November 24, 2009

GEOSCIENCE GROUP, INC.

RPA Design, P.C.
5960 Fairview Road, Suite 500
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Attention: Mr. Cullen Keen
Project Manager

Reference: Report of Geotechnical Subsurface Exploration
Hefner VA Medical Center
Building 42 Additions & Renovations
Salisbury, North Carolina
Geoscience Project No. CH09.0088.GE

Geoscience Group, Inc. (Geoscience) has completed the subsurface exploration and geotechnical evaluation for the referenced project. This work was authorized by RPA Design, P.C., and performed in general accordance with Geoscience Proposal No. CH09.175P.GE. The purpose of this exploration was to determine the general subsurface conditions at the site, and to evaluate those conditions with regard to foundation support and site development. This report presents our findings along with our geotechnical conclusions and recommendations for design and construction of the project.

SCOPE OF EXPLORATION

The geotechnical subsurface exploration was performed to determine the suitability of the project site for supporting the new building and pavement construction. Geoscience performed eight (8) soil test borings, two (2) asphalt cores and three (3) soft digs at the approximate locations shown on the Test Location Diagram, Drawing No. CH09.0088.GE-1, included in the Appendix. The test locations were selected by the civil engineer (ColeJenest & Stone, P.A.) and the structural engineer (Zapata Engineering), and were approximated in the field by an engineer from Geoscience using the existing site features as reference. These investigative procedures are outlined separately below. In addition, elevations referenced in this report were interpolated from the topographic survey map prepared by R.B. Pharr & Associates, P.A.

Soil Test Borings: Eight (8) soil test borings (B-1 through B-8) were performed in the area of the proposed building and pavement construction. The soil test borings were advanced to depths ranging from approximately 10 to 35 feet below the ground surface using continuous-flight, hollow-stem augers; drilling fluid was not used in this process. Standard Penetration Tests were performed in the soil test borings at designated intervals in general accordance with ASTM D 1586-84. The Standard Penetration Test is used to provide an index for estimating soil strength and density. In conjunction with the penetration testing, split-barrel soil samples were recovered for soil classification and potential laboratory tests. Also, a bulk sample of the auger cuttings was obtained from soil test boring B-2 and returned to our laboratory for testing.

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Asphalt Cores: Two (2) asphalt cores (AC-1 and AC-2) were performed to determine the thickness of the existing asphalt pavements. Once the asphalt was cored, a hand auger was used to determine the stone thickness. The core samples recovered during the field exploration were returned to our laboratory for thickness measurements and visual inspection. The following table, Table No. CH09.0088.GE-1, presents the results of these measurements.

Table CH09.0088.GE-1

Core Designation	Asphalt Thickness (Inches)	Stone Thickness (Inches)
AC-1	3	3¾
AC-2	3	3½

Soft Digs: Three (3) soft digs (SD-1, SD-2 and SD-3) were performed to determine the location and depth of the below-grade sanitary sewer, storm sewer and electric utilities. However, at the time our field services were performed, the clean-outs for the sanitary sewer and storm sewer utilities were located in the field by an engineer from Geoscience. Since the clean-outs were located very close to the proposed soft dig locations, the soft digs were not performed. Once the utilities were located, a tape measure was used to determine the depth to the top of the utility and each test location was staked in the field for the project surveyors. The following table, Table No. CH09.0088.GE-2, presents the results of the soft digs.

Table CH09.0088.GE-2

Test Location	Ground Surface Elevation (feet-MSL)	Depth To Top Of Utility (feet)
SD-1*	687.4	8.7
SD-2*	687.4	3.7
SD-3	695.0	4.8

*The clean-outs were used to determine the depth of the sanitary and storm sewer utilities

Laboratory Services: The laboratory services provided for this project included visual classification of the soil samples by the project engineer. The color, texture and plasticity characteristics were used to identify each soil sample in general accordance with the Unified Soil Classification System (USCS). The results of the visual classifications are presented on the Test Boring Records included in the Appendix.

The laboratory testing performed on the bulk sample obtained from soil test boring B-2 consisted of a natural moisture content determination, an Atterberg Limits test, a Standard Proctor compaction test and California Bearing Ratio tests. The samples for the California Bearing Ratio tests were placed at various moisture contents and compaction criteria to determine the range of CBR values for these different conditions. The purpose of this laboratory testing was to evaluate the remolded soil properties with regard to pavement support. A brief description of the laboratory tests and the results obtained are included in the Appendix.

SITE AND SUBSURFACE FINDINGS

Site: The Hefner Veterans Affairs Medical Center is located at 1601 Brenner Avenue in Salisbury, North Carolina. Building 42, the subject of this investigation and report, is located in the westernmost portion of the medical center. The project area is located on the west and south sides of Building 42. The groundcover includes a combination of lawn grass, landscaped areas, asphalt pavements and concrete walkways. In addition, several below-grade utilities extend across the project area. The finished floor elevation of Building 42 is located at 688 feet (MSL). The ground surface outside the building ranges in elevation between 685 and 695 feet (MSL), and generally slopes downward towards an existing detention pond located southwest of Building 42.

Subsurface: The subsurface conditions at the site, as indicated by the soil test borings, generally consist of a surface layer of existing fill that is underlain by residual soils which have formed from the in-place weathering of the underlying parent bedrock. The generalized subsurface conditions are outlined below and illustrated on the Generalized Subsurface Profile, Drawing No. CH09.0088.GE-2, included in the Appendix. For soil descriptions and general stratification at a particular boring location, the respective Test Boring Record should be reviewed.

An upper layer of topsoil and roots was encountered in all the soil test borings to depths ranging from approximately ¼ to ½ foot. Beneath this topsoil in borings B-2, B-3, B-4, B-5, B-6 and B-8, existing fill was encountered to depths ranging from approximately 2½ to 8 feet below the ground surface. The existing fill materials generally consist of silty CLAY, clayey SILT and silty SAND soils, with varying amounts of rock fragments and/or trace organics. The Standard Penetration Test results within the existing fill range from 5 to 27 Blows Per Foot (BPF). It should be noted that the high resistance value of 27 BPF encountered in soil test boring B-3 appears to have been inflated by the presence of rock fragments.

Underlying the existing fill in soil test boring B-3, a residual silty CLAY soil was encountered between the approximate depths of 8 and 12 feet below the ground surface. In addition, a residual silty CLAY soil was encountered in boring B-7 between the approximate depths of 2½ and 5½ feet. The silty CLAY soils, as demonstrated by our visual classification, are highly plastic. When sampled, these silty CLAY soils exhibited Standard Penetration Resistance values of 7 and 11 BPF.

Residual sandy SILT and silty SAND soils, with varying amounts of clay, are present beneath the topsoil, existing fill and/or residual silty CLAY soils in all the soil test borings performed during this phase of exploration. These residual SILT and SAND soils extend to depths ranging from approximately 10 to 27 feet below the ground surface. The Standard Penetration Test results within these residual SILT and SAND soils range from 3 to 48 BPF.

Partially weathered rock was encountered in soil test borings B-3 and B-5 at the respective depths of approximately 17 and 27 feet below the ground surface. These depths to partially weathered rock correspond to elevations ranging between 662 and 678 feet (MSL). For engineering purposes, partially weathered rock is considered any dense residual soil exhibiting a Standard Penetration Resistance value in excess of 100 BPF. When sampled, the partially weathered rock generally consisted of a silty SAND soil.

Groundwater Observations: Groundwater measurements were attempted at the completion of each soil test boring and again prior to leaving the site. Groundwater was observed in soil test boring B-5 at a depth of approximately 28 feet below the ground surface. This depth to groundwater corresponds to an elevation of approximately 661 feet (MSL). No measurable groundwater was observed in any of the remaining soil test borings.

PROJECT DESCRIPTION

The proposed project will include the construction of an addition to the west side of Building 42. In addition, new pavements will be constructed at isolated areas across the site. We understand that the new building construction will be a single-story structure with a concrete slab-on-grade floor system, isolated columns and load bearing walls. Finished grades and structural loads were not available at the time this report was prepared. However, we are anticipating that the finished grades will be located close to the existing site grades, with maximum cut and fill depths on the order of 3± feet. In addition, the maximum wall and column loads are anticipated to be less than 3 kips per linear foot and 100 kips, respectively.

CONCLUSIONS AND RECOMMENDATIONS

The soil test borings performed at this site represent the subsurface conditions at the test locations only. Due to the prevailing geology and the presence of existing fill, there can be changes in the subsurface conditions over relatively short distances that have not been disclosed by the results of the soil test borings performed. Consequently, there may be undisclosed subsurface conditions that require special treatment or additional preparation once these conditions are revealed during construction.

Our conclusions and recommendations are based on the project description outlined above and on the data obtained from our field and laboratory testing program. Changes in the project or variations in the subsurface conditions may require modifications to our recommendations. Therefore, we will require the opportunity to review our recommendations in light of any new information and make the required changes.

DISCUSSION

Up to 8 feet of existing fill was encountered in soil test borings B-2, B-3, B-4, B-5, B-6 and B-8. Based on our visual observation of the soil samples and on the results of the Standard Penetration testing, it appears that a majority of these fill materials would be suitable for direct support of the building addition and pavement construction. However, an area of marginal fill was encountered in soil test boring B-8. In addition, there is the risk that improperly compacted or unsuitable fill materials could be present between the individual boring locations, particularly in the vicinity of the below-grade utilities. Therefore, to further verify the suitability of the existing fill, we recommend that a conscientious field observation program be implemented during construction. As a minimum, this observation program should include compacting and proofrolling of the building and pavement subgrades, and hand auger/penetrometer borings within the footing excavations as outlined in the subsequent sections of this report.

Residual highly plastic silty CLAY soils were encountered in soil test borings B-3 and B-7. In addition, these materials may be present between the individual boring locations. These residual silty CLAY soils exhibited a high plasticity and are very susceptible to moisture intrusion. Furthermore, our experience has been that these types of soils can soften when exposed to inclement weather and/or construction traffic. Therefore, any areas of highly plastic silty CLAY soils may need to be removed from the structural areas of the site and replaced with suitable properly compacted structural fill. Alternatively, depending on the depth and extent of the silty CLAY soils beneath the final grades, these materials could probably be left in-place or partially undercut and bridged with suitable compacted fill. Further recommendations in this regard can be provided once the plans for the project are finalized.

PROJECT DESIGN

Building Support: Provided the recommendations outlined herein are implemented, the proposed building addition can be adequately supported on a shallow foundation system consisting of spread footings bearing on suitable residual soils or on newly-placed structural fill. A net allowable bearing pressure of up to 3,000 pounds per square foot (PSF) can be used for design of the foundations. The net allowable bearing pressure is that pressure which may be transmitted to the soil in excess of the minimum surrounding overburden pressure. Minimum wall (strip) and column footing dimensions of 16 and 24 inches, respectively, should be maintained to reduce the possibility of a localized, "punching" type, shear failure. Exterior foundations and foundations in unheated areas should be designed to bear at least 18 inches below finished grades for frost protection.

The proposed slab-on-grade floor system can be adequately supported on suitable residual soils or on newly-placed structural fill provided the site preparation and fill recommendations outlined herein are implemented. A modulus of subgrade reaction equal to 120 pounds per cubic inch (PCI) can be used for design of the project floor slab. The floor slab should be structurally isolated from the building foundations to allow independent movement. Also, we recommend that a minimum 4-inch thick layer of Aggregate Base Course (ABC) stone be placed immediately beneath the floor slab to provide a capillary barrier and to increase the load distribution capabilities of the floor slab system. Furthermore, the use of a vapor barrier should be considered to reduce the potential for vapor transmission through the slab. However, proper curing techniques must be employed when using a vapor barrier to prevent uneven curing.

Seismic Design: Based on review of the North Carolina Building Code (NCBC) and the Standard Penetration test values encountered in the soil test borings, we recommend using a Site Class C for seismic design. The site classification was determined by using equation 16-45 and averaging the Standard Penetration test values.

Exterior Pavements: Suitable residual soils or newly-placed structural fill can provide adequate support for a pavement structure designed for the appropriate subgrade strength and traffic characteristics. The pavement subgrade must be prepared in accordance with the site preparation and fill recommendations provided in this report. The subgrade and the pavement surface should be sloped to a suitable outlet area to provide positive subsurface and surface drainage away from the pavement. Water within the base course layer and ponded water on the pavement surface can lead to softening of the subgrade and other problems that will result in accelerated deterioration of the pavement system.

As requested, a flexible (asphaltic) pavement system was designed for the project. The anticipated traffic volume for the pavements includes 400 automobiles (gross vehicle weight equal to 2 kips) per day, 5 trash trucks (gross vehicle weight equal to 34 kips) per week and 2 fully-loaded tractor-trailer trucks (gross vehicle weight equal to 70 kips) per week. Using a 20 year design life, this anticipated traffic volume is equal to approximately 40,000 total equivalent 18-kip single-axle load applications (EALs). ***It is Geoscience's recommendation that the traffic volumes used in the pavement design be reviewed by the development team to ensure that these estimates will not be exceeded.*** The pavement areas were designed using the laboratory CBR test results.

For construction, the asphalt pavement system should be referenced to the "Standard Specifications for Roads and Structures" published by the North Carolina Department of Transportation (NCDOT). This publication specifies material, asphalt mix design and placement requirements. The material chosen for use in the pavement system includes an Aggregate Base Course (ABC) in section 520 of the NCDOT reference, an asphaltic concrete intermediate course (Type I) specified in section 610 and an asphaltic concrete surface mix (Type S) also specified in section 610.

Pavement Type	Material Sections	Material Thickness
Asphaltic (Flexible)	Type S Surface Asphalt	1"
	Type I Intermediate Course	1½"
	Aggregate Base Course	8"

As noted above, the pavement section is based on the anticipated traffic volumes and the results of the CBR testing. The CBR samples were prepared at various percent compaction values and were greatly influenced by the amount of swell that occurred during sample inundation. Maintaining adequate surface and subsurface drainage will be critical for long term pavement performance. In addition, any new fill placed within 18 inches of the pavement base course section should be compacted to at least 98 percent of the Standard Proctor maximum dry density. Further recommendations in this regard should be provided during construction.

Cut And Fill Slopes: Permanent cut slopes within residual soils and properly compacted fill slopes should be no steeper than 2½(H):1(V) and should be properly seeded and/or protected to minimize erosion. For maintenance purposes, the permanent slopes may need to be flattened to allow access to mowing equipment. Temporary slopes in confined or open excavations should perform satisfactorily at inclinations of 1(H):1(V); however, if loose fill, groundwater or other soft/saturated soil conditions are encountered within the excavations, then flatter slopes, shoring and/or dewatering will be required. All excavations should conform to applicable OSHA regulations.

For permanent slopes less than 5 feet in height, the future building and pavement limits should be offset a minimum five (5) horizontal feet from the crest of the slope. For permanent slopes that are 5 or more feet in height, the future building and pavement limits should be offset a minimum horizontal distance equal to the slope height. Appropriately sized ditches should run above and parallel to the crest of all permanent slopes to divert surface runoff away from the slope face. To aid in obtaining proper compaction on the slope face, the fill slopes should be overbuilt with properly compacted structural fill and then excavated back to the proposed grades. **Also, any fill placed in sloping areas should be properly benched into the adjacent soils.**

Caution must be exercised when excavating adjacent to the existing building and pavements to prevent from undermining any existing foundation element or pavement system. The base of any excavation should maintain a minimum horizontal distance of one (1) foot from the edge of any existing foundation or pavement system for every vertical foot of excavation. If this minimum distance cannot be maintained, the existing building or pavement systems should be properly braced and/or protected. Alternatively, during undercutting, any unsuitable materials could probably be excavated incrementally while working immediately adjacent to existing foundations or pavements. Geoscience should be consulted in this regard during the construction phase.

PROJECT CONSTRUCTION

Site Preparation: The site preparation activities should include the removal of topsoil, asphalt, concrete, crushed stone, organic material and other soft or unsuitable soils from within the proposed construction limits. Provided the crushed stone remains free of any soil or debris, this material could be stockpiled onsite for future use within the new pavements. Special considerations with regard to the presence of existing fill and residual silty CLAY soils are outlined in the "Discussion" section of this report. It should be noted that shallow test pits will likely need to be performed during the site preparation activities to explore the suspected presence of any existing fill and residual silty CLAY soils between the individual soil test borings. In addition, all existing utilities should be properly relocated, as required, and the resulting excavations backfilled with suitable compacted fill.

Upon completion of the above preparatory operations, the exposed building and pavement subgrades should be compacted with a Caterpillar 815 roller (or similar size) making at least 6 passes over the exposed subgrades. These areas should then be proofrolled with a loaded dump truck or similar pneumatic-tired vehicle having a loaded weight of approximately 25 tons. The proofrolling operations should be performed under the observation of a geotechnical engineer or authorized representative from Geoscience. The proofrolling should consist of two (2) complete passes of the exposed areas, with each pass being in a direction perpendicular to the preceding one. Any areas that deflect, rut or pump during the proofrolling, and fail to be remedied with successive passes, should be undercut to suitable soils and backfilled with properly compacted structural fill.

Groundwater: As mentioned previously, groundwater was encountered in soil test boring B-5 at a depth of approximately 28 feet below the ground surface. Due to the anticipated final site grades and the measured depth to groundwater, we do not anticipate the need for permanent dewatering on this project.

Excavation: The results of the subsurface exploration indicate that, within the depth of the borings, the onsite soils can be excavated with conventional construction equipment. Although partially weathered rock was encountered in borings B-3 and B-5 beginning at a depth of approximately 17 feet, excavations to this depth are not anticipated for this project.

Fill Material And Placement: All fill used for the project should be free of organic matter and debris with a low to moderate plasticity (Plasticity Index less than 30). The fill should exhibit a maximum dry density of at least 90 pounds per cubic foot, as determined by a Standard Proctor compaction test (ASTM D 698). We recommend that moisture control limits, with respect to the optimum moisture content, be established for the proposed fill soils *prior to the start of site grading*. In addition, any fill soils placed wet of the optimum moisture content must remain stable under heavy pneumatic-tired construction traffic.

Based on our visual observation of the soil samples, the onsite sandy SILT and silty SAND soils generally appear suitable for use as project fill. However, the onsite silty CLAY and very clayey SILT soils are only marginally suitable since they are susceptible to inclement weather and with the introduction of repeated construction traffic can become remolded, resulting in a loss of strength. If the onsite soils are to be placed as fill, some moisture modification (drying and/or wetting) of these soils will be required. The type, extent and difficulty associated with obtaining the required moisture modification will be influenced by the soil plasticity, depth to groundwater and weather conditions encountered during construction.

All fill should be placed in lifts not exceeding twelve (12) inches loose thickness and should be compacted to at least 95 percent of its Standard Proctor maximum dry density. For isolated excavations around the footing locations, behind below-grade walls or within utility excavations, a hand tamper or walk-behind roller will likely be required. While using a hand tamper or walk-behind roller, the maximum lift thickness (loose) should not exceed 5 inches. We recommend that field density tests be performed on the fill as it is being placed, at a frequency determined by an experienced geotechnical engineer, to verify that proper compaction is achieved.

Footing Observations: We recommend that the footing excavations be observed by Geoscience to verify that suitable soils are present at, and below, the proposed bearing elevation. A footing observation program involving hand auger borings with Dynamic Cone Penetrometer tests must be performed within the footing excavations to confirm the suitability of the underlying soils. If soft or unsuitable materials are encountered, they will likely need to be undercut and replaced with a select fill material suitable for the design bearing pressure.

Bearing surfaces for foundations should not be disturbed or left exposed during inclement weather; saturation of the onsite soils can cause a loss of strength and increased compressibility. If construction occurs during inclement weather, and concreting of the foundation is not possible at the time it is excavated, a layer of lean concrete should be placed on the bearing surface for protection. Also, concrete should not be placed on frozen subgrades.

CLOSURE

Geoscience appreciates having had the opportunity to assist you during this phase of the project. If you have any questions concerning this report, please contact us.

Respectfully,
GEOSCIENCE GROUP, INC.

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APPENDIX

Boring Location Diagram
(Drawing No. CH09.0088.GE-1)

Generalized Subsurface Profile
(Drawing No. CH09.0088.GE-2)

Investigative Procedures

Test Boring Records

Compaction Test Plot

California Bearing Ratio Test Plots