APPENDIX C
Miller Geotechnical Report

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February 6, 2013

12-19237 50-100

Mr. Robert Peschel, PE
The Sigma Group
1300 W Canal Street
Milwaukee, WI 53233

Subject: **Geotechnical Exploration Report**
McKinley Marina
N Lincoln Memorial Drive
Milwaukee, Wisconsin

Dear Mr. Peschel:

This report summarizes the soil and ground water conditions at the subject site and provides recommendations for design and construction.

PROJECT DESCRIPTION

The Sigma Group provided a description of the project, which was in the preliminary design phase, at the internal kick-off meeting on January 4, 2013. It is our understanding that the project will consist of re-designing the layout of the Marina parking lots, which will include reconstruction or replacement of the existing pavements and parking lots. The site is presently used for public parking lots and as boat storage for the Marina. The topography is gently sloped, with surface runoff east towards Lake Michigan.

SCOPE OF EXPLORATION

The field work was performed on January 16, 2013, using a Mobile B53 truck-mounted drilling rig. Five (5) soil borings were advanced, each to a depth of 15 feet. The locations of the borings are shown on the *Boring Location Plan* in the Appendix. Borings were staked by Miller Engineers & Scientists and elevations will be surveyed by The Sigma Group. All collected soil samples were screened for the presence of organic vapors using a portable photo-ionization detector (PID) as a relative indication of potential petroleum contamination. The PID readings (included on boring logs) showed no indication of petroleum contamination, so no samples have been analytically tested.

Temporary ground water observation wells were installed in three of the soil borings (B1, B3, and B4) to allow ground water table monitoring. The wells consist of 2" diameter PVC pipe with a 10' screen at the bottom. A steel flush mount cap was placed level with the pavement to allow for future ground water level readings. We understand that these will be abandoned at some time in the future by The Sigma Group. This can be accomplished by removing steel cap, pulling out the PVC pipe, and then filling the holes with bentonite chips. At that time *Well/Drillhole/Borehole Abandonment* forms (3300-5) should be forwarded to the Wisconsin Department of Natural Resources (WDNR).

After ground water level measurements were made in borings B2 and B5, they were backfilled with bentonite "hole plug" in accordance with the *Wisconsin Administrative Code Chapter NR 141.25. Well/Drillhole/Borehole Abandonment* forms (3300-5) were forwarded to the Wisconsin Department of Natural Resources (WDNR) and copies are included in the Appendix.

SUBSURFACE CONDITIONS

Existing pavements on-site typically consist of 3 to 6 inches thickness of Hot Mix Asphalt (HMA) over 6 to 20 inches thickness of dense graded aggregate base. An exception is the westernmost parking lot (boring B1) where the asphalt is underlain by 4.5 inches of Portland Cement concrete.

Soils below the aggregate base typically consist of sandy to gravelly, stiff clay fill with asphalt and brick chunks and occasional soft and very stiff zones. The thickness of the clay fill is approximately 5 to 9 feet at the western edge of the property, increasing to approximately 10 to 12 feet at the eastern edge. At boring B2, the clay fill is interbedded with fine grained, medium dense sand. Below the clay fill is loose to medium dense, fine grained sand. Ground water was measured at depths ranging from 5 to 10 feet at boring completion.

CONCLUSIONS AND RECOMMENDATIONS

Where final pavement grades are close to or slightly above existing grades, it may be advantageous to grind in place the existing asphalt pavement and mix it with the top half of existing aggregate base course. This can be graded and compacted to provide the base for new asphalt or concrete pavements. Similarly, the west lot existing pavement consisting of an asphalt overlay on top of Portland Cement Concrete (PCC) can be pulverized in place. The alternatives to dense graded aggregate base consisting of virgin crushed stone or crushed PCC are included in the pavement section recommendations in this report.

The clay soils that comprise the soil subgrade beneath existing pavements generally provide fair to poor support to pavements, and will soften upon exposure to water or disturbance. They also have substantial potential for frost heave. The clay soils are NOT suitable for infiltration of storm water. Relatively deep excavations into the sandy soils below the clay may not be stable, particularly below the ground water table, and may "quicken" with minor amounts of disturbance.

Based on our understanding of the type of construction planned and the data obtained from field exploration, we make the following recommendations.

Site Preparation and Grading

1. All deposits of organic topsoil, and any loose/soft subgrade should be stripped from the proposed construction site. The upper foot of soil exposed below structures and pavements should be compacted to at least 98% of the Standard Proctor (ASTM D698) Maximum Dry Density prior to placing fill. Clay soil should not be allowed to vary more than 3% of the Optimum Moisture Content prior to casting footings, slabs, or placing aggregate base course.
2. Any fill in areas of buildings, structures, pavements, or walks should consist of compacted granular material conforming to *Envelope A* (in the Appendix) provided

the contours of the underlying clay soil do not trap any water that has infiltrated. Otherwise, stiff clay should be used.

3. All fill should be compacted to at least 98% of the Standard Proctor (ASTM D698) Maximum Dry Density and should be free of frozen, organic, or corrosive materials. Fill materials should also be free of oversized pieces which may prevent uniform compaction and create concentrated stresses on proposed structures, or interfere with grading. Fill should be placed in lifts of 12 inches or less and compacted to provide uniform support to structures and pavements.
4. Permanent surface grades should be designed to provide adequate surface drainage away from buildings. A minimum of 5% slope for the first 10 feet is recommended. We recommend a minimum slope of 1% in parking lot pavements and at least 2% crown slopes in drives.

Foundations

Conventional spread footings can be used to support light buildings or structures. We recommend these have at least 42" of final cover for frost protection and be proportioned for not more than 2,000 psf allowable soil bearing stress.

The diameter of shallow caisson foundations supporting light poles should be selected so they do not require excavation below the ground water table into sand soils. Their depths should be sufficient to resist frost heave effects but also avoid bearing over on soft soil layers that are present at some locations and depths. Meeting these criteria may be problematic at some locations due to localized soil conditions, and may require specific alternative solutions. For the more typical conditions, caisson foundations bearing on stiff clay or medium dense sand may be proportioned for end bearing up to 5,000 psf and lateral resistance of 2,000 psf

Underground Utilities

1. Buried water bearing utilities should be located below frost depth. Unless insulated in accordance with Wisconsin Administrative Code SP382.3, sanitary sewers should have at least 3 1/2 feet of protective overburden in areas where snow is not cleared and at least 5 feet where snow is cleared. Water supply lines should have at least 6 feet of soil cover, unless protected by insulation.
2. Bedding material for conduits should be selected and placed in accordance with the recommendations of the pipe manufacturers and in accordance with Chapter 8.43 of *Standard Specifications for Sewer and Water Construction in Wisconsin.*
3. Utility trench backfill **under structures and pavements should be compacted to at least 98% of the Standard Proctor (ASTM D698)** Maximum Dry Density from 1 foot above the top of the conduit on upward. Trench backfill should be placed in lifts of 12 inches or less. Excavated soils may be used for trench fill if practical, but site soils may be difficult to compact if not near the optimum moisture content (ASTM D698). In that case, we recommend granular material conforming to *Envelope A,* be used for utility trench backfill or granular material described in Table 37, Chapter 8.43.4, *Standard Specifications for Sewer and Water Construction in Wisconsin.*

Storm Water Management

Low permeability clay typically comprising the top five to ten feet of soils on this site is **not suitable** for storm water infiltration.

Pavement Considerations

After removal of any unsuitable or soft surficial soils, the underlying clay subgrade of the site is expected to have a modulus of subgrade reaction (K) of approximately 60 pci and a soil support value (S) of 4.5 if prepared in accordance with the **Site Preparation and Grading** section. Any fill that will be placed under paved areas should be compacted to at least 98% of the Standard Proctor (ASTM D698) Maximum Dry Density. Clay subgrade should be maintained within 3% of the Optimum Moisture Content during and after compaction and until gravel base course is placed to avoid subgrade volume change.

Asphalt Pavement

Based on the information above we recommend the following flexible pavement sections:

Drives and Parking	**Light Traffic – $2x10^5$ ESALs (E-0.3)**			**Medium Traffic – $5x10^5$ ESALs (E-1)**		
HMA Thickness (inches)	3.5	3.5	3.5	4	4	4
12.5 mm max aggregate surface mix (inches)	*1.75*	*1.75*	*1.75*	*1.75*	*1.75*	*1.75*
25 mm max aggregate binder mix (inches)	*1.75*	*1.75*	*1.75*	*2.25*	*2.25*	*2.25*
Base Type*	A	B	C	A	B	C
Base Thickness	13.5	9.5	7	15.5	10.5	7.5
Total Section Thickness (inches)	17	13	10.5	19.5	14.5	11.5

**Base types are: A – crushed gravel, B – mixture of milled Asphalt Concrete (AC) and gravel, or C – mixture of pulverized in place AC and Portland Cement Concrete (PCC).*

Granular base course should consist of crushed stone conforming to WisDOT 1 1/4" Gradation, Section 305, compacted to at least 95% of the Modified Proctor (ASTM D1557) Maximum Dry Density. Asphalt and gravel mixtures and pulverized AC and PCC should be compacted likewise. Asphalt concrete binder and surface courses should meet the requirements of Section 315 of the *State of Wisconsin Standard Specifications for Highway Construction.*

Flexible pavements are not recommended for areas where trucks will turn frequently or be parked, or in areas where other high point loads are expected (such as where dumpsters will be stored). Asphalt pavement may deform and fail prematurely under sustained high load areas. We recommend that concrete pavement be placed in areas that will be subject to heavy, concentrated loads.

Concrete Pavement

Based on the previously mentioned subgrade reaction value (K) of 65 pci and the Wisconsin Concrete Pavement Association Design Guide, for a 35-year design life the following rigid pavement section thicknesses are recommended for high point load traffic areas:

Truck Parking and Turning Areas	Light Traffic ($2x10^5$ ESALs)	Medium Traffic ($5x10^5$ ESALs)
Concrete Pavement	6 inches	7 inches
Aggregate Base Course*	6 inches	6 inches

**Aggregate base course may consist of crushed gravel, milled AC and gravel, or milled AC and pulverized PCC.*

CONSTRUCTION CONSIDERATIONS

We recommend that the exposed subgrade be proof-rolled before placement of any new base materials in order to locate any soft areas. Soft soils should be removed and replaced in accordance with our recommendations for *Site Preparation and Grading.*

Trench/excavation spoil, heavy equipment, and heavy vibrating machinery should not be permitted within a lateral distance of the depth of the trench/excavation or 3 feet, whichever is greater. We anticipate that the sidewalls of excavations, and any utility line excavations to depths greater than 4 feet below surrounding grades, may cave to 1 vertical to 1.5 horizontal or flatter. Excavation safety is the excavation contractor's responsibility and should be conducted in strict adherence to OSHA and other applicable codes.

Special precautions should be taken for earthwork during winter months. Footings or fills should not be placed on frozen soils. Exposed subgrade soil should be adequately protected with insulating blankets or hay.

CLOSURE

This report was prepared for the exclusive use of our client and project design professionals for evaluation of the site and for design and construction planning purposes only. Our recommendations are applicable only to the project as described and conditions disclosed by our borings. It was not prepared for uses or parties other than those specifically named or for applications other than those enumerated herein. For purposes or uses other than those specifically named, this report may contain information that is insufficient or inaccurate.

We appreciate participating in this project with you. Please call if you have any questions or comments pertaining to our work.

Prepared by,
MILLER ENGINEERS & SCIENTISTS

Roger G. Miller, P.E.
Chairman

Tony Oxley, E.I.T.
Project Engineer

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WISCONSIN ROGER G. MILLER E-43756 SHEBOYGAN, WI PROFESSIONAL ENGINEER
2/6/2013

MILLER ENGINEERS SCIENTISTS

Appendix

General Conditions–Soil Report

General Conditions–Data Collection

Site Location Map

Boring Location Plan

Classification of Soils for Engineering Purposes

General Notes

Final Logs

Gradation Analysis

Envelope A, Granular Fill

Well/Drillhole/Borehole Abandonment Forms (3300-5)

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General Conditions – Soil Report

This report has been prepared to aid in the evaluation of this property for the intended use described herein, and to assist in the design or planning of this project. In the event any changes in the design as outlined herein, or changes in the vertical position or horizontal location of the facility are planned, the conclusions and recommendations contained in this report shall not be considered valid unless such changes are reviewed and the conclusions of this report modified in writing by Miller Engineers & Scientists, hereinafter referred to as "THE ENGINEER", who prepared this report.

The analysis and recommendations submitted in this report are our opinions based on the data obtained and subsurface conditions noted from the field investigation described at the locations indicated on the accompanying map and/or diagram. This report does not reflect any variations which may occur between, beyond, or below the depths of these test pits or borings. The nature and extent of such variations may not become evident until excavation and construction begin. If variations then appear evident, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.

This soil and foundation engineering report has been prepared for this project by Miller. This report is only for the purposes stated in the contract and may not be sufficient to prepare an accurate bid. The Engineer is responsible for the conclusions and opinions contained herein based on the supplied data relative only to the specific project and location outlined in this report. In the event conclusions or recommendations are made by others, such conclusions or recommendations are not the responsibility of the Engineer.

It is recommended that the Engineer be retained to review designs, plans, and specifications using the conclusions of this report to determine whether any change in concept may have any effect on the validity of the recommendations contained in this document. If the Engineer is not retained for this review, Miller assumes no responsibility for misinterpretation or misapplication of these recommendations or for their validity in the event changes have been made in the project and/or design content. Review of the design, plans, and specifications will be noted in writing by the Engineer upon the Client's request.

There is the possibility that variations in soil conditions will be encountered during construction. In order to permit correlation between soil data in this report and the actual soil conditions encountered during construction, it is recommended that the soil and foundation engineer be retained to perform periodic review during the excavation and foundation construction phases of the work. The soil and foundation Engineer assumes no responsibility for construction compliance with the design concepts, specifications, or recommendations unless he has been retained to perform on-site review during the course of construction.

As a pert of the above review, it is recommended that the Engineer review all areas where fills are to be placed, and test and approve each class of fill material to be used. The fills should be tested by performing grain-size analyses (ASTM D421, D422, or D1140) and by performing laboratory control-moisture density (proctor) tests (ASTM D698 or D1557) on representative samples prior to their delivery and placement. The fills should be field tested for degree of compaction. Fills receiving foundation structures such as footings, slabs-on-grade, frost walls, or piers should be tested for bearing capacity.

The presence of our field representative, if such services are required by the Client, will be for the sole purpose of providing record observations and field soils testing,. Our work does not include supervision, management, or direction of the actual work of the Contractor, his employees, or agents. The Contractor for this project should also be advised. The Contractor should be informed that neither the presence of our field representative nor the observation and testing by our firm shall excuse him in any way for defects discovered in his work. It is understood that our firm will not be responsible for job or site safety.

This report was prepared in accordance with generally accepted soil and foundation engineering practices and makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of the agreement between the Engineer and his Client, included in this report. The report has not been prepared for uses or parties other than those specifically named, or for uses or applications other than those enumerated herein. The report may contain insufficient or inaccurate information for other purposes, applications, building sites, or other uses.

Soil Sampling Methods

Field sampling techniques were employed during this exploration to obtain the data presented in the Boring Logs, and in the report, in accordance with ASTM D420, D1452, D1586 (where applicable), and D1587 (where applicable).

During soil exploration with a drilling rig, sampling is typically accomplished by driving a "standard" split barrel tool ("split spoon") of 2-inch outer diameter into undisturbed soil with a 140-pound weight falling 30 inches. The sum of the number of blows required to advance the tool in two successive 6-inch increments following 6 inches of seating are recorded on the Boring Logs under "N" column. This comprises the Standard Penetration Test (SPT), details of which are prescribed by test method ASTM D1586. When this same tool is used during manual sampling, a smaller weight is dropped and -less height is used. In that case, the specific information is recorded on the field logs and is converted to SPT "N" values shown on the Boring Logs in the report according to the ratio of the actual energy used during manual sampling to the SPT energy-per-blow.

Sampling in cohesive soils may also be performed by hydraulically pushing steel sharpened-edge thin walled tubes into undisturbed soil. Tubes were advanced below the tip on the lead auger in the boring to retrieve a relatively undisturbed sample, in accordance with ASTM D1587. The tubes are equipped with pressure-releasing ports to allow water to escape as the tube is advanced. The sampling methods are indicated by symbols on the Boring Logs.

Samples were brought to the surface, examined by the drilling foreman, and sealed in containers (or sealed in the tubes) to reduce loss of moisture. They were returned to our laboratory for classification per ASTM D2487 methods. Some samples were subjected to tests as described in the text of the report.

A field log was prepared for each boring by the drilling foreman during on-site operations in order to record field occurrences, sampling intervals, and ground water observations. The field logs and laboratory test data sheets are available for inspection at the Engineer's office. They are not included in this report because they do not represent the Engineer's final opinions or interpretations.

A Boring Log of each test pit or boring was prepared by the writer of the report or the Engineer's staff. Each Boring Log contains the writer's interpretation of field conditions or changes in substrata between recovered samples based on the field data received along with the laboratory test data obtained following the field work or on subsequent site observations. The Boring Logs were prepared by assembling and analyzing field and laboratory data. Therefore, the Boring Logs contain both factual and interpretive information. Our opinions are based on the Boring Logs, not the field logs.

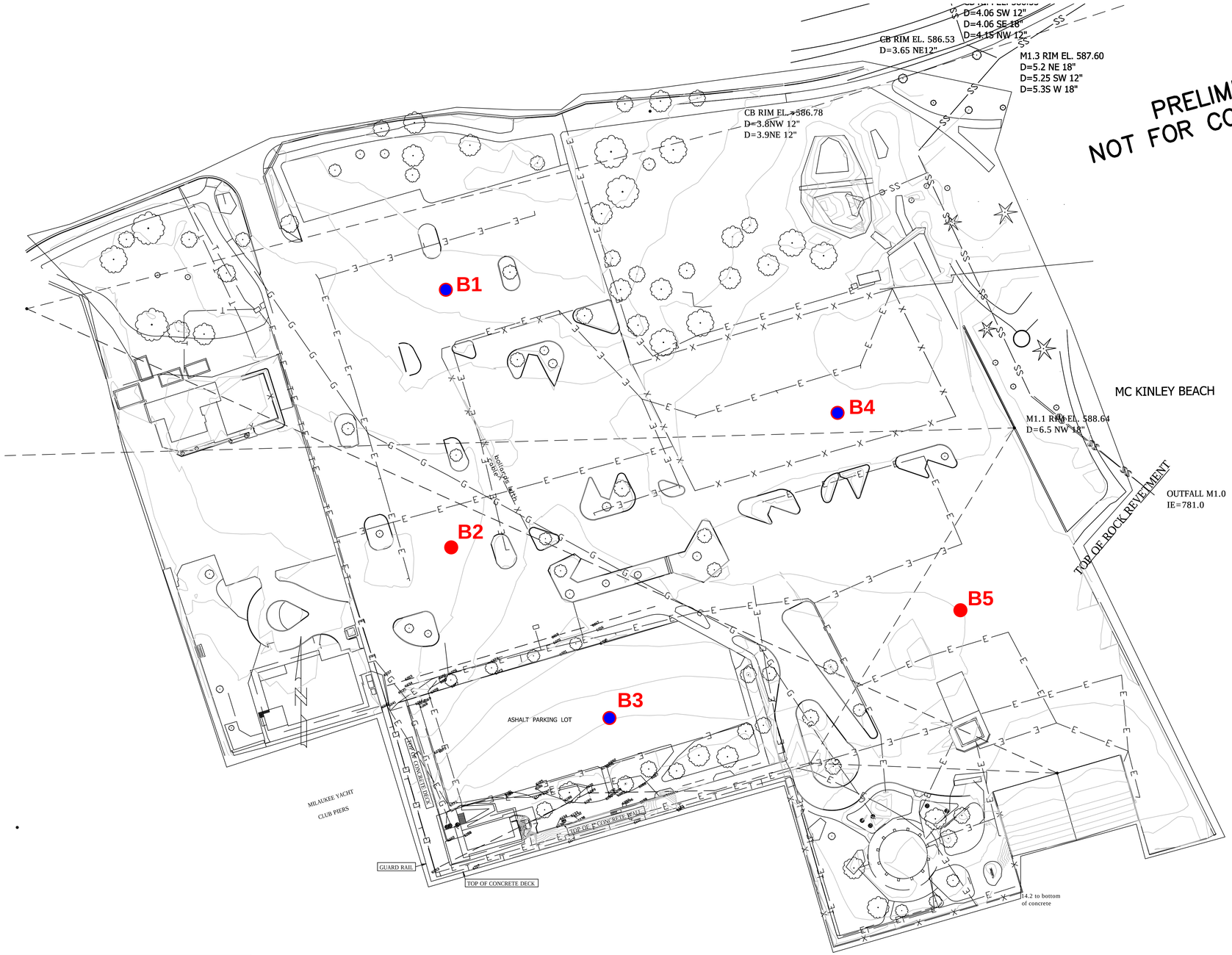
The Boring Logs list boring methods, sampling methods, depths of sampling, amounts of recovery in sampling tools, indications of the presence of subsoil types, and ground water level observations. Results of laboratory tests are arrayed on the Boring Logs at the appropriate depths below grade. The horizontal lines on the Boring Logs which designate the interface between successive layers represent approximate boundaries. The transition between strata in some cases may actually be gradual or variable.

We caution that the Boring Logs alone do not constitute the report, and as such they should not be excerpted from the other appendix exhibits nor from any of the written text. Without the written report it is possible to misinterpret the meaning of the information reported on the Boring Logs. If the report is to be reproduced for bidding or reference purposes, the entire numbered report and appendix exhibits should be bound together as a separate document or as a reference section of a specification booklet, including all maps.

Pocket penetration tests taken in the field or on samples examined in the laboratory are listed on the Boring Logs in a column marked "pp". These tests were performed only to indicate relative stiffness in consistency between successive layers of cohesive soil. It is not recommended that the listed values be used to determine allowable bearing capacities. Soil strength and bearing capacities were interpreted in the report by the Engineer and considered field and laboratory testing methods as described in t he text of the report.

Ground water observations were made with tape measurements in the open drill holes by field personnel at the times and dates stated on the Boring Logs. Fluctuations commonly occur in the ground water level due to variations in rainfall, seasonal temperature, nearby site improvements, underdrainage, wells, severity of winter frosts, overburden weights, and the permeability of the subsoils. Because variations can be expected, final designs and construction planning should allow for the need to temporarily or permanently dewater excavations or subsoils.

Site Location Map



LEGEND

- SECTION 1/4 SECTION LINE
- PROPERTY LINE
- EASEMENT
- CHAIN LINK FENCE
- TREE LINE
- OVERHEAD UTILITY LINE
- ELECTRIC
- TELEPHONE
- FIBER OPTIC
- CABLE TV
- SANITARY SEWER
- FORCE MAIN
- STORM SEWER
- WATER MAIN
- GAS
- EXISTING CONTOUR
- MANHOLE
- CATCH BASIN
- CATCH BASIN (ROUND)
- ROOF DRAIN
- HYDRANT
- WATER VALVE
- GAS VALVE
- UTILITY POLE
- GUY WIRE
- GAS METER
- ELECTRIC METER
- UTILITY PEDESTAL
- TRAFFIC SIGNAL
- LIGHT POLE
- SOIL BORING
- MONITORING WELL
- IRON PIPE FOUND/SET
- REBAR FOUND/SET
- CHISELED CROSS FOUND/SET
- PK NAIL FOUND/SET
- SPIKE/NAIL
- MONUMENT
- BENCHMARK
- SIGN
- DECIDUOUS TREE
- CONIFEROUS TREE
- BUSH
- POST

GENERAL NOTES:

1. BEARINGS BASED ON WISCONSIN STATE PLANE COORDINATE SYSTEM.
2. VERTICAL DATUM IS CITY OF MILWAUKEE DATUM. TO CONVERT TO NGVD 1929 ADD 580.603. BENCHMARK IS SOUTHWEST FLANGE BOLD ON HYDRANT IN NORTHEAST QUADRANT OF W. OREGON STREET AND S. 3RD STREET WITH AN ELEVATION OF 12.93.
3. FEMA FLOODPLAIN INFORMATION DIGITIZED FROM FIRM PANEL 55079C 0093 E DATED 9/26/2008. BASE FLOOD ELEVATION FOR SITE IS 584 (NGVD) OR 3.4 (CITY DATUM).

Boring Location

Boring with Temporary Groundwater Level Observation Well (10' Screen)

THE UNDERGROUND UTILITY INFORMATION SHOWN ON THIS MAP IS BASED ON FIELD DATA AS MARKED BY DIGGERS HOTLINE AND OBTAINED DURING THIS SURVEY. INFORMATION FURNISHED BY UTILITY COMPANIES AND THE LOCAL MUNICIPALITY, AND AS-BUILT INFORMATION. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, ITS ACCURACY AND COMPLETENESS CANNOT BE GUARANTEED.

TO OBTAIN LOCATIONS OF PARTICIPANTS UNDERGROUND FACILITIES BEFORE YOU DIG IN WISCONSIN

CALL DIGGERS HOTLINE
1-800-242-8511
TOLL FREE

WIS STATUTE 182.0175(1974)
REQUIRES MIN. 3 WORK DAYS
NOTICE BEFORE YOU EXCAVATE

MILW. AREA 259-1181

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Fax: 414-643-4210

PROJECT TITLE
LOCATION
ADDRESS
ACAD, WISCONSIN

SITE SURVEY

NO.	REVISION	DATE	BY

DRAWING NO. 3127-500-A.dwg
DRAWN BY:
DATE:
PROJECT NO:
CHECKED BY:
APPROVED BY:
SHEET NO.:

C001

File: N:\milwco\3127 Mckinley Marina\060 CAD\C - Civil\500 Production - Civil Plans\500-Site Survey\3127-500-A.dwg

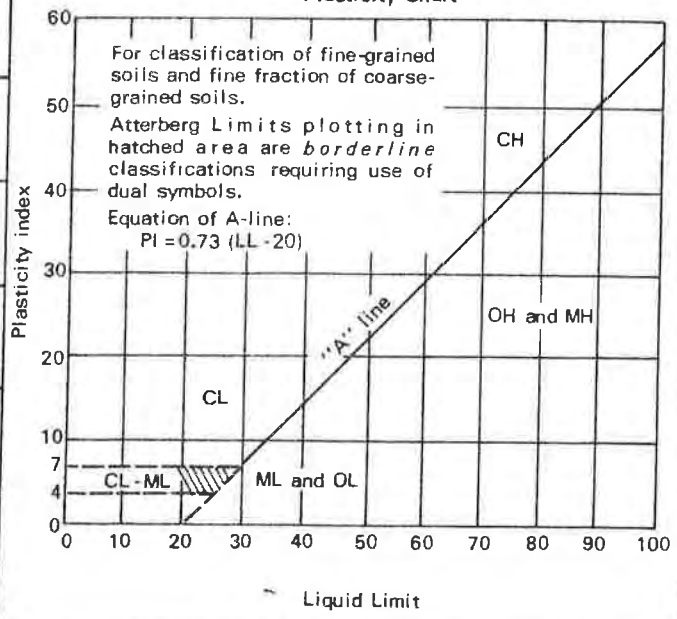
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM Designation: D 2487 – 69 AND D 2488 – 69

(Unified Soil Classification System)

Major divisions			Group symbols	Typical names	Classification criteria	
Coarse-grained soils: More than 50% retained on No. 200 sieve*	Gravels: 50% or more of coarse fraction retained on No. 4 sieve	Clean gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines: Less than 5% pass No. 200 sieve . . . . . GW, GP, SW, SP; More than 12% pass No. 200 sieve . . . . . GM, GC, SM, SC; 5 to 12% pass No. 200 sieve . . . . . *Borderline* classifications requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ greater than 4; $C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW
		Gravels with fines	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are *borderline* classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
	Sands: More than 50% of coarse fraction passes No. 4 sieve	Clean sands	SW	Well-graded sands and gravelly sands, little or no fines	$C_U = \frac{D_{60}}{D_{10}}$ greater than 6; $C_Z = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3	
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW
		Sands with fines	SM	Silty sands, sand-silt mixtures	Atterberg limits below "A" line or P.I. less than 4	Atterberg limits plotting in hatched area are *borderline* classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" line with P.I. greater than 7	
Fine-grained soils: 50% or more passes No. 200 sieve*	Silts and clays: Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
			OL	Organic silts and organic silty clays of low plasticity		
	Silts and clays: Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
			CH	Inorganic clays of high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity, organic silts		
	Highly organic soils		Pt	Peat, muck and other highly organic soils		

Plasticity Chart



*Based on the material passing the 3 in. (76 mm) sieve.

LOG OF TEST BORING
GENERAL NOTES

Descriptive Soil Classification

GRAIN SIZE TERMINOLOGY

Soil Fraction	Particle Size	U.S. Sieve Size
Boulders	Larger Than 12"	Larger Than 12"
Cobbles	3" to 12"	3" to 12"
Gravel: Coarse	3/4" to 3"	3/4" to 3"
Fine	4.76mm to 3/4"	#4 to 3/4"
Sand: Coarse	2.00mm to 4.76mm	#10 to #4
Medium	0.42mm to 2.00mm	#40 to #10
Fine	0.074mm to 0.42mm	#200 to #40
Fines	Less Than 0.074mm	Smaller Than #200
Silt	0.005mm to 0.074mm	Smaller Than #200
Clay	Smaller Than 0.005mm	

(Plasticity characteristics differentiate between silt and clay.)

COMPOSITION TERMINOLOGY (ASTM D2487)

Primary Constituent: Gravel	Sand	Fines (Silt or Clay)
with sand...>=15% sand	with gravel.....>=15% gravel	with gravel....15-29% gravel
with silt.....5-12% silt	with silt.....5-12% silt	gravelly.....>=30% gravel
with clay.....5-12 clay	with clay.....5-12% clay	with sand.....15-29% sand
silty.....>12% silt	silty.....>12% silt	sandy.....>=30%sand
clayey.....>12% clay	clayey.....>12% clay	

RELATIVE DENSITY
COHESIONLESS SOILS

Term	"N" Value
Very Loose	0-4
Loose	4-10
Medium Dense	10-30
Dense	30-50
Very Dense	over 50

The penetration resistance, N, is the summation of the number of blows required to affect two successive 6" penetrations of the 2" split-barrel sampler. The sampler is driven with a 140 lb. weight falling 30" and is seated to a depth of 6" before commencing the standard penetration test (ASTM 1586).

CONSISTENCY
COHESIVE SOILS

Term	pp (tons/sq. ft.)	"N" Value
Very Soft	0.00 to 0.25	<2
Soft	0.25 to 0.50	2-4
Medium	0.50 to 1.00	4-8
Stiff	1.00 to 2.00	8-15
Very Stiff	2.00 to 4.00	15-30
Hard	over 4.00	>30

PLASTICITY

Term	Plasticity Index
None to slight	0 to 4
Slight	5 to 7
Medium	8 to 22
High to Very High	over 22

SYMBOLS

DRILLING AND SAMPLING

CS--Continuous Sampling
RC--Rock Coring: Size AW, BW, NW, 2" W
RQD--Rock Quality Designator
RB--Rock Bit
FT--Fish Tail
DC--Drove Casing
C--Casing: Size 2 1/2", NW, 4", HW
CW--Clear Water
DM--Drilling Mud
HSA--Hollow Stem Auger
FA--Flight Auger
HA--Hand Auger
SS--2" Diameter Split-Barrel Sample
2ST--2" Diameter Thin-Walled Tube Sample
3ST--3" Diameter Thin-Walled Tube Sample
PT--3" Diameter Piston Tube Sample
AS--Auger Sample
PS--Pitcher Sample
NR--No Recovery
VS--Vane Shear Test

LABORATORY TESTS

pp--Penetrometer Reading, tons/sq.ft.
qu--Unconfined Strength, tons/sq. ft.
MC--Moisture Content, %
LL--Liquid Limit, %
PL--Plastic Limit, %
PI--Plasticity Index, %
SL--Shrinkage Limit, %
LI--Loss on Ignition, %
D--Dry Unit Weight, lbs./cu. ft.
pH--Measure of Soil Alkalinity or Acidity
FS--Free Swell, %
HNu--ppmv as Benzene
TLV--ppmv as Hexane
TPH--Total Petroleum Hydrocarbons, ppm

WATER LEVEL MEASUREMENTS

▼--Water Table Interpretation

Note: Water level measurements recorded in notes on the boring logs represent conditions at the time indicated and may not reflect static levels, especially in cohesive soils.

MILLER
ENGINEERS
SCIENTISTS

Project:	**McKinley Marina**	Job No:	**12-19237**	Boring No:	**B1**
Client:	**The Sigma Group**	Drilled By:	**M&K Environmental**	Elevation:	**~588.5**
Location:	**Milwaukee, WI**	Drilling Begun:	**1/16/13**	Drilling Completed:	**1/16/13**

SAMPLE TYPE: 1" Geoprobe | No Recovery | Grab Sample | Auger Sample | 3" Shelby Tube | 2" Split Spoon

ELEV. DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	RECOVERY (in.)	SPT (N)	SOIL DESCRIPTION	USC
0					6" ASPHALT	
					4.5" CONCRETE	
	1		13	14	1.5" Sandy GRAVEL - damp, dark yellowish brown (10YR 4/6)	GW
					Sandy CLAY FILL - moist, stiff, black (7.5YR 2.5/1), PID - 18.7ppmv	CL
	2		8	12	....3" sand seam, very dark gray (7.5YR 3/1) ....dark gray (7.5YR 4/1), PID = 3.8ppmv	
5						
	3		15	4	....PID = 10.2ppmv	
					Sandy CLAY with peat FILL - moist, soft, black (7.5YR 2.5/1), PID = 11.8ppmv	
					Sandy CLAY FILL - moist, stiff, gray (7.5YR 6/1), PID = 4.2ppmv	
	4		15	13	SAND - wet, fine-grained, poorly graded, medium dense, very dark gray (7.5YR 3/1), PID = 0.0ppmv	SP
10						
	5		14	16	....PID = 0.0ppmv	
	6		12	9	....loose, dark gray (7.5YR 4/1), PID = 0.0ppmv	CL
					LEAN CLAY - moist, stiff, dark gray (7.5YR 4/1)	
15					EOB at 15' - temporary ground water observation well installed	
20						

PLASTIC M.C. LIQUID — 10 20 30 40

■ UNCONFINED COMPRESSION (tsf) — 1.0 2.0 3.0 4.0

▲ POCKET PEN (tsf) ▲ — 1.0 2.0 3.0 4.0

● BLOW COUNT (N) ● — 10 20 30 40

ELEV. DEPTH (ft): 0, 5, 10, 15, 20

MILLER ENGINEERS SCIENTISTS

Water Level	Date	Time		Cave-in Depth
	1/16/13	14:30	7.7 ft.	ft.
			ft.	ft.
			ft.	ft.

Borehole Abandonment
Date: 1/16/2013
Material: observation well

Crew: M, T & T
Rig: B53
Method: rotary HSA

GEOTLOG 19237 GINT.GPJ MLLR_ENG.GDT 2/4/13 14:50

Project:	**McKinley Marina**	Job No:	**12-19237**	Boring No:	**B2**
Client:	**The Sigma Group**	Drilled By:	**M&K Environmental**	Elevation:	**~585.5**
Location:	**Milwaukee, WI**	Drilling Begun:	**1/16/13**	Drilling Completed:	**1/16/13**

SAMPLE TYPE: 1" Geoprobe | No Recovery | Grab Sample | Auger Sample | 3" Shelby Tube | 2" Split Spoon

ELEV. DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	RECOVERY (in.)	SPT (N)	SOIL DESCRIPTION	USC
0					6" ASPHALT	
	1		15	19	6" Sandy GRAVEL - damp, dark yellowish brown (10YR 4/6)	GW
					Gravelly CLAY FILL - moist, stiff, black (7.5YR 2.5/1) with some slag chunks, PID = 0.0ppmv	CL
	2		16	11	SAND - moist, fine-grained, poorly graded, medium dense, brown (7.5YR 5/2) ....dark gray (7.5YR 4/1), PID = 0.0ppmv	SP
5						
	3		18	18	Sandy CLAY FILL - moist, very stiff, brown (7.5YR 4/2) ....PID = 0.0ppmv	CL
					SAND - wet, fine-grained, poorly graded, medium dense, very dark gray (7.5YR 3/1), PID = 0.0ppmv	SP
	4		15	16	Sandy CLAY FILL - moist, very stiff, brown (7.5YR 4/3) ....PID = 0.0ppmv	CL
					SAND - wet, fine-grained, poorly graded, medium dense, very dark gray (7.5YR 3/1)	SP
10	5		12	8	....loose, PID = 0.0ppmv	
	6		18	11	....medium dense, trace gravel, PID = 0.0ppmv	
					LEAN CLAY - moist, stiff, brown (7.5YR 5/2), PID = 0.0ppmv	CL
15					EOB at 15'	
20						

PLASTIC M.C. LIQUID: 10 20 30 40

■ UNCONFINED COMPRESSION (tsf): 1.0 2.0 3.0 4.0

▲ POCKET PEN (tsf) ▲: 1.0 2.0 3.0 4.0

● BLOW COUNT (N) ●: 10 20 30 40

ELEV. DEPTH (ft): 0, 5, 10, 15, 20

GEOTLOG 19237 GINT.GPJ MLLR_ENG.GDT 2/4/13 14:50

MILLER ENGINEERS SCIENTISTS

Water Level	Date	Time		Cave-in Depth	
	1/16/13	**10:10**	**5.5** ft.	**6**	ft.
			ft.		ft.
			ft.		ft.

Borehole Abandonment

Date: **1/16/2013**

Material: **bentonite**

Crew: **M, T & T**

Rig: **B53**

Method: **rotary HSA**

Project:	**McKinley Marina**	Job No:	**12-19237**	Boring No:	**B3**
Client:	**The Sigma Group**	Drilled By:	**M&K Environmental**	Elevation:	**~590.0**
Location:	**Milwaukee, WI**	Drilling Begun:	**1/16/13**	Drilling Completed:	**1/16/13**

SAMPLE TYPE: 1" Geoprobe | No Recovery | Grab Sample | Auger Sample | 3" Shelby Tube | 2" Split Spoon

ELEV. DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	RECOVERY (in.)	SPT (N)	SOIL DESCRIPTION	USC
0					5" ASPHALT	
	1		13	11	9" Sandy GRAVEL - damp, dark yellowish brown (10YR 4/6) ....PID = 0.0ppmv	GW
					Gravelly CLAY FILL - moist, stiff, brown (7.5YR 4/3) and black (7.5YR 2.5/1) with some asphalt chunks	CL
	2		18	12	....very dark gray (7.5YR 3/1) with some asphalt and brick chunks, PID = 0.0ppmv	
5						
	3		14	3	....soft, with some ceramic pieces and asphalt chunks, PID = 0.0ppmv	
					LEAN CLAY - moist, stiff, brown (7.5YR 4/3)	CL
	4		13	13	....some slag pieces, PID = 0.0ppmv	
10						
	5		11	9	....PID = 0.0ppmv ....piece of gravel	
					SAND - wet, fine-grained, poorly graded, medium dense, very dark gray (7.5YR 3/1)	SP
	6		14	17	....PID = 0.0ppmv	
15					EOB at 15' - temporary ground water observation well installed	
20						

PLASTIC M.C. LIQUID — 10 20 30 40

UNCONFINED COMPRESSION (tsf) — 1.0 2.0 3.0 4.0

POCKET PEN (tsf) — 1.0 2.0 3.0 4.0

BLOW COUNT (N) — 10 20 30 40

ELEV. DEPTH (ft)

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Water Level	Date	Time		Cave-in Depth
	1/16/13	**14:20**	**9.9** ft.	ft.
			ft.	ft.
			ft.	ft.

Borehole Abandonment
Date: **1/16/2013**
Material: **observation well**

Crew: **M, T & T**
Rig: **B53**
Method: **rotary HSA**

GEOTLOG 19237 GINT GPJ MLLR_ENG GDT 2/4/13 14:50

Project:	**McKinley Marina**	Job No:	**12-19237**	Boring No:	**B4**
Client:	**The Sigma Group**	Drilled By:	**M&K Environmental**	Elevation:	**~585.5**
Location:	**Milwaukee, WI**	Drilling Begun:	**1/16/13**	Drilling Completed:	**1/16/13**

SAMPLE TYPE: 1" Geoprobe | No Recovery | Grab Sample | Auger Sample | 3" Shelby Tube | 2" Split Spoon

ELEV. / DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	RECOVERY (in.)	SPT (N)	SOIL DESCRIPTION	USC
0					3" ASPHALT	GW
	1		14	10	11" Sandy GRAVEL - damp, dark yellowish brown (10YR 4/6) ....PID = 0.0ppmv	CL
					Gravelly CLAY FILL - moist, stiff, very dark gray (7.5YR 3/1)	
	2		12	15	....brown (7.5YR 4/2), PID = 0.0ppmv	
5						
	3		13	13	SAND - wet, fine-grained, poorly graded, medium dense, very dark gray (7.5YR 3/1) ....PID = 0.0ppmv	SP
	4		12	5	....loose, PID = 0.0ppmv	
10						
	5		15	9	....PID = 1.0ppmv ....small shell	
	6		17	20	....medium dense, PID = 0.0ppmv	
15					GRAVEL - wet, medium dense, very dark gray (7.5YR 3/1)	GP
					EOB at 15' - temporary ground water observation well installed	
20						

PLASTIC M.C. LIQUID — 10 20 30 40

■ UNCONFINED COMPRESSION (tsf) — 1.0 2.0 3.0 4.0

▲ POCKET PEN (tsf) ▲ — 1.0 2.0 3.0 4.0

● BLOW COUNT (N) ● — 10 20 30 40

ELEV. / DEPTH (ft): 0, 5, 10, 15, 20

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Water Level	Date	Time		Cave-in Depth
	1/16/13	13:05	5.75 ft.	ft.
			ft.	ft.
			ft.	ft.

Borehole Abandonment
Date: **1/16/2013**
Material: **observation well**

Crew: **M, T & T**
Rig: **B53**
Method: **rotary HSA**

GEOTLOG 19237 GINT.GPJ MLLR_ENG.GDT 2/4/13 14:50

Project:	**McKinley Marina**	Job No:	**12-19237**	Boring No:	**B5**
Client:	**The Sigma Group**	Drilled By:	**M&K Environmental**	Elevation:	**~587.0**
Location:	**Milwaukee, WI**	Drilling Begun:	**1/16/13**	Drilling Completed:	**1/16/13**

SAMPLE TYPE: 1" Geoprobe | No Recovery | Grab Sample | Auger Sample | 3" Shelby Tube | 2" Split Spoon

ELEV. DEPTH (ft)	SAMPLE NO.	SAMPLE TYPE	RECOVERY (in.)	SPT (N)	SOIL DESCRIPTION	USC
0					3.5" ASPHALT	
	1		18	18	20" Sandy GRAVEL - moist, medium dense, dark yellowish brown (10YR 4/6) ....PID = 0.0ppmv	GW
					Sandy CLAY FILL - moist, stiff, black (7.5YR 2.5/1)	CL
	2		15	8	....gravelly, dark grayish brown (10YR 4/2) ....PID = 0.0ppmv	
					....black (7.5YR 2.5/1)	
5					LEAN CLAY - moist, stiff, brown (7.5YR 4/2)	CL
	3		9	9	....PID = 0.0ppmv ....chunk of gravel	
	4		11	8	....gravelly, includes mix of organic silt and peat, PID = 0.0ppmv	
10						
	5		18	20	....PID = 0.0ppmv	
					SAND - wet, fine-grained, poorly graded, medium dense, very dark gray (7.5YR 3/1)	SP
	6		11	5	....loose, PID = 0.0ppmv	
15					EOB at 15'	
20						

PLASTIC M.C. LIQUID — 10 20 30 40

UNCONFINED COMPRESSION (tsf) — 1.0 2.0 3.0 4.0

POCKET PEN (tsf) — 1.0 2.0 3.0 4.0

BLOW COUNT (N) — 10 20 30 40

ELEV. DEPTH (ft)

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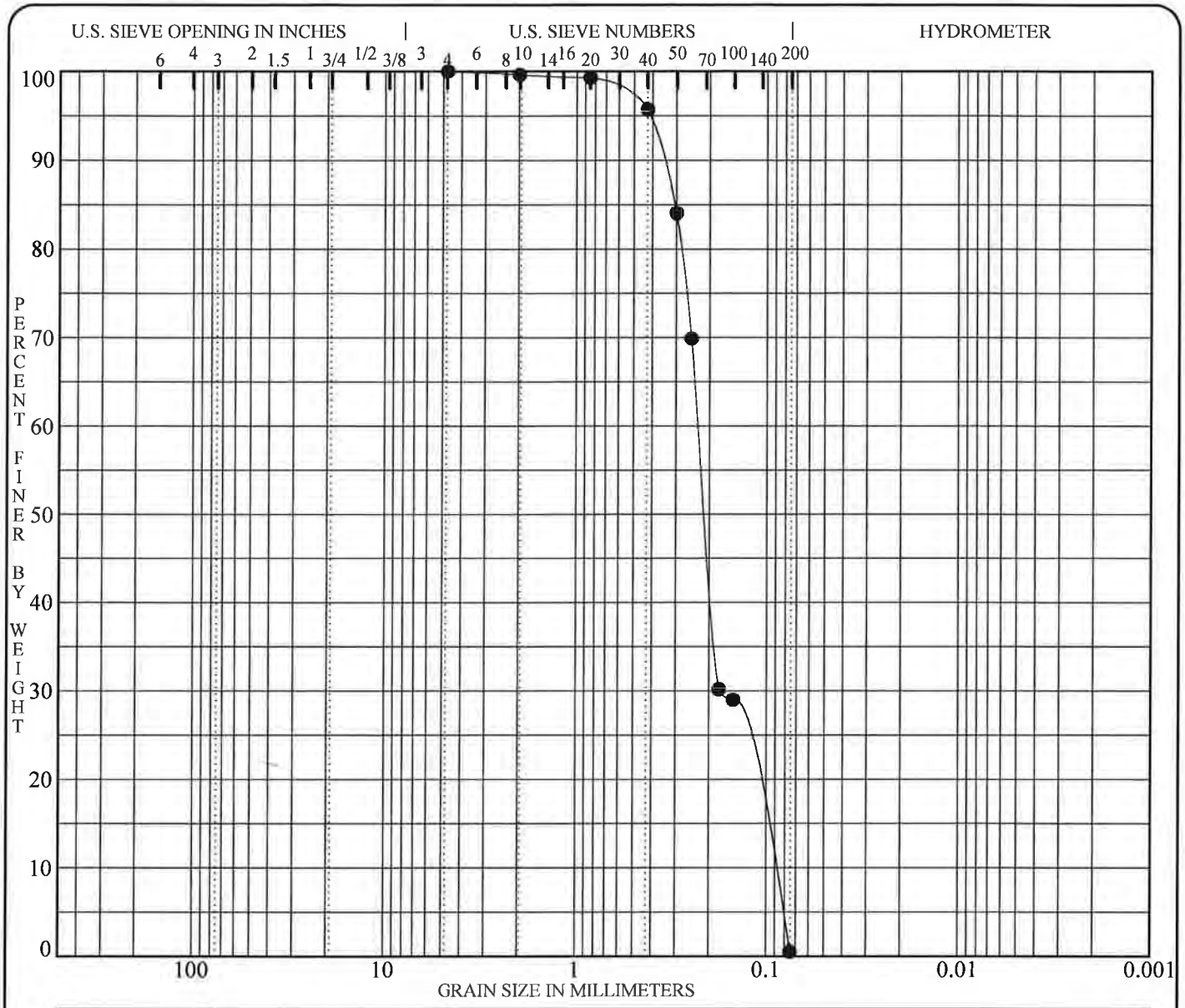
Water Level	Date	Time		Cave-in Depth
	1/16/13	**14:15**	**8.5** ft.	**9.5** ft.
			ft.	ft.
			ft.	ft.

Borehole Abandonment
Date: **1/16/2013**
Material: **bentonite**

Crew: **M, T & T**
Rig: **B53**
Method: **rotary HSA**

GEOTLOG 19237 GINT.GPJ MLLR_ENG.GDT 2/4/13 14:50



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Cc	Cu
● **B4-3**	**POORLY GRADED SAND(SP)**					**1.39**	**2.4**
LAB ID: **B4**							

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **B4-3**	**4.75**	**0.23**	**0.174**	**0.0944**	**0.0**	**99.5**	**0.5**	

CLIENT : **The Sigma Group**
PROJECT: **McKinley Marina**

JOB NO.: **12-19237**
TEST DATE: **1/18/13**
SOURCE: **Boring B4**
SAMPLED BY: **Miller Eng.**
TESTED BY: **TRO**
REVIEWED BY: **RGM**

MILLER ENGINEERS SCIENTISTS

GRAIN SIZE ANALYSIS
ASTM D422

GRAFSIEV 19237 GINT GPJ MLLR_ENG GDT 1/18/13 09:23

GRADATION ANALYSIS

CLIENT:	The Sigma Group	JOB NO.:	12-19237
PROJECT:	McKinley Marina		
LAB ID:	B4	TEST DATE:	1/16/2013
SPECIFICATION:		TESTED BY:	TRO
SAMPLED BY:	Miller Eng.	REVIEWED BY:	RGM
SPECIMEN IDENTIFICATION:	B4-3	SOURCE:	Boring B4

TOTAL WEIGHT OF SAMPLE (g): 61.67

SIEVE TEST ANALYSIS (ASTM D422)

SIEVE SIZE	%FINER	REQUIRED SPECS	
		MIN	MAX
#200	0.5		
#100	29.0		
#80	30.2		
#60	69.9		
#50	84.0		
#40	95.7		
#20	99.3		
#10	99.6		
#4	100.0		

TABLE_SIEVE 19237 GINT GPJ MLLR_ENG.GDT 1/18/13 09:24

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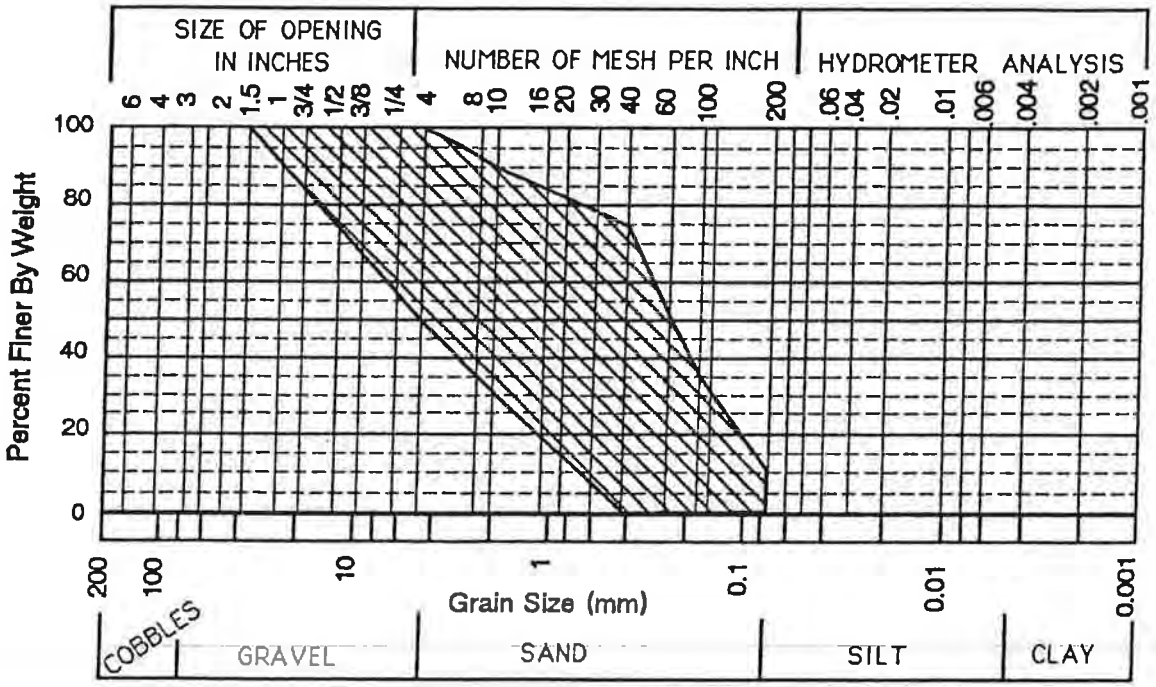
STRUCTURAL GRANULAR FILL

ENVELOPE "A"



SIEVE	PERCENT FINER
1 1/2"	100%
#4	50 - 100%
#10	30 - 90%
#40	0 - 75%
#100	0 - 35%
#200	0 - 10%

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Informational Use Only

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ■ Other ☐ _____

Form 4400-113A Rev. 6-97 2

Facility/Project Name: Mc Kinley Marina	Local Grid Location of Well ☐ _____ ft ☐ N. ☐ S. _____ ft ☐ E. ☐ W.	Well Name: B1
Facility License, Permit or Monitoring No.	Grid Origin Location (Check if estimated: ☐) Lat. ° ' " Long. ° ' " or St. Plane _____ ft. N. _____ ft. E. S/C/N	Wis. Unique Well No. _____ DNR Well ID No. _____
Facility ID _____	Section Location of Waste/Source: _____ 1/4 of ne 1/4 of Sec. 32, T. 7 N, R. 22 ■ E ☐ W	Date Well Installed 1/16/2013 (m m d d y y y y)
Type of Well: Well Code _____ /	Location of Well Relative to Waste/Source: u ☐ Upgradient s ☐ Sidegradient d ☐ Downgradient n ■ Not Known	Well Installed By: (Person's Name and Firm) Mike Mc Ardle, M&K Environmental & Soils Drilling, LLC
Distance Well Is From Waste/Source Boundary _____ ft.		

A. Protective pipe, top elevation _____ ft. MSL

B. Well casing, top elevation _____ ft. MSL

C. Land surface elevation _____ ft. MSL

D. Surface seal, bottom _____ ft. MSL or 0 0 0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☐ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ■ 4 1
_____ Other ☐ _____

15. Drilling fluid used: Water ☐ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ■ 9 9

16. Drilling additives used? ☐ Yes ■ No

Describe _____

17. Source of water (attach analysis):

_____

E. Bentonite seal, top _____ ft. MSL or 1 0 ft.

F. Fine sand, top _____ ft. MSL or 3 0 ft.

G. Filter pack, top _____ ft. MSL or 3 5 ft.

H. Screen joint, top _____ ft. MSL or 4 0 ft.

I. Well bottom _____ ft. MSL or 1 4 0 ft.

J. Filter pack, bottom _____ ft. MSL or 1 4 0 ft.

K. Borehole, bottom _____ ft. MSL or 1 4 0 ft.

L. Borehole, diameter 6.00 in.

M. O.D. well casing 2.38 in.

N. I.D. well casing 2.00 in.

1. Cap and lock? ☐ Yes ☐ No

2. Protective cover pipe:
a. Inside diameter: __.__ in.
b. Length: __.__ ft.
c. Material: Steel ■ 0 4
_____ Other ☐ _____
d. Additional protection? ☐ Yes ■ No
If yes, describe: _____

3. Surface seal: Bentonite ☐ 3 0
Concrete ☐ 0 1
_____ Other ☐ _____

4. Material between well casing and protective pipe:
Bentonite ☐ 3 0
None
_____ Other ☐ _____

5. Annular space seal: a. Granular Bentonite ☐ 3 3
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
c. _____ Lbs/gal mud weight . . . . . Bentonite slurry ☐ 3 1
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 5 0
e. .55 Ft³ volume added for any of the above
f. How installed: Tremmie ☐ 0 4
Tremmie pumped ☐ 0 2
a. Gravity ■ 0 8
Bentonite granules ■ 3 3
b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite pellets ☐ 3 2
c. Bentonite chips Other ☐ _____

6. Bentonite seal:

7. Fine sand material: Manufacturer, product name & mesh size
a. American Materials #40 -60
b. Volume added: .34 Ft³

8. Filter pack material: Manufacturer, product name & mesh size
a. American Materials #35-45
b. Volume added: 1.2 Ft³

9. Well casing: Flush threaded PVC schedule 40 ■ 2 3
Flush threaded PVC schedule 80 ☐ 2 4
Johnson Screen Other ☐ _____

10. Screen material: Schedule 40 pvc
a. Screen type: Factory cut ■ 1 1
Continuous slot ☐ 0 1
_____ Other ☐ _____
b. Manufacturer Johnson Screen
c. Slot size: 0.1 0 in.
d. Slotted length: 1 0 0 ft.

11. Backfill material (below filter pack): None ■ 1 4
_____ Other ☐ _____

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

Signature: Michael P. McArdle Firm: M&K Environmental & Soils Drilling, LLC

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281 283, 289, 291, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 291, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be

Informational Use Only

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ■ Other ☐ _____

Form 4400-113A Rev. 6-97 2

Facility/Project Name
Mc Kinley Marina

Facility License, Permit or Monitoring No.

Facility ID

Type of Well
Well Code _____ /

Distance Well Is From Waste/Source Boundary ft.

Local Grid Location of Well ☐ ft ☐ N. ☐ S. _____ ☐ ft ☐ E. ☐ W.

Grid Origin Location (Check if estimated: ☐)
Lat. ° ′ ″ Long. ° ′ ″ or
St. Plane _____ ft. N. _____ ft. E. S/C/N

Section Location of Waste/Source
_____ 1/4 of ne 1/4 of Sec. 32 , T. 7 N, R. 22 ■ E ☐ W

Location of Well Relative to Waste/Source
u ☐ Upgradient s ☐ Sidegradient
d ☐ Downgradient n ■ Not Known

Well Name
B4

Wis. Unique Well No. _____ **DNR Well ID No.** _____

Date Well Installed 1 / 16 / 2013 (m m d d y y y y)

Well Installed By: (Person's Name and Firm)
Mike Mc Ardle
M&K Environmental & Soils Drilling, LLC

A. Protective pipe, top elevation _____ ft. MSL
B. Well casing, top elevation _____ ft. MSL
C. Land surface elevation _____ ft. MSL
D. Surface seal, bottom _____ ft. MSL or 0 0 0 ft.

12. USCS classification of soil near screen:
GP ☐ GM ☐ GC ☐ GW ☐ SW ☐ SP ☐
SM ☐ SC ☐ ML ☐ MH ☐ CL ☐ CH ☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☐ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ■ 4 1
_____ Other ☐ __

15. Drilling fluid used: Water ☐ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ■ 9 9

16. Drilling additives used? ☐ Yes ■ No
Describe _____

17. Source of water (attach analysis):
_____

E. Bentonite seal, top _____ ft. MSL or 1 0 ft.
F. Fine sand, top _____ ft. MSL or 3 0 ft.
G. Filter pack, top _____ ft. MSL or 3.5 ft.
H. Screen joint, top _____ ft. MSL or 5 0 ft.
I. Well bottom _____ ft. MSL or 1 5 0 ft.
J. Filter pack, bottom _____ ft. MSL or 1 5 0 ft.
K. Borehole, bottom _____ ft. MSL or 1 5 0 ft.
L. Borehole, diameter 6.00 in.
M. O.D. well casing 2.38 in.
N. I.D. well casing 2.00 in.

1. Cap and lock? ☐ Yes ☐ No
2. Protective cover pipe:
a. Inside diameter: __.__ in.
b. Length: __.__ ft.
c. Material: Steel ■ 0 4
_____ Other ☐ __
d. Additional protection? ☐ Yes ■ No
If yes, describe: _____
3. Surface seal: Bentonite ☐ 3 0
Concrete ☐ 0 1
_____ Other ☐ __
4. Material between well casing and protective pipe: Bentonite ☐ 3 0
None Other ☐ __
5. Annular space seal: a. Granular Bentonite ☐ 3 3
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
c. _____ Lbs/gal mud weight . . . . . Bentonite slurry ☐ 3 1
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 5 0
e. .55 Ft³ volume added for any of the above
f. How installed: Tremmie ☐ 0 4
Tremmie pumped ☐ 0 2
a. Gravity ■ 0 8
6. Bentonite seal: Bentonite granules ■ 3 3
b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite pellets ☐ 3 2
c. Bentonite chips Other ☐ __
7. Fine sand material: Manufacturer, product name & mesh size
a. American Materials #40 -60
b. Volume added: .34 Ft³
8. Filter pack material: Manufacturer, product name & mesh size
a. American Materials #35-45
b. Volume added: 1.2 Ft³
9. Well casing: Flush threaded PVC schedule 40 ■ 2 3
Flush threaded PVC schedule 80 ☐ 2 4
Johnson Screen Other ☐ __
10. Screen material: Schedule 40 pvc
a. Screen type: Factory cut ■ 1 1
Continuous slot ☐ 0 1
_____ Other ☐ __
b. Manufacturer Johnson Screen
c. Slot size: 0.10 in.
d. Slotted length: 10.0 ft.
11. Backfill material (below filter pack): None ■ 1 4
_____ Other ☐ __

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

Signature: Michael P. McArdle Firm: M&K Environmental & Soils Drilling, LLC

Please complete both Forms 4400-113A and 4400-113B and return them to the appropriate DNR office and bureau. Completion of these reports is required by chs. 160, 281 283, 289, 291, 293, 295, and 299, Wis. Stats., and ch. NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291, 291, 293, 295, and 299, Wis. Stats., failure to file these forms may result in a forfeiture of between $10 and $25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on these forms is not intended to be used for any other purpose. NOTE: See the instructions for more information, including where the completed forms should be

Informational Use Only

State of Wisconsin
Department of Natural Resources

Route to: Watershed/Wastewater ☐ Waste Management ☐ Remediation/Redevelopment ■ Other ☐ _____

Form 4400-113A Rev. 6-97 2

Facility/Project Name
Mc Kinley Marina

Facility License, Permit or Monitoring No.

Facility ID

Type of Well
Well Code _____ /

Distance Well Is From Waste/Source Boundary ft.

Local Grid Location of Well ☐ ft ☐ N. ☐ S. _____ ft ☐ E. ☐ W.

Grid Origin Location (Check if estimated: ☐)
Lat. ° ′ ″ Long. ° ′ ″ or
St. Plane _____ ft. N. _____ ft. E. S/C/N

Section Location of Waste/Source
_____ 1/4 of ne 1/4 of Sec. 32 ,T. 7 N, R. 22 ■ E ☐ W

Location of Well Relative to Waste/Source
u ☐ Upgradient s ☐ Sidegradient
d ☐ Downgradient n ■ Not Known

Well Name
B3

Wis. Unique Well No. _____ **DNR Well ID No.** _____

Date Well Installed 1 1/1 6/2 0 1 3 (m m d d y y y y)

Well Installed By: (Person's Name and Firm)
Mike Mc Ardle
M&K Environmental & Soils Drilling, LLC

A. Protective pipe, top elevation _____ ft. MSL
B. Well casing, top elevation _____ ft. MSL
C. Land surface elevation _____ ft. MSL
D. Surface seal, bottom _____ ft. MSL or 0 0 0 ft.

12. USCS classification of soil near screen:
GP☐ GM☐ GC☐ GW☐ SW☐ SP☐
SM☐ SC☐ ML☐ MH☐ CL☐ CH☐
Bedrock ☐

13. Sieve analysis performed? ☐ Yes ☐ No

14. Drilling method used: Rotary ☐ 5 0
Hollow Stem Auger ■ 4 1
_____ Other ☐ __

15. Drilling fluid used: Water ☐ 0 2 Air ☐ 0 1
Drilling Mud ☐ 0 3 None ■ 9 9

16. Drilling additives used? ☐ Yes ■ No
Describe _____

17. Source of water (attach analysis):
_____

E. Bentonite seal, top _____ ft. MSL or 1 0 ft.
F. Fine sand, top _____ ft. MSL or 3 0 ft.
G. Filter pack, top _____ ft. MSL or 3.5 ft.
H. Screen joint, top _____ ft. MSL or 5 0 ft.
I. Well bottom _____ ft. MSL or 1 5 0 ft.
J. Filter pack, bottom _____ ft. MSL or 1 5 0 ft.
K. Borehole, bottom _____ ft. MSL or 1 5 0 ft.
L. Borehole, diameter 6.00 in.
M. O.D. well casing 2.38 in.
N. I.D. well casing 2.00 in.

1. Cap and lock? ☐ Yes ☐ No
2. Protective cover pipe:
a. Inside diameter: __.__ in.
b. Length: __.__ ft.
c. Material: Steel ■ 0 4
_____ Other ☐ __
d. Additional protection? ☐ Yes ■ No
If yes, describe: _____
3. Surface seal: Bentonite ☐ 3 0
Concrete ☐ 0 1
_____ Other ☐ __
4. Material between well casing and protective pipe: Bentonite ☐ 3 0
None Other ☐ __
5. Annular space seal: a. Granular Bentonite ☐ 3 3
b. _____ Lbs/gal mud weight . . . Bentonite-sand slurry ☐ 3 5
c. _____ Lbs/gal mud weight . . . . . Bentonite slurry ☐ 3 1
d. _____ % Bentonite . . . . . Bentonite-cement grout ☐ 5 0
e. .55 Ft³ volume added for any of the above
f. How installed: Tremmie ☐ 0 4
Tremmie pumped ☐ 0 2
a. Gravity ■ 0 8
6. Bentonite seal: Bentonite granules ■ 3 3
b. ☐ 1/4 in. ☐ 3/8 in. ☐ 1/2 in. Bentonite pellets ☐ 3 2
c. Bentonite chips Other ☐ __
7. Fine sand material: Manufacturer, product name & mesh size
a. American Materials #40 -60
b. Volume added: .34 Ft³
8. Filter pack material: Manufacturer, product name & mesh size
a. American Materials #35-45
b. Volume added: 1.2 Ft³
9. Well casing: Flush threaded PVC schedule 40 ■ 2 3
Flush threaded PVC schedule 80 ☐ 2 4
Johnson Screen Other ☐ __
10. Screen material: Schedule 40 pvc
a. Screen type: Factory cut ■ 1 1
Continuous slot ☐ 0 1
_____ Other ☐ __
b. Manufacturer Johnson Screen
c. Slot size: 0.1 0 in.
d. Slotted length: 1 0 0 ft.
11. Backfill material (below filter pack): None ■ 1 4
_____ Other ☐ __

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Signature: Mark P. McArdle Firm: M&K Environmental & Soils Drilling, LLC

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State of Wis., Dept of Natural Resources
dnr.wi.gov

Well / Drillhole / Borehole Filling & Sealing

Form 3300-005 (R4/08)

Notice: Completion of this report is required by chs.160, 281, 283, 289, 291-293, 295, and 299, Wis.,and NR 141, Wis. Adm. Code. In accordance with chs. 281, 289, 291-293, 295 and 299, Wis. Stats., failure to file this form may result in a forfeiture of between $10-25,000, or imprisonment for up to one year, depending on the program and conduct involved. Personally identifiable information on this form is not intended to be used for any other purpose. Return form to the appropriate DNR office and bureau. See instructions on reverse for more information.

■ **Verification Only of Fill and Seal**

Route to:
☐ Drinking Water ☐ Watershed/Wastewater ☐ Remediation/Redevelopment
☐ Waste Management ☐ Other:

1. Well Location Information

County	WI Unique Well # of Removed Well	
Milwaukee		**B2**

Latitude / Longitude (Degrees and Minutes): ____ ° ____ . ____ 'N ____ ° ____ . ____ 'W
Method code(see instructions):

1/4 / 1/4	1/4	Section	Township	Range	
or Govt Lot#	**ne**	**32**	**7** N	**22**	■ E ☐ W

Well Street Address:
Well City, Village or Town:
Well ZIP Code:
Subdivision Name:
Lot #:
Reason for Removal From Service: **Project completion**
WI Unique Well # of Replacement Well:

2. Facility / Owner Information

Facility Name: **Mc Kinley Marina**
Facility ID (FID or PWS):
License/Permit/Monitoring #:
Original Well Owner:
Present Well Owner:
Mailing Address of Present Owner: **1750 N. Lincoln Memorial Drive**
City of Present Owner: **Milwaukee** State: **WI** ZIP Code: **53202**

3. Well / Drillhole /Borehole Information

☐ Monitoring Well
☐ Water Well
■ Borehole / Drillhole

Original Construction Date (mm/dd/yyyy): January 16, 2013
If a Well Construction Report is available please attach

Construction Type:
■ Drilled ☐ Driven (Sandpoint) ☐ Dug
☐ Other (specify):

Formation Type:
■ Unconsolidated formation ☐ Bedrock

Total Well Depth From Ground Surface (ft.)	Casing Diameter (in.)
	na
Lower Drillhole Diameter (in.)	**Casing Depth (ft.)**
6"	**na**

Was well annular space grouted? ☐ Yes ☐ No ☐ Unknown

If yes, to what depth (feet)?	Depth to Water (feet)
	11.0 est

4. Pump, Liner, Screen, Casing & Sealing Material

Pump and piping removed?	☐ Yes	☐ No	■ N/A
Liner(s) removed?	☐ Yes	☐ No	■ N/A
Screen removed?	☐ Yes	☐ No	■ N/A
Casing left in place?	☐ Yes	☐ No	■ N/A
Was casing cutoff below surface?	☐ Yes	☐ No	■ N/A
Did material rise to surface?	■ Yes	☐ No	☐ N/A
Did material settle after 24 hours?	☐ Yes	■ No	☐ N/A
If yes, was hole retopped?	☐ Yes	☐ No	☐ N/A
If bentonite chips were used, were they hydrated with water from a known safe source?	■ Yes	☐ No	☐ N/A

Required Method of Placing Sealing Material
■ Conductor Pipe-Gravity ☐ Conductor Pipe-Pumped
☐ Screened & Poured (Bentonite Chips) ☐ Other (Explain):

Sealing Materials
☐ Neat Cement Grout ☐ Clay-Sand Slurry (11 lb./gal.wt.)
☐ Sand-Cement (Concrete) Grout ☐ Bentonite-Sand Slurry " "
☐ Concrete ■ Bentonite Chips

For Monitoring Wells and Monitoring Well Boreholes Only:
☐ Bentonite Chips ☐ Bentonite - Cement Grout
☐ Granular Bentonite ☐ Bentonite - Sand Slurry

5. Material Used To Fill Well / Drillhole

	From (ft)	To (ft.)	No. Yards, Sacks Sealant or Volume (circle one)	Mix Ratio or Mud Weight
bentonite chips	Surface	**15'**	**1 bag**	

6. Comments

7. Supervision of Work

Name of Person or Firm Doing Filling & Sealing	License #	Date of Filling & Sealing (mm/dd/yyyy)
M&K Environmental & Soils Drilling, LLC		January 16, 2013

Street or Route: PO Box 216
Telephone Number: (920) 946 4288
City: Glenbeulah State: WI ZIP Code: 53073
Signature of Person Doing Work:
Date Signed: January 16, 2013

DNR Use Only
Date Received:
Noted By:
Comments:

State of Wis., Dept of Natural Resources
dnr.wi.gov

Well / Drillhole / Borehole Filling & Sealing

Form 3300-005 (R4/08) Page 1 of 2

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Milwaukee		**B5**

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° . 'W

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1/4 / 1/4	1/4	Section	Township	Range
or Govt Lot#	**ne**	**32**	**7** N	**22** ■ E ☐ W

Well Street Address

Well City, Village or Town | Well ZIP Code

Subdivision Name | Lot #

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M&K Environmental & Soils Drilling, LLC		January 16, 2013

Street or Route	Telephone Number
PO Box 216	(920) 946 4288

City	State	ZIP Code
Glenbeulah	WI	53073

Signature of Person Doing Work

Date Signed: January 16, 2013

DNR Use Only

Date Received	Noted By

Comments