BUNNELL-LAMMONS ENGINEERING, INC.
GEOTECHNICAL, ENVIRONMENTAL AND CONSTRUCTION MATERIALS CONSULTANTS

February 13, 2009

Mr. R. Norris Barger, MBA, CPA
Transylvania County Schools
Morris Education Center
400 Rosenwald Lane
Brevard, North Carolina 28712

Subject: **Report of Limited Subsurface Exploration**
Proposed Greenhouse Parking Area
Rosman, North Carolina
BLE Project J09-6322-01

Dear Mr. Barger:

Bunnell-Lammons Engineering, Inc. (BLE) is pleased to present this report of limited subsurface exploration for the proposed greenhouse parking area to be located to the northwest and southwest of the existing Rosman School Greenhouse. Our services were provided in general accordance with Bunnell-Lammons Engineering (BLE) Proposal No. P09-0023 dated January 21, 2009 and accepted by you on the same date. The purpose of this limited exploration was to determine general subsurface conditions and evaluate these conditions relative to construction of a parking area. This report describes the work performed, and presents the results obtained, along with our geotechnical recommendations relative to construction of the proposed parking area.

Project Information and Observations

Project information is based on conversations between Mr. Barger with Transylvania County Schools and our Mr. Sam Interlicchia and several site visits performed in the latter part of January and the beginning of February 2009.

We understand that the gravel parking area is proposed for construction to the northwest and southwest of the existing greenhouse structure. The proposed gravel parking area is estimated to be less than an acre in size and will have an entrance and exit on Broad Street. We also understand that the elevation of the proposed parking area will be close to the existing grade around the greenhouse, which will require approximately 4 to 5 feet of fill to achieve the design subgrade elevation.

The site is currently vacant and has been stripped of vegetation. Surface water throughout the property appears to flow toward the south/southwest bisecting the approximate center of the site to a storm drainpipe located in the southwest corner of the property.

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The existing soil conditions appeared to be wet and loose with some areas of silt and sediment build up. Yielding (pumping and rutting) was apparent in the existing subgrade soils. The existing subgrade in the southwest area had standing water in several areas and was very soft and loose under foot traffic.

Subsurface Conditions

The site was explored by performing eight hand auger borings within the proposed parking area. The hand auger borings were extended to depths between 4 feet and 9 feet below the existing ground surface. The borings were advanced by manually twisting a sharpened steel auger into the soil. At regular intervals, the soils were tested with a dynamic cone penetrometer to provide quantitative data about the soil strength. The dynamic cone penetrometer (DCP) is an instrument composed of a conical point driven with blows from a 15-pound hammer falling 20 inches. The point is driven into the soil in three increments of 1-3/4 inches. The number of hammer blows required to drive each increment is recorded. The average number of blows of the final two increments is an index to soil strength and bearing capacity.

The hand auger borings encountered alluvium and residual soil. The alluvial soil (water deposited) was encountered in a layer approximately 3 to 8 feet thick. The alluvial soil consisted of very loose and loose very silty fine to medium sand. Residual soil (i.e. weathered in-place), comprised of silty sand was encountered directly beneath the alluvial soil. The consistency of the residual soil was estimated to be firm to very firm. The alluvial soils within the hand auger borings caved within a few minutes after excavation due to groundwater seepage. Ground water was present within the alluvium at the time of boring.

All eight hand auger borings were terminated in residual soils or possible residual soils at depths of 4 to 9 feet. Ground-water levels may fluctuate several feet with seasonal and rainfall variations. Normally, the highest ground-water levels occur in late winter and spring and the lowest levels occur in late summer and fall.

Conclusions and Recommendations

It is our understanding that approximately 4 to 5 feet of fill will need to be placed to raise the site grade for the parking lot. Based on our hand auger borings and our experience with similar soils, the following three options for remediating the soft/loose alluvial soils are offered; 1) leave alluvium soils in place, 2) leave alluvium soil layer in place in conjunction with a heavy woven geotextile or biaxial geogrid, or 3) partial excavation and replacement of the alluvial soil layer in conjunctions with a heavy woven geotextile or biaxial geogrid. These three options need to be evaluated by the owner to consider the potential risks associated with performing no or partial remediation. Settlement of the parking area will still occur and this is a risk the owner must accept.

Because of the depth of the existing alluvial soils and depth to ground water, complete excavation and replacement would likely require extensive dewatering and would not be economical. Placing fill soils directly on the existing alluvial soil (option 1) will create unacceptable differential settlements and is not recommend. Leaving the alluvial soils in place in conjunction with a heavy woven geotextile or biaxial geogrid (option 2) appears to be the most reasonable balance of the practical considerations of installation and cost. We believe that this method of remedial repair will be the most cost-effective option. This option has been used for similar subsurface conditions and has performed satisfactorily. There still is the possibility of future settlement and pothole development in the parking area, due to the variable consolidation under the weight of any new fill placed. All of the options are discussed below.

Option 1

This option consists of leaving the alluvial soil layer in place below the new fill soils. At a minimum, we recommend removing any organic material from the surface prior to placing new-engineered fill. This option would be the least costly, but would also assume the most risk of consolidation and settlement of the alluvial layer. Settlement of the underlying soils could potentially lead to settlements and potholed areas developing within the parking area. There will also be difficulty in placing the new fill over the existing soft/loose soils.

Option 2

In order to employ option 2, we recommend placing a layer of biaxial geogrid such as Tensar BX1100 or a heavy woven geotextile fabric over the subgrade soils (after removing any organic material from the surface) prior to placing new structural fill to help reduce differential settlement and provide increased subgrade strength. Ruts and small depression should be filled in prior to deploying the geosynthetic (geotextile or geogrid). The geosynthetic should extend at least 5 feet beyond the edge of the proposed parking. The geosynthetic should be pulled taut during placement with no wrinkles or folds, and with no significant void space between the geosynthetic and the underlying soil. Successive sheets of geosynthetic should be overlapped a minimum of 24-inches with the uphill sheet overlapping the downhill sheet. A 12 to 16-inch thick layer of washed stone or railroad ballast should be placed over the geotextile fabric to aid in placement and compaction of the structural fill "in the dry". Water should not be allowed to saturate the fill during placement and compaction. Additional drainage measures may be required if wet weathered springs or wetter than expected conditions are encountered during remediation. Once the geotextile and stone are placed, structural fill placement may commence. This option would be more costly than option 1, but there would be less potential for settlement.

Option 3

This option consists of removing approximately half the depth of the soft wet alluvial soil prior to placing new-engineered fill. A maximum depth of approximately 3 feet is anticipated. However, we recommend that the undercutting operation be monitored by BLE to confirm when suitable soils are encountered. It is possible that the undercutting depth may be less or more than what is expected. Once removed, a biaxial geogrid such as Tensar BX1100 or a heavy woven geotextile fabric should be placed over the subgrade soils prior to placing new structural fill to help reduce differential settlement and provide increased subgrade strength. The geosynthetic should extend at least 8 feet beyond the edge of the parking area. The geosynthetic should be pulled taut during placement with no wrinkles or folds, and with no significant void space between the geosynthetic and the underlying soil. Successive sheets of geosynthetic should be overlapped a minimum of 24-inches with the uphill sheet overlapping the downhill sheet. A 12 to 16-inch thick layer of washed stone or railroad ballast should be placed over the geotextile fabric to aid in placement and compaction of the structural fill "in the dry". Water should not be allowed to saturate the fill during placement and compaction. This option would be more costly than option 2, but there would be less alluvial soil to consolidate, potentially leading to less overall settlement.

Fill Placement

Regardless of the option chosen, we anticipate that the initial lift of fill should be thicker than normal (12 to 18-inch thick lift) to act as a bridge lift. Light ground pressure equipment (tracked equipment) should be used in the initial 2-foot thickness of fill over the prepared subgrade to minimize rutting. The fill should be placed in uniformly compacted thin lifts to at least 95 percent of the standard Proctor maximum dry density (ASTM D 698) at moisture contents within ±3% of the standard Proctor optimum moisture content.

The alluvial soils undercut will likely be too wet as excavated to reuse without first drying. Material excavated from the undercut area should be evaluated as it is excavated to determine which parts, if any are suitable for reuse. Material not suitable for structural fill placement may be used in landscaped areas or hauled offsite.

To verify that our recommendations are implemented and interpreted correctly, we recommend that a representative be on-site during the undercutting, geotextile installation, excavation and fill placement. Once compaction begins for either option, a sufficient number of density tests should be performed by an experienced engineering technician working under the direction of the BLE geotechnical engineer to measure the degree of compaction being obtained.

Water (rain or surface water runoff) should not be allowed to pond on the fill area. If the fill soils are softened by water exposure, the softened soils must be removed prior to continuing with fill placement. We also recommend that once the soil subgrade is at the design elevation it be covered with at least 8-inches of stone base as soon as practical to protect the soil subgrade from deterioration.

With any option, we recommend that shallow ditches be excavated throughout the areas with standing water to facilitate drainage. These areas should be allowed to drain as long as practical before commencing work.

In addition, if underground utility lines (water, sewer or electrical) will be installed within the parking area, these lines should be installed before the geotextile or biaxial geogrid is placed (option 2 or 3). Utility line trenches should not cut through the geogrid.

Related civil design factors such as subgrade drainage, shoulder support, cross-sectional configurations, surface elevations, and environmental factors which will significantly affect the service life must be included in the preparation of the construction drawings and specifications. Normal periodic maintenance will be required.

We appreciate the opportunity to be of service to you. If you have any questions concerning our observations and recommendations as presented in this letter, please do not hesitate in contacting us.

Sincerely,
BUNNELL-LAMMONS ENGINEERING, INC.

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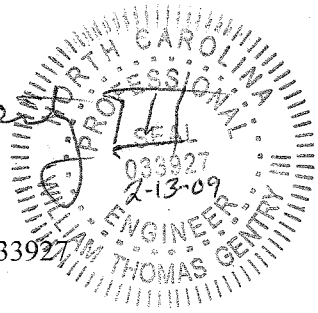

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