Preliminary Geotechnical Engineering Report

Ridgeland Commons Project
Oak Park, Illinois
August 23, 2011
Terracon Project No. 11115050

Prepared for:
Park District of Oak Park
Oak Park, Illinois

Prepared by:
Terracon Consultants, Inc.
Naperville, Illinois

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Terracon

August 23, 2011

Park District of Oak Park
218 Madison Street
Oak Park, Illinois 60302

Attn: Mr. Neil Adams
Project Manager

Re: Preliminary Geotechnical Engineering Report
Proposed Ridgeland Commons Project
Oak Park, Illinois
Terracon Project Number: 11115050

Dear Mr. Adams:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our Proposal No. P11110244 dated June 18, 2011. This report presents the findings of the subsurface exploration and provides preliminary geotechnical recommendations regarding the design and construction of foundations and floor slabs for the proposed improvements.

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.

Madhu R. Karri, P.E.
Project Engineer

Stephen A. Bucher, P.E.
Illinois No. 062-040512
Renews on 11/30/11

STEPHEN A. BUCHER
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ENGINEER
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cc: Mr. Eric Penney - Nagle Hartray

EXECUTIVE SUMMARY

Terracon Consultants, Inc. has completed geotechnical exploration for the proposed improvements at the Ridgeland Commons Park located at the southwest corner of the intersection of Lake Street and North Ridgeland Avenue in Oak Park, Illinois. We understand that project plans are in preliminary stages and that the locations of additions or new structures have yet to be determined. Six (6) borings, designated B-1 through B-6, were performed to depths of approximately 25 feet below the existing ground surface to characterize the subsurface profile at the site.

Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. The following geotechnical considerations were identified:

- The project site is currently occupied by Park District facilities including an existing building, outdoor swimming pool, baseball fields, and associated parking and drive areas. Existing fill was encountered at the boring locations to depths ranging from about 3 to 5 feet. Based on conditions encountered in the borings, some compactive effort may have been applied to portions of the fill; however, no documentation regarding placement and compaction of the fill was provided for our review. In our opinion, foundation excavations should extend through the fill and bear on native, medium stiff to very stiff clay or on engineered fill that extends to approved native soils.

- Provided the owner accepts the risks associated with support of building floor slabs over undocumented fill in exchange for reduced construction costs, stable portions of the existing fill could be left in place for support of building floor slabs. If a portion of the existing fill is left in place, thorough observation/testing of the existing fill should be performed to reduce the risk of settlement of slabs and other elements supported on/above these materials.

- Close monitoring of the construction operations discussed herein will be critical in achieving the design subgrade support. We therefore recommend that Terracon be retained to provide observation/testing during this portion of the work.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
PROPOSED RIDGELAND COMMONS PROJECT
OAK PARK, ILLINOIS
Terracon Project No. 11115050
August 23, 2011

1.0 INTRODUCTION

Terracon Consultants, Inc. (Terracon) has completed a Preliminary Geotechnical Engineering Report for the proposed improvements at the Ridgeland Commons Park located at the southwest corner of the intersection of Lake Street and North Ridgeland Avenue in Oak Park, Illinois. Six (6) borings, designated B-1 through B-6, were performed to depths of approximately 25 feet below the existing ground surface in the proposed building areas. Logs of the borings and a boring location diagram are included in Appendix A of this report.

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

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

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site layout	See Appendix A, Exhibit A-2: Boring Location Diagram
Structures	We understand that two options are being considered for the proposed construction: Option 1 includes possible additions/ expansions to the existing building on the east side of the park, including the basement area. Option 2 includes construction of a new one and two-story building at the western portion of the site. The new buildings will contain a basement level. An in-ground swimming pool will also be constructed. Both options would also include an at-grade skating rink and consideration of artificial turf athletic fields.

ITEM	DESCRIPTION
Finished floor elevation	Not provided. Assumed to match or be close to the floor level of existing building.
Maximum loads	Columns: 50 to 150 kips (assumed) Walls: 2 to 3 klf (assumed) Floor slab: 100 psf max (assumed)
Maximum allowable settlement	Columns: 1 inch (assumed) Walls: ¾ inch over 40 feet (assumed)
Grading	Cut/ fill assumed to be less than about 3 feet in building and athletic field areas. Basement and pool excavations assumed to extend to depths of about 10 to 12 feet below existing grades.

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	This project site is located at the southwest corner of the intersection of Lake Street and North Ridgeland Avenue in Oak Park, Illinois.
Existing improvements	The existing facility includes an indoor skating rink, outdoor swimming pool and grass covered baseball fields. Associated sidewalk/ landscaped areas surround the building and pool areas. An asphalt paved parking lot is located in the northeast portion of the facility.
Existing topography	The ground surface is relatively flat with about 2 feet of elevation change across the baseball field. An earthen berm is located near the southwest corner of 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
1	6 to 13 inches	3½ to 4 inches of asphalt over 8 to 9 inches of crushed stone aggregate or 6 inches of topsoil	N/A

Stratum	Approximate Depth to Bottom of Stratum (feet)	Material Description	Consistency/Density
2	3 to 5 feet	Existing Fill: Lean clay with varying amounts of sand, and traces of gravel, rootlets and broken limestone pieces	N/A
3	Termination depths of 25 feet	Native soils: Lean clay, trace sand and gravel	Medium stiff to very stiff

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 soil types; in situ, the transition between materials may be gradual.

3.3 Water Level Observations

The borings were observed while drilling and immediately after completion for the presence and level of groundwater. Groundwater was not observed in the borings at these times. Although we did not encounter water in the borings, based on our experience in Chicago area, gray coloring of soils is usually an indication of long term water level (where the transition of brown clay to gray clay occurs). In general, it takes a long period of time for groundwater to develop and stabilize in a borehole where low permeability clay soils are encountered. Therefore, groundwater could be anticipated at depths of about 5 to 8 feet below existing grades (where brown lean clay transitions to gray lean clay in the borings). Long term observations in piezometers or observation wells sealed from the influence of surface water are often required to define groundwater levels in materials of this type.

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 can develop over low permeability soils or within existing fill materials. Therefore, groundwater levels during construction or at other times in the life of the structures 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 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Preliminary Geotechnical Considerations

■ Existing fill comprised primarily of lean clay with varying amounts of sand and traces amounts of gravel, organics, and limestone pieces was encountered at the boring locations to depths ranging from about 3 to 5 feet below existing grades. Based on conditions encountered in the borings, the fill appears to be somewhat variable in terms of composition and consistency. Some compactive effort may have been applied to portions of the fill; however, no documentation regarding placement and compaction of the fill was provided for our review. In our opinion, foundation excavations should extend through the fill and bear on medium stiff to very stiff native clay soils or on engineered fill that extends to approved native soils. Considering the likely basement level construction, we expect that foundations will typically bear below the fill.

■ Provided the owner is willing to accept the risk associated with supporting the new floor slabs over the existing fill materials in exchange for reduced construction costs, it is our opinion that stable portions of the existing fill could be left in place for support of the new building floor slabs. It should be noted that undocumented fill may contain soft soils or other unsuitable materials and these conditions may not be disclosed by the widely spaced, small-diameter borings. If these conditions are present and are not discovered and corrected during construction, larger than normal settlement resulting in cracking or other damage could occur in slabs and utilities supported on or above the existing fill. These risks can be reduced by thorough observation and testing during construction, but they cannot be eliminated without complete removal and replacement of the fill. To reduce the risk of adverse slab performance and provide more uniform support for slabs, the existing fill materials should be observed and tested during construction. Where unsuitable conditions are observed, the materials should be improved by scarification/compaction or be removed and replaced with engineered fill.

■ Underground utilities may be present within or near the proposed improvements. If these utilities are to remain in place, we recommend that the backfill be tested by a representative of Terracon at the time of construction. If these utilities are to be relocated, the resulting trenches should be overexcavated, backfilled, and tested in accordance with the recommendations in section **4.2 Earthwork**.

■ If the existing fill is left in place for support of the new synthetic turf system, thorough observation/testing of the existing fill should be performed to reduce the risk of uneven settlement of the new surface. The subgrade soils should be observed and tested by proofrolling to evaluate the suitability of this material for support of the construction equipment used to place and compact the drainage aggregate and install the turf layers. Unstable areas should be improved by compaction or be removed and replaced with engineered fill. The undercut areas should be backfilled with new engineered fill that meets the material requirements and placement/compaction guidelines provided in this report.

■ In general, we recommend that the exposed subgrade be thoroughly evaluated after stripping asphalt or topsoil and completing required cuts, but prior to the start of any fill operations. We recommend that Terracon be retained to evaluate the bearing material for the foundations and floor slab subgrade soils.

Subsurface conditions, as identified by the field and laboratory testing programs, have been reviewed and evaluated with respect to the proposed project information known to us at this time. Preliminary recommendations for earthwork and the design and construction of shallow foundations and floor slabs for the proposed improvements are presented in the following sections.

4.2 Earthwork

Earthwork on this project should be observed and evaluated by Terracon. Recommendations for site preparation, excavation, subgrade preparation, and placement of engineered fill for the project are provided in the following sections.

4.2.1 Site Preparation

Pavements, sidewalks, and other existing improvements that are currently present within proposed construction areas should be removed. Existing utilities that would interfere with proposed construction should be removed or relocated. A representative of Terracon should observe excavations created by demolition/ removal of existing improvements prior to placement of new fill.

Where the new construction will overlap with any currently landscaped areas, site preparation in these areas should include removal of vegetation, organic materials and any loose, soft, or otherwise unsuitable materials. Organic soils removed during site preparation could be utilized as fill for landscaped areas, but these materials should not be used as fill beneath the proposed building or pavement areas.

The soils exposed following removal of existing pavements and/ or stripping of organic materials should be observed and tested by Terracon prior to placing new engineered fill and/ or construction of new slabs. Terracon's representative should observe proofrolling of the exposed soils. Proofrolling can be accomplished using a loaded tandem-axle dump truck with a gross weight of at least 25 tons, or similarly loaded equipment. Areas that display excessive deflection (pumping) or rutting during proofroll operations should be improved by scarification/compaction or by removal and replacement with engineered fill.

4.2.2 Engineered Fill Material Requirements

Engineered fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Cohesive	CL, CL-ML	Below/ adjacent to foundations, slabs, and pavements
Granular	GW, GP, GM, GC, SW, SP, SM, SC	Below/ adjacent to foundations, slabs, and pavements
Unsuitable	CH, MH, OL, OH, PT	Non-structural locations
On-site soils	CL	The on-site soil appears suitable for use as fill.

1. Engineered fill should consist of approved materials that are free of organic matter and debris. Cohesive fill materials should have liquid limit less than 45 and a plasticity index less than 20; cohesive soils that do not meet these criteria should be considered “unsuitable”. Frozen material should not be used, and fill should be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation prior to use on this site.
2. Based on visual and tactile examination of recovered soil samples and the results of the laboratory tests, most of the on-site lean clay soils (native and fill) would likely meet the criteria for engineered fill. However, any organic materials, rock fragments larger than 3 inches, and other unsuitable materials should be removed prior to use of the existing fill materials in new fill sections.

4.2.3 Fill Placement and Compaction Requirements

Item	Description
Fill Lift Thickness	9 inches or less in loose thickness when heavy, self-propelled compaction equipment is used. 4 to 6 inches in loose thickness when hand-guided equipment (i.e., a jumping jack or plate compactor) is used.
Minimum Compaction Requirement [1, 2] **Below Foundations and Slabs-on-grade**	95% of the material’s modified Proctor maximum dry density (ASTM D 1557). This level of compaction should extend beyond the edges of footings at least 8 inches for every foot of fill placed below the foundation base elevation.
Moisture Content of Cohesive Soil	-2% to +3% of modified Proctor optimum (ASTM D 1557)
Moisture Content of Granular Material [3]	Workable moisture levels

1. We recommend that each lift of fill be tested by Terracon for moisture content and compaction prior to the placement of additional fill or concrete. If the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. If the granular material is a coarse sand or gravel, is of a uniform size, or has a low fines content, compaction comparison to relative density (ASTM D 4253/4254) may be more appropriate. In this case, granular materials should be compacted to at least 60% of the material’s maximum relative density.
3. The gradation of a granular material affects its stability and the moisture content required for proper compaction. Moisture levels should be maintained to achieve compaction without bulking during placement or pumping when proofrolled.

4.2.4 Artificial Turf Field

The subgrade soils can be disturbed by construction traffic especially if the soils become wet. Therefore, the contractor should be careful to avoid subgrade disturbance. Repeated passes of heavy construction equipment should be avoided and lighter weight, track-mounted equipment should be used. Surface and subsurface drainage should be maintained and improved to reduce saturation and softening of the subgrade soils. The subgrade preparation recommendations provided in this report are intended to provide support for construction equipment. If the manufacturer or licensed turf contractor have different requirements for the turf system, Terracon should be notified so that supplemental recommendations can be provided.

An approximately 6-inch thick free-draining granular base layer is recommended below the artificial turf system. The free-draining granular material should consist of crushed limestone containing less than 6 percent fines passing the #200 sieve (e.g., Illinois CA-7, or an approved alternate gradation). Based on our experience with artificial turf systems on other projects, a layer of approximately 2 inches of smaller-sized crushed limestone (3/8-inch or 1/2-inch size "chips") is typically placed as a leveling course above the free-draining aggregate to facilitate fine grading and provide a working surface for placement of the turf system. The granular materials should be compacted as recommended in the **Earthwork** section of this report.

4.2.5 Grading and Drainage

During construction, grades should be developed to direct surface water flow away from or around the site. Exposed subgrades should be sloped to provide positive drainage so that saturation of subgrades is avoided. Surface water should not be permitted to accumulate on the site.

Final surrounding grades should be sloped away from the structure to promote rapid surface drainage. Accumulation of water adjacent to the building could contribute to significant moisture increases in the subgrade soils and subsequent softening/ settlement. Roof drains should discharge into a storm sewer or at least 10 feet away from the building.

4.2.6 Earthwork Construction Considerations

Although excessive seepage is generally not anticipated in shallow frost depth excavations for this project, any excavations for basement level construction and/or pool construction should consider the possibility of encountering seepage. When seepage is encountered, the contractor is responsible for employing appropriate dewatering methods to control seepage and facilitate construction. In our experience, dewatering of excavations in clay soils can typically be accomplished using sump pits and pumps. If water bearing sand seams and layers are intercepted, a more extensive dewatering system may be required.

Care should be taken to avoid disturbance of prepared subgrades. Unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted and/ or subjected to repetitive construction traffic. New fill compacted above optimium moisture content or that accumulates water during construction can also become disturbed under construction equipment. Construction traffic over the completed subgrade should be avoided to the extent practical. If the subgrade becomes saturated, desiccated, or disturbed, the affected materials should either be scarified and compacted or be removed and replaced. Subgrades should be observed and tested by Terracon prior to construction of slabs.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, "Excavations" and its appendices, and in accordance with any applicable local, state, and federal safety regulations. The contractor should be aware that slope height, slope inclination, and excavation depth should in no instance exceed those specified by these safety regulations. Flatter slopes than those dictated by these regulations may be required depending upon the soil conditions encountered and other external factors. These regulations are strictly enforced and if they are not followed, the owner, contractor, and/or earthwork and utility subcontractor could be liable and subject to substantial penalties. Under no circumstances should the information provided in this report be interpreted to mean that Terracon is responsible for construction site safety or the contractor's activities. Construction site safety is the sole responsibility of the contractor who shall also be solely responsible for the means, methods, and sequencing of the construction operations.

4.3 Preliminary Foundation Recommendations

In our opinion, the proposed additions or new buildings can be supported by conventional spread footing foundations bearing on native medium stiff to very stiff clays or newly placed engineered fill that extends to suitable native soil. Footings should not be supported on or above the existing undocumented fill. Since existing fill extended to depths of about 3 to 5 feet below existing grades, some overexcavation below typical "frost depth" foundation bearing levels will likely be needed to reach suitable bearing soils. Where existing undocumented fill or other unsuitable conditions are encountered at design footing bearing depth, the remedial methods recommended in Section 4.3.2 should be implemented. Based on the borings, we expect that basement level foundations will extend below the fill and bear in the native stiff to very stiff cohesive soils. Design recommendations for shallow foundations to support the proposed building are presented below.

4.3.1 Preliminary Foundation Design Considerations

DESCRIPTION	VALUE
Net allowable bearing pressure [1]	
For footings bearing at frost depth (3 ½ feet) within native, medium stiff clay:	2,000 psf
For footings bearing at 5 to 8 feet within native, stiff to very stiff clay:	4,000 psf
Minimum footing dimensions	Isolated footings: 30 inches Continuous footings: 18 inches
Minimum embedment below finished grade for frost protection [2]	3½ feet

DESCRIPTION	VALUE
Approximate total settlement from foundation loads [3]	1 inch
Estimated differential settlement from foundation loads [3]	1/2 to 2/3 of the total settlement

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. This pressure assumes that any existing fill or lower strength soils, if encountered, will be undercut and replaced with engineered fill.
2. For perimeter footings, footings beneath unheated areas, and footings that will be exposed to freezing conditions during construction.
3. Foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of engineered fill, and the quality of the earthwork operations and footing construction.

If additions to the existing building are considered, new foundations placed adjacent to the existing foundations may cause some additional settlement of the existing structure. To help reduce this effect, new footings placed near existing footings should be founded at approximately same elevation as the existing footings. The clear distance between new footings and existing footings bearing at the same depth should be at least equal to the base width of the new footing.

Support of the addition on existing foundations is not anticipated, but if increasing the loads on the existing foundations is considered, then additional building settlements could occur. The structural capacity of the existing foundation should be evaluated by the project structural engineer where any increase in loading is planned. During construction, Terracon should also observe and test the bearing conditions beneath existing footings where increased loading is planned.

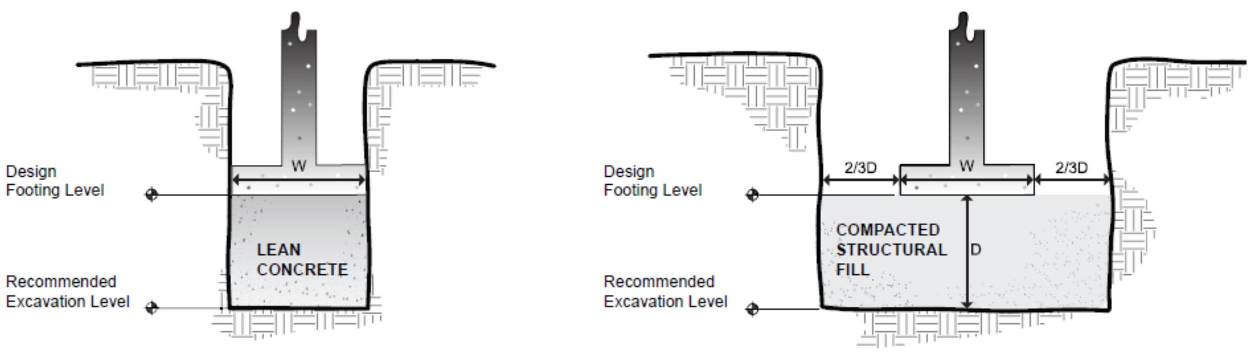
Where the addition will attach to the existing building, connections with sufficient flexibility to accommodate independent movement should be utilized. Differential settlement between new and existing structures may approach the estimated total settlement unless foundations are tied together.

4.3.2 Preliminary Foundation Construction Considerations

The base of each foundation excavation should be free of water and loose soil prior to placing concrete. Concrete should be placed as soon after excavating as possible to reduce bearing soil disturbance. If the soils at bearing level become excessively dry, disturbed, saturated, or frozen, the affected soil should be removed prior to placing concrete. Placement of a lean concrete mud-mat over the bearing soils should be considered if the excavations must remain open overnight or for an extended period of time.

Footings should bear directly on tested and approved native soils, on lean concrete that extends to approved native soils, or on new engineered fill that extends to approved native soils. If existing fill or otherwise unsuitable bearing soils are encountered in footing excavations, the excavation could be extended deeper to suitable soils and the footing could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. If lean concrete backfill (minimum 28-day compressive strength of 1,500 psi) is used, widening of excavation may not be needed.

Where engineered fill will be placed to support the footings, the excavations should be widened at least 8 inches beyond each footing edge for every foot of new fill placed below the design footing base elevation. The overexcavated depth should then be backfilled up to the foundation base elevation with an approved granular material that is placed in lifts and compacted to at least 95% of the material's modified Proctor maximum dry density. We recommend that backfill materials consist of well-graded crushed stone similar to Illinois Department of Transportation (IDOT) gradation CA-6. The recommended extents of the overexcavation and backfill procedure are illustrated in the following figure.



Lean Concrete Backfill **Overexcavation / Backfill**

NOTE: Excavations in sketches shown vertical for convenience. Excavations should be sloped as necessary for safety.

4.4 Seismic Site Class

The International Building Code (IBC) requires structural design to be in accordance with the appropriate site class definition for soil profile type. Based upon the Site Class Definitions in Table 1615.1.1 of the 2009 International Building Code, and the average shear wave velocity of 1,175 ft/s derived from our seismic survey data, Terracon recommends a Class D seismic site classification for design.

The average shear-wave velocity analysis and recommendations presented in this report are based upon the data obtained from the seismic refraction system performed at the indicated location and on the indicated date. This analysis does not reflect variations that may occur across the site, or variations that may occur throughout the year, such as groundwater fluctuations. The refraction microtremor method is an approximate method, and one of many methods that can be used to determine shear-wave velocities. There are other costlier methods that can be used to further increase the accuracy of the seismic site classification and shear-wave profile.

4.5 Preliminary Floor Slab Recommendations

4.5.1 Preliminary Floor Slab Design Recommendations

ITEM	DESCRIPTION
Floor slab support	Existing fill soils, native soils or new engineered fill materials that have been prepared in accordance with section 4.2 and tested/approved by Terracon
Modulus of subgrade reaction	100 pounds per square inch per inch (psi/in) for point loading conditions
Granular leveling course [2]	6 inches of free draining granular material

1. Floor slabs should be structurally independent of any building footings or walls to reduce the possibility of floor slab cracking caused by differential movement between the slab and foundation.
2. The floor slab should be placed on a leveling course comprised of well-graded granular material (e.g., IDOT CA-6 aggregate) compacted to at least 95% of the material's modified Proctor maximum dry density (ASTM D 1557)

Joints should be constructed at regular intervals as recommended by the American Concrete Institute (ACI) to help control the location of cracking. It should be understood that differential settlement between the floor slabs and foundation could occur.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings, or when the slab will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.5.2 Preliminary Floor Slab Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of base rock and concrete and corrective action will be required.

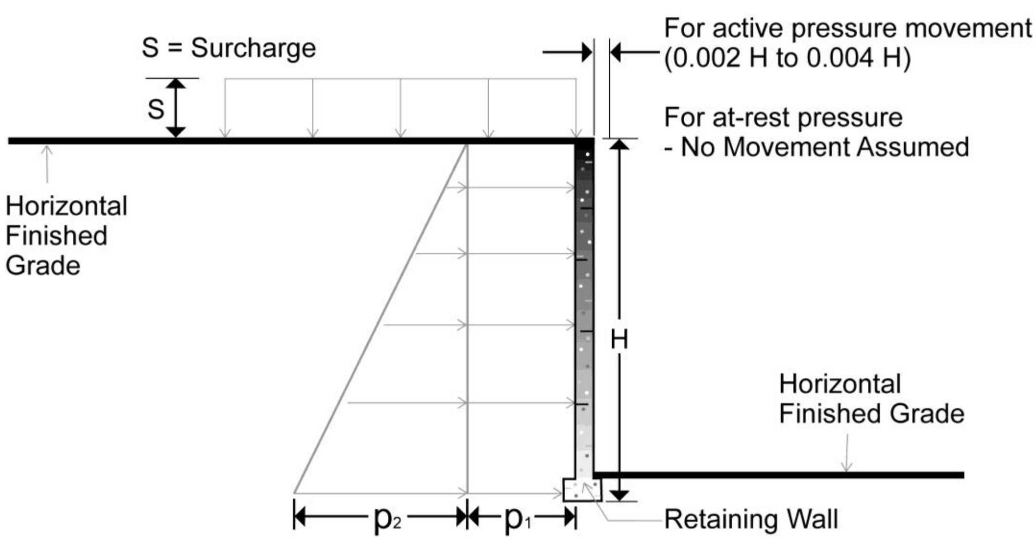
Terracon should review the condition of the floor slab subgrades immediately prior to placement of the granular leveling course and construction of the slabs. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas containing backfilled trenches. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill.

4.6 Preliminary Below Grade Wall Considerations

4.6.1 Lateral Earth Pressures

Below grade basement and swimming pool walls that will be subjected to unbalanced backfill levels should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free-standing cantilever retaining walls and assumes wall movement. The "at-rest" condition assumes no wall movement and should be used for the design of basement walls. The recommended design lateral earth pressures are for cast-in-place concrete walls, do not include a factor of safety, and do not provide for possible hydrostatic pressure on the walls.

Backfill placed against structures should consist of granular or cohesive engineered fill. For the granular values to be valid, the granular fill must extend out from the base of the wall at an angle of at least 45 from vertical for the active and at-rest cases and at least 60 degrees from vertical for the passive case. To calculate the resistance to sliding, a value of 0.35 should be used as the ultimate coefficient of friction between the concrete and the underlying soil.



Lateral Earth Pressure Parameters				
Pressure Conditions	Coefficient For Backfill Type	Equivalent Fluid Unit Weight (pcf)	Surcharge Pressure, P_1 (psf)	Earth Pressure, P_2 (psf)
Active (Ka)	Granular - 0.33	40	(0.33)S	(40)H
	Lean Clay - 0.42	50	(0.42)S	(50)H
At-Rest (Ko)	Granular - 0.46	55	(0.46)S	(55)H
	Cohesive - 0.58	70	(0.58)S	(70)H
Passive (Kp)	Granular – 3.0	360	---	---
	Cohesive – 2.4	290	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 **H** to 0.004 **H**, where **H** is wall height
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where S is surcharge pressure
- In-situ soil backfill weight a maximum of 120 pcf
- Horizontal backfill, compacted to at least 95 percent of modified Proctor maximum dry density
- Loading from heavy compaction equipment not included
- No hydrostatic pressures acting on wall
- No dynamic loading
- No safety factor included in soil parameters
- Ignore passive pressure in frost zone

4.5.3 Subsurface Drainage

Drains should be constructed at the base of below grade walls to reduce the risk of hydrostatic loading. The drain pipe should be located with its invert at the bottom of the wall and should be surrounded with free-draining granular material graded to prevent the intrusion of fines. A 2-foot wide layer of free-draining granular material should be placed adjacent to the wall. For exterior locations, the granular material should extend from the drainage pipes to within 2 feet of final grade and be capped with a cohesive fill material placed and compacted as recommended in Section 4.2 of this report. At interior locations, the granular material should extend up to the floor slab subgrade elevation. As an alternative to filter graded gravel, free-draining 1-inch nominal size gravel could be used for the drains if the entire system, including the gravel, is encapsulated with an appropriate geotextile filter fabric.

The drainage networks (pipes) for perimeter subdrains should be sloped to provide positive gravity drainage to sumps equipped for automated pumping or to a down gradient storm sewer or other suitable outlet that will allow gravity drainage. Redundant pumps with battery backup power could be considered to reduce the risk of hydrostatic pressure and seepage in the event of pump and/or power failure. Periodic maintenance of drainage systems is necessary so that they do not become plugged and inoperative.

A prefabricated drainage structure placed against below grade walls may also be used as an alternative to free-draining granular fill above the pipe. A prefabricated drainage structure consists of a plastic drainage core or mesh that is covered with filter fabric to prevent soil intrusion. The drainage structure is fastened to the wall after the wall has been waterproofed.

4.7 Additional Evaluation

The preliminary subsurface exploration program for this project consisted of six widely-spaced borings across the site. Specific information about anticipated structure locations, foundation loads, finished floor elevations and site grading was not available at the time this preliminary report was prepared. We recommend Terracon be retained to perform additional field exploration and laboratory testing and to prepare a design-phase geotechnical engineering report when more detailed information becomes available.

5.0 GENERAL COMMENTS

Since the project is in the conceptual design stage, the general geotechnical considerations contained in this report should be considered for preliminary planning purposes only. Once precise building/ structure footprints, foundation loads, floor elevations, and site grades have been determined, Terracon should be retained to review this information. Additional subsurface exploration should be performed so that specific geotechnical recommendations and design parameters can be provided for the project.

Support of slabs on or above existing fill is discussed in this report. Even with the construction observation/testing recommended in this report, a risk remains for the owner that unsuitable materials within or buried by the fill will not be discovered. This may result in larger than normal settlement and damage to slabs supported above existing fill, requiring additional maintenance. This risk cannot be eliminated without removing the existing fill from below the building areas, but can be reduced by thorough observation and testing as discussed herein.

The analysis and preliminary recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of geotechnical 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.

This 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. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION

Field Exploration Description

The boring locations were laid out at the site by Terracon representative crew utilizing a site plan provided by the client and measuring from existing site features. Right angles for the boring locations were estimated. Ground surface elevations were not provided. The locations 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 a truck-mounted, rotary drill rig using continuous flight hollow-stemmed augers to advance the boreholes. Soil samples were obtained using split-barrel sampling procedures, in which a standard 2-inch (outside diameter) split-barrel sampling spoon is driven into the ground with a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. These values, also referred to as SPT N-values, are an indication of soil strength and are provided on the boring logs at the depths of occurrence. The samples were sealed and transported to the laboratory for testing and classification.

The drill crew prepared a field log of each boring. These logs included visual classifications of the materials encountered during drilling and the driller's interpretation of the subsurface conditions between samples. The 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.

Geophysical (ReMi) Testing Description

Terracon used a seismic refraction system (SRS) consisting of a seismograph and 24 geophones to perform a site-specific seismic class survey. A linear array of 24 geophones was placed in an accessible area as illustrated in the attached diagram. A computer was used to record refraction microtremors produced by ambient seismic noise. The data was then processed using a wavefield-transformation data-processing technique and an interactive Rayleigh-wave dispersion-modeling tool. The refraction microtremor method exploits aspects of spectral analysis of surface waves (SASW) and multi-channel analysis of surface waves (MASW) to derive a shear wave profile and an average shear-wave velocity along the array for a corresponding depth of about 100 feet.

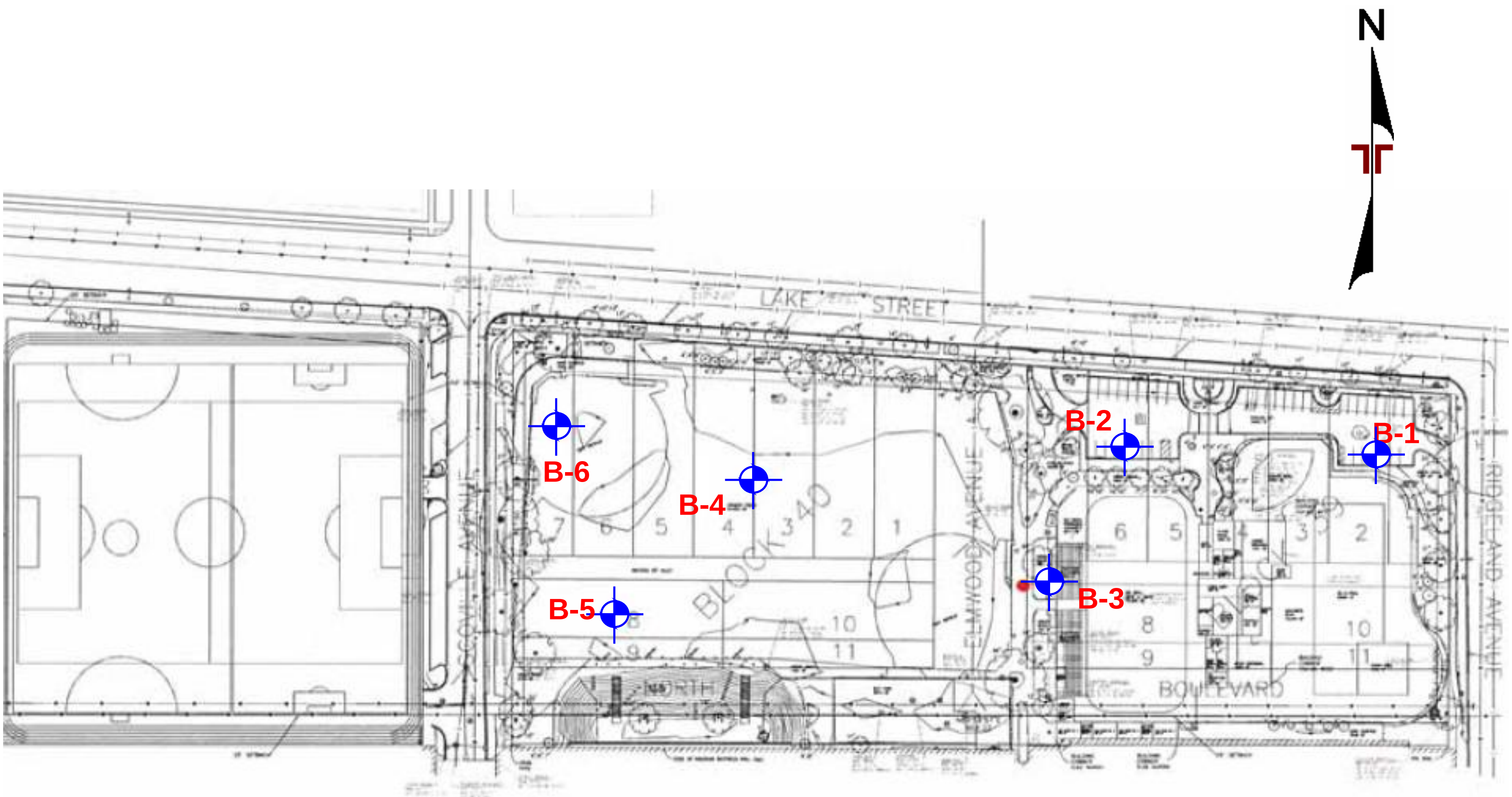


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: MRK	Project No. 11115050
Drawn by: MRK	Scale: N.T.S.
Checked by: SAB	File Name: 11115050 BLD
Approved by: SAB	Date: 8/19/2011

Terracon
Consulting Engineers & Scientists
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BORING LOCATION DIAGRAM

RDIGELAND COMMONS PROJECT

LAKE STREET & N RIDGELAND AVENUE

OAK PARK, ILLINOIS

Exhibit

A-2

LOG OF BORING NO. 1

OWNER: **Park District of Oak Park**

SITE: **Ridgeland Common Park, Oak Park, Illinois**

PROJECT: **Ridgeland Commons Project**

Graphic Log depth	Description	Depth, ft.	USCS Symbol	Number	Type	Recovery, in.	SPT - N ** Blows / ft.	Water Content, %	Dry Unit Wt pcf	Unconfined Strength, psf
0.33	**Approx. 4" Asphalt**				PA					
1	**Approx. 9" Crushed Stone Fill**			1	SS	10	9	15		
3	**FILL: LEAN CLAY, TRACE SAND AND GRAVEL**, brown and brown gray				PA					
5	**LEAN CLAY, TRACE SAND AND GRAVEL**, brown gray, medium stiff		CL	2	SS	14	7	17		2000*
	LEAN CLAY, TRACE SAND AND GRAVEL, gray, very stiff	5			PA					
			CL	3	SS	14	17	12		5000*
					PA					
			CL	4	SS	16	16	15		5000*
		10			PA					
			CL	5	SS	14	27	14		8000*
		15			PA					
			CL	6	SS	18	16	16		5000*
		20			PA					
25			CL	7	SS	18	19	15		6000*
	BOTTOM OF BORING	25								

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

*Pocket Penetrometer
**140 Lbs Automatic SPT Hammer

WATER LEVEL OBSERVATIONS, ft		
WL	NONE WD	NONE AB
WL		

EXHIBIT A-3

Terracon

BORING STARTED	8-1-11
BORING COMPLETED	8-1-11
RIG GC	FOREMAN DS
APPROVED MK	JOB # 11115050

LOG OF BORING NO. 2

OWNER **Park District of Oak Park**

SITE **Ridgeland Common Park**
Oak Park, Illinois

PROJECT **Ridgeland Commons Project**

Depth (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
0.33	**Approx. 3½" Asphalt**				PA					
1	**Approx. 8" Crushed Stone Fill**			1	SS	14	10	21		
3	**FILL: LEAN CLAY, TRACE SAND AND GRAVEL**, brown and brown gray				PA					
5	**LEAN CLAY, TRACE SAND AND GRAVEL**, brown gray, medium stiff		CL	2	SS	14	6	23		2000*
	LEAN CLAY, TRACE SAND AND GRAVEL, gray, very stiff	5			PA					
			CL	3	SS	16	19	14		6000*
					PA					
			CL	4	SS	18	19	15		6000*
		10			PA					
			CL	5	SS	18	18	15		5500*
		15			PA					
			CL	6	SS	18	19	16		5500*
		20			PA					
25			CL	7	SS	18	17	16		5000*
	BOTTOM OF BORING	25								

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

*Pocket Penetrometer
**140 Lbs Automatic SPT Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	▽ NONE	WD	▼ NONE AB
WL	▽		▽

EXHIBIT A-4

Terracon

BORING STARTED			8-1-11
BORING COMPLETED			8-1-11
RIG	GC	FOREMAN	DS
APPROVED	MK	JOB #	11115050

LOG OF BORING NO. 3

OWNER Park District of Oak Park	
SITE Ridgeland Common Park, Oak Park, Illinois	PROJECT Ridgeland Commons Project

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
	FILL: LEAN CLAY, TRACE SAND, GRAVEL AND BROKEN LIMESTONE PIECES, brown and brown gray				PA					
				1	SS	14	8	18		
3	**LEAN CLAY, TRACE SAND AND GRAVEL WITH OCCASIONAL SAND SEAMS**, brown gray, medium stiff to stiff				PA					
			CL	2	SS	18	8	16		2500*
		5			PA					
			CL	3	SS	16	9	21		3000*
8	**LEAN CLAY, TRACE SAND AND GRAVEL**, gray, very stiff				PA					
			CL	4	SS	16	18	14		5500*
		10			PA					
			CL	5	SS	18	15	11		4500*
		15			PA					
			CL	6	SS	16	22	12		6500*
		20			PA					
			CL	7	SS	18	21	14		6000*
25	BOTTOM OF BORING	25								

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

*Pocket Penetrometer
**140 Lbs Automatic SPT Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	∇ NONE	WD	▼ NONE AB
WL			

EXHIBIT A-5

Terracon

BORING STARTED	8-1-11		
BORING COMPLETED	8-1-11		
RIG	GC	FOREMAN	DS
APPROVED	MK	JOB #	11115050

LOG OF BORING NO. 4

OWNER **Park District of Oak Park**

SITE **Ridgeland Common Park**
Oak Park, Illinois

PROJECT **Ridgeland Commons Project**

GRAPHIC LOG	DESCRIPTION	DEPTH, ft.	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
0.5	**Approx. 6" Topsoil Fill**				PA					
	FILL: LEAN CLAY, TRACE SAND, GRAVEL AND ROOTLETS, dark brown and brown			1	SS	12	14	19		
					PA					
5				2	SS	12	7	21		
	LEAN CLAY, TRACE SAND AND GRAVEL WITH OCCASIONAL SAND SEAMS, brown gray, very stiff	5			PA					
8			CL	3	SS	10	24	13		7000*
	LEAN CLAY, TRACE SAND AND GRAVEL, gray, stiff to very stiff				PA					
			CL	4	SS	16	13	12		4000*
		10			PA					
				5	SS	NR	12			
		15			PA					
			CL	6	SS	18	12	15		3500*
		20			PA					
25			CL	7	SS	18	17	13		5000*
	BOTTOM OF BORING	25								

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

*Pocket Penetrometer
**140 Lbs Automatic SPT Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	WD	NONE AB
WL			

EXHIBIT A-6

Terracon

BORING STARTED	8-1-11
BORING COMPLETED	8-1-11
RIG GC	FOREMAN DS
APPROVED MK	JOB # 11115050

LOG OF BORING NO. 5

OWNER: Park District of Oak Park	
SITE: Ridgeland Common Park, Oak Park, Illinois	PROJECT: Ridgeland Commons Project

Strata depth	DESCRIPTION	DEPTH, ft.	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
0.5	**Approx. 6" Topsoil Fill**				PA					
3	**FILL: LEAN CLAY, TRACE SAND, GRAVEL AND ROOTLETS**, dark brown and brown			1	SS	11	14	23		
					PA					
5	**LEAN CLAY, TRACE SAND AND GRAVEL WITH OCCASIONAL SAND SEAMS**, brown, stiff		CL	2	SS	12	10	15		3000*
	LEAN CLAY, TRACE SAND AND GRAVEL, gray, stiff to very stiff	5			PA					
			CL	3	SS	12	18	16		5500*
					PA					
			CL	4	SS	16	16	15		5000*
		10			PA					
			CL	5	SS	16	11	12		3500*
		15			PA					
			CL	6	SS	16	12	16		3500*
		20			PA					
25			CL	7	SS	16	19	13		5500*
	BOTTOM OF BORING	25								

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

*Pocket Penetrometer
**140 Lbs Automatic SPT Hammer

WATER LEVEL OBSERVATIONS, ft		
WL ▽ NONE	WD ▼ NONE	AB
WL ▼	▼	

BORING STARTED	8-1-11		
BORING COMPLETED	8-1-11		
RIG	GC	FOREMAN	DS
APPROVED	MK	JOB #	11115050

Terracon

EXHIBIT A-7

LOG OF BORING NO. 6

OWNER: Park District of Oak Park

SITE: Ridgeland Common Park, Oak Park, Illinois

PROJECT: Ridgeland Commons Project

Depth (ft)	DESCRIPTION	DEPTH, ft.	USCS SYMBOL	NUMBER	TYPE	RECOVERY, in.	SPT - N ** BLOWS / ft.	WATER CONTENT, %	DRY UNIT WT pcf	UNCONFINED STRENGTH, psf
	FILL: LEAN CLAY, TRACE SAND, GRAVEL AND BROKEN LIMESTONE PIECES, dark brown and brown				PA					
				1	SS	14	11	26		
3	**LEAN CLAY, TRACE SAND AND GRAVEL WITH OCCASIONAL SAND SEAMS**, brown, stiff				PA					
			CL	2	SS	14	10	17		3000*
		5			PA					
			CL	3	SS	16	12	17		3500*
8	**LEAN CLAY, TRACE SAND AND GRAVEL**, gray, stiff to very stiff				PA					
			CL	4	SS	18	18	15		5500*
		10			PA					
			CL	5	SS	18	15	12		4500*
		15			PA					
			CL	6	SS	16	21	13		6500*
		20			PA					
			CL	7	SS	16	24	14		7500*
25	BOTTOM OF BORING	25								

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

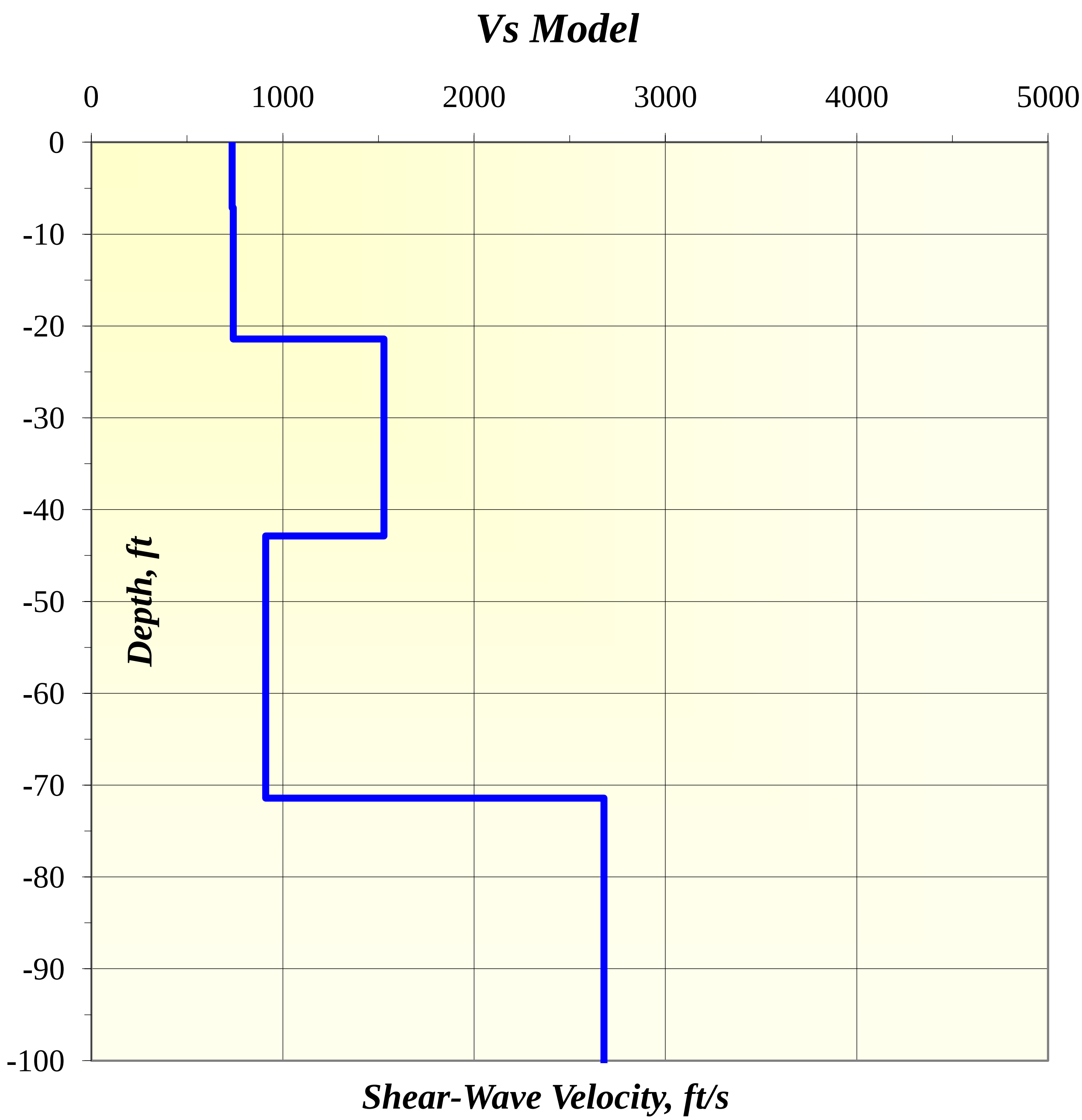
*Pocket Penetrometer
**140 Lbs Automatic SPT Hammer

WATER LEVEL OBSERVATIONS, ft			
WL	NONE	WD	NONE AB
WL			

BORING STARTED	8-1-11
BORING COMPLETED	8-1-11
RIG	GC
FOREMAN	DS
APPROVED	MK
JOB #	11115050

Terracon

EXHIBIT A-8



Vs Model
0
1000
2000
3000
4000
5000
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Depth, ft
Shear-Wave Velocity, ft/s

APPENDIX B
SUPPORTING INFORMATION

Laboratory Testing

The soil samples obtained from the borings were tested in the laboratory to measure their natural water contents. A pocket penetrometer was used to help estimate the approximate unconfined compressive strength of selected native cohesive samples. The test results are provided on the boring logs in Appendix A.

The soil samples were classified in the laboratory based on visual observation, texture, plasticity, and the limited laboratory testing described above. The soil descriptions presented on the boring logs for native soils are in accordance with the enclosed General Notes and Unified Soil Classification System (USCS). The estimated USCS group symbols for native soils are shown on the boring logs, and a brief description of the USCS is included in 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	HS:	Hollow Stem Auger
ST:	Thin-Walled Tube – 2" O.D., 3" O.D., unless otherwise noted	PA:	Power Auger (Solid Stem)
RS:	Ring Sampler - 2.42" I.D., 3" O.D., unless otherwise noted	HA:	Hand Auger
DB:	Diamond Bit Coring - 4", N, B	RB:	Rock Bit
BS:	Bulk Sample or Auger Sample	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	WS:	While Sampling	BCR:	Before Casing Removal
WCI:	Wet Cave in	WD:	While Drilling	ACR:	After Casing Removal
DCI:	Dry Cave in	AB:	After Boring	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

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-in. (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 $\geq$ 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 $\geq$ 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 $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] $PI \geq 4$ 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.