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July 29, 2005

Mr. Thomas J. Hafner, P.E.
Director of Public Works
City of Delafield
500 Genesee Street
Delafield, WI 53018

Subject: **Report on Test Drilling**
Well Siting Study
Delafield, Wisconsin
Earth Tech Project No. 86145

Dear Mr. Hafner,

Exploratory borings were drilled to investigate potential well sites for the City of Delafield within the proposed Village Square development at Highway 16 and Highway 83. A total of three borings were drilled. This letter summarizes the information obtained from the borings. Figure 1 shows the project area and the location of borings drilled in the project area.

The borings will be referred to as borings B1, B2, and B3. The sites for exploratory drilling were selected to maximize the separation distance from existing surface water resources planned stormwater facilities within the proposed development and to provide information on the lateral continuity of the formations encountered. The separation distance between a well and the stormwater facilities must be in accordance with Wisconsin Administrative Code requirements.

The borings were drilled to evaluate subsurface conditions (formations, saturated thickness, and general water quality) and the potential of each site to support a municipal water supply well. Table 1 summarizes the exploratory boring data. Following is a description of the boring sites, geology, water quality, and the potential for each site to support a municipal supply well.

SUMMARY OF TEST DRILLING

Drilling, Sampling, and Abandonment Procedures

CTW Corporation of Lannon, Wisconsin, drilled borings using the dual tube (air rotary) drilling method. Earth Tech staff collected core samples and water samples and performed borehole logging. Boring logs are included in Appendix A.

Formation samples were collected continuously and composited for each 5-foot interval. Formation samples were retrieved from the drill rig cyclone as drilling proceeded. During air rotary drilling, formation cuttings are lifted, nearly instantaneously, from the area of the drill bit through the drill pipe, and to the surface. This drilling method was specified for its ability to provide representative formation samples.

TABLE 1

SUMMARY OF TEST BORING DATA
DELAFIELD, WISCONSIN

BORING	DATE DRILLED	DATE ABANDONED	LOCATION 1/4, 1/4, S, T, R	ESTIMATED SURFACE ELEVATION (FT MSL)	DEPTH OF TEST BORING (FT)	APPROXIMATE STATIC WATER LEVEL DEPTH (FT)	APPROXIMATE AVAILABLE SATURATED THICKNESS (FT)	ESTIMATED MAXIMUM AVAILABLE DRAWDOWN (FT)
B1	5/24/2005	5/26/2005	SE, NE, 4, 7N, 18E	~965	200	62	NA	NA
B2	5/27/2005	6/1/2005	SE, NE, 4, 7N, 18E	~965	335	62	70	153
B3	6/8/2005	6/9/2005	SE, NE, 4, 7N, 18E	~965	315	55	45	147

Where directed, the driller airlifted water for water quality sampling from the borings. When airlifting samples was not possible, a bailer was used to retrieve water samples. The clarity from water samples retrieved from the boring ranged from very turbid/muddy to slightly turbid. Samples were immediately analyzed in the field for pH, temperature, and conductivity. Samples collected for analyses of nitrate, manganese, and iron were filtered in the field through a filter with 0.045 μm openings. Samples were initially taken at ten-foot intervals, then at 20-foot intervals beginning at 155 feet in boring B2. All samples were also tested in the field for nitrate, manganese and iron. Samples were also prepared for laboratory analysis by the Marquette University Water Quality Center. Lab samples were prepared at 50-foot intervals and at selected depths based on the quality of formation.

Borings were abandoned by CTW immediately after completion of drilling by filling with bentonite chips. Bentonite chips were poured in each boring from the ground surface. Abandonment of borings was performed in accordance with the requirements of the Wisconsin Administrative Code.

Boring B1

Boring B1 was drilled at a location approximately 250 feet north of the Vettelson Road right-of-way and 175 feet east of the west property line of the exploration area. Figure 1 shows the boring locations. The boring was drilled on undeveloped land with native vegetation, mostly grasses and reeds. Surrounding land uses are agricultural, low-density residential, low-density commercial, train tracks, and a major roadway. The low-density residential and commercial developments lie to the north of Vettelson Road adjacent to the exploration area. The train tracks lie to the south of Vettelson Road and the major roadway lies to the north of the exploration area, adjacent to the

proposed development. The nearest residence is approximately 225 feet west of boring B1. The approximate ground surface elevation of the site is 965 feet above mean sea level (MSL).

Boring B1 was drilled on May 24-26, 2005, to a total depth of 200 feet. The drill bit was unable to advance past 200 feet and no material could be airlifted. Assuming bedrock had been encountered, the boring was terminated. Subsequent borings indicate that the obstruction in B1 was probably a large boulder. Formation encountered above 200 feet was primarily gravely sand with a 5-foot layer of well-graded gravel directly above the 200-foot stopping point. Clay was encountered from 172 to 185 feet. Sand and gravel were encountered from 172 feet until the water table was reached at 62 feet. Above the water table to the surface was a mixture of silt, clay, sand, and gravel. The formation encountered between 135 and 145 feet appears to have the best yield potential.

Groundwater was encountered in boring B1 at a depth of approximately 62 feet below the ground surface. Boring B1 was abandoned on May 26, 2005.

Boring B2

Boring B2 was drilled at a location approximately 150 feet north of the Vettelson Road right-of-way and 100 feet west of the east property line of the exploration area (Figure 1). The boring was drilled on undeveloped land with native vegetation, mostly grasses and reeds. Surrounding land uses are agricultural, low-density residential, low-density commercial, train tracks, and a major roadway. The low-density residential and commercial developments lie to the north of Vettelson Road adjacent to the exploration area. The train tracks lie to the south of Vettelson Road and the major roadway lies to the north of the exploration area, adjacent to the proposed development. The nearest residence is approximately 230 feet southeast of boring B2. The approximate ground surface elevation of the site is 965 feet above mean sea level (MSL).

Boring B2 was drilled on May 27 and 31, 2005, to a total depth of 335 feet. Clay was encountered at 310 feet and continued until 335 feet, at which depth the boring was terminated. Above the clay layer was sand and gravel from an interval of 270 to 310 feet. A thin layer of clay was encountered at an interval of 262 to 265 feet. Above the clay was sandy, well-graded gravel from 185 to 255 feet. Another clay layer was encountered from an interval of 173 to 185 feet. Above the clay was a layer of fine to medium sand from 120 to 175 feet. Sand and gravel with traces of silt and clay were found from 120 feet to the ground surface. The formation from 185 to 255 appears to have the best yield potential.

Groundwater was encountered in boring B2 at a depth of 62 feet below the ground surface. Boring B2 was abandoned on June 1, 2005.

Boring B3

Boring B3 was drilled at a location approximately 100 feet north of the Vettelson Road right-of-way and 100 feet west of the east property line of the exploration area (Figure 1). Surrounding land

uses are agricultural, low-density residential, low-density commercial, train tracks, and a major roadway. The low-density residential and commercial developments lie to the north of Vettelson Road and the major roadway lies to the north of the exploration area, adjacent to the proposed development. The nearest residence is approximately 200 feet east of boring B3. The approximate ground surface elevation of the site is 965 feet above mean sea level (MSL).

Boring B3 was drilled on June 8 and 9, 2005, to a total depth of 315 feet. Clay was encountered at 265 feet and continued until 315 feet, at which depth the boring was terminated. Above the clay was a slightly silty layer of sand and gravel that extended to 230 feet. At a depth of 185 to 230 feet was a good water-bearing formation of clean, coarse sand and well-graded gravel. Above this layer was an 8-foot layer of sand and clay from 177 to 185 feet. From 105 to 175 feet was a layer of sand with areas of trace gravel and silt. The sand ranged from fine to coarse. From 70 to 105 feet was a well-graded sandy gravel formation. From 50 to 70 feet was a layer of sand with trace gravel. From 34 to 50 feet was a mixture of sand, silt, and gravel with traces of clay. A clay lens occurred from 33 to 34 feet. Above the clay lens and extending to the ground surface was a mixture of sand and gravel. The formation from 185 to 230 feet appears to have the best yield potential.

Groundwater was encountered in boring B3 at a depth of 55 feet below the ground surface. Boring B3 was abandoned on June 9, 2005.

DATA EVALUATION

Saturated Thickness and Potential Yield

The borings drilled in the exploration area are within several hundred feet of each other, and it appears that the sandy gravel formation encountered below a depth of approximately 185 feet is laterally extensive locally. The sandy gravel formation was encountered in each boring at a depth from 185 to 190 feet. The depth of the formation was not determined for boring B1 because the boring was terminated at 205 feet due to an obstruction. The formation is thicker in boring B2, but contains sandier formation, with several lenses of finer sand. Boring B3 contains a larger, uninterrupted interval of clean, sandy well-graded gravel. The depth of this formation is greater in boring B2 than in boring B3. Calculations for maximum available drawdown for boring B3 are based on the well screen being constructed at a depth of 230 feet. The well screen could be constructed at a greater depth in a slightly sandier and siltier formation to allow for a greater maximum available drawdown. Boring logs in Appendix A show sketches of the general formation encountered in each boring.

There appears to be approximately 70 feet of usable saturated thickness in the vicinity of boring B2 and approximately 45 to 75 feet of usable saturated thickness in the vicinity of boring B3. Both of these intervals occur from approximately 185 to 260 feet below the ground surface. Although the thickness of this formation was not obtained from boring B1, the sand and gravel formation was encountered at a depth of 185 feet. It is apparent that the thickness and depth of the formation is relatively uniform within the exploration area.

Sieve analyses of select formation samples collected from borings B2 and B3 were performed so that potential screen slot sizes, well yield, and entrance velocities could be estimated. The sieve results confirm the observations made in the field that the formation varies between well-graded sandy gravel and formation that is slightly back loaded with coarse gravel. Two plots of the sieve results for each of the two formations encountered are in Appendix B.

Water Quality

Water samples were collected at selected intervals. Samples were collected as water was airlifted to the surface and discharged through the cyclone. Field tests were performed immediately on unfiltered samples. Water samples were then filtered through filters with 0.045 µm openings. Every sample was tested in the field and selected samples at areas of interest were placed in laboratory prepared bottles for lab testing. Samples collected for analysis for nitrate were preserved using sulfuric acid. Samples collected for analysis for iron and manganese were preserved using nitric acid. Water quality results are available in Table 2.

TABLE 2

AVERAGE WATER QUALITY CHARACTERISTICS OVER SATURATED THICKNESS INTERVAL DELAFIELD, WISCONSIN

Boring	pH	Conductivity (uS)	Iron (mg/l)	Manganese (mg/l)	Nitrate (mg/l)
B1	8.1 - 8.8	231	--	--	--
B2	8.1 – 8.7	122	0.89	0.06	0.62
B3	7.7 – 8.3	71	0.49	0.02	0.77

Earth Tech performed field testing. Field test results for pH and conductivity are included in Appendix C. The Water Quality Center at Marquette University performed analyses for dissolved iron, dissolved manganese, and nitrate-nitrogen. Laboratory test results for iron, manganese, and nitrate are included in Appendix C.

Samples taken at 235 feet for boring B2 and 295 feet for boring B3 showed concentrations of iron and nitrate that greatly exceed the concentrations at the other depths. High levels of turbidity that could not be filtered from these samples may have caused interference in the testing process. Future examination of the test well water quality will confirm these parameters.

Boring B1

Iron and nitrate concentrations for boring B1 are below both the secondary and primary standards. Manganese concentrations exceed the secondary standard at select intervals. Further investigation of the presence of manganese will be conducted at the test well phase to determine if

treatment will be needed. The pH of the unfiltered water samples ranged from approximately 8.1 to 8.8. No hydrogen sulfide odor was apparent in any of the water samples.

Boring B2

Iron concentrations exceed the secondary standard in two cases. Manganese concentrations exceed the secondary standard in all but one case. Further investigation into the presence of manganese and iron will be conducted at the test well phase to determine if treatment will be needed. Nitrate concentrations did not exceed the primary standard in any of the samples. The pH of the unfiltered water samples ranged from approximately 8.1 to 8.7. No hydrogen sulfide odor was apparent in any of the water samples.

Boring B3

Iron and manganese concentrations exceed the secondary standard at several depths. Further investigation into the presence of manganese and iron will be conducted at the test well phase to determine if treatment will be needed. Nitrate concentrations did not exceed the primary standard in any of the samples. The pH of the unfiltered water samples ranged from approximately 7.7 to 8.3. No hydrogen sulfide odor was apparent in any of the water samples.

COMPARISON OF TEST BORING SITES

Yield and Water Quality

Long-term yield and the ability to support a sustainable municipal supply well will depend on the actual hydraulic conductivity of the formation encountered and the lateral extent of the water-bearing formation. It is recommended that potential long-term yield be evaluated by constructing and pumping a test well at the B3 site and analyzing the drawdown response measured in observation wells.

Water quality appears to be similar at each test boring site. The average concentrations of iron and manganese generally exceed the secondary standards for these contaminants. The average concentrations for nitrate are all below the primary drinking water standard. Further evaluation of the concentration of these contaminants will be done at the test well phase to determine the treatment requirements. During test pumping, it will be important to evaluate trends in iron and manganese concentrations.

Wellhead Protection Planning

The sites are comparable on the basis of wellhead protection. The sites are located relatively close together in the undeveloped exploration area.

It is believed that the properties located along Vettelson Road each have private water supply wells and private sewage disposal systems. The depths of the wells immediately surrounding the exploration area are not known. However, well logs have been obtained for private wells in the

further surrounding area. These logs show wells that are completed in the first good sand and gravel formation above the clay layer and in the dolomite aquifer. This is a good indication that the wells immediately surrounding the exploration area are also completed in these two regions. A map showing the location of the private wells in relationship to the boring sites is included as Figure 1.

Potential contaminant sources in the surrounding area include a Wisconsin environmental repair site and an agricultural property including a barnyard, milk cows, and manure. These sites are located to the northeast and the southeast of the exploration area respectively. There is a storage area located behind a commercial property to the west along Vettleson Road. A site visit did not identify any obvious potential sources of contamination within the storage area. Figure 2 shows the location of the potential contaminant sources in relation to the borings.

CONCLUSIONS AND RECOMMENDATIONS

Each of the test borings encountered similar formation and water quality, with the most promising appearing in boring B3. Based on available water quality data, average iron, nitrate, and manganese concentrations are within acceptable regulatory standards. The need for treatment for iron and manganese removal is uncertain at this time, and will be further examined in the test well phase.

It is recommended that a test well be constructed at boring B3 to further evaluate water quality, yield, and aquifer response to pumping. The test well should be pumped for a minimum of 72 hours, and water samples should be collected from the test well and be analyzed for general water quality parameters, volatile organic compounds (VOCs), synthetic organic compounds (SOCs), inorganic compounds, and radionuclides.

The test well will be designed to provide several types of information. First, the drilling of the test well will provide additional information on the site geology. The screen selection process will further classify the formation soils, identify the optimum size of gravel pack, and define the type and degree of development required to obtain good well efficiency. Pump tests will quantify the characteristics of the aquifer, in terms of storativity, transmissivity, hydraulic conductivity and specific yield. Accurate identification of these parameters will facilitate more accurate calculation of the zone of influence and recharge area of a well at that location. Observation wells will be constructed to the full depth of the test well and at varying distances from the well to reveal the shape and extent of the cone of depression. An additional observation well or wells constructedonly to the depth of the nearest private wells will provide specific information on the potential for influence on nearby wells and surface water features.

A test pumping duration of 72 hours is typical. It is much longer than a production well would ever be pumped continuously, and is within that time frame in which equilibrium is typically reached when aquifer recharge equals the well withdrawal rate and the cone of depression stabilizes or a positive or negative boundary condition is encountered. The conditions observed during the pump test will identify any appropriate recommendations for pumping limitations that should be observed to maintain a sustainable condition without negative impacts.

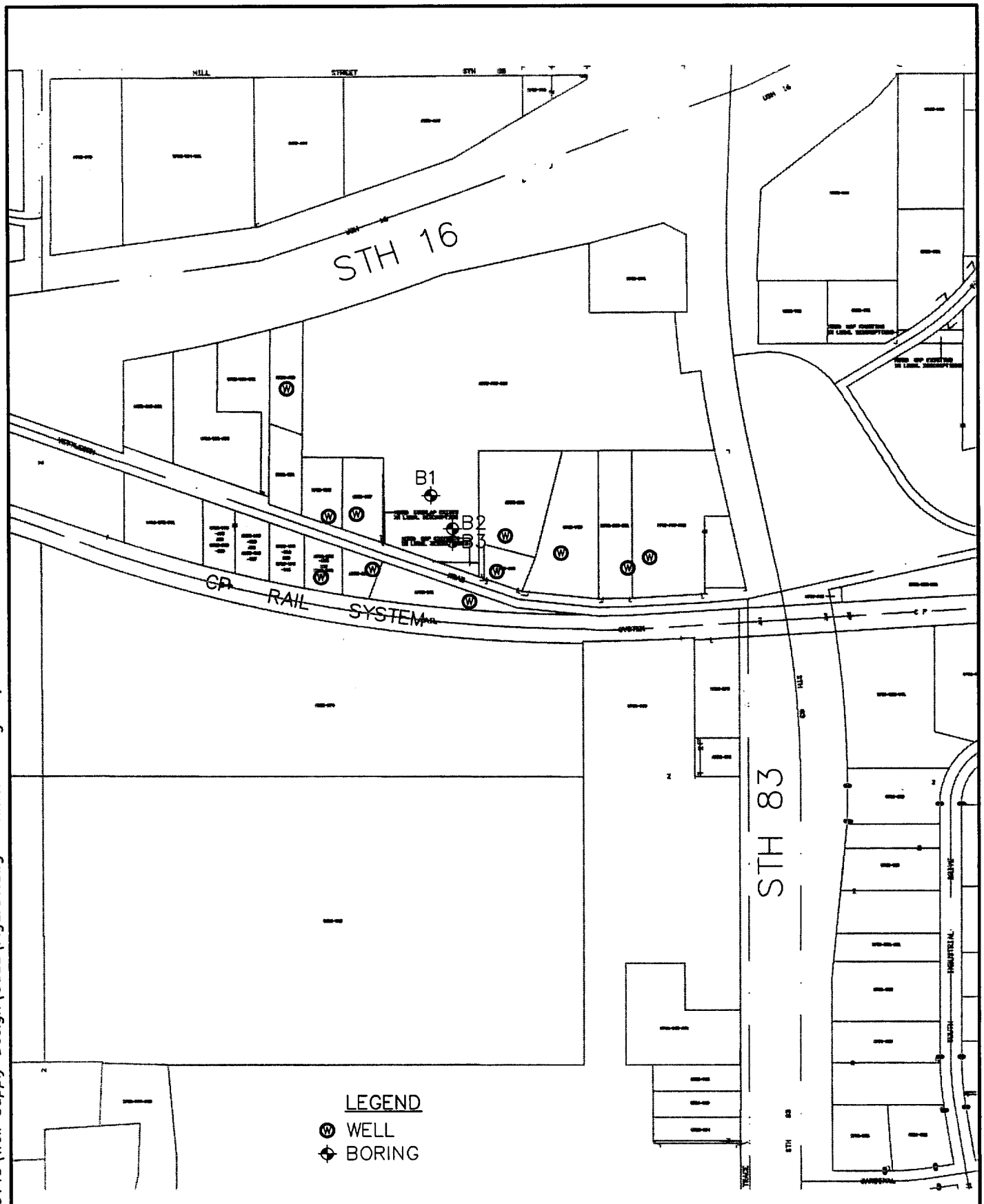
Water withdrawal from a well in the deeper sand and gravel aquifer is part of a water cycle that also includes natural and artificial additions to the groundwater and interconnected surface waters. In conjunction with the recharge area delineation, the impacts of stormwater infiltration, wastewater discharges, and water conservation measures on the local water cycle will also be considered. If a permanent well is recommended for the site, the well design, pumping capacity, and operational restrictions will be defined in accordance with a sustainable water resource plan for the City.

Sincerely,

Earth Tech, Inc.

John Isleb, P.E.
Project Engineer

FIGURES



File: L:\work\86145\Well Supply Design\Cadd\Figure1.dwg Time: Aug 01, 2005 - 6:25am

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FIGURE 1
EXPLORATORY BORING AND PRIVATE WELL LOCATIONS
TEST WELL
CITY OF DELAFIELD

JUNE 2005

86145

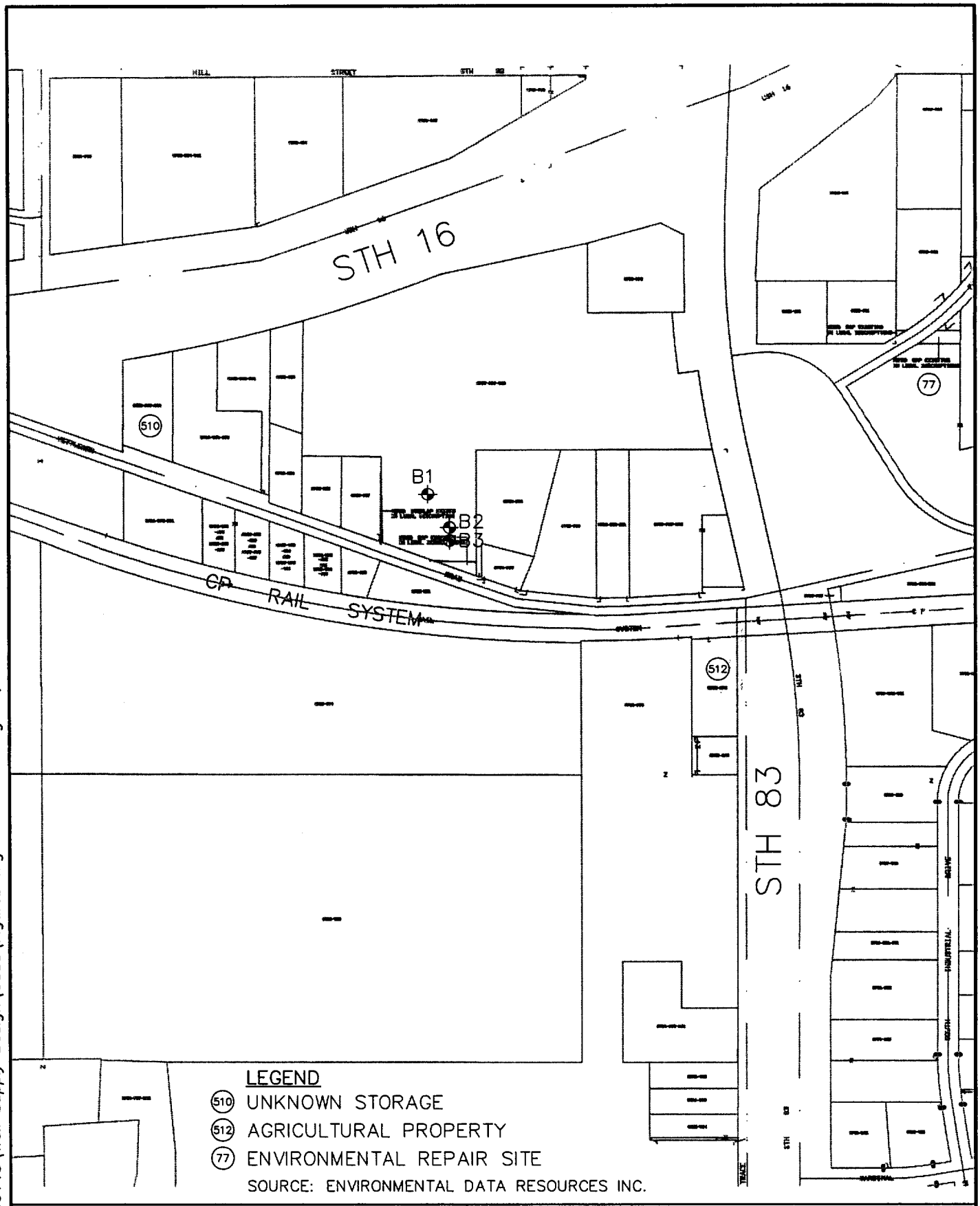

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FIGURE 2
POTENTIAL CONTAMINANT SOURCES

TEST WELL
CITY OF DELAFIELD

JUNE 2005

86145

APPENDIX A

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Revelopment ☐ Other ☐ _____

Facility/Project Name: Delafield Test Borings	License/Permit/Monitoring Number: _____	Boring Number: B-1	
Boring Drilled By: Name of crew chief (first, last) and Firm — First Name: Lonnie Last Name: Firm: CTW	Date Drilling Started: 05/24/2005	Date Drilling Completed: 05/26/2005	Drilling Method: Dual Tube
WI Unique Well No. _____	DNR Well ID No. _____	Well Name:	Final Static Water Level: _____ Feet MSL
Surface Elevation: _____ Feet MSL	Borehole Diameter: 6 inches		
Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐ State Plane _____ N, _____ E S/C/N	Lat ___ ° ___ ' ___ " Long ___ ° ___ ' ___ "	Local Grid Location: _____ Feet ☐ N ☐ S _____ Feet ☐ E ☐ W	
SE 1/4 of NE 1/4 of Section 4, T 7 N, R 18 E/W			
Facility ID	County: Waukesha	County Code: 68	Civil Town/City/ or Village: Delafield

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
CONTINUOUS SAMPLES DUAL TUBE			5	Blind drill to 14' yellow/brown 10 YR 5/4										
			10											
			15	- yellow/brown 10 YR 5/4 sandy silty gravel										
			20	- angular/sub angular w./ trace med rounded 10 YR 5/4 silty gravel w/ sand										
			25	- yellow/brown 10 YR 5/4 small/med gravel very angular trace fine/clean sand										
				SAA = same as above										
			30	- B 10 YR 5/4 F/C sand trace small angular gravel										
			35	- yellow brown 10 YR 5/4 fine - med sand										
			40	yellow/brown 10 YR 5/4 fine sand trace clay 40-41										
			45	light yellow brown 10 YR 6/4 fine sand dry										
			50	SAA dry @ 55'										
			55	SAA trace gravel @ 57' dry										
			60											

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

Signature _____ Firm _____

Sample Number and Type	Sample Length Att. & Recovered (in.)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			65	light yellow brown 10 YR 4/4 fine med sand trace gravel dry water table @ 61.5'										▽ water @ 62'
				SAA lab sample taken 11 AM										
			70	light yellow brown 10 YR 6/4 fine med sandy gravel										
			75	SAA - clean										
			80	SAA slightly finer, clean										
			85	SAA										
			90	SAA slightly coarser, clean										
			95	SAA finer @ 99' sand fine clay inclusions @ 98'-100'										
			100	med clean sandy gravel angular, sub angular, rounded										
			105	SAA										
			110	SAA										
			115	SAA 4" sand seam @ 118'										
			120	SAA med clean sandy gravel water sample clear, good yield										
			125	SAA 6" sand seam @ 128'										
			130	small gravelly med clean sand water sample clear, poor yield										
			135	med clean sand gravel										
			140	gravelly small clean sand - coarse water sample clear, very good yield										
			145	angular, sub angular, round small - med gravel, clean										
			150	fine - med sand 10 YR 4/5 LT brown water sample turbid moderate yield										
			155	SAA trace small ∅, SA gravel @ 157'										
			160											

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Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			165	SAA										
				165-172 very fine sand (pass through sieve) trace small angular gravel, med round gravel										
			170	172-175 grey 10YR 5/1 dense clay cohesive plastic										
			175	(5/25/05) no recovery, slight gravels less @ 175' poor recovery, water sample turbid 8:45 AM										
			180	apparent clay as above										
			185	Med sand, trace gravel										water could n be air @185'
			190	gravelly sand angular, sub angular small to med										
			195	well graded med sandy gravel (fine-large) angular, sub angular										
			200	SAA apparent bedrock @ ≈ 200' boring terminated @ 205'										
			205											

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State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Revelopment ☐ Other ☐ _____

Facility/Project Name: Delafield Test Borings	License/Permit/Monitoring Number: _____	Boring Number: B-2
Boring Drilled By: Name of crew chief (first, last) and Firm — First Name: Lonnie Last Name: Firm: CTW	Date Drilling Started: 05/27/2005	Date Drilling Completed: 05/31/2005
Drilling Method: Dual Tube	WI Unique Well No.: _____	DNR Well ID No.: _____
Well Name:	Final Static Water Level: _____ Feet MSL	Surface Elevation: 965 Feet MSL
Borehole Diameter: 6 inches	Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐	State Plane _____ N, _____ E S/C/N
Lat ° ' "	Long ° ' "	Local Grid Location ☐ N ☐ E _____ Feet ☐ S _____ Feet ☐ W
SE 1/4 of NE 1/4 of Section 4, T 7 N, R 18 E/W	Facility ID	County: Waukesha
County Code: 68	Civil Town/City/ or Village: Delafield	

Sample Number and Type	Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
CONTINUOUS SAMPLE DUAL TUBE			5	clayey sand										
			10	Sandy, well graded gravel										
			15	SAA										
			20	SAA										
			25	Sand, trace gravel										
			30	small - med sand, well graded gravel										
			35	SAA										
			40	med gravel, fine sand										
			45	fine sand, trace gravel										
			50	clayey gravel										
			55	small, - med gravel										
			60	fine sand, trace gravel										

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

Signature _____ Firm _____

Sample Number and Type	Sample Length Att. & Recovered (in.)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			65	small gravely sand										water @ 62'
				fine sand										
			70	fine sand changes to sandy gravel @ 72' small-med gravel										
			75	gravely sand changes to sandy gravel										
			80	sandy gravel, well graded gravel										
			85	well graded gravel, trace sand										
			90	90-92 gravely sand 92-95 even mix gravel/sand										
			95	small-med gravel, trace sand										
			100	gravely sand, changes from gravel to sand @ 101'										
			105	sandy gravel										
			110	SAA, becomes sandier @ 115'										
			115	sandy gravel, even mix										
			120	fine sand										
			125	gravely sand										unable air lift sample
			130	sand, trace gravel										
			135	fine, med sand										
			140	SAA										
			145	fine-med sand										
			150	SAA finer										
			155	SAA										1 of 4 able to air lift
			N/A											

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Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			165	SAA										
				SAA										
			170	SAA trace clay 173'										
			175	clay, plastic, trace gravel										
			180	silted clay										
			185	sandy, well graded gravel change @ 185										
			190	SAA										
			195	SAA										
			200	sandy, trace gravel										
			205	sandy gravel										
			210	well graded gravel										
			215	gravely sand										
			220	sandy gravel										
			225	SAA										
			230	even mix gravel/sand										
			235	sandy gravel well graded										
			240	SAA										
			245	SAA										
			250	SAA										
			255	gravely sand, trace clay										

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Sample Number and Type	Sample Length Att. & Recovered (in.)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			260	260-262 SM 262-265 silty clay turning to dense clay trace sand										
			265	sand, trace clay										
			270	gravely sand										
			275	gravel turned to sand 277										
			280	med sand trace gravel 284 angular gravel										
			285	gravely fine-med sand										
			290	291 sandy gravel 293 gravely sand										
			295	sandy med angular gravel well graded 298 fine-med sand										
			300	300 well graded gravel gravely sand -										
			305	308 sand changes to silty clay trace sand, plastic clay										
			310	silty clay										
			315	clay										
			320	clay, trace gravel and sand										
			325	clay										
			330	ran out of stem boring abandoned										
			335											

Preliminary - Not for further distribution

State of Wisconsin
Department of Natural Resources

SOIL BORING LOG INFORMATION

Form 4400-122 Rev. 7-98

Route To: Watershed/Wastewater ☐ Waste Management ☐
Remediation/Revelopment ☐ Other ☐ _____

Facility/Project Name	License/Permit/Monitoring Number	Boring Number
Delafield Test Borings	_ _ _ _ _ _ _	B3

Boring Drilled By: Name of crew chief (first, last) and Firm	Date Drilling Started	Date Drilling Completed	Drilling Method
First Name: Lonnie Last Name: Firm: CTW	06/08/2005	06/09/2005	Dual Tube

WI Unique Well No.	DNR Well ID No.	Well Name	Final Static Water Level	Surface Elevation	Borehole Diameter
_ _ _ _ _ _	_ _ _ _		~910 Feet MSL	965 Feet MSL	6 inches

Local Grid Origin ☐ (estimated: ☐) or Boring Location ☐
State Plane _____ N, _____ E S/C/N
SE 1/4 of NE 1/4 of Section 4, T 7 N, R 18 E/W
Lat ° ' "
Long ° ' "
Local Grid Location ☐ N ☐ E _____ Feet ☐ S _____ Feet ☐ W

Facility ID	County	County Code	Civil Town/City/ or Village
	Waukesha	68	Delafield

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth in Feet (Below ground surface)	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
Continuous Samples Dual Tube			5	no sample collected/ analyzed										
			15	clean, well graded, sandy gravel										
			20	Med-fine sand trace gravel										
			25	fine sand, trace small gravel										
			30	silty, fine sand trace small gravel tens clay lens 33-34										
			35	silty fine sand, trace med gravel and clay										
			40	silty clay, trace sand and gravel										
			45	silty fine sand, passed through sieve										
			50	fine sand, trace gravel, coarser than above, recovered by sieve										
			55	very little recovery small gravel										water @ 55'
			60											

Preliminary - Not for further distribution

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

Signature _____ Firm _____

Sample Number and Type	Sample Length Att. & Recovered (in.)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P 200	RQD/ Comments
			65	fine sand changing to med sand trace gravel										
				fine sand [redacted] with med angular gravel changing to coarser @ 70										
			70	clean sandy angular sub angular gravel, unable to airlift water sample @ 75'										
			75	well graded sandy angular sub-angular gravel										
			80	SAA (great formation)										
			85	SAA										
			90	SAA										
			95	blade water @ 95										Very + poor yi
				SAA sandier										
			100	SAA										
			105	sand, trace small gravel										
			110	SAA unable to bail or airlift sample @ 115'										
			115	fine-med sand trace gravel										
			120	fine sand trace gravel @ 123										
			125	coarse sand, trace gravel										
			130	fine-med sand										
			135	dark brown/blk water										moderat turbid sample
				fine sand turning coarser @ 140										
			140	fine-med coarse sand										
			145	SAA finer										
			150	SAA										
			155	coarse sand trace gravel										air lif sample with s
			160											

Preliminary-Not for further distribution

Sample: Number and Type	Sample: Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Soil Properties: Moisture Content	Soil Properties: Liquid Limit	Soil Properties: Plasticity Index	Soil Properties: P200	RQD/ Comments
			165	SAA										
			170	SAA										
			175	fine sand, sample lifted @175' too sandy, not collected										
			180	fine sandy @ 177 ~~trace~~ clay trace sand										
			185	clay, trace sand										
			190	Sandy gravel, well graded, angular, sub angular										
			195	SAA										
			200	Well graded sandy gravel, clean										Al sam extremely turbid, gravel li with sa
			205	SAA										
			210	SAA										
			215	SAA sample easily air lifted										highly moderat turbid
			220	SAA										
			225	SAA										
			230	SAA, sandier										
			235	SAA, sandier, silty, not as clean										moderat yield, sa and gra also f
			240	silty, gravely sand										
			245	coarse sandy gravel										
			250	SAA										
			255	sandy gravel, not clean										unable Al sam @ 255
		6/9		SAA										

Preliminary - Not for further distribution

Sample Number and Type	Sample Length Att. & Recovered (in)	Blow Counts	Depth in Feet	Soil/Rock Description And Geologic Origin For Each Major Unit	USCS	Graphic Log	Well Diagram	PID/FID	Soil Properties: Compressive Strength	Moisture Content	Liquid Limit	Plasticity Index	P 200	RQD/ Comments
			265	Sand, @ 262 clayey sand trace gravel, @ 265 changes to sandy clay										
			270	silty, clayey sand changing to silty sand										
			275	sandy clay, @ 275 changes to clayey sand trace gravel										
			280	clay, trace sand										
				SAA										
			285	changes to silty sand @ 285										
			290	silty sand trace clay										
			295	silty fine and coarse sand clayey sand @ 298										Preliminary - Not for further distribution
			300	clayey sand changing to silty sand 304-305 sandy clay										
			305	sandy clay										
			310	dense clay										
			315											

APPENDIX B

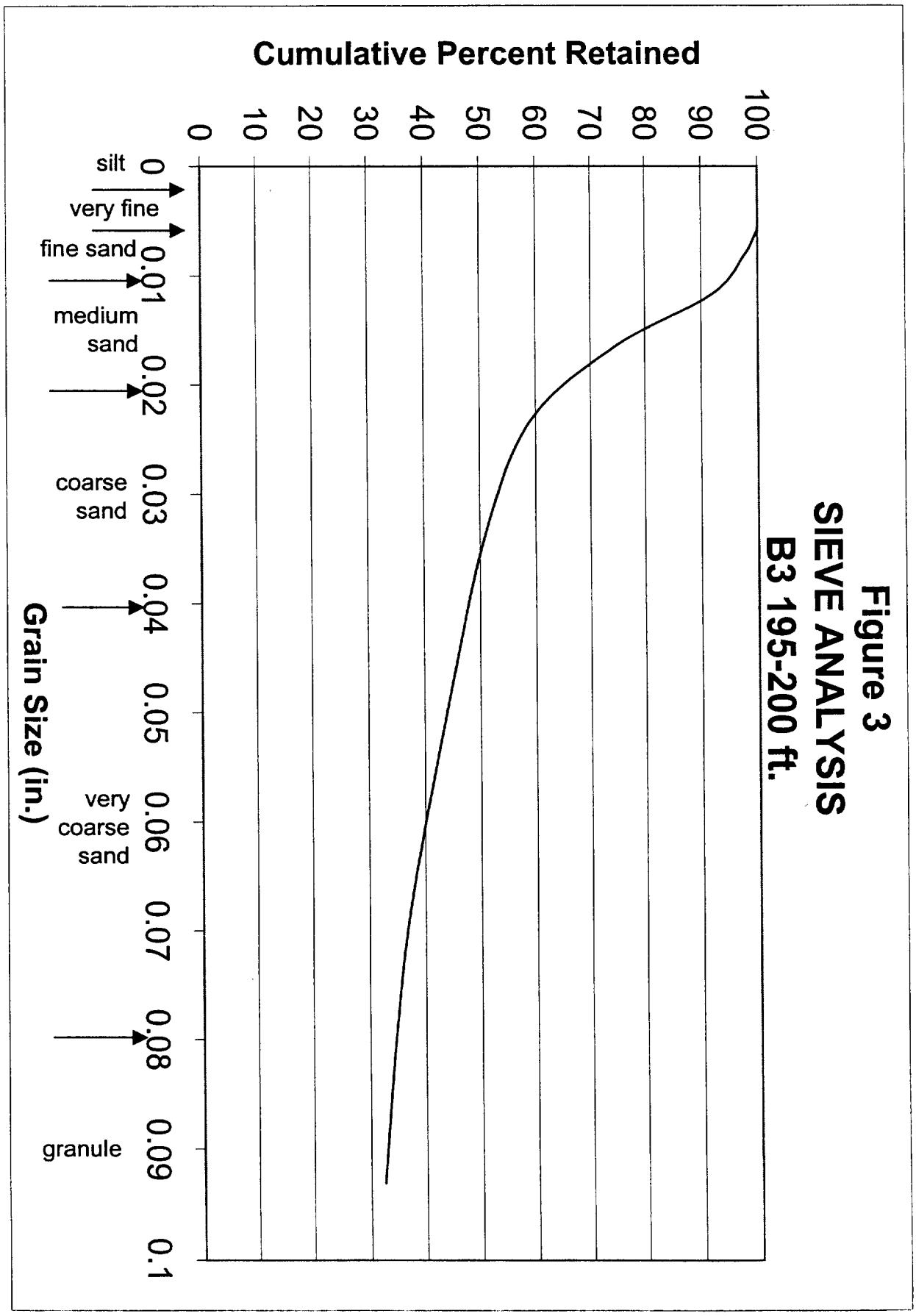

Figure 3
SIEVE ANALYSIS
B3 195-200 ft.

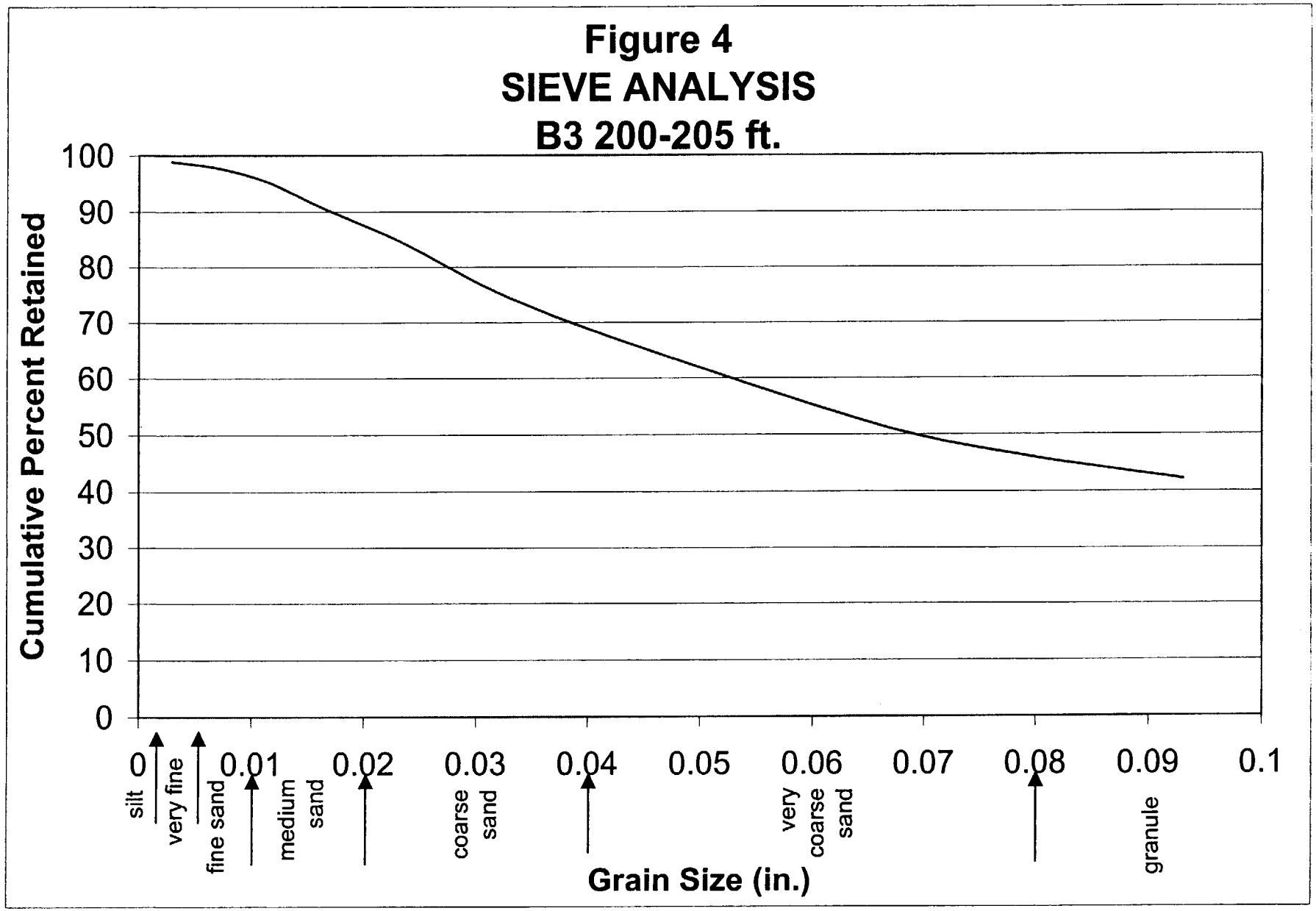
Figure 4
SIEVE ANALYSIS
B3 200-205 ft.
Cumulative Percent Retained
100
90
80
70
60
50
40
30
20
10
0
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
0.1
silt
very fine
fine sand
medium sand
coarse sand
very coarse sand
granule
Grain Size (in.)

APPENDIX C

WATER QUALITY CENTER

MARQUETTE
UNIVERSITY

June 14, 2005

To: John Isleb
EarthTech
1020 North Broadway
Milwaukee, WI 53202
FAX: 414-225-5111
Phone: 414-225-5147

Re: Project Number 86145

Sample	Analysis Date	$N\text{-}NO_3$ (mg/L)	Mn (mg/L)	Fe (mg/L)
B-1-70'	6-13-05	1.11	0.053	0.077
B-1-115'	6-13-05	1.13	0.066	0.050
B-1-165'	6-13-05	1.09	0.027	0.160
B-1-195'	6-13-05	1.25	0.040	0.050
B-2-95'	6-13-05	1.19	0.119	0.216
B-2-115'	6-13-05	1.90	0.106	1.403
B-2-145'	6-13-05	1.23	0.053	0.160
B-2-195'	6-13-05	0.82	0.079	1.707
B-2-215'	6-13-05	0.41	0.040	0.077
B-2-235'	6-13-05	7.79	0.325	14.73
B-3-95'	6-13-05	0.54	0.225	1.238
B-3-135'	6-13-05	0.56	0.093	3.641
B-3-155'	6-13-05	0.78	0.013	0.050
B-3-195'	6-13-05	0.84	0.013	0.216
B-3-215'	6-13-05	0.76	0.027	0.768
B-3-235'	6-13-05	0.78	0.027	0.243
B-3-295'	6-13-05	6.05	0.027	0.685

All test methods from *"Standard Methods for the Examination of Water and Wastewater"*, 19th Edition, 1995.

A copy of the chain of custody is attached.

If there are any questions concerning these results, please give me a call (414-288-3523).

Mike Dollhopf
Laboratory Manager

D.H. ZITOMER
DIRECTOR
(414) 288-5733

MIKE DOLLHOPF
LAB MANAGER
(414) 288-3523

WI DNR LAB #241293690
FAX: (414) 288-6149

OLIN ENGINEERING CENTER P.O. BOX 1881 MILWAUKEE, WISCONSIN 53201-1881

Date:_____

°C

Sample #	Boring #	Time	pH	Conductivity	Temp (°F)	Fe (mg/L)	NO_3^- (mg/L)	Mn (mg/L)	Observations
5/24/05 B1 - 70 ft	1		8.2	µS 58	11.6	.01	>30	0.053	70 ft
B1 - 90 ft	1	14:20	8.8	6.4	11.6	0.00	1.2	0.087	
B1 105 ft	1	14:35	8.1 ~~8.3~~	80	SLOT READING	0.00	3.0	0.117	
B1 115 ft	1	14:50	8.2	432	"	0.00	1.5	0.084	
B1 125 ft	1	15:05	8.0	OFF CHART	"	0.00	0.0	0.065	
B1 135 ft	1	15:23	8.2	600	"	0.12	0.0	0.067	

Date:_____

VERY UNSTABLE

°C

Sample #	Boring #	Time	pH	Conductivity	Temp (°F)	Fe (mg/L)	NO_3 (mg/L)	Mn (mg/L)	Observations
B-1 145'	1	15:35	8.19	45.5 µS	18.5	0.11	0.0	0.054	
B-1 155'	1	15:50	8.27	390 µS	18.5	0.02	0.0	0.054	
165 B-1	1		8.18	off range	18.5	0.09	0.0	0.062	
7/25 175 B-1	1	8:45	~~8.42~~ NA	~~845 µS~~ NA	~~23.6~~ NA	0.00	0.0	0.034	
7/26 185 B-1	1	10:20	8.3	360	NOT READING				NO recovery NO water apparent in zone
B-1 205	1	12:00	8.3	200	22.0	0.37	2.5	0.085	BAILED FROM TUBE RUSTY RED NOT RECOVERING W.L. 200' ± DRILLING WATER?

Date:_____

°C

Sample #	Boring #	Time	pH	Conductivity	Temp (~~°F~~)	Fe (mg/L)	NO_3^- (mg/L)	Mn (mg/L)	Observations
B1 195	1	11:30				0.02	3.4	0.049	
B2 75	2	10:10 AM	8.3	µS 713	24.7	0.21	0.8	0.105	
B2 85	2	10:30 AM	8.45	no reading	22	0.28	0.00	0.14	still turbid after filter
B2 95	2	10:55 AM	8.2		20.7	0.00	2.9	0.067	~~still turbid after filter~~
B2 105	2	11:15 AM	8.11	340 µS	22.5	0.02	1.5	0.072	
B2 115	2	11:30 AM	8.31	100 µS	23.7	0.09	0.3	0.086	filtered twice still turbid

Date:_____

°C

Sample #	Boring #	Time	pH	Conductivity	Temp (°F)	Fe (mg/L)	NO_3 (mg/L)	Mn (mg/L)	Observations
B2 125	2								unable to airlift no sample taken
B2 135	2		8.18	60 µs	21.3	0.00	0.1	0.073	
B2 145	2	12:15				0.00	1.1	0.055	
B2 155	2	12:30	8.3	79 µs	19.6	0.26	0.00	0.126	able to air lift good amount of water 1st time today (turbid after filt
B2 175	2	2:25	8.18	106 µs	23.7	0.09	in clay	.202	TAF
B2 195	2	2:30	8.18	79 µs	22.2	0.07	(LAB)	.107	

Date:_____

°C

Sample #	Boring #	Time	pH	Conductivity	Temp (°F)	Fe (mg/L)	NO_3 (mg/L)	Mn (mg/L)	Observations
B2 215	2	2:40	8.3	µs 123.3	21.C	0.00	(LMB)	0.04	
B2 235	2	2:55	8.38	µs 185	21.8	0.48	(LMB)	0,145	
B2 255	2	3:10	8.33	µs 94	23.8	0.42	0.00	0.163	
5/31 B2 275	2	10:00 AM	8.73	127 µs	19.1	.01	0.00	.041	
B2 295	2	10:45 AM	8.7	140 µs	20.5				filter was unable to remove turbidity sample not tested for Fe, NO_3, Mn

Date: 6/8/05

°C

Sample #	Boring #	Time	pH	Conductivity	Temp (°F)	Fe (mg/L)	NO_3^- (mg/L)	Mn (mg/L)	Observations
6/8/05 B3 95	3	11:45	8.03	52 µS	30.6	0.65	0.00	0.149	very turbid poor yield
B3 135	3	1:50	8.05	55 µS	20.9	1.26	0.00	0.231	moderately turbid unable to airlift sample used bailer
B3 155	3	2:10	7.98	86 µS	32.5	0.06	0.2	0.001	air lifted sample mixed with sand very turbid
B3 195	3	2:55	7.74	115 µS	27.7	0.05	0.06	0.024 0.024	AL sample extremely turbid sand/grav lifted with sample
B3 215	3	3:20	8.16	126 µS	16.7	0.22	0.00	.061	high yield moderately turbid
B3 235	3	3:35	8.17	74 µS	29.0	0.10	0.00	0.016	moderate yield sand and grav also AL turbid

unable to collect sample @ 255 AL gravel/sand mixed w/ water

Date: 6/9/05

Sample #	Boring #	Time	pH	Conductivity	Temp (°F)	Fe (mg/L)	NO_3^- (mg/L)	Mn (mg/L)	Observations
B3 295	3	9:30	8.34	.87 µS	27.8	0.35	0.00	.06	