboratory: WTL (L-8612)
						Date: June 23, 1986

GRAIN SIZE ANALYSIS



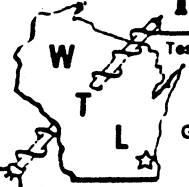
UNIFIED	GRAVEL		SAND		SILT OR CLAY	
AASHTO	GRAVEL		COARSE	FINE	SILT	CLAY

NUMBER	DEPTH	w	w _L	w _p	CLASSIFICATION	Project: Two Rivers L.F., Client Job No. 148E06103
DNR-10B	4'-5.2'				SANDY SILTY CLAY, little fine to coarse gravel	For: Hydro-Search, Inc.
						Laboratory: WTL (L-8612)
						Date: June 23, 1986

RECEIVED JUL 02 1986

Wisconsin

TESTING LABORATORIES



Testing and Inspection of:
Soils
Concrete
Asphalt
Geotechnical Reports
Soil Borings
Rock Coring

June 30, 1986

Hydro-Search, Inc.
Suite 101
210 Regency Court
Waukesha, Wisconsin 53186

Attention: Thomas VanBiersel

Re: Laboratory Soil Testing
Two Rivers L.F.
Client's No. 148E06103
(L-8612)

Gentlemen:

Submitted herewith are the results of four (4) permeability tests performed on soil samples from the referenced project. These samples were delivered to our laboratory by the client on June 6 and 9, 1986.

As you requested, the unused portions of the soil samples will be available for pick-up at your convenience.

If there are any questions regarding these data, please contact our office. We appreciate the opportunity to be of service to you.

Very truly yours,

Jeffrey G. Smith, P.E.
Geotechnical Engineer

JGS/jlt

Copies ~~(3)~~ Client

SUMMARY OF LABORATORY PERMEABILITY TEST RESULTSTwo Rivers L.F.

<u>Boring Number</u>	<u>Sample Depth</u>	<u>Moisture Content</u>	<u>Dry Density</u>	<u>Permeability*</u>
DNR-10B	4.0'-5.2'	10.9%	123.5' PCF	2.16×10^{-7} Cm./Sec.
DNR-10A	19.0'-20.5'	21.4%	105.3 PCF	2.22×10^{-8} Cm./Sec.
DNR-8G	44.0'-45.5'	27.6%	95.8 PCF	4.40×10^{-8} Cm./Sec.
DNR-6	19.5'-21.0'	25.8%	99.5 PCF	4.39×10^{-8} Cm./Sec.

NOTES:

* Permeability values were obtained from falling head permeability test procedures. The test specimens were undisturbed 3 in. O.D. Shelby tube samples.

APPENDIX C
OPERATIONAL SAFETY PLAN

HYDRO-SEARCH, INC.

**OPERATIONAL SAFETY PLAN
TWO RIVERS LANDFILLS
MANITOWOC COUNTY, WISCONSIN**

1. Purpose

The purpose of this plan is to establish personnel protection standards, mandatory operating procedures, and provide for contingencies that may arise during the drilling and testing program at the Two Rivers Landfills, Manitowoc County, Wisconsin.

2. Applicability

The provisions of this plan are mandatory for all personnel working on-site for this project. All project personnel working in the field are required to submit an original signed copy of the agreement sheet (last page) prior to any on-site project activity. Implementation of this plan is left to the discretion of the HSI coordinator on site.

3. Scope

The Two Rivers Landfills are operating solid waste disposal facilities. DNR records indicate that these sites have accepted unknown quantities of hazardous materials. Therefore, several potential hazards could be encountered when drilling within filled areas or adjacent undisturbed materials.

Ground water that occurs within a part of the site can be expected to contain low-levels of hazardous materials. The measured concentrations in water should not produce air concentrations that exceed threshold limit values, and is not likely to pose a health hazard. Higher concentrations could be encountered which would require operating precautions contained within this plan.

Methane is often produced from the degradation of organic

material at landfills. The potential to encounter explosive levels of methane at the site must be considered high. Special monitoring and operational procedures must be followed to prevent accidents caused by methane induced explosions and potential oxygen deficiency. This is especially true when drilling in low-lying areas that are relatively isolated from wind currents.

Bacteria and viruses within the buried fill can cause illness and disease. As detailed within this plan, direct skin contact with buried fill materials and inhalation of fill produced gas must be minimized to prevent possible health hazards caused by any disease producing organisms.

4. Responsibilities

The Hydro-Search, Inc. field coordinator will be responsible for directing all field activities. These activities will include:

- 1) coordinating selection of drill site locations with DNR project manager
- 2) air monitoring, and
- 3) implementation of safety procedures.

The Hydro-Search, Inc. field coordinator will be Thomas Van Biersel. All support personnel on the project will comply with the operational procedures defined by the Hydro-Search, Inc. field coordinator.

5. Determination of Hazard Level

The level of hazard during drilling will be based upon:

- 1) location of the drilling site,

- 2) expected materials to be encountered,
- 3) periodic monitoring of air quality during the drilling operations, and
- 4) continuous observation of drilling conditions.

Air quality monitoring will include the use of an explosive gas detector and a photoionization trace gas analyzer.

Drilling conditions at the site can change rapidly. Periodic monitoring may only provide confirmation of the field personnel's observations. Therefore, acute awareness of drilling conditions is required to assure personnel safety.

6. Equipment Requirements

During all drilling operations the following equipment will be worn:

- 1) work gloves, preferably PVC coated,
- 2) steel-toed boots, and
- 3) hard hat with splash shield or safety glasses.
- 4) surgical-type dust mask or organic vapor-acid gas (code yellow) respirators available.

During drilling operation under caution or Level C conditions, the following equipment will be worn:

- 1) neoprene gloves (disposable inner gloves with outer work gloves are acceptable),
- 2) disposal coveralls (PVC coated tyvek),
- 3) hard hat, with splash shield, or safety glasses,
- 4) steel-toed safety boots constructed from neoprene, or as an alternate butyl rubber, or steel-toed boots with disposable cover boots constructed from suitable materials, and
- 5) respirator equipped with organic vapor/acid (code yellow) gas cartridges.

Respirators

Where total ionizable gas readings exceed background values, organic vapor/acid gas respirators will be worn. All respirators must be NIOSH/MSHA approved. All field personnel will have been trained in the use, cleaning, and limitations of their respective respirator.

7. Disrobing Procedure

The following stepwise procedure will be used where direct contact with any contaminants occurs, or when personnel depart from the work area:

- 1) disposal of overboots, or thorough scrubbing of rubber work boots,
- 2) disposal of Tyvek clothing,
- 3) disposal of any spent canisters,
- 4) disposal of inner gloves,
- 5) use of new set of inner gloves to clean all personnel equipment, (e.g., respirators), and
- 6) departure from work area.

All disposable equipment will be discarded into a container placed at the work area.

8. Special Precautions

The following conditions are prohibited during the drilling program to minimize potential health risks.

- 1) wearing of contact lenses.
- 2) eating, smoking, or tobacco chewing.
- 3) direct handling of materials produced during drilling (i.e., skin contact).

9. Contingencies

Any injuries that occur during the performance of this project will be reported immediately to the field coordinator. First aid equipment will be present on-site at all times; injuries requiring medical assistance will be attended to immediately. All personnel assisting in or requiring on-site or off-site medical attention will follow procedures in Item 7, and will thoroughly wash all exposed areas with soap and water prior to leaving the area.

Emergency service numbers are listed on the following page.

On-Site Detention

If during operation explosive gas is encountered, the following procedures will be followed:

<u>Explosive Gas Levels</u>	<u>Action</u>
0% - 2.5%	Complete work with caution
2.5%	Halt operation and vent hole

If, during operation, volatile organics are encountered, the following procedures will be followed:

<u>Organic Solvent Levels</u>	
Background	Complete work (Level D)
Background - 5 ppm	Complete work with respirators on (Level C)
5 ppm	Halt operation (Level B)

If other situations occur that are considered to be potentially dangerous, stop all drilling activities and consult with either Michael Noel or Craig Eisen of Hydro-Search, Inc.

EMERGENCY TELEPHONE NUMBERS

IMMEDIATE EMERGENCIES

Two Rivers Fire Department	414-793-5521
Two Rivers Police Department	414-793-5511
Two Rivers Community Hospital	414-793-1178
Holy Family Medical Ambulance	414-684-8833
M & T Ambulance	414-683-2248
Manitowoc County Sheriff	414-683-4200

State your name, location, and nature of emergency.

AGREEMENT

I, _____, have read the Operation Safety Plan for drilling activities at the Two Rivers Landfills, and agree to follow the procedures contained herein.

(signed)

(date)

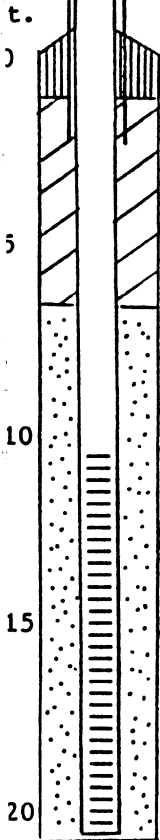
APPENDIX D
SOIL AND GROUND-WATER SCREENING RESULTS

APPENDIX E
WELL CONSTRUCTION SUMMARIES AND GROUND-WATER
MONITORING WELL INFORMATION FORMS (4400-89)

WELL/PROBE CONSTRUCTION SUMMARY

PROJECT: Two Rivers Landfills
 PROJECT NO.: 148E06103
 PERSONNEL: Thomas P. Van Biersel

ELEVATION:
 GROUND LEVEL: 646.3 ft. msl
 TOP OF RISER: 648.4 ft. msl
 TOP OF PROT. CASING: _____
 LOCATION OR COORDS: 0+65S, 2+75W



DRILLING SUMMARY:

TOTAL DEPTH: 20.5 feet
 BOREHOLE DIAMETER: 8 inches
 DRILLER: Pittsburgh Testing
 RIG: Acker AD2
 BIT(S): Hollow Stem Auger
 DRILLING FLUID: _____
 SURFACE CASING: _____

WELL DESIGN:

BASIC: GEOLOGIC LOG X GEOPHYS. LOG _____
 CASING STRING(S): C-CASING / S=SCREEN
+2.5 - 2.2 C2 _____
+2.4 - 10.5 C1 _____
10.5 - 20.5 S1 _____

CASING: C1: 2" ID Sch. 40 PVC with threaded flush joints
C2: 4" ID steel casing with locking cap

SCREEN: S1: 2" ID Sch. 40 PVC with 0.010 mill slot and threaded flush joints

CENTRALIZERS: _____

FILTER MATERIAL: Silica Sand:
6.0 - 20.5'

ANNULAR SEAL: Bentonite Pellets:
1.5' - 6.0'

CEMENT: Portland Cement: +1 - 1.5'

OTHER: _____


CONSTRUCTION TIME LOG:

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
DRILLING: 0 - 20.5'	1986 6/2	1657	1986 6/3	1624
GEOPHYSICAL LOGGING: CASING:				
C1, C2, S1	6/3	1624	6/3	1630
FILTER PLACEMENT:	6/3	1630	6/3	1649
CEMENTING:	6/3	1700	6/3	1725
DEVELOPMENT OTHER:				
Bentonite Pellets	6/3	1649	6/3	1700

DEVELOPMENT SUMMARY:

See Well Development Summary

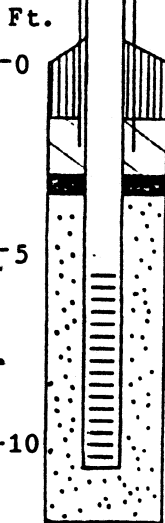
COMMENTS:

 Cement
 Bentonite Slurry/Granule
 Bentonite Pellets
 Sand

WELL/PROBE CONSTRUCTION SUMMARY

PROJECT: Two Rivers Landfills
 PROJECT NO.: 148E06103
 PERSONNEL: Thomas P. Van Biersel

ELEVATION:
 GROUND LEVEL: 601.6 ft. msl
 TOP OF RISER: 603.4 ft. msl
 TOP OF PROT. CASING: _____
 LOCATION OR COORDS: 1+90N, 13+90W



DRILLING SUMMARY:

TOTAL DEPTH: 12 feet
 BOREHOLE DIAMETER: 8 inches

DRILLER: Pittsburgh Testing

RIG: Acker AD2

BIT(S): Hollow Stem Auger

DRILLING FLUID: _____

SURFACE CASING: _____

WELL DESIGN:

BASIC: GEOLOGIC LOG X GEOPHYS. LOG _____

CASING STRING(S): C-CASING / S=SCREEN

+2.1 - 2.7 C2 _____
 +2.0 - 5.5 C1 _____
 +5.5 - 10.5 S1 _____

CASING: C1: 2" ID Sch. 40 PVC with
 threaded flush joints
 C2: 4" ID steel casing with
 locking cap

SCREEN: S1: 2" ID Sch. 40 PVC with
 0.010 mill slot and threaded
 flush joints

CENTRALIZERS: _____

FILTER MATERIAL: Natural Sand:
 4.0 - 12.0'

ANNULAR SEAL: Bentonite Gel: 1.5 -
 3.5'; Bentonite Pellets: 3.5 - 4.0'

CEMENT: Portland Cement: +1 - 1.5'

OTHER: _____


CONSTRUCTION TIME LOG:

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
DRILLING:	1986		1986	
0 - 12'	6/2	1345	6/2	1410
GEOPHYSICAL				
LOGGING:				
CASING:				
C1, C2, S1	6/2	1414	6/2	1415
FILTER				
PLACEMENT:				
CEMENTING:	6/2	1610	6/2	1630
DEVELOPMENT:				
OTHER:				
Bentonite	6/2	1510	6/2	1515
Slurry				
Bentonite	6/2	1440	6/2	1445
Pellets				

DEVELOPMENT SUMMARY:

See Well Development Summary

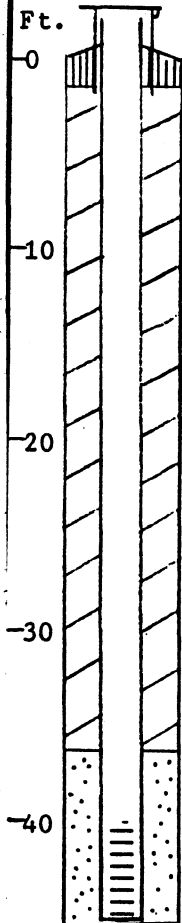
COMMENTS:

 Cement
 Bentonite Slurry/Granule
 Bentonite Pellets
 Sand

WELL/PROBE CONSTRUCTION SUMMARY

PROJECT: Two Rivers Landfills
 PROJECT NO.: 148E06103
 PERSONNEL: Thomas P. Van Biersel

ELEVATION:
 GROUND LEVEL: 600.9 ft. msl
 TOP OF RISER: 602.7 ft. msl
 TOP OF PROT. CASING: _____
 LOCATION OR COORDS: 2+00N, 13+90W



DRILLING SUMMARY:
 TOTAL DEPTH: 45 feet
 BOREHOLE DIAMETER: 8 inches
 DRILLER: Pittsburgh Testing
 RIG: Acker AD2
 BIT(S): Hollow Stem Auger
 DRILLING FLUID: _____
 SURFACE CASING: _____

WELL DESIGN:
 BASIC: GEOLOGIC LOG X GEOPHYS. LOG _____
 CASING STRING(S): C-CASING / S=SCREEN
+2.2 - 2.6 C2 - - -
+2.1 - 40 C1 - - -
40 - 45 S1 - - -

CASING: C1: 2" ID Sch. 40 PVC with threaded flush joints
C2: 4" ID steel casing with locking cap

SCREEN: S1: 2" ID Sch. 40 PVC with 0.010 mill slot and threaded flush joints

CENTRALIZERS: _____

FILTER MATERIAL: Natural Sand:
36.0 - 45.0'

ANNULAR SEAL: Bentonite Quick Gel:
36 - 1.5'

CEMENT: Portland Cement: +1 - 1.5'

OTHER: _____





CONSTRUCTION TIME LOG:

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
DRILLING:	1986		1986	
<u>0 - 45'</u>	<u>5/29</u>	<u>1120</u>	<u>5/29</u>	<u>1400</u>
GEOPHYSICAL				
LOGGING:				
CASING:				
<u>C1, S1,</u>	<u>5/30</u>	<u>1050</u>	<u>5/30</u>	<u>1052</u>
<u>C2</u>	<u>6/2</u>	<u>1310</u>	<u>6/2</u>	<u>1315</u>
FILTER				
PLACEMENT:				
CEMENTING:	<u>6/2</u>	<u>1315</u>	<u>6/2</u>	<u>1330</u>
DEVELOPMENT				
OTHER:				
<u>Bentonite</u>	<u>5/30</u>	<u>1530</u>	<u>6/2</u>	<u>1310</u>
<u>Slurry</u>				

DEVELOPMENT SUMMARY:

See Well Development Summary

COMMENTS:

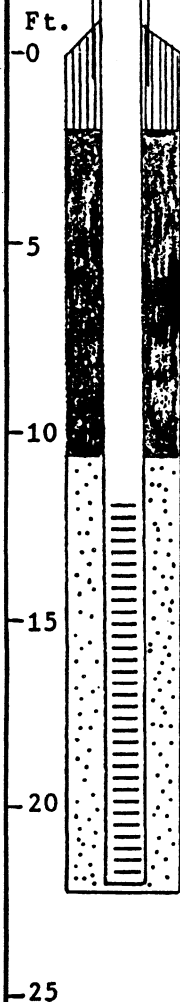
 Cement
 Bentonite Slurry/Granule
 Bentonite Pellets
 Sand

14

WELL/PROBE CONSTRUCTION SUMMARY

PROJECT: Two Rivers Landfills
 PROJECT NO.: 148E06103
 PERSONNEL: Thomas P. Van Biersel

ELEVATION:
 GROUND LEVEL: 613.4 ft. msl
 TOP OF RISER: 616.7 ft. msl
 TOP OF PROT. CASING: _____
 LOCATION OR COORDS: 8+95S, 16+65W



DRILLING SUMMARY:

TOTAL DEPTH: 22 feet
 BOREHOLE DIAMETER: 8 inches

DRILLER: Pittsburgh Testing

RIG: Acker AD2

BIT(S): Hollow Stem Auger

DRILLING FLUID: _____

SURFACE CASING: _____

WELL DESIGN:

BASIC: GEOLOGIC LOG X GEOPHYS. LOG _____

CASING STRING(S): C-CASING / S=SCREEN

+3.3 - 1.5 C2 _____

+3.2 - 11.8 C1 _____

11.8 - 21.8 S1 _____

CASING: C1: 2" ID Sch. 40 PVC with threaded flush joints
C2: 4" ID steel casing with locking cap

SCREEN: S1: 2" ID Sch. 40 PVC with 0.010 mill slot and threaded flush joints

CENTRALIZERS: _____

FILTER MATERIAL: Silico Sand:
10.5 - 22'

ANNULAR SEAL: Bentonite Pellets:
2 - 10.5'

CEMENT: Portland Cement: +1 - 2'

OTHER: _____

CONSTRUCTION TIME LOG:

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
DRILLING:	1986		1986	
0 - 22'	6/13	0730	6/13	0805
GEOPHYSICAL				
LOGGING:				
CASING:				
C1, S1	6/13	0805	6/13	0810
C2	6/13	0915	6/13	0920
FILTER				
PLACEMENT:	6/13	0855	6/13	0911
CEMENTING:	6/13	0914	6/13	0920
DEVELOPMENT				
OTHER:				
Bentonite	6/13	0911	6/13	0910
Pellets				

DEVELOPMENT SUMMARY:

See Well Development Summary

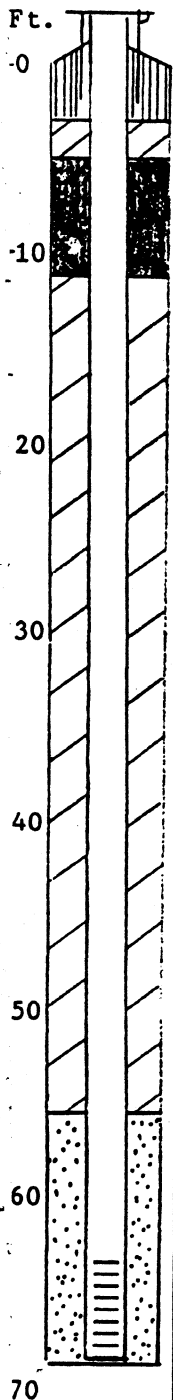
COMMENTS:

Cement
 Bentonite Slurry/Granule
 Bentonite Pellets
 Sand

WELL/PROBE CONSTRUCTION SUMMARY

PROJECT: Two Rivers Landfills
 PROJECT NO.: 148E06103
 PERSONNEL: Thomas P. Van Biersel

ELEVATION:
 GROUND LEVEL: 613.4 ft. msl
 TOP OF RISER: 615.7 ft. msl
 TOP OF PROT. CASING: _____
 LOCATION OR COORDS: 8+90S, 16+65W



DRILLING SUMMARY:

TOTAL DEPTH: 68 feet
 BOREHOLE DIAMETER: 8 inches
 DRILLER: Pittsburgh Testing
 RIG: Acker AD2
 BIT(S): Hollow Stem Auger
 DRILLING FLUID: _____
 SURFACE CASING: _____

WELL DESIGN:

BASIC: GEOLOGIC LOG X GEOPHYS. LOG _____
 CASING STRING(S): C-CASING / S=SCREEN
+2.5 - 2.3 C2 _____
+2.4 - 63.0 C1 _____
63.0 - 68.0 S1 _____

CASING: C1: 2" ID Sch. 40 PVC with threaded flush joints
C2: 4" ID steel casing with locking cap

SCREEN: S1: 2" ID Sch. 40 PVC with 0.010 mill slot and threaded flush joints

CENTRALIZERS: _____

FILTER MATERIAL: Natural Sand:
55.0 - 68.0'

ANNULAR SEAL: Bentonite/Slurry: 11 - 55'
Pellets: 5 - 11'; Granules: 3-5'

CEMENT: Portland Cement: +1 - 3.0'
 OTHER: _____


CONSTRUCTION TIME LOG:

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
DRILLING:	1986		1986	
<u>0 - 68'</u>	<u>6/11</u>	<u>1035</u>	<u>6/11</u>	<u>1630</u>
GEOPHYSICAL				
LOGGING:				
CASING:				
<u>C1, S1</u>	<u>6/11</u>	<u>1455</u>	<u>6/11</u>	<u>1505</u>
<u>C2</u>	<u>6/13</u>	<u>1405</u>	<u>6/13</u>	<u>1407</u>
FILTER				
PLACEMENT:				
CEMENTING:	<u>6/13</u>	<u>1400</u>	<u>6/13</u>	<u>1420</u>
DEVELOPMENT:				
OTHER:				
<u>Bentonite</u>	<u>6/12</u>	<u>1450</u>	<u>6/12</u>	<u>1635</u>
<u>Slurry</u>				
<u>Bentonite</u>	<u>6/13</u>	<u>1355</u>	<u>6/13</u>	<u>1400</u>
<u>Pellets &</u>				
<u>Granules</u>				

DEVELOPMENT SUMMARY:

See Well Development Summary

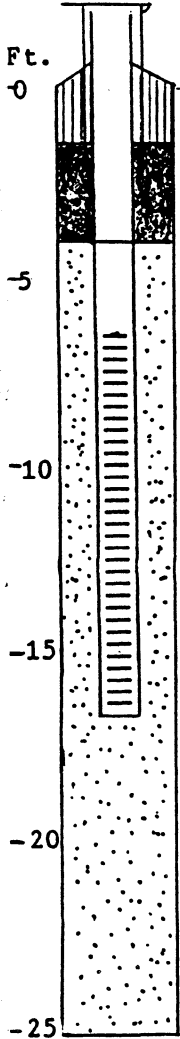
COMMENTS:

 Cement
Bentonite Slurry/Granule
Bentonite Pellets
Sand

WELL/PROBE CONSTRUCTION SUMMARY

PROJECT: Two Rivers Landfills
 PROJECT NO.: 148E06103
 PERSONNEL: Thomas P. Van Biersel

ELEVATION:
 GROUND LEVEL: 638.7 ft. msl
 TOP OF RISER: 640.4 ft. msl
 TOP OF PROT. CASING: _____
 LOCATION OR COORDS: 12+35S, 4+30W



DRILLING SUMMARY:

TOTAL DEPTH: 25 feetBOREHOLE DIAMETER: 8 inchesDRILLER: Pittsburgh TestingRIG: Acker AD2BIT(S): Hollow Stem Auger

DRILLING FLUID: _____

SURFACE CASING: _____

WELL DESIGN:

BASIC: GEOLOGIC LOG X GEOPHYS. LOG _____CASING STRING(S): C-CASING / S=SCREEN+2.0 - 2.8 C2 _____+1.9 - 6.5 C1 _____6.5 - 16.5 S1 _____CASING: C1: 2" ID Sch. 40 PVC with
threaded flush jointsC2: 4" ID steel casing with
locking capSCREEN: S1: 2" ID Sch. 40 PVC with
0.010 mill slot and threaded
flush joints

CENTRALIZERS: _____

FILTER MATERIAL: Natural Sand: 12-25'
Silica Sand: 4-12'ANNULAR SEAL: Bentonite Pellets:
1.5 - 4.0'CEMENT: Portland Cement: +1.5 - 1.0'

OTHER: _____

CONSTRUCTION TIME LOG:

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
	1986		1986	
DRILLING:				
0-25'	6/4	1405	6/4	1520
Reaming	6/5	1730	6/5	1800
GEOPHYSICAL				
LOGGING:				
CASING:				
C1, S1	6/5	1800	6/5	1805
C2	6/5	1921	6/5	1922
FILTER				
PLACEMENT:	6/5	1805	6/5	1805
CEMENTING:	6/5	1920	6/5	1930
DEVELOPMENT:				
OTHER:				
Bentonite	6/5	1917	6/5	1921
Pellets				

DEVELOPMENT SUMMARY:

See Well Development Summary

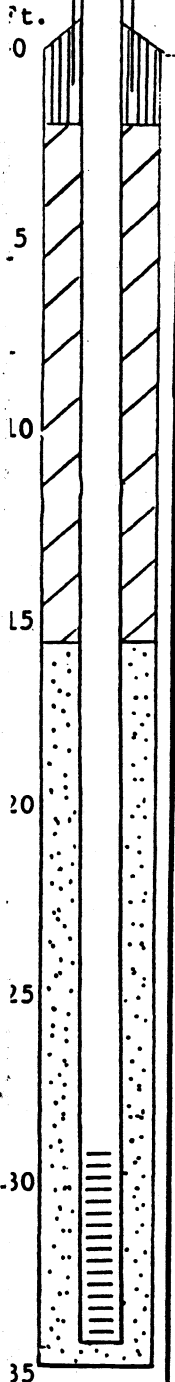
COMMENTS:

	Cement
	Bentonite Slurry/Granule
	Bentonite Pellets
	Sand

WELL/PROBE CONSTRUCTION SUMMARY

PROJECT: Two Rivers Landfills
 PROJECT NO.: 148E06103
 PERSONNEL: Thomas P. Van Biersel

ELEVATION:
 GROUND LEVEL: 638.8 ft. msl
 TOP OF RISER: 640.5 ft. msl
 TOP OF PROT. CASING: _____
 LOCATION OR COORDS: 12+40S, 4+30W



DRILLING SUMMARY:
 TOTAL DEPTH: 34.5 feet
 BOREHOLE DIAMETER: 8 inches
 DRILLER: Pittsburgh Testing
 RIG: Acker AD2
 BIT(S): Hollow Stem Auger
 DRILLING FLUID: _____
 SURFACE CASING: _____

WELL DESIGN:

BASIC: GEOLOGIC LOG X GEOPHYS. LOG _____
 CASING STRING(S): C-CASING / S=SCREEN
+1.7 - 3.1 C2 _____
+1.6 - 2.9 C1 _____
29 - 34 S1 _____

CASING: C1: 2" ID Sch. 40 PVC with
 threaded flush joints
 C2: 4" ID steel casing with
 locking cap

SCREEN: S1: 2" ID Sch. 40 PVC with
 0.010 mill slot and threaded
 flush joints

CENTRALIZERS: _____

FILTER MATERIAL: Natural Sand:
 19 - 34.5'

ANNULAR SEAL: Bentonite Slurry:
 2 - 19.0'

CEMENT: Portland Cement: +1 - 2.0'

OTHER: _____

CONSTRUCTION TIME LOG:

TASK	START		FINISH	
	DATE	TIME	DATE	TIME
DRILLING:	1986		1986	
0 - 34.5'	6/6	1940	6/6	1956
GEOPHYSICAL				
LOGGING:				
CASING:				
C1, S1	6/6	1957	6/6	2001
C2	6/7	1010	6/7	1015
FILTER				
PLACEMENT:				
CEMENTING:	6/7	1015	6/7	1030
DEVELOPMENT:				
OTHER:				
Bentonite	6/7	0720	6/7	0945
Slurry				

DEVELOPMENT SUMMARY:

See Well Development Summary

COMMENTS:

Cement
 Bentonite Slurry/Granule
 Bentonite Pellets
 Sand

[illegible]

APPENDIX F
WELL DEVELOPMENT SUMMARIES

WELL DEVELOPMENT SUMMARY

WELL DNR-1

PROJECT Two Rivers Landfills (148E06103)
LOCATION Two Rivers, Wisconsin
PERSONNEL Thomas P. Van Biersel

WELL LOCATION	0+00W, 14+00N
ELEVATION (PVC riser)	648.6 ft. msl
GROUND LEVEL	646.4 ft. msl

[illegible]

WELL DNR-3

WELL LOCATION	0+65S, 2+75W
ELEVATION (PVC riser)	648.4 ft. msl
GROUND LEVEL	646.3 ft. msl

[illegible]

WELL DEVELOPMENT SUMMARY

WELL DNR-5

PROJECT	<u>Two Rivers Landfills (148E06103)</u>
LOCATION	<u>Two Rivers, Wisconsin</u>
PERSONNEL	<u>Thomas P. Van Biersel</u>

WELL LOCATION	1+90N, 4+30W
ELEVATION (PVC riser)	603.4 ft. msl
GROUND LEVEL	601.6 ft. msl

[illegible]

WELL DEVELOPMENT SUMMARY

WELL DNR-6

PROJECT	<u>Two Rivers Landfills (148E06103)</u>
LOCATION	<u>Two Rivers, Wisconsin</u>
PERSONNEL	<u>Thomas P. Van Biersel</u>

WELL LOCATION 2+00N, 13+90W
ELEVATION (PVC riser) 602.7 ft. msl
GROUND LEVEL 600.9 ft. msl

[illegible]

WELL DEVELOPMENT SUMMARY

WELL DNR-7

PROJECT	<u>Two Rivers Landfills (148E06103)</u>
LOCATION	<u>Two Rivers, Wisconsin</u>
PERSONNEL	<u>Thomas P. Van Biersel</u>

WELL LOCATION	8+95S, 16+65W
ELEVATION (PVC riser)	616.7 ft. msl
GROUND LEVEL	613.4 ft. msl

[illegible]

WELL DEVELOPMENT SUMMARYWELL DNR-8

PROJECT Two Rivers Landfills (148E06103)
LOCATION Two Rivers, Wisconsin
PERSONNEL Thomas P. Van Biersel

WELL LOCATION 8+9DS, 16+65W
ELEVATION (PVC riser) 615.7 ft. msl
GROUND LEVEL 613.4 ft. msl

DATE 1986	TIME	METHOD	VOL. gal.	APP.	TEMP. C	pH s.u.	COND. umho/cm	HNu ppm	COMMENTS
6/13	1020	Bailer	5	Cloudy	10	8.1	482	--	Well installed
									6/12, not yet
									finished
6/13	1303	Bailer	5	Cloudy	9	8.1	466	--	Well installed
									6/12, not yet
									finished
6/13	1337	Bailer	5	Cloudy	10	8.0	500	--	Well installed
									6/12, not yet
									finished
6/13	1645	Bailer	5	Cloudy	9	8.2	485	--	Well finished
6/23	--	--	--	--	--	--	--	3.8	Riser: 0.2 ppm
									(WDNR)

WELL DNR-9

WELL LOCATION 12+35S, 4+30W
ELEVATION (PVC riser) 640.4 ft. msl
GROUND LEVEL 638.7 ft. msl

[illegible]

WELL DEVELOPMENT SUMMARY

WELL DNR-10

PROJECT	<u>Two Rivers Landfills (148E06103)</u>
LOCATION	<u>Two Rivers, Wisconsin</u>
PERSONNEL	<u>Thomas P. Van Biersel</u>

WELL LOCATION 12+40W, 4+30W
ELEVATION (PVC riser) 640.5 ft. msl
GROUND LEVEL 638.8 ft. msl

[illegible]

APPENDIX G
WATER LEVEL DATA

WATER LEVEL DATAWELL DNR-1

PROJECT Two Rivers Landfills (148E06103)
LOCATION Two Rivers, Wisconsin
PERSONNEL Thomas P. Van Biersel

WELL LOCATION D+00W, 14+00N
ELEVATION (PVC riser) 648.6 ft. msl
GROUND LEVEL 646.4 ft. msl

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.msl)		
6/10	1014	OWLP	41.98	39.8	606.6	TPV	Bailed 6 gallon
6/10	1920	OWLP	49.36	47.2	599.2	TPV	Sampled
6/13	1524	OWLP	43.12	40.9	605.5	TPV	
6/19	1003	OWLP	44.69	42.5	603.9	TPV	
6/23	--	--	45.35	43.2	603.2	WDNR	

*OWLP : Olympic Water Level Probe

WATER LEVEL DATA

WELL DNR-2

PROJECT Two Rivers Landfills (148E06103)
 LOCATION Two Rivers, Wisconsin
 PERSONNEL Thomas P. Van Biersel

WELL LOCATION 0+00W, 14+00N
 ELEVATION (PVC riser) 647.3 ft. msl
 GROUND LEVEL 645.4 ft. msl

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.msl)		
6/13	1522	OWLP	4.55	2.7	642.7	TPV	
6/19	1005	OWLP	5.74	3.8	641.6	TPV	
6/23	--	--	6.25	4.1	641.3	WDNR	

*OWLP : Olympic Water Level Probe

WATER LEVEL DATA

WELL DNR-3

PROJECT Two Rivers Landfills (148E06103)
 LOCATION Two Rivers, Wisconsin
 PERSONNEL Thomas P. Van Biersel

WELL LOCATION D+65S, 2+75W
 ELEVATION (PVC riser) 648.4 ft. msl
 GROUND LEVEL 646.3 ft. msl

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.msl)		
6/4	0720	OWLP	18.56	16.5	629.8	TPV	Installed 6/3
6/7	1006	OWLP	5.06	3.0	643.3	TPV	Bailed dry
6/7	1120	OWLP	18.32	16.2	630.1	DJB	
6/7	1756	OWLP	14.92	12.8	633.5	DJB	
6/8	1146	OWLP	8.82	6.7	639.6	TPV	Bailed dry
6/9	0823	OWLP	9.64	7.5	638.8	TPV	Bailed dry
6/9	1858	OWLP	12.96	10.9	635.4	TPV	Bailed dry
6/11	1258	OWLP	10.52	8.4	637.9	TPV	Sampled
6/13	1515	OWLP	5.07	3.0	643.3	TPV	
6/19	1015	OWLP	4.67	2.6	643.7	TPV	
6/23	--	--	6.15	4.1	642.2	WDNR	

*OWLP : Olympic Water Level Probe

WATER LEVEL DATA

WELL DNR-5

PROJECT Two Rivers Landfills (148E06103)
 LOCATION Two Rivers, Wisconsin
 PERSONNEL Thomas P. Van Biersel

WELL LOCATION 1+90N, 4+30W
 ELEVATION (PVC riser) 603.4 ft. ms1
 GROUND LEVEL 601.6 ft. ms1

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.ms1)		
6/2	1601	OWLP	5.78	4.0	597.6	TPV	Installed 6/2
6/3	0831	OWLP	5.65	3.8	597.8	TPV	Bailed dry
6/4	0730	OWLP	5.59	3.8	597.8	TPV	
6/7	1039	OWLP	5.45	3.6	598.0	DJB	
6/7	1800	OWLP	5.65	3.8	597.8	DJB	Bailed dry
6/7	1840	OWLP	7.25	5.4	596.2	DJB	
6/8	1332	OWLP	5.66	3.9	597.7	TPV	Bailed dry
6/9	0852	OWLP	5.68	3.9	597.7	TPV	Bailed dry
6/9	1916	OWLP	5.71	3.9	597.7	TPV	Bailed dry
6/10	1730	OWLP	5.57	3.8	597.8	TPV	Sampled
6/13	1506	OWLP	5.34	3.5	598.1	TPV	
6/19	0834	OWLP	5.37	3.6	598.0	TPV	
6/23	--	--	5.45	3.6	598.0	WDNR	

*OWLP : Olympic Water Level Probe

WATER LEVEL DATA

WELL DNR-6

PROJECT Two Rivers Landfills (148E06103)
 LOCATION Two Rivers, Wisconsin
 PERSONNEL Thomas P. Van Biersel

WELL LOCATION 2+00N, 13+90W
 ELEVATION (PVC riser) 602.7 ft. msl
 GROUND LEVEL 600.9 ft. msl

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.msl)		
5/30	1701	OWLP	34.31	32.5	568.4	TPV	Installed 5/30
6/2	0928	OWLP	17.56	15.8	585.1	TPV	Bailed dry
6/3	0832	OWLP	17.43	15.6	585.3	TPV	Bailed dry
6/4	0728	OWLP	17.12	15.3	585.6	TPV	
6/7	1040	OWLP	17.02	15.2	585.7	TPV	Bailed dry
6/7	1803	OWLP	17.02	15.2	585.7	TPV	Bailed dry
6/8	1350	OWLP	17.22	15.4	585.5	TPV	Bailed dry
6/9	0849	OWLP	17.34	15.5	585.4	TPV	Bailed dry
6/9	1917	OWLP	17.25	15.4	585.4	TPV	Bailed dry
6/10	1750	OWLP	17.06	15.3	585.6	TPV	Sampled
6/11	1507	OWLP	17.22	15.4	585.5	TPV	
6/19	0836	OWLP	17.07	15.3	585.6	TPV	
6/23	--	--	17.15	15.4	585.5	WDNR	

*OWLP : Olympic Water Level Probe

WELL DNR-7

WELL LOCATION 8+95S, 16+65W
ELEVATION (PVC riser) 616.7 ft. msl
GROUND LEVEL 613.4 ft. msl

[illegible]

*OWLP : Olympic Water Level Probe

WATER LEVEL DATA

WELL DNR-8

PROJECT Two Rivers Landfills (148E06103)
 LOCATION Two Rivers, Wisconsin
 PERSONNEL Thomas P. Van Biersel

WELL LOCATION 8+90S, 16+65W
 ELEVATION (PVC riser) 615.7 ft. msl
 GROUND LEVEL 613.4 ft. msl

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.msl)		
6/12	1530	OWLP	42.00	39.7	573.7	TPV	Installed 6/11
6/13	0820	OWLP	31.78	29.5	583.9	TPV	
6/13	1601	OWLP	31.86	29.6	583.8	TPV	
6/19	0924	OWLP	31.73	29.4	584.0	TPV	
6/23	--	--	31.85	29.6	583.8	WDNR	

*OWLP : Olympic Water Level Probe

WATER LEVEL DATA

WELL DNR-9

PROJECT Two Rivers Landfills (148E06103)
 LOCATION Two Rivers, Wisconsin
 PERSONNEL Thomas P. Van Biersel

WELL LOCATION 12+35S, 4+30W
 ELEVATION (PVC riser) 640.4 ft. msl
 GROUND LEVEL 638.7 ft. msl

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.msl)		
6/7	1132	OWLP	2.36	0.7	638.0	TPV	Installed 6/5
6/7	1854	OWLP	2.56	0.9	637.8	DJB	
6/8	1230	OWLP	3.86	2.2	636.5	TPV	Bailed dry
6/9	0944	OWLP	3.23	1.5	637.2	TPV	Bailed dry
6/9	1834	OWLP	3.56	1.9	636.8	TPV	Bailed dry
6/11	1707	OWLP	1.61	+0.1	638.8	TPV	
6/13	1450	OWLP	1.87	0.2	638.5	TPV	
6/19	0939	OWLP	2.06	0.4	638.3	TPV	
6/23	--	--	3.45	1.7	637.0	WDNR	

*OWLP : Olympic Water Level Probe

WATER LEVEL DATAWELL DNR-10

PROJECT Two Rivers Landfills (148E06103)
LOCATION Two Rivers, Wisconsin
PERSONNEL Thomas P. Van Biersel

WELL LOCATION 12+40S, 4+30W
ELEVATION (PVC riser) 640.5 ft. msl
GROUND LEVEL 638.8 ft. msl

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.msl)		
6/7	1140	OWLP	25.00	23.3	615.5	TPV	Bailed dry
6/7	1856	OWLP	33.38	31.7	607.1	DJB	
6/8	1248	OWLP	29.96	28.3	610.5	TPV	Bailed dry
6/9	0947	OWLP	31.14	29.4	609.4	TPV	Bailed dry
6/9	1836	OWLP	33.38	31.7	607.1	TPV	Bailed dry
6/11	1709	OWLP	23.69	22.3	616.5	TPV	Bailed dry
6/13	1446	OWLP	31.02	29.3	609.5	TPV	
6/19	0937	OWLP	15.07	13.4	625.4	TPV	
6/23	--	--	9.88	8.2	630.6	WDNR	

*OWLP : Olympic Water Level Probe

WELL No. 10

WELL LOCATION	3+50S, 12+50W
ELEVATION (PVC riser)	625.4 ft. msl
GROUND LEVEL	622.4 ft. msl

[illegible]

*OWLP : Olympic Water Level Probe

WELL No. 12

WELL LOCATION	6+10S, 15+80W
ELEVATION (PVC riser)	624.2 ft. msl
GROUND LEVEL	622.2 ft. msl

[illegible]

Hydro-Search, Inc.

HYDROLOGISTS-GEOLOGISTS-ENGINEERS

WELL B#25

WELL LOCATION 9+00S, 7+00W
ELEVATION (PVC riser) 634.3 ft. msl
GROUND LEVEL 633.3 ft. msl

[illegible]

Hydro-Search, Inc.

HYDROLOGISTS-GEOLOGISTS-ENGINEERS

WATER LEVEL DATAWELL BH29

PROJECT Two Rivers Landfills (148E06103)
LOCATION Two Rivers, Wisconsin
PERSONNEL Thomas P. Van Biersel

WELL LOCATION 4+00N, 14+00W
ELEVATION (PVC riser) 608.9 ft. msl
GROUND LEVEL 608.4 ft. msl

DATE 1986	TIME	MEASURING DEVICE*	DEPTH (ft. below top of riser)	WATER LEVEL		BY	COMMENTS
				Depth (ft. below grade)	Elevation (ft.msl)		
6/19	0844	OWLP	6.59	6.1	602.3	TPV	

*OWLP : Olympic Water Level Probe

WELL_____ B#32

WELL LOCATION	2+00N, 14+00W
ELEVATION (PVC riser)	603.5 ft. msl
GROUND LEVEL	602.7 ft. msl

[illegible]

*OWLP : Olympic Water Level Probe

WELL BH34

WELL LOCATION	0+75S, 17+00W
ELEVATION (PVC riser)	599.3 ft. msl
GROUND LEVEL	598.4 ft. msl

[illegible]

Hydro-Search, Inc.

HYDROLOGISTS-GEOLOGISTS-ENGINEERS

WELL _____ BH#49

WELL LOCATION 12+50S, 13+50W
ELEVATION (PVC riser) 616.1 ft. msl
GROUND LEVEL 615.0 ft. msl

[illegible]

*OWLP : Olympic Water Level Probe

WELL 127A

WELL LOCATION	5+25N, 10+55W
ELEVATION (PVC riser)	627.7 ft. msl
GROUND LEVEL	626.1 ft. msl

[illegible]

*OWLP : Olympic Water Level Probe

APPENDIX H
FIELD WATER QUALITY SAMPLING AND ANALYSES

FIELD WATER QUALITY SAMPLING AND ANALYSES

PROJECT: Two Rivers Landfills
 LOCATION: Two Rivers, Wisconsin
 PERSONNEL: D.J. Buser/T.P. Van Biersel
 PROJECT NO.: 148E06103

INSTRUMENTS:

TEMPERATURE: Thermometer
 CONDUCTIVITY: YSI Model 33 S-C-T Meter
 pH: VWR - Mini pH Meter
 OTHER: HNu Model P1 101, 10.2 ev probe,
Span : 5

GENERAL: LOCATION		1			
WATER SOURCE		Drill rig water tank			
DATE		6/7/86			
CLOCK TIME		1600			
SAMPLING CONDITIONS					
SAMPLING METHOD		Grab			
DEPTH SAMPLE TAKEN		---			
WELL DEPTH		---			
WATER HEIGHT ON GAUGE OR STAFF		---			
DISCHARGE (CFS OR GPM)		---			
FIELD MEASUREMENTS AND ANALYSIS					
TEMPERATURE (°C or °F)		---			
ELEC. COND. (umhos/cm)	MEASURED	---			
	AT 25 °C	---			
pH		---			
Eh		---			
HNu (ppm)		---			
SAMPLES COLLECTED AND TREATED					
TRACE METALS		---			
ORGANIC		---			
CYANIDE		---			
VOLATILE ORGANICS		1			
LABORATORY: SENT TO:		Swanson			
DATE:		6/9/86			
SAMPLED/ANALYZED BY		DJB			

FIELD WATER QUALITY SAMPLING AND ANALYSES

PROJECT: Two Rivers Landfills
 LOCATION: Two Rivers, Wisconsin
 PERSONNEL: D.J. Buser/T.P. Van Biersel
 PROJECT NO.: 148E06103

INSTRUMENTS:

TEMPERATURE: Thermometer
 CONDUCTIVITY: YSI Model 33 S-C-T Meter
 pH: VWR - Mini pH Meter
 OTHER: HNu Model P1 101, 10.2 ev probe,
Span : 5

GENERAL: LOCATION		DNR-3	DNR-3	DNR-5	DNR-6	DNR-1
WATER SOURCE		Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well	Monitoring Well
DATE		6/10/86	6/10/86	6/10/86	6/10/86	6/10/86
CLOCK TIME		1258	1520	1730	1750	1014
SAMPLING CONDITIONS						
SAMPLING METHOD		Grab/Bailer	Grab/Bailer	Grab/Bailer	Grab/Bailer	Grab/Bailer
DEPTH SAMPLE TAKEN		10.52 - 20'	10.50 - 20'	6' - 10'	17.06 - 45'	41.98'
WELL DEPTH		20.5'	20.5'	10.5'	45'	83'
WATER HEIGHT ON GAUGE OR STAFF		10.52	---	5.57'	17.06'	41.98'
DISCHARGE (CFS OR GPM)		0.5 gal.	---	0.5 gal.	0.5 gal.	6.0
FIELD MEASUREMENTS AND ANALYSIS						
TEMPERATURE (°C or °F)			8	11	9	8
ELEC. COND. (umhos/cm)	MEASURED		960	880	229	570
	AT 25°C		960	880	229	
pH			7.2	6.7	7.7	7.2
Eh						
HNu (ppm)			ND	0.2	ND	ND
SAMPLES COLLECTED AND TREATED						
TRACE METALS			3	3	3	
ORGANIC			3	3	3	
CYANIDE			1	1	1	
VOLATILE ORGANICS			2	2	2	
LABORATORY: SENT TO:			DNR	DNR	DNR	
DATE:			6/10/86	6/11/86	6/11/86	
SAMPLED/ANALYZED BY		TPV	TPV	TPV	TPV	

FIELD WATER QUALITY SAMPLING AND ANALYSES

PROJECT: Two Rivers Landfills
 LOCATION: Two Rivers, Wisconsin
 PERSONNEL: D.J. Buser/T.P. Van Biersel
 PROJECT NO.: 148E06103

INSTRUMENTS:

TEMPERATURE: Thermometer
 CONDUCTIVITY: YSI Model 33 S-C-T Meter
 pH: VWR - Mini pH Meter
 OTHER: HNu Model P1 101, 10.2 ev probe,
Span : 5

GENERAL: LOCATION		DNR-1	Duplicate	Blank	LR #5	
WATER SOURCE		Monitoring Well	Monitoring Well (DNR1)	Distilled	Leachate Riser #5	
DATE		6/10/86	6/10/86	6/10/86	6/10/86	
CLOCK TIME		1920	1920	2100	2130	
SAMPLING CONDITIONS						
SAMPLING METHOD		Grab/Bailer	Grab/Bailer	Grab/Bailer	Grab/Bailer	
DEPTH SAMPLE TAKEN		55 - 83'	55 - 83'	---	>3'	
WELL DEPTH		83'	83'	---	10'	
WATER HEIGHT ON GAUGE OR STAFF		49.36'	49.36'	---	3'	
DISCHARGE (CFS OR GPM)		2.0	2.0	---	0	
FIELD MEASUREMENTS AND ANALYSIS						
TEMPERATURE (°C or °F)		9	9	13		
ELEC. COND. (umhos/cm)	MEASURED	590	590	1		
	AT 25 °C					
pH		7.4	7.4	7.9	7 (pH paper)	
Eh						
HNu (ppm)		ND	ND	ND	4.0 ppm	
SAMPLES COLLECTED AND TREATED						
TRACE METALS		3	3	3	3	
ORGANIC		3	3	3	3	
CYANIDE		1	1	1	2	
VOLATILE ORGANICS		2	2	2	2	
LABORATORY: SENT TO:		DNR	DNR	DNR	DNR	
DATE:		6/11/86	6/11/86	6/11/86	6/11/86	
SAMPLED/ANALYZED BY		TPV	TPV	TPV	TPV	

APPENDIX I
DRILLING FLUID ANALYSIS



Laboratory Services Division
3490 North 127th Street
Brookfield, Wisconsin 53005
telephone (414) 783-6111

REPORT NUMBER B 3313

RECEIVED JUN 26 1986

ANALYTICAL REPORT

SHIP
TO

Hydro-Search, Inc.
Suite 101
210 Regency Court
Waukesha, WI 53186

Atten: Mr. Doug Frazer

DATE June 25, 1986

PURCHASE ORDER NO. 109E06103

SEI JOB NO. L4664

DATE COLLECTED

DATE RECEIVED 6-09-86

PAGE 1 OF 2

Water Sample

See Attachment

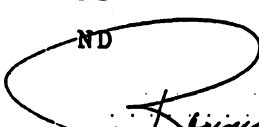
Respectfully Submitted
Swanson Environmental, Inc.

Rosemary L. Dineen *Norman Crabb*
Rosemary L. Dineen Norman Crabb, Ph.D.
Chemist Director

<u>DETECTION</u> <u>IMIT (µg/l)</u>	<u>VOLATILES</u> <u>(Purge & Trap)</u>	<u>SEI ID</u> <u>Sample ID</u>	<u>4664-1</u> <u>Two Rivers LF</u>
50	Acrolein		ND
50	Acrylonitrile		ND
1	Benzene		ND
10	Bromomethane		ND
2	Bromodichloromethane		2
1	Bromoform		ND
2	Carbon tetrachloride		ND
2	Chlorobenzene		ND
1	Chloroethane		ND
4	2-Chloroethylvinylether		ND
1	Chloroform		10
10	Chloromethane		ND
2	Dibromochloromethane		ND
1	1,1-Dichloroethane		ND
1	1,2-Dichloroethane		ND
1	1,1-Dichloroethene		ND
1	trans-1,2-Dichloroethene		ND
1	1,2-Dichloropropane		ND
2	cis-1,3-Dichloropropene		ND
2	trans-1,3-Dichloropropene		ND
1	Ethylbenzene		ND
1	Methylene chloride		<1
3	1,1,2,2-Tetrachloroethane		ND
1	Tetrachloroethene		<1
1	1,1,1-Trichloroethane		<1
1	1,1,2-Trichloroethane		<1
1	Trichloroethene		<1
1	Trichlorofluoromethane		ND
1	Toluene		<1
10	Vinyl chloride		ND
1	Xylene		ND

ND - Not detected

< - Below detection limit


Rosemary L. Dineen
Chemist

89072241839



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050859- Environmental Investi-
gation of the City of
Two Rivers Landfills,
Manitowoc County, Wis-
consin

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