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September 25, 2015

Mr. Steve Bodette
City of Colorado Springs
Parks, Recreation, Cultural Services
Park Planning & Development
1401 Recreation Way, MC 1200
Colorado Springs, CO 80905

Subject: Results of Geotechnical Engineering Study, Deerfield Hills Community Center Addition, 4290 Deerfield Hills Road, Colorado Springs, Colorado

Project No. 15-2-166

Dear Mr. Bodette:

This report presents the results of a geotechnical engineering study for the proposed addition to the community center building at 4290 Deerfield Hills Road in Colorado Springs, Colorado. The project site is shown on the attached Fig. 1. The study was conducted in accordance with the scope of work in our proposal C15-170R, dated September 8, 2015, to provide engineering recommendations for foundations, floor slabs, and other related geotechnical engineering criteria.

PROPOSED CONSTRUCTION

We understand the project will consist of constructing an approximately 800 to 900 sf addition to the southwest side of the existing building. The addition will be single-story with a slab-on-grade floor, with no basement or below grade space. It is our understanding the building addition will consist of wood framing with a brick wainscot and fiber cement siding exterior finish. Foundation loads are expected to be light to moderate, typical of the proposed construction. Site grading is anticipated to be negligible, with construction occurring near the existing grades. If proposed construction varies significantly different from that described above or depicted in this report, we should be notified to reevaluate the recommendations contained herein.

SITE CONDITIONS

The area of proposed construction is within a landscaped area along the southwest side of the existing community center, as shown on Fig. 1. The building entrance is located at the approximate center of the southwest building side, and concrete sidewalks lead to the entrance from a parking lot, which is located to the southwest. Within the proposed addition footprint area, the ground slopes gently down to the southwest. Vegetation in the area consisted of trees and shrubs, and portions of the ground were covered with landscape mulch.

FIELD EXPLORATION

The field exploration of subsurface conditions consisted of drilling one boring at the approximate location shown on the attached Fig. 1. The field exploration was completed on September 14, 2015 using a conventional 2WD truck mounted drill rig. The location of the boring was determined by pacing from the site features.

The boring was drilled with 4-inch diameter continuous flight solid stem auger, and was logged by a representative of Kumar & Associates, Inc. Samples of the soils were taken with a 2-inch I.D. California sampler. The sampler was driven into the various strata with blows from a 140-pound hammer falling 30 inches. Penetration resistance values, when properly evaluated, provide an indication of the relative density or consistency of the soils. Depths at which the samples were taken and the penetration resistance values are shown on the boring log, which is presented on Fig. 2.

LABORATORY TESTING

Samples obtained from the exploratory boring were visually classified in the laboratory by the project engineer and samples were selected for laboratory testing. Laboratory testing included index property tests such as in-situ moisture content and dry unit weight, grain size analysis, and Atterberg limits. Additional testing performed included concentration of water soluble sulfates. The testing was conducted in general accordance with recognized test procedures, primarily those of the American Society for Testing of Materials (ASTM). Results of the laboratory testing program are shown on Figs. 2 and 3, and are summarized in Table I.

SUBSURFACE CONDITIONS

Man-placed fill consisting of silty to clayey sand was encountered in Boring 1 to an approximate depth of 4.5 feet. Our borings did not determine the exact lateral or vertical extent of the fill.

Below the fill, native soils consisting of silty sand and poorly graded sand with silt were encountered, extending to the 25-foot depth explored. Sampler penetration blow counts indicate the native granular soils are loose to medium dense.

Ground water was not encountered at the time of drilling. Fluctuations in the ground water level may occur with time.

FOUNDATION RECOMMENDATIONS

Considering the data obtained from the field exploration and laboratory testing programs, and the nature of the proposed construction, we recommend the building addition be supported with spread footings bearing on the native soils or a layer of moisture-conditioned, properly compacted nonexpansive fill extending to undisturbed natural soils. The existing fill encountered should be considered unsuitable for support of the proposed building foundations unless documentation is available stating the fill placement was properly controlled. Shallow foundations placed on uncontrolled fill can experience unacceptable total and differential settlements potentially resulting in structural distress.

The design and construction criteria presented below should be observed for a spread footing foundation system. The construction details should be considered when preparing project documents.

1. We recommend the building be supported with spread footings bearing on the native soils or a layer of moisture-conditioned, properly compacted nonexpansive fill extending to undisturbed natural soils. Footings should be designed for an allowable soil bearing pressure of 2,000 psf.

2. All existing fill encountered within the addition footprint should be removed and replaced with properly compacted fill prior to placement of new fill or concrete. The extent of fill removal should include a 1:1 projection outside of the addition footprint, excluding fill within a 1:1 projection from the edge of existing building foundations.

3. Structural fill placed for support of foundations should be compacted to 98% of the standard Proctor maximum dry density (ASTM D 698), within two percentage points of the optimum moisture content.

4. The on-site soils, minus any organic matter or deleterious materials, are suitable for use as nonexpansive structural fill. The contractor should be aware that some of the excavated soils may have an elevated moisture content, and as such, require drying back to within the specified limits in order to achieve adequate compaction. Import soil, if required, should consist of a nonexpansive soil having a maximum size of 2 inches, a maximum 40% passing the No. 200 sieve, and a maximum plasticity index of 15. Proposed structural fill materials should be evaluated by the geotechnical engineer prior to their use.

5. We estimate total movement for footings designed and constructed as discussed in this section will not exceed 1 inch. Differential settlements across the building footprint are estimated to be approximately ½ to ¾ of the total settlement. The settlement will be differential with respect to the existing construction; plan details should provide for this differential movement.

6. Spread footings should have a minimum width of 16 inches for continuous footings and 24 inches for isolated pads.

7. Exterior footings and footings beneath unheated areas should be provided with adequate soil cover above their bearing elevation for frost protection. We recommend placement of foundations be at least 30 inches below the exterior grade.

8. The lateral resistance of a footing placed on native soils or properly compacted fill material will be a combination of the sliding resistance of the foundation on the foundation materials and passive earth pressure against the side of the footing. Resistance to sliding at the bottoms of the footings may be calculated based on an allowable coefficient of friction of 0.3. Passive pressure against the sides of the foundation may be calculated using an allowable equivalent fluid unit weight of 170 pcf. Compacted fill placed against the sides of the footings to resist lateral loads should be a nonexpansive soil compacted to at least 95% of the standard Proctor maximum dry density, within two percent of the optimum moisture content.

9. Continuous foundation walls should be reinforced top and bottom to span an unsupported length of at least 10 feet.

10. Areas of loose or soft material encountered within the foundation excavation should be removed and replaced with properly compacted structural fill. New fill should extend down from the edges of the footings at a 1 horizontal to 1 vertical projection.

11. Granular foundation soils should be densified with a smooth vibratory compactor prior to placement of concrete.

12. A representative of the geotechnical engineer should observe all footing excavations prior to fill and concrete placement.

SEISMIC DESIGN CRITERIA

The generalized subsurface profile was assumed to consist of generally granular overburden soils, underlain by relatively deep claystone bedrock. The weighted average of the estimated shear wave velocities for this subsurface profile to a depth of 100 feet indicates an IBC design Site Class D. Based on the subsurface profile and site seismicity, liquefaction is not a design consideration.

FLOOR SLABS

The native on-site soils, exclusive of topsoil, are suitable to support lightly to moderately loaded slab-on-grade construction. The existing fill should not be relied on for support of floor slabs. Prior to placement of new fill and/or concrete, existing fill should be removed (excluding that portion that extends 1:1 down from the edge of existing foundations) and replaced with suitable nonexpansive fill. The specifications for structural fill and a discussion regarding the suitability for reuse of the on-site materials are presented under the "Foundation Recommendations" section of this report. Structural fill placed for support of floor slabs above the footing bearing elevation should be compacted to at least 95% of the standard Proctor maximum dry density, within two percentage points of the optimum moisture content.

Floor slabs should be separated from all bearing walls and columns with expansion joints which allow unrestrained vertical movement. Floor slab control joints should be used to reduce damage due to shrinkage cracking. The appropriate joint spacing is dependent on slab thickness, concrete aggregate size and slump, and should be determined using recognized guidelines such as those of the Portland Cement Association (PCA) or American Concrete Institute (ACI). The joint spacing and any requirements for slab reinforcement should be established by the designer based on experience and the intended slab use.

If moisture-sensitive floor coverings will be used, mitigation of moisture penetration into the slabs such as by use of a vapor barrier, may be required. If an impervious vapor barrier membrane is used, special precautions will be required to reduce potential differential curing problems which could cause the slabs to warp. Section 302.1R of the ACI Manual of Concrete Practice addresses this topic.

WATER SOLUBLE SULFATES

The concentration of water soluble sulfates measured in a sample obtained from the exploratory boring was less than 0.01%. This concentration of water soluble sulfates represents a Class 0 severity of exposure to sulfate attack on concrete exposed to these materials. The degree of attack is based on a range of Class 0 to Class 3 severity of exposure as presented in ACI 201. Based on this information and our experience with the soil types encountered, we believe special sulfate resistant cement will not be required for concrete exposed to the on-site soils.

SURFACE DRAINAGE

Providing proper surface drainage, both during construction and after the construction has been completed, is very important for acceptable performance of the building. The following recommendations should be used as guidelines and changes should be made only after consultation with the geotechnical engineer.

1. Excessive wetting or drying of the foundation excavations and underslab areas should be avoided during construction.

2. Exterior backfill should be adjusted to within two percentage points of the optimum moisture content and compacted to at least 95% of the standard Proctor (ASTM D 698) maximum dry density.

3. Care should be taken when compacting around the foundation and underground structures to avoid damage to the structure.

4. The ground surface surrounding the exterior of the structures should be sloped to drain away from the foundation in all directions. We recommend a minimum slope of 6 inches in the first 10 feet in unpaved areas. Site drainage beyond the 10-foot zone should be designed to promote runoff and reduce water infiltration. A minimum slope of 3 inches in the first 10 feet is recommended in the paved areas. These slopes may be changed as required for handicap access points in accordance with the Americans with Disabilities Act.

5. Ponding of water should not be allowed on backfill material or within 10 feet of the foundation walls, whichever is greater.

6. Roof downspouts and drains should discharge well beyond the limits of all backfill.

7. Excessive landscape irrigation should be avoided within 10 feet of the foundation walls.

EXCAVATION CONSIDERATIONS

To avoid loss of support of the existing foundations, temporary excavations should not extend within a 1 horizontal to 1 vertical projection extending down from the edge of existing foundations, unless braced. Excavations that are required to extend within this zone should be properly shored or the existing foundations underpinned to prevent loss of support to existing foundations. Shoring or underpinning which allows the foundation supporting soils to yield will result in foundation movement and distress to the existing building.

In our opinion, excavation of the overburden soils should be possible with conventional heavy-duty equipment. We recommend temporary excavation slopes in the soils be constructed in accordance with OSHA regulations. In accordance with OSHA criteria, the on-site soils classify as an OSHA Type C soil. Temporary unretained excavations in Type C materials should have slopes no steeper than 1½:1 (H:V). A properly braced excavation or the use of a trench box should be used where the indicated unretained slopes cannot be accommodated. Flatter slopes will be required where ground-water seepage is encountered. If soils different from those indicated in this report are encountered, the OSHA soil type may vary and the required cut slopes may need to be adjusted.

DESIGN AND SUPPORT SERVICES

Kumar & Associates, Inc. should be retained to review the project plans and specifications for conformance with the recommendations provided in this report. We are also available to assist the design team in preparing specifications for geotechnical aspects of the project and, if necessary, perform additional studies to accommodate any changes in the proposed construction.

We recommend that Kumar & Associates, Inc. be retained to provide observation and testing services to document that the requirements of the plans and specifications are being followed during construction, and to identify possible variations in subsurface conditions from those encountered in this study.

LIMITATIONS

This study has been conducted in accordance with generally accepted geotechnical engineering practices in this area for use by the client for design purposes. The conclusions and recommendations submitted in this report are based upon the data obtained from the exploratory boring at the approximate location indicated on Fig. 1 and the proposed type of construction. This report may not reflect subsurface variations that occur, and the nature and extent of variations across the site may not become evident until site grading and excavations are performed. If during construction, fill, soil, rock or water conditions appear to be different from those described herein, Kumar & Associates, Inc. should be advised at once so that a re-evaluation of the recommendations presented in this report can be made. Kumar & Associates, Inc. is not responsible for liability associated with interpretation of subsurface data by others.

The scope of services for this project does not include any environmental assessment of the site or identification of contaminated or hazardous materials or conditions. If the owner is concerned about the potential for such contamination, other studies should be undertaken.

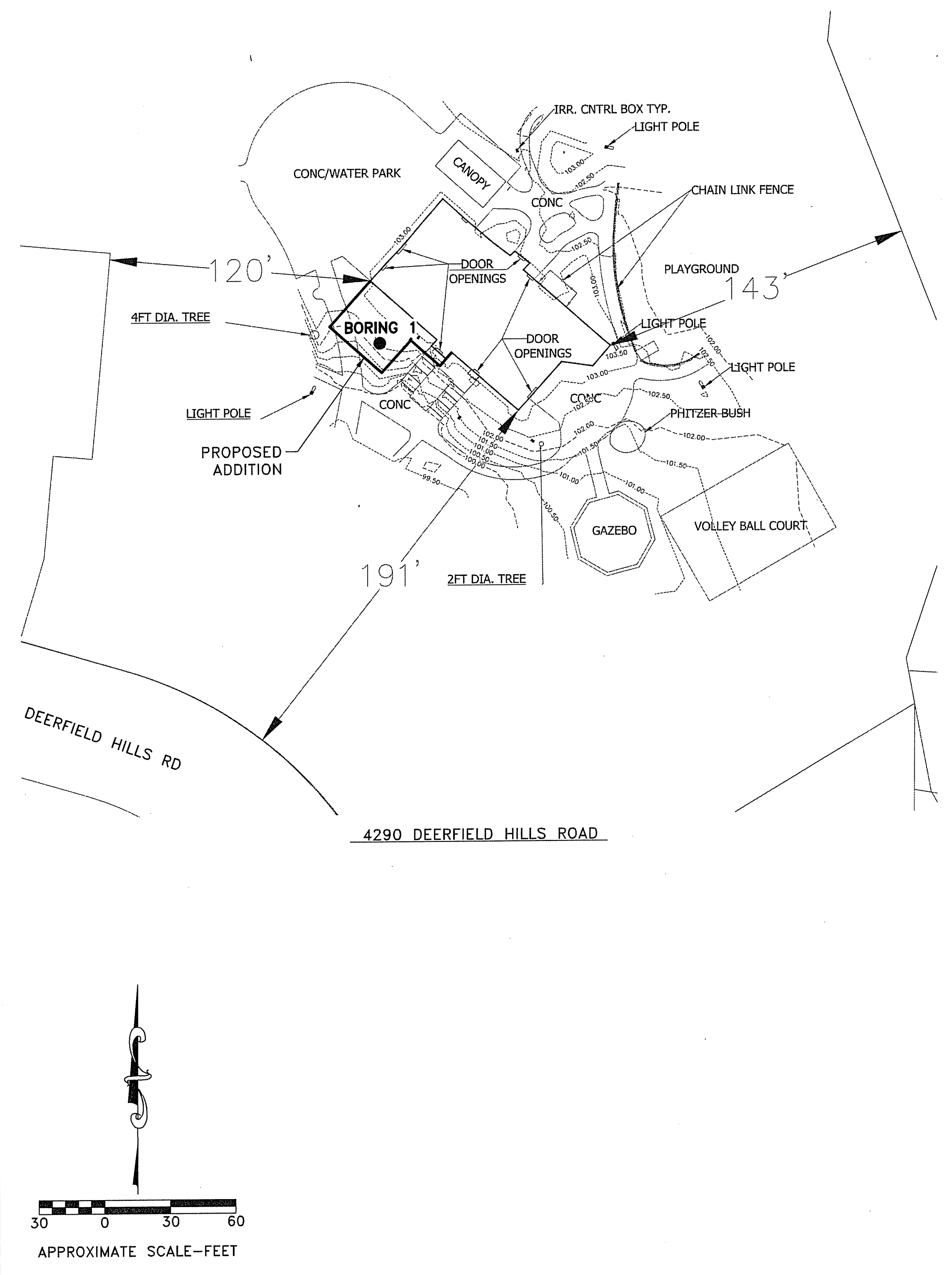
If you have any questions or require any additional information, please do not hesitate to call.

KUMAR & ASSOCIATES, INC.
Duane P. Craft, P.E.

COLORADO REGISTERED PROFESSIONAL ENGINEER DUANE P. CRAFT 37553

9/25/15

DPC:bj
Reviewed by: JAN
Attachments



15-2-166	Kumar & Associates	LOCATION OF EXPLORATORY BORING	Fig. 1

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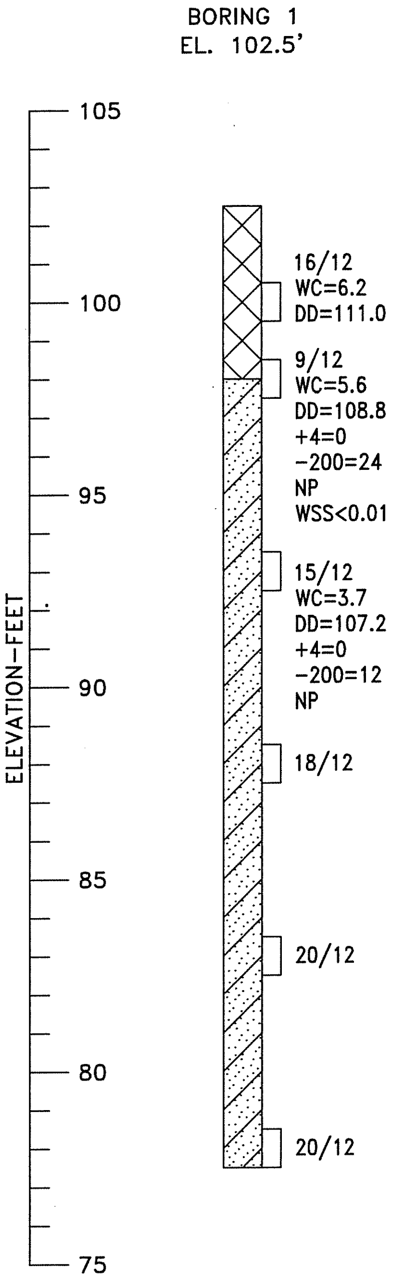


LEGEND

FILL: SILTY TO CLAYEY SAND, FINE TO MEDIUM GRAINED, SLIGHTLY MOIST, BROWN.

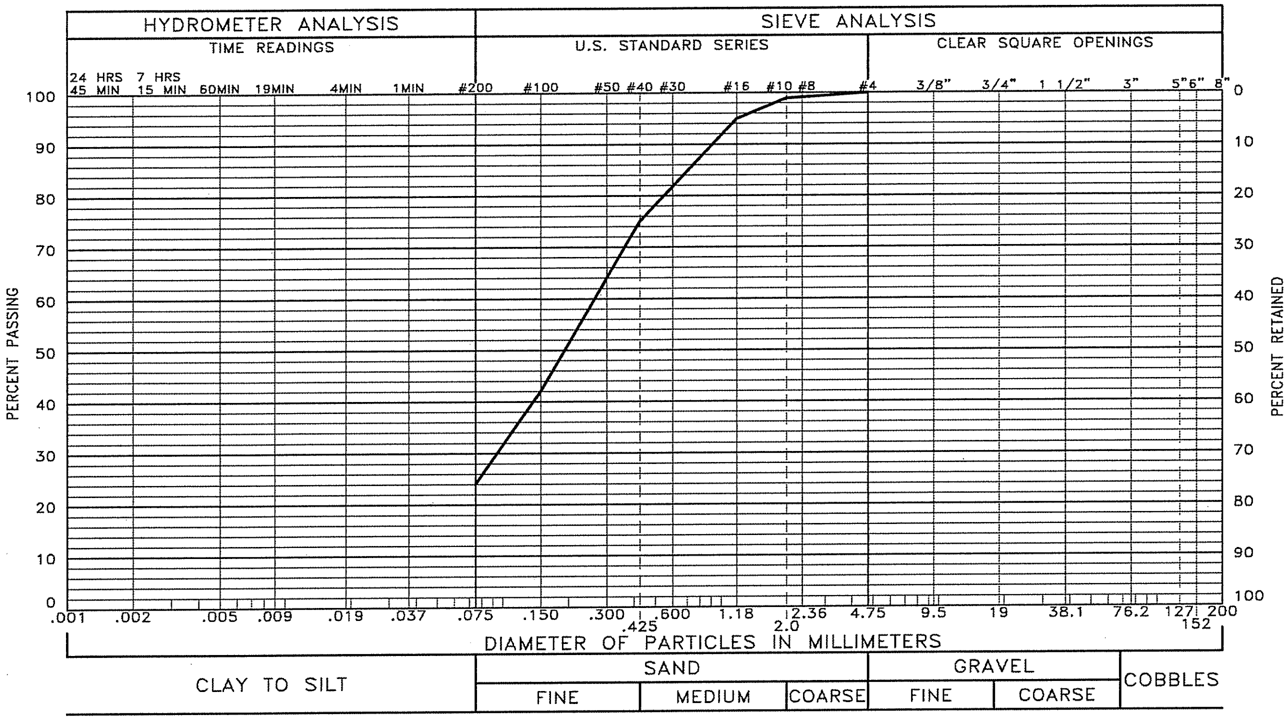
SILTY SAND TO POORLY GRADED SAND WITH SILT (SM,SP–SM), FINE TO MEDIUM GRAINED, LOOSE TO MEDIUM DENSE, SLIGHTLY MOIST, BROWN.

DRIVE SAMPLE, 2–INCH I.D. CALIFORNIA LINER SAMPLE.

16/12 DRIVE SAMPLE BLOW COUNT. INDICATES THAT 16 BLOWS OF A 140–POUND HAMMER FALLING 30 INCHES WERE REQUIRED TO DRIVE THE SAMPLER 12 INCHES.

NOTES

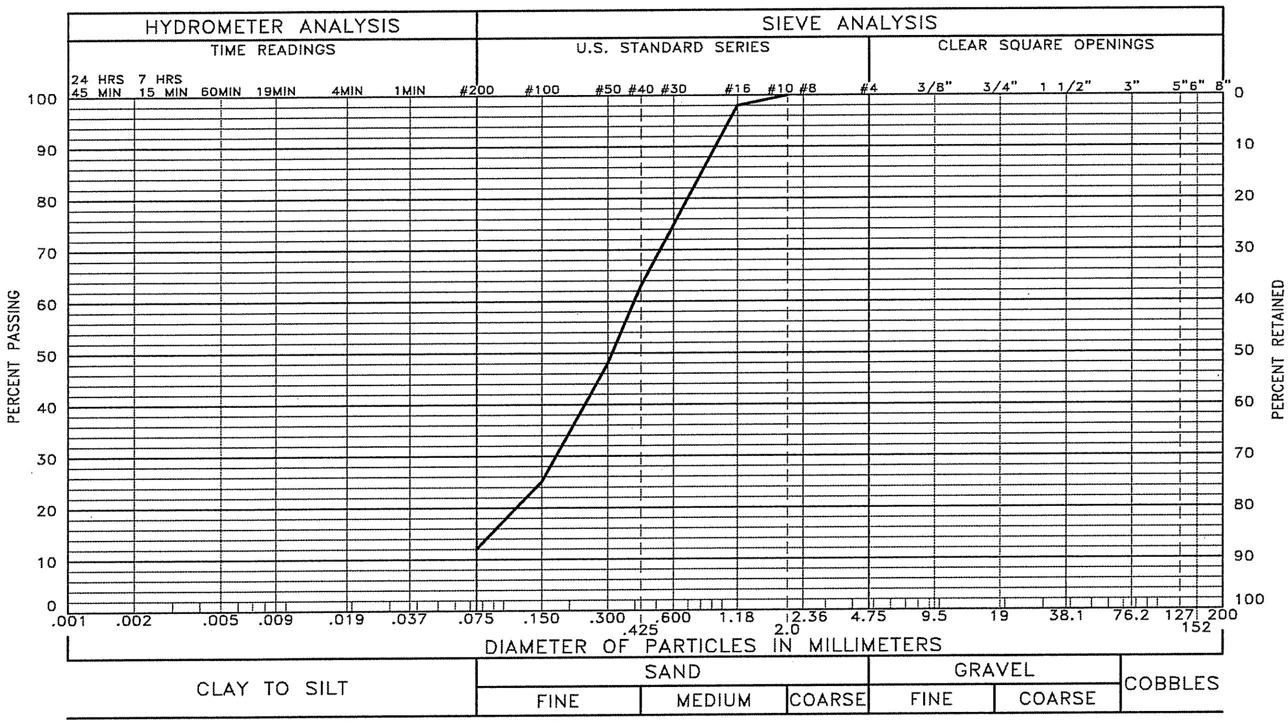
1. THE EXPLORATORY BORING WAS DRILLED ON SEPTEMBER 14, 2015, WITH A 4–INCH DIAMETER CONTINUOUS FLIGHT POWER AUGER.
2. THE LOCATION OF THE EXPLORATORY BORING WAS MEASURED APPROXIMATELY BY PACING FROM FEATURES SHOWN ON THE SITE PLAN PROVIDED.
3. THE ELEVATION OF THE EXPLORATORY BORING WAS OBTAINED BY INTERPOLATION BETWEEN CONTOURS ON THE SITE PLAN PROVIDED.
4. THE EXPLORATORY BORING LOCATION AND ELEVATION SHOULD BE CONSIDERED ACCURATE ONLY TO THE DEGREE IMPLIED BY THE METHOD USED.
5. THE LINES BETWEEN MATERIALS SHOWN ON THE EXPLORATORY BORING LOG REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES AND THE TRANSITIONS MAY BE GRADUAL.
6. GROUNDWATER WAS NOT ENCOUNTERED IN THE BORING AT THE TIME OF DRILLING. FLUCTUATIONS IN THE WATER MAY OCCUR WITH TIME.
7. LABORATORY TEST RESULTS:
   - WC = WATER CONTENT (%) (ASTM D 2216);
   - DD = DRY DENSITY (pcf) (ASTM D 2216);
   - +4 = PERCENTAGE RETAINED ON NO. 4 SIEVE (ASTM D 422);
   - −200 = PERCENTAGE PASSING NO. 200 SIEVE (ASTM D 1140);
   - NP = NON–PLASTIC (ASTM D 4318);
   - WSS = WATER SOLUBLE SULFATES (%) (CP–L 2103).



GRAVEL 0 % SAND 76 % SILT AND CLAY 24 %

PLASTICITY INDEX NP

SAMPLE OF: Fill: Silty Sand (SM) FROM: Boring 1 @ 4'



GRAVEL 0 % SAND 88 % SILT AND CLAY 12 %

PLASTICITY INDEX NP

SAMPLE OF: Poorly Graded Sand with Silt (SP-SM) FROM: Boring 1 @ 9'

These test results apply only to the samples which were tested. The testing report shall not be reproduced, except in full, without the written approval of Kumar & Associates, Inc. Sieve analysis testing is performed in accordance with ASTM D422, ASTM C136 and/or ASTM D1140.

15-2-166	Kumar & Associates	GRADATION TEST RESULTS	Fig. 3

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Kumar & Associates, Inc.

TABLE I

SUMMARY OF LABORATORY TEST RESULTS

Project No.: 15-2-166
Project Name: Deerfield Hills Community Center
Date Sampled: 9/14/2015
Date Received: 9/15/2015

SAMPLE LOCATION		DATE TESTED	NATURAL MOISTURE CONTENT (%)	NATURAL DRY DENSITY (pcf)	GRADATION		PERCENT PASSING NO. 200 SIEVE	ATTERBERG LIMITS		WATER SOLUBLE SULFATES (%)	SOIL OR BEDROCK TYPE (Unified Soil Classification)
BORING	DEPTH (ft)				GRAVEL (%)	SAND (%)		LIQUID LIMIT	PLASTICITY INDEX		
1	2	9/18/15	6.2	111.0							Fill: Clayey Sand
1	4	9/18/15	5.6	108.8	0	76	24		NP	<0.01	Fill: Silty Sand (SM)
1	9	9/15/15	3.7	107.2	0	88	12		NP		Poorly Graded Sand with Silt (SP-SM)