REPORT OF PRELIMINARY GEOTECHNICAL ENGINEERING INVESTIGATION

FAIR OAKS SPORTS COLUMBUS
COLUMBUS, INDIANA

PREPARED FOR:

CITY OF COLUMBUS
123 WAHINGTON STREET
COLUMBUS, INDIANA 47201

Patriot Engineering and Environmental, Inc.
6150 East 75th Street
Indianapolis, Indiana 46250

November 10, 2021

PATRIOT ENGINEERING
and ENVIRONMENTAL, Inc.
Engineering Value for Project Success

November 10, 2021

Ms. Mary Ferdon
City of Columbus
123 Washington Street
Columbus, Indiana 47201

Re: Report of Preliminary Geotechnical Engineering Investigation
Fair Oaks Sports Columbus
2224 25th Street
Columbus, Indiana
Patriot Project No.: 21-1223-01G

Dear Mary:

Attached is the report of our preliminary geotechnical engineering investigation for the above referenced project. This investigation was completed in general accordance with our Proposal No. P21-1223-01G dated August 5, 2021.

This report includes graphic logs of three (3) soil borings drilled at the proposed project site. Also included in the report are the results of laboratory tests performed on samples obtained from the site, and geotechnical recommendations pertinent to the site development, foundation design, and construction.

We appreciate the opportunity to perform this geotechnical engineering investigation and are looking forward to working with you during the construction phase of the project. If you have any questions regarding this report or if we may be of any additional assistance regarding any geotechnical aspect of the project, please do not hesitate to contact our office.

Respectfully submitted,
Patriot Engineering and Environmental, Inc.

Ian Grafe William D. Dubois

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Geotechnical Engineer

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2224 25th Street
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1.0 INTRODUCTION

1.1 General

The city of Columbus is planning the construction of a new sports facility to be located at 2224 25th Street in Columbus, Indiana. The results of our geotechnical engineering investigation for the project are presented in this report.

1.2 Purpose and Scope

The purpose of this investigation is to determine the general near surface and subsurface conditions within the project area and to develop the geotechnical engineering recommendations necessary for the design and construction of the proposed structure. This was achieved by drilling soil borings, and by conducting laboratory tests on samples taken from the borings. This report contains the results of our findings, geotechnical engineering interpretation of these results with respect to the available project information, and recommendations to aid in the design and construction of the proposed facility.

2.0 PROJECT INFORMATION

The proposed project is located at 2224 25th Street in Columbus, Indiana. The project consists of a roughly 70-foot tall field house of slab-on-grade construction, approximately 600 feet by 250 feet in plan dimension, with adjacent parking and roadway areas.

Based on information provided by Perkins and Will, we understand that the proposed structure will have isolated column loads not exceeding 190 kips, uplift at isolated columns not exceeding 75 kips, and that floor loads will not exceed 150 pounds per square foot (psf). Additionally, based on visual observations of the existing site, it is assumed that any grade raise fill to complete the construction of building pads, finished pavement subgrades, etc., will not exceed 2 feet above the existing pavement surface.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Site Conditions

The project site is presently a parking lot north of the Fair Oaks Mall. A portion of the mall will be removed to make space for the sports complex, which will connect to the mall at two entrances. The surrounding area is generally an area of residential and commercial development. The topography in the area proposed for construction is generally flat.

3.2 General Subsurface Conditions

Our interpretation of the subsurface conditions is based upon three (3) soil borings drilled at the approximate locations shown on the Boring Location Map (Figure No. 2) in Appendix "A". All depths discussed below refer to depths below the existing pavement surface. Based on the results of the soil borings completed at the site, the following subsurface profile is presented. A description of each general soil unit has been identified and is described below:

Asphalt and Crushed Stone – A layer of asphalt pavement was encountered at the surface at the boring locations. The asphalt layer was about 4 to 5 inches thick in the borings. Below the asphalt layer, a layer of crushed stone was encountered in two (2) of the borings. The crushed stone layer was about 4 to 6 inches thick in the borings.

Clayey Sand (SC) – The pavement layer is generally underlain by very loose to loose clayey sand. The clayey sand encountered from 0 to 6 feet below existing grade. Standard Penetration Test N-values in this silty sand varied from 4 to 10 blows per foot (bpf).

Sand (SP-SM) – Beneath the clayey sand layer, loose to dense, sand was encountered to depths of 100 feet below existing grade. Standard Penetration Test N-values in this sand varied from 10 to 50 bpf.

Sandy Clay (CL) – Below the existing pavement in Boring B-3, a layer of stiff to very stiff sandy clay was encountered to a depth of 3.5 feet below the existing ground surface. The natural moisture content of this material was 12 percent (%). The sandy silty clay layer has unconfined compressive strengths, as determined by a hand penetrometer, of 2.75 tons per square foot (tsf). The Standard Penetration Test N-values (blow counts) in this material was 9 bpf.

The soil conditions described above are general, and some variations in the descriptions should be expected; for more specific information, please refer to the boring logs presented in Appendix “A”. It should be noted that the dashed stratification lines shown on the soil boring logs indicate approximate transitions between soil types. In-situ stratification changes could occur gradually or at different depths.

As previously mentioned, unsuitable very loose sands were encountered in Boring B-1, at depths up to 6 feet below the existing ground surface.

3.3 Groundwater Conditions

The term groundwater pertains to any water that percolates through the soil found on site. This includes any overland flow that permeates through a given depth of soil, perched water, and water that occurs below the “water table”, a zone that remains saturated and water-bearing year-round.

Groundwater was observed during drilling in all of the soil borings performed at the site at a depth of 18.5 feet below the existing pavement surface. Groundwater was not observed in the borings immediately after removing the augers from the borings. The borings caved to depths of 9.6 to 16 feet below the existing ground surface, which is above the groundwater levels encountered during drilling.

It should be recognized that fluctuations in the groundwater level should be expected over time due to variations in rainfall and other environmental or physical factors. ***The true static groundwater level can only be determined through observations made in cased holes over a long period of time, the installation of which was beyond the scope of this investigation.***

4.0 DESIGN RECOMMENDATIONS

4.1 Basis

Our recommendations are based on data presented in this report, which include soil borings, laboratory testing, and our experience with similar projects. Subsurface variations that may not be indicated by a dispersive exploratory boring program can exist on any site. If such variations or unexpected conditions are encountered during construction, or if the project information is incorrect or changed, we should be informed immediately since the validity of our recommendations may be affected.

4.2 Foundations - General

The soil borings at the site generally indicate that the site can be developed as planned, provided sound construction practices are followed and appropriate measures are taken to address soil and groundwater issues. However, only 3 widely spaced soil borings were performed at the site. Due to the preliminary nature of this geotechnical engineering investigation and widely spaced borings, further site structure specific soil borings should be performed to provide earth work and foundation design recommendations tailored to the actual structure location and loading conditions prior to construction. These additional borings are necessary to establish final design foundation depths and bearing pressures and should be taken to depths of 20 feet below the existing pavement surface. It is important to obtain an adequate coverage of borings for the final report. *Patriot* would be pleased to assist you in the planning and performance of this follow-up exploration phase and the development of a more project specific geotechnical engineering report.

4.3 Foundations

As previously mentioned, very loose clayey sand was encountered in Boring B-1 from a depth of about 3.5 to 6 feet below existing grade. ***If very loose sands, existing fill materials, or other unsuitable materials are encountered at the footing level or below, they must be undercut and replaced with well-compacted and tested structural fill prior to construction of foundations or the footings can be extended to suitable natural soils.*** Following the excavation of the footing areas, the foundations subgrade should be visually observed and probed by a *Patriot* representative at the direction of a geotechnical engineer at multiple locations at isolated footings and at every 10 feet (maximum) along wall footings to a depth of 3 to 5 feet. Any unsuitable soils encountered at the footing subgrade or below should be removed and replaced with well-compacted and tested structural fill.

Provided the above recommendations are followed, the proposed structure can be supported on spread footings bearing on the native undisturbed loose to medium dense sands or stiff to very stiff clays encountered at shallow depths or on new well-compacted and tested structural fill overlying the same. These footings should be proportioned using a net allowable soil bearing pressure ranging from 2,000 to 4,000 pounds per square foot (psf). For proper performance at the recommended design bearing pressure, foundations must be constructed in compliance with the recommendations for footing excavation inspection that are discussed in Section 5.0 *"Construction Considerations"*.

In using the above net allowable soil bearing pressures, the weight of the foundation and backfill over the foundation need not be considered. Hence, only loads applied at or above the minimum finished grade adjacent to the footing need to be used for dimensioning the foundations. Each new foundation should be positioned so it does not induce significant pressure on adjacent foundations; otherwise the stress overlap must be considered in the design.

All exterior foundations and foundations in unheated areas should be located at a depth of at least 24 inches below final exterior grade for frost protection. However, interior foundations in heated areas can bear at depths of approximately 18 inches below the finished floor. We recommend that wall (strip) footings be at least 18 inches wide and column footings be at least 24 inches wide for bearing capacity considerations.

We estimate that the total foundation settlement should not exceed approximately 1 inch and that differential settlement should not exceed about ¾ inch. Careful field control during construction is necessary to minimize the actual settlement that will occur.

Positive drainage of surface water, including downspout discharge, should be maintained away from structure foundations to avoid wetting and weakening of the foundation soils both <u>during</u> construction and <u>after</u> construction is complete.

Additionally, if uplift is the controlling factor for the design of the building, an intermediate foundation system, such as micropiles, may be used to help anchor the building. We understand that uplift forces on the building will be no greater than 75 kips at their highest, but that some portions of the building will experience greater uplift forces than downward forces. If the *Client* would like, we would be happy to help with the design of micropiles or other intermediate foundation systems; however, the structural engineer will need to evaluate uplift forces for the foundations.

4.4 Floor Slabs

The near surface or shallow subgrade soils encountered within the proposed building footprint generally consist of loose to medium dense sands, which, if properly prepared, are suitable for support of floor slabs. ***However, very loose sands were encountered in the area of Boring B-1. Very loose sands should be removed and replaced with well-compacted structural fill.***

We recommend that all floor slabs be designed as "floating", that is, fully ground supported and not structurally connected to walls or foundations. This is to minimize the possibility of cracking and displacement of the floor slabs because of differential movements between the slab and the foundation. Although the movements are estimated to be within the tolerable limits for the structural safety, such movements could be detrimental to the slabs if they were rigidly connected to the foundations. Additionally, we recommend that all slabs should be liberally jointed and designed with the appropriate reinforcement for the anticipated loading conditions.

The building floor slabs should be supported on a minimum 6 inch thick well-compacted granular base course (i.e. Indiana Department of Transportation (INDOT) No. 53 crushed stone) bearing on a suitably prepared subgrade (Refer to Section 5.0 *"Construction Considerations"*). The granular base course is expected to help distribute loads and equalize moisture conditions beneath the slab.

Provided that the recommendations above for floor slab design and construction are followed, a modulus of subgrade reaction, "K_{30}" value of 85 to 115 pounds per cubic inch (pci), is recommended for the design of ground supported floor slabs. It should be noted that the "K_{30}" modulus is based on a 30 inch diameter plate load empirical relationship.

4.5 Seismic Considerations

For structural design purposes, we recommend using a ***Site Classification of "D"*** as defined by the 2014 Indiana Building Code (modified 2012 International Building Code (IBC)). Furthermore, along with using a Site Classification of "D", we recommend the use of the maximum considered spectral response acceleration and design spectral response acceleration coefficients provided in Table No. 1 below. Refer to Appendix "B" for *"Seismic Site Class Evaluation"* report summary.

Table No. 1: Seismic Design Spectral Response Acceleration Coefficients

Period (seconds)	Maximum Considered Spectral Response Acceleration Coefficient	Soil Factor	Design Spectral Response Acceleration Coefficient
0.2	S_S = 0.171 g	1.60	S_{DS} = 0.182 g
1.0	S_1 = 0.092 g	2.40	S_{D1} = 0.147 g

These values were obtained from the *"Earthquake Ground Motion Parameters"* program for seismic design, developed by the United States Geological Survey (USGS) Earthquake Hazard Program, utilizing latitude 39.2255° (degree) north and longitude 85.8997° (degree) west as the designation for identifying the location of the parcel. Other earthquake resistant design parameters should be applied consistent with the minimum requirements of the 2014 Indiana Building Code.

4.6 Pavements

The near surface or shallow subgrade soils encountered within the proposed building footprint generally consist of loose to medium dense sands, which, if properly prepared, are suitable for support of pavements. ***However, very loose sands were encountered in the area of Boring B-1. Very loose sands should be removed and replaced with well-compacted structural fill.***

If construction is performed during a wet or cold period, the contractor will need to exercise care during the grading and fill placement activities in order to achieve the necessary subgrade soil support for the pavement section (Refer to Section 5.0 "Construction Considerations"). The base soil for the pavement section will need to be firm and dry. The subgrade should be sloped properly in order to provide good base drainage. To minimize the effects of groundwater or surface water conditions, the base section for the pavement system should be sufficiently high above adjacent ditches and properly graded to provide pavement surface and pavement base drainage.

As requested, *Patriot* is providing preliminary minimum design recommendations for rigid heavy duty (concrete), and flexible light duty (asphalt) pavement sections. These design recommendations have been evaluated and based on estimated design criteria (i.e. 15

year design life, equivalent single axle loading (ESAL) of 300,000 for rigid (concrete) pavement sections and 300,000 for flexible (asphalt) pavement sections), along with our evaluation of the subsurface conditions.

Our recommended minimum pavement design sections provided below are based on a soil support evaluation performed in accordance with generally accepted procedures set forth by the American Association of State Highway and Transportation Officials (AASHTO) "*Guide for Design of Pavement Structures, 1993*". **It should be recognized that because actual traffic loading conditions determined from a traffic study were not available for the referenced facility, all traffic loading conditions considered and utilized for design purposes were estimated based on our past experience with similar projects and the following design assumptions:**

- Design Life or 15 years
- 18-kips Equivalent Single Axle Loading (ESAL) *estimated* design value:
  - Rigid Pavement = 300,000
  - Flexible Pavement = 300,000
- Initial Serviceability:
  - Flexible Pavement = 4.2
  - Rigid Pavement = 4.5
- Terminal Serviceability of 2.0 (for both flexible and rigid pavement)
- Reliability of 80 percent (%) (for both flexible and rigid pavement)
- Standard Deviation
  - Flexible Pavement = 0.45
  - Rigid Pavement = 0.35
- Estimated California Bearing Ratio (CBR) of 3
- The crushed stone base course will not contain more than 10 percent (%) fines and will be compacted to at least 100 percent (%) of the maximum Standard Proctor dry density.
- Asphalt will be placed and compacted in accordance with the INDOT 2016 Standard Specification Requirements.
- Good to Excellent Drainage Condition – Assumes water in subgrade is removed within 1 day. Please note, the shallow subgrade soils encountered at the site generally consist of clays with Relatively low permeability's; which means the soils have relatively poor drainage characteristics. Therefore, we recommend installing longitudinal subsurface drains throughout the length of the proposed pavement areas. Additionally, we recommend the installation of series of finger drains within

the proposed pavement areas; which if appropriate and feasible could be connected to storm-sewer inlets. In addition to providing good drainage, the installation of underdrains underlying pavement sections founded over low permeability soils will generally aid in improving long-term performance of the pavement sections, as well as helping lower maintenance costs.

Based on the above design parameters, provided below are the calculated minimum pavement design thicknesses for rigid (concrete) pavement loading and flexible (asphalt) pavement for the provided loading. Refer to Appendix "B" "*Pavement Design Evaluation & Design Sections*" for detailed design calculations.

Table 2: Preliminary Rigid Pavement Design (Minimum Thicknesses)

Traffic Loading Conditions(1)	Concrete (Inches)(2)	Aggregate Base Course (Inches)(3)	Modulus of Subgrade Reactions (psi)	Design Life (Years)(1)
300,000 ESAL's	5.5	6	100	15

(1) Estimated ESAL based on estimated number of truck passes per day

(2) Minimum of 4,000 pounds per square inch (psi) concrete strength with suitable reinforcement

(3) Indiana Department of Transportation (INDOT) No. 53 Crushed Stone, containing no more than 10 percent (%) fines.

Table 3: Preliminary Flexible Pavement Design (Minimum Thicknesses)

Traffic Loading Conditions(1)	Asphalt Surface Course HMA 9.5 mm (Inches)(2)	Asphalt Base Course HMA 19 mm (Inches)(2)	Aggregate Sub-Base (Inches)(3)	Design Life (Years)(1)
300,000 ESAL's	1.5	4.5	8	15

(1) Estimated ESAL based on estimated number of truck passes per day

(2) Indiana Department of Transportation (INDOT) Specified Hot Mix Asphalt (HMA)

(3) Indiana Department of Transportation (INDOT) No. 53 Crushed Stone, containing no more than 10 percent (%) fines.

4.7 Excavations of Existing Foundations/ Underground Utilities

We recommend that an attempt be made to obtain drawings of all past or existing underground structures onsite. We also recommend that these documents including this report be made available to the project contractors. Buried foundations and slabs may prove to be obstructions for the proposed construction at the project site. We also recommend that existing foundations, pavements, utilities, and backfill be excavated at least 2 feet beyond the proposed structures construction and underground utility limits. Backfill required to reach the design subgrade should be performed in accordance with Section 5.3 *"Structural Fill and Fill Placement Control"*.

No structural elements of the proposed project should be placed over old foundations or slabs, which can create "hard spots" or over vacated utility lines or "voids", unless structurally designed to handle the hard and soft spots. In addition, if basement walls are encountered, we recommend cutting these 2 feet below proposed subgrade and backfilling with structural fill as specified above.

It should also be noted that the sandy soils encountered in the borings should be expected to be free-flowing and tend to readily cave and/or slough into excavations; therefore, over-excavation, benching and/or shoring may be required in order to maintain the side slopes within isolated portions of excavations.

4.8 Storm-Water Management Wells

During construction, existing dry wells will be removed. Because of this, the existing soils at the site are being evaluated to determine if they can support the planned storm-water runoff without the need for additional wells being installed. The soils encountered at the site primarily consist of clayey sands underlain by fine to medium grained sands. These sands, encountered at depths of 3.5 to 6 feet below the existing pavement surface, are considered favorable for infiltration of water.

The soils encountered in our borings should be readily excavated using conventional earthwork equipment. ***Additionally, depending on the invert elevation of the proposed detention basin, sand layers and seams could be encountered which are expected to be free-flowing and will tend to readily cave and/or slough into excavations; therefore, over-excavation, benching and/or shoring should be expected in order to maintain the side slopes of the excavations.***

Depending on seasonal conditions and the invert elevation of the proposed detention basin, localized and sporadic groundwater infiltration should be expected to be encountered in the detention basin excavation (Refer to Section 5.4 *"Groundwater*

Considerations"). Furthermore, it should also be noted that there may be the potential for encountering heaving of sand layers near the groundwater elevations during construction.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Site Preparation

All areas that will support foundations, floors, pavements, or newly placed structural fill must be properly prepared. All loose surficial soil or "topsoil" and other unsuitable materials must be removed. Unsuitable materials include frozen soil, relatively soft material, relatively wet soils, deleterious material, or soils that exhibit a high organic content.

Approximately four (4) to five (5) inches of asphalt pavement underlain by approximately four (4) to six (6) inches of crushed stone was encountered in the borings. The pavement was measured at discrete locations as shown on the Boring Location Map (Figure No. 2) in Appendix "A". The pavement thickness measured at the boring locations may or may not be representative of the overall average pavement thickness at the site.

Prior to construction of floor slabs, pavements or the placement of new structural fill, the exposed subgrade must be evaluated by a Patriot representative, which will include proofrolling of the subgrade. Proofrolling should consist of repeated passes of a loaded, pneumatic-tired vehicle such as a tandem-axle dump-truck or scraper. The proofrolling operations should be observed by a *Patriot* representative, and the proofrolling vehicle should be loaded as directed by *Patriot*. Any area found to rut, pump, or deflect excessively should be compacted in-place or, if necessary, undercut and replaced with structural fill, compacted as specified in Section 5.3 *"Structural Fill and Fill Placement Control"*.

Care must be exercised during grading and fill placement operations. ***The combination of heavy construction equipment traffic and excess surface moisture can cause pumping and deterioration of the near surface soils. The severity of this potential problem depends to a great extent on the weather conditions prevailing during construction.*** The contractor must exercise discretion when selecting equipment sizes and also make a concerted effort to control construction traffic and surface water while the subgrade soils are exposed. We recommend that heavy construction equipment (i.e. dump trucks, scrapers, etc.) be rerouted away from the building and pavement areas. If such problems do arise, the operations in the affected area should be halted and the *Patriot* representative contacted to evaluate the condition.

5.2 Foundation Excavations

Excavation will be performed on sandy soils that can be easily disturbed. If the subgrade soil is disturbed, it should be re-compacted or a crushed stone layer should be placed at the subgrade level.

Upon completion of the foundation excavations and prior to the placement of reinforcing steel, a *Patriot* representative should check the exposed subgrade to confirm that a bearing surface of adequate strength has been reached. Any localized soft soil zones encountered at the bearing elevations should be further excavated until adequate support soils are encountered. The cavity should be backfilled with structural fill as defined below, or the footing can be poured at the excavated depth. Structural fill used as backfill beneath footings should be limited to lean concrete, well-graded sand and gravel, or crushed stone placed and compacted in accordance with Section 5.3 *"Structural Fill and Fill Placement Control"*.

If it is necessary to support spread footings on structural fill, the fill pad must extend laterally a minimum distance beyond the edge of the footing. The minimum structural pad width would correspond with a point at which an imaginary line extending downward from the outside edge of the footing at a 1H:2V (horizontal: vertical) slope intersects the surface of the natural soils. For example, if the depth to the bottom of excavation is 4 feet below the bottom of the foundation, the excavation would need to extend laterally beyond the edge of the footing at least 2 feet, as shown in Illustration "A" found at the conclusion of this report.

Excavation slopes should be maintained within all requirements set-forth by the Occupational Safety and Health Standards (OSHA), but specifically Section 1926 Subpart "P" – *"Excavations"*. We recommend that any surcharge fill or heavy equipment be kept at least 5 feet away from the edge of the excavation.

In addition, excavations that occur near existing in-use foundations should be carefully performed making a conscious effort not to undermine the support of the in-use foundations. If it is necessary to excavate soil adjacent to and below the bearing elevation of any in-use foundations, *Patriot* should be contacted to make further recommendations regarding these excavations. Please refer to Illustration "B" at the end of this report for further details.

Construction traffic on the exposed surface of the bearing soil will potentially cause some disturbance of the subgrade and consequently loss of bearing capacity. However, the degree of disturbance can be minimized by proper protection of the exposed surface.

5.3 Structural Fill and Fill Placement Control

Structural fill, defined as any fill which will support structural loads, should be clean and free of organic material, debris, deleterious materials, and frozen soils. Samples of the proposed fill materials should be tested prior to initiating the earthwork and backfilling operations to determine the classification, the natural and optimum moisture contents and maximum dry density and overall suitability as a structural fill. ***Structural fill should have a liquid limit less than 40 and a plasticity index less than 20.***

All structural fill beneath floor slabs, adjacent to foundations and over foundations, should be compacted to at least 95 percent (%) of its maximum Standard Proctor dry density (ASTM D-698). This minimum compaction requirement should be increased to 100 percent (%) of the maximum Standard Proctor dry density for fill supporting footings, provided these are designed as outlined Section 4.0 *“Design Recommendations”*.

Structural fill supporting, around and over utilities should be compacted to at least 95 percent (%) of its maximum Standard Proctor dry density (ASTM D-698) for utilities underlying structural areas (i.e. buildings, pavements, sidewalks, etc.). However, the minimum compaction requirement can be reduced for backfill around and over the utilities to 90 percent (%) of the maximum Standard Proctor dry density where utilities underlie greenbelt areas (i.e. grassy lawns, landscaping, etc.). It is recommended that a clean well-grade granular material be utilized as the bedding material, as well as the backfill material around and over the utility lines.

In cut areas, where pavement sections are planned, the upper 10 inches of subgrade should be scarified and compacted to a dry density of at least 100 percent (%) of the Standard Proctor maximum dry density (ASTM D-698). Any grade-raise fill placed within 1 foot of the base of the pavement section should also be compacted to at least 100 percent (%) of the Standard Proctor maximum dry density. This can be reduced to 95 percent (%) for structural fill placed more than 1 foot below the base of the pavement section.

To achieve the recommended compaction of the structural fill, we suggest that the fill be placed and compacted in layers not exceeding 8 inches in loose thickness (the loose lift thickness should be reduced to 6 inches when utilizing small hand compactors) and within the range of 2 percentage (%) points below or above the optimum moisture content value. All fill placement should be monitored by a *Patriot* representative. ***Each lift should be tested for proper compaction at a frequency of at least one (1) test every 2,500 square feet (ft^2) per lift for the building areas, at least one (1) test every 10,000 square feet (ft^2) per lift for the parking and roadway areas, and at a frequency of at least one (1) test for every 50 lineal feet of utility installation*.**

5.4 Groundwater Considerations

Groundwater was observed during our field activities at depths of about 18.5 feet below the existing ground surface; which is expected to be below the anticipated foundation excavation depths; however, depending on seasonal conditions, localized and sporadic groundwater infiltration may occur into the building foundation excavations on this site.

Groundwater inflow into shallow excavations **above** the groundwater table is expected to be adequately controlled by conventional methods such as gravity drainage and/or pumping from sumps. More significant inflow can be expected in deeper excavations **below** the groundwater table requiring more aggressive dewatering techniques, such as well or wellpoint systems. For groundwater to have minimal effects on the construction, foundation excavations should be constructed and poured in the same day, if possible.

6.0 INVESTIGATIONAL PROCEDURES

6.1 Field Work

A total of three (3) soil borings were drilled, sampled, and tested at the project site between September 13 and 15, 2021 at the approximate locations shown on the Boring Location Map (Figure No. 2) in Appendix “A”. The depths that the soil borings were advanced to are shown on the Boring Logs in Appendix “A”. All depths are given as feet below the existing ground surface.

The borings were advanced using 3¼ inch inside diameter hollow-stem augers. Samples were recovered in the undisturbed material below the bottom of the augers using the standard drive sample technique in accordance with ASTM D 1586-74. A 2 inch outside diameter by 1$^3/_8$ inch inside diameter split-spoon sampler was driven a total of 18 inches with the number of blows of a 140-pound hammer falling 30 inches recorded for each 6 inches of penetration. The sum of blows for the final 12 inches of penetration is the Standard Penetration Test result commonly referred to as the N-value (or blow-count). Split-spoon samples were recovered at 2.5 feet intervals, beginning at a depth of 1 foot below the existing surface grade, extending to a depth of 10 feet, and at 5 feet intervals thereafter to the termination of the boring.

Water levels were monitored at each borehole location during drilling and upon completion of the boring. The boreholes were backfilled with auger cuttings and boring performed in pavement areas were patched prior to demobilization for safety considerations.

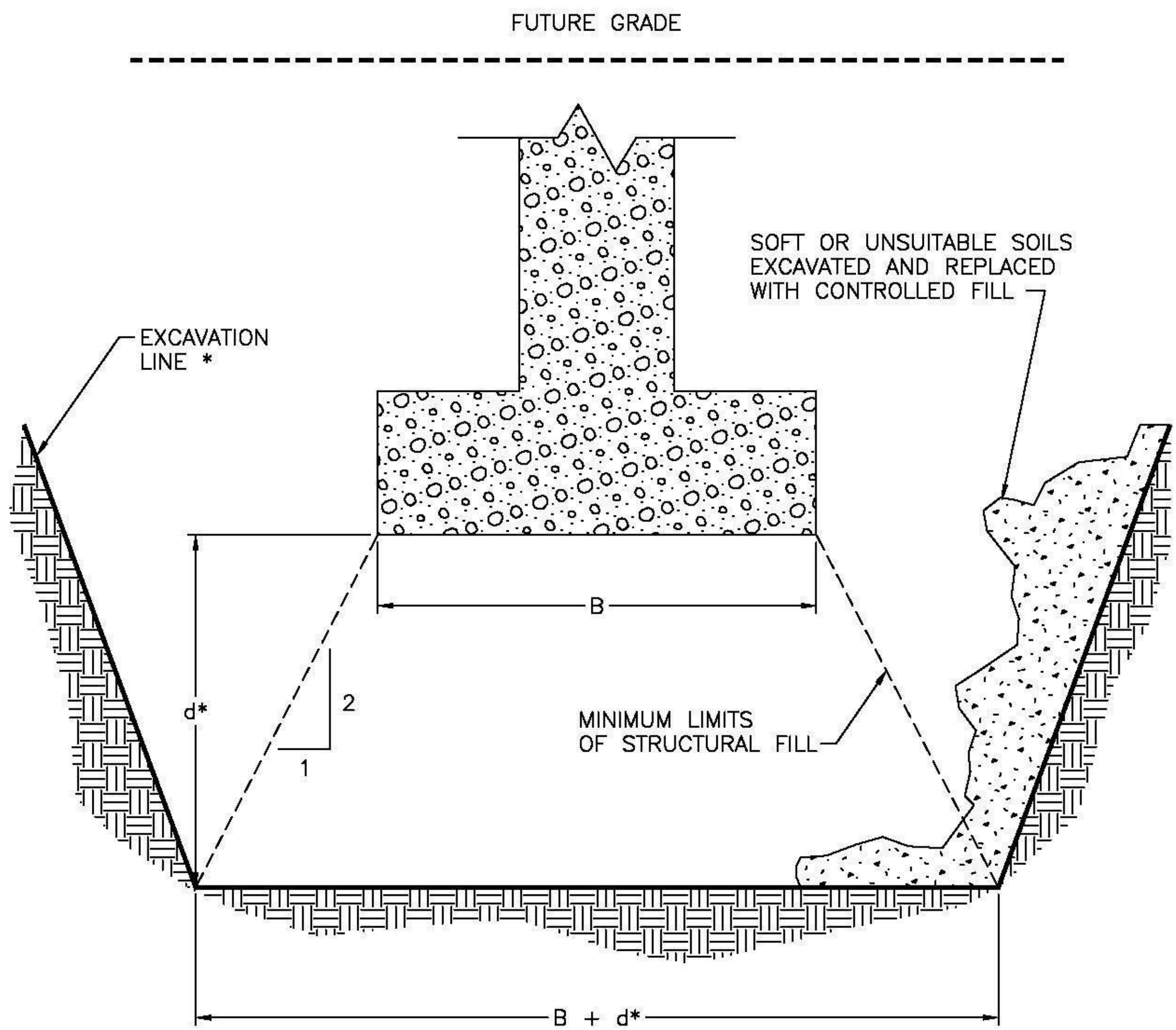
Upon completion of the boring program, of the samples retrieved during drilling were returned to *Patriot*'s soil testing laboratory where they were visually examined and classified. A laboratory-generated log of each boring was prepared based upon the driller's field log, laboratory test results, and our visual examination. Test boring logs and a description of the classification system are included in Appendix "A" in this report. Indicated on each log are the primary strata encountered, the depth of each stratum change, the depth of each sample, the Standard Penetration Test results, groundwater conditions, and selected laboratory test data. The laboratory logs were prepared for each boring giving the appropriate sample data and the textural description and classification.

6.2 Laboratory Testing

Representative samples recovered in the borings were selected for testing in the laboratory to evaluate their physical properties and engineering characteristics. Laboratory analysis included Natural Moisture Content Analysis (ASTM D 2216) and an estimate of the cohesive soil strength was determined utilizing a hand penetrometer (q_p). The results of laboratory tests are summarized in Section 3.2 *"General Subsurface Conditions"*. Soil descriptions on the boring logs are in accordance with the Unified Soil Classification System (USCS).

7.0 ILLUSTRATIONS

See Illustrations "A" and "B" on the following pages. These illustrations are presented to further visually clarify several of the construction considerations presented in Section 5.2 *"Foundation Excavations"*.



*d IS DEPTH TO SUITABLE SOILS

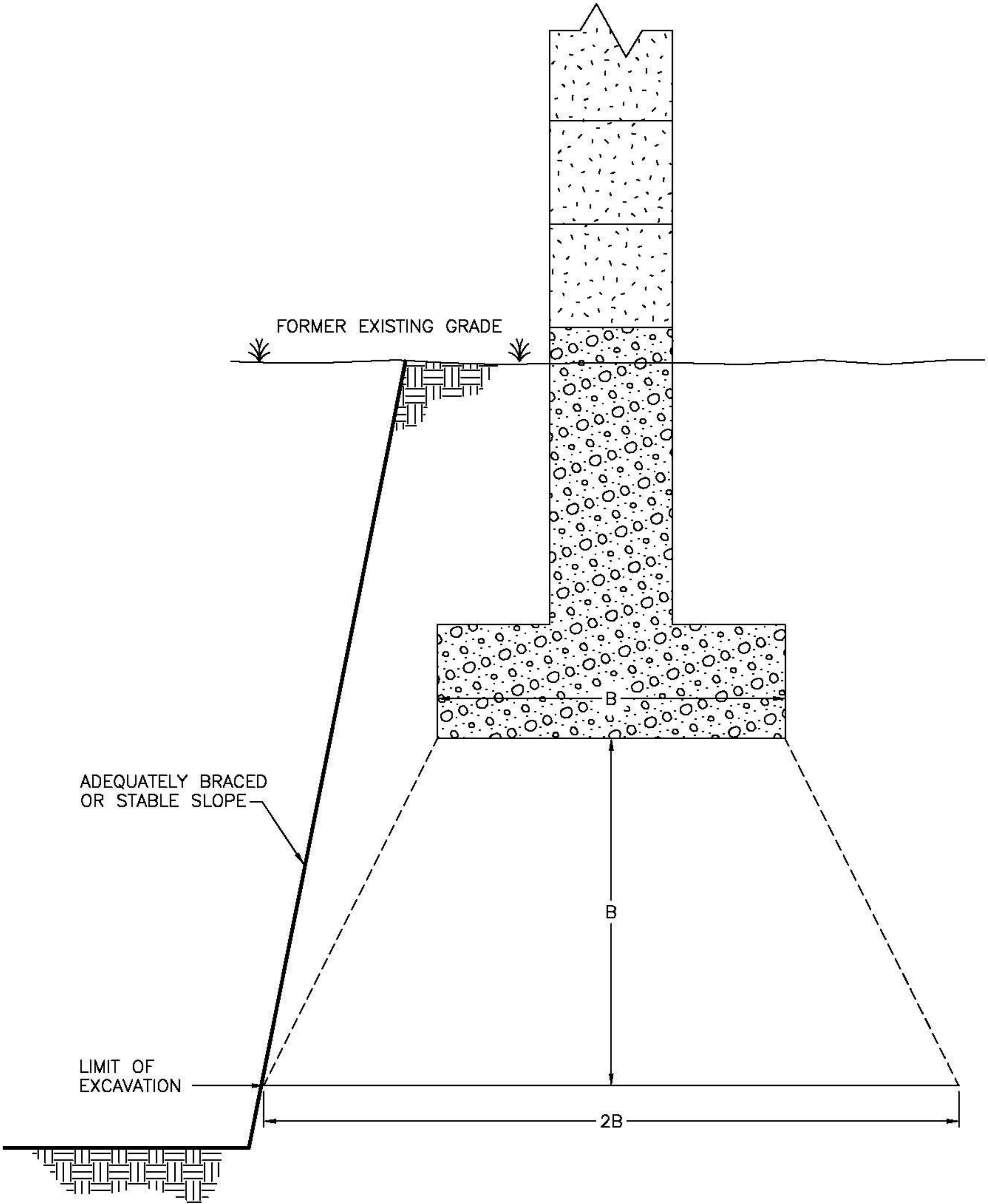
* IN COMPLIANCE WITH OSHA STANDARDS

PATRIOT ENGINEERING and Environmental, Inc.
Engineering Value for Project Success
Consulting Environmental, Geotechnical and Materials Engineers

Excavation for Footings
In an Area of Fill
ILLUSTRATION A

job. no.:

figure:



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Excavation Near Existing
In Use Foundations

ILLUSTRATION B

job. no.:	figure:

APPENDIX A

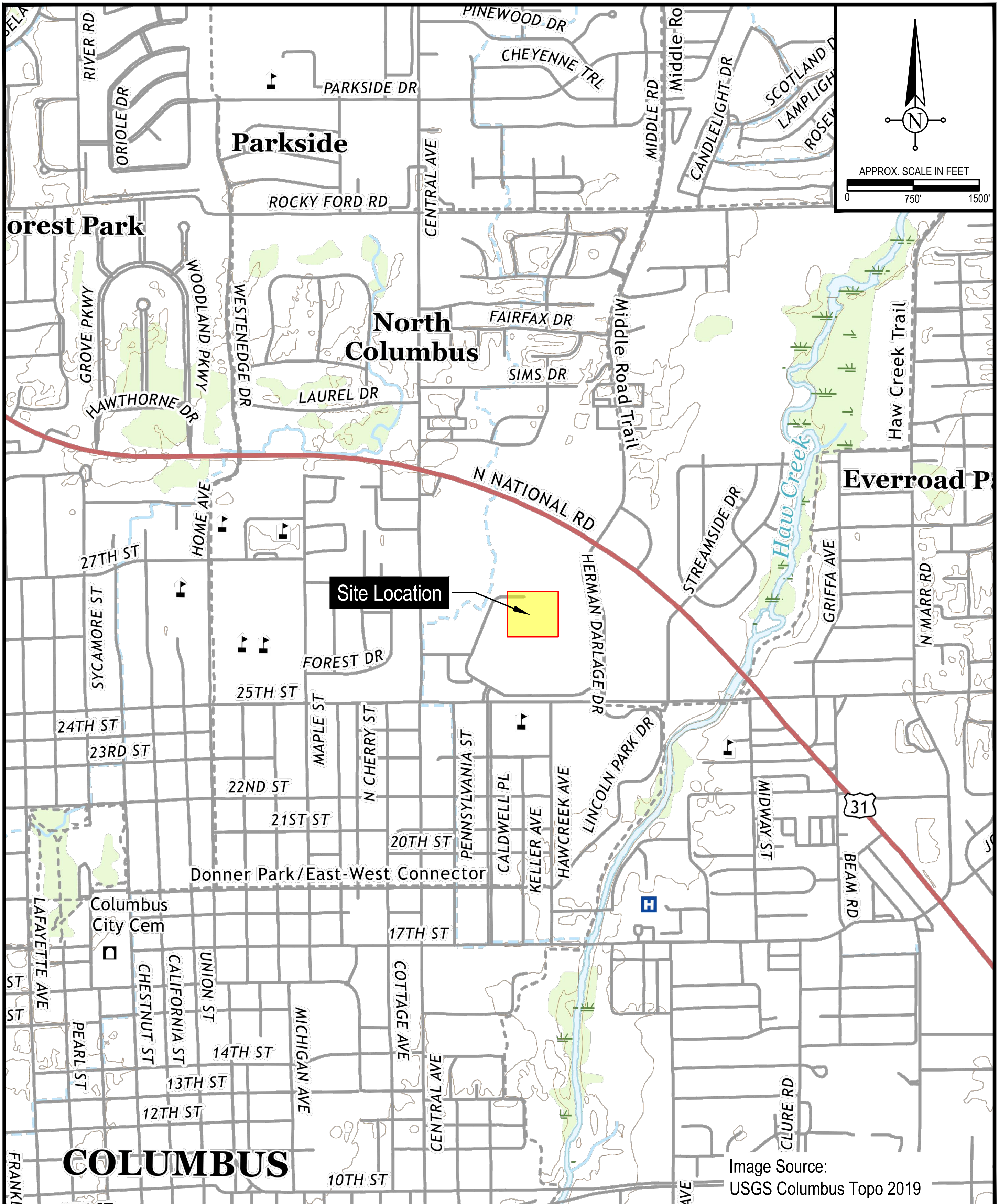
SITE VICINITY MAP (FIGURE NO. 1)

BORING LOCATION MAP (FIGURE NO. 2)

BORING LOGS

BORING LOG KEY

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)



Patriot Engineering & Environmental, Inc.

Project: Fair Oaks Sports Columbus
2224 25th Street
Columbus, Indiana

	Drawn By: J. DuMond
Project Number: 21-1223-01	Approved: I. Grafe
Date: November 10, 2021	DWG: 21-1223-01_geo

Figure 1

Site Vicinity Map

Patriot Engineering & Environmental, Inc.

NOTES:
1. Boring locations were staked by PATRIOT. All locations are shown as approximate.
2. All locations were determined in the field with references to existing landmarks.
3. Image Source: Google Earth 10-11-2019
4. Scale as shown.

Project: Fair Oaks Sports Columbus 2224 25th Street Columbus, Indiana	
	Drawn By: J. DuMond
Project Number:21-1223-01	Approved: I. Grafe
Date: November 10, 2021	DWG: 21-1223-01_geo

Figure 2

Soil Boring Location Map

PATRIOT ENGINEERING and Environmental Inc.

Indianapolis, Terre Haute, Evansville, Fort Wayne, Lafayette, Bloomington Louisville, KY Dayton, Cincinnati, OH

LOG OF BORING B-1

Fair Oaks Sports Complex
2224 25th Street
Columbus, Indiana

Client Name	: City of Columbus Indiana	Driller	: J. Boeche
Project Number	: 21-1223-01G	Sampling	: Splitspoon
Logged By	: B. Smith	Approx. Elevation	: +/- feet
Start Date	: 09/13/2021	Latitude	:
Drilling Method	: HSA	Longitude	:

Water Levels
- During Drilling - 18.5 feet
- After Completion - Dry
- After 24 Hours - N/A

Depth (Feet)	Elevation (Feet)	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	qp tsf	w %	REMARKS
0					ASPHALT (5")						
					SAND (6")						
			SC		Brown, slightly moist, loose, CLAYEY SAND with little to some gravel	1	78	7/5/5			Bulk sample was collected from 1.0 to 4.0 feet. As-received moisture content- 9.3%
5			SC		Brown, slightly moist, very loose, CLAYEY SAND with little gravel	2	67	2/2/2			
			SP-SM		Brown, slightly moist, medium dense to loose, fine to medium grained, SAND with trace silt and trace gravel	3	0	7/10/9			Sample No. 3: Two attempts were made to obtain a splitspoon sample. Classification is based on field observations.
						4	78	5/4/6			
10											
15						5	67	5/8/12			Boring caved to 16.0 feet upon auger removal.
		▼	SP-SM		Brown, saturated, dense to medium dense, fine to medium grained, SAND with trace silt and trace gravel	6	83	5/10/10			
20											
25						7	83	3/4/8			Heaving sands encountered at 25 feet. Wash rotary was introduced into the augers to facilitate sampling.
30						8	67	7/20/19			
35			SP-SM		Brown, saturated, medium dense, fine to medium grained, SAND with trace silt and little gravel	9	33	6/11/13			

LOG OF BORING B-1

PATRIOT ENGINEERING and Environmental Inc.
Indianapolis, Terre Haute, Evansville, Fort Wayne, Lafayette, Bloomington
Louisville, KY Dayton, Cincinnati, OH

Fair Oaks Sports Complex
2224 25th Street
Columbus, Indiana

Client Name	: City of Columbus Indiana	Driller	: J. Boeche
Project Number	: 21-1223-01G	Sampling	: Splitspoon
Logged By	: B. Smith	Approx. Elevation	: +/- feet
Start Date	: 09/13/2021	Latitude	:
Drilling Method	: HSA	Longitude	:

Water Levels
- ▼ During Drilling - 18.5 feet
- ▽ After Completion - Dry
- ◆ After 24 Hours - N/A

Depth (Feet)	Elevation (Feet)	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	qp tsf	w %	REMARKS
35			SP-SM		Brown, saturated, medium dense, fine to medium grained, SAND with trace silt and little gravel						
			SP-SM		Gray, saturated, medium dense to dense, fine to medium grained, SAND with trace silt and trace gravel	10	83	7/12/13			
40											
						11	83	7/16/18			
45											
						12	33	14/14/16			
50					Boring terminated at 50 feet.						
55											
60											
65											
70											

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PATRIOT ENGINEERING and Environmental Inc.
Indianapolis, Terre Haute, Evansville, Fort Wayne, Lafayette, Bloomington, Louisville, KY Dayton, Cincinnati, OH

LOG OF BORING B-2

Fair Oaks Sports Complex
2224 25th Street
Columbus, Indiana

Client Name	: City of Columbus Indiana	Driller	: J. Boeche
Project Number	: 21-1223-01G	Sampling	: Splitspoon
Logged By	: B. Smith	Approx. Elevation	: +/- feet
Start Date	: 09/13/2021	Latitude	:
Drilling Method	: HSA	Longitude	:

Water Levels
- ▼ During Drilling - 18.5 feet
- ▽ After Completion - Dry
- ◆ After 24 Hours - N/A

Depth (Feet)	Elevation (Feet)	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	qp tsf	w %	REMARKS
0					ASPHALT (4")						
					CRUSHED STONE (6")						
			SC		Brown, slightly moist, loose, CLAYEY SAND with trace gravel	1	72	3/6/3			Bulk sample was collected from 1.0 to 4.0 feet. As-received moisture content- 13.9%
			SP-SM		Brown, slightly moist, loose to medium dense, fine to medium grained, SAND with trace silt and trace to little gravel	2	50	3/4/5			
5						3	33	4/5/7			
						4	67	4/8/7			
10											
15						5	50	9/8/9			
18.5		▼	SP-SM		Brown, saturated, medium dense, fine to medium grained, SAND with trace silt and trace gravel	6	50	6/6/6			
20											Heaving sands encountered at 20 feet. Mud rotary was introduced into the augers to facilitate sampling.
						7	50	8/10/12			Boring caved to 9.6 feet upon auger removal.
25											
						8	56	10/11/13			
30											
						9	50	8/12/13			
35											

PATRIOT ENGINEERING and Environmental Inc.
Indianapolis, Terre Haute, Evansville, Fort Wayne, Lafayette, Bloomington Louisville, KY Dayton, Cincinnati, OH

LOG OF BORING B-2

Fair Oaks Sports Complex
2224 25th Street
Columbus, Indiana

Client Name	: City of Columbus Indiana	Driller	: J. Boeche
Project Number	: 21-1223-01G	Sampling	: Splitspoon
Logged By	: B. Smith	Approx. Elevation	: +/- feet
Start Date	: 09/13/2021	Latitude	:
Drilling Method	: HSA	Longitude	:

Water Levels
- During Drilling - 18.5 feet
- After Completion - Dry
- After 24 Hours - N/A

Depth (Feet)	Elevation (Feet)	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	qp tsf	w %	REMARKS
35			SP-SM		Brown, saturated, medium dense, fine to medium grained, SAND with trace silt and trace gravel						
						10	50	5/9/14			
40											
			SP-SM		Gray, saturated, medium dense, fine to medium grained, SAND with trace silt and trace gravel	11	33	7/11/13			
45											
						12	67	10/12/14			
50					Boring terminated at 50 feet.						
55											
60											
65											
70											

PATRIOT ENGINEERING and Environmental Inc.
Indianapolis, Terre Haute, Evansville, Fort Wayne, Lafayette, Bloomington
Louisville, KY Dayton, Cincinnati, OH

LOG OF BORING B-3

Fair Oaks Sports Complex
2224 25th Street
Columbus, Indiana

Client Name	: City of Columbus Indiana	Driller	: J. Boeche
Project Number	: 21-1223-01G	Sampling	: Splitspoon
Logged By	: B. Smith	Approx. Elevation	: +/- feet
Start Date	: 09/13/2021	Latitude	:
Drilling Method	: HSA	Longitude	:

Water Levels
▼ During Drilling - 18.5 feet
▽ After Completion - Dry
◆ After 24 Hours - N/A

Depth (Feet)	Elevation (Feet)	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	qp tsf	w %	REMARKS
0					ASPHALT (4")						
					CRUSHED STONE (4")						
			CL		Gray, slightly moist, stiff, SANDY CLAY with trace gravel	1	83	3/4/5	2.75	12	Bulk sample was collected from 2.0 to 5.0 feet. As-received moisture content- 12.7%
5			SP-SM		Brown, slightly moist, medium dense, fine to medium grained, SAND with trace silt and trace gravel	2	83	5/11/11			
						3	67	4/10/11			
10						4	89	9/9/10			
											Boring caved to 11.5 feet upon auger removal.
15						5	72	9/9/11			
20		▼	SP-SM		Brown, saturated, medium dense to dense, fine to medium grained, SAND with trace silt and trace gravel	6	89	3/4/10			Heaving sands encountered at 20 feet. A gel mix was introduced to facilitate sampling.
25						7	50	7/8/8			
30						8	72	7/10/14			
35						9	61	8/15/17			

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LOG OF BORING B-3

Fair Oaks Sports Complex
2224 25th Street
Columbus, Indiana

Client Name	: City of Columbus Indiana	Driller	: J. Boeche
Project Number	: 21-1223-01G	Sampling	: Splitspoon
Logged By	: B. Smith	Approx. Elevation	: +/- feet
Start Date	: 09/13/2021	Latitude	:
Drilling Method	: HSA	Longitude	:

Water Levels
- During Drilling - 18.5 feet
- After Completion - Dry
- After 24 Hours - N/A

Depth (Feet)	Elevation (Feet)	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	qp tsf	w %	REMARKS
35			SP-SM		Brown, saturated, medium dense to dense, fine to medium grained, SAND with trace silt and trace gravel						
38.5			SP-SM		Gray, saturated, medium dense to dense, fine to medium grained, SAND with trace silt and trace to little gravel	10	33	8/12/13			
40											
43.5						11	61	6/11/13			
45											
48.5						12	61	5/11/10			
50											
53.5						13	33	6/5/7			Water was introduced into the augers at 53.5 feet to facilitate drilling and sampling
55											
58.5						14	78	4/8/13			
60											
63.5						15	50	6/9/11			
65											
68.5						16	61	16/18/17			
70											

PATRIOT ENGINEERING
and Environmental Inc.
Indianapolis, Terre Haute, Evansville,
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LOG OF BORING B-3

Fair Oaks Sports Complex
2224 25th Street
Columbus, Indiana

Client Name	: City of Columbus Indiana	Driller	: J. Boeche
Project Number	: 21-1223-01G	Sampling	: Splitspoon
Logged By	: B. Smith	Approx. Elevation	: +/- feet
Start Date	: 09/13/2021	Latitude	:
Drilling Method	: HSA	Longitude	:

Water Levels
- During Drilling - 18.5 feet
- After Completion - Dry
- After 24 Hours - N/A

Depth (Feet)	Elevation (Feet)	Water Level	USCS	GRAPHIC	DESCRIPTION	Samples	Rec %	SPT Results	qp tsf	w %	REMARKS
70			SP-SM		Gray, saturated, medium dense to dense, fine to medium grained, SAND with trace silt and trace to little gravel						
						17	72	7/10/38			
75											
						18	67	8/14/17			
80											
						19	56	6/13/16			
85											
						20	50	4/11/15			
90											
						21	50	13/26/24			
95											
			SP-SM		Brown, saturated, dense, fine to medium grained, SAND with trace silt and trace gravel	22	67	14/16/16			
100											
105											

Boring terminated at 100 feet.

BORING LOG KEY

UNIFIED SOIL CLASSIFICATION SYSTEM
FIELD CLASSIFICATION SYSTEM
FOR SOIL EXPLORATION

NON COHESIVE SOILS
(Silt, Sand, Gravel and Combinations)

Density

Very Loose	-4 blows/ft. or less
Loose	-5 to 10 blows/ft.
Medium Dense	-11 to 30 blows/ft.
Dense	-31 to 50 blows/ft.
Very Dense	-51 blows/ft. or more

Grain Size Terminology

Soil Fraction		Particle Size	US Standard Sieve Size
Boulders		Larger than 12”	Larger than 12”
Cobbles		3” to12”	3” to 12”
Gravel:	Coarse	¾” to 3”	¾” to 3”
	Small	4.76mm to ¾”	#4 to ¾”
Sand:	Coarse	2.00mm to 4.76mm	#10 to #4
	Medium	0.42mm to 2.00mm	#40 to #10
	Fine	0.074mm to 0.42mm	#200 to #40
Silt		0.005mm to 0.074 mm	Smaller than #200
Clay		Smaller than 0.005mm	Smaller than #200

RELATIVE PROPORTIONS FOR SOILS

Descriptive Term	Percent
Trace	1 - 10
Little	11 - 20
Some	21 - 35
And	36 - 50

COHESIVE SOILS
(Clay, Silt and Combinations)

Consistency	Unconfined Compressive Strength (tons/sq. ft.)	Field Identification (Approx.) SPT Blows/ft.
Very Soft	Less than 0.25	0 - 2
Soft	0.25 – < 0.5	3 - 4
Medium Stiff	0.5 - < 1.0	5 - 8
Stiff	1.0 - < 2.0	9 -15
Very Stiff	2.0 - < 4.0	16 - 30
Hard	Over 4.0	> 30

Classification on logs are made by visual inspection.

Standard Penetration Test - Driving a 2.0” O.D., $1^{3/8}$” I.D., sampler a distance of 1.0 foot into undisturbed soil with a 140 pound hammer free falling a distance of 30.0 inches. It is customary for **Patriot** to drive the spoon 6.0 inches to seat into undisturbed soil, then perform the test. The number of hammer blows for seating the spoon and making the tests are recorded for each 6.0 inches of penetration on the drill log (Example - 6/8/9). The standard penetration test results can be obtained by adding the last two figures (i.e. 8 + 9 = 17 blows/ft.).

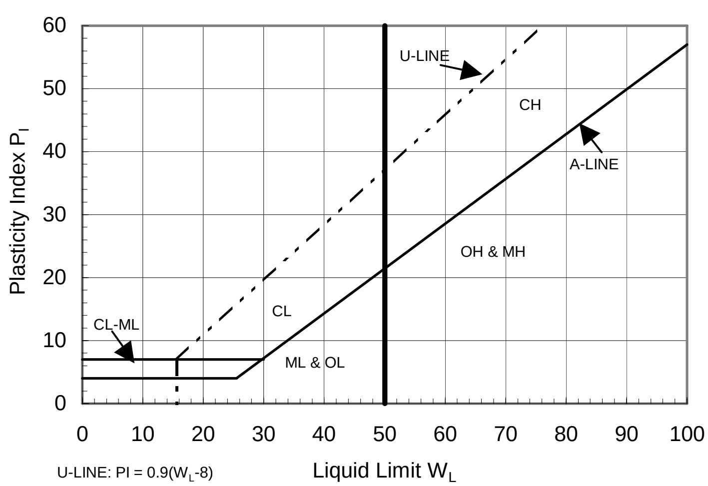
Strata Changes - In the column “Soil Descriptions” on the drill log the horizontal lines represent strata changes. A solid line (———) represents an actually observed change, a dashed line (- - - - - -) represents an estimated change.

Groundwater observations were made at the times indicated. Porosity of soil strata, weather conditions, site topography, etc., may cause changes in the water levels indicated on the logs.

Groundwater symbols: ▼-observed groundwater elevation, encountered during drilling; ∇-observed groundwater elevation upon completion of boring.

Unified Soil Classification System

Major Divisions			Group Symbol	Typical Names	Classification Criteria for Coarse-Grained Soils	
Coarse-grained soils (more than half of material is larger than No. 200)	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	$C_U \geq 4$ $1 \leq C_C \leq 3$	$C_U = \frac{D_{60}}{D_{10}}$ $C_C = \frac{D^2_{30}}{D_{10} D_{60}}$
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting all gradation requirements for GW ($C_U < 4$ or $1 > C_C > 3$)	
		Gravels with fines (appreciable amount of fines)	GM d u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below A line or $P_I < 4$	Above A line with $4 < P_I < 7$ are borderline cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits above A line or $P_I > 7$	
	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	$C_U \geq 6$ $1 \leq C_C \leq 3$	$C_U = \frac{D_{60}}{D_{10}}$ $C_C = \frac{(D_{30})^2}{D_{10} D_{60}}$
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting all gradation requirements for SW ($C_U < 6$ or $1 > C_c > 3$)	
		Sands with fines (appreciable amount of fines)	SM d u	Silty sands, sand-silt mixtures	Atterberg limits below A line or $P_I < 4$	Limits plotting in hatched zone with $4 \leq P_I \leq 7$ are borderline cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above A line with $P_I > 7$	
Fine-grained soils (more than half of material is smaller than No. 200)	Silt and clays (liquid limit <50)		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity	1. Determine percentages of sand and gravel from grain size curve. 2. Depending on percentages of fines (fraction smaller than 200 sieve size), coarse-grained soils are classified as follows: Less than 5% - GW, GP, SW, SP More than 12% - GM, GC, SM, SC 5-12% - Borderline cases requiring dual symbols	
			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 >50)		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays or high plasticity, fat clays		
			OH	Organic clays of medium to high plasticity, organic silts		
	Highly organic soils		PT	Peat and other highly organic soils		



U-LINE: PI = 0.9(W_L-8)
A-LINE: PI = 0.73(W_L-20)

Plasticity Chart

APPENDIX B

SEISMIC SITE CLASS EVALUATION

ATC Hazards by Location

Search Information

Address: 2224 25th St, Columbus, IN 47201, USA

Coordinates: 39.2254801, -85.8997443

Elevation: 639 ft

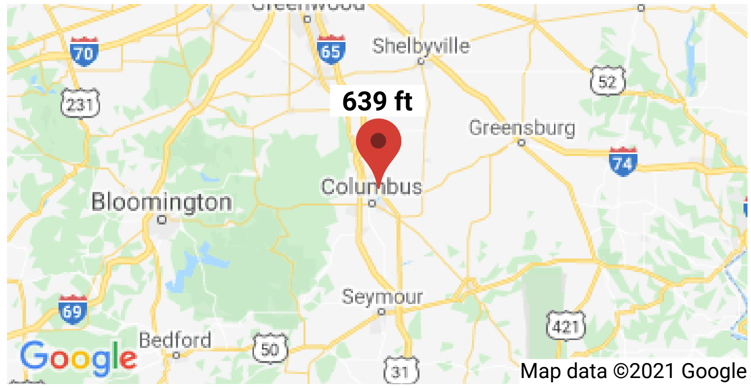
Timestamp: 2021-09-28T15:17:30.420Z

Hazard Type: Seismic

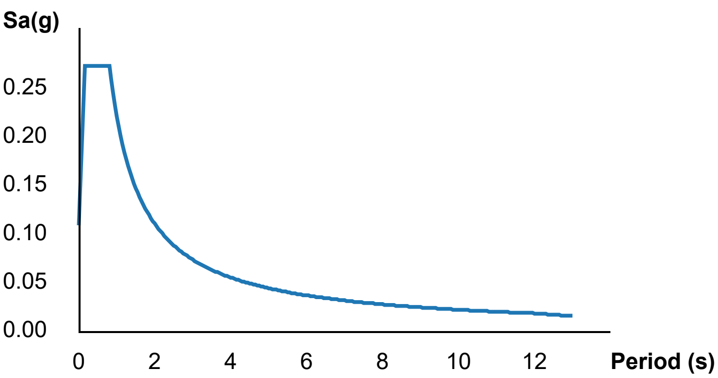
Reference Document: IBC-2012

Risk Category: III

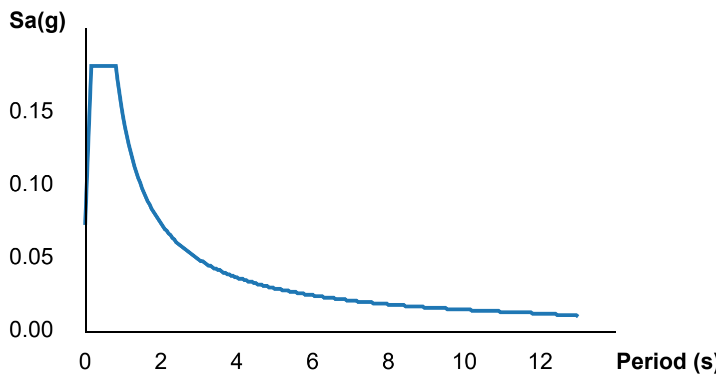
Site Class: D



MCER Horizontal Response Spectrum



Design Horizontal Response Spectrum



Basic Parameters

Name	Value	Description
S_S	0.171	MCE_R ground motion (period=0.2s)
S_1	0.092	MCE_R ground motion (period=1.0s)
S_{MS}	0.273	Site-modified spectral acceleration value
S_{M1}	0.221	Site-modified spectral acceleration value
S_{DS}	0.182	Numeric seismic design value at 0.2s SA
S_{D1}	0.147	Numeric seismic design value at 1.0s SA

Additional Information

Name	Value	Description
SDC	C	Seismic design category
F_a	1.6	Site amplification factor at 0.2s
F_v	2.4	Site amplification factor at 1.0s

CR_S	0.903	Coefficient of risk (0.2s)
CR_1	0.864	Coefficient of risk (1.0s)
PGA	0.078	MCE_G peak ground acceleration
F_{PGA}	1.6	Site amplification factor at PGA
PGA_M	0.125	Site modified peak ground acceleration
T_L	12	Long-period transition period (s)
SsRT	0.171	Probabilistic risk-targeted ground motion (0.2s)
SsUH	0.189	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
SsD	1.5	Factored deterministic acceleration value (0.2s)
S1RT	0.092	Probabilistic risk-targeted ground motion (1.0s)
S1UH	0.107	Factored uniform-hazard spectral acceleration (2% probability of exceedance in 50 years)
S1D	0.6	Factored deterministic acceleration value (1.0s)
PGAd	0.6	Factored deterministic acceleration value (PGA)

The results indicated here DO NOT reflect any state or local amendments to the values or any delineation lines made during the building code adoption process. Users should confirm any output obtained from this tool with the local Authority Having Jurisdiction before proceeding with design.

Disclaimer

Hazard loads are provided by the U.S. Geological Survey Seismic Design Web Services.

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APPENDIX C

PAVEMENT DESIGN EVALUATION

AND DESIGN SECTIONS

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Rigid Design Inputs

Project Name:	Fair Oaks Sports Complex
Route:	2224 25th Street
Location:	Columbus, Indiana
Owner/Agency:	
Design Engineer:	Patriot Engineering

Rigid Pavement Design/Evaluation

Concrete Thickness	6.00	**inches**	**Load Transfer Coefficient**	3.20	
Total Rigid ESALs	300,000		**Modulus of Subgrade Reaction**	100	**psi/in.**
Reliability	80.00	**percent**	**Drainage Coefficient**	1.00	
Overall Standard Deviation	0.35		**Initial Serviceability**	4.50	
Flexural Strength	650	**psi**	**Terminal Serviceability**	2.00	
Modulus of Elasticity	4,400,000	**psi**			

Modulus of Subgrade Reaction (k-value) Determination

Resilient Modulus of the Subgrade	4,500.0	**psi**
Depth to Rigid Foundation	0.00	**feet**
Loss of Support Value (0,1,2,3)	0.0	

Modulus of Subgrade Reaction	100	**psi/in.**

Engineer: ______________________________

WinPAS

Pavement Thickness Design According to

1993 AASHTO Guide for Design of Pavements Structures

American Concrete Pavement Association

Flexible Design Inputs

Project Name:	Fair Oaks Sports Complex
Route:	2224 25th Street
Location:	Columbus, Indiana
Owner/Agency:	
Design Engineer:	Patriot Engineering

Flexible Pavement Design/Evaluation

Structural Number	3.18		**Subgrade Resilient Modulus**	4,500.00	**psi**
Total Flexible ESALs	300,000		**Initial Serviceability**	4.20	
Reliability	80.00	**percent**	**Terminal Serviceability**	2.00	
Overall Standard Deviation	0.45				

Layer Pavement Design/Evaluation

Layer Material	Layer Coefficient	Drainage Coefficient	Layer Thickness	Layer SN
Asphalt Cement Concrete	0.39	1.00	1.50	0.58
Asphalt Cement Concrete	0.36	1.00	4.50	1.62
Crushed Stone Base	0.14	1.00	7.00	0.98
			ΣSN	3.18

Engineer: ______________________

APPENDIX D

GENERAL QUALIFICATIONS

STANDARD CLAUSE FOR UNANTICIPATED SUBSURFACE CONDITIONS

GENERAL QUALIFICATIONS

of Patriot Engineering's Geotechnical Engineering Investigation

This report has been prepared at the request of our client for his use on this project. Our professional services have been performed, findings obtained, and recommendations prepared in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied.

The scope of our services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report or on the test borings logs regarding vegetation types, odors or staining of soils, or other unusual conditions observed are strictly for the information of our client and the owner.

This report may not contain sufficient information for purposes of other parties or other uses. This company is not responsible for the independent conclusions, opinions or recommendations made by others based on the field and laboratory data presented in this report. Should there be any significant differences in structural arrangement, loading or location of the structure, our analysis should be reviewed.

The recommendations provided herein were developed from the information obtained in the test borings, which depict subsurface conditions only at specific locations. The analysis, conclusions, and recommendations contained in our report are based on site conditions as they existed at the time of our exploration. Subsurface conditions at other locations may differ from those occurring at the specific drill sites. The nature and extent of variations between borings may not become evident until the time of construction. If, after performing on-site observations during construction and noting the characteristics of any variation, substantially different subsurface conditions from those encountered during our explorations are observed or appear to be present beneath excavations, we must be advised promptly so that we can review these conditions and reconsider our recommendations where necessary.

If there is a substantial lapse of time between the submission of our report and the start of work at the site, or if conditions have changed due to natural causes or construction operations at or adjacent to the site, we urge that our report be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

We urge that Patriot be retained to review those portions of the plans and specifications that pertain to earthwork and foundations to determine whether they are consistent with our recommendations. In addition, we are available to observe construction, particularly the compaction of structural backfill and preparation of the foundations, and such other field observations as may be necessary.

In order to fairly consider changed or unexpected conditions that might arise during construction, we recommend the following verbiage (Standard Clause for Unanticipated Subsurface Conditions) be included in the project contract.

STANDARD CLAUSE FOR UNANTICIPATED SUBSURFACE CONDITIONS

"The owner has had a subsurface exploration performed by a soils consultant, the results of which are contained in the consultant's report. The consultant's report presents his conclusions on the subsurface conditions based on his interpretation of the data obtained in the exploration. The contractor acknowledges that he has reviewed the consultant's report and any addenda thereto, and that his bid for earthwork operations is based on the subsurface conditions as described in that report. It is recognized that a subsurface exploration may not disclose all conditions as they actually exist and further, conditions may change, particularly groundwater conditions, between the time of a subsurface exploration and the time of earthwork operations. In recognition of these facts, this clause is entered in the contract to provide a means of equitable additional compensation for the contractor if adverse unanticipated conditions are encountered and to provide a means of rebate to the owner if the conditions are more favorable than anticipated.

At any time during construction operations that the contractor encounters conditions that are different than those anticipated by the soils consultant's report, he shall immediately (within 24 hours) bring this fact to the owner's attention. If the owner's representative on the construction site observes subsurface conditions which are different than those anticipated by the consultant's report, he shall immediately (within 24 hours) bring this fact to the contractor's attention. Once a fact of unanticipated conditions has been brought to the attention of either the owner or the contractor, and the consultant has concurred, immediate negotiations will be undertaken between the owner and the contractor to arrive at a change in contract price for additional work or reduction in work because of the unanticipated conditions. The contract agrees that the following unit prices would apply for additional or reduced work under the contract. For changed conditions for which unit prices are not provided, the additional work shall be paid for on a time and materials basis."

Another example of a changed conditions clause can be found in paper No. 4035 by Robert F. Borg, published in ASCE Construction Division Journal, No. CO2, September 1964, page 37.