GREENBAUM ASSOCIATES, INC.
GEOTECHNICAL & MATERIALS ENGINEERS

994 Longfield Avenue
Louisville, Kentucky 40215
502/361-8447
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August 30, 2021

Ms. Laura Barlow
LDG Development, LLC
1469 S. 4th St.
Louisville, KY 40208

SUBJECT: GEOTECHNICAL REPORT
PROPOSED APARTMENT DEVELOPMENT
3323, 3325, AND 3331 FREY'S HILL ROAD
LOUISVILLE, KENTUCKY
GREENBAUM PROJECT NUMBER 21-106 G2

Dear Ms. Barlow:

Attached is the report of the geotechnical investigation that we carried out for the above referenced apartment development. Soils at this site are competent to support spread footings designed based on an allowable net bearing capacities in the range of 2,000- to 2,500- pounds per square foot. However, fat clay is present at this site. We recommend the use of lime stabilization of building and pavement subgrade to prevent swelling and softening of the fat clay, where it is present. Further detail on foundations and other geotechnical considerations are provided in the body of the attached report.

If you have any questions regarding this report, please call.

Sincerely,

GREENBAUM ASSOCIATES, INC.

Sandor R. Greenbaum

Sandor R. Greenbaum, P.E.
Principal Engineer

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GEOTECHNICAL INVESTIGATION

FOR

PROPOSED APARTMENT DEVELOPMENT

3323, 3325, AND 3331 FREY'S HILL ROAD

LOUISVILLE, KENTUCKY

FOR

LDG DEVELOPMENT, LLC

1469 SOUTH FOURTH STREET

LOUISVILLE, KY 40202

BY

GREENBAUM ASSOCIATES, INC.

994 LONGFIELD AVENUE

LOUISVILLE, KENTUCKY 40215

AUGUST 30, 2021

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APPENDIX

1.0 Introduction

LDG Development, LLC intends to build a new apartment development to be located on a site composed of parcels that include 3323, 3325, and 3331 Frey's Hill Road in Louisville, Kentucky. The bulk of this property is currently vacant, but the easternmost portion is occupied by an AT&T facility. This development is to consist of sixteen apartment buildings, a clubhouse and a swimming pool. 3331 Frey's Hill Road, the northern section of the property, has been used for dumping with various piles of earth and manmade materials such as demolition debris blocking access to the property in conjunction with a ring of trees surrounding the perimeter of the property. A boring location plan is included in the appendix of this report that shows the approximate boring locations relative to the proposed development. A site location plan is also included in the appendix of this report.

A karst survey was performed earlier and the locations of four potential karst features are identified in that report.

We were contracted by LDG Development, LLC to carry out a geotechnical investigation directed at determining the foundation and pavement support characteristics of the materials upon which this apartment development will be supported. Work was coordinated through Ms. Laura Barlow, Development Coordinator with LDG Development, LLC.

2.0 General Geology

The soils below this site are shown by the Kentucky Geological Survey to be residuum, the residual product of weathering of the local bedrock. It is shown by the Geological Survey to be underlain by the Louisville Limestone which it describes as:

> Dolomitic limestone and dolomite, yellowish gray to light olive gray, in quarry exposures interval more than 20 feet thick near top of lower half of unit has brownish cast; finely crystalline; argillaceous in zone about 15 to 20 feet above base; pyritic; thin to very thin bedded in upper part, thick bedded near base; bedding defined by stylolites; irregular rubbly bedding common; chert in discontinuous 0.2-foot-thick layers in uppermost few feet. Prominent bench forming massive beds at about 35 feet and at 60 feet above base of unit, used in obtaining supplementary structural data. Fossils include brachiopods, among which Pentamerus is fairly common. in a layer

about 20 feet above base, algal stromatolites, and corals; silicified remains of distinctive "chain" coral Halysites aids in distinguishing Louisville residual soils from those of overlying units. Unit thins irregularly northward from between 70 and 80 feet thick along south edge of quadrangle to between 40 and 45 feet along north edge, owing to truncation by pre-Jeffersonville erosion. Contact with underlying unit abrupt to gradational through less than 1 foot. Sinks develop in unit on uplands.

3.0 Investigation

A total of 19 borings were performed across the accessible portion of the site to 15-feet depth or auger refusal, the shallower, by standard penetration procedures. Diedrich D-25 and GeoProbe D66DT track-mounted drill rigs were used to carry out the borings through the use of 2-¼ and 3-¼ inch inside diameter hollow stem augers and automatic hammers. Boring locations were staked using a nylon tape from existing topography, so boring locations are only as accurate at this method allows.

The standard penetration procedure involves driving a standard 2-inch diameter split spoon in the formation at selected intervals using a 140-pound hammer falling through 30 inches. The blow counts for each 6 inches of drive, to a total of 18 inches, are recorded and the number of blows for the 12 inches after the first 6 inches is a standard measure of the condition of the soil. As the split spoon is removed from the ground, it retrieves a sample of the soil in a disturbed condition. Nevertheless, this sample is suitable for certain classification tests and is representative of the soils at the depth tested.

Soil samples were returned to the laboratory where a program of testing was carried out. This testing included a grain size analysis, an Atterberg Limits' test and a natural moisture determination.

Grain size determination arrives at a curve of grain size against that fraction of the soil that is finer than that particular grain size. It also allows the determination of the clay fraction, silt fraction, sand fraction, etc. in any particular soil sample. Based on this division of grain sizes, the field soils classifications are refined and the boring logs adjusted. In the case of fine grained soils, the soils are largely silt and clay; thus requiring that the soils be suspended in an aqueous medium and the rate at which the particles drop out is measured in order to arrive at the grain size distribution. Silt and clay grains are so fine that sieve analysis alone will not function in this range. The coarse fraction of this sample is

separated from the fine and run through a nest of sieves in order to further detail the grain size distribution in the coarse range. In this case only the sieve analysis portion of the test was performed since little sand and silt was present in the soil samples selected for testing.

The Atterberg Limits determination arrives at those moisture contents at which the soil turns from a solid state to a plastic condition (the Plastic Limit) and then from a plastic condition to a liquid condition (The Liquid Limit). The points in question are arrived at by standard procedures that accept specific cohesive and flow properties of the soil as standards for these limits. Knowing the moisture content of the soil in relation to these limits provides a broad measure of the soil strength and soil characteristics. The arithmetic difference between these two limits is called the Plasticity Index and all three together are used for classifying the soils in a number of standard systems.

The natural moisture determination arrives at the in-situ moisture content of the soil and is useful for correlating the strength of various samples of like texture and in conjunction with the Atterberg limits, gives a strong measure of the strength range the soils are likely to be found in.

4.0 Findings

4.1 Boring Results

Most of this site is covered by 4- to 8-inches of topsoil. However, the easternmost portion of the property, the AT&T property, is covered by 3- to 4-inches of asphalt over 4- top 10-inches of crushed stone. There is also a gravel strip along that property covered by 4- to 18-inches of crushed stone.

Below the surface cover, the shallow soils are moist, medium stiff to very stiff, brown, lean clay to about 3- to 4-feet depth, though this lean clay is frequently absent. The underlying soil, and the uppermost soil where the lean clay is absent, is moist, medium stiff to very stiff, reddish brown, fat clay with ferromagnesian nodules and, frequently, chert. Coloration of the fat clay in some of the deeper samples differs. Bedrock is limestone and was encountered as shallow as 9.7 feet but is deeper than the 15-foot termination depth of the borings in about half of the borings performed. No water was encountered in any of the borings.

The tables below provide a tabulation of N-values as measured by the standard penetration test, corrected for the energy of the automatic hammer, as well as depth to auger refusal, where encountered.

Depth	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08	B-09	B-10
1 – 2.5 feet	18	21	20	9	7	13	14	17	9	10
3.5 – 5 feet	17	12	14	14	9	12	12	16	13	13
6 – 7.5 feet	21	20	26	23	17	12	14	22	18	14
8.5 – 10 ft.	22	23	3	22	27	7	17	13	14	50/2"
13.5 – 15 ft.	50/1"	50/2"	7		33	8	7	3		
Refusal	14.1'	13.7'		11.6'					10.3'	9.7'

Depth	B-11	B-12	B-13	B-14	B-15	B-16	B-17	B-18	B-19
1 – 2.5 feet	8	13	8	38	16	9	9	10	14
3.5 – 5 feet	8	14	5	12	15	12	12	10	7
6 – 7.5 feet	5	13	5	18	25	7	10	13	30
8.5 – 10 ft.	9	12	9	8	39	8	14	22	14
13.5 – 15 ft.	13				13	5	12	14	14
Refusal		13.0'	13.2'	12.6'					

4.2 Laboratory Results

A sample of soil was tested and classified and was found to be fat clay. This fat clay is very plastic, indicating it may have a high swell potential. The result of this testing is summarized in the table below with more detailed results provided in the appendix of this report. Moisture content, where performed, is shown graphically on the boring logs.

Soil Sample	Grain Size Distribution			Atterberg Limits			Soil Classification	
	Percent Sand	Percent Silt	Percent Clay	Liquid Limit	Plastic Limit	Plasticity Index	Unified	AASHTO
B-02 @ 1' – 2.5'	3	19	78	93	19	74	CH	A-7-6

4.3 Historic Aerial Photographs

Aerial photographs dating back to 1985, available on Google Earth, were examined. The 1985 image is of such a large scale that no detail can be discerned at this site. In the 1993 photograph, included in the appendix of this report, structures can be seen on the 3331 Frey's Hill Road property, but none on the southern properties other than those present today on the AT&T property. More recent images show the northern property being used for storage of large objects, then they are removed, and the property becomes overgrown. There is no significant change to the southern parcels.

4.4 Seismicity

By the 2018 edition of the Kentucky/International Building Code, this is a Very Dense Soil and Soft Rock Profile, Site Class C. The Spectral Response Acceleration Coefficients, for this area, as provided by U.S.G.S., FEMA Design Parameters are:

$S_S = 0.192$ g	$S_{MS} = 0.230$ g	$S_{DS} = 0.154$ g
$S_1 = 0.101$ g	$S_{M1} = 0.172$ g	$S_{D1} = 0.115$ g

5.0 Recommendations

5.1 Foundations

The proposed buildings may be supported on spread footings bearing on shallow soil or structural fill placed in accordance with section 5.3 of this report. The buildings proposed for the western and central portions of the site may have foundations designed based on an allowable net bearing capacity of up to 2,500 pounds per square foot. Those in the eastern portion of the site and on the 3331 Frey's Hill Road property should have a lower allowable net bearing capacity of no more than 2,000 pounds per square foot. This includes the easternmost two rows of buildings. Water is standing on portions of the 3331 Frey's Hill Road property, so it is likely that undercut and refill will be required on this property. This property could not be accessed to perform borings due to piles of dumped materials blocking access from the west and trees surrounding the perimeter of the property not blocked by dumped materials.

Much of the soils at this stie are fat clay, so where foundations bear in areas that are in cut or where foundations bear on soils taken from cut areas, the bearing strata may be fat clay. Where fat clay is encountered in foundation bearing surfaces, it will have to be undercut at least one foot and must be replaced with either lean clay compacted in accordance with the requirements of section 5.3 or lean concrete (lean concrete only where significant depth of soil remains below the foundation bearing level). In addition, foundations must be poured wall to wall in the foundation excavation to limit percolation.

Once foundation bearing surfaces are exposed, an engineer or senior engineering technician from this office should be present to view all bearing surfaces. Where soft areas are encountered, undercut will need to extend to firm material or to a level determined to be acceptable by the geotechnical engineer **and should be refilled with either lean concrete (fc' = 2,000 psi) or open**-graded stone such as Number 57 stone. If topsoil is encountered in the foundation bearing surface, it should be removed and should be replaced as discussed above.

Soil bearing foundations exposed to weather must bear at least 30 inches below finished grade in order to insulate the bearing strata from freezing. Interior foundations protected from freezing are exempt from this requirement. Continuous footings must be at least 16 inches wide and isolated footings must be at least 24 inches wide.

Settlement of foundations designed based on the above criteria should be below that which is considered acceptable for this type of construction; that is total settlement should be less than one inch and differential settlement should be less than three quarters of an inch.

For shallow foundations, friction along the base of the footing can be used to resist lateral forces. A friction coefficient of 0.35 may be used, which assumes that the footing concrete is placed directly against the natural cut faces. The coefficient of friction value recommended is an ultimate value and a minimum factor of safety of 1.5 must be applied when determining the allowable sliding resistance.

5.2 Slab-On-Grade

Prior to placement of the fill in the slab area, the subgrade must be proofrolled and carefully examined by a geotechnical engineer for areas of soft or loose soil. If soft or loose soils are encountered, they must be undercut and **refilled in accordance with instructions given by the geotechnical engineer's on-site** representative. Undercut and refill in soft areas consists of excavating to a depth

up to two feet below subgrade elevation and refill should be with "Surge Rock", 6-inch minus or Number 3 stone. Large rock should not be used in areas where trenching will be required to install piping or conduit. Where fat clay is present, lean clay must be used as backfill.

Should fat clay be found to be in the subgrade of slab-on-grade, there are two means of preventing the problem of softening and swelling below the slab. These are:

- Lean clay should be used as fill in the top foot in fill areas and the top foot of soil in cut areas should be replaced with lean clay where fat clay is found to be present.
- The slab subgrade should be treated with 5 percent lime to at least 12 inches depth to modify the fat clay so that it is no longer subject to unacceptable volume change.

Given the prevalence of fat clay and lack of lean clay at this site, chemical stabilization of slab subgrade using lime is likely to be less expensive than undercut and refill with lean clay. To keep the cost of lime stabilization to a minimum, as much slab and pavement subgrade should be stabilized at one time as possible. Given how fat this clay is, not treating the clay by one of the two methods discussed would almost certainly result in movement of the slab-on-grade and thickened-slab foundations. In addition to floors cracking and being out-of- level. Doorways will become out-of-square and interior plumbing may be affected.

A slab-on-grade that is structurally separated from the walls, columns and foundations is preferable, though thickened slab may be used. Separation of slab-on-grade from foundations will minimize the stress caused by possible differential settlement between the slabs and the foundations and between adjacent slabs. A vapor barrier must be incorporated into the design and at least four inches of Dense Graded Aggregate (DGA) should underlie the slab. The floor slab may be designed based on a Modulus of Subgrade Reaction of 75 kips per cubic foot.

5.3 Site Preparation and Earthwork

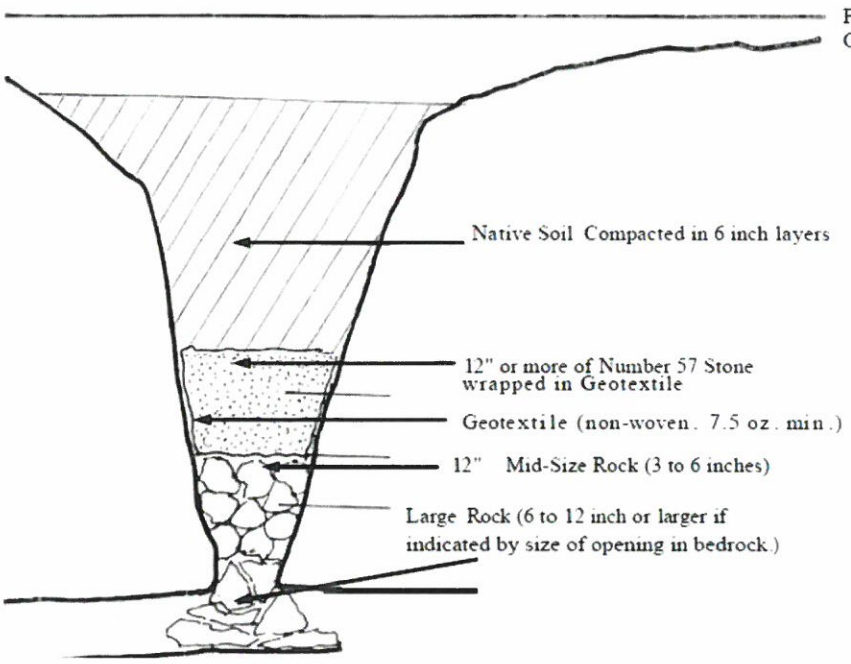
Prior to fill placement all vegetation and topsoil (soil containing more than 4 percent organic content) must be removed from below the area to be filled. Where trees or bushes have been present, the entire rootball should be removed and the resulting excavation should be refilled with soil compacted as described in this section of the report. Then, prior to placement of fill, the exposed subgrade should

be proofrolled by a fully loaded tri-axle truck to delineate any yielding or rutting areas that may require treatment such as undercut and refill or drying.

All fill should be placed in lifts not exceeding 8 inches in uncompacted thickness and must be compacted to at least 98 percent of the soils maximum dry density as determined by the Standard Proctor (ASTM D-698). Soil moisture content should be within 2 percent of optimum as determined from the Standard Proctor.

The site should be maintained in a well-drained condition both during and after construction. Site grading should provide for drainage of surface run-off away from the proposed building and pavement.

A few of closed contour depressions that are potential sinkholes were discovered as part of an earlier karst investigation. If a sinkhole is discovered during earthwork, a geotechnical engineer from this office should be consulted. Sinkholes must be treated by excavating to expose the opening in the rock and installing a filter constructed of non-woven geotextile and Kentucky Number 57 Stone as is illustrated below. Springs must be treated by installation of a spring box and pipe to divert flow to an area that will not affect use of the site, but these are probably present along the stream to the east, where they will not effect construction. Treatment of karst features must be performed under the direction of a geotechnical engineer from this company.



Soil from any off-site borrow sources should be tested and approved by this office prior to being used on the site. Satisfactory borrow materials are those falling in one of the following classifications: GC, SM, SC, ML, or CL. Soil types MH, CH and OH soils and peat are unsatisfactory borrow materials. To the extent possible, fat clay (CH) should be reserved for deep fill, that at least a foot below foundation bearing surfaces and a foot below pavement subgrade.

The placement of compacted fill should be carried out by an experienced excavator with the proper materials. The excavator must be prepared to adapt his procedures, equipment and materials to the type of project, to weather conditions, and the structural requirements of the engineer. Methods and materials used in summer may not be applicable in winter; soil used in proposed fill may require wetting or drying for proper placement and compaction. Conditions may also vary during the course of a project or in different areas of this site. These needs should be addressed in the project drawings and specifications.

During freezing conditions, the fill must **not** be frozen when delivered to the site. It also must not be allowed to freeze during or after compaction. Since the ability to work the soil while keeping it from freezing depends in part on the soil type, the specifications should require the contractor to submit a sample of his proposed fill before construction starts, for laboratory testing. If the soil engineer determines that it is not suitable, it should be rejected. In general, silty sand, clayey sand, and cohesive/semi-cohesive soils should not be used as fill under freezing conditions. All frozen soil of any type should be rejected for use as compacted fill.

It is important that compacted fill be protected from freezing after it is placed. The excavator should be required to submit a plan for protecting the soil. The plan should include details on the type and amount of material (straw, blankets, extra loose fill, topsoil, etc.) proposed for use as frost protection. The need to protect the soil from freezing is ongoing throughout construction and applies both before **and** after concrete is placed, until backfilling for final frost protection is completed. Foundations placed on frozen soil can experience heaving and significant settlement, rotation, or other movement as the soil thaws. Such movement can also occur if the soil is allowed to freeze **after** the concrete is placed and then allowed to thaw. The higher the percentage of fines (clay and silt) in the fill, the more critical is the need for protection from freezing.

The contractor should be required to adjust the moisture content of the soil to within a narrow range near the optimum moisture content (as defined by the applicable Proctor or AASHTO Test). In general, fill should be placed within 2% of optimum moisture. The need for moisture control is more critical as the percentage of fines increases. Naturally occurring cohesive/semi-cohesive soil are often much wetter than the optimum. Placing and attempting to compact such soils to the specified density may be difficult. Even if compacted to the specified density, excessively wet soils may not be suitable as pavement subgrades due to pumping under applied load. This is especially true when wet cohesive/semi-cohesive soil is used as backfill in utility trenches and like situations. Excessively wet soil in thick fill sections may cause post-construction settlement beyond that estimated for fill placed at or near (±2%) the optimum moisture content.

5.4 Earth Pressures

Any retaining walls should be constructed with a drainage blanket of sand or a synthetic drainage material. Synthetic drainage media should be available from suppliers of geotextile. The wall should be drained at its base by a perforated PVC underdrain or weepholes at a spacing of not more than 10 feet. Where a relatively thin drainage blanket is used, the retaining wall should be designed based on a coefficient of active earth pressure (K_a) of 0.36 and a soil unit weight (γ_w) of 130 pounds per cubic foot. This results in an equivalent fluid pressure of 47 pounds per cubic foot. Where granular backfill completely fills the area defined by a plane extending upward from the base of the wall at a 45-degree angle, the retaining wall may be designed based on a coefficient of active earth pressure (K_a) of 0.27 and a soil unit weight (γ_w) of 130 pounds per cubic foot. This results in an equivalent fluid pressure of 35 pounds per cubic foot.

However, where the wall is restrained from movement, as in the case of building basement walls bearing against the basement slab or building frame, the wall must be designed based on the "at rest" earth pressure. The coefficient of "at rest" earth pressure (K_0) is 0.47 with a soil unit weight (γ_w) of 130 pounds per cubic foot in the case of a thin drainage blanket behind the wall, resulting in an equivalent fluid of 61 pounds per cubic foot unit weight. Where granular backfill completely fills the area defined by a plane extending upward from the base of the wall at a 45-degree angle, the retaining wall may be designed based on a coefficient of "at rest" earth pressure (K_0) of 0.43 and a soil unit weight (γ_w) of 130 pounds per cubic foot. This results in an equivalent fluid pressure of 56 pounds per cubic foot.

The table below summarizes the design earth pressures.

	Active Earth Pressure Coefficient (K_a)	Passive Earth Pressure Coefficient (K_p)	Coefficient of Earth Pressure at Rest (K_0)	Equivalent Fluid Pressure on Cantilever Walls	Equivalent Fluid Pressure on Braced Walls
Fill Material/Local Soils	0.36	2.77	0.47	47 pcf	61 pcf
Granular Backfill	0.27	3.69	0.43	35 pcf	56 pcf

Surcharge above the wall will add additional load. A uniform surcharge must be multiplied by the appropriate coefficient of earth pressure to determine the additional load applied to the wall.

Any retaining wall design must use appropriate factors of safety. It is critical that drainage be provided as mentioned earlier in this section in order to avoid hydrostatic pressure. Hydrostatic pressure would increase pressure against the wall substantially.

5.5 Light- and Heavy-Duty Pavement

Pavement subgrade should be examined and proofrolled as described under "Floor Slabs". If soft areas are encountered, the soft soils will need to be undercut and refilled in accordance with the instructions of the geotechnical engineer's on-site representative. Subgrade stabilization was discussed in section 5.2 for slab-on-grade. The same approach should be taken for pavement subgrade, but the requirement for a stable, non-yielding subgrade is even more important in the case of asphalt pavement. Lime stabilization of pavement subgrade will probably be the least expensive means to ensure adequate pavement support given the widespread presence of fat clay.

A pavement analysis was conducted using a life cycle of 20 years and a cumulative 18-kip equivalent single axle load of 20,000 for light traffic loads and 160,000 for moderate traffic loads. Recommendations are provided for both flexible and rigid pavement systems. However, rigid pavement should be used in special truck traffic areas, such as those areas which receive frequent traffic by garbage trucks. The concrete pavement should extend throughout the areas that require extensive turning and maneuvering of garbage trucks or other heavy trucks. Heavily loaded pavement areas that are not designed to accommodate

these conditions often experience localized pavement failures, particularly if flexible pavement sections are used.

The minimum recommended thickness for both hot mixed asphalt concrete (HMAC) and reinforced Portland cement concrete (PCC) pavement sections are presented in the table below for the described light, moderate and special traffic condition.

Recommended Pavement Section					
Component	Light		Moderate		Special
	Rigid	Flexible	Rigid	Flexible	Rigid
Reinforced Portland Cement Concrete (PCC)	5 inches		6 inches		7 inches
Hot Mixed Asphalt Concrete (HMAC)		3 inches		4 inches	
Crushed Limestone Base (Dense Graded Aggregate)	4 inches	8 inches	4 inches	8 inches	4 inches

The Portland cement concrete should be air-entrained and conform to ASTM C-94 (Standard Specifications for Ready-Mixed Concrete) and have a minimum compressive strength of 4,000 pounds per square inch. Reinforcing should meet the requirements of ACI.

Hot mix asphalt concrete and Dense Graded Aggregate should meet the requirements of the Kentucky Transportation Cabinet. The top inch and a half of asphalt should be a surface mix, the remainder being a base mix.

5.6 Temporary Earth Slopes or Cuts

Temporary earth cuts necessary to construct foundations or utility lines should be no deeper than 4 feet without benching or sloping. Cuts deeper than this should be sloped no steeper than one horizontal to one vertical or should have benches every 2 feet of height equating to this slope. If vertical faces deeper than 4 feet are used, bracing designed for short term loads may be used. Excavations should comply with OSHA regulations. If soft soils are encountered, Greenbaum Associates, Inc. should view the cut face prior to personnel entering the excavation.

5.7 Limitations

We strongly recommend that bearing surfaces and compaction be monitored by Greenbaum Associates, Inc. Our technicians will be available to further assist you in providing these and other normally specified quality control

services. The report is preliminary until such time as these examinations are completed to confirm conditions consistent with those discovered in the investigation.

The conclusions and recommendations offered in this report are based on the subsurface conditions encountered in the borings. No warranties can be made regarding the continuity of conditions between or beyond borings. If, during construction, soil conditions are encountered that differ from those indicated in this report, a representative of Greenbaum Associates, Inc. should inspect the site to determining if design modification is required.

This study was directed at a specific apartment development and associated pavement at this location to be constructed within a reasonably short period after this study. Use for any other location, structures or substantial changes in construction period may invalidate the recommendations. The geotechnical engineer should be consulted relative to any substantial change in these.

This study is directed at mechanical properties of the soils and includes no sampling, testing or evaluation for environmental considerations.

LDG Development, LLC	Greenbaum Associates, Inc.	**Site Location Plan** Proposed Apartment Development 3323, 3325, & 3331 Frey's Hill Rd., Louisville, KY Greenbaum Project Number: 21-106 G2

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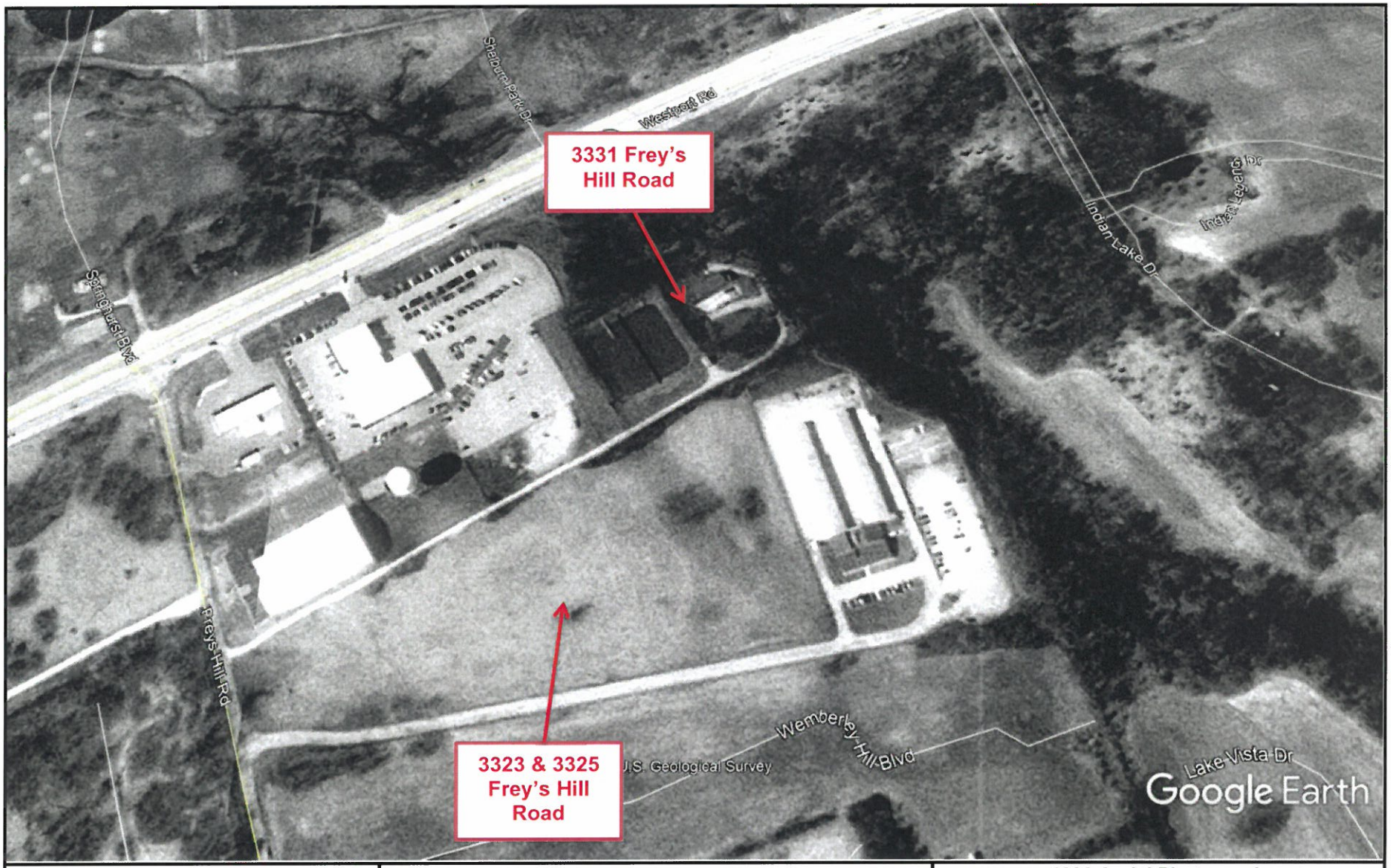
LDG Development, LLC	Greenbaum Associates, Inc.	**Boring Location Plan** Proposed Apartment Development 3323, 3325, & 3331 Frey's Hill Rd., Louisville, KY Greenbaum Project Number: 21-106 G2



LDG Development, LLC	Greenbaum Associates, Inc.	**1993 Aerial Photograph** Proposed Apartment Development 3323, 3325, & 3331 Frey's Hill Rd., Louisville, KY Greenbaum Project Number: 21-106 G2

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SEP 08 2021
PLANNING & DESIGN SERVICES

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SOIL DESCRIPTION TERMINOLOGY

Soils are identified and classified in this report according the the Unified Classification System with the following modifiers:

RELATIVE DENSITY OF GRANULAR SOILS

Description	Blows/Foot
Very Loose	0 to 4
Loose	5 to 10
Medium Dense	11 to 30
Dense	31 to 50
Very Dense	51 to 80
Extremely Dense	81+

CONSISTENCY OF COHESIVE SOILS

Description	N-value	q_u (tsf)
Very Soft	0 to 2	0 to 0.25
Soft	3 to 4	0.26 to 0.50
Medium Stiff	5 to 8	0.51 to 1.0
Stiff	9 to 15	1.1 to 2.0
Very Stiff	16 to 30	2.1 to 4.0
Hard	>30	4.1 to 8.0
Very Hard		8.1+

PARTICAL SIZES

Components		Size or Sieve No.
Boulders		over 12 inches
Cobbles		3 to 12 inches
Gravel -	Coarse	$^3/_4$ to 3 inches
	Fine	No. 4 to $^3/_4$ inch
Sand -	Coarse	No. 10 to No. 4
	Medium	No. 40 to No. 10
	Fine	No. 200 to No. 40
Fines (silt and clay)		Finer than No. 200

SOIL MOISTURE

	Descriptive Term
Dry	Dry of Standard Proctor Optimum
Damp	Moist (sand only)
Moist	Near Standard Proctor Optimum
Wet	Wet of Standard Proctor Optimum
Saturated	Free Water in Sample

ROCK DESCRIPTION TERMINOLOGY

The Rock Quality Determination (Deere et. Al., 1969) method of determining rock quality as reported here was obtained by summing up the total length of core recovered in each run, counting only those pieces of core which are four inches (10 cm.) in length or longer and which are hard and sound. The sum is then represented as a percentage over the length of the run. If the core is broken by handling or by the drilling process, the fresh broken pieces are fitted together and counted as one piece provided that they the requisite length of four inches (10 cm.). RQD is reported as a percentage.

RELATIONSHIP BETWEEN RQD AND ROCK QUALITY

RQD (%)	Description of Rock Quality
0 to 25	Very Poor
26 to 50	Poor
51 to 75	Fair
76 to 90	Good
91 to 100	Excellent

21-" ZONE -0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-01

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **Diedrich D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **14.1** Rock: **0** Total Depth: **14.1**
Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **8/9/21 - 8/9/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N VALUE
					Topsoil (7 inches)	OL	Ground	
		SPT			Moist, Very Stiff, Brown, Lean Clay	CL		14
		SPT			Moist, Very Stiff, Reddish Brown, Fat Clay	CH		13
5		SPT			Same, with Ferromagnesian Nodules and Chert	CH		16
		SPT			Moist, Very Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH		17
10		SPT			Same, Dark Brown	CH		>> 50/1"
					AUGER REFUSAL @ 14.1 FEET			

STANDARD PENETRATION TEST (blows/ft)
PL — MC — LL
10 20 30 40 50 60 70 80 90

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-01**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - [illegible] ZONE [illegible] - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-02

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **Diedrich D-25 Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **13.7** Rock: **0** Total Depth: **13.7**
Logged By: **S. Greenbaum** Driller: **B. Sumler** Date Logged: **8/9/21 - 8/9/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N VALUE
					Topsoil (7 inches)	OL	Ground	
		SPT			Moist, Very Stiff, Brown, Lean Clay	CL		16
		SPT			Moist, Stiff, Reddish Brown, Fat Clay	CH		9
5		SPT			Same, with Ferromagnesian Nodules	CH		15
		SPT			Moist, Very Stiff, Dark Brown, Fat Clay with Ferromagnesian Nodules	CH		18
10		SPT			Same, with Chert	CH		>> 50/2"
					AUGER REFUSAL @ 13.7 FEET			

STANDARD PENETRATION TEST
(blows/ft)
PL — MC — LL
10 20 30 40 50 60 70 80 90

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-02**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-03
Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **2 1/4 Inch ID Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/22/21 - 8/22/21**

DEPTH (feet)	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)
	SPT			Topsoil (6 inches)	OL	Ground
	SPT			Moist, Very Stiff, Brown, Lean Clay with Chert	CL	
5	SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH	
	SPT			Same, Very Stiff	CH	
10	SPT			Moist, Soft, Brown, Fat Clay with Weathered Limestone	CH	
	SPT			Same, Medium Stiff	CH	
15				TERMINATED @ 15.0 FEET		

STANDARD PENETRATION TEST (blows/ft)
PL — MC — LL
10 20 30 40 50 60 70 80 90

N VALUE: 15, 11, 20, 2, 5

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-03**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21-1 ZONE -0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-04

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **2 1/4 Inch ID Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **11.6** Rock: **0** Total Depth: **11.6**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/22/21 - 8/22/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST (blows/ft) PL MC LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (6 inches)	OL	Ground		
		SPT			Moist, Stiff, Brown, Lean Clay	CL			7
5		SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH			11
		SPT			Same, Very Stiff, with Chert	CH			18
10		SPT			Moist, Very Stiff, Yellowish Brown, Fat Clay with Ferrmagnesian Nodules	CH			17
					AUGER REFUSAL @ 11.6 FEET				

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-04**

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-05

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/22/21 - 8/22/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)
		SPT			Topsoil (5 inches)	OL	Ground
					Moist, Medium Stiff, Brown, Lean Clay	CL	
		SPT			Moist, Stiff, Reddish Brown, Fat Clay	CH	
5		SPT			Same, Very Stiff, with Ferromagnesian Nodules	CH	
		SPT			Same, with Chert	CH	
10		SPT			Same, Hard, with Weathered Limestone	CH	
15					TERMINATED @ 15.0 FEET		

STANDARD PENETRATION TEST (blows/ft)
MC
PL — LL
10 20 30 40 50 60 70 80 90

N VALUE: 5, 7, 13, 21, 25

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-05**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - N ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-06

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/19/21 - 8/19/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST (blows/ft)	N VALUE
					Topsoil (5 inches)	OL	Ground		
		SPT			Moist, Stiff, Brown, Lean Clay	CL			10
					Moist, Stiff, Reddish Brown, Fat Clay	CH			
		SPT							9
5									
		SPT			Same, with Ferromagnesian Nodules	CH			9
					Same, Medium Stiff	CH			
		SPT							5
10									
					Same, with Chert	CH			
		SPT							6
15					TERMINATED @ 15.0 FEET				

PL — MC — LL
10 20 30 40 50 60 70 80 90

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SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-06**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - " ZONE " - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-07

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/20/21 - 8/20/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST (blows/ft) PL MC LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (5 inches)	OL	Ground		
		SPT			Moist, Stiff, Brown, Lean Clay	CL			11
		SPT			Moist, Stiff, Reddish Brown, Fat Clay	CH			9
5		SPT			Same, Very Stiff, with Ferromagnesian Nodules	CH			11
		SPT			Same, Stiff	CH			13
10		SPT			Same, Medium Stiff	CH			5
15					TERMINATED @ 15.0 FEET				

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-07**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC	**HOLE No. B-08**
Project: Frey's Hill Road Apartments Louisville, KY	
Project No.: 21-106 G2	Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**

Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/20/21 - 8/20/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST (blows/ft)	N VALUE
					Topsoil (5 inches)	OL	Ground		
		SPT			Moist, Very Stiff, Brown, Lean Clay	CL			13
		SPT			Moist, Very Stiff, Reddish Brown, Fat Clay	CH			12
5		SPT							17
		SPT			Same, with Chert	CH			10
10		SPT			Moist, Soft, Gray and Brown Mottled, Fat Clay with Weathered Limestone	CH			2
15					TERMINATED @ 15.0 FEET				

PL — MC — LL

10 20 30 40 50 60 70 80 90

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

SAMPLER TYPE

SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD

HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-08**

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-09

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **10.3** Rock: **0** Total Depth: **10.3**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/20/21 - 8/20/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	N VALUE
					Asphalt (3 inches)	Ground	
					Crushed Stone (10 inches) GW		
		SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules CH		7
		SPT					10
5							
		SPT			Same, Very Stiff, with Chert CH		14
		SPT			Same, Stiff CH		11
10					AUGER REFUSAL @ 10.3 FEET		

STANDARD PENETRATION TEST
● (blows/ft)
PL — MC — LL
10 20 30 40 50 60 70 80 90

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SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-09**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - [illegible] ZONE [illegible] - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-10

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **9.7** Rock: **0** Total Depth: **9.7**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/21/21 - 8/21/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	N VALUE
					Asphalt (3 inches)	Ground	
					Crushed Stone (4 inches) GW		
		SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules CH		8
					Same, with Chert CH		
		SPT					10
5					Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules CH		
		SPT					11
					Same, Very Stiff CH		
		SPT			Highly Weathered Limestone		>> 50/2"
					AUGER REFUSAL @ 9.7 FEET		

STANDARD PENETRATION TEST
● (blows/ft)
PL MC LL
10 20 30 40 50 60 70 80 90

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PLANNING & DESIGN SERVICES

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-10**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - [illegible] ZONE [illegible] - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-11

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**

Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**

Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**

Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/21/21 - 8/21/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST (blows/ft)	N VALUE
					Asphalt (4 inches)	GW	Ground		
					Crushed Stone (7 inches)				
		SPT			Moist, Medium Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH		6	6
		SPT							
5		SPT						4	4
					Same, Stiff	CH			
		SPT						7	7
10									
		SPT							10
15					TERMINATED @ 15.0 FEET				

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-11**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-12

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **13.0** Rock: **0** Total Depth: **13.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/21/21 - 8/21/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	STANDARD PENETRATION TEST (blows/ft)	N VALUE
		SPT			Topsoil (5 inches) OL Moist, Stiff, Brown, Lean Clay CL	Ground		10
		SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules CH			11
5		SPT						10
		SPT						9
10					Same, with Weathered Limestone (hard drilling) CH			
					AUGER REFUSAL @ 13.0 FEET			

STANDARD PENETRATION TEST: (blows/ft) — MC — PL — LL — 10 20 30 40 50 60 70 80 90

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SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-12**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-13

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **13.2** Rock: **0** Total Depth: **13.2**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/21/21 - 8/21/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	STANDARD PENETRATION TEST (blows/ft)	N VALUE
					Crushed Stone (#57 Stone?, 4 inches) GP	Ground		
		SPT			Moist, Medium Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules CH			6
		SPT						4
5		SPT						4
		SPT			Same, Stiff CH			7
10					AUGER REFUSAL @ 13.2 FEET			

PL — MC — LL
10 20 30 40 50 60 70 80 90

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SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-13**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - [illegible] ZONE [illegible] - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-14

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **12.6** Rock: **0** Total Depth: **12.6**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/21/21 - 8/21/21**

DEPTH (feet)	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION	ELEVATION (feet)	N VALUE
				Crushed Stone (#3 Stone?, 18 inches) GP	Ground	
	SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules CH		29
5	SPT					9
	SPT			Same, Very Stiff, with Chert CH		14
	SPT			Same, Medium Stiff CH		6
10				AUGER REFUSAL @ 12.6 FEET		

STANDARD PENETRATION TEST
(blows/ft)
MC
PL LL
10 20 30 40 50 60 70 80 90

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PLANNING & DESIGN SERVICES

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-14**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-15

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/20/21 - 8/20/21**

DEPTH (feet)	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)
				Topsoil (4 inches)	OL	Ground
	SPT			Moist, Very Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH	
	SPT					
5						
	SPT			Same, Very Stiff	CH	
	SPT			Same, Hard, with Chert	CH	
10						
	SPT			Moist, Stiff, Brown, Fat Clay with Ferromagnesian Nodules	CH	
15				TERMINATED @ 15.0 FEET		

STANDARD PENETRATION TEST (blows/ft)
MC
PL LL
10 20 30 40 50 60 70 80 90

N VALUE: 12, 11, 19, 30, 10

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-15**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-16

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/19/21 - 8/19/21**

DEPTH (feet)	GRAPHIC LOG	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	STANDARD PENETRATION TEST (blows/ft) PL MC LL 10 20 30 40 50 60 70 80 90	N VALUE
					Topsoil (6 inches)	OL	Ground		
		SPT			Moist, Stiff, Brown, Lean Clay	CL			7
		SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH			9
5		SPT			Same, Medium Stiff	CH			5
		SPT							6
10									
		SPT							4
15					TERMINATED @ 15.0 FEET				

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SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-16**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-17

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/19/21 - 8/19/21**

DEPTH (feet)	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)
				Topsoil (6 inches)	OL	Ground
	SPT			Moist, Stiff, Brown, Lean Clay	CL	
	SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH	
5	SPT			Same, with Chert	CH	
	SPT					
10	SPT					
15				TERMINATED @ 15.0 FEET		

STANDARD PENETRATION TEST (blows/ft)
MC between PL and LL
10 20 30 40 50 60 70 80 90

N VALUE: 7, 9, 8, 11, 9

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-17**

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-18

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/19/21 - 8/19/21**

DEPTH (feet)	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)
				Topsoil (7 inches)	OL	Ground
	SPT			Moist, Stiff, Brown, Lean Clay	CL	
	SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH	
5	SPT			Same, with Chert	CH	
	SPT			Same, Very Stiff	CH	
10	SPT			Same, Stiff	CH	
	SPT					
15				TERMINATED @ 15.0 FEET		

STANDARD PENETRATION TEST
(blows/ft)
MC
PL — LL
10 20 30 40 50 60 70 80 90

N VALUE
8
8
10
17
11

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-18**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

21 - ZONE - 0102

Greenbaum Associates Inc
Louisville, Ky 40215 502-361-8447

Client: LDG Development, LLC
Project: Frey's Hill Road Apartments Louisville, KY
Project No.: 21-106 G2

HOLE No. B-19

Sheet 1 of 1

Boring Location: **See Boring Location Plan** Surface Elevation: **Ground** Station: **n/a**
Drilling Equipment: **GeoProbe 66T Track-Mounted Drill w/Auto Hammer** Drilling Method: **3 1/4 Inch Hollow Stem Auger**
Depth to water immediately: **Dry** Overburden: **15** Rock: **0** Total Depth: **15.0**
Logged By: **S. Greenbaum** Driller: **J. Kinderman** Date Logged: **8/19/21 - 8/19/21**

DEPTH (feet)	SAMPLE NO.	RECOVERY %	RQD %	MATERIAL DESCRIPTION		ELEVATION (feet)	N VALUE
	SPT			Topsoil (7 inches)	OL	Ground	
	SPT			Moist, Stiff, Brown, Lean Clay	CL		11
	SPT			Same, Medium Stiff	CL		5
5	SPT			Moist, Stiff, Reddish Brown, Fat Clay with Ferromagnesian Nodules	CH		23
	SPT			Same, with Chert	CH		11
10	SPT						11
15				TERMINATED @ 15.0 FEET			

STANDARD PENETRATION TEST
● (blows/ft)
MC
PL ▲ LL
10 20 30 40 50 60 70 80 90

SAMPLER TYPE
SS - Split Spoon
ST - Shelby Tube
HQ - Rock Core, 2-1/2"
NX - Rock Core, 2-1/8"
CU - Cuttings
CT - Continuous Tube

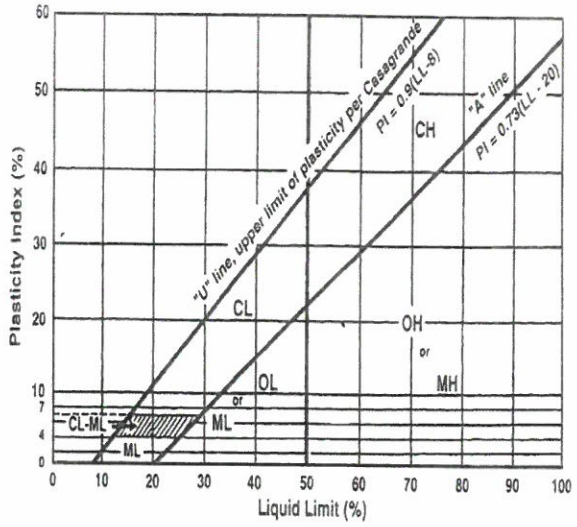
DRILLING METHOD
HSA - Hollow Stem Auger
CFA - Continuous Flight Augers
DC - Driving Casing
RW - Rotary Wash
RC - Rock Core

Hole No. **B-19**

LOG WITH WELL AND SPT GRAPH 21-106.GPJ 08-053.GPJ 8/30/21

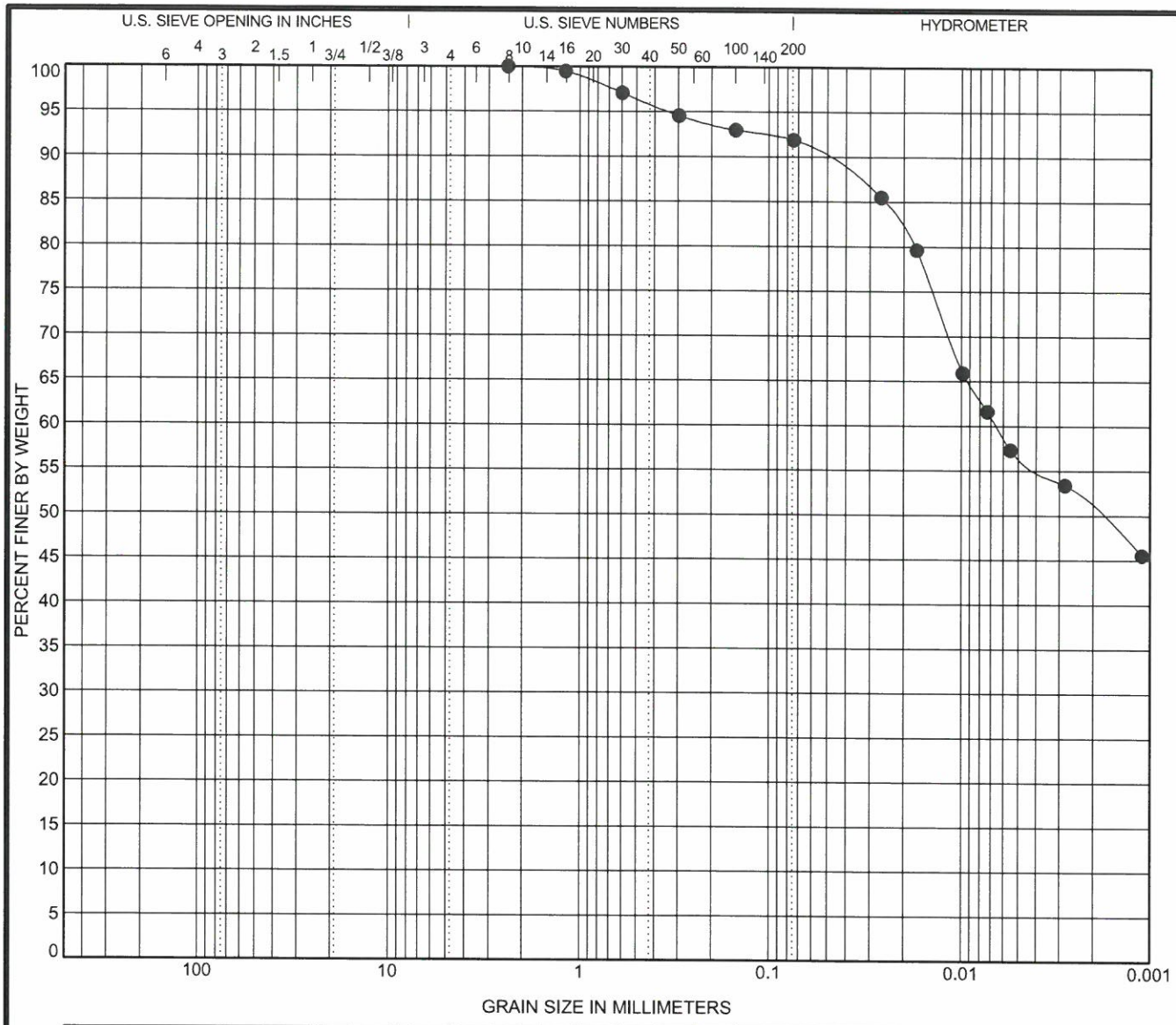
CLASSIFICATION OF SOILS FOR ENGINEERING PURPOSES

ASTM D2487 and D2488

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 larger than No. 4 sieve)	**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 that 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 requireing dual symbols[b] $C_u=D_{60}/D_{10}$ greater than 4 $C_u=(D_{30})^2/(D_{10}\times D_{60})$ 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 / u	Silty gravels, gravel-sand-silt mixtures	Atterberg limits below "A" line with P. I. less than 4 / Above "A" line with P. I. between 4 and 7 are *borderline* cases requireing us of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Atterberg limits below "A" line with P. I. greater 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 $C_u=(D_{30})^2/(D_{10}\times D_{60})$ 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 / u	Silty sands, sand-silt mixtures	Atterberg limits above "A" line or P.I. < 4 / Limits plotting in hatched zone with P.I. between 4 and 7 are *borderline* cases requireing use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Atterberg limits above "A" lime with P.I. > 7
Fine-grained soils (More than half meterial is smaller than No. 200 sieve)	Silts and clays (Liquid limit less than 50)		**ML**	Inorganic silts and very fine sands, silty or clayey fine sands, or clayey silts with slight plasticity	 Plasticity Chart
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
			OL	Organic silts and organic siltyclays of low plasticity	
	Silts and clays (Liquid limit less that 50)		**MH**	Inorganic silts, micaceous or diatomaceous fine sand or silty soils, elastic silts	
			CH	Inorganic slays 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 les; the suffix u used when L. L. is greater than 28.

[b] Borderline classifications, used for soils possessing characeristics of two groups, are designated by combinations of group symbols. For exampls: GW-GC, well-graded gravel-sand misture with clay binder.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-02	4.0	FAT CLAY(CH)	93	19	74		

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-02	4.0	2.38	0.007			0.0	8.1	35.1	56.8

Greenbaum Associates Inc
Louisville, Ky 40215
502-361-8447

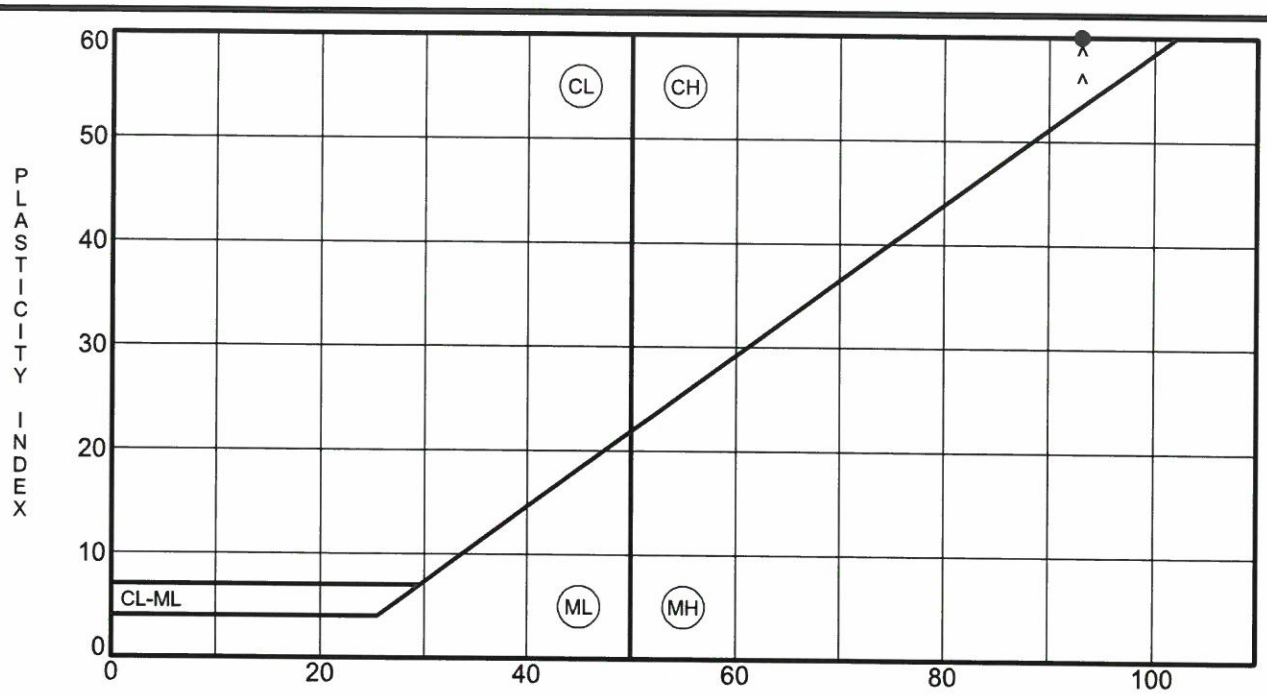
GRAIN SIZE DISTRIBUTION

Project: Frey's Hill Road Apartments

Location: Louisville, KY

Number: 21-106 G2

US GRAIN SIZE 2 10-20 J GREENBAUM.GDT 8/30/21



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-02**	**4.0**	**93**	**19**	**74**	**92**	**FAT CLAY(CH)**

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Greenbaum Associates Inc
Louisville, Ky 40215
502-361-8447

ATTERBERG LIMITS' RESULTS

Project: Frey's Hill Road Apartments
Location: Louisville, KY
Number: 21-106 G2

US ATTERBERG LIMITS 21-106.GPJ GREENBAUM.GDT 8/30/21

21- ZONE -0102