REPORT OF

SUBSURFACE EXPLORATION AND GEOTECHNICAL ENGINEERING ANALYSIS

HIGHLAND PARK MIXED-USE DEVELOPMENT
515 ROGER WILLIAMS AVENUE
HIGHLAND PARK, ILLINOIS

ECS PROJECT NO. 16:10434

FOR

IMPERIAL REALTY COMPANY
CHICAGO, ILLINOIS

DECEMBER 30, 2014

ECS MIDWEST, LLC

"Setting the Standard for Service"

Geotechnical • Construction Materials • Environmental • Facilities

December 30, 2014

Attn: Al Klairmont and Ann Regan
Imperial Realty Company
4747 West Peterson Avenue
Suite 200
Chicago, Illinois 60646

CC Peter Szczelina: pszczelina@fitzgeraldassociates.net

ECS Project No. 16:10434

Reference: Report of Subsurface Exploration and Geotechnical Engineering Services, Highland Park Mixed-Use Development, 515 Roger Williams Avenue, Highland Park, Illinois

Dear Mr. Klairmont and Ms. Regan:

As authorized by your acceptance of our Proposal No. 16:12286-GP, dated March 12, 2014, ECS Midwest, LLC (ECS) has completed the subsurface exploration and geotechnical engineering analyses for the proposed Highland Park Mixed-Use Development to be constructed at 515 Roger Williams Avenue in Highland Park, Illinois.

A report, including the results of our subsurface exploration, boring data, laboratory testing, recommendations regarding the geotechnical design and construction aspects at the project site, a Boring Location Plan and Boring Logs are enclosed herein. The recommendations presented are intended for use by your office and for use by other professionals involved in the design and construction stages of the project described herein.

We appreciate the opportunity to be of service to Imperial Realty Company on this project. If you have questions with regard to the information and recommendations contained in this report, or if we may be of further service to you during the planning and/or construction phase of this project, please do not hesitate to contact the undersigned.

Respectfully,

ECS MIDWEST, LLC

BRETT GITSKIN
062-045078

Eric Borys

Eric R. Borys, E.I.T.
Project Engineer

Brett Gitskin, P.E.
Senior Principal Engineer
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REPORT

PROJECT

Subsurface Exploration and
Geotechnical Engineering Analysis
Highland Park Mixed-Use Development
515 Roger Williams Avenue
Highland Park, Illinois

CLIENT

Attn: Al Klairmont and Ann Regan
Imperial Realty Company
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Chicago, Illinois 60646

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No. 184-004247

PROJECT NO. 16:10434

DATE December 30, 2014

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EXECUTIVE SUMMARY

The subsurface conditions encountered during our subsurface exploration and ECS' conclusions and recommendations are summarized below. This summary should not be considered apart from the entire text of the report with all the qualifications and considerations mentioned herein. Details of our conclusions and recommendations are discussed in the following sections and in the Appendix of this report.

The proposed project site is located at the addresses of 515 Roger Williams Avenue in Highland Park, Illinois. The site is bound to the south by Roger Williams Avenue to the east by Union Pacific Railroad tracks, to the north by undeveloped wooded, residential lots and to the west by residential and retail developments. The site is currently developed with an at-grade parking lot and a one to two story retail structure. ECS understands the existing building will be demolished prior to the new construction. ECS' subcontracted union drillers performed six (6) SPT soil borings at the project site for the development of the new 4-story structure. The observations from borings B-1 through B-6 are summarized as follows.

Surficial material at the project site consisted of 8 to 14 inches of pavement sections, typically 3 to 6 inches of bituminous pavement or concrete underlain by 5 to 10 inches of gravel subbase materials. The surficial materials were observed to be underlain by undocumented Silty CLAY FILL (CL/ML FILL) at borings B-1 through B-6 to depths ranging from 3 to 7½ feet below the existing surface grade. The existing fill soils within the footprint of the proposed building structure (B-1 thorugh B-4) were observed to depths ranging from 3 to 7½ feet below the existing surface grade. The undocumented Silty CLAY FILL soils were generally observed to be underlain by natural Silt CLAY (CL/ML) soils to the termination depths of the soil borings (i.e, 10 to 25 feet). The natural Silty Clay soils were observed to exhibit unconfined compressive strength values (Qp) in the range of 1½ tsf to greater than 4½ tsf (stiff to hard consistencies). The natural Silty Clay Soils were observed with moisture contents in the range of 14 to 24 percent. The long-term water table at the project site is anticipated to be in the range of 12 to 16 feet below the existing surface grade.

At soil borings B-2 and B-4, a petro-chemical odor was present in the Silty Clay fill during soil boring operations and during the classification of the soil samples observed by ECS at depths ranging from about 2½ to 7½ feet below the surface. The nature and extent of the petro-chemical odor at soil borings B-2 and B-4 is beyond the scope of this report.

We do not recommend supporting the new additions on or over existing undocumented fill. We recommend shallow foundations extend through the existing fill (i.e., beyond the depth of the existing fill) and can be designed for a maximum net allowable soil bearing pressure of 5,000 psf. The proposed building can be supported on a shallow foundation system (i.e., wall and spread footings) bearing in competent natural soils or new granular engineered fill/lean concrete overlying competent natural soils. A shallow foundation system bearing in the competent natural soils or new granular engineered fill/lean concrete overlying competent natural Silty CLAY soils can be designed for a maximum allowable soil bearing pressure of 5,000 psf. Competent soils can be identified on the boring log as natural Silty CLAY (2½ tsf or greater). **In no case shall excavations for the new structure extend below adjacent foundations and slabs unless underpinning or other forms of engineered support are provided.**

For the design and construction of the slabs-on-grade for the building, the preliminary recommendations provided in the section entitled **Subgrade Preparation and Earthwork Operations** should be followed. We have provided several slab and pavement subgrade preparation options for the project team to consider and the options were developed based on cost versus risk associated with the construction efforts. Extreme care must be taken during earthwork activities adjacent to existing structures to prevent undermining of existing structure foundations and ground level slabs. Excavations below existing foundations and slabs should consider appropriate preventative measures, such as shoring and underpinning, to avoid undermining or loss of subgrade support beneath structures.

More detailed recommendations with regard to foundations, subgrade preparation and earthwork operations, fill placement, slab and pavement design, underslab drainage, retaining wall design and construction dewatering are included herein and must be fully reviewed and understood so that the intent of the recommendations are properly utilized during design and construction of the proposed development. We recommend that ECS be retained during construction of the proposed development to monitor all earthwork/subgrade preparation to verify that the exposed subgrade materials and the soil bearing pressures will be suitable for the proposed structure.

Report Prepared By:	Report Reviewed By:
Eric R. Borys, E.I.T. Project Engineer	Brett Gitskin, P.E. Senior Principal Engineer

PROJECT OVERVIEW

Introduction

This report presents the results of our subsurface exploration and geotechnical engineering analysis performed for the proposed Highland Park Mixed-Use Development to be constructed at 515 Roger Williams Avenue in Highland Park, Illinois. A General Location Plan, included in the Appendix of this report, shows the approximate location of the project site.

This study was conducted in general accordance with ECS Proposal No. 16:12286-GP, dated March 12, 2014 and authorized by your office. In preparing this report, we have utilized information from our current subsurface exploration, as well as information from nearby sites.

Site Location and Existing Site Conditions

The proposed project site is located at the addresses of 515 Roger Williams Avenue in Highland Park, Illinois. The site is bound to the south by Roger Williams Avenue to the east by Union Pacific Railroad tracks, to the north by undeveloped wooded, residential lots and to the west by residential and retail developments. The site is currently developed with an at-grade parking lot and a one to two story retail structure. ECS understands the existing building will be demolished prior to the new construction. Based on available online resources (i.e. Google Earth®) existing site grades are expected to be in the range of approximately EL. +672 feet to EL. +674 +/-. Based on our conversations with the project team, the existing structure does not have a below grade levels.

Proposed Construction

Based on the information provided to ECS, we understand the proposed development at the project site will consist of the following:

- A new 4-story slab-on-grade mixed-use structure will be constructed throughout the southern portion of the site (lot-line construction). ECS understands the 1st story will be retail and the 2nd through 4th stories will be residential. The building has been designed as a podium building for the first floor, meaning precast concrete columns, beams, and precast floor slab for the 2nd level floor. The 2nd thru 4th floors will be wood stud framing. The western elevation of the new structure will be constructed adjacent to an existing building.

- The proposed loads consist of:
    - Column Loads: Total Load of 200 kips (125 kips DL and 75 kips LL)
    - Wall Loads: Total Load of 6 kips per lineal foot (4½ klf DL and 1½ klf LL)

- The associated site amenities (i.e., parking lots and drives aisles).

- A retaining wall along the north side of the site.

If our understanding of the proposed construction is inaccurate, or if the design changes, please notify ECS immediately so that we can review the proposed scope of work to verify it is applicable for the proposed construction.

Purpose of Exploration and Scope of Work

The purpose of this exploration was to explore the subsurface conditions within the immediate area of the proposed construction and to develop engineering recommendations to guide the geotechnical design and construction aspects of the project. We accomplished these purposes by performing the following scope of services:

1. Reviewing the geotechnical reports from nearby project sites by ECS;

2. Drilling six (6) soil borings at the project site to a depths ranging from 10 to 25 feet below the existing site grades using an auger drill rig. Soil borings B-1 through B-4 were drilled within the approximate footprint of the 4-story building and borings B-5 and B-6 were drilled in the vicinity of the proposed parking areas;

3. Performing laboratory tests on selected representative soil samples from the borings to help estimate pertinent engineering properties;

4. Analyzing the field and laboratory data to develop appropriate geotechnical design and construction recommendations; and,

5. Preparing this geotechnical report of our findings and recommendations.

The conclusions and recommendations contained in this report are based on six (6) soil borings (Borings B-1 through B-6) conducted at the project site under ECS' direction. Soil borings B-1 through B-4 were drilled to about 25 feet below the existing site grade elevation in within the approximate footprint of the proposed 4-story structure. Soil borings B-5 through B-6 were drilled to about 10 feet below the existing site grade in the vicinity of the proposed parking areas (northern portion of the project site). The subsurface exploration included split-spoon soil sampling, standard penetration tests (SPT) and groundwater level observations in the boreholes. The results of the completed soil borings, along with a Boring Location Plan, are included in the Appendix of this report.

The borings were located in the field by ECS personnel. The boring locations are shown on the "Boring Location Plan" included in the Appendix of this report. The elevations shown on the boring logs were interpreted from topographic information provided by Google Earth$^{®}$. Note that elevations gleaned from Google Earth® are not to be considered accurate and should not be relied upon for final design or construction.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

The soil borings were located in the field by an ECS representaive. As required by the State of Illinois, ECS' subcontracted union driller notified Illinois's One-Call System, JULIE, to verify underground utilities in the vicinity of the project site prior to drilling operations.

The soil borings were performed with a truck-mounted rotary-type auger drill rig, which utilized hollow stem-augers to advance the boreholes. Representative soil samples were obtained at 2½-foot intervals to a depth of 10 feet and at 5-foot intervals thereafter to the termination depth of the borings by means of conventional split-barrel sampling procedures. In this procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval, after an initial setting of 6 inches, is termed the Standard Penetration Test (SPT) or N-value and is indicated for each sample on the boring logs. The SPT value can be used as a qualitative indication of the in-place relative density of cohesionless soils. In a less reliable way, it also indicates the consistency of cohesive soils.

The drill rig utilized an automatic trip hammer to drive the sampler. Consideration of the effect of the automatic hammer's efficiency was included in the interpretation of subsurface information for the analyses prepared for this report.

The drill crew maintained a field log of the soils encountered in the borings. After recovery, each geotechnical soil sample was removed from the sampler and visually classified. Representative portions of each soil sample were then sealed in jars and delivered to our laboratory in Buffalo Grove, Illinois for further visual examination and laboratory testing. After completion of the drilling operations, the boreholes were backfilled with auger cuttings to the existing ground surface.

Laboratory Testing Program

Representative soil samples were selected and tested in our laboratory to check field classifications and to help estimate pertinent engineering properties. The laboratory testing program included visual classifications, unconfined compressive strength testing utilizing a calibrated pocket penetrometer and moisture content determinations.

Each soil sample was classified on the basis of texture and plasticity in accordance with the Unified Soil Classification System. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring log. A brief explanation of the Unified System is included in the Appendix of this report. The various soil types were grouped into the major zones noted on the boring log. The stratification lines designating the interfaces between earth materials on the boring logs and profiles are approximate; in situ, the transitions may be gradual.

Unconfined compressive strength tests were performed on cohesive soil samples with the use of a calibrated hand penetrometer. In the hand penetrometer test, the unconfined compressive strength of a soil sample is estimated, to a maximum of 4½ tons per square foot (tsf) by measuring the resistance of a soil sample to penetration of a small, calibrated spring-loaded cylinder.

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposal.

EXPLORATION RESULTS

Soil Conditions

The conclusions and recommendations contained in this report are based on six (6) soil borings (Borings B-1 through B-6) conducted at the project site under ECS' direction. Soil borings B-1 through B-4 were drilled to about 25 feet below the existing site grade elevation in within the approximate footprint of the proposed 4-story structure. Soil borings B-5 through B-6 were drilled to about 10 feet below the existing site grade in the vicinity of the proposed parking areas (northern portion of the project site). The subsurface conditions encountered at the boring locations performed at the site can be summarized as follows.

Surficial material at the project site consisted of 8 to 14 inches of pavement sections, typically 3 to 6 inches of bituminous pavement or concrete underlain by 5 to 10 inches of gravel subbase materials. The surficial materials were observed to be underlain by undocumented Silty CLAY FILL (CL/ML FILL) at borings B-1 through B-6 to depths ranging from 3 to 7½ feet below the existing surface grade. The existing fill soils within the footprint of the proposed building structure (B-1 thorugh B-4) were observed to depths ranging from 3 to 7½ feet below the existing surface grade and appeared to be deeper towards the east. The undocumented Silty CLAY FILL soils were generally observed to be underlain by natural Silt CLAY (CL/ML) soils to the termination depths of the soil borings (i.e, 10 to 25 feet). A layer of Silty Sand With Gravel (SC) was observed at boring B-1 from 17 to 22 feet below grade.

The existing undocumented Silty CLAY FILL soils were observed to exhibit unconfined compressive strength values (Qp) in the range of 1 tsf to greater than 4½ tsf which is indicative of stiff to hard consistencies for cohesive soils. The existing Silty CLAY FILL soils were observed with moisture contents in the range of 14 to 25 percent. *The existing fill must be considered undocumented as we have not been provided with the in-place density test results or other construction phase documentation. If such information is available, ECS should be provided the documentation for review.*

The natural Silty Clay soils were observed to exhibit unconfined compressive strength values (Qp) in the range of 1½ tsf to greater than 4½ tsf (stiff to hard consistencies). The natural Silty Clay Soils were observed with moisture contents in the range of 14 to 24 percent. The softer Slity Clay soils (i.e, less than 2 tsf material) was generally observed at depths of 20 feet to 25 feet.

At soil borings B-2 and B-4, a petro-chemical odor was present in the Silty Clay fill during soil boring operations and during the classification of the soil samples observed by ECS at depths ranging from about 2½ to 7½ feet below the surface. The nature and extent of the petro-chemical odor at soil borings B-2 and B-4 is beyond the scope of this report.

It should be noted that bid quantity estimation by "averaging" depths and strata changes from boring logs is not recommended. Too many variations exist for such "averaging" to be valid, particularly in the surficial material thicknesses, soil types and condition, depth and groundwater conditions. A different scope of professional services would be required to obtain subsurface information needed for land purchase considerations and earthwork bid preparation. This scope could include additional borings and possibly test pits. Even with this additional information, contingencies should always be carried in construction budgets or land purchase agreements to cover variations in subsurface conditions.

Groundwater Observations

Observations for groundwater were made during sampling and upon completion of the drilling operations at the boring locations. In auger drilling operations, water is not introduced into the boreholes, and the groundwater position can often be obtained by observing water flowing into or out of the boreholes. Furthermore, visual observation of the soil samples retrieved during the auger drilling exploration can often be used in evaluating the groundwater conditions.

Groundwater was observed at depths ranging from 18 to 22½ feet below existing site grades during drilling and at depths ranging from 18½ to 23 feet after auger removal. At soil boring B-1, the soil boring was observed to cave-in at 19½ feet below the existing surface grade. Glacial till soils in the Midwest frequently oxidize from gray to brown above the level at which the soil remains saturated. The long-term groundwater level is often interpreted to be near this zone of color change. Based on the results of this exploration, the long-term groundwater level may be located at a depth of approximately 12 to 16 feet below existing site grades.

The highest groundwater observations are normally encountered in late winter and early spring and our current groundwater observations are not expected to be at the seasonal maximum water table. It should be noted that the groundwater level can vary based on precipitation, evaporation, surface run-off and other factors not immediately apparent at the time of this exploration.

ANALYSIS AND RECOMMENDATIONS

Overview

The conclusions and recommendations presented in this report should be incorporated in the geotechnical engineering design and construction aspects of the project to reduce possible soil and/or foundation related problems. This is particularly important since the project site is underlain by as much as 7½ feet of undocumented fill soils.

The following sections present specific geotechnical engineering recommendations with regard to the design and construction of the proposed building. These include recommendations with regard to subgrade preparation and earthwork, fill placement, building foundations and floor slab design and pavement recommendations. Discussion of the factors affecting the building foundations for the proposed construction, as well as additional recommendations regarding the geotechnical engineering design and construction aspects at the project site are included below. We recommend that ECS review the final design and specifications to check that the earthwork and foundation recommendations presented in this report have been properly interpreted and implemented in the design and specifications.

Existing Building Demolition/Backfilling

The existing structure (slab-on-grade) at the project site will be demolished as part of the proposed project. To limit the potential for future settlement of the proposed 4-story structure, it is critical that the existing structures be properly demolished and backfilled prior to construction. Improper demolition and backfilling could lead to foundation and floor slab/pavement distress caused by unacceptable total and differential settlements.

The existing structures (i.e., slabs, foundation, walls, etc.) should be completely removed during demolition activities and backfilled with compacted engineered fill to the final design site grades. It has been our experience that many demolition contractors place the debris in excavations from the structure and cap with soil. These types of activities will not provide a suitable subgrade for foundations, slabs or pavements. The foundation contractor should mobilize appropriate equipment to remove and/or break up existing foundations and other obstructions without delay. All underground utilities to remain should be positively located, properly protected and supported prior to and during excavation and subgrade preparation activities. Underground utilities within the proposed building areas should be relocated or removed and backfilled with engineered fill.

ECS highly recommends that the demolition and backfilling operations at the project site be observed by an experienced ECS geotechnical engineer or his qualified representative retained on your behalf to confirm and document that work is performed in general accordance with the recommendations detailed herein and the backfill materials used are approved materials and adequately placed and compacted.

Design Implications of Existing Fill – Building Areas

The primary geotechnical concern at the project site is the presence of up to about 7½ feet of undocumented fill. Our visual observations and field and laboratory test results indicate the composition of the fill is somewhat variable with inclusions of organic matter and inert debris. The variable depth, composition and consistency of the fill make quantifying the risk associated with the fill essentially impossible. The following paragraphs discuss various risk based alternatives relative to foundation and floor slab support.

Low Risk

The best way to minimize the risk associated with the existing fill is to completely remove and replace the fill with new engineered fill. Once all of the undocumented fill is removed, new engineered fill may be placed as recommended in the **Fill Placement** section of this report. The project team and contractor should determine the footing embedment depths of the adjacent structure on the west side of the site prior to excavation of the full depth of existing fill soils. **If the existing fill excavations are close to the adjacent structure and extend below the existing footings, the existing foundations would have to be shored and existing structures underpinned to help reduce the potential for damage to adjacent construction**. If you elect to install an excavation support system for the purpose of removing and replacing the existing fill, a specialty geotechnical contractor should be retained to design and install such a system. Undercutting operations should be observed a full-time basis to verify that proper and not excessive undercutting is performed.

Moderate Risk

If the client is willing to accept some risk of post-construction settlement related distress, you may consider shallow undercutting and replacement of the upper 2 to 3 feet of existing fill. Prior to considering any partial undercutting of floor slab subgrades, the bearing depth of the existing building foundations should be confirmed so that maximum theoretical undercut depth can be established. Existing fill may be undercut to the bearing depth of the existing foundations and the resulting excavation backfilled with new engineered fill placed in accordance with the **Fill Placement** section of this report. Partial undercutting and replacement should help reduce, but not eliminate, the risk of distress related to differential movement between the floor slab and foundations.

High Risk

Supporting the new structure on the existing undocumented fill will require the client to accept risks for intolerable or excessive post-construction settlement. Excessive post-construction settlement of building foundations can result in damage to interior and exterior finishes, as well as structural framing components. If the client elects to support the new structure on the undocumented existing fill, future structural and geotechnical repairs should be expected. As previously stated, ***ECS does not recommend supporting the new structure on the existing fill and the decision to do so would be done at the client's sole risk***.

Design Implications of Existing Fill – Pavement Areas

Within pavement areas, shallow undercutting and replacement of the existing fill can be an effective strategy to providing suitable support for new pavements. The following pavement support alternatives are presented.

Option I – Undercut 2 Feet and Replace

The undocumented fill may be undercut a minimum of 2 feet below the finished subgrade elevation and replaced with new engineered fill. The exposed undercut subgrade should then be proofrolled using a loaded dump truck having an axle weight of at least 10 tons. The intent of the proofroll is to aid in identifying localized soft or unsuitable material which may be required to be removed after initial undercutting. If soft or yielding soils are observed during the proofroll of the undercut subgrades, the soft or yielding soils may be undercut up to 2 additional feet (or until natural material is exposed) and replaced with properly compacted engineered fill. Alternatively, the undercut subgrade may be overlain with a heavy weight woven stabilization geotextile (i.e., Mirafi RS 580i). The compacted engineered fill should be placed in accordance with the **Fill Placement** section of this report. Proofrolling of the subgrade should be performed under the observation of an ECS geotechnical engineer or his authorized representative.

Although, ECS considers Option I relatively low risk for premature pavement distress, periodic pavement maintenance should still be anticipated.

Option II – Proofroll and Replace as Required

If the client elects to accept additional risk relative to premature pavement distress, they may elect to leave the existing fill in-place and evaluate the pavement subgrades using conventional proofrolling and make only as needed repairs. The proofrolling should be performed as previously described and localized unstable areas may be undercut up to 2 feet and replaced with new engineered fill as described in the **Fill Placement** section of this report. Alternatively, it may be possible to overlay the unstable areas with the previously described heavy weight geotextile. All proofrolling should be observed by an ECS geotechnical engineer to provide appropriate recommendations at the time of construction. ECS considers this option to result in moderate risk for premature pavement distress and the need for more frequent pavement repair

General – Undercutting Considerations

To help limit the volume of soil removed (as a result unstable conditions revealed by the proofrolling), we recommend that soft or yielding soils be evaluated in approximately 6-inch intervals. That is to say, if soft or yielding soils are identified, the contractor should remove 6 inches of material in the subject area and then proofroll/evaluate the undercut subgrade. This will potentially limit the need to remove 2 feet of soil at all locations where soft or yielding soils are identified at the design subgrade. A DCP (dynamic cone penetrometer) can also be used in conjunction with proofrolling to establish appropriate depths for remedial action.

Steps should be taken by the contractor to control surface water runoff and to remove water from precipitation that may accumulate in the subgrade areas, especially during the wet season. When wet and subjected to construction traffic, softening and disturbance of the exposed subgrade may occur. Construction traffic should be especially limited when the subgrade is wet. During final preparation of the subgrade, a smooth drum roller is often used to provide a flat surface and provide for better drainage to reduce the negative impact of rain events. We also recommend sealing, crowning and sloping the subgrade to provide positive drainage off the subgrades.

Exposure to the environment may weaken the subgrade soils if the excavations remain open for too long a period. If the subgrade soils are softened by surface water intrusion or exposure, the softened soils must be removed from the subgrade excavation bottom immediately prior to placement of concrete and/or engineered fill.

Groundwater seepage is could potentially be factor during construction operations at the subgrades. If groundwater is encountered, we believe sump and pump system should be adequate to remove accumulated seepage from the bottom of excavations prior to placement of engineered granular fill.

Excavations should comply with the requirements of OSHA 29CFR, Part 1926, Subpart P, "Excavations" and its appendices, as well as other applicable codes. This document states that the contractor is solely responsible for the design and construction of stable, temporary excavations. The excavations should not only be in accordance with current OSHA excavation and trench safety standards but also with applicable local, state, and federal regulations. The contractor should shore, slope or bench the excavation sides when appropriate.

If problems are encountered during the earthwork operations, or if site conditions deviate from those encountered during our subsurface exploration, ECS should be notified immediately. We recommend that the project geotechnical engineer or his representative be on site to monitor stripping and site preparation operations and observe that unsuitable soils have been satisfactorily removed and observe the proofrolling of the subgrades. These observations are particularly important due to presence of undocumented fill at the site.

Fill Placement

All fills should consist of an approved material, free of organic matter and debris, particles greater than 3-inches and have a Liquid Limit and Plasticity Index less than 40 and 15, respectively. Unacceptable fill materials include topsoil and organic materials (OH, OL), high plasticity silts and clays (CH, MH), and low-plasticity silts (ML). Under no circumstances should high plasticity soils be used as fill material in proposed structural areas or close to site slopes. The surficial topsoil is not suitable for re-use as engineered fill.

The existing Silty Clay fill (CL/ML FILL) appears to be suitable for reuse as backfill material. The Siltly Clay fill should be observed for the presence of high degrees of organics (roots/topsoil) as observed at soil borings or construction debris. If high degrees of organics or other debris are observed within the existing Silty Clay fill soils, the existing Silty Clay fill soils should either be (1) screened for organics or (2) considered not suitable for reuse as engineered fill within structural areas. The on site natural Silty Clay (CL/ML) are considered suitable for reuse as engineered fill.

The on-site soils will likely require moisture content adjustments, such as the application of discing or other drying techniques or spraying of water to the soils prior to their use as compacted fill (termed manipulation). The planning of earthwork operations should recognize and account for increased costs associated with manipulation of the on-site materials considered for reuse as compacted fill.

Fill materials should be placed in lifts not exceeding 8-inches in loose thickness and moisture conditioned to within ±2 percentage points of the optimum moisture content. Soil bridging lifts should not be used, since excessive settlement of new overlying construction will likely occur. Controlled fill soils should be compacted to a minimum of 95 percent of the maximum dry density obtained in accordance with ASTM D1557, modified Proctor method.

The expanded footprint of the proposed building and pavement fill areas should be well defined at the time of fill placement, minimum of 10 feet beyond building and 5 feet beyond pavement areas. Grade control should be maintained throughout the fill placement operations. All fill operations should be observed on a full-time basis by a qualified soil technician to determine that the specified compaction requirements are being met. A minimum of one compaction test per 2,500 square foot area or 50 linear feet of wall or utility trench should be tested in each lift placed. The elevation and location of the tests should be clearly identified at the time of fill placement.

Compaction equipment suitable to the soil type used as fill should be used to compact the fill material. Theoretically, any equipment type can be used as long as the required density is achieved; however, the standard of practice typically dictates that a vibratory roller be utilized for compaction of granular soils and a sheepsfoot roller be utilized for compaction of cohesive soils. In addition, a steel drum roller is typically most efficient for compacting and sealing the surface soils. All areas receiving fill should be graded to facilitate positive drainage from the work areas and free of water associated with precipitation and surface runoff. Care must be taken when using vibratory compaction adjacent to the existing building to help prevent damage to interior and exterior finishes.

It should be noted that prior to the commencement of fill operations and/or utilization of off-site borrow materials, the Geotechnical Engineer of Record should be provided with representative samples to determine the material’s suitability for use in a controlled compacted fill and to develop moisture-density relationships. To expedite the earthwork operations, if off-site borrow materials are required, it is recommended they consist of suitable fill materials in accordance with the recommendations previously outlined in this section. If frost susceptible soils are imported to the project site, the frost susceptible soils should not be placed within 3½ feet of final site grades in unheated areas.

Fill materials should not be placed on frozen soils or frost-heaved soils and/or soils that have been recently subjected to precipitation. All frozen soils should be removed prior to continuation of fill operations. Borrow fill materials, if required, should not contain frozen materials at the time of placement. All frost-heaved soils should be removed prior to placement of controlled, compacted fill, granular subbase materials, and foundation or slab concrete.

Foundation Recommendations

Supporting the new additions on shallow foundations and slabs-on-grade directly on or over existing undocumented fill requires the client to assume risk of post-construction total and differential settlement. The risks associated with supporting shallow foundations and slabs-on-grade on the existing fill, can essentially be eliminated by removing and replacing the undocumented fill.

Shallow Foundations - Design Bearing Pressure Considerations

We recommend that the new structure be supported on shallow foundations extending through the existing fill (i.e., below the existing fill depths) and the foundations can designed for a maximum net allowable soil bearing pressure of 5,000 psf. The proposed building can be supported on a shallow foundation system (i.e., wall and spread footings) bearing in competent natural soils or new granular engineered fill/lean concrete overlying competent natural soils. At some locations, existing fill soils will need to be removed as deep as 7½ feet below the existing grade. A shallow foundation system bearing in the competent natural soils or new granular engineered fill/lean concrete overlying competent natural Silty CLAY soils can be designed for a maximum allowable soil bearing pressure of 5,000 psf. Competent soils can be identified on the boring log as natural Silty CLAY (2½ tsf or greater).

Shallow Foundations – Construction Considerations

If the client elects to leave or a portion of the existing fill in-place for slab support, some unsatisfactory bearing materials (i.e. heavily organic laden soil, debris laden soils, etc.) will likely be encountered at the proposed bearing elevation. If such materials are encountered, the foundation excavation should extend until suitable bearing soils are encountered. The over-excavated volume should be replaced with compacted granular engineered fill. If granular engineered fill is utilized (i.e., CA-6), the engineered fill should be compacted to a minimum of 95 percent of the maximum dry density in accordance with modified Proctor method, ASTM D 1557. The zone of the engineered fill placed below the foundations should extend 1 foot beyond the outside edges of the footings and from that point, outward laterally 1 foot for every 2 feet of fill thickness below the foundation. If lean concrete is utilized, lateral over-excavation is not required, but the lean concrete should extend 6 inches beyond the outside edges of the footing.

Regardless of the client's decision to remove and replace the existing fill, we recommend that all foundation excavations be monitored full-time by an ECS Geotechnical Engineer or his representative to verify that soils suitable for the design bearing pressure are encountered. ECS also recommends that DCP tests, hand auger or other suitable tests are performed at the foundation subgrades to verify that the exposed bearing soils are suitable and consistent for the final design bearing pressure.

To help reduce the potential for foundation bearing failure and excessive settlement due to local shear or "punching" action, we recommend that continuous footings have a minimum width of 18 inches and that isolated column footings have a minimum lateral dimension of 30 inches. In addition, footings should be placed at a depth to provide adequate frost cover protection. For this region, we recommend the exterior footings and footings beneath unheated areas be placed at a minimum depth of 3½ feet below finished grade. The interior footings in heated areas can be placed at a minimum of 2 feet below grade provided that suitable soils are encountered and that the foundations will not be subjected to freezing weather either during or after construction.

Settlement of individual footings, designed in accordance with our recommendations presented in this report, is expected to be within tolerable limits for the proposed buildings. For footings placed on suitable natural soils, or properly compacted granular engineered fill overlaying suitable natural soils, maximum total settlement is expected to be in the range of 1 inch or less. Maximum differential settlement between adjacent columns is expected to be in the range of ½ inch. These settlement values are based on our engineering experience with the soil and the anticipated structural loading, and are to guide the structural engineer with his design.

Slabs-On-Grade

Provided the recommendations of this report are strictly followed, thickness of conventional slabs-on-grade can be determined utilizing an assumed modulus of subgrade reaction of 150 pounds per cubic inch (pci) if the existing fill soils are completely removed and replaced with engineered fill or ground improvement is implemented. If the client elects to partially undercut and replace the existing fill with new engineered fill to a depth of at least 2 feet, a modulus of subgrade reaction of 100 pci may be used. A modulus of subgrade reaction of 75 pci is appropriate for supporting the slab on existing fill determined to be unyielding during proofrolling. Regardless, the slabs-on-grade should not be thinner than 5 inches or as determined by the structural engineer.

We also recommend consideration be given to the floor slab being underlain by a minimum of 6 inches of granular material having a maximum aggregate size of 1½ inches and no more than 2 percent soil passing the No. 200 sieve. This granular layer will facilitate the fine grading of the subgrade and help prevent the rise of water through the floor slab. Prior to placing the granular material, the floor subgrade should be free of standing water, mud, and frozen soil. Before the placement of concrete, a vapor barrier may be placed on top of the granular material to provide additional moisture protection. Welded-wire mesh reinforcement should be placed in the upper half of the floor slab and attention should be given to the surface curing of the slab to minimize uneven drying of the slab and associated cracking and/or slab curling. The use of a blotter or cushion layer above the vapor retarder can also be considered for project specific reasons. Please refer to ACI 302.1R04 *Guide for Concrete Floor and Slab Construction* and ASTM E 1643 *Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs* for additional guidance on this issue.

We recommend that the floor slab be isolated from the foundation footings so differential settlement of the structure will not induce shear stresses on the floor slab. For maximum effectiveness, temperature and shrinkage reinforcements in slabs on ground should be positioned in the upper third of the slab thickness. The Wire Reinforcement Institute recommends the mesh reinforcement be placed 2 inches below the slab surface or upper one-third of slab thickness, whichever is closer to the surface. Adequate construction joints, contraction joints and isolation joints should also be provided in the slab to reduce the impacts of cracking and shrinkage. Please refer to ACI 302.1R04 *Guide for Concrete Floor and Slab Construction* for additional information regarding concrete slab joint design.

Underslab Drainage

Based on the groundwater levels observed during the subsurface exploration, we do not anticipate a significant volume of water will persist near the slab subgrade elevation. Consequently, a permanent underslab drainage system does not appear necessary.

However, it should be noted that surface runoff and limited groundwater seepage may accumulate at the slab subgrade such as a perched water condition. As such, we recommend that positive drainage be implemented around the perimeter of the proposed building to help reduce the potential for water accumulation under the floor slab and foundation elements, which could potentially weaken the bearing soils. The contractor shall be responsible for providing adequate surface water drainage throughout construction.

Lateral Earth Pressure Considerations

For the design of earth retaining walls, the equivalent fluid pressure distributions presented below can be used to determine lateral earth pressure loads imposed on the walls. Please note that the values presented below are for granular soils as backfill soils. Clays should not be utilized behind below-grade or retaining walls.

Soil Parameter	Equivalent Fluid Pressure for Granular Soils
“At Rest” Earth Pressure (K_o)	65 pcf
“Active” Earth Pressure (K_a)	45 pcf
“Passive” Earth Pressure (K_p)	320 pcf

The lateral earth pressure values presented in the proceeding table assume level backfill fill in behind the wall, and do not account for hydrostatic pressures against the walls or surcharge loads, including the building to the west.

Resistance to sliding can be provided by friction between the bottom of the wall foundation and the underlying soils and by passive resistance of soil adjacent to the wall foundation. The passive resistance should only be used in situations where the soil adjacent to the toe of the wall will not be eroded or otherwise removed in the future. A coefficient of friction of 0.35 for concrete bearing on approved soils is recommended.

Irrespective of the retaining wall system chosen, the design of the new retaining walls that will retain compacted earth should consider their global stability. We recommend that the global factor of safety should be at least 1.5. Other factors of safety shall be as follows:

Factor of Safety against Sliding > 1.5
Factor of Safety against Overturning > 2.0
Factor of Safety against Bearing Capacity Failure > 2.0

Drainage behind earth retaining walls is essential towards relieving hydrostatic pressures. Drainage behind conventional poured in-place concrete retaining walls can be established by providing a perimeter drainage system located just above the below grade/retaining wall footings which discharges by gravity flow to a suitable outlet. The space between the interior face of the wall and the earth fill should be backfilled with a open-graded aggregate extending from the perimeter drainage system to just below the top of the wall. To prevent frost heave effects from acting against these walls, the granular backfill should extend a minimum of 24 horizontal inches behind the wall. The granular backfill should be covered with impermeable materials to help minimize the seepage of water into that backfill from the surface. As an alternative to the recommended granular porous fill backfill, a suitable fabricated drainage board could be utilized on the rear face of poured in-place concrete retaining walls. These materials should be covered with a filter fabric having an equivalent opening size (EOS) consistent with the size of the soil to be retained. The material should be placed in accordance with the manufacturer’s recommendations and connected to a perimeter drainage system, which in turn should be routed to properly drain.

Pavement Design Recommendations

Prepared in strict accordance with recommendations of this report, we recommend the following minimum pavement sections. The minimum pavement sections were developed based on assumed traffic conditions and an IBR of 3 for the subgrade soils.

Table 1: Pavement Section Recommendations

Pavement Material	Compacted Material Thicknesses (Inches)		
	Flexible Pavement (Light Duty)	Flexible Pavement (Heavy Duty)	Rigid Pavement (Standard)
Portland Cement Concrete	--	--	6
Bituminous Surface Course	1½	1½	--
Bituminous Base Course	2	3	--
Crushed Granular Subbase	8	12	8
Total Pavement Section Thickness	11½	16½	14

All pavement materials and construction should be in accordance with the Guidelines for AASHTO Pavement Design and IDOT Standard Specifications for Road and Bridge Construction.

The pavement sections specified in the table above are general pavement recommendations based on the anticipated usage at the project site and were not developed based on specific traffic patterns/loading and resiliency factors, as those parameters were not provided by the design team. We recommend the project team provide ECS with design traffic loads so that we can verify the recommendations detailed herein are appropriate for the anticipated traffic loads. The table above provides “Light Duty” and “Heavy Duty” flexible and “Standard” rigid pavement recommendations. The light-duty pavement section assumes that typical traffic loading will be limited to standard automobiles and does not account for more heavily loaded vehicles (i.e., garbage and delivery trucks) and should be used for parking lanes. The "Heavy-Duty" pavement section is recommended for pavements to be subjected with frequent traffic such as drive lanes (especially at the entries and exits), delivery areas and points of ingress/egress. The rigid pavement section could be considered for loading areas and dumpster enclosure areas (if applicable).

It should also be noted that the pavement sections specified in the table above were developed for the anticipated in-service traffic conditions only and do not provide an allowance for construction traffic conditions or traffic conditions in excess of typical residential/collector street traffic. Therefore, if pavements will be constructed early during site development to accommodate construction traffic, consideration should be given to the construction of designated haul roads, where thickened pavement sections can be provided to accommodate the construction traffic, as well as the future in-service traffic. ECS can provide additional design assistance with pavement sections for haul roads upon request.

We recommend the crushed granular base course should be compacted to at least 95 percent of the maximum dry density obtained in accordance with ASTM D1557, modified Proctor method. During asphalt pavement construction, the wearing and leveling course should be compacted to a minimum of 93 percent of the theoretical density value. Prior to placing the granular material, the pavement subgrade soil should be properly compacted, observed to be stable during a final proofroll and free of standing water, mud, and frozen soil.

Adequate construction joints, contraction joints and isolation joints should be provided in the areas of rigid pavement to reduce the impacts of cracking and shrinkage. Please refer to ACI 330R-92 *Guide for Design of Concrete Parking Lots*. The Guide recommends an appropriate spacing strategy for the anticipated loads and pavement thickness. It has been our experience that joint spacing closer to the minimum values results in a pavement with less cracking and better long term performance.

The pavements should be designed and constructed with adequate surface and subsurface drainage. Good drainage should help minimize the possibility of the subgrade materials beneath the pavement becoming saturated over a long period of time. Infiltration and subterranean water are the two sources of water that should be considered in the pavement design for the project. Infiltration is surface water that enters the pavement through the joints, pores, cracks in the pavement and through shoulders and adjacent areas pavements as a result of precipitation. Subterranean water is a source of water from a high water table on the site. The long term groundwater level on the site is estimated to be located approximately 12 to 16 feet below existing site grades. Therefore, infiltration is the most important source of water to be considered for this project.

Pavement Maintenance

Regular maintenance and occasional repairs should be implemented to keep pavements in a serviceable condition. In addition, to help minimize water infiltration to the pavement section and within the base course layer resulting in softening of the subgrade and premature deterioration of the pavement, we recommend the timely sealing of joints and cracks using elastomeric caulk.

We recommend exterior pavements should be reviewed for distress/cracks twice a year, once in the spring and once in the fall.

Sound maintenance programs should help maintain and enhance the performance of pavements and attain the design service life. A preventative maintenance program should be implemented early in the pavement life to be effective. The “standard in the industry” supported by research indicates that preventative maintenance should begin within 2 to 5 years of the construction of the pavement. Failure to perform preventative maintenance will reduce the service life of the pavement and increase the costs for both corrective maintenance and full pavement rehabilitation.

Adjacent Construction and Monitoring

Extreme care must be taken during earthwork and foundation activities adjacent to existing structures. Vibratory compaction equipment can cause interior and exterior building finishes to crack. Mass or localized undercutting adjacent to existing structures may undermine existing foundations and slabs. Excavation below existing foundations and slabs shall consider appropriate preventative measures, such as shoring and underpinning to help prevent loss of subgrade support. **In no case shall excavations extend below adjacent foundations and slabs unless underpinning or other forms of engineered support are provided.**

PROJECT CONSTRUCTION RECOMMENDATIONS

General Construction Considerations

We recommend that the subgrade preparation, fill placement, installation of the foundations, and construction of slabs be monitored by an ECS geotechnical engineer or his representative. Methods of verification and identification such as proofrolling, DCP testing, vane shear tests, and hand auger probe holes will be necessary to further evaluate the subgrade soils and help identify unsuitable soils. The contractor should be prepared to over-excavate footing, slab-on-grade and pavement subgrades at isolated locations (as necessary). We recommend that excavations of new foundations be monitored on a full-time basis by an ECS geotechnical engineer or his representative to verify that the soil bearing pressure and the exposed subgrade materials will be suitable for the proposed structure and are consistent with the boring log information obtained during this geotechnical exploration. We would be pleased to provide these services.

Foundation Subgrade

If unsuitable bearing soils are encountered at the proposed bearing elevation, the footings should extend until suitable bearing soils are encountered or the unsuitable soils should be removed beneath the base of the footing and replaced with compacted granular engineered fill. If granular engineered fill is utilized (i.e., CA-6), the engineered fill should be compacted to a minimum of 95 percent of the maximum dry density in accordance with modified Proctor method, ASTM D 1557. The zone of the engineered fill placed below the foundations should extend 1 foot beyond the outside edges of the footings and from that point, outward laterally 1 foot for every 2 feet of fill thickness below the foundation. Undercutting of the unsuitable foundation subgrades adjacent to the existing building must be performed with extreme care so not to undermine adjacent construction. We recommend that the excavation/backfill of building foundations be monitored full-time by an ECS Geotechnical Engineer or his representative to verify that the soil bearing pressure is consistent with the boring log information obtained during the geotechnical exploration.

Construction Dewatering

Based on the subsurface information obtained from the borings and our understanding of the proposed construction, dewatering efforts during construction should be minimal unless rainfall or snow melt becomes excessive. We believe the use of gravity flow ditches and sump pumps should be adequate to maintain a dry excavation during excavation and construction. The sump pits should be located around the perimeter of the excavations.

Exposure to the environment may weaken the soils within excavations if the excavations remain open for too long a period. If the subgrade soils are softened by surface water intrusion or exposure, the softened soils must be removed from the excavation bottom immediately prior to placement of concrete or engineered fill.

Closing

This report has been prepared to aid in the evaluation of this property and to assist the architect and/or engineer in the design of this project. The scope is limited to the specific project and locations described herein and our description of the project represents our understanding of the significant aspects relative to soil and foundation characteristics. In the event that any change in the nature or location of the proposed construction outlined in this report are planned, we should be informed so that the changes can be reviewed and the conclusions of this report modified or approved in writing by the geotechnical engineer. It is recommended that all construction operations dealing with earthwork, slab-on-grade and foundations be reviewed by an experienced geotechnical engineer to provide information on which to base a decision as to whether the design requirements are fulfilled in the actual construction. If you wish, we would welcome the opportunity to provide field construction services for you during construction.

The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings and tests performed at the locations as indicated on the Boring Location Plan and other information referenced in this report. This report does not reflect variations, which may occur between the borings. In the performance of the subsurface exploration, specific information is obtained at specific locations at specific times. However, it is a well known fact that variations in soil conditions exist on most sites between boring locations and also such situations as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, after performing on-site observations during the construction period and noting characteristics and variations, a reevaluation of the recommendations for this report will be necessary.

In addition to geotechnical engineering services, ECS Midwest, LLC has the in-house capability to perform multiple additional services as this project moves forward. These services include the following:

- Environmental Consulting;
- Project Drawing and Specification Review; and,
- Construction Material Testing / Special Inspections

We would be pleased to provide these services for you. If you have questions with regard to this information or need further assistance during the design and construction of the project please feel free to contact us.

APPENDIX

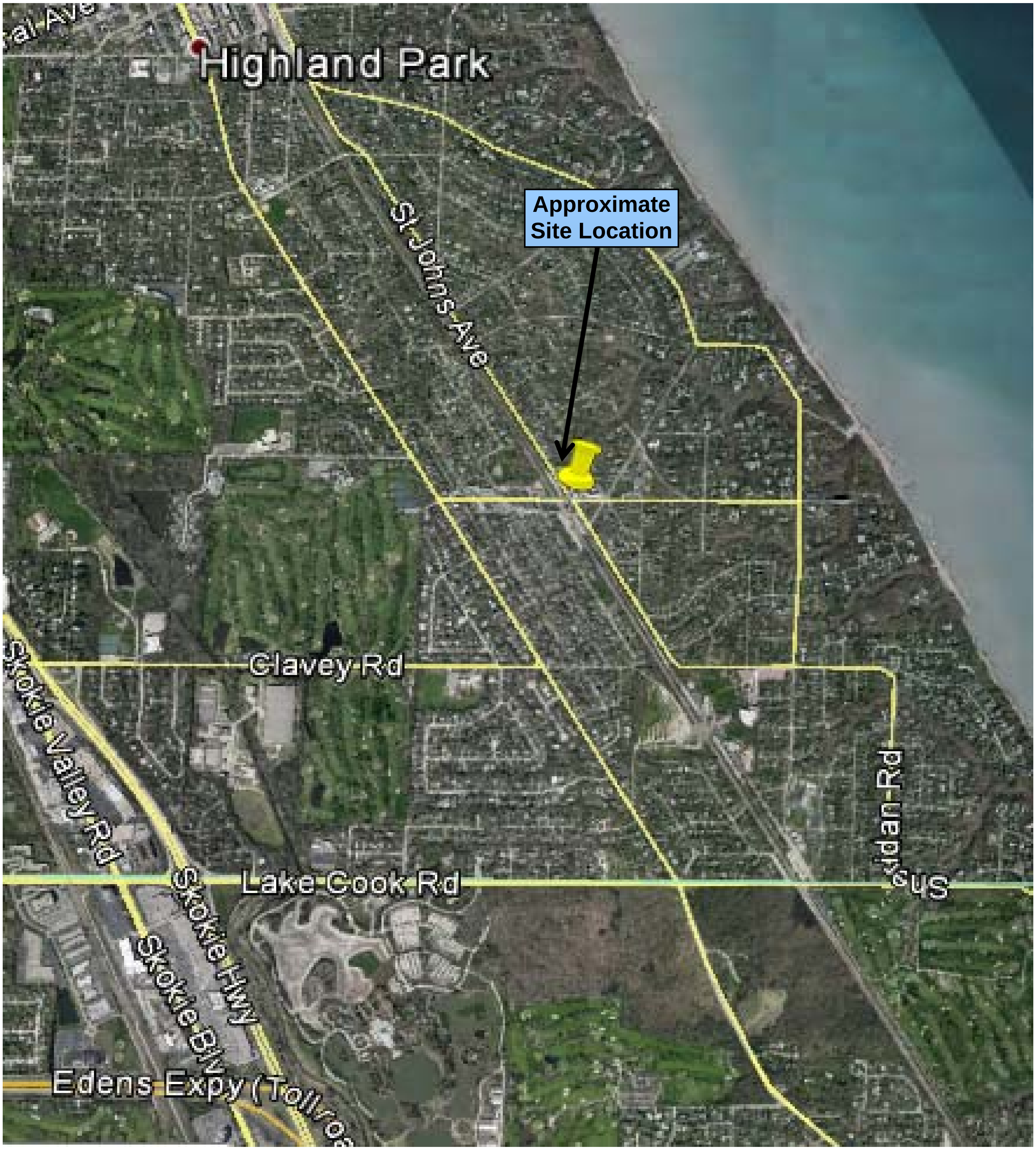
General Location Plan

Boring Location Plan

Boring Logs

Unified Soil Classification System

Reference Notes for Boring Logs



GENERAL LOCATION PLAN

ECS PROJECT NO. 16:10424
HIGHLAND PARK MIXED-USE DEVELOPMENT
515 ROGER WILLIAMS AVE
HIGHLAND PARK, ILLINOIS

⊕ APPROXIMATE SOIL BORING LOCATION

BORING LOCATION DIAGRAM

Highland Park Mixed-Use Development

Fitzgerald Associates Architects

ENGINEER MTB	SCALE NTS
DRAFTING LGM	PROJECT NO. 10434
REVISIONS	SHEET FIGURE 2
	DATE 12/18/14

CLIENT Fitzergald Assocates Architects	JOB # 10434	BORING # B-1	SHEET 1 OF 1	
PROJECT NAME Highland Park Mixed-Use Development	ARCHITECT-ENGINEER			
SITE LOCATION 515 Roger Williams Avenue, Highland Park, Illinois				
NORTHING	EASTING	STATION		

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% ✕ — WATER CONTENT% ● — LIQUID LIMIT% △

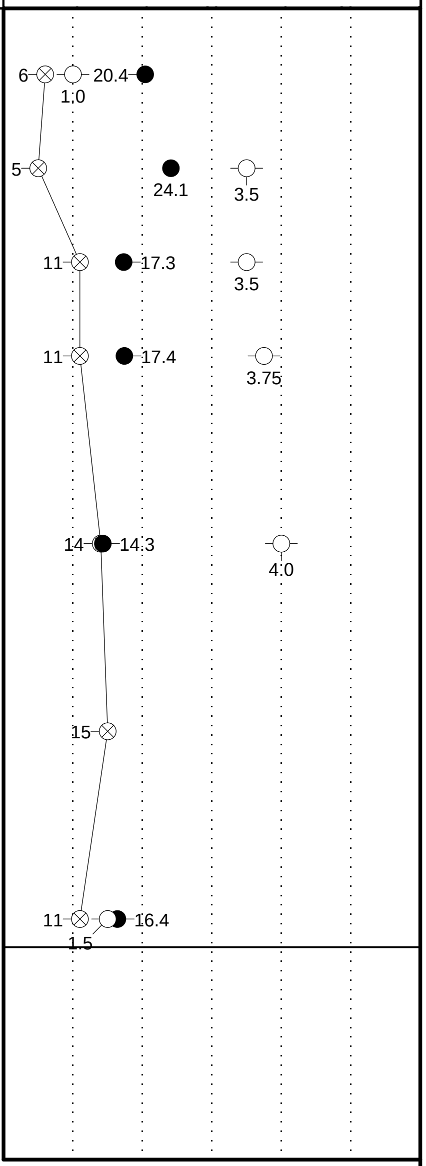
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 672

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Bituminous Pavement Depth [3"], Gravel Depth [5"]			
	S-1	SS	18	12	(CL/ML FILL) SILTY CLAY, Trace Sand, Trace Gravel, Dark Gray, Moist, Stiff		670	4 2 4
	S-2	SS	18	18	(CL/ML) SILTY CLAY, Trace Sand, Trace Gravel, Light Brown Transitioning to Gray at Approximately 12 Feet, Moist, Very Stiff to Hard A larger quantity of sand is present in the sample taken between 5½ and 8 feet			2 2 3
5								
	S-3	SS	18	18			665	5 5 6
	S-4	SS	18	18				4 5 6
10								
							660	
	S-5	SS	18	18				4 6 8
15								
					(SC) CLAYEY SAND WITH GRAVEL, Trace Silt, Gray, Wet, Medium Dense		655	
						▼		
	S-6	SS	18	14				6 7 8
20								
					(CL/ML) SILTY CLAY, Trace Sand, Trace Gravel, Brownish Gray, Moist, Stiff		650	
	S-7	SS	18	14				3 5 6
25					END OF BORING @ 25'			
							645	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 18' WS ☐ WD ☐	BORING STARTED 12/15/14	
WL(BCR) WL(ACR) 18½'	BORING COMPLETED 12/15/14	CAVE IN DEPTH @ 19½'
WL	RIG CME-45 FOREMAN Euker S.	DRILLING METHOD CFA

CLIENT	JOB #	BORING #	SHEET
Fitzergald Assocates Architects	10434	B-2	1 OF 1

PROJECT NAME: Highland Park Mixed-Use Development

ARCHITECT-ENGINEER:

SITE LOCATION: 515 Roger Williams Avenue, Highland Park, Illinois

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY

RQD% – — –   REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

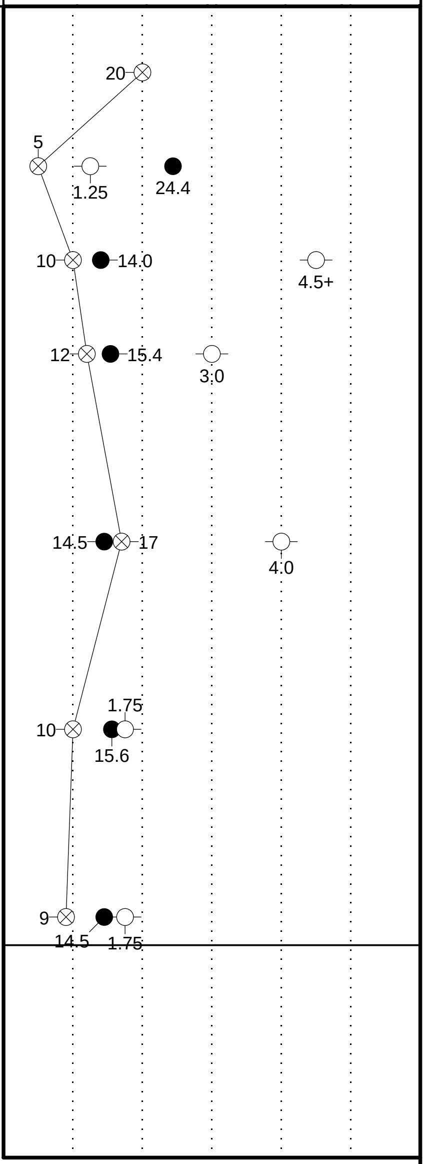
DESCRIPTION OF MATERIAL   ENGLISH UNITS

BOTTOM OF CASING   LOSS OF CIRCULATION

SURFACE ELEVATION 672

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	BLOWS/6"
0					Bituminous Pavement Depth [1"], Concrete Depth [6"], Gravel Depth [4"]	
	S-1	SS	18	12	(CL/ML FILL) SILTY CLAY, Dark Gray and Gray, Moist, Stiff Mild Petro Chemical Odor at Sample S-2	5 15 5
	S-2	SS	18	14		1 2 3
5						
	S-3	SS	18	18	(CL/ML) SILTY CLAY, Trace Sand, Trace Gravel, Light Brown Transitioning to Gray at Approximately 12 Feet, Moist, Hard to Stiff	3 4 6
	S-4	SS	18	18		4 5 7
10						
	S-5	SS	18	12		4 7 10
15						
	S-6	SS	18	18		3 5 5
20						
	S-7	SS	18	14		3 4 5
25					END OF BORING @ 25'	
30						

WATER LEVELS   ELEVATION (FT): 670, 665, 660, 655, 650, 645



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL 18½' WS ☐ WD ☐	BORING STARTED 12/15/14	
WL(BCR) WL(ACR) 23'	BORING COMPLETED 12/15/14	CAVE IN DEPTH
WL	RIG CME-45 FOREMAN Euker S.	DRILLING METHOD CFA

CLIENT	JOB #	BORING #	SHEET
Fitzergald Assocates Architects	10434	B-3	1 OF 1

PROJECT NAME
Highland Park Mixed-Use Development

ARCHITECT-ENGINEER

SITE LOCATION
515 Roger Williams Avenue, Highland Park, Illinois

NORTHING
EASTING
STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% ✕ — WATER CONTENT% ● — LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤   LOSS OF CIRCULATION ⟩100%⟩

SURFACE ELEVATION 674

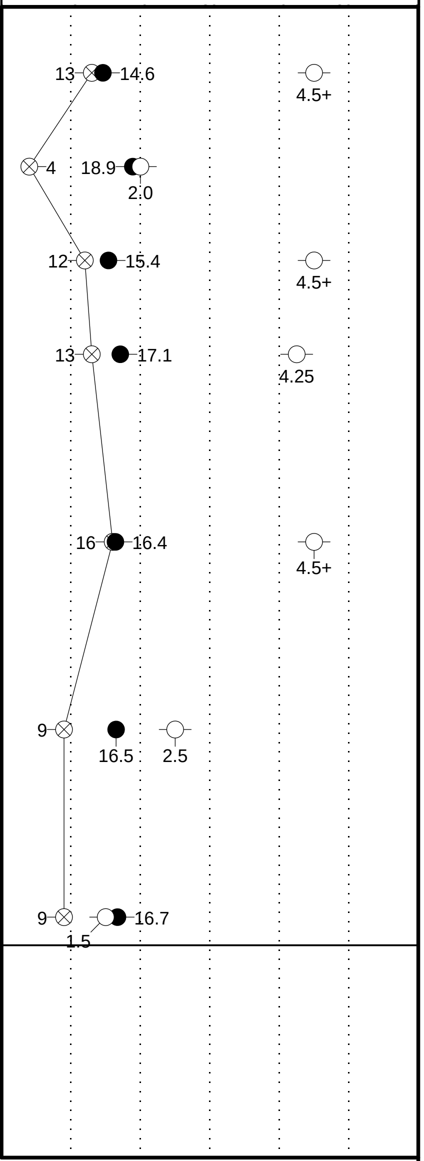
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	ELEVATION (FT)	BLOWS/6"
0						
	S-1	SS	18	18		5 6 7
	S-2	SS	18	16	670	2 2 2
5						
	S-3	SS	18	18		5 5 7
	S-4	SS	18	18	665	4 6 7
10						
	S-5	SS	18	18	660	6 7 9
15						
	S-6	SS	18	18	655	4 4 5
20						
	S-7	SS	18	18	650	3 4 5
25						
					645	
30						

Bituminous Pavement Depth [4"], Gravel Depth [10"]

(CL/ML FILL) SILTY CLAY, With Topsoil, Trace Sand, Trace Gravel, Gray to Brown, Moist, Hard to Very Stiff

(CL/ML) SILTY CLAY, Trace Sand, Trace Gravel, Light Brown Transitioning to Gray at Approximately 16 Feet, Moist, Hard to Stiff

END OF BORING @ 25'



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL WS ☐ WD ☐	BORING STARTED 12/15/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/15/14	CAVE IN DEPTH
WL	RIG CME-45 FOREMAN Euker S.	DRILLING METHOD CFA

CLIENT: Fitzergald Assocates Architects
JOB #: 10434
BORING #: B-4
SHEET: 1 OF 1
PROJECT NAME: Highland Park Mixed-Use Development
ARCHITECT-ENGINEER:
SITE LOCATION: 515 Roger Williams Avenue, Highland Park, Illinois
NORTHING:
EASTING:
STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING — LOSS OF CIRCULATION 100%
SURFACE ELEVATION 673

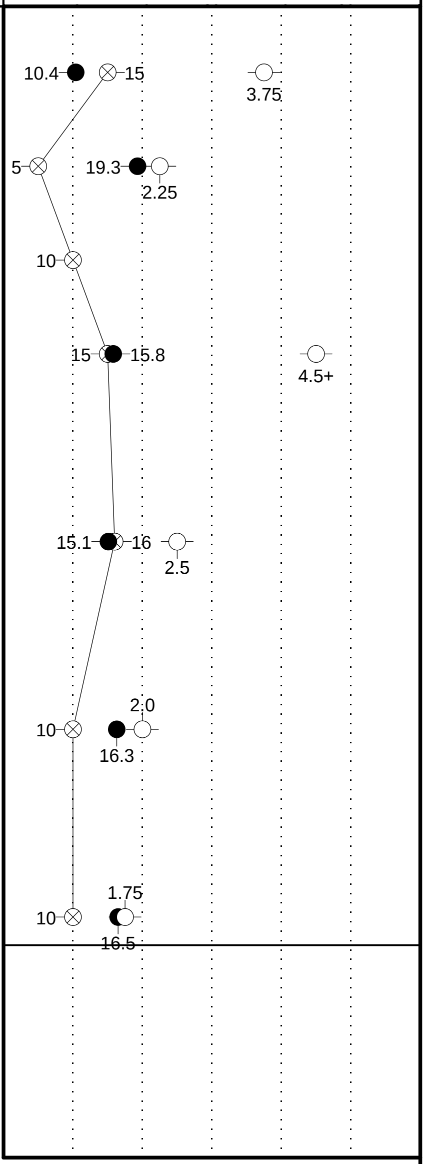
-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — —   REC% ———

PLASTIC LIMIT% ×   WATER CONTENT% ●   LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Bituminous Pavement Depth [3"], Gravel Depth [5"]			
	S-1	SS	18	12	(CL/ML FILL) SILTY CLAY, With Construction Debris, Trace Sand, Trace Gravel, Dark Gray and Light Gray, Moist, Very Stiff		670	6 6 9
5	S-2	SS	18	10	Mild Petro Chemical Odor at Sample S-3			2 2 3
	S-3	SS	18	18				3 3 7
10	S-4	SS	18	18	(CL/ML) SILTY CLAY, Trace Sand, Trace Gravel, Light Brown Transitioning to Gray at Approximately 12 Feet, Moist, Hard to Stiff		665	6 7 8
15	S-5	SS	18	18			660	7 8 8
20	S-6	SS	18	18			655	3 5 5
25	S-7	SS	18	18		∇	650	3 5 5
30					END OF BORING @ 25.00'		645	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

∇ WL 22½' WS ☐ WD ☐	BORING STARTED 12/15/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/15/14	CAVE IN DEPTH
WL	RIG CME-45 FOREMAN Euker S.	DRILLING METHOD CFA

CLIENT	JOB #	BORING #	SHEET
Fitzergald Assocates Architects	10434	B-5	1 OF 1

PROJECT NAME: Highland Park Mixed-Use Development

ARCHITECT-ENGINEER:

SITE LOCATION: 515 Roger Williams Avenue, Highland Park, Illinois

NORTHING:
EASTING:
STATION:

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 672

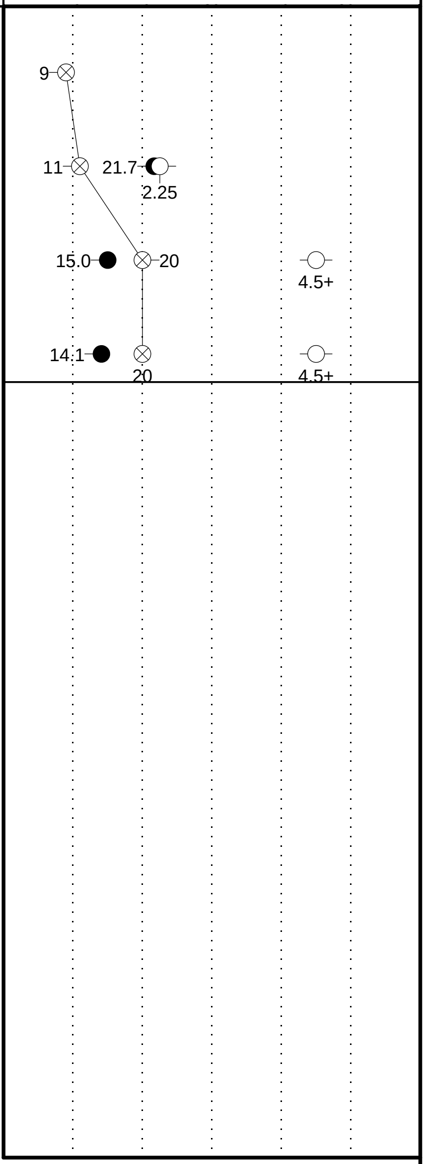
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Concrete Depth [6"], Gravel Depth [5"]			
	S-1	SS	18	8	(CL/ML FILL) SILTY CLAY FILL, Trace Sand, Trace Gravel, Trace Silt, Gray, Moist		670	6 5 4
	S-2	SS	18	0	(CL/ML) SILTY CLAY, Trace Sand, Trace Gravel, Grayish Brown to Light Brown, Moist, Very Stiff to Hard			4 5 6
5								
	S-3	SS	18	18			665	6 9 11
	S-4	SS	18	18				6 8 12
10					END OF BORING @ 10'			
							660	
15								
							655	
20								
							650	
25								
							645	
30								

○ CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL WS ☐ WD ☐	BORING STARTED 12/15/14	
WL(BCR) WL(ACR)	BORING COMPLETED 12/15/14	CAVE IN DEPTH
WL	RIG CME-45 FOREMAN Euker S.	DRILLING METHOD CFA

CLIENT
Fitzergald Assocates Architects

JOB #
10434

BORING #
B-6

SHEET
1 OF 1

PROJECT NAME
Highland Park Mixed-Use Development

ARCHITECT-ENGINEER

SITE LOCATION
515 Roger Williams Avenue, Highland Park, Illinois

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING LOSS OF CIRCULATION

SURFACE ELEVATION 673

SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	BLOWS/6"
S-1	SS	18	18	2 3 3
S-2	SS	18	18	2 3 4
S-3	SS	18	18	6 7 11
S-4	SS	18	18	5 7 11

Bituminous Pavement Depth [3"], Gravel Depth [9"]

(CL/ML FILL) SILTY CLAY, Trace Gravel, Trace Sand, Gray, Moist, Stiff

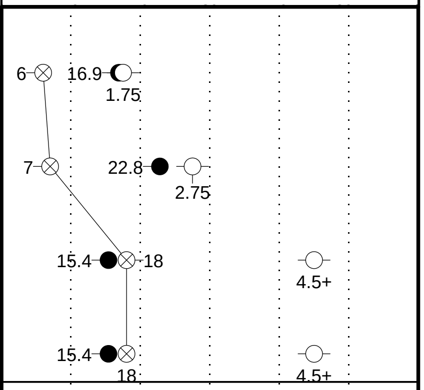
(CL/ML) SILTY CLAY, Trace Sand, Trace Gravel, Light Brown and Light Gray, Moist, Very Stiff to Hard

END OF BORING @ 10'

DEPTH (FT): 0, 5, 10, 15, 20, 25, 30

ELEVATION (FT): 670, 665, 660, 655, 650, 645

WATER LEVELS



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

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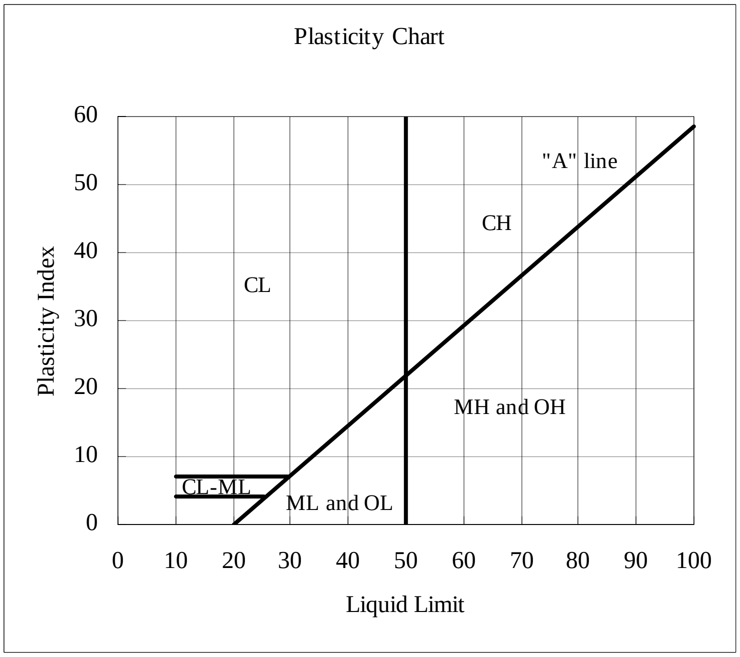
WL(BCR) WL(ACR)	BORING COMPLETED 12/15/14	CAVE IN DEPTH
WL	RIG CME-45 FOREMAN Euker S.	DRILLING METHOD CFA

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

Major Divisions			Group Symbols		Typical Names	Laboratory Classification Criteria		
Coarse-grained soils (More than half of material is larger than No. 200 Sieve size)	Gravels (More than half of coarse fraction is larger than No. 4 sieve size)	Clean gravels (Little or no fines)	GW		Well-graded gravels, gravel-sand mixtures, little or no fines	Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent GW, GP, SW, SP More than 12 percent GM, GC, SM, SC 5 to 12 percent Borderline cases requiring dual symbols [b]	$C_u = D_{60}/D_{10}$ greater than 4 $C_c = (D_{30})^2/(D_{10} x D_{60})$ between 1 and 3	
			GP		Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW	
		Gravels with fines (Appreciable amount of fines)	GM[a]	d	Silty gravels, gravel-sand mixtures		Atterberg limits below “A” line or P.I. less than 4	Above “A” line with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			GC		Clayey gravels, gravel-sand-clay mixtures		Atterberg limits below “A” line or P.I. less than 7	
	Sands (More than half of coarse fraction is smaller than No. 4 sieve size)	Clean sands (Little or no fines)	SW		Well-graded sands, gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ greater than 6 $C_c = (D_{30})^2/(D_{10} x D_{60})$ between 1 and 3	
			SP		Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW	
		Sands with fines (Appreciable amount of fines)	SM[a]	d	Silty sands, sand-silt mixtures		Atterberg limits above “A” line or P.I. less than 4	Limits plotting in CL-ML zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols
				u				
			SC		Clayey sands, sand-clay mixtures		Atterberg limits above “A” line with P.I. greater than 7	
Fine-grained soils (More than half material is smaller than No. 200 Sieve)	Silts and clays (Liquid limit less than 50)		ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity			
			CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL		Organic silts and organic silty clays of low plasticity			
	Silts and clays (Liquid limit greater than 50)		MH		Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH		Inorganic clays of high plasticity, fat clays			
			OH		Organic clays of medium to high plasticity, organic silts			
	Highly Organic soils		Pt		Peat and other highly organic soils			

[a] Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u used when L.L. is greater than 28.

[b] Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC,well-graded gravel-sand mixture with clay binder. (From Table 2.16 - Winterkorn and Fang, 1975)

REFERENCE NOTES FOR BORING LOGS

MATERIALS

■	**ASPHALT**	
░	**CONCRETE**	
☷	**SUBBASE STONE / GRAVEL**	
▩	**TOPSOIL**	
░	**FILL**	Man-placed or disturbed soils
▓	**GW**	**WELL-GRADED GRAVEL** gravel-sand mixtures, little or no fines
○	**GP**	**POORLY-GRADED GRAVEL** gravel-sand mixtures, little or no fines
▦	**GM**	**SILTY GRAVEL** gravel-sand-silt mixtures
▧	**GC**	**CLAYEY GRAVEL** gravel-sand-clay mixtures
▒	**SW**	**WELL-GRADED SAND** gravelly sand, little or no fines
⋯	**SP**	**POORLY-GRADED SAND** gravelly sand, little or no fines
⦙	**SM**	**SILTY SAND** sand-silt mixtures
▨	**SC**	**CLAYEY SAND** sand-clay mixtures
▥	**ML**	**SILT** non-plastic to medium plasticity
▥	**MH**	**ELASTIC SILT** high plasticity
▨	**CL**	**LEAN CLAY** low to medium plasticity
▨	**CH**	**FAT CLAY** high plasticity
▒	**OL**	**ORGANIC SILT or CLAY** non-plastic to low plasticity
×	**OH**	**ORGANIC SILT or CLAY** high plasticity
≈	**PT**	**PEAT** highly organic soils
▤	**WEATHERED ROCK**	
+	**IGNEOUS ROCK**	
≋	**METAMORPHIC ROCK**	
▦	**SEDIMENTARY ROCK**	

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12-inches (300-mm) or larger
Cobbles		3-inches to 12- inches (75-mm to 300-mm)
Gravel:	Coarse	¾-inch to 3-inches (19-mm to 75-mm)
	Fine	4.75-mm to 19-mm (No. 4 sieve to ¾-inch)
Sand:	Coarse	2.00-mm to 4.75-mm (No. 10 to No. 4 sieve)
	Medium	0.425-mm to 2.00-mm (No. 40 to No. 10 sieve)
	Fine	0.074-mm to 0.425-mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074-mm (smaller than a No. 200 sieve)

WATER LEVELS[1]

▽	WL	Water Level (WS)(WD) (WS) While Sampling (WD) While Drilling
▽	BCR	Before Casing Removal
▼	ACR	After Casing Removal
▽	WL	Water Level as stated
	DCI	Dry Cave-In
	WCI	Wet Cave-In

RELATIVE PROPORTIONS

Trace	<5%
Little	5% - <15%
With	15% - <30%
Adjective *(ex: "Silty")*	30% - <50%

COHESIVE SILTS & CLAYS

UNCONFINED COMP. STRENGTH, Q_P[2] (TSF)	SPT[3] (BPF)	CONSISTENCY (COHESIVE ONLY)
<0.25	≤2	Very Soft
0.25 - 0.49	3 - 4	Soft
0.50 - 0.99	5 - 8	Medium Stiff
1.00 - 1.99	9 - 15	Stiff
2.00 - 3.99	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[3] (BPF)	DENSITY
≤4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
51 - 99	Very Dense
≥100	Partially Weathered Rock to Intact Rock

[1] The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally taken.

[2] Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).

[3] Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2-inch OD split-spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).