Preliminary Geotechnical Engineering Report

Waterloo Preliminary Geotechnical Evaluation

Waterloo, Iowa

January 13, 2012

Terracon Project No. 13115139.01

Prepared for:

PACLAND

Bellevue, Washington

Prepared by:

Terracon Consultants, Inc.

Cedar Falls, Iowa

January 13, 2012

Terracon

PACLAND
11711 SE 8th St., Ste. 303
Bellevue, Washington 98005

Attn: Mr. Paul Manzer
P: [425] 453 9501
E: pmanzer@pacland.com

Re: Preliminary Geotechnical Engineering Report
Waterloo Preliminary Geotechnical Evaluation
Waterloo, Iowa
Terracon Project Number: 13115139.01

Dear Mr. Manzer:

Terracon Consultants, Inc. (Terracon) has completed the preliminary geotechnical engineering services for the above referenced project. This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations concerning earthwork and the design and construction of foundations and floor slabs for the project being considered.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Kurt A. Drilling

Kurt A. Drilling
Staff Geologist

Jason P. Heinz

Jason P. Heinz, P.E.
Iowa No. 18345

Enclosures

Copies to: 2 – Client
1 – File

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WATERLOO, IOWA

Terracon Project No. 13115139.01
January 13, 2012

1.0 INTRODUCTION

A preliminary geotechnical engineering report has been completed for a development under consideration. The proposed project site is located south of U.S. Highway 20 and east of Ansborough Avenue in Waterloo, Iowa. Five (5) borings, designated Nos. 1 through 5, were performed to depths of about 20 to 50 feet below existing grades. Logs of the borings along with a Site Location Map and Boring Location Diagram are included in Appendix A of this report.

The purpose of these services is to provide preliminary information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- foundation design and construction
- seismic considerations
- floor slab design and construction

2.0 PROJECT INFORMATION

2.1 Project Description

Item	Description
Site layout	Information concerning proposed structure locations and project layout is not available. Refer to Appendix A, Exhibit A-2, Boring Location Diagram, for soil boring locations.
Potential improvements	Project information for the proposed development is not available. We assume the project will consist of the construction of a building or buildings with associated paved parking lots and driveways. Building structural information is not available. We anticipate that the building(s) will be a 1, 2, or 3-story structure(s) with no below-grade areas and slab-on-grade floors. We assume the buildings will include metal-framing and perimeter masonry or pre-cast concrete walls.

Item	Description
Assumed maximum loads	■ Columns: 150 kips ■ Walls: 6 kips per lineal foot (klf) ■ Office floor slabs: 150 pounds per square foot (psf) ■ Equipment floor slabs: 250 psf
Assumed maximum allowable settlement	■ Total: 1 inch ■ Differential: ½-inch
Grading	Information on potential site grading is not available. However, we anticipate the building floor slab(s) and other critical structures will be near existing grades in higher areas of the site and above the existing grades in the areas of drainage ways.
Assumed maximum cut and fill slopes	3H:1V
Below-grade areas	Information not available; none assumed
Retaining walls	Information not available; none assumed

2.2 Site Location and Description

Item	Description
Location	South of U.S. Highway 20 and east of Ansborough Avenue in Waterloo, Iowa.
Existing improvements	Existing agricultural field.
Current ground cover	Remains of harvested soy bean plants and topsoil.
Existing topography	Site grades generally decrease from the west to the east. Based on available 24K Topographic USGS maps of the site, it appears that as much as 35 feet of relief exists across the site.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/ Density
Surface	10 to 18 inches	Topsoil	N/A
1	8 to 11½	Sandy lean clay, trace gravel, with occasional seams and layers	Medium Stiff to Stiff
2	>20 & >50 (Bottom of Borings)	Sandy lean clay, trace gravel, with occasional seams and layers	Very Stiff to Hard

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in material types; in situ, the transition between materials may be gradual. More detailed descriptions of the materials encountered in each of the borings can be found on the boring logs in Appendix A of this report.

3.2 Groundwater

The boreholes were observed during and after drilling for the presence and level of groundwater. Delayed groundwater level measurements were also performed on December 29, 2011. The following table summarizes groundwater observations at the boring locations.

Boring	Depth to Groundwater 12/28/11 (feet)		Depth to Groundwater 12/29/11 (feet)
	While Drilling/Sampling	After Drilling	
1	9½	16½	None
2	None	None	None
3	14	None	4
4	8	4½	4
5	9	13½	5

Due to the relatively low permeability of soils encountered in the borings, a relatively long period of time is necessary for a groundwater level to develop and stabilize in a borehole. Long term observations in piezometers or observation wells sealed from the influence of surface water would be necessary to better define groundwater levels at this site.

A review of the Black Hawk County, Iowa Soil Survey published by the United States Department of Agriculture / Soil Conservation Service indicates that Dinsdale silty clay loam, Klinger silty clay loam, Kenyon loam, and Maxfield silty clay loam soils are primarily present at or near the proposed development. According to the soil survey, these soils have seasonally high groundwater depths of about 0 feet in drainage ways and about 4 feet in other areas of the site.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff, and other factors not evident at the time the borings were performed. In addition, perched water develops within granular soils within or overlying lower permeability soil. Therefore, groundwater levels during construction or at other times during the life of the development may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

4.0 PRELIMINARY ENGINEERING RECOMMENDATIONS

4.1 Geotechnical Considerations and Discussion

Based on the limited information obtained from the subsurface exploration conducted, it is our opinion that following earthwork operations monitored by a representative of the geotechnical engineer, the site soils would be suitable for satisfactory support of lightly loaded structures. The use of intermediate or deep foundations could be required for support of moderately-loaded structure(s). Geotechnical considerations for this project include:

- The presence of lower strength soil;
- The presence of relatively shallow groundwater.

Once the surface layer of organic soil is removed, medium stiff, sandy lean clay with sand seams and layers is anticipated to be exposed. It is our experience that these soils will have variable, moisture contents and some moisture conditioning would be necessary to use the soil as structural fill. These soils are sensitive to changes in moisture, are moderately frost-susceptible, and are susceptible to disturbance from construction activities. Therefore, we anticipate that some corrective earthwork would be required to establish a satisfactory subgrade support conditions for foundations, floor slabs, and pavements.

Groundwater was observed in Borings 1 and 3 to 5 at depths of about 4 to 5 feet below existing grades. Excavations which extend near or below these depths could encounter groundwater seepage. Typically, the majority of groundwater seepage that is encountered in glacial soils in the area can be removed using conventional sump pit and pump systems. In some instances, however, large, extensive networks of sand and silt seams and layers can release more significant amounts of water and the removal of groundwater can require that French drains and/or a series of sump pit and pumps be installed.

4.2 Preliminary Earthwork Recommendations

4.2.1 Site Preparation

Based on the results of the borings, stripping depths of about 10 to 18 inches may be anticipated to remove surficial organic materials. Actual stripping depths may be variable for this project and should be evaluated by Terracon personnel during construction.

The near-surface soils in the borings consist of sandy lean clay with sand seams and layers consistent with local geology. These soils vary in moisture during seasonal wet periods and require some drying to achieve typical compaction levels. With an increase in moisture content, these soils also lose strength.

Prior to the placement of structural fill in areas below design grade, the subgrade should be moisture conditioned and compacted to the density and moisture content ranges recommended in this report. Excessively wet or dry material should either be removed or moisture conditioned and recompacted. This process will help to delineate soft or disturbed areas. Larger pavement and floor slab areas may also be proofrolled to identify unstable areas. If unsuitable areas are observed during these processes, subgrade improvement will then be necessary to establish a suitable subgrade support condition; especially during wet or cool periods of the year.

Methods of subgrade improvement could include scarification, moisture conditioning, and recompaction, and removal of unstable materials and replacement with granular fill (with or without geosynthetics). The appropriate method of improvement, if required, would be dependent on factors such as schedule, weather, the size of area to be stabilized, and the nature of the instability. More detailed recommendations can be provided during construction as the need for subgrade improvement occurs. Performing site grading operations during warm seasons and dry periods would help reduce the amount of subgrade stabilization required.

- **Scarification and Recompaction** - It should be feasible to scarify, moisture condition (e.g. dry), and recompact the exposed soils. However, the success of this procedure would depend primarily upon favorable weather and sufficient time to dry the soils. Even with adequate time and favorable weather, stable subgrades may not be achieved if the thickness of the unstable material is greater than about 1 to 1½ feet.

- **Crushed Stone/Aggregate** - The use of crushed stone, crushed concrete, and/or gravel could be considered to improve subgrade stability. Typical undercut depths range from about ½ to 1 foot. The use of a geotextile or geogrid could also be considered after underground work, such as utility construction, is completed. We recommend that equipment not be operated above the fabric or geogrid until one full lift of crushed stone fill is placed above it. The maximum particle size of granular material placed over geotextile fabric or geogrid generally should not exceed 1½ inches. Granular gradation requirements provided by the geosynthetic product manufacturer should be verified prior to material purchase and delivery to the site.

- **Chemical Stabilization** - Improvement of subgrades with Portland cement, Class C fly ash, or lime kiln dust could be considered for unstable or higher water content soils. Chemical modification should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the geotechnical engineer prior to use. The hazards of chemicals blowing across the site or onto adjacent property should also be considered. Additional testing would be needed for us to develop specific recommendations to improve subgrade stability by blending chemicals with the site soils. This testing could include, but not be limited to, determining the most suitable stabilizing agent, the optimum amounts required, the potential for sulfate induced heave, and freeze-thaw durability of the subgrade.

A Terracon representative should observe subgrade preparation and could assist in developing appropriate stabilization procedures based on conditions encountered during construction.

4.2.2 Preliminary Structural Fill Material Requirements

On a preliminary basis, we recommend the following for structural fill for this project (i.e. fill that will support foundations, floor slabs, and pavements).

- Granular Fill
  - Typical conditions for conventional local practice and construction
  - Recommend an imported, aggregate layer below building floor slabs
  - Recommend an imported, aggregate layer below pavements
  - Recommend a free-draining backfill behind retaining walls with drain lines
  - Limestone quarries and sand pits are within reasonable distances from the site
- Cohesive Fill
  - Typical conditions for conventional local practice and construction.
  - We recommend that structural cohesive fill consist of low-plasticity soil with a liquid limit of 45 or less and a plasticity index of 23 or less
  - The on-site soils generally appear suitable for use as low-plasticity cohesive fill. Moisture conditioning should be anticipated.
- Compaction
  - Typical conditions for conventional local practice and construction
  - Minimum 98% compaction (ASTM D698, 'standard Proctor') for structural fill below footing foundations and equipment floor slabs, and ≤18 inches below pavements.
  - Minimum 95% compaction (ASTM D698, 'standard Proctor') for all other locations and elevations.
  - Moisture content of structural fill should generally be in the range of -2% to +3% from optimum to achieve adequate compaction levels.

4.3 Preliminary Foundation Recommendations

Foundation System	Estimated Net Allowable Bearing Pressure[1] or Individual Capacity	Maximum column load (DL + LL)	Estimated maximum settlement
Spread footings bearing on medium stiff to stiff, native soil and/or compacted structural fill	2,000 to 2,500 psf	~200 kips	1 inch
Spread footings bearing on very stiff to hard native soil [2]	4,000 to >6,000 psf	~500 kips	1 inch
Spread footings bearing on a ground improvement system [3]	3,000 to 5,000 psf	-	1 inch
Deep foundations [4]	50 to 100 tons (piles) 400 tons (shafts)	~750 kips	1 inch [4]

1. The net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable soils/materials, where present, will be removed and replaced with properly placed and compacted structural fill.
2. In-situ soil testing is preferred for structures with heavier loadings and where net allowable bearing pressures in excess of 4,000 to 6,000 psf provide cost savings.
3. Ground improvement systems are proprietary and designed by others. The most prevalent ground improvement systems include aggregate elements via replacement and displacement methods.
4. Deep foundation systems that could be considered at this site, and be installed by experienced, local contractors, include augered cast-in-place (ACIP) piles, driven piles, and drilled shafts. Deep foundation elements would be extended into hard, glacial clay encountered in the borings at variable depths. The settlement of individual or groups of deep foundation elements is partially dependant on whether the resistance(s) are side friction or end bearing.

4.4 Seismic Considerations

Codes Used	Site Classification
2006/2009/2012 International Building Code (IBC) [1]	D [2]

1. In general accordance with the *2006/2009/2012 International Building Codes,* Table 1613.5.2.
2. The 2006/2009/2012 International Building Codes require a site soil profile determination extending a depth of 100 feet for seismic site classification. The current scope requested does not include the required 100 foot soil profile determination. Borings for this report extended to a maximum depth of approximately 50 feet and this seismic site class considers that similar subsurface conditions are present below the depths explored for this project. Additional exploration to greater depths could be considered to confirm the conditions below the current depth of exploration. Alternatively, a geophysical exploration could be utilized in order to attempt to justify a higher seismic site class.

4.5 Grade-supported Slabs

- Typical conditions for conventional local practice and construction.
- At a minimum, the native subgrade should be scarified and compacted to the levels recommended in this report prior to the placement of structural fill and the granular base.
- Floor slabs should be provided with a granular base with a minimum thickness of 6 inches.
- Slabs with frost-depth stoops are often provided in front of critical ingress/egress areas.

4.6 Retaining Walls

- Typical conditions for conventional local practice and construction.
- Free-draining, granular backfill and drain tile are typically provided.

4.7 Pavements

- Typical conditions for conventional local practice and construction.
- Exterior pavements should be provided with at least 8 inches of compacted earth fill.
- Appropriate sub-drainage should be provided to remove water from the granular base in cut areas and areas of anticipated frequent wetting.
- Typical, minimum recommended pavement sections are the following:

Pavement Type	Standard Duty [1]	Heavy Duty [2]	Truck Traffic
Portland Cement Concrete [3]	5 inches	6 inches	7 to 9 inches
PCC Crushed Stone Base [4]	4 inches	4 inches	4 inches
Asphaltic Cement Concrete	4 inches	7 inches	-
ACC Aggregate Base [4]	6 inches	6 inches	-

1. Parking areas subjected to low volumes of automobile traffic.
2. Automobile entry drives subject to light truck traffic (e.g., weekly garbage trucks and small Fed-Ex/UPS trucks).
3. 4,000 psi at 28 days and 5 to 7 percent air content. PCC pavements are recommended for trash container pads and in any other areas subjected to heavy wheel loads, concentrated loads, and/or turning traffic. Special designs should be performed for truck driveways.
4. Crushed stone bases with thicknesses of at least 6 inches would be necessary in areas where pavement subdrains are provided.

The pavement sections provided in this report represent minimum recommended thicknesses and, as such, periodic maintenance should be anticipated.

4.8 Additional Exploration, Testing, and Evaluation

This subsurface exploration program included five soil borings widely spaced across the site. Specific information concerning building layout and floor levels, structural loading and design conditions, and site grading information was not available. Final earthwork, slab, pavement, and foundation recommendations will depend on the location of the structure(s), design grades selected, bearing elevations and pressures, and the structural loading conditions. Additional field exploration, laboratory testing, and engineering evaluations are recommended when more detailed building and site development information becomes available.

5.0 GENERAL COMMENTS

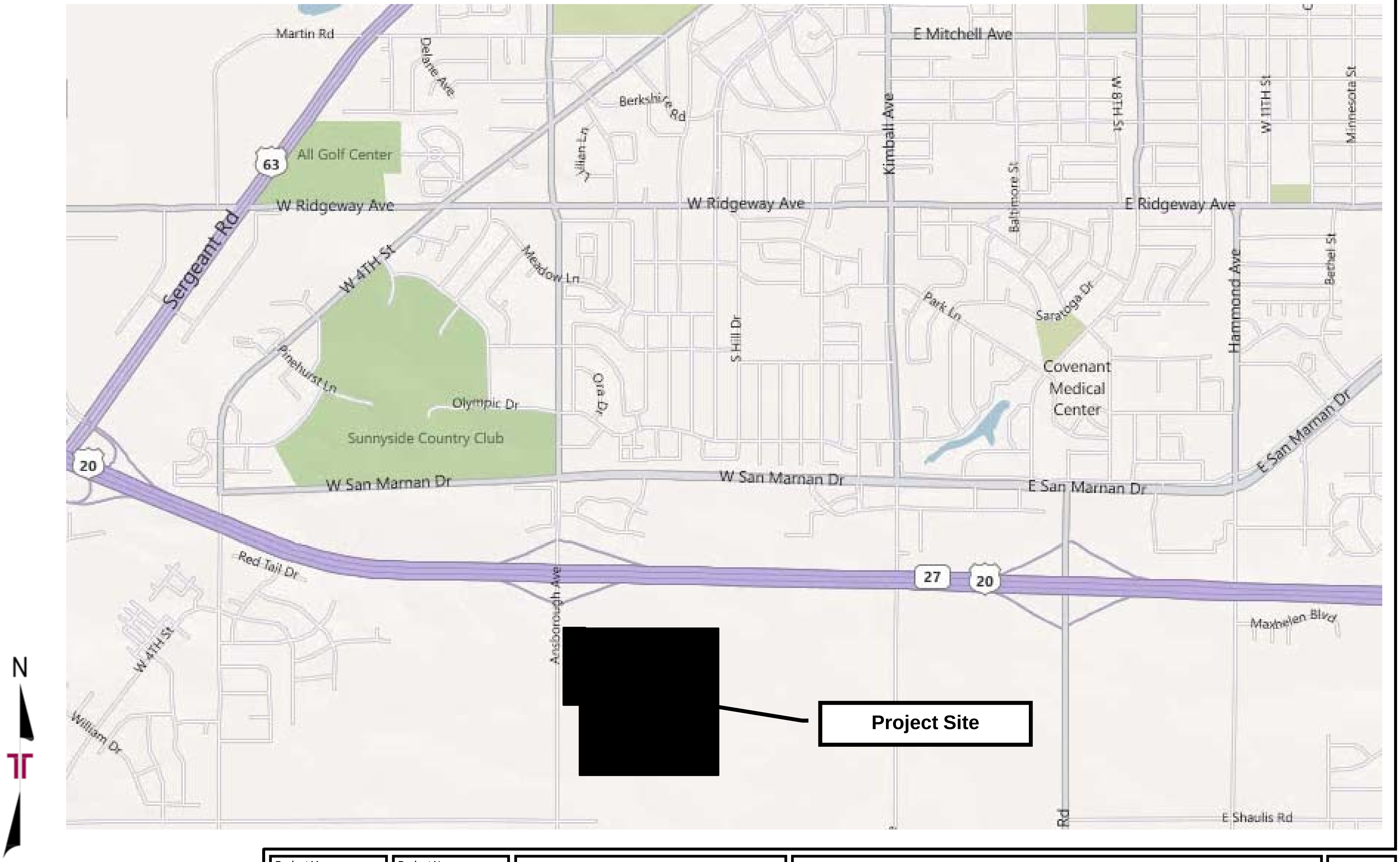
The discussion presented in this preliminary report is based upon the limited data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations, which may occur between borings or across the site. The nature and extent of such variations may not become evident until additional subsurface exploration is performed and subsequent construction is undertaken.

Terracon should be retained to provide additional subsurface explorations once the facility layout, site grading plans, and structural loads are further developed. Upon completion of the final subsurface exploration, Terracon should be retained to review the design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This preliminary report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made.

APPENDIX A
FIELD EXPLORATION



[redacted]

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: JPH	Project No. 13115139
Drawn by: KAD	Scale: N. T. S.
Checked by: JPH	File Name: 13115139_A1.ppt
Approved by: JPH	Date: 1/10/2012

Terracon
Consulting Engineers & Scientists
6612 Chancellor Drive, Suite 102 Cedar Falls, Iowa 50613
PH. (319) 277-4016 FAX. (319) 277-4320

SITE LOCATION MAP

WATERLOO PRELIMINARY GEOTECHNICAL EVALUATION

U. S. HIGHWAY 20 AND ANSBOROUGH AVENUE
WATERLOO, IOWA

Ex. No.
A-1

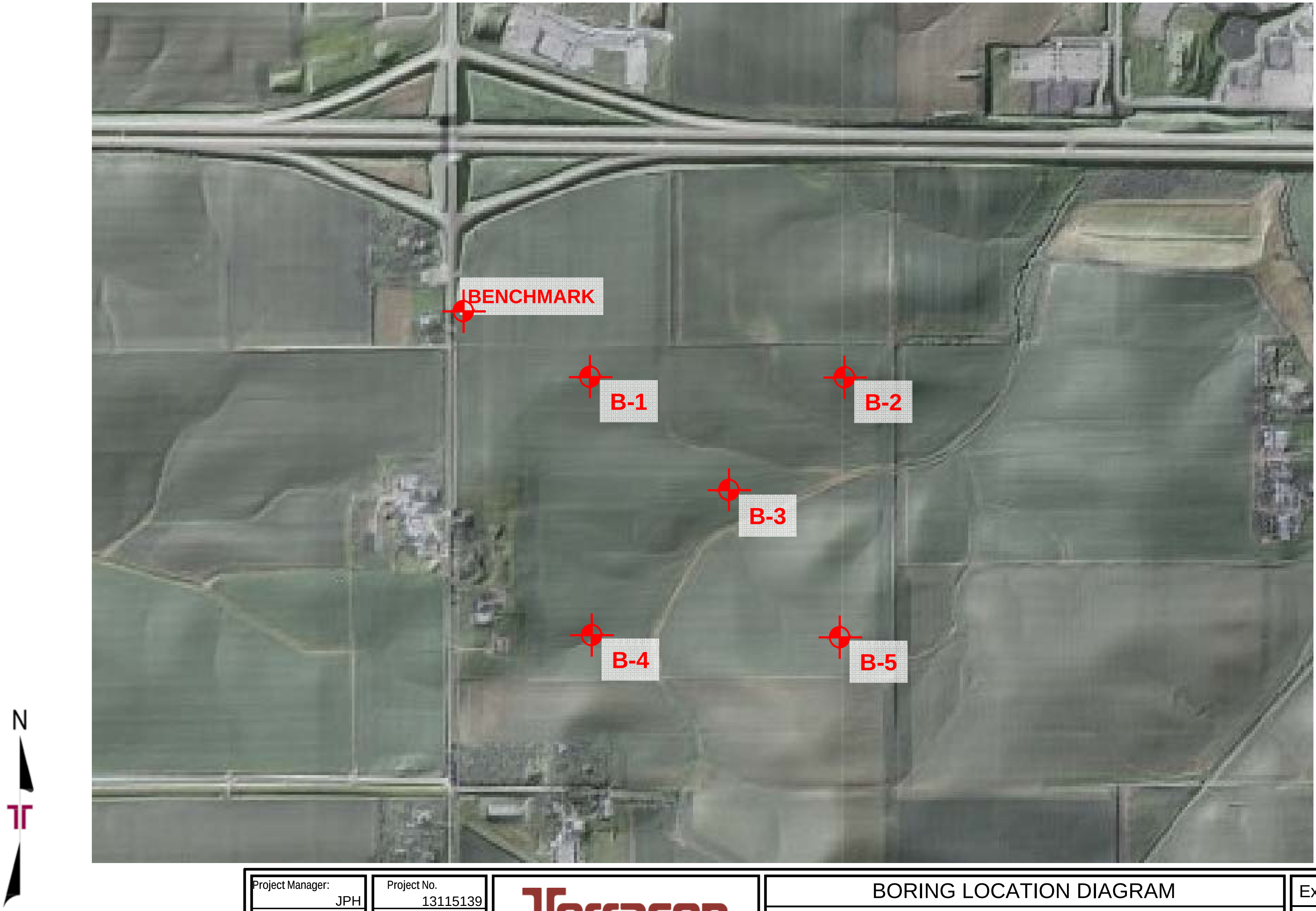


DIAGRAM IS FOR GENERAL LOCATION
ONLY, AND IS NOT INTENDED FOR
CONSTRUCTION PURPOSES

Project Manager: JPH	Project No. 13115139
Drawn by: KAD	Scale: N. T. S.
Checked by: JPH	File Name: 13115139_A2.ppt
Approved by: JPH	Date: 1/12/2012

Terracon
Consulting Engineers & Scientists
6612 Chancellor Drive, Suite 102 Cedar Falls, Iowa 50613
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BORING LOCATION DIAGRAM

WATERLOO PRELIMINARY GEOTECHNICAL EVALUATION

U. S. HIGHWAY 20 AND ANSBOROUGH AVENUE
WATERLOO, IOWA

Exhibit
A-2

LOG OF BORING 1

Page 1 of 1

CLIENT **PACLAND**

SITE **SE of Highway 20 and Ansborough Avenue**
Waterloo, Iowa

PROJECT **Waterloo Preliminary Geotechnical Evaluation**

Approx. Surface Elevation: 102.0 ft

GRAPHIC LOG	Depth, ft	DESCRIPTION	Elevation, ft
⁂	0.83	**Approx. 10" Topsoil**	101
▨	11.5	**SANDY LEAN CLAY, TRACE GRAVEL, WITH OCCASIONAL SAND SEAMS AND LAYERS**, Gray and Brown, Medium Stiff to Stiff ▽	90.5
▨	20	**SANDY LEAN CLAY, TRACE GRAVEL, WITH OCCASIONAL SAND SEAMS**, Brown Gray to Gray, Very Stiff ▼	82
		BOTTOM OF BORING	

USCS SYMBOL	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES RECOVERY, in.	SAMPLES SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	TESTS DRY UNIT WT pcf	TESTS UNCONFINED STRENGTH, psf	TESTS LIQUID LIMIT (LL) PLASTICITY INDEX (PI)
		PA						
CL-SC	1	SS	7	6	27		*2000	
		PA						
SC/CL	2	SS	10	5	16			
		PA						
CL-SC	3	ST	24		19	111	1820	
		PA						
CL-SC	4	ST	24		16	109	2100 *2000	
		PA						
CL	5	SS	15	15	15		*6500	
		PA						
CL	6	SS	18	12	13		*7000	
		PA						
CL-SC	7	SS	18	28	15		*6500	

DEPTH, ft.: 5, 10, 15, 20

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 9.5	WS	▼ 16.5 AB
WL	▽		▽
WL	DCI @ 4 ft. 12/29/11		

Terracon

BORING STARTED	12-28-11
BORING COMPLETED	12-28-11
RIG CME 750	FOREMAN RF
	JOB # 13115139

BOREHOLE 13115139.GPJ TERRACON.GDT 1/13/12

LOG OF BORING 2

Page 1 of 1

CLIENT **PACLAND**

SITE **SE of Highway 20 and Ansborough Avenue**
Waterloo, Iowa

PROJECT **Waterloo Preliminary Geotechnical Evaluation**

GRAPHIC LOG	DESCRIPTION Approx. Surface Elevation: 93.0 ft	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	LIQUID LIMIT (LL) PLASTICITY INDEX (PI)
	Approx. 12" Topsoil				PA						
	1 — 92		CL	1	SS	4	5	25		*2500	
	SANDY LEAN CLAY, TRACE GRAVEL, Brown to Gray and Brown, Stiff		CL	2	ST	14		23	111	3090	LL = 35 PI = 19
		5			PA						
			CL	3	ST	10		14	118	3330 *3500	
	8.5 — 84.5				PA						
			CL	4	SS	18	21	14		*7500	
		10			PA						
	SANDY LEAN CLAY, TRACE GRAVEL, Brown and Gray to Gray, Very Stiff to Hard		CL	5	SS	17	22	13		*9000+	
					PA						
			CL	6	SS	13	25	13		*9000+	
		15			PA						
			CL	7	SS	17	22	13		*9000+	
	20 — 73	20									
	BOTTOM OF BORING										

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ None WD	▼ None	AB
WL	▼ None (12/29)	▽	
WL			

BORING STARTED			12-28-11
BORING COMPLETED			12-28-11
RIG	CME 750	FOREMAN	RF
		JOB #	13115139

LOG OF BORING 3

Page 1 of 2

CLIENT **PACLAND**

SITE **SE of Highway 20 and Ansborough Avenue**
Waterloo, Iowa

PROJECT **Waterloo Preliminary Geotechnical Evaluation**

Approx. Surface Elevation: 89.5 ft

DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	LIQUID LIMIT (LL) PLASTICITY INDEX (PI)
Approx. 18" Topsoil 1.5 88				HS						
SANDY LEAN CLAY, TRACE GRAVEL, WITH OCCASIONAL SAND SEAMS AND LAYERS, Brown to Gray and Brown, Medium Stiff to Stiff ▼		CL	1	SS	6	6	27		*2000	
		CL-SC	2	ST	14		17 16		*1500	LL = 24 PI = 12
	5			HS						
		CL	3	ST	10		18	111	2530 *2500	
				HS						
		SC/CL	4	SS	15	9	16			
11 78.5	10			HS						
SANDY LEAN CLAY, TRACE GRAVEL, WITH SAND SEAMS AND LAYERS, Gray and Brown, Very Stiff		CL	5	SS	18	13	17		*6000	
				HS						
∇ 15 74.5		SC/CL	6	SS	18	14	20			
SANDY LEAN CLAY, TRACE GRAVEL, WITH OCCASIONAL SAND SEAMS, Brown and Gray to Gray, Hard	15			HS						
		CL	7	SS	15	24	12		*9000+	
	20			HS						
		CL	8	SS	18	24	12		*9000+	
cobbles from about 26 to 27.5 ft.	25			HS						
	30	CL	9	SS	10	43	14		*9000+	

Continued Next Page

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ 14	WS	▼ None ACR
WL	▼ 4 (12/29)		▼
WL	WCI @ 5 ft. 12/29/11		

Terracon

BORING STARTED	12-28-11
BORING COMPLETED	12-28-11
RIG CME 750	FOREMAN RF
	JOB # 13115139

LOG OF BORING 3

Page 2 of 2

CLIENT **PACLAND**

SITE **SE of Highway 20 and Ansborough Avenue**
Waterloo, Iowa

PROJECT **Waterloo Preliminary Geotechnical Evaluation**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	SAMPLES: NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	TESTS: WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)
	<u>SANDY LEAN CLAY, TRACE GRAVEL, WITH OCCASIONAL SAND SEAMS</u>, Brown and Gray to Gray, Hard				HS							
		35	CL	10	SS	18	44	11		*9000+		
					HS							
		40	CL	11	SS	18	46	9		*9000+		
					HS							
		45		12	SS	NR	49					
					HS							
	50 39.5	50	CL	13	SS	15	45	10		*9000+		
	BOTTOM OF BORING											

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 14 WS	▼ None ACR	
WL	▼ 4 (12/29)	▽	
WL	WCI @ 5 ft. 12/29/11		

BORING STARTED	12-28-11		
BORING COMPLETED	12-28-11		
RIG	CME 750	FOREMAN	RF
		JOB #	13115139

LOG OF BORING 4

Page 1 of 1

CLIENT
PACLAND

SITE **SE of Highway 20 and Ansborough Avenue**
Waterloo, Iowa

PROJECT
Waterloo Preliminary Geotechnical Evaluation

Approx. Surface Elevation: 100.0 ft

Depth, ft	DESCRIPTION	Elevation
0.92	**Approx. 11" Topsoil**	99
8	**SANDY LEAN CLAY, TRACE GRAVEL, WITH OCCASIONAL SAND SEAMS**, Brown to Gray and Brown, Medium Stiff	92
17	**SANDY LEAN CLAY, TRACE GRAVEL, WITH SAND SEAMS AND LAYERS**, Brown and Gray, Very Stiff	83
20	**SANDY LEAN CLAY, TRACE GRAVEL, WITH OCCASIONAL SAND SEAMS**, Gray, Hard	80
	BOTTOM OF BORING	

USCS SYMBOL	SAMPLES NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	TESTS WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)
		PA							
CL-SC	1	SS	10	5	16		*1500		
CL-SC	2	ST	13		24	97	*1500 1940		
		PA							
CL-SC	3	ST	15		19	104	1710 *2000		
		PA							
CL-SC SW	4	SS	17	15	15		*4500		
		PA							
SC/CL	5	SS	4	17	16				
		PA							
CL	6	SS	18	18	14		*8000		
		PA							
CL	7	SS	18	25	12		*9000+		

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft

WL	▽ 8 WD ▼ 4.5	AB
WL	▼ 4 (12/29) ▽	
WL	WCI @ 7 ft. 12/29/11	

Terracon

BORING STARTED	12-28-11
BORING COMPLETED	12-28-11
RIG CME 750	FOREMAN RF
	JOB # 13115139

LOG OF BORING 5

Page 1 of 1

CLIENT **PACLAND**	
SITE **SE of Highway 20 and Ansborough Avenue Waterloo, Iowa**	PROJECT **Waterloo Preliminary Geotechnical Evaluation**

Approx. Surface Elevation: 102.0 ft

Depth	DESCRIPTION		Elevation
1.08	**Approx. 13" Topsoil**		101
9	**SANDY LEAN CLAY, TRACE GRAVEL, WITH OCCASIONAL SAND SEAMS**, Brown to Gray and Brown, Medium Stiff to Stiff	▼ (5) ▽ (9)	93
17	**SANDY LEAN CLAY, TRACE GRAVEL**, Gray and Brown, Very Stiff	▼ (13.5)	85
20	**SANDY LEAN CLAY, TRACE GRAVEL**, Olive Gray, Hard		82
	BOTTOM OF BORING		

USCS SYMBOL	SAMPLES				TESTS				
	NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)
		PA							
CL	1	SS	3	5	25		*1000		
CL	2	ST	11		18	106	2040 *2000		
		PA							
CL-SC	3	ST	10		19	108	1940 *1500		
		PA							
CL	4	ST	22		16	112	4120		
		PA							
CL	5	SS	12	23	15		*7000		
		PA							
CL	6	SS	14	35	12		*7000		
		PA							
CL	7	SS	18	37	13		*9000+		

DEPTH, ft.: 5, 10, 15, 20

The stratification lines represent the approximate boundary lines between soil and rock types: in-situ, the transition may be gradual.

*Calibrated Hand Penetrometer
**CME 140 lb. SPT automatic hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ 9	WS ▼ 13.5	AB
WL	▼ 5	(12/29) ▽	
WL	WCI @ 12 ft. 12/29/11		

Terracon

BORING STARTED	12-28-11		
BORING COMPLETED	12-28-11		
RIG	CME 750	FOREMAN	RF
		JOB #	13115139

Field Exploration Description

The boring locations were laid out in the field by Terracon personnel using a hand held GPS unit and GPS coordinates provided by the client. Ground surface elevations indicated on the boring logs were determined in the field using differential leveling techniques and a surveyor's level and rod. Surface elevations at the boring locations were referenced to land survey point L.S. 8505 near the northwest corner of the proposed site. This reference was assigned an arbitrary elevation of 100.0 feet. Surface elevations at the boring locations were rounded to the nearest ½-foot. The locations and elevations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The borings were drilled with an atv-mounted rotary drill rig using solid-stem and hollow-stem augers and wash boring drilling methods to advance the boreholes. Samples were obtained in the borings using the split-barrel and thin-wall tube sampling procedures. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split-barrel sampler the last 12 inches of the typical total 18-inch penetration by means of an automatic hammer with a free fall of 30 inches, is the standard penetration resistance value (N). The N-value is used to estimate the relative density of cohesionless soils, and to a lesser extent, the consistency of cohesive soils. In the thin-walled tube sampling procedure a thin-walled, seamless steel tube with a sharp cutting edge is pushed hydraulically into the soil to obtain a relatively undisturbed sample.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed for this project. A greater efficiency is achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. This higher efficiency has an effect on the standard penetration resistance blow count (N) value. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions. The borings were backfilled with auger cuttings after delayed groundwater levels were obtained.

During the field exploration, a field log of each boring was prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples.

APPENDIX B
SUPPORTING INFORMATION

Laboratory Testing

Portions of recovered soil samples were tested in our laboratory to measure their natural water content, and dry unit weight. Unconfined compression tests were performed on selected samples and a calibrated hand penetrometer was used to estimate the approximate unconfined compressive strength of some samples. The calibrated hand penetrometer has been correlated with unconfined compression tests and provides a better estimate of soil consistency than visual examination alone. Liquid and plastic limits testing and laboratory compaction characteristics testing were also performed on portions of selected samples. The test results are provided on the boring logs included in Appendix A, and also follow in this Appendix B.

Descriptive classifications of the soils indicated on the boring logs are in general accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification System Symbols. A brief description of this classification system is attached to this report.

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DRILLING & SAMPLING SYMBOLS:

SS: Split Spoon - 1-$^{3}/_{8}$" I.D., 2" O.D., unless otherwise noted
ST: Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted
RS: Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted
DB: Diamond Bit Coring - 4", N, B
BS: Bulk Sample or Auger Sample

HS: Hollow Stem Auger
PA: Power Auger (Solid Stem)
HA: Hand Auger
RB: Rock Bit
WB Wash Boring or Mud Rotary

The number of blows required to advance a standard 2-inch O.D. split-spoon sampler (SS) the last 12 inches of the total 18-inch penetration with a 140-pound hammer falling 30 inches is considered the "Standard Penetration" or "N-value".

WATER LEVEL MEASUREMENT SYMBOLS:

WL: Water Level
WCI: Wet Cave in
DCI: Dry Cave in

WS: While Sampling
WD: While Drilling
AB: After Boring

BCR: Before Casing Removal
ACR: After Casing Removal
N/E: Not Encountered

Water levels indicated on the boring logs are the levels measured in the borings at the times indicated. Groundwater levels at other times and other locations across the site could vary. In pervious soils, the indicated levels may reflect the location of groundwater. In low permeability soils, the accurate determination of groundwater levels may not be possible with only short-term observations.

DESCRIPTIVE SOIL CLASSIFICATION: Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

CONSISTENCY OF FINE-GRAINED SOILS

Unconfined Compressive Strength, Qu, psf	Standard Penetration or N-value (SS) Blows/Ft.	Consistency
< 500	0 - 1	Very Soft
500 – 1,000	2 - 4	Soft
1,000 – 2,000	4 - 8	Medium Stiff
2,000 – 4,000	8 - 15	Stiff
4,000 – 8,000	15 - 30	Very Stiff
8,000+	> 30	Hard

RELATIVE DENSITY OF COARSE-GRAINED SOILS

Standard Penetration or N-value (SS) Blows/Ft.	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 50	Dense
> 50	Very Dense

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 – 29
Modifier	≥ 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75mm)
Sand	#4 to #200 sieve (4.75 to 0.075mm)
Silt or Clay	Passing #200 Sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 – 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1-10
Medium	11-30
High	> 30

Rev. 4/10

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Exhibit C-1

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above “A” line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below “A” line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above “A” line		CH	Fat clay [K,L,M]
			PI plots below “A” line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add “with cobbles or boulders, or both” to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add “with sand” to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add “with organic fines” to group name.

[I] If soil contains ≥ 15% gravel, add “with gravel” to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add “with sand” or “with gravel,” whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add “sandy” to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add “gravelly” to group name.

[N] PI ≥ 4 and plots on or above “A” line.

[O] PI < 4 or plots below “A” line.

[P] PI plots on or above “A” line.

[Q] PI plots below “A” line.

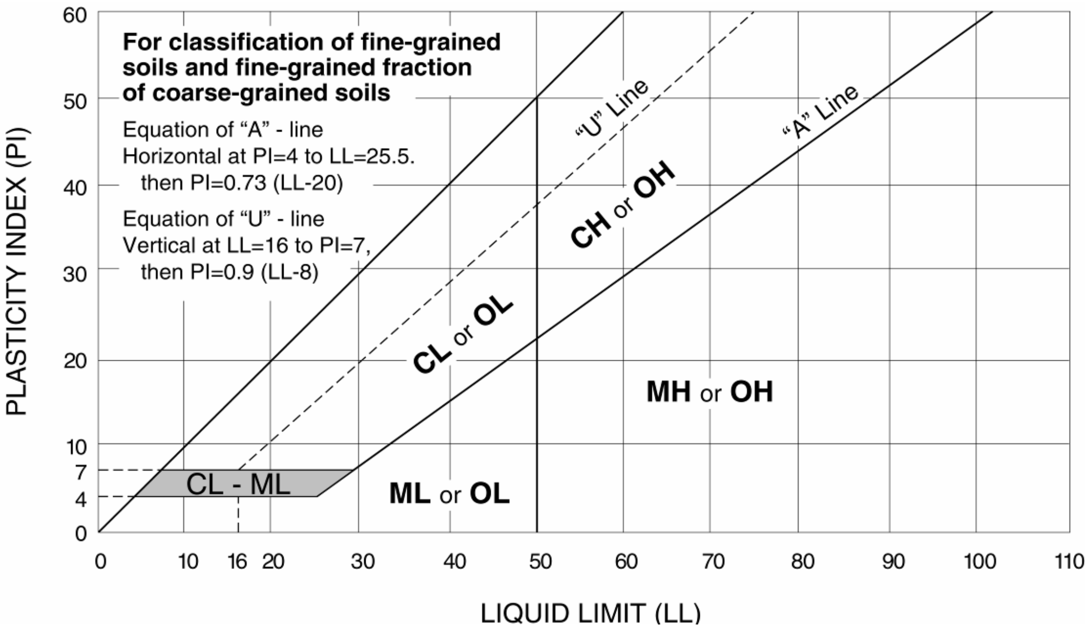

Exhibit C-2