CVT
Chosen Valley Testing

Design Phase Geotechnical Evaluation:

Proposed Industrial Development
SE of Int. S Black River Street and Interstate 90
Sparta, Wisconsin

Prepared for:

City of Sparta

August 5, 2016
9494.16.WIL

Chosen Valley Testing, Inc.

Geotechnical Engineering and Testing • 135 Buchner Place, La Crosse, WI 54603 • Telephone (608) 782-5505 • Fax (608) 785-2818

City of Sparta
Attn: Todd R. Fahning
Administrator
Director of Community Development
bldg@spartawisconsin.gov

August 5, 2016

Re: **Design Phase Geotechnical Evaluation**
Proposed Industrial Development
SE of Int. S Black River Street and Interstate 90
Sparta, Wisconsin
CVT Number: 9494.16.WIL

Dear Mr. Fahning:

We have completed the geotechnical evaluation authorized for the proposed Industrial Development on the south end of Sparta, WI. The attached report provides a description of our findings, recommendations, and analysis. We appreciate the opportunity to provide our services on this project. If you have any questions or need additional information, please contact us at (608) 782-5505 or in Rochester, MN Office at (507) 281-0968.

Sincerely,
Chosen Valley Testing, Inc.

Frederick Schuster, EIT
Geotechnical Engineer

Devin M. Ehler, PE
Geotechnical Engineer

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Design Phase Geotechnical Evaluation
Proposed Industrial Development
SE of Int. S Black River Street and Interstate 90
Sparta, Wisconsin

CVT Project Number: 9494.16.WIL
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A. Introduction

The intent of this report is to present our results to the client in the same logical sequence that led us to arrive at the opinions and recommendations expressed. Since our services must often be completed before the design, assumptions are sometimes needed to prepare a proper evaluation and to analyze the data. A complete and thorough review of this entire document, including the assumptions and the appendices, should be undertaken immediately upon receipt.

A.1. Purpose

This report was prepared to assist planning and design of the proposed Industrial Development on the south end of Sparta, WI. Our services were authorized by Mr. Todd R. Fahning, City Administrator of the City of Sparta.

A.2. Scope

To provide data for analysis, a total of nine penetration test borings and one manual boring were performed. The borings were drilled to depths of about 3 to 21 feet. Our scope included recommendations for earthwork, utilities, pavements, and building foundations.

A.3. Boring Locations and Elevations

The borings locations were determined by Chosen Valley Testing based on a site layout provided by the City of Sparta. The approximate locations as drilled are shown on the Boring Location Sketches in the Appendix. This sketch was created by plotting GPS coordinates gathered in the field from a handheld device onto an aerial of the site and overlaying the site layout using Google Earth Software.

Ground surface elevations were estimated to the nearest 2-foot contour using the Map of Existing provided by MSA Professional Services to the City of Sparta, and are indicated on the Log of Boring sheets in the Appendix. These estimated elevations should be considered very approximate.

A.4. Geologic Background

A geotechnical report is based on subsurface data collected for the specific structure or problem. Available geologic data from the region can help interpretation of the data and is briefly summarized in this section.

Geologic maps suggest that the natural soils in the area are primarily alluvial (water deposited) sands overlying residual (bedrock derived) sand. Bedrock is commonly within 5 to 50 feet of the surface and typically consists of Cambrian Age Sandstone.

B. Subsurface Data

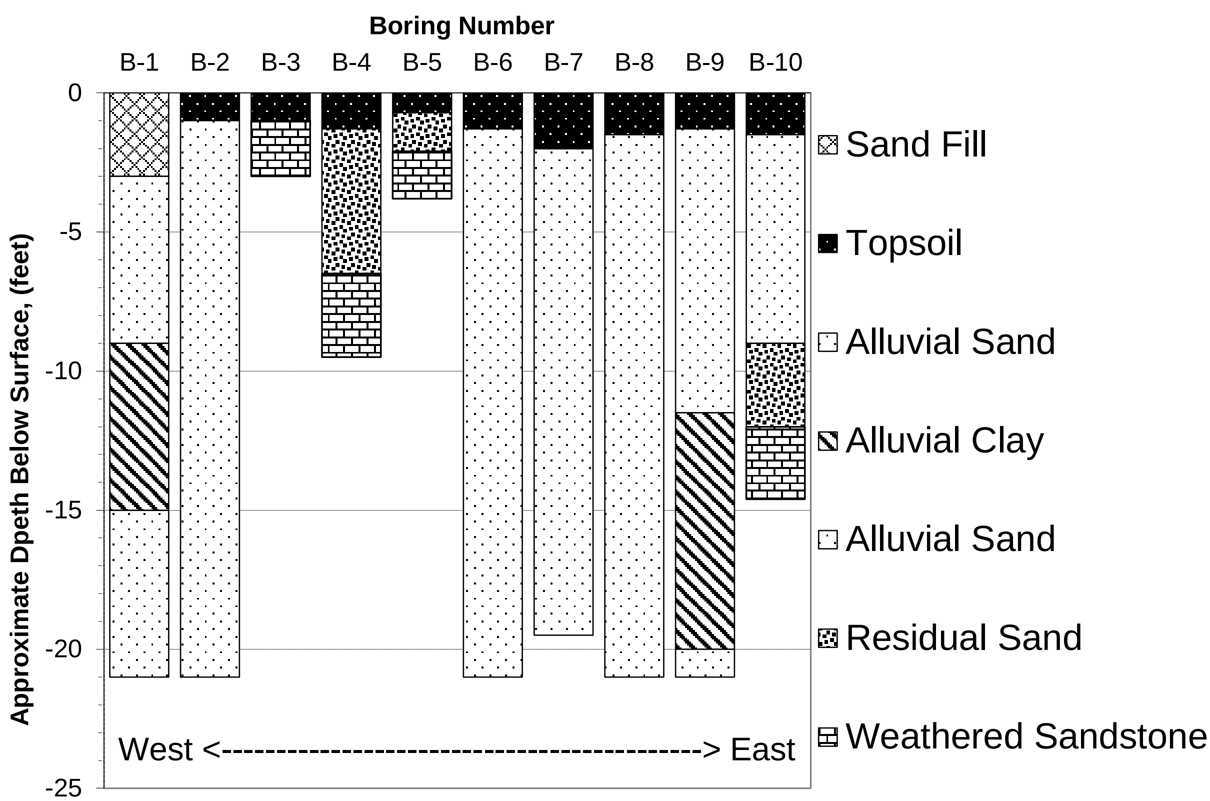
Methods: All of the borings were performed using penetration test procedures (Method of Test D1586 of the American Society for Testing and Materials). This procedure allows for the extraction of intact soil specimen from deep in the ground. With this method, a hollow-stem auger is drilled to the desired sampling depth. A 2-inch OD sampling tube is then screwed onto the end of a sampling rod, inserted through the hole in the auger's tip, and then driven into the soil with a 140-pound hammer dropped repeatedly from a height of 30 inches above the sampling rod. The sampler is driven 18-inches into the soil, unless the material is too hard. The samples are generally taken at 2½ to 5-foot intervals. The core of soil obtained is classified and logged by the driller and a representative portion is then sealed in a jar and delivered to the soils engineer for review.

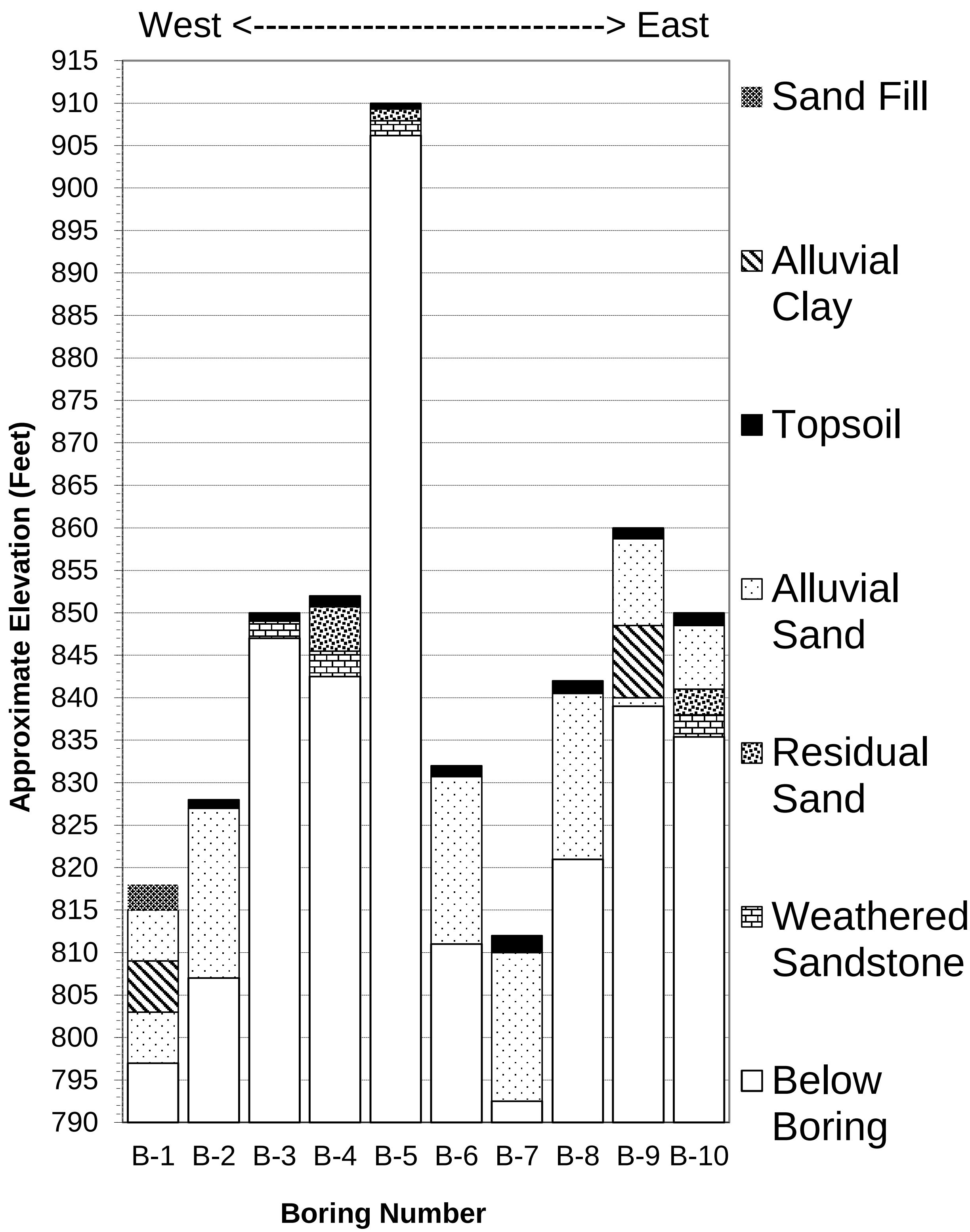
B.1. Stratification

At the surface, the borings generally encountered about 1 to 2 feet of slightly organic silty/clayey sand topsoil with the exception of the southwestern boring (B-1). This boring met sand fill to about 3 feet in an area that appeared to be a sand borrow/mine with excavations and mounds of sand present.

Beneath the topsoil or sand fill, the borings generally came across alluvial and residual clean sands to depths of about 1 to 21 feet, followed by weathered sandstone below approximately 1 to 12 feet in the central and northeastern borings (B-3, B-4, B-5, and B-10), which were located at higher elevations on site. Alluvial clay, sandy clay, and clayey sand were also met within the clean sand deposits from around 9 to 20 feet in the southwestern and southeastern most borings on site (B-1 and B-9).

The boring data has been summarized in the following depth and elevation cross-sections. For more detailed information, the reader is referred to the individual Log of Boring sheets in the Appendix.




West <----------------------------> East
Approximate Elevation (Feet)
915
910
905
900
895
890
885
880
875
870
865
860
855
850
845
840
835
830
825
820
815
810
805
800
795
790
B-1
B-2
B-3
B-4
B-5
B-6
B-7
B-8
B-9
B-10
Boring Number
Sand Fill
Alluvial Clay
Topsoil
Alluvial Sand
Residual Sand
Weathered Sandstone
Below Boring

B.2. Penetration Test Results

The number of blows needed for the hammer to advance the penetration test sampler is an indicator of soil characteristics. The number of blows to advance the sampler 1 foot is called the penetration resistance or "N"-value. The results tend to be more meaningful for natural mineral soils, than for fill soils. In fill soils, compaction tests are more meaningful.

Penetration resistance values (N-values) of 7 to 27 Blows per Foot (BPF) were recorded in the alluvial sands, indicating they were loose to medium dense The alluvial clays to clayey sands returned values ranging from 3 to 9 BPF, indicating they were soft to rather stiff or very loose to loose.

The residual sands returned values ranging from 11 to 18 BPF, indicating they were medium dense. Resistance values of 50 hammer blows for 0 to 4 inches of sampler advancement were recorded in the weathered sandstone, indicating it was very dense.

A key to the descriptors used to qualify the relative density of soil (such as *soft, stiff, loose*, and *dense*,) can be found on the Legend to Soil Description in the Appendix.

A pocket penetrometer tests were performed to help estimate the compressive strength of the cohesive soils. The alluvial clays returned values of ½ to 3 tons per square foot (tsf).

B.3. Groundwater Data

During the drilling operation, the drillers may note the presence of moisture on the sampling instrument, in the cuttings, or within the boreholes. These observations are recorded on the boring logs. The water level may vary with weather; time of year and other factors and the presence or absence of water during the drilling is subject to interpretation and is not always conclusive.

Water was observed in Borings B-6 and B-7 around 2 ½ to 17 ½ feet below the surface during our exploration and water bearing samples were returned from the 15 and 20-foot samples in Boring B-1. The water depths correspond near elevations 809 ½ to 814 ½ feet and the water bearing samples were collected below elevation 803 feet. The alluvial clay samples also had slightly elevated moisture levels. We would expect moisture to be capable of perching above the less permeable clays and bedrock. Long term monitoring with piezometers or wells would be required to better estimate the groundwater levels on site. Groundwater levels would be expected to fluctuate seasonally, similar to water levels in nearby streams and rivers, along with local weather patterns.

C. Design Information

Each structure has a different loading configuration and intensity, different grades, and different structural and performance tolerances. Therefore, the geotechnical exploration will be construed differently from one structure to another. If the initial structure should change design, we should be engaged to review these conditions with respect to the prevailing soil conditions. Without the opportunity to review any such changes, the recommendations may no longer be valid or appropriate.

Design information for the industrial park was not provided. Some cut and fill earthwork is expected to be required to achieve proper drainage and construction elevations. Utility pipes are assumed to bear on the order of 5 to 12 feet below the final grades. Streets are expected to carry typical industrial traffic. We have assumed that the probable structures at the site would be common industrial warehouse-type buildings primarily consisting of metal and/or wood framing.

CVT should be retained for review and further analysis once final plans are available.

D. Development Rough Grading

D.1. Stripping

The topsoil and fill materials should stripped and completely removed from any cut and fill areas. The topsoil was about 1 to 2 feet thick at the locations explored. The topsoil can be stockpiled for re-use as fill during final grading in green areas. Some mounds of fill materials were observed on the west end of the site where sand appears to have been mined.

D.2. Over-Sizing

The stripped surfaces should be over-sized at least 1-foot beyond the edge of buildings and pavements for each foot of fill needed below. This over-sizing can be reduced by up to 50% if rather precise staking is present during grading. However, additional over-sizing provides a nominal safety factor against stakes getting moved or knocked down during construction.

D.3. Filling and Compaction

All fill placed in building areas, and fill more than 3 feet below paved areas, should be compacted to at least 95% of the soil's maximum standard Proctor density. Fill placed in the upper 3 feet of paved areas should be compacted to 100%. Compaction to 90% is usually sufficient in green areas.

The sands found below the topsoil on site are generally considered suitable for use as bulk fill, provided they can be properly compacted. The alluvial clays found below 9 to 11 ½ feet in the southwest and southeast parts of the site were very wet at the time of our exploration and may be difficult to work with under these conditions. We recommend limiting the use of clay fill to green areas to prevent the risk of building or pavement settlement. Clays should still not be placed too dry or excessive settlement in green areas could occur.

E. Utility Recommendations

E.1. Dewatering

Based on the boring data and the assumed utility depths of 5 to 12 feet, water bearing sands are expected to be encountered about 2½ feet below the surface at the low point on the north end of the site where Boring B-7 was drilled. This depth corresponds near elevation 809 ½ feet. Aggressive water removal techniques, such as well points, are expected to be required to keep excavations dry that extend in to water bearing sands.

E.2. General Support

Based on the assumed utility embedment depths, open cut installations are expected to encounter primarily clean sands with some clay and weathered sandstone. These materials appear to be generally suitable for support of utilities, provided the clay is not overly wet. In the event that unstable soils are encountered at invert elevation, a bedding of clean sand or gravel is recommended in the base of the utility trenches to provide a stable surface for the crew laying the pipes. Correction depths on the order of 1 to 2 feet is typically adequate to treat this condition, but should be evaluated during construction by geotechnical personnel.

As mentioned, shallow bedrock was encountered in a few of the west-central borings at or above assumed pipe embedment depth. Bedrock and oversized materials (cobbles or boulders) should be removed from at least ½ to 1-foot away from utilities and replaced with clean sands or gravels to prevent point loads from developing on and rupturing the pipes. Rock removal below auger refusal depths in the borings are expected to require more specialized techniques, such as blasting, hydraulic hammering, or mechanical rock splitting. Ideally, contractors bidding the work should have experience with the local bedrock conditions.

E.3. Trench Sidewalls

The contractor will be required to slope or shore the excavations as needed to meet OSHA requirements for safety. The sand and clay will likely classify as Type C soils as defined by OSHA. Trench boxes or other stabilization methods may be necessary when excavating vertically.

E.4. Trench Bottom Stability

Utilities are expected to bear primarily on clean sand and some clay and weathered sandstone. To prevent any point loads on pipes, we recommend providing a ½ to 1-foot layer of sand or gravel, having less than 10% particles passing a #200 sieve, below any utilities where weathered bedrock is met at bearing depth. The natural soils are expected to be generally suitable for support of utilities.

Again, if soft or saturated clays are encountered at invert elevation, a bedding of clean sand or gravel is recommended at the base of the utility trenches to provide a stable surface for crews installing pipes. We recommend using clean sand or gravel fill having less than 10% particles passing a #200 sieve, subject to the conditions observed. For severely wet conditions, we recommend using clean, 1½ inch minus aggregate that is wrapped in filter fabric. Based on the data, assumed utility depths, and conditions at the time of our exploration, clean sand or gravel without filter fabric is expected to be generally adequate.

E.5. Fill Placement and Compaction

Materials placed as backfill below paved areas should be compacted to at least 95% of their maximum standard Proctor density (ASTM D 698). Fill within three feet of subgrade elevation should be compacted to 100%. In green areas, 90% compaction is normally adequate. Again, bedrock and oversize materials should be kept at least ½ to 1-foot away from utilities, to limit potential for point loads on the pipes.

The materials available for use as fill are expected to consist primarily of clean sands. To promote uniformity with adjoining portions of the subgrade through any paved areas, we recommend using fill material that is similar to the surrounding subgrade soil type.

F. Pavement Recommendations

F.1. Additional Grading Recommendations

Based on implementation of our mass grading and utility recommendations, the near-surface soils are expected to be dominated by clean sands. After grading and utility installation, we recommend scarifying and compacting any near-surface soils that have not been disturbed by construction in order to even out any localized discontinuities in the subgrade soils and to provide a more gradational transition between differing materials. This action is intended to limit differential frost heave and provide more uniform pavement support. New fill needed in paved areas should consist of a uniform soil type. Ideally, clean sands or gravels having less than 12% particles passing a number 200 sieve would be used as fill in paved areas and clays would be limited to use in green areas. The onsite sands are expected to meet the recommended sand specifications.

All fill in paved areas should be compacted to 100% of its maximum standard Proctor density in the top 3 feet and to at least 95% below. Compaction to 90% is usually sufficient in green areas.

The completed pavement subgrade should be able to pass a test roll. Areas not passing the test roll should be reworked and stabilized as needed to pass the test roll.

F.2. Pavement Design

Based on the boring data, subgrade soils are expected to dominantly consist of clean sand. This material typically possess an R-value ranging from 50 to 70. We recommend using an R-value of 50 for design.

For pavements carrying primarily standard auto traffic, we recommend a minimum flexible pavement section consisting of at least 3 inches of asphalt over 6 inches of aggregate base. Pavements that are expected to carry more heavy truck traffic, we recommend at least 4 inches of asphalt over 8 inches of aggregate base.

These sections should be considered preliminary, subject to review by the project civil engineering consultant, and subject to their experience with pavement design and performance in the area of the project.

The above pavement sections also assume that subgrades have been sufficiently scarified and compacted to pass a test roll. Observation of the test roll should be documented by qualified geotechnical personnel. The necessity of scarifying and recompacting the subgrade would be determined by the test roll.

G. Preliminary Building Recommendations

G.1. Additional Exploration

The uppermost natural soils at the site are expected to consist primarily of clean sand and some weathered sandstone. Depending on foundation elevations, clays may also be encountered at bearing depths. The clay on site is considered rather compressible and may be prone to excessive settlement, depending on building loads, grades, and design. Due to the limited boring data for individual sites, and in the absence of specific building design info, the following recommendations are necessarily rather general. We recommend additional borings are performed on a site by site basis for more specific geotechnical recommendations.

G.2. Grading Recommendations

G.2.a. Stripping and Excavation: We recommend stripping and removing all topsoil and fill materials from building areas, along with any organics, debris, and otherwise deleterious materials that may be discovered during construction.

Foundations that encounter clay at bearing depth will likely require soil corrections to minimize settlements to tolerable levels. Corrections on the order of 2 feet are normally sufficient for light metal/wood framed structures.

G.2.b. Oversizing: Any corrective excavations should be oversized at least 1-foot horizontally beyond the edge of the building areas for each foot of fill needed below footing grade. This oversizing can be reduced by up to 50% if rather precise staking is present during grading.

G.2.c. Filling and Compaction: We recommend using clean, sands or gravels having less than 12% particles passing the number 200 sieve as structural fill where needed. The poorly-graded sands on site are expected to meet this specification.

All fill below building areas should be compacted to at least 95% of its standard Proctor density. Compaction tests are recommended to document that these compaction levels have been achieved.

G.3. Building Design

G.3.a. Foundation Depth: We recommend placing foundations for heated structures at least 48 inches below the exposed ground surface for frost protection. Interior foundations in heated areas may be placed directly below slabs. Footings for unheated structures should be placed at least 60 inches below the exposed ground surface.

G.3.b. Bearing Capacity and Settlement: A 1,500 psf bearing capacity is commonly used for light structures bearing on the natural soils. Again, geotechnical analysis is strongly recommended to address specific conditions at each site for specific buildings. Further exploration and analysis is also expected to result in obtaining a higher, less conservative bearing capacity, which would allow use of smaller footings with less concrete and rebar.

H. General Grading Recommendations

H.1. Stripping and Excavation

The soils on site are expected to support a variety of construction equipment, provided the sands are not overly dry and loose. Standard vehicles with tires may have difficulty driving across the site if the sands are overly dry and loose.

A backhoe is recommended for excavations. Excavation of weathered bedrock above the refusal depths in the borings can likely be accomplished using a large backhoe with a “toothed” bucket. For excavations into the rock materials below the refusal depths, more aggressive removal techniques, such as blasting, hydraulic hammering, or mechanical rock splitting, may be required.

H.2. Compaction

All fill should be placed in lifts adjusted to the compactor being used and the material being compacted. We recommend limiting lifts to no more than 1-foot – assuming large, self-propelled or tow-behind compactors are used. Thinner lifts would be required for smaller compaction equipment.

If the earthwork occurs during freezing temperatures, good winter construction practices should be used. No frozen fill should be used nor should structural filling take place on frozen ground.

H.3. Construction Testing and Documentation

The grading and excavations should be evaluated and documented by qualified geotechnical personnel, after the unsuitable soils are removed and prior to the placement of any new fill, concrete, or pavements. Fill placed below building and paved areas should be evaluated for conformance to the project gradation recommendations and should be tested for compaction. If the filling proceeds during periods of freezing weather, full-time testing should be considered to help confirm that imported fill is thawed prior to and during compaction, and that all snow has been removed before placement of the fill.

Although our firm offers testing services relating to civil and structural components of the building (such as concrete testing, reinforcement observations, etc.) specification of such services is beyond our work scope and the designer should be consulted as to such requirements.

I. Level of Care

The services provided for this project have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in this area, under similar budget and time constraints. This is our professional responsibility. No other warranty, expressed or implied, is made.

J. Certification

WISCONSIN DEVIN M. EHLER E-44630 ROCHESTER, MN PROFESSIONAL ENGINEER	I hereby certify that this report was prepared by me or under my direct supervision, and that I am a duly registered engineer under the laws of the State of Wisconsin. Devin Ehler Devin M. Ehler, PE Geotechnical Engineer Registration Number 44630 Date: August 5, 2016

Appendix

Boring Location Sketch

Log of Boring 1-10

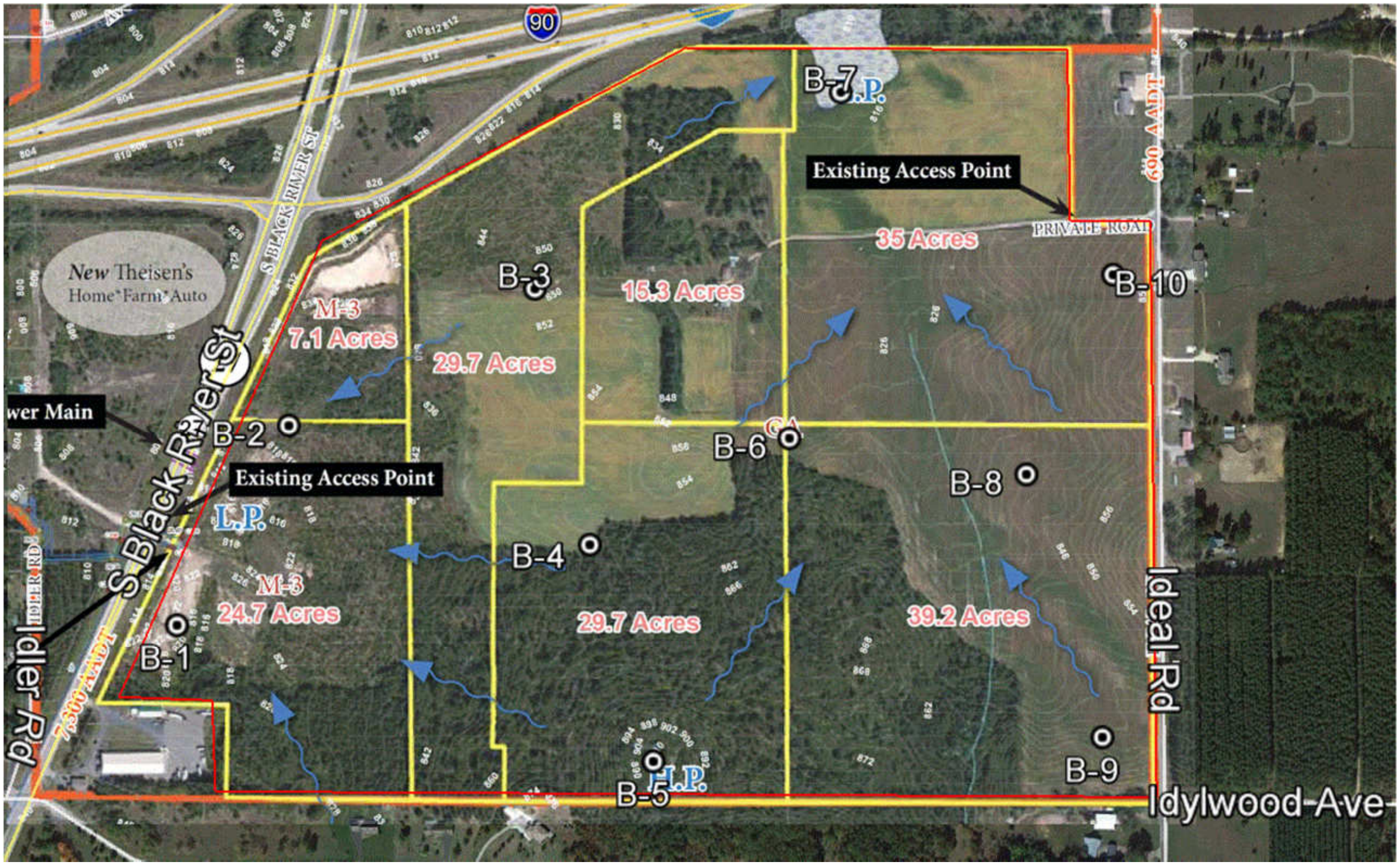
Legend to Soil Description

CVT
Chosen Valley Testing, Inc.

Legend
⊙ Boring Location

N

Boring Location Sketch
Proposed Industrial Park
SE of Int. S Black River St and I-90
Sparta, Wisconsin
9494.16.WIL



LOG OF BORING

CHOSEN VALLEY TESTING

CVT

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: **B-01** LOCATION: See attached sketch DATE: 7/14/2016 SCALE: 1" = 3'

Elev. 818.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
815.0	3.0		**SAND FILL**	15		Surface Elevations estimated to the nearest 2-foot contour using the Map of Existing provided by MSA Professional Serivces to the City of Sparta.
809.0	9.0	SP SM	**POORLY-GRADED SAND with SILT** fine grained, light brown to light gray, moist, medium dense. (Alluvium)	21 11		
803.0	15.0	CL	**LEAN CLAY** gray, very wet, soft to rather stiff. (Alluvium)	9 3		PP = 0.5 tsf PP = 0.5 tsf, MC = 23.7%
800.0	18.0	SC	**CLAYEY SAND** fine grained, brown, wet to water bearing, loose. (Alluvium)	4		
797.0	21.0	SP SM	**POORLY-GRADED SAND with SILT** fine grained, trace seams of silt, light brown, water bearing, loose. (Alluvium)	7		
			End of boring. Boring sealed upon completion.			

CVT STANDARD 9494.16.WIL (SPARTA INDUSTRIAL PARK).GPJ LOG A GNNN06.GDT 7/25/16

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: **B-02** LOCATION: See attached sketch DATE: 7/14/2016	SCALE: 1" = 3'

Elev. 828.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
827.0	1.0	SM	**Slightly Organic SILTY SAND** trace roots, dark brown. (Topsoil)			
		SP	**POORLY-GRADED SAND** very fine to fine grained, light brown, moist, loose to medium dense. (Alluvium)	7		
				13		
				25		
				27		
				24		
			Brown, fine to medium grained below 14 feet.	22		
807.0	21.0			21		
			End of boring. Boring sealed upon completion.			

LOG OF BORING

CHOSEN VALLEY TESTING

CVT

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: **B-03** LOCATION: See attached sketch DATE: 7/14/2016 SCALE: 1" = 3'

Elev. 850.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
849.0	1.0	SM	**Slightly Organic SILTY SAND** trace roots, brown. (Topsoil)			
847.0	3.0	SP	**POORLY-GRADED SAND** fine grained, white, moist, very dense. (Weathered Sandstone)	*		* 50 = 1" (set)
			End of boring. Boring terminated due to auger refusal around 3 feet, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 9494.16.WIL (SPARTA INDUSTRIAL PARK).GPJ LOG A GNNN06.GDT 7/25/16

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: **B-04** LOCATION: See attached sketch DATE: 7/14/2016 SCALE: 1" = 3'

Elev. 852.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
850.7	1.3	SM	**SILTY SAND** fine grained, brown, moist. (Topsoil)			
845.5	6.5	SP	**POORLY-GRADED SAND** trace gravel, very fine to fine grained, white, moist, medium dense. (Residuum)	11 15		
842.5	9.5	SP	**POORLY-GRADED SAND** fine grained, white, moist, very dense. (Weathered Sandstone)	* *		* 50 = 4" (set) * 50 = 0" (set)
			End of boring. Boring terminated due to auger refusal around 9.5 feet, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 9494.16.WIL (SPARTA INDUSTRIAL PARK).GPJ LOG A GNNN06.GDT 7/25/16

LOG OF BORING

CHOSEN VALLEY TESTING

CVT

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: **B-05** LOCATION: See attached sketch DATE: 7/8/2016 SCALE: 1" = 3'

Elev. 910.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
909.3	0.7	SC	**Slightly Organic CLAYEY SAND** trace roots, black to dark brown. (Topsoil)			
907.9	2.1	SP	**POORLY-GRADED SAND** trace gravel, fine grained, white to tan, moist. (Residuum)			
906.2	3.8	SP	**POORLY-GRADED SAND** fine grained, white, moist. (Weathered Sandstone)			
			End of boring. Boring terminated due to hand auger refusal around 3.8 feet, presumably on bedrock. Boring sealed upon completion.			

CVT STANDARD 9494.16.WIL (SPARTA INDUSTRIAL PARK).GPJ LOG A GNNN06.GDT 7/25/16

LOG OF BORING

CHOSEN VALLEY TESTING

CVT

PROJECT:	9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin
BORING:	**B-06**
LOCATION:	See attached sketch
DATE:	7/14/2016
SCALE:	1" = 3'

Elev. 832.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
830.7	1.3	SM	**<u>Slightly Organic SILTY SAND</u>** trace roots, fine grained, brown. (Alluvium)			
		SP	**<u>POORLY-GRADED SAND</u>** very fine to fine grained, light brown, moist, loose to medium dense. (Alluvium)	8		
				10		
				18		
			Trace gravel below 9 feet.	25		
			Wet below 12 feet	16		
			No gravel observed below 15 feet.	19		
			Water bearing below 17.5 feet.		▽	Water encountered below 17.5 feet during drilling.
811.0	21.0			23		
			End of boring. Boring sealed upon completion.			

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: **B-07** LOCATION: See attached sketch DATE: 7/14/2016 SCALE: 1" = 3'

Elev. 812.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
810.0	2.0	SM	**Slightly Organic SILTY SAND** trace roots, black to dark brown. (Topsoil)			
		SP	**POORLY-GRADED SAND** very fine to fine grained, light gray to white, water bearing, loose to medium dense. (Alluvium)	5	▽	Water encountered below 2.5 feet during drilling.
				8		
			Light brown, fine to medium grained below 7 feet.	11		
				17		
				18		
792.5	19.5		Trace gravel around 15 feet.	23		
			End of boring. Boring sealed upon completion.			

CVT STANDARD 9494.16.WIL (SPARTA INDUSTRIAL PARK).GPJ LOG A GNNN06.GDT 7/25/16

LOG OF BORING

CHOSEN VALLEY TESTING

CVT

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: B-08 LOCATION: See attached sketch DATE: 7/14/2016 SCALE: 1" = 3'

Elev. 842.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
840.5	1.5	SC	**Slightly Organic CLAYEY SAND** trace roots, brown. (Topsoil)			
		SP	**POORLY-GRADED SAND** very fine to fine grained, light brown, moist, loose to medium dense. (Alluvium)	7		
				9		
				14		
				15		
				15		
				21		
821.0	21.0		Seam of clay encountered around 20 feet.	24		
			End of boring. Boring sealed upon completion.			

CVT STANDARD 9494.16.WIL (SPARTA INDUSTRIAL PARK).GPJ LOG A GNNN06.GDT 7/25/16

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: **B-09** LOCATION: See attached sketch DATE: 7/14/2016 SCALE: 1" = 3'

Elev. 860.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
858.7	1.3	SC	**Slightly Organic CLAYEY SAND** trace roots, brown. (Topsoil)			
848.5	11.5	SP	**POORLY-GRADED SAND** very fine to fine grained, light brown, moist, loose to medium dense. (Alluvium)	8 7 12 18		
842.0	18.0	CL	**LEAN CLAY** gray, very wet, medium. (Alluvium)	7 6		PP = 1.0 tsf, MC = 23.9% PP = 1.0 tsf, MC = 21.0%
840.0	20.0	CL	**SANDY LEAN CLAY** brown and gray, wet. (Alluvium)			PP = 3.0 tsf
839.0	21.0	SP SM	**POORLY-GRADED SAND with SILT** fine grained, light brown, moist, medium dense. (Alluvium)	13		

End of boring.
Boring sealed upon completion.

CVT STANDARD 9494.16.WIL (SPARTA INDUSTRIAL PARK).GPJ LOG A GNNN06.GDT 7/25/16

LOG OF BORING

CHOSEN VALLEY TESTING **CVT**

PROJECT: 9494.16.WIL Design Phase Geotechnical Evaluation Proposed Industrial Park Between Hwy 27 and Ideal Rd Sparta, Wisconsin	BORING: **B-10** LOCATION: See attached sketch DATE: 7/14/2016 SCALE: 1" = 3'

Elev. 850.0	Depth 0.0	USCS Symbol	Description of Materials (ASTM D 2487/2488)	BPF	WL	Tests and Notes
848.5	1.5	SM	**Slightly Organic SILTY SAND** fine grained, brown. (Topsoil)			
841.0	9.0	SP	**POORLY-GRADED SAND** very fine to fine grained, light brown to white, moist, loose to medium dense. (Alluvium)	7 10 12		
838.0	12.0	SP	**POORLY-GRADED SAND** fine grained, white, moist, medium dense. (Residuum)	18		
835.4	14.6	SP	**POORLY-GRADED SAND** fine grained, white, moist, very dense. (Weathered Sandstone)	* *		* 50 = 3" (set) * 50 = 1" (set)
			End of boring. Boring sealed upon completion.			

CVT STANDARD 9494.16.WIL (SPARTA INDUSTRIAL PARK).GPJ LOG A GNNN06.GDT 7/25/16

UNIFIED SOIL CLASSIFICATION (ASTM D-2487/2488)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	Cu>4 AND 1<Cc<3	GW	WELL-GRADED GRAVEL
			Cu>4 AND 1>Cc>3	GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	Cu>6 AND 1<Cc<3	SW	WELL-GRADED SAND
			Cu>6 AND 1>Cc>3	SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY
			PI>4 AND PLOTS<"A" LINE	ML	SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY
			PI PLOTS <"A" LINE	MH	ELASTIC SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT

Relative Proportions of Sand and Gravel

TERM	PERCENT
Trace	< 15
With	15 - 29
Modifier	> 30

Relative Proportions of Fines

TERM	PERCENT
Trace	< 5
With	5 - 12
Modifier	> 12

Grain Size Terminology

TERM	SIZE
Boulder	< 12 in.
Cobble	3 in. - 12 in.
Gravel	#4 sieve to 3 in.
Sand	#200 sieve to #4 sieve
Silt or Clay	Passing #200 sieve

SAMPLE TYPES

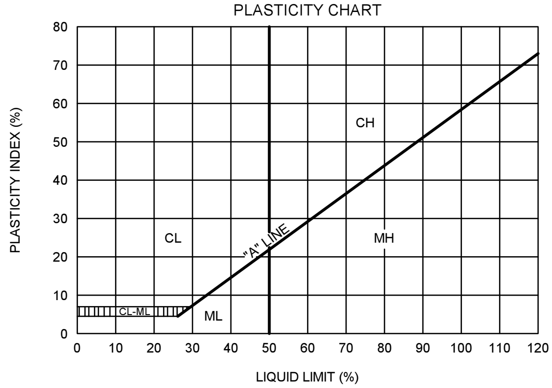
- Hollow Stem
- Standard Penetration Test
- Hand Augered

TEST SYMBOLS

MC	-	MOISTURE CONTENT
OC	-	ORGANIC CONTENT
CN	-	CONSOLIDATION
DD	-	DRY DENSITY
PP	-	POCKET PENETROMETER
RV	-	R-VALUE
SA	-	SIEVE ANALYSIS
P200	-	% PASSING #200 SIEVE
LL	-	LIQUID LIMIT
PI	-	PLASTISITY INDEX
SW	-	SWELL TEST
UU		Unconsolidated Undrained triaxial

- WATER LEVEL (WITH TIME OF) MEASUREMENT

PLASTICITY CHART



PENETRATION RESISTANCE (RECORDED AS BLOWS / 0.5 FT)				
SAND & GRAVEL		SILT & CLAY		
RELATIVE DENSITY	BLOWS/FOOT*	CONSISTENCY	BLOWS/FOOT*	COMPRESSIVE STRENGTH (TSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 1	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 3	0.25 - 0.50
MEDIUM DENSE	10 - 30	RATHER SOFT	4 - 5	0.50 - 1.0
DENSE	30 - 50	MEDIUM	6 - 8	
VERY DENSE	OVER 50	RATHER STIFF	9 - 12	1.0 - 2.0
		STIFF	13 - 16	
		VERY STIFF	17 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

Chosen Valley Testing, Inc.

Job No. 9494.16.WIL

LEGEND TO SOIL DESCRIPTIONS

CVT